ISONIC 3505

Superior Performance 140 dB Dynamic Range Portable All-In-One Digital Ultrasonic Flaw Detector and Recorder

Operating Manual

Revision 1.07

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EC Declaration of Conformity

Council Directive 89/336/EEC on Electromagnetic Compatibility, as amended by Council Directive 92/31/EEC & Council Directive 93/68/EEC
Council Directive 73/23/EEC (Low Voltage Directive), as amended by Council Directive 93/68/EEC

We, **Sonotron NDT Ltd.**, 4 Pekeris Street, Rehovot, 7670204 Israel, certify that the product described is in conformity with the Directives 73/23/EEC and 89/336/EEC as amended

ISONIC 3505

Portable All-In-One Digital Ultrasonic Flaw Detector and Recorder

The product identified above complies with the requirements of above EU directives by meeting the following standards:

Safety

EN 61010-1:1993

EMC

EN 61326:1997
EN 61000-3-2:1995 /A1:1998 /A2:1998 /A14:2000
EN 61000-3-3:1995

ISO 9001 REGISTERED
DNV Certification B.V., The Netherlands
MGMT. SYS. RvA C 024

STR-R REGISTERED COMPANY
ISO 9001:2000

UKAS QUALITY MANAGEMENT 001

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Declaration of Compliance

We, **Sonotron NDT Ltd.**, 4 Pekeris Street, Rehovot, 7670204 Israel certify that the product described is in conformity with National and International Codes as amended

ISONIC 3505

Portable All-In-One Digital Ultrasonic Flaw Detector and Recorder

The product identified above complies with the requirements of following National and International Codes:

- ASME Section I – Rules for Construction of Power Boilers
- ASME Section VIII, Division 1 – Rules for Construction of Pressure Vessels
- ASME Section VIII, Division 2 – Rules for Construction of Pressure Vessels. Alternative Rules
- ASME Section VIII Article KE-3 – Examination of Welds and Acceptance Criteria
- ASME Code Case 2235 Rev 9 – Use of Ultrasonic Examination in Lieu of Radiography
- Non-Destructive Examination of Welded Joints – Ultrasonic Examination of Welded Joints. – British and European Standard BS EN 1714:1998
- Non-Destructive Examination of Welds – Ultrasonic Examination – Characterization of Indications in Welds. – British and European Standard BS EN 1713:1998
- Calibration and Setting-Up of the Ultrasonic Time of Flight Diffraction (TOFD) Technique for the Detection, Location and Sizing of Flaws. – British Standard BS 7706:1993
- WI 00121377, Welding – Use Of Time-Of-Flight Diffraction Technique (TOFD) For Testing Of Welds. – European Committee for Standardization – Document # CEN/TC 121/SC 5/WG 2 N 146, issued Feb, 12, 2003
- ASTM E 2373 – 04 – Standard Practice for Use of the Ultrasonic Time of Flight diffraction (TOFD) Technique
- Non-Destructive Testing – Ultrasonic Examination – Part 5: Characterization and Sizing of Discontinuities. – British and European Standard BS EN 583-5:2001
- Non-Destructive Testing – Ultrasonic Examination – Part 2: Sensitivity and Range Setting. – British and European Standard BS EN 583-2:2001
- Manufacture and Testing of Pressure Vessels. Non-Destructive Testing of Welded Joints. Minimum Requirement for Non-Destructive Testing Methods – Appendix 1 to AD-Merkblatt HP5/3 (Germany).– Edition July 1989

ISO 9001 REGISTERED
DNV Certification B.V., The Netherlands

FCC Rules

This **ISONIC 3505** Superior Performance 140 dB Dynamic Range Portable All-In-One Digital Ultrasonic Flaw Detector and Recorder (hereinafter called **ISONIC 3505**) has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Safety Regulations

Please read this section carefully and follow the regulations in order to ensure your safety and operate **ISONIC 3505** as intended

Please notice the warnings and notes printed in this manual and on the unit

The **ISONIC 3505** has been built and tested according to the regulations specified in EN60950/VDE0805. It was in perfect working condition on leaving the manufacturer's premises

In order to retain this standard and to avoid any risk in operating the equipment, the user must make sure to comply with any hints and warnings included in this manual

Depending on the power supply the **ISONIC 3505** complies with protection class I /protective grounding/, protection class II, or protection class III

Exemption from statutory liability for accidents

The manufacturer shall be exempt from statutory liability for accidents in the case of non-observance of the safety regulations by any operating person

Limitation of Liability

The manufacturer shall assume no warranty during the warranty period if the equipment is operated without observing the safety regulations. In any such case, manufacturer shall be exempt from statutory liability for accidents resulting from any operation

Exemption from warranty

The manufacturer shall be exempt from any warranty obligations in case of the non-observance of the safety regulations
The manufacturer will only warrant safety, reliability, and performance of the **ISONIC 3505** if the following safety regulations are closely observed:

- Setting up, expansions, re-adjustments, alterations, and repairs must only be carried out by persons who have been authorized by manufacturer
- The electric installations of the room where the equipment is to be set up must be in accordance with IEC requirements
- The equipment must be operated in accordance with the instructions
- Any expansions to the equipment must comply with the legal requirements, as well as with the specifications for the unit concerned
- Confirm the rated voltage of your **ISONIC 3505** matches the voltage of your power outlet
- The mains socket must be located close to the system and must be easily accessible
- Use only the power cord furnished with your **ISONIC 3505** and a properly grounded outlet /only protection class I/
- Do not connect the **ISONIC 3505** to power bar supplying already other devices. Do not use an extension power cord
- Any interruption to the PE conductor, either internally or externally, or removing the earthed conductor will make the system unsafe to use /only protection class I/
- Any required cable connectors must be screwed to or hooked into the casing
- The equipment must be disconnected from mains before opening
- To interrupt power supply, simply disconnect from the mains
- Any balancing, maintenance, or repair may only be carried out by manufacturer authorized specialists who are familiar with the inherent dangers
- Both the version and the rated current of any replacement fuse must comply with specifications laid down
- Using any repaired fuses, or short-circuiting the safety holder is illegal
- If the equipment has suffered visible damage or if it has stopped working, it must be assumed that it can no longer be operated without any danger. In these cases, the system must be switched off and be safeguarded against accidental use
- Only use the cables supplied by manufacturer or shielded data cable with shielded connectors at either end
- Do not drop small objects, such as paper clips, into the **ISONIC 3505**
- Do not put the **ISONIC 3505** in direct sunlight, near a heater, or near water. Leave space around the **ISONIC 3505**
- Disconnect the power cord whenever a thunderstorm is nearby. Leaving the power cord connected may damage the **3505** or your property
- When positioning the equipment, external monitor, external keyboard, and external mouse take into account any local or national regulations relating to ergonomic requirements. For example, you should ensure that little or no ambient light is reflected off the external monitor screen as glare, and that the external keyboard is placed in a comfortable position for typing

- Do not allow any cables, particularly power cords, to trail across the floor, where they can be snagged by people walking past
- The voltage of the External DC Power Supply below 11 V is not allowed for the **ISONIC 3505** unit
- The voltage of the External DC Power Supply above 16 V is not allowed for the **ISONIC 3505** unit
- Charge of the battery for the **ISONIC 3505** unit is allowed only with use of the AC/DC converters / chargers supplied along with it or authorized by Sonotron NDT

Remember this before:

- balancing
- carrying out maintenance work
- repairing
- exchanging any parts

Please make sure batteries, rechargeable batteries, or a power supply with SELV output supplies power

Software

ISONIC 3505 is a software controlled inspection device. Based on present state of the art, software can never be completely free of faults. **ISONIC 3505** should therefore be checked before and after use in order to ensure that the necessary functions operate perfectly in the envisaged combination. If you have any questions about solving problems related to use the **ISONIC 3505**, please contact your local Sonotron NDT representative

1. Introduction

ISONIC 3505 carries the exceptionally innovative ultrasonic card with ***never-saturated-receiver*** – for the first time ever the instrument keeps the linearity over **140 dB dynamic range** digitizing the originally received signals **independently on the gain and rectification settings** in every firing / receiving cycle. Once the single A-Scan or the sequence of A-Scans forming a record is stored into a file it may be reproduced the off-line in the form desired by an operator (RF, half- or full wave rectified, FFT) at any gain level over the 140 dB range. So even in case of very significant deviation of the pre-inspection gain setting from the required one the observation and evaluation of the recorded data may be performed at the right levels ***without secondary scanning***

The **top level ultrasonic performance** of **ISONIC 3505** is achieved thanks to the above noted ***never-saturated-receiver*** and to the **versatile firing circuit** allowing forming of either ***Spike, Unipolar-***, or ***Bipolar Square Wave*** initial pulse with wide-range-tunable duration and amplitude (up to 400 Vpp). The high stability of the square wave initial pulse amplitude within entire duration of the positive and negative half-waves, the extremely short boosted rising and falling edges and the automatic adaptive damping allows optimizing of the ultrasonic wave penetration into various materials characterized either by high or low grain size, sound attenuation, and the like and improving of the signal to noise and the resolution

ISONIC 3505 may be operated as:

- superior performance **A-Scan** set including the *spectrum analyzer for ultrasonic signals*
- fully featured (data capturing and enhanced postprocessing) standalone **TOFD** unit
- **CHIME** system
- general purpose **CB-Scan** machine for the performing of:
    - **SRGW** (short range guided wave) inspection and imaging also known as **SRUT**
    - surface / shear wave inspection and mapping

  volume overlay incidence angle / skip corrected high resolution flaw detection **B-Scan** and**Thickness Profile** recorder
- **C-Scan** through raster scanning with straight- and angle beam probes either mechanic-free or with use of the mechanized or automatic XY scanner (optional)

with 100% raw data storage

Thanks to the ***never-saturated-receiver*** **ISONIC 3505** is featured with the ability of **individual gain control** for both independent gates over the range of 140 dB separately from the rest of the **A-Scan** reproduced at the global instrument gain. This opens a number of new abilities such as:

- implementing *pulse echo* and *back echo attenuation* inspections simultaneously with use of the same **A-Scan** whilst monitoring the back echo amplitude at the clearly visible level without affecting the sensitivity of the pulse echo inspection
- increasing the *detectability of subsurface defects* for **TOFD** inspection through **shortening the tail of lateral wave signal dynamically**
- precise materials characterization through the **signal spectrum analysis independent on the instrument gain setting**
- etc

ISONIC 3505 is fully controllable over Ethernet and featured with the *hardware triggering in/out terminals* and the *interface echo triggering* making it suitable for use in various integrated systems

The lifetime free software upgrade policy is provided for **ISONIC 3505** as for all other instruments from **Sonotron NDT**

ISONIC 3505 is packed into the IP 65 reinforced plastic case with no intake air or any other cooling means. The large 800X600 8.5” bright screen provides fine resolution and visibility for all types of inspection data presentation at strong ambient light along with the optimized power consumption rate for the outdoor operation

Ultrasonic Pulsing / Receiving:

- Versatile Pulser with the Booster of the Rising and Falling Edges of the Initial Pulse and the Automatic Adaptive Damping – Switchable Pulsing Modes:
    - Spike Pulse
    - Unipolar Square Wave Initial Pulse with boosted rising and falling edges and guaranteed mark level stability and active damping
    - Bipolar Square Wave Initial Pulse with boosted rising and falling edges and guaranteed mark level stability and active damping
        - Smoothly Tunable Amplitude (14 Levels)
        - Smoothly Tunable Duration
        - 10 Grades of Automatic Adaptive Active Damping
- Wide Band 140 dB Dynamic Range Never-Saturated Receiver
- Digitizing of the Originally Received Signals over Entire 140 dB Dynamic Range Independently on Gain and Rectification Settings
- - 30 ... + 110 dB Global Analogue Gain
- Signal Presentation
    - Rectified A-Scan (Full / Positive / Negative Half Wave)
    - RF A-Scan - No Time Base Limit
    - Logarithmic Scale A-Scan
    - Simultaneous Frequency Domain (FFT) + Time Domain Signal Presentation
    - Artificial Intelligence (AI) A-Scan
- Comprehensive Signal Filtering: 32-Taps FIR Band Pass Digital Filter with Smoothly Controllable Lower and Upper Frequency Limits
- 2 Independent Gates (A, B)
    - Independent on the Global Analogue Gain Gain per Gate A setting covering the whole range of Gain manipulation (-30 through + 110 dB Analogue Gain)
    - Independent on the Global Analogue Gain Gain per Gate B setting covering the whole range of Gain manipulation (-30 through + 110 dB Analogue Gain)
- DAC / DGS / TCG
    - Theoretical DAC (dB / mm /// dB / inch)
    - Experimental DAC (reflector by reflector echo height measurement) - DAC creating procedure supported by Artificial Intelligence (AI)
    - Unlimitedly Expandable DGS Probes Database
    - Intuitive DGS Calibration
- Interface Echo A-Scan start (Additional IE Gate)
- Built-In Incremental Encoder Interface
- Triggering Output Terminal for the External Devices - Sync Out
- Triggering Input Terminal for the External Devices - Sync In

TOFD Scanning and Recording:

- Encoded / Time Based Recording and Imaging
- Real Time Lateral Wave Amplitude Stabilizer
- Gain per Gate Manipulation (- 30 ... + 110 dB) for the Desired Region of Interests (ROI) on the TOFD A-Scan
- All Functional TOFD Postrpocessing:
    - Recovery and Evaluation of Captured A-Scans
    - Off-Line Global Gain Manipulation (- 30 ... + 110 dB)
    - Off-Line Gain per Gate Manipulation (- 30 ... + 110 dB) for 2 Independent Gates
    - Off-Line lateral Wave Amplitude Stabilizer for Creating TOFD Map
    - Parabolic Cursors
    - SAFT
    - Defects Sizing
        - Depth / Height
        - Position Along the Fusion Line / Length
    - Linearization
    - Straightening
    - Removal Lateral Wave for Increasing Near Surface Detection Ability
    - Rectification
    - Zooming Desired Segments of TOFD Map
    - Automatic creating of inspection reports - hard copy / PDF File

Non-TOFD Scanning and Recording:

- True-To-Geometry Volume Corrected Flaw Detection B-Scan - Angle beam and Straight Beam Probes
- Horizontal Plane View CB-Scan for Shear, Surface, and Guided Waves Inspections
- High Resolution Flaw Detection B-Scan
- Thickness B-Scan
- Encoded / Time Based Recording and Imaging
- DAC / DGS / TCG Normalization for Flaw Detection Scans
- 100% Raw Data Capturing
- Gain per Gate manipulation (- 30 ... + 110 dB) for the desired Region of Interest (ROI) on the Recorded A-Scan
- Comprehensive Postrpocessing for All Types of non TOFD Line Scanning Records as Above Including:
  - Recovery and Evaluation of Captured A-Scans
  - Off-Line Global Gain Manipulation (- 30 ... + 110 dB)
  - Off-Line Gain per Gate Manipulation (- 30 ... + 110 dB) for 2 Independent Gates
  - Off-Line DAC / DGS Normalization of the Recorded Images / DAC / DGS Evaluation
  - Numerous Filtering / Reject Options (by Geometry / Position / By Amplitude / dB-to-DAC / etc)
  - Defects Sizing and Echo-Dynamic Pattern Recognition
  - Automatic creating of inspection reports - hard copy / PDF File

Raster Scanning (optional):

- Versatile encoded scanning
  - Mechanics-free manual
  - Mechanized
  - Automatic
- Contact or Immersion
- Thickness (Distance) or Amplitude C-Scan (Top View)
- Thickness profile or flaw detection End and Side Views
- Curvature correction
- DAC / DGS / TCG Normalization for the Flaw Detection Imaging
- 100% Raw Data Capturing
- Gain per Gate manipulation (- 30 ... + 110 dB) for the desired Region of Interest (ROI) on the Recorded A-Scan
- Comprehensive Postrpocessing for All Types of non TOFD Line Scanning Records as Above Including:
  - Recovery and Evaluation of the Captured A-Scans
  - Off-Line Global Gain Manipulation (- 30 ... + 110 dB)
  - Off-Line Gain per Gate Manipulation (- 30 ... + 110 dB) for 2 Independent Gates
  - 3D Viewing
  - Off-Line DAC / DGS Normalization of the Recorded Images / DAC / DGS Evaluation
  - Numerous Filtering / Reject Options (by Geometry / Position / By Amplitude / dB-to-DAC / etc)
  - Defects Sizing and Echo-Dynamic Pattern Recognition
  - Automatic creating of inspection reports - hard copy / PDF File

General:

- *Dual Core 1.6 GHz clock 2 GB RAM 120 GB SSD W'7PRO on-board control computer*
- *Intuitive User Interface*
- *Single and multi-axis encoder connection*
- *Comprehensive postprocessing and data reporting toolkit*
- *Remote control and data capturing with use of a regular PC with no need in special software*
- *No intake air / no cooling IP 65 light rugged case*
- *Sealed all-functional keyboard and mouse*
- *8.5" bright touch screen*
- *Ethernet, USB, sVGA terminals*
- *VAUT*
- *GPS*

ISONIC 3505 is fully compliant with the following codes

- ASME Section I – Rules for Construction of Power Boilers
- ASME Section VIII, Division 1 – Rules for Construction of Pressure Vessels
- ASME Section VIII, Division 2 – Rules for Construction of Pressure Vessels. Alternative Rules
- ASME Section VIII Article KE-3 – Examination of Welds and Acceptance Criteria
- ASME Code Case 2235 Rev 9 – Use of Ultrasonic Examination in Lieu of Radiography
- Non-Destructive Examination of Welded Joints – Ultrasonic Examination of Welded Joints. – British and European Standard BS EN 1714:1998
- Non-Destructive Examination of Welds – Ultrasonic Examination – Characterization of Indications in Welds. – British and European Standard BS EN 1713:1998
- Calibration and Setting-Up of the Ultrasonic Time of Flight Diffraction (TOFD) Technique for the Detection, Location and Sizing of Flaws. – British Standard BS 7706:1993
- WI 00121377, Welding – Use Of Time-Of-Flight Diffraction Technique (TOFD) For Testing Of Welds. – European Committee for Standardization – Document # CEN/TC 121/SC 5/WG 2 N 146, issued Feb, 12, 2003
- ASTM E 2373 – 04 – Standard Practice for Use of the Ultrasonic Time of Flight Diffraction (TOFD) Technique
- Non-Destructive Testing – Ultrasonic Examination – Part 5: Characterization and Sizing of Discontinuities. – British and European Standard BS EN 583-5:2001
- Non-Destructive Testing – Ultrasonic Examination – Part 2: Sensitivity and Range Setting. – British and European Standard BS EN 583-2:2001
- Manufacture and Testing of Pressure Vessels. Non-Destructive Testing of Welded Joints. Minimum Requirement for Non-Destructive Testing Methods – Appendix 1 to AD-Merkblatt HP5/3 (Germany).– Edition July 1989

2. Technical Data

Special

Number of Channels:	1
Pulsing/Receiving Modes:	Single / Dual
Initial Pulse:	Switchable type: • Spike • Unipolar Square Wave • Bipolar Square Wave
Transition:	≤7.5 ns (10-90% for rising edges / 90-10% for falling edges)
Amplitude:	Smoothly tunable (14 levels): • 10...200 V into 50 Ω for the Spike and Unipolar Pulse • 20...400 Vpp into 50 Ω for the Bipolar Pulse
Damping:	Smoothly Tunable (10 levels) Automatic Adaptive Active Damping
Half Wave Duration:	50…1000 ns controllable in 10 ns step
Analogue Gain:	- 30... + 110 dB controllable in 0.5 dB resolution
Advanced Low Noise Design:	85 µV peak to peak input referred to 80 dB gain / 25 MHz bandwidth
Frequency Band:	0.2 … 25 MHz
A/D Conversion:	32 bit @ 100 MHz Physical Sampling Rate
Digital Filter:	32-Taps FIR band pass with controllable lower and upper frequency limits; non-linear acoustics technique supported
Display Mode - Signal Presentation:	• Rectified A-Scan: Full / Positive / Negative Half Wave • RF A-Scan - No Time Base Limit • Logarithmic Scale A-Scan • Simultaneous Frequency Domain (FFT) + Time Domain (RF) • Artificial Intelligence (AI) A-Scan
Ultrasound Velocity:	300...20000 m/s (11.81…787.4 "/ms) controllable in 1 m/s (0.1 "/ms) resolution
Range (Time Base):	0.5...3000 µs - controllable in 0.01 µs resolution
Display Delay:	- 2.5 ... 1500 µs - controllable in 0.01 µs resolution
Probe Angle:	0…90° controllable in 1° resolution
Probe Delay:	0 ... 100 µs controllable in 0.01µs resolution - expandable
Reject:	0...99 % of screen height controllable in 1% resolution
Gates:	2 Independent gates (**A** and **B** with the **Start / Width** controllable over entire time base in 0.1 mm /// 0.001" resolution
Threshold:	5…95 % of A-Scan height controllable in 1 % resolution
Gain per Gate:	• Independent on the Global Analogue Gain **Gain per Gate A** setting covering the whole range of Gain manipulation (-30 ... + 110 dB Analogue Gain) • Independent on the Global Analogue Gain **Gain per Gate B** setting covering the whole range of Gain manipulation (-30 ... + 110 dB Analogue Gain)
DAC / TCG:	• Controllable over Entire 140 dB Dynamic Range / Time Base Manipulation Range • Multi-curve • Slope ≤ 20 dB/µs • Available for the Rectified and RF A-Scans • Theoretical – through Entering dB/mm (dB/") factor • Experimental – (reflector by reflector echo height measurement) / capacity - up to 40 points / DAC creating procedure supported by Artificial Intelligence (AI)
DGS:	• Standard Library for 18 probes / unlimitedly expandable • Intuitive Calibration Procedure
Interface Echo Start:	Standard Feature Implemented through the Separate **IE** Gate
Digital Readout:	• 27 automatic functions • Dual Ultrasound Velocity Measurement Mode for Multi-Layer Structures • Curved Surface / Thickness / Skip correction for angle beam probes • Ultrasound Velocity and Probe Delay Auto-Calibration for the Probes of All Types
Freeze A-Scan:	• Freeze All • Freeze Peak *Note:* Signal Evaluation, Manipulating of the Global Gain over - 30 ... +110 dB Range, Gates Positions and Gain per Gate over - 30 ... +110 dB Range and Signal Presentation Settings (Display Mode) is Possible for the Frozen A-Scans

Sync In Terminal:	Positive TTL-level Pulse - Standard Feature
Sync Out Terminal:	Positive TTL-level Pulse - Standard Feature
Scanning and Imaging:	• Thickness Profile B-Scan • True-To-Geometry Angle / Skip Corrected Cross-sectional B-Scan • High Resolution B-Scan • Horizontal Plane View CB-Scan • TOFD • Thickness C-Scan - Top-, Side-, End- Views and 3D; slicing and curvature correction included (optional: dual axis coordinate encoder and application SW required) • Flaw Detection C-Scan - Top-, Side-, End- Views and 3D; slicing and curvature correction included (optional: dual axis coordinate encoder and application SW required) • XYɣ-encoded CB-Scan (optional: dual axis coordinate / probe swiveling angle encoder and application SW required) • Editable Color Palette • DAC / DGC / TCG Normalization of the Images Related to the Amplitude Based Inspections
Standard Length of the Single Line Scanning Record:	50…20000 mm (2"…800"), automatic scrolling
GPS Coordinate:	Obtained and Displayed Automatically Along with UT Data with Use of the External GPS Receiver Connected to Instrument's USB Port
VAUT:	Video Data from One or Two External Cameras Connected to Instrument's USB Port(s) is Displayed Automatically Along with UT Data
Data Storage:	• 100% Raw Data Capturing • GPS Coordinate Embedded Into the Data File in Case of GPS Receiver Connected • Photo Embedded Into the Single A-Scan Data File in Case of USB Camera Connected • Video Embedded Into the Scanning Results Data File in Case of USB Camera Connected
Postrpocessing:	• Built-in means for the comprehensive postprocessing in the instrument • ISONIC Office 35 - postprocessing package for the computer running under W'XP, W'7, W'8, W'10

General

PRF:	20...5000 Hz controllable in 1 Hz resolution
On-Board Computer CPU:	Dual Core Intel Atom N2600 CPU 1.6 GHz
RAM:	2 GB
Quasi HDD:	SSD Hard Drive 120 GB
Screen:	Sun readable 8.5” touch screen 800 x 600
Controls:	Sealed keyboard and mouse
Standard Ports:	• 2 x USB (optionally expandable up to 8) • Ethernet • sVGA
Operating System:	W'7PRO
Encoder:	• Single Axis Incremental TTL encoder - Built-In • Multi-Axis (>=2) Incremental TTL Encoder - Optional
Remote Control:	• From an external computer running under W'XP, W'7, W'8, W'10 through Ethernet • No special software required • All calibration and inspection data is stored in the control computer
Ambient Temperature:	• -30°C ... +60°C (operation) • -50°C ... +60°C (storage)
Housing:	• Rugged reinforced plastic case with the stainless steel carrying handle • IP 65 • No air intake • The cooling is not required
Dimensions:	292x295x115 mm (11.50"x11.61"x4.53") - with / without battery inside
Weight:	4,400 kg (9.70 lbs) – with battery 3.750 kg (8.27 lbs) – without battery

3. ISONIC 3505 – Scope of Supply

4, Pekeris st., Rabin Science Park, Rehovot, 7670204, Israel
Phone: +972-(0)8-9311000, Fax: +972-(0)8-9477712
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3.1. The standard package and basic accessories / spare parts

#	*Item*	*Order Code (Part ##)*
	The Instrument - Standard Delivery Kit	
1	**ISONIC 3505** – Superior Performance 140 dB Dynamic Range Portable All-In-One Digital Ultrasonic Flaw Detector and Recorder ⇨ Versatile Pulser with Boosted Rising and Falling Edges and the Automatic Adaptive Damping – Switchable Pulsing Modes ▷ Spike (up to 200 V) ▷ Bipolar / Unipolar Square Wave Initial Pulse (up to 200 V / 400 Vpp) with boosted rising and falling edges and guaranteed mark level stability and active damping ▷ Unipolar Square Wave Initial Pulse (up to 200 V) with boosted rising and falling edges and guaranteed mark level stability and active damping → 14 levels of the Initial Pulse Amplitude → Half wave pulse duration 50...1000 ns → Automatic Adaptive Active Damping - 10 grades ⇨ Wide Band 140 dB Dynamic Range Never-Saturated Receiver ⇨ Digitizing of the Originally Received Signals over Entire 140 dB Dynamic Range Independently on Gain and Rectification Settings ⇨ - 30 ... + 110 dB **Global Analogue Gain** ⇨ Signal Presentation → Rectified A-Scan (Full / Positive / Negative Half Wave) → RF A-Scan - No Time Base Limit → Logarithmic Scale A-Scan → Simultaneous Frequency Domain (FFT) + Time Domain SIgnal Presentation → Artificial Intelligence (AI) A-Scan ⇨ Comprehensive Signal Filtering: 32-Taps FIR Band Pass Digital Filter with Smoothly Controllable Lower and Upper Frequency Limits ⇨ 2 Independent Gates (A, B) ⇨ Independent on the *Global Analogue Gain* **Gain per Gate A** setting covering the whole range of Gain manipulation (-30 through + 110 dB Analogue Gain) ⇨ Independent on the *Global Analogue Gain* **Gain per Gate B** setting covering the whole range of Gain manipulation (-30 through + 110 dB Analogue Gain) ⇨ DAC / DGS / TCG ⇨ Theoretical DAC (db / mm /// db / inch) ⇨ Experimental DAC (reflector by reflector echo height measurement) - DAC creating procedure supported by Artifical Intelligence (AI) ⇨ unlimitedly expandable DGS probes database ⇨ intuitive DGS calibration ⇨ Interface Echo A-Scan start (IE gate) ⇨ Built-In Incremental Encoder Interface ⇨ Hardware triggering output terminal for the extrnal devices ⇨ Hardware triggering input terminal for the extrnal devices ⇨ On-board PC: 1.6 GHz Dual Core Intel Atom CPU, RAM 2 GB, 120 GB Internal Strorage SSD Hard Drive, Win 7EMB ⇨ High Brightness High Color Touch Screen ⇨ Sealed Front Panel Keyboard and Mouse ⇨ 2 X USB, Ethernet terminals, sVGA output ⇨ Remote control from external PC ⇨ VAUT (Video Aided UT) technology ⇨ GPS coordinate embedding into the inspection / calibration data files ⇨ **TOFD Scanning and Recording** → Encoded / Time Based Recording and Imaging → Real time lateral wave amplitude stabilizer for creating TOFD Map → Gain per Gate manipulation (- 30 through + 110 dB) for the desired Region of Interest (ROI) on the TOFD A-Scan	SA 809005

#	*Item*	*Order Code (Part ##)*
	➪ All Functional TOFD Postrpocessing Including: → Recovery and Evaluation of Captured A-Scans → Off-Line Global Gain Manipulation (- 30 through + 110 dB) → Off-Line Gain per Gate Manipulation (- 30 through + 110 dB) for 2 Independent Gates → Off-Line lateral wave amplitude stabilizer for creating TOFD Map → Parabolic Cursors → SAFT → Defects Sizing ▶ Depth / Height ▶ Position Along the Fusion Line / Length → Linearization → Straightening → Removal Lateral Wave for Increasing Near Surface Detection Ability → Rectification → Zooming Desired Segments of TOFD Map → Automatic creating of inspection reports - hard copy / PDF File	
                     2 3 4 5	➪ **Non-TOFD Line Scanning and Recording** → True-To-Geometry Volume Corrected Flaw Detection B-Scan - Angle beam and Straight Beam Probes → Horizontal Plane View CB-Scan for Shear, Surface, and Guided Waves → Thickness B-Scan → High Resolution Flaw Detection B-Scan ▶ Encoded / Time Based Recording and Imaging ▶ DAC / DGS / TCG Normalization for Flaw Detection Scans ▶ 100% Raw Data Capturing ▶ Gain per Gate manipulation (- 30 through + 110 dB) for the desired Region of Interest (ROI) on the recorded A-Scan → Comprehensive Postrpocessing for All Types of non TOFD Line Scanning Records as Above Including: ▶ Recovery and Evaluation of Captured A-Scans ▶ Off-Line Global Gain Manipulation (- 30 through + 110 dB) ▶ Off-Line Gain per Gate Manipulation (- 30 through + 110 dB) for 2 Independent Gates ▶ Off-Line DAC / DGS Normalization of the Recorded Images / DAC / DGS Evaluation ▶ Numerous Filtering / Reject Options (by Geometry / Position / By Amplitude / dB-to-DAC / etc) ▶ Defects Sizing and Echo-Dynamic Pattern Recognition ▶ Automatic creating of inspection reports - hard copy / PDF File Internal Rechargeable Battery Li-Ion-board Charging AC/DC Converter / Battery Charger for charging the battery inside the instrument Travel Hard Case Postprocessing SW Package for PC: **IOFFICE 35** ➪ comprehensive postprocessing of inspection results files captured by ISONIC 3505 ➪ automatic creating of the Inspection Report in MS Word® format	 SK 3505102 SK 3505103 SK 3505104 SWA99C0260
Spare / Extra Items - Optional		
6	Internal Rechargeable Battery Li-Ion 9 AH / 14.8V	SK 3500102
7	Battery Charger for Charging the extra-battery outside of the instrument	SK 3500105
8	AC/DC Converter for powering the instrument from mains and charging the battery inside	SK 3500104
9	Ultrasonic probes, fixtures, encoders, scanners, cables and other accessories depending on the inspection tasks to be resolved	
Postprocessing SW Packages and Utilities		
10	Postprocessing SW Package for PC: **IOFFICE 35** ➪ comprehensive postprocessing of inspection results files captured by ISONIC 3505 ➪ automatic creating of the Inspection Report in MS Word® format	SWA99C0260

3.2. Optional Line Scanning Incremental Encoders

#	*Item*	*Order Code (Part ##)*
Optional: Incremental Encoders - One Axis		
1	Twister - Rotary Adapter	S 904050
2	Simplest One-Axis Mechanical Encoder with Probe Clamping Unit for B/D Scan Imaging - use with conventional probes, guided wave probes and **ISONIC 35..** Instruments	SK 2001138 ABI
3	Simplest One-Axis Mechanical Encoder with Probe Clamping Unit for TOFD / CHIME/ CB-Scan / Thickness Profile / Straight Beam B-Scan imaging - use with conventional probes, TOFD probes, guided wave probes and **ISONIC 35..** Instruments	SK 2001138 FM
4	Wheels-Free Compact One-Axis Mechanical Encoder for line scanning with phased array probes and for TOFD / CHIME/ CB-Scan / Thickness Profile / Straight Beam B-Scan imaging	SK 2001108 PA
5	Magnetic wheel encoder for scanning with phased array probes and guided wave probes	SK 2001116 PA
Spare Encoder Cable 2 meters length		
6	Spare Encoder cable for connecting SK 2001108 PA, SK 2001116 PA, SK 2001118 PA encoders to **ISONIC 35..** series instruments	SK 899106

3.3. Optional Software and Encoders for the XY- and XYβ- manual raster scanning

#	*Item*	*Order Code (Part ##)*
	Optional Inspection SW Packages - XY and XYβ Raster Scanning with use of the Airborme Ultrasound Encoder	
1	**Straight Beam XY Raster Scanning** SW Package for ISONIC 3505, ISONIC 3507 - Manual Scanning with Airborne Ultrasound Encoding of the Probe Position ⇨ Corrosion Mapping of Flat Plates and Panels ⇨ Corrosion Mapping of Tube Walls (min OD = 80 mm) ⇨ Flaw Detectionn of the Flat Plates and Panels ⇨ Flaw Detection of of Tube Walls (min OD = 80 mm) ▷ Use of Single or Dual Element Probes ▷ 100% raw data capturing ▷ Real Time C-Scan (Top View), Side View, End View Imaging → Amplitude / Thickness (Depth) C-Scan (switchable) → Flaw Detection / Amplitude Side and End Views (switchable) → Curvature correction on the tubes ▷ Back Wall Echo / TT Signal Amplitude Attenualtion C-Scan ▷ Comprehensive Postprocessing Including → Play Back and Evaluation of the captured A-Scans → Off-Line Gain Manipulation over Entire Dynamic Range → Defects sizing - coordinates and projection dimensions (XYZ) → Polygoning and statistical analysis → Profiling of the scanned volume → Curvature correction → Comprehensive Inspection Report	SWA 3506608
2	**FLOORMAP** - Short Range Guided Wave Inspection (SRUT) of the annular rings, plates, etc SW Package for ISONIC 3505, ISONIC 3507 - manual scanning, airborne ultrasound encoding of the probe position and swiveling angle ⇨ Use of SRUT probes ⇨ XY and XYβ scanning strategy ⇨ 100% raw data capturing ⇨ Real Time forming of the CB-Scan image composed based on the A-Scans and XY- and XYβ probe position ⇨ Comprehensive Postprocessing Including ▷ Play Back and Evaluation of the captured A-Scans ▷ Off-Line Gain Manipulation over Entire Dynamic Range ▷ Defects sizing - coordinates and projection dimensions (XY) ▷ Comprehensive Inspection Report	SWA 3506634

