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OmniScan X3 Introduction

Olympus Scientific Solutions

DSM Team | Quebec | April 2020

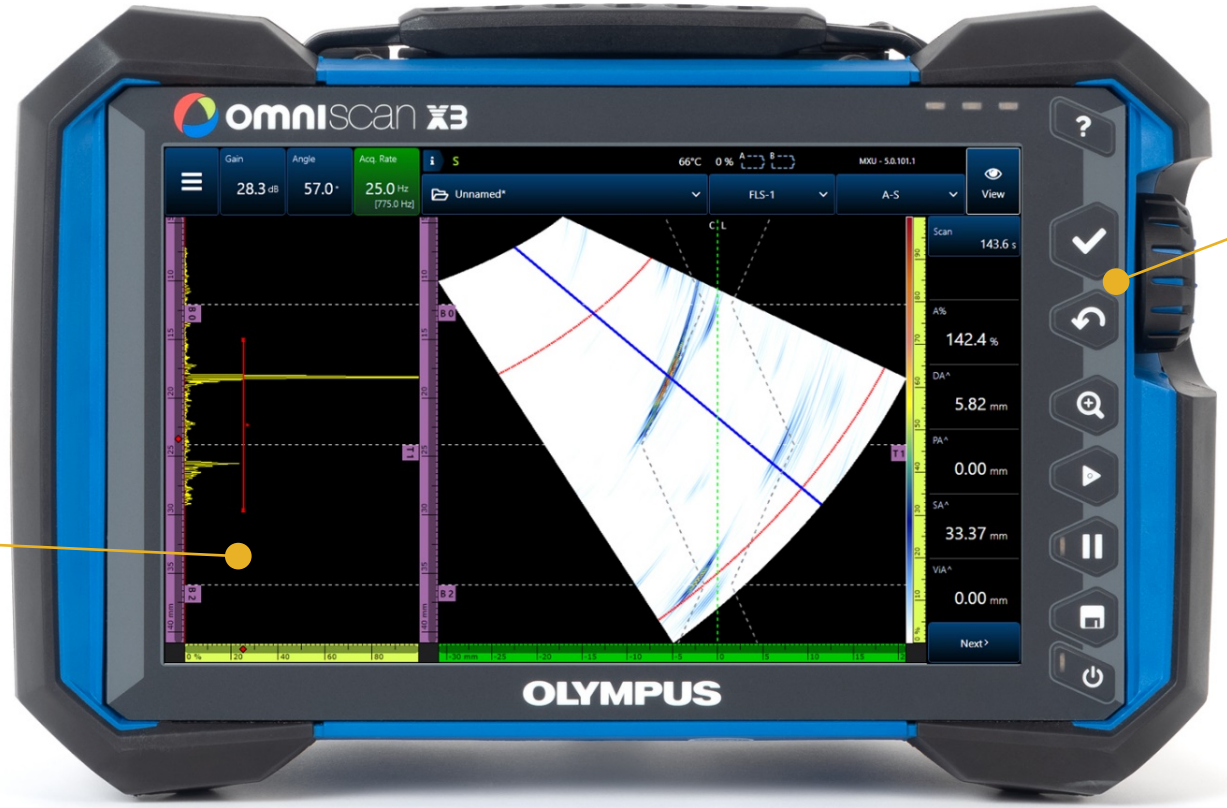
Product

omniscan X3

Top View


Two UT P/R channels
(P1-R1, P2-R2)
LEMO connector:
Encoder inputs
Alarm output
Quick connect phased
array connector

Front View



10.6-inch (27 cm), 16:9 wide resistive touch screen

Knob and direct-access keys

omniscan X3

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Left View

- With Door Open

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Back View

- Stand Open

omniscan X3

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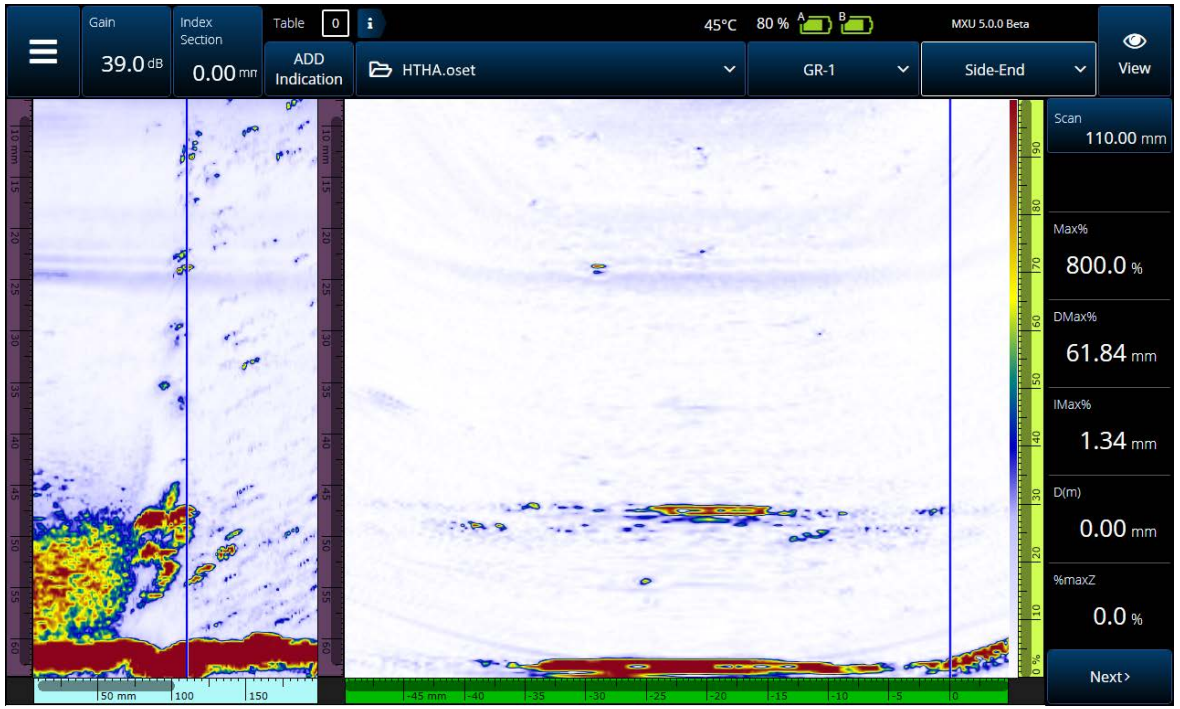
1. Innovative TFM

Live TFM Envelope Processing

New and Unique

- Provides Crisp TFM Imaging

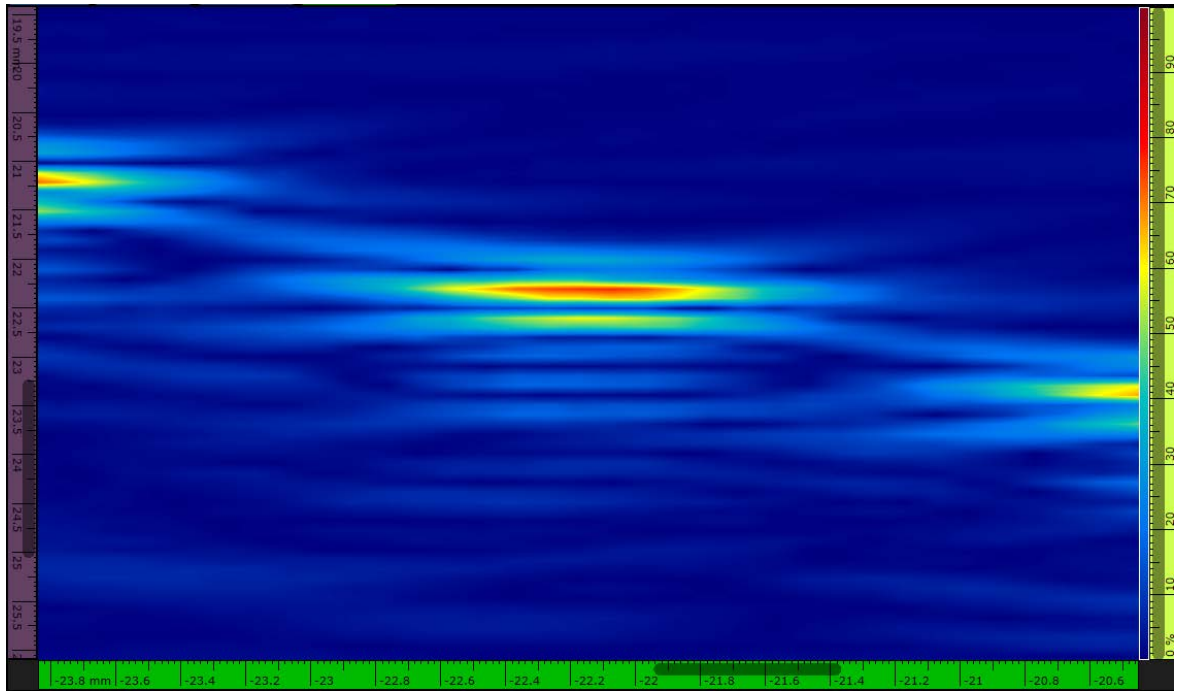
SDH Resolution Block



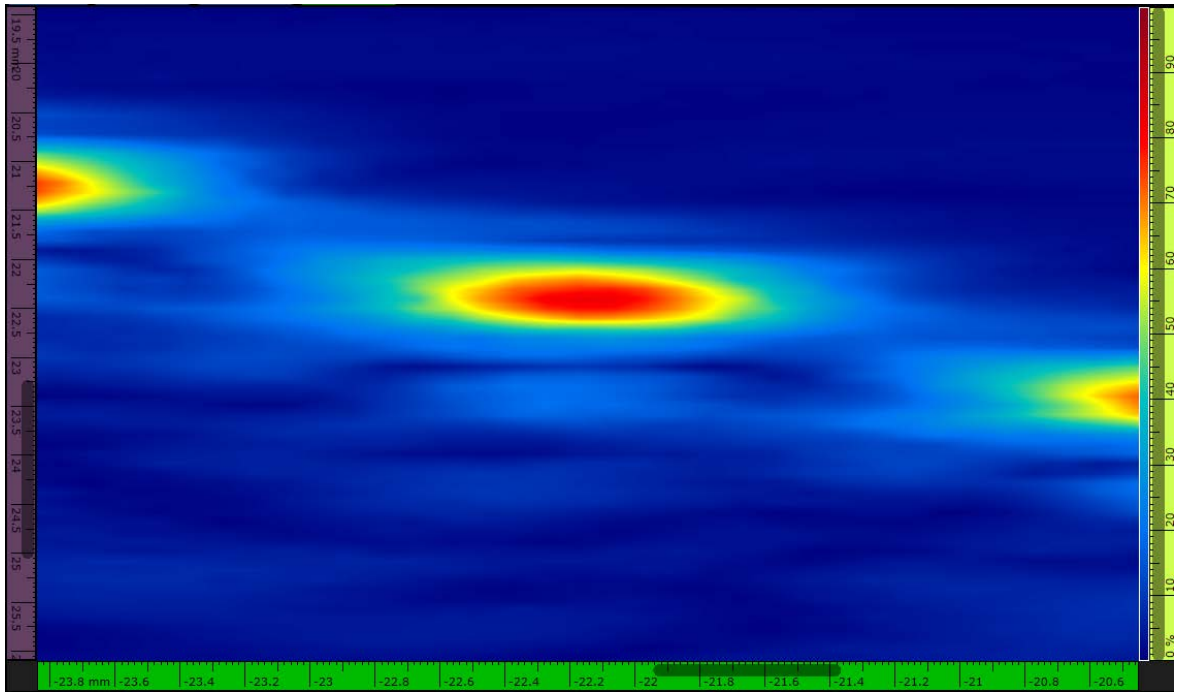
HTHA

Advantages of the Envelope Processing

- Simplified Representation



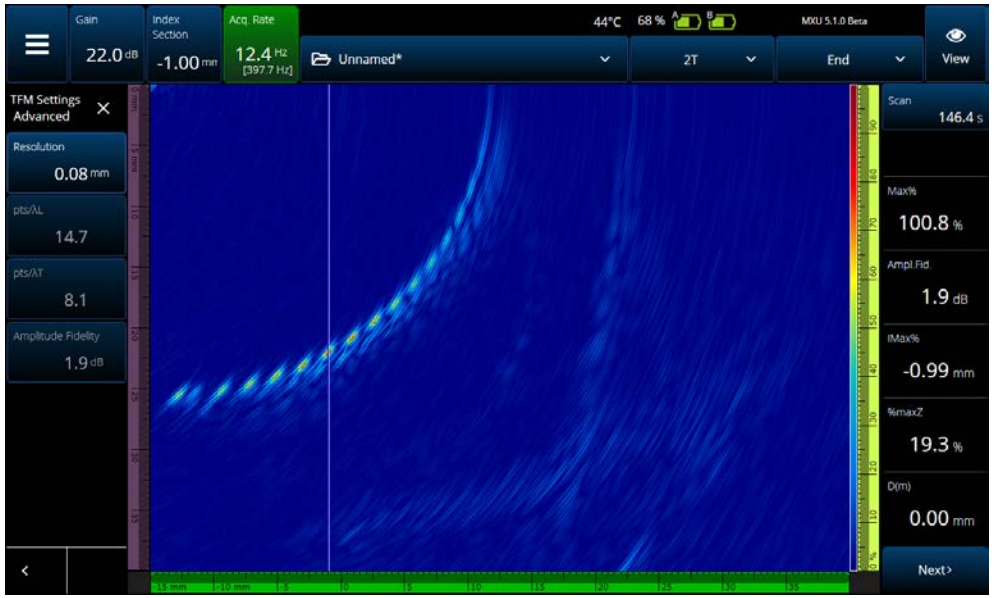
Envelope OFF



Envelope ON

Advantages of the Envelope Processing

- Lower Density Grid – Higher Productivity

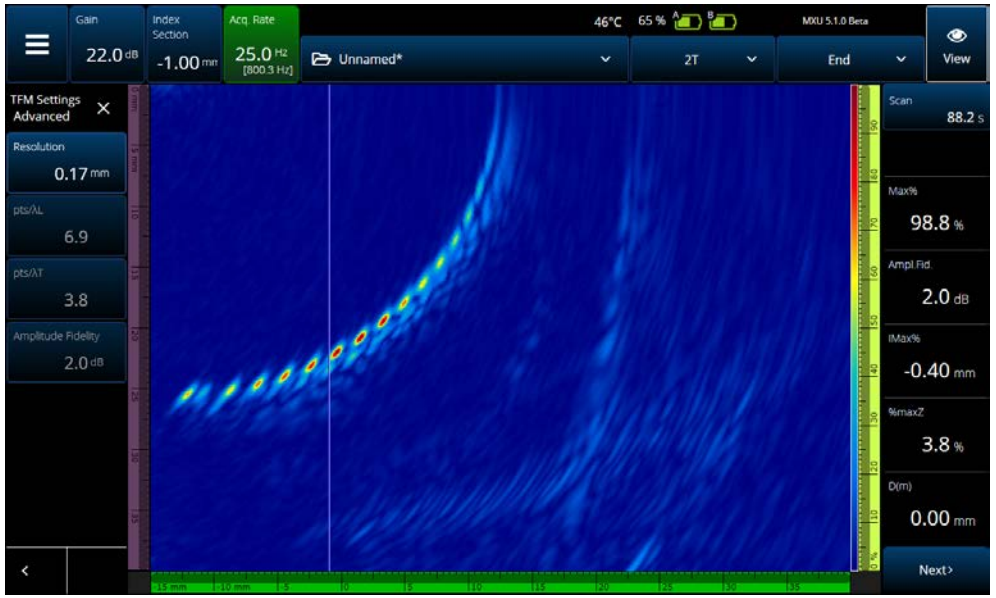


Resolution: 0.08mm (688X500 grid)

Pts/λT: 8.1 (AF: 1.9dB)

PRF: 12.4Hz

Envelope OFF



Resolution: 0.17mm (324X235 grid)

Pts/λT: 3.8 (AF: 2.0dB)

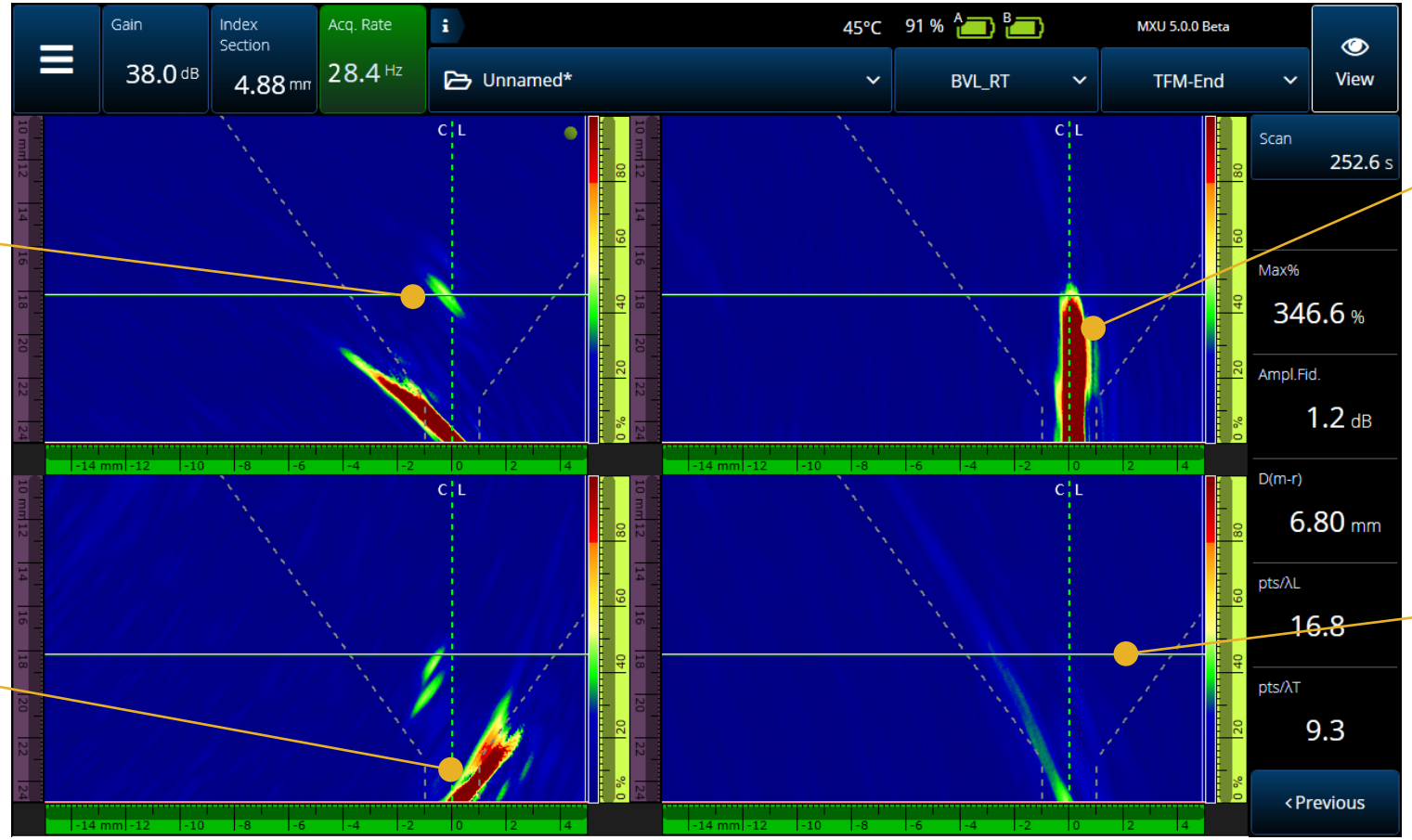
PRF: 25.0Hz

Envelope ON

40mm thick carbon steel demo block, 5L32-A32 probe, 55mmX40mm zone, TT wave set.

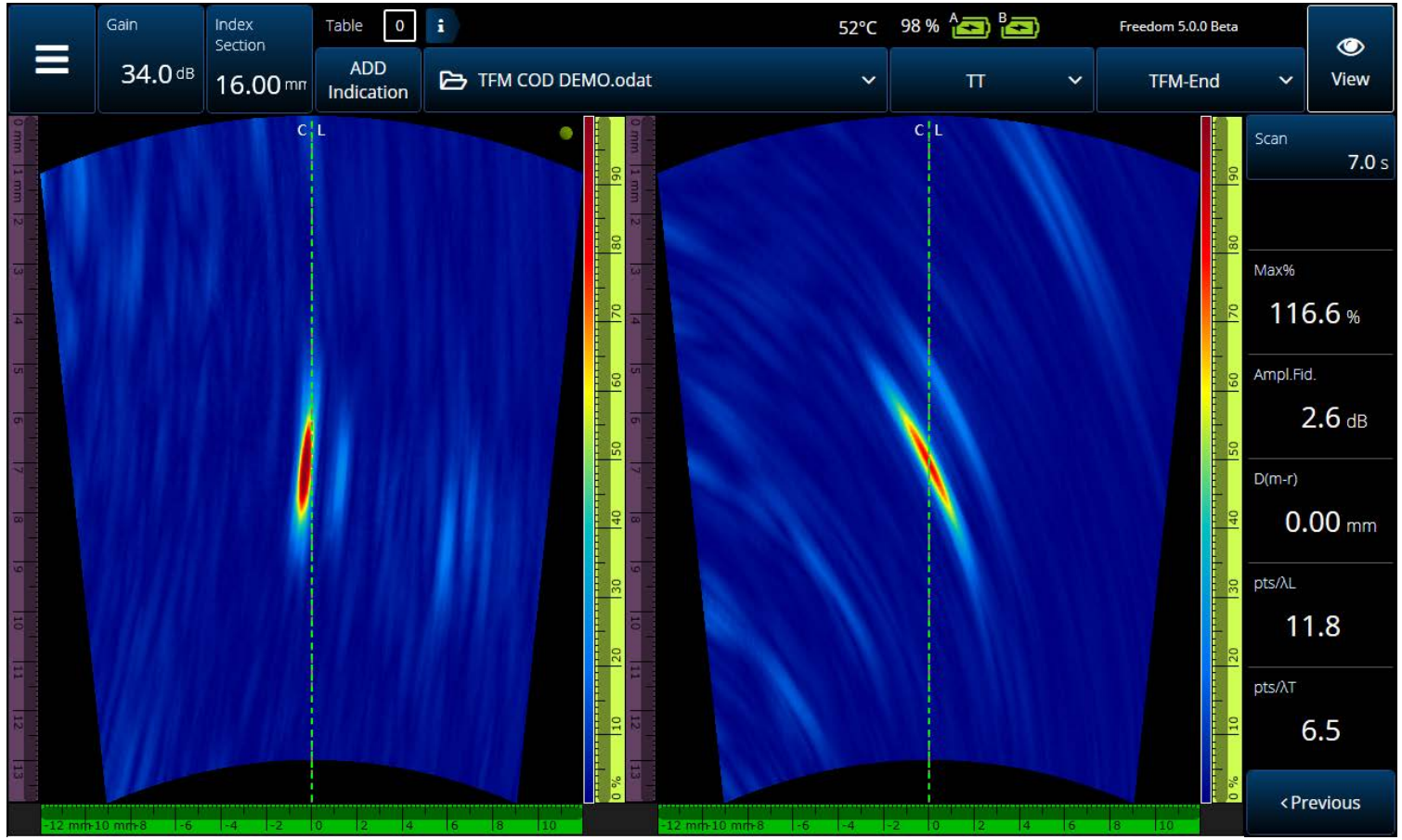
4 TFM Modes

- Facilitate Interpretation and Sizing



TFM and COD

- Excellent Pipeline Integrity Tool



Improve Your "AIM"

New and Unique

- Onboard Acoustic Influence Map

- Visualize the coverage of Wave Sets (TFM modes)
- See where sensitivity stops
- Adjust the scan plan accordingly

Cost-Effective 64-Element TFM

32:128PR for all your PAUT needs

64-element TFM when you need it

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2. Improved Phased Array

Double Your Speed

- Compared with the OmniScan ™ MX2 Flaw Detector

12KHz

Any View

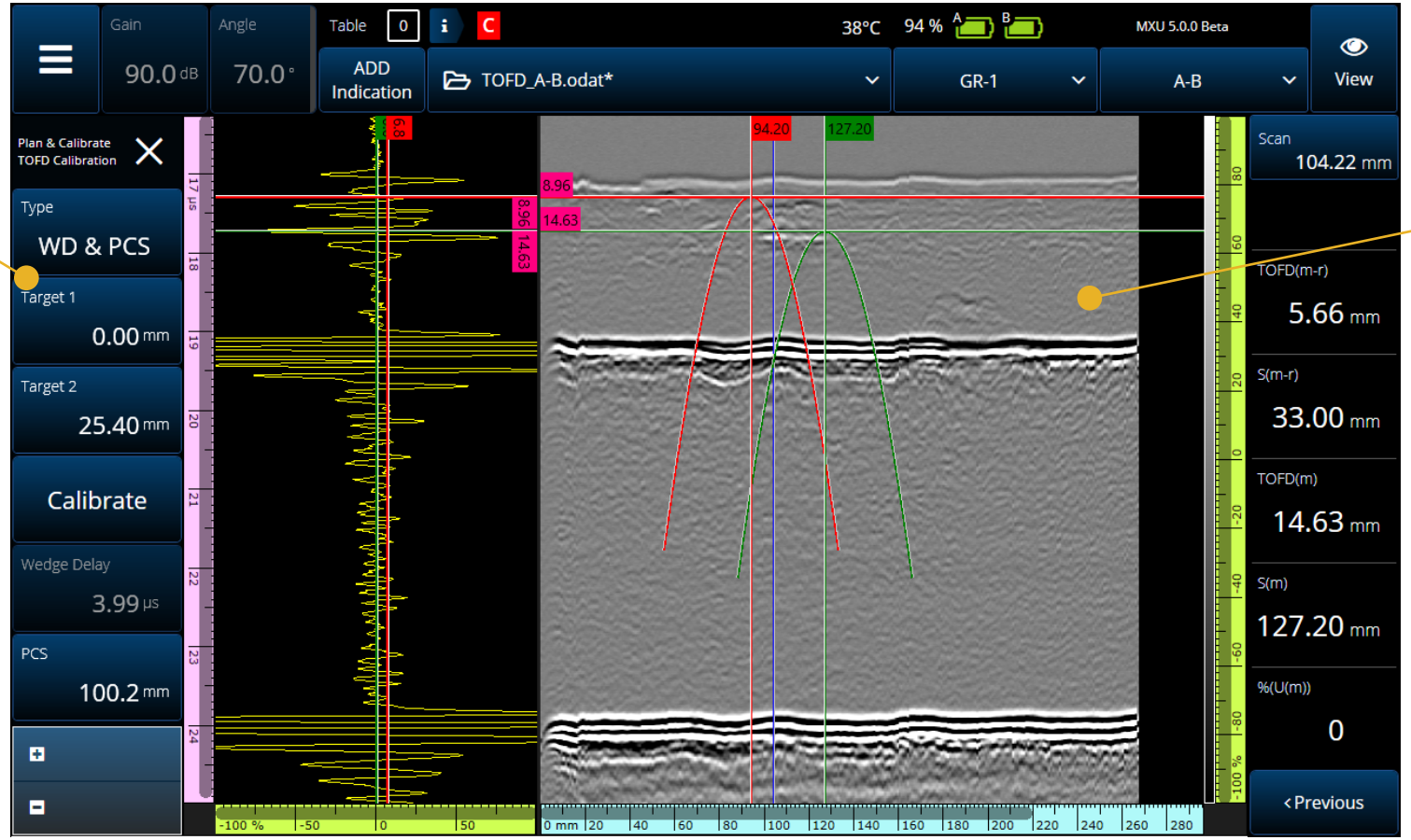
6KHz

When showing S-Scan

Improved TOFD Experience

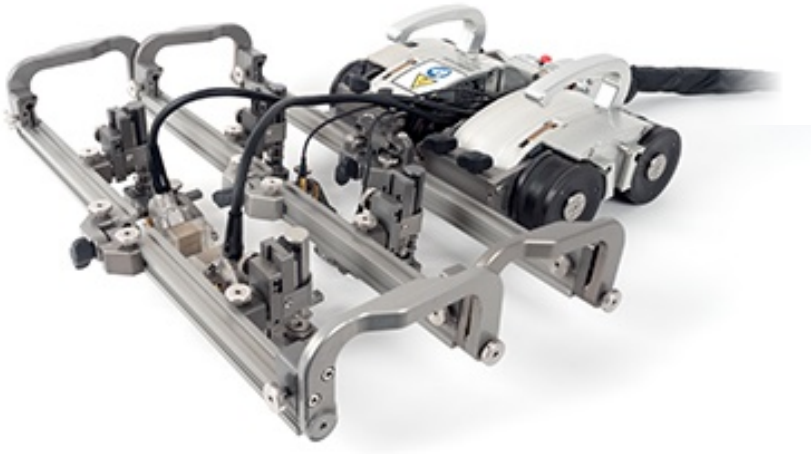
- Simplified Interface Reduces the Number of Steps

Single TOFD menu



High-quality TOFD signals

Compatible with Existing Probes and Scanners



Weld Scanners

Corrosion Scanners

Aerospace Scanners

Fully Compatible

OmniScan MX2 and MX1 File Compatibility

MX1

MX2, SX

Setup

Setup

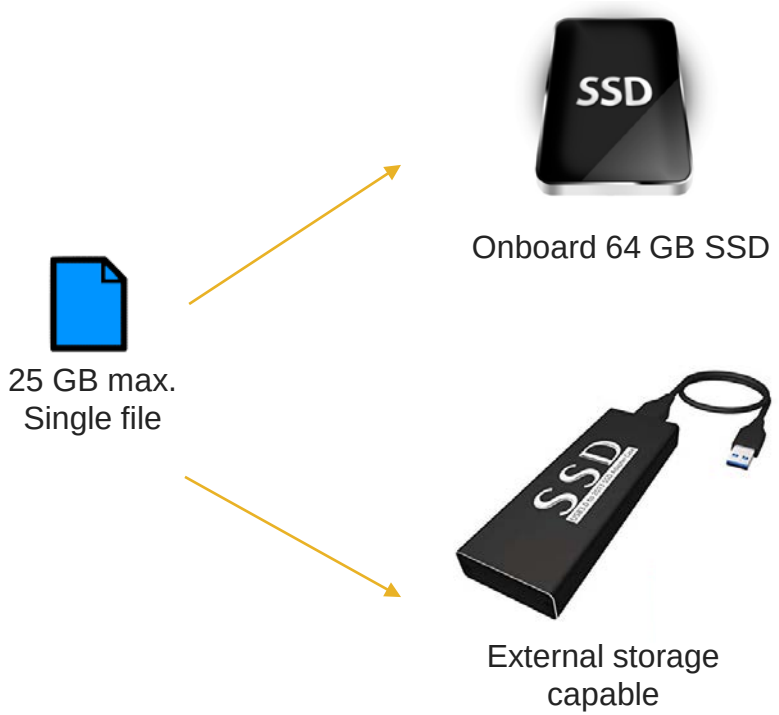
Data

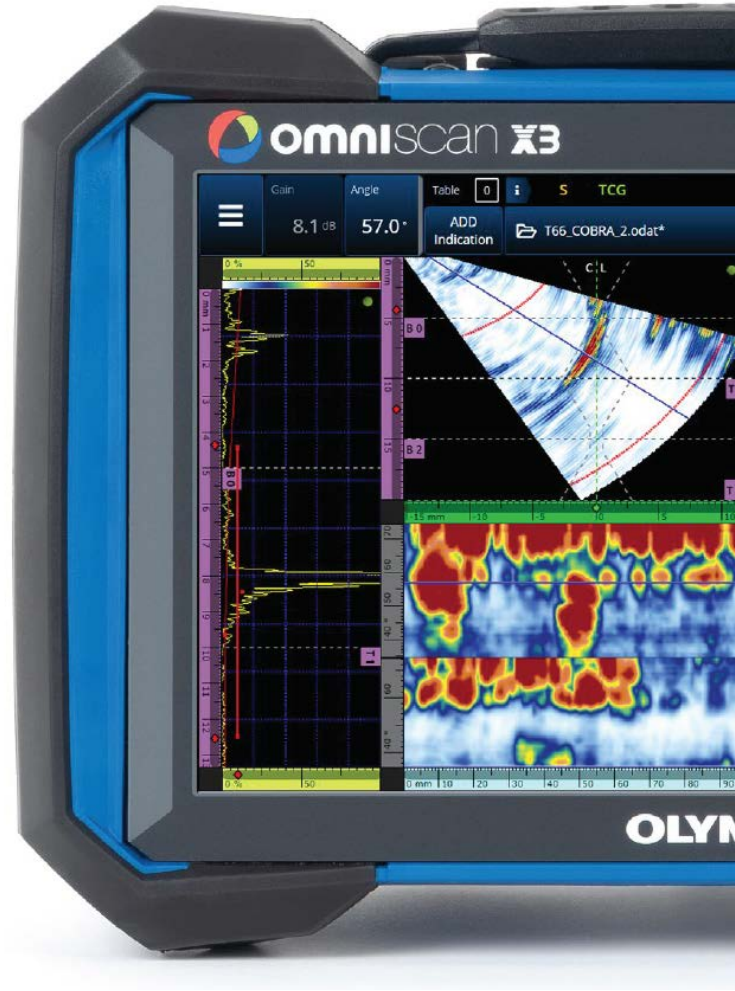
2010 2016 2018 2019 2020 2022 2025

Review Data over Time

Comply with Older Procedures

Larger Files, Flexible Storage





Optimized File Size for Big Jobs

- 25GB Maximum File Size Expands the Possibilities

10m (33ft) Weld (1)

13m^2 (140ft^2) Area (2)

20m (65.6ft) Diameter (3)

(1) A single scan using 4 TFM groups optimized for a thickness of 50mm.
(2) Scan up to a single 7.6m X 1.7m storage tank plate with 1mm X 1mm resolution using the HydroFORM ™ scanner.
(3) A single pass of a wind tower weld using 4 sector scans, 2 linear scans and 2 TOFD groups.

File Transfer Options

USB 3.0 drives (fastest)

SD card (legacy)

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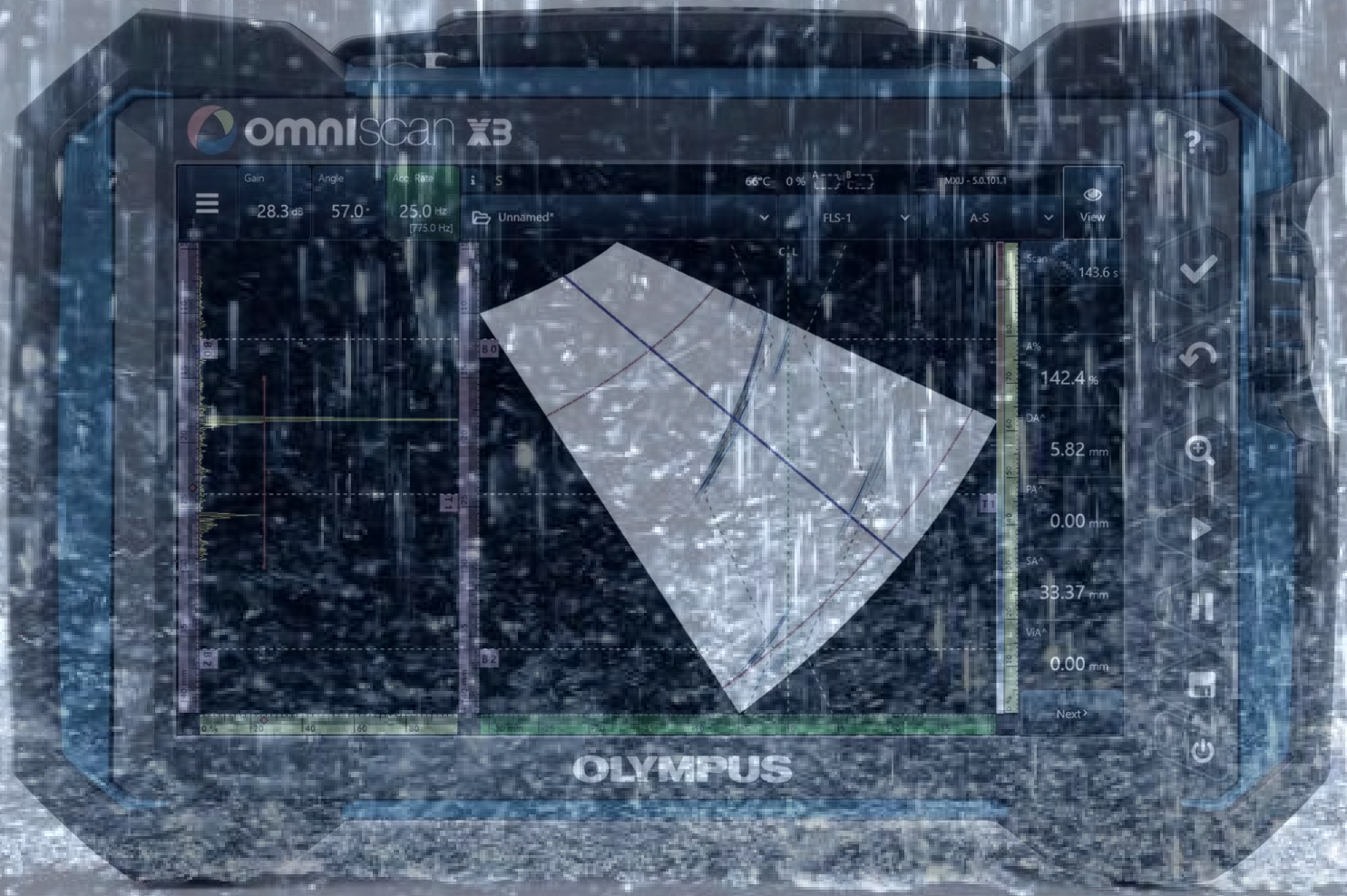
3. Reliable and Easy to Use

Certified IP65



Rain and Dust Proof

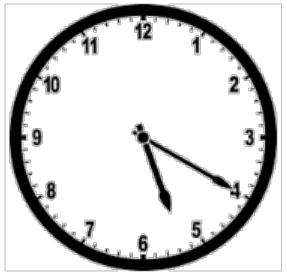
User-Replaceable Cooling Fan

- Enclosure Remains Sealed

Unit still works without fan
(overheats faster)

Prevents voiding
IP65 and calibration

Existing OmniScan Batteries



Unit still works without fan
(overheats faster)

Prevents voiding
IP65 and calibration

Onboard GPS*

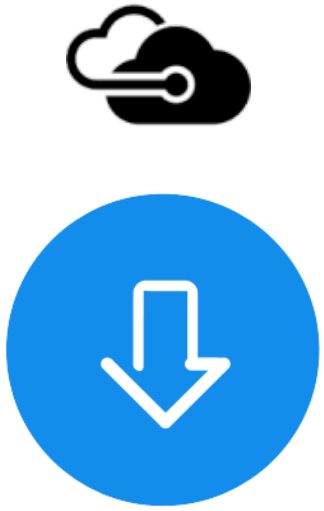
GPS TECHNOLOGY

Data includes time stamp and GPS position

* As of the product launch date, GPS is restricted in China and prohibited in Saudi Arabia

Wireless Connectivity to the OSC*

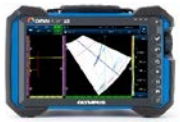
(Olympus Scientific Cloud ™)



Download Latest Software

* Requires regional WLAN dongle, which is sold separately.

Three Models to Choose From



Specification	16:64PR	16:128PR	32:128PR
Targeted application	Manual PA/TFM, pipeline integrity, small pipes, corrosion	High productivity weld, composites	High productivity weld, austenitic, CRA, HTHA, thicker walls
Pulsers (PA)	16	16	32
Receivers	64	128	128
TFM elements	32	32	64
UT channels (P/R)	2	2	2
Groups	Up to 2 PA + 1 UT or up to 2 TFM	Up to 8 total TFM: up to 4	Up to 8 total TFM: up to 4
All other specifications	Identical		

OMNISCAN X3

Confidence You Can See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Scan Plan - Part & Weld

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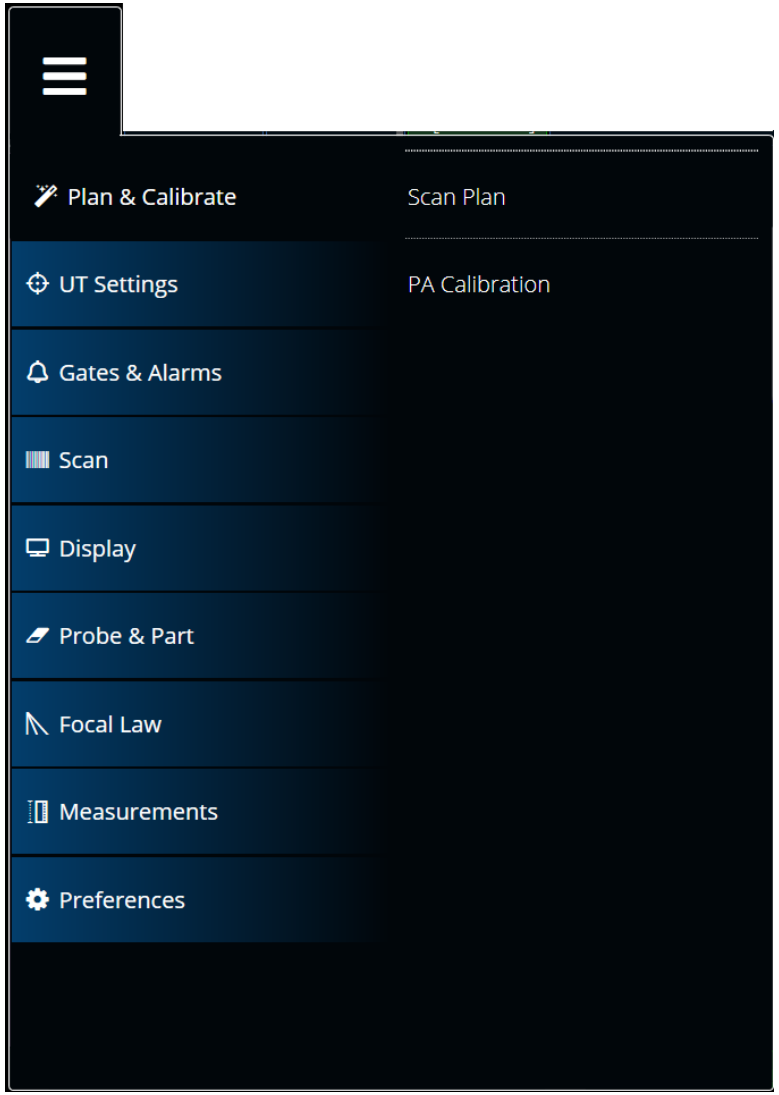
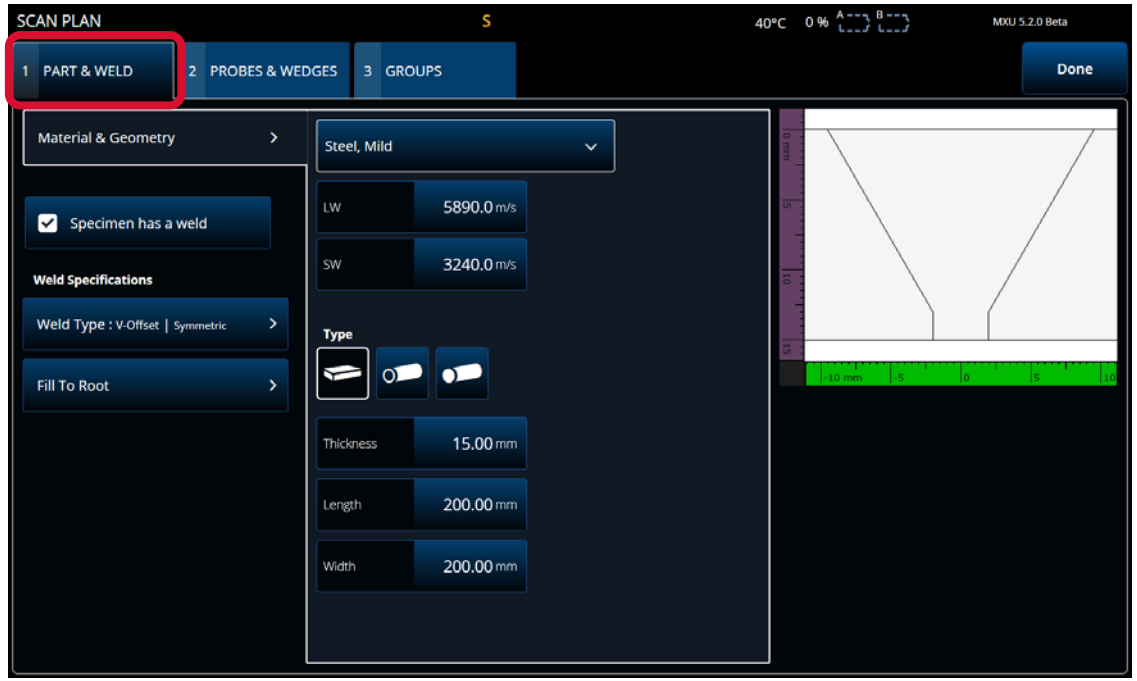
Scan Plan - Overview

- The OmniScan X3 Scan Plan wizard is designed to make the task of creating, modifying, or deleting new groups fast and efficient.
- The software will give us step by step guidance in a logical sequence for populating the essential parameters required by the focal law calculator for beam formation.
- Additionally, during the wizard steps many parameters of the inspection such as the weld overlay, scanner information, probe orientation, etc. will be populated as well.



