User Manual UTView
FAAST-PA

Version of June 18, 2020

Contents

1 General presentation of UTView

1.1 FAAST-PA presentation

UTView is Socomate's standard software to drive Phased Array FAAST-PA, SOCOSWIFT/SOCOSWIFT+ or SOCOSCAN/SOCOSCAN+, and Conventional UT SOCO-X-UT or SOCO-X-HV.

This manual is dedicated to FAAST-PA which is a Phased Array UT (PAUT) system much more powerful than conventional Phased Array system. Thanks to its technology, the FAAST system has the capability to transmit multiple sound beams, multi-oriented and/or multi-focused, through PA probes with only one single shot, and then to process signals received from all beams in real time.

To illustrate this principle, let us consider the case of an 1-D linear PA probe; on ONE shot several oriented beams are generated, as it is shown in below:

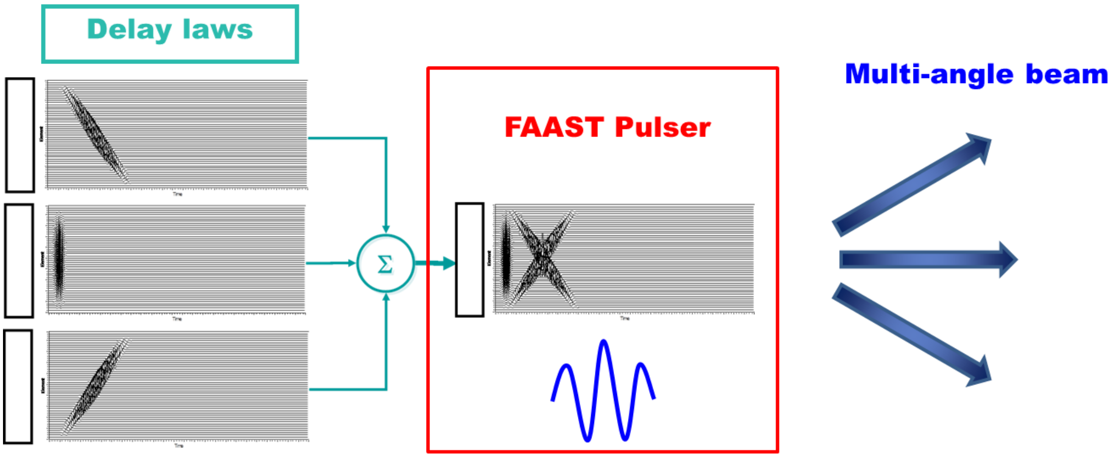


Figure 1: Principle of FAAST Pulser

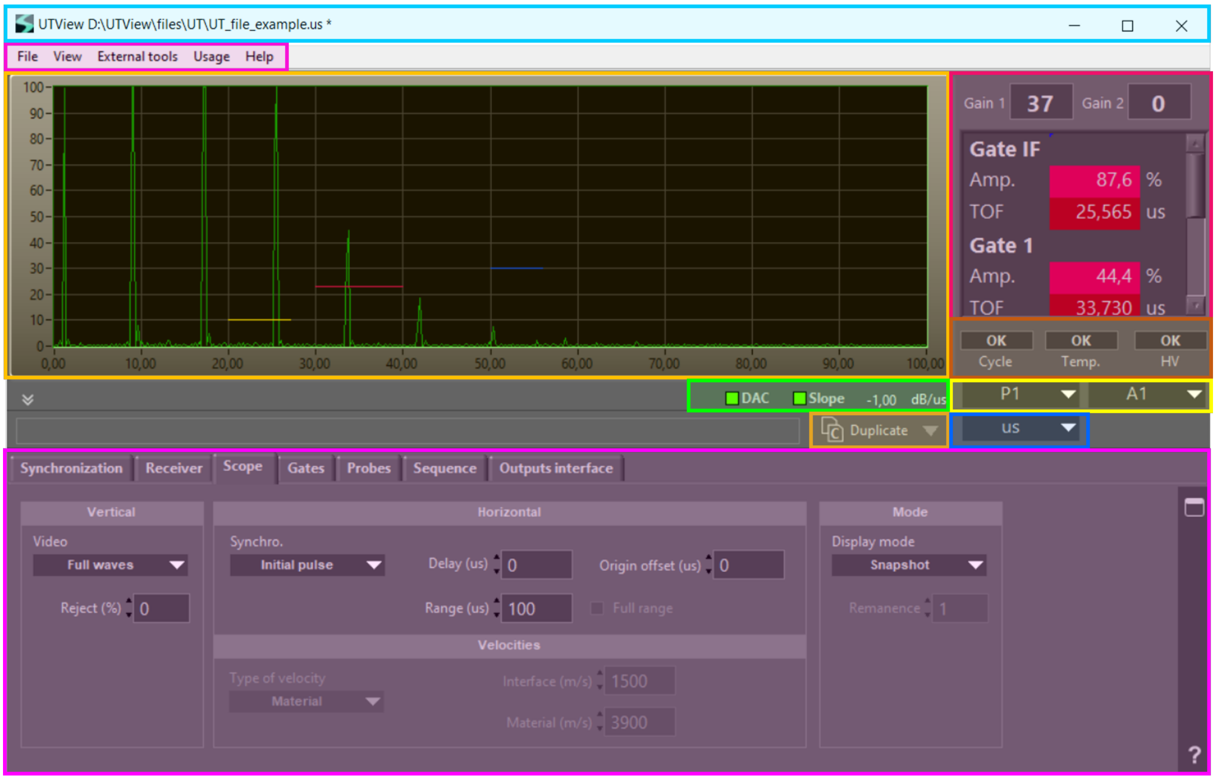
This patented technology (WO 03029808) revolutionizes the NDT environment when speaking about UT inspection due to its high speed testing capabilities, as it is able to replace several conventional Phased Array systems running in parallel. At higher inspection speeds, it offers even more savings due to the reduction of Phased Array probes, mechanical parts, maintenance and calibration time.

The FAAST technology has no limit to the number of delay laws that can be summed in its pulser (see Chapter Emission), and this in a single shot.

All FAAST-PA devices are full parallel, and is declined in different channel configuration:

- 32:32
- 2× 32:32
- 64:64
- 2× 64:64
- 96:96
- 128:128

1.2 IHM presentation



UTView's IHM is divided in several parts:

- Title bar
- Menu bar
- A-scan screen
- Leds indicators
- Duplicate
- Value & measurement area
- Warnings
- Probe and A-scan selection
- unit
- Parameter tab

Title bar

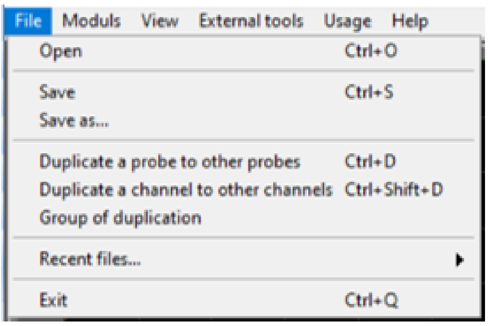
In the title bar is notified the UT file path (example D:\UTView \files\UT\UT_file_example.us).
In the same level, there are "minimize", "maximize" and "close" buttons.

An asterisk (*) will appear near of the UT file name, to indicate you that a parameter of the UT settings was modified. It will disappear when UT file will be saved.

Menu bar

The menu gathers a list of options such as:

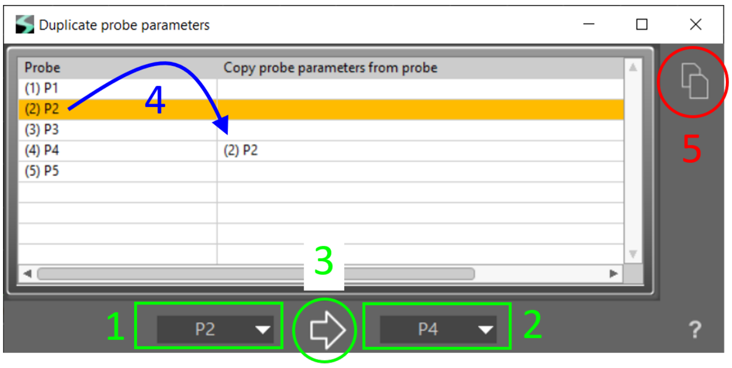
1 **File**



- "Open": open an UT-file
- "Save": save the UT settings in the current file name
- "Save as…": save the UT settings under another file name
- "Duplicate a probe to other probes"
- "Duplicate a channel to others channels"
- "Group of duplication": create duplication groups
- "Recent files…": open one of the last 4 recent UT files being used
- "Exit": exit the application program

Duplicate a probe to other probes

This tool allows to duplicate all probe parameters from one particular to another one. // Please refer to Chapter Probe for details.



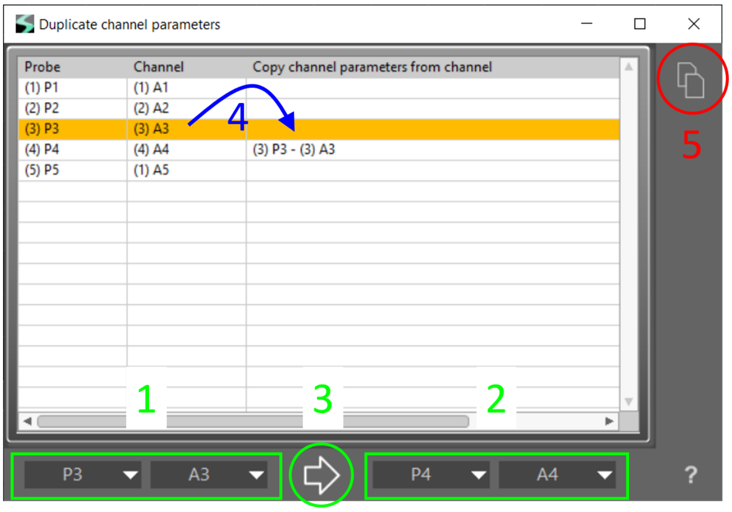
You have 2 ways to select copy source-destination probes:

- Select source in the probe list 1, and destination in probe list 2. Click on the central arrow (3) to fill the table.
- Drag and drop the source probe to the destination probe line (4)

When it is all set, you can click on run copy button (5). When copy is done, you can close window.

Duplicate a channel to others channels

This tool allows to duplicate all ultrasonic parameters from one channel to another one.



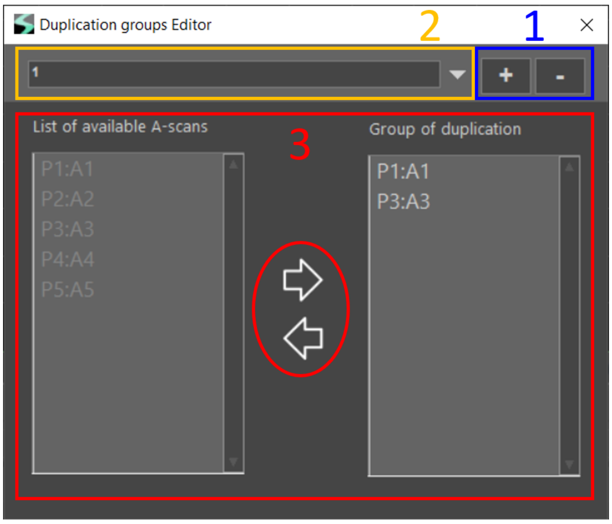
You have 2 ways to select copy source-destination channels:

- Select source in the probe-channel list 1, and destination in probe-channel list 2. Click on the central arrow (3) to fill the table.
- Drag and drop the source channel to the destination channel line (4)

When it is all set, you can click on run copy button (5). When copy is done, you can close window.

Group of duplication

This editor allows to create groups of duplication *i.e.* groups of particular A-scans for which we want to duplicate same ultrasonic parameters (ex. gate position/width).

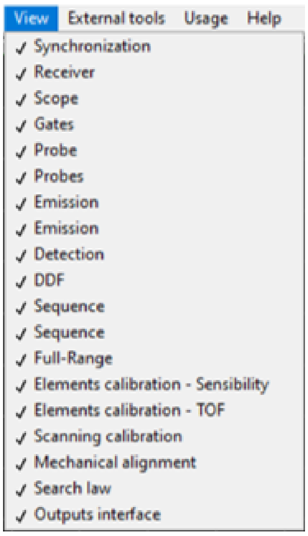


You can add or delete group of duplication respectively with buttons "+" or "-" (1).
You can select one group of duplication from the menu list (2).
You can add an A-scan from the "List of available A-scans" to the "Group of duplication" by clicking to the add button 

You can remove an A-scan from the "Group of duplication" by clicking to the remove button . It will appear in the "List of available A-scans" (3).

2 **View**

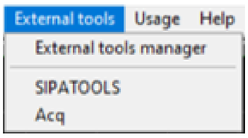
By default, you can see all parameter tabs. You can choose to disable one (and then it will not appear in IHM) by just clicking on the tab name.



You can reactivate it by just re-clicking on the tab name.

3 **External tools**

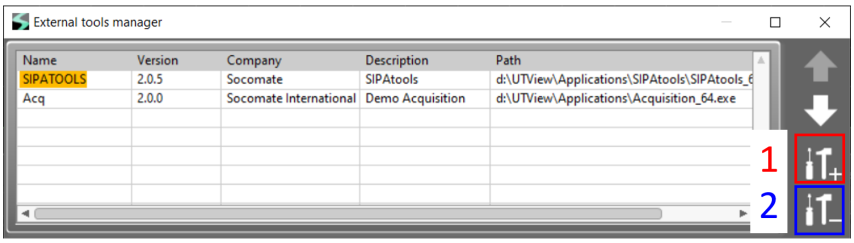
From this menu, you can call external programs from the list.



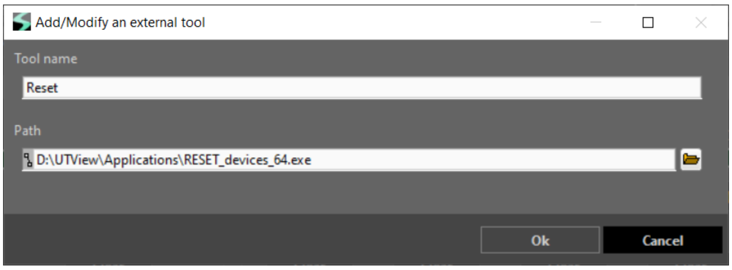
By default, you have 2 available tools:

- a "demo acquisition" software, which shows C-scan and A-scan acquisition capabilities
- "SIPATools", the Socomate software dedicated to delay laws calculation

You can manage tools list with "External tools Manager".



If you want to add one tool, you have just to click on the button (1). A window will appear where you can fill name and path of the tool. Then click "OK" to add it on the list.

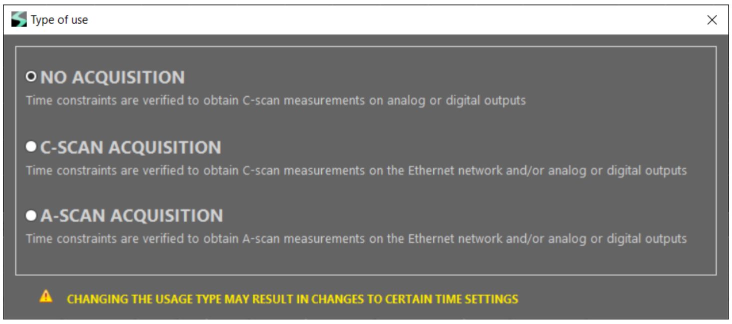


You can remove a tool from the list by simply clicking on the button (2).

4 **Usage**

According to the UT application, it is possible to optimize time constraints in the UT file. by clicking on "Usage", a window containing 3 choices for type of use will appear:

- "NO ACQUISITION"
- "C-SCAN ACQUISITION"
- "A-SCAN ACQUISITION"



You can refer to Chapter Time constraints for more details.

5 **Help**

From "Help", you have two choices:

- UTView Help...: open UTView user manual
- About UTView...: show information about the product

A-scan screen

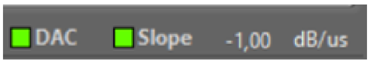
The A-scan screen displays the UT signals with four gates, and, when requested, the DAC curve and the rejection level.

In the bottom left corner of window, you can have access to A-scan tools by clicking the double arrow down (. You can hide A-scan tools by clicking the double arrow up ( )

Button	Description
	Change plot colors
	Capture an A-scan to send to file or clipboard or printer
	Play/Stop A-scan plot
	Save current A-scan as a reference
	Open and show an A-scan reference file
	Delete A-scan reference plot

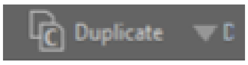
Leds indicators

The Leds indicators show:

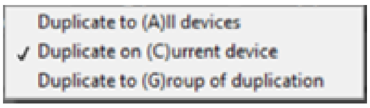


- if the DAC is active ( ) or not ( )
- if the DAC is using an additional coefficient of correction (DAC slope) ( ) or not ( )

Duplicate



In the IHM, the "Duplicate" menu gives you the choices between:

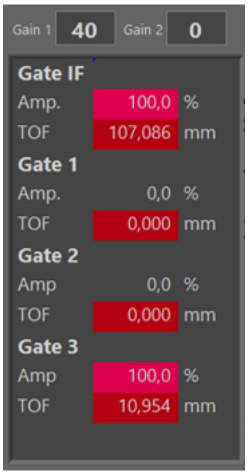


- Duplicate to (A)ll devices: modification parameters will be duplicate to all A-scan corresponding to all devices. The letter "A" will appear in duplicate activation button.
- Duplicate on (C)urrent device: modification parameters will be duplicate to all A-scan corresponding to the current device. The letter "C" will appear in duplicate activation button.
- Duplicate to (G)roup of duplication: modification parameters will be duplicate to all A-scan belonging to the same group of duplication. The letter "G" will appear in duplicate activation button.

You can activate "Duplication" by clicking the button. It will switch on .

You can deactivate "Duplication" by re-clicking the button. It will switch off .

The value & measurement area



This tab shows “Gain 1” and “Gain 2” values. You can also command them from here. Please refer to Chapter Receiver for more details.

For each “Gates” (See Chapter Gate), you have following information:

- Amplitude of echo detected in Gate in % of Full-Screen High (FSH)
- TOF/WT of echo detected in Gate
- Amplitude and TOF/WT alarms status

TOF or WT values are automatically displayed according to the choice of “distance processing” in Gate tab (See chapter Gate for explanation).

Warnings

(a) No warning (b) One warning is on

This IHM part indicates status of:

- Cycle (or PRF) warning
- Temperature warning
- HV (High Voltage) ready

FAAST-PA temperature range operation is 0-30 °C (32-86 °F). Warning temperature occurs when:

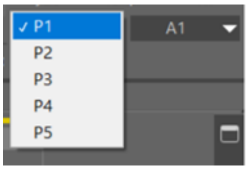
- CPU temperature is above 60 °C (140 °F), or
- Processor temperature is above 65 °C (149 °F)

Warnings status are in A-scan frame. It means

1. If there is not A-scan (No synchronization for example), warnings could not be on
2. Returned warnings correspond to device where the A-scan is executed. So be careful if multiple devices are used!

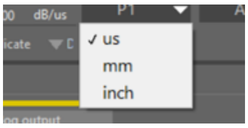
Warnings	Possible causes	Recommendation
Cycle	Ext. Trigger or Encoder is faster than PRF	Increase time cycle
Temperature	Device temperature is too high Air cooling malfunction	Switch off device Switch off device. Check cooling system
HV	Voltage has been cut off by protection	Switch off the device If problem persists, contact Socomate's support

Probe and A-scan selection



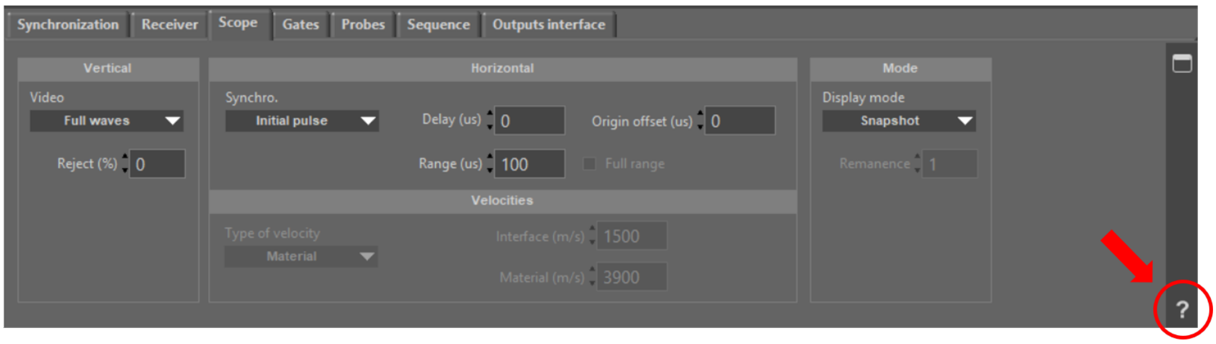
From this IHM part, you can select which Probe and A-scan you want to setup. The selected one is displayed in A-scan screen beside.

Unit



You can choose to represent TOF/WT in time (µs) or in distance (mm or inch). If you choose one of the distance unit, you have to define "Interface" or "material" celerity for time-distance conversion.

Parameter Tab

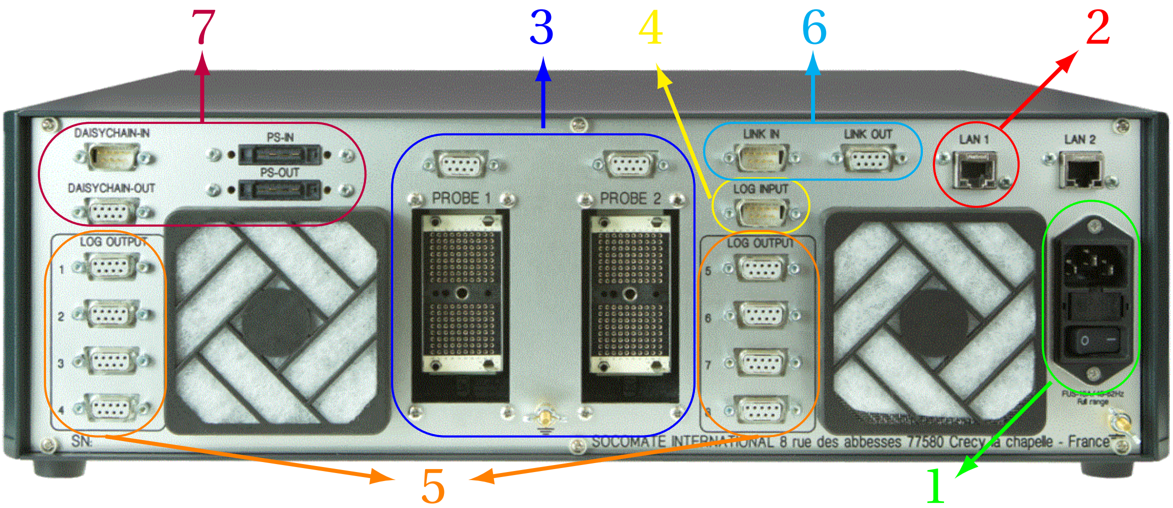


From this IHM part, you have access to all available panels used for UT setup. In the following you will find detailed description and explanations for each and every one of them.

From IHM, and for each panels, you can have access to contextual help, *i.e.* help concerning the current panel, by clicking the question mark (in right down corner).

2 FAAST-PA device description

Hereafter you will find description of the FAAST-PA back-panel.

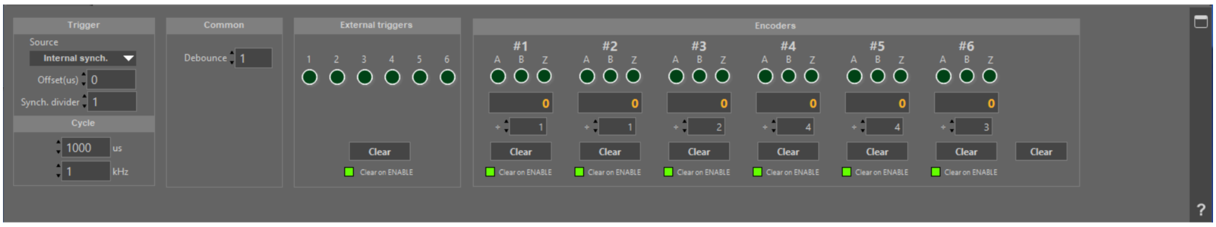


1. Power supply connection. Put the switch to 1 to power on the device
2. Ethernet port (LAN 1 by default). Connection to the driver PC.
3. Hypertronic socket(s). Connection for 1 (or 2) probe(s) according to the hardware configuration.
4. *Log Input* socket. Connect *CB1* cable to *INT LOG_IN* board. (See Chapter “Synchronization” for details)
5. *Log Output* sockets. Connect *CB1* cable to *INT LOG_OUT* or *INT ANALOG_OUT* boards. (See Chapter “Outputs” for details)
6. *Link In/Out* sockets. Connection between MASTER and SLAVES devices.

7. *Daisy Chain* sockets. Extension of the number of channels by stacking 2 or more FAAST-PA devices (for example 2×128Ch → 256Ch).

3 Synchronization

This tab allows you to set the source of the ultrasound triggering and the period of UT shots.



3.1 Preamble – ini file setup

The ability to use an external source is only available if an input module (INT LOG_IN) is defined in "UTView.ini" file (Devices section) (See example below).

```
[Devices]
    [Device 1]
        TYPE=FAAST-PA
        IP=192.168.1.200
        Port=6500
        [Login]
            Module=INTLOG_IN
        [/Login]
        [Logout 1]
            Modules=
        [/Logout 1]
    [/Device 1]
[/Devices]
```

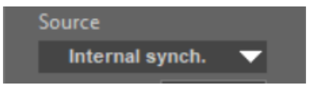
When an input module (INT LOG_IN) is defined in "UTView.ini" file, it has to be connected to the FAAST-PA device even if you want to run the system in internal synchronization, otherwise A-scans will be frozen.

You can refer to the chapter FAAST-PA device description for guidelines to connect this module to device.

3.2 Trigger

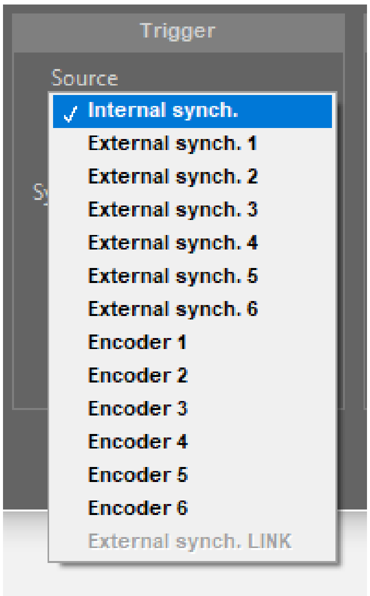
Source

Internal synchronization



Without "INT LOG_IN" module, you can use only internal synchronization.

Available synchronization with “INT LOG_IN” module

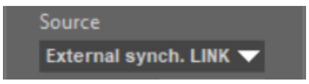


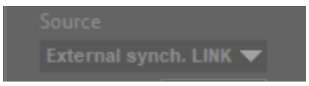
When you connect input module to your device, you have different choices to synchronize UT shots from:

- Internal synchronization
- one of six triggers
- one of six encoders

For more information about the “INT LOG_IN” module, you can refer to the document: LOG INPUT manual.pdf (in HELP folder).

Synchronization with another device



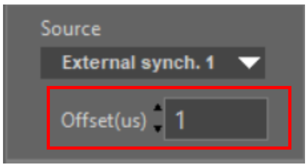
or,


It is also possible to synchronize one device with another one.

This requires first to connect them via *LINK IN/OUT* connectors. If necessary you can refer to Chapter FAAST-PA device description for guidelines.

And, in “Sequence” tab, you have to choose adequate “link of synchronization” (Refer to Chapter Sequence for more details).

Offset

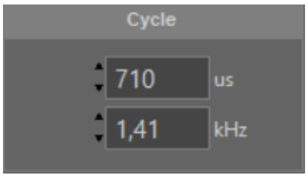


You can define a time shift (in us) between the input trigger signal and the US shot. This feature is especially interesting in the case of multiple probes to avoid interference between them.

Synch. divider

Only in case of external signal, this parameter sets the divider value of trigger signal. Value is an integer comprised between 1 (no divider) and 1024.

3.3 Cycle



In this tab you can set both:

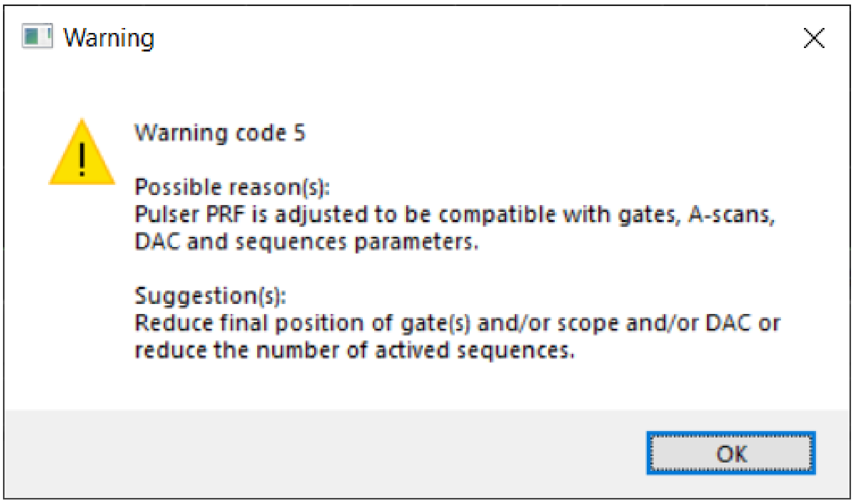
- the *Pulse Repetition Time* (PRT), *i.e.* the time between two shots. Unit is in µs.
- the *Pulse Repetition Frequency* (PRF), *i.e.* the number of shots per second. Unit is in kHz.

Because of the units used for these two values, they are linked by the relation :

$$PRT = \frac{10^{-3}}{PRF}$$

Maximum value which can be set is 20 000 µs (or 0.05 kHz).

Minimum value depends on the UT setup. When you tried to set a smaller time than the minimum possible, a warning pop-up window appears and system puts automatically the minimum value.

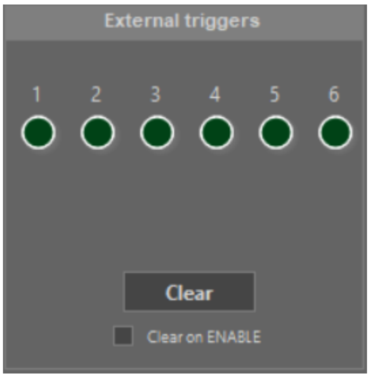


When the synchronization source is internal then this value sets the shooting period.