#	*Item*	*Order Code (Part ##)*
	XYβ - Airborne Ultrasound Encoder Set	
3	Airborne Ultrasound Encoder for Monitoring The Coordinates / Swiveling Angle of Ultrasonic Probe Manually Manipulated Over the Material including:	SE 356000
	⇨ Electronic Module	S 356004
	⇨ USB Cable for connection to ISONIC Series Instrument	S 356008
	⇨ Sync / Pulser - Receiver Bridge Unbilical	S 356012
	⇨ Umbilical for connection the ultrasonic probe and airborne ultrasound emitter	S 356016
	⇨ Jumper for calibration procedure	S 356020
	⇨ Set of 2 (two) receivers of Airborne Ultrasound	S 43530
	⇨ Holder for Airborne Ultrasound Receivers with Magnetic Attachments to Object Under Test	S 23540
	⇨ Single Emitter of Airborne Ultrasound	S 43560
	Optional Double Emitters of Airborne Ultrasound: XYβ - Encoding, Monitoring Probe Coordinates and Swiveling Angle	
4	Dual Emitter of Airborne Ultrasound for Monitoring of the Probe Swiveling Angle	S 43550
5	Dual Emitter of Airborne Ultrasound Monitoring of the Probe Swiveling Angle - the Receivers of Airborne Ultrasound Placed on the Tank Shell	S 43555
	XYβ - Airborne Ultrasound Encoder Set: spare items	
6	Airborne Ultrasound Encoding Electronic Module	S 356004
7	USB Cable for connection to ISONIC Series Instrument	S 356008
8	Sync / Pulser - Receiver Bridge Umbilical	S 356012
9	Umbilical for connection the ultrasonic probe and airborne ultrasound emitter	S 356016
10	Jumper for calibration procedure	S 356020
11	Set of 2 (two) receivers of Airborne Ultrasound	S 43530
12	Holder for Airborne Ultrasound Receivers with Magnetic Attachments to Object Under Test	S 23540
13	Single Emitter of Airborne Ultrasound	S 43560
14	Dual Emitter of Airborne Ultrasound for Monitoring of the Probe Swiveling Angle	S 43550
15	Dual Emitter of Airborne Ultrasound Monitoring of the Probe Swiveling Angle - the Receivers of Airborne Ultrasound Placed on the Tank Shell	S 43555

3.4. Probe holders for conventional probes – line and raster scanning

#	*Item*	*Order Code (Part ##)*
	Probe Holders for Fitting Standard Ultrasonic Probes Into Incremental Encoder / Airboirne Ultrasound Encoder	
1	Probe Holder for MWB type Ultrasonic Probes with Rear Connector	SW 4070
2	Probe Holder for SWB type Ultrasonic Probes with Rear Connector	SW 4080
3	Probe Holder for WB type Ultrasonic Probes with Rear Connector	SW 4090
4	Probe Holder for MWB type Ultrasonic Probes with Top Connector	SW 4070C
5	Probe Holder for WSY type Ultrasonic Probes	SW 4070A
6	Probe Holder for MSWQC type Ultrasonic Probes with Plastic Wedges - 0.25" - 45 deg	S 4070B - 001
7	Probe Holder for MSWQC type Ultrasonic Probes with Plastic Wedges - 0.25" - 60 deg	S 4070B - 002
8	Probe Holder for MSWQC type Ultrasonic Probes with Plastic Wedges - 0.25" - 70 deg	S 4070B - 003
9	Probe Holder for MSWQC type Ultrasonic Probes with Plastic Wedges - 0.25" - 90 deg	S 4070B - 004
10	Probe Holder for MB, MSEB, type Ultrasonic Straight Beam Single or Dual Element Probes with Rear Connector (Also fits DA 301 - DA 305 probes)	SW 4070D
11	Probe Holder for MB, MSEB, type Ultrasonic Straight Beam Single or Dual Element Probes with Rear Connector (Also fits DA 301 - DA 305, K 1 N probes) - Reduced Dimensions	SW 4070D - 001
12	Probe Holder for Ultrasonic Straight Beam Single Element Probes with Hard Ceramic Contact Faces (K … N Series, f.e. K 2 N, K 4 N, K 5 N, K 6 N)	SW 4070E
13	Probe Holder for Ultrasonic Straight Beam Single Element Probes with Hard Ceramic Contact Faces (K … N Series, f.e. K 2 N, K 4 N, K 5 N, K 6 N) - Reduced Dimensions	SW 4070E - 001
14	Probe Holder for DA 312 Ultrasonic Dual Element Probes with Rear Connector	SW 4070 F2G
15	Probe Holder for Ultrasonic Straight Beam Single Element Probes with Delay Line (Mini DFR Series)	SW 4070 FR
16	Probe Holder for Ultrasonic Straight Beam Single Element Shock Wave Probes (K … K Series, f.e. K 2 K, K 5 K, K 10 K, etc)	SW 4070 KP
17	Probe Holder for CLF 4 Ultrasonic Straight Beam Single Element Probe	SW 4070 LD
18	Probe Holder for B, SEB type Ultrasonic Straight Beam Single or Dual Element Probes with Rear Connector	SW 4090 A
19	Probe Holder for any other type of Ultrasonic Probe specified by customer	SW_XX
20	Irrigation Channel for any type of Probe Holder specified by customer	XX_SWIR

4. Operating ISONIC 3505

Please read the following information before you use **ISONIC 3505**. It is essential to read and understand the following information so that no errors occur during operation, which could lead damaging of the unit or misinterpretation of inspection results

4.1. Preconditions for ultrasonic testing with ISONIC 3505

Operator of **ISONIC 3505** must be certified as at least *Level 2 Ultrasonic Examiner* additionally having the adequate knowledge of

- operating digital ultrasonic flaw detector
- basics of computer operating in the **Windows™** environment including turning computer on/off, keyboard, touch screen and mouse, starting programs, saving and opening files

4.2. ISONIC 3505 Controls and Terminals

SINGLE mode of operation

DUAL mode of operation


Power LED:
lights when the
instrument is
switched on
Low Battery
Warning LED
Battery Charge
Status LED
Touch Screen
LAN (Ethernet) terminal
2 X USB terminal
sVGA terminal
Battery compartment
Power DC IN terminal for
connection to external AC/DC
converter / charger
Power button: ON/OFF
Keyboard
Mouse
POWER
LOW-BAT
CHARGE
Sonotron NDT
ESC
1
2
3
4
5
F
OK
dB
ISONIC 3505
RIGHT
LEFT
POINTER
POSITION

4.3. Carrying Handle

To manipulate carrying handle:

Press from both sides

Rotate handle while pressed until settling into the desired position, then release

4.4. Turning On / Off

Normally **ISONIC 3505** is powered from the internal battery. The battery should be inserted into its compartment covered and secured with 2 screws

If necessary the internal battery may be charged inside the instrument while it is working. For that purpose the external AC/DC converter / charger should be connected to the appropriate terminal of the instrument and the power cord of the external AC/DC converter should be connected to the mains 100…240 VAC / 40…60 Hz

⚠ It's not recommended to power **ISONIC 3505** on without the battery inside

To switch **ISONIC 3505** on press on the power button and keep it pressed for several seconds (up to 30) until the **POWER** LED on the front panel lightens

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4, Pekeris st., Rabin Science Park, Rehovot, 7670204, Israel
Phone: +972-(0)8-9311000, Fax: +972-(0)8-9477712
www.sonotronndt.com

Wait until **ISONIC 3505** start screen becomes active automatically upon the boot up routine is completed – this may take up to 45 seconds

Click on [1 Operate] or press [1] on the front panel keyboard to start the operation of **ISONIC 3505** – refer to the Chapters 5 and 6 of this Operating Manual

Click on [2 Postprocessing] or press [2] on the front panel keyboard to open the instrument files explorer and start postprocessing

Click on [3 Settings] or press [3] on the front panel keyboard to enter into the instrument settings dialogue

Click on [4 Exit to Windows] or press [4] on the front panel keyboard if it is necessary to fulfill some general purpose Windows procedures

To turn the instrument OFF click on [5 Shut Down] or press [5] on the front panel keyboard or press the power button

⚠ After turning **OFF** wait at least 10…30 seconds before switching the instrument **ON** again

5. UDS 3-9 Pulser Receiver

5.1. Start Up UDS 3-9 Pulser Receiver

In the start screen Click on 

or press  on the front panel keyboard to start the operation of **ISONIC 3505** – refer to the Chapters 5 and 6 of this Operating Manual

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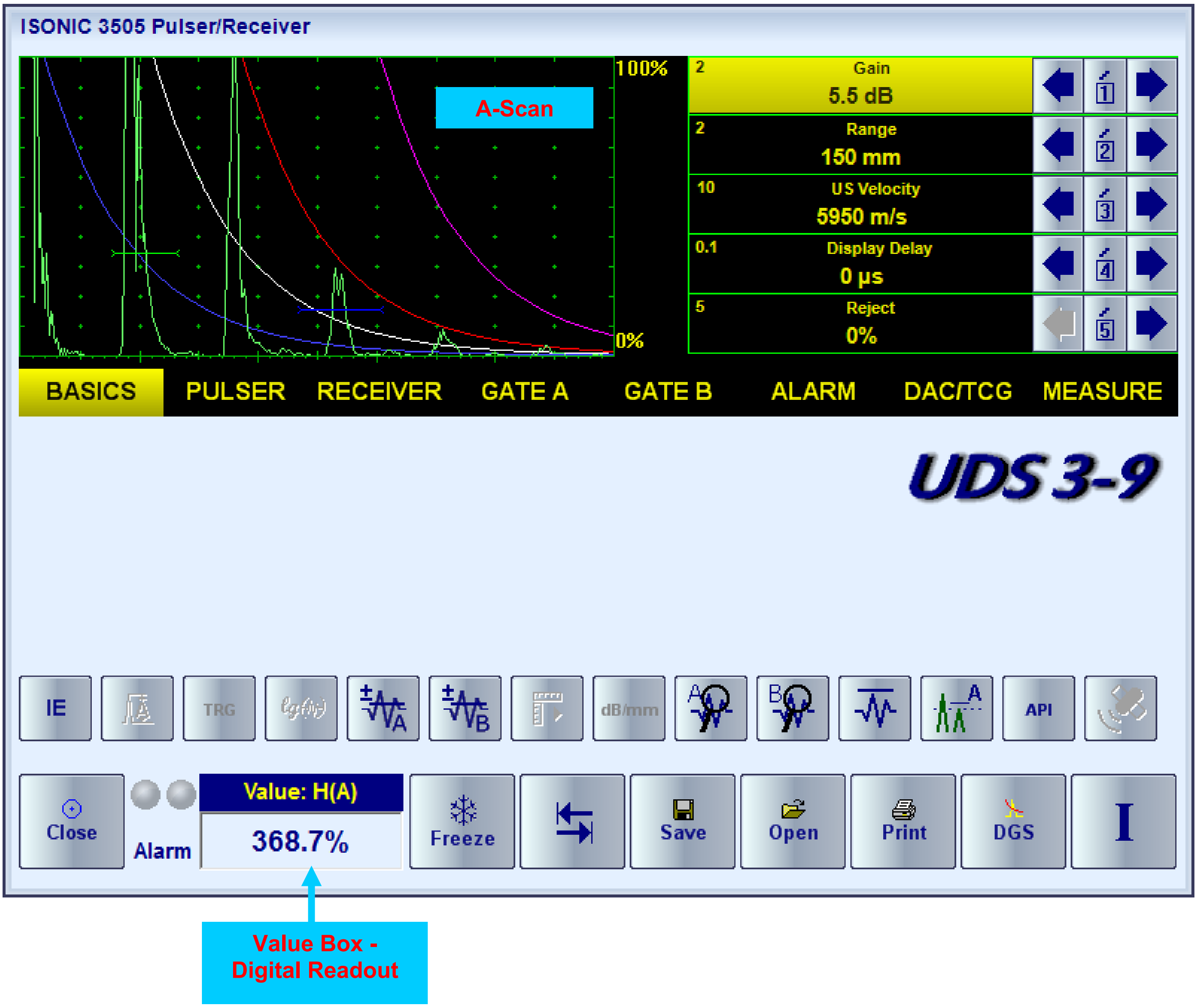
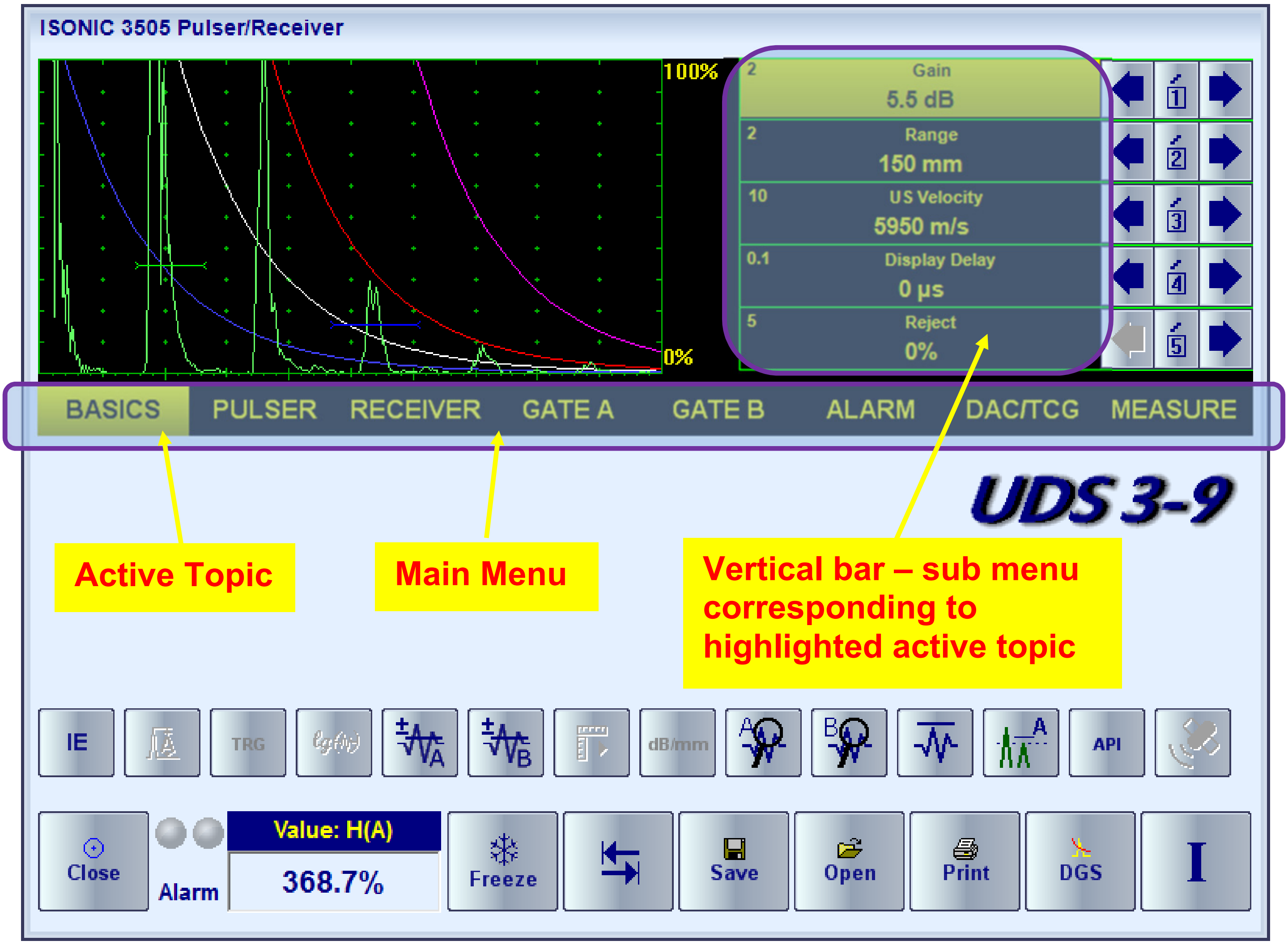
5.2. Main Operating Surface

UDS 3-9 is fully controllable through the main operating surface:



5.2.1. Main Menu

The **Main Menu** consists of eight topics; each topic is associated with corresponding **submenu** appearing as vertical bar showing names for five parameters or modes of operation, their current settings and current value of the increment/decrement for a parameter. The active topic is highlighted



To activate a topic the following manipulations are applicable:

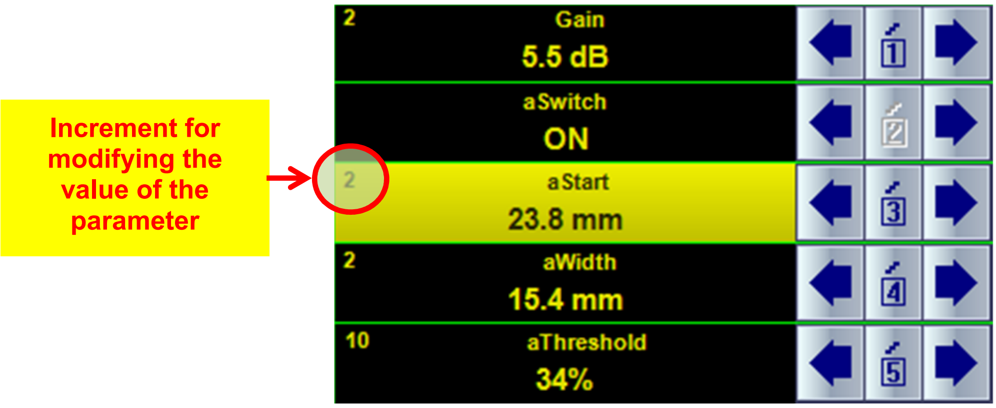
- Press  on front panel keyboard getting the desired topic highlighted

  OR
- Touch the topic's name on the screen

  OR
- Place the mouse pointer above the topic and left click

5.2.2. How to Control the Desired Parameter / Mode of Operation

Here is an example of settling the parameter **aStart**



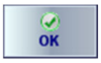
To select the **aStart** parameter to be modified:

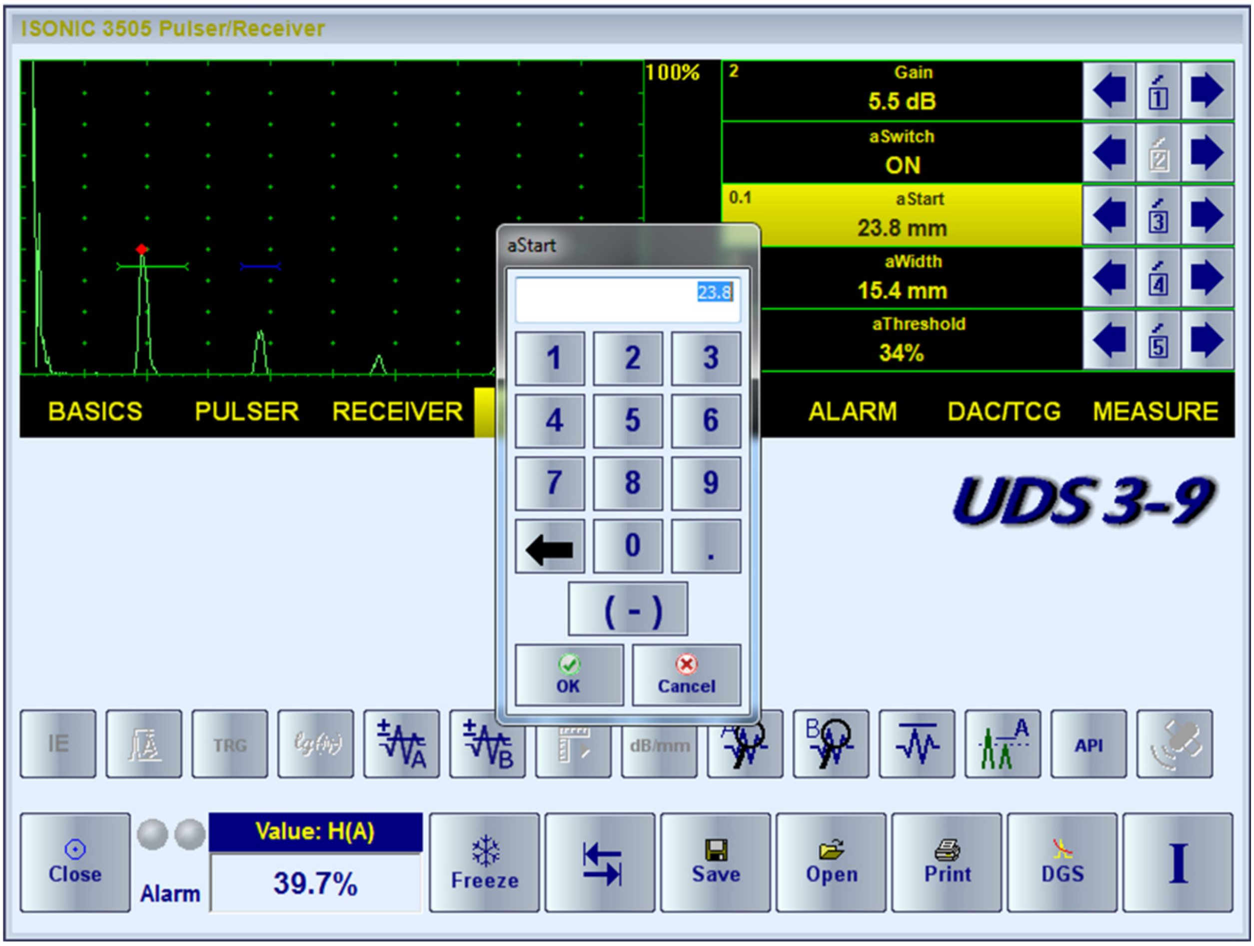
- Touch the name of the parameter (aStart 23.8 mm) on the screen or left mouse click on it then use ◀ , ▶ on the screen or ◀ , ▶ on the keyboard

OR

- Click on [3] or press on [3] on the keyboard ate least one then use ◀ , ▶ on the screen or ◀ , ▶ on the keyboard (the multiple clicking on on [3] or pressing on [3] allows settling of the desired increment for modifying of the adjusted value of the parameter)

OR

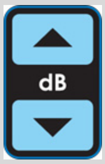
■ Double click on the parameter name  and enter the desired value in the popup windows then click on  or press  on the keyboard



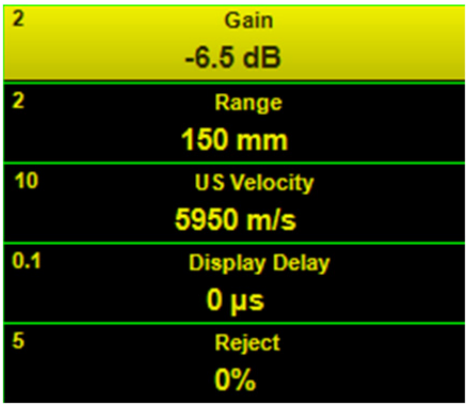
The **global instrument gain** may be controlled in the same manner as every parameter provided the corresponding sub menu is active

OR

with use of the dedicated buttons on the keyboard



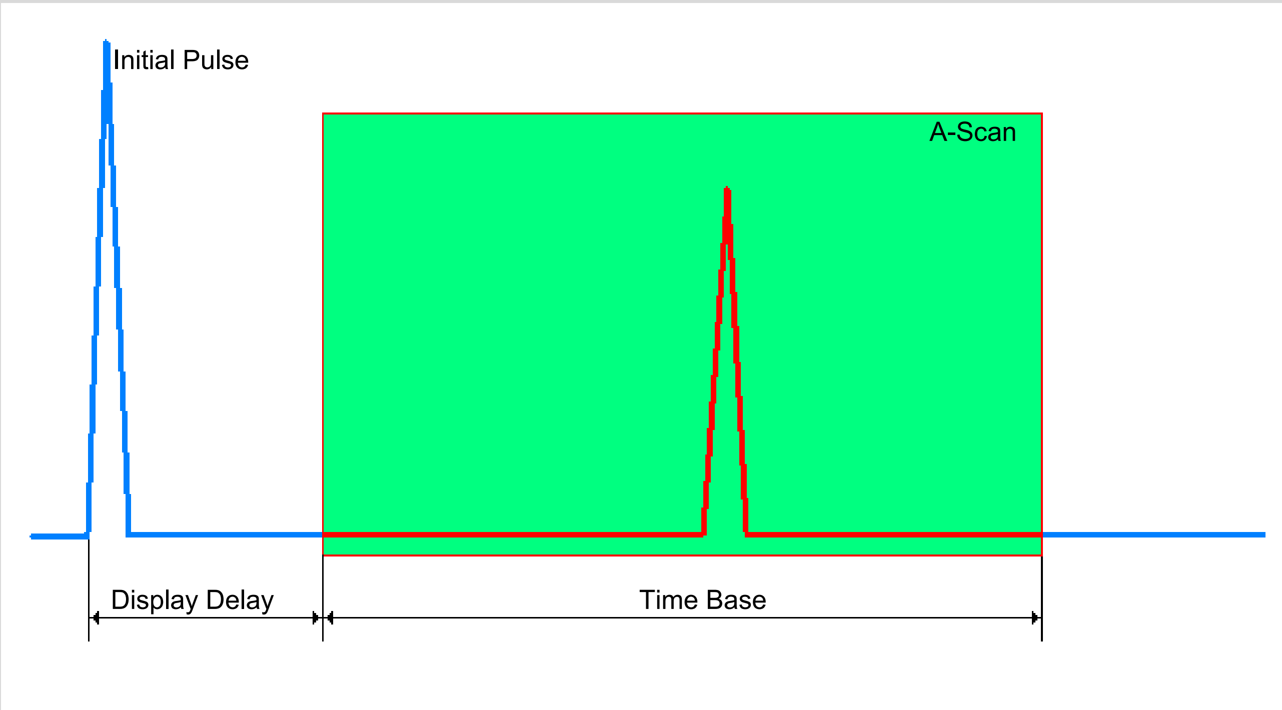
5.2.3. Sub Menu BASICS



Beside the **global instrument gain** the following parameters are controllable through the sub menu **BASICS**:

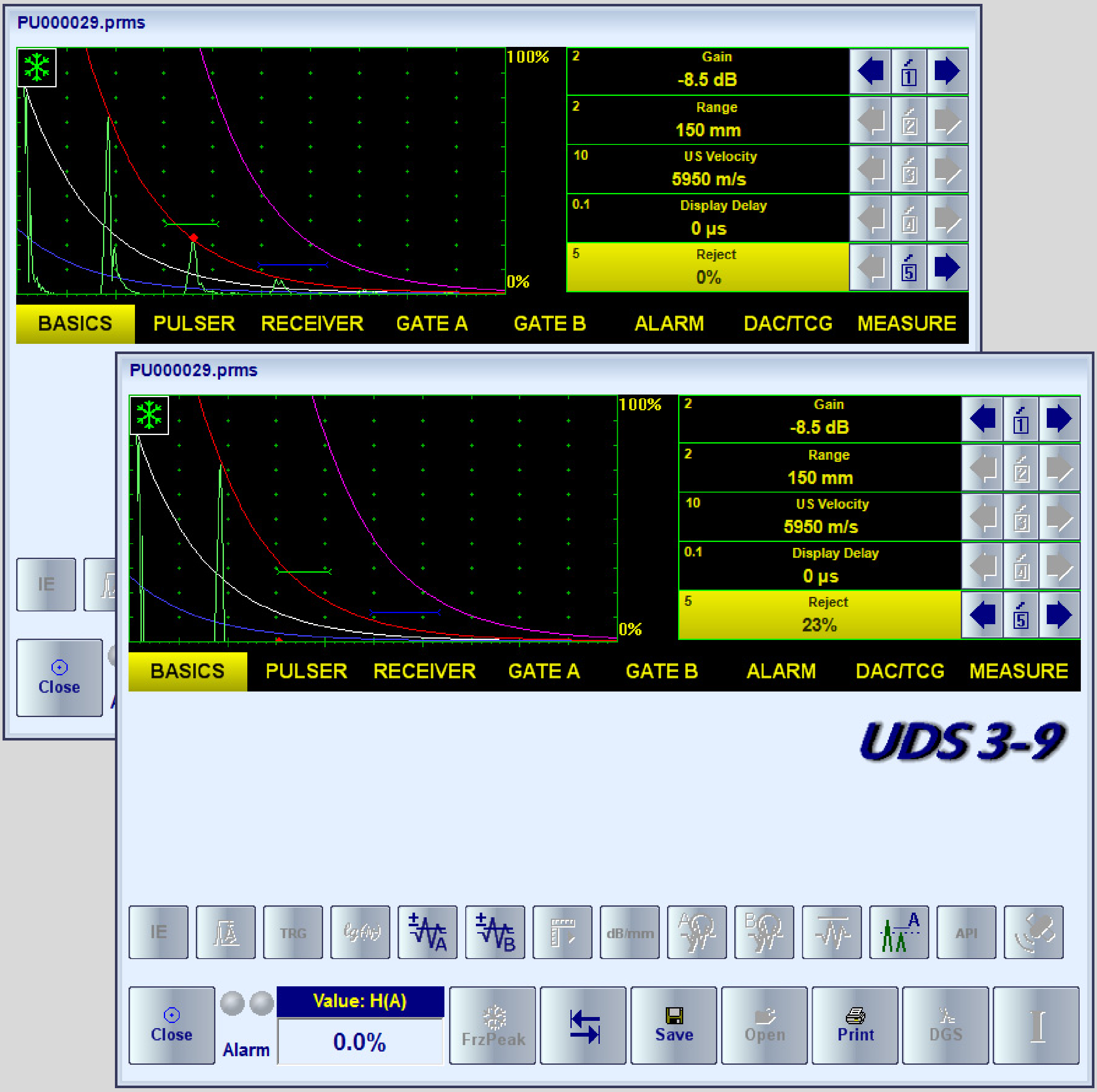
- **Display Delay**
- **Range**
- **USVelocity** (Ultrasonic velocity in the material)
- **Reject**

The illustration of the emitting initial pulse / receiving an echo process, corresponding indication, and meaning of **Display Delay** / **Range / US Velocity**:



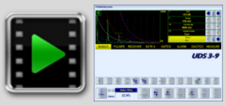
$$Range(mm) = \frac{TimeBase(\mu s) \times USVelocity(mm/\mu s)}{2}$$

The rectified signals with echo height below **Reject** level are suppressed on the A-Scan; the signals exceeding the **Reject** level are indicated with the same height

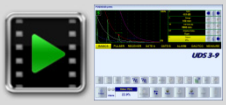


The **Reject** level setting is ignored whilst representing the *non-rectified (RF)* signals or using the *logarithmic (Log)* signal presentation (refer to paragraph 5.2.5)

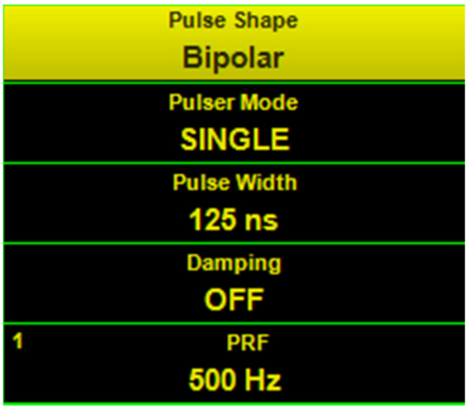
The instrument screen movie below illustrates manipulating of the **Reject**, **USVelocity, Range, Display Delay**, and **Gain** settings

	
Youtube https://www.youtube.com/watch?v=sj9DSQZK1lw	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_SubMenu_BASICS.mp4

The instrument screen movie below illustrates the limits for the **Display Delay** setting

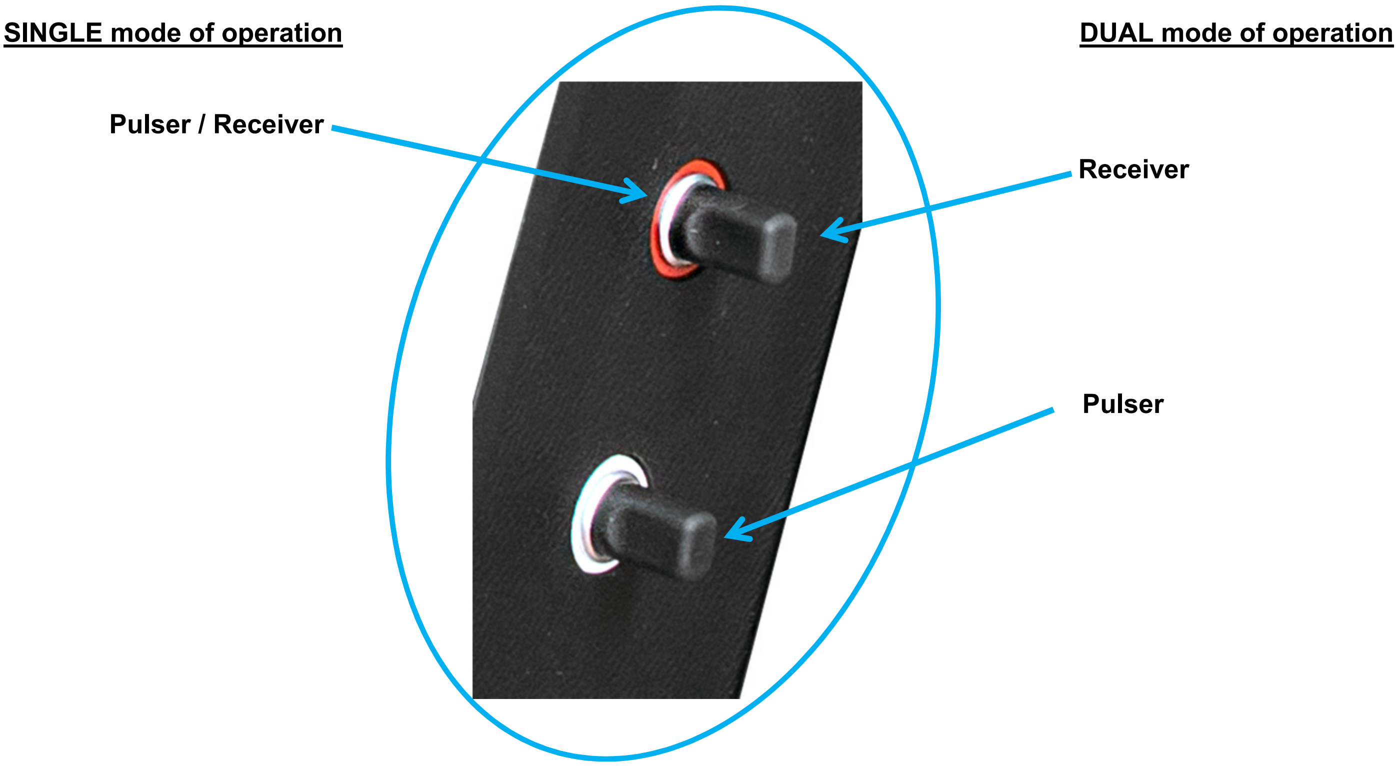
	
Youtube https://www.youtube.com/watch?v=4NlyuagAG4A	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_D_Delay.mp4

5.2.4. Sub Menu PULSER



The **Pulser Mode** setting defines the pulsing / receiving mode:

- **SINGLE** – operating of the single crystal (single element) probe
- **DUAL** – operating of the twin crystal (dual element) probes or a pair of single element probes one as the emitter, second – as the receiver

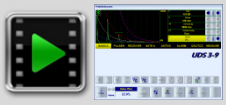


ISONIC 3505 allows generating of the initial pulse in 3 shapes:

- Spike
- Unipolar square wave with the tunable **Pulse Width**
- Bipolar square wave with the tunable **Pulse Width** (in case of bi-polar initial pulse the **Pulse Width** is controllable for both the positive and negative half wave simultaneously)

The amplitude of the initial pulse is smoothly tunable for all shapes – there are 14 possible grades of **Firing Level**; the maximal grade (14) corresponds to 200 V amplitude of the unipolar initial pulse / 400 Vpp amplitude of the bipolar initial pulse. To settle the **Firing Level** click on  then use the corresponding control:

The instrument screen movie below taken with no probe connected to the **ISONIC 3505** instrument illustrates the possible shapes of the initial pulse and manipulations related to the settling the **Pulse Width** and **Firing Level**

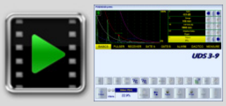
	
Youtube https://www.youtube.com/watch?v=8HPKQ9gXooo	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505-Pulser_01.mp4

Primarily the **Pulse Width** for the square wave initial pulse either unipolar or bipolar should be settled to

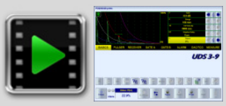
$$PulseWidth(ns) = \frac{1000}{2 * F(MHz)}$$

where **F** is the nominal frequency of the ultrasonic probe. However there is a number of inspections applications where the **Pulse Width** differs from the primary setting significantly

The shape of the initial pulse should be selected and its pulse width to be tuned then if applicable whilst observing the signal from the material; the instrument screen movie below illustrates an example for the influence of the shape of initial pulse and **Pulse Width** on the echo amplitude

	
Youtube https://www.youtube.com/watch?v=wyTTCLMNqXQ	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505-Pulser_02.mp4

There are 10 grades for the active **Damping** of the initial pulse available; varying **Damping** allows optimizing (shortening) of the duration of the echoes received from the material without affecting their amplitudes - the instrument screen movie below illustrates an example of the same

	
Youtube https://www.youtube.com/watch?v=-qNSkZBY7Oc	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505-Pulser_03.mp4

The **PRF** setting should be selected in order to compromise the maximal possible speed of scanning with preventing of the phantom echoes:

$$PRF(Hz) \leq (3 \ldots 10)\left\{DisplayDelay(\mu s) + \frac{1000 * USVelocity(m/s)}{2 * Range(mm)}\right\}$$

To switch into external triggering mode click on 

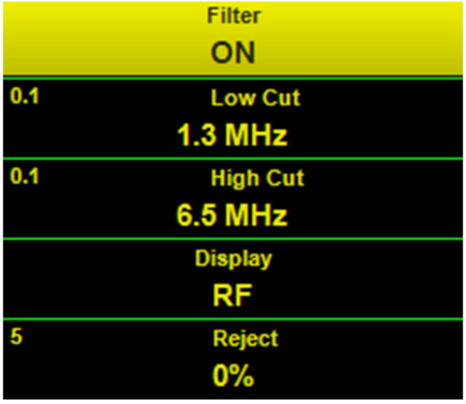
then delivery external Sync pulse (positive, +5 V) to the **IN** triggering terminal. Whilst in the external triggering mode:

- the initial pulse will be generated and A-Scan formed upon the external Sync pulse received
- the **PRF** will be defined by the external source
- the control button will look like here 

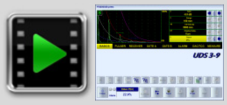
To return to the self-triggering (internal synchronization) click on 

Whilst in the internal synchronization mode the synch pulse (positive, +5 V) is generated on the **OUT** triggering terminal – refer to the paragraph 4.2 of the present Manual

5.2.5. Sub Menu RECEIVER



The **Filter** setting settles the digital filter **ON** or **OFF**. Use of the digital filter allows optimizing of the signal presentation for the large number of inspection applications; an example is illustrated by the instrument screen movie below

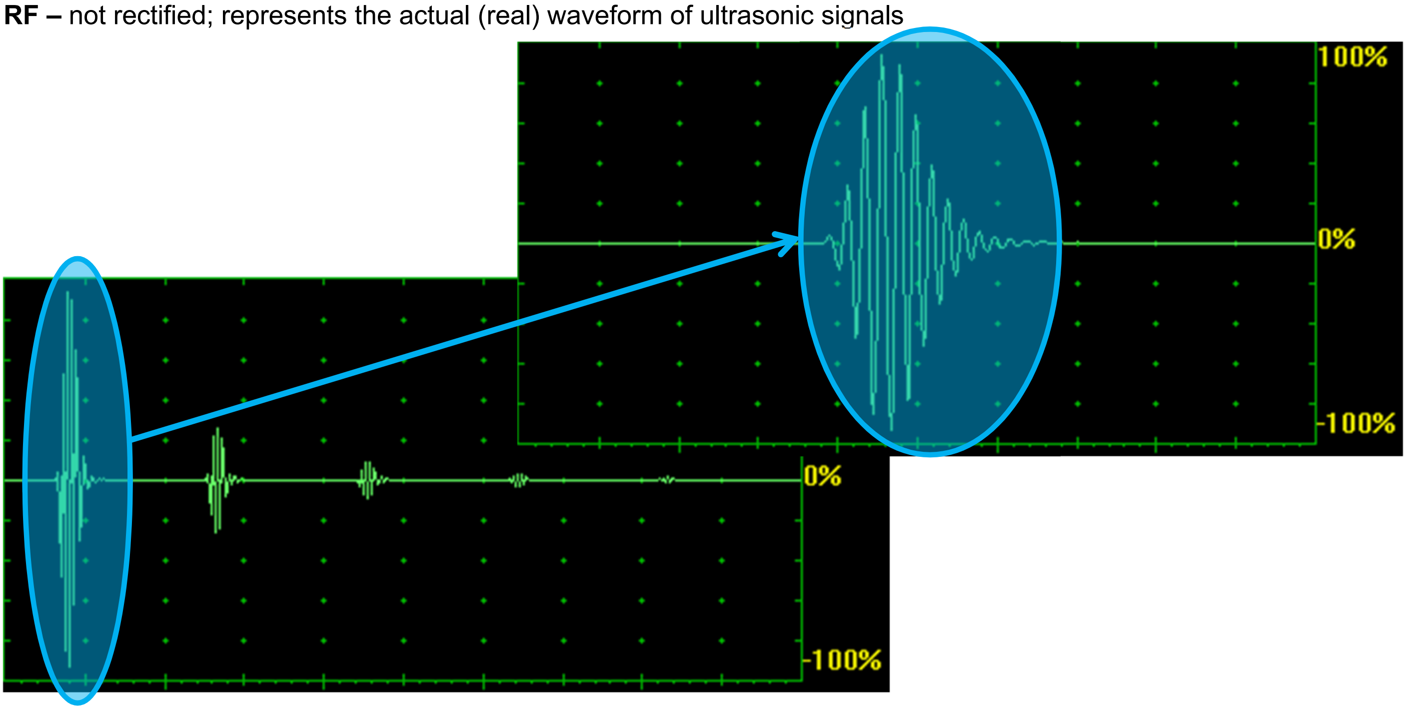


Youtube	Download
https://www.youtube.com/watch?v=zONfhQbCcjU	http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505-Receiver_01.mp4

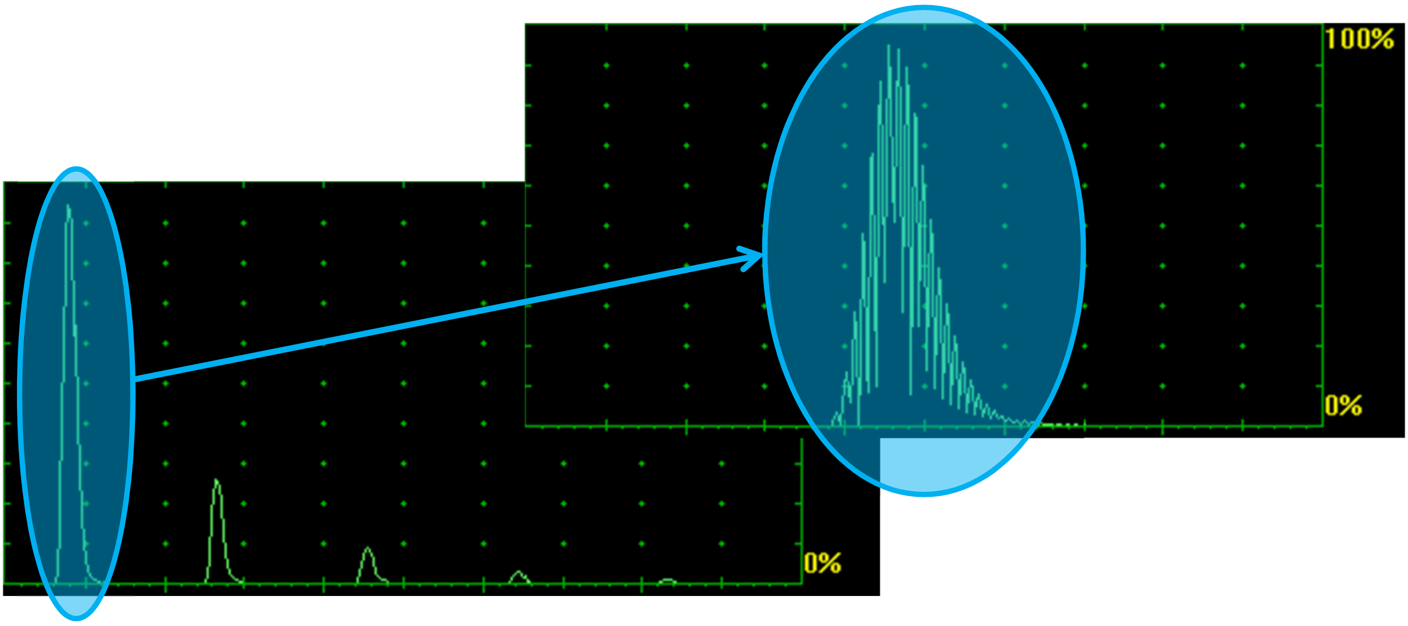
The **Display** settings define the way of signal presentation

<u>Independently on the time base and DAC, TCG settings the ***regular*** ways of the time domain signal presentation may be toggled between:</u>

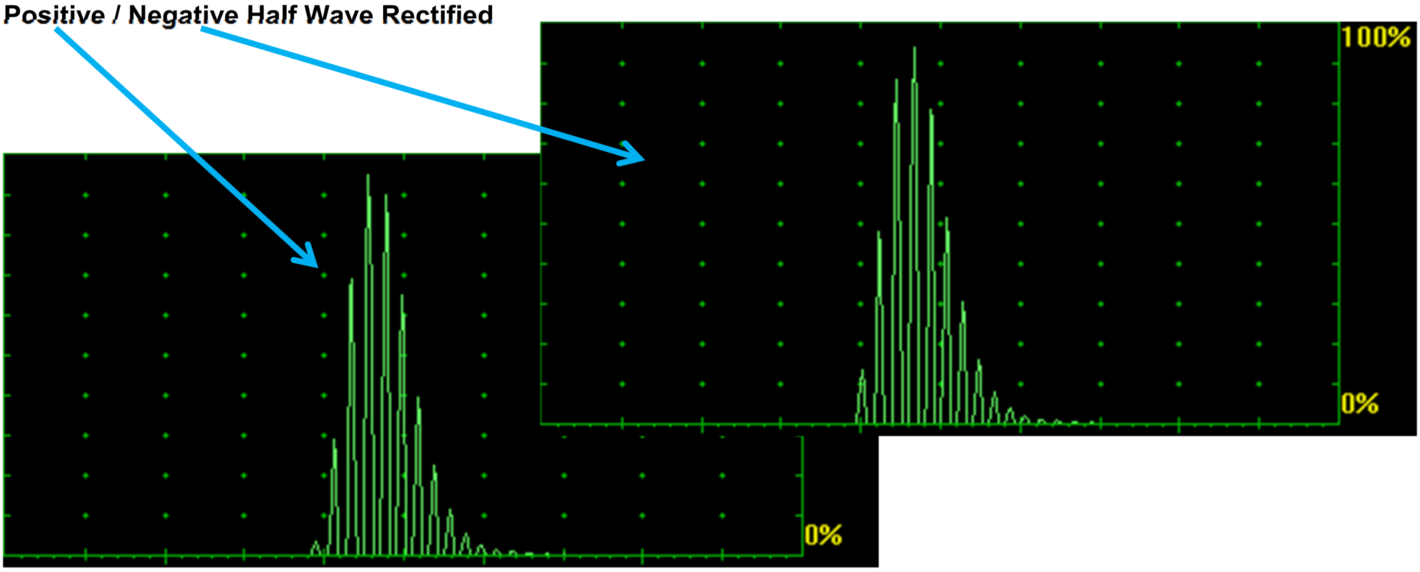
RF – not rectified; represents the actual (real) waveform of ultrasonic signals



Full Wave Rectified

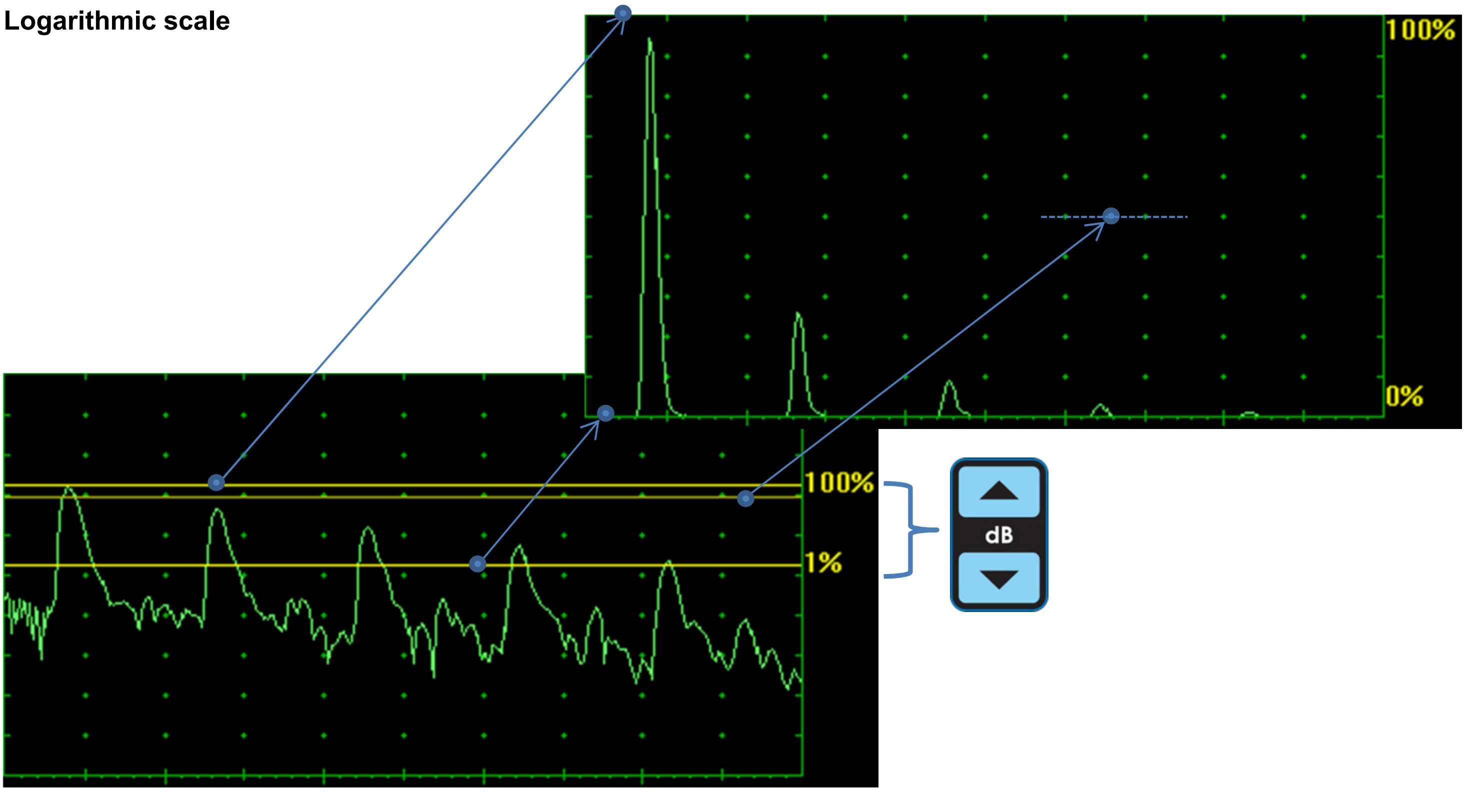


Positive / Negative Half Wave Rectified



The ***special*** ways of the time domain signal presentation

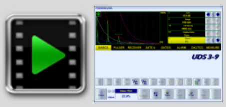
Logarithmic scale



Thanks to keeping the receiver's linearity over 140 dB dynamic range the signals may be presented with the use of *logarithmic scale*; comparing to the linear scale signals presentation the logarithmic scale presentation will not depend on the **Gain** setting, which defines just the position of 3 parallel lines above the logarithmic A-Scan:

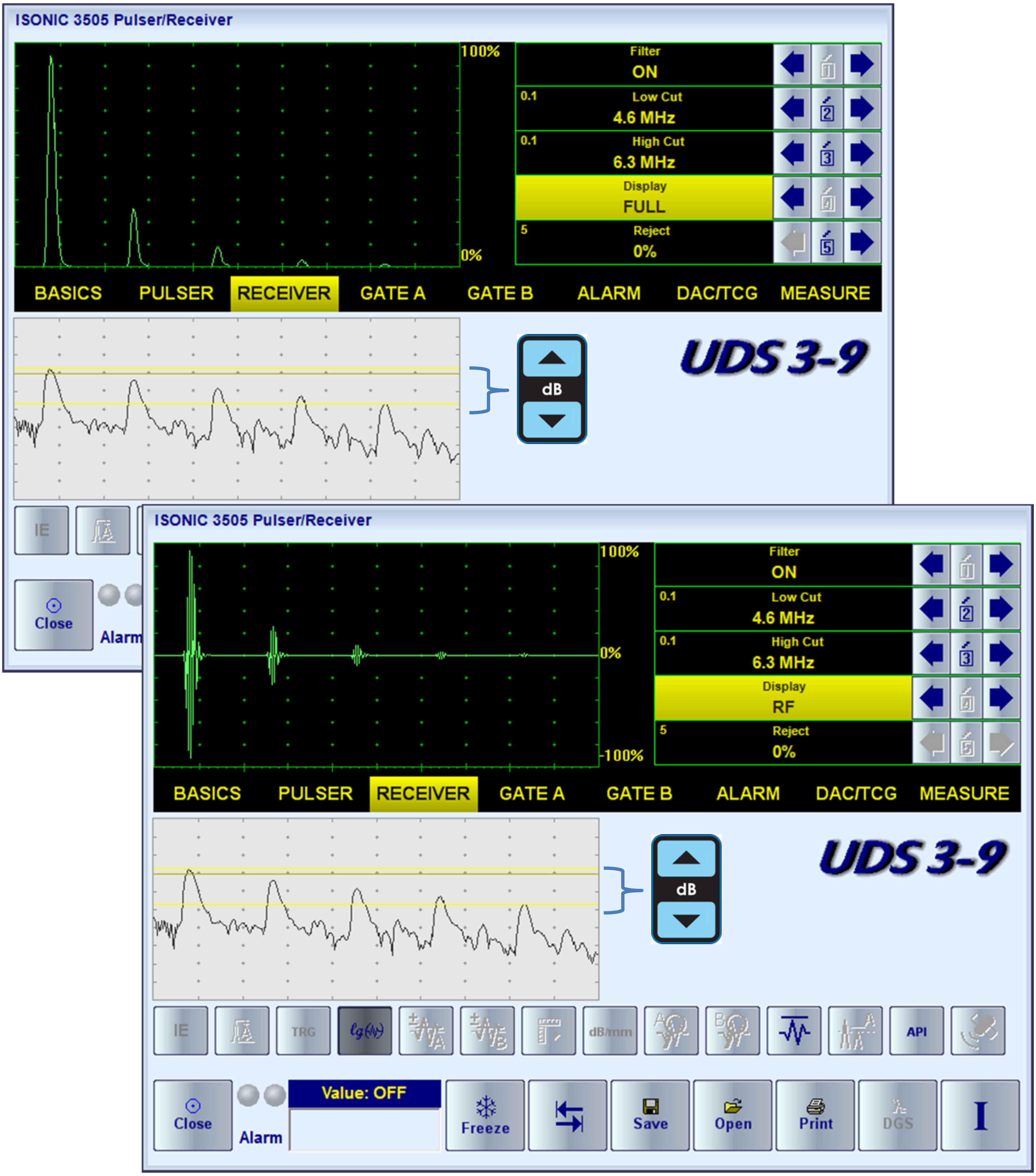
- the upper line corresponds to 100% level of the linear scale A-Scan
- the lower line corresponds to 1% level of the linear scale A-Scan
- the middle (red) line corresponds to 50% level of the linear scale A-Scan

The instrument screen movie illustrates the variability of time domain signal presentation available in the **ISONIC 3505**

	
Youtube https://www.youtube.com/watch?v=aj2TmWGcU-k	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505-Receiver_02.mp4

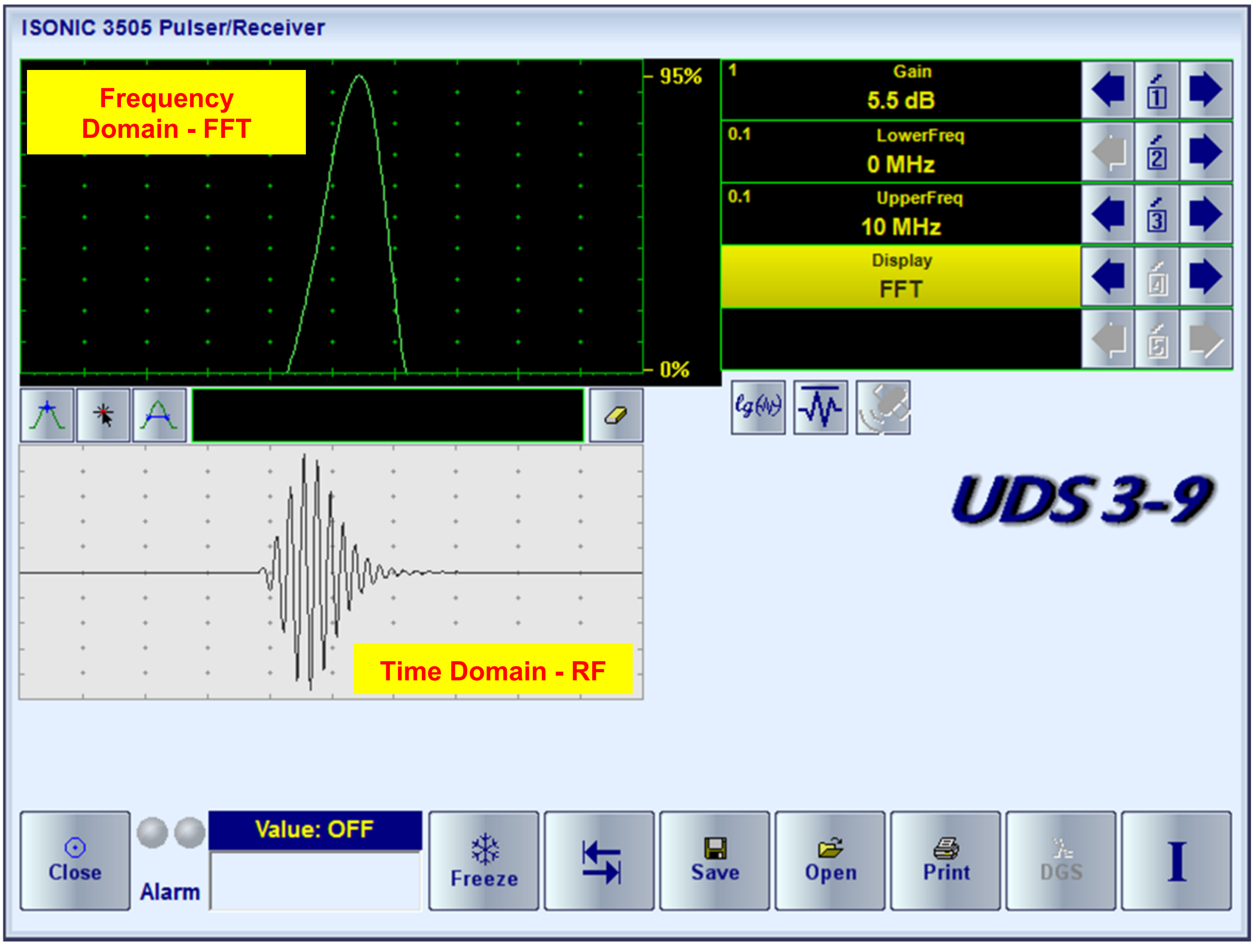
Combined Dual A-Scan (Linear and Logarithmic)

It may be switched ON/OFF through clicking on 

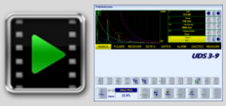


Frequency Domain

The *Frequency domain signal presentation* is available through **FFT** Display mode provided the DAC, DGS, TCG functions are inactive. The **FFT** graph is accompanied with the time domain signal presentation – **RF** mode

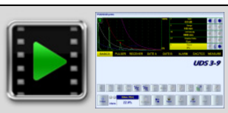


The **FFT** graph may be presented with use of the linear or logarithmic vertical scale – toggled through click on  and evaluated accordingly. The instrument screen movie below illustrates the frequency domain signal presentation and evaluation



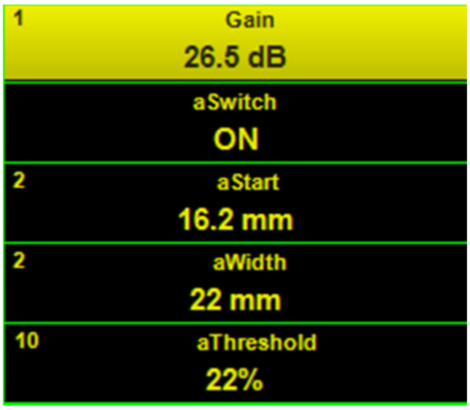
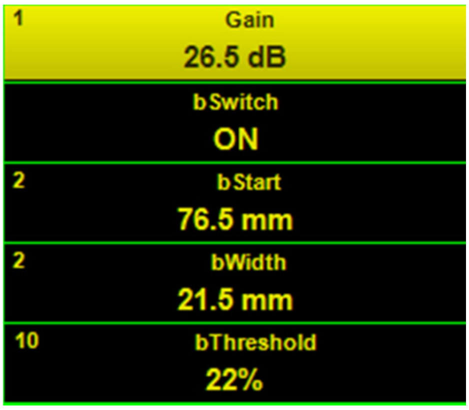
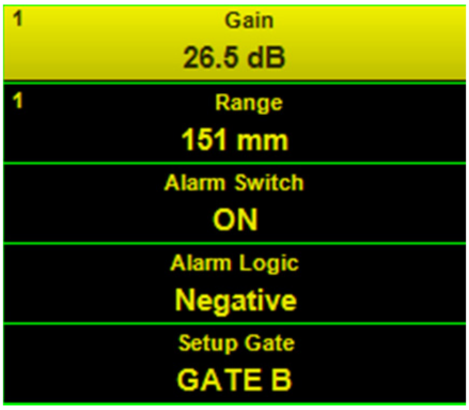
Youtube	Download
https://www.youtube.com/watch?v=9APrOSMUr0A	http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505-Receiver_03.mp4

Thanks to the never-saturated receiver of **ISONIC 3505** the shape of **FFT** graph and the results of related measurements do not depend on **Gain** setting – see the instrument screen movie below

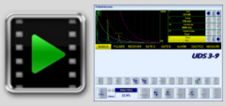


Youtube	Download
https://www.youtube.com/watch?v=pAFWQweVS9M	http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_FFT_GAIN.mp4

5.2.6. Sub Menus GATE A, GATE B, ALARM

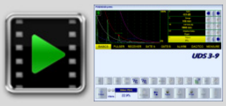
GATE A	GATE B	ALARM
		

The instrument screen movie below illustrates controlling of the **Gates A** and **B**, the **Alarm Logic**, and **Gain per Gate** settled through the controls activated through click on the , buttons

	
Youtube https://www.youtube.com/watch?v=9ZuOQ1FcgF0	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_Gating_01.mp4

Gain per Gate A and **Gain per Gate B** are controllable over the **entire gain manipulation range** from –30 through +110 dB independently on the **Gain** (the global instrument gain) setting: *up to 3 independent gain settings may be acting within the same A-Scan*. The **Gain per Gate** settings have a priority over the **Gain**; in case of the full or partial matching of the **Gate A** and **Gate B** the **Gain per Gate A** setting has a priority

The **Display Delay** and **Range** of the **A-Scan** may be toggled from the default setting to the *Gate zoom* and back through click on the , as it is illustrated by the instrument screen movie below

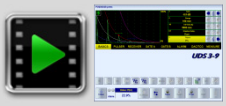
	
Youtube https://www.youtube.com/watch?v=T4nATW5EsC0	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_Gating_02.mp4

5.2.7. Sub Menu DAC / TCG

ISONIC 3505 is featured with 3 ways for creating **DAC**, **TCG**. Independently on the way the **DAC** was created there are provided:

- up to 3 additional curves with the operator's selected *dB-displacement* within **+/-30 dB range**
- positioning of the main and additional **DAC** curves according to the global **Gain** manipulated by an operator
- one-click toggling between **DAC** and *TCG*
- varying *Display Mode* whilst **DAC** or **TCG** is active

The typical manipulations related to the creating a DAC are presented in the instrument screen video below:

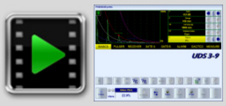
	
Youtube https://www.youtube.com/watch?v=CL9LA2TJLAc	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES\ISONIC_3505/i3505_DAC_TCG.mp4

5.2.7.1. Experimental DAC

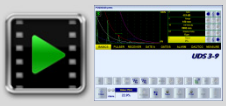
The experimental **DAC** is captured through insonifying the equal reference reflectors through difference material travel distance and storing the sequence of maximized echo

The experimental **DAC** is created through recording as sequence of echoes from the equal reflectors detected through various sound paths; the maximal capacity 40 echoes (points). The user friendly dialogue is combined with the **Gain per Gate A** function bringing each echo maximum in the *Region of Interest* defined by the gate position to the commonly used level of 80...90%% FSH automatically and extremely easing maximizing of each indication taken into the **DAC** without affecting the global **Gain** setting

The video below illustrates creating of the experimental **DAC** for flat bottom hole with use of compression wave straight beam probe

	
Youtube https://www.youtube.com/watch?v=mTGXB6zOoms	**Download** http://www.sonotronndt.com/Movies2/i3505_DAC_Points_Compression_Wave.mp4

The next video illustrates creating of the experimental **DAC** for side drilled hole with use of shear wave angle beam probe

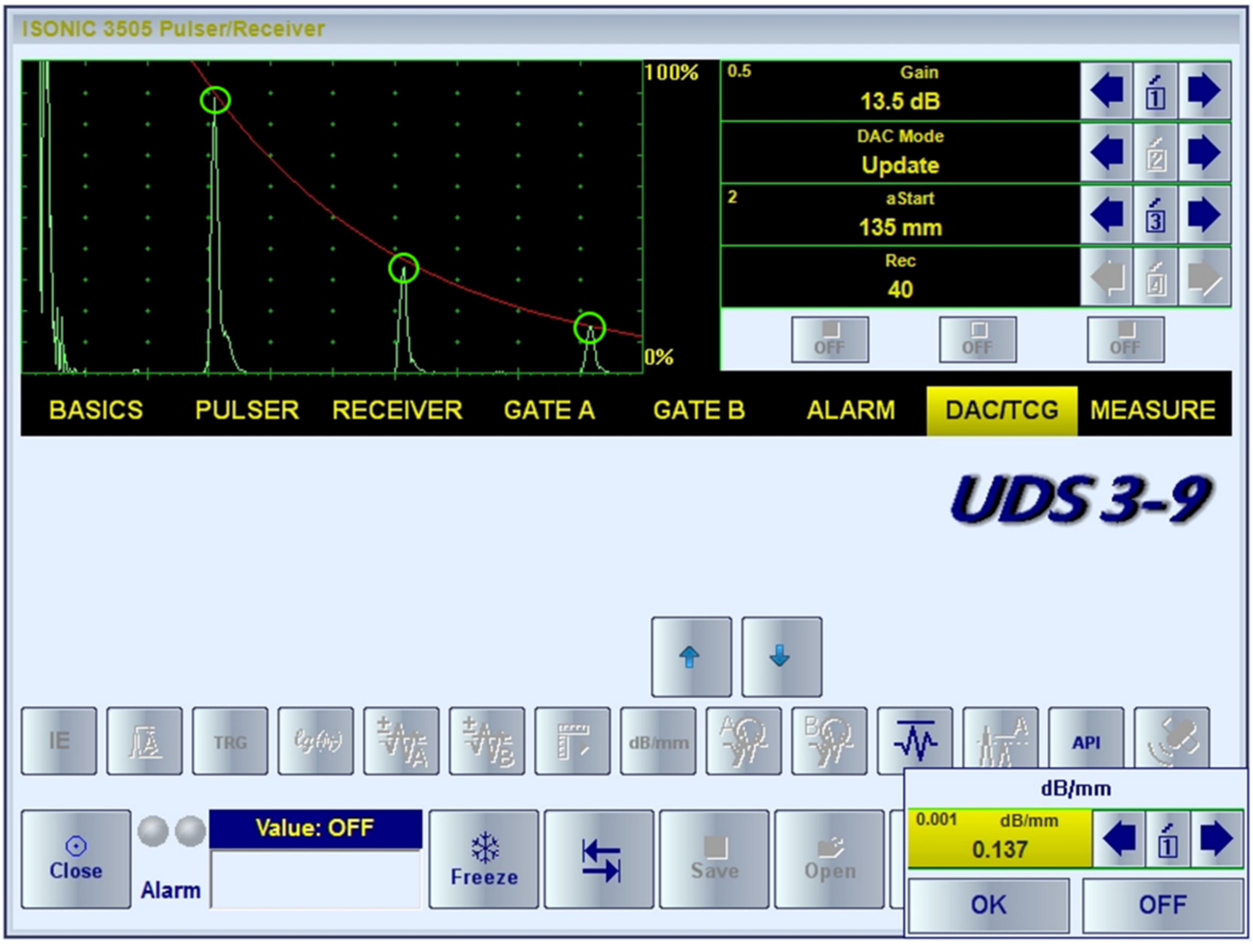
	
Youtube https://www.youtube.com/watch?v=SkAkVWiiKc0	**Download** http://www.sonotronndt.com/Movies2/i3505_DAC_Points_SDH_Shear_Wave.mp4

