

TD-SCAN

ADVANCED ULTRASONIC SOFTWARE

For

FocusScan Rx II
FocusScan Rx

(TouchScreen Interface)



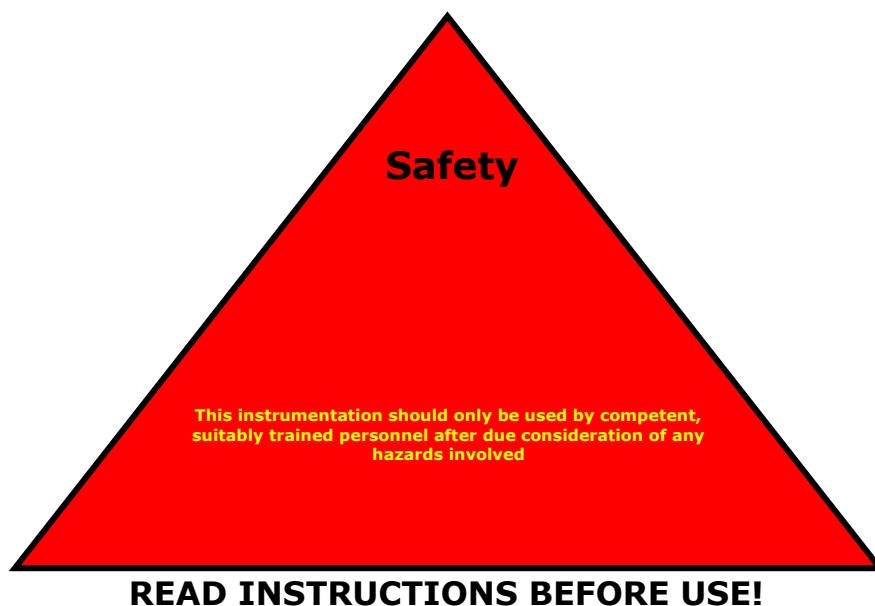
Manufactured in Great Britain

USER GUIDE AND TECHNICAL REFERENCE MANUAL

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§ Legacy product with limited support.

Important Safety Information



Due to the potential hazards associated with any electrical equipment it is important that the user is familiar with the instructions covering the capabilities and operation of the instrument. The user should ensure that all reasonable safety precautions are followed and if in any doubt, should seek advice from a suitably qualified and trained person before proceeding.

***** WARNING *****

NO attempt should be made to remove protective covers or access the internals of the system unless the equipment is isolated from the electrical supply and then only by a suitably trained and qualified technician. Failure to comply with these instructions may expose the user to electrical hazard.

All equipment supplied MUST only be used in dry conditions and is not suitable for operation in damp or wet environments.

Regulatory Information

The TD range of equipment conforms to the following European and International Directives and Specifications:

- 2006/95/EC (Low Voltage Directive)
- 2004/108/EC (Electromagnetic Compatibility Directive)
- 93 / 68 / EEC (CE-Marking Directive).
- EN55022 Class B and EN 50082-1 for use in the following areas: residential, business and light industry
- BS/EN 61326: 2006 Electrical equipment for measurement, control and laboratory use. EMC requirements, General requirements.

Intellectual Property

The following trademarks are owned by the respective organisations:

- *Lemo* is a trademark of Interlemon Holding S.A. (Interlemon Holding Ag)(Interlemon Holding Ltd)
- *Windows* is a trademark of the Microsoft Corporation, registered in the U.S. and other countries.
- *ESBeamTool* is a trademark of Eclipse Scientific Inc., registered in the Canada. and other countries.

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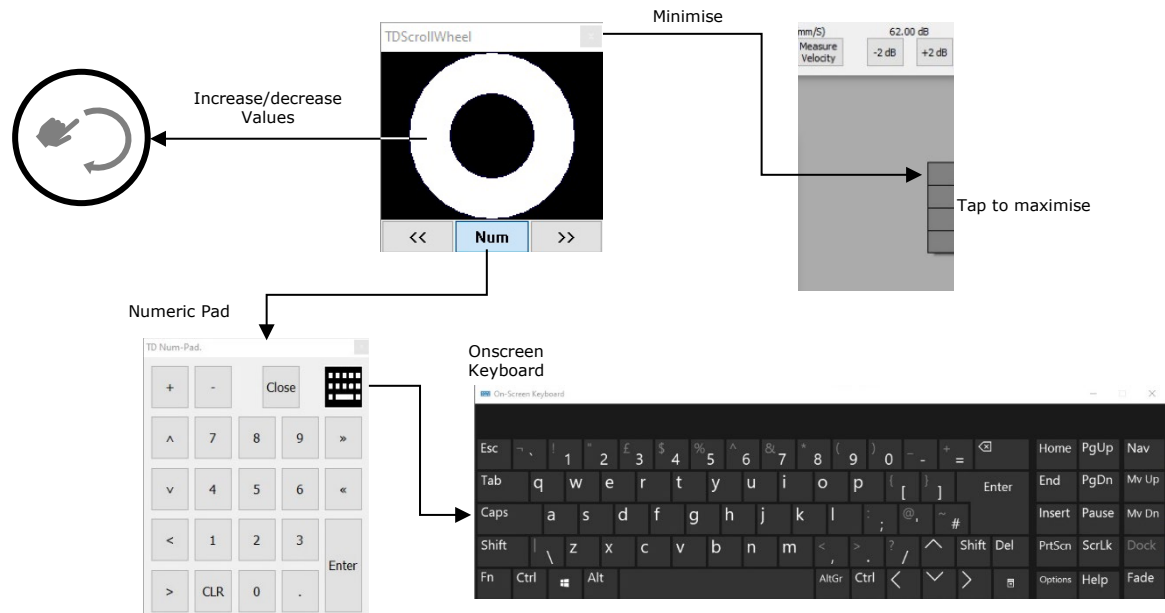
Tools and Conventions

Scroll-Wheel

The TDScan touchscreen interface features a unique floating scroll-wheel widget that is the hub of all input for numbers and letters. The scroll-wheel is displayed on the opening page below the A-Scan display and may be used to open the numeric keypad and full onscreen keyboard.

The Scroll-wheel opens on the right lower side of the screen and may then be positioned anywhere on the screen by dragging it to the desired location.

If the user prefers hardware input, Bluetooth enabled or wired keyboard and mouse may be attached to the USB ports.



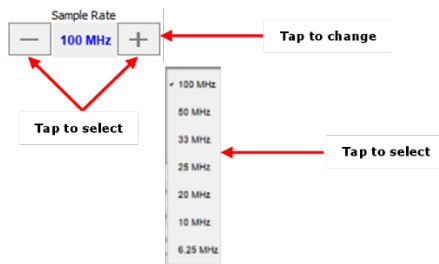
Mouse and Keyboard (external)

A wired or Bluetooth external mouse and keyboard may be used via the USB ports. All the onscreen controls may be used with external input devices or using the touchscreen functionality. There are certain keyboard shortcuts that make analysis easier and more efficient using a Keyboard.

Superview	View Mode	+ Key (zoom in)	- Key (zoom out)	Shift Key (larger step)	Ctrl +	Ctrl -	Arrows (move image)		Shift Key (larger step)	
							↑↓	←→	↑↓	←→
Superview	B-scan	✓	✓	✓			-	-	-	-
	C-scan	✓	✓	-			✓	✓	✓	✓
	D-scan	-	-	-			-	-	-	-
	S-scan	✓	✓	✓			✓	-	✓	-
	A-scan	✓ Time Base	✓ Time Base	-	✓ Amplitude up	✓ Amplitude down	✓	✓ Left/Right	-	✓
ToFDS/ware	Shift+F5	Contrast down								
	Shift+F6	Contrast up								

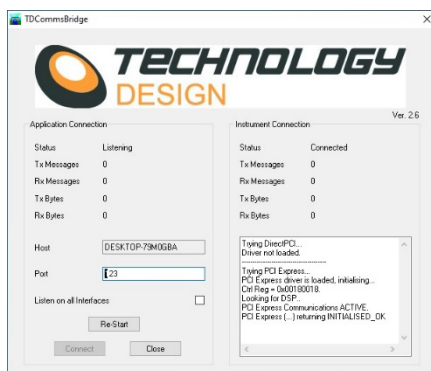
Information input

Information may be entered into dialogues by selecting values from drop-down menus, typing letters and numbers directly into text boxes or tapping on the plus (+) and minus (-) buttons on either side of text boxes



TD CommsBridge

CommsBridge is a pre-installed TD app that allows the FSRX range of systems to be controlled remotely from a Windows PC or Laptop. Please refer [Appendix B](#) for a step-by-step guide.



SOFTWARE USER GUIDE

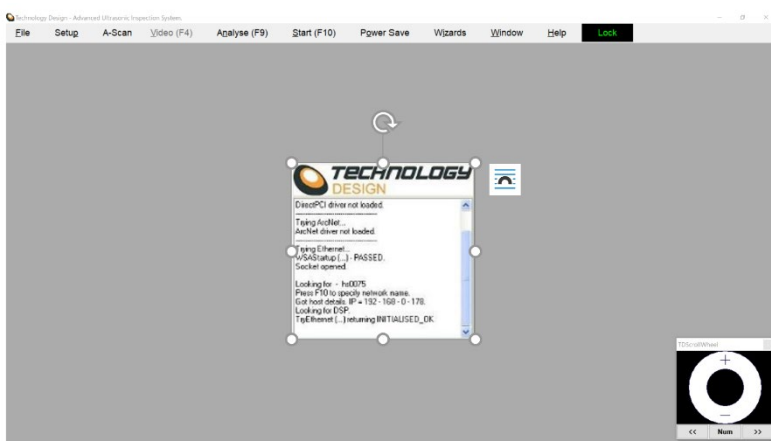
FocusScan RX and FocusScan RX II systems are supplied with the TDScan advanced ultrasonic software suite pre-installed. TDScan is a suite of software that is used on all Technology Design ultrasonic acquisition systems. Using TDScan, operators can define Phased array, ToFD and Pulse echo ultrasonic setups for data acquisition, scanner control, data analysis and reporting. In addition, TDScan may be used in tandem with other software applications to control acquisition systems remotely, trigger mechanical devices such as go/no-go gates, alarms, flashing lights etc. based in amplitude criteria.

TDScan version 20.05 and later is able to compute and display Total Focus Method (TFM) data.

This instruction manual describes and explains the TDScan controls used to operate TD ultrasonic systems using the touchscreen user interface. TDScan may be displayed with user interfaces that are optimised for either mouse control or touch screen control. The touchscreen interface is also able to be controlled using a mouse.

Starting the software

To start the TDScan software, double tap the TD-Scan icon on the Windows® desktop. The TECHNOLOGY DESIGN logo splash screen displays as the software starts. During start-up the previous set-up parameters are loaded from the PC's HDD or SSD to the ultrasonic circuitry. After a short time (1 – 3 seconds), the splash screen is replaced by the A-Scan display window.



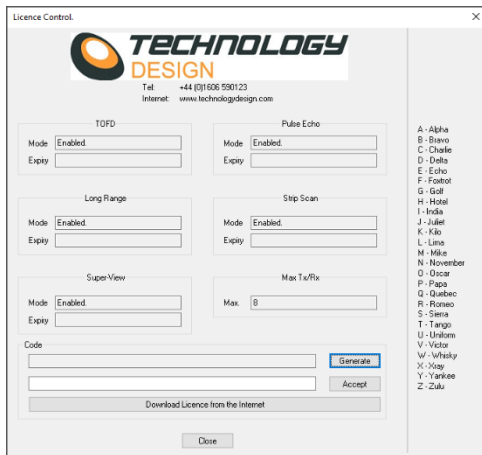
Running the software for the first time

When running the software for the first time, the software will start normally and display the A-Scan window. The TD Scroll Wheel will also appear below the A-Scan window. It is recommended that the user check the licence status at this point (See [Licence](#) below).



Software Licence

By default, the **TD Advanced Ultrasonic Software** may be used as a free data viewer without any purchased licence scheme. The software can however also be programmed with various licence schemes. The licence scheme may be temporary or permanent and is dependent on the current ownership status of the equipment or the current account status of the organisation. The application of a licence is interactive and may be applied manually by contacting Technology Design by telephone/email or automatically over the internet (**See: Applying a Licence** in [Appendix B](#) for guidance on the licence procedures).



Generate	Causes TD-Scan software to generate an encryption code when applying a licence manually.	Provide this code to the TD licence giver. Note: remain in the licence generator after providing the code until the return code is entered.
Accept	Causes the licence generator to match the encrypted codes and generate a licence.	Enter the code returned by the licence giver and ensure it is correct before Tapping Accept .
Download Licence from the Internet	Activates the automatic licence generation procedure.	An internet connection and pre-authorised licence scheme is required.

The basic licence scheme options are:

Disabled	No licence (Free Viewer mode , enabled by default)	- Online software tools and most offline tools will not function. Viewer mode (View data only – no analysis tools) is active. This mode allows users to view saved data with minimal functionality. Useful for distribution to end-users who only need to view the data with basic information.
Enable	Permanent Licence	- Full online and offline functionality. No further action required. Note for Pocket-Scan & PS45 users: Licence is recorded in the unit's circuitry & not on the PC. - This means that the Pocket-Scan or PS45 may be used with any PC that has the TD software is installed.
Enabled (time limited)	Temporary Licence (Fixed-time or recurring licences may be applied by agreement or depending on customer/user account status)	- The remaining time is displayed in the licence generator. After the time period expiry, the licence reverts to Disabled, therefore the viewer mode (View data only with no analysis tools) is activated. Note for Pocket-Scan & PS45 Users: The temporary licence is housed on the HDD of the PC. Note – When using certain legacy versions of the TDScan software, inserting a USB licence key (dongle) may overwrite the temporary licence and render the software module inactive.
Offline Only USB Key required (Dongle)	Activated by USB Key	- Full analysis functionality only. - USB Key (dongle) required. Important: The USB key (dongle) is meant to be used on a remote PC to allow analysis on the stand-alone PC and if plugged into a TD system, the Offline only licence will take precedence.
Offline Only (time limited)	Temporary Licence	- Full analysis functionality only. - Remaining time is displayed in the licence generator. After the time period expiry, the licence reverts to Disabled, therefore the viewer mode (View data only with no analysis tools) is activated. - The temporary licence is housed on the HDD of the PC.

Licences when using CommsBridge

All TD systems with integrated PC boards (TD-scan, Focus-Scan variants & Handy-Scan variants) can be controlled remotely over Ethernet using TD's CommsBridge software. When the link is established the A-scan is live and setup can take place but the ability to collect data is dependent on the licence type and where it is housed. TD units that have a temporary licence do not transfer the temporary licence to the PC when being used remotely (i.e. TD-CommsBridge running on the unit, and TD-Scan software running on a separate PC).

The A-Scan display window



The A-Scan display window shows the digitised ultrasonic signal received from the transducer as well as control features like *Data Acquisition Gates, Peak Search Gates, Cursors, Zero Marker and Gain Step Selector*. Data displayed on the information bar below the A-scan window may change depending on how the user has chosen to display data or on the channel settings.

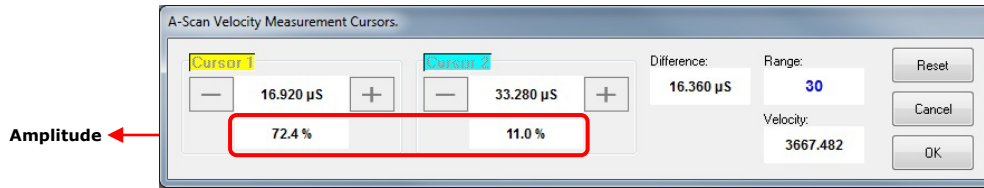
The horizontal RED line in the A-Scan display area is a graphical representation of *Data Collection Gate 1*. When enabled, *Gate 2* is drawn in BLUE, and *Gate 3* is drawn in YELLOW (See *Gates* category).

Gain	This field is located above the gain adjustment buttons. It shows the gain setting for the selected channel.	
Measure Velocity	Activates the A-scan velocity measurement procedure	Use this procedure to determine the test material velocity and enter it automatically. (see A-scan velocity Measurement Cursors below)
Channel (Also referred to as <i>group</i>)	The channel number of the A-Scan currently displayed. This value may be changed by Tapping the Up/Down arrows to the right of the text, using the left mouse button or by using the Up/Down arrow keys.	Note: using this control will change the channel being viewed as an A-Scan but will not change the channel in the <i>Collection Hardware Setup</i> window. (see <i>Channel Page - Channel</i>)
F-L	The focal law number of the A-scan currently displayed. This value may be changed by Tapping the +/- arrows	Phased Array Only. The box will be greyed out in ToFD and Pulse Echo channels
TX	Transmit transducer number.	Pulse echo, ToFD & Phased array (fixed angle)
RX	Receive transducer number.	
Tx/Rx Angle	Transmit/Receive angle of a sectorial scan	Phased Array only – only one angle at a time can be displayed in the A-scan window.
Start	The time or distance at the left edge of the A-Scan display. Changing this value scrolls the A-Scan Left/Right . Values may be entered via the keyboard (the Enter key must be pressed for the software to use the value), or the Up/Down - Arrow/Page keys. The shift key may be used in conjunction with the Up/Down - Arrow/Page keys to scroll faster. An alternative method of scrolling the A-scan is: Left Tap, Hold & Drag the mouse.	
Units	Choose the unit displayed on the baseline of the A-Scan from the drop-down menu . Time - Displayed as µS Microseconds. Range - Displayed as mm-R or in-R. Depth - Displayed as mm-D or in-D.	- Changing the Units will change the displayed values on the A-Scan time base accordingly and will also change the positional displays in the Cursors window. Range - No corrections made for <i>Dual Linear Arrays</i>. Depth - No corrections made for <i>curved surface</i> or <i>Dual Linear Arrays</i>.
Zoom	Controls the amount of data displayed in the A-Scan display window. Values of +4, +2, 1:1, x2, x3, x4, x5, x6, x6.3 are available.	
TCG view	This list controls the display of the Amplitude Correction curve on the A-Scan display. (Only available for Pulse Echo & Phased array channels).	The system displays a TCG curve (Time Corrected Gain). The menu items zoom the TCG view vertically for ease of viewing. See Manual Time Corrected Gain (TCG) in Appendix A for guidance on setting up TCG (theoretical).
Show	Activates the Peak Search Gates in the A-Scan window and real-time Surface Projection (P), Amplitude (A), Range (R) & Depth (D) value boxes. The current active skip leg is also shown.	Drag the orange vertical dashed delimiters to encompass the area of interest. The highest amplitude

		signal between the delimiters is identified by an orange cross at the apex of the signal.
Cursors	Opens the cursor control dialog box.	See A-Scan Display Cursors for an explanation of the cursors.
Persist	Activates a coloured fill-in on the A-scan display that remains on-screen after the A-scan peak has moved.	Useful during calibration or measurement because once the signal is maximised the probe may be removed and the persistent image used for measurement.
80	Sets the vertical scale to show 80% full scale, with -6dB steps.	
400	Sets the visible A-scan scale to 400%	Only useful when 14 bits per sample is enabled
+2dB / -2dB	Increases / Decreases gain in 2dB steps	

A-scan Velocity Measurement Cursors

This procedure allows the user to measure the ultrasound velocity in a test material. Prior calibration is not necessary to use this procedure (for detailed instructions see **How to Measure Velocity** in [Appendix B](#))



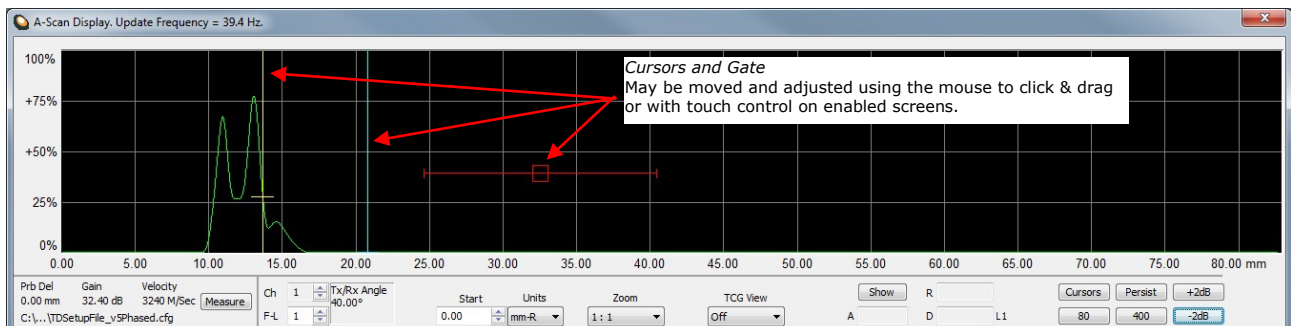
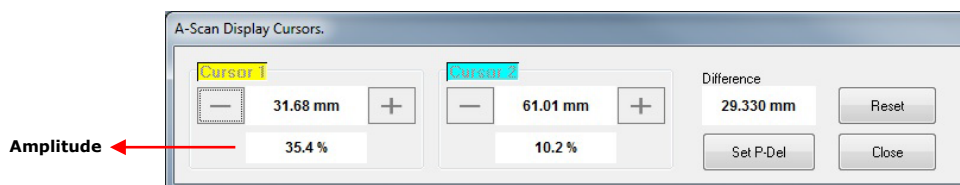
Time Cursors		
Cursor 1	Defines the position of Cursor 1 in microseconds on the base line	Place cursor at the apex of a signal from a reflector of a known range.
Cursor 2	Defines the position of Cursor 2 in microseconds on the base line	Place cursor at the apex of a signal from a known range. This could be a repeat signal from the same reflector used for Cursor 1 or another reflector of a known range.
Difference	The difference in microseconds between the Cursor 1 and Cursor 2 values.	
Reset	Displays Cursors 1 and 2 in the visible A-scan space	A convenient way to move the cursors into the visible window.
Velocity	Ultrasound velocity in the test material in metres per second	- The choice of shear or Compression velocity is automatically made based on the <i>Wave Type</i> choice made in the probe page. - Velocity is derived from: $(2 \times \text{Range}/\text{Difference}) \times 1000$
Amplitude	Amplitude at point where cursor bisects signal	This point is highlighted by a short horizontal line.

A-Scan Display Cursors

To open the *A-Scan Display Cursors* dialogue box, Tap the *Cursors* button on the A-Scan display window. Two coloured vertical cursors corresponding to the cursor controls are displayed in the A-scan window. A short horizontal line will appear at the point where the cursor bisects a signal.