When an external signal is used this value determines the minimum time between two shots. The device may raise an "cycle alarm" if a new shooting occurs before this minimum time (see "Warnings" section in Chapter General presentation of UTView).

According to the "Usage" defined in the UT file setting, cycle time could be automatically modified to be compatible with the time system constraints (See Chapter "Time constraints" for details).

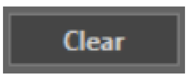
3.4 External triggers



LEDS indicator

The LED linked to the ext. trigger will be switch on at each pulse.

Clear

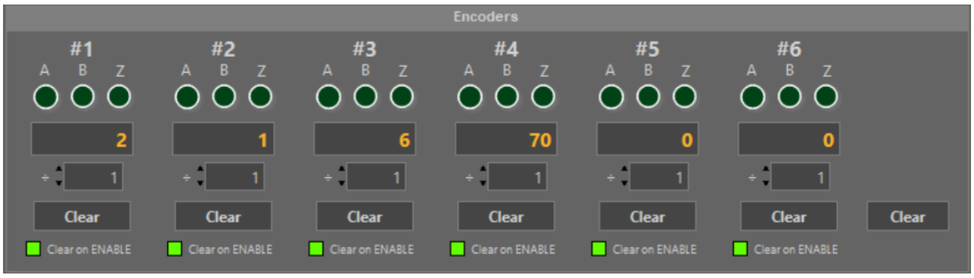


With this button, you can clear the input trigger counter.

Clear on ENABLE

By clicking on square, you can choose to clear ( ) or not ( ) the external trigger counter on the rising front of ENABLE signal.

3.5 Encoders



For each encoder, you have the same parameters.

LEDS indicator

The LED indicates which signal is active:

- A
- B
- Z (Reset)

Please refer to the document LOG INPUT manual.pdf (in HELP folder) for more details.

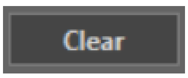
Counter

This tab indicates the encoder counter.

Divider

Divider value to apply to encoder input.

Clear



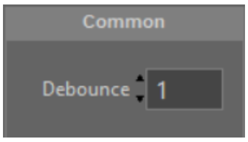
With this button, you can clear the encoder counter.

Clear on ENABLE

By clicking on square, you can choose to clear ( ) or not ( ) the encoder counter on the rising front of ENABLE signal.

With the  button on the right end, you can clear all the encoder counters.

3.6 Common

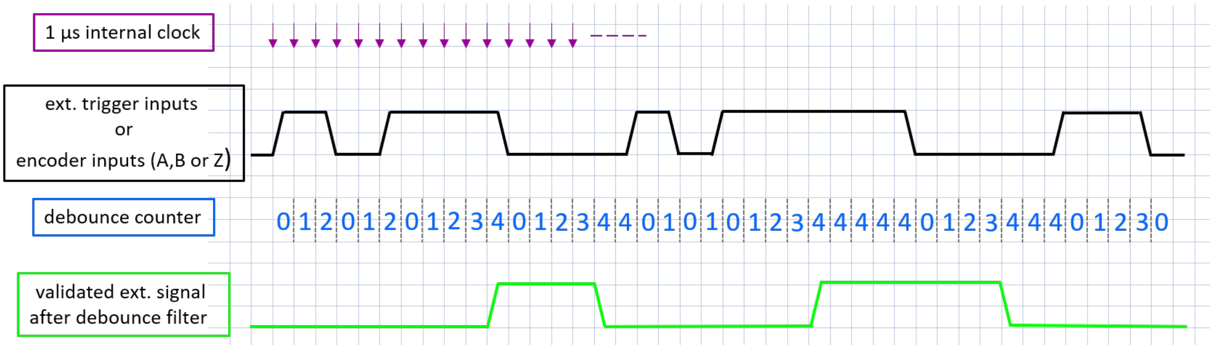


Debounce

It is the value of anti-rebounds filter to apply in external signal input:

- external trigger
- encoder (A,B or Z)

To illustrate this filter, let's consider the example with number of **debounce=3**.



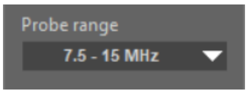
1. at each (sampled) change of state of the signal, the counter goes to 0.
2. at each sample with the same level, the counter is incremented by 1 as it is sill below "debounce+1" (in our example 4).
3. When the counter = "debounce+1", filtered signal follows input signal, otherwise it stays with previous state.

4 Receiver

This tab determines the parameters of reception of an A-scan channel.

4.1 Amplifier

Probe range

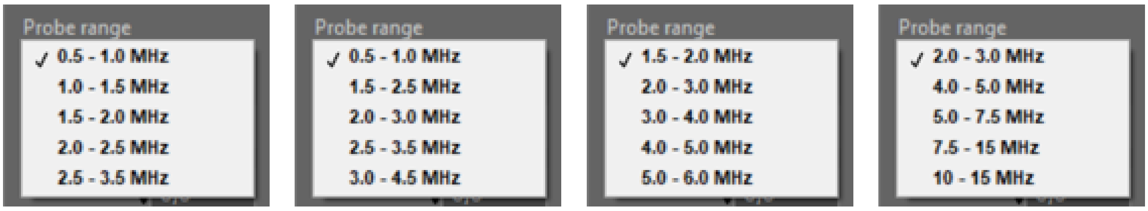


This menu allows to select "Probe range" of your probe.

In a first step, you have to define the probe frequency resolution (FS) in "UTView.ini" file. The value of FS could be set at 50, 66.6, 100 or 200 MHz (see example below).

```
[Devices]
    [Device 1]
        TYPE=FAAST-PA
        IP=192.168.1.200
        Port=6500
        FS=200MHz
        [Login]
            Module=
        [/Login]
        [Logout 1]
            Modules=
        [/Logout 1]
    [/Device 1]
[/Devices]
```

According to FS value defined in "UTView.ini" file, you can have the lists below:



(a) $FS = 50\,\text{MHz}$ (b) $FS = 66.6\,\text{MHz}$ (c) $FS = 100\,\text{MHz}$ (d) $FS = 200\,\text{MHz}$

See below bandwidth table based on “Probe range” :

Sampling Frequency FS=50MHz

Probe range	0.5-1.0 MHz	1.0-1.5 MHz	1.5-2.0 MHz	2.0-2.5 MHz	2.5-3.5 MHz
f_0 (MHz)	0.9	1.5	1.9	2.9	3.0
Δf (MHz)	0.5	0.8	1.1	2.2	2.1

Sampling Frequency FS=66.6MHz

Probe range	0.5-1.0 MHz	1.5-2.5 MHz	2.0-3.0 MHz	2.5-3.5 MHz	3.0-4.5 MHz
f_0 (MHz)	0.8	1.5	2.4	3.0	3.8
Δf (MHz)	0.7	1.2	1.5	2.0	2.7

Sampling Frequency FS=100MHz

Probe range	1.5-2.0 MHz	2.0-3.0 MHz	3.0-4.0 MHz	4.0-5.0 MHz	5.0-6.0 MHz
f_0 (MHz)	1.7	2.7	4.1	5.3	5.7
Δf (MHz)	0.8	1.8	3.4	4.9	4.0

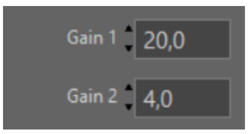
Sampling Frequency FS=200MHz

Probe range	2.0-3.0 MHz	4.0-5.0 MHz	5.0-7.5 MHz	7.5-15 MHz	10-15 MHz
f_0 (MHz)	3.3	4.9	7.7	10.1	12.8
Δf (MHz)	1.6	4.4	8.4	13.6	12.1

where f_0 and Δf are central frequency and bandwidth of filter.

As an example, “Probe range=7.5-15 MHz” means you can use a probe with a center frequency from 7.5 to 15 MHz.

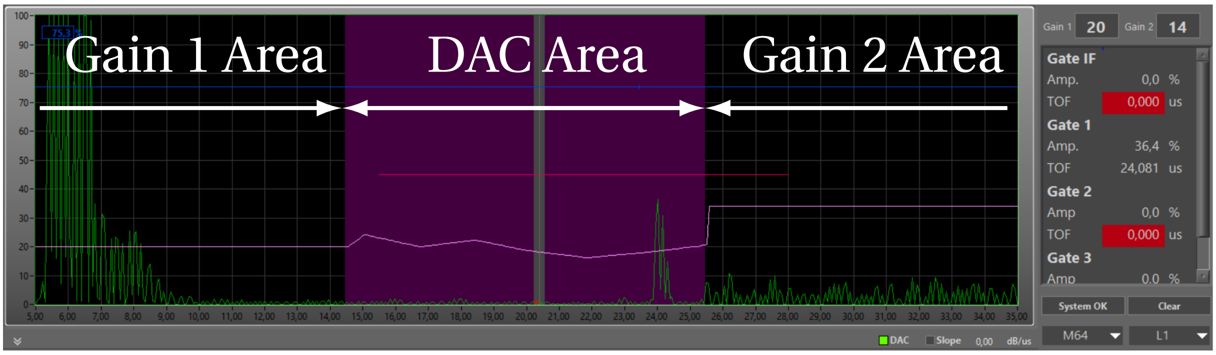
Gain



This menu allows you to set value of main Gain (“Gain 1”) and rear Gain (“Gain 2”), which is relative to the first one.

1 “Gain 1”: value can be set from 0 to 70 dB with 0.1 dB resolution.
2 “Gain 2”: value can be set from -70 to +70 dB with 0.1 dB resolution.

Gain application is divided in 3 areas:

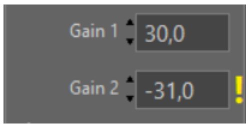


- “Gain 1” is applied from the shot origin until the DAC zone beginning
- DAC zone (see next section)
- “Gain 2” is applied after the DAC zone end

The effective gain applied in Gain 2 Area is given by “Gain 1 + Gain 2”. It is often used to reduce a back-wall echo that could be saturated by the DAC correction.

The real applied gain (which takes into account Gain 1 and Gain 2) is always limited to the dynamic 0-70 dB. If you set an out of range gain system will warn you with an exclamation mark, as you can see in examples below

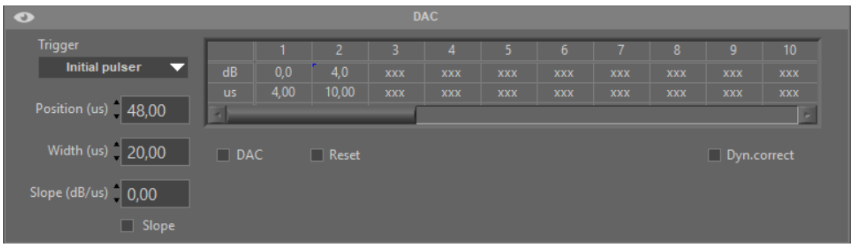
Gain 1 + Gain 2 > 70 dB



Gain 1 + Gain 2 < 0 dB

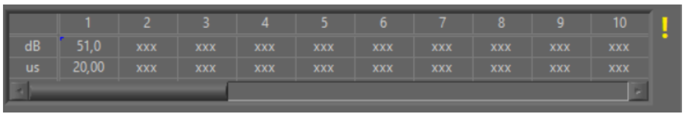
4.2 Depth Amplitude Correction (DAC)

The DAC tab allows to adjust the value of gain as a function of time and thus as the attenuation in the material. The DAC correction begins with the main Gain 1, this means all variation of the main gain leads the move of all DAC curve (like an offset).

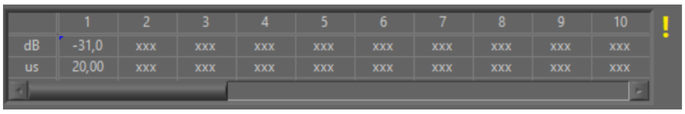


Its dynamic is 70 dB with a maximum slope at 50 dB/100ns.

The real applied gain which is “Gain1 + DAC gain correction” is also always limited to the dynamic 0-70 dB. If you set an out of range gain correction in DAC table, system will warn you with an exclamation mark, as you can see in examples below, where Gain 1 = 30 dB:

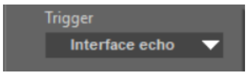


Gain 1 +
DAC correction > 70 dB



Gain 1 +
DAC correction < 0 dB

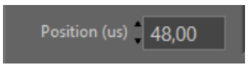
Trigger



This parameter selects the triggering origin of the DAC. You have the choice between:

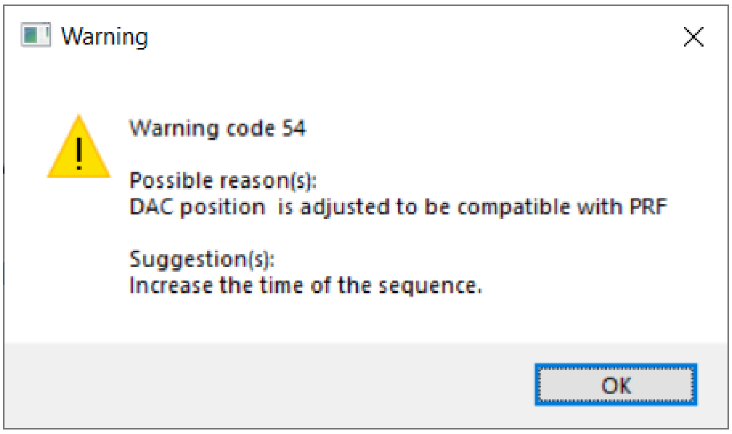
- Initial pulse
- Echo in interface gate
- Start of interface gate

Position

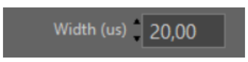


This parameter sets the starting position of DAC area (according to trigger choice).

Minimum value is 0.02 µs and maximum depends on UT setting. If you want to set a bigger value than the maximum possible, a warning pop-up window appears and system put automatically the maximum value.

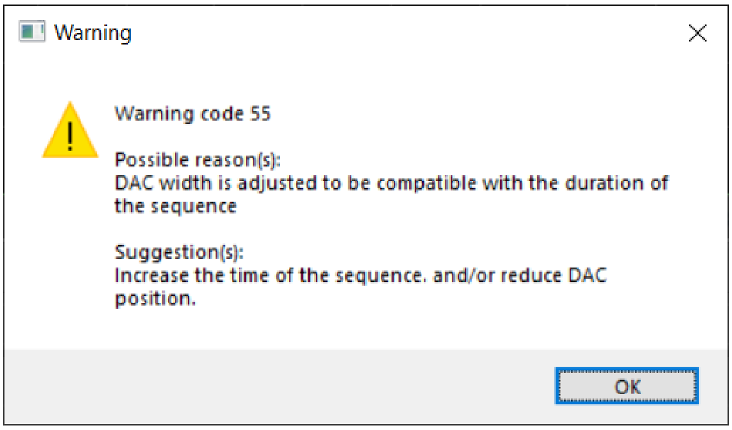


Width

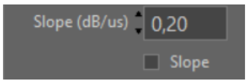


This parameter sets the duration of DAC area.

Minimum value is 0.02 µs and maximum depends on UT setting. If you want to set a bigger value than the maximum possible, a warning pop-up window appears and system put automatically the maximum value.



Slope

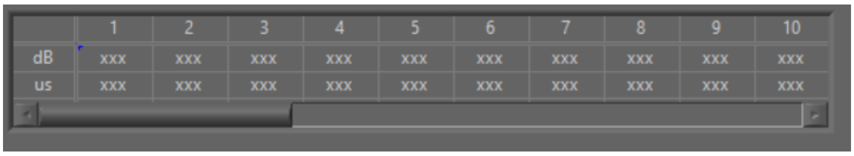


This parameter sets the slope adjusting value (in dB/µs or dB/mm or dB/inch according to current “unit”). This slope is added to DAC curve. This parameter is useful if you control homothetic pieces. You have to create a DAC curve on one piece and only adjust slope value for others pieces.

By clicking on square, you can validate ( ) or not ( ) the slope adjustment. The activation status is also visible in IHM main window.

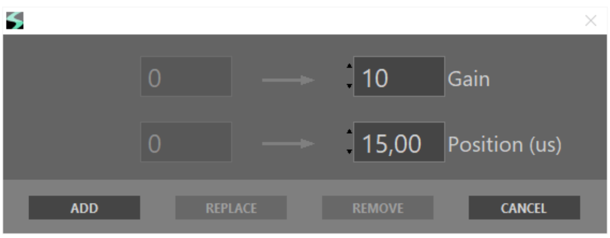
Methods to define DAC

You have at your disposal two methods to fill the DAC table. Maximum DAC points you can set is 29.



1 The manual method

Click in the table and a form window (as you can see below) appears where you can enter a new value or replace an existing value. Click to “ADD” button to validate your choice and put new point in table.

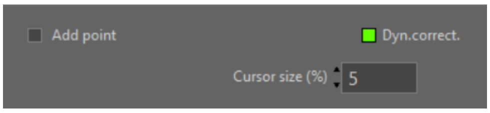


2 The automatic method

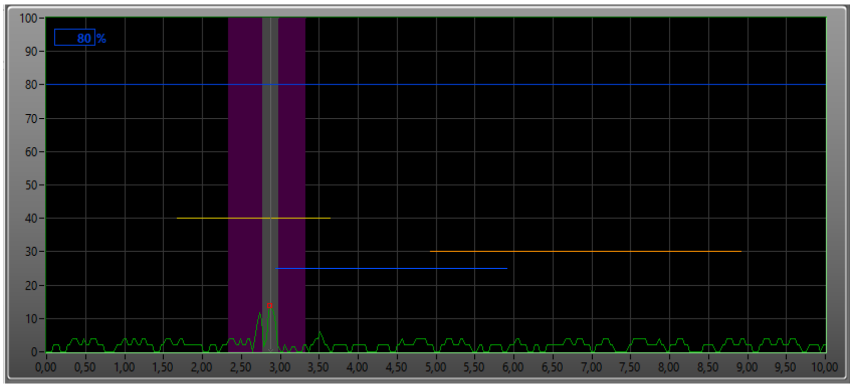
Automatic method is possible only if A-scan is visualized in these video modes (See Chapter Scope):

- Positive wave
- Negative wave
- Full waves

☞ **HF video does not allow to use automatic DAC points setting**



Activate "Dyn.Correct." by clicking the square button ( ). Then, the Echo selection tools appear in A-scan screen.



- Move the gray cursor over the area to be corrected. A red square will automatically be placed on the highest amplitude (in cursor size)
- Adjust the amplitude desired value with the blue horizontal slider or by entering the value directly in the blue rectangle (in top left corner)
- Click the "Add Point" button. System will automatically determine DAC point and put it in the table.

You can adjust the Echo capture size in the control named "Cursor Size (%)". The size is expressed as a percentage of the DAC area size.

DAC Activation

By clicking the square button, you can activate DAC correction ( ) or not ( ). The activation status is also visible in IHM main window.

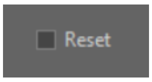
DAC curve visualization

You can display the DAC curve in overprint on the A-scan screen by clicking on "eye" button.

DAC curve is displayed on A-scan screen.

DAC curve is not displayed on A-scan screen.

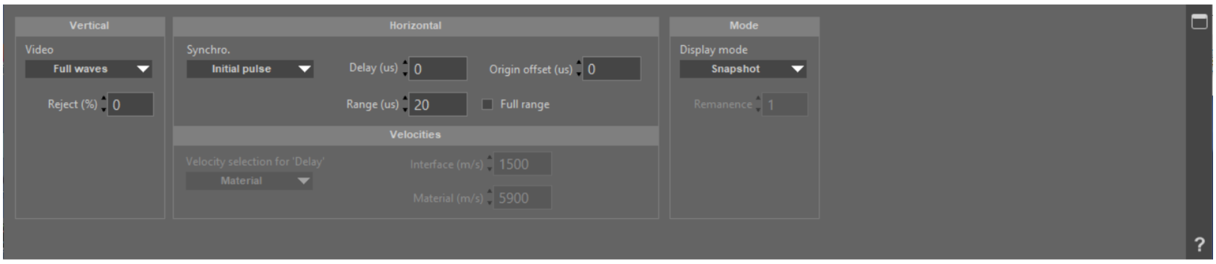
Reset DAC



You can erase the DAC table at any time by clicking the “Reset” button.

5 Scope

This tab allows you to set the A-scan signal display.



5.1 Vertical axis

Video

In "Video" menu, you can select the A-scan signal display type.

Let consider $s(t)$ the A-scan signal.

HF

Display of the positive and negative parts of signal, *i.e.*

$$s(t)$$

Positive wave

Display only positive part of signal, *i.e.*

$$\frac{1}{2}\left[|s(t)| + s(t)\right]$$

Negative wave

Display only negative rectified part of signal, *i.e.*

$$\frac{1}{2}\left[|s(t)| - s(t)\right]$$

Full waves

Display the positive and negative rectified parts of signal, *i.e.*

$$|s(t)|$$

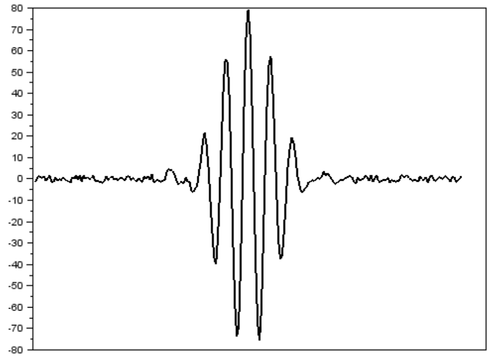
Envelope

Display the Hilbert envelope of the signal, *i.e.*

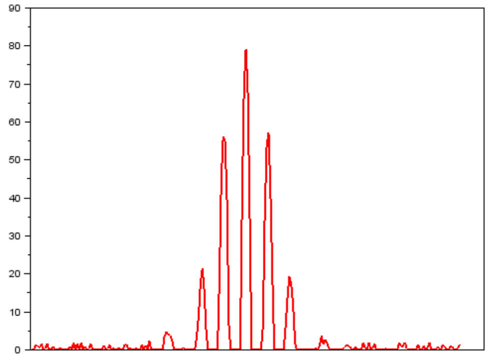
$$\mathrm{Env}\{s(t)\} = \sqrt{s(t)^2 + \hat{s}(t)^2},$$

with $\hat{s}(t) = s(t) \otimes \frac{1}{\pi t}$, the Hilbert transform of $s(t)$.

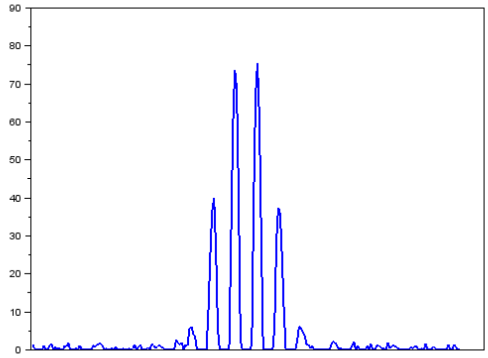
In figures below, we give examples of A-scan visualization.



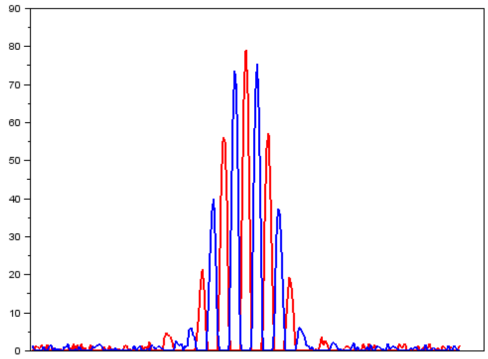
HF display



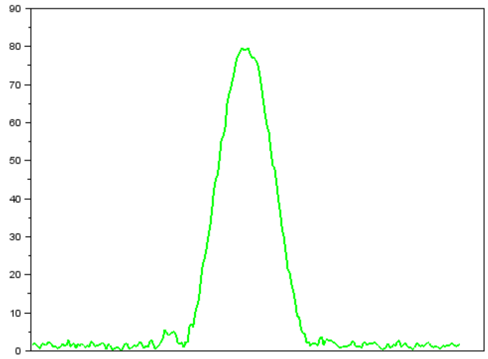
(a) Positive wave



(b) Negative wave



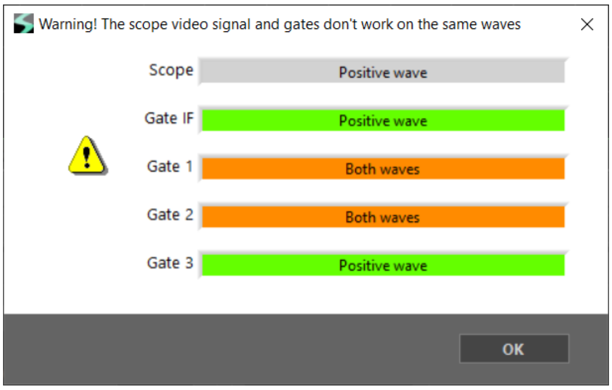
(c) Full wave



(d) Envelope

Positive displays

If you work with a scope video signal different from **Gate phase** consideration (see Chapter Gate), this situation could imply misinterpretation of data. In this case, system will send a warning pop-up to inform you.



Reject

The effect of "Reject" parameter depends of what is defined in UTView.ini file in "Global section" :

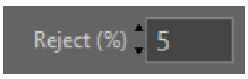
```
Global section
——————————————
This section defines parameters for all devices.

[Global]
    VIDEO_REJECTION=REJECT/THRESHOLD
[/Global]
```

You have the choice of 2 methods:

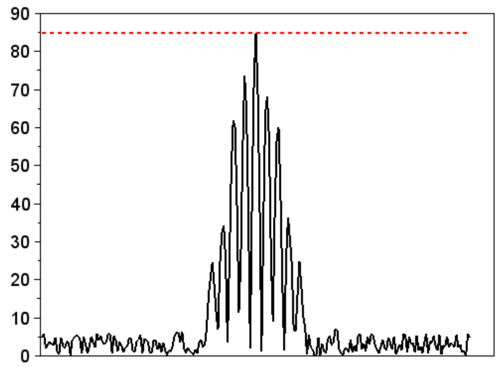
1 REJECT: delete signal less than reject value.
2 THRESHOLD: reduces the signal of the threshold value.

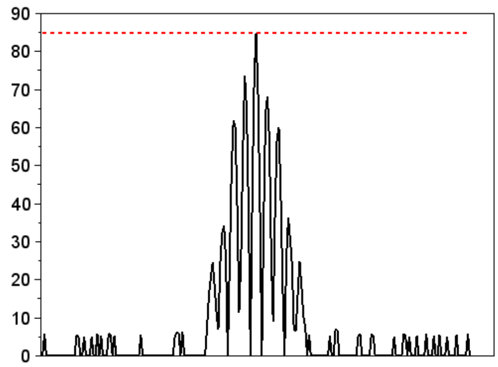
If none of them is defined, by default this is REJECT mode which will be set.



Whatever the method defined, this value can be set with an integer between 0 and 10 (which represent a % FSH).

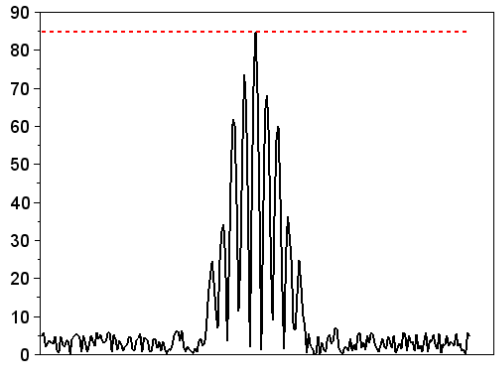
In figures below, we give examples of "Reject" and "Threshold" applications.

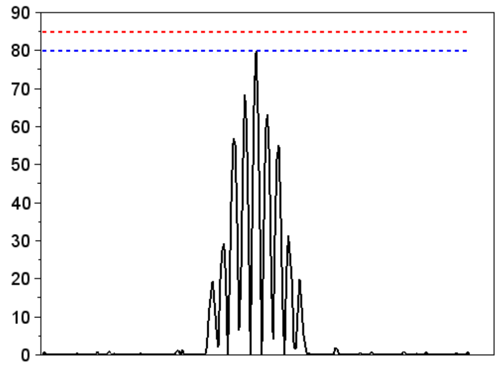




(a) No reject

(b) 5% reject





(a) No threshold

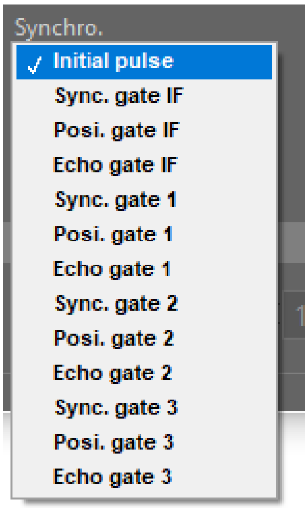
(b) 5% threshold

In case of **THRESHOLD** method, we advise you to use this rejection only as a last resort. Indeed, with this method **you degrade amplitude linearity**. It is always better to reduce noise by other means (wiring, sensor, reception filter, gain *etc.*).

5.2 Horizontal axis

Synchro.

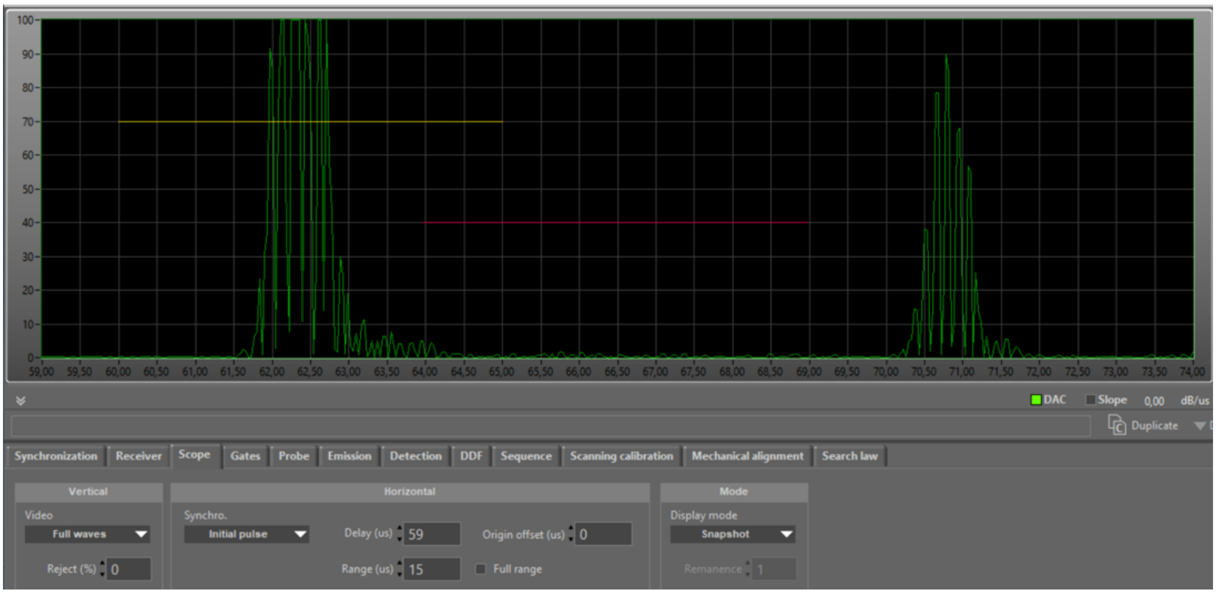
This parameter selects the triggering origin of A-scan display. You can synchronize the display of the A-scan signal from the following events:



Hereafter, we give two examples of scope display synchronization.

