

vi. Time Corrected Gain (TCG)

Manual Method

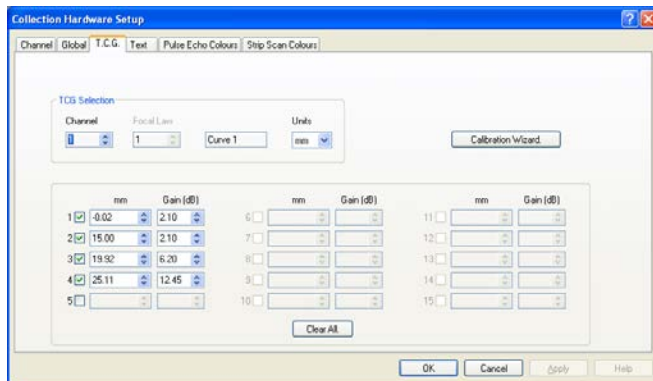
- a. Select the desired curve number from the **T.C.G. Curve** drop-down menu (**Setup - Collection Hardware – Channel – Hardware**). Only one curve per channel may be selected but a single curve may be referenced by multiple channels.
- b. Select the zoom factor from **TCG View** on the A-Scan window.
- c. Click the **T.C.G.** tab in the **Collection Hardware** window.
- d. Select the curve to view from the DAC curve drop-down menu. Any values already in the dialogue may be removed by clicking the **Clear All** button.
- e. Select the units (mm or μs).
- f. Click the position **1** check box. A marker appears (usually in the bottom left corner of the A-Scan). It appears as a small yellow square identified by the position number.
- g. Maximise the 1st reference signal and move the first marker across the base of the signal by clicking on the **mm/ μs** up/down arrow control.
- h. Adjust the gain using the **Gain (dB)** up/down arrow control to position the apex of the signal at the reference amplitude.
- i. Click the position **2** check box. The second marker appears on the baseline below the previous marker.
- j. Repeat the process with subsequent markers until the range through the material has been covered.
- k. To disable the TCG/DAC for any single channel, select **Off** from the **T.C.G. Curve** drop-down menu mentioned in point *a* above.

Phased Array Wizard

The TCG wizard is activated after a valid calibration has been completed. The phased array wizard may be activated from three different points within the software:

- a. Click the **Wizards** menu and select one of the **PA wizard** options.
 - i. **PA Wizard** – Starts the wizard at the equipment setup section. Complete this section to proceed to the *calibration* and *TCG* section.
 - ii. **PA Calibration Wizard – Channel x** – Allows the user to re-enter the wizard at the *calibration* and *TCG* section by-passing the setup section. These menu items will only be displayed for channels that have already been calibrated.
- b. Click **Setup – Collection Hardware – Probe – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.
- c. Click **Setup – Collection Hardware – TCG – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.
 - a. Click **Setup – Collection Hardware – TCG – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.

T.C.G. Page



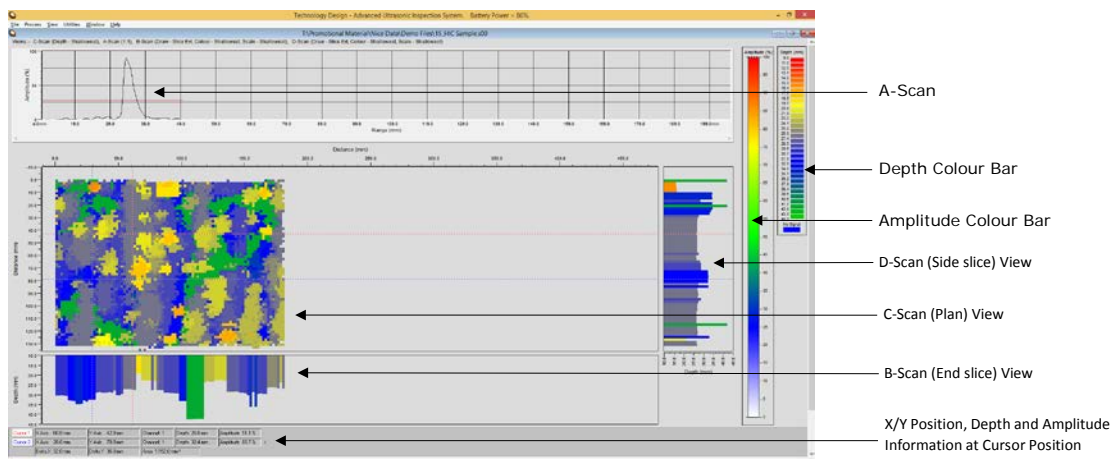
See: Time Corrected Gain (TCG) in Appendix A for guidance on setting up TCG.