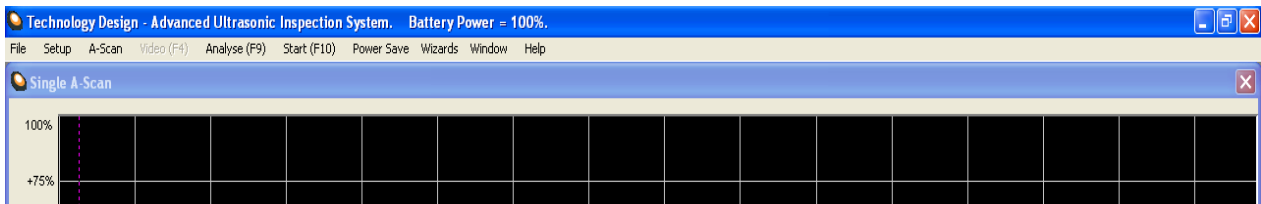
The purpose of the A-Scan Display Cursors is to measure precisely any point on the A-Scan. The cursors may be used for calibration procedures.

Cursors may be moved by dragging with the mouse pointer or adjusting the values in the *A-Scan Display Cursors* window.



Time Cursors		
Cursor 1	Defines the position of Cursor 1 in microseconds on the base line	
Cursor 2	Defines the position of Cursor 2 in microseconds on the base line	
Difference	The difference in microseconds between the Cursor 1 and Cursor 2 values.	
Reset	Displays Cursors 1 and 2 in the visible A-scan space	A convenient way to move the cursors into the visible window.
Amplitude	Amplitude at point where cursor bisects signal	This point is highlighted by a short horizontal line.

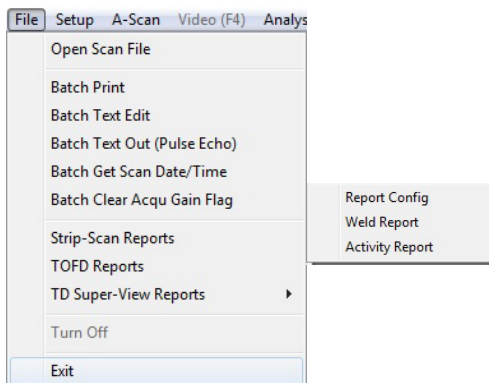
Online Menu Structure



By default, the system is in the *On-line* state if the licence scheme allows it, *and* the PC is communicating with a remote unit (ultrasonic circuitry). In this state all on-line and Off-line controls are available to configure the ultrasonic, drive control circuitry, acquire data and analyse data. If there is no communication with a remote unit, the system will enter the *Off-line* state. Using an appropriate USB Key (Dongle) in the *Off-line* state enables the analysis controls. Without a USB Key (Dongle), data may be displayed but only a limited set of analysis tools are available.

Online menus		
File	Displays a drop-down menu with various file functions (<i>see File Menu section below</i>)	
Setup	Displays a drop-down menu with all system setup and configuration controls and functions (<i>see Setup Menu section below</i>)	This is the menu that is used most.
A-Scan	Displays or hides the A-scan window.	Under certain circumstances the A-scan window may be hidden. Use this control to re-display it.
Video(F4)	Displays a video image. Only enabled when a video tracking system is connected.	The image is useful for viewing the scan surface, probe and tracking target.
Analyse(F9)	Displays a file browser window.	Select the file(s) to open for analysis.
Start(10)	Displays various dialogues and/or a file browser window.	The dialogues displayed depend on setup and configuration settings.
Power Save	Activates the power save procedure manually. Only available on Handy-Scan models.	In Power-Save mode the DSP is powered down. Re-activated by Tapping the menu item. This preserves the battery charge for longer.
Wizards	Displays a drop-down menu from which wizards may be activated. (<i>see Appendix C for detailed wizard instructions</i>)	
Window	Displays a drop-down menu with standard Windows® sort and display configurations for multiple file windows open in analysis mode.	
Help	Displays a drop-down menu where various help items may be selected.	

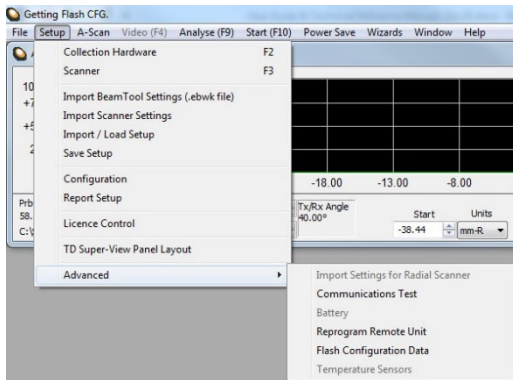
File Menu



File		
Open Scan File	Opens the <i>Select Scan File(s)</i> dialogue.	Select data files to open with a .SCN or .S00, .s01, .s02, etc. file extension.
Batch Print	Opens <i>Printer</i> dialogue and <i>Select Scan File(s)</i> dialogue.	Allows selection of multiple data files for unattended printing.
Batch Text Edit	Opens the <i>Batch Text Edit</i> dialogue.	Allows user defined header text to be edited in multiple data files simultaneously.
Batch Text Out (Pulse Echo)	Currently inactive	
Batch Get Scan Date/Time	Opens a file browser window.	Allows user to select multiple data files from which the hard coded date & time of acquisition is output to a .txt file in the same folder.
Batch Clear Acqu Gain Flag	Opens a file browser window.	Clears the additional acquisition gain (if any) from the files selected by a user.
Strip-Scan Reports	Opens the <i>Strip-Scan Reports</i> dialogue.	Allows selection of template file and generation of automated reports for the Strip-Scan software.
TOFD Reports	Opens the <i>TOFD Reports</i> dialogue.	Allows selection of template file and generation of automated reports for the TOFD software.
TD Super-View Reports	Opens a sub-menu with 3 three reporting utility options for Semi-auto reporting. (<i>See Reports section</i>)	There are various way to produce reports within the TD-Scan software: a) Simple Data/header/cursor print.

		b) Semi-auto Excel® report c) Fully auto user defined report format.
Turn Off	Shuts TD-Scan Software down	
Exit	Shuts down the TD-Scan software	Tapping the  in the top right-hand corner has the same effect.

Setup Menu

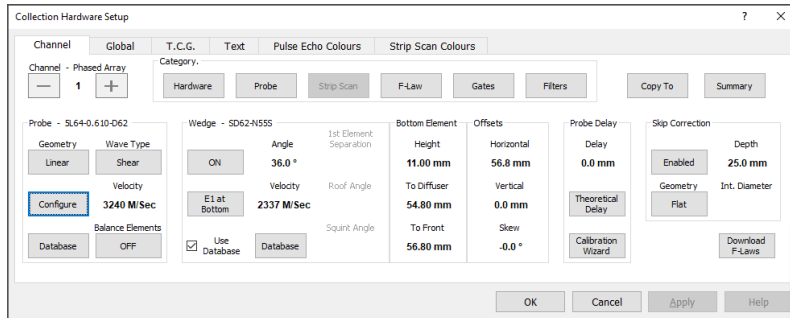


Setup		
Collection Hardware F2	Opens the <i>Collection Hardware Setup</i> window (see <i>Collection Hardware</i> sections below).	Controls to configure UT hardware, Probe, Focal Laws, Gates, Filters, Zone Discrimination, Colours and TCG are contained in this window.
Scanner F3	Opens the <i>Scanner Setup</i> window (see <i>Scanner Setup</i> sections below).	Controls to configure several different scanner interfaces are contained in this window.
Import BeamTool Settings (.ebwk file)	Opens the <i>Select Scan File(s)</i> dialogue.	Phased Array scan plans developed in ESBeamTool® can be imported into the TD-Scan software for convenient automated system configuration.
Import Scanner Settings	Opens the <i>Select Scan File(s)</i> dialogue.	Configure the system scanner without affecting the current UT setup by selecting an existing data file.
Import/Load Setup	Opens the <i>Select Setup File(s)</i> dialogue.	Configure the system by selecting a previously saved .setup file or an existing .SCN file. <i>Note: select all files to see all file extensions.</i>
Save Setup	Opens the <i>Save Setup File</i> dialogue.	Setup files may be saved from the current system configuration. The file, with a .SETUP file extension contains setup data from all channels.
Configuration	Opens the <i>Configuration Editor</i> window. (See <i>Configuration Editor</i> section)	System configuration may be edited in this window.
Report Setup	Opens the <i>Configure Reports</i> window. (See <i>Reports</i> section – currently under editing)	Here user definable ToFD and StripScan reports can be configured to extract any available setup and analysis data that the user desires.
Licence Control	Opens the <i>Licence Control</i> dialogue. (See <i>Licence</i> section)	Licence schemes are configured in this window. The licence procedure is interactive and requires communication with the TD licence server via the Internet or with a TD operator.
TD Super-View Panel Layout	Opens the <i>Super-View Display Control</i> window.	Super-View is TD's advanced imaging and analysis software for phased array and pulse echo.
Advanced		
Import Settings for Radial Scanner	Not currently used	
Communications Test	Opens the <i>Communications Test</i> window	The integrity of communication between the PC software and a remote acquisition unit may be verified using this facility. Test failure may point to a poor connection in the umbilical connecting the host PC and remote unit. <i>Note: Usually only used by service personnel.</i>
Battery	Opens the battery information window	Only available to service personnel
Reprogram Remote Unit	Opens the <i>Select the Program™.PRG™</i> file to download dialogue.	Allows the user to reprogram the ultrasonic circuitry with new firmware. When a new version of the TD-Scan software is installed The following warning message may be encountered each time the software starts: "The remote unit has version x.xx software, this release of the P.C. software was tested with version y.yy. This may cause incorrect system operation." To remove the

		message, see <i>Reprogramming the Remote Unit</i> in Appendix B for detailed instructions for the procedure.
Flash Configuration Data	Opens the <i>Flash Configuration Data</i> window.	Displays hardware configuration data. Adjustment controls only accessible by service personnel.
Temperature Sensors	Opens the <i>Temperature Sensors</i> window.	Project specific – not currently used.

Collection Hardware F2

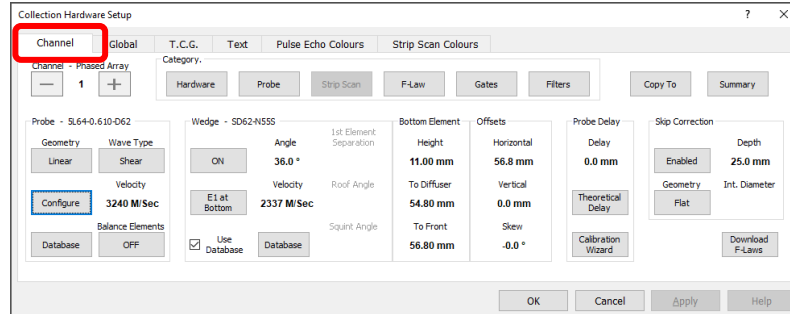
To open the *Collection Hardware Set-up* dialog box, from the *Setup* menu select *Collection Hardware*. (F2 hot key).



The **tabs** at the top of the dialog box display groups of related controls.

Channel	The parameters that are programmable channel by channel	
Global	The parameters that are common to all channels	
T.C.G	Time Corrected Gain curve configuration	Amplitude correction is displayed as a Time Corrected Gain curve (TCG). See: <i>Time Corrected Gain (TCG)</i> in Appendix B for guidance on setting up TCG.
Text	The text parameters that are saved in the ultrasonic data files	
Pulse Echo Colours	Set-up of the Pulse Echo Depth/Amplitude colour tables	
Strip Scan Colours	Set-up of Strip Scan / Long Range colours	

Channel Tab



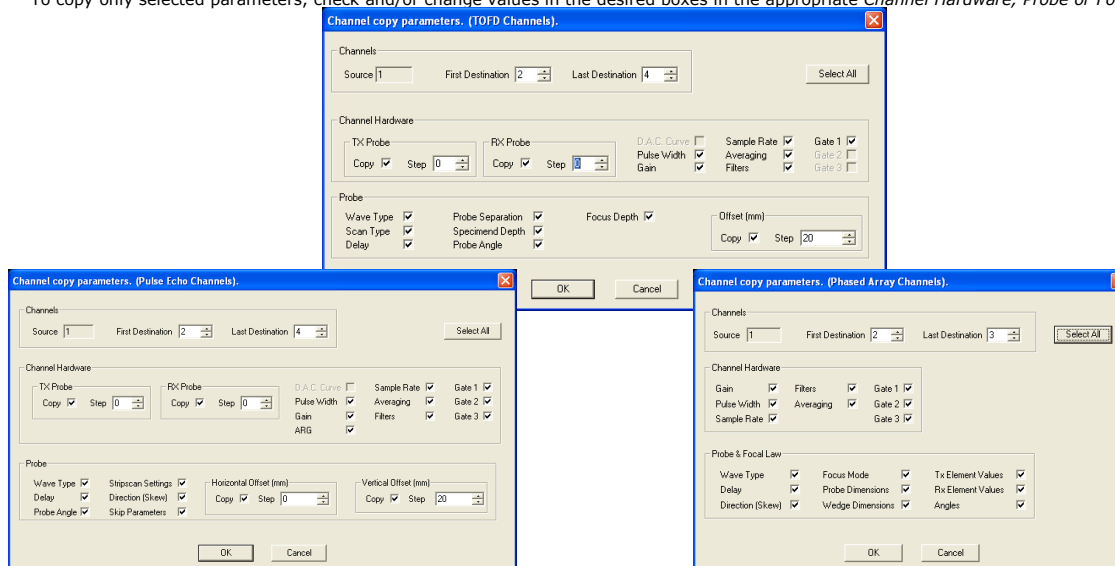
Channel Number	The current channel. This value may be modified by Tapping the Up/Down arrow to the right of the text, or by using the Up/Down arrow keys on the keyboard.	Channel refers to a group of software settings designated by a number.
Category		
Category Buttons	Changes the displayed parameters in the dialog box to the different categories of channel parameters: Channel Hardware Probe F-Law Gates Filters	Tapping a button will display the appropriate controls for the category.
Lock A-Scan Display Channel	When enabled, changing the channel number in this dialog box also changes the displayed channel in the A-Scan display window.	Important: Changing the channel number in the A-Scan display window however does not change the channel displayed in the <i>Collection Hardware Setup</i> window.
Copy To	Opens the <i>Channel Copy Parameters</i> dialog box.	See <i>Channel Copy Parameters</i> below.
Summary	Opens the <i>Channel Summary</i> dialog box. The channel summary dialog box displays all parameters for enabled channels and can be saved to a delimited text file.	Useful for QA purposes.
Enabled	Enables/disables a channel	Channels are sometimes referred to as 'groups'.
Channel Mode	Selector for type of ultrasonics: Pulse Echo ToFD Phased Array	Selecting a UT type changes the Category pages to display appropriate groups of controls.

Channel Copy Parameters

The *Channel Copy Parameters* dialogue is a convenient way to copy the parameters from one channel to another or to multiple channels. The dialogue is specific to selected *Channel Mode* (**Phased Array**, **ToFD** or **Pulse Echo**).

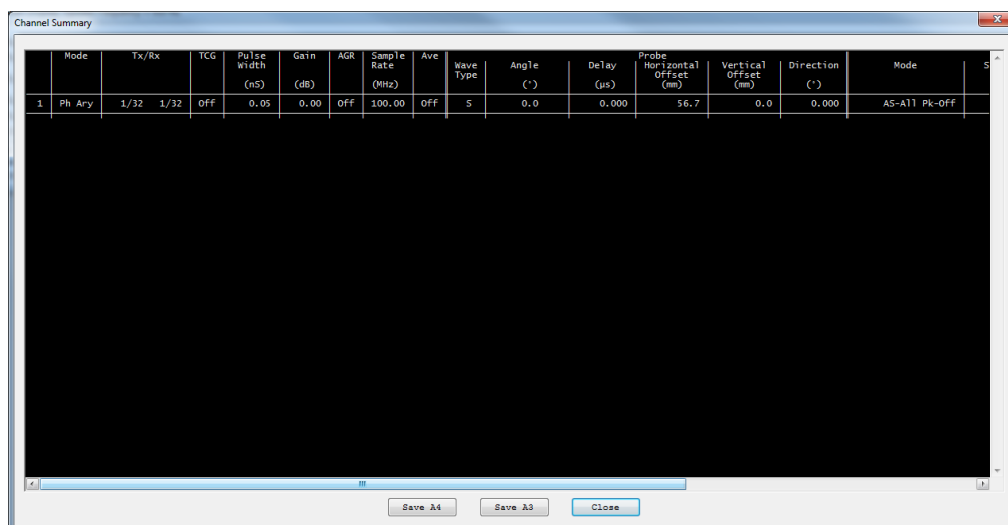
To copy a channel:

- Select a channel number from *First Destination* and a number from *Last Destination*.
- To copy all parameters from the source destination Tap the *Select All* button
- To copy only selected parameters, check and/or change values in the desired boxes in the appropriate *Channel Hardware*, *Probe* or *Focal Law* areas

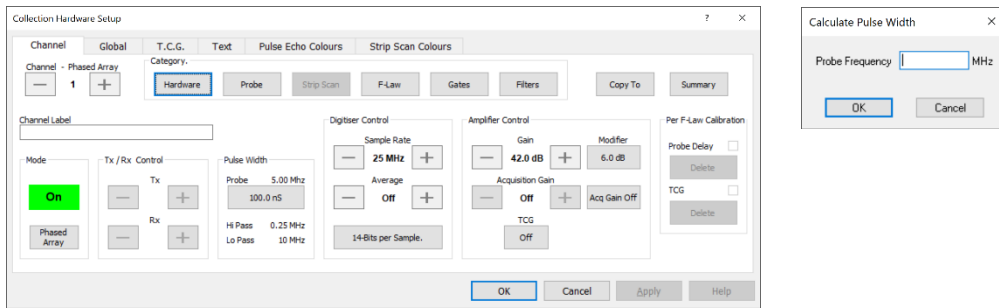


Channel Summary

The *Channel Summary* is a text dialogue that tabulates the setup parameters for each channel. Tapping the **Save** button allows the user to save the information as an A4 or A3 sized **RTF** file.



Channel Hardware Category (PE, ToFD & PA)



The screenshot shows two windows from a software application. The main window is 'Collection Hardware Setup' with tabs for Channel, Global, T.C.G., Text, Pulse Echo Colours, and Strip Scan Colours. The 'Channel' tab is active, showing settings for Channel 1, Mode (On), Tx/Rx Control, Pulse Width (5.00 MHz), Hi Pass (0.25 MHz), Lo Pass (10 MHz), Digitiser Control (Sample Rate: 25 MHz, Average: Off, 14-bits per Sample), Amplifier Control (Gain: 42.0 dB, Acquisition Gain: Off, TCG: Off), and Per F-Law Calibration. A 'Calculate Pulse Width' dialog box is open, showing a 'Probe Frequency' input field and 'OK' and 'Cancel' buttons.

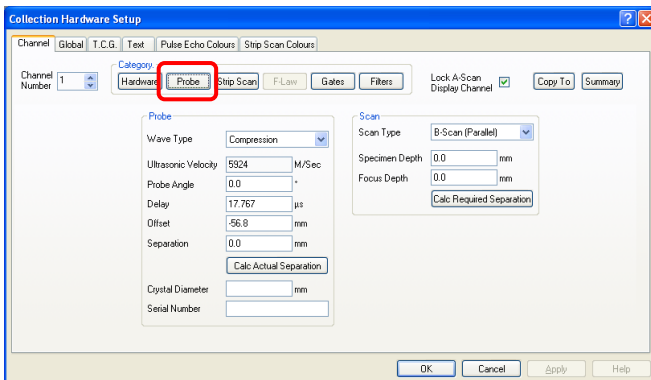
Channel Label	An identification label may be entered here	
Mode		
ON/OFF button	Enable or disable the channel	Tap the button to change between On and OFF.
Channel Mode button	Sets the channel's mode of operation: TOFD Pulse Echo Phased Array	
TX/RX Control (ToFD/Pulse Echo only)		
TX	This value sets the TX transducer number	The Lemo® socket to which the probe is connected.
RX	This value sets the RX transducer number	The Lemo® socket to which the probe is connected.
Pulse Width		
Probe		Enter the <i>probe frequency</i> and tap OK . The Pulse Width will be calculated automatically and displayed on the button. The probe frequency, Hi-pass and Lo-pass filters are displayed for convenience in this area.
Pulse Width button	Opens the Calculate Pulse Width dialogue box.	Tap the button to open the Calculate Pulse Width window. The calculation is as follows $((1 \div \text{Frequency}) \div 2)$
Probe	Displays transducer frequency for the calculated pulse width.	
Hi Pass Filter	Shows the value of the Hi-Pass filter.	To adjust this value, Tap the filters button.
Lo Pass Filter	Shows the value of the Lo-Pass filter.	To adjust this value, Tap the filters button.
Calculate Pulse Width dialogue box		
Probe Frequency	Enter the transducer frequency in Mhz.	This is the <i>Centre Frequency</i> of the probe.
OK	Executes the calculation that controls the width of the pulse used to excite the TX transducer according to the formula $((1 / \text{TX transducer frequency}) / 2)$	
Digitiser Control		
Sample Rate	Sets the digitiser frequency along with the Master Clock, which is set in the Global page.	To ensure a true representation of the signal amplitude, 5 times the probe frequency is a commonly accepted sample rate (digitisation frequency)
Average	Controls averaging for the channel. For Pulse Echo channels, averaging is performed before peak detection. This gives greatly improved performance for detecting very low amplitude signals.	Signal averaging is a software technique used to reduce random noise. It is most often used in ToFD applications.
Bits per Sample button	Sets the bit rate at 8 or 14 bits.	Tap the button to change between 8 bit and 14 bit. 8 bit: signal will saturate at 100% FSH 14 bit: signal will saturate at 400% FSH 14 Bit mode provides several advantages: - Greater dynamic amplitude range. - Greater visual resolution at high zoom factor. - Unsatuated ToFD backwall signals easier to achieve.
Amplifier Control		
Gain	Controls the channel's gain.	
+6dB / -6dB	Increase / Decreases gain in 6dB steps	
T.C.G. Curve	Used to select an amplitude correction curve for the channel.	The amplitude correction is displayed as a Time Corrected Gain curve (TCG). See: <i>Time Corrected Gain (TCG)</i> in Appendix B for guidance on setting up TCG and Appendix C for detailed instructions for the wizard.

		Note: this control is used when the curve is established manually (theoretical). For 'per focal law' TCG, use the wizard.
Generate XLS File	Generates a record of amplitudes for each focal law for each active channel in Excel® format.	This file is located at C:\TD-Logs\ChannelGains
Acquisition Gain (Pulse Echo/Phased Array only)		
Enabled	<i>Acquisition Gain</i> allows the user to define an amount of gain that will be added to the base gain during data acquisition. This feature satisfies the requirement of certain inspection procedures to apply additional sensitivity during acquisition.	This gain should <i>not</i> be confused with transfer correction.
Gain Increase	Additional gain to be applied during data collection.	This additional gain may be permanently removed during analysis by selecting Remove Acquisition Gain in the Process menu.
Auto Gain Reduction (Pocket-Scan only)		
Enabled	<i>Auto Gain Reduction (AGR)</i> is a feature that is available to the first 20 Pulse Echo channels. When enabled the currently displayed channel becomes a <i>Master</i> channel and a <i>Slave</i> channel with the same configuration is automatically created. The channel number of the Slave channel is 1xx, where xx is the channel number of the Master channel. If during data collection, data for the Master channel exceeds 96% FSH, the Slave channel is activated with the specified reduced gain. If the data being collected by the Master is less than 96%, then the slave channel is not activated.	Example: If the <i>Master</i> is channel 1 , then the <i>Slave</i> channel will be 101 .
Gain Reduction	The amount of gain reduction to apply to Slave channels.	Only applicable to Pocket-Scan variants. When enabled, if the amplitude of a signal in the gate exceeds 96% FSH, a slave channel will be enabled automatically (Ch.+100) and the gain will be reduced by the amount defined by the user.