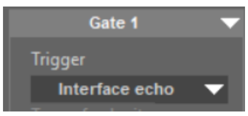
Example 1: Synchro on Initial pulse

In this first example, the “intial pulse” is the origin trigger of A-scan display.

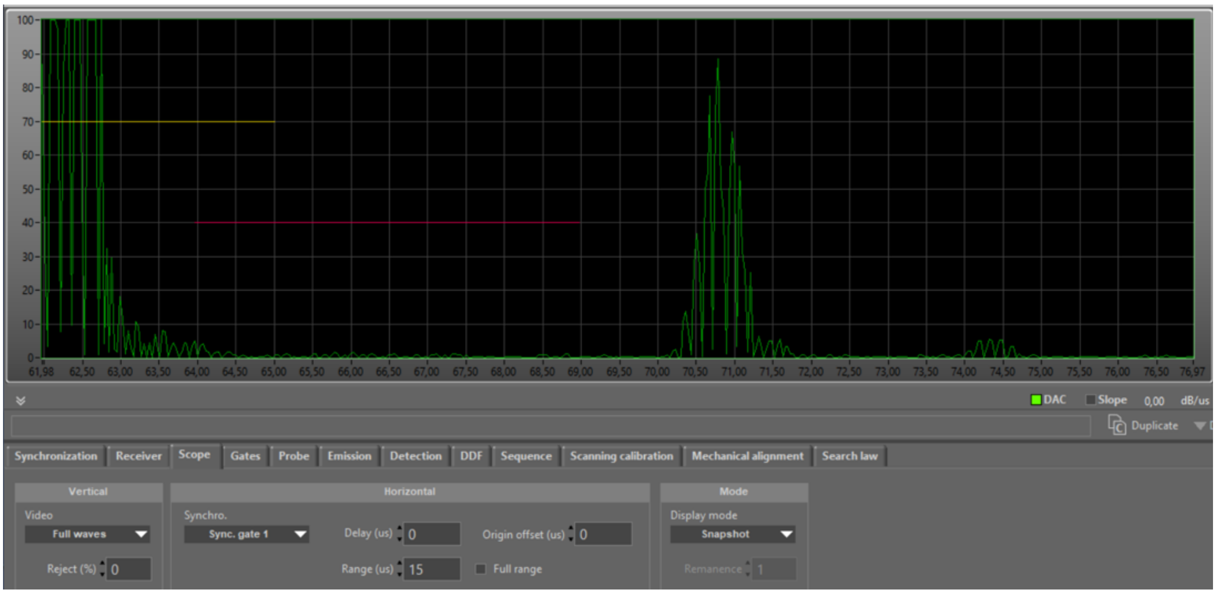


Example 2: Synchro on Synch. Gate 1

In the second example, the A-scan is synchronized with the trigger of Gate 1 (see Chapter Gate for detailed explanation).



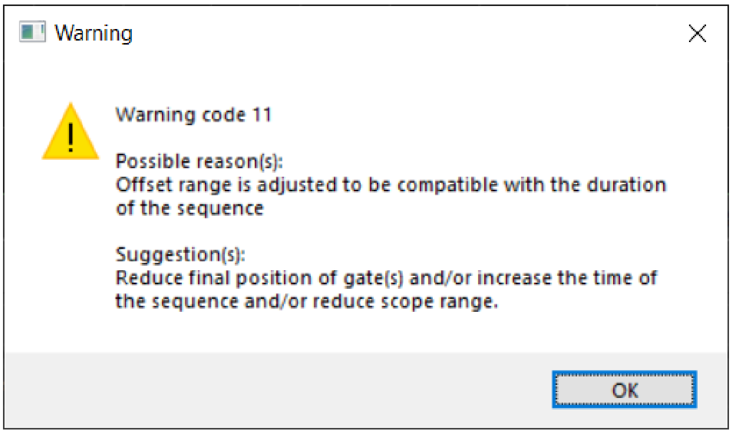
In this example, Gate 1 is triggered with echo in Gate IF. Then, A-scan display is triggered with the same event.



Delay

This parameter sets the time or distance delay of the A-scan display from the triggering origin.

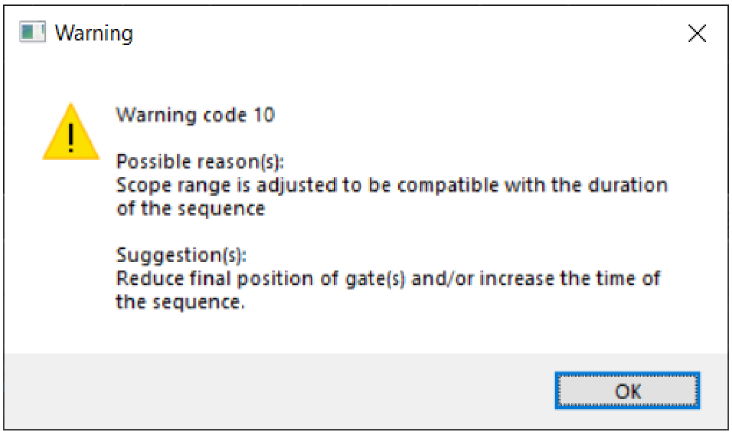
Minimum value is 0 µs and maximum allowed by system is 655 µs. But maximum possible value depends on UT setting. If you want to set a bigger value than the maximum possible, a warning pop-up window appears and system put automatically the maximum value.



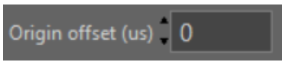
Range

This parameter sets the time or distance range of A-scan display.

Minimum value is 1 µs and maximum allowed by system is 1310 µs. But maximum possible value depends on UT setting. If you want to set a bigger value than the maximum possible, a warning pop-up window appears and system put automatically the maximum value.

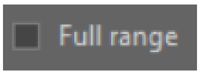


Origin offset

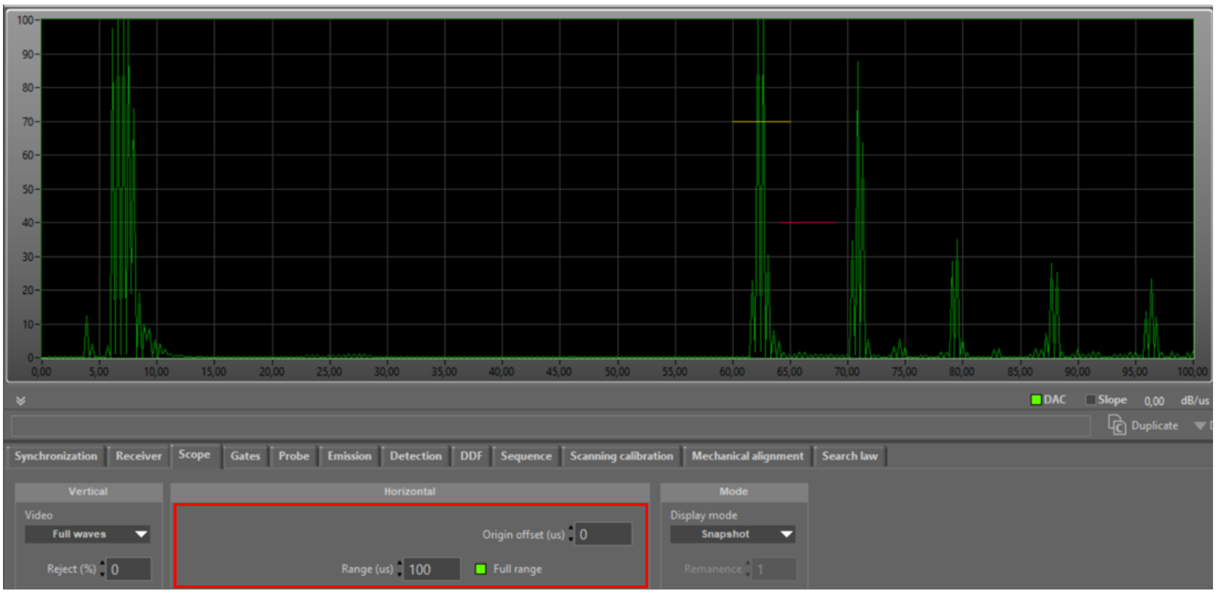


This +/− offset allows to modify the scale origin. Value could be set in the interval $[-1310\mu s, 1310\mu s]$.

Full range



This button toggles range to “normal” range and “extended” range, where A-scan is fully displayed from initial pulse.

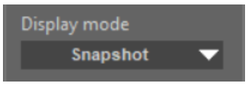


When “Full range” button is active (), system automatically sets trigger on “Initial pulse” and “Delay” to zero. These parameters could not be modified and are no longer visible in IHM.

It is possible to adjust the extended range by using “Range” control.

When you turn off “Full range” button(), you come back to normal display and you will retrieve the previous settings.

5.3 Mode

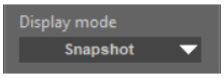


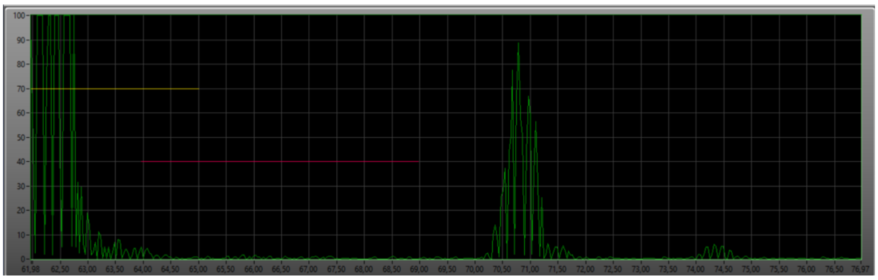
This parameter selects the digital A-scan display mode.

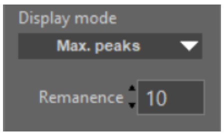
There are two available modes:

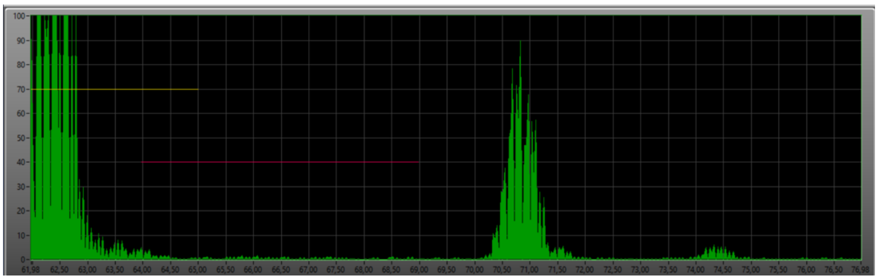
- “Snapshot”: displayed signal corresponds to ultrasonic firing returned by the device when requested.
- “Max. peaks”: displayed signal is a composition of N shots (Remanence) that have been made since the last display request. The composition holds the extreme values of each shot.

“Max. peaks” mode is more likely to see an echo on the screen if it appears on a very short time. This feature is very convenient for setting the ultrasonic parameters when using UT system dynamic calibration.





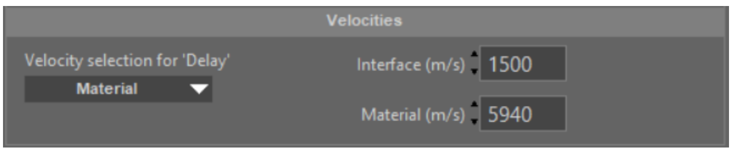


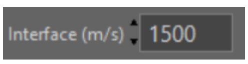


Examples of display modes

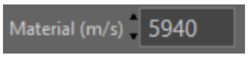
5.4 Velocities

This tab is displayed only when you choose “unit” as mm or inch.

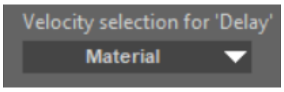




This parameter sets the ultrasound velocity (in m/s) into the propagation medium before interface (usually water). Value could be an integer between 500 and 30000.



This parameter sets the ultrasound velocity (in m/s) into the material to be inspected. Value could be an integer between 500 and 30000.



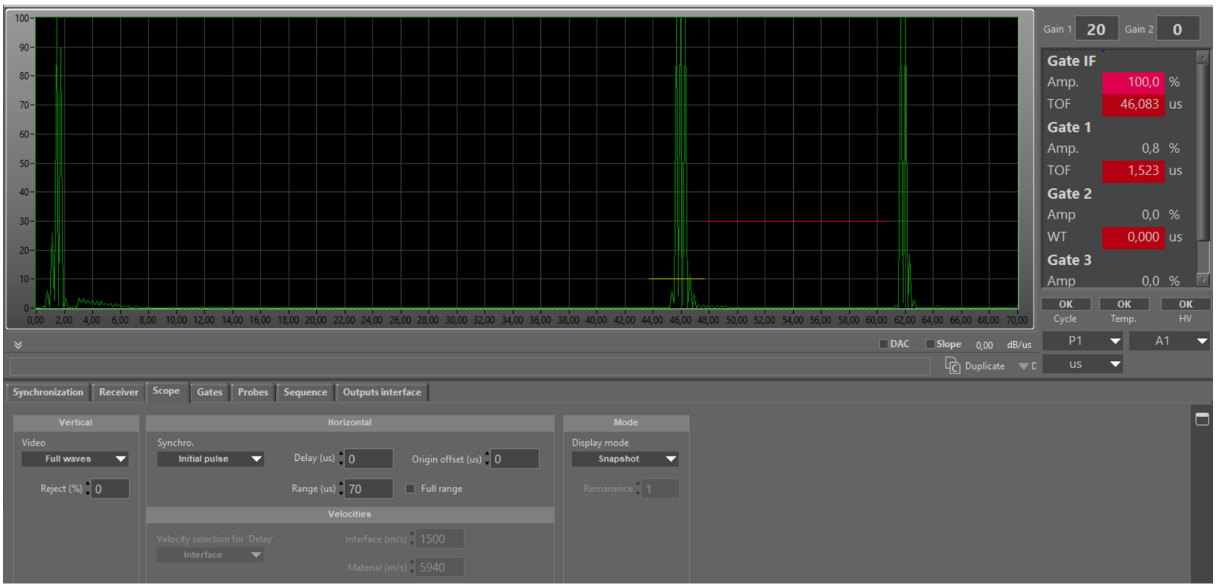
This menu allows to choose which propagation medium velocity (Interface or Material) you want to use for A-scan scope "Delay"

Examples

Lets see some scope examples to illustrate velocities use.

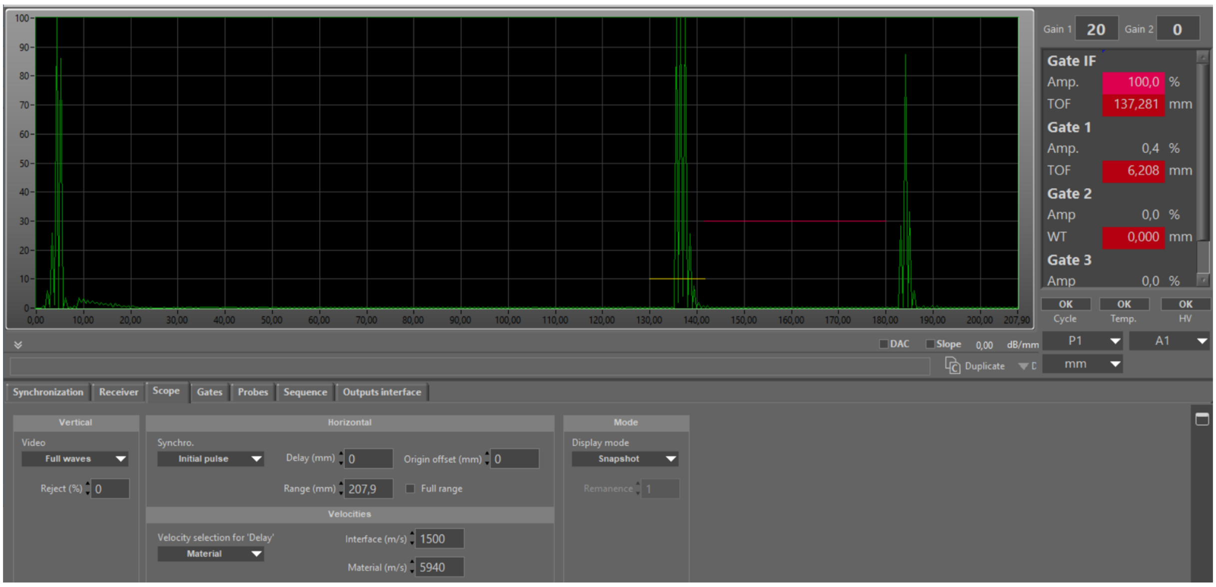
Example 1

Chosen unit is µs. We see an Interface echo at 46 µs.



Example 2

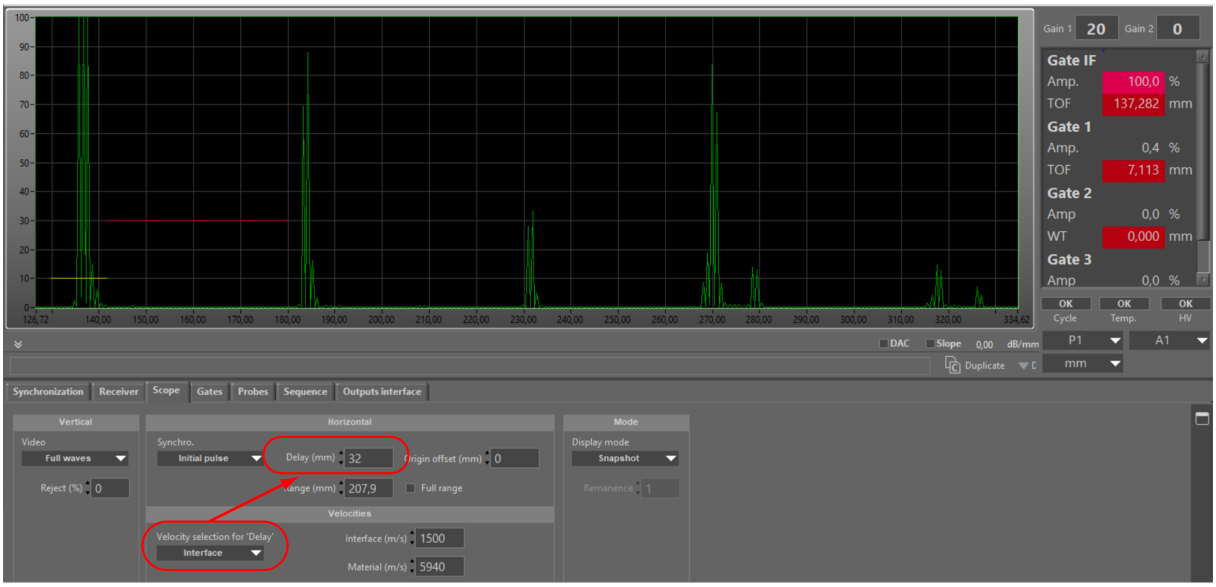
Chosen unit is mm. We see an Interface echo at 137.2 mm.



The scope range is only dependent to “Material” velocity.

Example 3

Chosen unit is mm. We see an Interface echo at 137.2 mm.

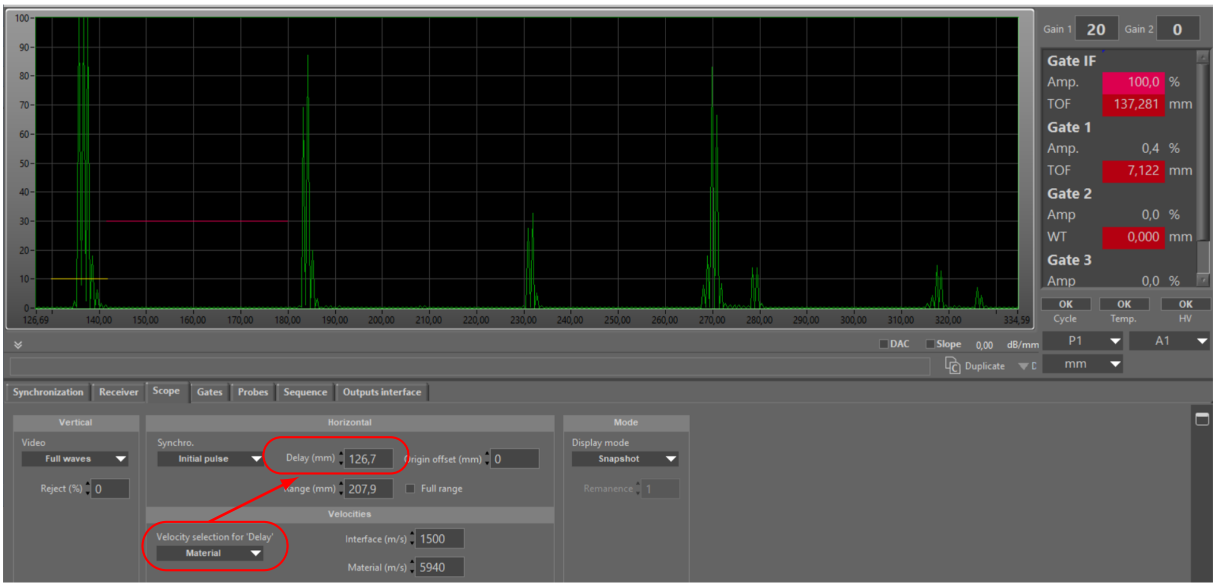


“Delay” is set at 32 mm taking into account “Interface” velocity.

In this case, if the A-scan scope begins at the “interface” echo, the Delay value represents the water-path (in mm).

Example 4

Chosen unit is mm. We see an Interface echo at 137.2 mm.

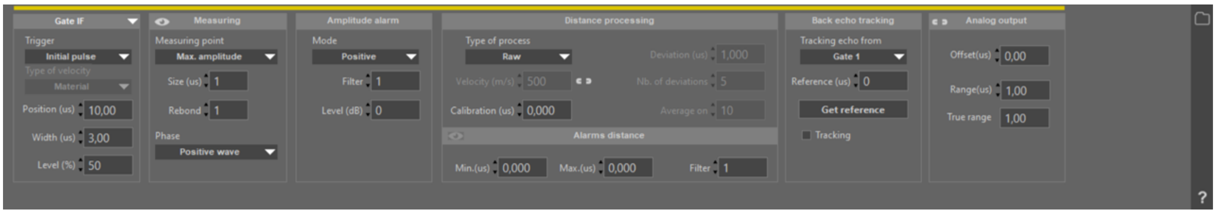


"Delay" is set at 126.7 mm taking into account "Material" velocity.

In this case, the "starting value" of A-scan scope is the same as "Delay" value.

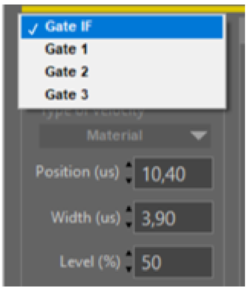
6 Gate

Use this tab to position the measuring gates and their operating modes.



6.1 Gates

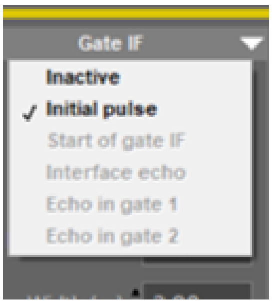
Four Gate tabs are available: Gate IF (yellow), Gate 1 (red), Gate 2 (blue) and Gate 3 (orange).



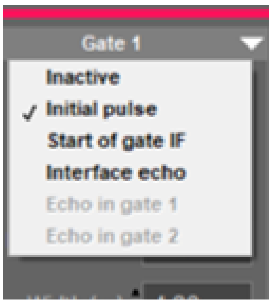
First gate named “Gate IF” is more specifically designed to detect and measure an interface echo between coupling material and the part to be controlled. The detection of an echo in this gate can be used to synchronize the display, the DAC zone and the other gates.

Trigger

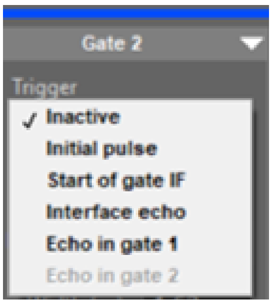
The other three gates can only synchronize the next following gates, as we can see in the **Trigger** selection:



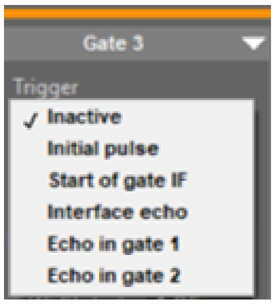
(a) Trig. Gate IF



(b) Trig. Gate 1



(c) Trig. Gate 2



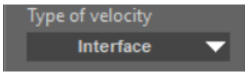
(d) Trig. Gate 3

Thus, the detection of an echo in Gate 1 can synchronize the triggering of Gate 2 and/or Gate 3. The detection of an echo in Gate 2 can synchronize the triggering of Gate 3.

Each gate can measure the amplitude of an echo and give its position according to the chosen trigger.

Type of velocity

You can represent echo position in time (µs) or in distance (mm or inch), by choosing first time (µs) or distance unity (mm or inch) in the user interface main panel.



If you work with distance unity, then this tab will be available (only) for "Gate IF". You can choose between speed velocity in "Material" or "Interface", whose values have to be filled in the "Velocities" part of **Scope** tab.

The chosen velocity will be used to define "Position" and "Width" of IF Gate.

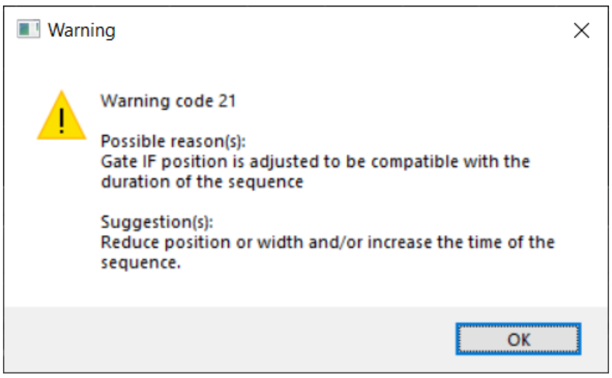
For the other Gates 1, 2 and 3, if a distance unit is chosen, the "Material" velocity is automatically taken into account for "Position" and "Width" of these Gates.

Position and Width

These Gate parameters are defined below:

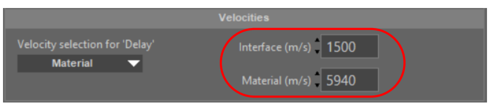
- **Position**: set the beginning of the Gates according to the chosen trigger (minimum value is 0.02 µs)
- **Width**: set the width of the Gates (minimum value is 0.02 µs)

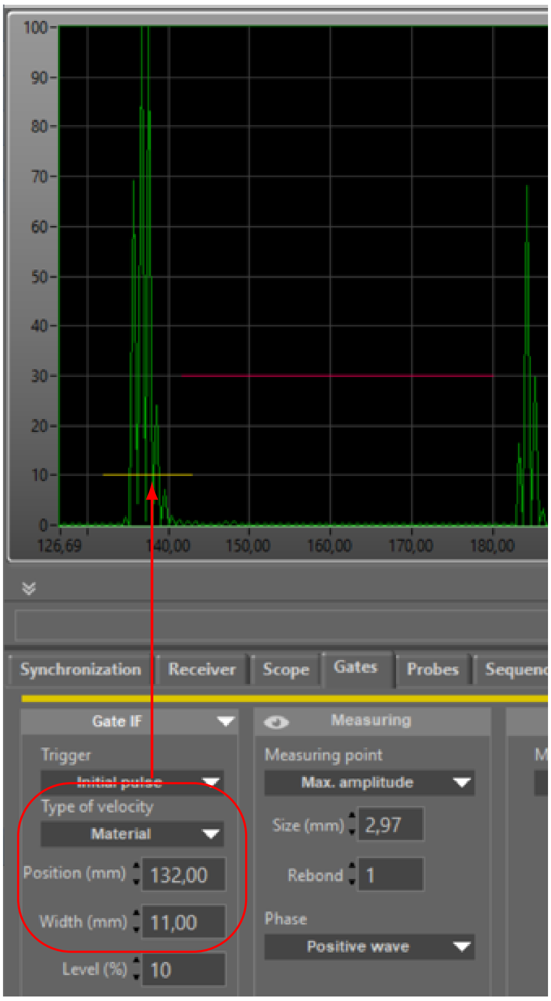
Please note that **Position** or **Width** are limited to the maximum allowed by system which is 1310 µs). But maximum possible values depend on UT configuration. If you want to set too big value, application will automatically set the maximum possible value and a warning pop-up appears indicating why there are limitation and giving suggestion to overpass if necessary.

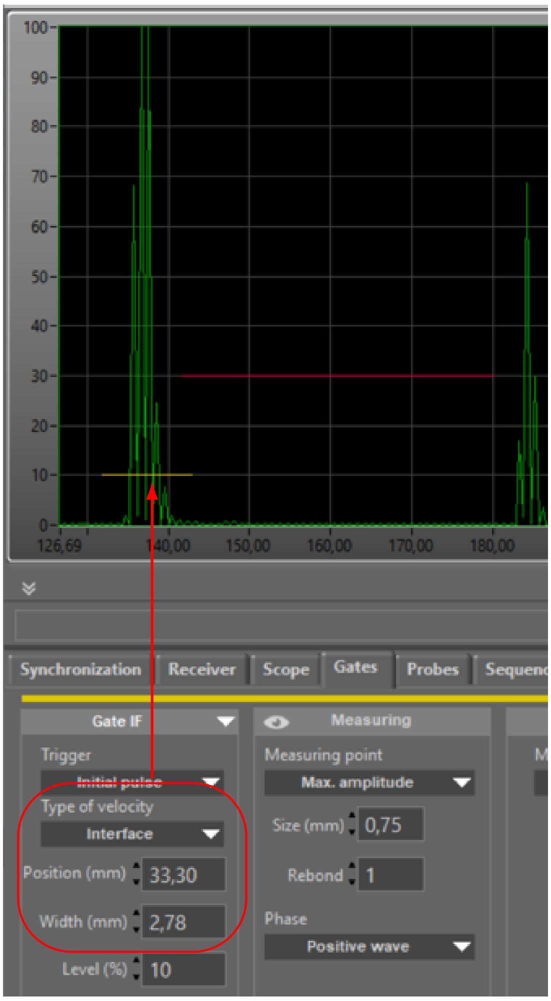


Examples

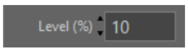
The choice of "Type of velocity" can be done only for Gate IF. Lets take examples to illustrate it.