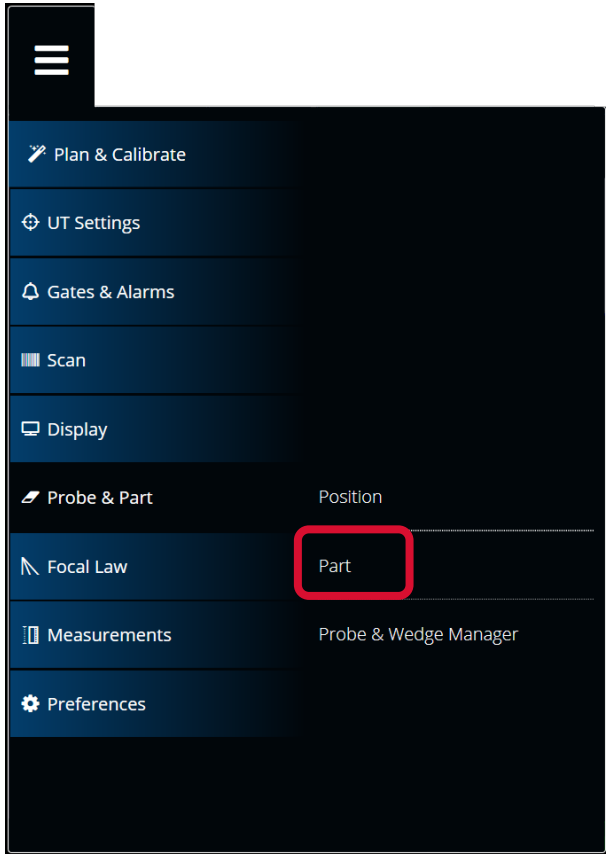
Part & Weld - Overview

- The Part & Weld tab is the first of three primary wizard functions that are used to prepare an inspection or “.oset” file in the X3.
- The parameters of the Part & Weld wizard are common to all of the groups created.
- The part wizard contains the following functions that are common to all groups in the setup:
  - Material. This will associate two velocities to the group. One for shear and one for longitudinal.
  - Material Thickness.
  - Part geometry: Plate\Tube and dimensions.
  - Scan orientation: axial or circumferential.
  - Weld Overlay creation. Weld overlays assist in analysis by superimposing an image of the weld on the data.
- Part and Weld representation is updated as both are defined.



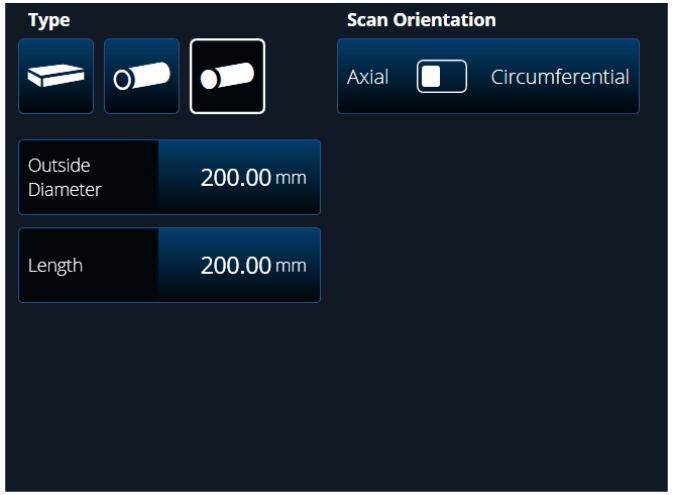
Part & Weld – Part Thickness

- The material thickness is not directly related to the focal law formation but is necessary for the skip lines on the A-scan and S-scan, and the trigonometry readings such as DA. (Depth of signal in gate A)
- Material thickness is entered during the part wizard process and can also be modified in Probe & Part > Part menu.
- Part thickness can be changed at anytime without affecting the beam or calibration.



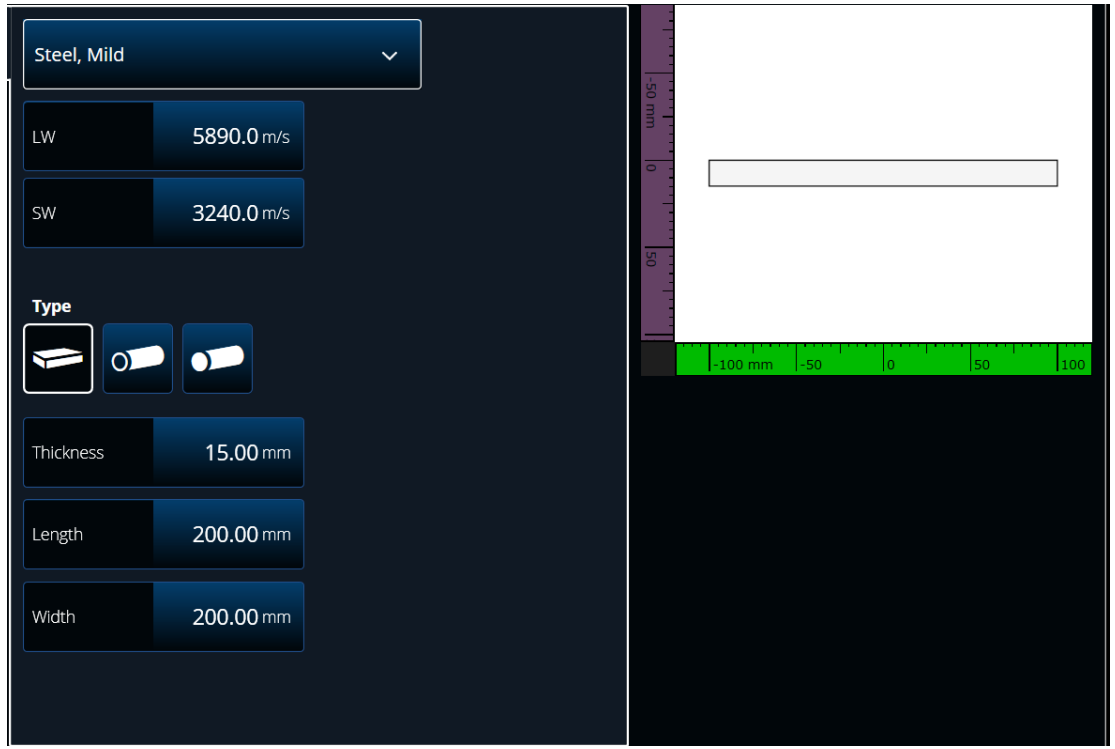
Part & Weld – Material & Geometry

- The material and geometry is the first step of the Part definition.
- Selecting the Material presets values for both the LW and SW. This is common to the different geometries of parts.
  - The material velocity values can be manually edited.
- The Type of material will update the representation as well as provide different dimensions to fill:
  - Plate: Thickness, Length, Width.
  - Tube: Thickness, Length, Scan Orientation, and Outside Diameter.
  - Bar: Outside Diameter, Length and Scan Orientation.
- A Tube Axial scan also as an additional Angular Opening field.



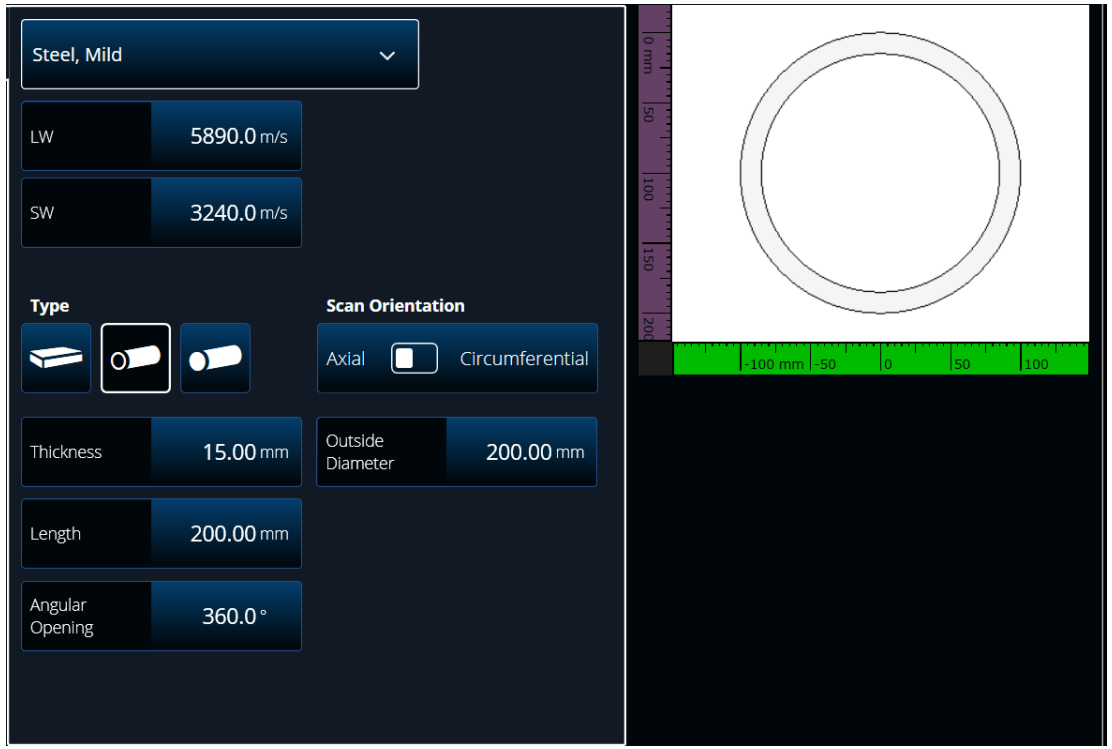
Part & Weld – Plate definition

- The plate geometry is used to represent flat surfaces.
- It is also possible to consider a curved surface as flat and to use a flat calibration block and wedge if the material allows it and the diameter is large enough.
  - Conditions are written in the code governing the inspection such as ASME, ISO or other.
- Thickness of the material should be as accurate as possible to respect the scan plan and to calculate the trigonometry readings.
  - It is that much more important when defining a TFM scan plan because of the data processing involved to convert FMC data to TFM.
- Length and Width parameters are used for the part representation.
  - Make sure the part is wide enough to allow the probe and wedge to sit on it completely. It should not be too wide either as this will affect the zoom ratio of the representation and make the visualization difficult



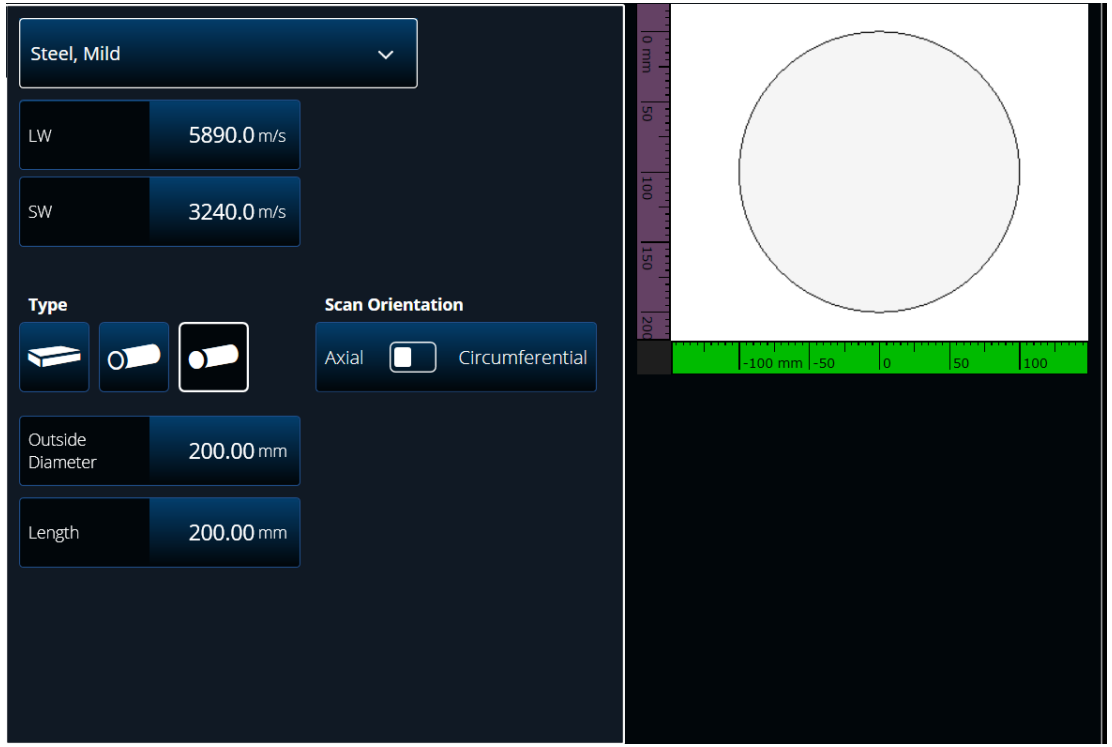
Part & Weld – Tube definition

- The tube geometry is used to represent a curved surface with a thickness, meaning that it is hollow.
- In addition to the parameters for a plate, we also define:
  - Scan Orientation.
  - Outside Diameter.
  - Angular Opening.
- Scan Orientation:
  - It refers to the movement of the probe.
  - Axial follows the length of the part and uses COD wedges.
  - Circumferential follows the circumference of the part and uses AOD wedges.
- Outside Diameter:
  - Outside diameter of the part, in mm or inches.
  - The outside diameter cannot be less than 2X the thickness.
- Angular Opening:
  - Only available for Axial scan orientation.
  - It defines the portion of a complete circle that will be represented.



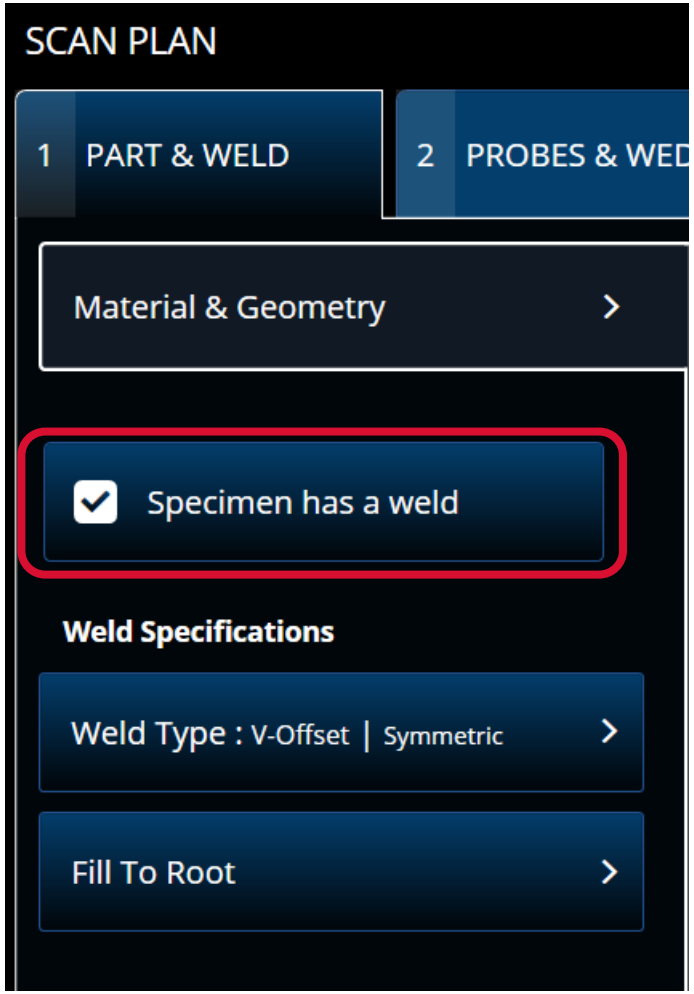
Part & Weld – Bar definition

- The bar geometry is used to represent a curved part that is full such as billets.
- The parameters to fill are quite similar to the tube with the exception of the thickness that is not available.
  - Since a bar is considered a full part, only the diameter is useful to define it.
- Note that no weld configuration is possible with a bar.



Part & Weld – Weld Selection

- Defining a weld has no impact on the focal generation, whether we use Conventional UT, Phased Array or TFM.
- The weld definition, and later-on weld overlay, are tool to help the operator during the scan plan definition and data interpretation.
- The weld geometry is updated on the scan plan throughout the Scan Plan wizard and helps to select the proper probe, position it correctly to not interfere with any obstacles and also to validate adequate coverage:
  - Perpendicularity to the bevel.
  - 100% volume coverage.
  - Other criterias as defined by the inspection procedure.
- When checking the Specimen has a weld box, weld definition parameters become available.
  - Weld Type is used to select the primary weld geometry.
  - Fill to Root is used to define the weld as per the engineering drawings.

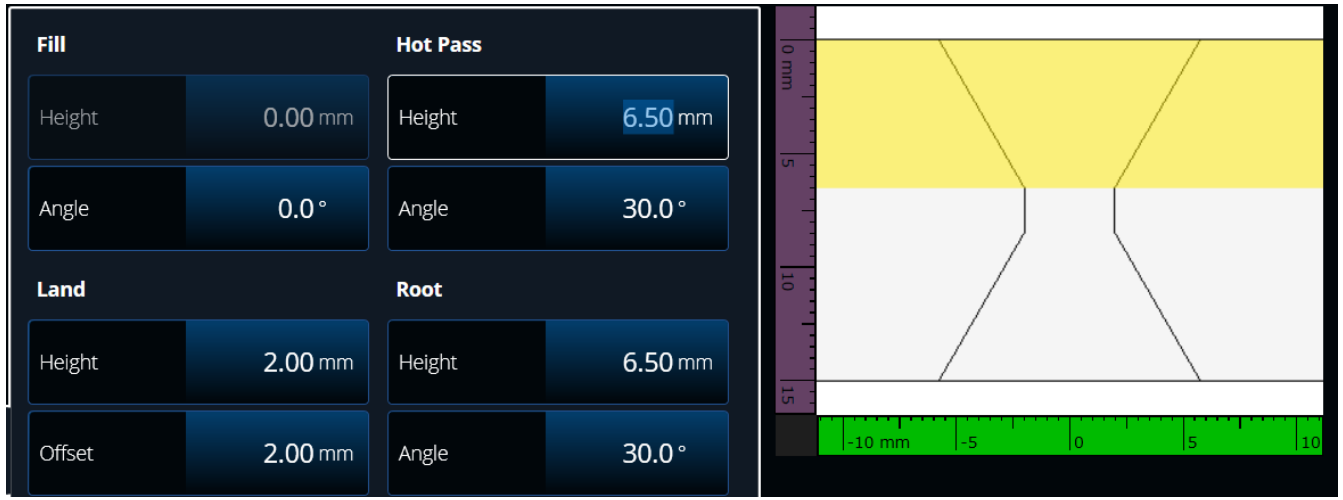


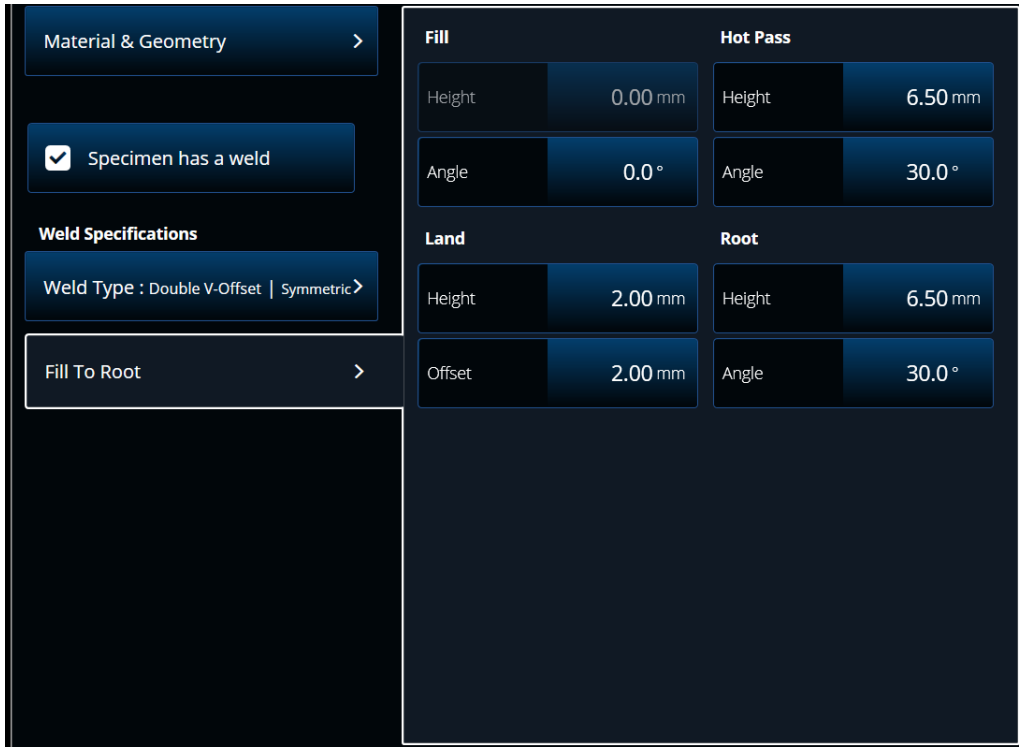
Part & Weld – Weld Type

- Using the Weld Type tab, 2 sets of parameters are available, each being a single item selection:
  - Weld Template.
  - Symmetry Type.
- Modifications to the weld type and the different weld areas parameters will update the weld representation.
- Weld Template:
  - 6 selections are available to cover most of the butt joint weld configurations.
  - The selected configuration will affect the parameters of the Fill to Root tab so that only the required parameters are available.
- Symmetry Type:
  - Allows to define a symmetrical weld preparation or asymmetrical where one side of the weld is flat.

Part & Weld – Fill to Root

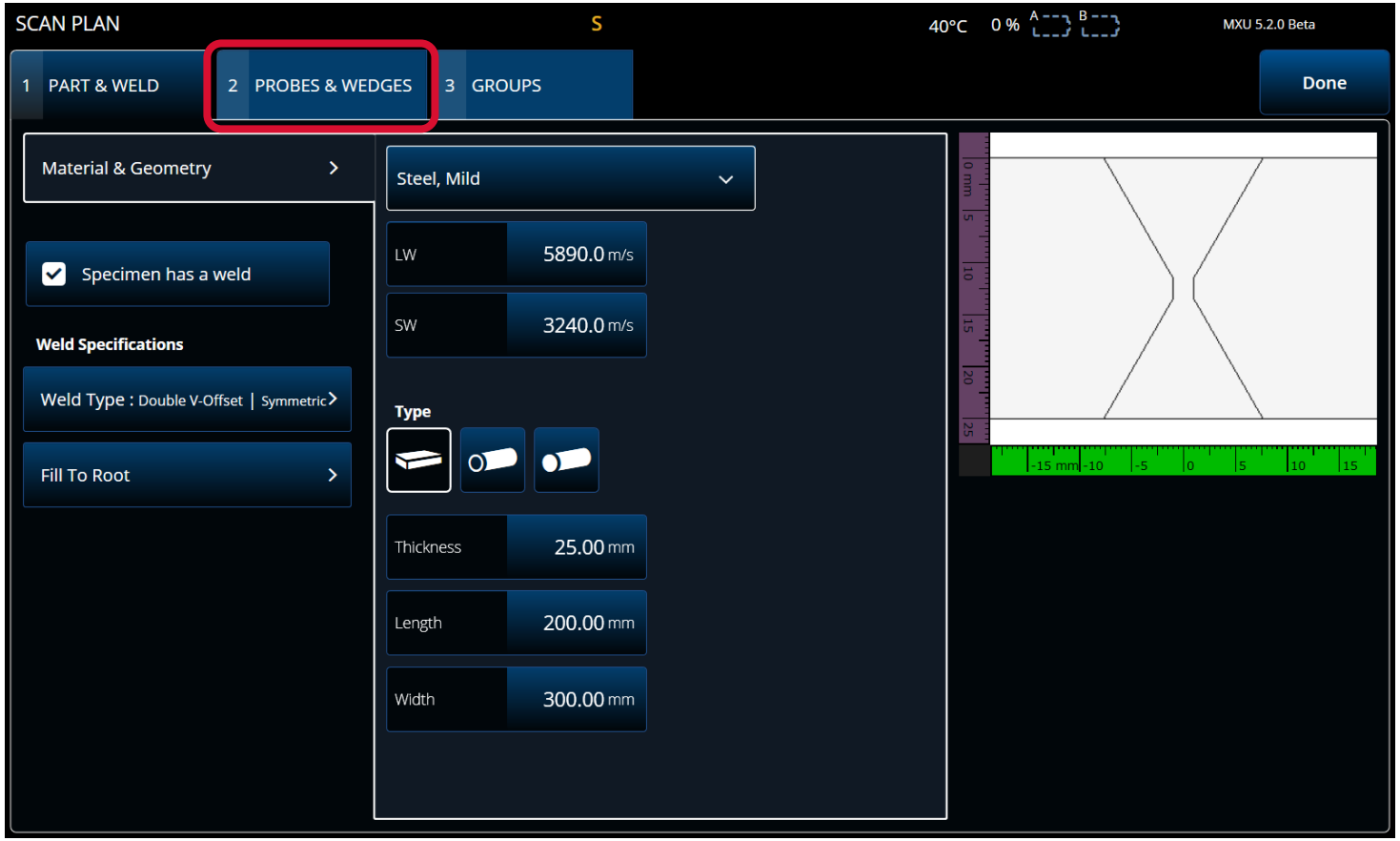
- Fill to Root is used to define the weld as per the engineering drawings.
- Parameters of Height, Offset and Angle are available for the different components of the weld.
- To assist the operator during this step, selecting a parameter highlights the associated region on the weld representation.





Part & Weld – Completed

- Once the part is defined to match the engineering drawing, the Part & Weld is completed and you can proceed to the next tab: Probe & Wedge.

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Scan Plan – Probe & Wedge PA

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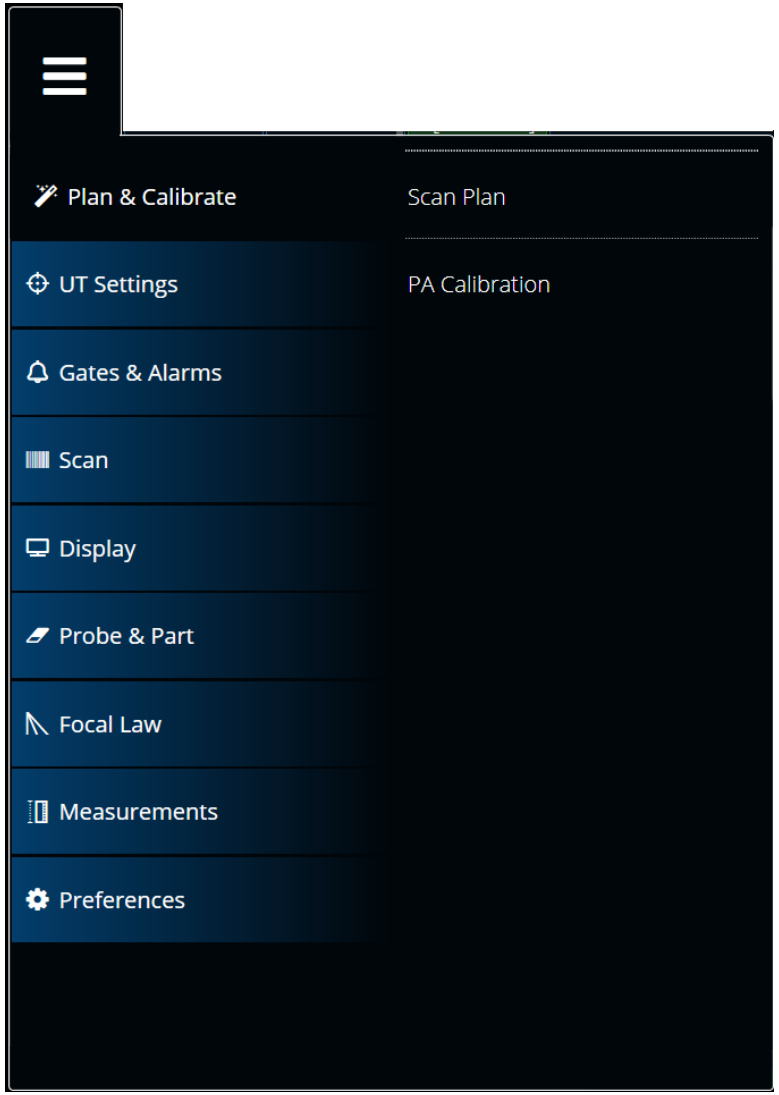
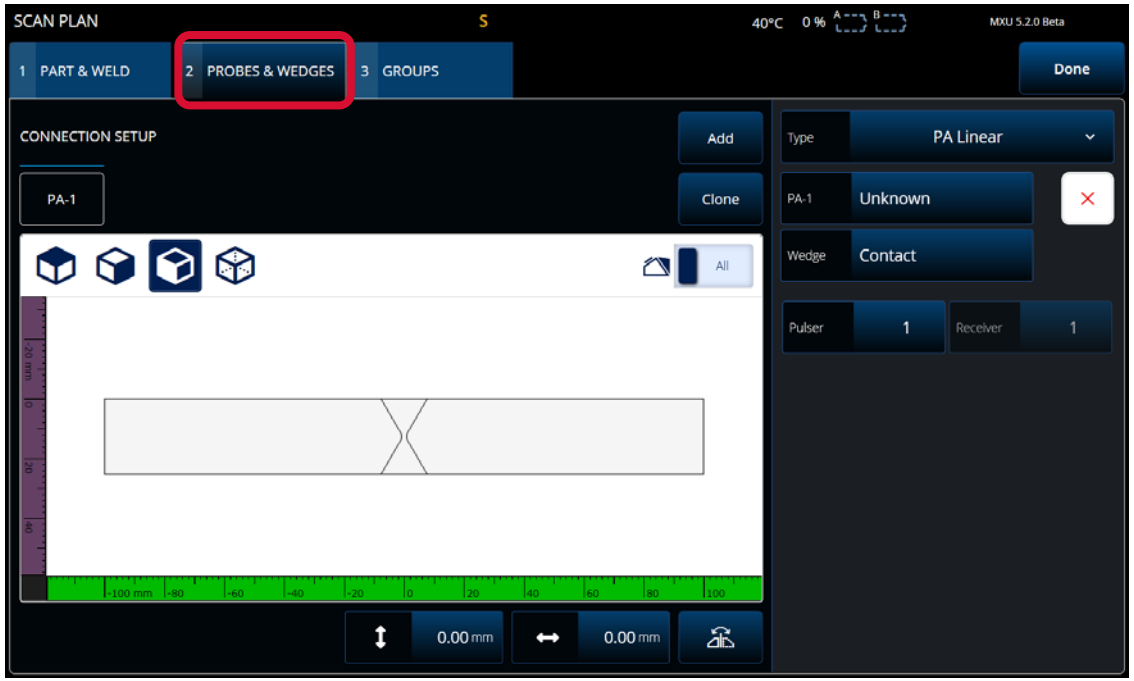


Probe & Wedge PA - Overview

- The Probe & Wedge tab is the second of three primary wizard functions that are used to prepare an inspection or ".oset" file in the X3.
- This section should be done after completion of the Part & Weld section since the weld geometry and part thickness will have an impact on probe and wedge positioning.
- The Probe and Wedge wizard contains the following functions :
  - Add and Remove Probe, including the ability to Clone an existing probe.
  - Probe type selection.
  - Probe and Wedge selection.
  - Pulser selection.
  - Probe and wedge positioning.
  - Different view options and perspectives.
- Scan Plan representation is updated as parameters are defined.

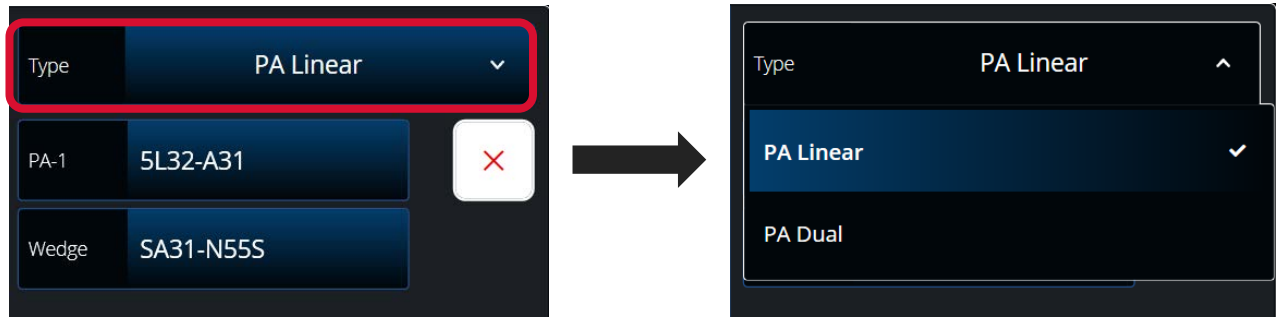


Probe & Wedge PA – Probe and Wedge selection

- The Probe & Wedge tab is the step to define the probe, single or multiple, that will be used for the inspection.
- The default probe is a Phased Array one.
  - The default probe has no dimensions or parameters so it is important to select one.
- There are 3 selections to do:
  - Probe type: Linear or Dual.
    - Note: different X3 models might not offer the same Dual selections as the higher models.
  - Probe: a temporary pane opens for probe selection. First select the probe series on the left-hand side, then the model on the right-hand side.
  - Wedge: similar to the probe selection, a temporary pane opens with the wedges from the same series as the selected probe by default. All wedges can be accessed by selecting the Show All button.

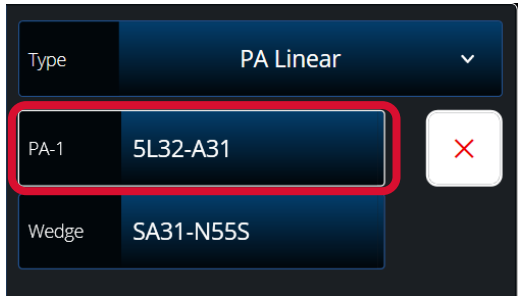
Probe & Wedge PA – Probe Type selection

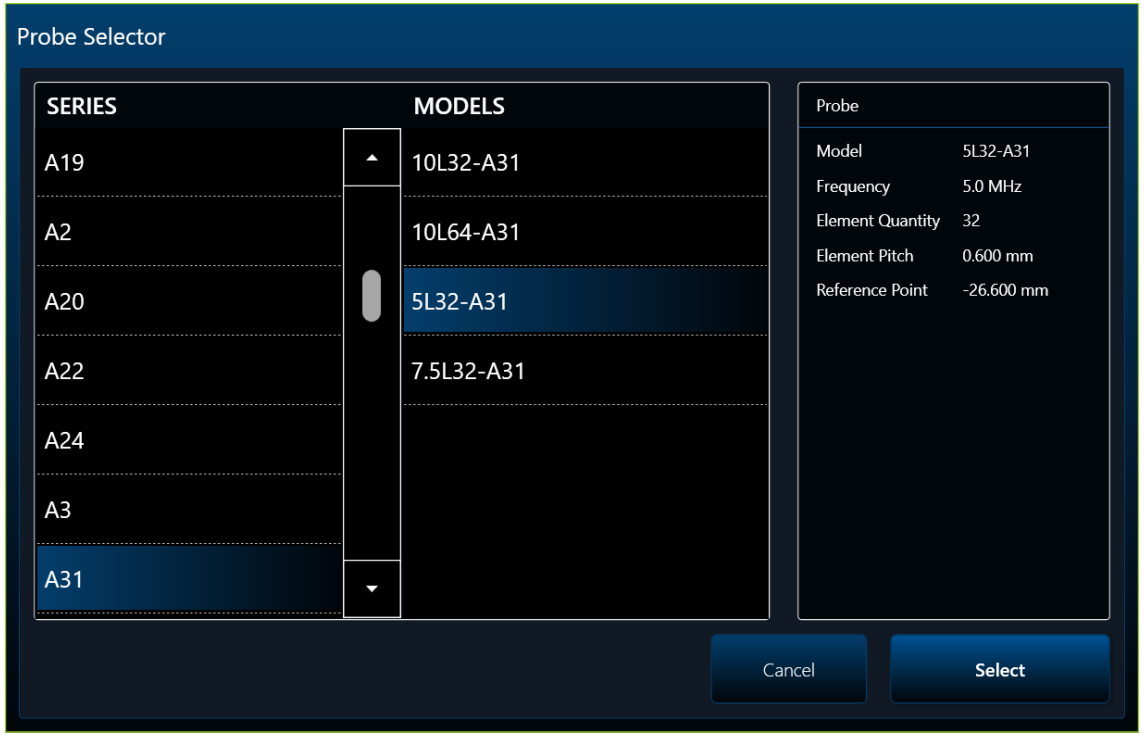
- Probe type: Linear or Dual:
  - Note: different X3 models might not offer the same Dual selections as the higher models.
- With the OmniScan X3, Linear and Dual probes from the standard offer are managed the same way:
  - Probe selection.
  - Wedge selection.
  - Focal law configuration.
- No need for an external calculator.



Probe & Wedge PA – Probe selection

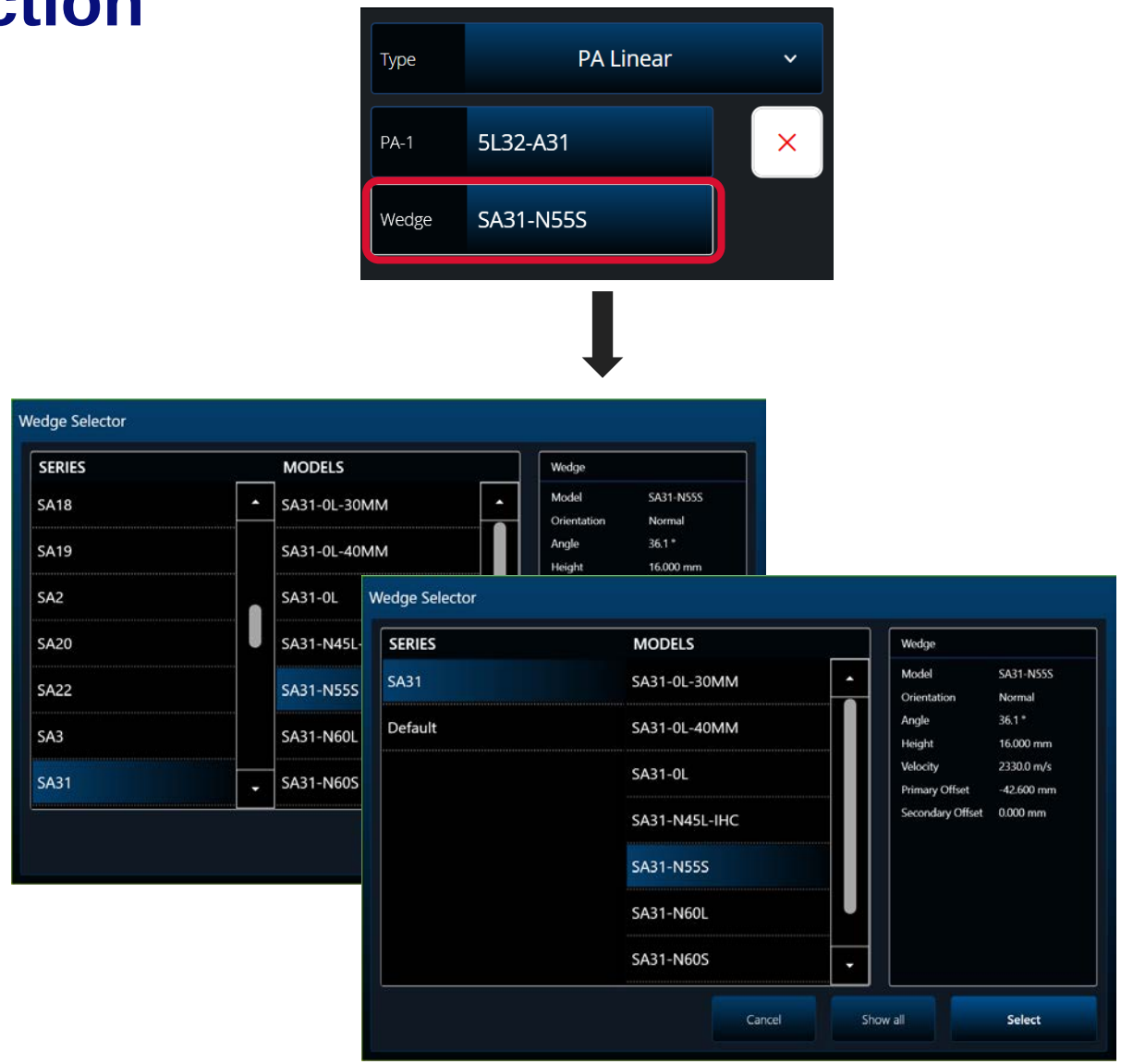
- Probe:
  - A temporary pane opens for probe selection.
  - First select the probe series on the left-hand side
  - Then select the model on the right-hand side.
- Customs probes cannot be created from the Scan Plan wizard.
- They can be created from the main screen menu, using the Probe & Part > Probe & Wedge Manager.
- The saved user defined probes can be selected during the Probe & Wedge wizard. They are located under User at the end of the probe series list.





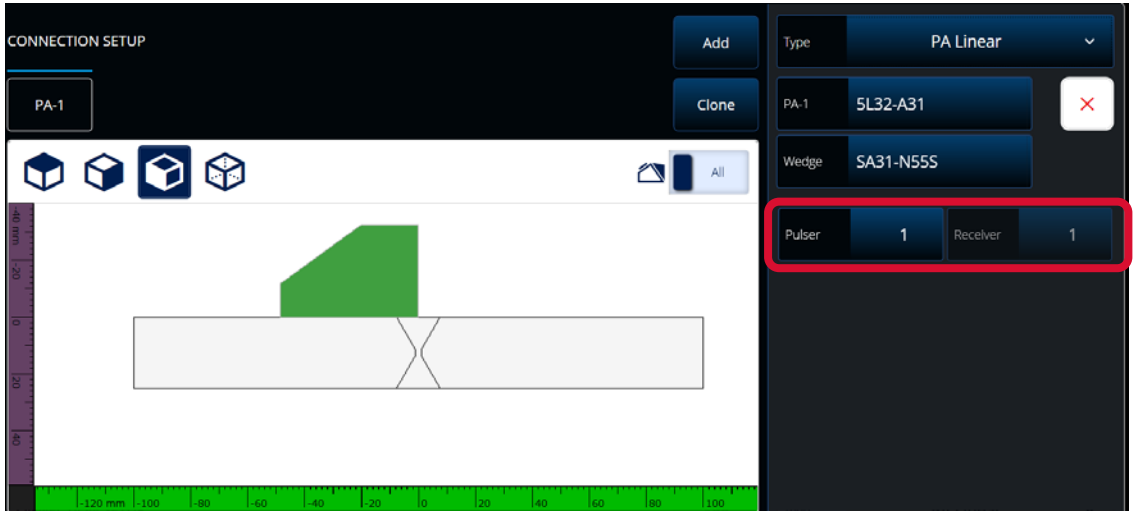
Probe & Wedge PA – Wedge selection

- Wedge:
  - Similar to the probe selection, a temporary pane opens.
  - The default list is the wedges from the same series as the selected probe.
  - All wedges can be accessed by selecting the Show All button.
- When the complete list of wedges is displayed:
  - First select the wedge series on the left-hand side
  - Then select the model on the right-hand side.
- Customs wedges cannot be created from the Scan Plan wizard.
- They can be created from the main screen menu, using the Probe & Part > Probe & Wedge Manager.
- The saved user defined wedges can be selected during the Probe & Wedge wizard. They are located under User at the end of the wedge series list.