TCG Selection		Amplitude correction is displayed as a <i>Time Corrected Gain (TCG)</i> curve.
Channel	Allows user to change the displayed channel.	
Focal Law	Allows user to choose a focal law. The TCG values for the selected focal law will be displayed. Only active when 'per focal law' values are available.	Only enabled when 'per focal law' TCG values are available. 'Per focal law' values can only be setup through the phased array calibration wizard.
Curve number	Allows the user to select the TCG curve to be used. Only active when the curve is derived from the theoretical setup method.	Only one curve per channel may be selected but a single curve may be referenced by multiple channels.
Units	Allow units to be specified in time (μs) or distance (mm).	
Calibration Wizard	Opens the phased array wizard at the calibration/TCG page	Bypasses the equipment setup section of the phased array wizard.

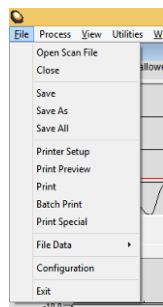
Position Check boxes (1,2,3...)	Enables each position. Positions can only be enabled or disabled in sequence.	Positions and values will be enabled and populated automatically if the wizard is used to establish the TCG curve.
Time/Distance vs Gain pairs (mm/μs & Gain(dB) columns)	A maximum of 15 Time/Distance vs Gain pairs may be defined. The software linearly interpolates gain with respect to time between the specified points.	Using TCG, the peaks are adjusted to the reference amplitude (straight line at a given amplitude). Note: DAC differs in that the reference amplitude line is adjusted to the peak height.
Clear All	Clears all the Displayed TCG values and disables the position check boxes.	

PE/Corrosion Mapping - Offline Analysis. (Original software)

Typical PE/Corrosion map display



PE/Corrosion Mapping Offline Analysis - File menu options



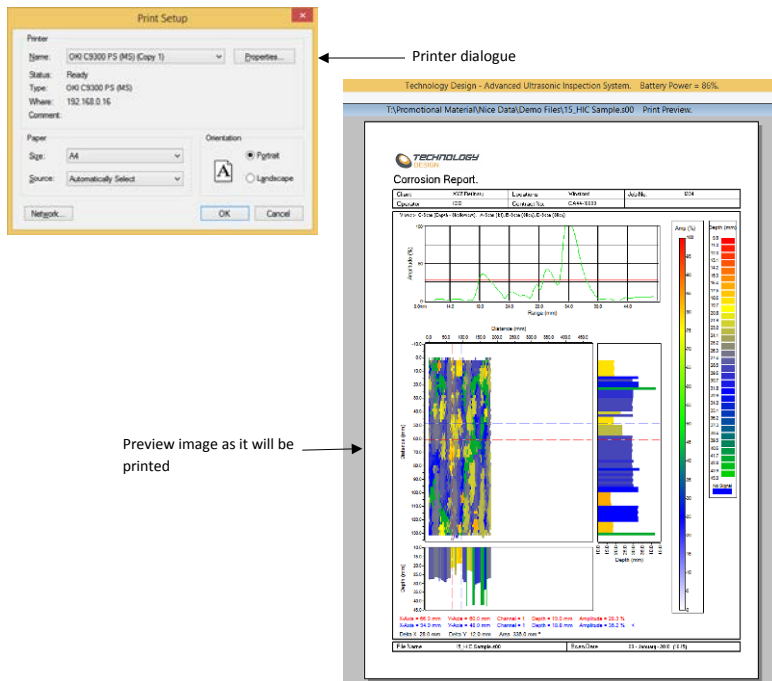
Open Scan File	Opens the Select Scan File(s) dialogue	Allows a any data file to be opened using Windows® Open File features
Close	Closes the file that is currently in the foreground	
Save	Saves the file that is currently in the foreground	
Save as	Opens the Select Scan File(s) dialogue	Allows the file that is currently in the foreground to be saved with a different name and folder location.
Save all	Saves all files that are currently open	
Printer Set-up	Opens the Print Setup dialogue	Allows selection and configuration of a printer and its settings

Print Preview	Print preview provides a graphical view of the printout prior to initiating the print	
Print	Selected file is printed.	The print out is presented in a simple report format that includes any annotation, user entered header and certain measurement information. Useful for producing quick simple reports.
Batch Print	Selection of multiple files allows unattended printouts	
Print Special	Allows data images larger than the display area to be printed over multiple pages.	
File Data	Allows user to change certain key parameters off-line, data is then automatically re-calculated	
Configuration	Opens the <i>Configuration Editor</i> window.	System configuration parameters including printout formats may be edited NB- System Configuration settings are not saved as part of the setup file or data file.
Exit	Exit Software	

Print Preview and Print

Print Preview allows the user to view an image before printing the image on paper. The *Print Preview* window will look similar to the image below.