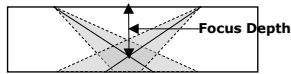
Channel Tab – Probe Category

The probe page allows the user to enter or select transducers and wedges. Depending on which

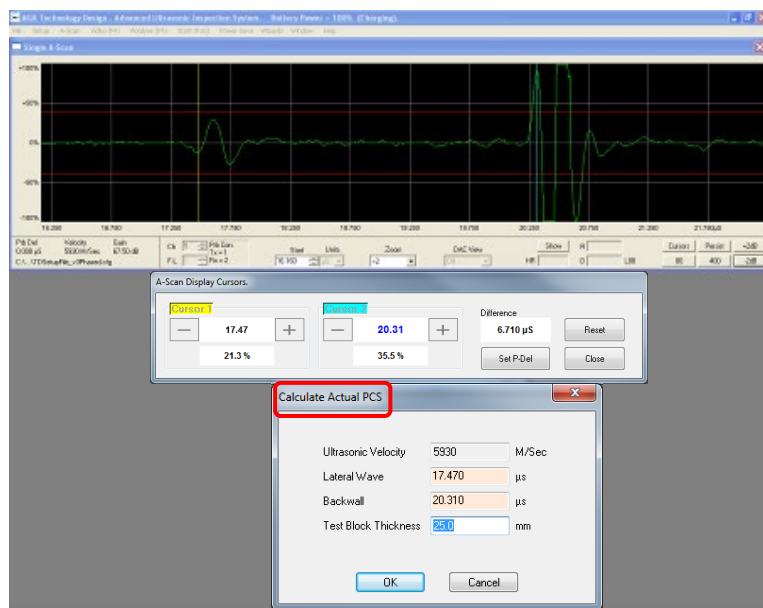
Channel Tab – Probe Category - TOFD



Probe		
Wave Type	This field allows the selection of an ultrasonic wave type. Compression or Shear.	TOFD inspections are normally performed using compression waves.
Ultrasonic Velocity	The programmed velocity for the selected wave type within the material under inspection.	Entered in the Global page.
Probe Angle	The angle at which the ultrasonic energy is imparted into the test material.	Refracted angle.
Delay	The time taken for the ultrasound to travel through the wedge.	This value is normally calculated off-line by the software.
Offset	The distance from a datum on the scanner to the subsequent probes.	The datum is usually taken as the centre of the 1 st wedge. The offset is the measurement from datum to a subsequent wedge. If the subsequent wedge is trailing the datum, then the offset is a negative number.
Separation	The distance between the TX and RX transducers.	Probe Centre Separation (PCS)
Calc Actual Separation	Opens a dialog box that allows the probe separation to be accurately measured. The TOFD transducers must be placed on a calibration block where the material velocity and thickness are known. Then place the cursors over the lateral wave and backwall signals on the A-Scan display. This method of measuring the separation yields more accurate results in the offline measuring utilities.	If this procedure is executed accurately but errors still occur during analysis, then the material velocity is probably incorrect. See 'How to Measure Velocity' in Appendix A for procedure.
Crystal Diameter	Provides a space to enter the probe crystal diameter	Used by the auto-reporting facility and may be left blank
Serial Number	Provides a space to enter the probe serial number	Used by the auto-reporting facility and may be left blank
Scan		
Scan Type	B-Scan (Parallel) / D-Scan (Non-Parallel). This value controls the mathematical formulae used during off-line data analysis.	In relation to a weld, <i>Non-Parallel</i> is when the probes are moved along the length of the weld (direction of sound is at 90° to probe movement) and <i>Parallel</i> is across the

		weld (direction of sound is the same direction as probe movement)
Specimen Depth	The depth (thickness) of the material under test.	
Focus Depth	The required focus depth. This value is used to calculate the required transducer separation.	The depth at which the lines of highest sound pressure (probe angle) cross. 
Calc Required Separation	Determines the optimum probe separation to focus the ultrasonic energy at the specified focus depth. (Values for Focus Depth and Probe Angle are needed for the calculation)	See 'Calc Required Separation' in Appendix A for procedure.

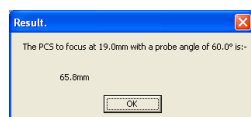
Channel Tab – Probe Category – TOFD – Calculate Actual PCS (Separation)



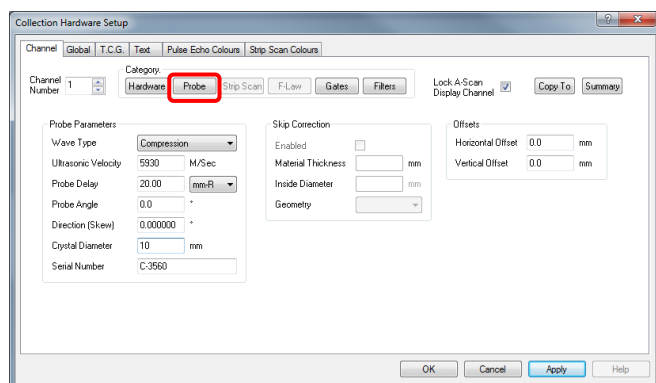
Ultrasonic Velocity	The programmed velocity for the selected wave type within the material under inspection.	Entered in the Global page.
Lateral wave	Move Cursor 1 (yellow) to the a point on the lateral wave signal	The peak (+ or -) of the first deflection is a convenient point
Backwall	Move Cursor 2 (cyan) to the a point on the backwall signal	Use the corresponding opposite phase peak to that chosen for the lateral wave.
Test Block Thickness	The wall thickness of the material through which the sound is travelling.	

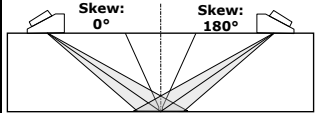
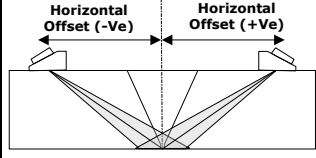
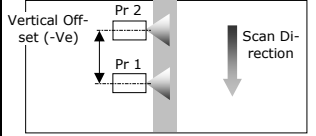
Channel Tab – Probe Category – TOFD – Calculate Required PCS

Tapping the **Calc Required Separation** button displays the **Result** dialogue. The dialogue box displays the Probe Centre Separation (PCS) using the following formula: $2 \times (\text{focus depth} \times \tan\theta)$.

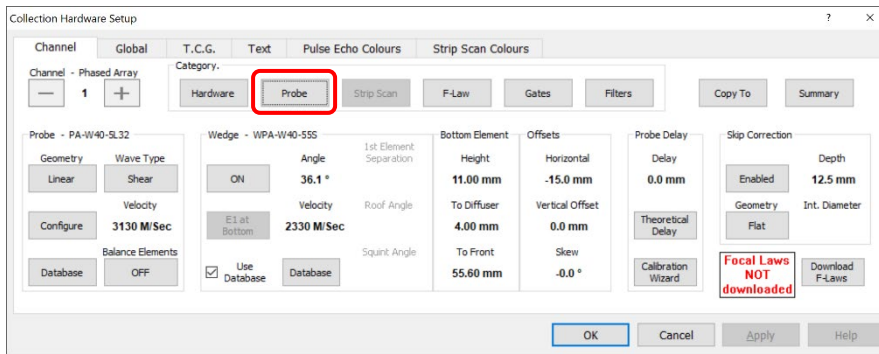


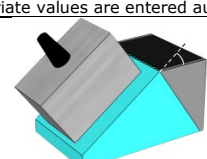
Channel Tab – Probe Category - Pulse Echo

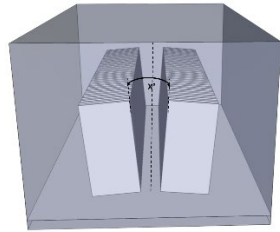
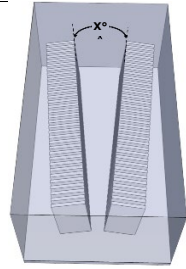


Probe Parameters		
Wave Type	Allows the selection of <i>Shear/Compression</i> probes.	
Ultrasonic Velocity	Ultrasonic velocity of the selected wave type. The ultrasonic velocity is configured in the Global page , and is used to convert time to distance.	
Probe Delay	This value accounts for the time taken for the ultrasound to travel from the crystal to the material surface. The value may be determined by using the calibration procedure. The value may be displayed as: mm-R (Range or beam path) mm-D (True depth) µs (Time in microseconds)	See 'Probe Calibration' in Appendix B for procedure.
Probe Angle	The angle of ultrasonic energy imparted into the material. The data collection software position corrects the peak data taking into account Probe Angle , Direction (Skew) , and skip .	
Direction (Skew)	If the probe angle is non-zero, then the ultrasound has a direction relative a datum. (From a top down view, 0° is on the left & 180° is on the right of the datum)	
Internal Radius	Internal radius of a tubular test item. Corrects the position of peak data when the Rotational tab is selected in the Scanner Setup window.	When the probe is positioned circumferentially on the inside surface of a pipe, the software will provide the correct position of a reflector based on the value provided
Crystal Diameter	Provides a space to enter the probe crystal diameter	For information only and may be left blank
Serial Number	Provides a space to enter the probe serial number	For information only and may be left blank
Skip Correction		
Enable	Enables/Disables skip correction	
Material Thickness	Thickness of the material being inspected.	If Skip Correction is selected in the Global Page , this value is entered automatically & greyed out. If not then the value may be entered by the operator.
Inside Diameter	Internal diameter of a tubular test piece.	Only available when Curved is selected in Geometry .
Geometry	Geometry of the material under inspection. There are two choices: Flat Curved	Curved is only used when Curved Surface Correction is required when the sound direction is circumferential. (See Appendix B)
Offsets		
Horizontal Offset	The horizontal distance from the test piece datum to the TX transducer datum.	Probe datum is the sound emission point. 
Vertical Offset	The vertical distance from the datum on the scanner to the TX transducer from a top down view perspective.	The scanner datum point usually corresponds to the centre axis of the 1 st wedge. 

Channel Tab – Probe Category - Phased Array



Probe		
Geometry	This field shows the selected probe geometry. The choices are: • Linear • 2D_Matrix • Dual Linear Dual Matrix (only on 128 Element systems)	2D-Matrix is limited to 128 element systems.
Configure	This button activates the <i>Array Geometry</i> dialogue box where the array parameters are entered. (See <i>Phased Array-Geometry subcategory below</i>)	See below: <i>Channel Tab – Probe Category - Phased Array – Geometry subcategory</i>
Database	This button activates the <i>Probe Selector</i> dialogue box where the appropriate transducer may be selected from a list.	The user can define new probes or modify existing probes in this dialogue.
Wave Type	The wave type used for this channel. • Shear • Compression If a wedge is being used, then both compression & shear waves are imparted into the material. The focal law generator uses this selection to focus the desired wave type.	NOTE: When using a 0° or no wedge, very little compression wave energy may be imparted into the material at wedge angles greater than 24 degrees. (This angle is a variable dependant on the velocity of compression waves in the wedge and material).
Velocity	Shows the velocity of the selected wave type in the material. This value is entered in the <i>Global</i> page.	Units: <i>Metres Per Second</i> or <i>Inches per micro second</i>
Balance Elements	• Toggle between On and Off On opens the element balancing dialog box.	<i>Element Balancing</i> is useful in determining if there are any malfunctioning or dead elements. Element balancing is a utility that: • Determines the difference in sensitivity for each of the transducer's elements. • Homogenises the array response by adjusting the gain for each element individually. See – 'Element Balancing' in Appendix B for procedure. Warning: Enabling element balancing for scanning has the effect of equalising the response of each working element however, if an element's natural response requires more than +12dB of gain, no additional gain is added to that element. Also, element balancing uses the same sign signal (when un-rectified) for all elements.
Wedge		
ON/OFF	Toggles between On and Off	On enables all wedge controls.
E1 at Bottom/Top	Toggles between Bottom and Top	Select the location of the 1st element of an array on a wedge: (i) at the bottom of the wedge (thin end) or (ii) the top of the wedge (Thick end). Note: most setups will have bottom selected, and most wedge datasheets provide values assuming the 1st element is at bottom. **Beware: The arrays of many transducers are <u>not</u> centred in the transducer housing and parameters should be adjusted accordingly.
Use Database	This button activates the <i>Wedge Selector</i> dialogue box where the appropriate wedge may be selected from a list or entered manually.	• The user can define new wedges or modify existing wedges in this dialogue. • When a wedge is selected from the list, all parameters are entered automatically. • If a setup is imported from <i>ESBeamTool</i>, the appropriate values are entered automatically.
Angle	The angle of the wedge/probe contact surface in relation to the diffraction face of the wedge	
Velocity	The compression wave velocity within the wedge material.	The longitudinal wave velocity of ultrasound in Rexolite® is approximately 2330m/second.

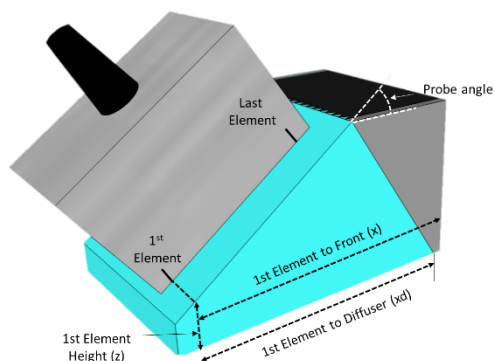
Database	Click to open the <i>Wedge Selector</i> dialogue box	Wedges may be selected or modified. Additional wedges may be entered as required.
1st Element Separation	Enter the separation between dual arrays at the 1 st element position	
Roof Angle	Enter the vertical set angle between dual arrays	
Squint	Enter the horizontal set angle between dual arrays	

Wedge Selector Database

Wedge ID	Manufacturer	Probe	Z(mm)	Velocity(M/s)	Angle	Type	X(mm)	Xd(mm)	Y(mm)	L(mm)	W(mm)	H(mm)	Shape	Dia. (mm)	Geo Type	Roof	Squint	Yc(mm)	Tz/At/Right	RxTxSame	Mapping
WPA-W70-0L-IMW	PHOENIX	PA-W70-SL64	8.20	2330	0.00	IHC	76.50	74.50	20.00	82.00	40.00	47.50	FLAT	0.00	SLA	0.00	0.00	0.00	NO	NO	TYPE1
WPA-W40-5SS	PHOENIX	PA-W40-SL32	11.00	2330	36.10	Plan	55.60	53.60	20.00	62.00	40.00	33.50	FLAT	0.00	SLA	0.00	0.00	0.00	NO	NO	TYPE1
WPA-W20-5SS-IMW	PHOENIX	W20	7.00	2330	36.10	IHC	20.30	20.00	20.00	25.00	40.00	15.50	FLAT	0.00	SLA	0.00	0.00	0.00	NO	NO	TYPE1
PA-WBRA-60S	PHOENIX	PA-WBRA-7.7L16	4.80	2330	38.50	IHC	16.40	16.40	0.00	30.00	30.00	13.00	ADD	60.30	SLA	0.00	0.00	0.00	NO	NO	TYPE1
SPWZ3-H5SS	OLYMPUS	SL32-PZW3	14.30	2330	36.00	IHC	60.40	57.40	20.00	66.50	40.00	0.00	FLAT	0.00	SLA	0.00	0.00	0.00	NO	NO	TYPE1
SPWZ3-H5SS	OLYMPUS	SL32-PZW3	14.30	2330	36.00	IHC	60.40	57.40	20.00	66.50	40.00	0.00	FLAT	0.00	SLA	0.00	0.00	0.00	NO	NO	TYPE1
SNW1-0L	OLYMPUS	NW1	20.00	2330	0.00	IHC	64.50	64.50	18.30	66.00	36.50	22.00	FLAT	0.00	SLA	0.00	0.00	0.00	NO	NO	TYPE1

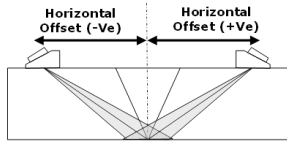
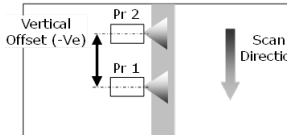
Wedge Selector		
Show Popular/Show All	Show Popular: only the last six wedges selected are displayed. Show All: all wedges in the database are displayed.	

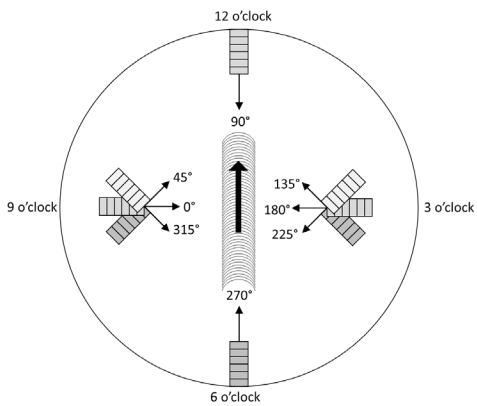
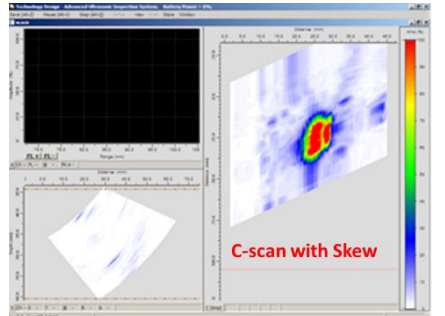
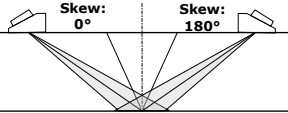
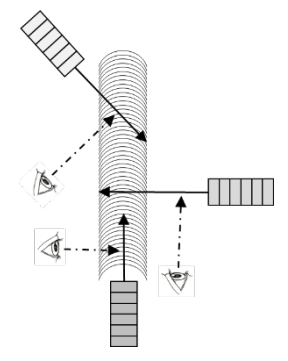
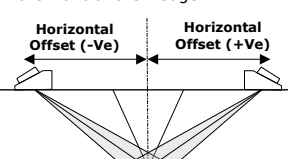
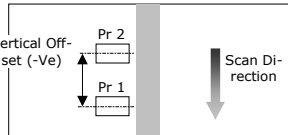
Wedge Parameter Guide Sketch



Wedge Parameters		
Enabled	Enables/Disables the wedge options.	When the <i>Enabled</i> button is enabled.
Bottom Element		
Height	The height of the lowest element in relation to the diffraction surface	This is usually element 1 but could be the last element.
To Diffuser	The distance of the lowest element to the diffuser	Not the front of the wedge.

		The focal law generator checks that the upper beam does not intersect the wedge's diffusion face. A warning is given if an intersection occurs.
To Front	The distance of the lowest element to the front of the wedge	All projection measurements are made from the front of the wedge. The focal law generator takes the distance between the diffuser and front of wedge into account.

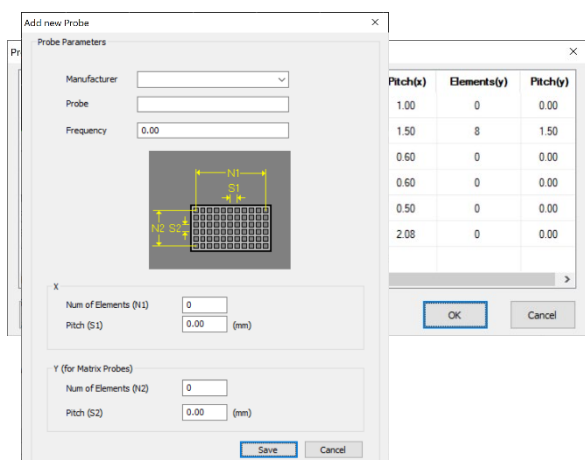
Offsets		
Horizontal	The distance from the test piece datum to the wedge front.	
Vertical	The distance separate probes.	
Probe Delay	Accounts for the time taken for ultrasound to travel from the crystal to the material surface. The value may be determined by using the calibration procedure. For the phased array system this also accounts for extra delays generated by the Tx & Rx delay values in the focal law.	See 'Probe Calibration' in Appendix B for procedure. NOTE: THE PROBE DELAY MUST BE VERIFIED AFTER MODIFICATION OF ANY VALUE THAT AFFECTS THE FOCAL LAWS.
µs / mm-R	Displays probe delay value as either time (microseconds) or distance (millimetres).	mm-R : millimetres Range (Beam-path)
Calibration Wizard	Starts the phased array wizard at the <i>calibration/TCG</i> section and by-passes the <i>equipment setup</i> section of the wizard.	See – 'Wizard instructions' in Appendix C for a detailed procedure.
Theoretical Delay	Activates automatic calculation of probe delay.	No physical action is required. The delay is calculated and entered into the <i>Probe Delay</i> text box automatically. <i>Note:</i> A valid setup must be defined to use this control sensibly.

Direction (Skew)	Angular position of probe in relation to probe movement. • 0° = 9 o'clock if 12 o'clock is in the primary direction of movement. • 180° = 3 o'clock if 12 o'clock is in the primary direction of movement  	 - Any compass point may be used. The B & S scan imaging view is perpendicular to the sound beam.  - The C-scan image for a scan with a designated skew will be displayed with the actual skew in relation to the weld centre.
Show	This option displays a diagram that illustrates the skew angles.	
Skip Correction:		
Enable	Enables/Disables skip correction.	
Material Thickness	The thickness of the material being inspected.	Skip Correction is the process of ensuring correct depth measurement in the B and S scan mirror images. See Appendix B for a detailed explanation. If <i>Skip Correction</i> is selected in the <i>Global Page</i>, this value is entered automatically & greyed out. If not then the value may be entered by the operator.
Inside Diameter	Enter the inside diameter of a tube	
Geometry	The geometry of the material under inspection.	Currently only Flat is available.
Offsets		
Horizontal Offset	The horizontal distance from the test piece datum to the probe datum.	
		- Without a wedge the <i>Probe</i> datum is the element at the lowest point on the wedge (either 1st or Last). - With a wedge the <i>Probe</i> datum is the front of the wedge. 
Vertical Offset	The vertical distance from the datum on the scanner to the TX probe from a top down view perspective.	
		The <i>scanner</i> datum point usually corresponds to the centre axis of the 1st wedge. 
Download Focal Laws (F9)	Forces the software to re-calculate the focal law(s) for all phased array channels and send them to the remote unit (UT circuitry).	Note: focal law changes will not be displayed in the A-scan until this, or the OK button is Taped. Apply will NOT execute the focal laws.