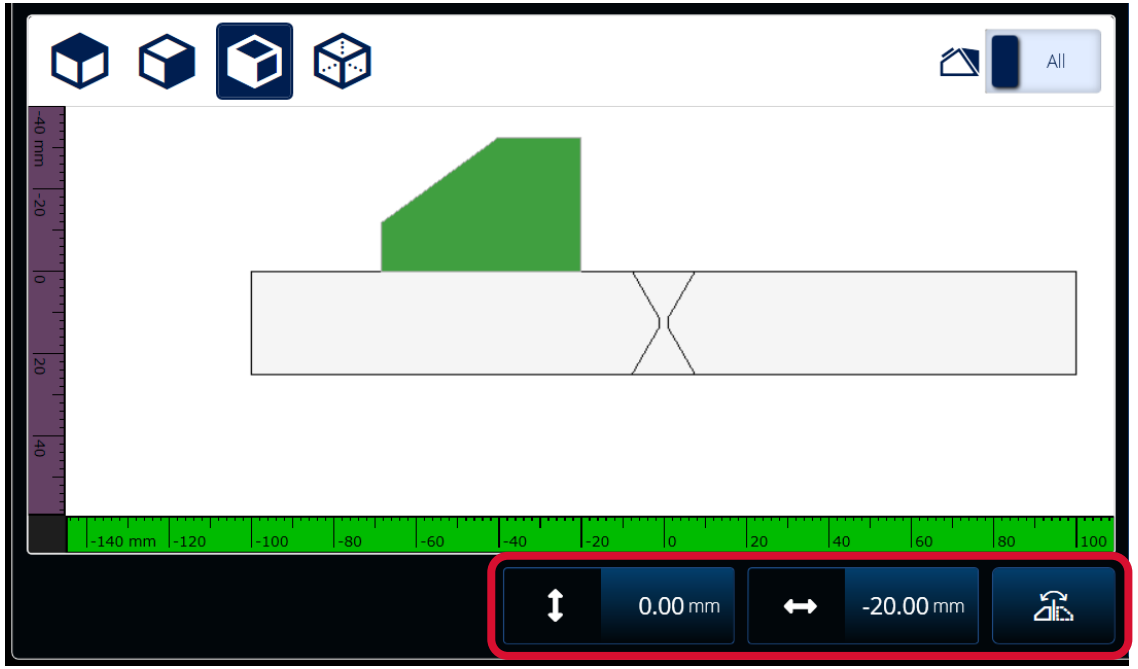
Probe & Wedge PA – Pulser and Receiver

- The number of the pulser associates the wiring of element #1 on the probe to connector wiring. In this example, for a 32:128 OmniScan X3, pulser 1 on the phased array connector of the instrument is wired to element #1 on the probe.
- For a one probe inspection, the pulser is always 1.
- When two probes are connected to the PA connector using a splitter, probe 1 is typically identified by pulser 1 and probe 2 pulser is dependent on the splitter configuration.
- The pulser connection information is found directly on the splitter or adapter.
- The receiver is automatically adjusted to reflect probe wiring.



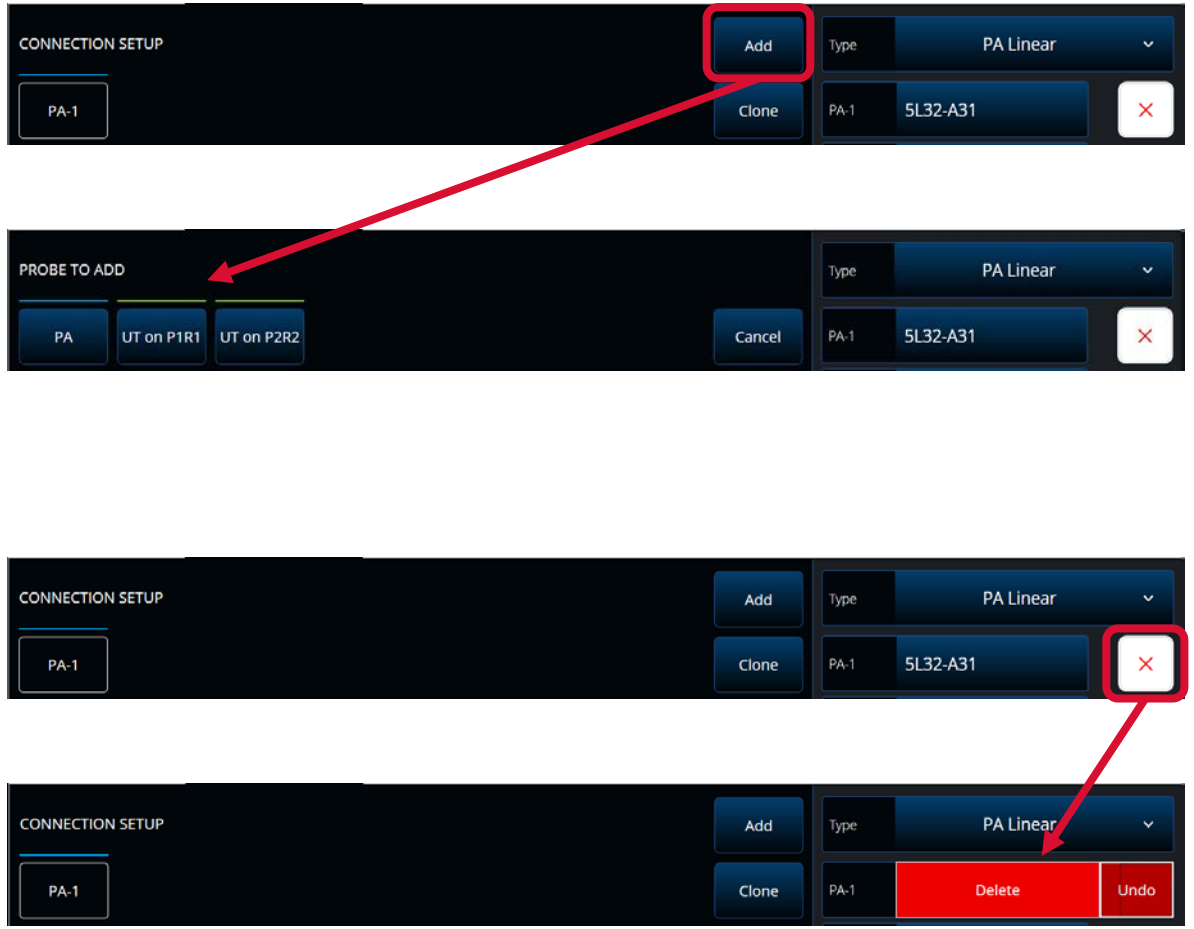
Probe & Wedge PA – Position

- The scan and index offsets are necessary for encoded inspections using a scanner to define the relationship between the probe and component.
- The index offset is the relationship of the probe\wedge face to the weld centerline. Typical (-) for the left side or skew 90 and (+) for the right side or skew 270.
- The scan offset is the distance between 2 probes on the scan axis so the data can be reconciled in the data for analysis for multi probe inspection.
- The probe skew is the orientation of the probe relative to the weld center line.
- The OmniScan X3 supports skew 90 and 270, the control to adjust this parameter is a flip button.



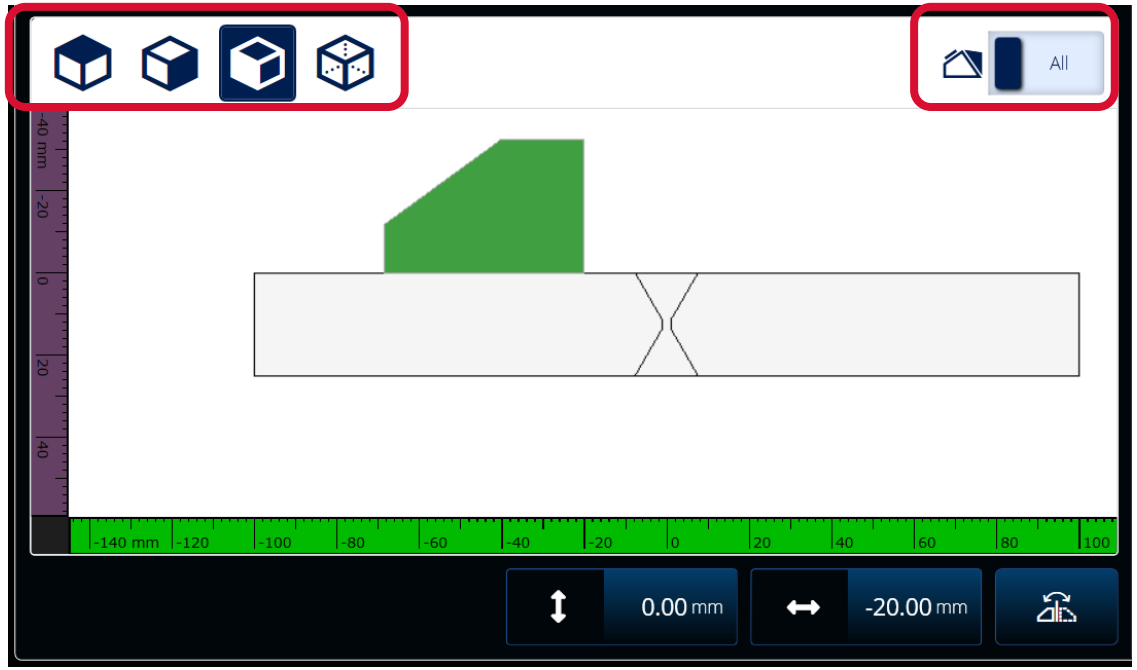
Probe & Wedge PA – Add, Remove and Clone

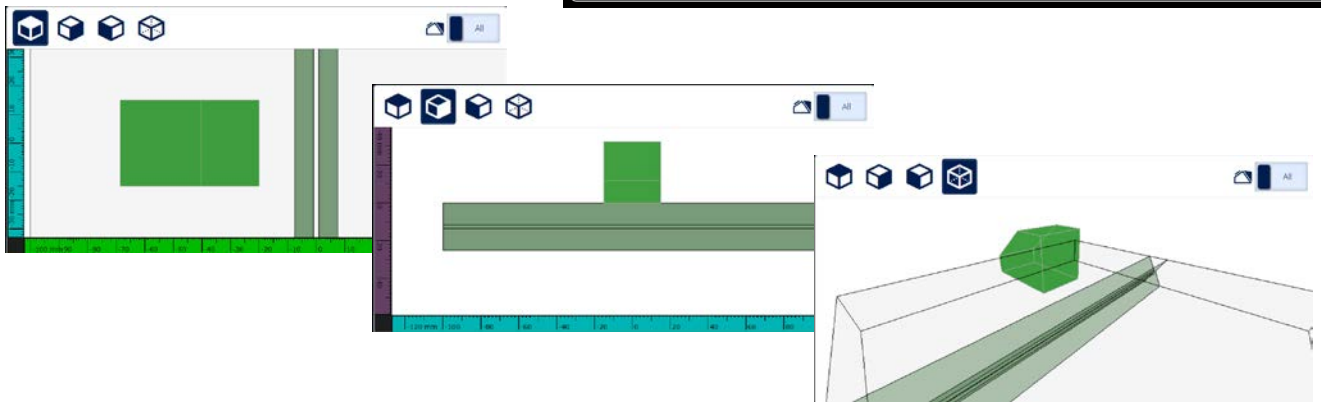
- The OmniScan X3 is a multi group instrument with the ability to define up to 8 groups with most configurations.
  - TFM scan is limited to 4 TFM groups using the same probe.
  - The OmniScan X3 16:64PR offers either 2 PA groups + 2 TOFD, or 2 TFM groups.
- A default group can be added using the Add button.
- The technology (PA or UT) and connector are then selected.
- Alternatively, the current group can be cloned and all the settings will be replicated.
- If a group needs to be removed, the remove button has 2 steps to avoid accidental delete.



Probe & Wedge PA – View and Representation

- The scan plan view offers different representations from different perspectives:
  - Top
  - Side
  - End (default)
  - 3D
- For multi group configurations, the display can be toggled between:
  - All for visualisation of the complete scan plan.
  - Current to focus only on the current probe being edited.



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Scan Plan – Probe & Wedge UT

Olympus Scientific Solutions

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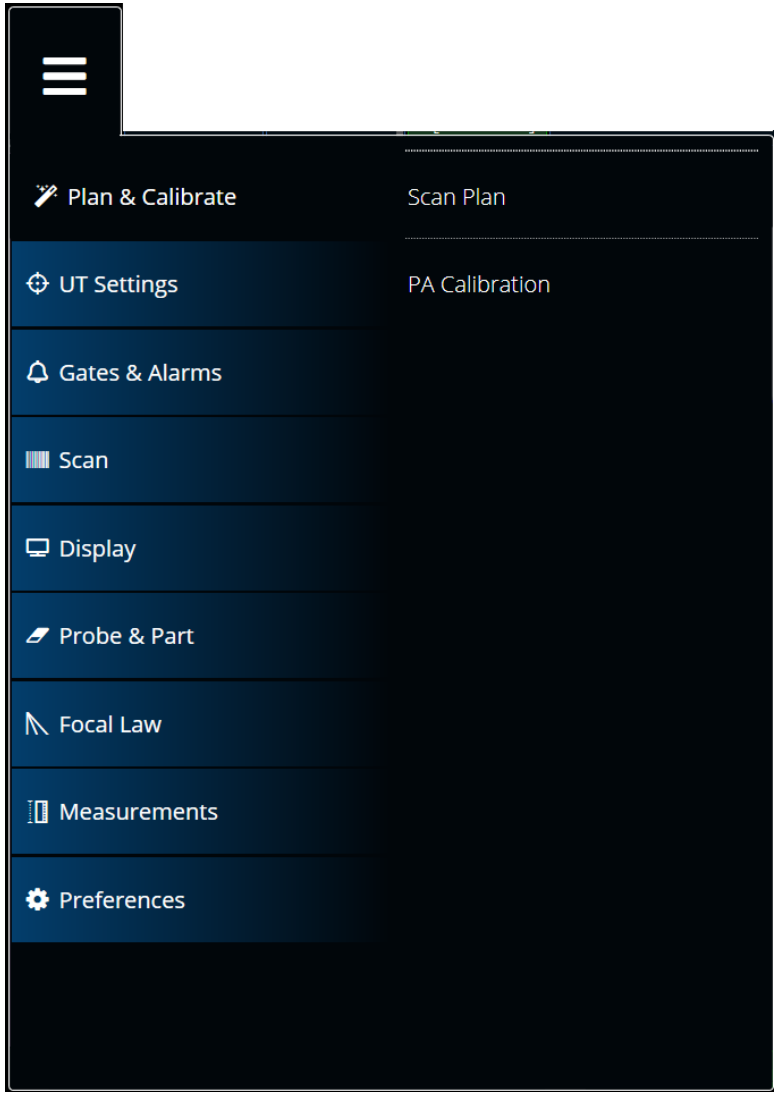
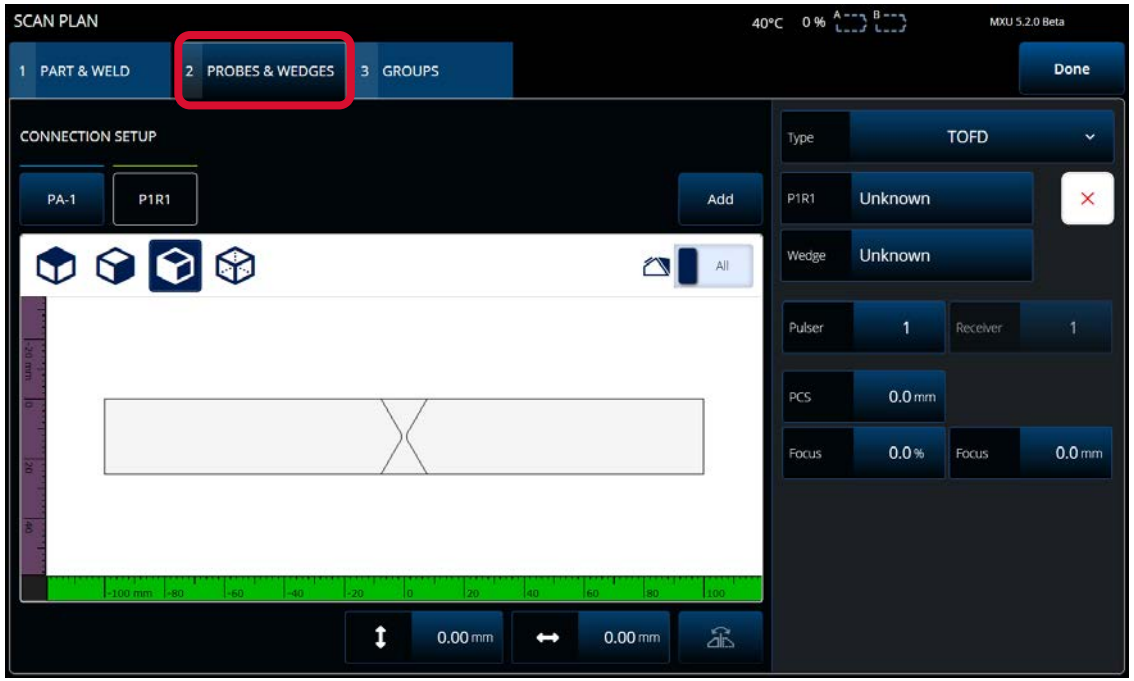
Scan Plan - Overview

- The OmniScan X3 Scan Plan wizard is designed to make the task of creating, modifying, or deleting new groups fast and efficient.
- The software will give us step by step guidance in a logical sequence for populating the essential parameters required by the focal law calculator for beam formation.
- Additionally, during the wizard steps many parameters of the inspection such as the weld overlay, scanner information, probe orientation, etc. will be populated as well.



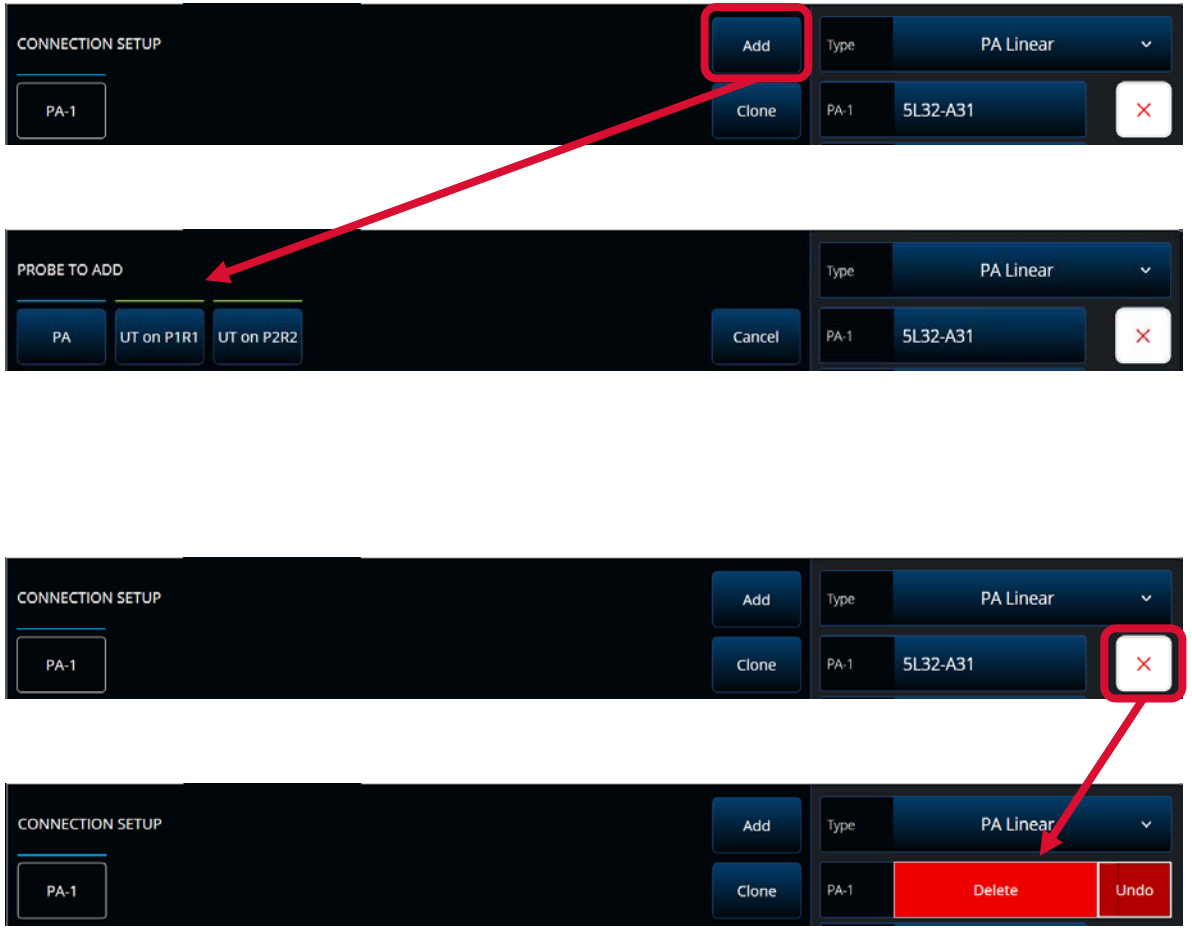
Probe & Wedge UT - Overview

- The Probe & Wedge tab is the second of three primary wizard functions that are used to prepare an inspection or ".oset" file in the X3.
- This section should be done after completion of the Part & Weld section since the weld geometry and part thickness will have an impact on probe and wedge positioning.
- The Probe and Wedge wizard contains the following functions :
  - Add and Remove Probe, including the ability to Clone an existing probe.
  - Probe type selection.
  - Probe and Wedge selection.
  - Pulser selection.
  - Probe and wedge positioning.
  - TOFD only: PCS and focus (% and mm or in)
  - Different view options and perspectives.
- Scan Plan representation is updated as parameters are defined.



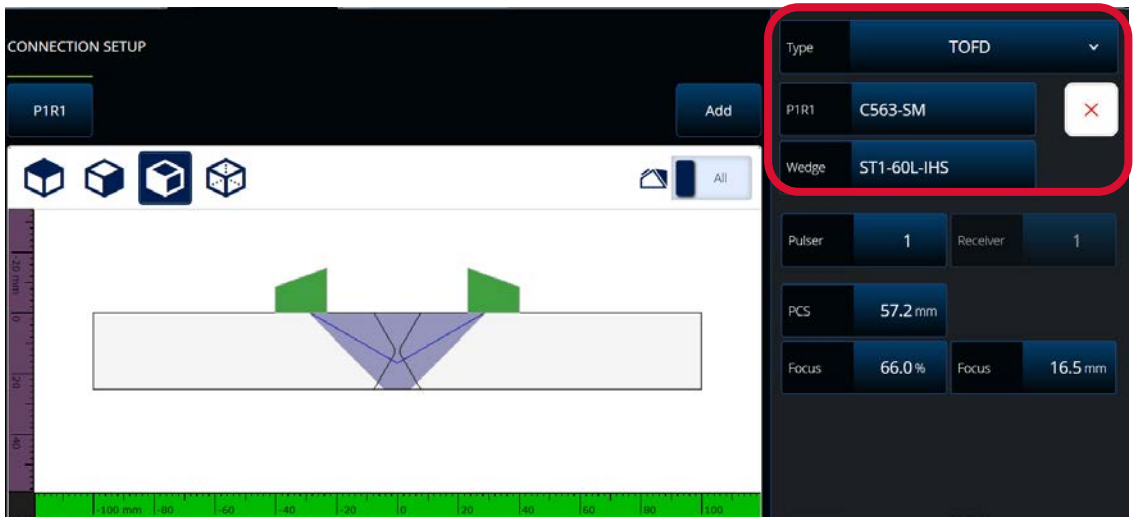
Probe & Wedge UT – Add, Remove and Clone

- The OmniScan X3 is a multi group instrument with the ability to define up to 8 groups with most configurations.
  - TFM scan is limited to 4 TFM groups using the same probe.
  - The OmniScan X3 16:64PR offers either 2 PA groups + 2 TOFD, or 2 TFM groups.
- The default group being Phased Array, a new group must be added to define a UT or TOFD inspection group.
- The technology (PA or UT) and connector are then selected.
  - The OmniScan X3 features 2 dedicated UT channels, P1R1 and P2R2.
- Alternatively, the current group can be cloned and all the settings will be replicated.
- If a group needs to be removed, for example the default PA group, the remove button has 2 steps to avoid accidental delete.



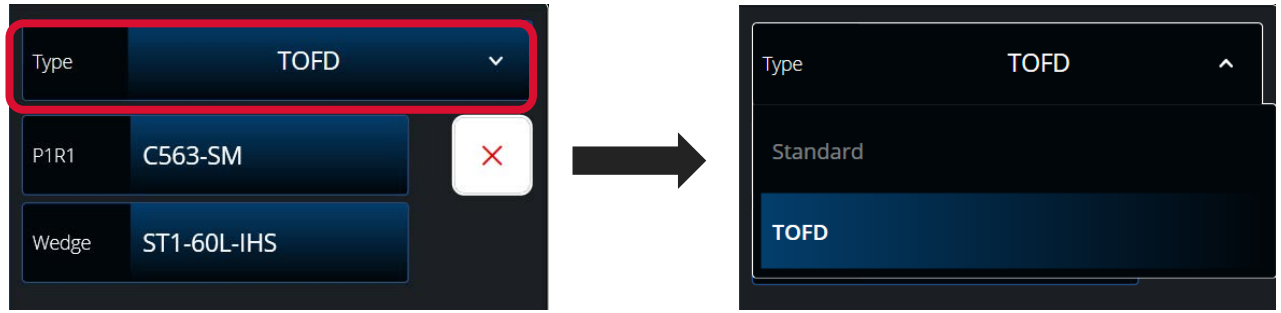
Probe & Wedge UT – Probe and Wedge selection

- The Probe & Wedge tab is the step to define the probe, single or multiple, that will be used for the inspection.
- There are 3 selections to do:
  - Probe type: Standard and TOFD.
  - Probe: a temporary pane opens for probe selection. First select the probe series on the left-hand side, then the model on the right-hand side.
  - Wedge: similar to the probe selection, a temporary pane opens with the wedge series on the left-hand side and the wedge models on the right-hand side.



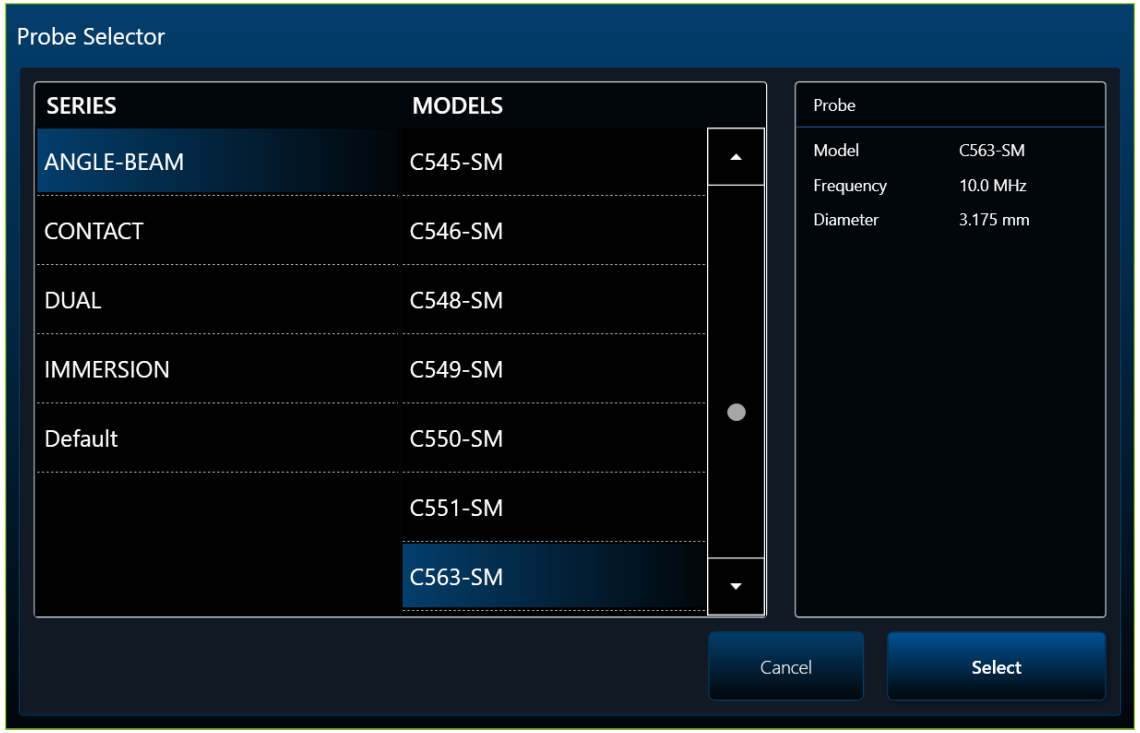
Probe & Wedge UT – Probe Type selection

- Probe type: Standard or TOFD:
- The selection of TOFD instead of the standard UT probe type will automatically adjust parameters to reflect the technique:
- PCS.
- TOFD layouts.
- TOFD readings.
- TOFD calibrations.
- The scan plan will also shortcut to the essential TOFD parameters.



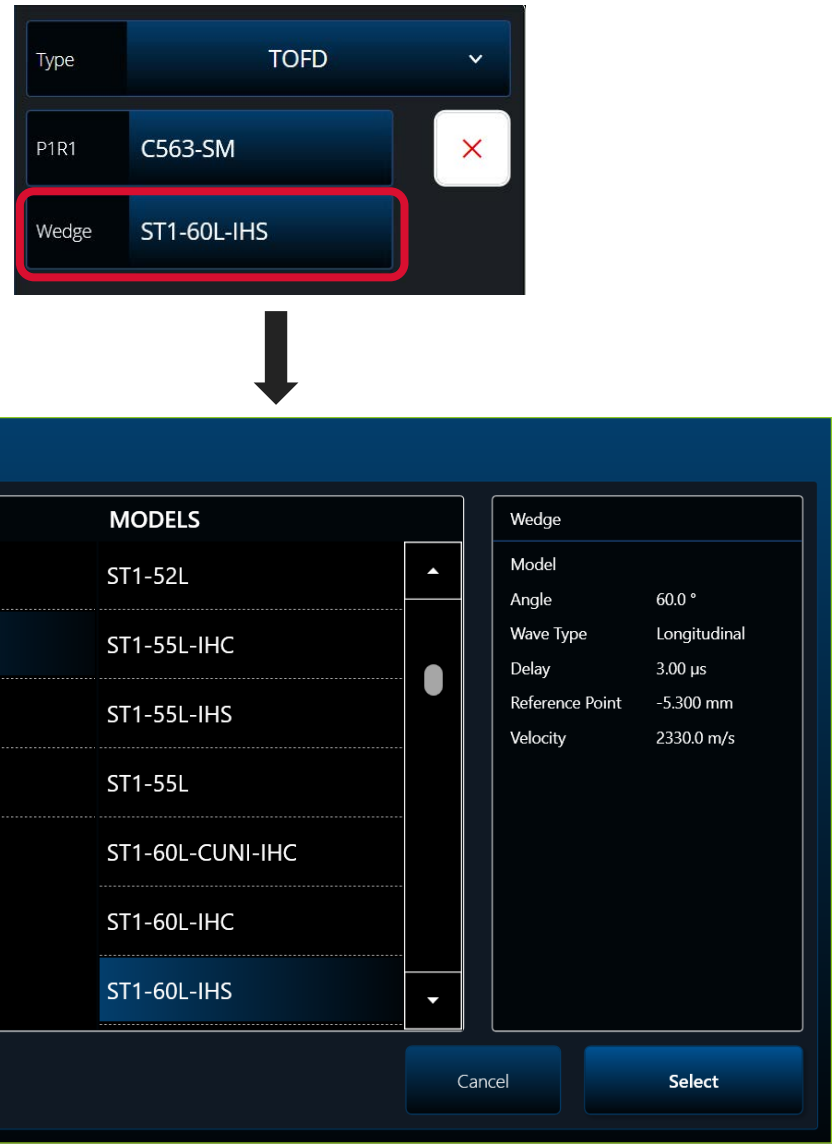
Probe & Wedge UT – Probe selection

- Probe:
  - A temporary pane opens for probe selection.
  - First select the probe series on the left-hand side
  - Then select the model on the right-hand side.
- Customs probes cannot be created from the Scan Plan wizard.
- They can be created from the main screen menu, using the Probe & Part > Probe & Wedge Manager.
- The saved user defined probes can be selected during the Probe & Wedge wizard. They are located under User at the end of the probe series list.



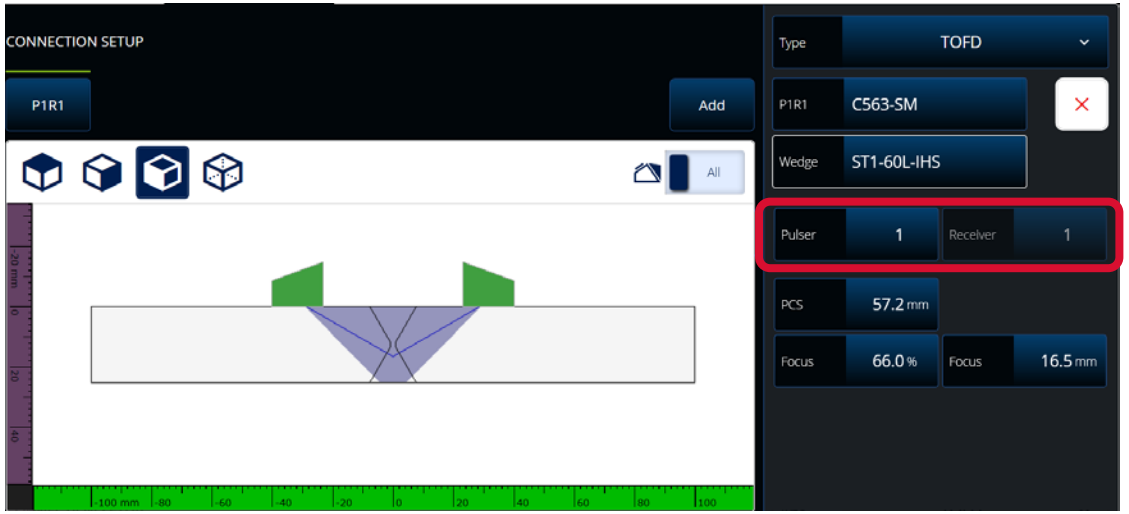
Probe & Wedge UT – Wedge selection

- Wedge:
  - Similar to the probe selection, a temporary pane opens with the wedge series on the left-hand side and the wedge models on the right-hand side.
- Customs wedges cannot be created from the Scan Plan wizard.
- They can be created from the main screen menu, using the Probe & Part > Probe & Wedge Manager.
- The saved user defined wedges can be selected during the Probe & Wedge wizard. They are located under User at the end of the wedge series list.



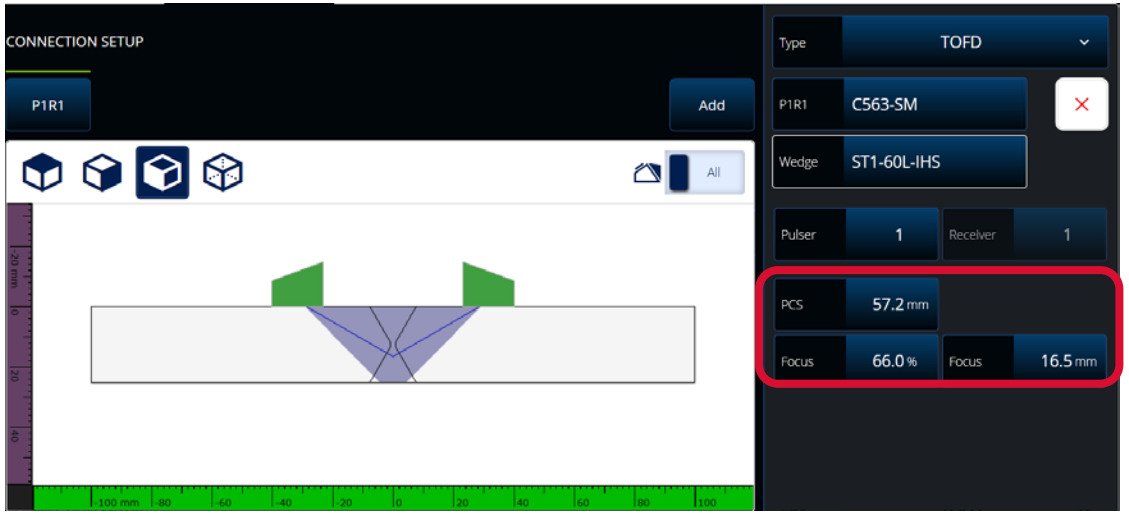
Probe & Wedge UT – Pulser and Receiver

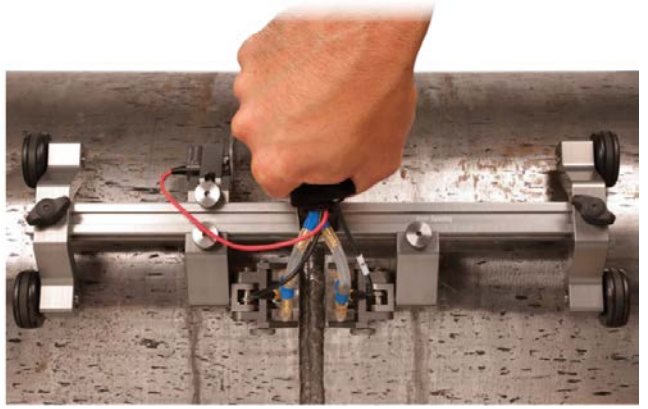
- The number of the pulser is associated to the connection of the transmitter probe.
- Similarly, the number of the receiver is associated to the connection of the receiving probe.
- The OmniScan X3 features 2 dedicated UT channels:
- P1R1
- P2R2
- When UT probes are connected to the PA connector using an adapter, pulser and receiver connections are dependent on the adapter configuration.
- The connection information is found directly on the splitter or adapter.



Probe & Wedge UT – TOFD PCS and Focus

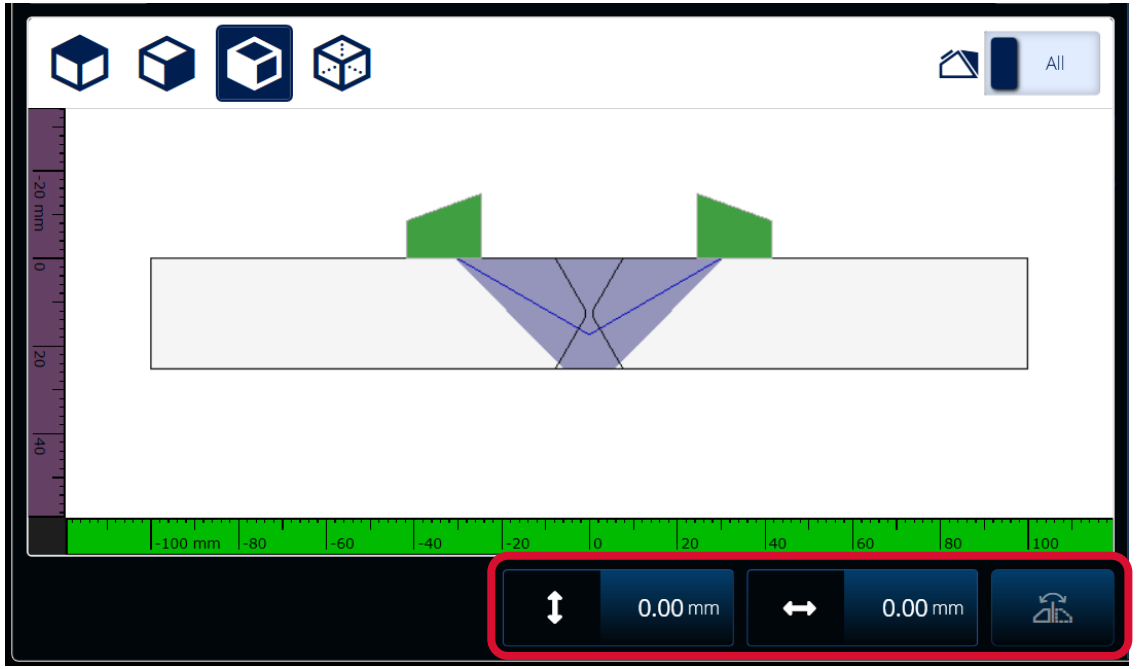
- The beam exit point distance between the two probes is called probe center spacing (PCS) and is an essential variable for both inspection strategy and calibration of the UT data required for depth and height sizing.
- A TOFD group uses a single longitudinal wave angle beam A-scan in a pitch catch configuration between two probes that are positioned for the beam center of the transmitter and receiver to focus at a strategic position in the weld. Typically 2/3 of the thickness (66%) in single TOFD group inspection.
- The TOFD group beam focus can be changed in two ways:
  - Change the angle of the beam by changing the wedge.
  - Change the PCS by moving the probes closer or farther apart.





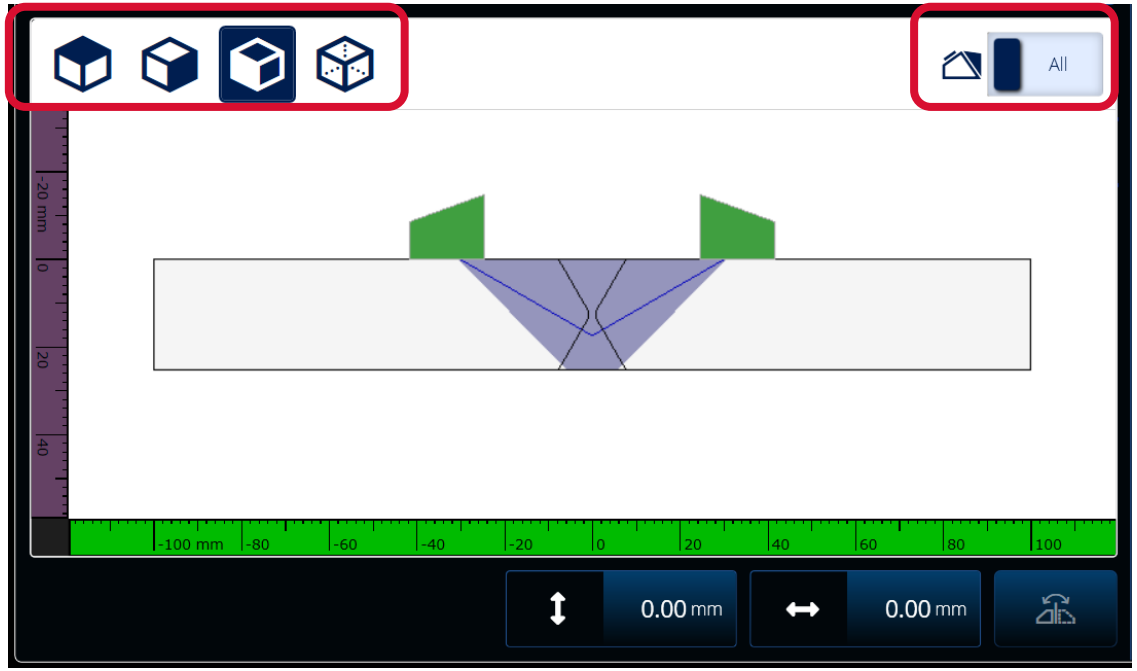
Probe & Wedge UT – Position

- The scan and index offsets are necessary for encoded inspections using a scanner to define the relationship between the probe and component.
- The index offset is the relationship of the probe\wedge face to the weld centerline. Typical (-) for the left side or skew 90 and (+) for the right side or skew 270.
- The scan offset is the distance between 2 probes on the scan axis so the data can be reconciled in the data for analysis for multi probe inspection.
- The probe skew is the orientation of the probe relative to the weld center line.
- The OmniScan X3 supports skew 90 and 270, the control to adjust this parameter is a flip button.
  - Note: the skew parameter is not available for TOFD configurations.



Probe & Wedge UT – View and Representation

- The scan plan view offers different representations from different perspectives:
  - Top
  - Side
  - End (default)
  - 3D
- For multi group configurations, the display can be toggled between:
  - All for visualisation of the complete scan plan.
  - Current to focus only on the current probe being edited.