Level

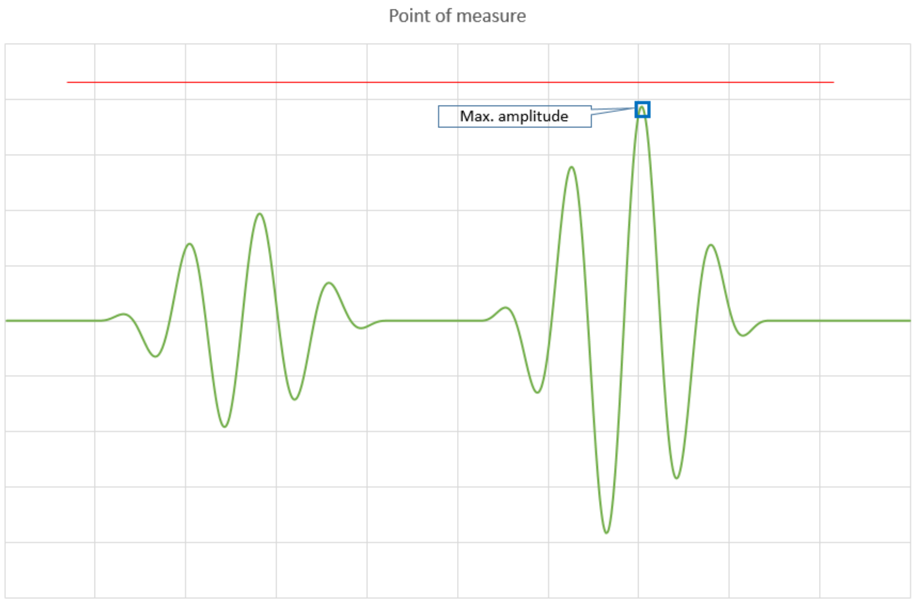


This tab allows to set the level of Gates and defines the threshold used in **Measuring point** methods (described in the following).

6.2 Measuring

The pictures below show the different methods for **measuring point** (Amplitude/TOF or distance).

Max. amplitude



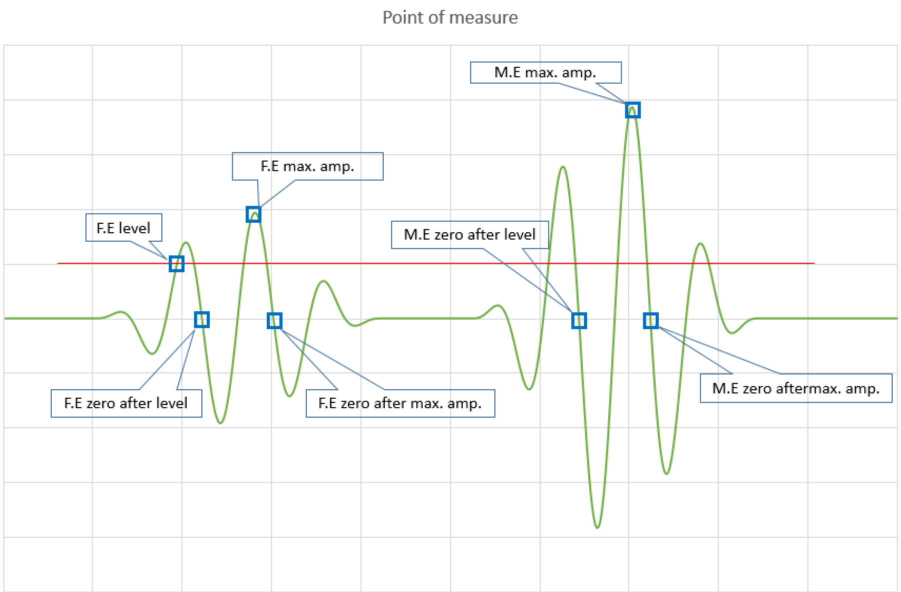
This method returns Amplitude and TOF (or Distance) of the biggest echo measured in a Gate.

Methods based on Gate level

With the other next methods, contrary to the previous one, there is an additional condition to return measuring point:

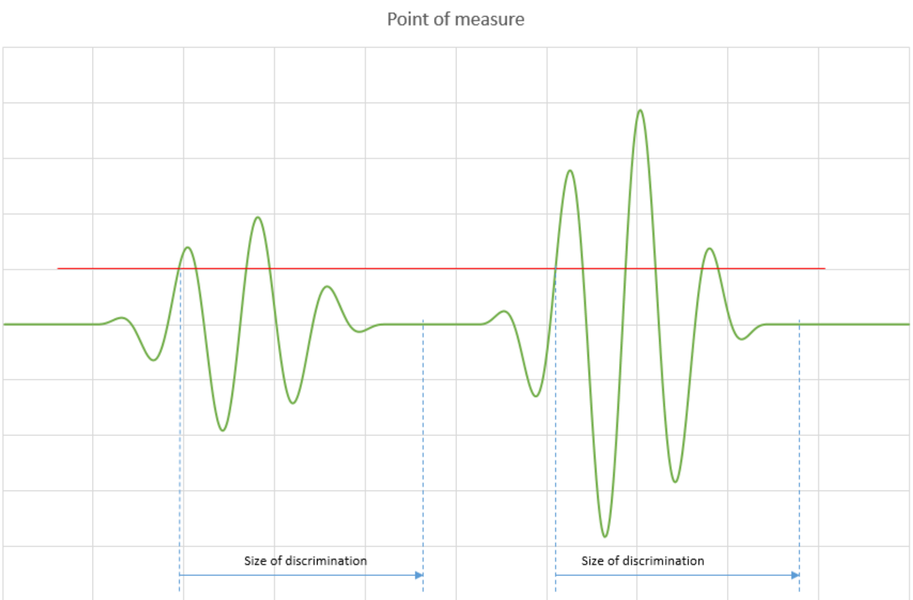
Measured Echo in the gate has to be bigger than the threshold defined by Gate level (see 6.1).

Measuring Method	Part of Echo taking into account	Description
F.E level	**F**irst **E**cho	First crossing point of Gate with the selected Waveform
F.E zero after level	**F**irst **E**cho	First zero-crossing point after the first crossing point of Gate level
F.E max. amp	**F**irst **E**cho	Maximum Peak point of the selected Waveform over the Gate level
F.E zero after max. amp	**F**irst **E**cho	First zero-crossing point after the Maximum Peak of the selected Waveform over the Gate level
M.E zero after level	**M**ax **E**cho	First zero-crossing point after the first crossing point of Gate level
M.E max.amp	**M**ax **E**cho	Maximum Peak point of the selected Waveform over the Gate level
M.E zero after max. amp	**M**ax **E**cho	First zero-crossing point after the Maximum Peak of the selected Waveform over the Gate level



Size

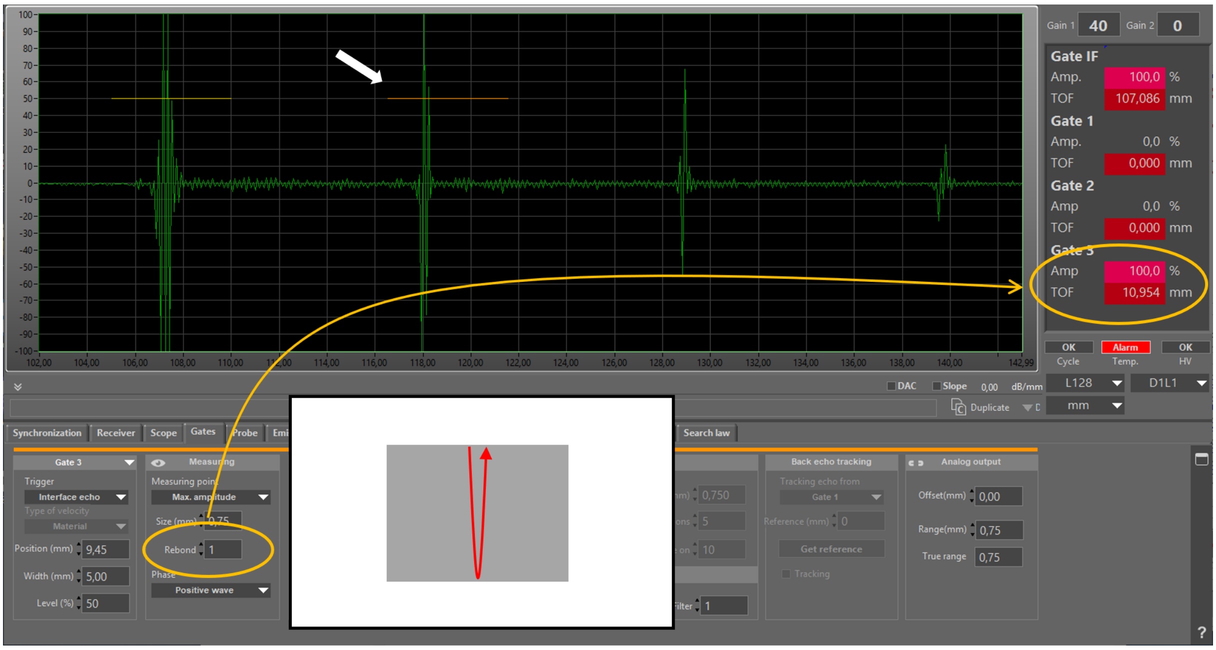
Usually an echo consists of several periods of oscillations. So this **Size** parameter will allow system to discriminate several echoes in the gate.

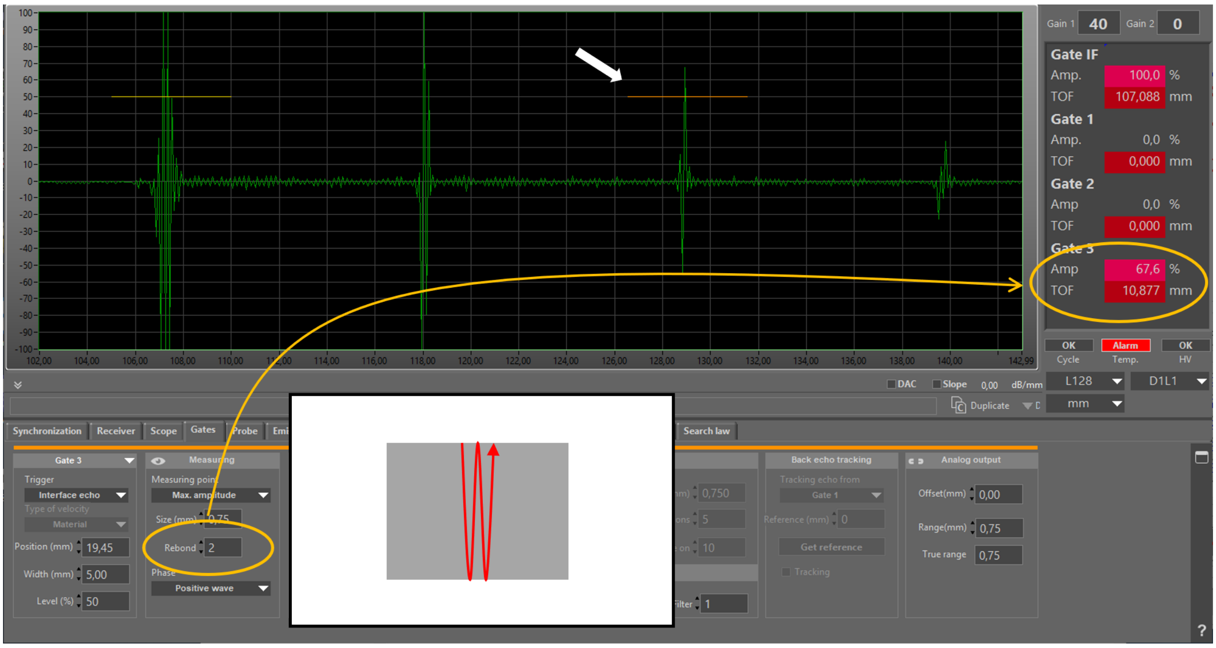


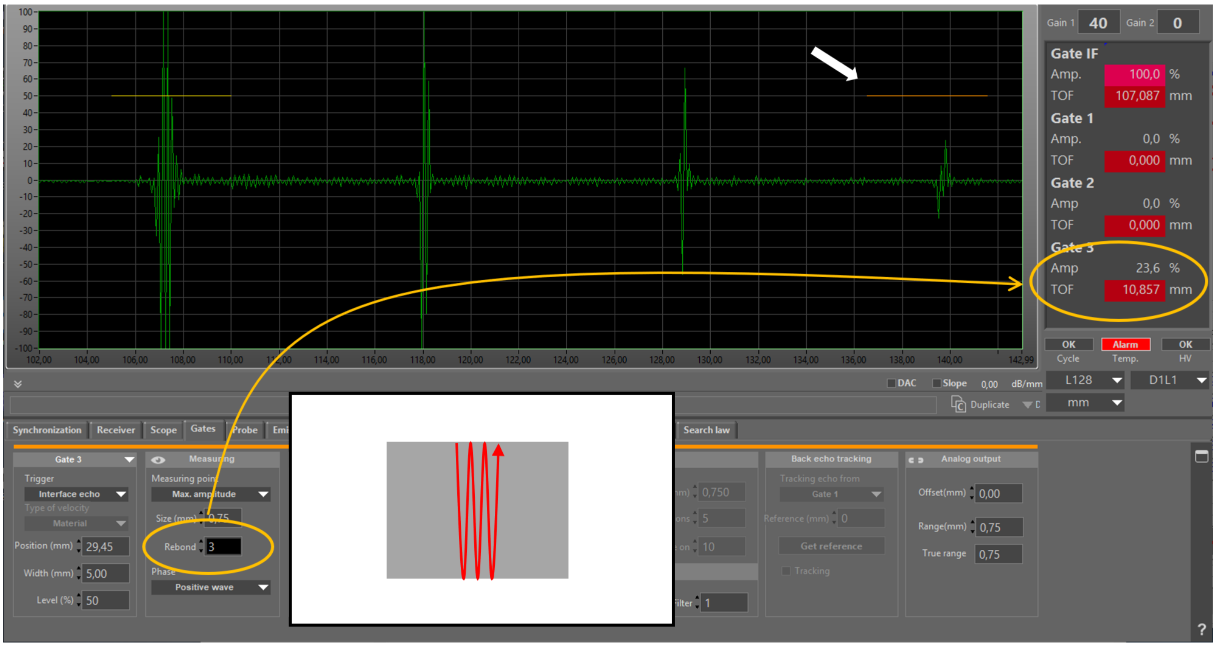
Rebond

In case of thickness measurement, you can specify the number of rebounds taken into account. According to the number defined (max. 7), system will compute automatically the right TOF (as it is shown in example below).

When it is possible, measurement on multi-skip echo is an interesting feature as it could give more accurate data.





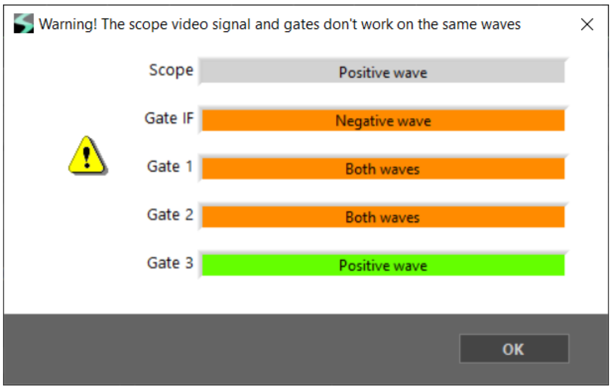


Phase

You can select the **Phase** on which the echo will be measured. Three options are available:

- Positive wave
- Negative wave
- Both wave

If you work with a scope video signal different from the chosen **Phase**, this situation could imply misinterpretation of data. In this case, system will send a warning pop-up to inform you.



6.3 Amplitude alarm

The amplitude alarm determines whether the echo is above or below the detection level, respectively when **Mode** is "Positive" or "Negative".

Positive mode (or "Apparition" mode) gives an amplitude alarm when echo detected in gate is bigger than the threshold defined by gate level. Goal of this mode is to send alarm when defect is detected in gate.

Negative mode (or "Disappearance" mode) gives an amplitude alarm when echo detected in gate is lower than the threshold defined by gate level. Goal of this mode is to send alarm in case of loss of echo (as for example interface echo or back-wall echo).

In order to make more robust the alarm sending, with regard to electrical parasites or false alarm, in Positive mode you can set **Filter** and **level** parameters.

Level

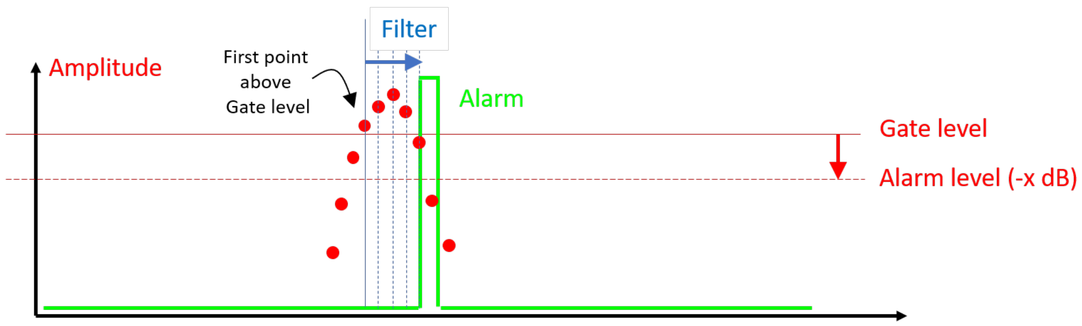
This parameter sets level (in dB) (relative to Gate Level) for alarm detection. Its value must be between -15 (minimum) and 0 dB (maximum).

Filter

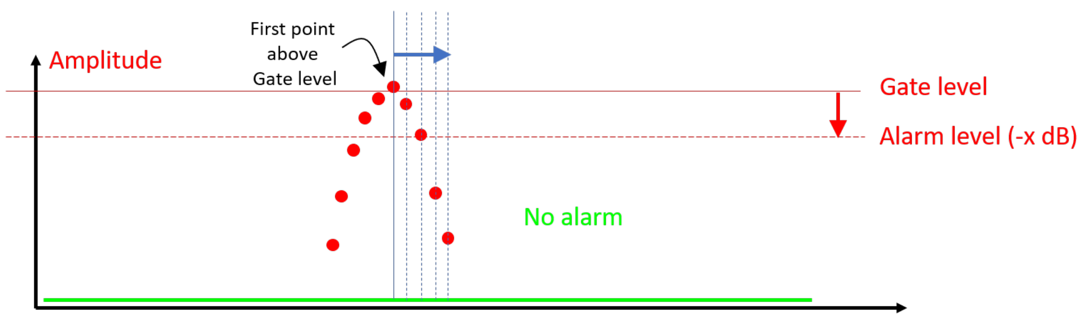
This parameter filters the alarm detection of signals by **setting the required number of consecutive shots** for which amplitude is above Alarm Level, with the condition that **at least one detection is above the gate level**.

Example cases

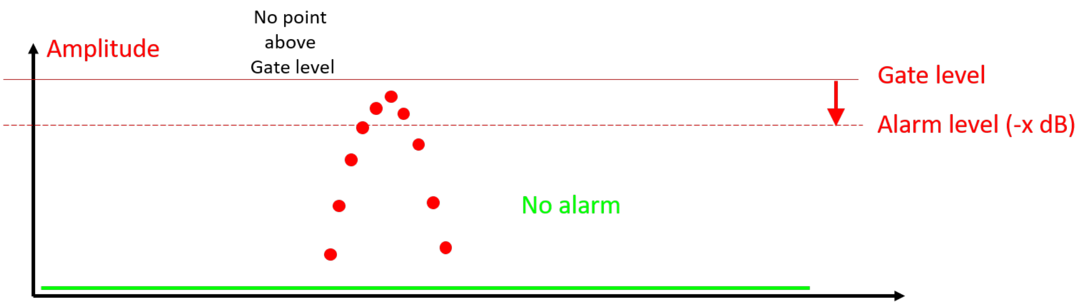
Let's take 3 cases to illustrate the alarm filtering process, with by example, Filter = 5 and level $= -2$ dB.



For 5 consecutive shots, amplitude in gate was above the alarm level, with at least one amplitude above the Gate level. There is an alarm.



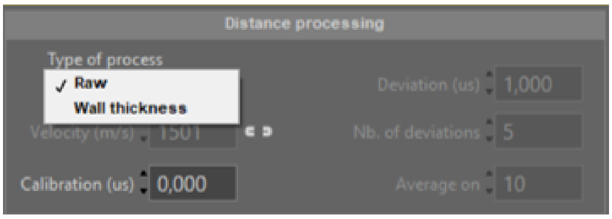
In spite of one amplitude is above the Gate level, there is not enough consecutive shots with amplitude above the alarm level. There is no alarm.



In spite of some amplitude are above the alarm level, none is above the Gate level. There is no alarm.

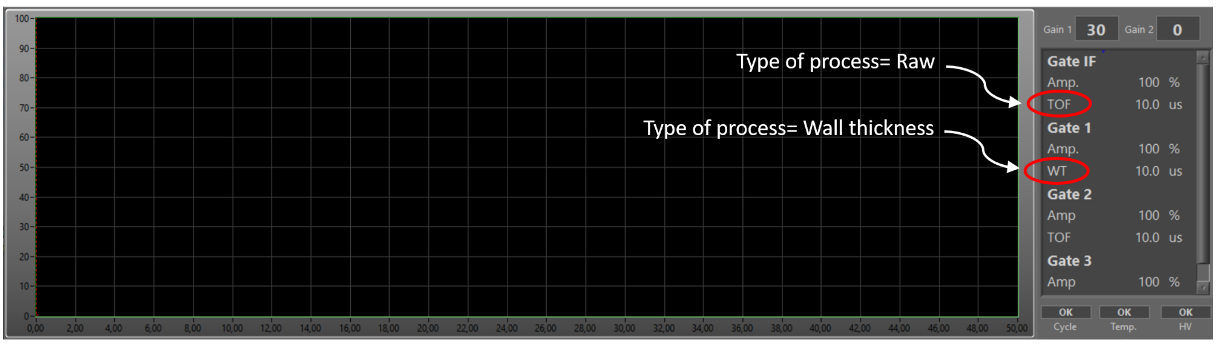
6.4 Distance processing

Two measurement processes of the position of an echo in a gate must be distinguished:



- The “Raw” mode (“TOF”) in which no treatment is applied to the measurement. It is usually used when looking for defects.
- The “Wall thickness” mode (“WT”) which is more dedicated to measure the thickness of a material. In this case, a real time treatment is applied to the measurement. Goal of this treatment it to remove aberrant and parasitic values.

Please note that if you choose TOF or WT, it will appear in user interface main window.



WT-Deviation

Maximum measurement deviation between two successive TOF values to take in account the last value into the WT process; above this deviation, the last value inside tolerances will become the prior one. Its value could be set between 0 (minimum) and 80 µs (maximum).

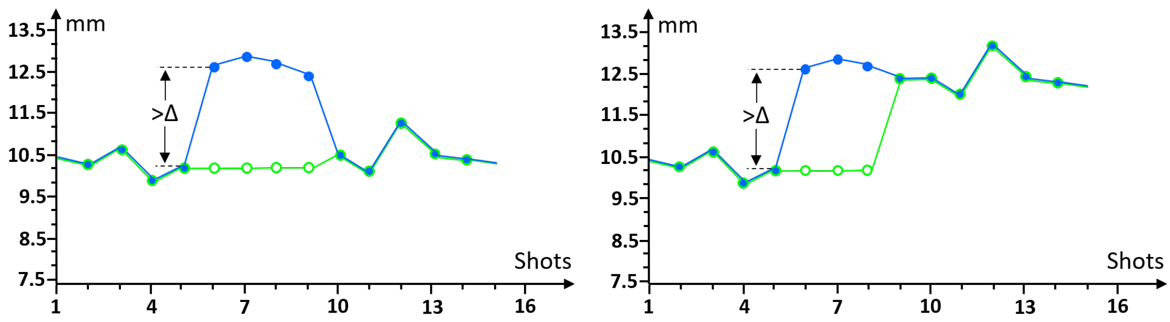
WT-Nb. of deviations

After N measurement over max. deviation, the $N+1$ value will be taken in account on WT processing. Its value could be set between 1 (minimum) and 15 (maximum).

WT-Average on

Moving average on number of successive processed measurements. Its value could be set between 1 (minimum) and 15 (maximum).

Example cases



(a) Example 1:
Deviation Δ =1 mm
Number of deviation=10

(b) Example 2:
Deviation Δ =1 mm
Number of deviation=3

In these examples, blue curves are the "Raw measure" and green curves are the "WT measure" *i.e.* after data filtering. The process maintains the measure for N points when deviation is over the defined deviation tolerance (Example 1). If the measure is greater than the defined deviation for more than N points then the measurement will be taken into account and become the new reference (Example 2).

Calibration

The "TOF" or "WT" measurement can be adjusted with a **Calibration** value.

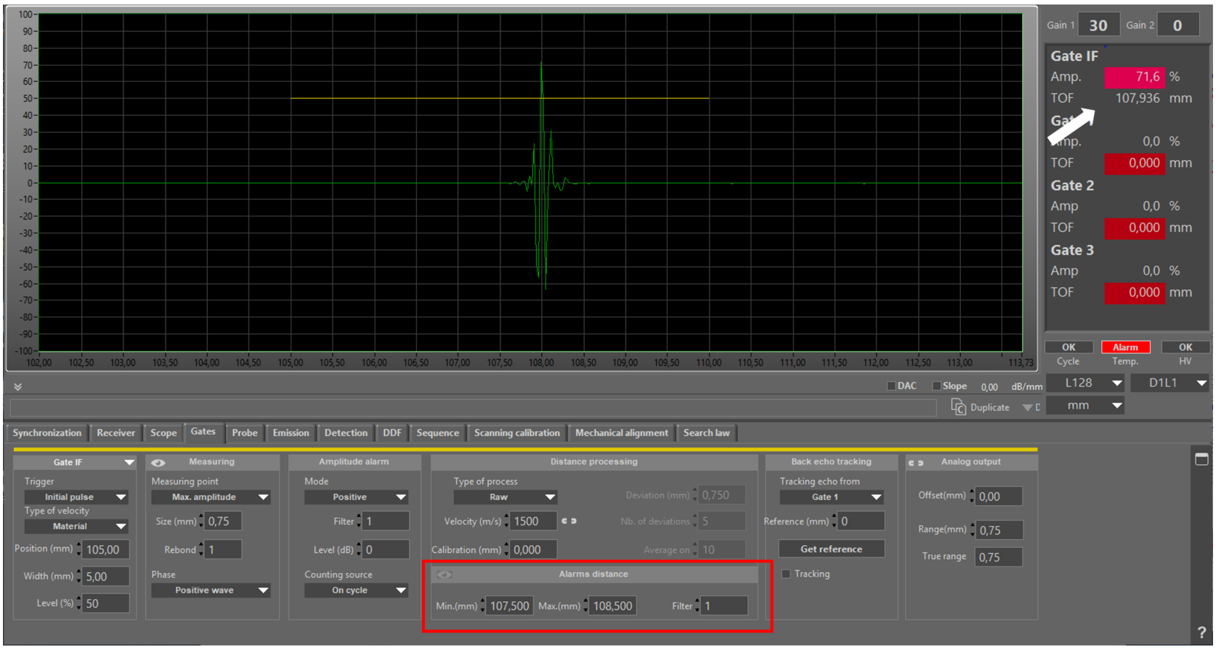
Velocity

If you want to work with distance unity (mm or inch) instead of time (µs), you have to define value of **Velocity** to convert TOF/WT measurement in distance. The velocity value defined here will be used only for TOF or WT measurement in Gates.

: The speed used to convert the distance measurement is the same as the A-Scan signal display (*i.e.* “Material” velocity).

: The speed used to convert the distance measurement is independent of the one used to display the A-scan signal (*i.e.* “Material” velocity).

6.5 Alarms distance

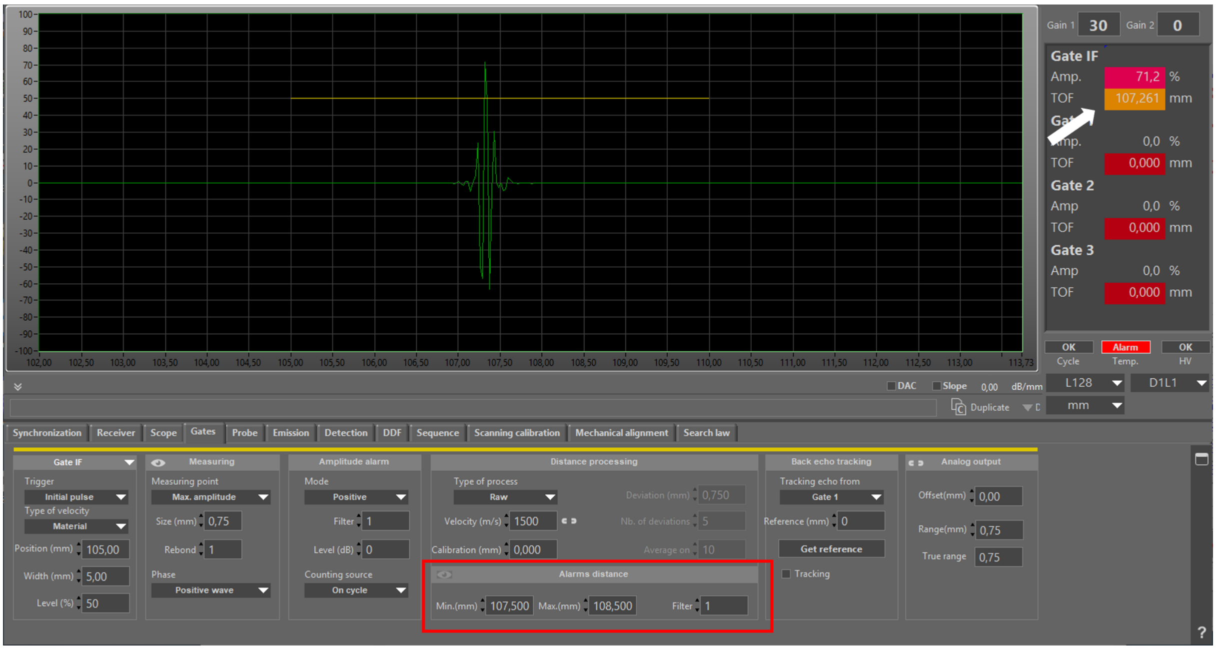


You can send an TOF/WT alarm if the echo position measured in the gate is outer the range [Min., Max.].