Channel Tab – Probe Category - Phased Array – Probe selection

Probe list	Details of probes stored in the probe database. This list is editable, and the user can modify or delete existing probes or enter new probes.	Select and Tap OK or Double Tap to select a probe. By default, only the last 6 probes selected are displayed.
Show all available probes	Causes the entire probe database to be displayed.	Initially only the last 6 probes selected are displayed.
Add...	Opens the Add New Probe dialogue.	Users can add any phased array probe. Probe details required are available from the manufacturers' probe data sheets.
Edit...	Opens the Edit Existing Probe dialogue.	

Channel Tab – Probe Category - Phased Array – Probe selection – Add new Probe

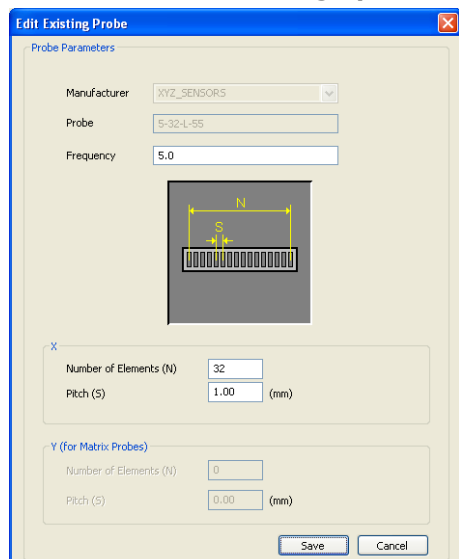


The 'Add new Probe' dialog box contains the following fields and sections:

- Probe Parameters:**
 - Manufacturer: Dropdown menu
 - Probe: Text input field
 - Frequency: Text input field (0.00)
- Diagram:** A schematic of a probe array with dimensions N1, N2, S1, and S2.
- X:**
 - Num of Elements (N1): Text input field (0)
 - Pitch (S1): Text input field (0.00) (mm)
- Y (for Matrix Probes):**
 - Num of Elements (N2): Text input field (0)
 - Pitch (S2): Text input field (0.00) (mm)
- Buttons:** OK, Cancel, Save, Cancel

Manufacturer	Allows users to enter a name or displays a dropdown list of existing names.	
Probe	Allows users to enter a name – usually the manufacturer's product descriptor.	
Frequency	Allows users to enter the probe frequency.	
X		
Number of Elements (N)	Enter the number of elements in a <i>linear array</i> or the number of elements in the X axis if a <i>matrix array</i> .	
Pitch (S)	Enter the distance between the element centres.	
Y (for Matrix Probes)		
Number of Elements (N)	Enter the number of elements in the Y axis array.	
Pitch (S)	Enter the distance between the element centres.	

Channel Tab – Probe Category - Phased Array – Probe selection – Edit Probe

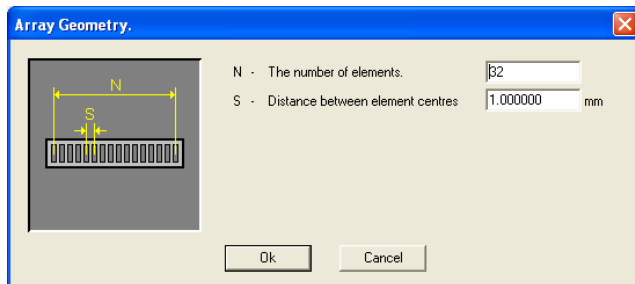


The 'Edit Existing Probe' dialog box contains the following fields and sections:

- Probe Parameters:**
 - Manufacturer: Dropdown menu (XYZ_SENSORS)
 - Probe: Text input field (S-32-L-SS)
 - Frequency: Text input field (5.0)
- Diagram:** A schematic of a probe array with dimensions N, S, and S.
- X:**
 - Number of Elements (N): Text input field (32)
 - Pitch (S): Text input field (1.00) (mm)
- Y (for Matrix Probes):**
 - Number of Elements (N): Text input field (0)
 - Pitch (S): Text input field (0.00) (mm)
- Buttons:** Save, Cancel

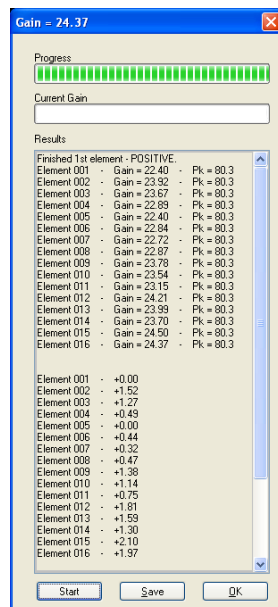
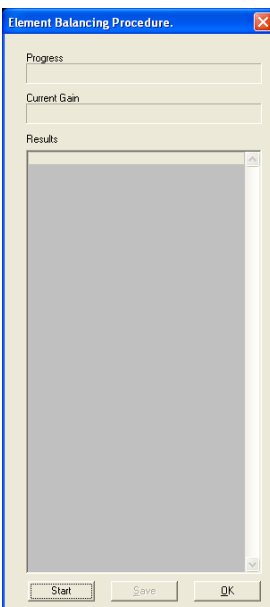
Manufacturer	Displays the selected probe's manufacturer.	
Probe	Displays the probe descriptor.	
Frequency	Allows users to change the probe frequency.	
X		
Number of Elements (N)	Allows users to change the number of elements in the array.	
Pitch (S)	Allows users to change the distance between element centres.	
Y (for Matrix Probes)		
Number of Elements (N)	Not currently used	
Pitch (S)	Not currently used	

Channel Tab – Probe Category - Phased Array – Geometry



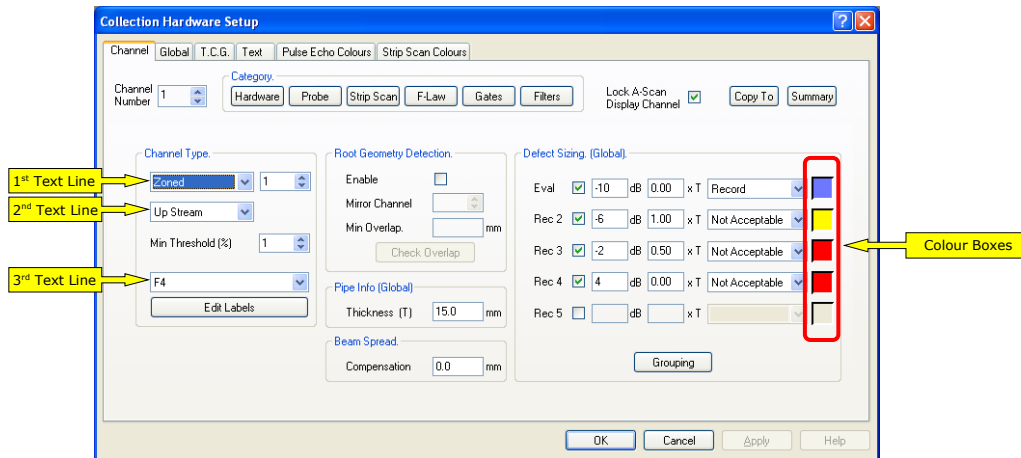
N - The number of elements	The number of elements in the array.	NOTE: only the connected elements.
S - Distance between element centres	The distance between element centres.	
Ok	Queues any changes for execution by the focal law generator and closes the dialogue box.	
Cancel	Discards any changes and closes the dialogue box.	

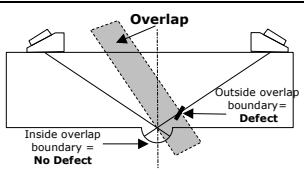
Channel Tab – Probe Category - Phased Array – Balance Elements



Start	Starts the <i>Element Balancing</i> procedure.	See – ' <i>Element Balancing</i> ' in Appendix A for procedure.
Save	Saves the <i>Element Balancing</i> data to a delimited text file	The data can be converted into a spreadsheet or other format and used to generate a graphical record of probe performance.
OK	Closes the <i>Element Balancing Procedure</i> dialogue box	

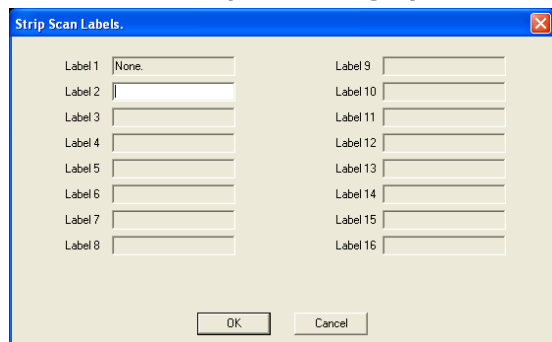
Channel Tab – Strip Scan Category



Strip Scan:		PHASED ARRAY & PULSE ECHO ONLY. - Activated by selecting the <i>Strip Scan</i> tab in <i>Scanner Setup</i>.
Channel Type		
1st Text Line (Type)	Selects what the channel is used for: Zoned Volumetric Couplant Check	
(Zone)	Only applicable when the channel type is <i>zoned</i> . Each channel can only have one associated zone	Each zone could however have multiple associated channels
2nd Text Line (Stream)	Selects the location of data relative to the weld and product flow Up Stream Down Stream	Stream = Product flow
Min Threshold (%)	Amplitude threshold that triggers automatic evaluation.	
3rd Text Line (Label)	Each zoned channel may have a user defined label that describes which part of the weld the channel is looking at. E.g. "Cap", "Root", etc.	When a setup is imported from <i>ESBeamTool Zonal</i> the zone labels will be allocated by automatically.
Edit Labels	Allows the operator to edit the table of label text.	
Root Geometry Detection		
Enable	Enables/Disables root geometry detection.	Root geometry detection is effected by following the operator defined Minimum Overlap rule.
Mirror Channel	Specifies an identical channel that is aimed at the same zone from the opposite direction.	
Min Overlap	The distance by which the beam centre crosses the weld centre. Any signal that appears before or after the entered value is regarded as a defect	
Check Overlap	This button activates the <i>Root Geometry Overlap Check</i> dialogue box. (See <i>Root Geometry Overlap Check</i> subcategory below)	
Pipe Info (Global)		
Thickness (T)	Material wall thickness. May be automatically entered by the system or manually entered by the user.	If a <i>Skip Correction</i> value is entered in the <i>Global</i> tab, then this value is automatically displayed & the text box greyed. If not then the value may be entered manually. The manually entered value affects all channels.
Beam Spread		
Compensation	Specifies the beam spread value	
Defect Sizing (Global)		
Eval	Enables an automatic data recording threshold to be established, expressed as: <i>Indication lengths relative to wall thickness then signal attenuation relative to an amplitude reference level.</i>	
REC x (x = 2 to 5)	Enables automatic data evaluation thresholds to be established expressed as: <i>Indication lengths relative to wall thickness then signal attenuation relative to an amplitude reference level.</i> The result of the evaluation may be designated Record or Not Acceptable .	This table facilitates the defining of a recording and acceptance hierarchy according to a Code Acceptance Criteria. e.g. EN 17:12 or other ECA
Grouping	This button activates the <i>Strip-Scan Indication Grouping</i> dialogue box. (See <i>Strip-Scan Indication Grouping</i> subcategory below)	

Colour Boxes	Allows colours to be defined corresponding to the recording levels.	The colours will be displayed as a filled area within the <i>Time-of-Flight (TOF)</i> trace in each <i>time and amplitude</i> strip. This enables instant visual evaluation according to the acceptance criteria. See Adjusting Colours & Depth-a-ii in Appendix A for instructions.
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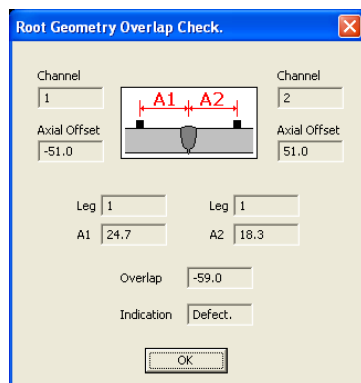
Channel Tab – Strip Scan Category – Edit Labels



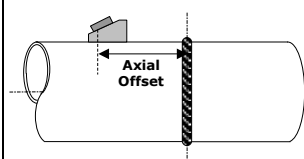
The dialog box titled "Strip Scan Labels" contains two columns of input fields for labels 1 through 16. Label 1 is set to "None". At the bottom are "OK" and "Cancel" buttons.

Label x	Enter the desired zone label	X = 2 to 16
OK	Stores the labels for use in the zone setup	Tap the 3 rd text line in the Strip Scan page to view labels.
Cancel	Cancels the operation & closes the dialogue.	

Channel Tab – Strip Scan Category – Root Geometry Overlap Check

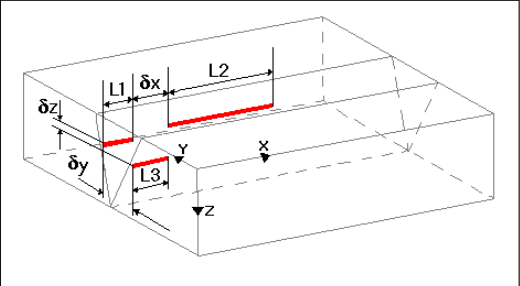


The dialog box titled "Root Geometry Overlap Check" shows settings for two channels. Channel 1 has an axial offset of -51.0 and Channel 2 has 51.0. A diagram shows two probe beams A1 and A2 with an overlap of -59.0. The indication is set to "Defect".

Channel	The channel and its mirror that are being checked.	
Axial Offset	The distance from the test piece datum to the TX probe datum.	Pulse echo probe datum = the sound emission point Phased Array probe datum = the element at the lowest point on the wedge (either 1st or Last). 
Leg	Displays the reflected skip in which the signal is located	
A1, A2	Displays the range to the signal for each probe	
Overlap	Displays the distance of the amount by which the two opposite beams overlap.	
Indication	Displays either Defect or Root based on the overlap criteria.	

Channel Tab – Strip Scan Category – Strip-Scan Indication Grouping

Strip-Scan Indication Grouping.



OK
Cancel

Enable X Grouping ☒ (Same Zone & Stream).
Enable Z Grouping ☒ (Adjacent Zones, Same Stream).

Min Separation.
dx: 200.0 % Lmax
dr (ToF) 5.0 mm

Cumulative length.
Enable ☒
For any length of weld equal to x T_r, the maximum cumulative length of all individually acceptable indications above the recording level, shall not exceed % of this length, for level dB.

Min Separation.
dx: 200.0 mm
dr (ToF) 5.0 mm

Enable X Grouping	Enables defect grouping in length, evaluated within the same weld zone and on the same side of the weld.	
Enable Z Grouping	Enables defect grouping in length, evaluated in adjacent weld zones and on the same side of the weld.	
Min Separation		
Dx	Evaluates grouping criteria based on defect proximity using: • Dynamic • Absolute	Dynamic: Distance between adjacent defects based on a % of the length of the defects (% Lmax). Absolute: Distance between adjacent defects based on a fixed length (mm).
Dr (ToF)	Evaluates grouping criteria based on defect proximity using beam path distance.	
Cumulative Length		
Enable	Enables/Disables cumulative length evaluation.	The acceptance criteria are entered into the three text boxes based on the <i>amplitude and length</i> of defect in a given length of <i>weld</i> .

Channel Tab – Focal Law Category (F-Law)

Collection Hardware Setup

Channel: Global T.C.G. Text Pulse Echo Colours Strip Scan Colours

Category: Hardware Probe Strip Scan F-Law Gates Filters Copy To Summary

Tx Control: First Active Number of Active Element 1 connection

Rx Control: First Active Number of Active Element 1 connection

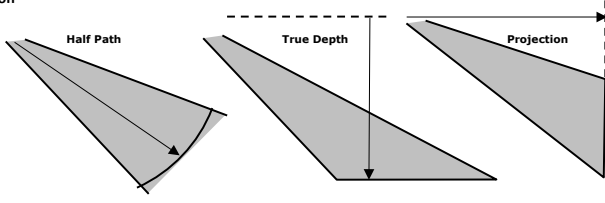
Focal Law Control: Beamset Sectional Min. Angle Max. Angle Angle Step Stride Skew Angle

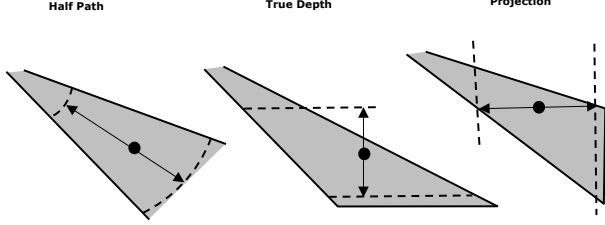
Focus Control: Focus Mode Half Path Tx Focal Range (mm) Rx Focal Range (mm) Dynamic Focusing Disabled

F-Law Balancing Disabled
Download F-Laws

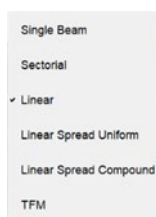
OK Cancel Apply Help

Tx Control		
First Active	The first active <i>Transmit</i> element in the array.	
Number of Active	The number of elements used for transmitting.	
Element 1 connection	Where element 1 of the Tx transducer connects to the system.	This value is either 1(for connector#1) or 65 (for connector #2) • When the same probe is used for Tx & Rx, the value is the same in the Rx Control. • When separate Tx & Rx probes are used then the values will be different (1 & 65)
RX Control		
First Active	The first active <i>Receive</i> element in the array.	
Number of Active	The number of elements used for receiving.	
Element 1 connection		This value is either 1(for connector#1) or 65 (for connector #2) • When the same probe is used for Tx & Rx, the value is the same in the TX and Rx Controls. When separate Tx & Rx probes are used then the values will be different (1 & 65)

Focal Law Control		
Beamset	Choose a beamset from the drop-down list: • Single Beam A single beam at a user-defined angle will be generated. • Sectorial A beamset consisting of multiple beams at different angles is generated from the same aperture. • Linear A beamset consisting of multiple beams at the same angle is generated from the different apertures moving progressively along the array. • Linear Spread Uniform The aperture is stepped progressively along the array. One beam is generated from each step of the aperture. - The first beam and the last beam are always the user defined lowest and highest angles. The more steps, the more angles between user defined lowest and highest. • Linear Spread Compound The aperture is stepped progressively along the array. The number of always remains static across the entire array (e.g., 40°-50° will have 11 beams if the angle step is 1; i.e., 1 angle per step). Regardless of the number of user-defined aperture steps, the number of beams remains the same and are divided among the steps. There may be more, or less than one beam per step however the total number of beams remains the same. • TFM Enables Full Matrix Capture mode and software controls to define TFM parameters and display live TFM data.	Choosing a beamset will display different text boxes and labels appropriate to the parameters of each selection. (See Beamsets section below for more detail) Total Focus Method (TFM) is the synthetic focussing of phased array beams within each pixel of a defined diagnostic grid in an inspected part.
Focus Control		
Focus Mode	Changes the way focus is calculated. Clicking the button changes the <i>focus Mode</i>. The focus mode only affects channels that have multiple focal laws, i.e., Linear and all Sectorial beamset variations. The focal law generator supports 3 different focus modes: • Half Path • True Depth • Projection 	Depending on the focus mode selected the focal value fields in the Tx & Rx dialogue areas will change to <i>Focal Range (mm)</i>, <i>Focal Depth (mm)</i> or <i>offset to Vertical (mm)</i> If focus is not required, then set the <i>Focal Range/Depth/Offset</i> fields to a value in the <i>Far Field</i>. The illustrations on the left show the plane of measurement at the focal point/s of each focal law. <i>Half Path</i> is measured from the centre of each beam where it refracts into the test material at the refracted angle; <i>True Depth</i> is measured from the surface of the test piece and <i>Projection</i> is measured from the front of the wedge. To determine the approximate end of the Near Field use the simplified formula $N = \frac{A^2}{4 \times \lambda}$ Where: A = aperture length $\lambda = \frac{\text{Material velocity}}{\text{Probe frequency}}$

Dynamic Focusing	Enables or disables dynamic focusing. 	Using <i>Dynamic Depth Focus (DDF)</i> effectively extends a point of focus to a focal zone. When enabled, entry of min/max focus points is required. The focal law generator creates Rx delay laws that enable the system's hardware to dynamically change the delay laws for each element sample-by-sample in real time. Note: Focusing (including DDF) is only possible in the <i>Near Field</i> of an ultrasonic beam. To determine the approximate end of the Near Field, use the simplified formula $N = \frac{A^2}{4 \times \lambda}$ Where: A = aperture length $\lambda = \frac{\text{Material velocity}}{\text{Probe frequency}}$
F-Law Balancing ENABLED/DISABLED	Opens the Focal Law Balance dialogue. The status of the procedure is displayed on the button.	This is an alternative procedure to ensure amplitude correction (balancing) across focal laws for a given reflector. Primarily, <i>Angle Corrected Gain</i> is executed as part of the TCG procedure in the phased array wizard.
Download F-Laws	Executes changes made to setup parameters that effect focal laws.	Multiple changes may be made before executing the changes in the system hardware. Using the <i>Download F-Laws</i> button has the same effect as using the OK button without closing the window.

Channel Tab – Focal Law Category - Beamsets



Beamset drop-down list

Selecting a beamset from the *Beamsets* drop-down menu will result in appropriate options being displayed in the *Focal Law Control* area.

Focal Law Control

Beamset: Single Beam

Tx Angle: 0.0

Angle Step: 1.0

Rx Angle: 0.0

Stride: 1

Skew Angle: 0.0

Single Beam selected

Focal Law Control

Beamset: Sectorial

Min. Angle: 40.0

Angle Step: 1.0

Max. Angle: 65.0

Stride: 1

Skew Angle: 0.0

Sectorial Beamset selected

Focal Law Control

Beamset: Linear

Tx Angle: 0.0

Index Points: 2

Rx Angle: 0.0

Stride: 1

Skew Angle: 0.0

Sectorial Beamset selected

Focal Law Control

Beamset: Linear Spread Uniform

Min. Angle: 40.0

Index Points: 2

Max. Angle: 65.0

Stride: 1

Skew Angle: 0.0

Linear Spread Uniform

Focal Law Control

Beamset: Linear Spread Compound

Min. Angle: 40.0

Angle Step: 1.0

Max. Angle: 65.0

End Element: 64

Beams: 25

Linear Spread Compound

Focal Law Control

Beamset: TFM

Capture Mode: Full Matrix

Tx Index Points: 64

Rx Index Points: 64

Stride: 1

Rx Stride: 1

TFM

Focal Law Controls		
Angle Step	Enter an angular step in degrees	Sectorial and Linear Spread Compound beamsets
Stride	Enter the number of elements to skip between index movements	Linear and TFM (changeable in Custom capture mode only) beamsets
Index Points	Enter the number of steps the aperture will make	Linear and Linear Spread Uniform beamsets
Capture mode	Toggles between Full Matrix, Half Matrix and Custom	Full Matrix – Pulses on all elements individually in sequence. Receives on all elements simultaneously. Half Matrix – Pulses on every second element individually in sequence. Receives on all elements simultaneously. Custom – User enters the number of sequential elements to pulse and the number of elements to receive simultaneously.
TX Index Points	Enter the number of elements to pulse individually in sequence	Only available in Custom TFM capture mode.
RX Index Points	Enter the number of elements to receive on simultaneously	Only available in Custom TFM capture mode.
Tx Angle	Enter the Transmit angle	Single and Linear beamsets.
Rx Angle	Enter the Receive angle	Single and Linear beamsets.
Min. Angle	Enter the minimum beamset angle	Sectorial, Linear Spread Uniform and Linear Spread Compound beamsets
Max. Angle	Enter the maximum beamset angle	Sectorial, Linear Spread Uniform and Linear Spread Compound beamsets
End Element	Enter the last element for the beamset	Linear Spread Compound beamset

Channel Tab – Focal Law Category – Beamsets – TFM

Detailed information is contained in the document **User Guide -FMC-TFM**.