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Scan Plan – Groups PA

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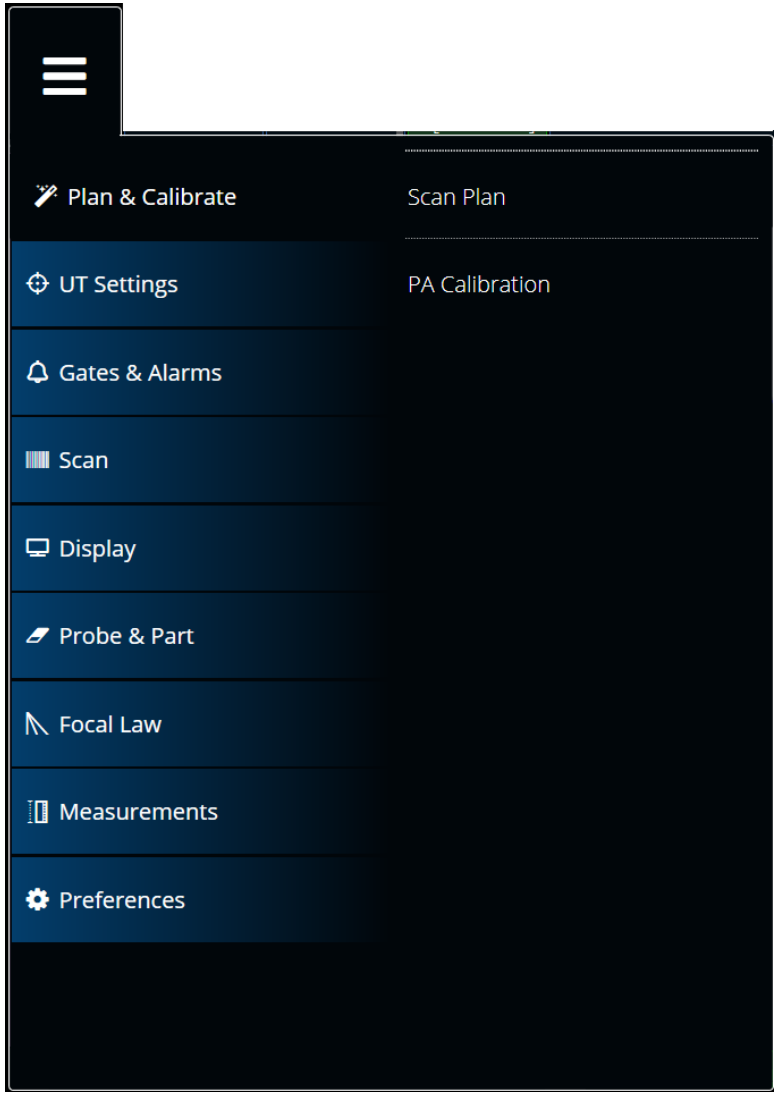
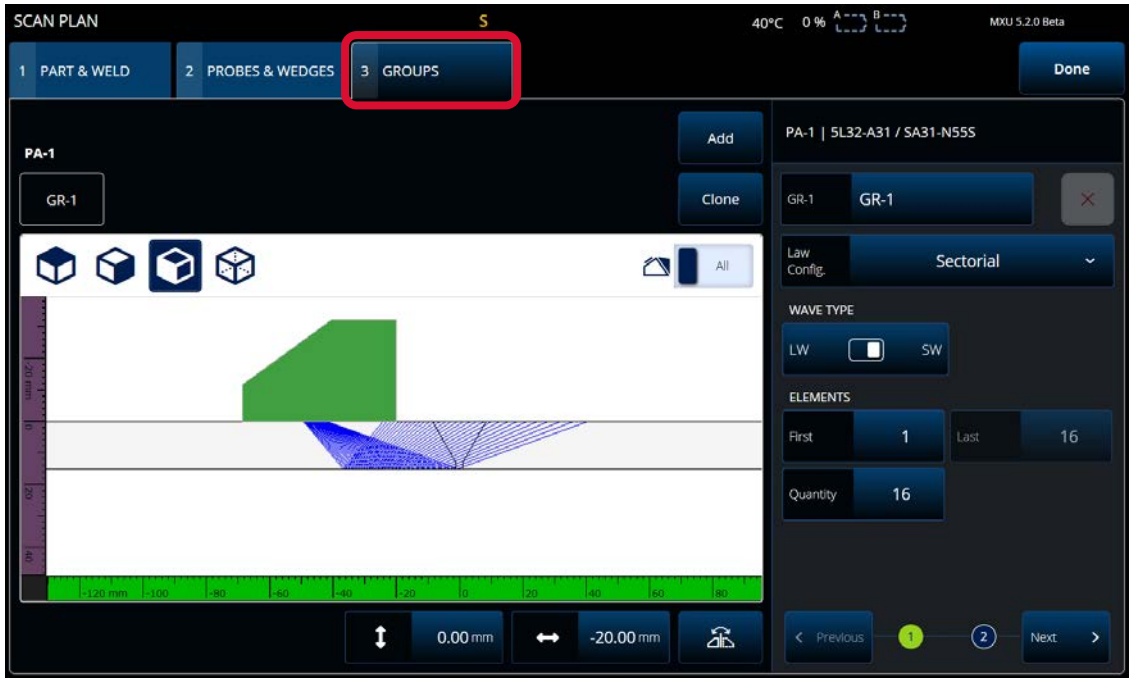
Scan Plan - Overview

- The OmniScan X3 Scan Plan wizard is designed to make the task of creating, modifying, or deleting new groups fast and efficient.
- The software will give us step by step guidance in a logical sequence for populating the essential parameters required by the focal law calculator for beam formation.
- Additionally, during the wizard steps many parameters of the inspection such as the weld overlay, scanner information, probe orientation, etc. will be populated as well.



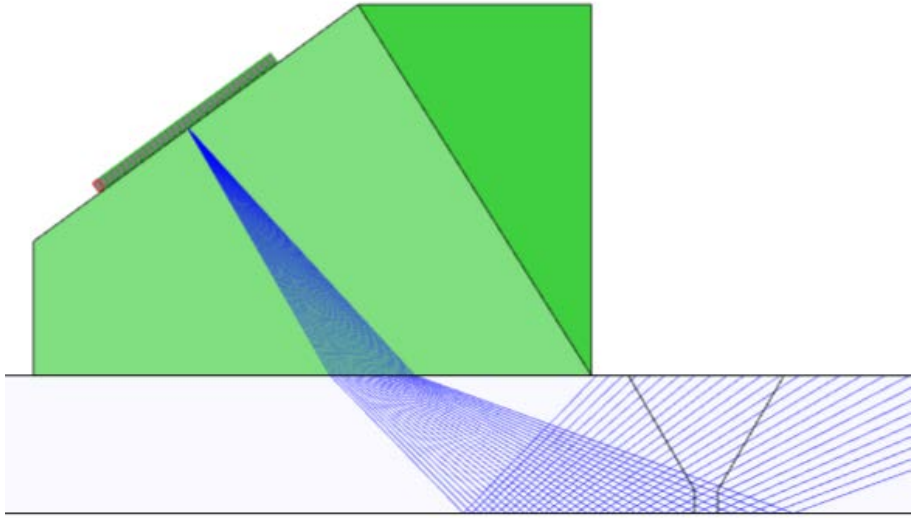
Groups PA - Overview

- The Groups tab is the last of three primary wizard functions that are used to prepare an inspection or “.oset” file in the X3.
- This section should be the final one to complete.
- The Groups wizard for phased array offers the following law configurations and their associated parameters:
  - Sectorial.
  - Linear.
  - Compound.
  - 0° with overlap.
- Law configuration selection will update the available parameters to reflect the technique.
  - These parameters are usually available on 2 panes.
- Scan Plan representation is updated as parameters are defined.



Groups PA – Sectorial Scan Reminder

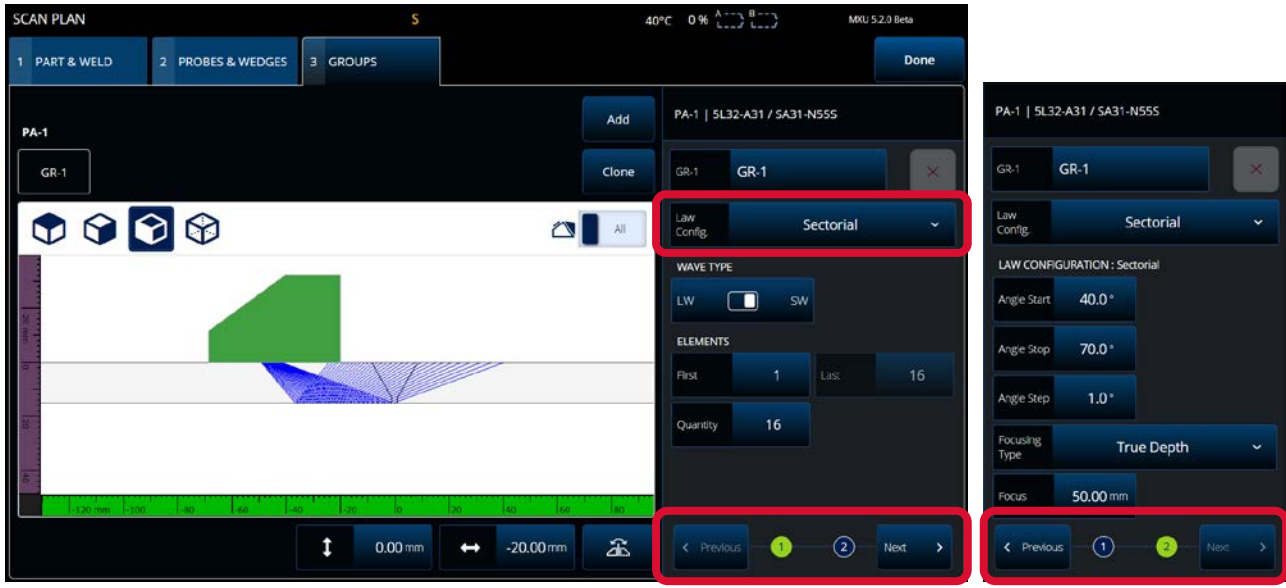
- Definition:
  - Focal laws of different angles generated using the same elements.
  - A-scan density and coverage is defined by the range of angles (45–70) and angle resolution (45, 46, 47, etc.).
- Advantages:
  - Large coverage area in the inspected part from a small footprint on the surface.
  - Improved flaw characterization from multiple angles.
  - Fewer focal laws required for coverage of the weld area.
- Disadvantages:
  - Beam-to-beam resolution worsens as the sound path increases.
  - Limitations in ability to calibrate for long sound paths



Groups PA – Sectorial Scan

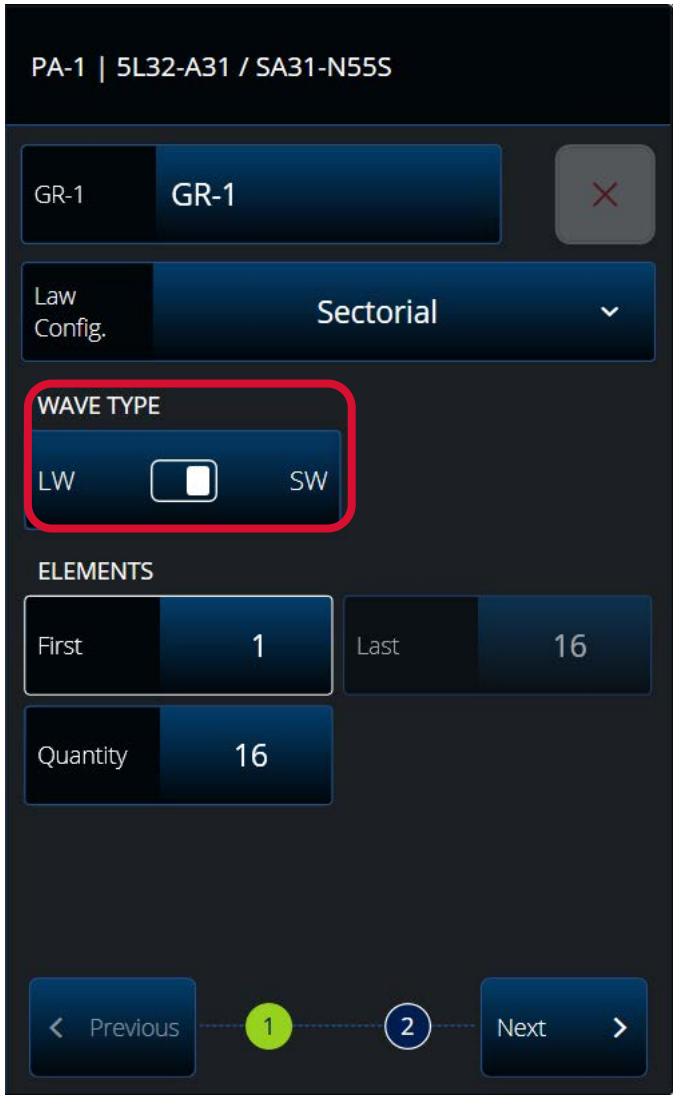
- The sectorial scan is selected from the law config drop down list.
- 2 panes of parameters are associated with this technique:
  - The first for wave type and probe elements (aperture).
  - The second is dedicated to angle configuration and focusing.
- You can move back and forth between the 2 panes using the Next and Previous buttons.

- At any time during the configuration, probe position can be adjusted using the controls below the scan plan representation.



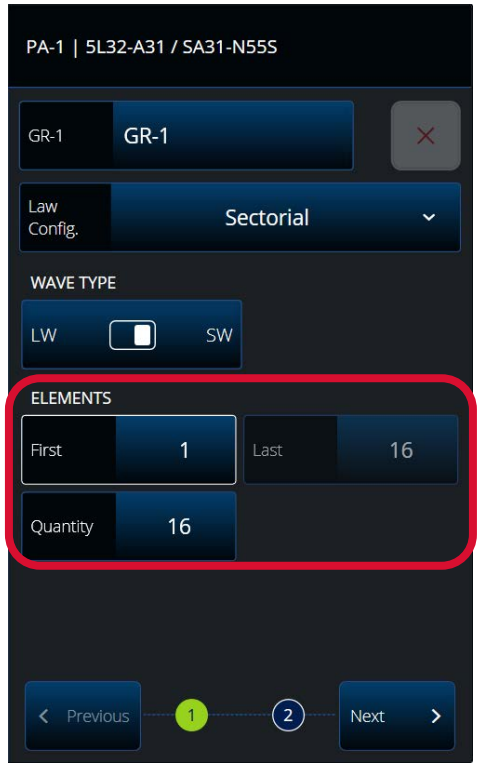
Groups PA – Sectorial Scan Wave Type

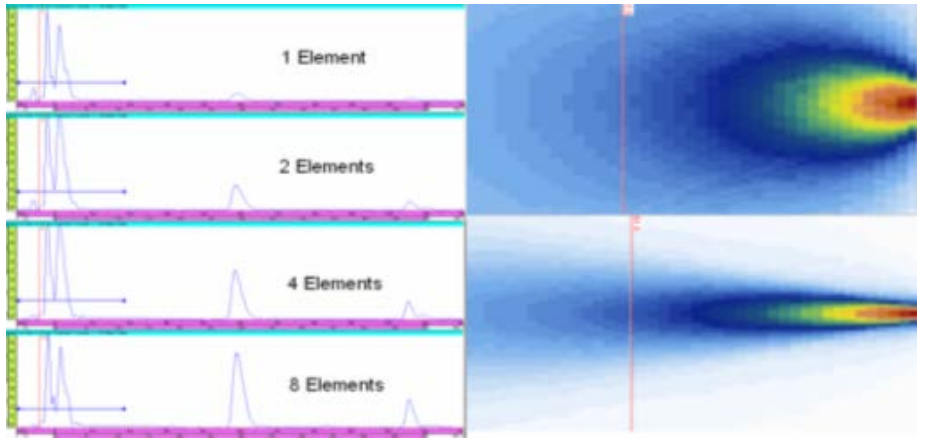
- When the material was entered in the part wizard, 2 velocities were associated with the setup for shear and longitudinal.
- Shear wave angle beam wedges are designed with an approx. incident angle of 36 degrees for a refracted angle of 55 degrees in carbon steel without beam steering.
- Longitudinal angle beam wedges are designed with an approx. incident angle of 20 degrees for a refracted 60 degree angle in carbon steel without beam steering.



Groups PA – Sectorial Scan Elements

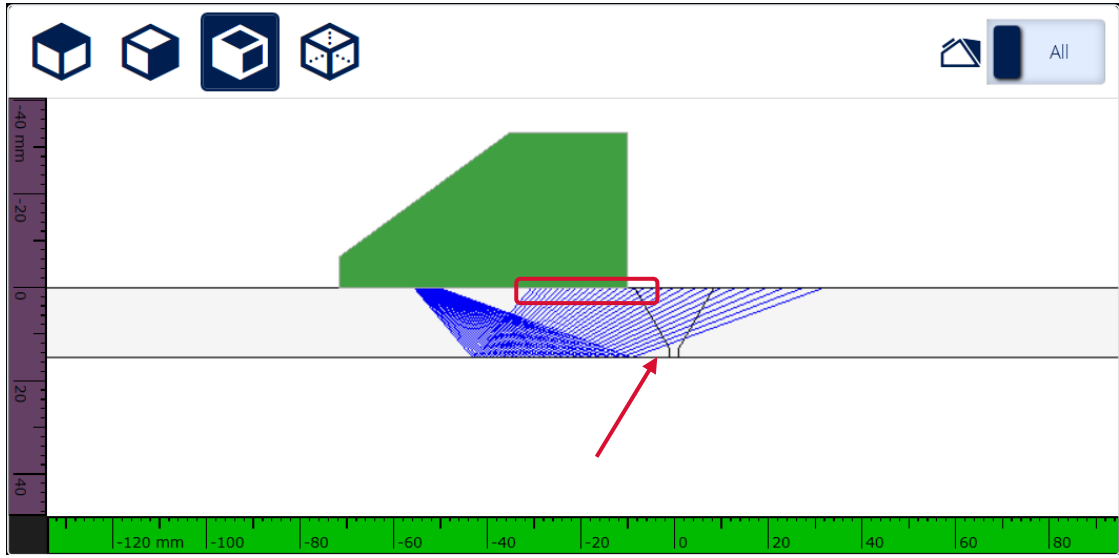
- The element quantity defines the size of the aperture or total number of elements used in the focal law. (A-scan)
- Element quantity selection cannot exceed the total elements available in the probe or instrument configuration.
- The first number of an instrument's pulser configuration determines the limit and it is directly related to the versatility and cost of the instrument. (16:64, 32:128, etc.)
- The larger the aperture, the longer the maximum focal distance.
- The more pulsers that are used given the same aperture, the more energy and beam steering will be available in the setup.

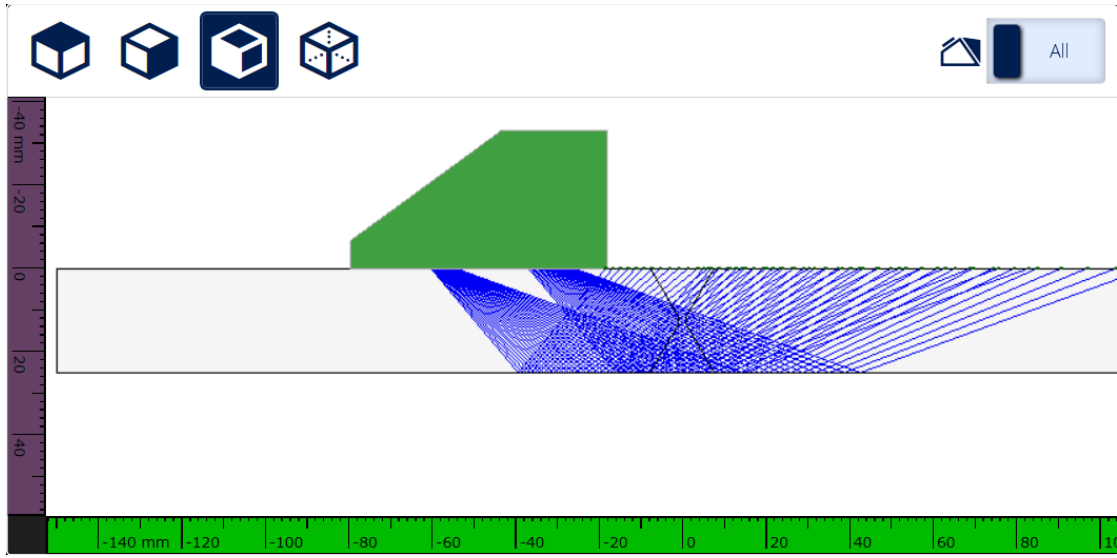




Groups PA – Sectorial Scan Elements

- The position of the aperture within the probe is defined by the first element.
- For a same aperture, using the lower or upper elements has different impacts on the signal:
  - Lower elements:
    - Shorter sound path in the wedge meaning less wedge attenuation and deeper near field in the part.
    - Depending on the wedge dimensions, it may be impossible to cover the weld properly and focal laws risk to skip into the wedge.
  - Upper elements:
    - More likely to not being physically restricted by the weld cap.
    - Longer sound path in the wedge and risk to create a corner wedge echo.
- It is a common inspection strategy to use two sector scan groups from the same probe for coverage. One from the back and one from the front for full coverage.



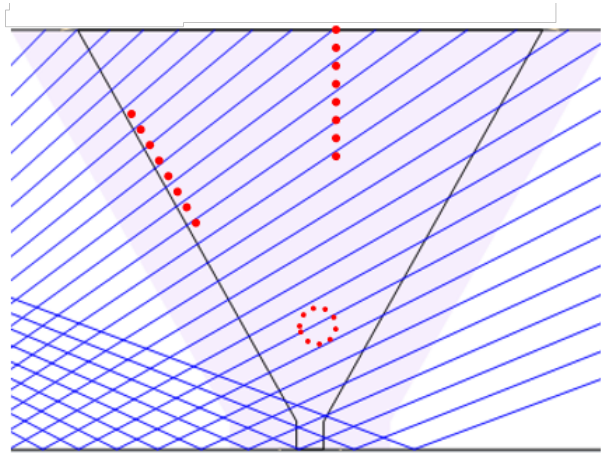


Groups PA – Sectorial Scan Angles

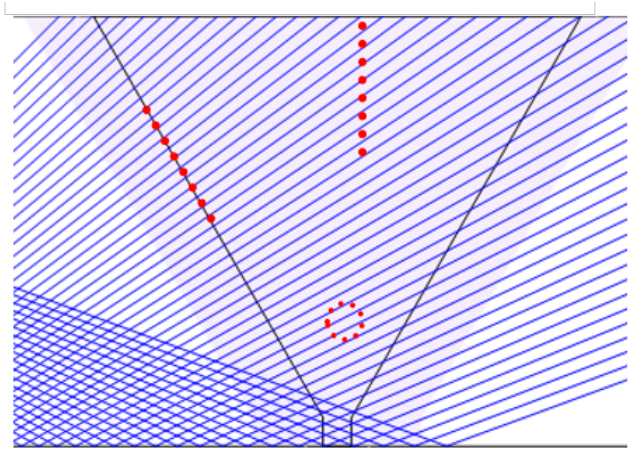
- Many factors affect the minimum and maximum beam steering for a setup.
- This is a function of physics, not software. For a given probe\wedge\aperture, programming an angle beyond the steering range will result in a velocity change and poor S\N ratio A-scan that cannot be predicted by the software.
  - Most shear wave angle beam wedges for .25-1mm pitch probes are capable of calibration from approx. 40-75 degrees depending on the sound path and size of the calibration target.
  - Most long wave angle beam wedges for .25-1mm pitch probes are capable of calibration from approx. 30-80 degrees.
- Beam steering is limited by the probe element size, aperture, wavelength, physics of UT (Snell's law) and most importantly, the ability to calibrate each A-scan in the group to the satisfaction of the application or procedure.

Groups PA – Sectorial Scan Angles

- The angle step resolution will define the total number of focal laws (A-scan) between the min\man angle and is directly related to file size and scanner speed.
- The default value for sectorial scan is 1.
- A larger angle step may be used to boost productivity if the beam overlap criteria is respected.
- A smaller angle step (0.5°) may be required for long sound paths where the beam overlap criteria is no longer respected with the standard 1°.



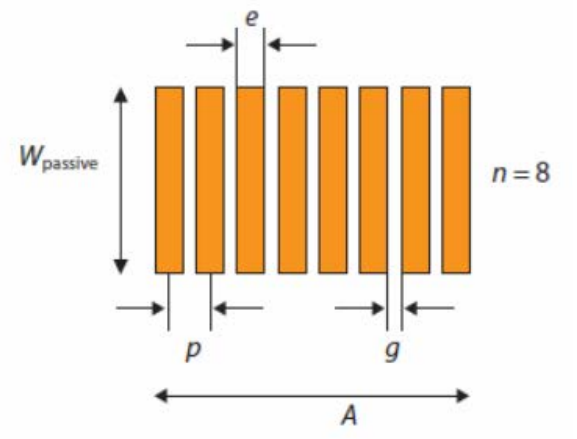
1 degree resolution



0.5 degree resolution

Groups PA – Sectorial Scan Focus

- In phased array inspection, the beam size, angle, and focus are capable of being manipulated within the limits of physics, the software, and the hardware.
- The maximum distance that the beam can be focused is defined by the near field calculation below.
- Any number entered into the focus depth field that is greater than the near field will result in an unfocused beam.
- The OmniScan X3 offers True Depth and Half-Path focusing.

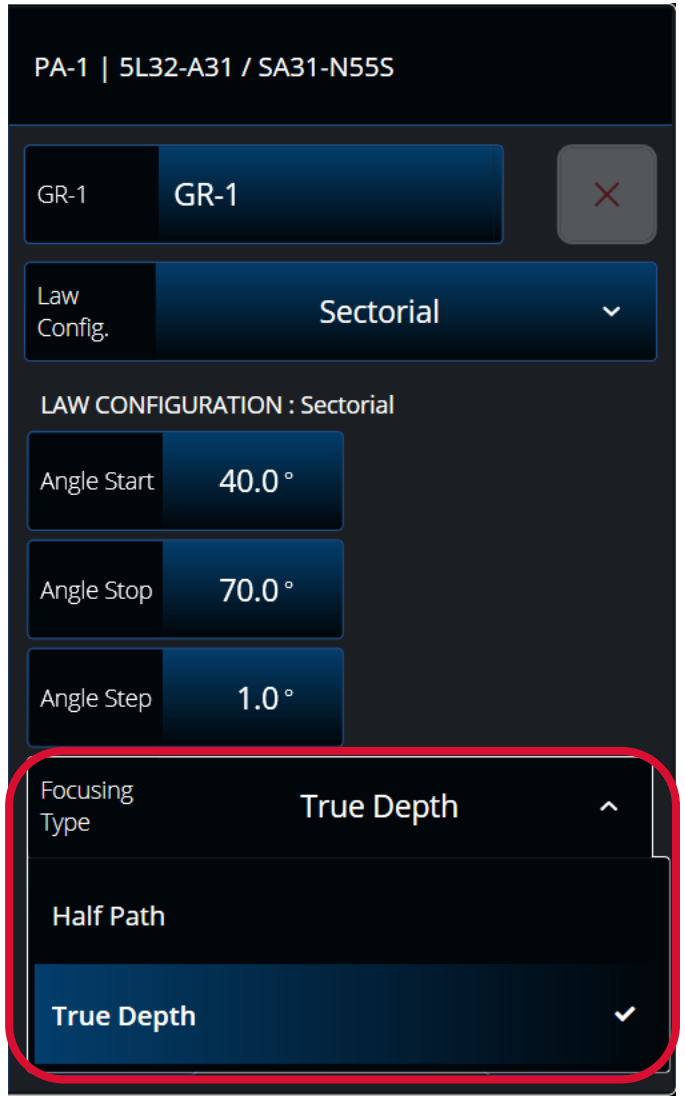


The *near-field (N)* value gives the maximum depth of usable focus for a given array. This value is given by the following formula:

$$N = \frac{D^2 f}{4c}$$

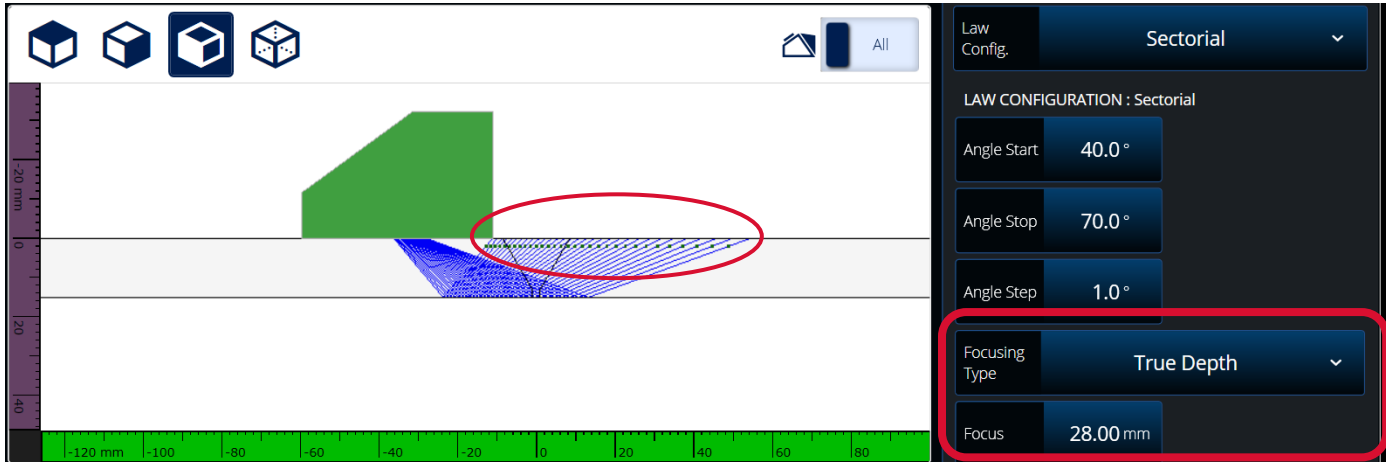
where D = element diameter
f = frequency
c = material velocity

- To calculate the near-field value in the active (primary) axis of a phased array probe: $D = n' \bullet p$, where n' is number of elements per group in the focal law.
- To calculate the near-field value in the passive (secondary) axis of a phased array probe: $D = Wpassive$, which is often called elevation.



Groups PA – Sectorial Scan Focus

- A typical weld inspection will use an unfocused strategy for detection of potential flaws while keeping a more uniform energy distribution.
- The focus can then be adjusted to optimize flaw characterization and sizing.
- The focus depth or path is updated on the scan plan representation to aid positioning the focus on the region of interest (weld bevel, root, cap, etc).

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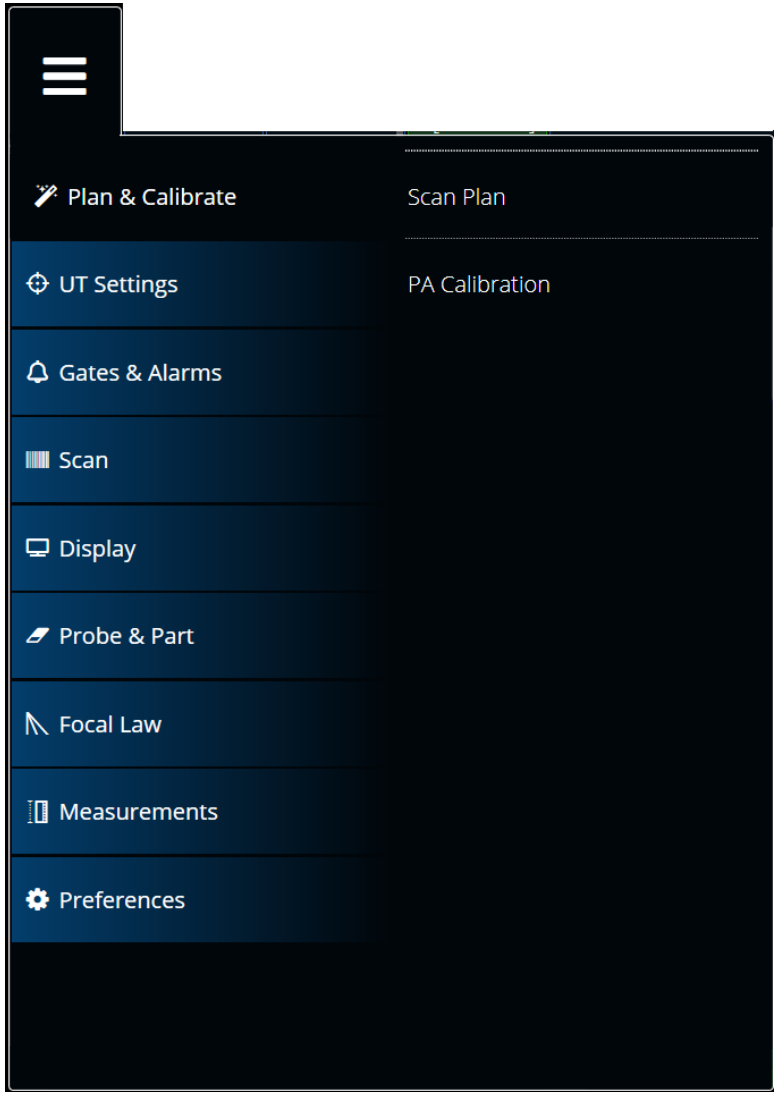
Scan Plan – Groups TFM

Olympus Scientific Solutions

DSM Team | Quebec | April 2020

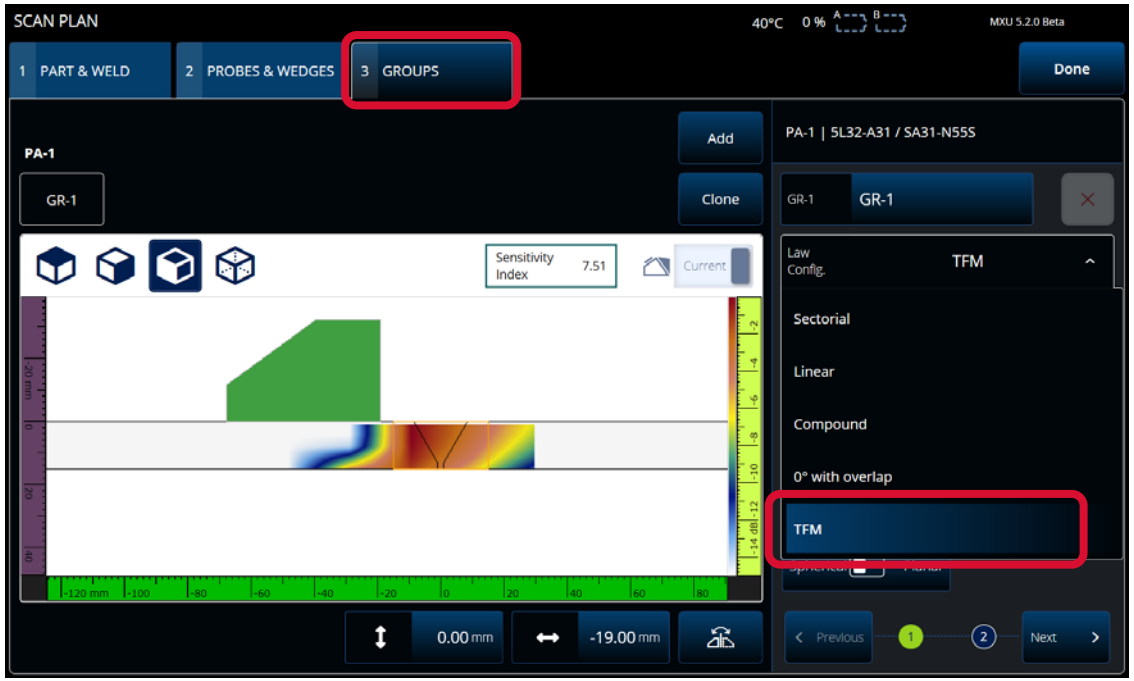
Scan Plan - Overview

- The OmniScan X3 Scan Plan wizard is designed to make the task of creating, modifying, or deleting new groups fast and efficient.
- The software will give us step by step guidance in a logical sequence for populating the essential parameters required by the focal law calculator for beam formation.
- Additionally, during the wizard steps many parameters of the inspection such as the weld overlay, scanner information, probe orientation, etc. will be populated as well.



Groups TFM - Overview

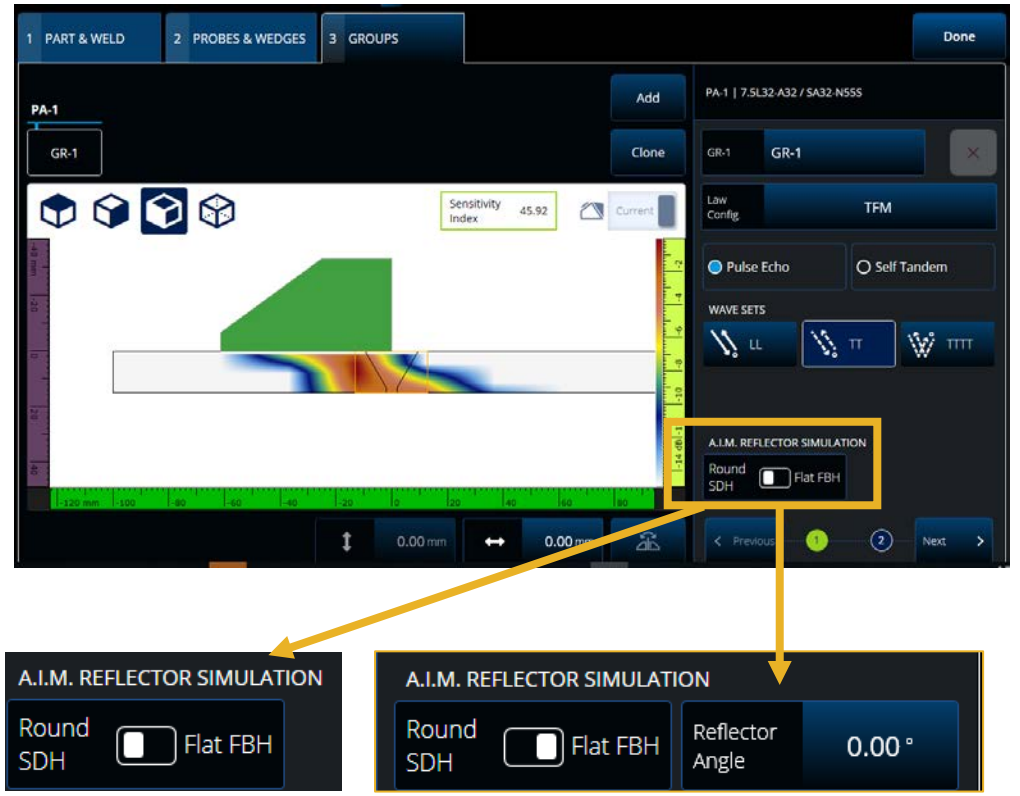
- The Groups tab is the last of three primary wizard functions that are used to prepare an inspection or “.oset” file in the X3.
- This section should be the final one to complete.
- The Groups wizard offers the TFM from the law config drop down menu.
- Multiple wave sets are available to best cover the weld.
- The scan plan representation is updated with the AIM, Acoustic Influence Map, to assist the user with the scan plan.



Groups TFM - Acoustic Influence Map

- A.I.M.
  - Simulation tool onboard of the OmniScan X3.

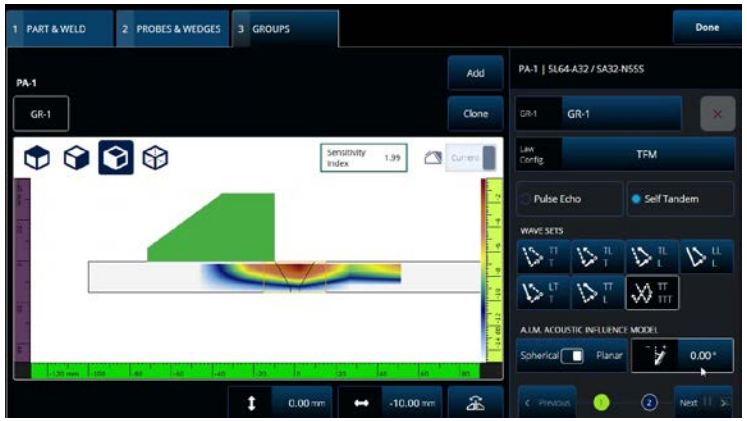
- Displays the expected ultrasonic response for a given wave set and reflector.
- Helps the user selecting the best wave set for a given reflector.
- Helps the user position the TFM zone where the ultrasonic response is expected to be good.



- User needs to select the Type of Defect:
  - SDH = Volumetric
  - Flat FBH = Planar

Groups TFM - Acoustic Influence Map

- In TFM, AIM will display the ultrasonic response and energy distribution depending on the selected Wave Set.
- The probe and geometry of the reflector and its angle will also have an impact on the AIM simulation:
  - Below is an example of the impact of the angle of a Planar Reflector.

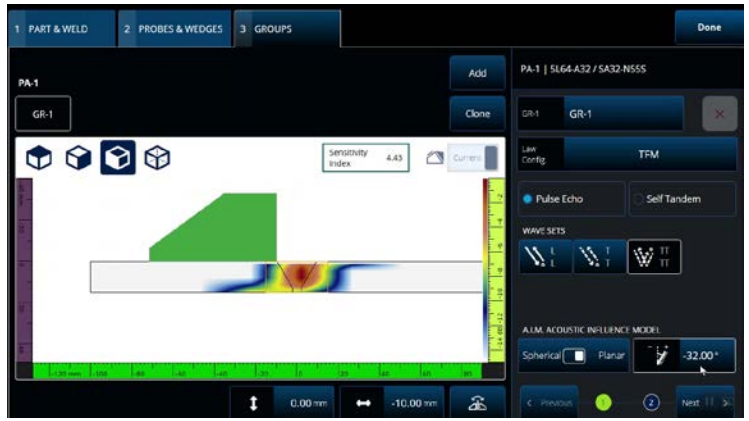


5T Self-Tandem

0° Planar Reflector

5T Self-Tandem

-32° Planar Reflector



4T Pulse-Echo

-32° Planar Reflector

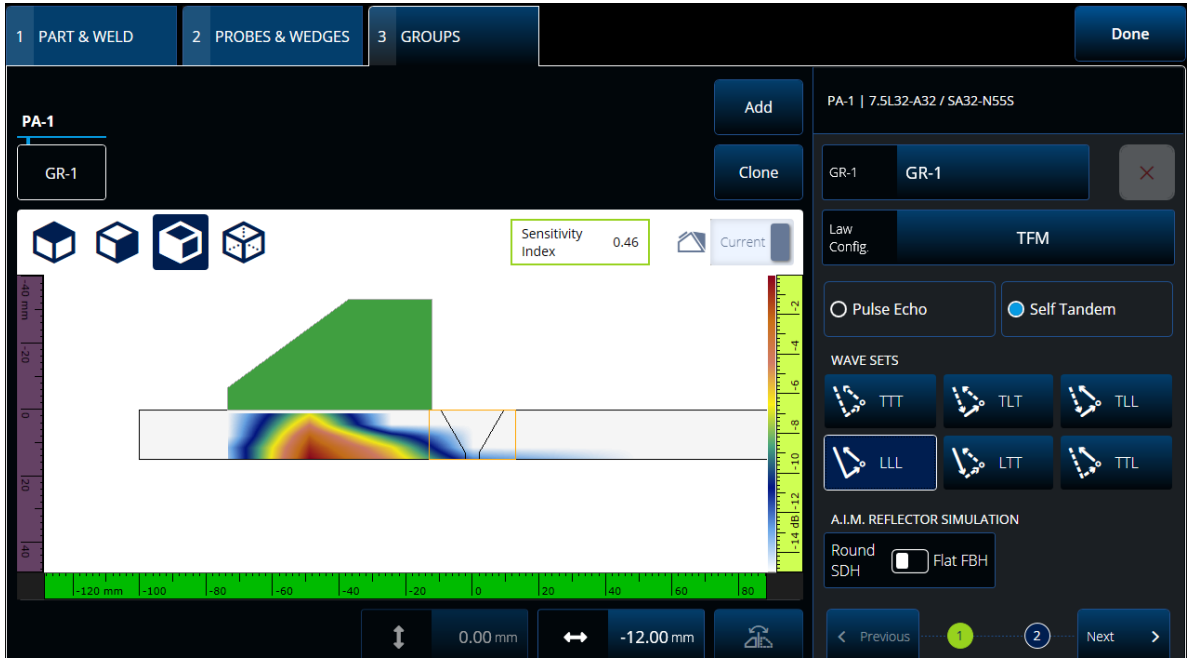
Groups TFM - Acoustic Influence Map

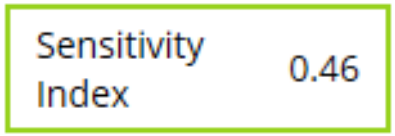
- AIM
  - Simulation tool onboard the OmniScan X3

- If we view the AIM as a heat map that helps the user selecting the best wave set for a given reflector:
  - The sensitivity Index would be the temperature. There is no hard limit on how “hot” it can get, but the hotter is the better.