The logo and document heading are defined in **Configuration-Report**. The heading is inherited from **Configuration** if saved during analysis and can be changed by opening the configuration editor from the **File** menu when the file is subsequently opened for analysis.

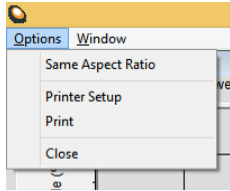


The image shows two windows from the software. On the left is the 'Print Setup' dialog box, which includes fields for Printer (Oki C3300 PS (MS) (Copy 1)), Paper (A4), and Source (Automatically Select). On the right is the 'Print Preview' window, which displays a 'Corrosion Report' with a header for 'Technology Design - Advanced Ultrasonic Inspection System'. The report contains a line graph of Amplitude (dB) vs. Range (mm), a color-coded depth map, and a bar chart of Amplitude (dB) vs. Depth (mm). A color scale on the right indicates amplitude values from 0 to 120 dB. At the bottom, technical parameters are listed: Pulse = 60.0 mm, Value = 60.0 mm, Channel = 1, Depth = 10.0 mm, Amplitude = 10.0 dB, Range = 20.0 mm, Value = 60.0 mm, Channel = 1, Depth = 10.0 mm, Amplitude = 10.0 dB, Pulse = 20.0 mm, Duty = 17.0 mm, Gain = 100.0 mm.

Printer dialogue

Preview image as it will be printed

Options Menu

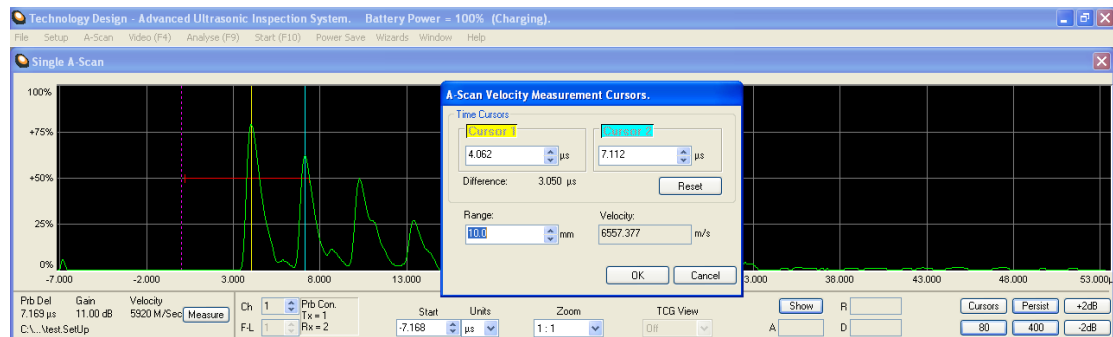


Same Aspect Ratio	Alters the aspect ratio of the image.	Clicking this control alternates between keeping the same aspect ratio as the original data and stretching the data to fit into the available space.
Print Setup	Displays the Print Setup dialogue.	
Print	Sends the document to the printer selected in Print Setup .	
Close	Closes the print preview window.	

iii. How to Measure Velocity

Automated Method

- Close all open windows leaving only the **A-Scan** window open.
- Set the system up with an appropriate basic setup.
- Click the **Measure** button on the A-Scan window. The **A-Scan Velocity Measurement Cursors** window appears.
- Place the probe on a calibration block or defect free area of the test piece. Adjust the A-Scan window so that two BWE's are displayed or the signals from two known thicknesses can be displayed ensuring that the peaks are not saturated.
- Adjust Cursor1 and Cursor2 to the peaks of two subsequent BWE's.
- Adjust the **Range** control to the known thickness of the material. The velocity of the material in metres per second will be displayed in the **Velocity** text box.
- Tap **OK**. Notice the velocity value changes on the A-Scan window and may also be viewed in the **Compression** velocity text box on the **Global** tab in the **Collection Hardware Setup** window.