As you can see in above example, TOF of IF echo is comprised between the defined range, there is no alarm.

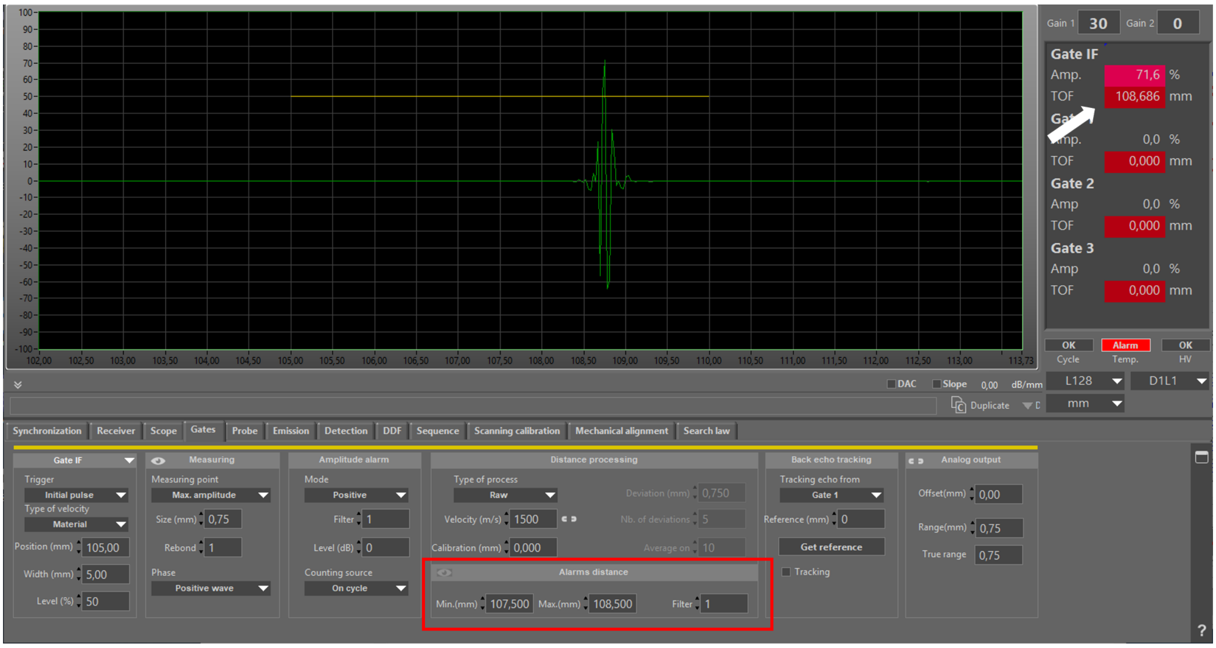
Min.

This parameter set the “Min.” TOF/WT tolerance. Alarm is on if measure is smaller than “Min.” (as you can see in example below). In this case, in main IHM, TOF/WT is highlighted in orange.



Max.

This parameter set the “Max.” TOF/WT tolerance. Alarm is on if measure is bigger than “Max.” (as you can see in example below). In this case, in main IHM, TOF/WT is highlighted in red.



Filter

“Filter” is the number of consecutive shots, with TOF/WT outer the [Min.,Max.] range, after which alarm could be on.

6.6 Back-echo tracking

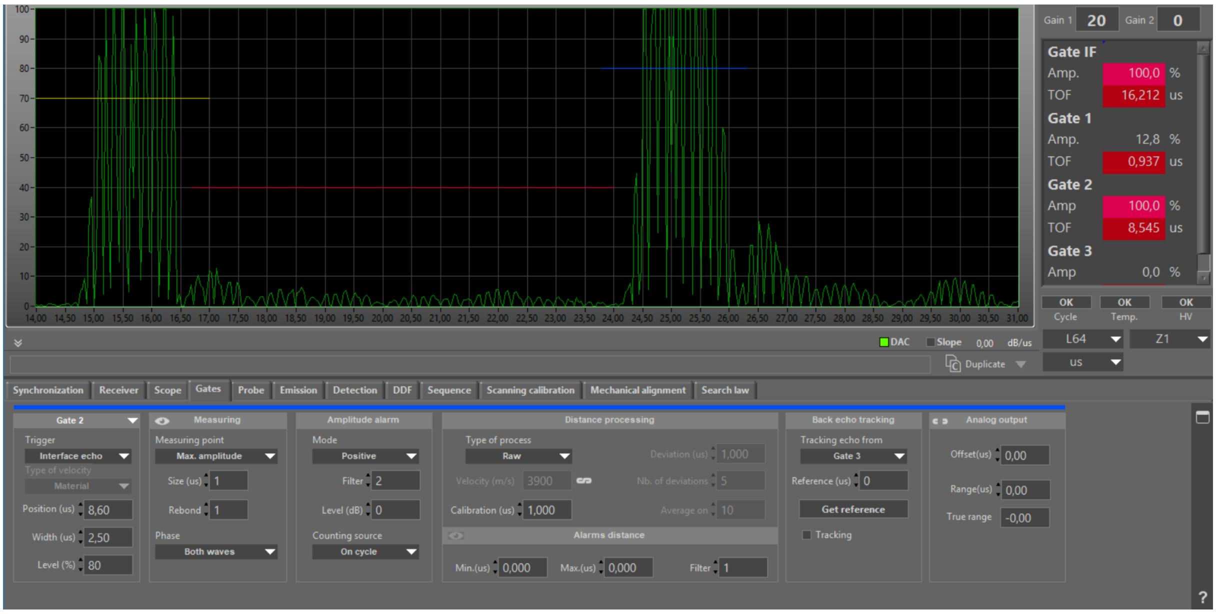
It is possible to automatically adjust the size of a gate according to the variation of the position of an echo measured in another gate. This feature allows for example to avoid the detection gate to cross the back-wall echo.

To use this mode, you have to choose :

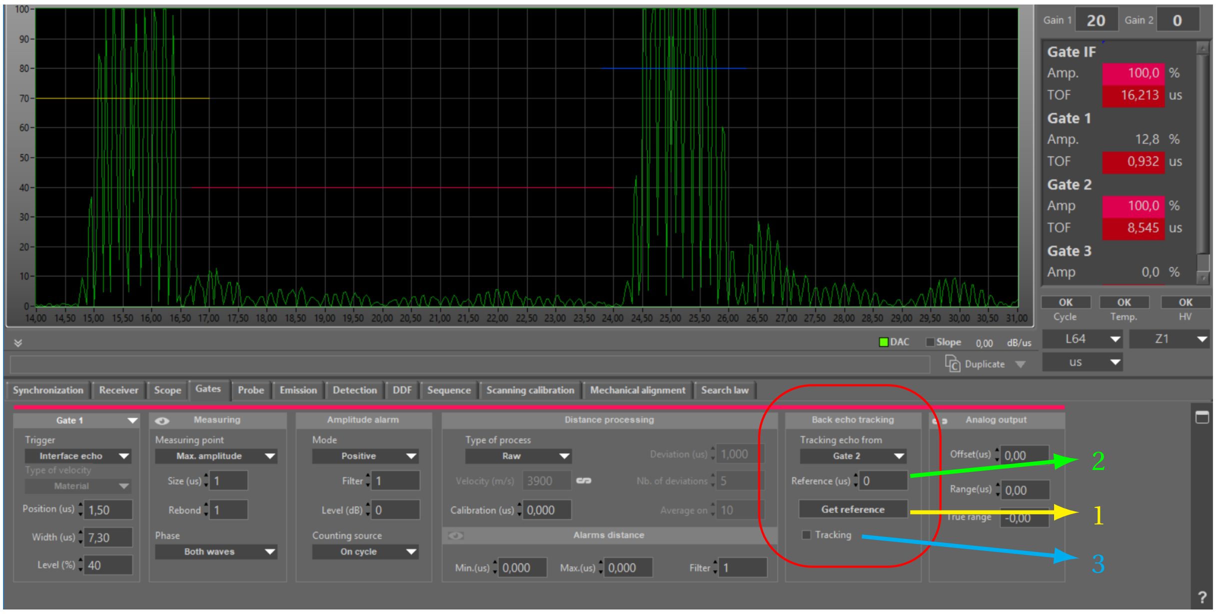
1 the detection gate, Gate 1 or 2
2 the gate for "tracking" which follow the detection gate (could be Gate 2 or 3)

Let's take the example of Gate 1 which is tracking from Back-wall echo in Gate 2.

☞ Define the position of Gate 2 to measure the back-wall echo. You can use both "Raw" or "Wall thickness" Distance processing.



☞ Apply Back-echo Tracking in Gate 1 from Gate 2



1 Define the position and width of Gate 1 as close as you want from Back-wall Echo.

2 Click on "Get reference" (1)

3 The reference value is updated (which is the TOF (or WT) of Back-wall echo in Gate 2) (2)

4 Activate Tracking by clicking on the button (3)

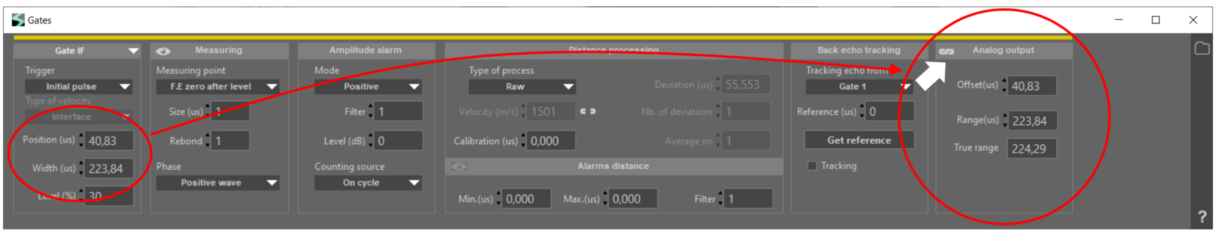
The system will adjust the detection gate width by applying the difference between the reference and the current measure.

6.7 Analog output

When using an analog output module (See Chapter Outputs), you can determine the "offset" and "range" of the position measurement. You have the option to link or not these parameters with the position and witdth of the gate.

: The parameters are related to the position and width of the gate.

: The parameters are independent of the position and width of the gate.

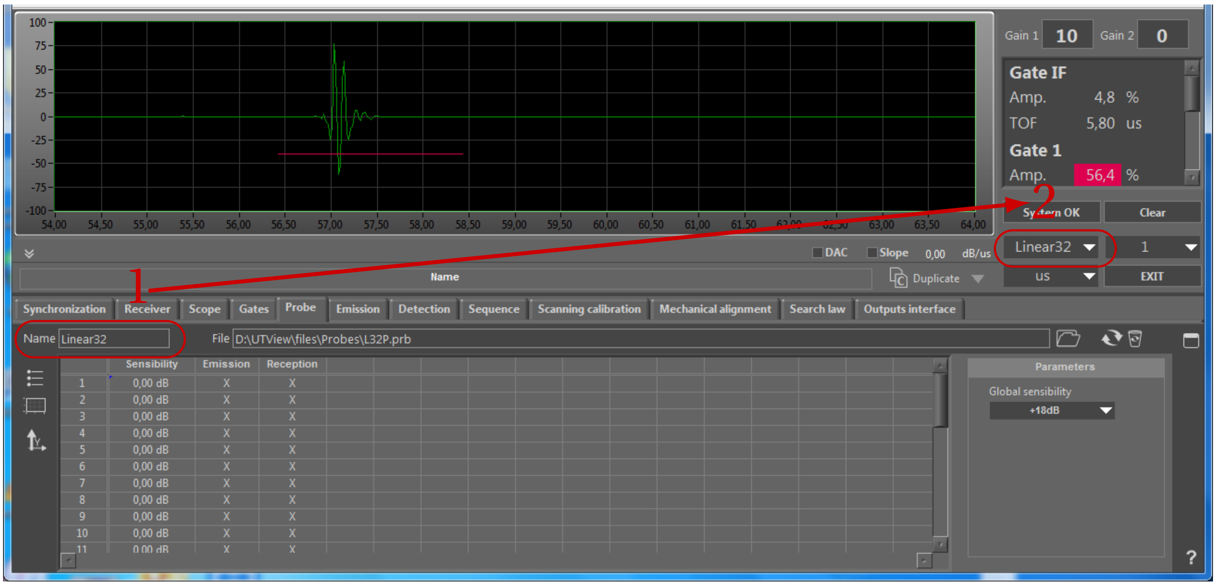


According to "Offset" and "Range" defined, system will inform you via the value "True range" the real dynamic used for analog output.

7 Probe

This tab allows you to define the probe used in the UT file and to check its characteristics, as element's sensibility.

7.1 Probe file loading



You can define your Phased Array probe with SIPATools and generate a probe file with ".prb" extension. In UTView interface, you can load your probe file by clicking . A window appears inviting you to choose a probe.

If you change type of probe in your UT file, you have to:

1 Delete all settings by clicking 

2 Restore all settings by clicking 

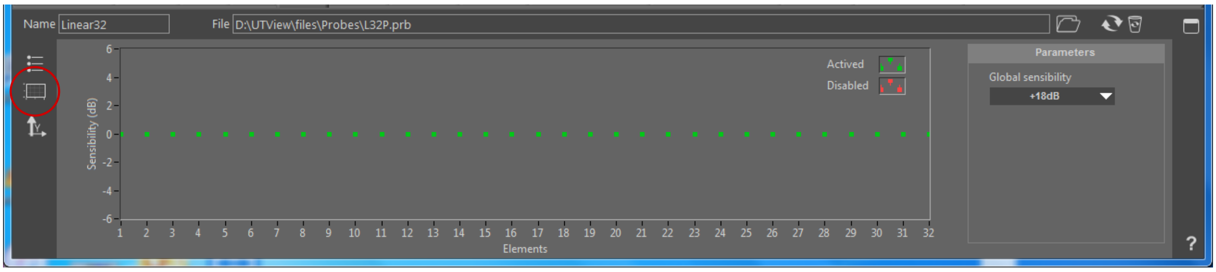
You can give name to the probe (max. 8 characters)(1). This name will appear to the probe list selection(2) .

According to the PA probe, you can adjust the gain range requested in your UT configuration with the parameter "Global sensibility". You can select 0, 6, 12, 18 or 24 dB. The effective gain applied is the summation of Global sensibility + Gain 1. As for example, these situations are equivalent:

Global sensibility	0	6	12	18	24
Gain 1 (dB)	50	44	38	32	26

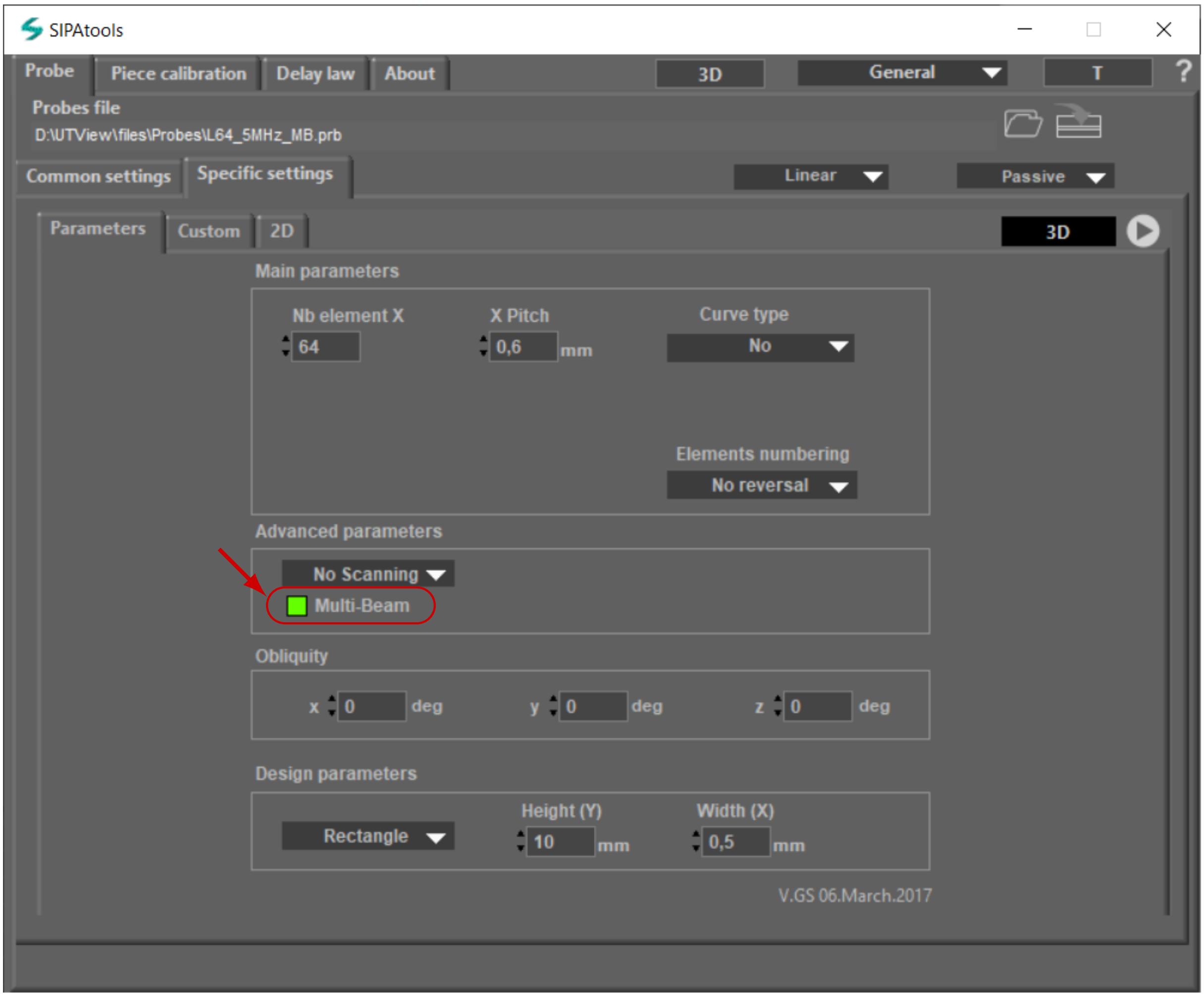
7.2 Element's sensibility

As information, you can see table of element's sensibility and you can know if an element is switch on/off in emission and/or reception (default view). You can see this information in graph if you click (see figure below). You can go back to the table by clicking .

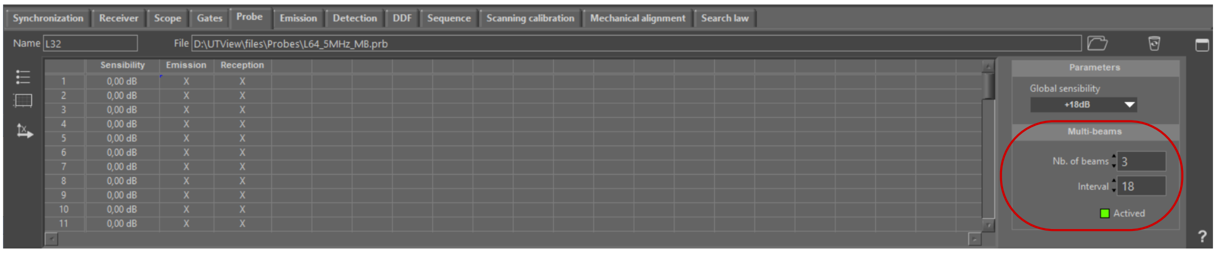


7.3 Multi-beams setting

If you want to use Multi-beams feature, you have to define first this option in your probe file with SIPATools. Activate multi-beams mode by clicking on the button (See figure below).



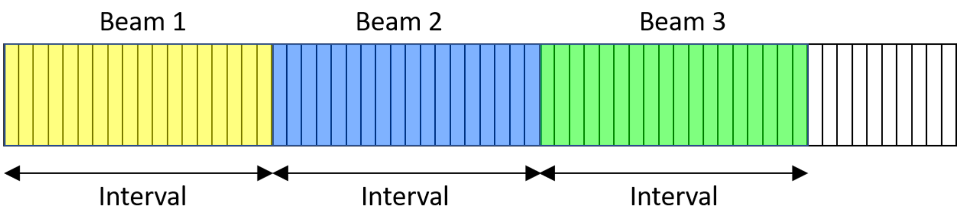
In UTView interface–Probe section, you have to define multi-beams parameters:



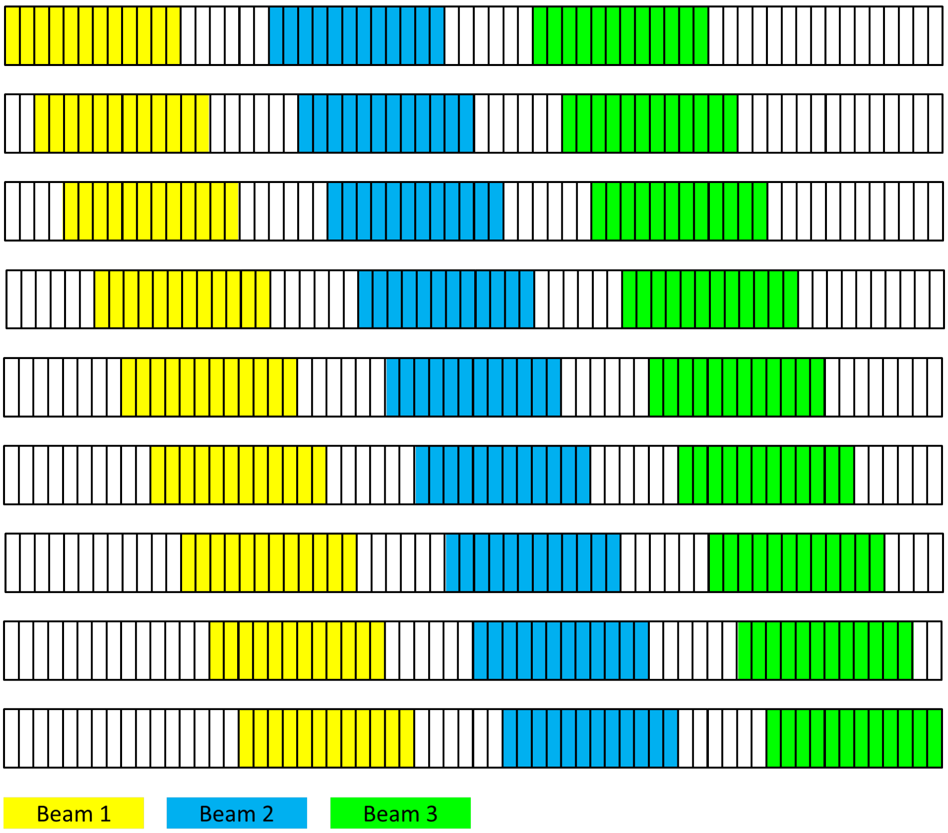
These two parameters are:

1 Number of Beams
2 Interval

"Interval" parameter represents the size of one beam as it is represented in figure below. Then, you can use delay laws with an aperture < Interval.

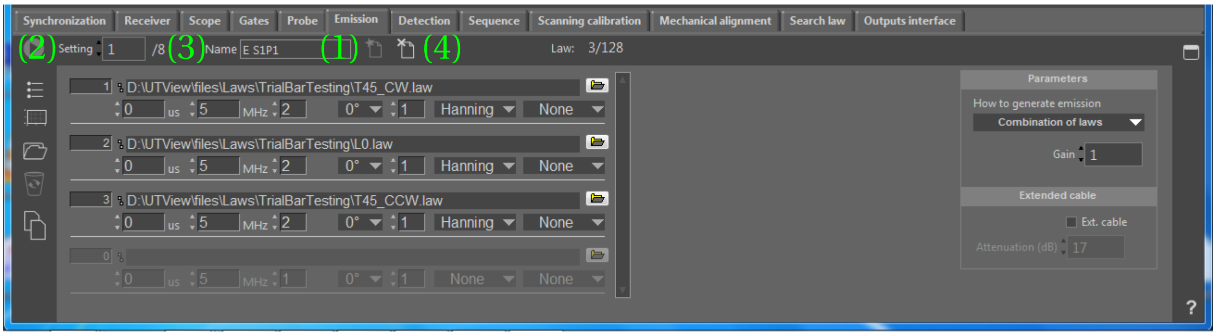


Let see an example with 3 Beams and Interval=18. We use delay laws with aperture of 12 elements. If we define the scanning step=2 and repetition=9 in sequence tab (see Chapter Sequence), the scanning schematic is as represented below:



8 Emission

This tab allows to define the “Pulser”, by applying delay laws and parameters.



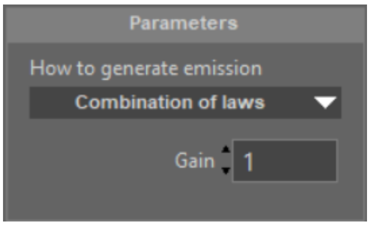
In a first step, you have to create a new pulser setting by clicking on  (1).

You can create different settings (2).

Each setting can be named (3) (max. 8 characters).

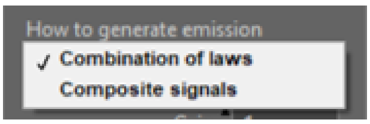
A setting can be deleted just by clicking on  (4).

8.1 Parameters



How to generate emission

The emitter module has in charge to supply electric pulsing signals for each PA element.



These signals can:

- be built from delay laws if you choose “Combination of laws” (See below § 8.2 for detailed explanation)
- be loaded from an external file if you choose “Composite signals” (See below § 8.4 for detailed explanation)

Gain

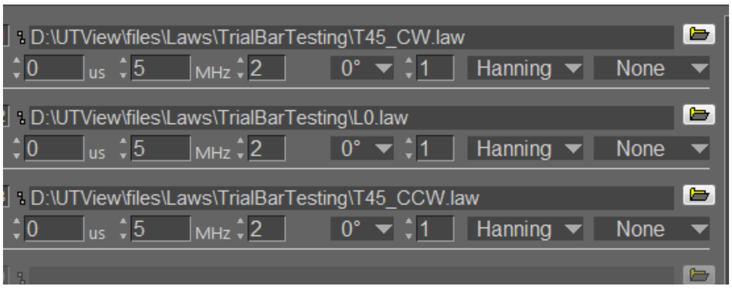
This parameters sets the level of pulsing signal. Value is comprised between 0 (*i.e.* no emission) and 1 (maximum level).

8.2 Laws combination setup

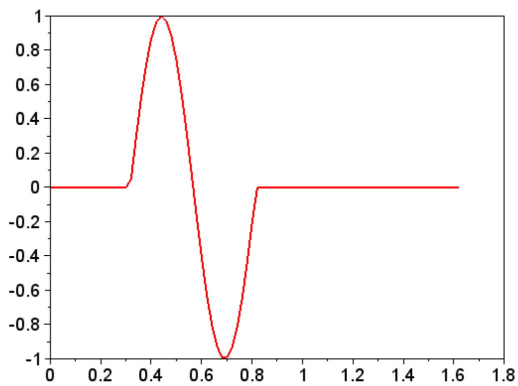
By choosing “Combination of laws” for pulser, you could use and combine several delay laws.

To compute and obtain delay laws, you can use “SIPATools” which is Socomate software dedicated to delay laws calculation.

In the list, click on the button to load a delay law in the table. According to delay laws and associated parameters, system will compute automatically the composite signal to apply to each element.

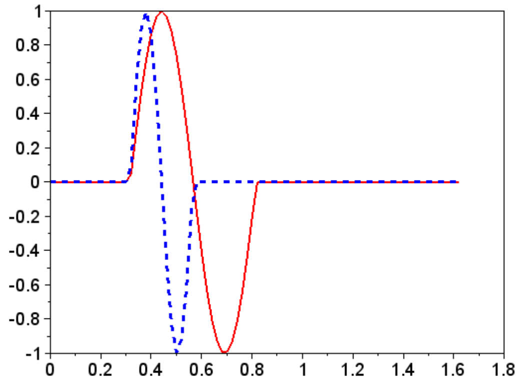


The FAAST-PA elementary pulse is sin-wave type as it is schematized bellow. For each delay law, we can apply different pulse signal which will depend on different parameters.



Pulse frequency

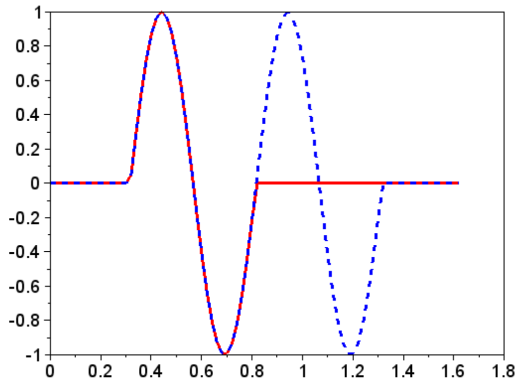
This parameter sets the “frequency” of the sinusoidal-type pulse signal. Unit is in MHz.



Example of pulsing signal. Frequency is 2MHz in red curve and 4MHz in blue dashed one.

Pulse period

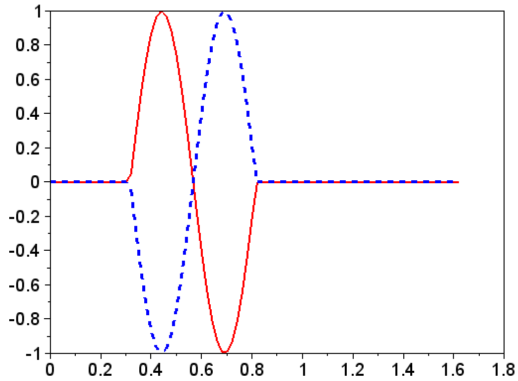
This parameter sets the “number of period” of the sinusoidal-type pulse signal. This value is not necessary an integer, it could be real number as for example “2.5”.



Example of pulsing signal, with 1 period in red curve and 2 periods in blue dashed one.

Pulse phase

This parameter sets the “phase of signal”. Values could be 0° or 180°.

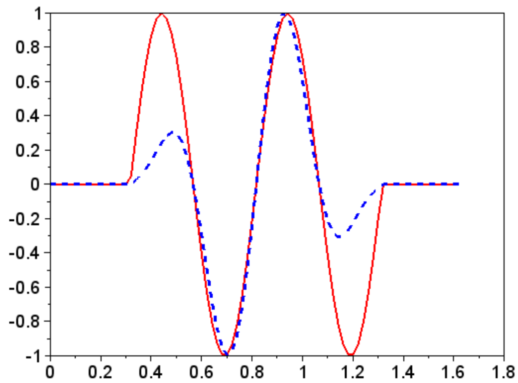


Example of pulsing signal, with 0° phase in red curve and 180° phase in blue dashed one.