It is recommended to to settle **Probe Delay** properly prior to creating every new experimental **DAC**

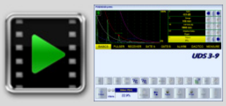
5.2.7.2. Theoretical DAC (dB/mm, dB/inch)

For some applications it may be required to create a **DAC** through entering of the *dB/mm* (*dB/inch*) factor. Usually the back wall echoes are used as reference signals in such cases, at least 2 (two) back wall echoes starting from the first one should be received

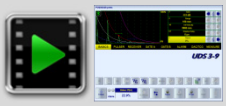
The goal of the calibration is to provide matching the tips of back wall echoes with the **DAC** line. To start the calibration it is necessary to obtain the **A-Scan**, on which the amplitude of the first back wall echo doesn't exceed 100% FSH; along with keying in **dB/mm** (**dB/inch**) factor the **DAC** may be displaced in the vertical direction using  buttons



The exemplary instrument screen movie is available here:

	
Youtube https://www.youtube.com/watch?v=Zt0otRBWcJc	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505-DAC_dB_per_mm_scr.mp4

An example is illustrated by the video below:

	
Youtube https://www.youtube.com/watch?v=xI32e4YfCLs	**Download** http://www.sonotronndt.com/Movies2/i3505_DAC_dB_per_MM.mp4

The **Probe Delay** and **USVelocity** should be settled properly prior to creating every new theoretical **DAC**

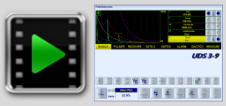
5.2.7.3. DGS

The expandable database for the standard probes is carried by the instrument allowing using of the **DGS** technology for the sensitivity calibration and distance amplitude correction. The calibration is performed in the user friendly dialogue: upon the probe is selected from the database the operator should select the desired inspection sensitivity, key in the reference block and material attenuation. At the next stage the probe should be placed onto the reference block as it is shown on the instrument screen and the reference signal should be maximized upon. The tip of the maximized echo should match with the DAC line corresponding to the maximal echo. The instrument **Gain** will be settled in one click then

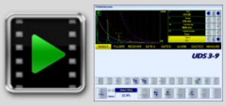
To settle new / update / cancel the **DGS** click on 

The process is illustrated by the videos below

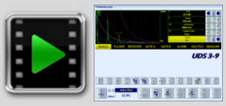
DGS for **MWB-45-4** probe type, settling the sensitivity for 1.5 mm FBH

	
Youtube https://www.youtube.com/watch?v=EIX11dBYcMc	**Download** http://www.sonotronndt.com/Movies2/i3505_DGS_MWB-45-4_1.5_MM_FBH.mp4

DGS for **MWB-60-2** type probe type, settling the sensitivity for 2 mm FBH

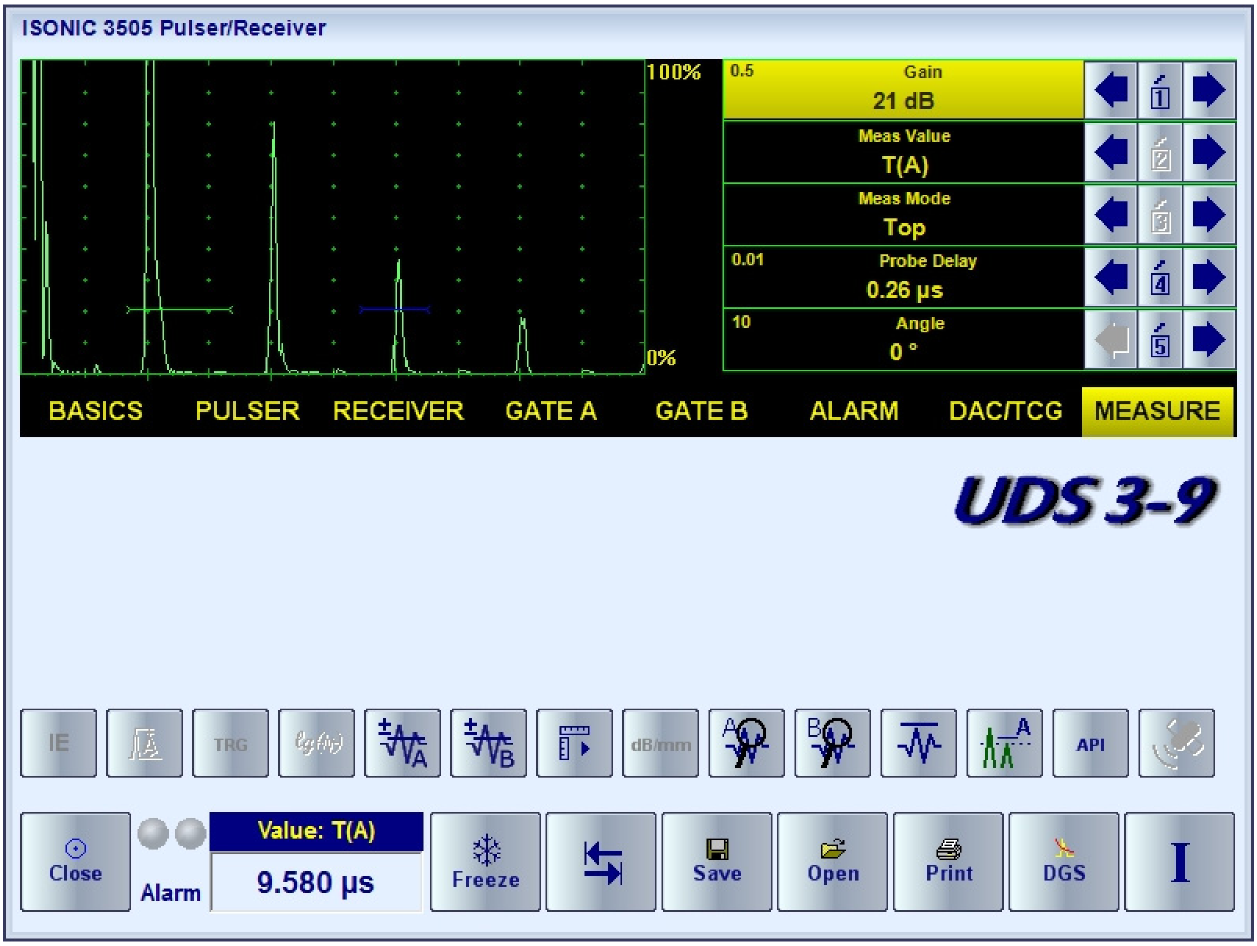
	
Youtube https://www.youtube.com/watch?v=KOgfA8DvICI	**Download** http://www.sonotronndt.com/Movies2/i3505_DGS_MWB-60-2_MM_FBH.mp4

DGS for **SWB-60-5** type probe type, settling the sensitivity for 2.4 mm FBH

	
Youtube https://www.youtube.com/watch?v=V6B2u5HSPu0	**Download** http://www.sonotronndt.com/Movies2/i3505_DGS_SWB-60-5_2.4MM_FBH.mp4

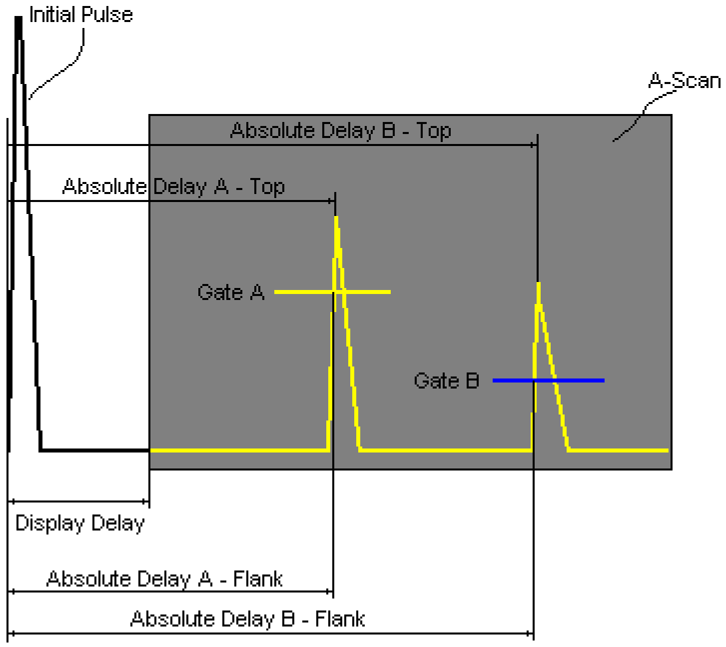
5.2.8. Sub Menu MEASURE

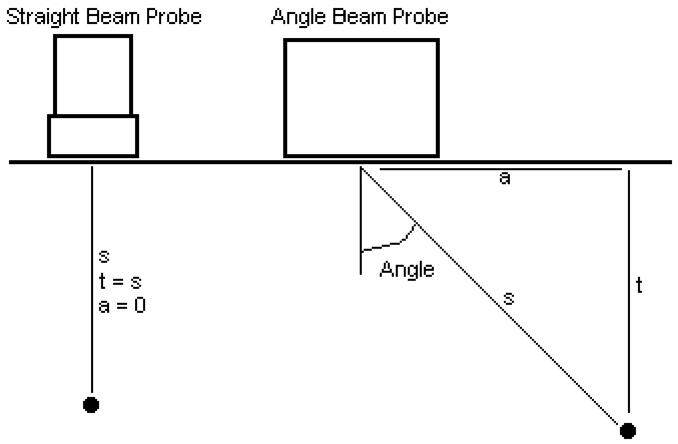
5.2.8.1. Gate Measurements



Meas Value setting indicates the type of measurable value, selected by the operator for the displaying in the **Value** box.

- The list of the values available for the digital d readout is provided below
- The evaluated signal should be gated
- The **Probe Delay**, **USVelocity**, **Angle** should be settled properly prior to taking the readings
- For 2 and more echoes matching with a **Gate** - refer to paragraph 5.2.8.2 of this Operating Manual





Value 1: **T(A)**
Time of Flight - **μs** of the echo matching with the **Gate A** measured with respect to **Probe Delay**:

T(A) = Absolute Delay A - Probe Delay

Value 2: **T(B)**
Time of Flight - **μs** of the echo matching with the **Gate B** measured with respect to **Probe Delay**:

T(B) = Absolute Delay B - Probe Delay

Value 3: **s(A)**
Material Travel Distance - **mm** or **in** of the echo matching with the **Gate A**:

s(A) = ½ · T(A) · US Velocity

Value 4: **s(B)**
Material Travel Distance - **mm** or **in** of the echo matching with the **Gate B**:

s(B) = ½ · T(B) · US Velocity

Value 5: **a(A)**
Projection Distance - **mm** or **in** of reflector returning the echo matching with the **Gate A**, measured with respect to *Beam Incident Point*:

a(A) = s(A) · sin (Angle)

Value 6: **a(B)**
Projection Distance - **mm** or **in** of reflector returning the echo matching with the **Gate B**, measured with respect to *Beam Incident Point*:

a(B) = s(B) · sin (Angle)

Value 7: **t(A)**
Depth - **mm** or **in** of reflector returning the echo matching with the **Gate A**:

t(A) = s(A) · cos (Angle)

Value 8: t(B)
Depth - **mm** or **in** of reflector returning the echo matching with the **Gate B**:

t(B) = s(B) · cos (Angle)

Value 9: ΔT - μs:

ΔT = T(B) – T(A)

Value 10: Δs - **mm** or **in**:

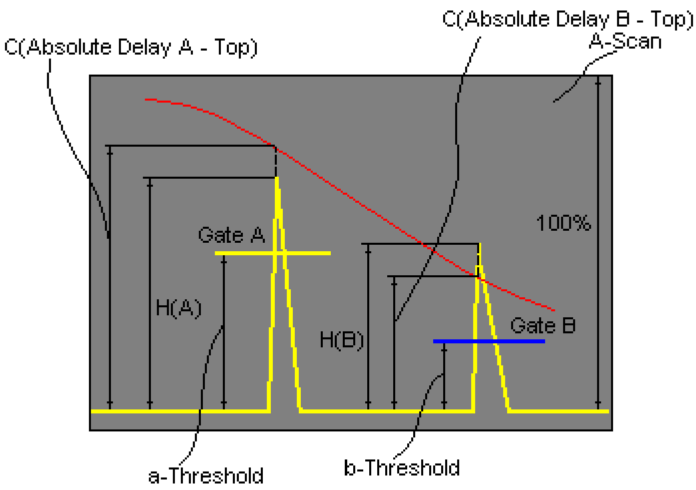
Δs = s(B) – s(A)

Value 11: Δa - **mm** or **in**:

Δa = a(B) – a(A)

Value 12: Δt - **mm** or **in**:

Δt = t(B) – t(A)



Value 13: H(A)
Amplitude - % of A-Scan height of the echo matching with the **Gate A**

Value 14: H(B)
Amplitude - % of A-Scan height of the echo matching with the **Gate B**

Value 15: V(A)
Amplitude - dB of the echo matching with the **Gate A** with respect to **aThreshold**:

$$V(A) = 20 \cdot \log_{10} (H(A) / aThreshold)$$

Value 16: V(B)
Amplitude - dB of the echo matching with the **Gate B** with respect to **bThreshold**:

$$V(B) = 20 \cdot \log_{10} (H(B) / bThreshold)$$

Value 17: ΔV - dB:

$$\Delta V = V(B) - V(A)$$

Value 18: ΔVC(A) (**dB to DAC**) – **dB**:

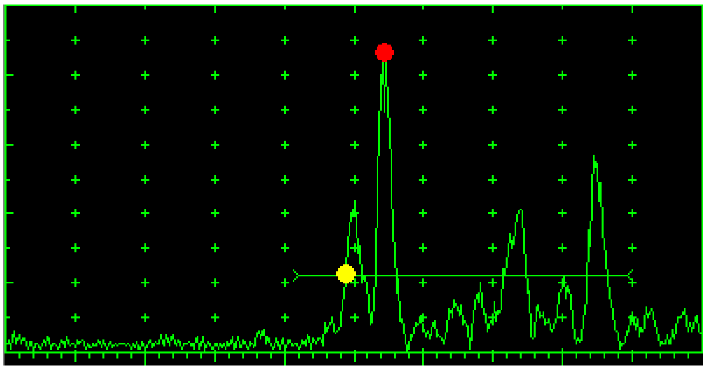
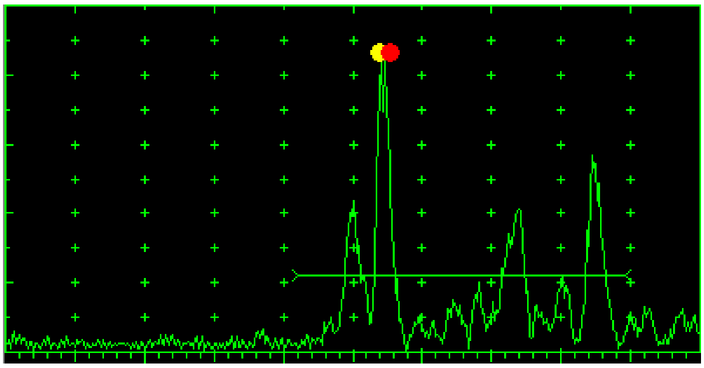
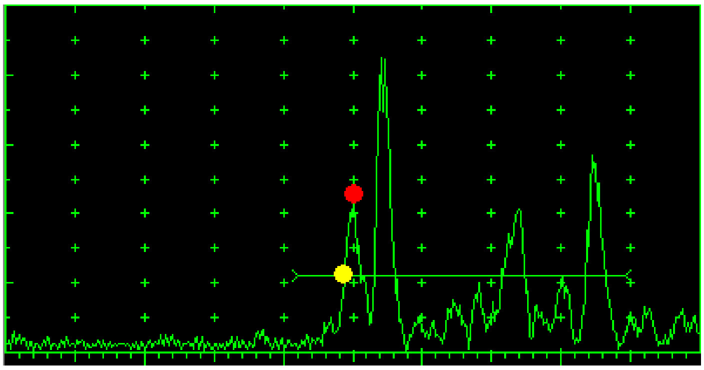
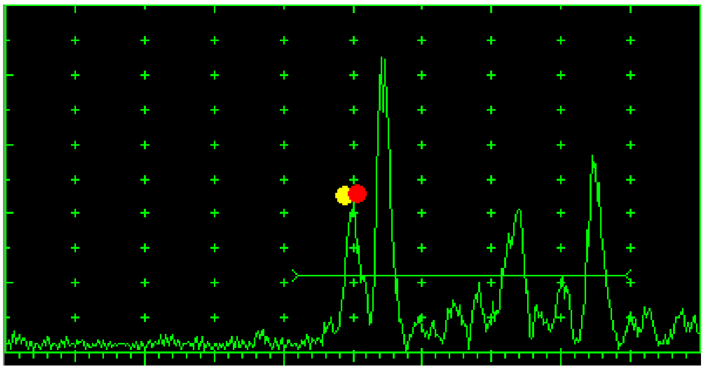
$$\Delta VC(A) = 20 \cdot \log_{10} (H(A) / C (Absolute Delay A\_Top))$$

Value 19: ΔVC(B) (**dB to DAC**) – **dB**:

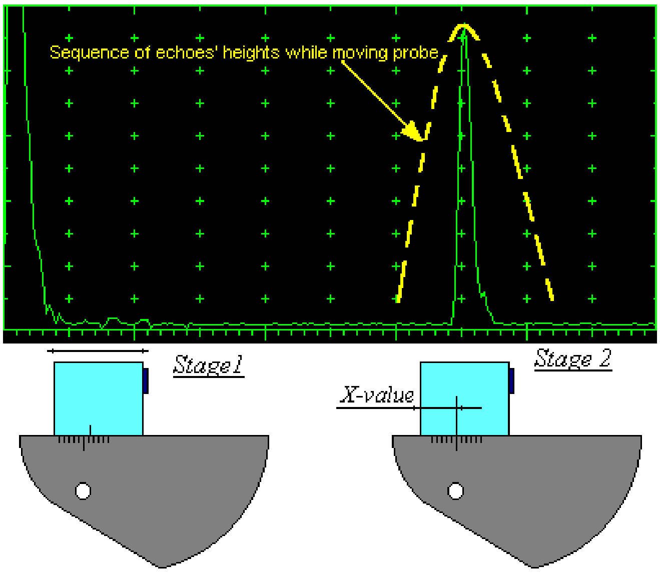
$$\Delta VC(B) = 20 \cdot \log_{10} (H(B) / C (Absolute Delay B\_Top))$$

5.2.8.2. Meas Mode Setting

The table below represents the distinguishing points on an **A-Scan**, which will be taken for automatic measurements depending on **Meas Mode** setting

Meas Mode setting	**A-Scan**
Meas Mode Flank ● - **T(A), T(B), s(A), s(B), t(A), t(B), a(A), a(B), ΔT, Δs, Δt, Δa** ● - **V(A), V(B), H(A), H(B), ΔV, ΔVC(A), ΔVC(B)**	
Meas Mode Top ● - **T(A), T(B), s(A), s(B), t(A), t(B), a(A), a(B), ΔT, Δs, Δt, Δa** ● - **V(A), V(B), H(A), H(B), ΔV, ΔVC(A), ΔVC(B)**	
Meas Mode Flank-First ● - **T(A), T(B), s(A), s(B), t(A), t(B), a(A), a(B), ΔT, Δs, Δt, Δa** ● - **V(A), V(B), H(A), H(B), ΔV, ΔVC(A), ΔVC(B)**	
Meas Mode Top-First ● - **T(A), T(B), s(A), s(B), t(A), t(B), a(A), a(B), ΔT, Δs, Δt, Δa** ● - **V(A), V(B), H(A), H(B), ΔV, ΔVC(A), ΔVC(B)**	

5.2.8.3. Determining Probe Delay – Small Size Shear Wave Angle Beam Probes (contact face width 12.5 mm / 0.5 in or less)



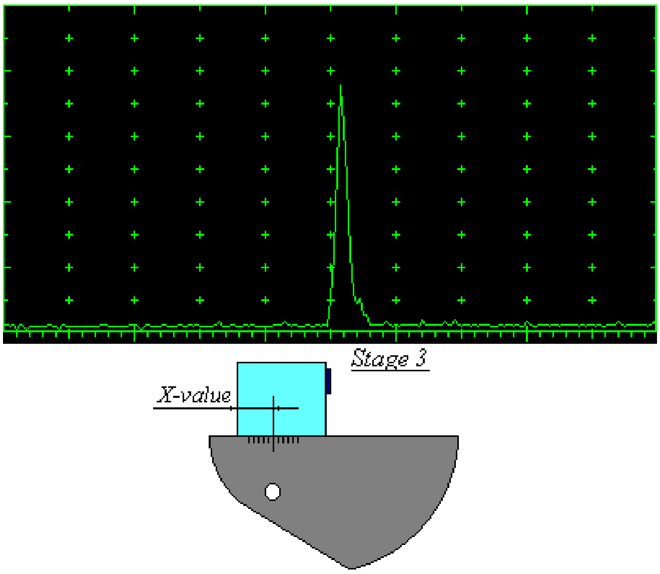
Mandatory settings

- **USVelocity** should be equal to the actual shear wave velocity in the V2 reference standard
- **Range** should be **50 mm** (**0.5 in**)
- **Display Delay** should be **0** **µs**

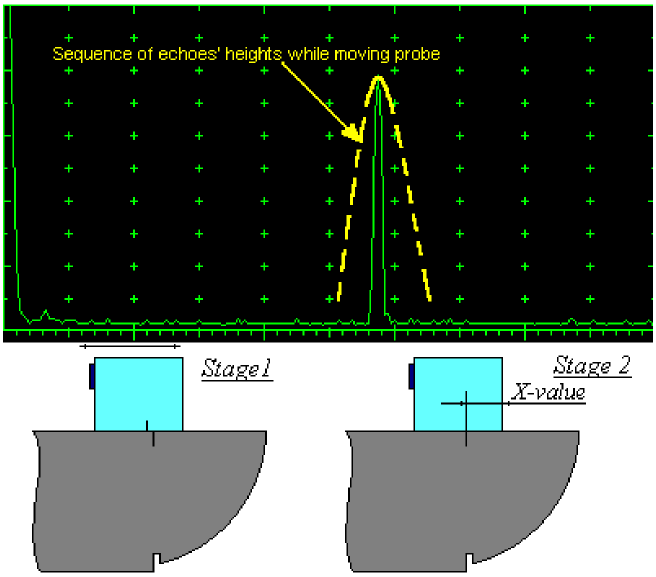
Stage 1: Manipulate probe over the main working surface of the V2 reference standard and maximize echo from 25 mm (1 in) concave radius surface

Stage 2: Fix probe in the found position - the center of 25 mm (1 in) concave radius surface will indicate **incident point** while the distance between probe's frontal edge and **incident point** is equal to **X-Value**

Stage 3: Whilst the probe still remains in the found position manipulate the **Display Delay** setting until settling the rising edge of the maximized echo to the 50%-grid of the **A-Scan** width: the settled *value of* **Display Delay** *will be equal to the actual* **Probe Delay**



5.2.8.4. Determining Probe Delay - Large and Medium Size Shear Wave Angle Beam Probes (contact face width between 12.5 mm / 0.5 in to 25 mm / 1 in)



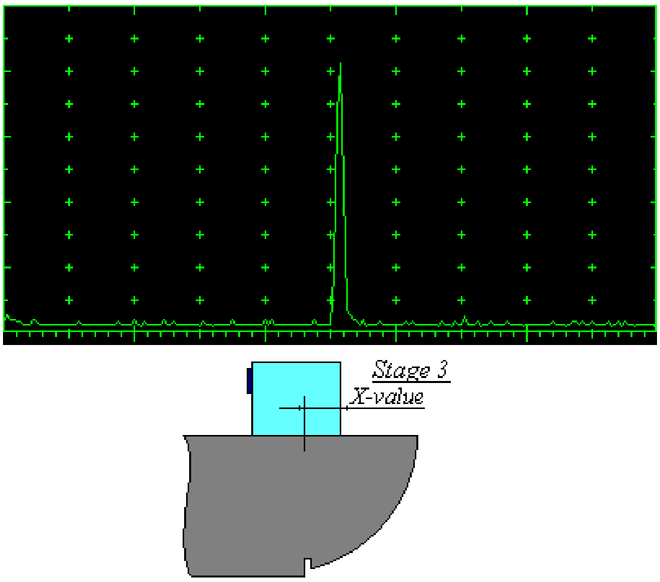
Mandatory settings

- **USVelocity** should be equal to the actual shear wave velocity in the V1 reference standard
- **Range** should be **200 mm** (**8 in**)
- **Display Delay** should be **0** μ**s**

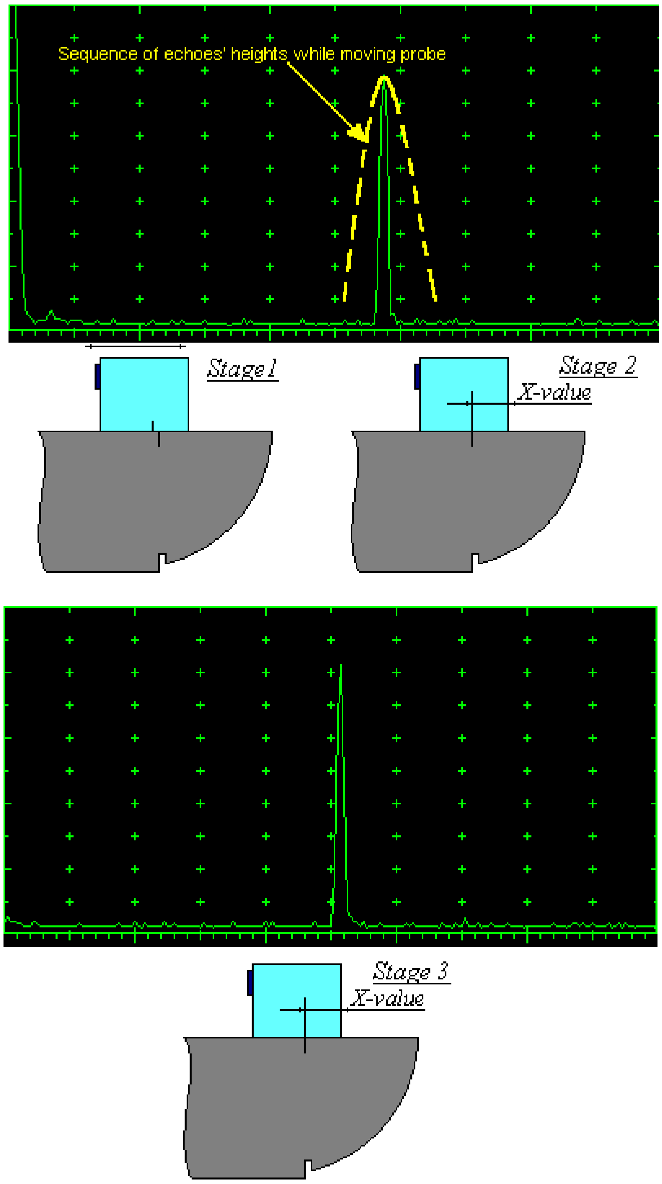
Stage 1: Manipulate probe over the main working surface of the V1 reference standard and maximize echo from 100 mm (4 in) concave radius surface

Stage 2: Fix probe in the found position - the center of 100 mm (4 in) concave radius surface will indicate **incident point** while the distance between probe's frontal edge and **incident point** is equal to **X-Value**

Stage 3: Whilst the probe still remains in the found position manipulate the **Display Delay** setting until settling the rising edge of the maximized echo to the 50%-grid of the **A-Scan** width: the settled *value of* **Display Delay** *will be equal to the actual* **Probe Delay**



5.2.8.5. Determining Probe Delay - Longitudinal Wave Angle Beam Probes (contact face width up to 25 mm / 1 in)



Mandatory settings

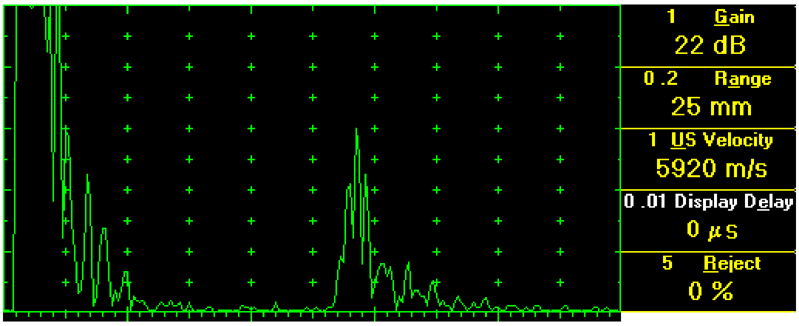
- **USVelocity** should be equal to the actual longitudinal wave velocity in the V1 reference standard
- **Range** should be **200 mm** (**8 in**)
- **Display Delay** should be **0** μ**s**

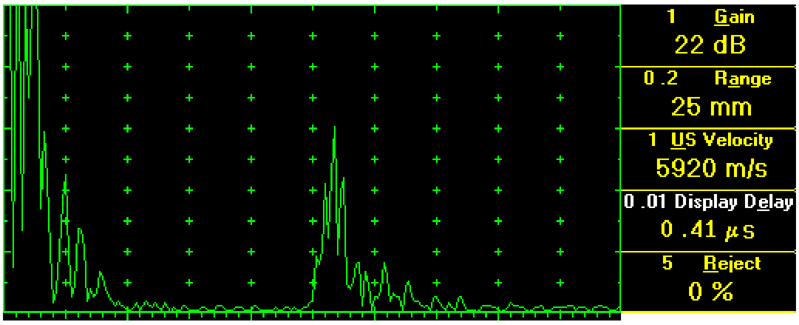
Stage 1: Manipulate probe over the main working surface of the V1 reference standard and maximize echo from 100 mm (4 in) concave radius surface

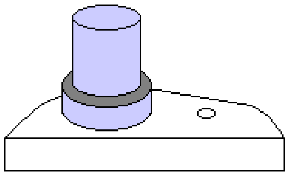
Stage 2: Fix probe in the found position - the center of 100 mm (4 in) concave radius surface will indicate **incident point** while the distance between probe's frontal edge and **incident point** is equal to **X-Value**

Stage 3: Whilst the probe still remains in the found position manipulate the **Display Delay** setting until settling the rising edge of the maximized echo to the 50%-grid of the **A-Scan** width: the settled *value of* **Display Delay** *will be equal to the actual* **Probe Delay**

5.2.8.6. Determining Probe Delay - Straight Beam (Normal) Single Element and Dual (TR) Probes







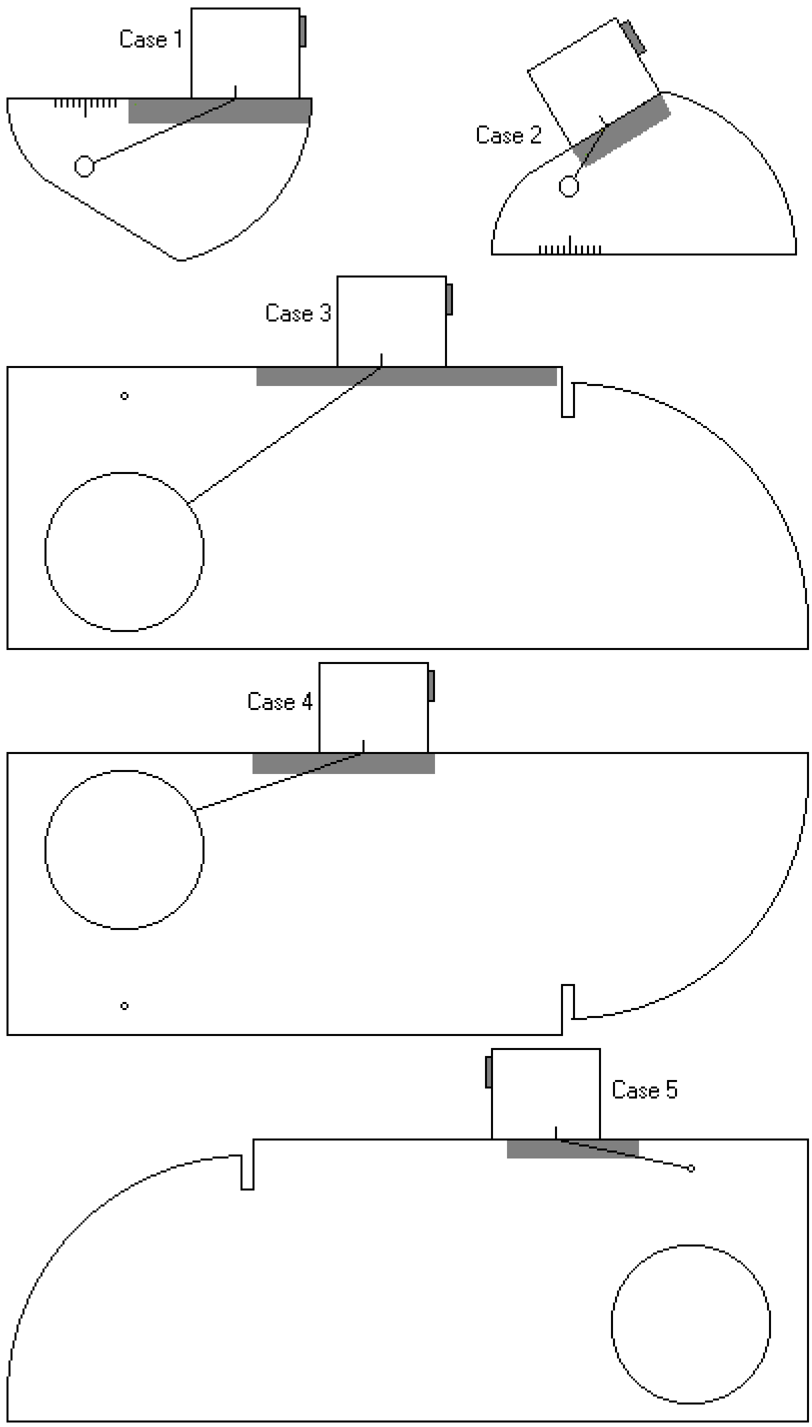
Mandatory settings

- **USVelocity** should be equal to the actual longitudinal wave velocity in the V2 reference standard
- **Range** should be **25 mm** (**1 in**)
- **Display Delay** should be **0 µs**

Stage 1: Apply probe to the side surface of the V2 reference standard to receive the first back wall echo

Stage 2: manipulate the **Display Delay** setting until settling the rising edge of the maximized echo to the 50%-grid of the **A-Scan** width: the settled *value of* **Display Delay** *will be equal to the actual* **Probe Delay**

5.2.8.9. Determining Incidence Angle (Probe Angle)



Determining of the incidence angle is based on the maximizing the side-drilled-hole (SDH) echo and reading the value of the angle from corresponding scale. Depending on probe dimensions and angles there are various reference blocks and scales applicable:

Case 1: Small size shear wave angle beam probe, incidence angle 35^o to 65^o, V-2 reference block