Collection Hardware Setup

Channel: Global T.C.G. Text Pulse Echo Colours Strip Scan Colours

Channel: Phased Array

Category: Hardware Probe Strip Scan F-Law Gates Filters

Copy To Summary

Tx Control: First Active 1 Number of Active 1 Element 1 connection 1

Rx Control: First Active 1 Number of Active 1 Element 1 connection 1

Focal Law Control: Beamset TFM Capture Mode Full Matrix

Tx Index Points: 64 Rx Index Points: 64

Stride: 1 Rx Stride: 1

Inspect Area (mm): Top 0.0 Left 0.0 Width 40.0 Height 40.0

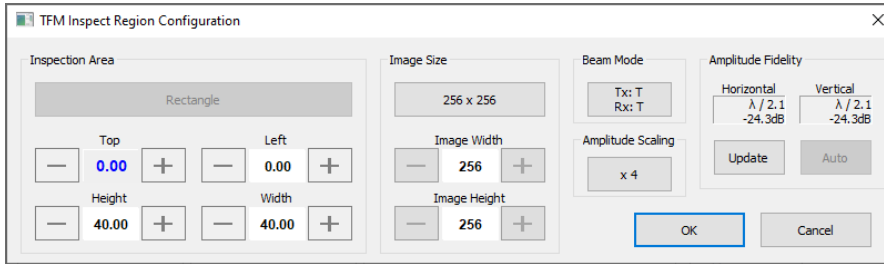
Amplitude Fidelity: Horizontal $\lambda / 2.1$ -24.3dB Vertical $\lambda / 2.1$ -24.3dB

Image Control: Width 256 Height 256 Mask Off

Edit Imaging Parameters Download F-Laws

OK Cancel Apply Help

Collection Hardware Setup (with TFM Beamset selected)		
Capture Mode	Toggles between Full Matrix, Half Matrix and Custom	Full Matrix – Pulses on all elements individually in sequence. Receives on all elements simultaneously. Half Matrix – Pulses on every second element individually in sequence. Receives on all elements simultaneously. Custom – User enters the number of sequential elements to pulse and the number of elements to receive simultaneously.
Inspect Area (mm)	Dimensions of the Area of Interest (ROI) is displayed in this information block.	Top – Zero is located at the scan surface. Left – Zero is located at the position of the 1 st element
Image Control	1. Pixel count for the Width and Height of the ROI is displayed in this information block. 2. Mask – Displays the On/Off status of the mask	Raw TFM data is unrectified and displays both negative and positive peaks, Mask converts the RF signal to a rectified signal by using the Hilbert Transform.
Amplitude Fidelity	Grid coarseness (λ/x) and resultant Amplitude Fidelity in dB are displayed in this information block	Amplitude Fidelity is the criterion used to ensure peak amplitude in each pixel of the grid is preserved within a certain tolerance across all grid pixels.
Beam Mode	Wave mode (Longitudinal or Transverse wave) for each transmit and receive leg are displayed in this information block.	Examples: L-L, T-T, TT-TT, TT-LL
Edit Imaging Parameters	Opens the TFM Inspect Region Configuration window	All TFM parameters are selected here
Download F-Laws	Executes changes made to setup parameters that effect focal laws.	To execute TFM parameter changes, use this button.



The dialog box is titled "TFM Inspection Region Configuration". It contains four main sections: "Inspection Area" with a "Rectangle" button and input fields for Top (0.00), Left (0.00), Height (40.00), and Width (40.00); "Image Size" with a "256 x 256" button and input fields for Image Width (256) and Image Height (256); "Beam Mode" with buttons for Tx: T, Rx: T, and Amplitude Scaling (x 4); and "Amplitude Fidelity" with buttons for Horizontal (λ / 2.1, -24.3dB) and Vertical (λ / 2.1, -24.3dB), and buttons for Update and Auto. There are OK and Cancel buttons at the bottom right.

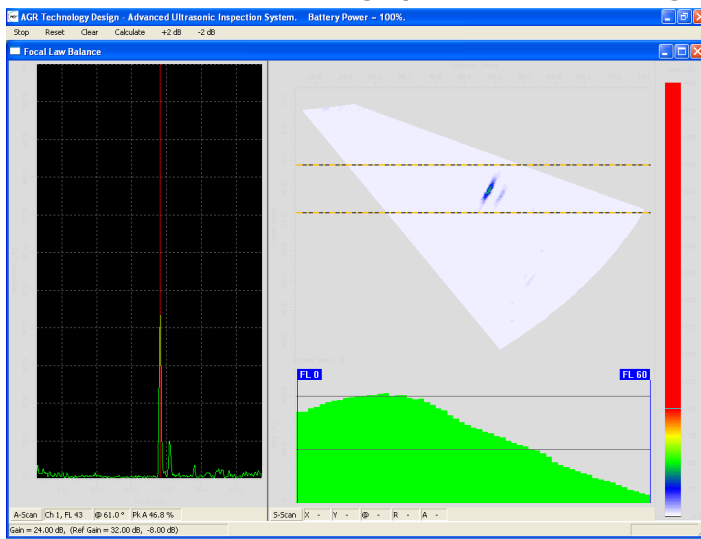
TFM Inspection Region Configuration		
Inspection Area		
Rectangle	Currently not in use.	
Top	Enter the depth at the Top of the Region of Interest (ROI)	- The default value is 0. Zero (0) is located at the test surface. - If the +/- buttons in the window are used, the Height value is increased or decreased in the opposite direction by 1 each time the button is pressed. If the value is typed, then the Height value remains the same.
Height	Enter the distance from top to bottom of ROI	If the +/- buttons in the window are used, the Top value is increased or decreased in the opposite direction by 1 each time the button is pressed. If the value is typed, then the Top value remains the same.
Left	Enter the location where the Left side of the ROI starts within the volume of the test material.	- The default value is 0. Zero (0) is located under the 1st element. - If the +/- buttons in the window are used, the Width value is increased or decreased in the opposite direction by 1 each time the button is pressed. If the value is typed, then the Width value remains the same.
Width	Enter the distance from left to right of ROI	If the +/- buttons in the window are used, the Left value is increased or decreased in the opposite direction by 1 each time the button is pressed. If the value is typed, then the Left value remains the same.
Image Size		
Button (pixel density)	Toggles between 128x128, 256x256, 512x512 and Custom	- Selects the number of pixels in the ROI grid. Custom allows the user to type precise values which aids accurate determination of Amplitude Fidelity.
Image Width	Displays number of pixels in the X direction across the ROI	When Custom is selected, these values are entered by the user.
Image Height	Displays number of pixels in the Y direction across the ROI	When Custom is selected, these values are entered by the user.
Beam Mode		
Tx: y / Rx: x	Opens the FMC Beam Mode Control window.	Longitudinal (L) and Transverse (T) beam modes for TX & Rx legs may be selected
Amplitude Scaling	Toggles between scaling values of x1, x2, and x4	The software uses softgain to scale the base gain by the factor chosen. This allows use of lower gain to achieve the same amplitude.
Amplitude Fidelity		
Horizontal	Grid coarseness (λ/x) and resultant Amplitude Fidelity in dB are displayed in this information block	Amplitude Fidelity is the criterion used to ensure peak amplitude in each pixel of the grid is preserved within a certain tolerance across all grid pixels.
Vertical	Grid coarseness (λ/x) and resultant Amplitude Fidelity in dB are displayed in this information block	Amplitude Fidelity is the criterion used to ensure peak amplitude in each pixel of the grid is preserved within a certain tolerance across all grid pixels.
Update	Forces amplitude fidelity calculation and updates the information blocks	
Auto	Not currently in use	



The dialog box is titled "FMC Beam Mode Control". It has a "Preview" section at the top. Below it, there are two columns: "Tx" and "Rx". Each column has a "No. of Legs" input field (set to 1) and a "Leg x" input field (set to L). There are buttons for "-" and "+" next to the "No. of Legs" field. At the bottom, there are OK and Cancel buttons.

FMC Beam Mode Control		
Preview	Not currently in use	
Tx and Rx		
No. of Legs	Select the number of legs to process from the + 7- buttons	Up to 6 legs may be processed.
Leg x	Toggle between L and T	Choose Longitudinal or Transverse wave modes

Channel Tab – Focal Law Category - Focal Law Balancing



Stop	Stops the <i>Focal Law Balance</i> procedure and closes the window	If a gain correction was calculated, Tapping <i>Stop</i> will activate the correction. To remove the correction, Tap <i>Reset</i> and then <i>Stop</i> .
Reset	Clears the <i>echo dynamic</i> & <i>scan</i> images and resets the gain values	
Clear	Clears the <i>echo dynamic</i> image	
Calculate	Causes the software to calculate and store the adjusted gain values. Once <i>calculation</i> is complete, a <i>gain correction curve</i> is displayed on the echo dynamic image and the corrected gain is displayed in the scan image.	
+2dB	Allows gain to be increased in 2dB steps	
-2dB	Allows gain to be decreased in 2dB steps	

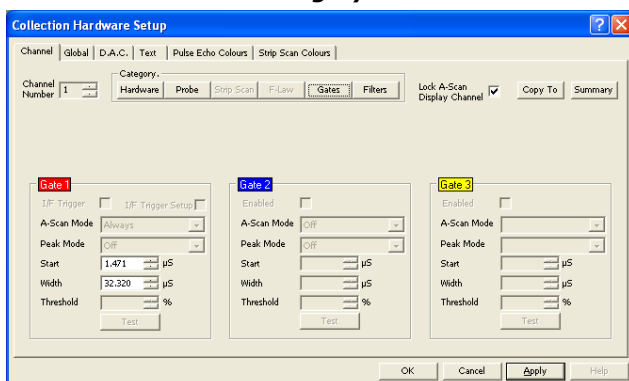
Channel Tab – Gates Category

In TDScan the term 'gate' refers to a defined data acquisition area on the time base. A secondary function of the gate applied when acquiring thickness data, e.g., corrosion mapping is the amplitude above which data will be acquired.

The **Gates** page is used to define the behaviour of the gate or gates.

When acquiring data in **Superview** mode, only the position of the gate on the time base has any relevance: all a-scans within the gate range are saved. Data display parameters may be adjusted in analysis mode.

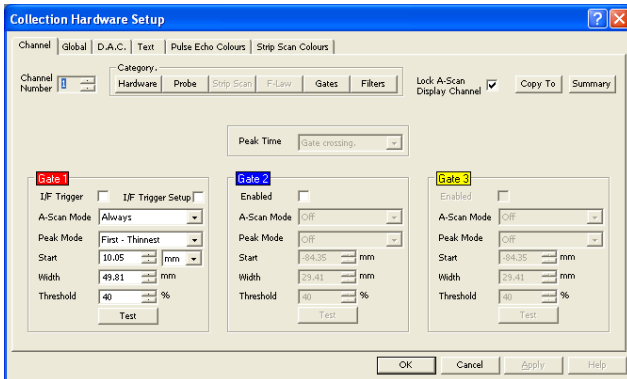
Channel Tab – Gates Category – TOFD



TOFD channels only have 1 data collection gate, and are drawn in RED on the A-Scan display.

Start	This is the start of the data collection data	Measured in microseconds(μ s)
Width	This is the width of the data collection gate	Measured in microseconds(μ s)

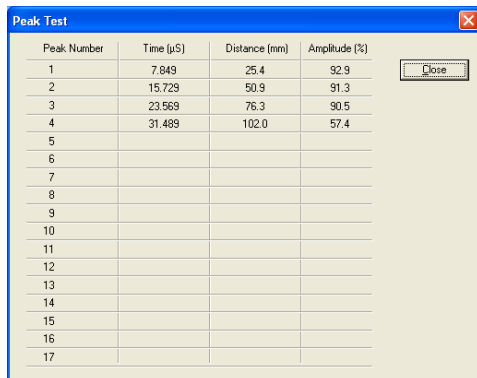
Channel Tab – Gates Category - Pulse Echo



Enabled	The enabled check boxes have the same functionality in each gate; it enables/disables the given gate. The gates run sequentially, therefore, if gate 2 is disabled, gate 3 is also disabled.																			
I/F Trigger (Gate 1 only)	This places gate 1 into interface trigger mode. Under normal operation (not I/F trigger), all timing is referenced from transducer excitation. However, in I/F trigger mode all time is referenced from the first signal that rises above the detection threshold of gate 1. This affects the timing of gates 2 & 3, plus the start of the DAC curve. I/F trigger is used for immersion system only.																			
I/F Trigger Setup	When selected, the couplant velocity is used to convert time to distance. The couplant velocity is entered in the Global page.	Note: There must be a clear separation between the trigger signal and subsequent signals for accurate measurement to be possible. Therefore paint thickness measurement and similar thin coating monitoring may not be possible. See 'I/F Trigger Setup' in Appendix B for procedure. Useful for emersion testing: - When the A-scan window is used to measure the distance to the interface signal through the couplant. - When the data views are set to display the interface. This view could be used for measuring tube ovality when a centrally located internal scanner is used. See 'I/F Trigger Setup' in Appendix B for procedure.																		
A-Scan Mode	This field controls A-Scan data collection: - Off..... A-Scan collection disabled. - Always..... An A-Scan is collected each time the scanner moves by the collection step. - If peak in gate..... An A-Scan is collected each time the scanner moves by the collection step if a signal is breaking the gate's threshold.																			
Peak Mode	The peak mode specifies what peak data the gate is to collect: <table><tr><td>Off.....</td><td>No peak data is collected.</td></tr><tr><td>All peaks.....</td><td>All the peaks in the gate are collected (Max = 16 peaks per gate)</td></tr><tr><td>First.....</td><td>The 1st peak in the gate is collected. Subsequent peaks are ignored.</td></tr><tr><td>First – Thinnest...</td><td>The system stores peak data at an operator defined distance (collection step). However, within the collection step, a particular transducer may have been excited many times, and thus many depth readings taken. In this mode, the software only stores 1 depth reading (the thinnest) within a collection step.</td></tr><tr><td>First – Thickest....</td><td>Same as First-Thinnest except the thickest reading is stored.</td></tr><tr><td>Between.....</td><td>The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness.</td></tr><tr><td>Between - Thinnest.....</td><td>The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness. (See First – Thinnest).</td></tr><tr><td>Between - Thickest.....</td><td>The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness. (See First – Thickest).</td></tr><tr><td>Loss of signal</td><td>If there is no signal in the gate, the loss of signal colour is drawn in the B, C, and D scan views. (See Pulse Echo Colours page).</td></tr></table>	Off.....	No peak data is collected.	All peaks.....	All the peaks in the gate are collected (Max = 16 peaks per gate)	First.....	The 1st peak in the gate is collected. Subsequent peaks are ignored.	First – Thinnest...	The system stores peak data at an operator defined distance (collection step). However, within the collection step, a particular transducer may have been excited many times, and thus many depth readings taken. In this mode, the software only stores 1 depth reading (the thinnest) within a collection step.	First – Thickest....	Same as First-Thinnest except the thickest reading is stored.	Between.....	The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness.	Between - Thinnest.....	The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness. (See First – Thinnest).	Between - Thickest.....	The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness. (See First – Thickest).	Loss of signal	If there is no signal in the gate, the loss of signal colour is drawn in the B, C, and D scan views. (See Pulse Echo Colours page).	No calibration is needed for this mode (0 is known) however accuracy is dependent on the correct material velocity.
Off.....	No peak data is collected.																			
All peaks.....	All the peaks in the gate are collected (Max = 16 peaks per gate)																			
First.....	The 1st peak in the gate is collected. Subsequent peaks are ignored.																			
First – Thinnest...	The system stores peak data at an operator defined distance (collection step). However, within the collection step, a particular transducer may have been excited many times, and thus many depth readings taken. In this mode, the software only stores 1 depth reading (the thinnest) within a collection step.																			
First – Thickest....	Same as First-Thinnest except the thickest reading is stored.																			
Between.....	The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness.																			
Between - Thinnest.....	The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness. (See First – Thinnest).																			
Between - Thickest.....	The difference between the 1st and 2nd peaks in the gate is calculated and stored as the depth/thickness. (See First – Thickest).																			
Loss of signal	If there is no signal in the gate, the loss of signal colour is drawn in the B, C, and D scan views. (See Pulse Echo Colours page).																			
Start	This is the start of the data collection data. (µS/mm)																			
Width	This is the width of the data collection gate. (µS/mm)																			
Threshold	To be collected as a peak, the signal must rise above the threshold level.																			

Test	The test button opens the gate test dialog box.	Provides a table that displays Time, Distance & amplitude for each peak in the gate that breaks the threshold.
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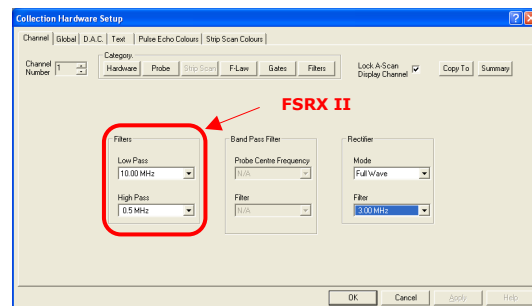
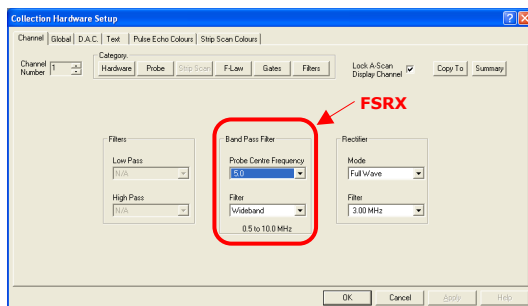
Channel Tab – Gates Category – Test (Pulse Echo and Phased Array)



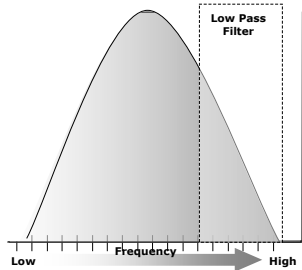
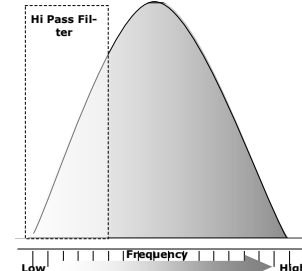
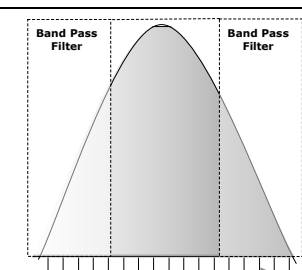
Peak Number	Time (µs)	Distance (mm)	Amplitude (%)
1	7.849	25.4	92.9
2	15.729	50.9	91.3
3	23.569	76.3	90.5
4	31.489	102.0	57.4
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			

The table provides numeric information about the signals that are in the gate and break the threshold.

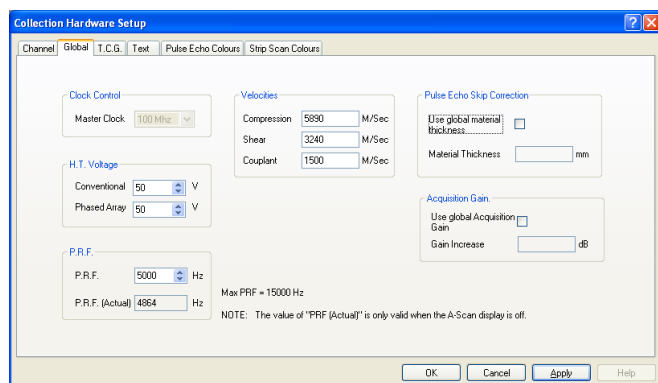
Channel Tab – Filters Category



High/Low pass filters are used to limit the frequency response of the instrument, and thus improve the signal to noise ratio. Depending on the system, either **Band-Pass Filters** or **Hi/Low Pass filters** are available.

Filters (Pocket-Scan, TD- Scan & FocusScan RXII)		
Low Pass	The low pass filter blocks frequencies greater than the selected value, and allows lower frequencies to pass through.	
High Pass	The high pass filter blocks frequencies lower than the selected value, and allows higher frequencies to pass through.	
Band Pass Filter (TD Handy-Scan & FocusScan RX)		
Probe Centre Frequency	Choose the dominant frequency of the probe	
Filter	The probe centre frequency determines a band of frequencies that are allowed through and blocks frequencies above and below the band. The choices are: • Narrowband • Wideband (centre frequency to lowest available frequency) • Broadband	
Rectifier		
Mode	Raw ultrasonic signals are bi-polar (have both +ve and -ve components). The rectifier makes the signals uni-polar (+ve or -ve only). The choices are: • Disable • Full Wave • ½Wave Positive • ½Wave Negative	Disable displays an un-rectified (RF) waveform. Displays an unrectified trace. Displays an rectified trace.
Filter	Controls the post rectifier filter. This has the effect of smoothing the jagged edges produced by the rectification process.	Note: over filtering may reduce resolution.

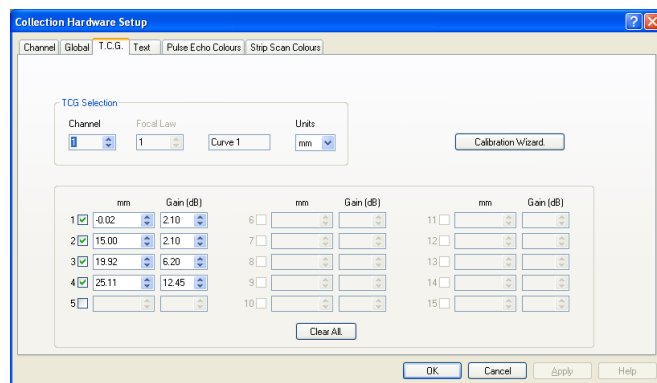
Global Page



Clock Control		
Master Clock	Controls the Master timing circuit within the TD unit. This value affects the available digitisation frequencies. There is no user definable functionality for this control.	
H.T. Voltage		
Conventional	Controls the voltage used to excite the TX transducer/s connected to the conventional connectors.	• ToFD and Pulse Echo only. • Values between 50 to 200 volts may be selected. • Note: If the HT voltage is above 50 volts when the system is powered down, a warning will appear at the next start-up.