Pulse Time–window

This parameter sets the time–window of the sinusoidal pulse signal. You have the choice between:

- None (no filter)
- Hamming
- Hanning
- Sin^2
- Sin^3



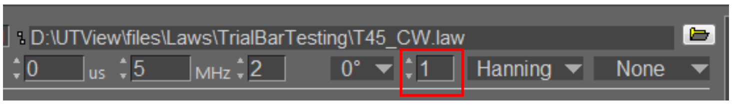
Example of pulsing signal, without time-window in red curve and with Hanning time-window in blue dashed one.

Spatial filter–apodization

This parameter sets the spatial filter (*i.e.* apodization) in the corresponding delay law. You have the choice between:

- None (no filter)
- Hamming
- Hanning
- Sin^2
- Sin^3

Gain



This parameter sets the relative gain to apply to each law in table.

Let's see examples below:

These 2 examples represent the same situation. Pulse voltage applied for "Law2" is 2 times bigger than for "Law1" and "Law3".

Offset

This parameter sets a time value to add to the delay law. Unit is in µs.

Other buttons

In the left side of table, you have different buttons.

- : Display delay laws in form of list (the table where you set all parameters)

- : Display delay laws in form of graph
- : Select a folder from where you can load delay laws
- : Delete all delay laws and parameters
- : When the button is active ( ), any modification is duplicated to all delay laws

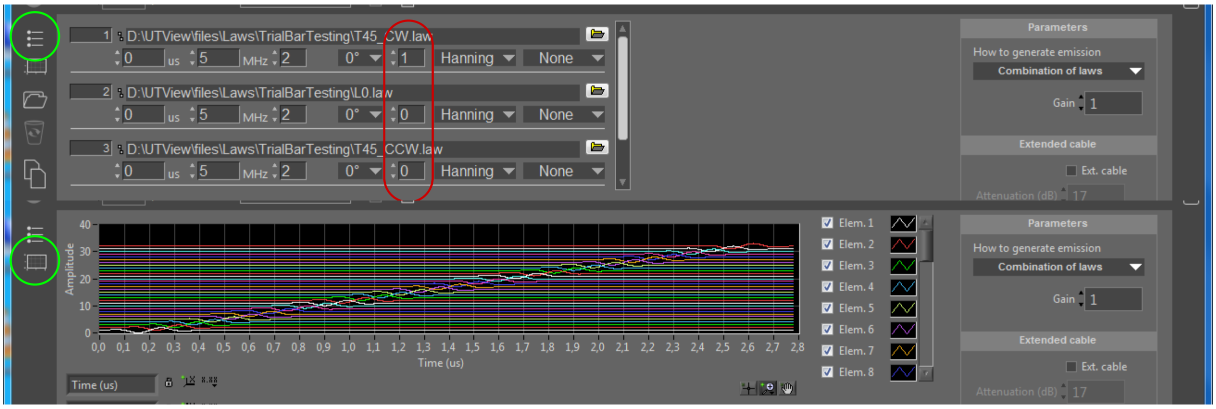
8.3 Pulser example

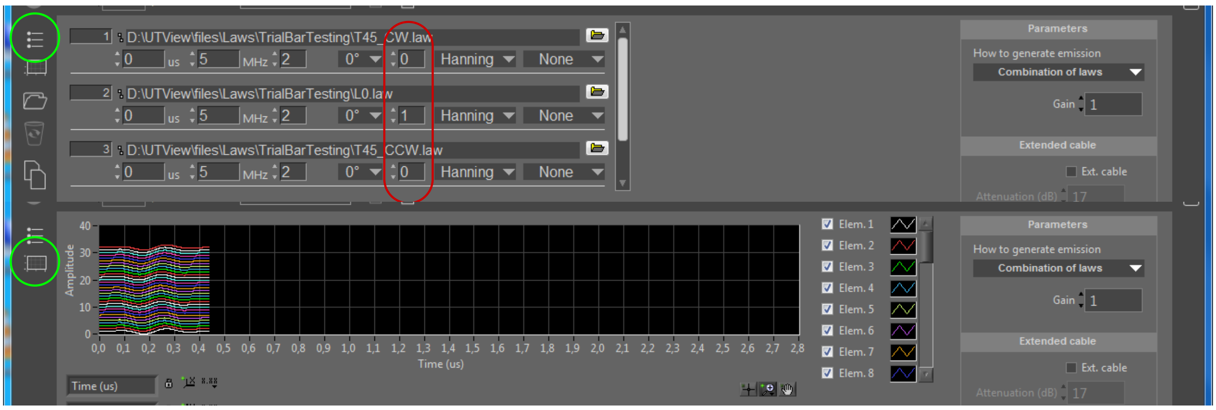
Let see an example of a linear PA probe, where we want to insonify a tested part in 3 angles :

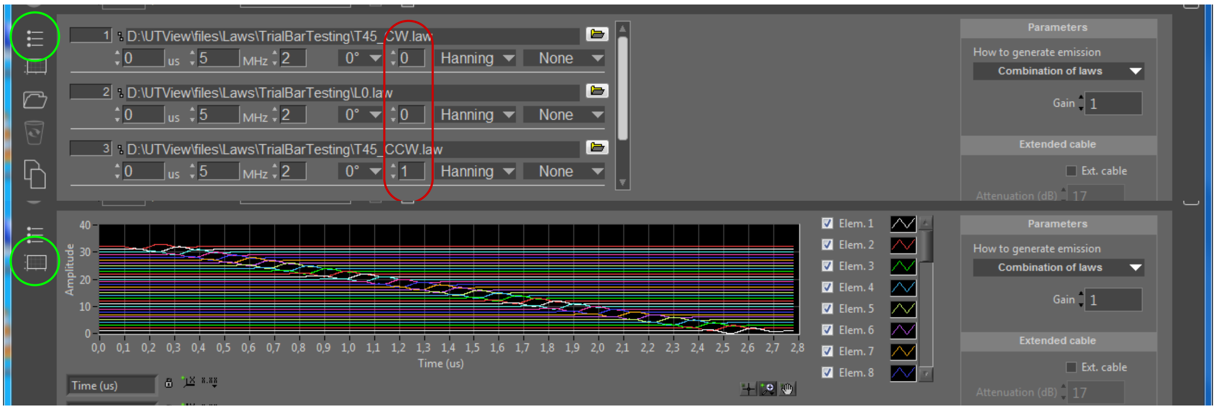
- 0° with compression waves
- +/- 45° with shear waves

To see the process of pulser definition, let see first one by one, each delay law. In practice, in delay law tab we can put 0 in period or in gain value, to not emit with a given delay law.

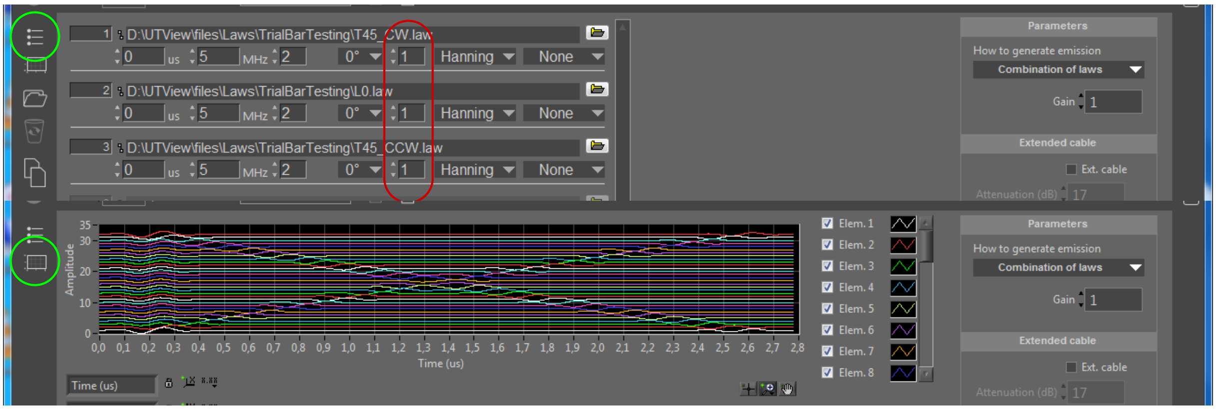
We see below, the pulse signal in graphic mode (by clicking) for each delay laws individually.







Let see now, the combination of these 3 delay laws:



After parameter(s) modification do not forget to apply your changes (by clicking) to validate them.

8.4 Composite signals pulser

It is possible to select an external file which defines the composite signal of each element. This file can be created by tiers applications and must be converted into composite signal format for FAAST-PA.

You have just to click on the button to load the file.

Format for imported pulser file

When you want to use arbitraries wave's forms to create an ultrasound shot, you have to import a text file with the following format:

```
[Pulser]
Pulser.ArbitraryImportedFile=1
[Data]
NumberOfElements=48
Resolution=20ns
Size=2048
Element1="0.0␣−1.23␣......"
Element2="10.0␣10.01␣......"
Element3="−5.2␣5.23␣......"
...
Element48="0.0␣1.0......"
```

Where:

- "NumberOfElements" defines the number of signals (one for each probe element)
- "Size" defines the number of points of wave form
- "Resolution" defines the resolution. *If this parameter is not set then resolution is switched to* 20 ns *by default.*
- "Element$i$ ="..." " is wave form for element i.
    - Each value is separated by one space
    - Wave form must be included into " "
    - Values are floating values (1.7E-308 to 1.7E+308)

Value encoding:

[sign] [digits] [.digits] [{d|D|e|E}[sign]digits]
If a wave form is not in range +/-1 then all waves form will be normalized to +/-1.

With:

- +1 is 100% of positive voltage of emitter.
- -1 is 100% of negative voltage of emitter.

If you don't want to use 100% of voltage, you have to create waves forms above +/-1.
For instance, create a wave in range +/-0.8 to get 80% of voltage emitter.

Remark:

Decimal point must be ".".

The final resolution of digitization is 50 MHz (20 ns). So, if you use a finest resolution (for instance 1 ns) then FAAST-PA system automatically decimates the inputs signals.

The signals are defined for maximum time of 40.96 µs (Size=2048 points at 20 ns, Size=1024 at 40 ns, ...). If signals are defined above 40.96 µs then system ignores these points.

All elements must have the same number of points.

If “NumberOfElements” is less than the number of element of probe then FAAST-PA creates some null signals for missing elements.

If “NumberOfElements” is greater than the number of element of probe then FAAST-PA ignores these elements.

9 Detection

This tab allows to set the delay laws in reception.

To compute and obtain delay laws, you can use “SIPATools” which is Socomate software dedicated to delay laws calculation.

The second main capability of FAAST-PA is to process several delay laws in parallel. The number of delay laws (=A-scans) which can be processed in parallel depends on the *FS* value (probe frequency resolution) defined in “UTView.ini” file (see example below):

```
[Devices]
    [Device 1]
        TYPE=FAAST-PA
        IP=192.168.1.200
        Port=6500
        FS=200MHz
        [Login]
            Module=
        [/Login]
        [Logout 1]
            Modules=
        [/Logout 1]
    [/Device 1]
[/Devices]
```

Maximum A-scans you can define in detection tab will depends on *FS* value as it is defined in table below.

FS (MHz)	Max number of delay laws in Detection
200	4
100	8
66.6	12
50	16

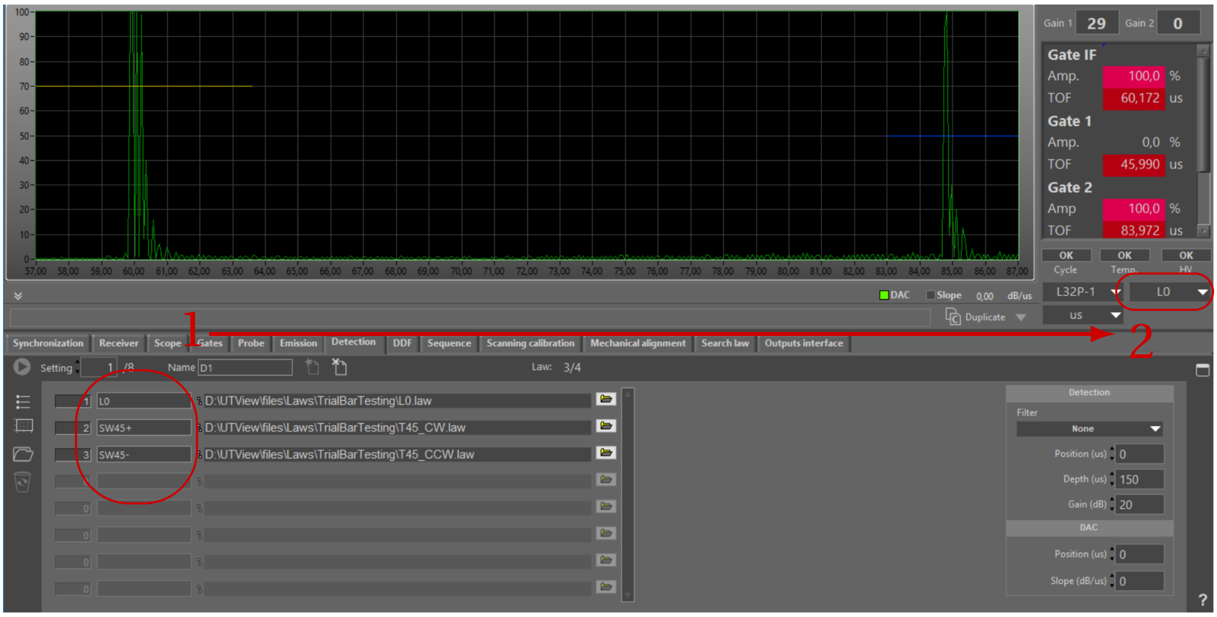
In a first step, you have to create a new detection setting by clicking on (1).

You can create different settings (2).

Each setting can be named (3) (max. 8 characters).

A setting can be deleted just by clicking on (4).

9.1 Detection delay laws setting



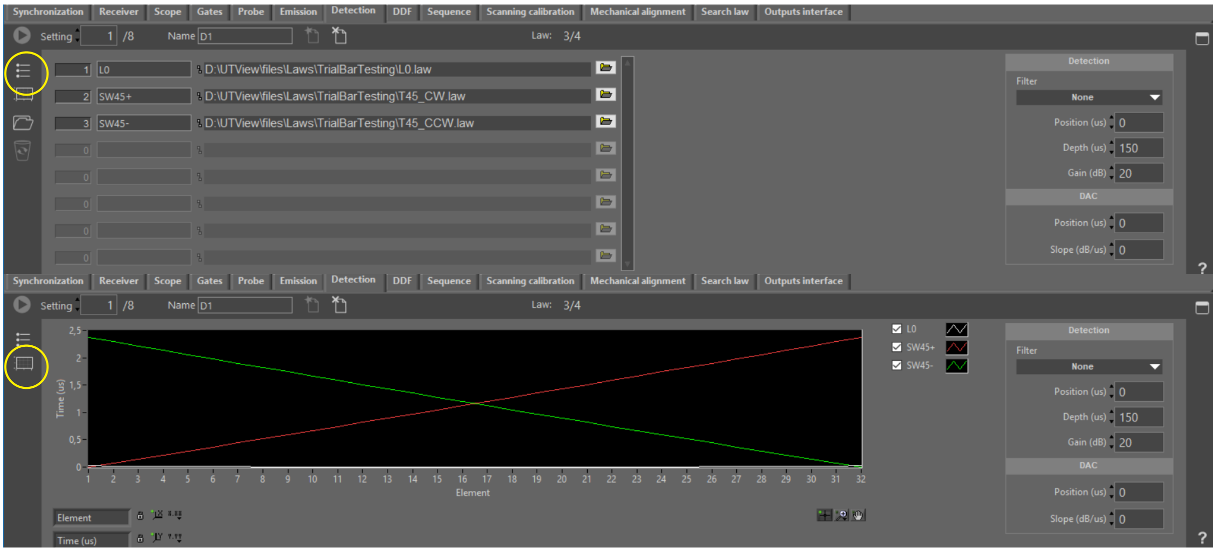
You have two ways to load file in the table:

1. In the list, click on the button to load a delay law.
2. By clicking on the left side of table, you can select a folder from where you can load delay laws

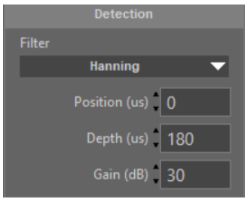
You can give name to each A-scan (1). These names will appear to the A-scans list selection (2).

On the left side of table, you have also these buttons which allow to:

- : Display delay laws in form of list
- : Display delay laws in graphic mode

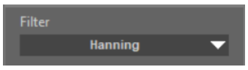


9.2 Detection parameters



These parameters are common for all delay laws of the detection setting.

Filter



This parameter sets the spatial filter (*i.e.* apodization) for all delay laws.
You have the choice between:

- None (no filter)
- Hamming
- Hanning
- Sin^2
- Sin^3

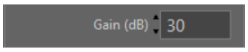
Position

This parameter determines the start of time window for detection.

Depth

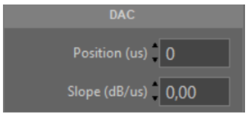
This parameter determines the depth of time window for detection.

Gain



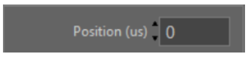
This parameter determines the gain to apply in detection area. Value could be set between 0 and 40 dB.

9.3 DAC parameters



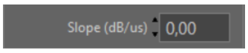
These parameters are common for all delay laws of the detection setting.

Position



This parameter determines the start of DAC area.

Slope



This parameter determines the slope to apply from DAC position.

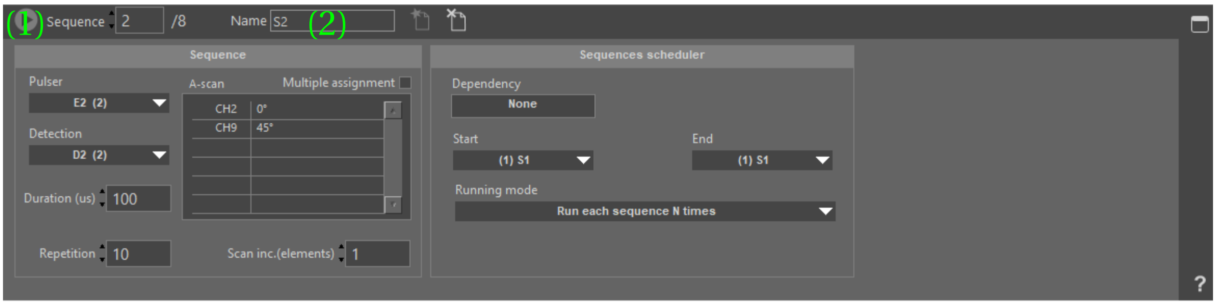
9.4 Remarks

After parameter(s) modification do not forget to apply your changes (by clicking) to validate them.

10 Sequence

This tab allow to define the sequences of ultrasonic shot. The sequential execution of 1) several different sequences and/or 2) the sequential and repetitive execution of one or more sequences, constitutes an US shot cycle.

The US cycle is triggered by the synchronization source you have chosen (see Chapter Synchronization).

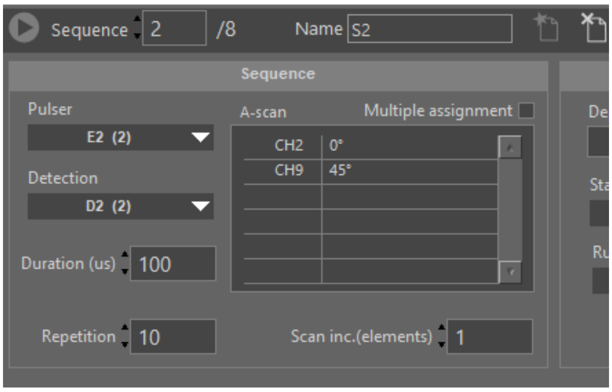


The sequence tab has in charge to manage the “Pulser” and “Detection” settings to play together.

The sequence tab has also in charge to assign a channel for each receiver law. It means that each law is equivalent to a conventional mono element probe with its own A-scan and gates to measure amplitudes and time of flight.

Up to 8 sequences can be defined ($\boxed{1}$). Each sequence can be named ($\boxed{2}$) (max. 8 characters).

10.1 Sequence parameters



Pulser

This tab allow to select a “Pulser” setting for emission (see chapter *Emission* for details).

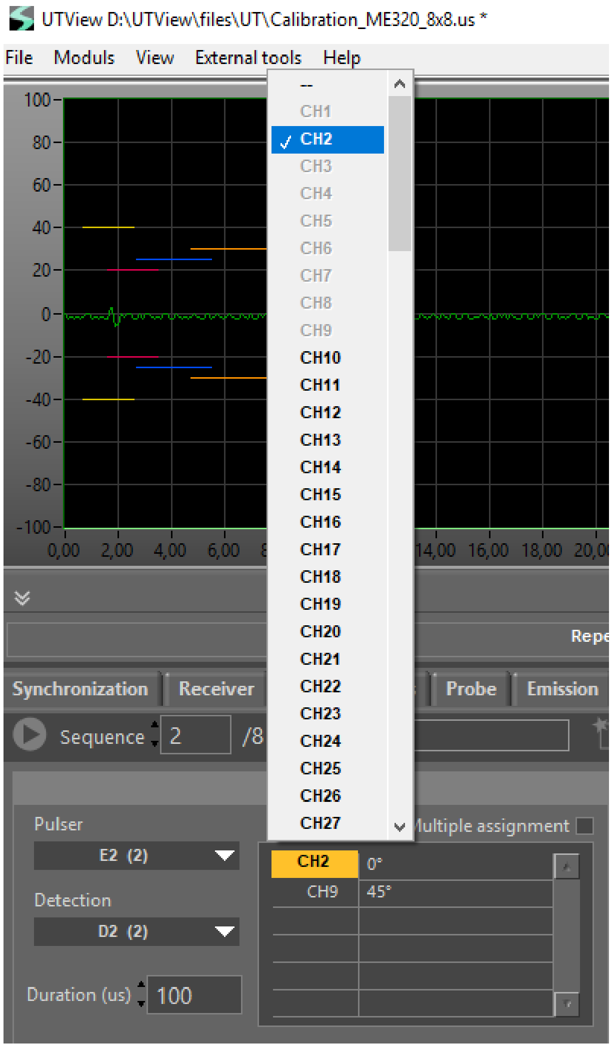
Detection

This tab allow to select a “Detection” setting for reception (see chapter Detection for details).

A-scan table

According to “Detection” setting, this table will assign automatically a measurement channel also call A-scan for each receiving laws composing the “Detection” setting.

You can click twice in the table to see the list of available channels. It is possible then to re-assign another channel with A-scan.



Multiple assignment

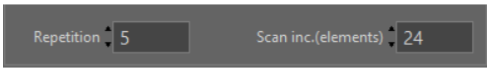
By checking the box Multiple assignment (meaning activate), you have the possibility to use the same channel in multiple sequences.

Duration

This parameter sets the time of the sequence. Make sure that this time is large enough to cover the ultrasonic path.

> In case you want to set a smaller "Duration" than possible, system will automatically set the minimum time possible. This value depends on
> - "Detection depth" time you have set (see Chapter Detection)
> - and the UT configuration "Usage" (see Chapter Time constraints for details)

Repetition & Scan Increment



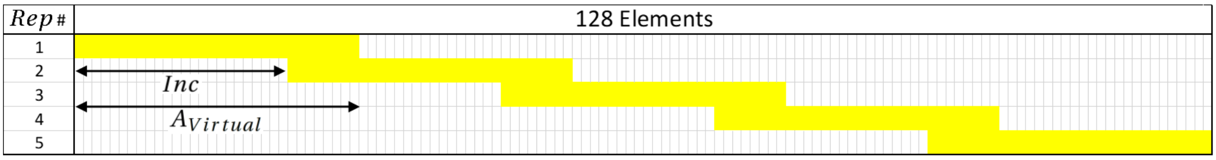
These parameters allow to set electronic scanning. You have to define:

- the "Repetition", *i.e.* the number of scanning
- the "Scan Increment", *i.e.* the step (in number of elements) between two repetitions.

If we consider the "Total Aperture" (A_{Total}) of PA probe with a "Virtual Aperture" ($A_{Virtual}$) used in electronic scanning, "Repetition" (Rep) and "Scan Inc." (Inc) are linked by:

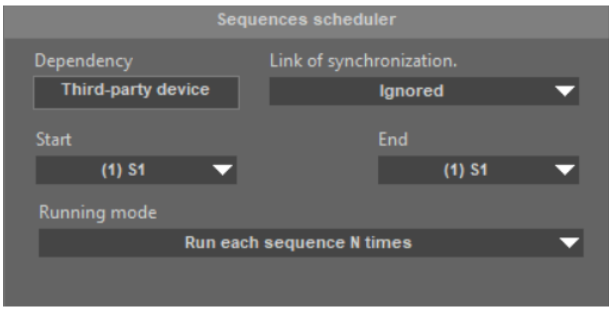
$$Rep = \frac{A_{Total} - A_{Virtual}}{Inc} + 1$$

As an example, let's take a 128E probe with a 32E virtual probe. If we set $Inc = 24$, according to the relation above $Rep = 5$. If you set these parameters, the scanning schematic will be as follow:



> According to PA probe and "Virtual Aperture" (defined by delay laws used in "Detection" setting), system will limit automatically these 2 parameters. As for example, if we consider previous case, Inc is set to 24, then maximum Rep is 5. System doesn't allow to set a bigger Rep value.

10.2 Sequences scheduler



Dependency

The parameter in "Dependency" has to be set first in "Probe section" of UTView.ini file (see example below). It defines the interdependence between probes. The values are:

- none (by default)
- probei, where i indicates the index of master probe which in charge to drive this probe
- THIRD_PARTY_DEVICE, when the probe has to be synchronized by an external device not included in the device declaration

```
Probes section
---------------
[Probes]
    ProbeParametersSource=PROBE_FILE

    [Probe 1]
        TYPE=PASSIVE_PROBE
        MAX_ELEMENTS=32
        MAX_APERTURE_ELEMENTS=32
        MAX_ASCAN_CHANNELS=128
        MAX_SETTINGS=8
        MAX_LAWS_PULSER=8
        MAX_LAWS_DETECTION=8
        Dependency=THIRD_PARTY_DEVICE
        [Connector 1]
            Type=FRB
            Device=1
            BaseConnector=1
            Elements=1..32
        [/Connector 1]
    [/Probe 1]      .
            .
            .
[/Probes]
```

Link of synchronization

In “Link of synchronization”, you have the choice between:

- Ignored
- Dependency on cycle
- Full dependence
- Synch. on A5
- Synch. on B5
- Synch. on Z5
- Synch. on A6
- Synch. on B6
- Synch. on Z6

For more detailed explanation on synchronization options, please refer to the document: LOG INPUT manual.pdf (in HELP folder).

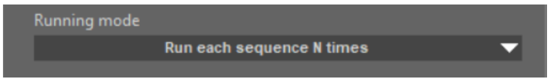
According to the “Link of synchronization”, system will automatically define “Trigger source” in “Synchronization” tab (see Chapter Synchronization for detail).

Sequences execution

This tab allows to define the US shot cycle by defining the “first” and “end” sequences you want to run.

The sequence choices depend on the sequence that are defined. We recall that you can set up-to 8 sequences.

The “first” sequence number has to be smaller than the “end” sequence number.



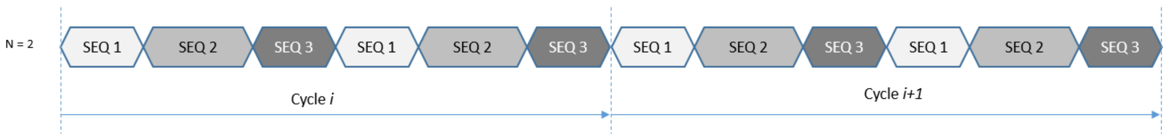
“Running mode” tab allow to select how the sequences will be chained. You have 2 options:

- Run chaining sequence N times
- Run each sequence N times

Run chaining sequence N times

This mode executes each sequence and redo N times.

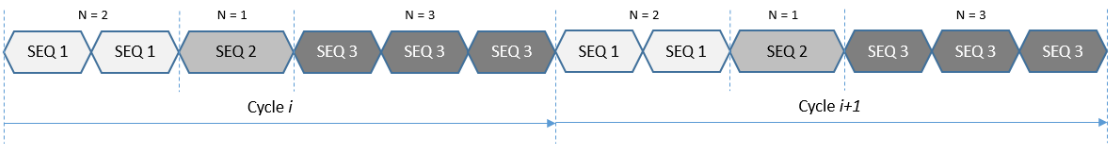
N is common for each sequence.



Run each sequence N times

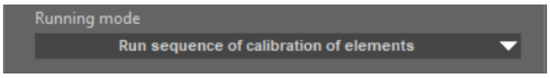
This mode executes a sequence N time before to go next sequence.

N is independent for each sequence.



Elements calibration

The third “Running mode” is specific and dedicated to PA elements calibration.



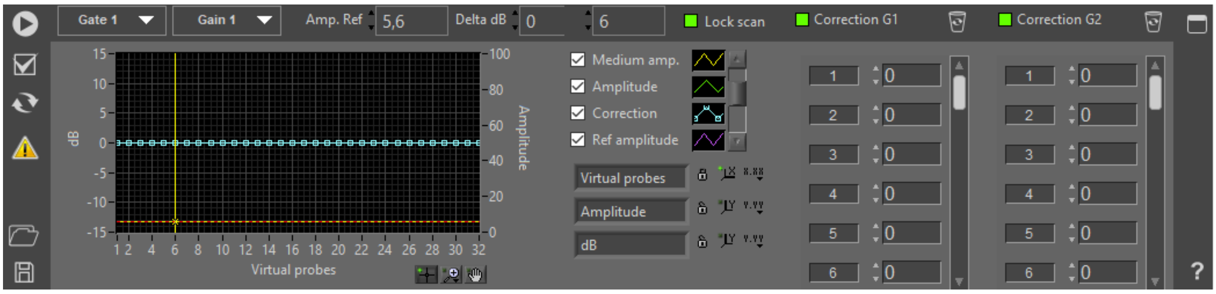
You can refer to Chapter Elements calibration for elements calibration guideline.

11 Scanning tool

This tab allows you to correct the main and secondary gain statements according to the position of the beam when performing an electronic scanning with a multi-elements probe. Each position corresponds to a virtual probe. The purpose of the calibration is that all virtual probes have the same response. Thus, during a control, a defect will have the same amplitude regardless of the virtual probe that detected it.

This tool calculates the correction values of one of the two gains by capturing the amplitude measurement in gates 1 or 2. However, you can manually enter each correction.