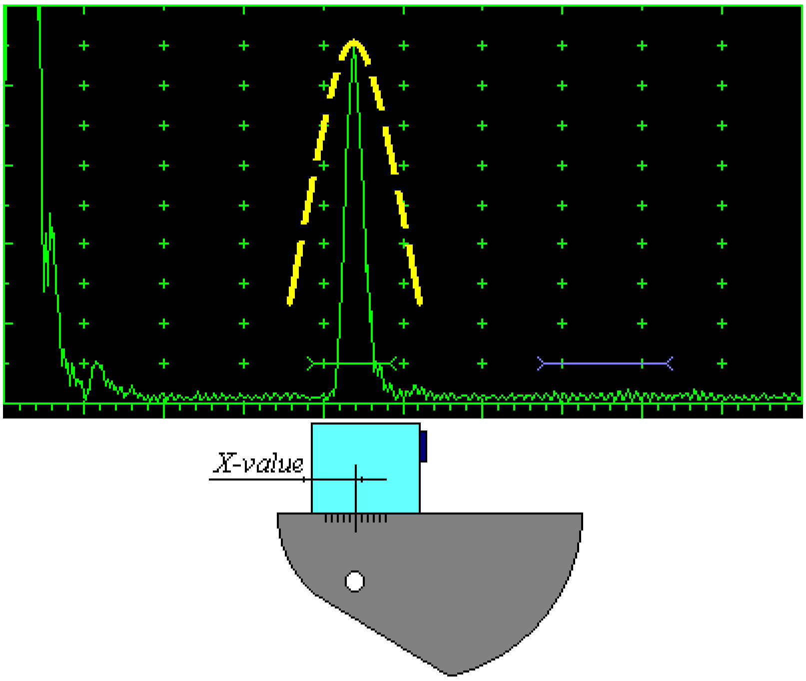
Case 2: Small size shear wave angle beam probe, incidence angle 65^o to 75^o, V-2 reference block

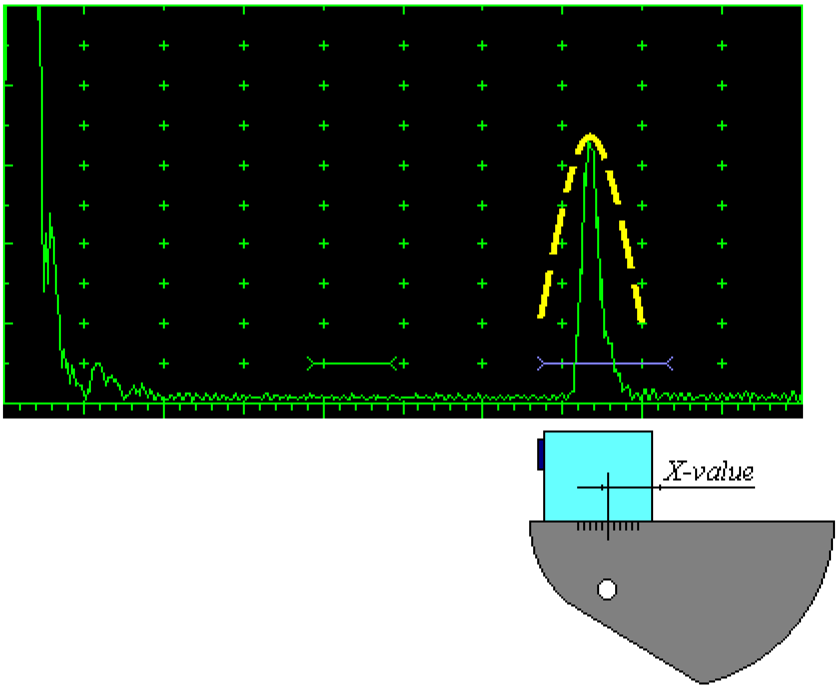
Case 3: Large and medium size shear wave angle beam probes and longitudinal wave angle beam probes, incidence angle 40^o to 66^o, V-1 reference block

Case 4: Large and medium size shear wave angle beam probes and longitudinal wave angle beam probes, incidence angle 60^o to 76^o, V-1 reference block

Case 5: Large and medium size shear wave angle beam probes and longitudinal wave angle beam probes, incidence angle 74^o to 80^o, V-1 reference block

5.2.8.10. Automatic Calibration of Probe Delay and US Velocity – Angle Beam: Example for the Small Size Shear Wave Probe (contact face width 12.5 mm / 0.5 in or less)

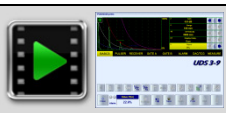




Mandatory settings

- The **Range** and
- **Display Delay** settings should provide the ability to observe the echoes from the close and far reflectors whilst maximizing each of them
- **Meas Mode** should be settled to **Top**
- **Gate A** and **Gate B** should be visible on the **A-Scan** completely
- **Gate A** should end before the **Gate B** starts

To start the calibration click on [icon] then on [2 AUTOCAL] and proceed as it is shown in the screen video below (in the present example the 25 mm and 50 mm concave radius surfaces in the V2 reference block used as the close and far reflector correspondingly):



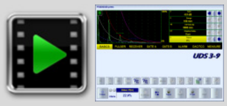
Youtube	Download
https://www.youtube.com/watch?v=ljpq3dv8f9A	http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_AUTOCAL_V2_SHEAR.mp4

5.2.8.11. Automatic Calibration of the Probe Delay and US Velocity – Straight Beam: Example for the Dual (TR) Probe

Mandatory settings

- The **Range** and
- **Display Delay** settings should provide the ability to observe the first and second back wall echoes
- **Meas Mode** should be settled to **Top**
- **Gate A** and **Gate B** should be visible on the **A-Scan** completely
- **Gate A** should end before the **Gate B** starts

To start the calibration click on  then on  and proceed as it is shown in the screen video below (in the present example the first and second back wall echo from the side surface of the V2 reference block used as the close and far reflector correspondingly):

	
Youtube https://www.youtube.com/watch?v=DykbYAscJoE	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_AUTOCAL_V2_TR_LONG.mp4

5.2.8.12. Angle Beam Probes – Thickness / Skip / Curved Surface Correction

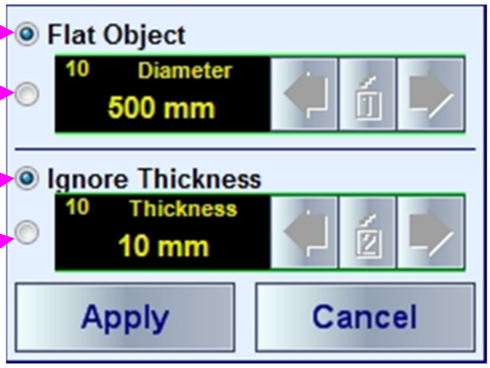
Set the **Angle** to the actual incidence angle value and click on  then on 

The shape of the material surface may be designated as

- **Flat** – click here
  Or
- **Curved** – click here

Whilst evaluating the reflectors depth the thickness of the material may be

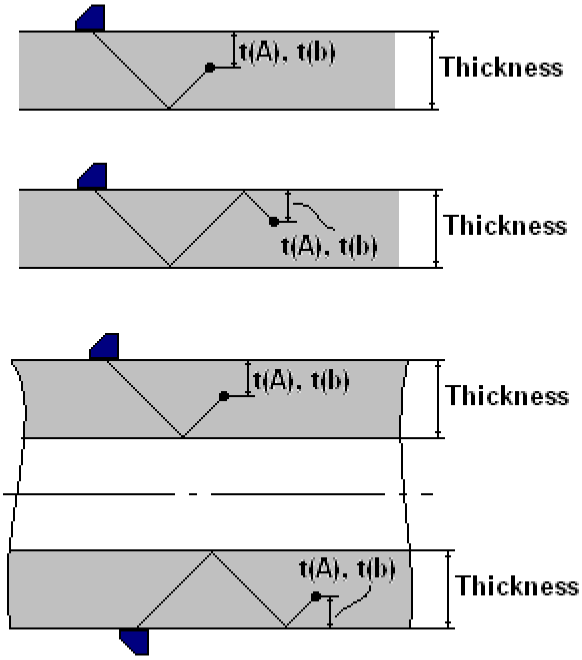
- **Ignored** – click here
  Or
- **Considered** – click here

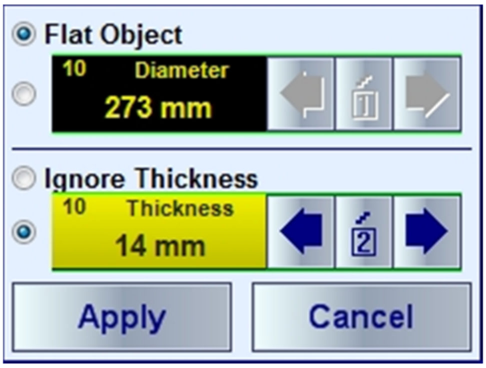


Case 1

Case 1 relates to the flat surface and semi-infinite volume of the material. In such case the depth **t(A)**, **t(B)** will be determined according to the paragraph 5.2.8.1

Case 2 represents the inspection of plates or tube walls in the longitudinal direction. The actual depth readings **t(A)**, **t(B)** will be provided for the half-, full-, multi-skip upon the actual **Thickness** of the material is entered:





Case 2

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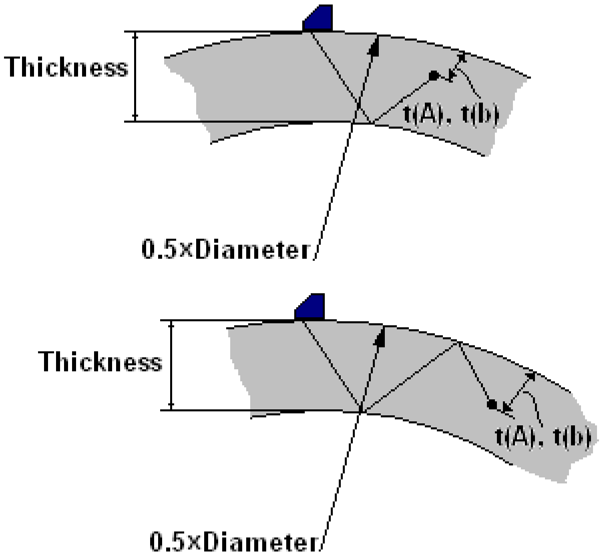
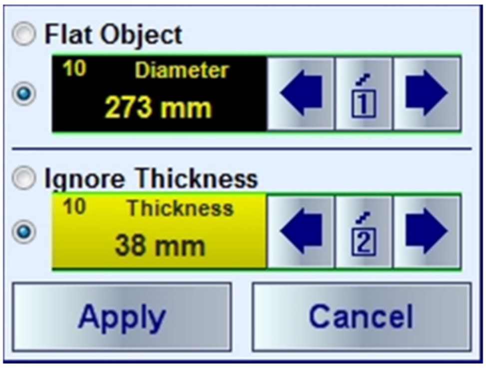
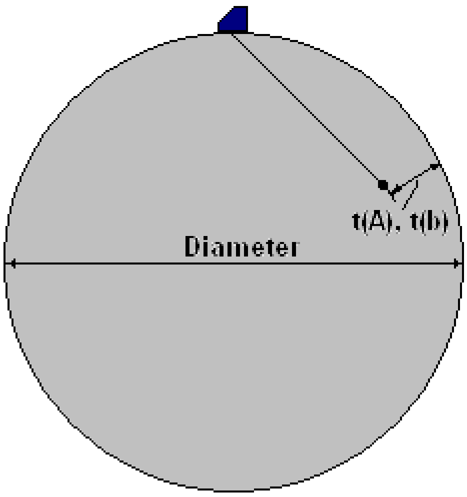
Case 3 represents the inspection of tubes in circumferential direction, The actual depth readings **t(A)**, **t(B)** will be provided for the half-, full-, multi-skip upon the actual **Thickness** and OD (Outside **Diameter**) are entered:

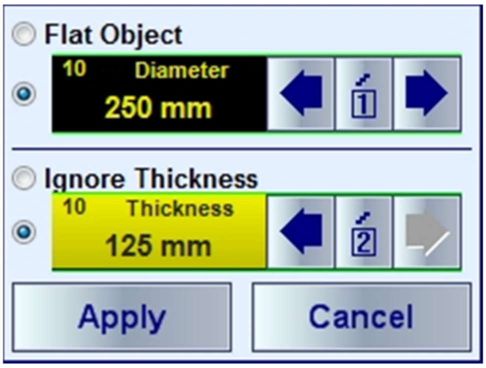




Case 3

Case 4 represents the inspection of cylindrical rods in circumferential direction, The actual depth readings **t(A)**, **t(B)** will be provided upon the actual **Diameter** is entered and the thickness is settled as **0.5**X**Diameter**:

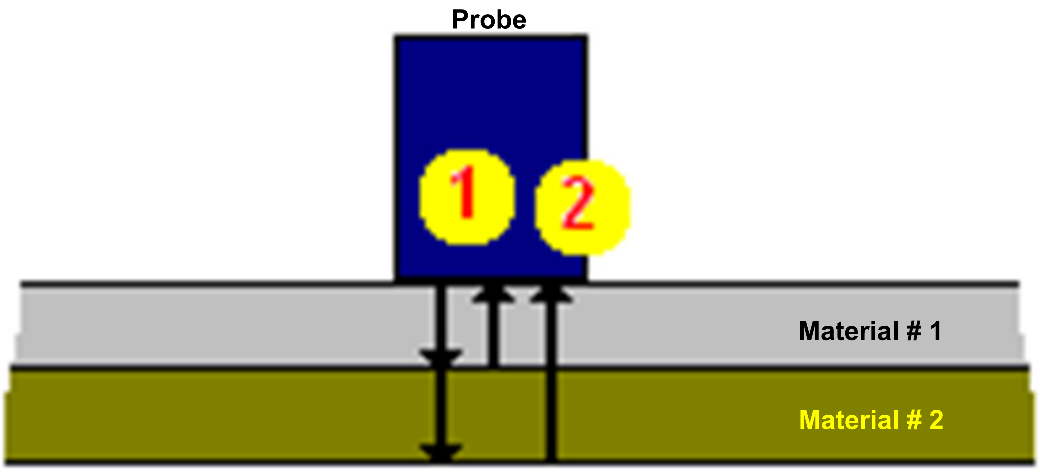




Case 4

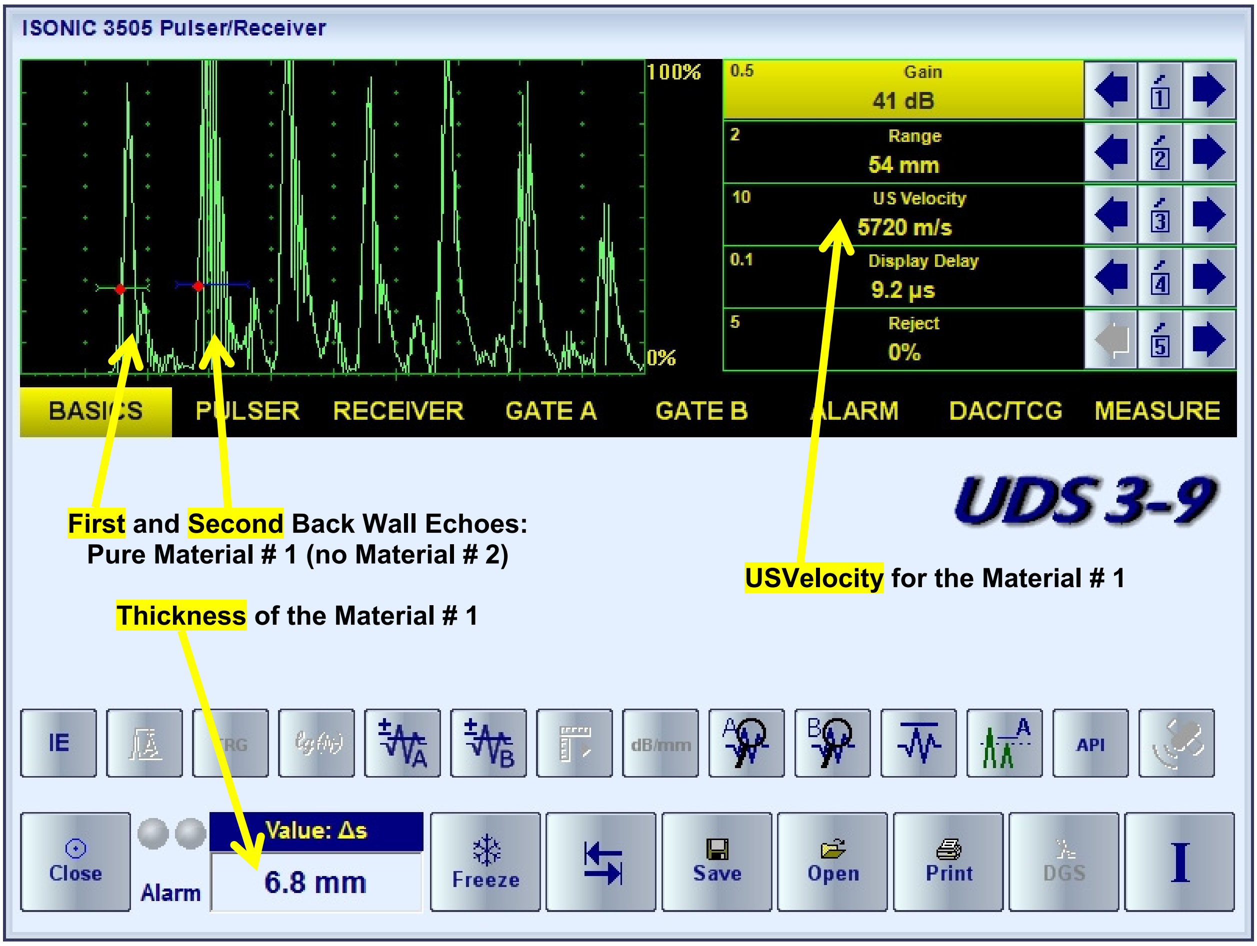
5.2.8.13. Dual Ultrasound Velocity Measurement Mode

Sometimes it may be necessary to measure the sound path distances in the dissimilar materials bonded to each other

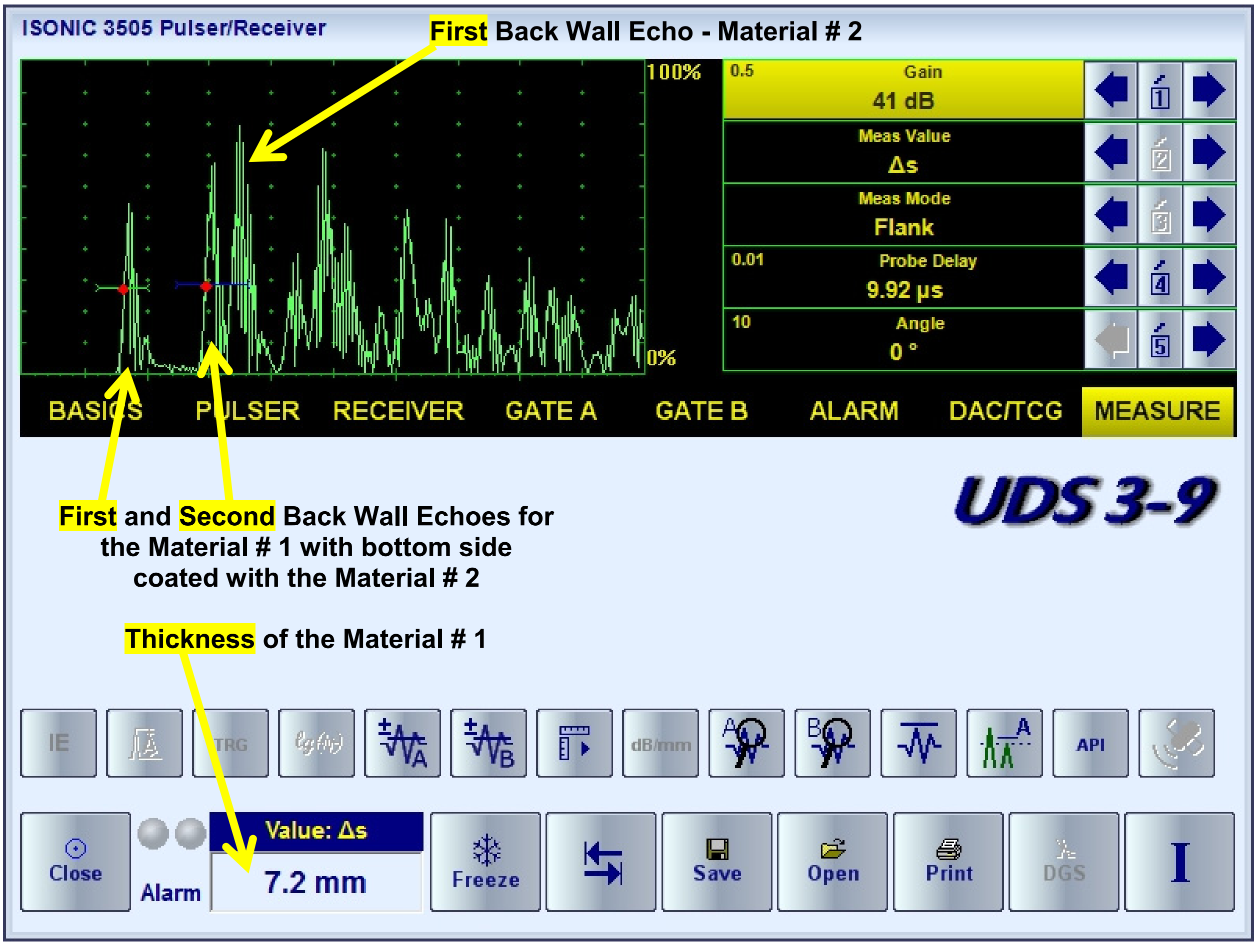


The typical instrument screen shots are presented below:

Screen # 1



Screen # 2

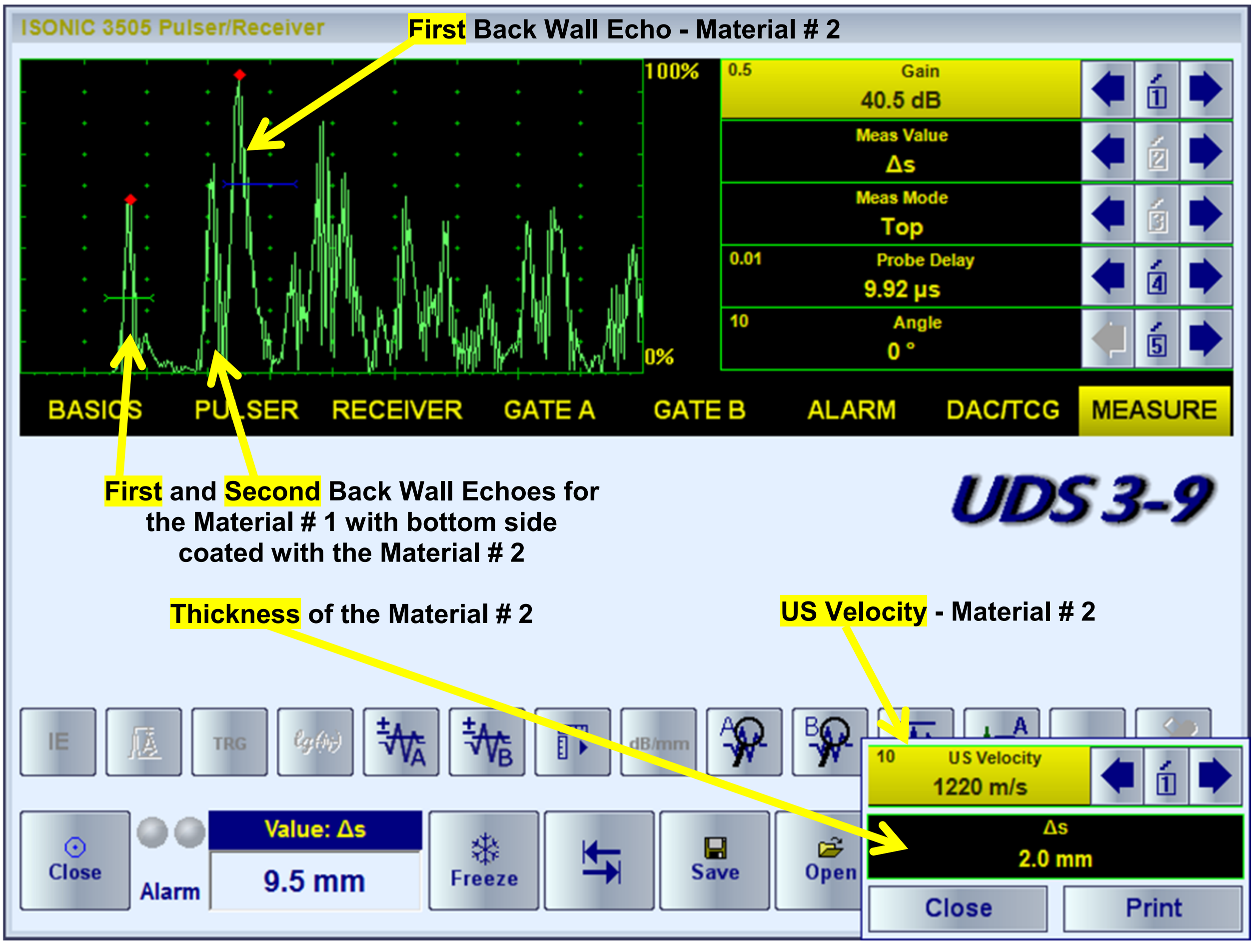


On obtaining *Screen # 2*

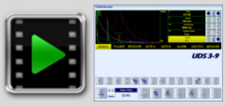
- set **Meas Mode** to **Top**
- set **Angle = 0°**
- cover the first back wall echo from the Material # 2 with the **Gate B**
- click on  then on 

- enter the **US Velocity** for the Material # 2 and take the digital readout upon

Screen # 3



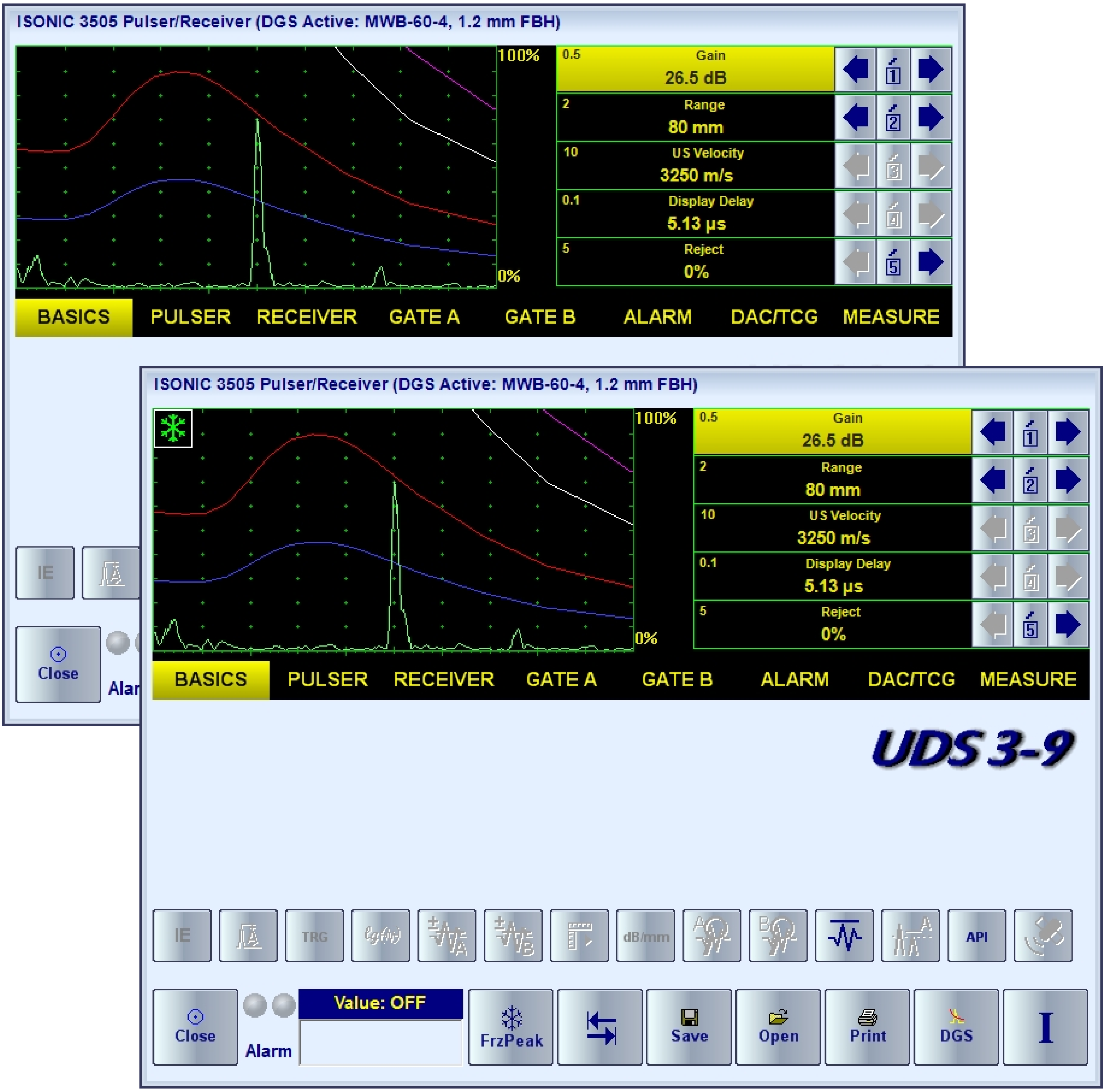
The corresponding instrument screen video:



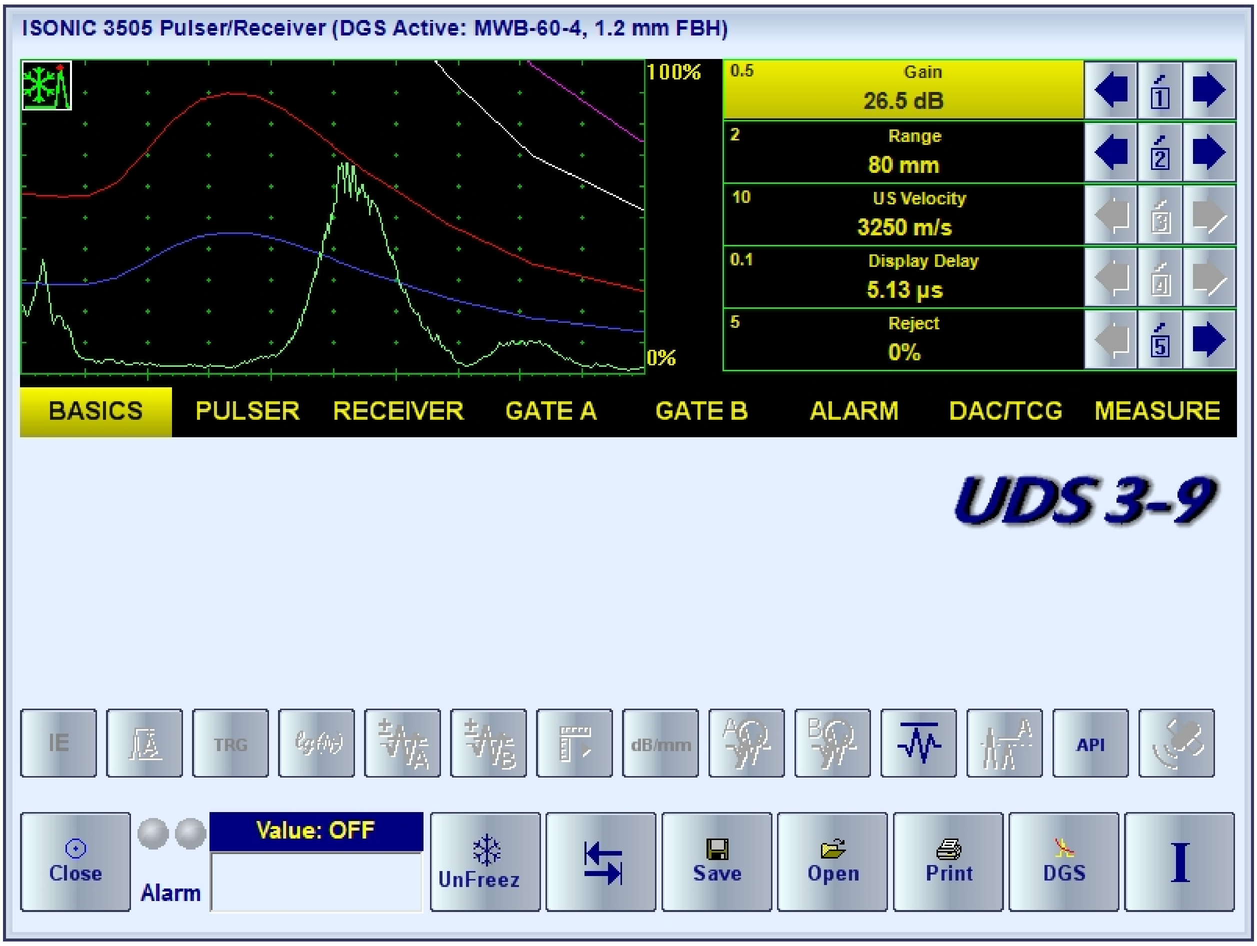
Youtube	Download
https://www.youtube.com/watch?v=fmkUw46QiDM	http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_DUAL_US_VEL.mp4

5.2.9. Freeze A-Scan / FFT Graph

To freeze the live **A-Scan / FFT Graph** click on  or press 

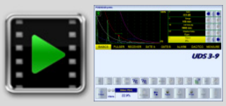


Whilst the rectified signals are presented on the A-Scan the next click on FrzPeak or pressing ❄ will enter into the **Freeze Peak** mode allowing the recording of the signal peak envelope through the scanning over indication:



The next click on UnFreez or pressing ❄ will return to the live **A-Scan / FFT Graph**

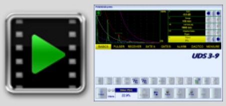
The instrument screen video illustrating Freeze / Freeze Peak / Unfreeze is available under the links below:

	
Youtube	**Download**
https://www.youtube.com/watch?v=tkx2uRQyNsI	http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_Frz_FrzPk.mp4

5.2.10. Zoom A-Scan / FFT Graph

Double click on **A-Scan / FFT Graph**

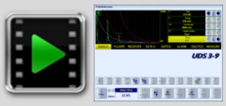
The illustrating video is available under the links below:



Youtube	Download
https://www.youtube.com/watch?v=tjCHK_EJ-yY	http://www.sonotronndt.com/Movies1/3505_ZOOM_A_SCAN.mp4

5.2.11. Normalized A-Scan

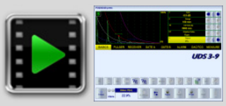
For some inspection applications it may be very useful keeping some reference signal at the desired standard level whilst scanning OR bring the signal obtained from the certain region of interest defined by the **Gate A** to the standard level. The example of using the ***normalized A-Scan*** allowing bringing of the signal from the discontinuity to the desired standard level is illustrated by the video below. The ***normalized A-Scan*** is used at parallel with the regular:



Youtube	Download
https://www.youtube.com/watch?v=lkv10ZsiOFk	http://www.sonotronndt.com/Movies3/TRAINING_MOVIES\ISONIC_3505/NORM_A_SCAN.mp4