Sensitivity Index

- 7.5MHz, LLL

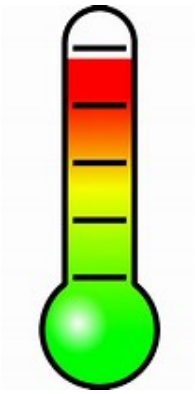




Groups TFM - Acoustic Influence Map

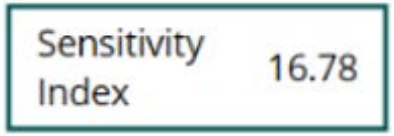
- AIM
  - Simulation tool onboard the OmniScan X3

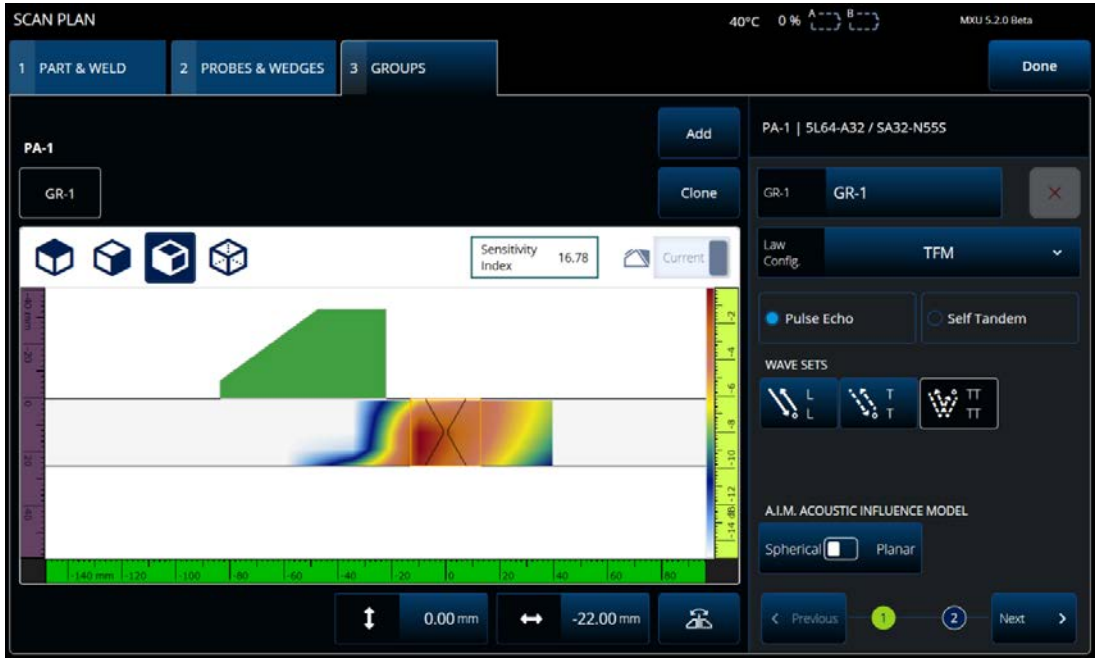
- If we view the AIM as a heat map that helps the user selecting the best wave set for a given reflector:
  - The sensitivity Index would be the temperature. There is no hard limit on how “hot” it can get, but the hotter is the better.



Sensitivity Index

- 5MHz, 4T



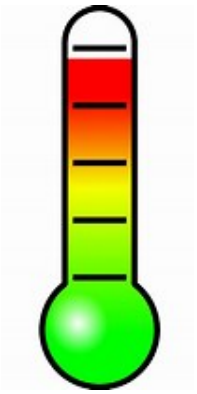


Groups TFM - Acoustic Influence Map

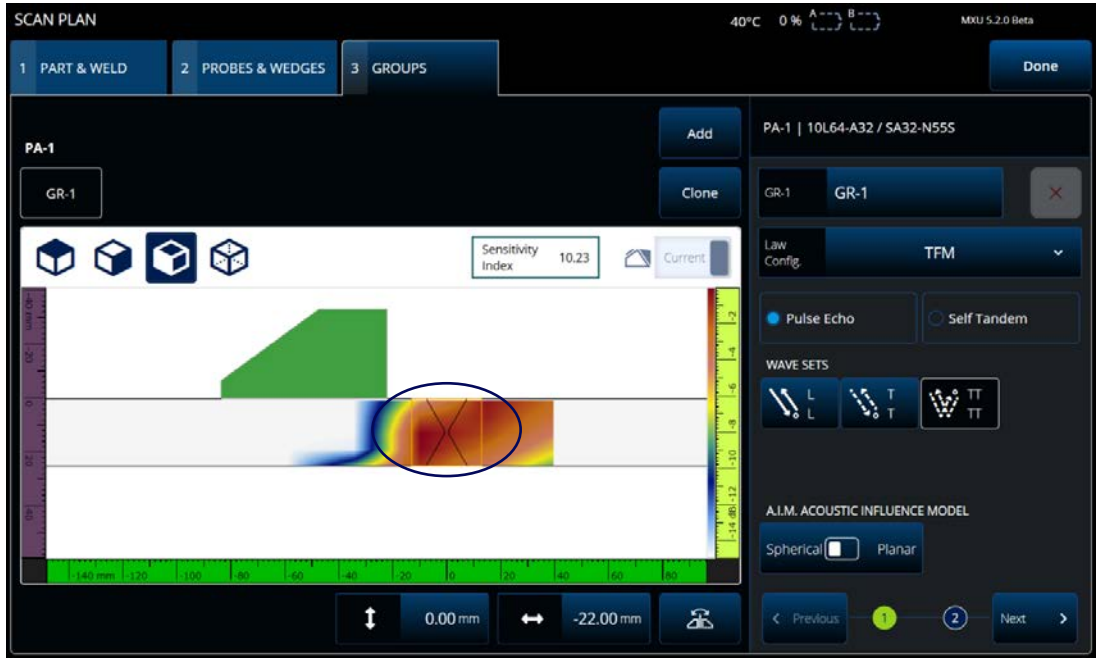
- AIM
  - Simulation tool onboard the OmniScan X3

- Here as an example, the sensitivity index decreased slightly when we select a 10Mhz probe rather then the previous 5Mhz, but the A.I.M. is more consistent throughout the full skip meaning less variation in the indication size and amplitude with the increasing sound path.

- This becomes an interesting tool for probe selection and procedure writing , to optimized setups…

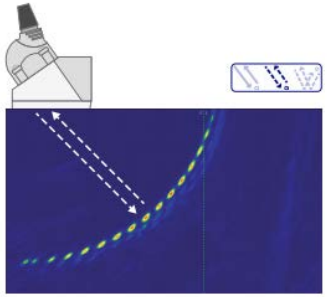


Sensitivity Index
- 10MHz, 4T

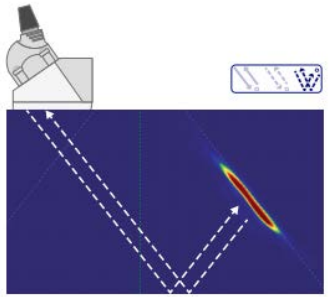


Groups TFM – Wave Sets

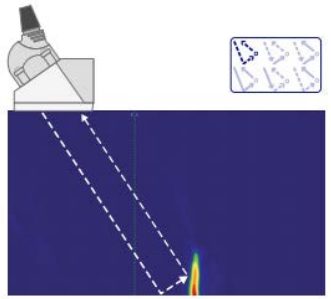
- In PAUT:
  - Most common → use a Pulse-echo method, where the same group of element (active aperture) pulses and then receives the sound.
  - The Self-tandem technique in Phased Array, while being less common and often dedicated to specialized application, uses one aperture to pulse and a different one to receive.
  - One of the advantages is that it allows for the detection of vertical flaws.
- In TFM:
- The calculated ultrasound path respects this logic.
- TFM uses the same principle when rebuilding the sound path. And just like when applied in Phased Array, the self tandem technique requires to be more precise when defining the inspection scan plan because of all the trigonometry involved. Parameters like material velocity and thickness are essential to get accurate.



Pulse-Echo first leg



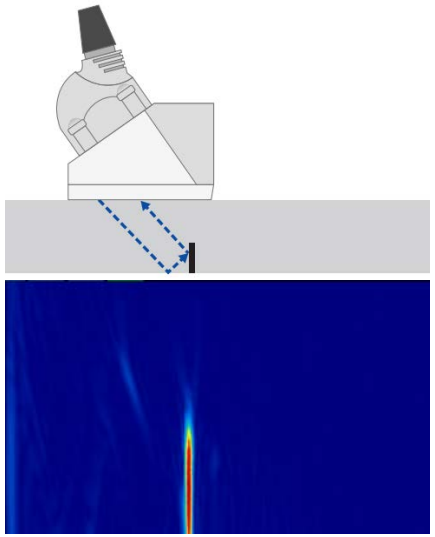
Pulse-Echo second leg



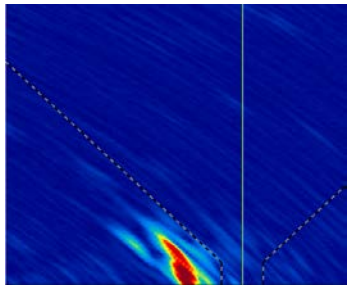
Self-Tandem TTT

Groups TFM – Wave Sets

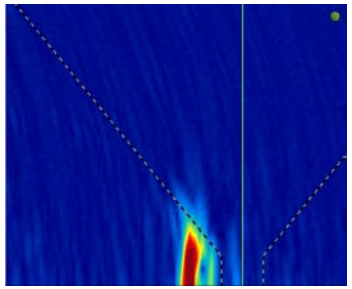
- Advantage → Visualization
  - Self-tandem also provides better imaging of flaws such as cracks.
  - The profile of the flaw is truer to reality.
  - TFM helps to remove doubts when using the right wave set: Pulse-Echo corner trap and tip diffraction may appear as 2 separate flaws for the beginners.



10mm notch using TTT Self-Tandem



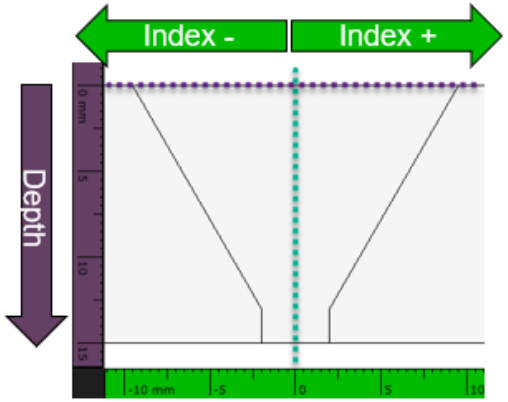
ID crack using Pulse-Echo



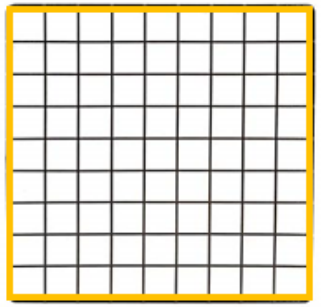
ID crack using Self-Tandem

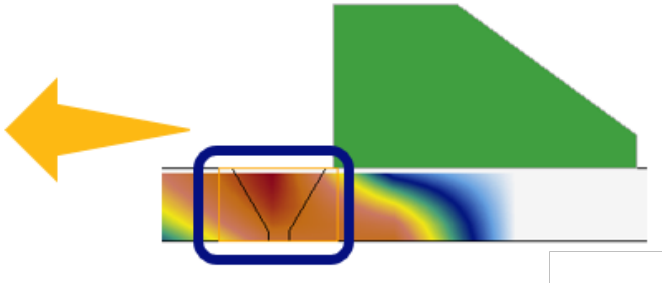
Groups TFM – TFM Zone

- The TFM zone is the area of the part that the technician chooses to view as images.
  - In PAUT, it is typically defined by the Ultrasound axis Start and Range as well as the Angle range.
- This is adjusted by the technician and can be moved anywhere within the part's volume.
- Images are constructed in the zone grid using the preselected wave set and the time of flight of the FMC data.



OmniScan™ X3 flaw detector's resolution is up to 1024 × 1024 pixels






OLYMPUS

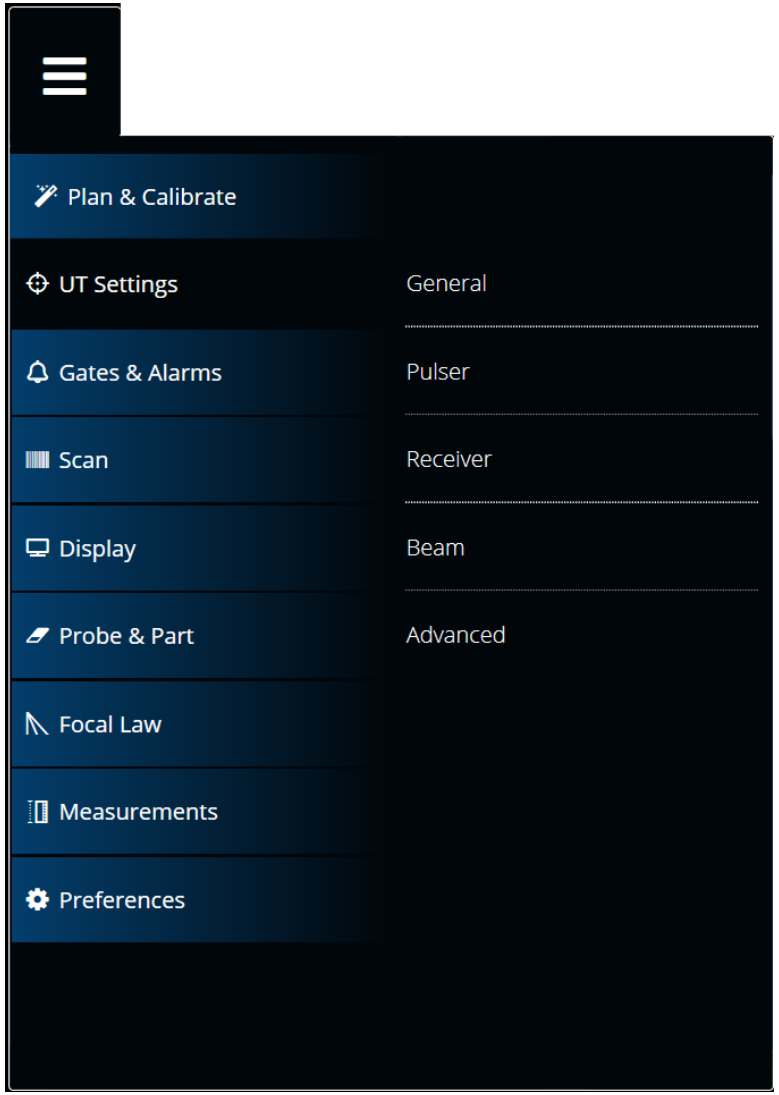
UT Settings - PA

Olympus Scientific Solutions

DSM Team | Quebec | April 2020

UT Settings - Overview

- After completion of the Scan Plan the group is created and it is necessary to configure the UT parameters such as gain, range, etc.
- The UT menu contains parameters similar to any digital conventional UT flaw detector but will manage groups of A-scans instead one.
- Some parameters of the UT menu such as voltage are dependent on the pulser configuration of the instrument and may be different on different models.
- In the UT menu are sub menus for UT general, pulser, receiver, beam and advanced that contain various options and parameters.
- Additionally, UT features such as gain can be changed at any time directly from the data view or header.



UT Settings - Gain

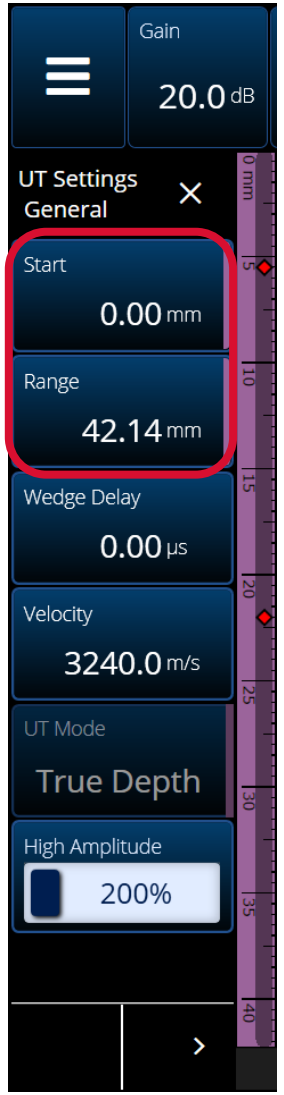
- The UT gain is always displayed in the upper left hand corner of the display and can be changed by using the touch screen and scroll knob or keyboard.
- This enables UT gain manipulation in full screen mode or from any menu without navigation.

UT Settings - Gain

- Editing the gain gives access to the set to 80% function.
- This is useful to automatically adjust the signal in gate A to 80%.

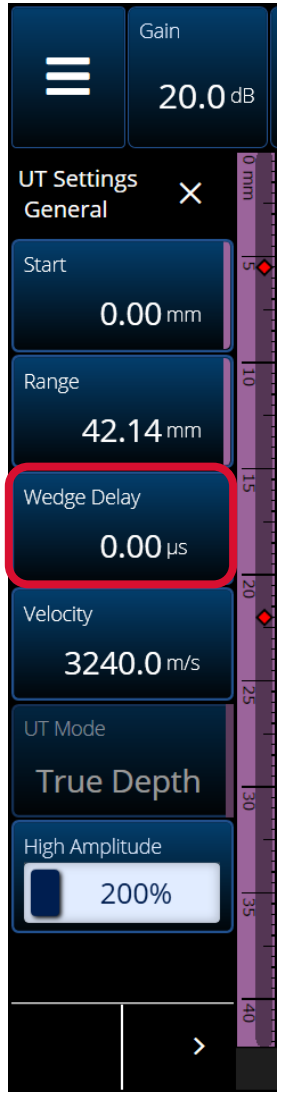
UT Settings – Start and Range

- The UT start and range function similarly to a conventional flaw detector except that what is entered for one A-scan is calculated to respect the same sound path for all A-scans in the group.
- Adjusting the start and range properly is essential for good gate placement and ensures that the A-scan points are over the area of interest of the inspection for optimum analysis.
- For welds that are less than 25mm thick, a good rule of thumb for typical weld inspection is to select the 45 degrees focal law and set the range to 2.5X the component thickness.



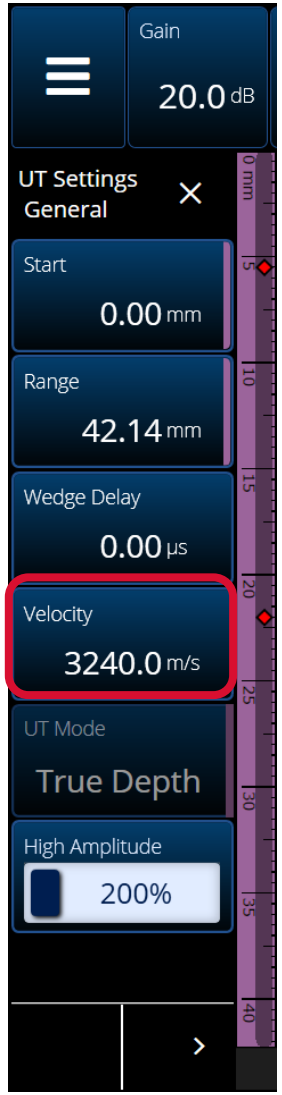
UT Settings – Wedge Delay

- The wedge delay parameter is used to increase the beam delay for all focal laws in the group.
- It can be useful for example when a wedge of unknown height is used to set the interface echo to 0.



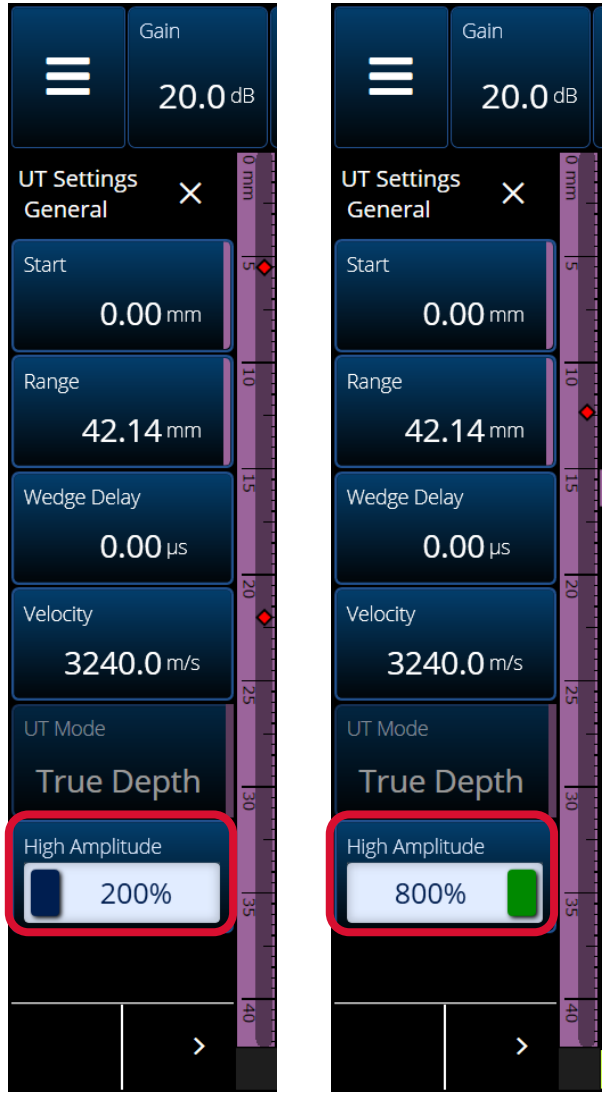
UT Settings – Velocity

- The material type and shear\longitudinal are normally selected during the group creation as part of the scan plan process.
- A wizard is available to calculate the velocity based on 2 calibration targets of known depth\sound path.
- Custom velocities can be entered manually as needed in the UT settings menu.
- The material velocity must be known prior to focal law creation. The velocity cannot be modified without recreating the focal laws.



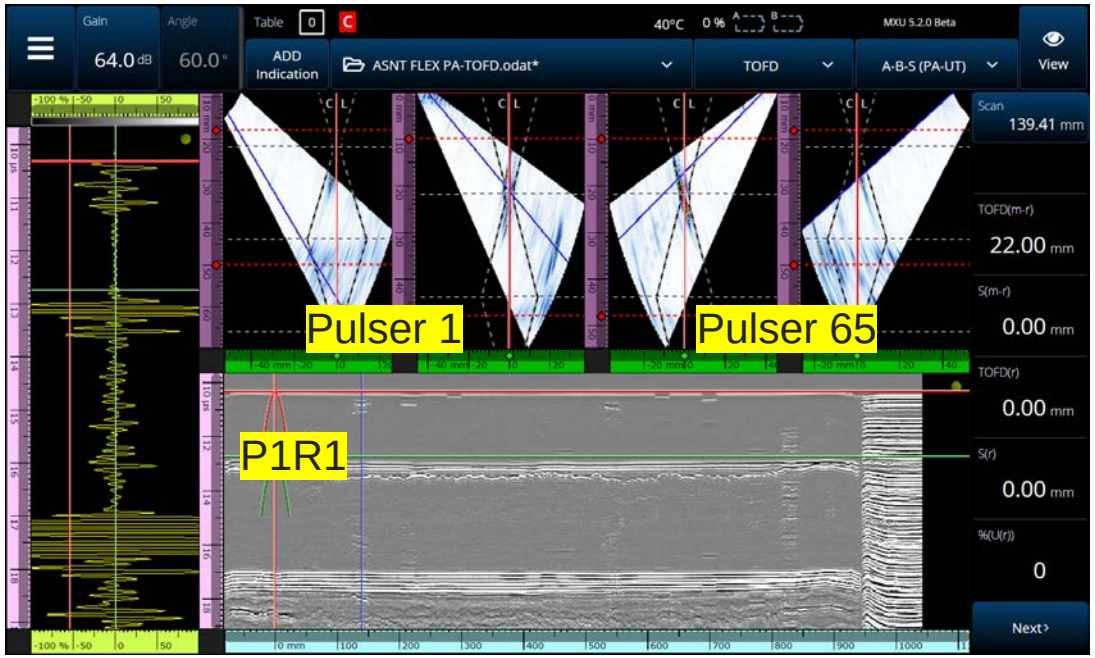
UT Settings – High Amplitude

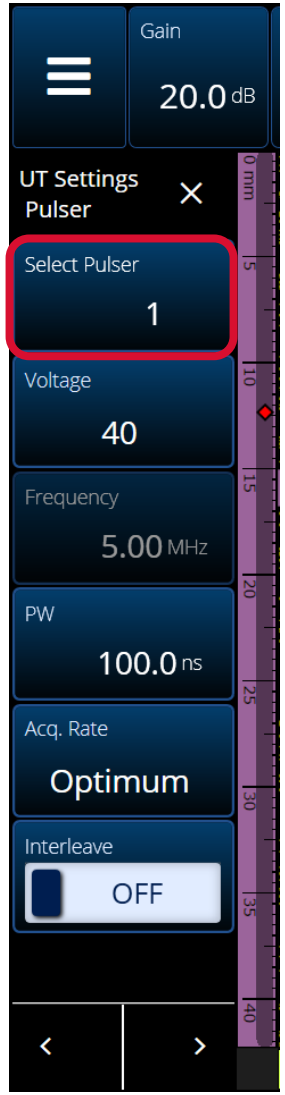
- The OmniScan X3 A-Scan has a amplitude resolution of 16 bits meaning 2^{16} samples on the % axis.
- The 200% mode is the default and should cover most of the applications.
- It provides greater signal resolution as these 2^{16} samples are distributed over a 200% range.
- For applications requiring higher inspection gain, it is likely to saturate the A-Scan with the 0-200% scale. In this case, the A-Scan range can be changed to 0-800%.
- Whether the 200% or the 800% mode is used, the A-Scan will only display up to 100%. However, readings are adjusted to the new capability.



UT Settings – Pulser

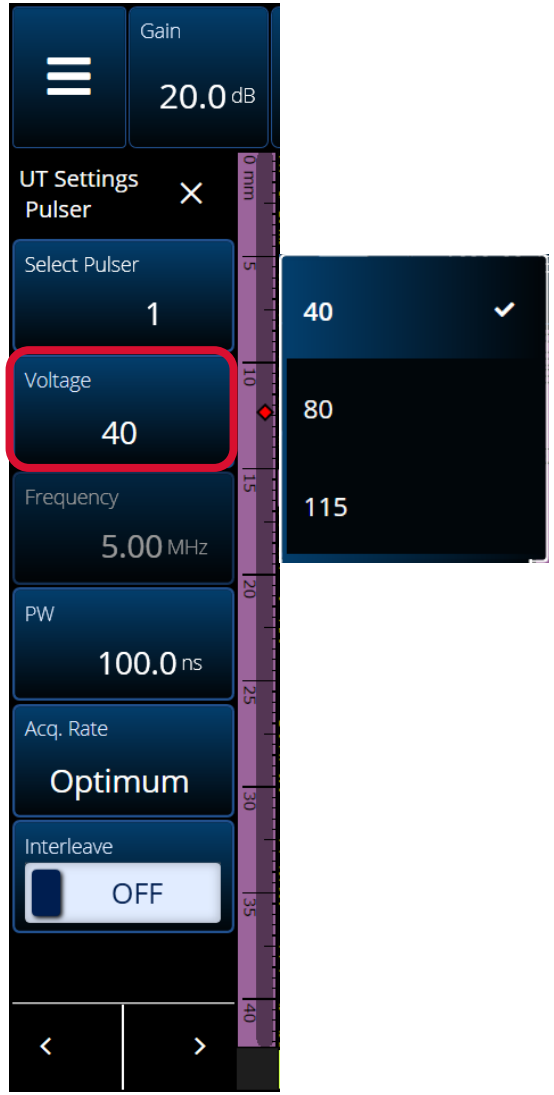
- The pulser values are entered during the scan plan process and associated probes or probe elements to the phased array connector wiring and instrument pulsers.
- The example below is of a 3 probe and 5 group configuration for an OmniScan X3 PA-TOFD inspection for which each probe is associated to a pulser.





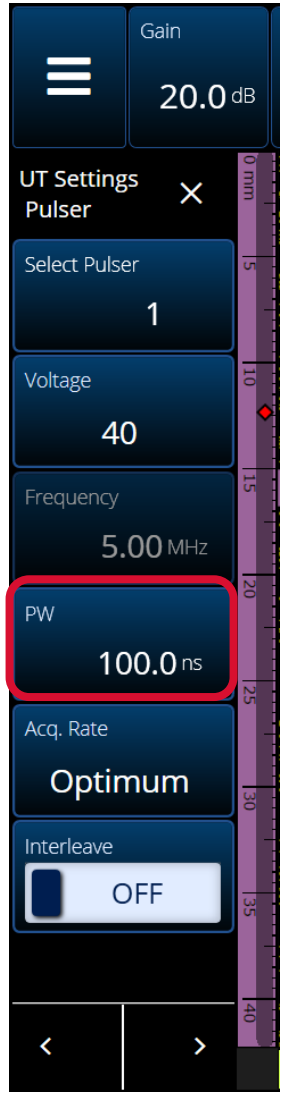
UT Settings – Voltage

- The voltage is not independently selectable for each group. What is used on group 1 must be used for all other groups using the same probe connector.
  - PA connector has its own voltage.
  - UT connectors have their own voltage.
- Voltage selected is directly related to battery life and heat and should be set correctly for the type and pitch of probe being used.
- High voltage used on small pitch probes such as the Cobra can be detrimental to the probe life and does not result in better performance.



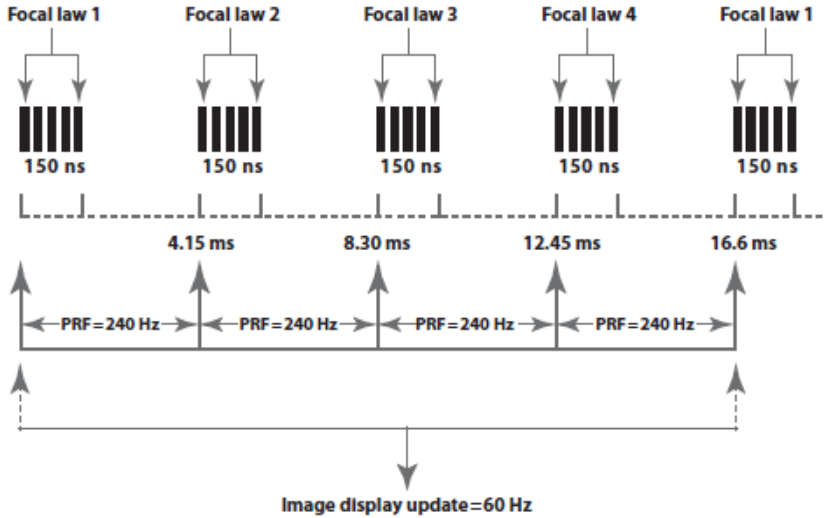
UT Settings – Pulse Width

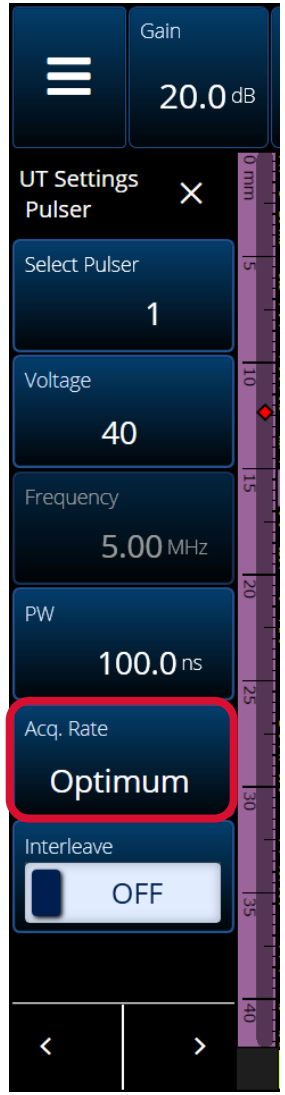
- Pulse width is automatically set according to probe frequency.
- It can be adjusted to compensate for probe deterioration or to accommodate certain applications.



UT Settings – Acq Rate

- The pulse repetition frequency (PRF) is the frequency at which pulsers are emitted and is expressed as the inverse of the time interval between the emission of pulses.
- The acquisition rate is the number of complete acquisition cycles expressed in Hz that the system can complete in one second and is directly related to PRF.
- Acquisition Rate includes options for:
  - Auto max. Will allow maximum Acq Rate (Scanner speed) for current configuration.
  - Optimum. Compromise of heat, battery power, scanner speed and common settings.
  - Manual. Any number up to the maximum allowed with current configuration.



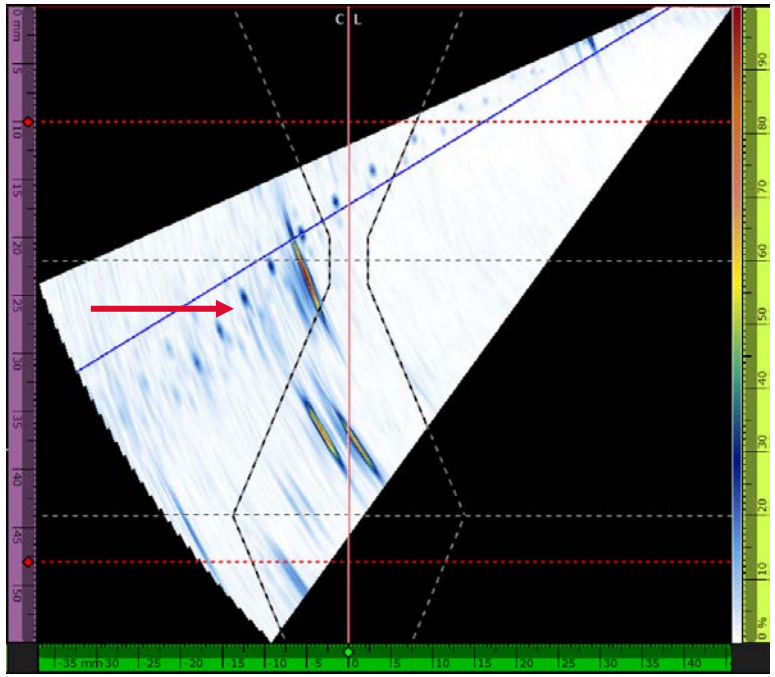


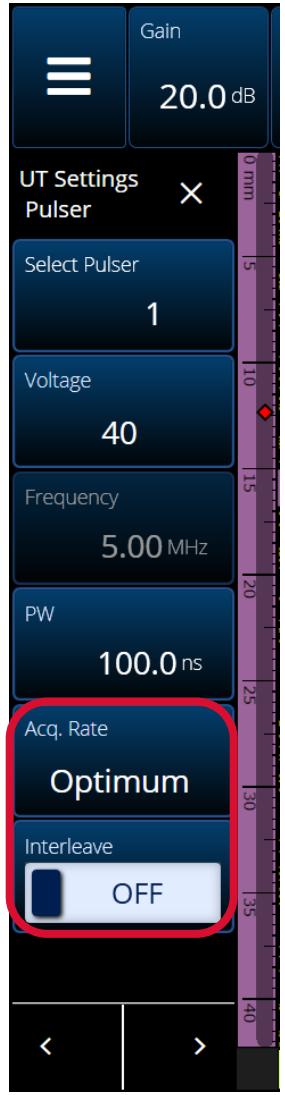
UT Settings - Acq Rate

- The header bar show the Acq rate with the PRF of the current group between parenthesis and it can be of 3 different colors:
  - Green: all is good (all data collected is kept and displayed).
  - Orange: no data lost but the display cannot keep up with the acquisition.
  - Red: data is lost. Generally indicating that the scanner is moving too fast compared to the acquisition rate.

UT Settings – Interleave

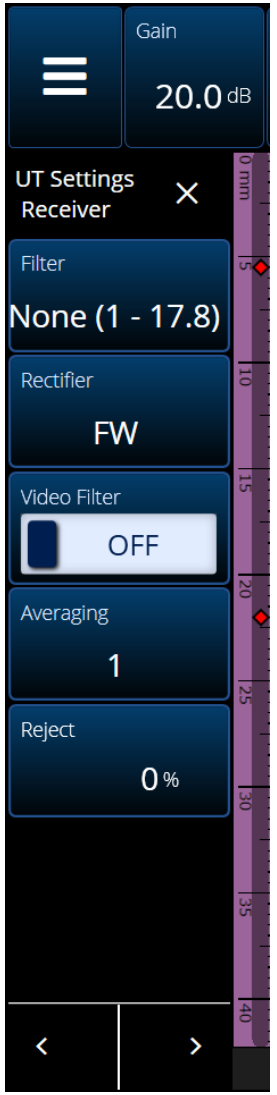
- Below is an example of ghost echoes due to excessive PRF. This phenomenon is also common on cylindrical components like studs and bolting, inspections requiring long sound paths like forgings and castings, and complex geometry such as valves and flange faces.
- Reduce the Acquisition Rate when this problem is suspected or turn ON the interleave.
- The interleave changes the firing sequence and allows for faster acquisitions without affecting the acquired data.





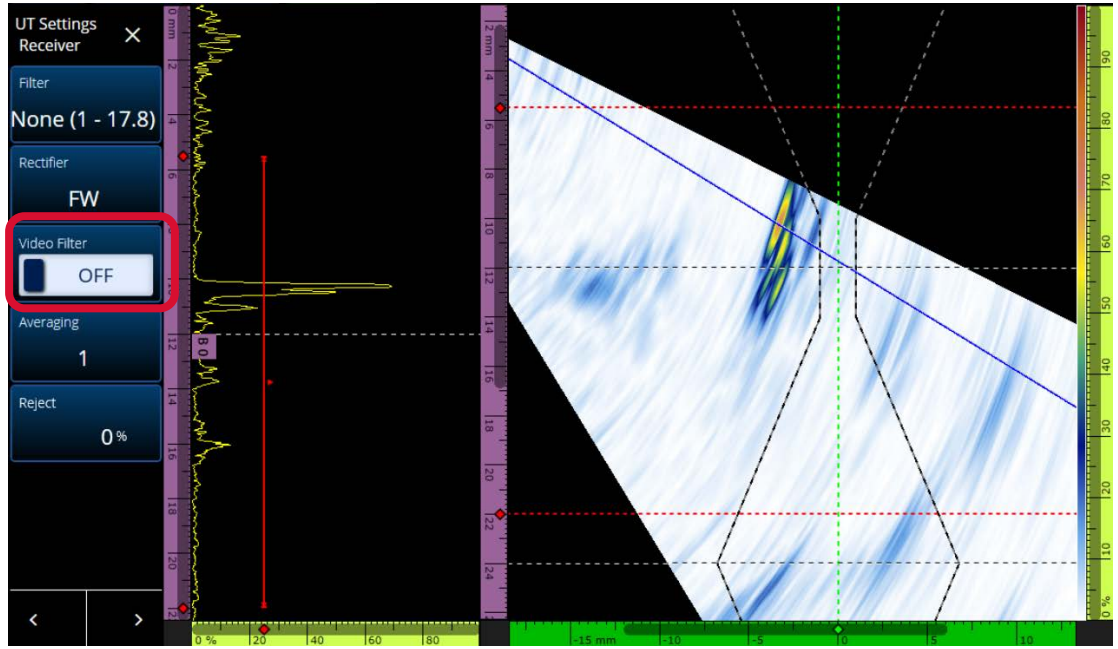
UT Settings – Receiver menu

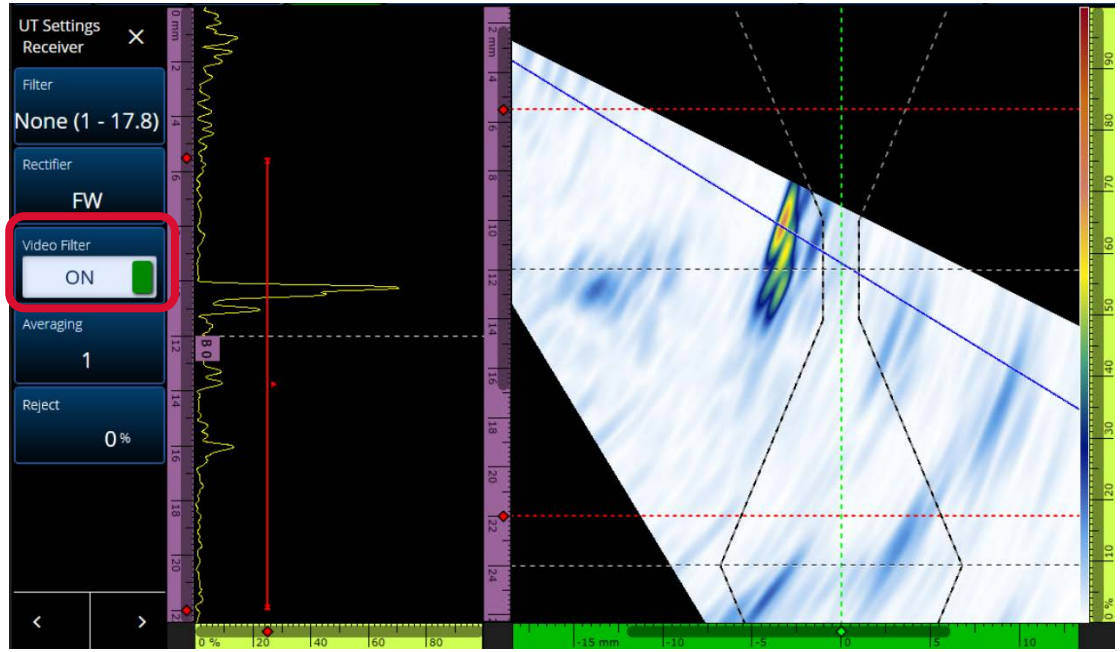
- Set the filter to the frequency of the probe or whichever filter works best including no filter.
- Turn on or off the video filter based on preference.
- Leave averaging at 1 for phased array inspection (1= no averaging). Averaging is only used on TOFD and conventional UT groups.
  - Otherwise the acquisition rate will be severely impacted.



UT Settings – Video Filter

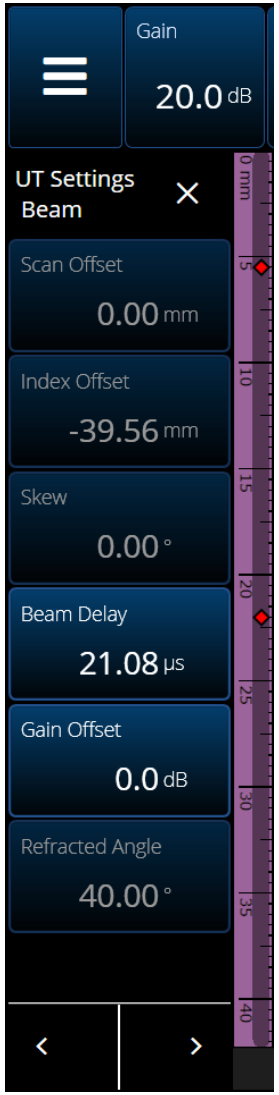
- The video filter provides a type of digital smoothing that can aid in sizing defects. It cannot be adjusted in analysis mode and the data file will be saved with the selected option.
- The video filter will change the signal sensitivity and must be set prior to calibration.