Manually

- Connect a probe to the system. No calibration is required.
- Ensure the measurement units on the A-Scan display window are set to microseconds (μs).
- Place the probe on a defect-free area of the material and ensure that at least two repeat signals from a reflector at a known range are visible on the A-Scan.
- Activate the cursors and place one cursor on each of the peaks of the two signals.
- To calculate the velocity in *metres per second*, calculate the following:

$$\frac{\text{Range} \times 2}{\text{Difference} (\mu\text{s})} \times 1000$$

Example:

Range=100mm

Difference between repeat signals = 61.47 μs

$$\frac{200}{61.47} \times 1000 = 3253\text{m/s}$$

iv. Calculate Required Separation (PCS)

- On the **Probe** page, *click* the **Calc Required Separation** button.
- The **A-Scan Display Cursors** window appears. Move the yellow cursor to a point on the lateral wave signal and the cyan cursor to the corresponding opposite phase on the backwall signal.
- Enter the material thickness.
- Click* **OK**.
- The correct *Probe Centre Separation* (PCS) is now displayed in the **Separation** text box.
- The following formula is applied:

$$2(t \times \tan \theta)$$

Example:

Focus Depth=25mm
Wedge angle = 60°

$$2(25 \times \tan 60)$$

$$2(25 \times 1.73) = 86.6\text{mm (PCS)}$$

v. Probe Calibration

There are three methods to calibrate the system. In **Phased array mode** all 3 are available, in **Pulse Echo mode** only manual calibration is available.

- Manually (PA & PE)** by physically determining the probe delay of a single focal law. For phased array the system then calculates the probe delay for all other focal laws theoretically.
- Theoretically (PA)** where the system calculates all the probe delays (for each focal law) without any physical action by the operator.
- Wizard (angled PA only)**. The delay for each focal law is determined experimentally by passing the probe (therefore each focal law) over a calibration reflector (*see Appendix C for detailed tutorials*). **NOTE:** A special procedure to calibrate a multi-focal law **Pitch/Catch** channel is activated when **Probe Delay – Manual - Calibrate** is selected in the phased array wizard.

Manual Method

This method uses one focal law to calibrate and then corrects all the other focal laws mathematically.

- Enter all values for a basic system setup.
- Change the measurement units from microseconds (μs) to millimetres (mm).
- Click* **Setup – Collection Hardware – Probe**.
- Clear the value in the **Delay** text box then *click* **Apply**.
- Click* the **Cursors** button on the **A-scan** window (the button may display as **C** only depending on screen resolution).
- Couple* the probe to a calibration piece and *maximise* the signal.
- Move* Cursor 1 to the peak *or* flank of the calibration signal.
- Enter* the range to the calibration reflector into the Cursor 2 text box and *press* **ENTER**. The **Difference** (delay) between the cursors is displayed below the cursor controls.
- Click* the **Set P-Del** button to transfer the delay to the **Probe Delay** text box on the **Probe Page**.
- Cross check the calibration by moving any cursor to a signal with known range & check that the range is correct. Alternatively, *click* the **Show** button on the **A-Scan** window and *move* the vertical dashed markers on the A-Scan to encompass the signal. The depth is displayed in the **D** text box.
- Note:** If the cross check is incorrect, the velocity is probably incorrect. We suggest you measure the velocity (*see 'How to Measure Velocity' in Appendix B*).

Theoretical Method

- Enter all values for a basic system setup.
- Simply *click* the **Theoretical Delay** button in **Setup – Collection Hardware – Probe**. The system will calculate and delay values of all focal laws for the channel and display the value of the first focal law in the **Probe Delay** text box.

Wizard (see Appendix C for detailed instructions on how to use the wizard)

The phased array wizard may be activated from three different locations within the software:

- Click* the **Wizards** menu and select one of the **PA wizard** options.
 - PA Wizard** – Starts the wizard at the *equipment setup* section. Complete this section to proceed to the *calibration* and *TCG* section.
 - PA Calibration Wizard – Channel x** – Allows the user to re-enter the wizard at the *calibration* and *TCG* section, by-passing the setup section. These menu items will only be displayed for channels that have already been calibrated.
- Click* **Setup – Collection Hardware – Probe – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.
- Click* **Setup – Collection Hardware – TCG – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.