		Warning: Piezo-electric crystal thickness reduces with increased probe frequency. Consequently, higher HT voltage may damage higher frequency probes.
Phased Array	This value controls the voltage used to excite the TX elements of phased array probes.	Phased Array. - Values between 50 to 200 volts may be selected. Note: If the HT voltage is above 50 volts when the system is powered down, a warning will appear at the next start-up. Warning: Piezo-electric crystal thickness reduces with increased probe frequency. Consequently, higher HT voltage may damage higher frequency probes.
P.R.F.		
P.R.F.	Pulse Repetition Frequency. This is the frequency at which enabled channels are sequenced.	
P.R.F. (Actual).	The average P.R.F every second. Note: To obtain a true figure of the PRF obtained during data collection the A-Scan display must be turned off.	
Velocities		
Compression	Velocity of compression waves within the test material.	See <i>How to Measure Velocity</i> in Appendix A for guidance on calculating velocity.
Shear	Velocity of shear waves within the test material.	See <i>How to Measure Velocity</i> in Appendix A for guidance on calculating velocity.
Couplant	Velocity of the couplant in an emersion system.	This value is only used for emersion testing.
Pulse Echo Skip Correction		See <i>Skip Correction</i> in Appendix A for an explanation of skip correction.
Use global material thickness	Allows a global (all channels) material thickness value to be used. When checked the value of material thickness in the Pulse Echo & Phased Array Probe page is overridden, with the Material Thickness value in the Global page.	
Material Thickness	Thickness of the material being tested.	If <i>Skip Correction</i> is not selected here, this value may be entered directly into the Probe Page of each channel individually.
Acquisition Gain		
Use Global Acquisition Gain	Allows an additional gain to be entered. The system gain is increased by the value entered for the duration of a scan when <i>Start (F10)</i> is Taped.	Used to satisfy certain codes that require additional gain while scanning. This gain can be removed off-line for analysis.
Gain Increase	Enter the additional gain value.	

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 (μ S) 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.
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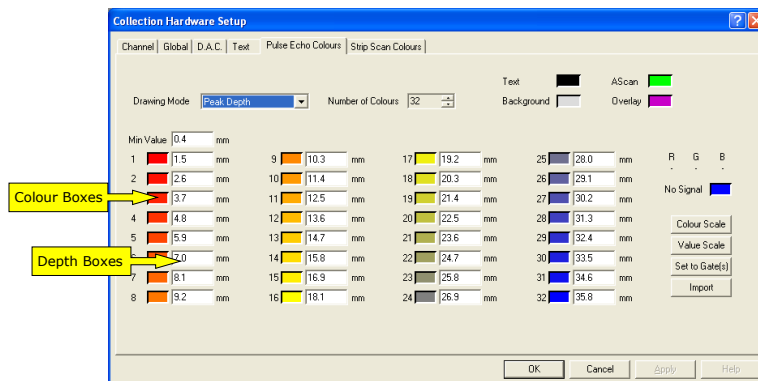
Text Page

In this page the operator may enter text that is to be stored with the ultrasonic data. The title for each text field is user definable, and is also stored in the data file. Undefined and unchecked fields do not appear on the printed output.

To access the text title set-up, select *Set-up* then *Configuration* on the menu, and select the *Text Block Headings* tab on the dialog box.

To change the text tiles offline, select *File* then *Configuration* on the menu, and select the *Text Block Headings* tab on the dialog box. To make the changes permanent, the file must be re-saved.

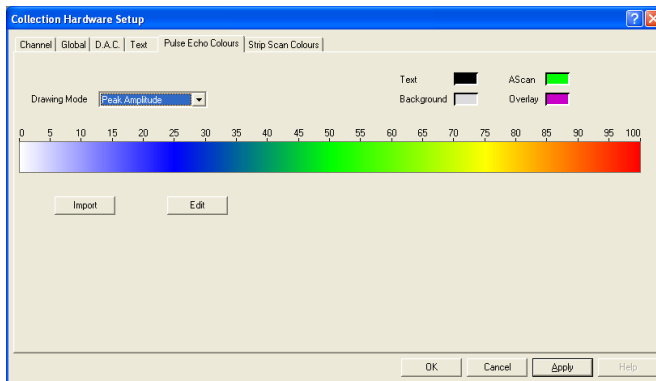
Pulse Echo Colours Page (Peak Depth)



Peak Depth allows the user to measure and view graphically the material depth. (See: *Adjusting Colours & Depth* in [Appendix A](#) for guidance on defining depths and colours.)

Drawing Mode	Allows the user to select the mode for onscreen colour definition of the data. The TD-Scan software has 3 independent colour tables for converting Pulse Echo and Phased Array data into colour images: • Peak Depth • Interface Depth • Peak Amplitude	Colour tables are stored in the ultrasonic data files. Offline each Pulse Echo window retains its own independent colour tables. On selection of the <i>Drawing Mode</i> , the data will be redrawn to display the data in the relevant mode.
Number of colours	Up to 32 colours may be selected.	The number of each colour is displayed to the left of its colour box.
Text	Defines the text colour.	
Background	Defines the background colour in the data area.	
AScan	Defines the colour of the A-scan trace.	
Overlay	Defines the colour of the weld overlay.	Weld overlays are defined in the <i>SuperView Display Control</i> .
Min Value	Depth at which measurement starts for the colour pallet.	Must be less than the depth in position 1
Colour boxes	Allows the user to adjust the colour for each available position based on the Number of Colours value.	Tap in the box to display an <i>Edit RGB</i> control. See: <i>Adjusting Colours & Depth</i> in Appendix B for guidance on defining a colour pallet.
Depth boxes	Allows the user to adjust the depth for each available position based on the Number of Colours value.	Depths may be entered directly into the boxes or arranged automatically. See: <i>Adjusting Colours & Depth</i> in Appendix B for guidance on defining depths.
R G B	Displays the selected colour numerically	
No Signal	Defines the colour when no signal is detected.	Only used if the channel is used as a couplant check channel, i.e. peak mode for the channel is set to <i>Loss of Signal</i> .
Colour Scale	Opens the Select Scale Ends dialogue.	Allows the user to define a colour scale automatically. See <i>Adjusting Colours & Depth</i> in Appendix B for detailed usage instructions.
Value Scale	Opens the Select Scale Ends dialogue.	Allows the user to define the depth scale automatically. See <i>Adjusting Colours & Depth</i> in Appendix B for detailed usage instructions.
Set to Gate(s)	Sets the depth scale in even steps from the beginning to the end of the gate.	If multiple gates are enabled, the depth scale will encompass the range of all gates.
Import	Opens the Select Scan File dialogue.	Allows the user to import a colour & depth scale from an existing scan file.

Amplitude Colours Page (Peak Amplitude)



The PE amplitude colour table contains 256 colours and is shown in the form of a colour bar. **Note:** This control is used to adjust the colours of Pulse Echo and Phased Array B, C, D & Sector scan projections. (**See:** *Adjusting Colours & Depth* in [Appendix B](#) for guidance on defining amplitude-based colours).

Drawing Mode	Allows the user to select the mode for onscreen colour definition of the data. The TD-Scan software has 3 independent colour tables for converting Pulse Echo and Phased Array data into colour images: • Peak Depth • Interface Depth • Peak Amplitude	Colour tables are stored in the ultrasonic data files. Offline, each Pulse Echo window retains its own independent colour tables. On selection of the <i>Drawing Mode</i> , the data will be redrawn to display the data in the relevant mode.
Text	Defines the text colour.	
Background	Defines the background colour in the data area.	
AScan	Defines the colour of the A-scan trace.	
Overlay	Defines the colour of the weld overlay.	Weld overlays are defined in the <i>Superview Display Control</i> .
Import	Allows colours from another PE scan file to be imported	
Edit	Allows the colour bar to be edited	See: <i>Adjusting Colours & Depth</i> in Appendix B for guidance on defining a colour pallet.

Amplitude Colour Edit

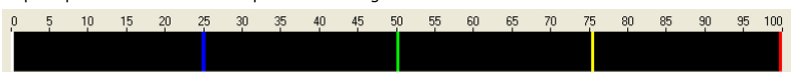


Amplitude	Displays the amplitude numerically (%FSH) at the point where the mouse pointer is located when in the colour bar.	
RGB	Displays the RGB values for the colour at the point where the mouse pointer is located when in the colour bar.	
Clear	Clears the colour bar, and the list of Auto Scale Points.	
Default	Sets the default colour palette.	
Auto Scale	Creates a gradual colour scale between the selected points.	See: <i>Adjusting Colours & Depth</i> in Appendix A for guidance on defining a colour pallet.

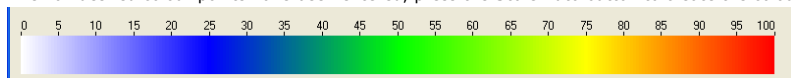
Creating a colour scale

- Press the **Clear** button. This clears the colour bar, and the auto scale points.
- Next place the mouse over a point on the colour bar you wish to set the colour of and press the mouse left button. This opens the colour edit dialog box.

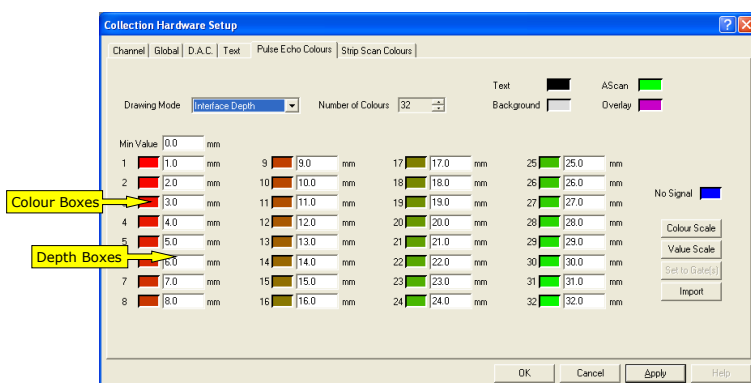
- Move the RGB sliders until the desired colour is created.
- Repeat point 2 for each colour point. See image below



- When all desired colour points have been entered, press the Scale Auto button to create the colour scales in the colour bar.



Amplitude Colours Page (Interface Depth)

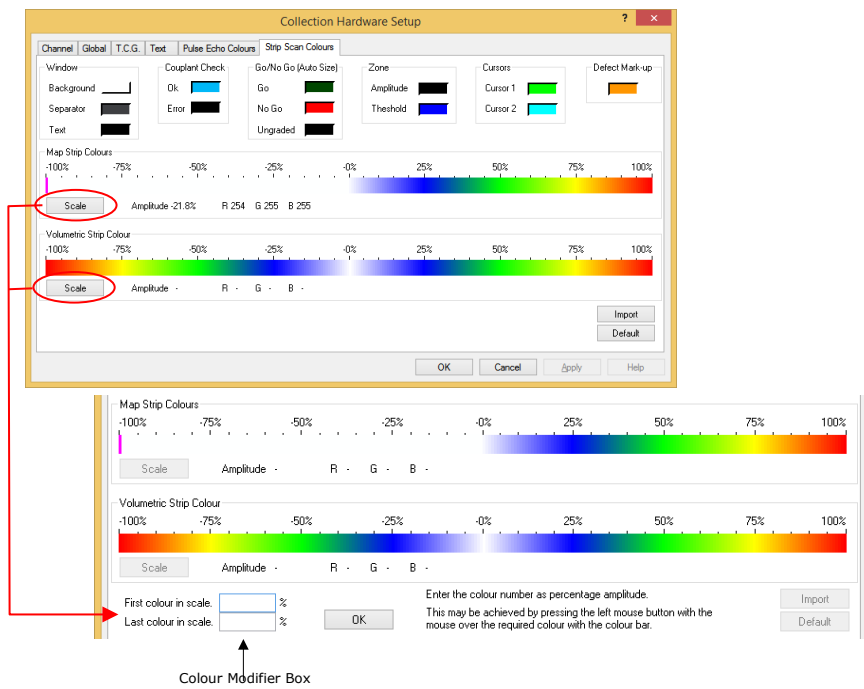


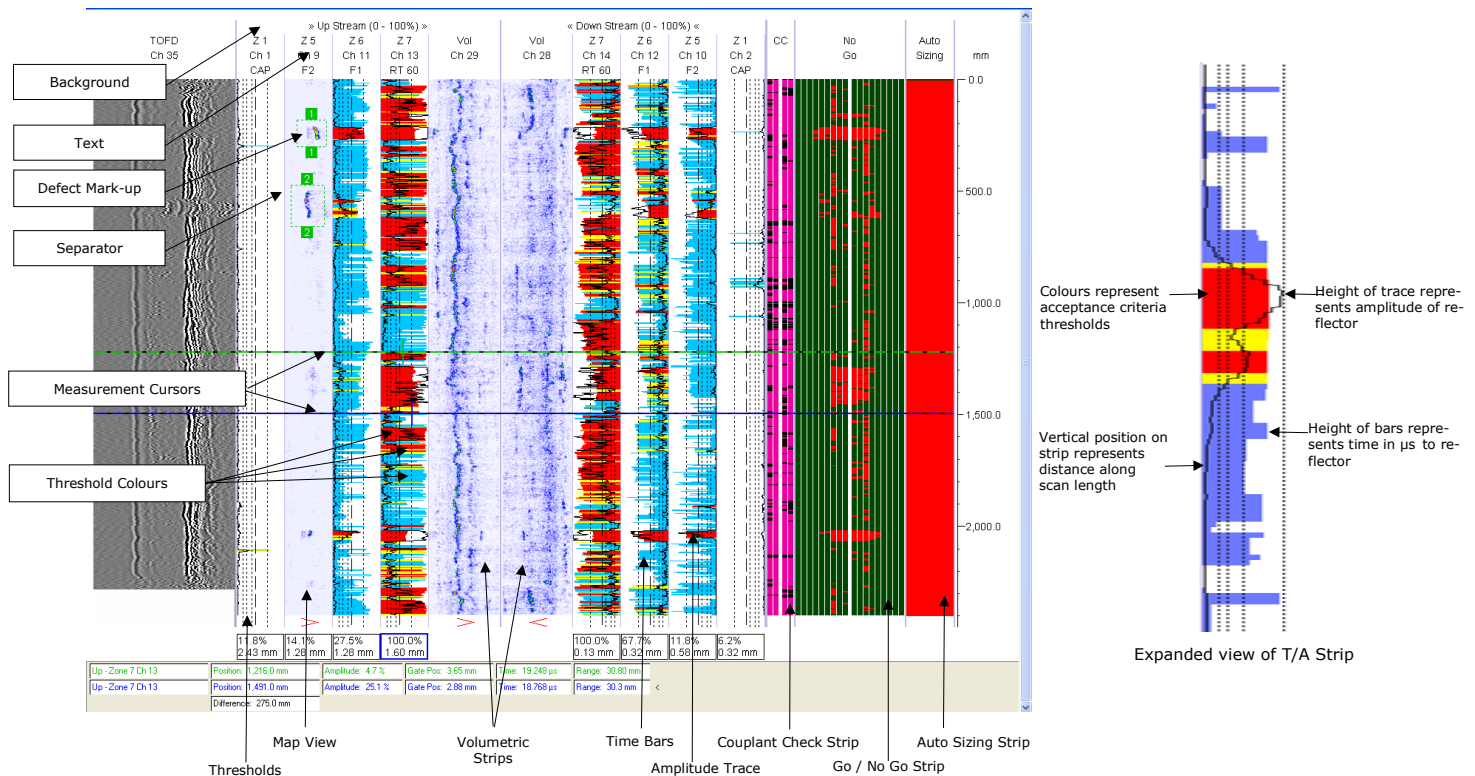
Interface Depth allows the user to measure and view graphically the couplant path when performing emersion techniques and is configured in the same way as *Peak Depth*. (See: *Adjusting Colours & Depth* in Appendix A for guidance on defining depths and colours.)

The advantage of *Interface Depth* is that the near surface topography of a test material may be mapped and could be useful in determining the extent of pipe ovality during internal pipe inspections.

Drawing Mode	Allows the user to select the mode for onscreen colour definition of the data. The TD-Scan software has 3 independent colour tables for converting Pulse Echo and Phased Array data into colour images: • Peak Depth • Interface Depth • Peak Amplitude	Colour tables are stored in the ultrasonic data files. Offline each Pulse Echo window retains its own independent colour tables. On selection of the <i>Drawing Mode</i> , the data will be redrawn to display the data in the relevant mode.
Number of colours	Up to 32 colours may be selected.	The number of each colour is displayed to the left of its colour box.
Text	Defines the text colour.	
Background	Defines the background colour in the data area.	
AScan	Defines the colour of the A-scan trace.	
Overlay	Defines the colour of the weld overlay.	Weld overlays are defined in the <i>Superview Display Control</i> .
Min Value	Depth at which measurement starts for the colour pallet.	Must be less than the depth in position 1
Colour boxes	Allows the user to adjust the colour for each available position based on the Number of Colours value.	Tap in the box to display an <i>Edit RGB</i> control. See: <i>Adjusting Colours & Depth</i> in Appendix B for guidance on defining a colour pallet.
Depth boxes	Allows the user to adjust the depth for each available position based on the Number of Colours value.	Depths may be entered directly into the boxes or arranged automatically. See: <i>Adjusting Colours & Depth</i> in Appendix B for guidance on defining depths.
R G B	Displays the selected colour numerically	
No Signal	Defines the colour when no signal is detected.	
Colour Scale	Opens the Select Scale Ends dialogue.	Allows the user to define a colour scale automatically. See <i>Adjusting Colours & Depth</i> in Appendix B for detailed usage instructions.
Value Scale	Opens the Select Scale Ends dialogue.	Allows the user to define the depth scale automatically. See <i>Adjusting Colours & Depth</i> in Appendix B for detailed usage instructions.
Set to Gate(s)	Sets the depth scale in even steps from the beginning to the end of the gate.	If multiple gates are enabled, the depth scale will encompass the range of all gates.
Import	Opens the Select Scan File dialogue.	Allows the user to import colour & depth settings from an existing scan file.

Strip Scan Colours Page



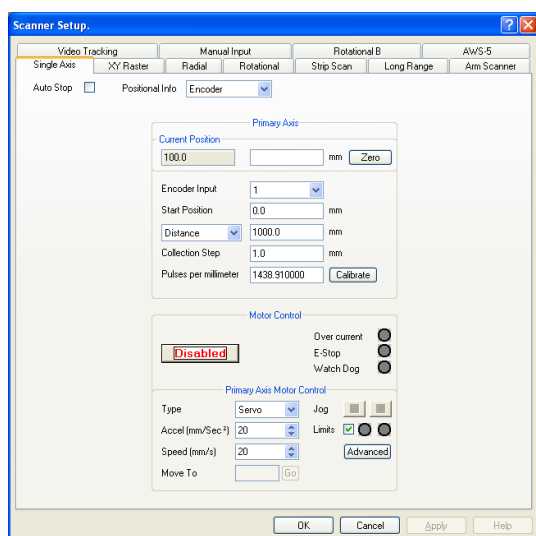


The **StripScan Colours** page allows the user to define the colours that are displayed in the *StripScan* window. The 2 images above illustrate the colours within a strip chart that may be adjusted. **Note:** Threshold colours in the time bars are adjusted in the *StripsScan* tab of the *Collection Hardware Setup* window.

Import	Opens the Select Scan File dialogue.	Allows the user to import colour & amplitude settings from an existing scan file.
Default Window	Applies the system default colour settings	
Background	Defines the colour of each object (See the illustration above to identify the elements)	Tap in the box to display an <i>Edit RGB</i> control. See Adjusting Colours & Depth in Appendix B , Section ix, a, ii for detailed usage instructions.
Separator		
Text		
Couplant Check		
OK	Defines the colour of each object (See the illustration above to identify the elements)	Tap in the box to display an <i>Edit RGB</i> control. See Adjusting Colours & Depth in Appendix B , Section ix, a, ii for detailed usage instructions.
Error		
Go/No Go (Auto Size)		
Go	Defines the colour of each object (See the illustration above to identify the elements)	Tap in the box to display an <i>Edit RGB</i> control. See Adjusting Colours & Depth in Appendix B , Section ix, a, ii for detailed usage instructions.
No Go		
Ungraded		
Zone		
Amplitude	Defines the colour of each object (See the illustration above to identify the elements)	Tap in the box to display an <i>Edit RGB</i> control. See Adjusting Colours & Depth in Appendix B , Section ix, a, ii for detailed usage instructions.
Time		
Threshold		
Cursors		
Cursor 1	Defines the colour of each object (See the illustration above to identify the elements)	Tap in the box to display an <i>Edit RGB</i> control. See Adjusting Colours & Depth in Appendix B , Section ix, a, ii for detailed usage instructions.
Cursor 2		
Map Strip Colours		
Scale	Opens the colour modifier box	See Adjusting Colours & Depth in Appendix B , for detailed instructions.
Volumetric Strip colours		
Scale	Opens the colour modifier box	See Adjusting Colours & Depth in Appendix B , for detailed instructions.

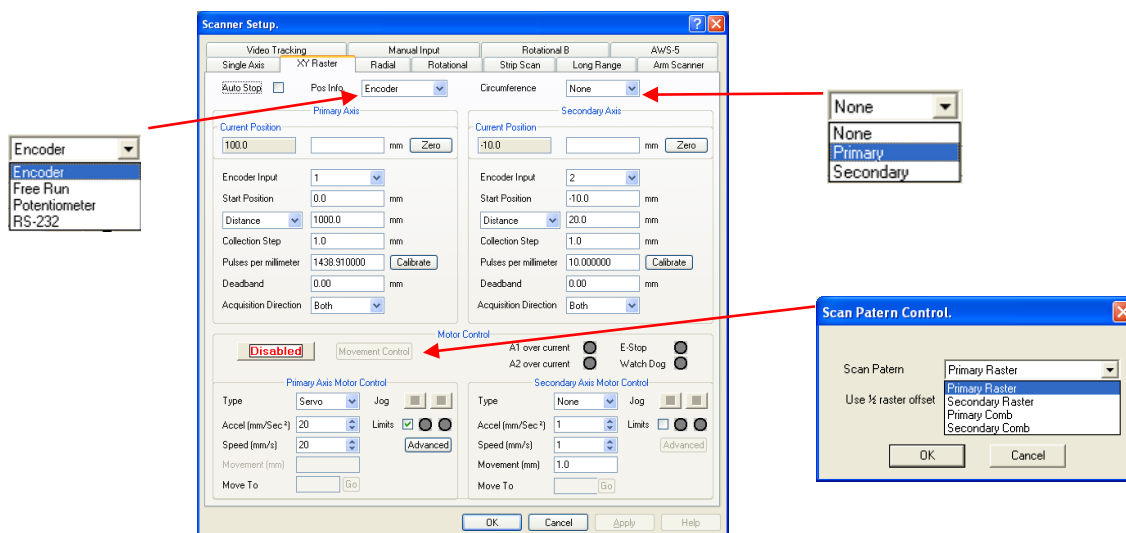
Scanner Set-up

The tabs at the top of the dialog box allow the selection of different scanner types. The scanner interfaces are all variations on the basic single or dual axis setup.