UT Settings – Receiver menu

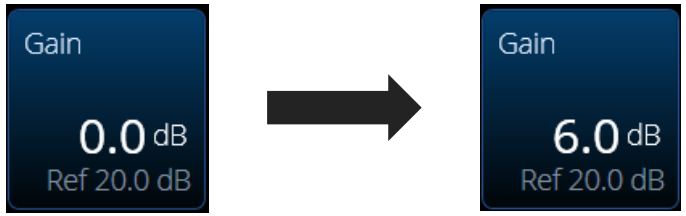
- Parameters in the beam sub menu are the result of either the scan plan calculator or calibration wizards and should not be adjusted manually.
- The beam index offset is the theoretical exit point of the beam in the wedge and is used for verification of exit point on a calibration block.
  - The index offset is different for each A-scan even in an S-scan using the same elements.
- The beam delay is calculated by the focal law wizard initially and adjusted during wedge delay calibration using the wizard.
- The focal law gain offset is different for each focal law and is adjusted during sensitivity calibration using the wizard.

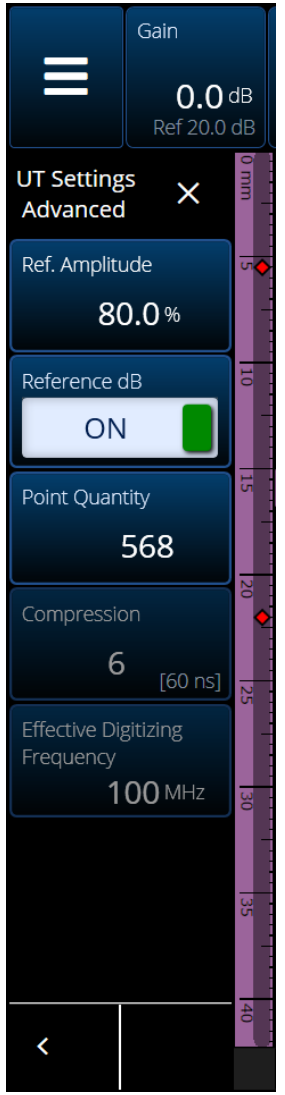


UT Settings – Reference amplitude

- The ref amplitude is used to specify the A-Scan full-screen height of the reference amplitude. The default value is 80%.
- Changing the ref amplitude affect the set to XX% function and also the A-Scan reference lines activated with the reference dB.

- The reference dB will display the reference amplitude line on the A-Scan with the -6dB line.
- It also fixes the gain so that calibration gain can be kept and scanning/analysis gain easily added and removed.





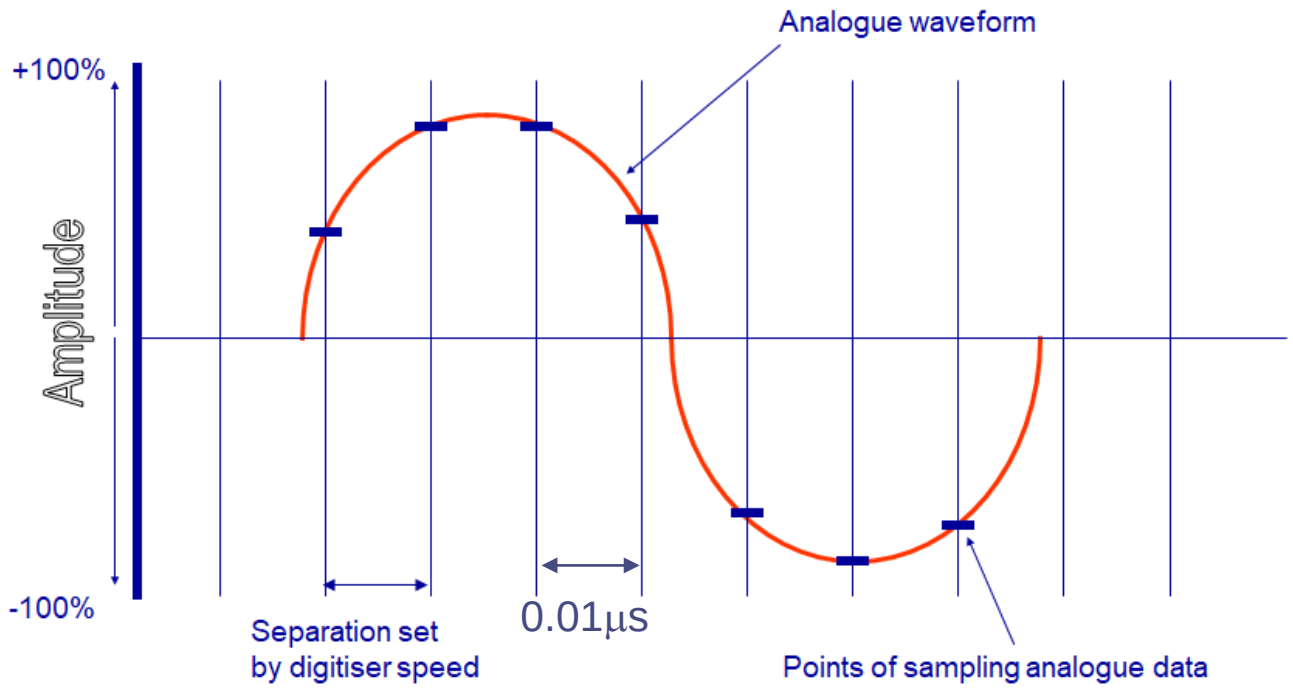
ASME 2019 – Essential Variables

- The ASME 2019 code requires both the Digitizing Frequency and the Net Digitizing Frequency as part of the essential variables tables.
- So how can we make sure we comply with this requirement?

	Essential	Nonessential
For compound E-scan and S-scan: all E-scan and S-scan variables apply	X	...
Digitizing frequency	X	...
Net digitizing frequency (considers points quantity and other data compression)	X	...
Instrument dynamic range setting	X	...
Pulser voltage	X	

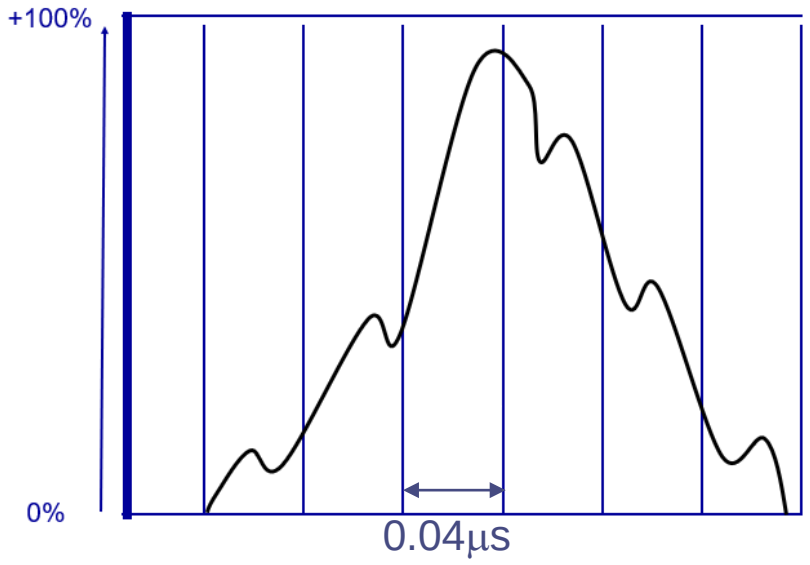
OmniScan X3 – PA Digitizing Frequency

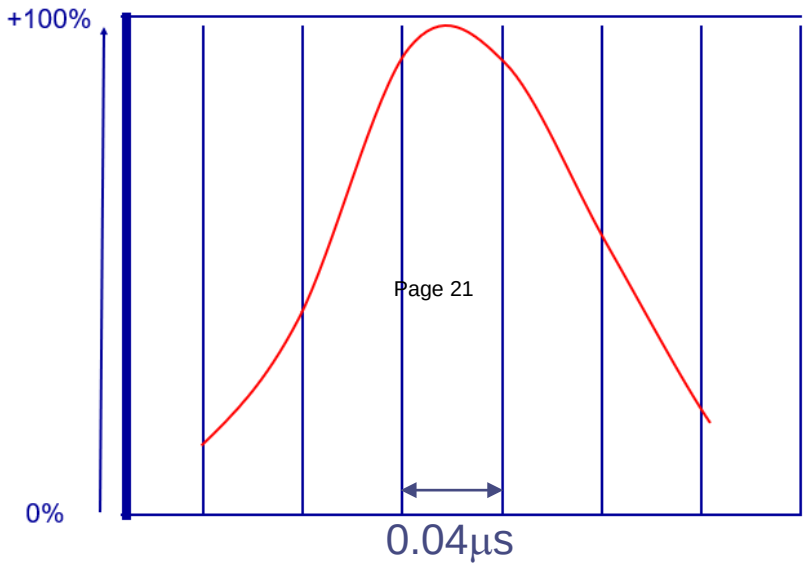
- The OmniScan X3 Phased Array Digitizing Frequency is set to 100MHz.
- This value cannot be changed by the user.
- It means a data point is acquired every 0.01µs.



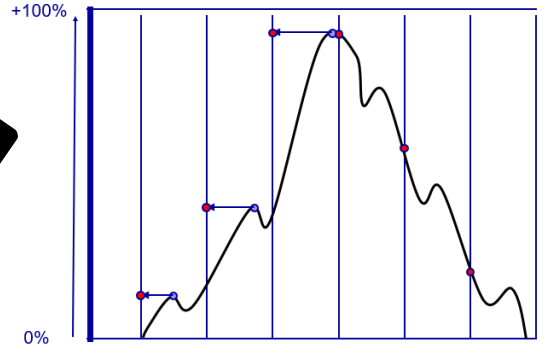
OmniScan X3 – Compression

- The term Compression (or Scale Factor) means that not all acquisition points are saved, only the most relevant out of X points.
- For example, with Compression of 4, the most relevant of a group of 4 consecutive points is recorded.
- Main benefits include: reduce the file size and increase the acquisition speed.

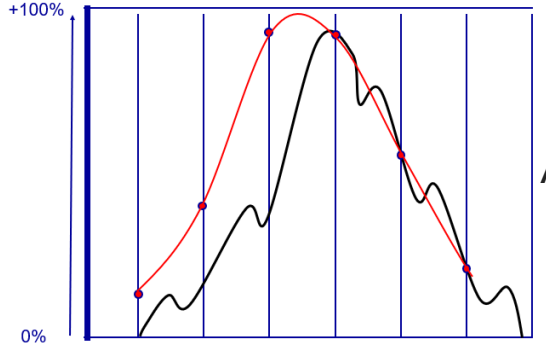




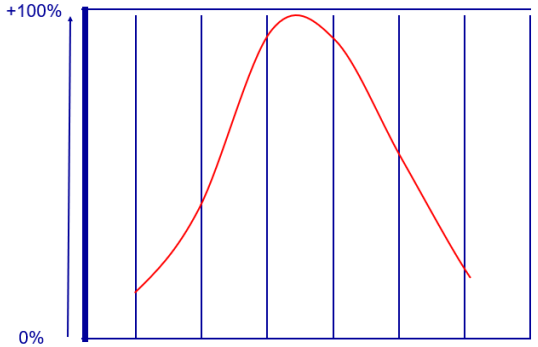
The position of the point is set to the start of the compression zone



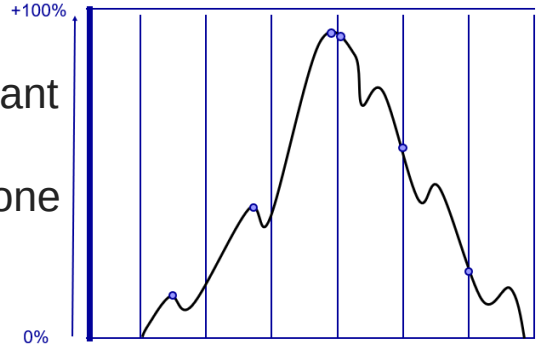
A new curve is created



The data is recorded with a compression of 4

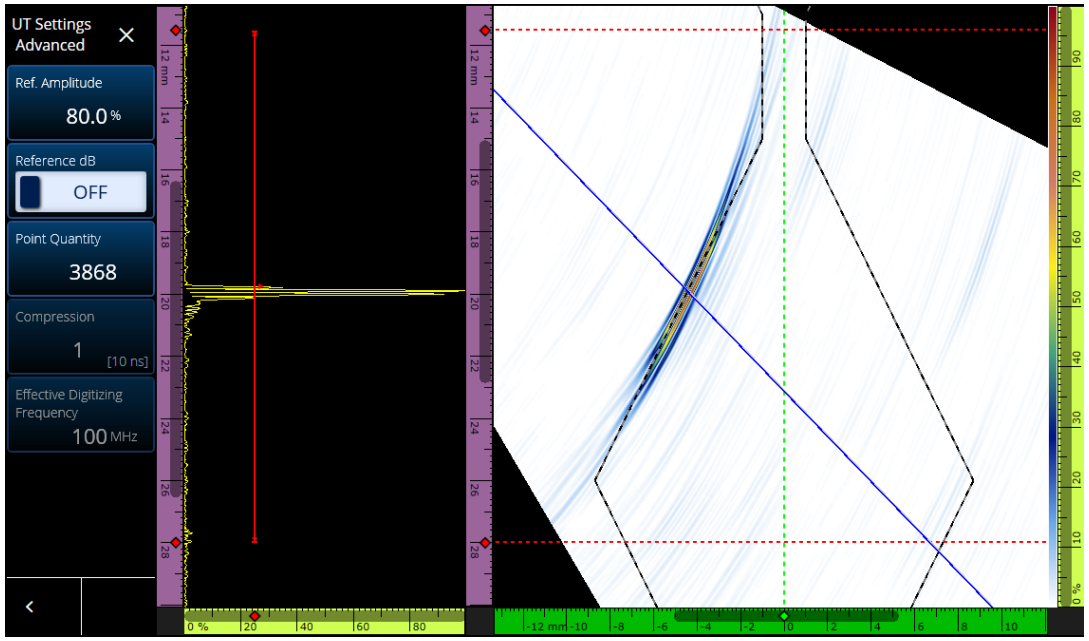


The most relevant point of the compression zone is detected

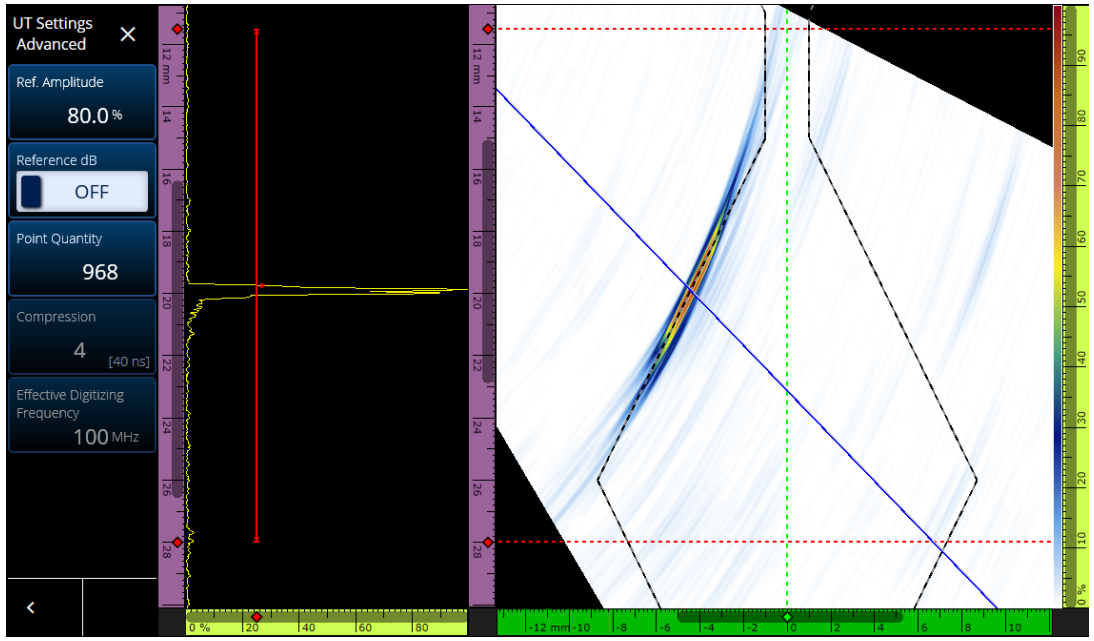


OmniScan X3 – Net Digitizing Frequency

- Referencing to ASME: this compression provides the Net Digiting Frequency.
- 1 point recorded every 0.04µs = Net Digitizing Frequency of 25MHz.



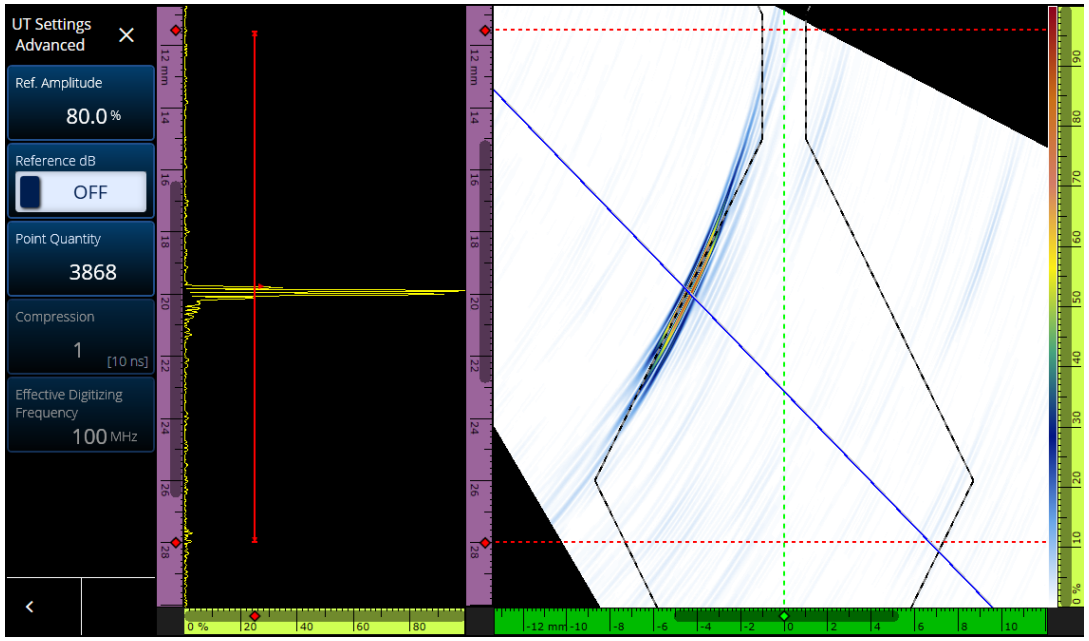
No Compression, Net Digitizing Frequency = 100MHz.



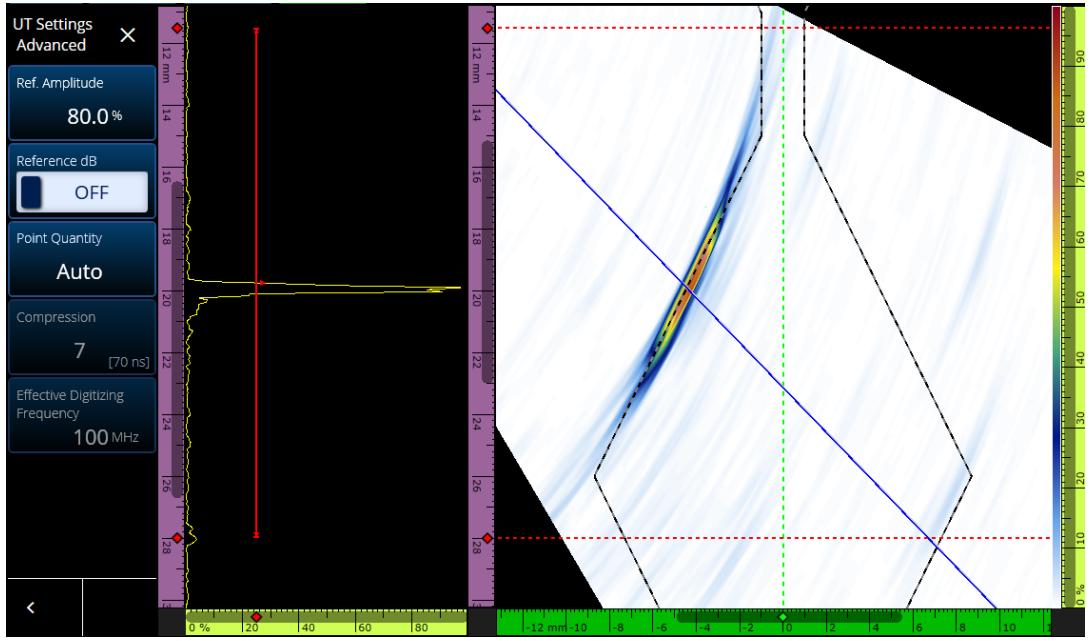
Compression of 4, Net Digitizing Frequency = 25MHz.

OmniScan X3 – Auto Point Qty

- The X3 defaults the Point Qty based on the input parameters to provide the best signal to productivity ratio. This is the Auto setting.



No Compression, Net Digitizing Frequency = 100MHz.



Point Qty Auto (Compression of 7), Net Digitizing Frequency = 14.3MHz.

How to calculate the setup?

- The X3 gives control over the Point Quantity.
- The Compression and hence the Net Digitizing Frequency are results.
- This approach is simpler in most cases but if a requirement of point-to-point resolution is asked, or number of points per probe wavelength, then it becomes difficult to calculate.
- The rule of thumb is to set up 5 points per wavelength.
- In the same package as this presentation, you can find an Excel sheet calculator (OmniScan pt qty-compression calculator.xlsx).

How to calculate the setup?

Criteria of points/wavelength or point-to-point resolution

OmniScan parameters from the UT Settings menu

Requirement

Resulting parameters:
- Point Qty to input in the X3
- Read only Compression and Net Digitizing Freq.

Intermediate calculations - Do Not Edit

Metric
Criteria - # of samples per wavelength

Known	Value	Units
Probe Frequency	5	MHz
Digitizing Frequency	100	MHz
Velocity	3240	m/s
Current Angle	40	deg
UT Range	100	mm
Required		
Number of samples per Wavelength	5	
Results		
Compression (Scale factor)	4	
Point Quantity	2015	points
Net Digitizing freq	25	MHz
Calculations		
Half-Path distance	130.54	mm
Full-Path distance	261.08	mm
Full-Path distance	80.58	us
Point qty without compression	8058	points
Probe period	0.2	us
Sampling rate	0.04	us

Imperial
Criteria - # of samples per wavelength

Known	Value	Units
Probe Frequency	5	MHz
Digitizing Frequency	100	MHz
Velocity	0.1276	in/us
Current Angle	40	deg
UT Range	4	in
Required		
Number of samples per Wavelength	5	
Results		
Compression (Scale factor)	4	
Point Quantity	2046	points
Net Digitizing freq	25	MHz
Calculations		
Half-Path distance	5.22	in
Full-Path distance	10.44	in
Full-Path distance	81.84	us
Point qty without compression	8184	points
Probe period	0.2	us
Sampling rate	0.04	us

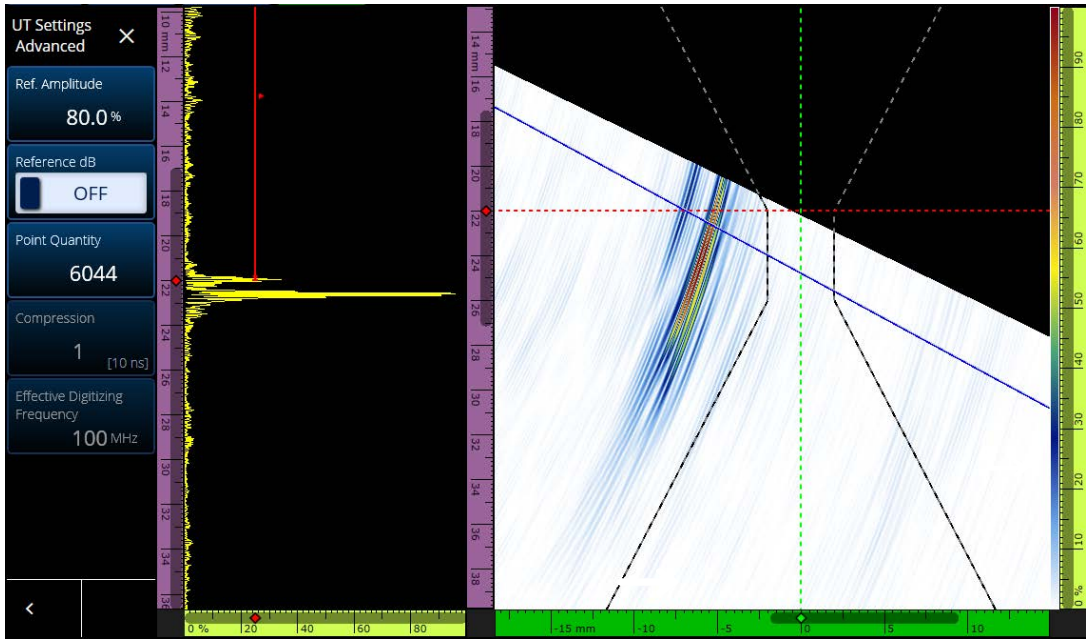
Metric
Criteria - point to point resolution

Known	Value	Units
Probe Frequency	5	MHz
Digitizing Frequency	100	MHz
Velocity	3240	m/s
Current Angle	40	deg
UT Range	100	mm
Required		
Point to point resolution	0.13	mm
Results		
Compression (Scale factor)	4	
Point Quantity	2015	points
Net Digitizing freq	25	MHz
Calculations		
Half-Path distance	130.54	mm
Full-Path distance	261.08	mm
Full-Path distance	80.58	us
Point qty without compression	8058	points
Sampling rate	0.04	us

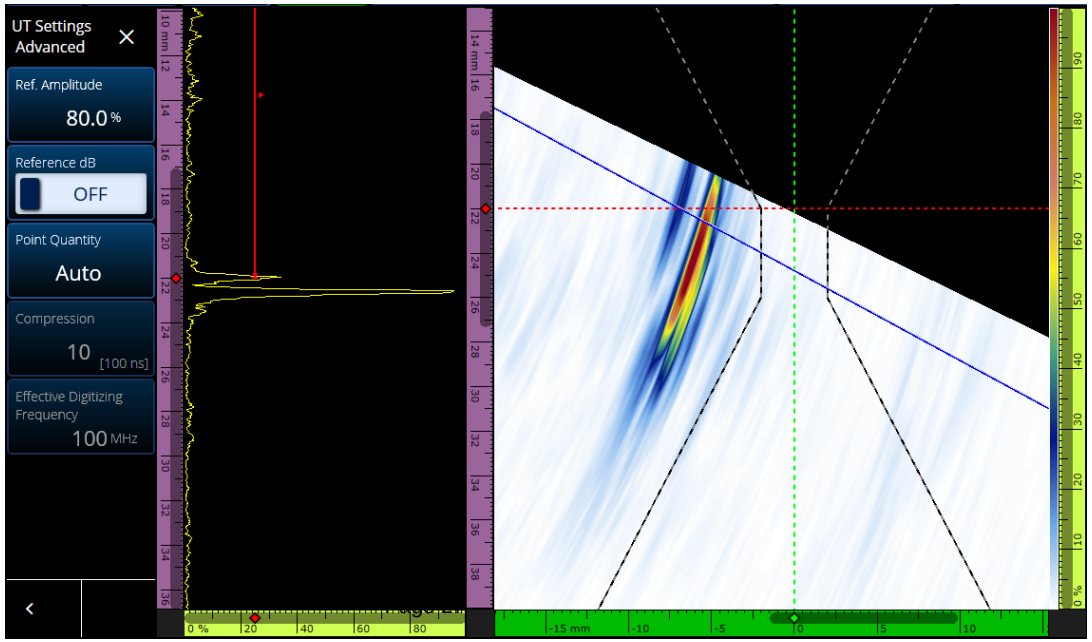
Imperial
Criteria - point to point resolution

Known	Value	Units
Probe Frequency	5	MHz
Digitizing Frequency	100	MHz
Velocity	0.1276	in/us
Current Angle	40	deg
UT Range	4	in
Required		
Point to point resolution	0.005	in
Results		
Compression (Scale factor)	4	
Point Quantity	2046	points
Net Digitizing freq	25	MHz
Calculations		
Half-Path distance	5.22	in
Full-Path distance	10.44	in
Full-Path distance	81.84	us
Point qty without compression	8184	points
Sampling rate	0.04	us

More Examples

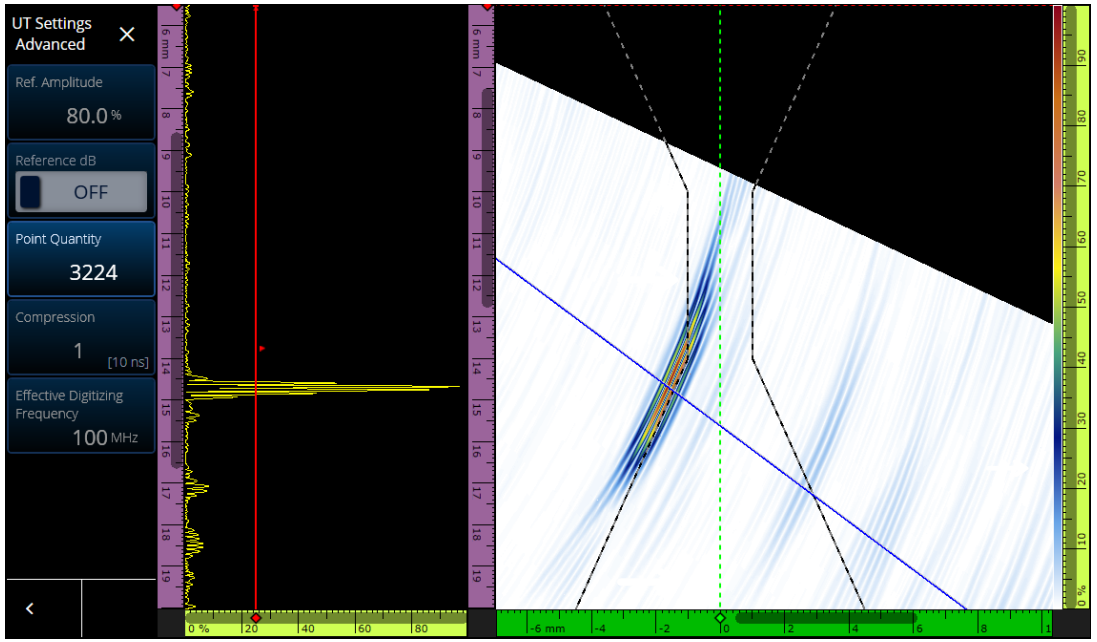


No Compression, Net Digitizing Frequency = 100MHz.

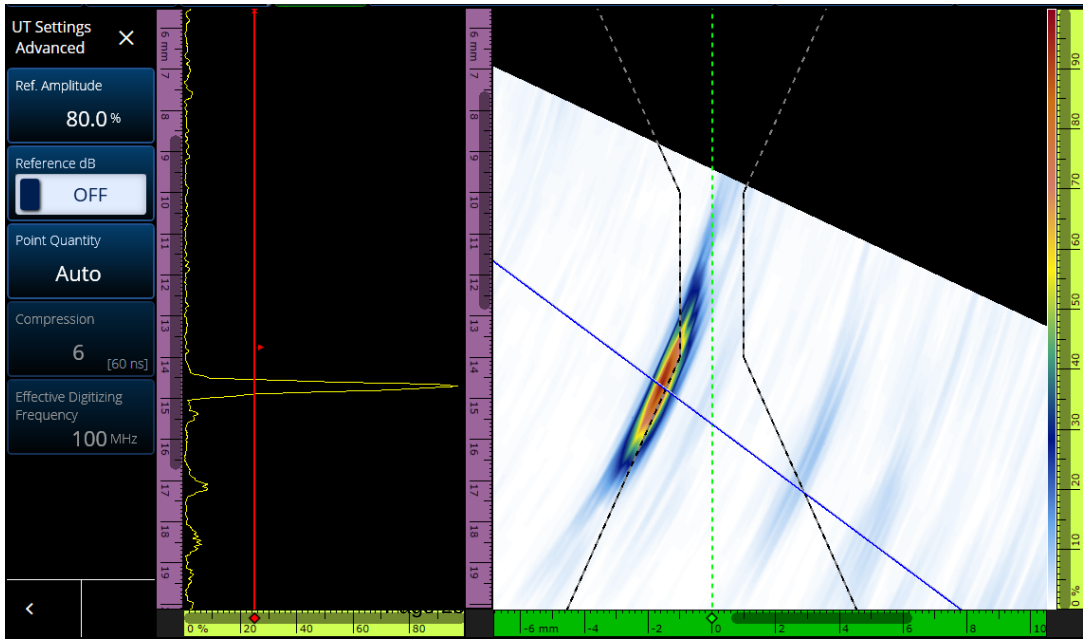


Point Qty Auto (Compression of 10), Net Digitizing Frequency = 10MHz.

More Examples

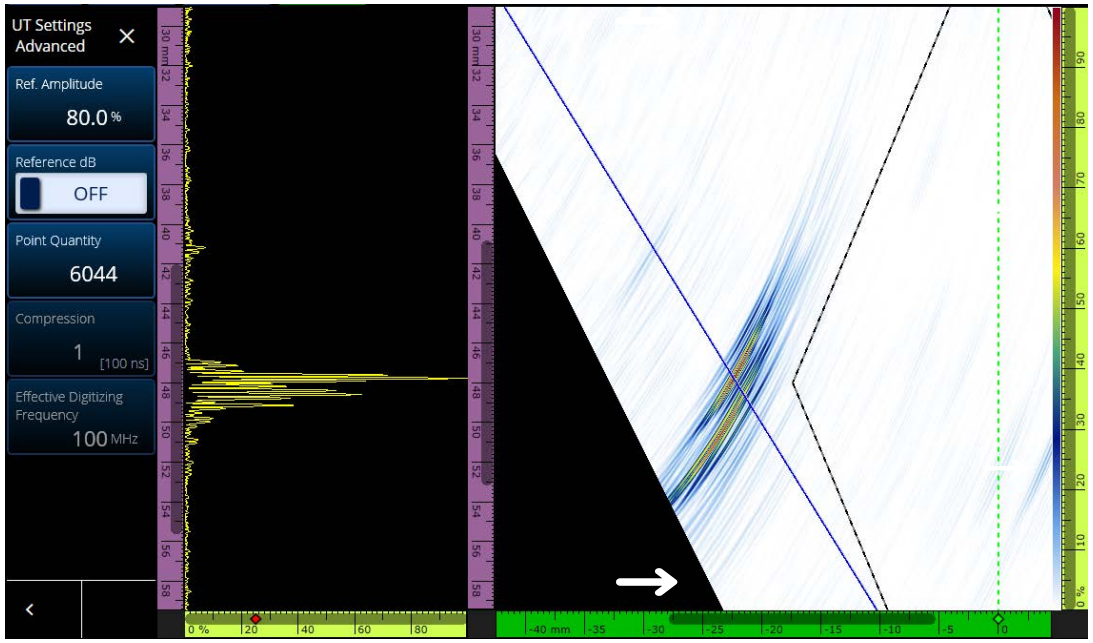


No Compression, Net Digitizing Frequency = 100MHz.

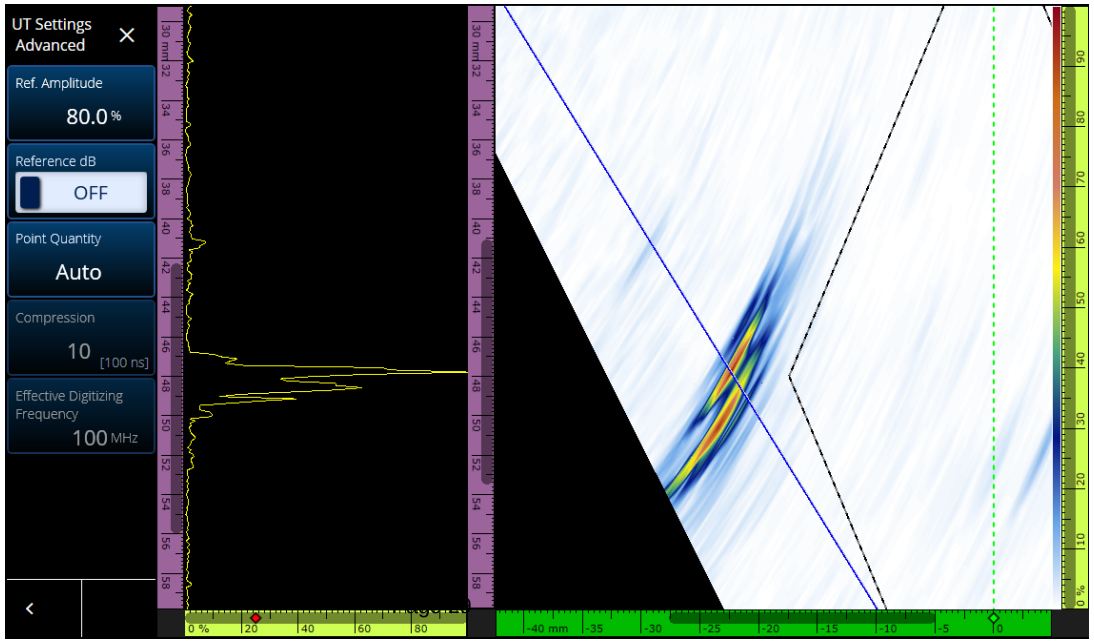


Point Qty Auto (Compression of 6), Net Digitizing Frequency = 16.7MHz.

More Examples



No Compression, Net Digitizing Frequency = 100MHz.



Point Qty Auto (Compression of 10), Net Digitizing Frequency = 10MHz.


OLYMPUS

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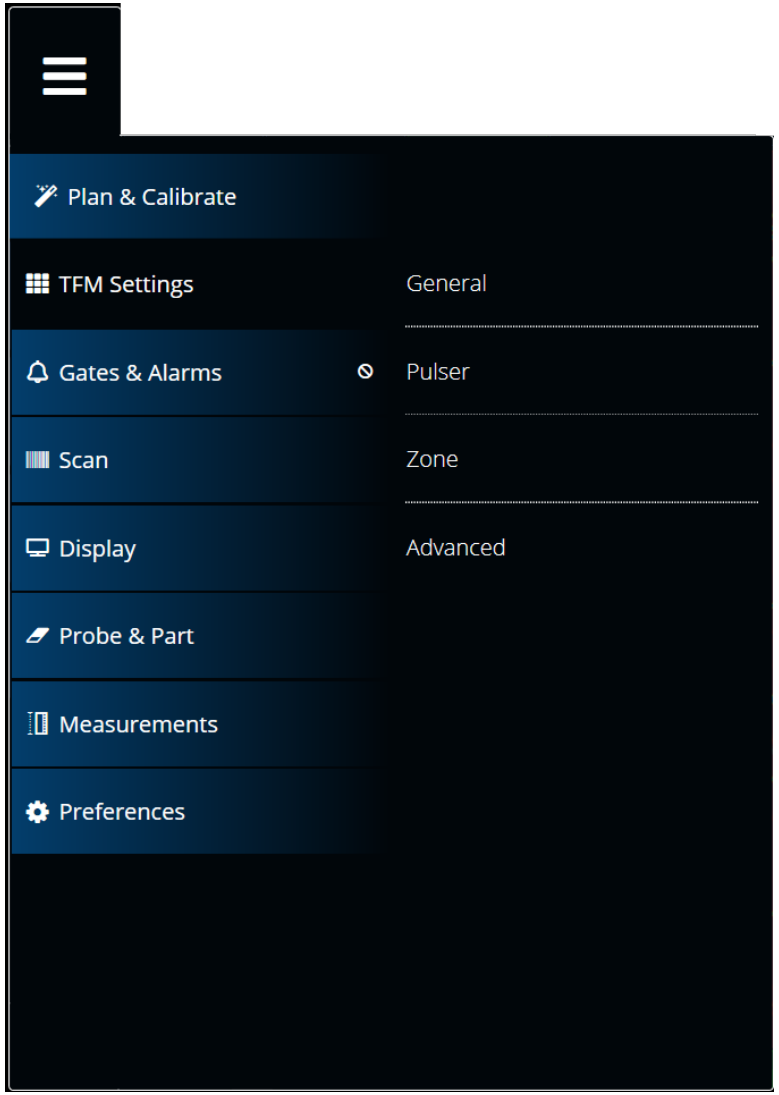
TFM Settings

Olympus Scientific Solutions

DSM Team | Quebec | April 2020

TFM Settings - Overview

- After completion of the Scan Plan the group is created and it is necessary to configure the TFM parameters such as envelope, resolution, etc.
- The menu contains parameters similar to the Phased Array ones like velocity, voltage and acq rate but also all the necessary tools to adjust the selected TFM wave set.
- In the TFM menu are sub menus for general, pulser, zone and advanced that contain various options and parameters.
- Additionally, UT features such as gain can be changed at any time directly from the data view or header.

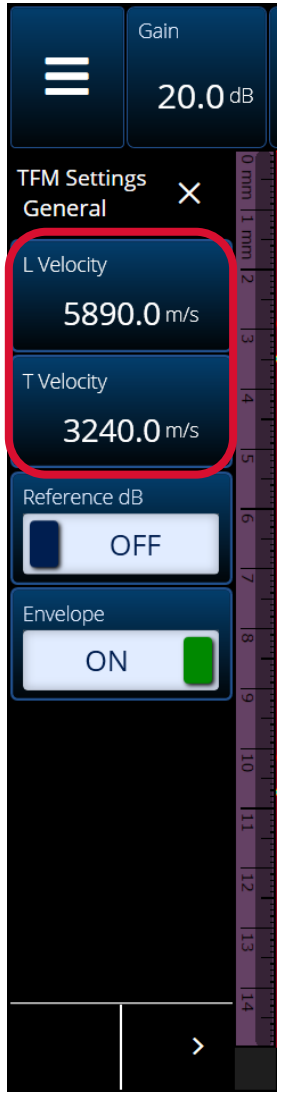


TFM Settings - Gain

- The UT gain is always displayed in the upper left hand corner of the display and can be changed by using the touch screen and scroll knob or keyboard.
- This enables UT gain manipulation in full screen mode or from any menu without navigation.

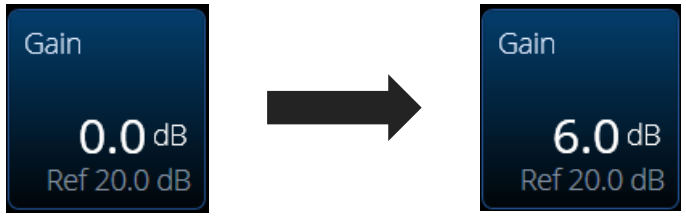
TFM Settings – Velocity

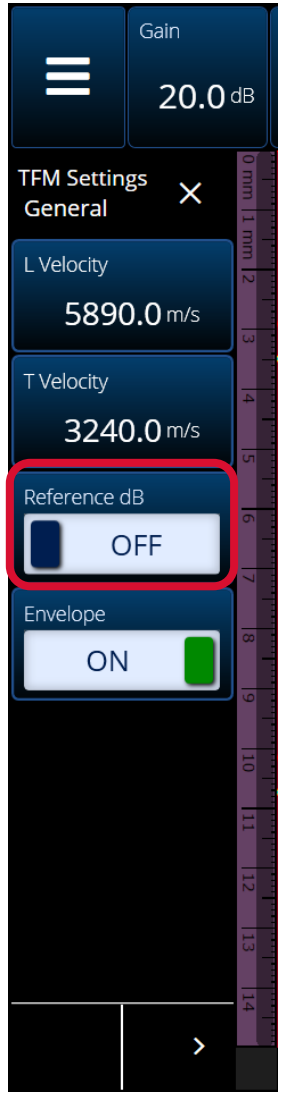
- The material type and shear\longitudinal are normally selected during the group creation as part of the scan plan process.
- Custom velocities can be entered manually as needed in the UT settings menu.
- The material velocity must be known prior to focal law creation. The velocity cannot be modified without recreating the focal laws.



TFM Settings – Reference dB

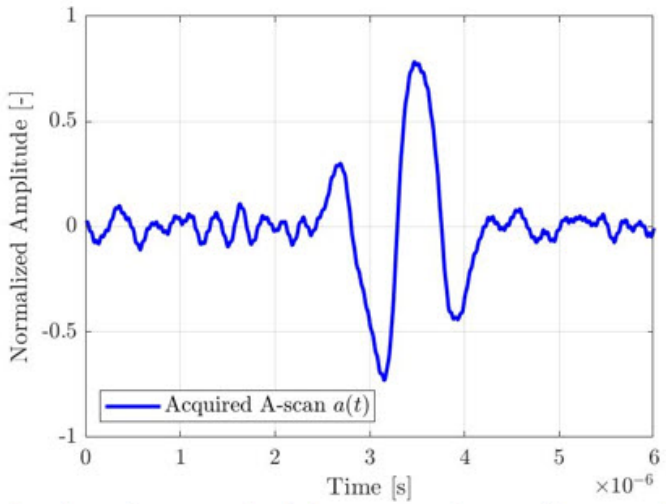
- The reference dB fixes the gain so that calibration gain can be kept and scanning/analysis gain easily added and removed.