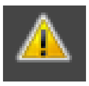
The tool can also be used to control the current correction and display an alarm if there is too much variation between the different virtual probes.



Start acquisition. The correction will be calculate when you release the button.

Check correction. The checking will be done when you release the button.

Restore the previous correction values.



Indicate an alarm.

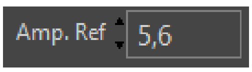
1 The amplitude signal is saturated.
2 No amplitude signal has been measured into the gate.
3 The sensibility of certain virtual probes is outside the limits!

Opens a file containing measurements and displays it overprinting on the chart. This allows to compare them with the results obtained and to check if there is a drift.

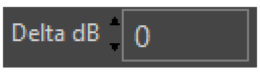
Saves common measurements in a file.

Determine the gate to capture the amplitude of signal.

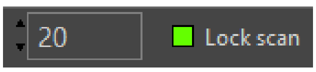
Determine the gain to correct or check.



Determine the reference amplitude to calculate or verify the correction.



Determine the threshold around the reference amplitude to detect an alarm.



Freezes scan to a given position.

Enable/Disable the correction of the main gain

Enable/Disable the correction of the secondary gain

Clear the correction of the main or secondary gain

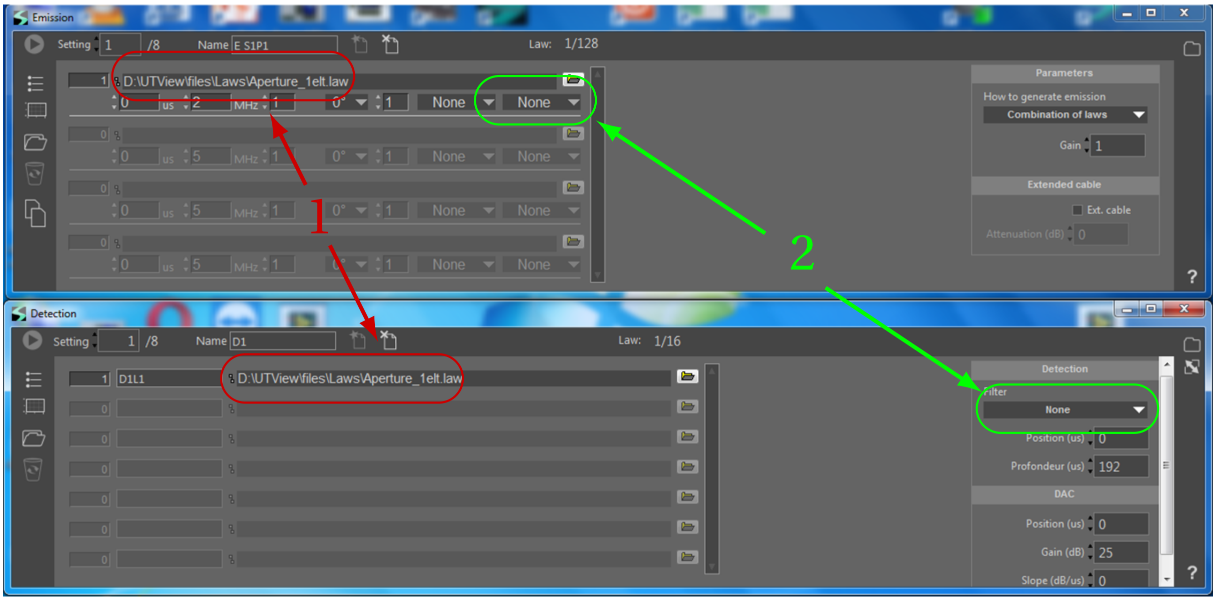
12 Elements calibration

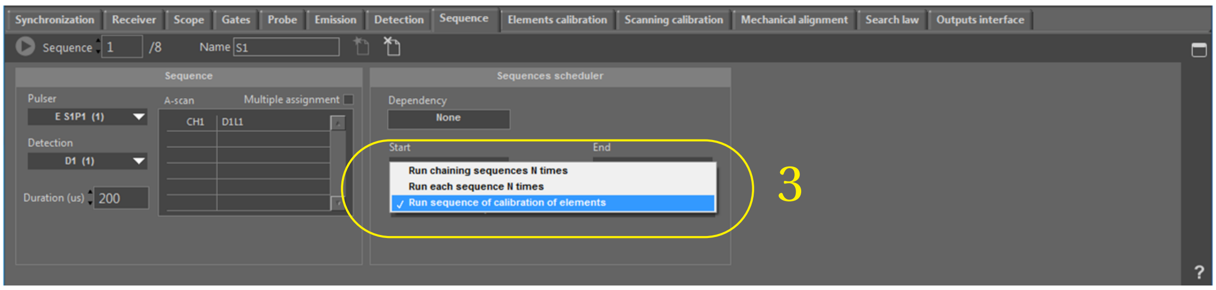
This module is a tool to check and adjust probe's elements sensibilities.

12.1 Foreword

Before to use the element's calibration tab, you have to:

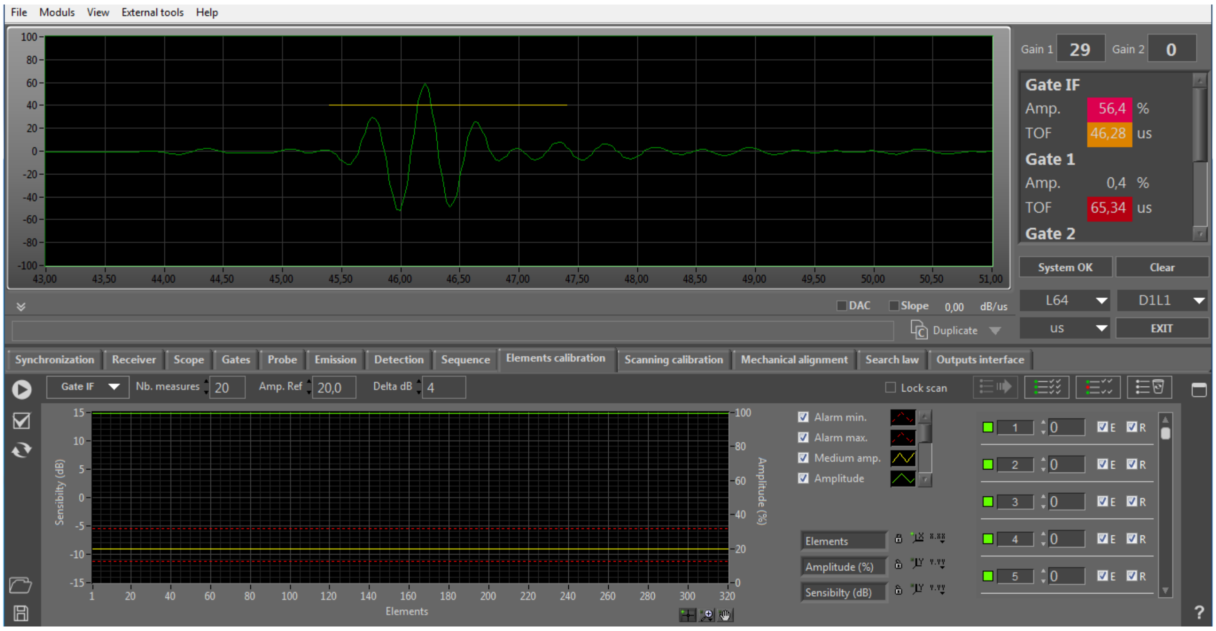
1. Use a delay law with an aperture of 1 element in Emission and in Detection
2. Be sure that no spatial filter ("None") is used
3. Choose "Run sequence of calibration of elements" as Sequence Running mode





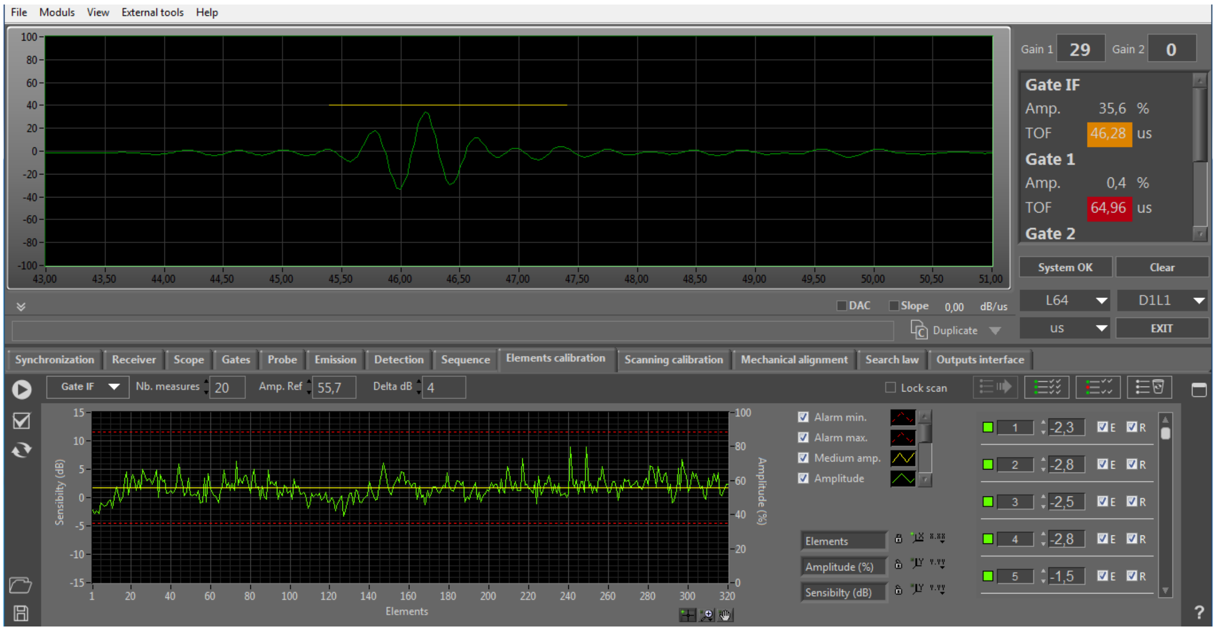
12.2 How to proceed for calibration?

The principle is to shot sequentially all elements on a target and measure amplitude for each element.



Before to launch calibration procedure, you have to select first some parameters:

1 Select the detection Gate
2 Define the threshold ("Delta dB")
3 Enter the number of measures ("Nb. measures"). The system will take average values of all measurements.



Run acquisition by clicking on : 

☞ It will cancel previous sensibility values and start amplitude measurements in the gate

The acquisition will be stopped automatically as soon as the number of measures is reached

☞ Average amplitude will be calculated
☞ Plots and values will be updated

Previous values can be restored if results are not satisfying. For this, click on

From values table, it is possible to activate or deactivate elements. One by one or by group. For example, elements outside the acceptable range can be deactivate

Correction can be stored in a file (which can be use as reference). For this, click on

12.3 How to compare correction with reference?

Click on

☞ Reference values will be plotted in the graphic window. So, it will be possible to compare reference values with new measurement values.

12.4 How to check elements calibration?

1 Select the detection Gate
2 Define the threshold ("Delta dB")
3 Enter the number of measures ("Nb. measures"). The system will take average values of all measurements.

Run checking acquisition by clicking on :

☞ The acquisition will be stopped automatically as soon as the number of measures is reached

13 Elements TOF calibration

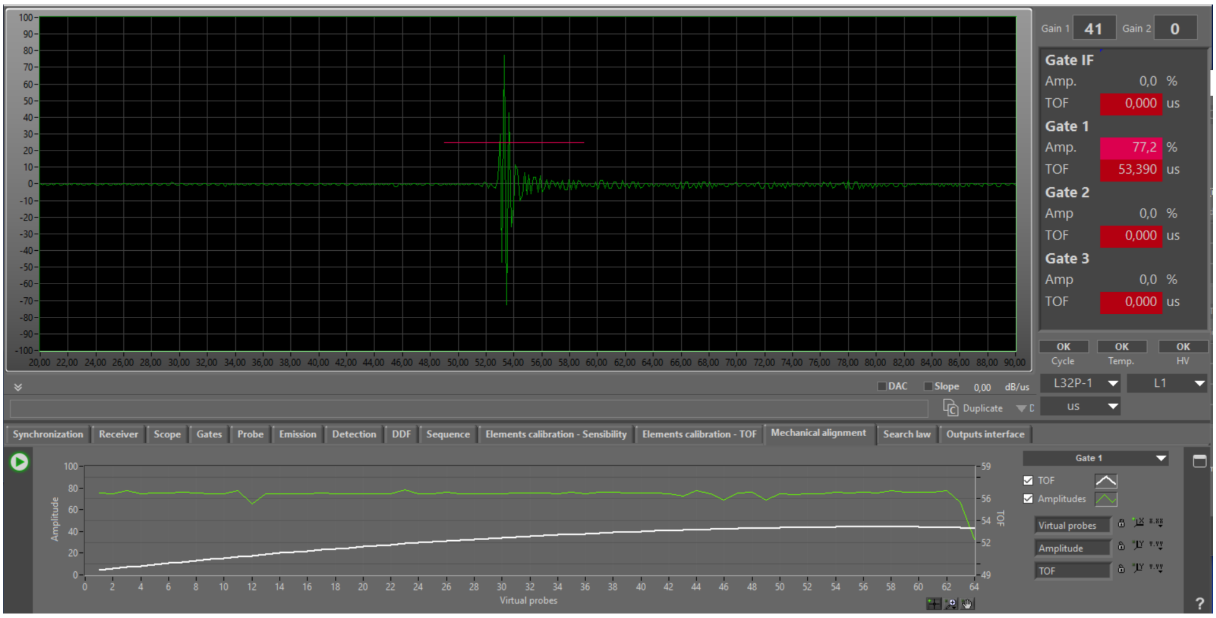
This module is a tool to adjust TOF probe's elements.

13.1 Foreword

Before to use the TOF element's calibration tab, you have to define Emission, Reception and Sequence as it is defined for element's–amplitude–calibration (see CHAPTER 12 for more details).

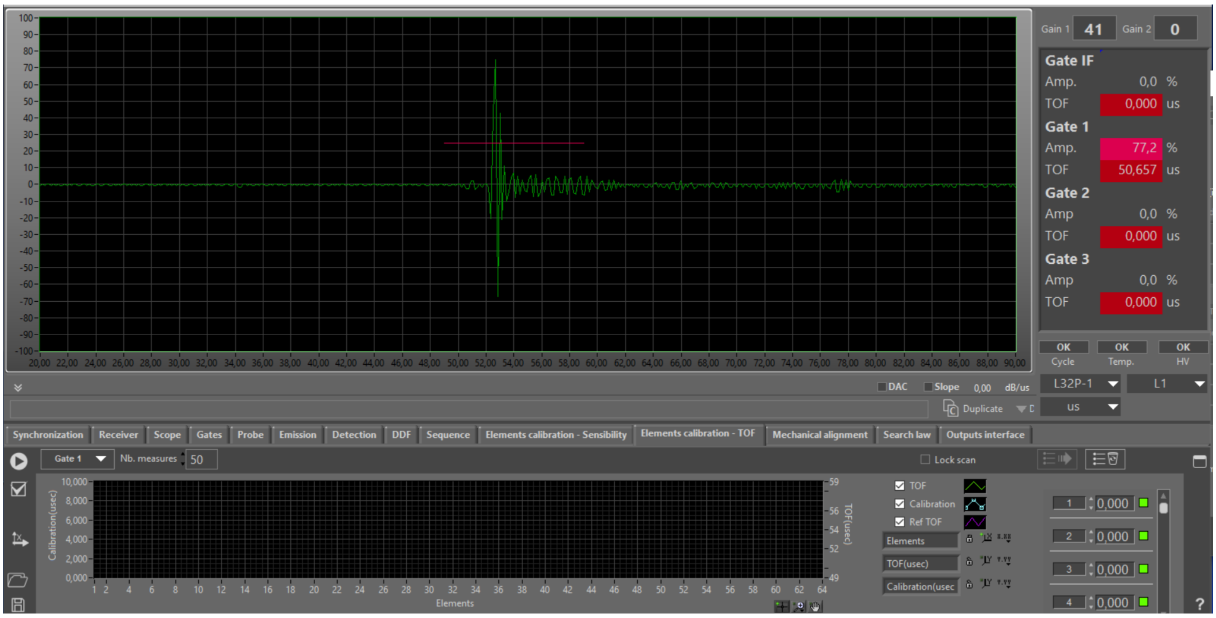
13.2 How to proceed for TOF calibration?

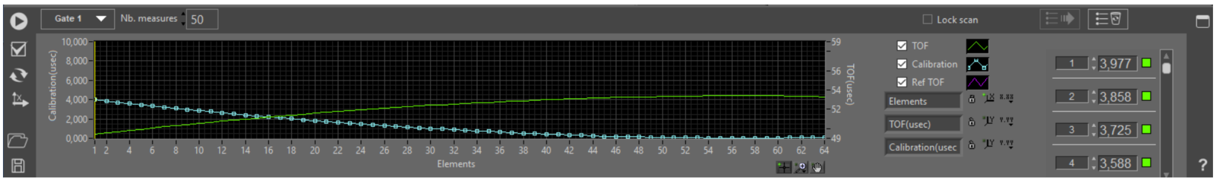
The principle is to shot sequentially all elements on a target and measure Time-Of-Flight (TOF) for each element. Hereafter is the TOF measurement before correction (white curve).



Before to launch TOF calibration procedure, you have to select first some parameters:

1 Select the detection Gate
2 Enter the number of measures ("Nb. measures"). The system will take average values of all measurements.





Run acquisition by clicking on : 

☞ It will cancel previous values and start TOF measurements in the gate

The acquisition will be stopped automatically as soon as the number of measures is reached

☞ Average TOF will be calculated
☞ Plots and values will be updated

Previous values can be restored if results are not satisfying. For this, click on 

Correction can be stored in a file (which can be use as reference). For this, click on 

13.3 How to compare TOF correction with reference?

Click on 

☞ Reference values will be plotted in the graphic window. So, it will be possible to compare reference values with new measurement values.

13.4 How to check elements TOF calibration?

1. Select the detection Gate
2. Enter the number of measures ("Nb. measures"). The system will take average values of all measurements.

Run checking acquisition by clicking on : ☑

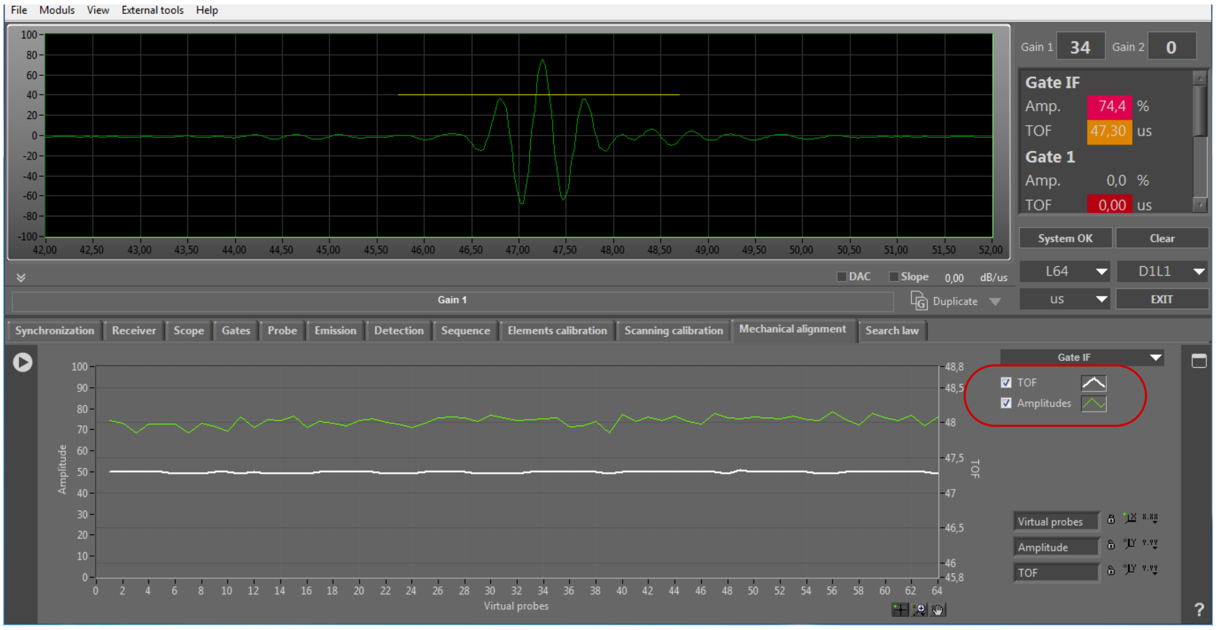
☞ The acquisition will be stopped automatically as soon as the number of measures is reached

14 Mechanical Tool

This tab allows you to check and to adjust if necessary the position of the PA probe according to the inspected part.

The principle is to shot sequentially all elements (or virtual probes) on a target, as the surface of inspected part, and measure Amplitude and Time-Of-Flight (TOF) for each. They are respectively represented in the green and white curves in below figure.

The goal is to have an horizontal TOF curve which means all elements (or virtual probes) are at equal distance from the surface of the part, and so PA probe could be considered correctly mechanically set.



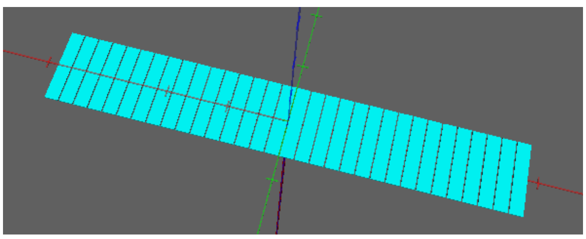
Select a gate 

and press the button 

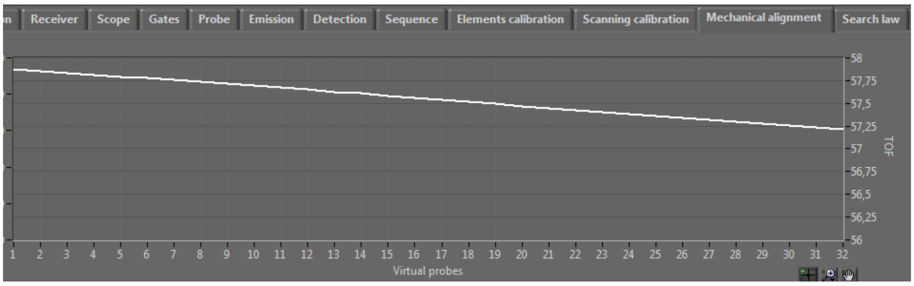
In the following, we give some examples of measures which could be obtained and their meanings.

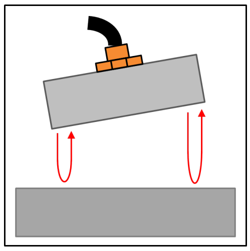
14.1 Examples obtained with a linear PA probe

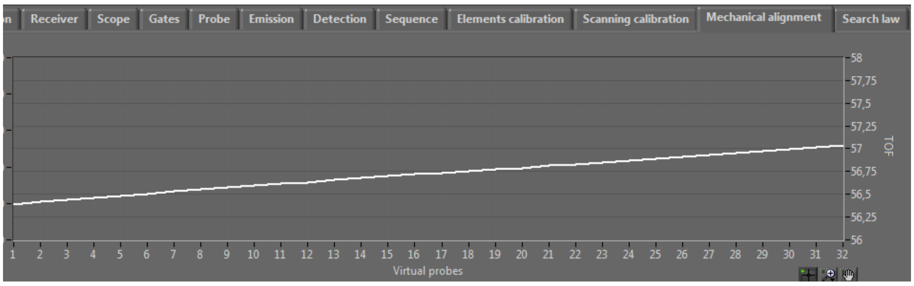
Let's see the case of a 32 linear PA probe above flat surface.

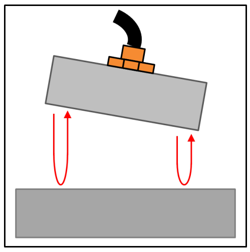


The slope in TOF curve means a probe's misalignment regarding the surface.

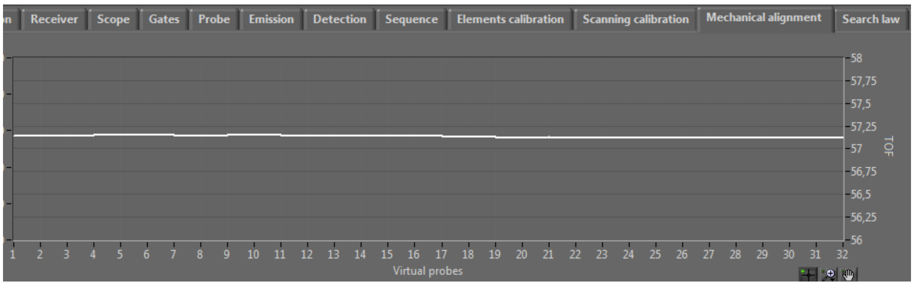


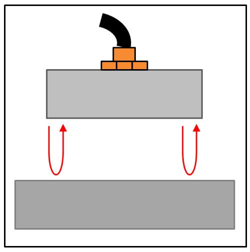






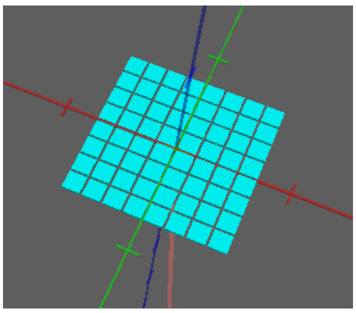
An horizontal TOF curve means a good alignment regarding the surface.

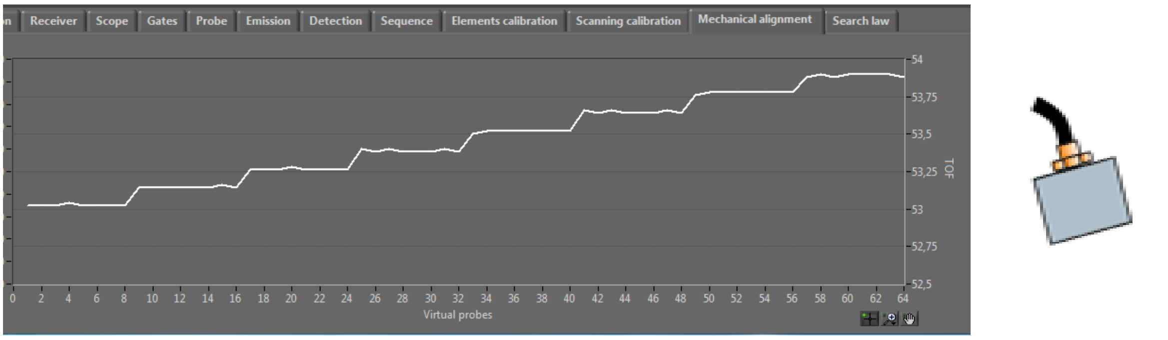


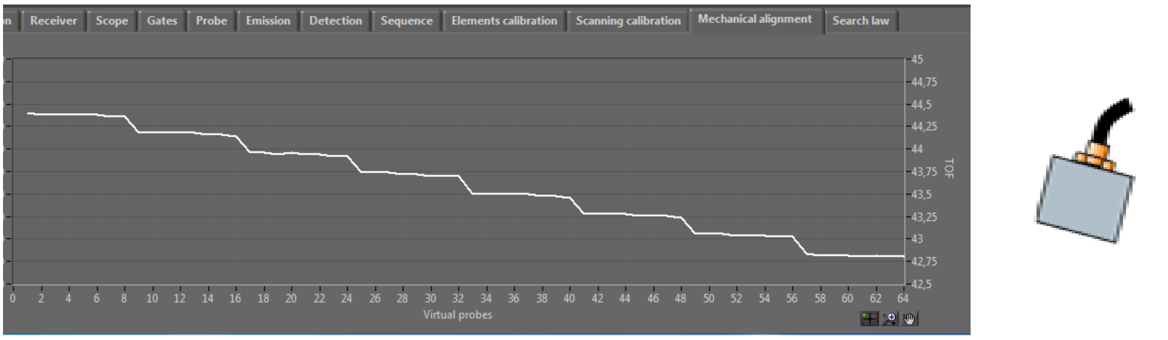


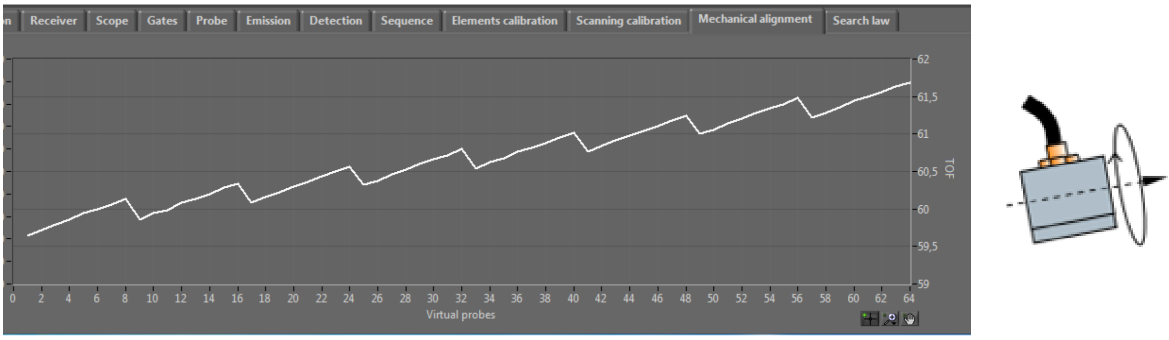
14.2 Examples obtained with a matrix PA probe

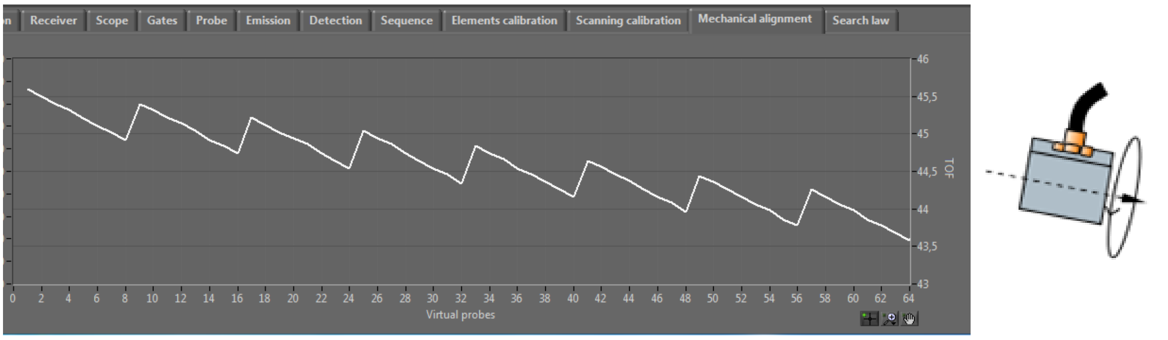
Let's see the case of a 8x8 matrix PA probe above flat surface.