5.2.12. Interface Echo

Usually for the immersion inspection it is necessary to start **A-Scan** upon receiving the interface chow from the material surface – for that purpose the instrument is featured with the **IE** (interface echo) gate that should be settled appropriately: the first signal crossing the **IE** gate level initiates the new **A-Scan** resettling the **Display Delay** accordingly following probe to material distance in real time. The process is illustrated by the video below



Youtube	Download
https://www.youtube.com/watch?v=rgnXnVNG4wY	http://www.sonotronndt.com/Movies3/TRAINING_MOVIES\ISONIC_3505/i3505_IE.mp4

5.2.13. Save / Open the instrument settings and corresponding A-Scan / FFT data into / from a file

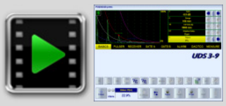
To save file comprising the **UDS 3-9 Pulser Receiver** settings accompanied with **A-Scan** or **A-Scan + FFT** graph data click on Save or press

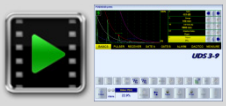
There are two types of files that may be created:

- the regular file of **.PRMS** type, which comprises the instrument settings and corresponding **A-Scan** or **A-Scan + FFT** graph. Which may be used for reporting or for being a source for the next setup of the instrument in the future
- the template file of **.PRMT** type, which comprises the instrument settings and corresponding **A-Scan** or **FFT** graph in the form of graphic template. On storing the template file the user is proposed to select a color of the wave form, which will be used then upon uploaded as the background reference whilst reproducing the live **A-Scan** or **FFT** graph. There are up to 3 **A-Scans** or **FFT** graphs stored into the same template file. Using a template allows easy and quick distinguishing between the reference data and evaluated sample

To upload the instrument settings along with the corresponding **A-Scan** or **A-Scan + FFT** graph OR **Template** image click on Open or press

The videos below illustrate the above based on the examples of creating and using of the template files

	
Youtube https://www.youtube.com/watch?v=m5R5hnInUYo	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES\ISONIC_3505/TMPLT01.mp4

	
Youtube https://www.youtube.com/watch?v=z-FXEC6seXM	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES\ISONIC_3505/TMPLT02.mp4

5.2.14. Activate Main Recording Menu

Click on I or press I on the front panel keyboard. Refer to Chapter 6 of the present Operating Manual for further instructions

5.2.15. Switch OFF UDS 3-9 Pulser Receiver

To switch OFF **UDS 3-9 Pulser Receiver** click on Close or press ESC on the front panel keyboard

6. Recording and Imaging

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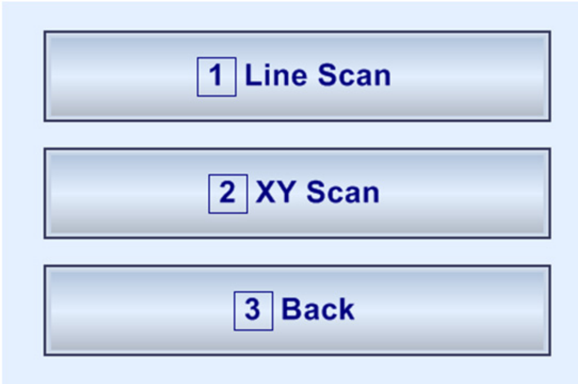
6.1. Main Recording Menu

Main Recording Menu is shown below:



Line scanning and recording ability is the standard feature of the **ISONIC 3505** instrument, to enter into which click on 

or press 

XY scanning and recording ability comprises several options, each requiring the use of the appropriate accessories and optional software available after purchasing of the corresponding license code, on getting the said accessories and obtaining the license code(s) click on 

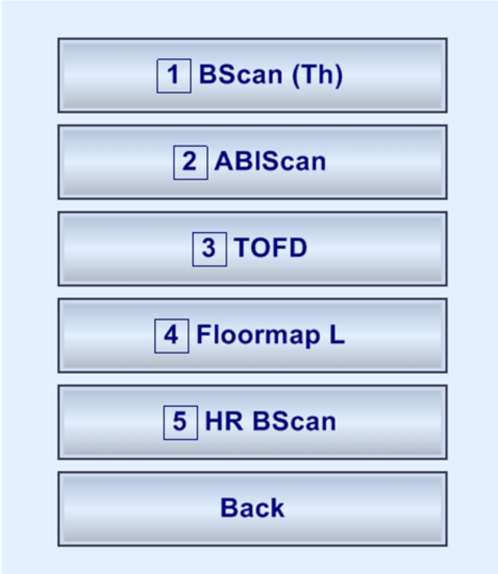
or press 

To return to the pure **A-Scan** or **A-Scan + FFT** mode of operation click on 

or press 

or 

6.2. Line Scanning and Recording Menu



Line Scanning and Recording Option	*Description*	*To start*
BScan (Th)	***Thickness B-Scan*** inspection, imaging, and recording	Click on [1 BScan (Th)] or press 1
ABIScan	***True-to-Geometry Flaw Detection B-Scan*** inspection, imaging, and recording with use of the straight and angle beam probes	Click on [2 ABIScan] or press 2
TOFD	***TOFD inspection*** of welds ***CHIME screening*** for the corrosion damages	Click on [3 TOFD] or press 3
Floormap L	***Short Range Guided Wave (SRUT)***, ***Surface Wave***, ***Angle Beam*** inspection with the ***Top View CB-Scan*** imaging and recording	Click on [4 Floormap L] or press 4
HR BScan	***High Resolution B-Scan*** inspection, imaging, and recording	Click on [5 HR BScan] or press 5

To return to the **Main Recording Menu** click on or press ESC

6.3. BScan(Th) - Thickness B-Scan inspection, imaging, and recording

6.3.1. Mandatory and optional settings of the UDS 3-9 Pulser Receiver

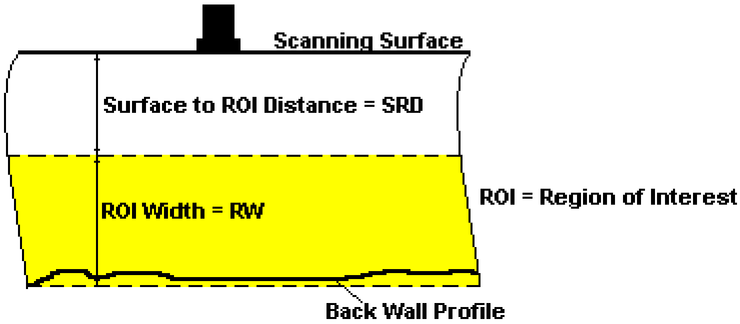
UDS 3-9 Pulser Receiver window – main operating surface screen appears upon clicking on 1 BScan (Th) or pressing 1

The following mandatory settings should be clarified in the inspection procedure and provided:

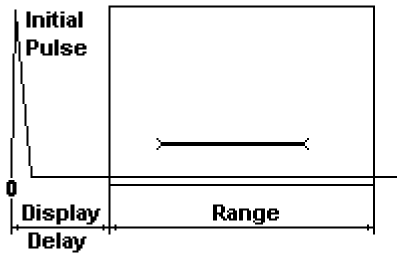
#	*Parameter or Mode*	*Submenu*	*Required Settings*	*Note*
1	**aSwitch**	**GATE A**	**ON**	
2	**Gain** **aThreshold**	**BASICS** **GATE A**	**Gain** and **aThreshold** settings to provide receiving an echo from the reflector representing the minimal area of thickness degradation to be detected, usually – FBH (flat bottom hole) of the given diameter; the height of the said echo to exceed the **aThreshold** providing the correct thickness reading; signals from other reflectors less then defined one not to exceed **aThreshold**	**Gain** and **aThreshold** setting to be performed just upon the **Pulse Width, Firing Level, Damping, Filter** and **Frequency Band** settings have been finalized
3	**DAC/TCG**	**DAC/TCG**	**DAC/TCG** settings to the meet the requirements of the inspection procedure	
4	**Pulser Mode**	**PULSER**	**Dual** for the dual element probes **Single** for the single element probes	
5	**Pulse Width, Firing Level, Damping**	**PULSER**	**Pulse Width, Firing Level,** and **Damping** settings to provide the optimal signal to noise ratio	
6	**Filter** **Frequency Band: Low Cut – High Cut limits**	**RECEIVER**	**Filter** and **Frequency Band** settings to match with probe's frequency and / or frequency band of the signals expected to be received	
7	**Display**	**RECEIVER**	**Display** mode may be either **Full, RF, PosHalf,** or **NegHalf**	The same **Display** mode to be used for both **Probe Delay** determining and the **Thickness Recording**
8	**USVelocity**	**BASIC**	**USVelocity** should be equal to the actual value of ultrasound velocity in the material	
9	**Probe Delay**	**MEASURE**	**Probe Delay** should be equal to the actual probe delay	**Probe Delay** may be determined according to the paragraph 5.2.8.6 or 5.2.8.11 of this Operating Manual or in a similar way
10	**Angle**	**MEASURE**	**Angle = 0°**	
11	**Meas Mode**	**MEASURE**	**Flank**	
12	**Range, Display Delay, aStart, aWidth**	**BASIC** **GATE A**	**Range, Display Delay, aStart,** and **aWidth** to be settled with reference to the **Region of Interest for the BScan(Th)** table below	
13	**aGain, bGain, Zoom A-Scan**	**All**	May be used with the purpose of optimizing **A-Scan** presentation	**aThreshold** setting to be performed just upon **aGain, bGain** settings have been finalized
14	Settings for other parameters and modes have no significance			

On completion click on I or press I on the front panel keyboard

To return to the **Line Scanning and Recording Menu** click on Close or press ESC on the front panel keyboard



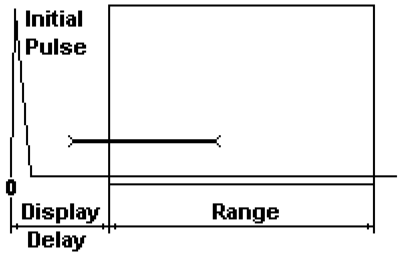
Case 1



$$SRD = aStart$$

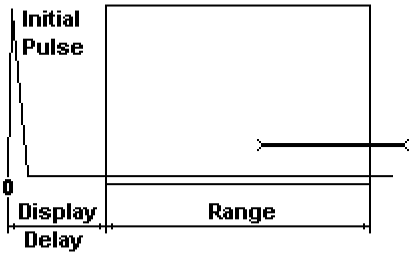
$$RW = aWidth$$

Case 2



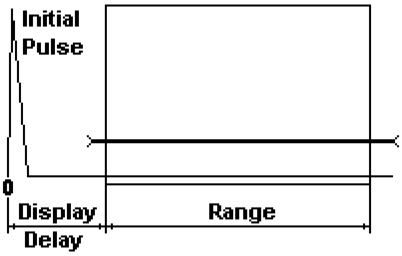
Not allowed

Case 3



Not allowed

Case 4



Not allowed

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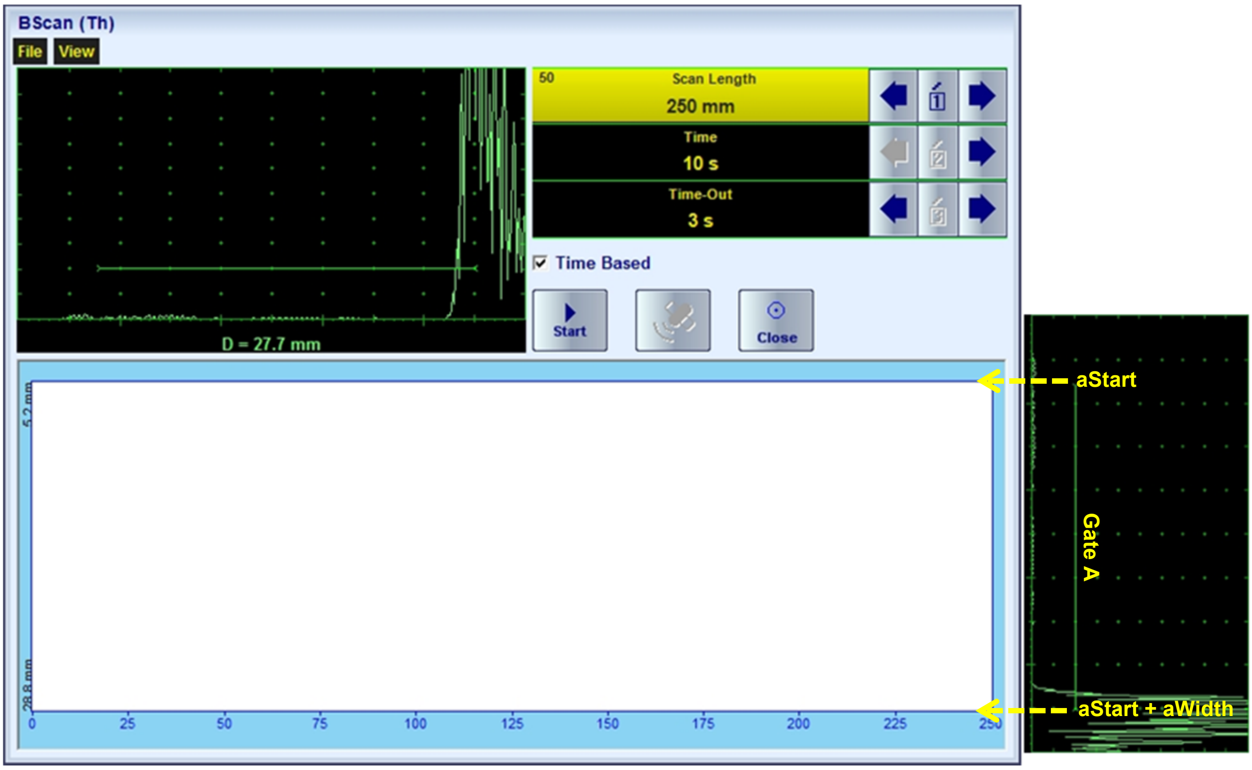
6.3.2. Thickness Profile: Scanning, Recording, and Imaging – Implementation

There are both the *time based* and the *encoded* scanning and recording possible, for the time based recording check the corresponding option

Encoded recording	Time based recording
☐ Time Based	☑ Time Based

For the *time based* mode of recording set the required **Scan Length** and the desired duration of the scanning (**Time**).

To start scanning and recording click on  or press on 

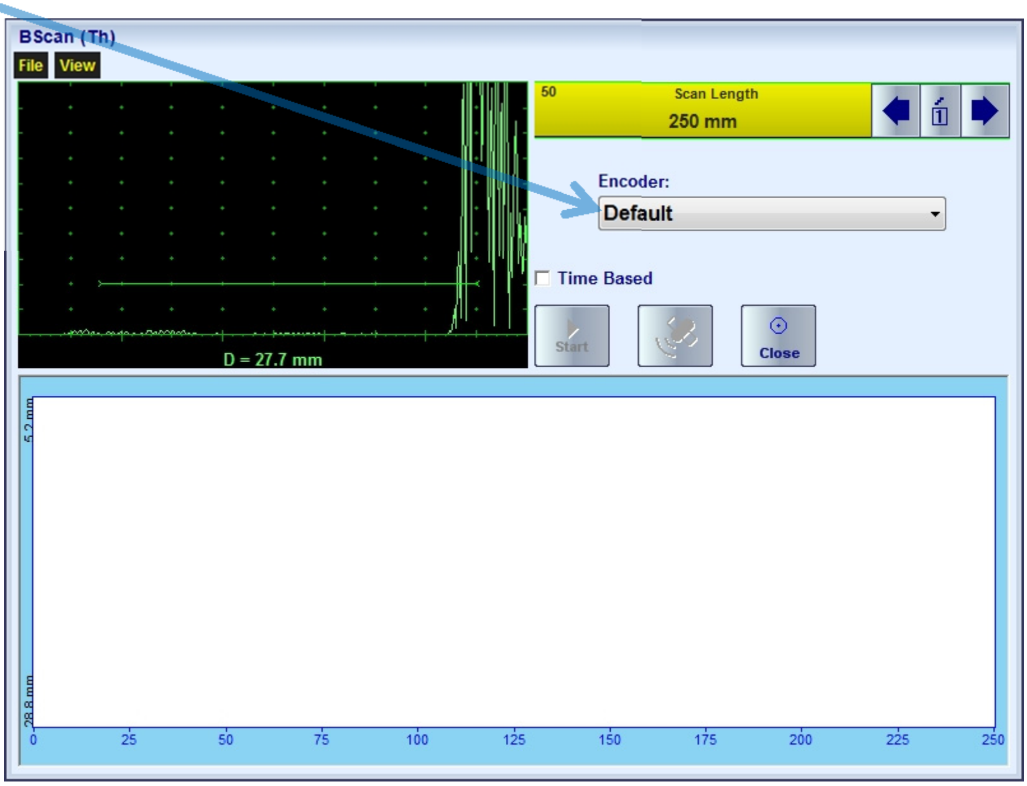


The **Region of Interest (ROI)** of the **BScan(Th)** record is defined by the **aStart** and **aWidth** settings

The **Time-Out** setting determines the time interval (pause) between clicking on  (or pressing on ) and actual start of the time-based recording. The pause may be necessary in order to prepare for the manual probe scanning that should be performed with the stable speed over the desired trace

The recoding will continue during the entire settled *scanning time* (**Time** setting). During the scanning time it is necessary to cover the desired **Scan Length** completely keeping the stable scanning speed. In order to interrupt the recording before the counting of the **Time Out** or *scanning time* completed click on  or press 

For the *encoded* mode fit the probe into the encoder (scanner) frame, set the required **Scan Length** and select the **type of the encoder** from the list of available. To start scanning and recording click on Start or press I

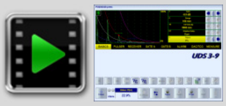


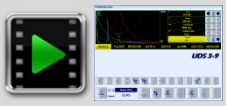
In order to complete or terminate the recording click on Stop or press on I

To save the **BScan(Th)** record press or use the File → Save...

In the same screen it is possible to call **BScan(Th)** record from the file for the viewing and postprocessing through the File → Open or pressing

The videos below illustrate sequence of operations based on the examples of performing **BScan(Th)** recording and postprocessing

	
Youtube https://www.youtube.com/watch?v=SyiczIDmqeE	**Download** http://www.sonotronndt.com/Movies1/3505_B-Scan_Th.mp4

	
Youtube https://www.youtube.com/watch?v=pC-TOTMFHFU	**Download** http://www.sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_Th_B-Scan_PP.mp4

To return to the **Line Scanning and Recording Menu** click on Close or press ESC

6.4. B-Scan cross-sectional imaging and recording of defects – straight and angle beam probes (ABIScan)

6.4.1. Mandatory and optional settings of the UDS 3-9 Pulser Receiver

UDS 3-9 Pulser Receiver window – main operating surface screen appears upon clicking on 2 ABIScan or pressing 2

The following mandatory settings should be provided:

6.4.1.1. Straight Beam Probes

#	*Parameter or Mode*	*Submenu*	*Required Settings*	*Note*
1	**Gain**	**BASICS**	**Gain** setting to be performed according to the inspection procedure providing required echo heights from reference reflectors	**Gain** setting to be performed just upon the **Pulse Width, Firing Level, Damping, Filter** and **Frequency Band** settings have been finalized
2	**DAC/TCG**	**DAC/TCG**	**DAC/TCG** settings to the meet the requirements of the inspection procedure	
3	**Pulser Mode**	**PULSER**	**Dual** for dual element probes **Single** for single element probes	
4	**Pulse Width, Firing Level, Damping**	**PULSER**	**Pulse Width, Firing Level,** and **Damping** settings to provide the optimal signal to noise ratio	
5	**Filter** **Frequency Band: Low Cut – High Cut limits**	**RECEIVER**	**Filter** and **Frequency Band** settings to match with probe's frequency and / or frequency band of the signals expected to be received	
6	**Display**	**RECEIVER**	**Display** setting may be either **Full, RF, PosHalf,** or **NegHalf**	The same **Display** mode to be used for both **Probe Delay** determining and **ABIScan** recording
7	**USVelocity**	**BASIC**	**USVelocity** should be equal to the actual value of ultrasound velocity in the material	
8	**Probe Delay**	**MEASURE**	**Probe Delay** should be equal to the actual probe delay	**Probe Delay** may be determined according to the paragraph 5.2.8.6 or 5.2.8.11 of this Operating Manual or in a similar way
9	**Angle**	**MEASURE**	**Angle = 0°**	
10	**aGain, bGain, Normalized A-Scan (Standard Level)**		May be used with the purpose of optimizing the **A-Scan** presentation	
11	Settings for other parameters and modes have no significance			

On completion click on I or press I on the front panel keyboard

To return to the **Line Scanning and Recording Menu** click on Close or press ESC on the front panel keyboard

6.4.1.2. Angle Beam Probes

#	*Parameter or Mode*	*Submenu*	*Required Settings*	*Note*
1	**Gain**	**BASICS**	**Gain** setting to be performed according to the inspection procedure providing required echo heights from reference reflectors	**Gain** setting to be performed just upon the **Pulse Width, Firing Level, Damping, Filter** and **Frequency Band** settings have been finalized
2	**DAC/TCG**	**DAC/TCG**	**DAC/TCG** settings to the meet the requirements of the inspection procedure	
3	**Pulser Mode**	**PULSER**	**Dual** for dual element probes **Single** for single element probes	
4	**Pulse Width, Firing Level, Damping**	**PULSER**	**Pulse Width, Firing Level,** and **Damping** settings to provide the optimal signal to noise ratio	
5	**Filter** **Frequency Band: Low Cut – High Cut limits**	**RECEIVER**	**Filter** and **Frequency Band** settings to match with probe's frequency and / or frequency band of the signals expected to be received	
6	**Display**	**RECEIVER**	**Display** setting may be either **Full, RF, PosHalf,** or **NegHalf**	The same **Display** mode to be used for both **Probe Delay** determining and **ABIScan** recording
7	**USVelocity**	**BASIC**	**USVelocity** should be equal to the actual value of ultrasound velocity in the material	
8	**Probe Delay**	**MEASURE**	**Probe Delay** should be equal to the actual probe delay	**Probe Delay** may be determined according to the paragraph 5.2.8.3, 5.2.8.4, 5.2.8.5, 5.2.8.10 of this Operating Manual or in a similar way
9	**Angle**	**MEASURE**	**Angle** setting to be ***equal to the actual incidence angle***	The incidence angle to be determined according to the paragraph 5.2.8.9 of this Operating Manual or in a similar way
10	**aGain, bGain, Normalized A-Scan (Standard Level)**		May be used with the purpose of optimizing the **A-Scan** presentation	
11	Settings for other parameters and modes have no significance			

On completion click on I or press I on the front panel keyboard

To return to the **Line Scanning and Recording Menu** click on Close or press ESC on the front panel keyboard

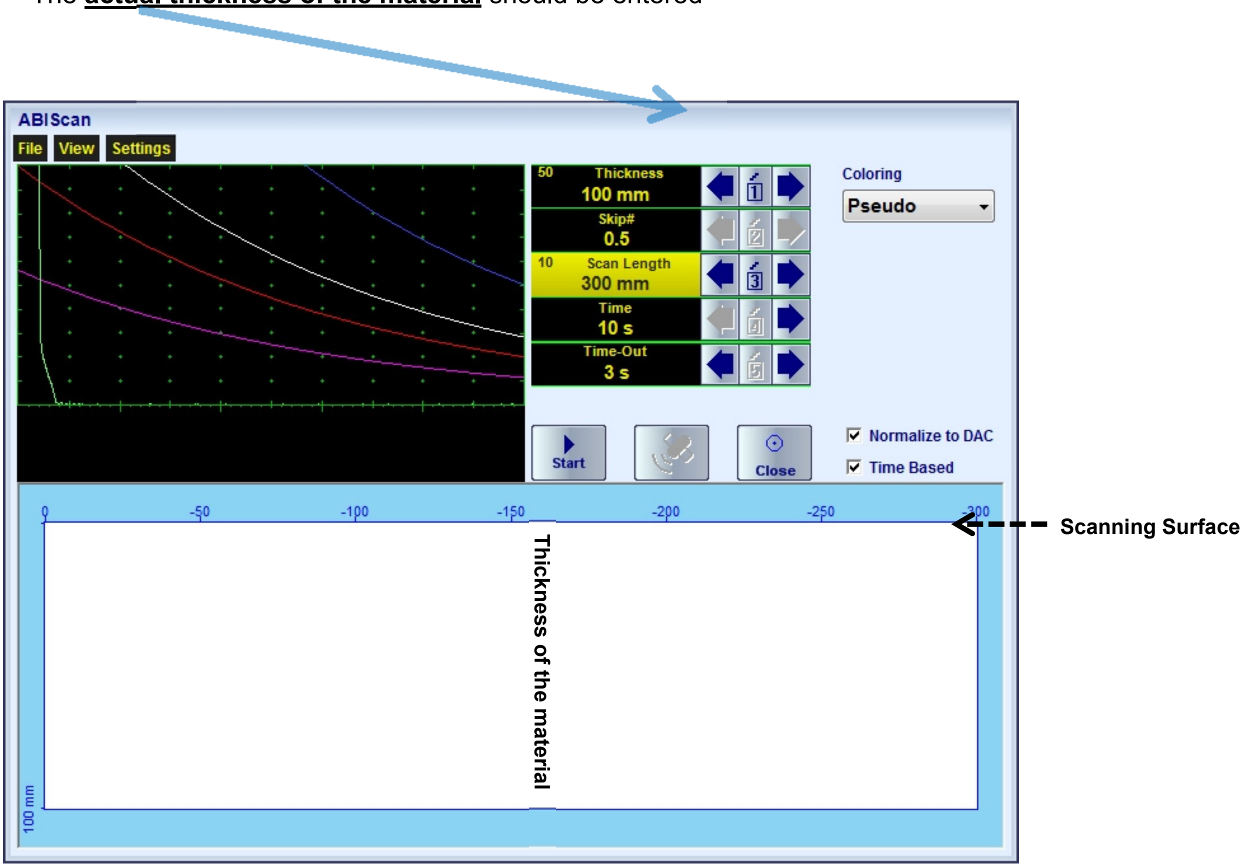
6.4.2. B-Scan: Scanning, Recording, and Cross Sectional Imaging – Implementation

There are both the *time based* and the *encoded* scanning and recording possible, for the time based recording check the corresponding option

Encoded recording	Time based recording
☐ Time Based	☑ Time Based

Prior to the scanning:

- The **actual thickness of the material** should be entered

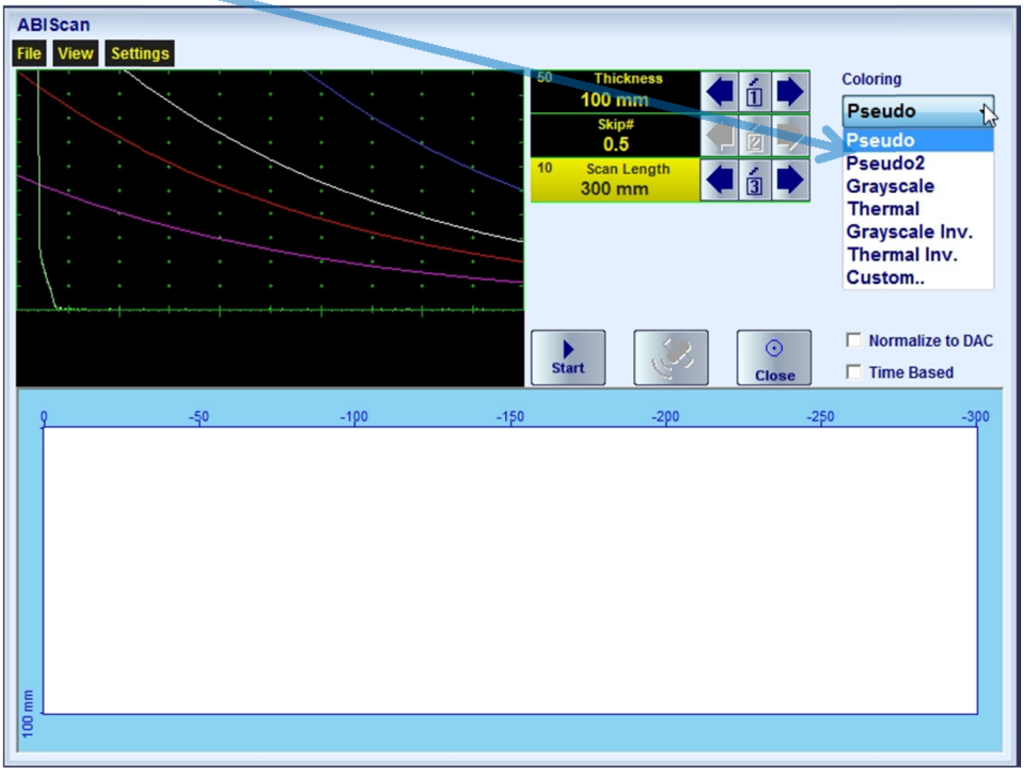


The **Scanning Surface** of the **ABIScan** record and the **Display Delay** setting of the accompanying **A-Scan** are defined by the **Probe Delay** setting entered according to the paragraph 6.4.1of this Operating Manual

The **Range** of the **A-Scan** accompanying the **ABIScan** record is defined by the **Thickness, Skip** settings and by the **Angle** setting entered according to the paragraph 6.4.11of this Operating Manual

4, Pekeris st., Rabin Science Park, Rehovot, 7670204, Israel
Phone: +972-(0)8-9311000, Fax: +972-(0)8-9477712
www.sonotronndt.com

- The desired **color palette** for representing the **ABIScan** image to be settled as well



The color palette may be:

- selected among the plurality of available standard scales
- customized or created by the user
- uploaded from the file

In case of **DAC** is active the echo amplitudes may be color coded according to their **dB-to-DAC** values, for that purpose check the corresponding option

DAC normalization id OFF	DAC normalization id ON
☐ Normalize to DAC	☑ Normalize to DAC

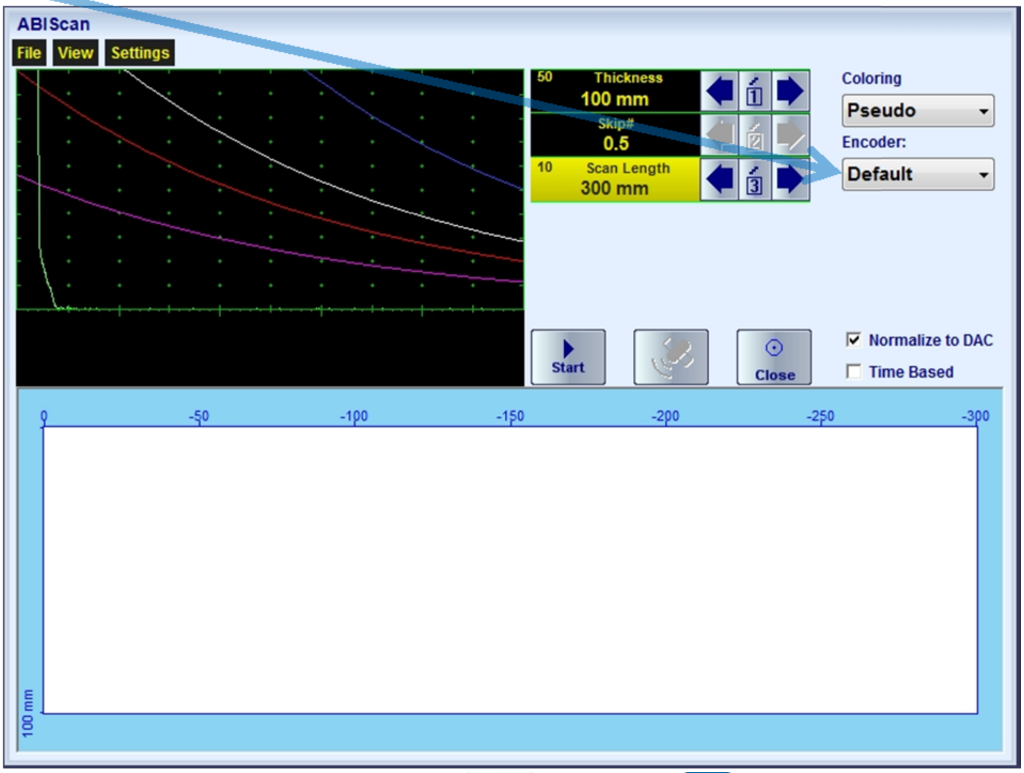
- The **skip coverage** should be selected (for the angle beam probes only) either half (0.5) or full (1)

For the *time based* recording set the required **Scan Length** and the desired duration of the scanning (**Time**). To start scanning and recording click on or press on

The **Time-Out** setting determines the time interval (pause) between clicking on (or pressing on) and actual start of the time-based recording. The pause may be necessary in order to prepare for the manual probe scanning that should be performed with the stable speed over the desired trace

The recoding will continue during the entire settled *scanning time* (**Time** setting). During the scanning time it is necessary to cover the desired **Scan Length** completely keeping the stable scanning speed. In order to interrupt the recording before the counting of the **Time Out** or *scanning time* completed click on or press

For the *encoded* mode fit the probe into the encoder (scanner) frame, set the required **Scan Length** and select the **type of the encoder** *from the list of available. To start scanning and recording click on*  or press 



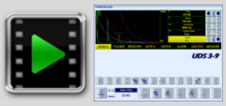
In order to complete or terminate the recording click on  or press on 

To save the **ABIScan** record press  or use the **File** → **Save...**

In the same screen it is possible to call **ABIScan** record from the file for the viewing and postprocessing through the **File** → **Open** or pressing 

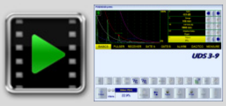
The videos below illustrate sequence of operations based on the examples of performing **ABIScan** recording and postprocessing

For the straight beam probes

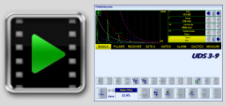


Youtube	Download
https://www.youtube.com/watch?v=JblrTEZsDdE	http://www.sonotronndt.com/Movies1/3505_B_SCAN_0deg.mp4

For the angle beam probes



Youtube	Download
https://www.youtube.com/watch?v=yW-9Gvb84E4	http://www.sonotronndt.com/Movies1/3505_B_SCAN_ANGLE_BEAM.mp4

	
Youtube	**Download**
https://www.youtube.com/watch?v=ZVolhH33hrQ	http://www.sonotronndt.com/Movies1/ISONIC_3505_ABIScan.mp4

To return to the **Line Scanning and Recording Menu** click on Close or press ESC

6.5. TOFD Inspection – RF B-Scan and D-Scan Imaging and Recording

6.5.1. Mandatory and optional settings of the UDS 3-9 Pulser Receiver

UDS 3-9 Pulser Receiver window – main operating surface screen appears upon clicking on 

or pressing 

The following mandatory settings should be provided:

#	*Parameter or Mode*	*Submenu*	*Required Settings*	*Note*
1	**Pulser Mode**	**PULSER**	**Dual**	
2	**Tuning, Pulse Width, Firing Level, Damping**	**PULSER**	**Pulse Width, Firing Level,** and **Damping** settings to provide the optimal signal to noise ratio	
3	**Filter** **Frequency Band: Low Cut – High Cut limits**	**RECEIVER**	**Filter** and **Frequency Band** settings to match with probe's frequency and / or frequency band of the signals expected to be received	
4	**Display**	**RECEIVER**	**RF**	
5	**USVelocity**	**BASIC**	**USVelocity** should be equal to the actual value of ultrasound velocity (compression wave) in the material	
6	**Probe Delay**	**MEASURE**	**Probe Delay** should be setteld equal to the actual ***Accumulated Probe Pair Delay***	The **Accumulated Probe Pair Delay** may be determined according to the paragraph 6.5.1.1 of this Operating Manual
7	**Display Delay** **Range**	**BASICS**	**Display Delay** and **Range** to provide clear **A-Scan** representing: ○ Lateral Wave and Longitudinal Wave Back Echo Signals at the beginning and at the end of **A-Scan** correspondingly OR ○ Lateral Wave, Longitudinal Wave Back Echo, and Mode Conversion Back Echo at the beginning, middle, and at the end of **A-Scan** correspondingly OR ○ Other combination of signals required by the inspection procedure	**Display Delay** and **Range** to be settled according to the paragraph 6.5.1.2 of this Operating Manual
8	**Gain**	**BASICS**	**Gain** settling to be providing according to the inspection procedure through bringing the amplitude of the designated reference signal to the required level	**Gain** setting to be performed with reference to the paragraph 6.5.1.3 of this Operating Manual just upon the **Pulse Width, Firing Level, Damping, Filter** and **Frequency Band** settings have been finalized
9	**aGain, bGain, Normalized A-Scan (Standard Level)**		May be used with the purpose of optimizing the **A-Scan** presentation	
10	Settings for other parameters and modes have no significance			

On completion click on  or press  on the front panel keyboard

To return to the **Line Scanning and Recording Menu** click on 

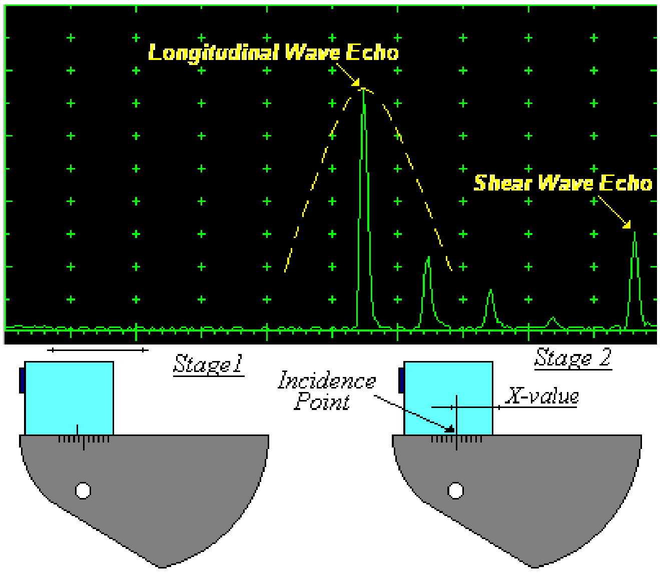
or press 

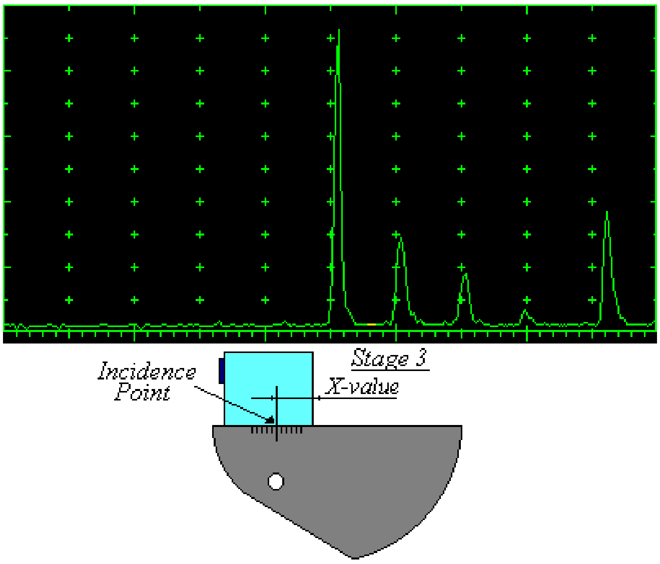
on the front panel keyboard

6.5.1.1. Accumulated Probe Pair Delay

Two probes to be used in order to capture the ***TOFD** Map*. The **Probe Delay** to be precisely measured for each of them whilst in the **UDS 3-9 Pulser Reciever** mode

Measuring Probe Delay - Miniature Probes (contact face width 12.5 mm / 0.5 in or less) – Pulse Echo Technique





In the submenu **PULSER** set:

- **Pulser Mode** to **Single**
- **Pulse Width** to **Spike** for the probe having the resonant frequency above 10 MHz or to **PW ns**, were **PW = 0.5 / F** (**F** is the probe resonant frequency)
- **Firing Level** to **14**
- **Damping** to **OFF**

In the submenu **RECEIVER** set:

- **Display** to **Full** or **RF**
- **Filter** to **OFF**

In the submenu **BASICS** set:

- **US Velocity** to **5920 m/s** (**233.1 in/ms**)
- **Range** to **50.0 mm** (**2 in**)
- **Display Delay** to **0 μs**
- **Reject** to **0%** (for the rectified A-Scan only)

Stage 1: Manipulate the probe over the main working surface of the V-2 reference standard and maximize the echo for the 25 mm (1 in) radius concave reflection, manipulate **Gain** to bring the echo amplitude to the desired standard level (recommended between 70 to 95% of the A-Scan height)

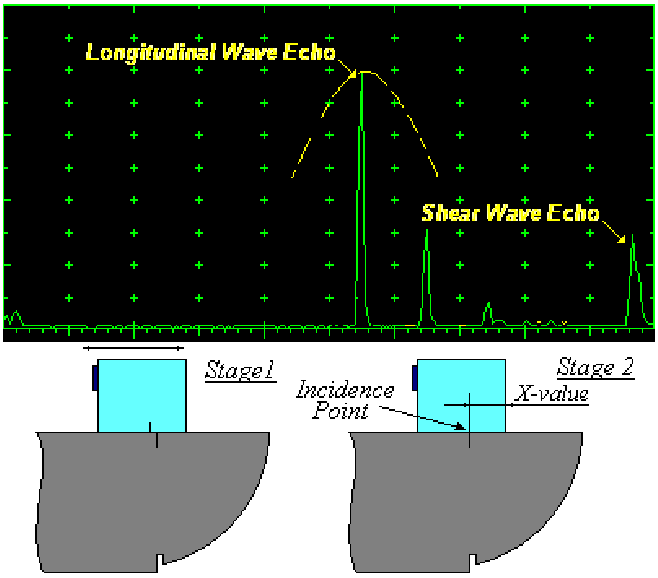
Stage 2: Fix the probe in found position - the center mark of the V-2 reference standard matches with the **incident point** whilst the distance between probe's frontal surface and **incident point** is equal to **X-Value**

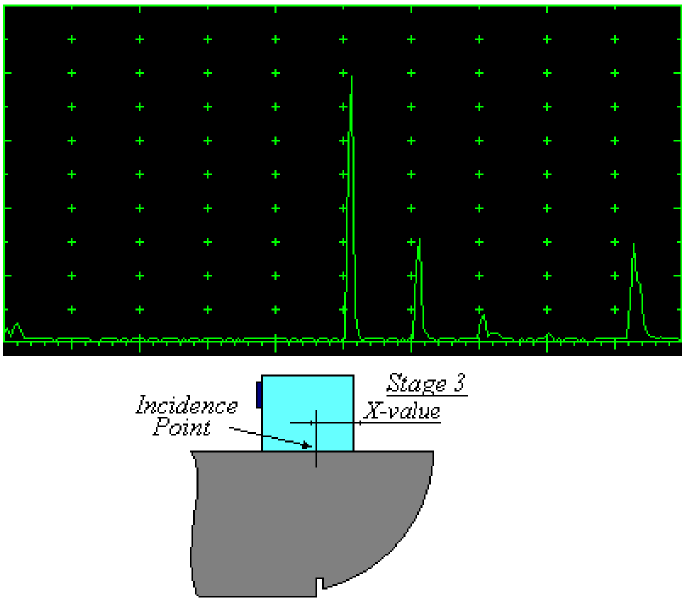
Stage 3: Tune **Display Delay** keeping the probe in the found position until rising edge of maximized echo matches with 50%-grid of the **A-Scan** width. Upon completing the **Display Delay** becomes equal to actual ***Probe Delay***

Supposing that **Probe Delay** values found for probes of the pair are **PD_1** and **PD_2**

Accumulated Probe Pair Delay = 0.5•(PD_1 + PD_2)

Measuring Probe Delay - Large and Medium Size Probes (contact face width more than 12.5 mm / 0.5 in) – Pulse Echo Technique





In the submenu **PULSER** set:

- **Pulser Mode** to **Single**
- **Pulse Width** to **Spike** for the probe having the resonant frequency above 10 MHz or to **PW ns**, were **PW = 0.5 / F** (**F** is the probe resonant frequency)
- **Firing Level** to **14**
- **Damping** to **OFF**

In the submenu **RECEIVER** set:

- **Display** to **Full** or **RF**
- **Filter** to **OFF**

In the submenu **BASICS** set:

- **US Velocity** to **5920 m/s** (**233.1 in/ms**)
- **Range** to **100.0 mm** (**4 in**)
- **Display Delay** to **0 µs**
- **Reject** to **0%** (for the rectified A-Scan only)

Stage 1: Manipulate the probe over the main working surface of the V-1 reference standard and maximize the echo for the 100 mm (4 in) radius concave reflection, manipulate **Gain** to bring the echo amplitude to the desired standard level (recommended between 70 to 95% of the A-Scan height)

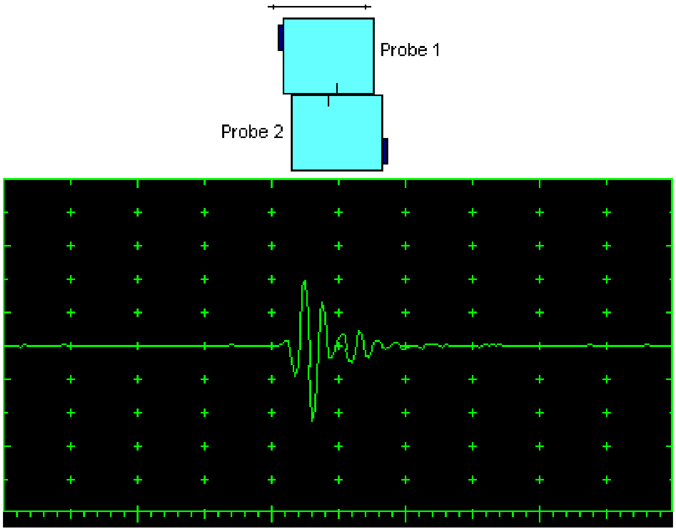
Stage 2: Fix the probe in found position - the center mark of the V-1 reference standard matches with the **incident point** whilst the distance between probe's frontal surface and **incident point** is equal to **X-Value**

Stage 3: Tune **Display Delay** keeping the probe in the found position until rising edge of maximized echo matches with 50%-grid of the **A-Scan** width. Upon completing the **Display Delay** becomes equal to actual ***Probe Delay***

Supposing that **Probe Delay** values found for probes of the pair are **PD_1** and **PD_2**

Accumulated Probe Pair Delay = $0.5 \bullet (PD_1 + PD_2)$

Direct Measurement of the Accumulated Probe Pair Delay - All Probes Sizes– Through Transmission Technique



In the submenu **PULSER** set:

- **Pulser Mode** to **Dual**
- **Pulse Width** to **Spike** for the probe having the resonant frequency above 10 MHz or to **PW ns**, were **PW = 0.5 / F** (**F** is the probe resonant frequency)
- **Firing Level** to **14**
- **Damping** to **OFF**

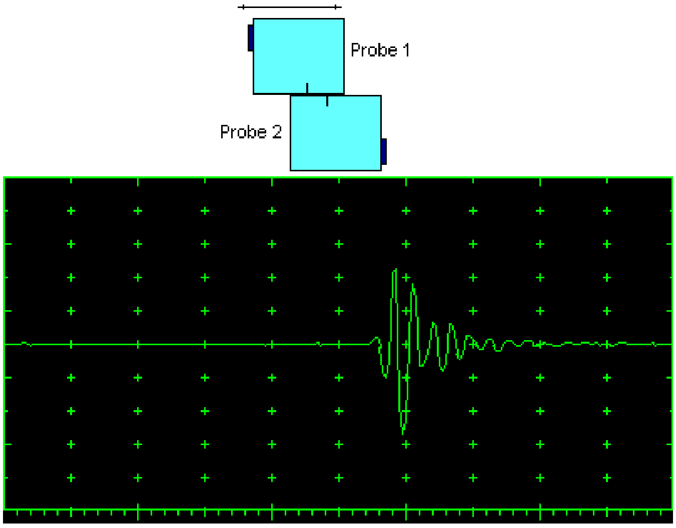
In the submenu **RECEIVER** set:

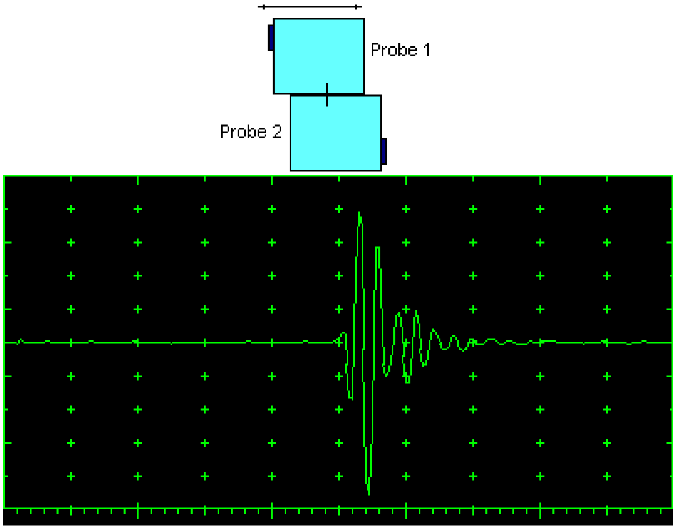
- **Display** to **Full** or **RF**
- **Filter** to **OFF**

In the submenu **BASICS**:

- **Display Delay** to **0 µs**

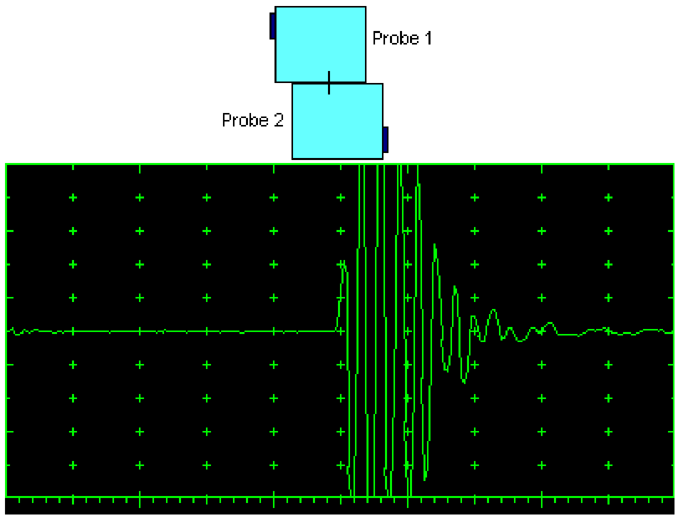
Stage 1: Manipulate probes over each other and setup of **Gain**, **Range**, and **USVelocity** providing the clear indication of the signal through the wedges from emitting to receiving crystal then maximize the signal and bring its amplitude to the desired standard level (recommended between 70 to 95% of the A-Scan height)



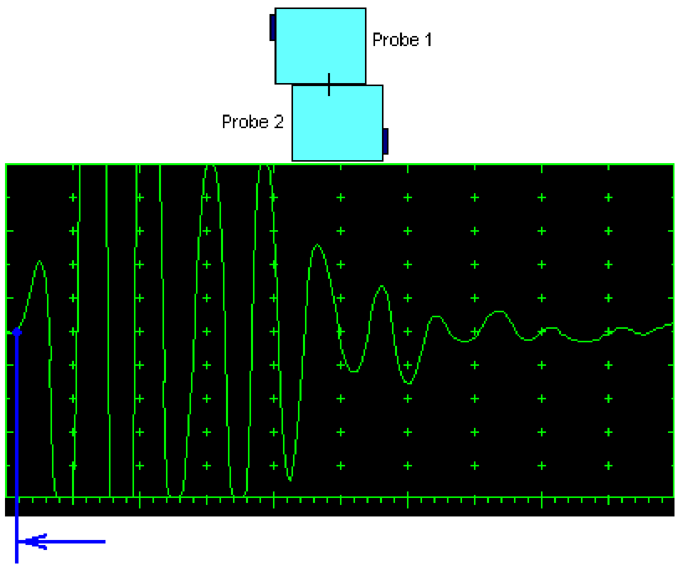


Stage 2: Fix the probes in the found positions corresponding to highest signal amplitude

Keeping the probes in the found position:



Stage 3: increase **Gain** to provide the height of the first half wave of the maximized signal to 20…25 % of the **A-Scan** height



Stage 4: Decrease **Range** to provide ~ 50% occupancy of the **A-Scan** width by the signal

Stage 5: Start increasing of **Display Delay** aiming displacement of signal's start point to the beginning of the **A-Scan** time base (zero horizontal position)

Stage 6: Stop **Display Delay** manipulation upon the target reached – at this moment the **Display Delay** setting represents the ***Accumulated Probe Pair Delay***

Accumulated Probe Pair Delay = Display Delay

Upon the **Accumulated Probe Pair Delay** has been found using one of the manners above settle the **Probe Delay** (submenu **MEASURE**) accordingly:

Probe Delay = Accumulated Probe Pair Delay

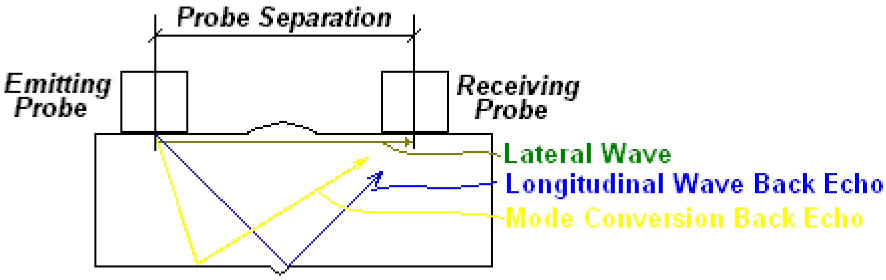
6.5.1.2. Display Delay and Range

Display Delay depends on **Accumulated Probe Pair Delay**, **Probe Separation**, and **USVelocity**:

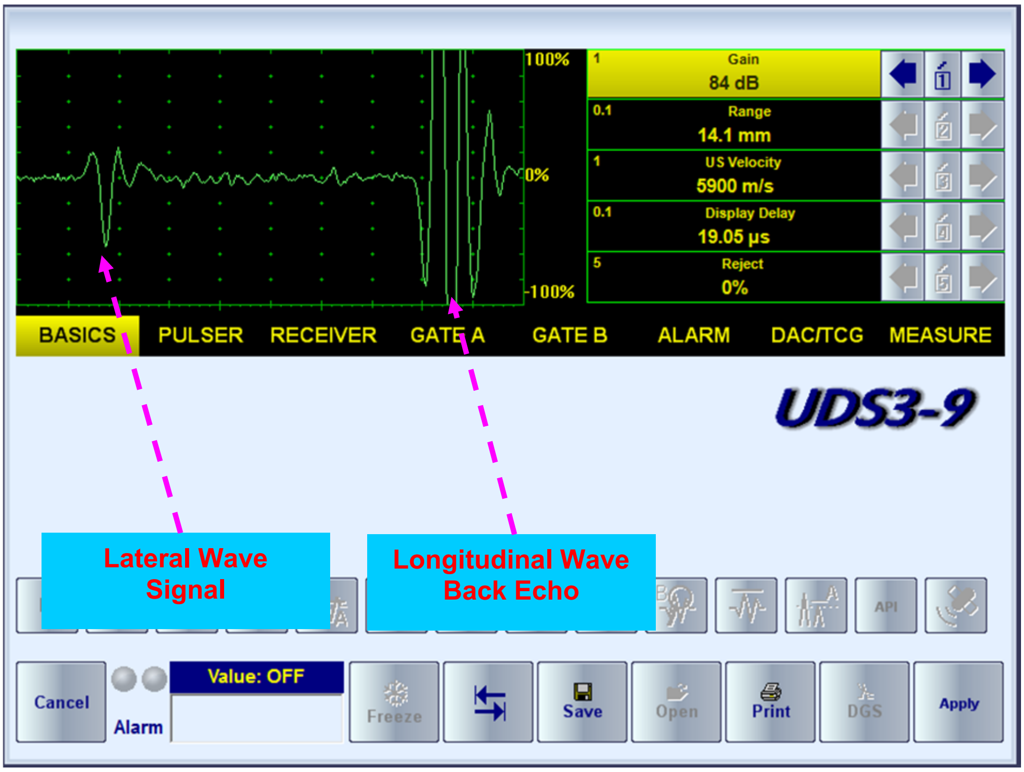
Display Delay ≤ Probe Delay + Probe Separation / USVelocity

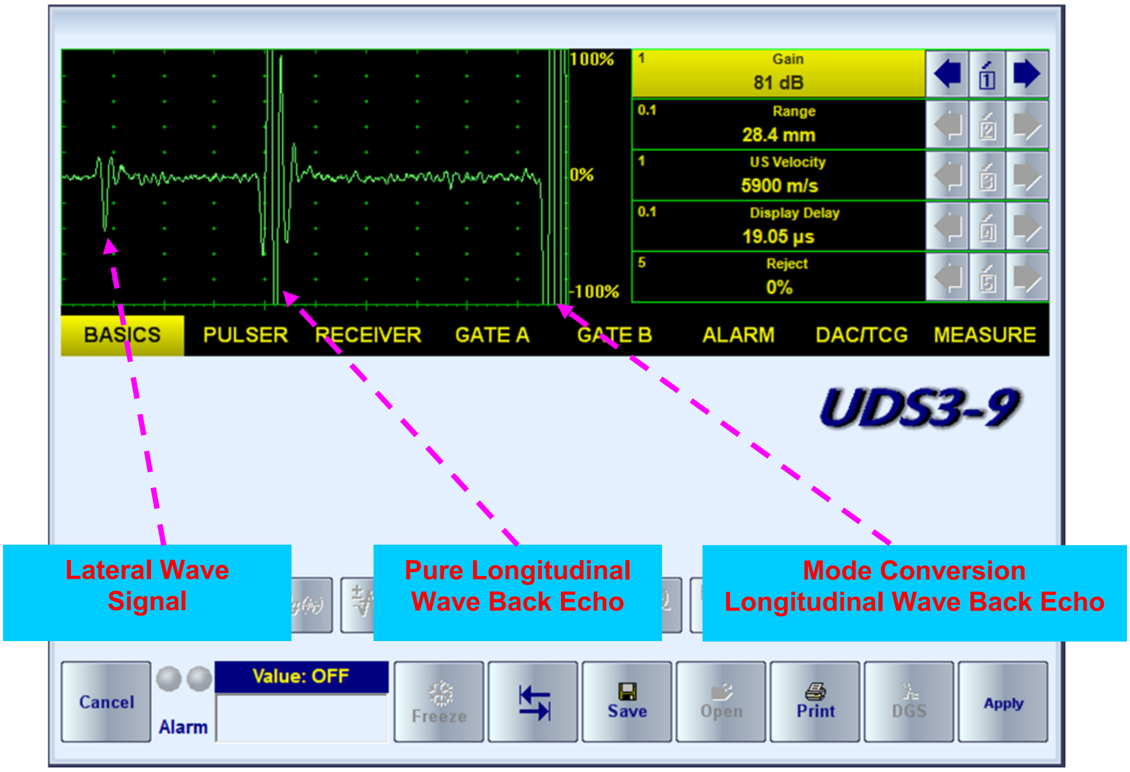
whereas:

- **USVelocity** is the actual value of longitudinal wave velocity in the material
- **Probe Separation** is the distance between incidence points of the emitting and receiving **TOFD** probes measured along the trace of lateral wave:



Probe Separation should be optimized according to the inspection procedure and the probes positioning in the **TOFD** fixture to be fixed upon. The **Display Delay** and **Range** to be adjusted then to provide representing of signals according to the inspection procedure – the typical examples are given below





6.5.1.3. Gain

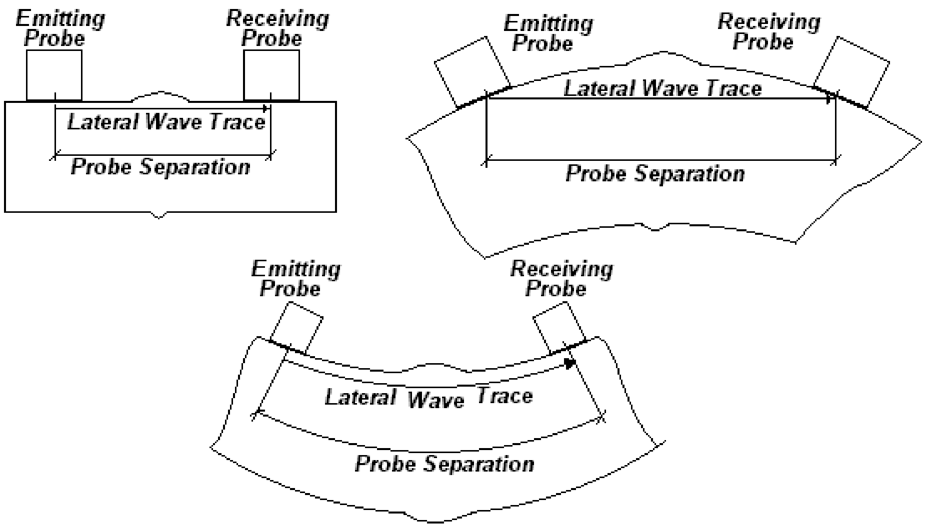
Depending on Inspection procedure (Inspection specs) **Gain** may be setup with the reference to:

- Representative flaw sample
- Artificial diffractors in the form of EDM notches or V-shaped notches
- Side drilled holes
- Grain noise
- The amplitude of the lateral wave signal

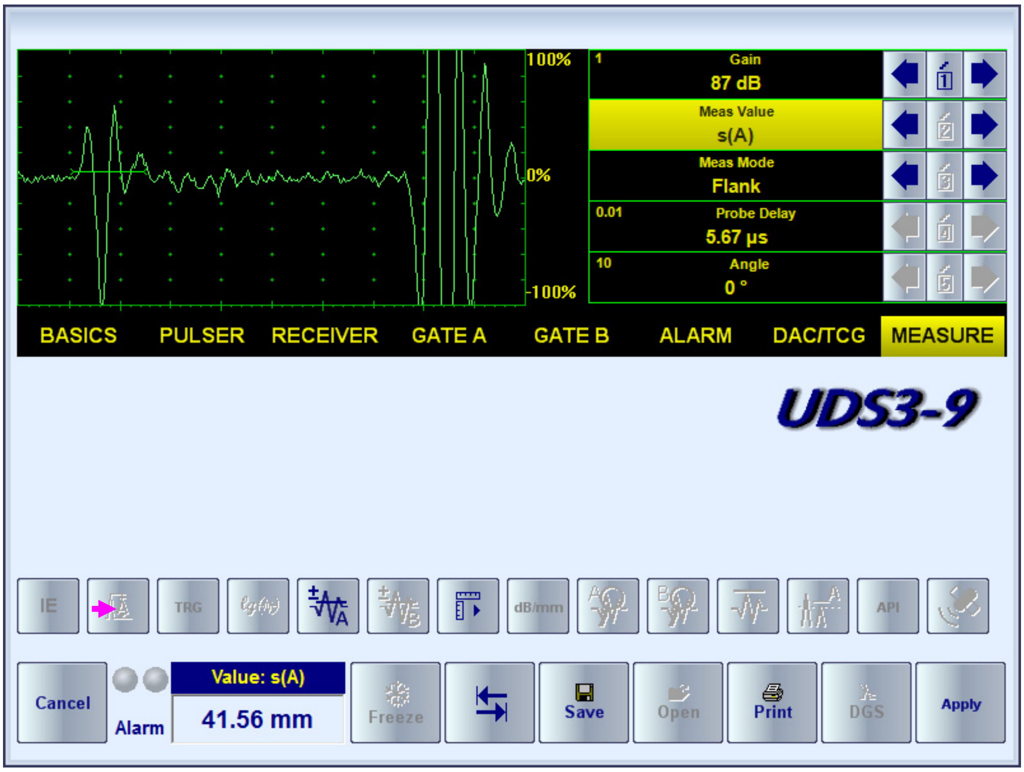
For the examples above the typical procedure of **Gain** setting was provided through bringing the amplitude of the lateral wave signal to 40%...60% of the **A-Scan** height

6.5.1.4. Probe Separation

Probe Separation should be determined properly and entered then in order to have the ability of precise defects sizing at posprocessing stage. The typical way of determining **Probe Separation** is the mechanical measurement of the distance between the incidence points of **TOFD** probes using a scale bar. However the mechanical measurements may be not accurate as necessary especially on the curved surfaces:



The **Probe Separation** may be defined more precisely in the manner explained below:



- Whilst observing the lateral wave signal on the **A-Scan** set **Gain** providing the height of the first half wave reaching 40…50% of the **A-Scan** height
- Activate **Gate A**, setup **aThreshold** to **5…10%**(submenu **GATE A**)
- Select **s(A)** as **Meas Value** and set **Meas Mode** as **Flank** (submenu **MEASURE**)
- Place **Gate A** over the first half wave of the lateral wave signal and obtain **s(A)** reading: the **Probe Separation** will be found as **2 X s(A)**

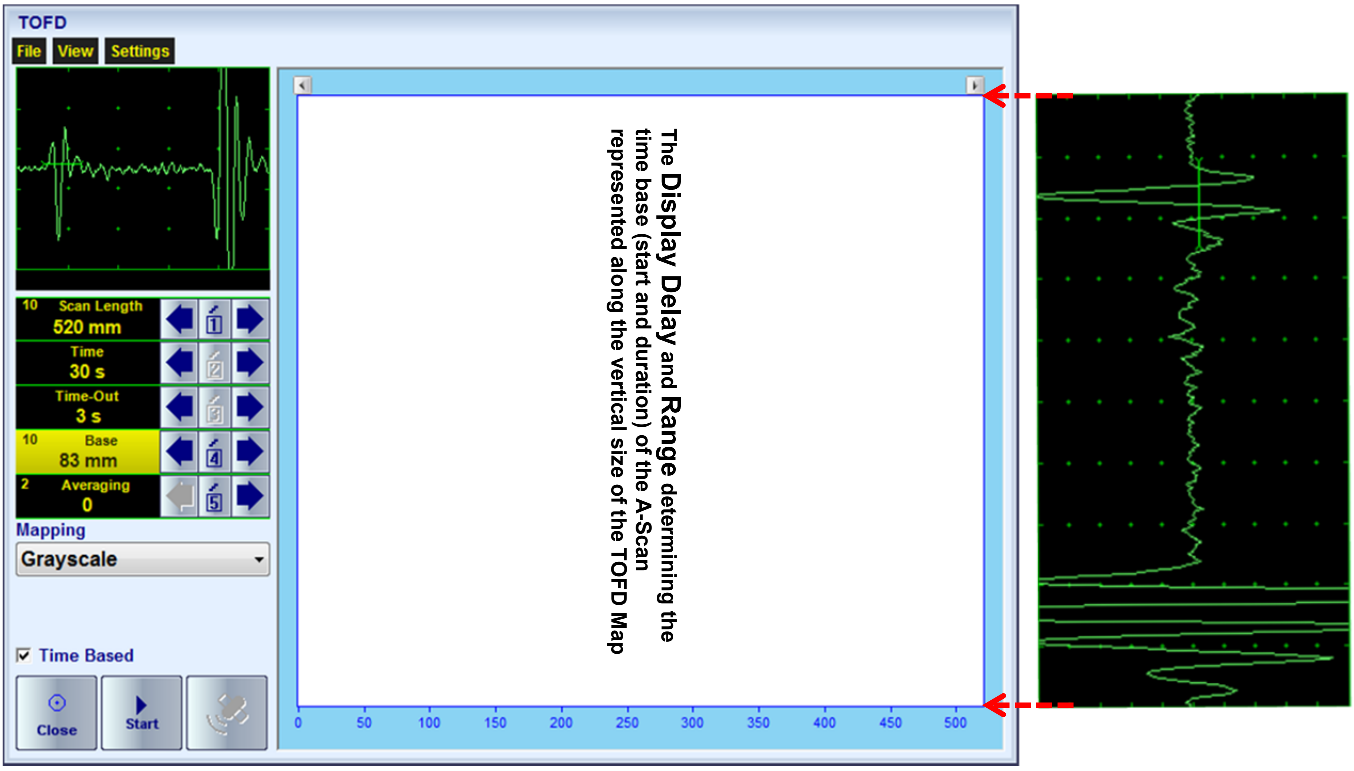
Probe Separation = 2 × s(A)

6.5.2. TOFD Scanning, Recording, and Imaging – Implementation

There are both the *time based* and the *encoded* scanning and recording possible, for the time based recording check the corresponding option

Encoded recording	Time based recording
☐ Time Based	☑ Time Based

Prior to the scanning the values of **Base** (**Base = Probes Separation**) and the required **Scan Length** to be entered

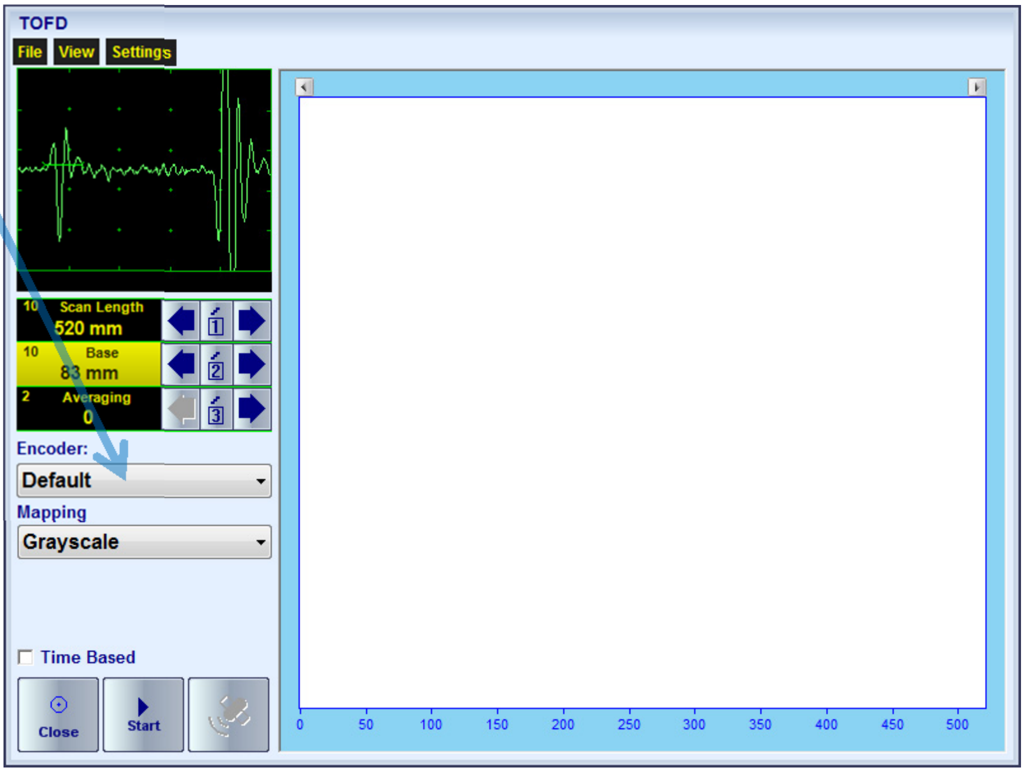


For the *time based* recording set the desired duration of the scanning (**Time**). To start scanning and recording click on Start or press on I