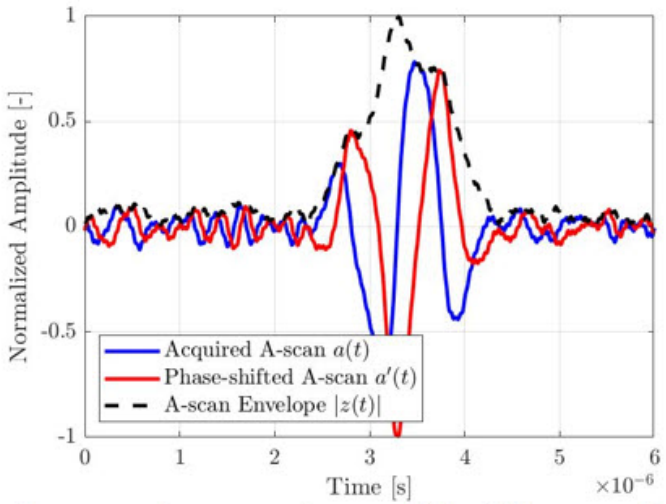


TFM Settings - Envelope

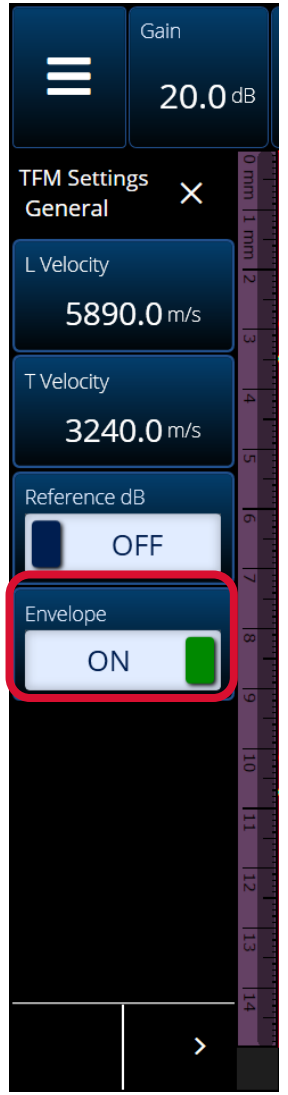
- The TFM envelope is obtained by computing the norm of two different TFM images: one computed using the standard acquired FMC and a second computed using the Hilbert transformed FMC.
  - No information is lost.
  - This is signal processing and **not a smoothing filter**.



Portion of an acquired elementary A-scan (from an FMC acquisition).

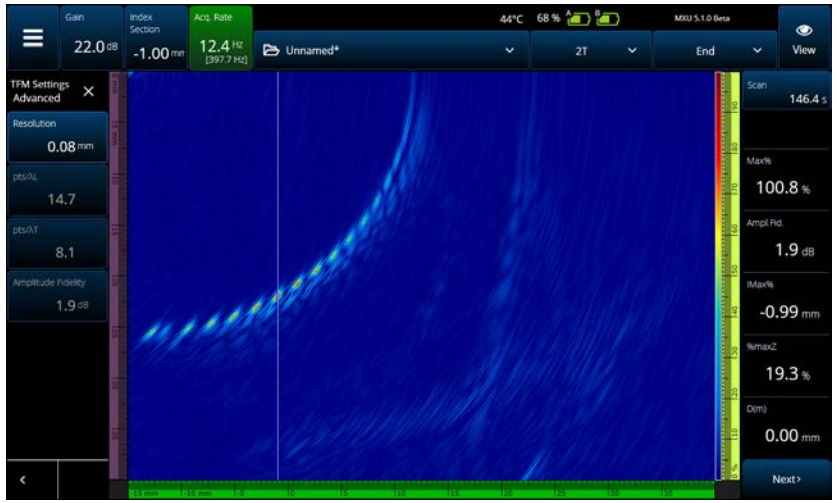


The same elementary A-scan with its Hilbert transform and the computed envelope.



TFM Settings - Envelope

- Envelope should be activate for all TFM scans, it brings the following advantages:
  - Improved basis for amplitude-based sizing methods.
  - Higher acquisition rate for equivalent Amplitude Fidelity value.
  - Improved Signal-to-Noise ratio.

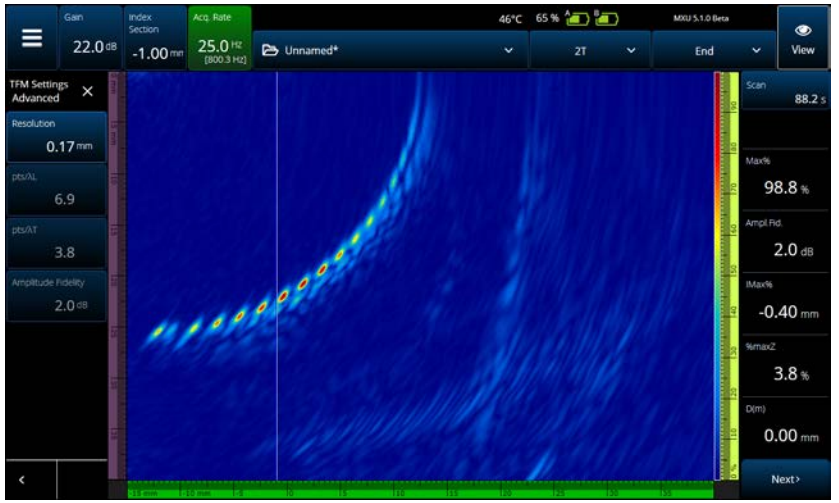


Resolution: 0.08mm

Amplitude Fidelity: 1.9dB

PRF: 12.4Hz

Envelope OFF



Resolution: 0.17mm

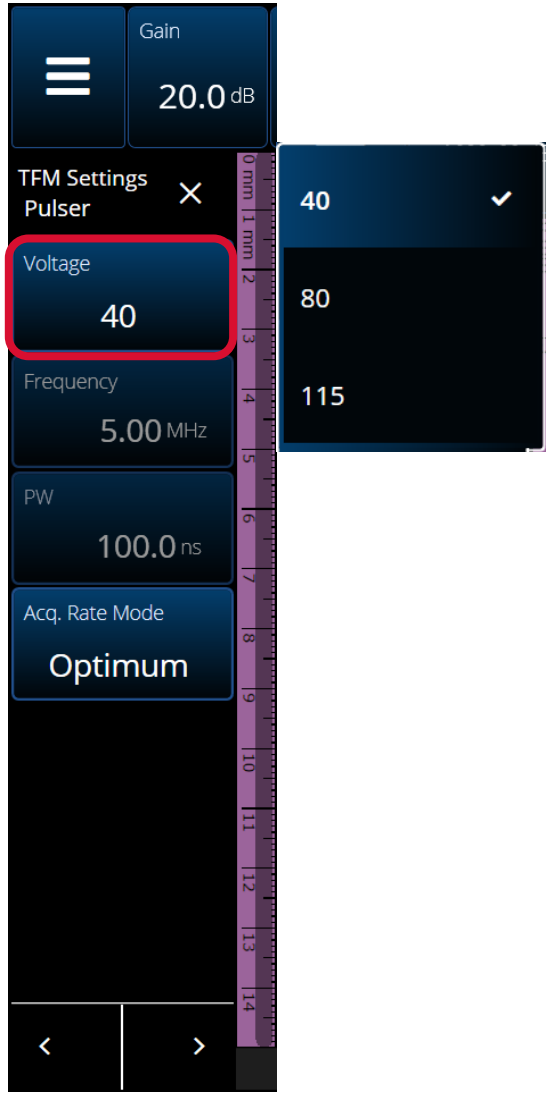
Amplitude Fidelity: 2.0dB

PRF: 25.0Hz

Envelope ON

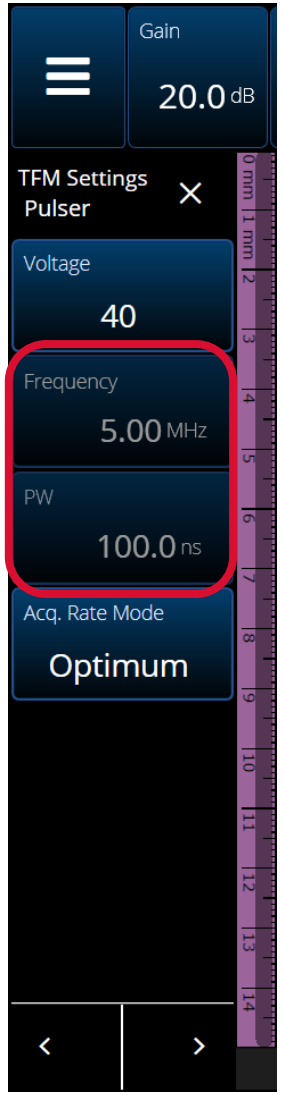
TFM Settings – Voltage

- The voltage is not independently selectable for each group. What is used on group 1 must be used for all other groups.
- Voltage selected is directly related to battery life and heat and should be set correctly for the type and pitch of probe being used.
- High voltage used on small pitch probes such as the Cobra can be detrimental to the probe life and does not result in better performance.



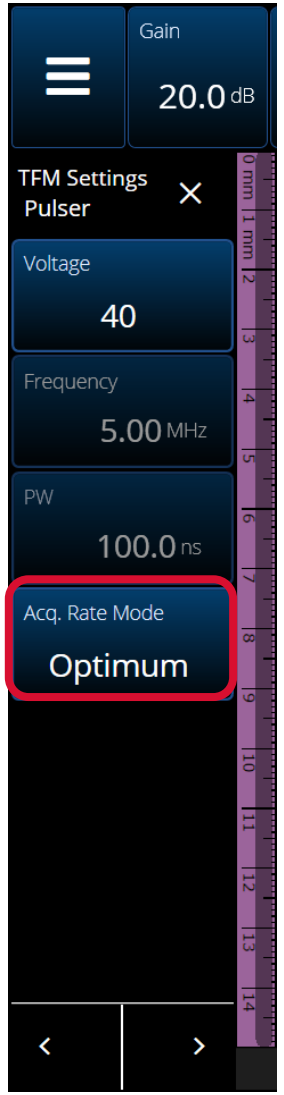
TFM Settings – Frequency and PW

- The frequency and pulse width (pw) parameters are displayed for reference only.
- They are based on probe selection during the scan plan and cannot be modified during scanning since both are essential parameters for TFM signal generation.



TFM Settings – Acq Rate

- The pulse repetition frequency (PRF) is the frequency at which pulsers are emitted and is expressed as the inverse of the time interval between the emission of pulses.
- The acquisition rate is the number of complete acquisition cycles expressed in Hz added to the time required to convert FMC signal to the resulting TFM wave set.
- It is is directly related to PRF and TFM signal process time.
- Acquisition Rate includes options for:
  - Auto max. Will allow maximum Acq Rate (Scanner speed) for current configuration.
  - Optimum. Compromise of heat, battery power, scanner speed and common settings.
  - Manual. Any number up to the maximum allowed with current configuration.



TFM Settings - Acq Rate

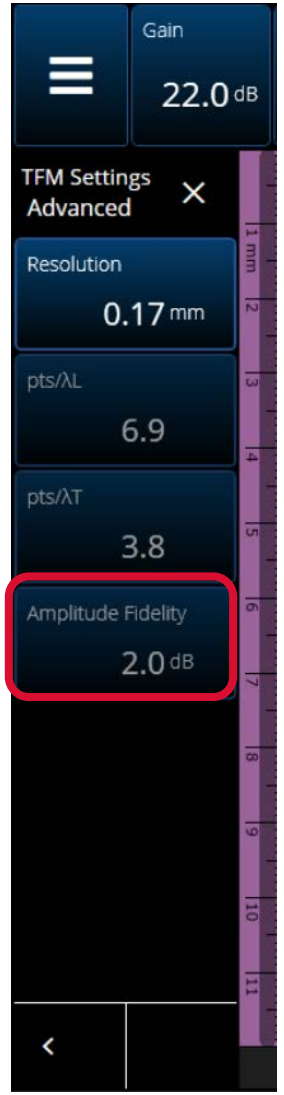
- The header bar show the Acq rate with the PRF of the current group between parenthesis and it can be of 3 different colors:
  - Green: all is good (all data collected is kept and displayed).
  - Orange: no data lost but the display cannot keep up with the acquisition.
  - Red: data is lost. Generally indicating that the scanner is moving too fast compared to the acquisition rate.

TFM Settings – Zone

- The TFM zone is typically defined during the scan plan definition and it represents the area of the part that the technician chooses to view as images.
  - In PAUT, it is typically defined by the Ultrasound axis Start and Range as well as the Angle range.
- This is adjusted by the technician and can be moved anywhere within the part's volume.
- Images are constructed in the zone grid using the preselected wave set and the time of flight of the FMC data.

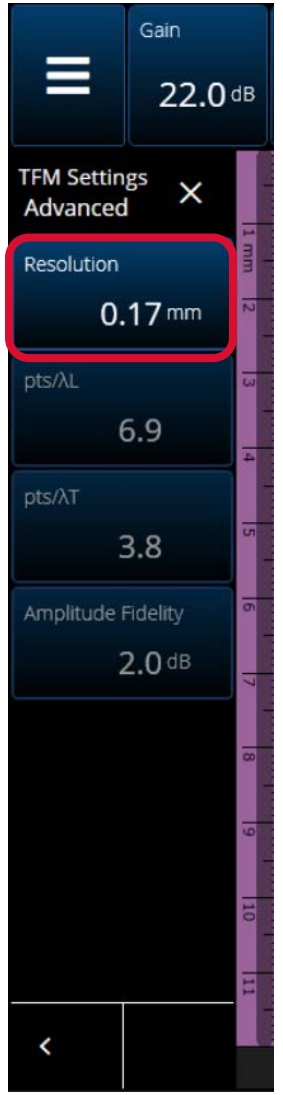
TFM Settings – Amplitude Fidelity

- Definition: Amplitude fidelity (AF) is the measurement (in dB) of the maximum amplitude variation of an indication caused by the TFM grid resolution.
- Parameters that have influence on the value:
  - Probe frequency and bandwidth.
  - Material velocity.
  - Grid resolution.
  - TFM Envelope.
  - Etc.
- ASME Code compliance for weld inspection: AF should not exceed 2 dB.
  - Mandatory Appendix XI Full Matrix Capture (FMC) and Nonmandatory Appendix F Examination of Welds Using Full Matrix Capture (FMC) – ASME BPVC Sec. V, Article 4. 2019



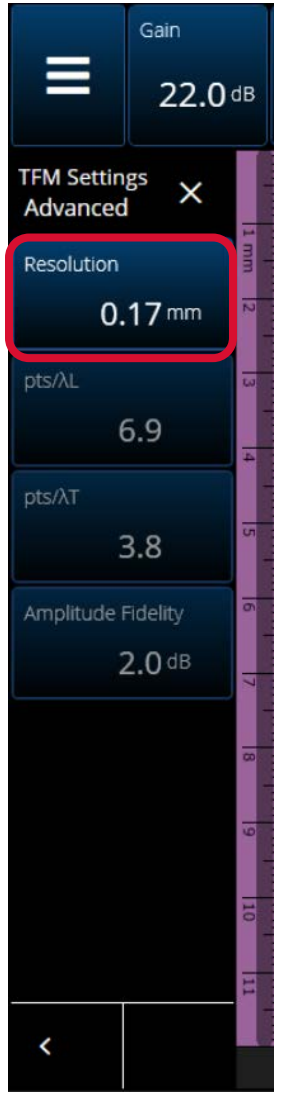
TFM Settings – Resolution

- The resolution is the distance between 2 consecutive TFM points.
- Additionally, the information of the number of point per wavelength is displayed.
  - This is function of the frequency of the probe and velocity of the material.
- To reach an Amplitude Fidelity of 2 dB, the resolution is adjusted:
  - Bigger resolution = more distance between points so higher Amplitude Fidelity.
  - Smaller resolution = less distance between points so smaller amplitude fidelity.
- True or false: the smallest possible amplitude fidelity is always better? False, this will have significant impact on the acquisition speed, making scanning impossible.



TFM Settings – Resolution

- With very small or very large TFM zones, it may be impossible to adjust AF to a perfect 2.0dB because the min or max of points in the TFM zone might be reached.
- The minimum point quantity is 64.
  - With a small zone, a minimum of 64 points must be respected. The resolution can then be maxed-out leaving no room for a coarser resolution, meaning the largest distance possible between 2 points can be reached and no further point can be removed. The result is an AF smaller than wanted.
- The maximum point quantity is 1024.
  - With a large zone, a maximum of 1024 points must be respected. The resolution minimum can be reached leaving no room for a finer resolution, meaning that no more points can be added to refine the grid of points. The result is an AF bigger than wanted.



OLYMPUS

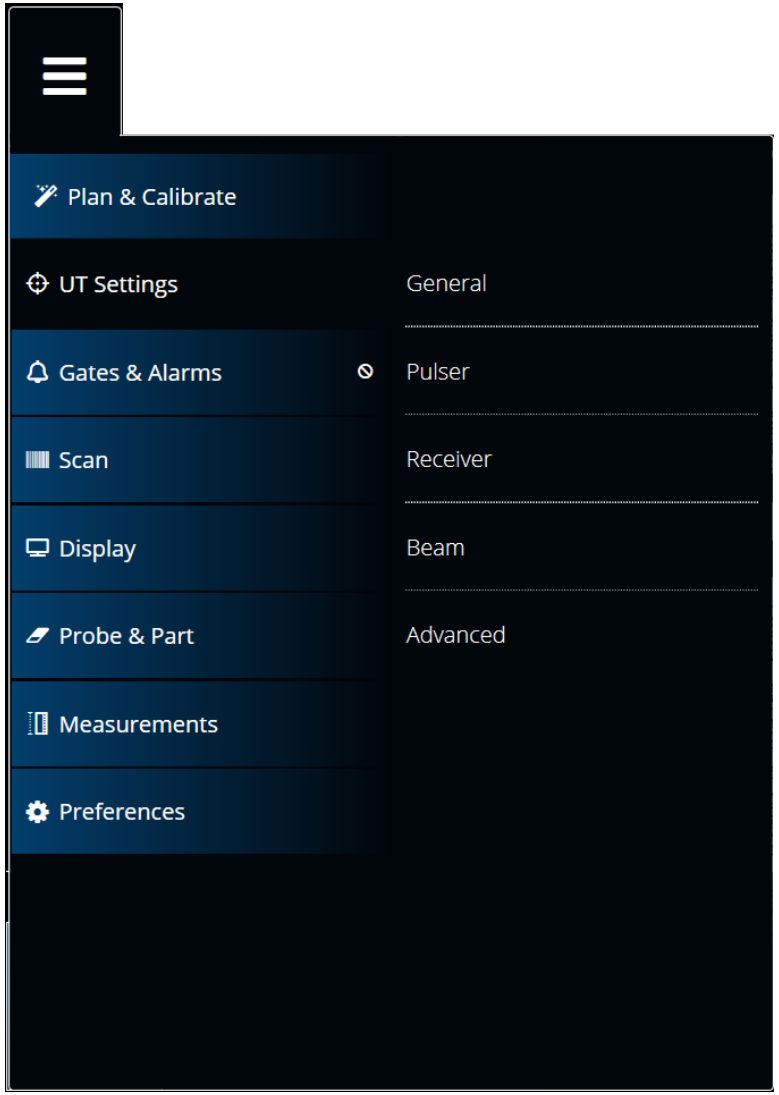
UT Settings - TOFD

Olympus Scientific Solutions

DSM Team | Quebec | April 2020

UT Settings - Overview

- After completion of the Scan Plan the group is created and it is necessary to configure the UT parameters such as gain, range, etc.
- The UT menu contains parameters similar to any digital conventional UT flaw detector but adapted to the TOFD set of parameters.
- In the UT menu are sub menus for UT general, pulser, receiver, beam and advanced that contain various options and parameters.
- Additionally, UT features such as gain can be changed at any time directly from the data view or header.

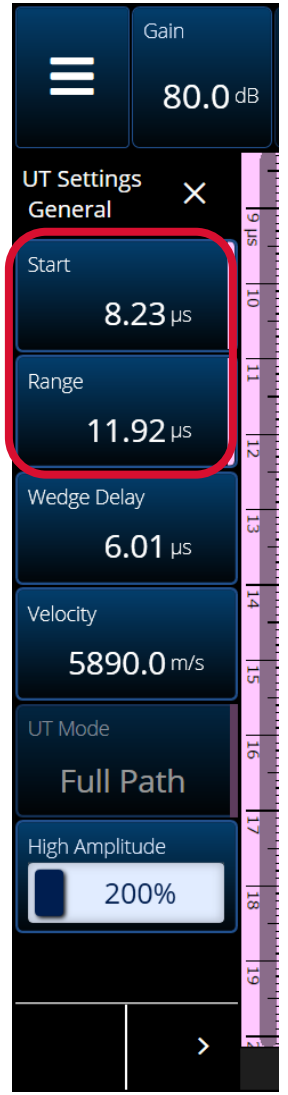


UT Settings - Gain

- The UT gain is always displayed in the upper left hand corner of the display and can be changed by using the touch screen and scroll knob or keyboard.
- This enables UT gain manipulation in full screen mode or from any menu without navigation.

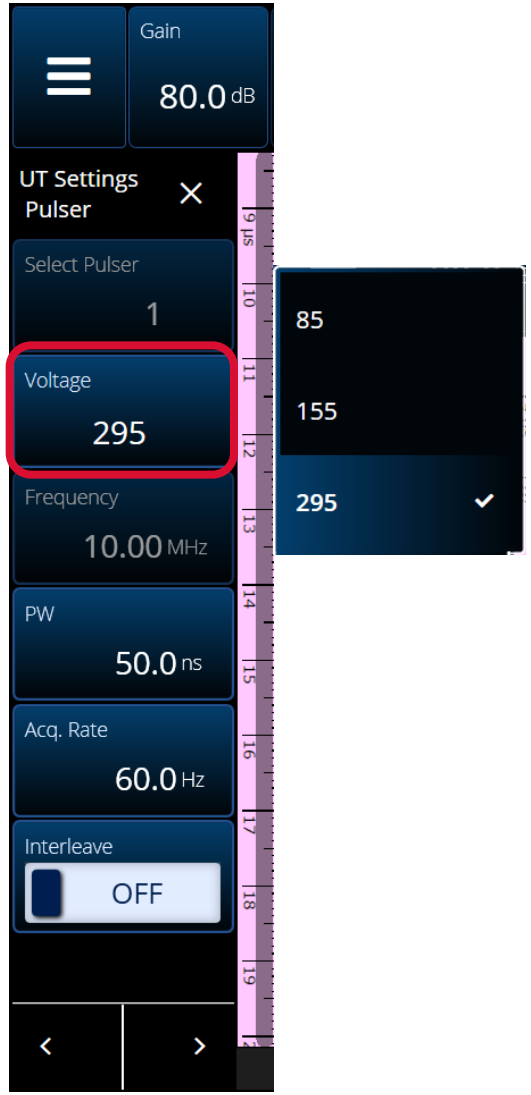
UT Settings – Start and Range

- The UT start and range function similarly to a conventional flaw detector. However, because the technique is TOFD, it is defined in us of sound path.
- The start and range are automatically set after completion of the scan plan to include the lateral wave, the backwall and the mode converted shear wave.
- Both can be further adjusted and setting the start and range properly ensures that the A-scan points are over the area of interest of the inspection for optimum analysis.



UT Settings – Voltage

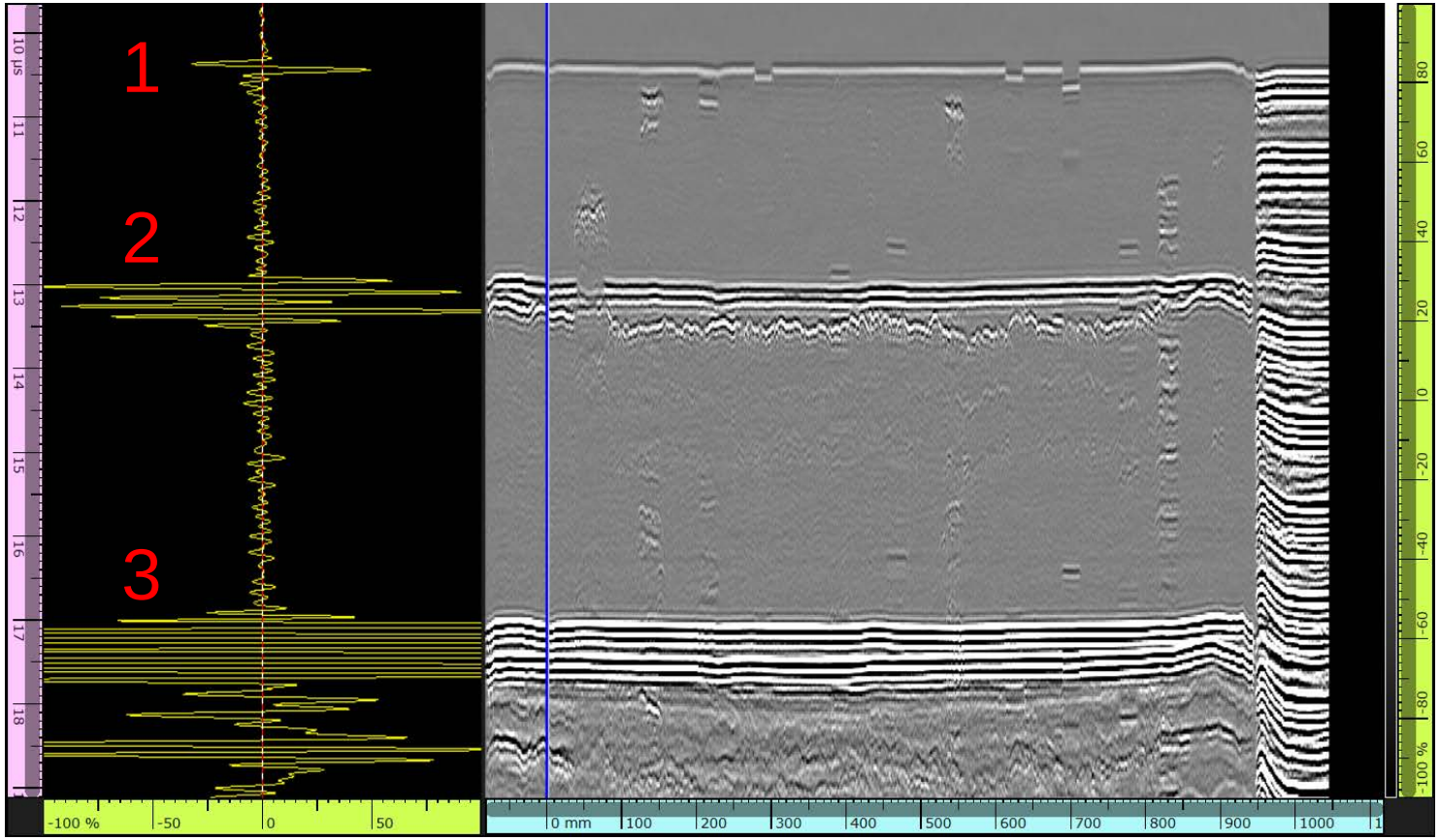
- The voltage is set by default to the highest value to optimize signal-to-noise ratio.
- The available voltages are dependent on the connector used:
  - Dedicated UT connectors will support higher voltages compared to the phased array connector. Phased array connector will allow lower voltages to protect the small elements from the phased array probes.
- The voltage should be kept to the highest setting unless the signal is saturated.



UT Settings – Sensitivity Level

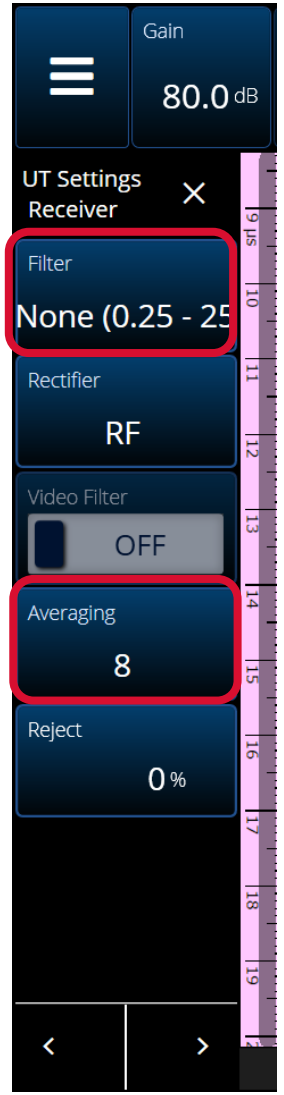
- Adjust the gain so that the lateral wave is approximately 50% amplitude.
- Adjust the UT start approximately 1us before the lateral wave and include enough range so that the mode converted shear wave signal is present.

1. Lateral wave
2. Backwall
3. Shear wave



UT Settings – Receiver

- Using the receiver submenu adjust the averaging for best results. Averaging is used to remove some types of noise from the A-scan.
  - Do no increase averaging if improved signal to noise ratio is not observed.
  - Typical inspection use 4-16.
- Under normal conditions, best TOFD results are acquired with no filter utilizing the entire band width of the probe when possible.

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Encoder Setup

Olympus Scientific Solutions

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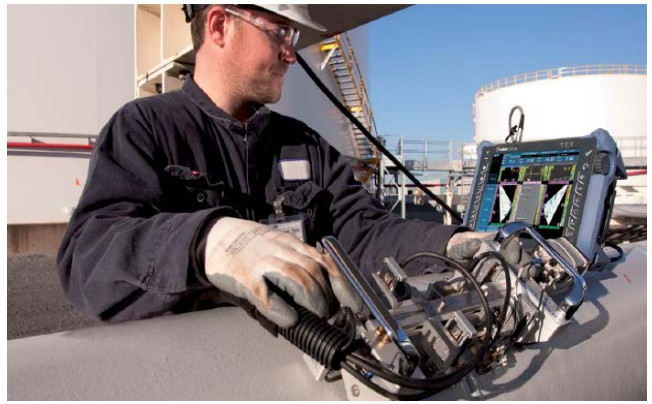
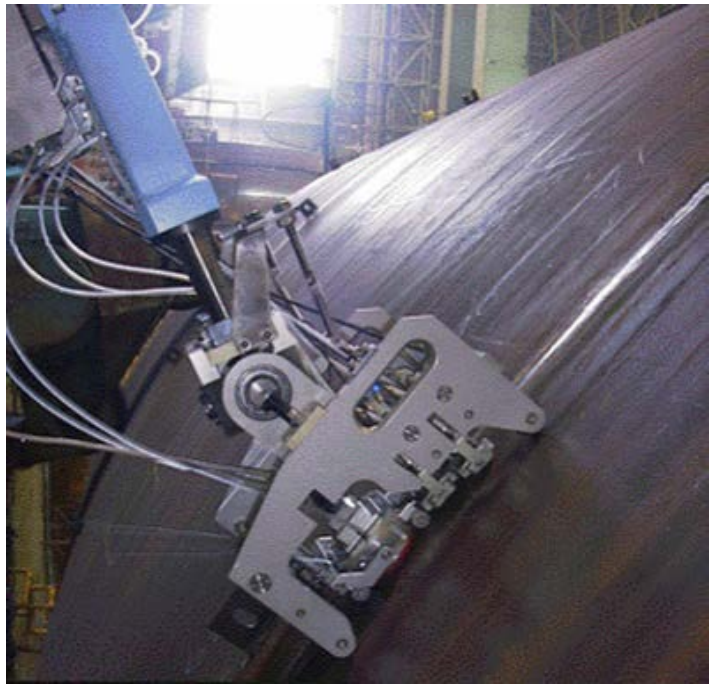
Encoder Setup - Overview

- The OmniScan X3 instrument have two axis encoder capability for recording data.
- A full range of application specific encoders and scanners can be found in the Olympus Industrial Scanners and Accessories Catalog.
- Additionally, the encoder connector specifications are available in the users manual allowing the OmniScan X3 to be integrated with any scanner to a patch cable using a standard 15 pin serial connector.
- The encoder input receptacle of the OmniScan SX\MX2 is on the top panel and uses an IP66 water resistant cable connector.



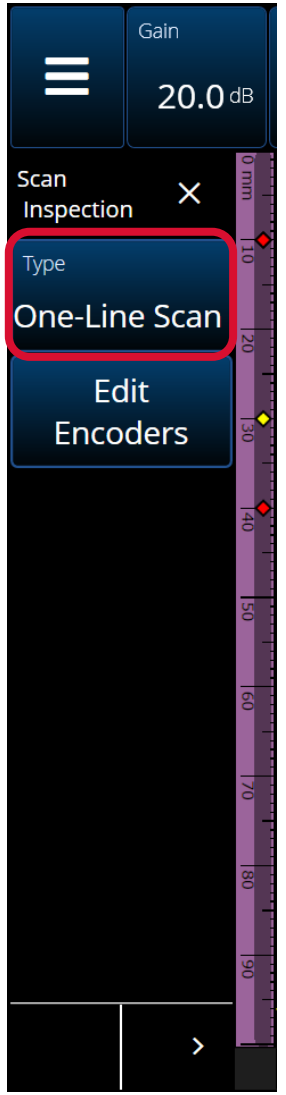
Encoder Setup - Encoders

- Encoders and scanners come in all shapes and sizes and are typically purchased based on the application requirements for geometry, precision, multi probe capability, durability and speed.
- Encoders and scanners allow the position and orientation of the probe in one or two axis to be recorded with the data allowing 2D data views such as S-scan, B-scan and C-scan.
- Encoded scanners can be as simple as a small wheel connected to the probe or a complex multi probe scanner with multi axis encoding using motion controllers and computer or PLC.



Encoder Setup – One-line Scan

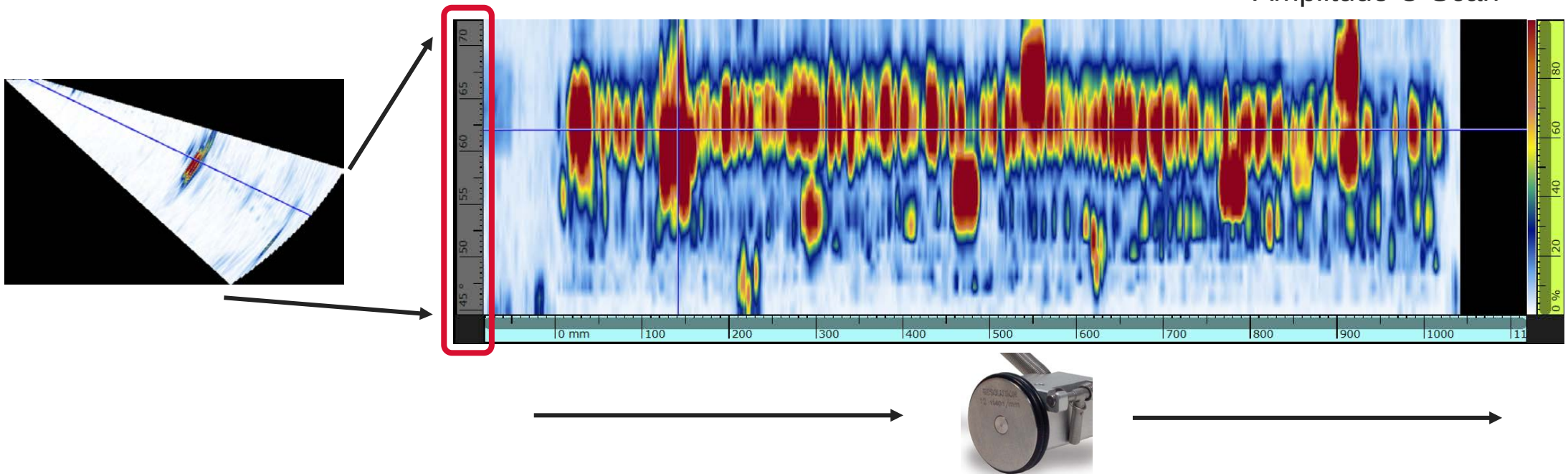
- A one line scan is typical of phased array weld inspection for both automated and manual push scanners.
- When one line scan is selected in Scan > Inspection > Type, only one of the two available encoders is utilized.
- A one line scan inspection records data in one axis only. The blue ruler seen on the C-scan and B-scan represents the probe movement in a typical weld inspection at probe skew 90\270.
- The scan axis in any configuration is always defined by a blue ruler and represents the mechanical probe movement.



Encoder Setup – One-line Scan Weld

- In the case of a one-line scan for weld inspection (using a sectorial configuration in the example below), the index axis represents the angle range of the sectorial scan. The bottom being the lower angles and the top the higher angles.
- This representation is called an Uncorrected C-Scan.
- When the speed of the scanner exceeds the PRF displayed in the header, and the indicator turns red, data points are missed and will appear in the C-scan and B-scan as black lines.

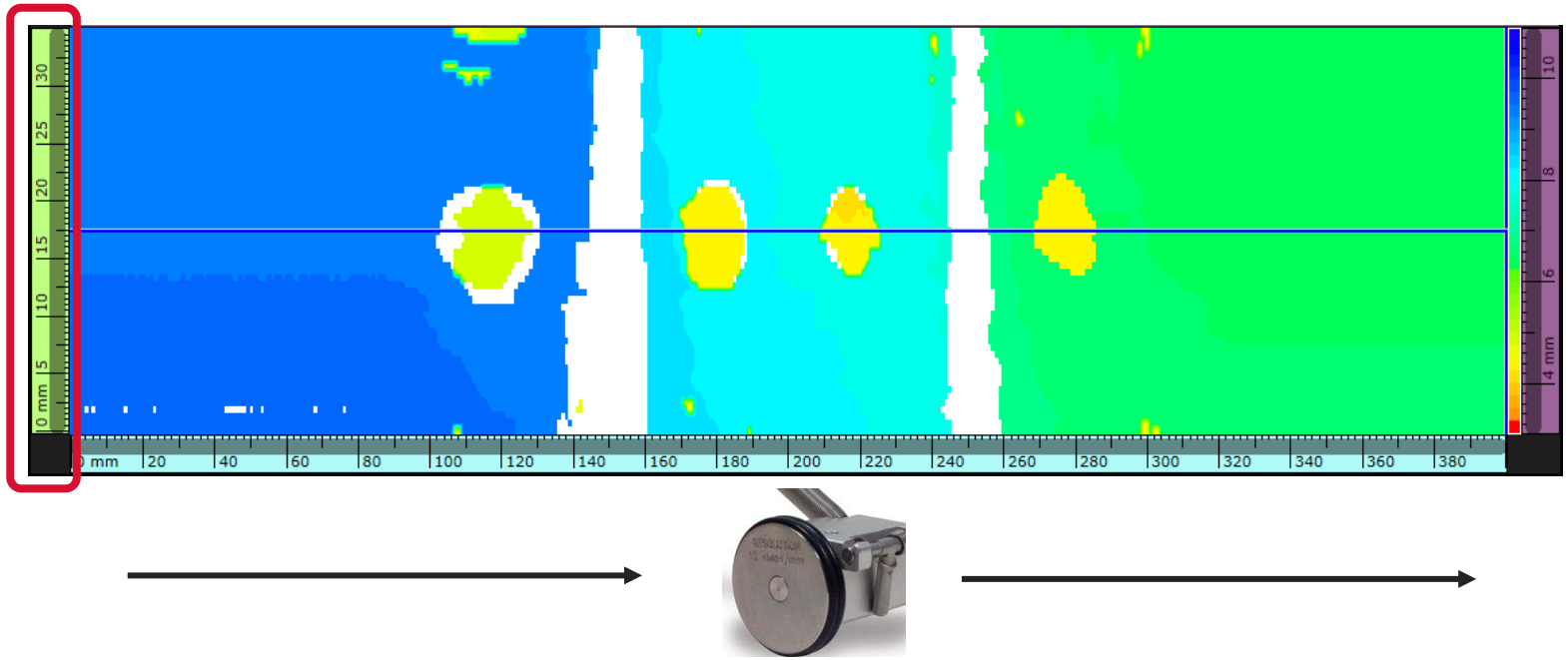
- Amplitude C-Scan



Encoder Setup – One-line Scan Corrected

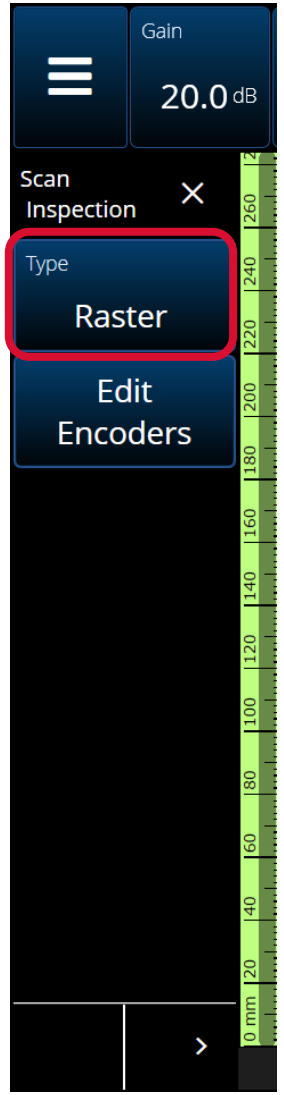
- When the 0° with overlap option is selected during the scan plan, the index axis of the C-Scan is corrected to represent the true width of the inspection.
- For a said probe, the element configuration will have an impact on the coverage:
  - The more total elements are used (last element – first element), the wider the coverage.
  - The bigger the aperture (element qty), the smaller the coverage.

- Thickness C-Scan



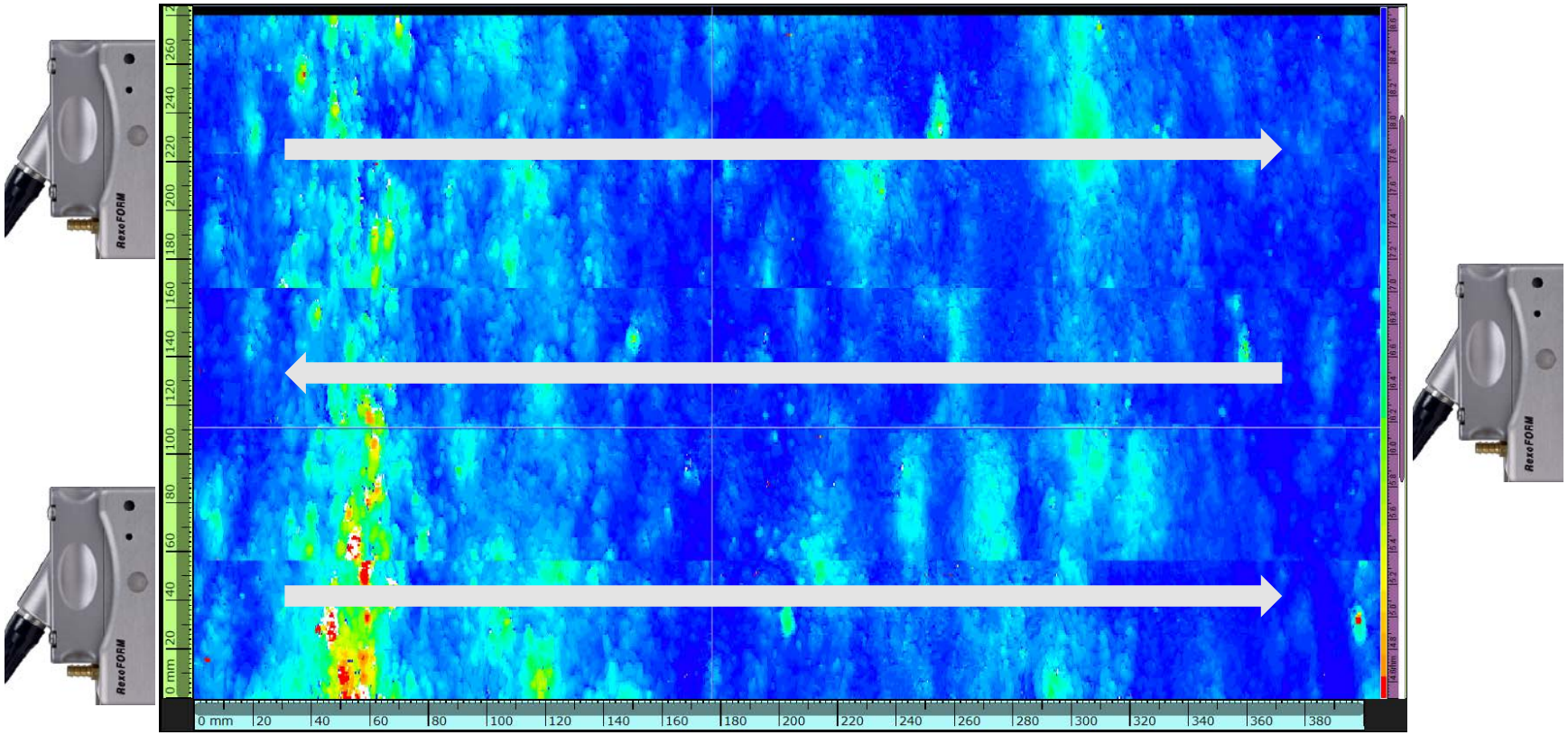
Encoder Setup – Raster Scan

- The raster scan will use both encoder 1 (Scan) and encoder 2 (Index).
- The blue horizontal axis (Scan) represents the probe mechanical movement at 1mm intervals and is controlled by encoder 1.
- The green vertical axis (Index) represents both the probe aperture and mechanical movement and is controlled by encoder 2.
- Two axis inspection raster scan is typically used for creating thickness C-scans for corrosion mapping and composite inspections but can be used for welds in some applications.