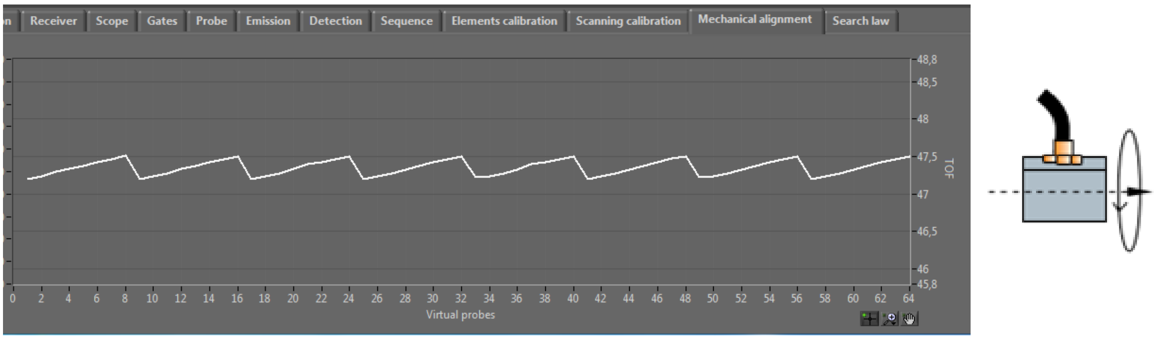


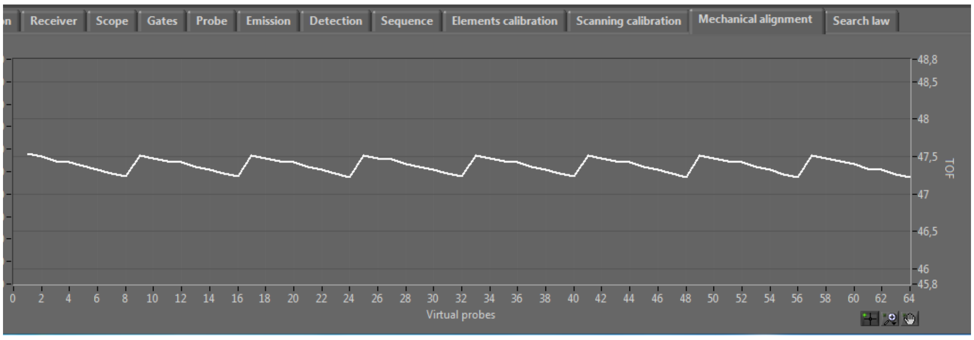

Receiver | Scope | Gates | Probe | Emission | Detection | Sequence | Elements calibration | Scanning calibration | Mechanical alignment | Search law
54
53,75
53,5
53,25
53
52,75
52,5
TOF
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Virtual probes


Receiver | Scope | Gates | Probe | Emission | Detection | Sequence | Elements calibration | Scanning calibration | Mechanical alignment | Search law
45
44,75
44,5
44,25
44
43,75
43,5
43,25
43
42,75
42,5
TOF
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Virtual probes

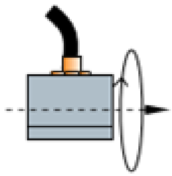

Receiver | Scope | Gates | Probe | Emission | Detection | Sequence | Elements calibration | Scanning calibration | Mechanical alignment | Search law
62
61,5
61
60,5
60
59,5
59
TOF
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Virtual probes

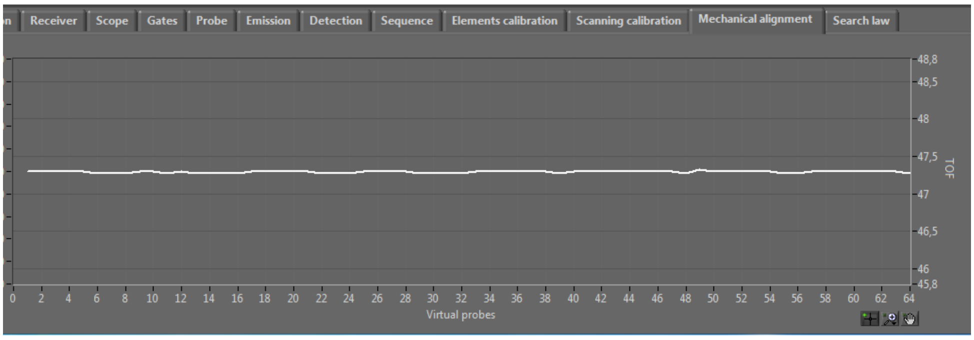

Receiver | Scope | Gates | Probe | Emission | Detection | Sequence | Elements calibration | Scanning calibration | Mechanical alignment | Search law
46
45,5
45
44,5
44
43,5
43
TOF
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Virtual probes


Receiver | Scope | Gates | Probe | Emission | Detection | Sequence | Elements calibration | Scanning calibration | Mechanical alignment | Search law
48,8
48,5
48
47,5
47
46,5
46
45,8
TOF
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Virtual probes

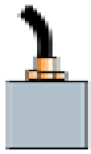


Receiver
Scope
Gates
Probe
Emission
Detection
Sequence
Elements calibration
Scanning calibration
Mechanical alignment
Search law
48,8
48,5
48
47,5
47
46,5
46
45,8
TOF
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Virtual probes



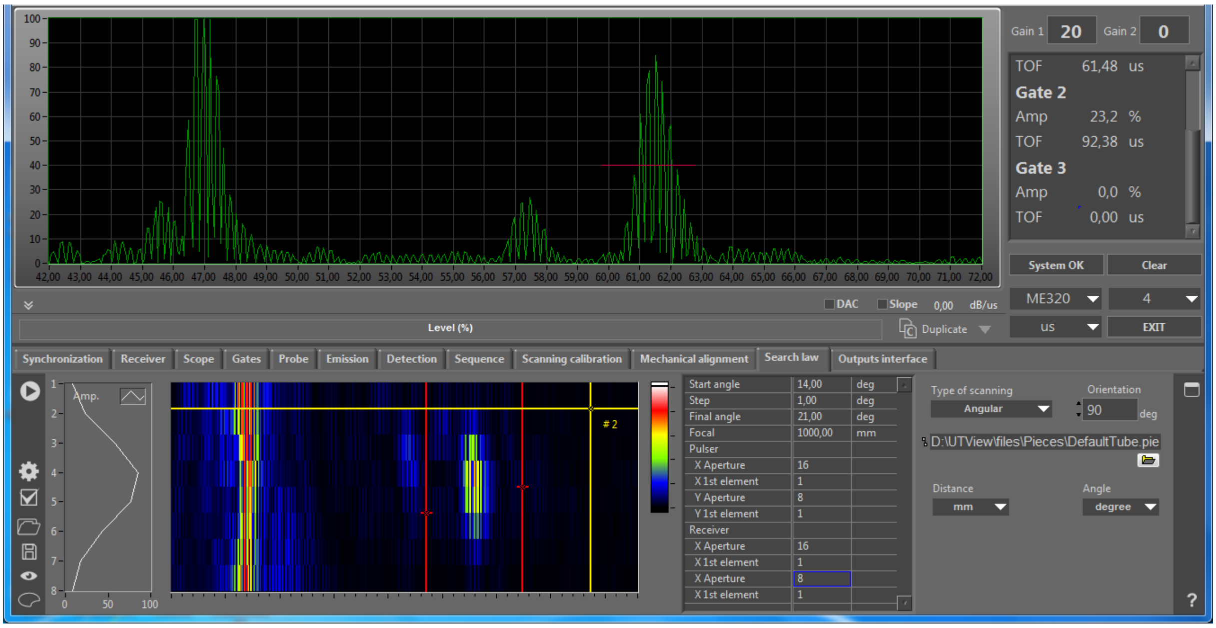


Receiver
Scope
Gates
Probe
Emission
Detection
Sequence
Elements calibration
Scanning calibration
Mechanical alignment
Search law
48,8
48,5
48
47,5
47
46,5
46
45,8
TOF
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Virtual probes



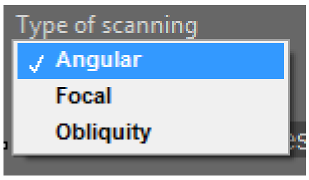
15 Law Search Tool

This module is a tool to look for optimal delay laws depending on an expected flaws.



The principle is to apply sequentially different delay laws calculated –automatically– according to a varying parameter. This parameter, called in IHM “Type of scanning” can be:

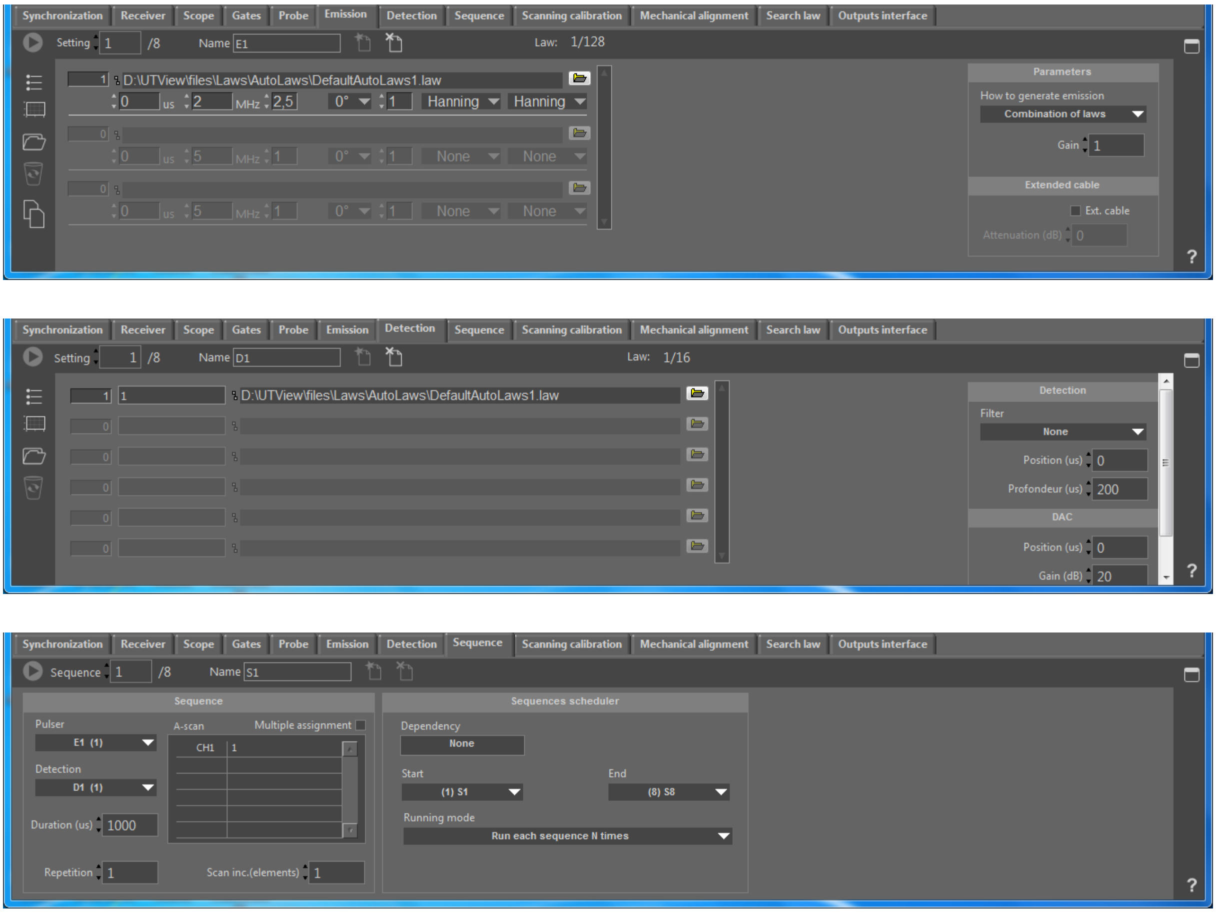
- Incidence angle (“Angular”)
- Focusing depth (“Focal”)
- Flaw obliquity (“Obliquity”) (only available with matrix probe)



15.1 Specific UT file

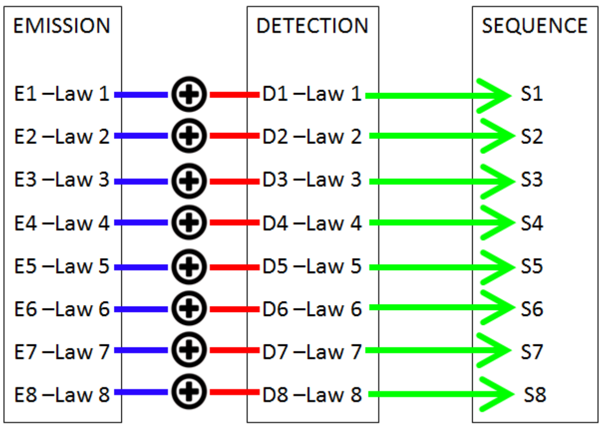
The principle of this tool is to perform several sequential shots – which define the scanning–, and so the UT file has to have a specific configuration:

1 Define as much pulser and detection as you have “scans”
2 Define each sequence where 1 pulser is combined with 1 detection



Example of Emission, Detection and Sequence

- It is important to define different laws in Emission (and in Detection), but the same one has to be used in Emission and Detection combined in a same Sequence (see the schematic below).
- As the final goal is to compare different “scans”, it is important to use the same parameters in all Emission and in all Detection.



Schematic configuration of the UT file

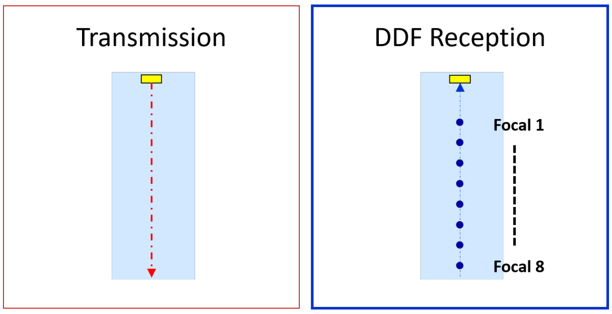
The UT file contains as A-scans as defined sequences. Once again, as the goal is to compare them, it is important the same US parameters (as the gain for example) are defined on each A-scans.

15.2 How can we find optimal delay law?

1. Define the type of scanning and load the piece (by clicking on . Define your main parameter.
2. Define your parametric research, (start value, step, aperture in Emission and in Reception, *etc.*). The final value is automatically computed according to the total played sequences you have defined.
3. Click button to launch laws calculation
4. Click button to start or to stop A-scans acquisition
5. Adjust the red cursors (in B-scan view) to select a time window of interest. The maximum amplitude between these two cursors are plotted in beside graph.
6. Use horizontal yellow cursor in B-scan view to scan the different A-scans. When you have selected the best law to detect flaw in interest, click button . You will then be invited to save selected law.

16 Dynamic Depth Focusing

This module allows to use *Dynamic Depth Focusing* in reception as it is schematized below.

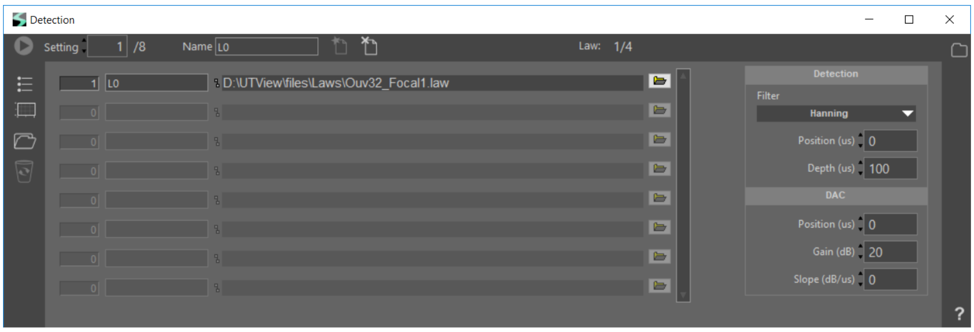


16.1 First step

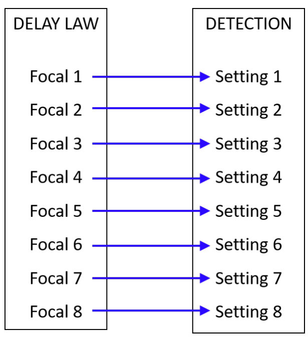
You have to define up to 8 detection settings.

In the first setting, you have to :

- use the delay law "Focal 1"
- define all the parameters in the left side of the tab (see chapter Detection)



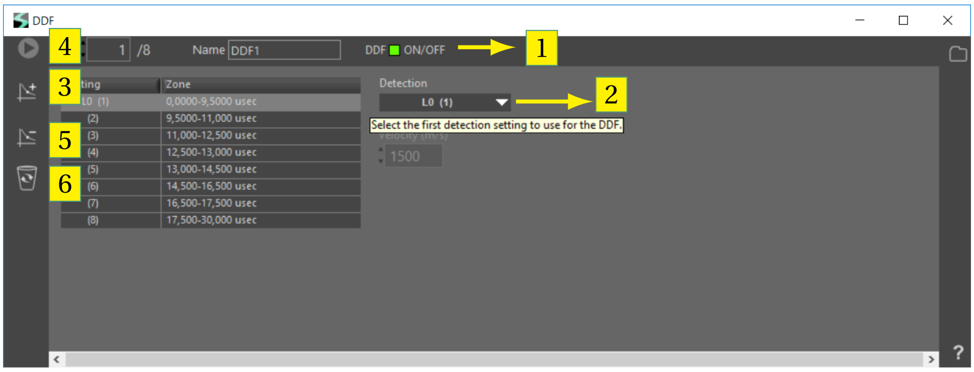
For the other detection settings, you have to use the different delay laws (Focal 1 <...< Focal 8) as it is schematized below.



Note: If you use DDF, the parameters of the other settings will not be used, only the delay laws.

16.2 DDF

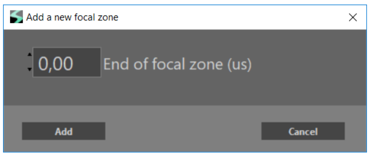
Open the DDF tab (as it is represented below).



1 Click DDF ON/OFF to activate or not DDF

2 Select the first detection setting to use for DDF

3 Add a new focal zone. Enter the value of focal zone's end (as it is shown below)



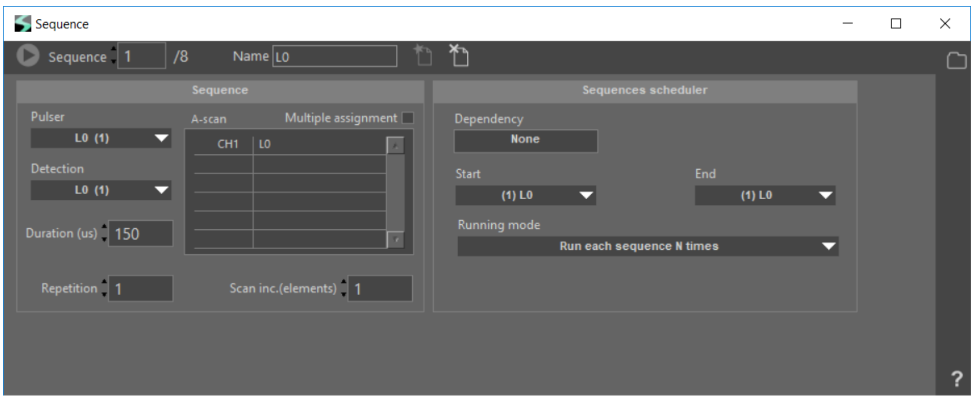
4 After defining all focal zones, apply DDF

5 If needed, you can remove one focal zone

6 If needed, you can also remove all focal zones

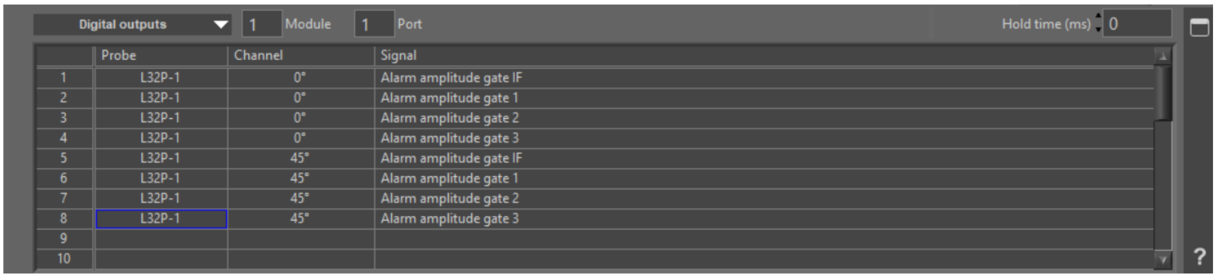
16.3 Sequence to defined

You have just to define the Pulser and the first detection setting you have used for DDF.



The definition of the other parameters is still the same as usual UT configuration (refer to chapter Sequence for more details).

17 Outputs



This tab allows to transmit results of measurements taken in the gates via two different modules:

- logical outputs for alarms
- analog outputs for amplitude and time (or distance) measurements

17.1 Preamble – ini file setup

This tab is only visible if you declared these modules in the UTView.ini file.

Hereafter, we give an example where a logical and an analog output modules are connected:

```
[Devices]
    [Device 1]
        TYPE=FAAST–PA
        IP=192.168.1.200
        Port=6500
        [Login]
            Module=
        [/Login]
        [Logout 1]
            Modules=INTLOG_OUT;INTANA_OUT
        [/Logout 1]
    [/Device 1]
[/Devices]
```

You can chain up-to four modules on the same port of the device. For guidelines to connect these modules to device, you can refer to the chapter FAAST-PA device description.

The number of outputs varies depending on the type of module:

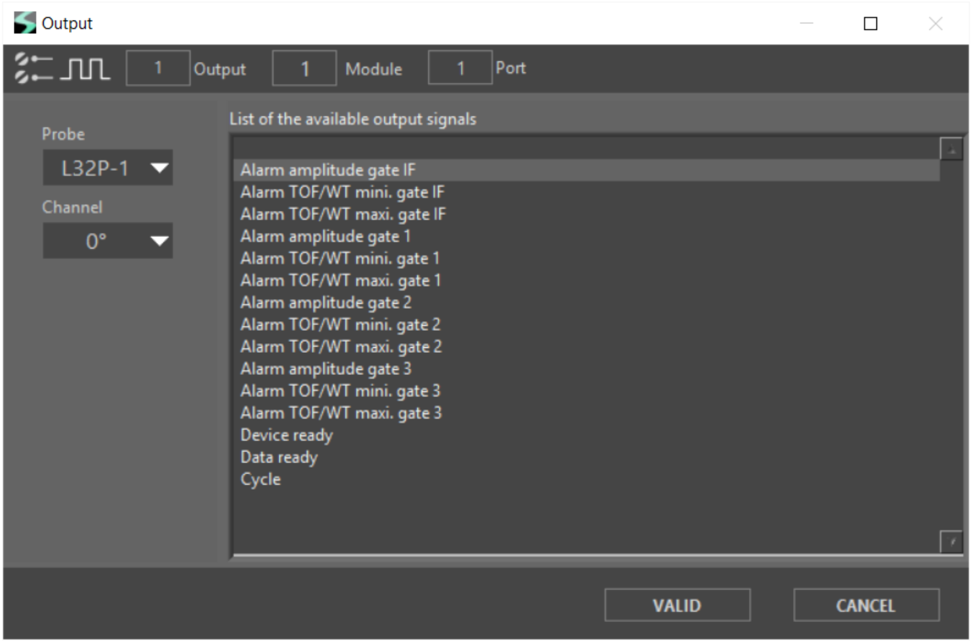
Output modules

Module	Outputs	
	Type	Number
INTLOG_OUT	Logic	32
INTANA_OUT	Analogic	16

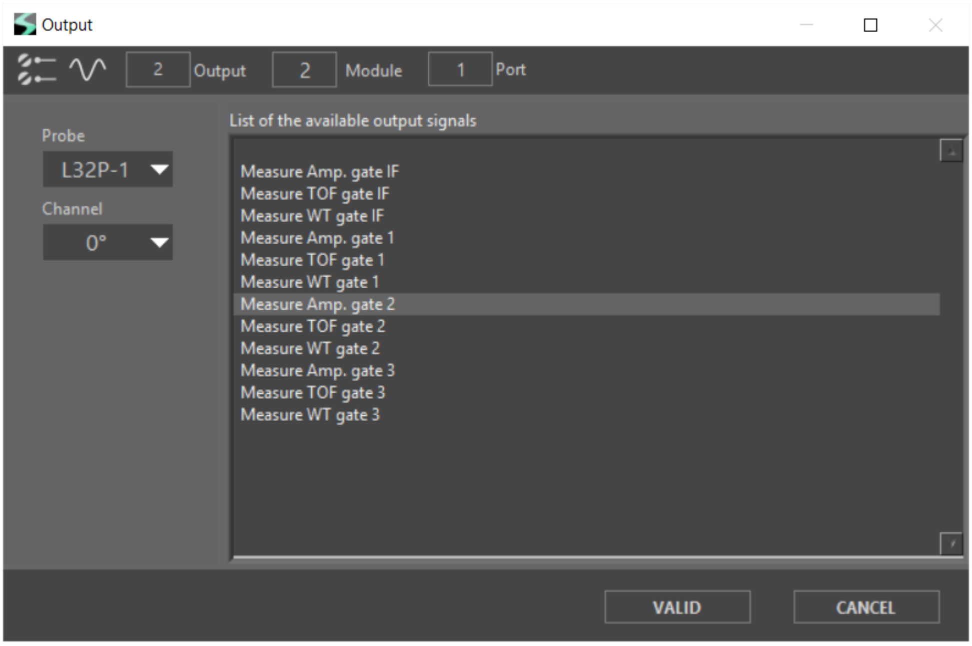
17.2 Output managing

To assign an alarm or an analog quantity to an output you must choose a module from the list that is proposed and click on the line of the table corresponding to the desired output.

A signal Type Selection window will appear to define the signal origin. You will need to select the probe and then the measuring channel (A-scan) and finally the signal.



Example of selecting a logical signal.

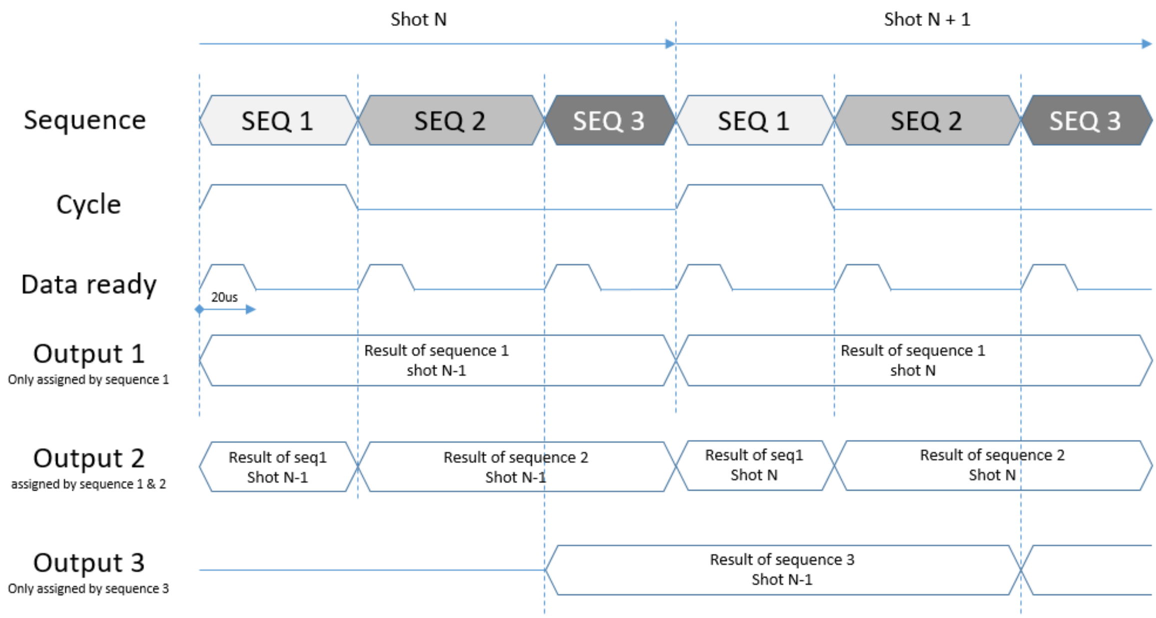


Example of selecting an analog signal.

17.3 Timing example

Hereafter we give an example where 3 sequences are executed.

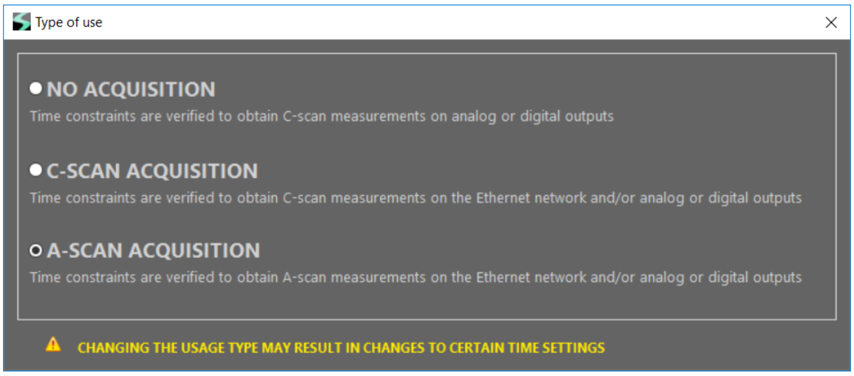
- The output 1 is assigned to only one sequence
- The output 2 is assigned by the two sequences
- The output 3 is assigned to only one sequence



18 Time constraints

According to the UT application, it is possible to optimize time constraints in the UT file. To do that, you can click on "Usage" in UTVIew software interface.

A window containing 3 choices for type of use will appear (see picture below).



Depending on the type of use, all the time parameters will be set automatically according to the system capabilities. The time rules are described in the table below:

Time constraints in us	Type of Use		
	No Acq.	C-scan Acq.	A-scan Acq.
Detection Min. time after the biggest A-scan	3	3	3
Sequence Min. time after detection's end	10	10	20
A-scan Mode : Compressed Min. time for the sequence	50	50	Max[50; 5 + 13 × (Number of stored A-scan + 1)]
A-scan Mode : Extended Min. time for the sequence	50	50	Max[50; 26.72 ns × (Number of stored A-scan + 1) × full size A-scan data frame]

Time settings could be modified if you change the type of use