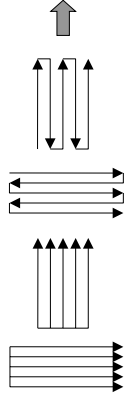


Scanner Set-up – Single or Dual (X-Y Raster) Axis.

When the **Single Axis** tab is chosen, the above scanner interface is displayed. When **XY Raster** is chosen, the interface below is displayed.

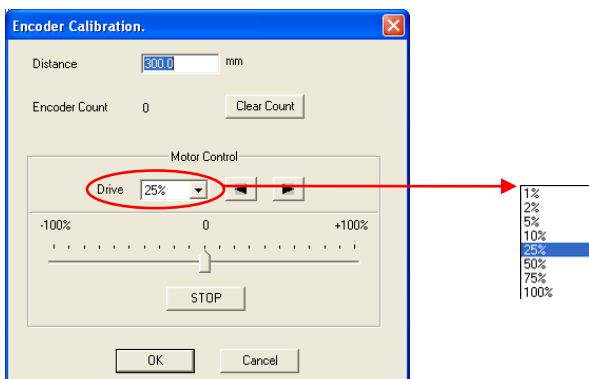
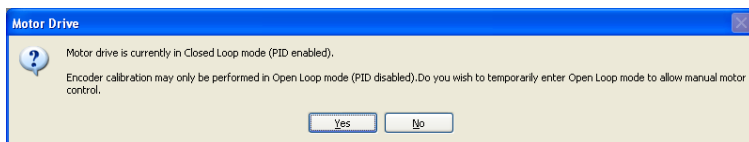


Auto Stop	When enabled, the data collection process is automatically terminated when the scanner reaches the end of the scan.	
Positional Info	Defines how distance information is recorded. There are 3 choices: Free Run (no positional encoder used) Probes must be moved at a user defined speed. Note: it is not recommended that this mode be used where the lengths of indications are to be measured because deviating from the chosen speed will change the displayed lengths of indications. Encoder (positional encoder required) An encoder provides accurate linear positional data that is recorded with the UT data. Potentiometer (XY Raster only) A potentiometer provides accurate linear positional data that is recorded with the UT data. RS232 (not used - project specific)	
Circumference (XY Raster only)	Defines the axis that will be in the circumferential direction. The choices are: None Primary Secondary	When the positional marker (black line) reaches the scan distance selected during the scanner setup, the marker will automatically revert to the zero position. (In reality the zero point is on the same plane as the 360° point but the data is displayed on a flat plane.)
Primary and Secondary Axes		
Current Position	Greyed text field - current position of the encoder in relation to zero.	This value is updated 10 – 100 times per second.

	White text field - Allows the operator to specify the current position of the encoder.	
Zero	Sets the position for the given axis to zero.	
Encoder Input	Specifies which encoder input the encoder for the given axis is connected to.	Either <i>Input 1</i> or <i>Input 2</i>
Start Position	The start position for the collected data.	The position, in relation to Zero, that the system will start to collect data.
Distance/End Position	Specifies the length of the data collection area in the given axis. There are 2 choices: • Distance • End Position	• Operator provides the scan distance. • Operator provides the end position of the scan. Useful if the operator does not want to calculate the actual length of the scan. But knows the desired end position.
Collection Step	Ultrasonic data is stored each time the scanner moves by this amount.	
Speed (mm/sec) (Free Run Only)	Sets the scanning speed, in free run only.	This value is user defined.
Pulses per mm (Encoder Only)	Sets the number of pulses per millimetre generated by the encoder. This value may be determined by using the <i>calibrate</i> option.	
Calibrate	Opens the encoder calibration dialog box.	See <i>Encoder Calibration</i> in Appendix B , for detailed instructions.
Motor Control:		
Enabled/Disabled	Enables the motor control software in the remote unit (Motion control board). ALL PARAMETERS MUST BE SET BEFORE ENABLING MOTOR CONTROL. • This option is only enabled in system with an on-board drive control board: currently only the FocusScan RX RX.	Calibrate the integrated encoder/s before attempting to drive the motor/s. Failing to do this may cause incorrect functioning.
Movement Control (XY Scanner only)	Opens the Scan Pattern Control dialogue box. The choices are: • Primary Raster..... • Secondary Raster..... • Primary Comb..... • Secondary Comb.....	Primary scanner movement 
Over current (A1 & A2)	Warning that an over current has been detected to the scanner	
E-Stop	Warning that the Emergency Stop button has been activated.	The Emergency Stop button is located on the Keypad of the TD-Scan and FocusScan RX instruments. Its purpose is to abruptly cut power from the drive control system in order to stop the motion of a scanner connected to the system.
Watch Dog	Warning that the Watchdog safety feature has activated.	The Watchdog is a hardware device in the drive control system that periodically polls the DSP. If no response is received it assumes that the DSP has lost control of the system and automatically shuts the drive control system down.
Primary or Secondary Axis Motor Control: (NOTE: The motor control area only becomes active when a motor is attached to either the Axis1 or Axis2 sockets)		
Type	Motor Type, currently only servo motors are directly supported.	
Accel	The rate of acceleration/deceleration.	
Speed	The velocity at which the given axis will move.	
Move To...Go	Enter a position to move to, the Go button must be pressed before the axis starts to move.	The Current Position of the axis is displayed at the top of the dialog box.
Jog	Moves the axis forward/backward by 1 collection step distance.	
Limits	If green; limit is inactive, if red; limit is active. The scanner will not move if a limit is active.	Limit switches are usually located at the extremities of an arm (trombone) scanner. This ensures that the scanner will stop when the limit of the arm extension is reached
Advanced	Opens the Advanced Motor Control dialog box (see <i>Advanced Motor Control</i> below).	

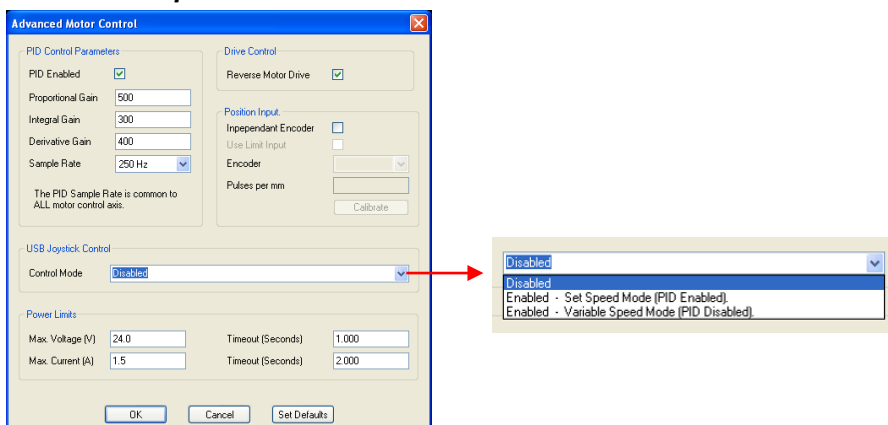
Scanner Set-up - Encoder Calibration

Tap the **Calibrate** button for either the **Primary Axis** or **Secondary Axis** to activate the **Encoder Calibration** dialogue box. If the PID has been enabled, a dialogue box will appear as follows, warning that the PID will be disabled during calibration.



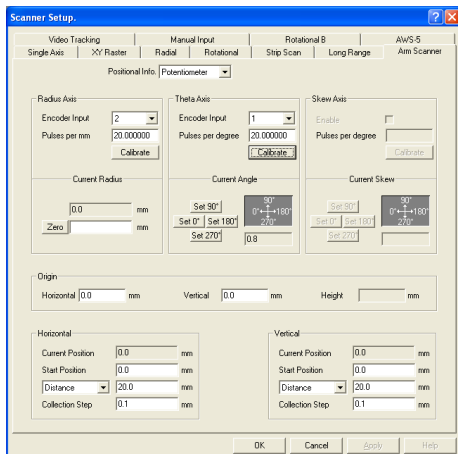
Distance	An arbitrary, measured distance selected by the operator.	The longer the calibration distance, the more accurate the calibration. 300mm is a reasonable distance.
Encoder Count	Displays the pulse count as the encoder wheel is turned	
Clear Count	Sets the encoder pulse counter to zero	Set this value to zero before moving the encoder for calibration.
OK	Ends the calibration procedure and closes the dialogue.	The pulses/mm will then be set in the system.
Motor Control:		
Drive	Applied percentage drive.	There are two methods to manually drive the motor in order to move the encoder for calibration: - Select the % drive from the dropdown list and tap the left or right arrow buttons. - Move the slider either left or right. As the slider moves further from the centre (0) the % drive increases.
-100%...0...+100%	Applied percentage drive.	A combination of both methods may be used if desired.
Stop	Cuts power to the motor and brings the slider to the zero position abruptly.	

Scanner Set-up – Advanced Motor Control



PID Control Parameters:		
PID Enabled	Allows the user to define a PID loop (PID = P roportional, I ntegral, D erivative)	PID is a mathematical method of correcting errors in encoder position and ensuring the accuracy of scanner positioning. Tuning a PID is not an exact science and a measure of experimentation may be required.
Proportional Gain	Gives fast response to sudden load changes and can reduce instability caused by high integral gain. This gain is typically many times higher than the integral gain so that relatively small deviations in speed are corrected while the integral gain slowly moves the speed to the setpoint. Like integral gain, when set too high, proportional gain can cause a "hard" oscillation of a few Hertz in motor speed.	
Integral Gain	Ensures that under steady state conditions that the motor speed (almost) exactly matches the setpoint speed. A low gain can make the controller slow to push the speed to the setpoint but excessive gain can cause 'hunting' around the setpoint speed. In less extreme cases, it can cause overshoot whereby the speed passes through the setpoint and then approaches the required speed from the opposite direction. Unfortunately, sufficient gain to quickly achieve the setpoint speed can cause overshoot and even oscillation but the other terms can be used to damp this out.	
Derivative Gain	Can be used to give a very fast response to sudden changes in motor speed. Within simple PID controllers it can be difficult to generate a derivative term in the output that has any significant effect on motor speed. It can be deployed to reduce the rapid speed oscillation caused by high proportional gain. However, in many controllers, it is not used.	
Sample Rate	Defines the frequency at which the PID control algorithm is executed.	250Hz should be sufficient in most cases.
Drive Control:		
Reverse Motor Drive	Allows the user to reverse the drive motor polarity.	The control software assumes that a positive control voltage moves the motor clockwise. However, due to differences in servo amplifiers and motor wiring, the motor may move in the opposite direction.
Position Input		
Independent Encoder	Allows the use of an encoder that is separate from the motor axis	The motor control software normally uses the same encoder and the axis.
Encoder	The encoder number for the motor control encoder.	
Pulses per mm	Sets the number of pulses generated by the control encoder. This value may be determined by the <i>calibrate</i> option.	
Calibrate	Opens the encoder calibration dialog box.	See Encoder Calibration in Appendix B , for detailed instructions.
USB Joystick Control		
Control Mode	Enables Joystick control. There are three choices: a. Disabled b. Set Speed Mode (PID Enabled) c. Variable Speed mode (PID Disabled)	A USB joystick can be used to control scanner movement. This is convenient, where many small accurate movements of the scanner are required to optimise the setup.
Power Limits		
Max. Voltage (V)	Maximum input voltage of the motor.	24 Volts
Timeout (Seconds)	Maximum time that the motor may be driven at full voltage.	The drive control software will be disabled if the timeout is exceeded.
Max. Current (A)	Maximum input current (amperage) to the motor.	4 Amps peak
Timeout (Seconds)	Maximum time that the motor may be driven at full current	The drive control software will be disabled if the timeout is exceeded. 2 seconds is reasonable.
Set Defaults	Changes the <i>PID</i> and <i>Power Limits</i> values to the system defaults	The values in the image above are set to default.

Scanner Set-up - Arm Scanner (p -theta)



Scanner Setup

Video Tracking | Manual Input | Rotational B | **Arm Scanner**

Single Axis | XY Raster | Radial | Rotational | Ship Scan | Long Range | Arm Scanner

Positional Info: Potentiometer

Radius Axis

Encoder Input: 2
Pulses per mm: 20.000000
Calibrate

Theta Axis

Encoder Input: 1
Pulses per degree: 20.000000
Calibrate

Skew Axis

Enable: ☐
Pulses per degree:
Calibrate

Current Radius

Current Radius: 0.0 mm
Zero: mm

Current Angle

Current Angle: 0.0
Set 90° | Set 180° | Set 270°

Current Skew

Current Skew: 0.0
Set 0° | Set 180° | Set 270°

Origin

Horizontal: 0.0 mm | Vertical: 0.0 mm | Height: mm

Horizontal

Current Position: 0.0 mm
Start Position: 0.0 mm
Distance: 20.0 mm
Collection Step: 0.1 mm

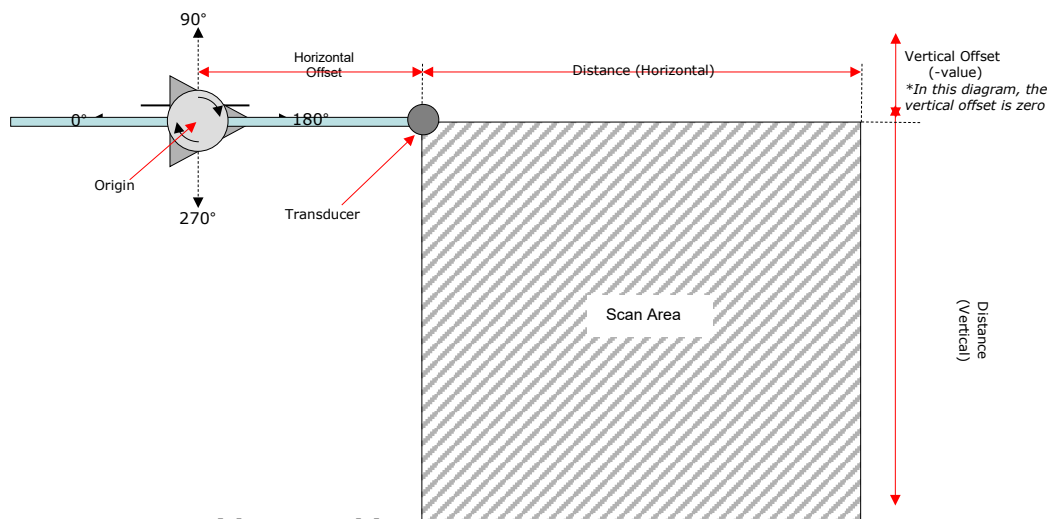
Vertical

Current Position: 0.0 mm
Start Position: 0.0 mm
Distance: 20.0 mm
Collection Step: 0.1 mm

OK Cancel Back Help

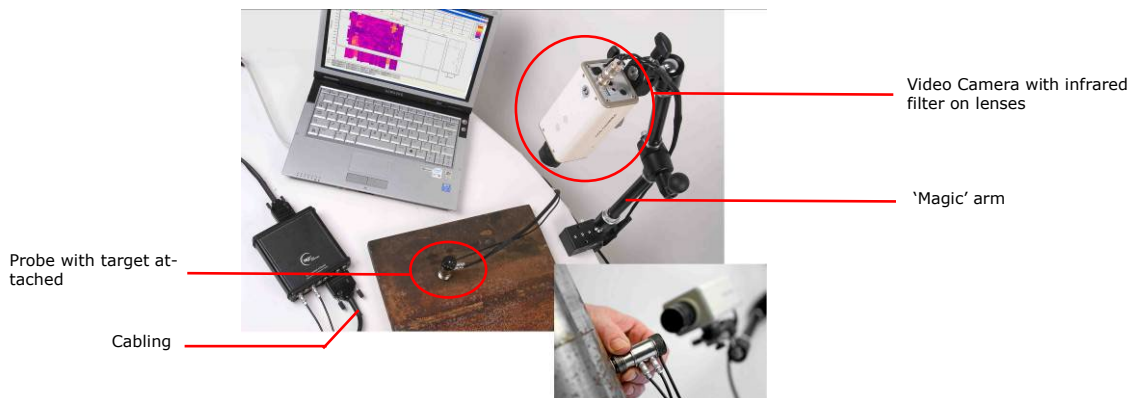
Positional Info	This list box allows selection of either encoder or potentiometer position data inputs.	
Theta (angle) Axis:		
Encoder Input	Specifies the encoder/potentiometer number to be used for the angle (rotary) axis.	
Pulses per degree	This is the pulses per millimetre generated by the encoder.	
Calibrate	The calibrate button opens the encoder/potentiometer calibration dialog box. Here the system measures the number of encoder pulses over a given distance.	
Current Angle	Set 0° -Sets the angle of the arm to 0°. Set 90° -Sets the angle of the arm to 90°. Set 180° -Sets the angle of the arm to 180° Set 270° -Sets the angle of the arm to 270°	Assuming the scanner is placed at the top left of the scan area, the <i>Current Angle</i> is 180°. (See sketch below)
Radius Axis:		
Encoder Input	Specifies the encoder/potentiometer number to use for the radius axis.	
Pulses per degree	This is the pulses per millimetre generated by the encoder.	
Current Radius	This is the current value of the radius axis. To set a new value, enter the value and press the apply button.	Assuming the scanner is placed at the top left of the scan area, when the probe is at 0/0 then the <i>Radius</i> is the same value as the <i>Horizontal Origin</i> but with the opposite sign (+). (see sketch below)
Origin:		
Horizontal	Specifies the Horizontal position of the origin. The origin is defined as the scanner's centre of rotation.	Assuming the scanner is placed at the top left of the scan area the <i>Horizontal Origin</i> is the distance from 0/0 to the pivot point of the scanner in the negative direction (-). (See sketch below)
Vertical	Specifies the Vertical position of the origin.	Assuming the scanner is placed at the top left of the scan area the <i>Vertical Origin</i> is the distance from 0/0 to the pivot point of the scanner in the negative direction (-). (See sketch below)
Horizontal:		
Current Position	Shows the current Horizontal position at the end of the arm after Polar to Cartesian coordinate conversion.	
Start Position	The Horizontal start position of the scan area.	
Distance	The width of the scan area.	
Collection Step	The Horizontal data resolution.	
Vertical:		
Current Position	Shows the current Vertical position at the end of the arm after Polar to Cartesian coordinate conversion.	
Start Position	The Vertical start position of the scan area.	
Distance	The height of the scan area.	
Collection Step	The Vertical resolution.	

Diagram of arm scanner (p-theta) setup.

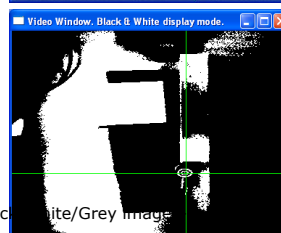
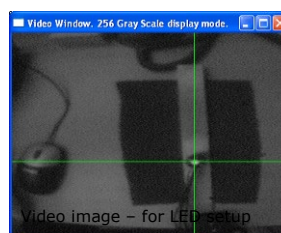
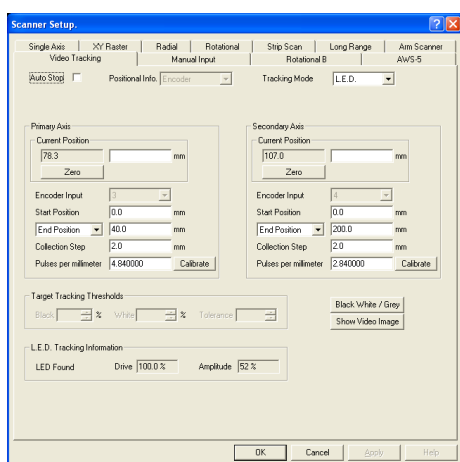


Scanner Set-up - Video Tracking.

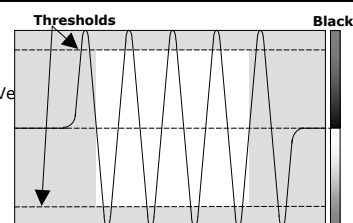
Video Tracking is a method of tracking the location of a probe using video camera signals converted into XY positional data. The location of the probe is tracked by attaching a target to a single or twin crystal probe that is recognised by the system through the video camera image. *Video Tracking* is one method of positional tracking that may be used with the TECHNOLOGY DESIGN corrosion mapping software. The **TD Corrosion Mapping Kit** incorporates all the hardware required for *Video Tracking* and may be used with all **Pocket-Scan**, **TD Handy-Scan**, **TD-Scan** and **FocusScan RX** variants.



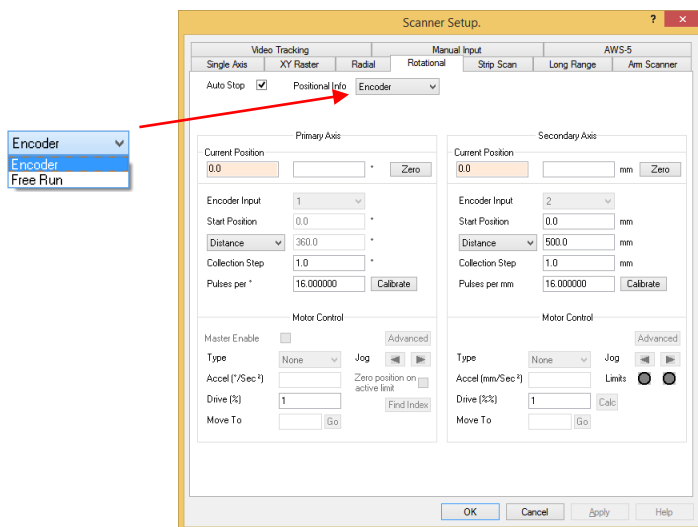
TD Corrosion Mapping Kit connected to a Pocket-Scan



Auto Stop	When enabled, the data collection process is automatically terminated when the scanner reaches the end of the scan.	Usually unchecked for corrosion mapping.
Position Info	Fixed - always encoder.	
Tracking Mode	Determines the probe tracking method. The choices are: L.E.D. Tracking or Target Tracking	L.E.D. Tracking - The target that is used to register the probe position is an infra-red light emitting diode (L.E.D.)  Target Tracking - The target that is used to register the probe position is a printed group of concentric black & white circles. A template (<i>Video Tracking Target2.doc</i>) is provided in the <i>Target</i> folder on the product installation CD.
Primary Axis and Secondary Axis		
Current Position	Greyed text field - current position of the L.E.D or target in relation to zero.	This value is updated 10 – 100 times per second.
	White text field - Allows the operator to specify the current position of the L.E.D or target.	
Zero	Sets the position for the given axis to zero.	
Encoder Input	Specifies which input the encoder is connected to for a given axis.	No user adjustment. Primary is always Input 3 and Secondary is Input 4 .
Start Position	Start position for the collected data.	The position, in relation to Zero, that the system will start to collect data.
Distance	Width of the scan area.	
Collection Step	Incremental resolution of encoder data.	Collection step refers to the distance between each successive A-scan capture in both the X and Y direction. (i.e. block or 'pixel' size).
Pulses per millimetre	Pulses per millimetre generated by the video tracking hardware.	
Calibrate	Opens the calibrate dialog box. Here the software measures the encoder pulses generated by the video tracking hardware for a measured movement.	
Target Tracking Thresholds:		



Black	The black threshold within the video image may be adjusted.	
White	The white threshold within the video image may be adjusted.	
Tolerance	The width tolerance may be adjusted.	
Black white / Grey	When the video window is open, the image alternates between a 256 grey scale image or a black, white, & one grey level image. (See illustration above)	As a guide use a black level of about 45%, white level at around 70% and tolerance set at 3. These values will change depending on the ambient light level. Constant good daylight is best. In low light environments use L.E.D tracking.
Show Video Image	Opens the Video window .	Tap the button to alternate between display modes in the video window. Set the threshold levels for black, white and grey in the <i>Black</i> and <i>White</i> fields.
L.E.D Tracking Information:		
Drive	Shows the percentage drive value used to power the L.E.D.	
Amplitude	Shows the amplitude at which the L.E.D. is being seen by the camera.	