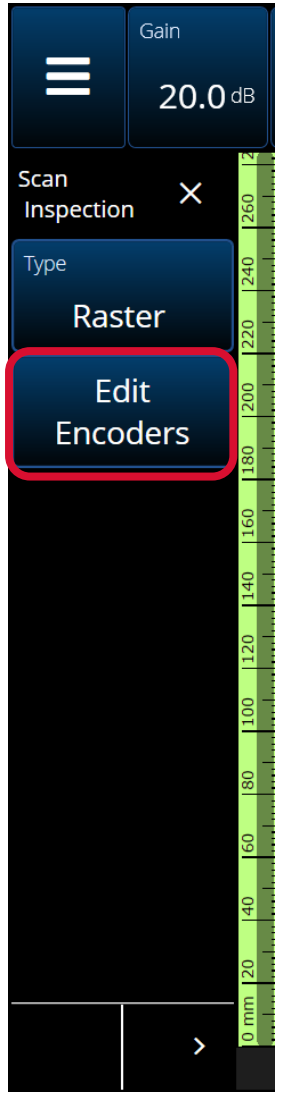
Encoder Setup – Raster Scan Corrected

- The C-scan below was acquired with a 2 axis raster scan. The blue horizontal axis (Scan) represents the probe mechanical movement at 1mm intervals and is controlled by encoder 1.
- The green vertical axis (Index) represents both the probe aperture and mechanical movement and is controlled by encoder 2.
- The 0° with overlap configuration is specifically designed to make the setup and acquisition of this inspection easy.



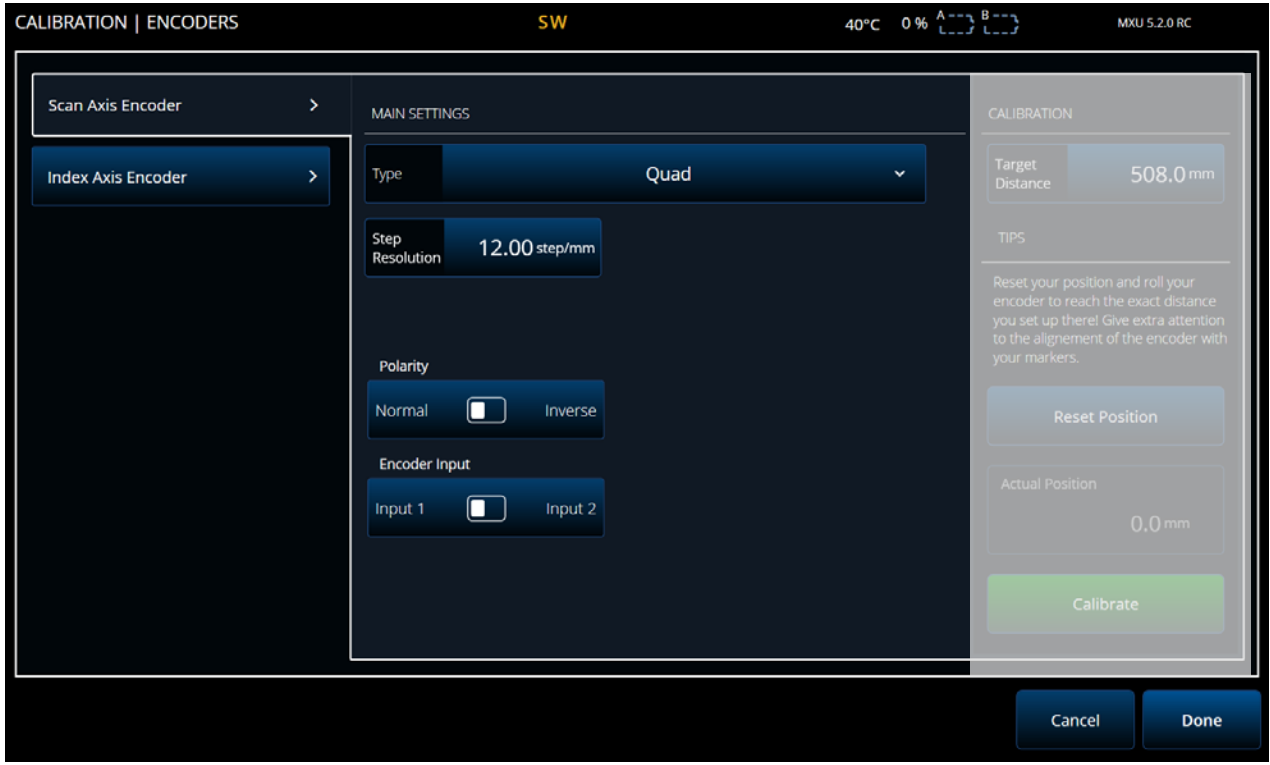
Encoder Setup – Edit Encoders

- With the OmniScan X3, encoders definition and calibration is performed in a single wizard-style configuration menu.
- This menu is accessed by selecting the edit encoders option.



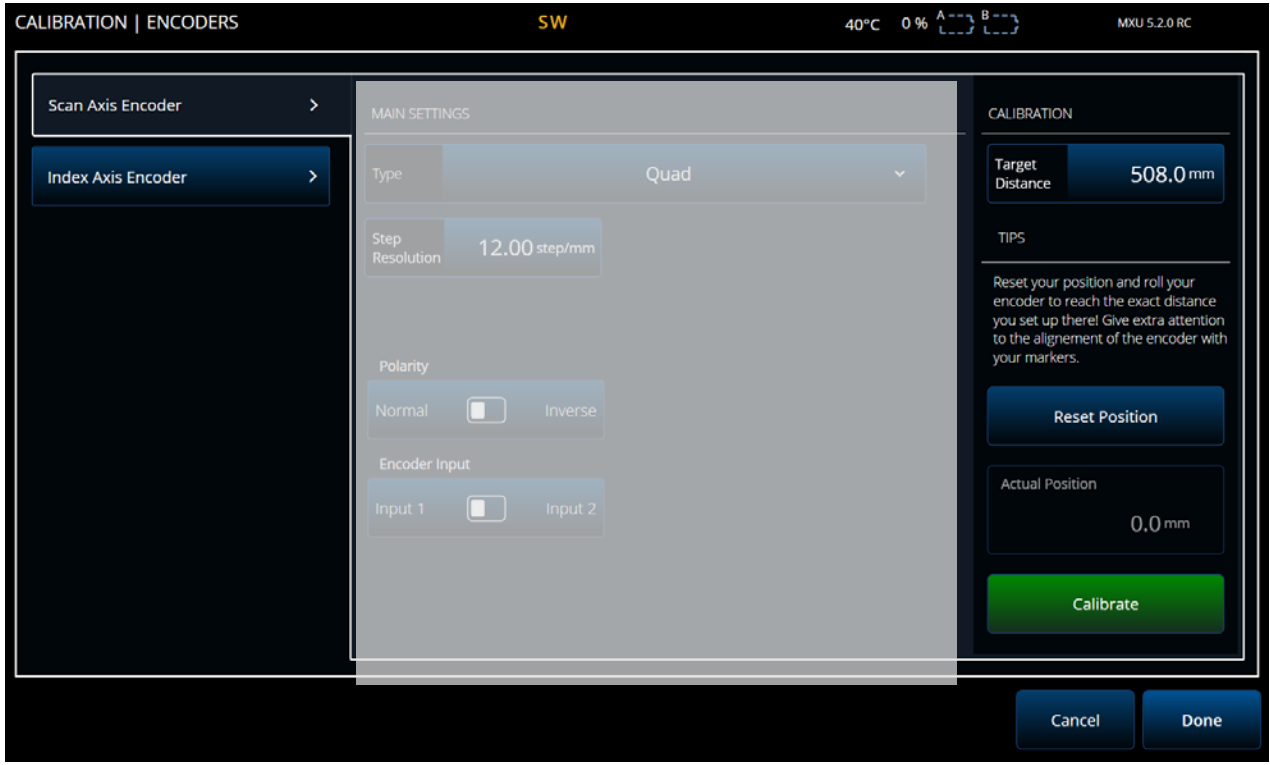
Encoder Setup – Edit Encoders

- The left-hand part of the menu is for encoder parameters input:
  - Selection of the scan axis encoder, index axis encoder.
  - Type of encoder, options are Quad, Clicker.
  - Encoder resolution, the factory value is normally written directly on the encoder.
  - Polarity: used to make sure the scan increments with the direction of the scanner.
  - Encoder input: Olympus scanner are designed so that scan axis is connected to encoder 1 and index to encoder 2. However, inverting them might be necessary to support different applications and custom scanners.



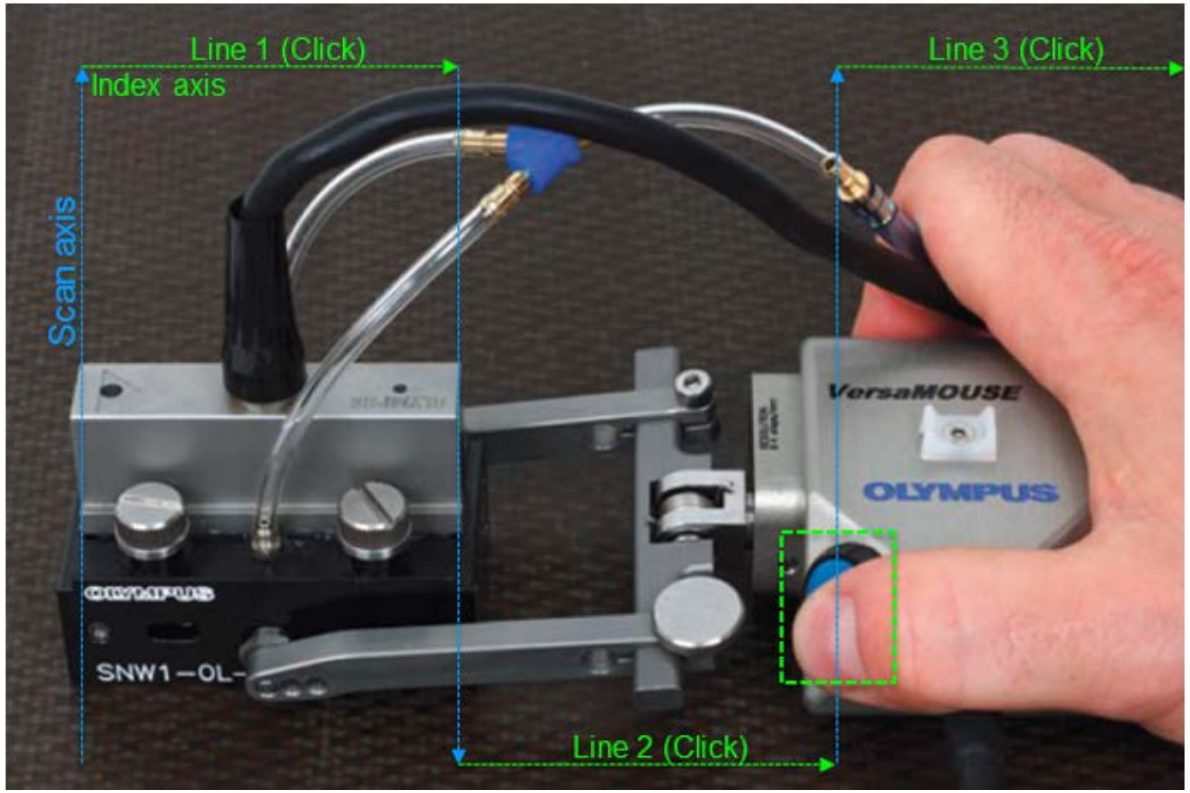
Encoder Setup – Encoder Calibration

- The right-hand part of the menu is for encoder calibration.
- It is recommended to perform the calibration over a distance significant of the inspection, a longer distance record will provide a more precise calibration. ASME recommends to confirm the calibration over a distance of at least 500mm (20in).
  - Target distance is the length of the calibration.
  - Press preset when the scanner is aligned with the start line.
  - Move the scanner slowly and in a straight line, avoid side-to-side movement.
  - Press calibrate when the scanner is aligned with the end line.
  - The software calculates the new resolution and also adjusts the encoder polarity to adapt to the scanning direction.



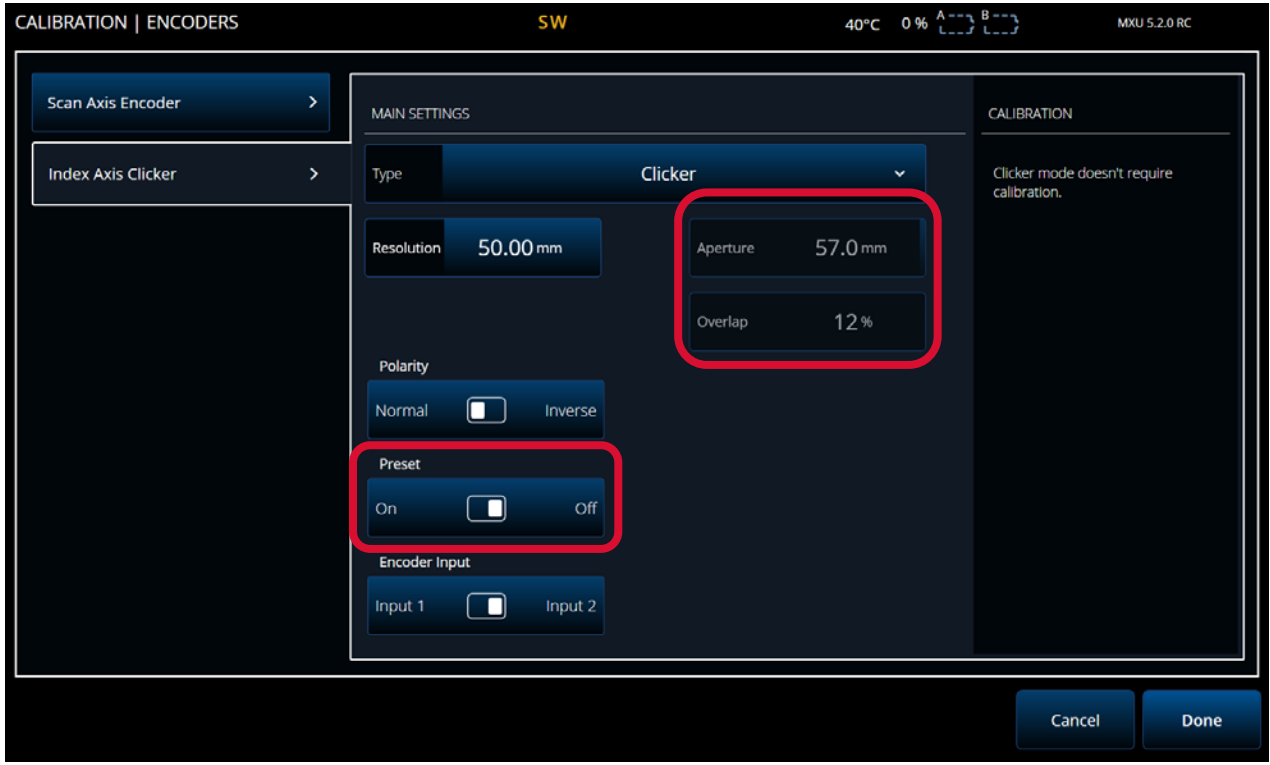
Encoder Setup – Raster Scan Clicker

- In the raster scan pictured below, the wheel is wired to encoder 1 (Scan) and the clicker button is wired to encoder 2. (Index)
- After each line scan the clicker is selected to index the encoder one probe length on the index axis. (1 probe aperture)
- The probe aperture is automatically calculated by the software based on focal law configuration and is provided in the Encoder configuration menu.



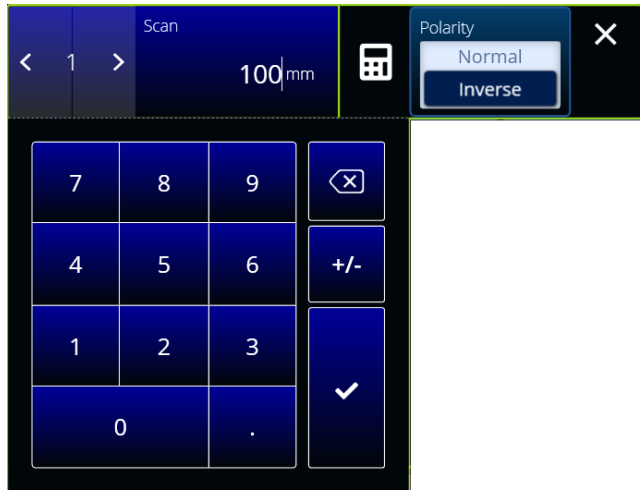
Encoder Setup – Edit Clicker

- The clicker configuration requires extra configuration.
- The clicker cannot be calibrated, instead, a step or jump resolution is defined. The clicker resolution represents the distance between 2 consecutive lines of scan.
- The software calculates the width of the total aperture based on element size, quantity, etc.
- The clicker resolution can be calculated based on the active aperture to include an overlap between lines of scan. The operator should refer to the governing code or procedure to know the exact overlap to respect.
- The preset option is used to reset the scan axis to the start position every time the clicker button is pressed.
  - This is useful for scanner designed to move in a single direction, for example the RollerFORM.



Encoder Setup – Jump to

- During scanning, it may be required skip a zone for various reasons:
  - Physical obstacles like a nozzle.
  - Offset between the scan area start and the actual scanning start position (scanner dimensions, physical limitations, etc).
- To skip the scan or index axis to a new location, press on the indicator above the readings bar and type in the new scan or index position.

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Indication Table

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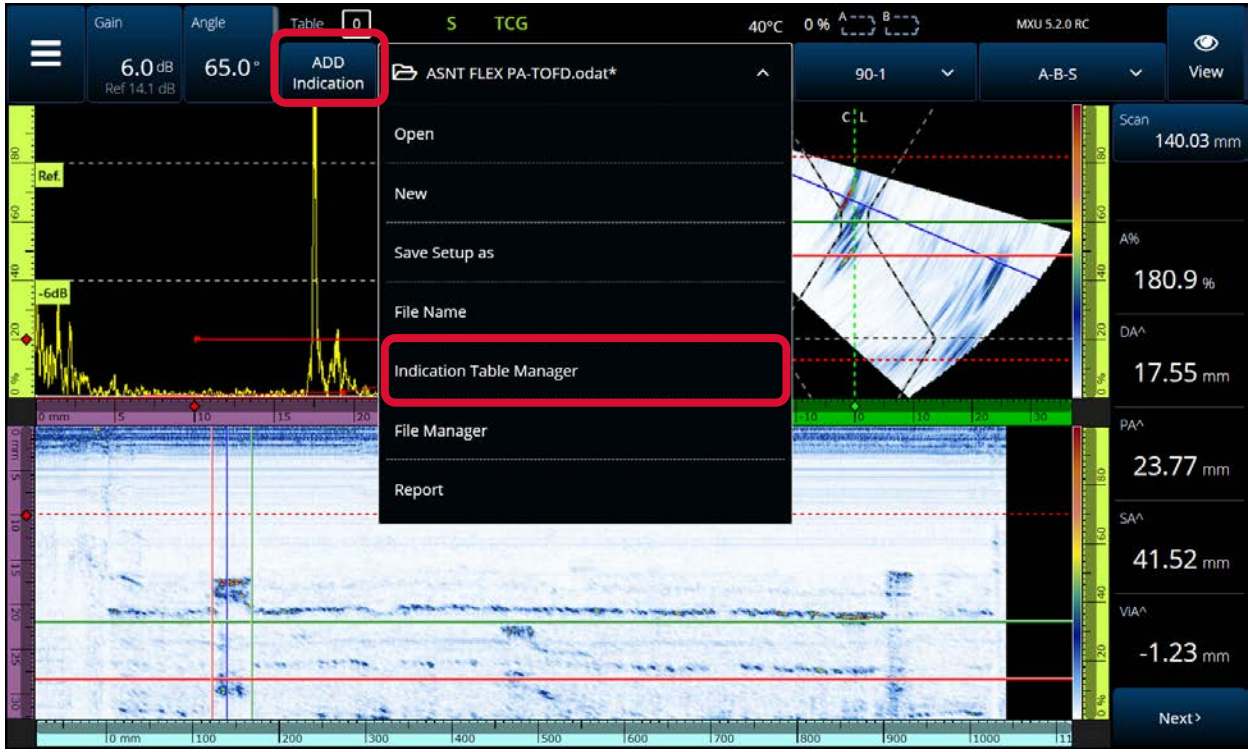
Indication Table - Overview

- The indication table is used to record flaws or indications and the associated readings.
- The indication table is always active but can be displayed or hidden from the header bar, in the drop down File menu.
- The indication table and its related analysis functions are then available.
- It is not necessary to show the table to add entries directly from the header bar.
- Once the analysis is completed, the indication table is exported to a .csv file along with screenshots of the data.



Indication Table – Add Indication

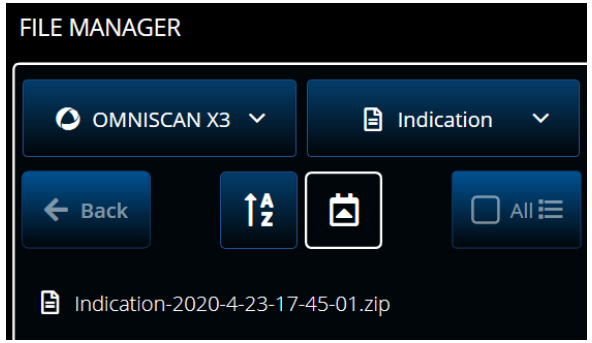
- When adding indications, ensure proper gate and cursor positioning.
  - The 10 active readings are recorded along with the indication.
  - Cursor positions impact sizing values and they will show on the screenshots.
- The total number of indications from the table is shown above the add indication button.

Indication Table – Indication Table Manager

- The indication table manager summarizes all the added indications and the technician fills characterization and grouping information.
- The reference number is used to group multiple indications into one. The different entries remain independent but they are referenced to a single flaw.
- The indication table manager proposes a list of flaw types to associate the entry to a flaw once it is characterized.
- Indications can be rejected and marked as flaws or only reported for documentation purposes and marked as accept.

Indication Table – Export

- Once the analysis is completed, the indication table is then exported to a .csv file format.
- A screenshot of each indication is bundled into a zip file with the .csv file.
- The indication table and screenshots can be retrieved from the file manager and transferred to a computer for custom reporting.



- *Note: the indication table and the entries are not saved with the data file.*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OmniPC 5

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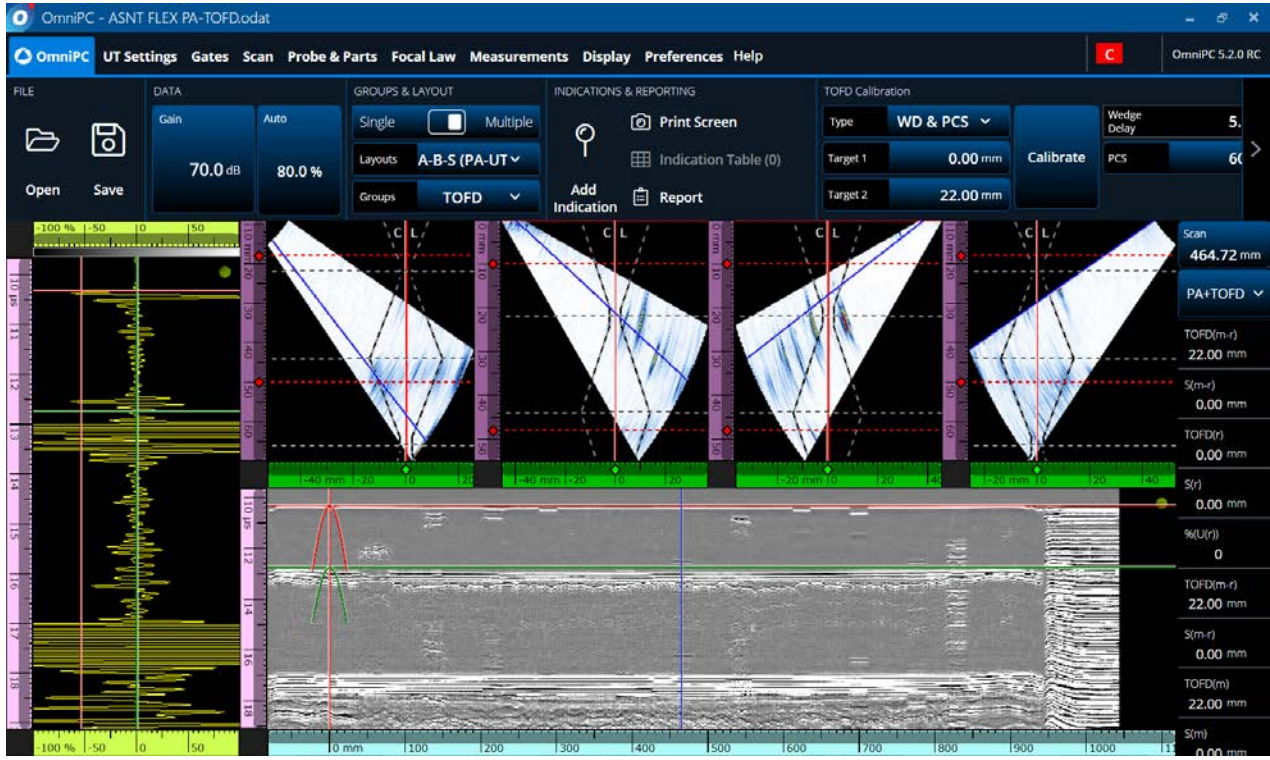
OmniPC - Overview

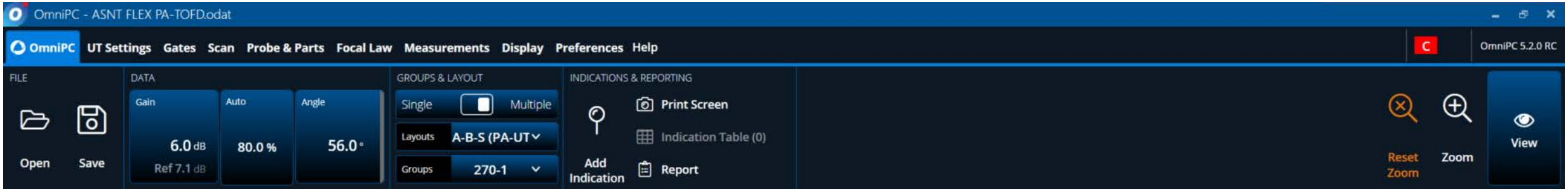
- OmniPC is the dedicated PC based analysis software for the OmniScan X3.
- It takes advantage of the flexibility and productivity of a computer to streamline the analysis process.
- Multiple instances of OmniPC can be opened simultaneously to compare data files.
- In order to function properly, the computer must meet the following specifications:

Specification	Minimum Requirements
Processor	Intel core i5 (4+ cores) – 2.0 GHz or more
Operating System	Windows 10 (64 bits)
Graphics Card	Intel HD graphics 4000 (DirectX 11)
Memory	8 GB
Hard Drive	65 GB of free space
Display	Full HD 1920 × 1080
Connecting Ports	USB 2.0



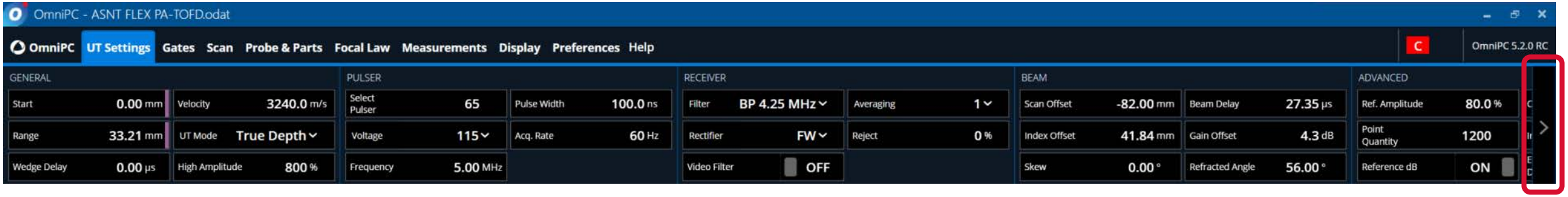
OmniPC – Productivity Bar

- Compared to the X3 instrument, all tools and indicators are located at the top of the screen under different tabs.
- This is so that parameters can be quickly visualized and adjusted if needed without scrambling through menus.
- The main window regroups the most commonly used parameters during the analysis process.



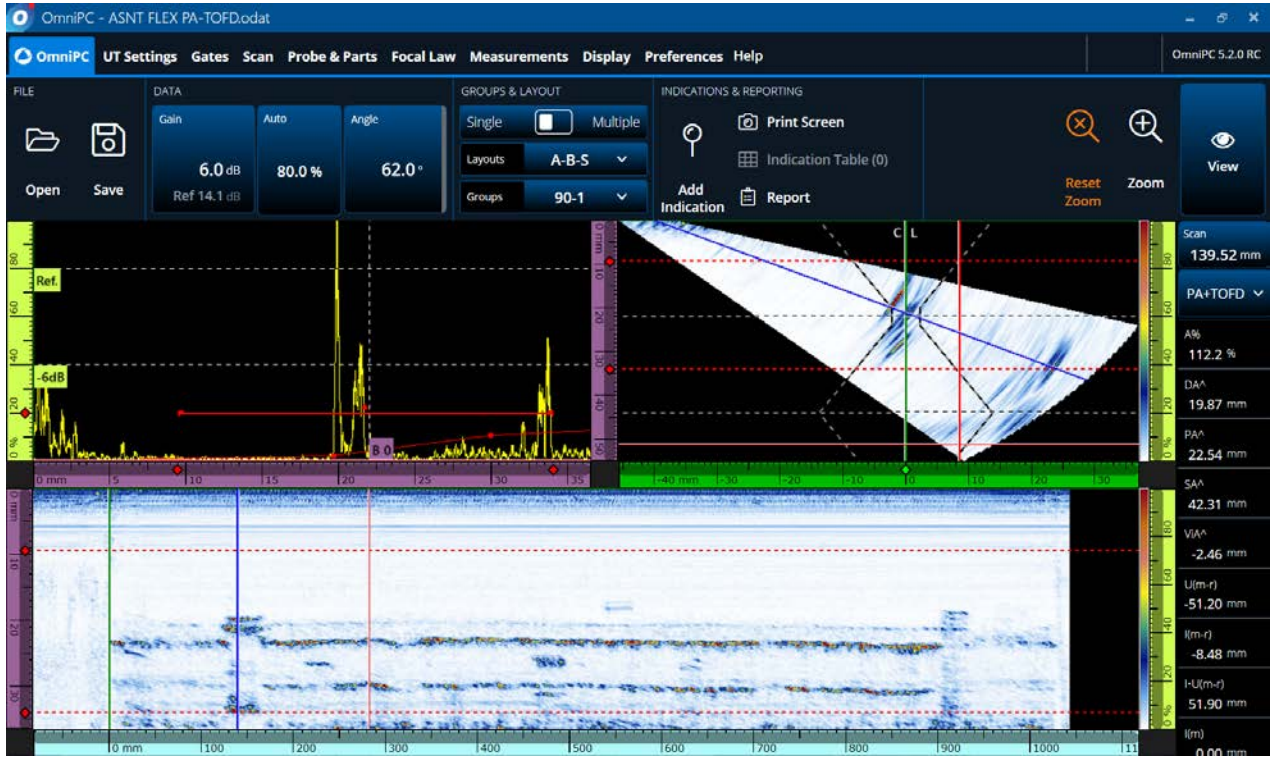
OmniPC – Productivity Bar

- In cases when too many parameters are available to fit on the screen simultaneously, the bar had sliding controls.
- These may or may not be necessary depending on the screen resolution.



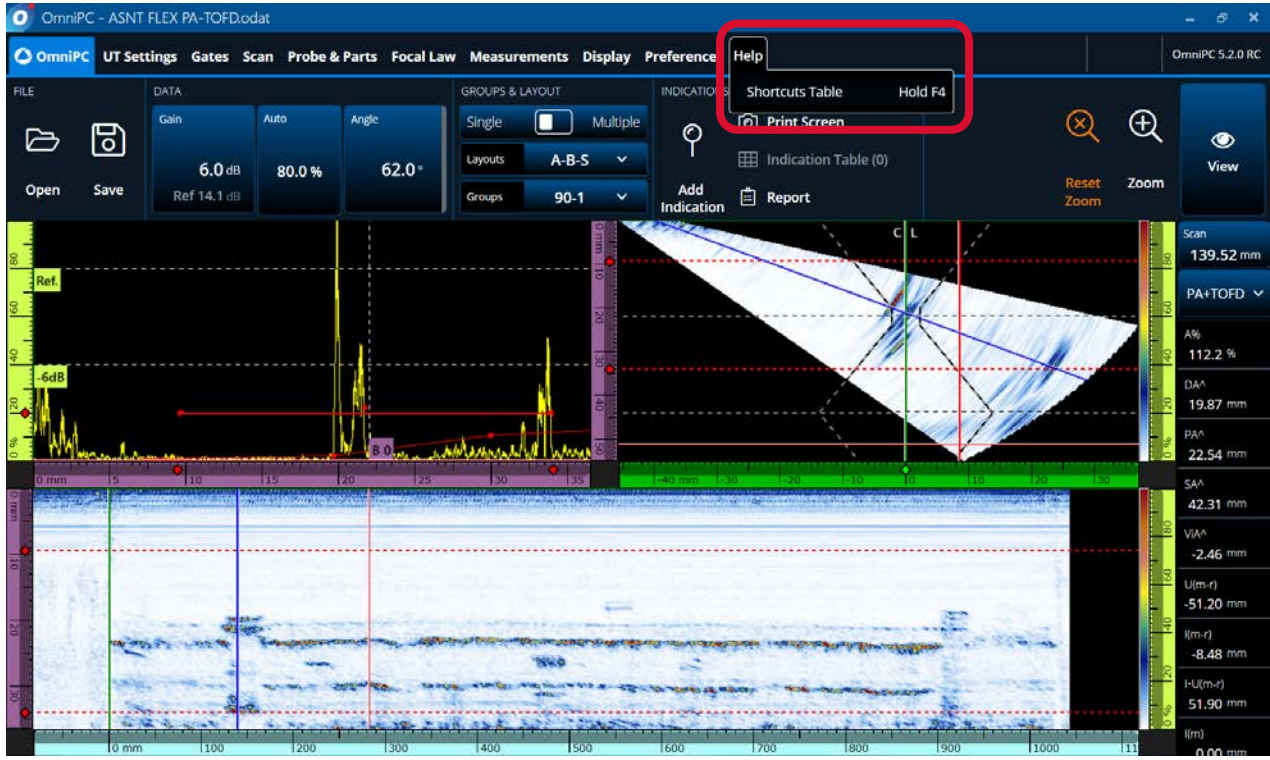
OmniPC – Drag and Drop

- The OmniScan X3 user interface is designed to provide the best touch screen user experience possible.
- Items like the cursors and the gates are move by first selecting it and then using the numeric pad or the scroll knob to adjust the value.
- Drag and drop is often missed and not precise on a touch screen environment.
- With OmniPC, using a mouse makes the selection and movement much more precise and fluid.
- The gates and cursors manipulation, and zoom to name a few can be done with a drag and drop.



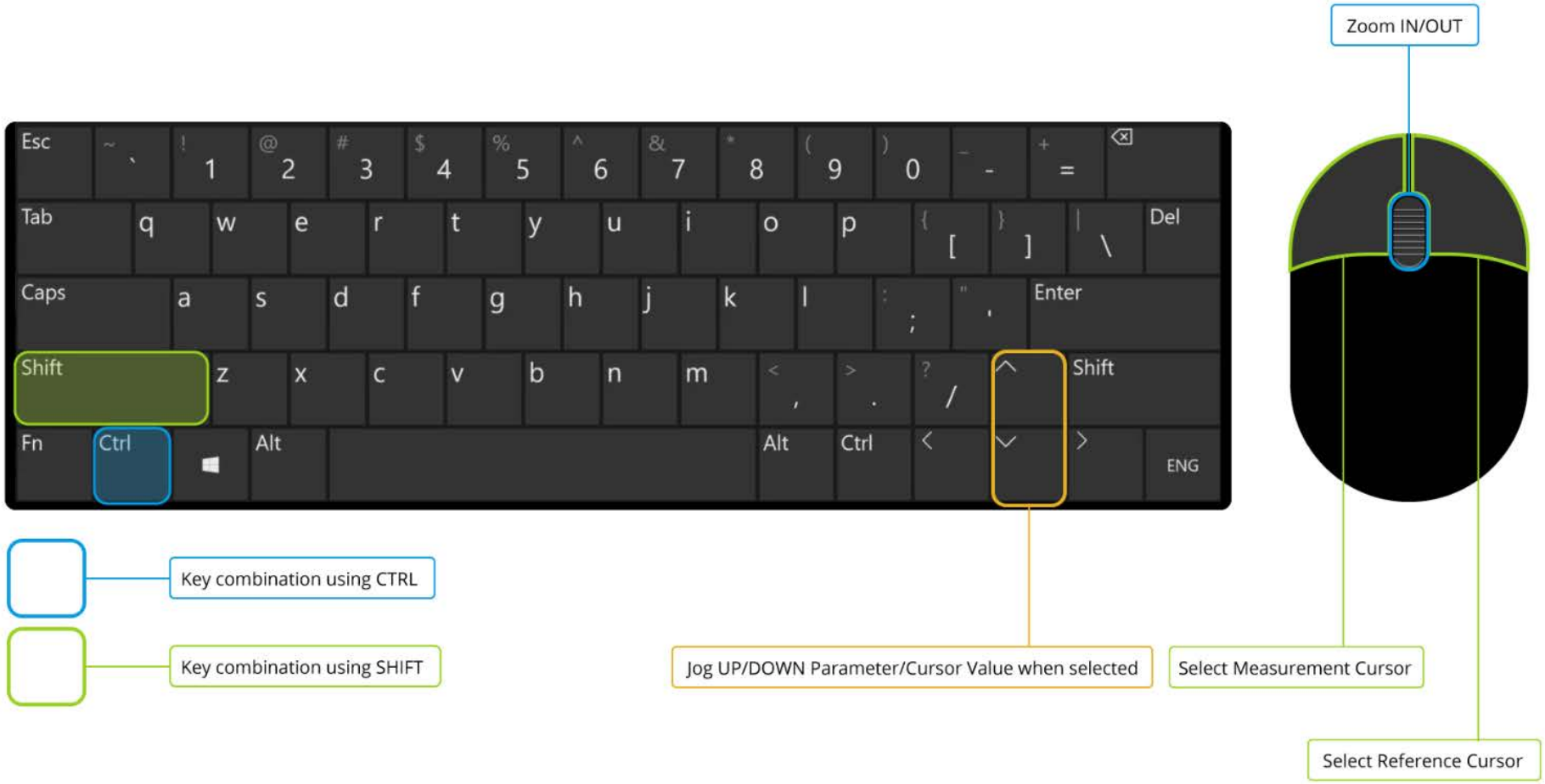
OmniPC – Shortcut keys

- Different shortcut keys are implemented in the OmniPC software to make the data analysis more efficient.
- It is mainly focused on cursor movement, data navigation and zoom.
- The complete list of shortcuts is accessible at all time from the help menu.



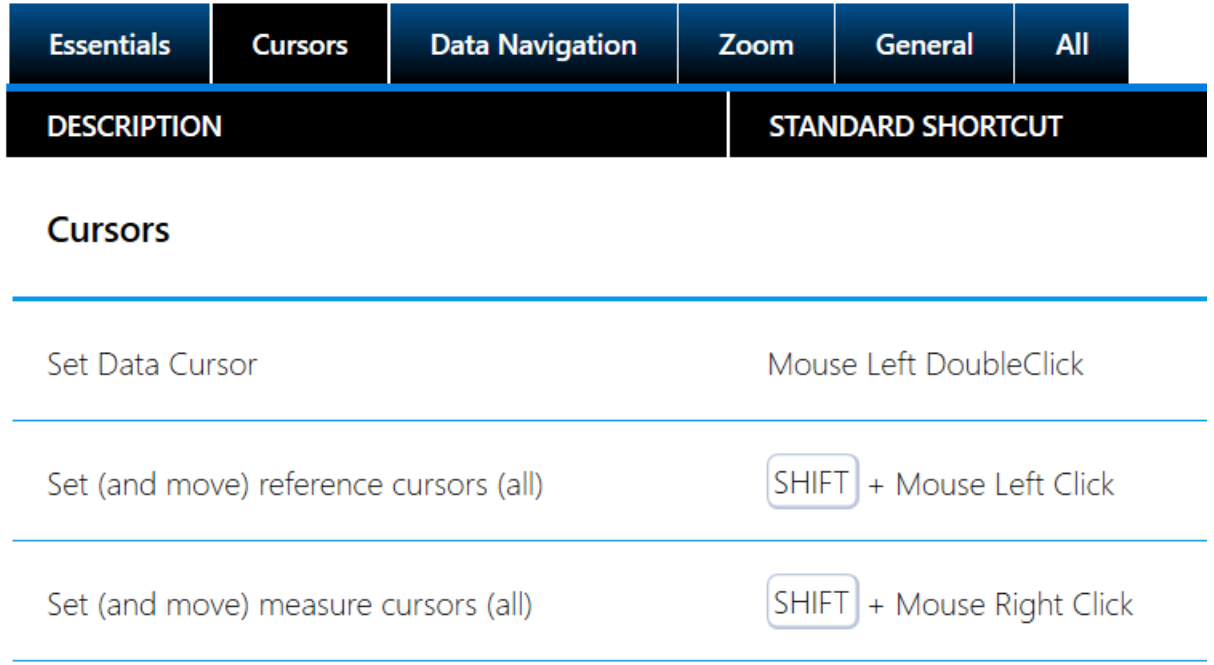
OmniPC – Shortcut Keys

- Here are the main controls



OmniPC – Shortcut Keys

- Cursor shortcuts



OmniPC – Shortcut Keys

- Data navigation shortcuts

Essentials | Cursors | Data Navigation | Zoom | General | All

DESCRIPTION	STANDARD SHORTCUT
Data Navigation	
Jog Selected UP	
Jog Selected DOWN	

OmniPC – Shortcut Keys

- Zoom shortcuts

Essentials | Cursors | Data Navigation | **Zoom** | General | All

DESCRIPTION	STANDARD SHORTCUT
Zoom	
Escape from Zoom Mode	ESC
Zoom IN concentric > When hovering Views	CTRL + Mouse Wheel Up
Zoom OUT concentric > When hovering Views	CTRL + Mouse Wheel Down
Zoom "box"	CTRL + Mouse Left Click + Drag
Move zoom box while maintaining dragging/ drawing zone	CTRL + Mouse Right Click + Move
Reset All Zoom	CTRL 0

OmniPC – Shortcut Keys

- File management shortcuts

Essentials | Cursors | Data Navigation | Zoom | General | All

DESCRIPTION	STANDARD SHORTCUT
General	
Open	CTRL O
Copy	CTRL C
Paste	CTRL V
Save	CTRL S
Save As	CTRL SHIFT S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