The **Time-Out** setting determines the time interval (pause) between clicking on Start (or pressing on I) and actual start of the time-based recording. The pause may be necessary in order to prepare for the manual probe scanning that should be performed with the stable speed over the desired trace

The recoding will continue during the entire settled *scanning time* (**Time** setting). During the scanning time it is necessary to cover the desired **Scan Length** completely keeping the stable scanning speed. In order to interrupt the recording before the counting of the **Time Out** or *scanning time* completed click on Stop or press I

For the *encoded* mode fit the probes into the scanner) frame, set the required **Scan Length** and select the **type of the encoder** from the list of available. To start scanning and recording click on or press

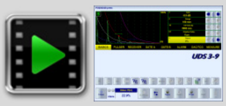


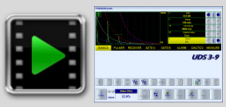
In order to complete or terminate the recording click on or press on

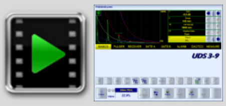
To save the **TOFD** record press or use the **File** → **Save...**

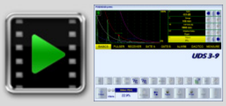
In the same screen it is possible to call **TOFD** record from the file for the viewing and postprocessing through the **File** → **Open** or pressing

The videos below illustrate sequence of operations based on the examples of performing **TOFD** recording and postprocessing

	
Youtube https://www.youtube.com/watch?v=uCis3U9aUoA	**Download** http://www.sonotronndt.com/Movies1/TOFD_WITH_ENCODER_LW_BE_MCBE.mp4

	
Youtube https://www.youtube.com/watch?time_continue=1&v=7fgaUJZLKAs	**Download** http://www.sonotronndt.com/Movies1/TOFD_WITH_SCANNER_LW_BE_MCBE.mp4

	
Youtube https://www.youtube.com/watch?time_continue=2&v=8L_9hMIU8Fc	**Download** http://www.sonotronndt.com/Movies1/TOFD_WITH_ENCODER_LW_BE.mp4

	
Youtube https://www.youtube.com/watch?time_continue=3&v=yuPmNg7M7tk	**Download** http://www.sonotronndt.com/Movies1/TOFD_WITH_SCANNER_LW_BE.mp4

To return to the **Line Scanning and Recording Menu** click on [Close] or press [ESC]

6.6. FLOORMAP L: CB-Scan horizontal plane-view imaging and recording of defects for shear, surface, and guided wave inspection

6.6.1. Mandatory and optional settings of the UDS 3-9 Pulser Receiver

UDS 3-9 Pulser Receiver window – main operating surface screen appears upon clicking on

or pressing

The following mandatory settings should be provided:

6.6.1.1. Angle Beam Inspection – Shear and Longitudinal Waves

#	*Parameter or Mode*	*Submenu*	*Required Settings*	*Note*
1	**Gain**	**BASICS**	**Gain** setting to be performed according to the inspection procedure providing required echo heights from reference reflectors	**Gain** setting to be performed just upon the **Pulse Width, Firing Level, Damping, Filter** and **Frequency Band** settings have been finalized
2	**DAC/TCG**	**DAC/TCG**	**DAC/TCG** settings to the meet the requirements of the inspection procedure	
3	**Pulser Mode**	**PULSER**	**Dual** for dual element probes **Single** for single element probes	
4	**Pulse Width, Firing Level, Damping**	**PULSER**	**Pulse Width, Firing Level,** and **Damping** settings to provide the optimal signal to noise ratio	
5	**Filter** **Frequency Band: Low Cut – High Cut limits**	**RECEIVER**	**Filter** and **Frequency Band** settings to match with probe's frequency and / or frequency band of the signals expected to be received	
6	**Display**	**RECEIVER**	**Display** setting may be either **Full, RF, PosHalf,** or **NegHalf**	The same **Display** mode to be used for both **Probe Delay** determining and **FLOORMAP** recording
7	**USVelocity**	**BASIC**	**USVelocity** should be equal to the actual value of ultrasound velocity in the material	
8	**Probe Delay**	**MEASURE**	**Probe Delay** should be equal to the actual probe delay	**Probe Delay** may be determined according to the paragraph 5.2.8.3, 5.2.8.4, 5.2.8.5, 5.2.8.10 of this Operating Manual or in a similar way
9	**Display Delay, Range**	**BASICS**	**Display Delay** and **Range** to represent the desired **Region of Interest (ROI)**	Refer to the paragraph 6.6.1.4 of this Operating Manual
10	**Angle**	**MEASURE**	**Angle** setting to be ***equal to the actual incidence angle***	The incidence angle to be determined according to the paragraph 5.2.8.9 of this Operating Manual or in a similar way
11	Settings for other parameters and modes have no significance			

On completion click on or press on the front panel keyboard

To return to the **Line Scanning and Recording Menu** click on or press on the front panel keyboard

6.6.1.2. Guided, Surface, Creeping, and Head Wave Inspection

#	*Parameter or Mode*	*Submenu*	*Required Settings*	*Note*
1	**Gain**	**BASICS**	**Gain** setting to be performed according to the inspection procedure providing required echo heights from reference reflectors	**Gain** setting to be performed just upon the **Pulse Width, Firing Level, Damping, Filter** and **Frequency Band** settings have been finalized
2	**DAC/TCG**	**DAC/TCG**	**DAC/TCG** settings to the meet the requirements of the inspection procedure	
3	**Pulser Mode**	**PULSER**	**Dual** for dual element probes **Single** for single element probes	
4	**Pulse Width, Firing Level, Damping**	**PULSER**	**Pulse Width, Firing Level,** and **Damping** settings to provide the optimal signal to noise ratio	
5	**Filter** **Frequency Band: Low Cut – High Cut limits**	**RECEIVER**	**Filter** and **Frequency Band** settings to match with probe's frequency and / or frequency band of the signals expected to be received	
6	**Display**	**RECEIVER**	**Display** setting may be either **Full, RF, PosHalf,** or **NegHalf**	The same **Display** mode to be used for both **Probe Delay** determining and **FLOORMAP** recording
7	**USVelocity**	**BASIC**	**USVelocity** setting to be equal to the actual value of ultrasound velocity in the material	
8	**Probe Delay**	**MEASURE**	**Probe Delay** setting to be equal to actual probe delay	For guided / surface / creeping / head wave inspection probe delay may be determined according to the paragraph 6.6.1.3 of this Operating Manual or similarly
9	**Display Delay, Range**	**BASICS**	**Display Delay** and **Range** to represent the desired **Region of Interest (ROI)**	Refer to the paragraph 6.6.1.4 of this Operating Manual
10	**Angle**	**MEASURE**	**90°**	
11	Settings for other parameters and modes have no significance			

On completion click on I or press I on the front panel keyboard

To return to the **Line Scanning and Recording Menu** click on Close or press ESC on the front panel keyboard

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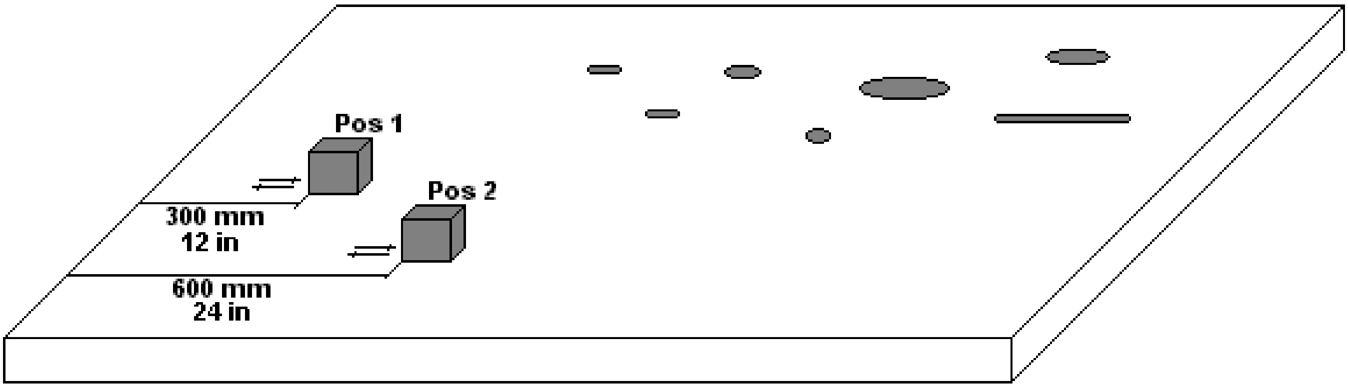
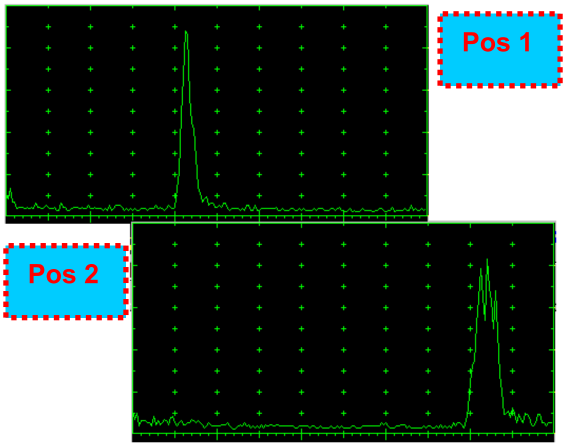
6.6.1.3. Determining Probe Delay and Ultrasound Velocity for the Guided / Surface / Creeping / Head Wave Inspection

The exemplary procedure for finding the **Probe Delay** and **US Velocity** settings required for the short range guided wave inspection:



(a) In the **UDS 3-9 Pulser Receiver** – submenu **BASICS** set **Range = 750 mm** (or **30 in**), then set **US Velocity = 3000 m/s** (or **120 in/ms**)
(b) Place the guided wave probe into position **Pos 1** on the reference plate providing **300 mm** (or **12 in**) distance between the probe's front surface and plate end
(c) Adjust **Gain** to provide the plate end echo amplitude of **80…90%** of the **A-Scan** height
(d) Adjust the **Display Delay** setting bringing the rising edge of plate end echo matching with **40%** grid on the horizontal **A-Scan** scale
(e) Place the guided wave probe into position **Pos 2** on the reference plate providing **600 mm** (or **24 in**) distance between the probe's front surface and plate end
(f) Adjust the **US Velocity** setting bringing the rising edge of plate end echo matching with **80%** grid on the horizontal **A-Scan** scale
(g) Place the guided wave probe into position **Pos 1** on the reference plate again providing **300 mm** (or **12 in**) distance between the probe's front surface and plate end
(h) Repeat steps (d) through (g) as above until further adjustments are not be necessary, i.e. placement of the guided wave probe into the positions **Pos 1** and **Pos 2** causes receiving of the plate end echoes with the rising edges appearing at **40%** and **80%** on the horizontal **A-Scan** scale correspondingly: at that point the **Display Delay** represents the actual **Probe Delay** and **US Velocity** setting represents it's actual value
(i) In the submenu **MEASURE** set **Probe Delay = Display Delay** whereas **Display Delay** has been found according to the steps (a) through (h) above



The **Probe Delay** and **US Velocity** settings for the surface / creeping / head wave inspection may be reached in the similar manner

6.6.1.4. Region of Interest (ROI)

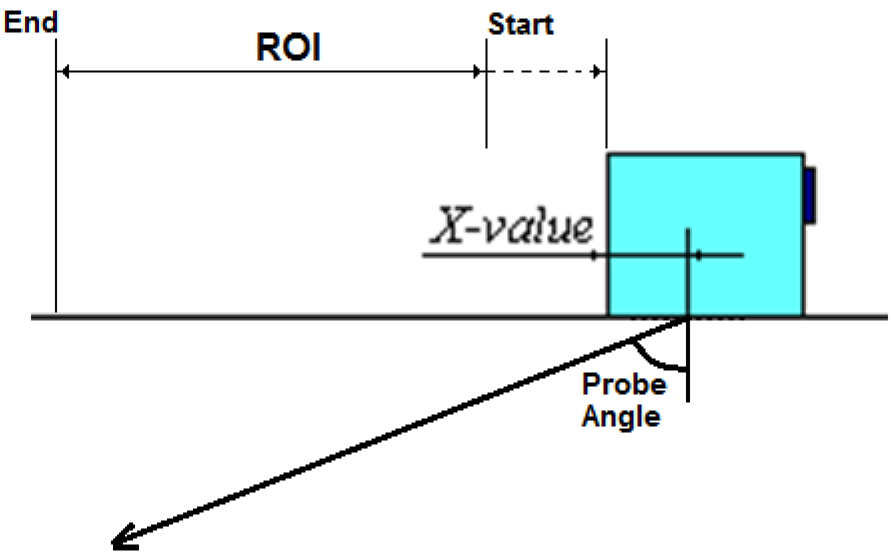
The **ROI** of the **FLOORMAP L** records is defined by the **Display Delay** and **Range** settings

For the ***angle beam inspection***:

Display Delay according to the equation

$$\textit{Display Delay} \geq \textbf{Probe Delay} + \frac{\textbf{2} \times \textbf{Xvalue}}{\textbf{USVelocity} \times \textbf{Sin(Probe Angle)}}$$

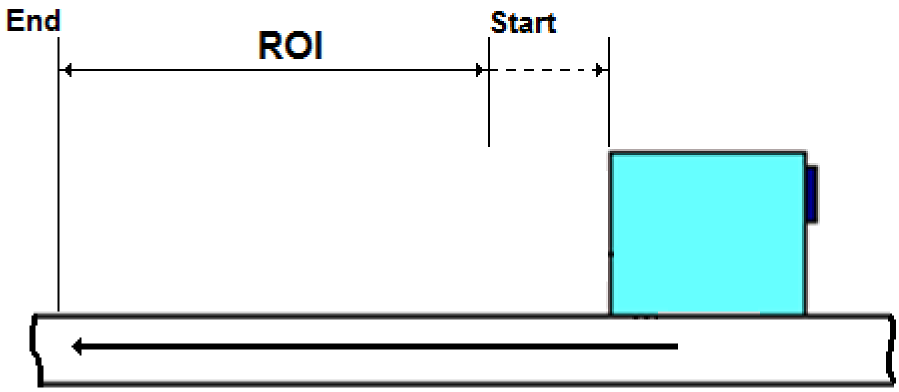
Range – according to the sketch below



For the **guided / surface / creeping / head wave inspection:**

Display Delay ≥ Probe Delay

Range – according to the sketch below

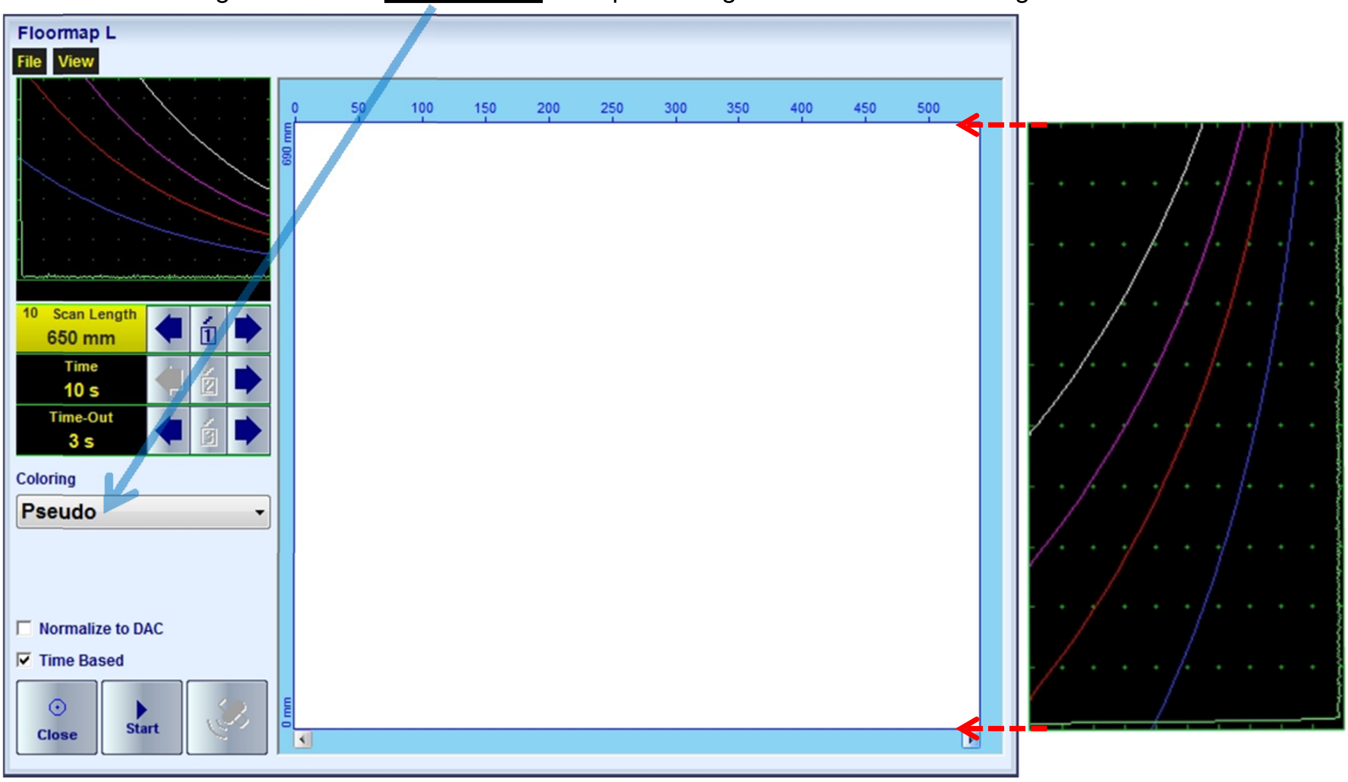


6.6.2. FLOORMAP L: Scanning, Recording, and Imaging – Implementation

There are both the *time based* and the *encoded* scanning and recording possible, for the time based recording check the corresponding option

Encoded recording	Time based recording
☐ Time Based	☑ Time Based

Prior to the scanning: the desired **color palette** for representing the **FLOORMAP L** image to be settled



The color palette may be:

- selected among the plurality of available standard scales
- customized or created by the user
- uploaded from the file

In case of **DAC** is active the echo amplitudes may be color coded according to their **dB-to-DAC** values, for that purpose check the corresponding option

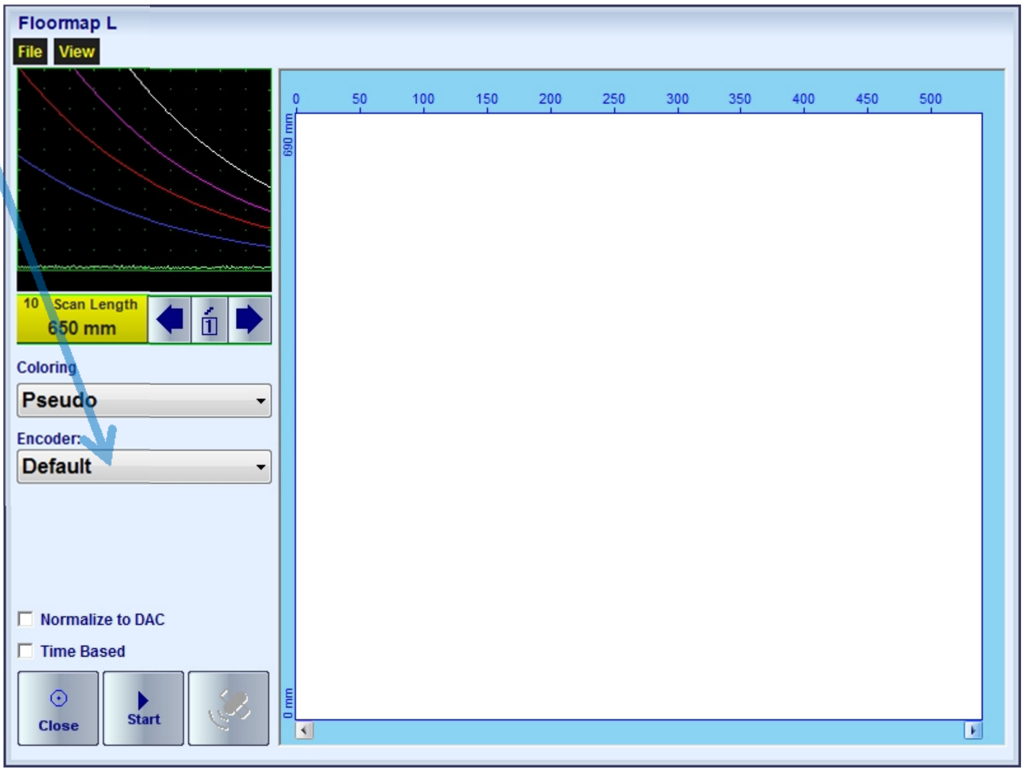
DAC normalization id OFF	DAC normalization id ON
☐ Normalize to DAC	☑ Normalize to DAC

For the *time based* recording set the required **Scan Length** and the desired duration of the scanning (**Time**). To start scanning and recording click on [Start] or press on [I]

The **Time-Out** setting determines the time interval (pause) between clicking on [Start] (or pressing on [I]) and actual start of the time-based recording. The pause may be necessary in order to prepare for the manual probe scanning that should be performed with the stable speed over the desired trace

The recoding will continue during the entire settled *scanning time* (**Time** setting). During the scanning time it is necessary to cover the desired **Scan Length** completely keeping the stable scanning speed. In order to interrupt the recording before the counting of the **Time Out** or *scanning time* completed click on [Stop] or press [I]

For the *encoded* mode fit the probe into the encoder (scanner) frame, set the required **Scan Length** and select the **type of the encoder** from the list of available. To start scanning and recording click on [Start] or press [I]

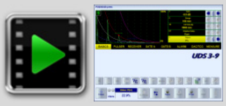


In order to complete or terminate the recording click on [Stop] or press on [I]

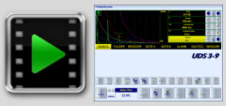
To save the **FLOORMAP L** record press [save icon] or use the **File** → **Save...**

In the same screen it is possible to call **FLOORMAP L** record from the file for the viewing and postprocessing through the **File** → **Open** or pressing [open icon]

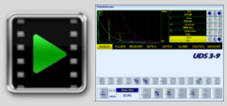
The videos below illustrate sequence of operations based on the examples of performing **FLOORMAP L** recording and postprocessing



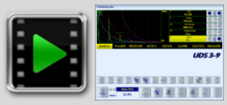
Youtube	Download
https://www.youtube.com/watch?v=xz1E9sLmC74	http://sonotronndt.com/Movies1/3505_FLORRMAP_L.mp4



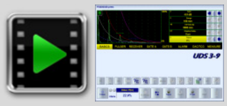
Youtube	Download
https://www.youtube.com/watch?v=qkbj1qxbEuM	http://sonotronndt.com/Movies1/i3505_SRUT_CUC.mp4



Youtube	Download
https://www.youtube.com/watch?v=EB45tEDGubs	http://sonotronndt.com/Movies2/i3505_SRUTGW_A_RING.mp4



Youtube	Download
https://www.youtube.com/watch?v=2N6QCu3N8L8	http://sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/FMAP_L.mp4



Youtube	Download
https://www.youtube.com/watch?v=tAfZ050Y518	http://sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_CB-Scan_VAUT_PP.mp4

To return to the **Line Scanning and Recording Menu** click on 

or press 

6.7. HR BScan: High resolution B-Scan

6.7.1. Mandatory and optional settings of the UDS 3-9 Pulser Receiver

UDS 3-9 Pulser Receiver window – main operating surface screen appears upon clicking on

or pressing

The following mandatory settings should be provided:

#	*Parameter or Mode*	*Submenu*	*Required Settings*	*Note*
1	**Gain**	**BASICS**	**Gain** setting to be performed according to the inspection procedure providing required echo heights from reference reflectors	**Gain** setting to be performed just upon the **Pulse Width, Firing Level, Damping, Filter** and **Frequency Band** settings have been finalized
2	**DAC/TCG**	**DAC/TCG**	**DAC/TCG** settings to the meet the requirements of the inspection procedure	
3	**Pulser Mode**	**PULSER**	**Dual** for dual element probes **Single** for single element probes	
4	**Pulse Width, Firing Level, Damping**	**PULSER**	**Pulse Width, Firing Level,** and **Damping** settings to provide the optimal signal to noise ratio	
5	**Filter** **Frequency Band: Low Cut – High Cut limits**	**RECEIVER**	**Filter** and **Frequency Band** settings to match with probe's frequency and / or frequency band of the signals expected to be received	
6	**Display**	**RECEIVER**	**Display** setting may be either **Full, RF, PosHalf,** or **NegHalf**	The same **Display** mode to be used for both **Probe Delay** determining and **HR BScan** recording
7	**USVelocity**	**BASICS**	**USVelocity** should be equal to the actual value of ultrasound velocity in the material	
8	**Probe Delay**	**MEASURE**	**Probe Delay** should be equal to the actual probe delay	**Probe Delay** may be determined according to the paragraph 5.2.8.6 or 5.2.8.11 of this Operating Manual or in a similar way
9	**Range**	**BASICS**	Freely installable according to the desired **Region of Interest (ROI)**	
10	**Angle**	**MEASURE**	**Angle = 0°**	
11	**aGain, bGain, Normalized A-Scan (Standard Level)**		May be used with the purpose of optimizing the **A-Scan** presentation	
12	Settings for other parameters and modes have no significance			

On completion click on or press on the front panel keyboard

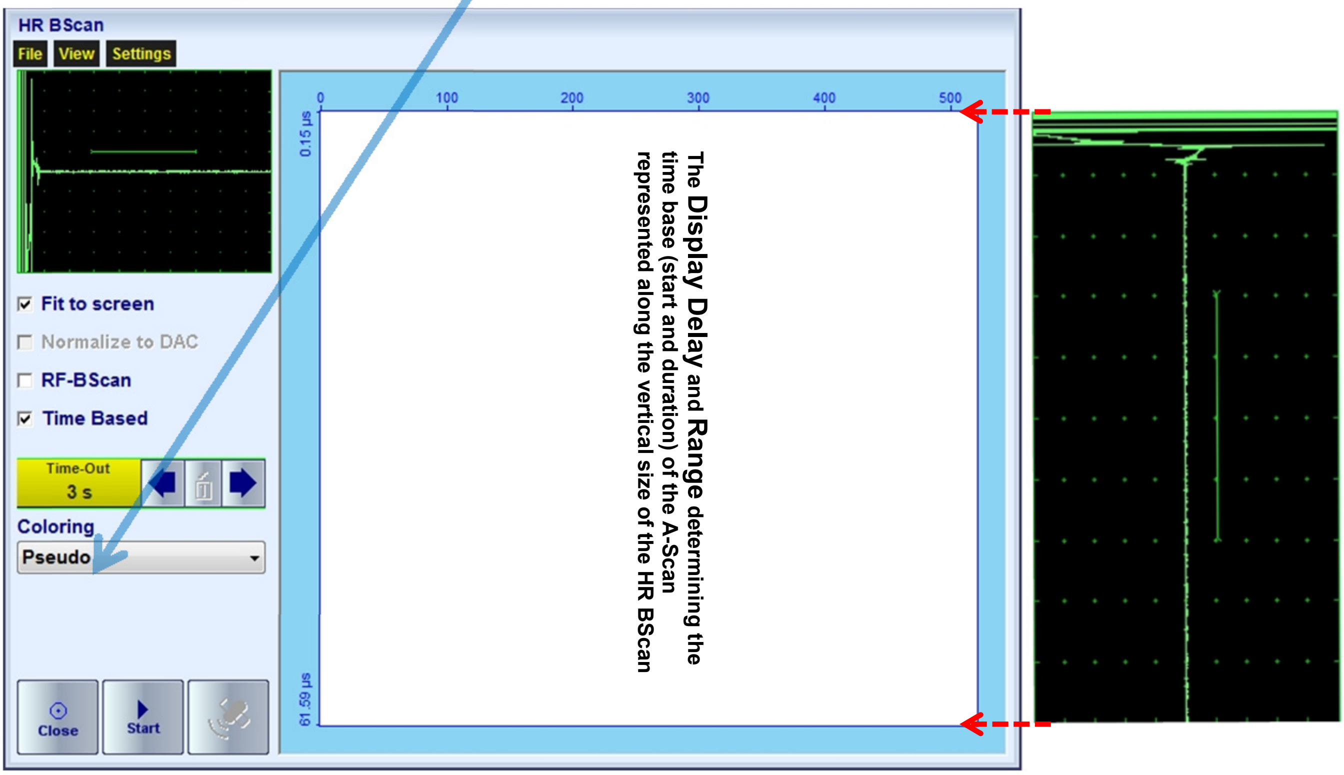
To return to the **Line Scanning and Recording Menu** click on or press on the front panel keyboard

6.7.2. HR BScan: Scanning, Recording, and Imaging – Implementation

There are both the *time based* and the *encoded* scanning and recording possible, for the time based recording check the corresponding option

Encoded recording	Time based recording
☐ Time Based	☑ Time Based

Prior to the scanning: the desired **color palette** for representing the **HR BScan** image to be settled



The color palette may be:

- selected among the plurality of available standard scales
- customized or created by the user
- uploaded from the file

In case of **DAC** is active the echo amplitudes may be color coded according to their **dB-to-DAC** values, for that purpose check the corresponding option

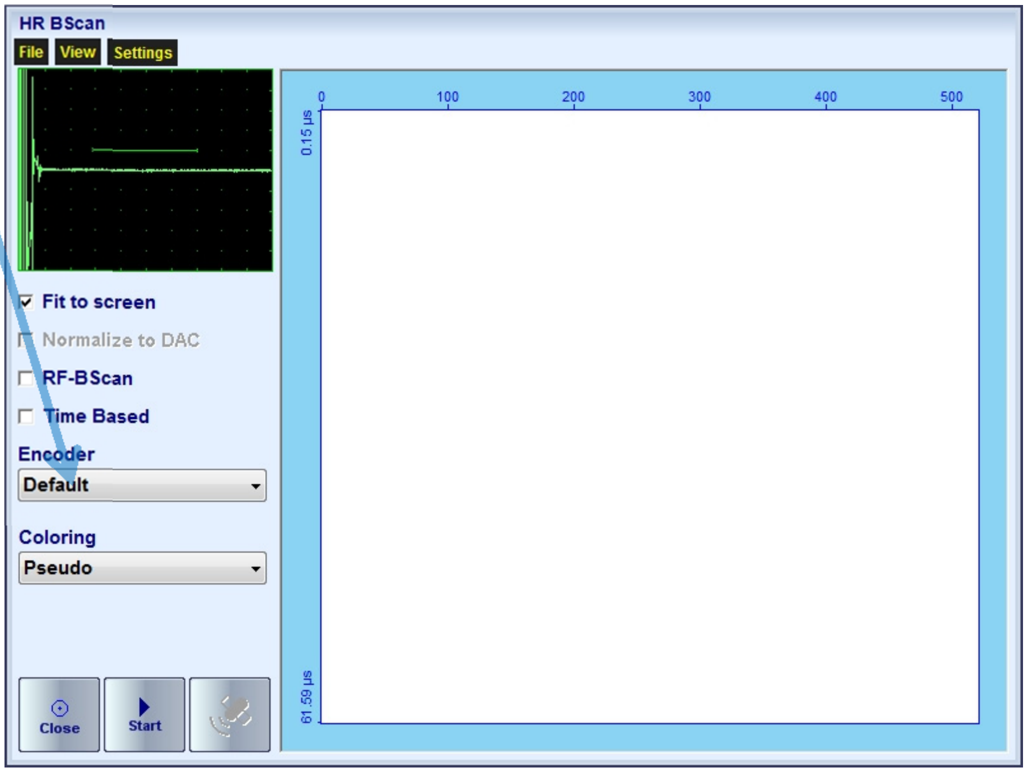
DAC normalization id OFF	DAC normalization id ON
☐ Normalize to DAC	☑ Normalize to DAC

For the *time based* recording set the required **Scan Length** and the desired duration of the scanning (**Time**). To start scanning and recording click on Start or press on I

The **Time-Out** setting determines the time interval (pause) between clicking on Start (or pressing on I) and actual start of the time-based recording. The pause may be necessary in order to prepare for the manual probe scanning that should be performed with the stable speed over the desired trace

The recoding will continue during the entire settled *scanning time* (**Time** setting). During the scanning time it is necessary to cover the desired **Scan Length** completely keeping the stable scanning speed. In order to interrupt the recording before the counting of the **Time Out** or *scanning time* completed click on Stop or press I

For the *encoded* mode fit the probe into the encoder (scanner) frame, set the required **Scan Length** and select the **type of the encoder** from the list of available. To start scanning and recording click on or press

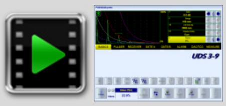


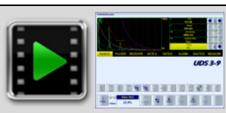
In order to complete or terminate the recording click on or press on

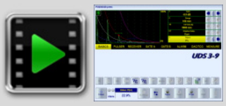
To save the **FLOORMAP L** record press or use the **File** → **Save...**

In the same screen it is possible to call **FLOORMAP L** record from the file for the viewing and postprocessing through the **File** → **Open** or pressing

The videos below illustrate sequence of operations based on the examples of performing **FLOORMAP L** recording and postprocessing

	
Youtube https://www.youtube.com/watch?v=rGLrgeJKCdg	**Download** http://sonotronndt.com/Movies1/HR_B_SCAN_GLASS_FIBER_FW_RECTIFIED_A-SCAN.mp4

	
Youtube https://www.youtube.com/watch?v=DAlSpXInPsM	**Download** http://sonotronndt.com/Movies1/HR_B_SCAN_GLASS_FIBER_RF_A-SCAN.mp4

	
Youtube https://www.youtube.com/watch?v=R8nd2XfpSU4	**Download** http://sonotronndt.com/Movies3/TRAINING_MOVIES/ISONIC_3505/i3505_HR_B-Scan_PP.mp4

To return to the **Line Scanning and Recording Menu** click on  or press 

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