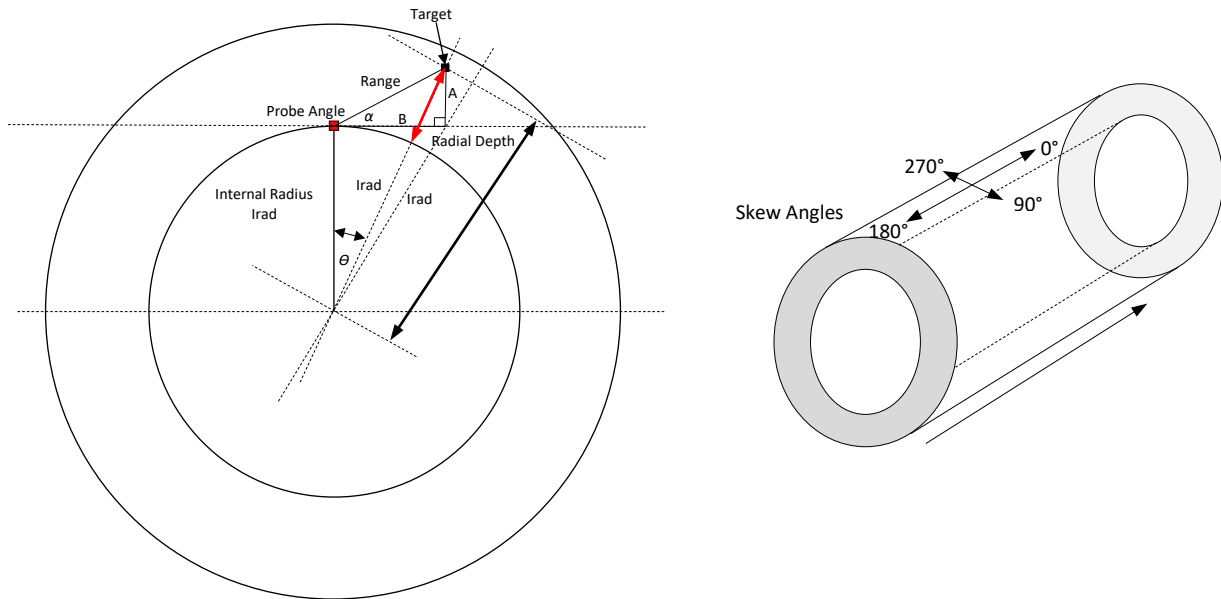
Scanner Set-up - Rotational.

Auto Stop	When enabled, the data collection process is automatically terminated when the scanner reaches the end of the scan.	
Positional Info	Defines how distance information is recorded. There are 2 choices:	
	Encoder (positional encoder required) Free Run (no positional encoder used)	An encoder provides accurate linear positional data that is recorded with the UT data. Probes must be moved at a user defined speed. Note: it is not recommended that this mode be used where the lengths of indications are to be measured because deviating from the chosen speed will cause inaccuracies in the displayed lengths of indications.
Primary and Secondary Axes		
Current Position	Greyed text field - current position of the encoder in relation to zero.	This value is updated 10 – 100 times per second.

	White text field - Allows the operator to specify the current position of the encoder.	
Zero	Sets the position for the given axis to zero.	
Encoder Input	Specifies which encoder input the encoder for the given axis is connected to.	Either <i>Input 1</i> or <i>Input 2</i>
Start Position	The start position for the collected data.	The position, in relation to Zero, that the system will start to collect data. - In the <i>Primary</i> direction (circumferential) the scan always starts at Zero. The text box is greyed. - In the <i>Secondary</i> direction (axial) this value may be manually adjusted.
Distance	Specifies the length of the data collection area in the given axis. In the <i>Secondary</i> direction there are two choices: Distance End Position	- In the <i>Primary</i> direction (circumferential) the value is fixed at 360°. The text box is greyed. - In the <i>Secondary</i> direction (axial) the operator provides either the <i>scan distance</i> or the <i>end position</i> of the scan. End Position is useful if the operator does not want to calculate the actual length of the scan. But knows the desired end position.
Collection Step	Ultrasonic data is stored each time the scanner moves by this amount.	<i>Primary</i> direction is in degrees <i>Secondary</i> direction is in mm or inches.
Speed (°/sec) or (mm/sec) (Free Run Only)	Sets the scanning speed, in <i>free run</i> mode only.	- This value is user defined. <i>Primary</i> direction is in degrees <i>Secondary</i> direction is in mm or inches.
Pulses per mm (Encoder Only)	Sets the number of pulses per millimetre, inch or degree generated by the encoder. This value may be determined by using the <i>calibrate</i> option.	<i>Primary</i> direction is in degrees <i>Secondary</i> direction is in mm or inches.
Calibrate	Opens the encoder calibration dialog box.	See <i>Encoder Calibration</i> in Appendix B , for detailed instructions.
Motor Control:		
Master Enabled	Enables the motor control software in the remote unit (motion control board). ALL PARAMETERS MUST BE SET BEFORE ENABLING MOTOR CONTROL. This option is only enabled in systems with an on-board drive control board: currently only the FocusScan RX RX.	Calibrate the integrated encoder/s before attempting to drive the motor/s. Failing to do this may cause incorrect functioning.
Primary or Secondary Axis Motor Control: (NOTE: The motor control area only becomes active when a motor is attached to either the Axis1 or Axis2 sockets)		
Type	Motor Type, currently only servo motors are directly supported.	
Accel (°/sec²) or (mm/sec²)	The rate of acceleration/deceleration. Primary Axis = °/sec Secondary Axis = mm/sec	
Drive % or Speed (°/sec) or Speed (mm/sec)	The velocity at which the given axis will move. The text will change depending on the PID settings in Advanced Motor Control : PID is disabled = Drive % PID is enabled = Speed (°/sec) in the Primary axis or Speed (mm/sec) in the Secondary axis	
Move To...Go	Enter a position to move to, the Go button must be pressed before the axis starts to move.	The Current Position of the axis is displayed at the top of the dialog box.
Jog	Moves the axis forward/backward by 1 collection step distance.	
Zero position on active limit	Re-defines the Zero position each time the appropriate limit switch is activated.	The zero position for each scan revolution may migrate over a distance resulting in positional inaccuracy. A limit switch ensures this does not occur by triggering the zero position correctly for each revolution.
Find Index	Currently inactive	
Limits	If green; limit is inactive, if red; limit is active. The scanner will not move if a limit is active.	Limit switches are usually located at the extremities of an arm (trombone) scanner. This ensures that the scanner will stop when the limit of the arm extension is reached
Advanced	Opens the Advanced Motor Control dialog box (see Advanced Motor Control above).	

Scanner Set-up – Data Display Protocols when using Rotational Scanner

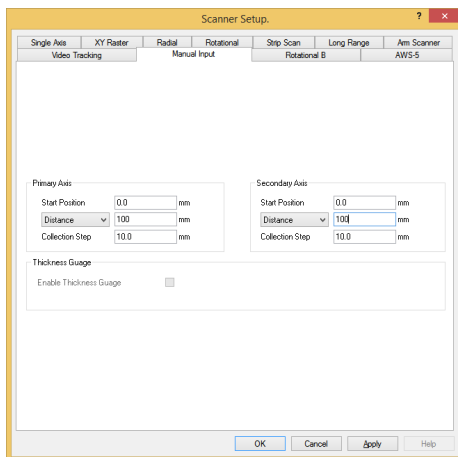
When the **Rotational** scanner tab is selected the TD-Scan software changes the way data is displayed to accommodate the complexity of determining reflector position. The sketch below illustrates how this is achieved.



Each view displays data from 1 channel. A drop-down list at the top left of the C-Scan view facilitates easy changing of displayed channels.

- Channels with skew angles of **90°** and **270°**.
 - B-Scan image:
 - Displayed as a volume corrected.
 - A-Scans at the edge of the image wrap round at 0° & 360°.
 - Vertical scale indicates radial depth.
 - Depth in the status-bar & cursors is the radial depth.
 - Horizontal scale in degrees.
 - The angle displayed in the status-bar and for the cursors is the project angle around the circumference, with 0° being top-dead-centre.
 - C-Scan image:
 - Displayed as a volume corrected.
 - A-Scans at the edge of the image wrap round at 0° & 360°.
 - Vertical scale indicates distance down the length of the bore.
 - Depth in the status-bar & cursors is the radial depth.
 - Horizontal scale is on degrees.
 - The angle displayed in the status-bar and for the cursors is the project angle around the circumference, with 0° being top-dead-centre.
 - D-Scan image:
 - This is not volume corrected.
 - Vertical scale indicates distance down the length of the bore.
 - Horizontal scale indicates range.
 - Depth in the status-bar & cursors is the radial depth.
- Channels with skew angles of **0°** and **180°**.
 - B-Scan image:
 - This is not volume corrected.
 - Vertical scale is in range.
 - The status-bar and cursors indicate range not depth.
 - Horizontal scale is in degrees.
 - C-Scan image:
 - Displayed as a volume corrected.
 - A-Scans with a skew angle of 0° are projected vertically in a positive direction down the length of the bore, whilst A-Scans with a 180° skew are projected vertically in a negative direction.
 - Horizontal scale is in degrees.
 - D-Scan image:
 - Displayed as a volume corrected.
 - Vertical scale indicates distance down the length of the bore.
 - Horizontal scale indicates depth.
 - The status-bar & cursors display depth.

Scanner Set-up – Manual Input.



When the **Manual Input** tab is selected there is no encoder feedback therefore multiple A-scans are not recorded. Use this mode for manual 'free-hand' scanning with imaging when a record (snapshot) of the currently displayed data may be required. When the scan is terminated, only the data currently displayed is saved.

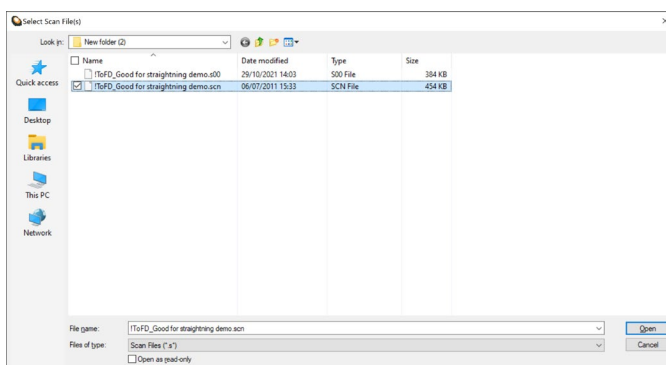
Manual Input may also be used to manually record a series of thickness gauge points on a grid matrix to produce a corrosion map similar in appearance to an X/Y encoded corrosion map. The grid mapping function is only available in the corrosion mapping software, i.e., SuperView disabled (see [Appendix B, item xxiii](#) for detailed instructions).

Primary and Secondary Axes		
Start Position	Allows the operator to specify the start position of the data collection grid.	This value is usually 0
Distance	Specifies the length of the data collection area in the given axis. There are two choices: Distance End Position	End Position is useful if the operator does not want to calculate the actual length of the scan. But knows the desired end position.
Collection Step	The size of each block or gauge point on the data collection grid.	The operator places the probe manually in each block to record the thickness

Offline Analysis

TOFD Offline Analysis.

To start the off-line analysis software, open a previously saved scan file. (From the main menu select *Analyse* or *File Open*, then use *Look in* to select the folder required, highlight the file or multiple files and Tap *Open*).

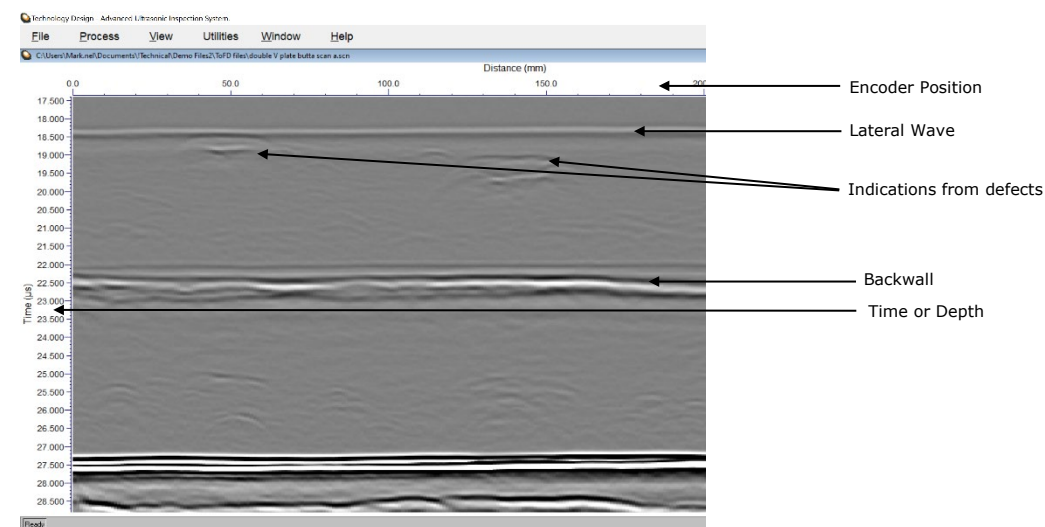


When in *Offline Analysis* mode the menu structure changes as in the illustration below. The menu items in each drop-down menu change depending on the type of ultrasonic file that is displayed (ToFD, Pulse Echo, Phased array, Long Range).

Technology Design - Advanced Ultrasonic Inspection System.

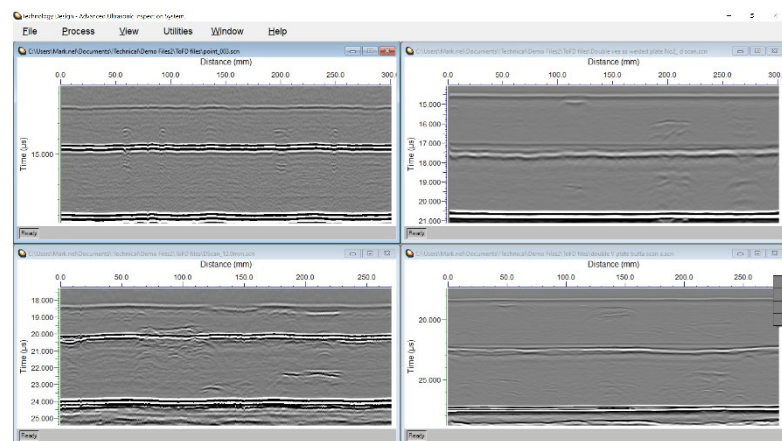
File Process View Utilities Window Help

TOFD Display.

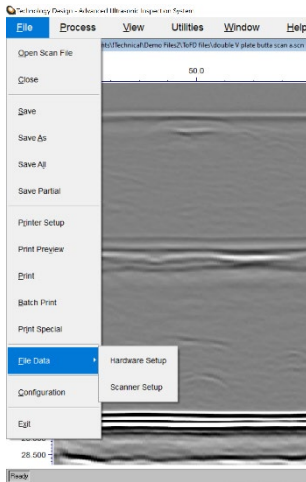


Multiple TOFD Images.

To analyse and view multiple TOFD images open several files and from the main menu and select *Window, Tile Vertically* or *Tile Horizontally*.

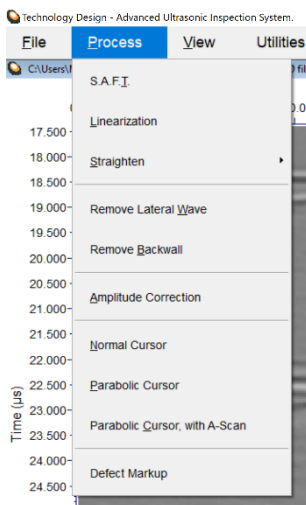


File menu options.



Open Scan File	Allows a TOFD/PE/Corrosion map file to be opened using Windows <i>Open File</i> features.	
Close	Closes the file that is currently in the foreground.	
Save	Saves the file that is currently in the foreground.	
Save as	Allows a file to be saved with a different name and folder location.	
Save all	Saves all files that are currently open.	
Save Partial	Allows the saving of an operator selected area.	
Printer Set-up	Opens the Print Setup dialogue	Allows the selection and configuration of a printer and its settings.
Print Preview	Allows preview of the printout prior to initiating a print.	
Print	Selected file is printed.	The printout is presented in a simple report format that includes annotation, user entered header and certain measurement information.
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	Opens a sub-menu that provides a choice: • Hardware Setup – Opens the <i>Collection Hardware Setup</i> window. • Scanner Setup – Opens the <i>Scanner Setup</i> window.	Allows user to change certain key parameters off-line, data is then automatically re-calculated. If any settings are changed, when the dialogue is closed, a windows browser window will appear offering to save the file with a different extension. This allows the user to preserve the original data.
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	

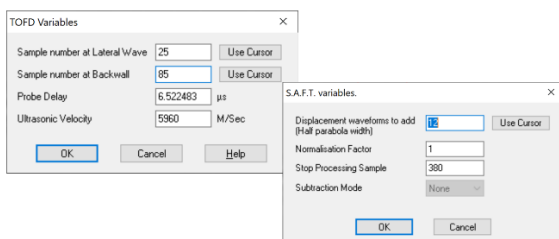
Process menu options.



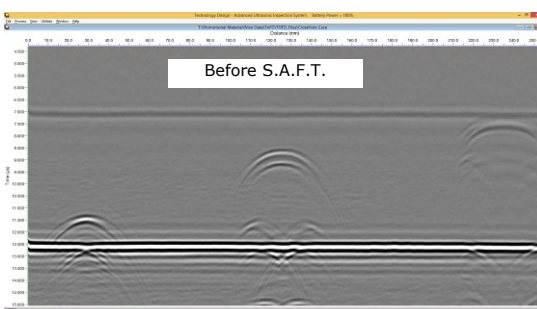
S.A.F.T.	Synthetic-Aperture-Focusing-Technique.	SAFT is a mathematical method of reducing or removing the effects of beam spread in the data image.
Linearization	Converts the data so that vertically, time is converted to depth.	ToFD data is initially viewed in a non-linear time scale, Linearization converts the time scale to a linear depth scale (true depth). Parabolic cursors are however often used instead of the <i>Linearization</i> option.
Straighten	Straightens the lateral wave.	
Remove Lateral Wave	Removes the lateral wave.	Useful when the lateral signal obscures a near surface defect.
Remove Backwall	Removes the backwall.	Useful when the Backwall signal obscures a near surface defect.
Amplitude Correction	Low-level signals are amplified so that the lateral wave is at constant amplitude throughout the scan's width.	
Normal Cursor	Shows the normal cursor. Use with linearized data to read depth values.	
Parabolic Cursor	Enables 2 parabolic cursors for defect sizing.	The cursors' arc shape represents the signal from a point reflector. The cursors can therefore be placed on the end cusps of linear defects to determine actual <i>length</i> dimensions. The <i>depth</i> measurement values are volume corrected and displayed in millimetres.
Parabolic Cursor, with A-Scan	Enables 2 parabolic cursors for defect sizing. The A-Scan is also displayed.	Same as above.
Defect Markup	Displays the Defect Markup dialogue.	Using parabolic cursors, the operator can record defect dimensions and enter or select other defect information. After completing defect sizing a numbered box is displayed and encompasses the defined defect.

Synthetic-Aperture-Focusing-Technique (S.A.F.T.)

Synthetic-Aperture-Focusing-Technique (SAFT) provides an accurate measurement of the spatial location and extent of flaws contained in the test material. Transit-time for the ultrasonic beam to travel to and from a point is a hyperbolic function of the probe position and target depth. When the equation of this hyperbola is known, A-scan signals can be shifted in time and added together. When a defect is present constructive interference of the waveforms forms a large signal. When no defect is present the interference is destructive, and the signal is small. To invoke the SAFT processing option select *Process, SAFT* from the main menu. The following dialogue boxes are displayed which allows you to set-up the necessary parameters for SAFT processing.



Only two out of four parameters in the **TOFD Variables** dialogue need to be entered, the software will automatically calculate the other two parameters. Tap *OK* to continue to the **S.A.F.T. variables** dialogue.

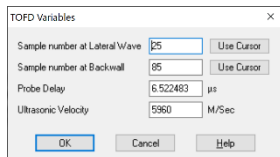


Displacement waveforms to add (Half parabola width)	Select half the parabola width.	Tap the <i>Use Cursor</i> button to define the area of interest manually.
Use Cursor	Allows the use of cursors to define the half parabola width.	Place one delimiter line on the centre of the cusp and the other on the edge.

Normalisation Factor	Boosts contrast (gain)	The SAFT process averages gain (contrast) therefore the overall contrast of the image will be lower after processing. Increasing the normalisation factor will increase or 'normalise' the contrast.
Stop Processing Sample	The sample at which SAFT processing will stop.	

Linearization.

To correct for the non-linearity of the beam angle spread, this utility will correct the vertical axis so that a direct depth reading can be taken. To invoke this option, select *Process, Linearization* from the *Process* menu. The following dialogue box is displayed which allows you to set-up the necessary parameters for linearization.



TOFD Variables

Sample number at Lateral Wave: 25 Use Cursor

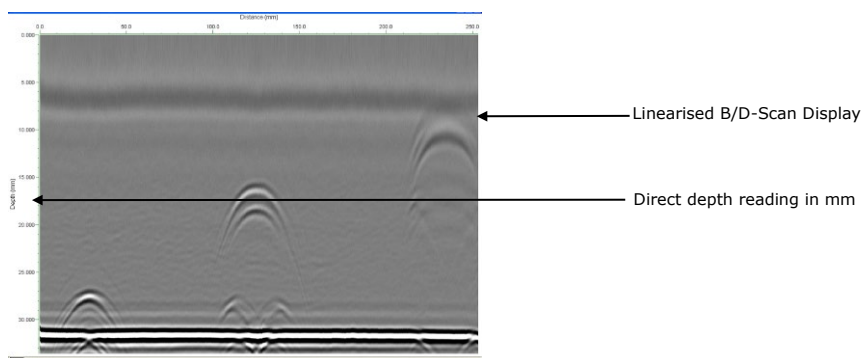
Sample number at Backwall: 85 Use Cursor

Probe Delay: 6.522483 µs

Ultrasonic Velocity: 5960 M/Sec

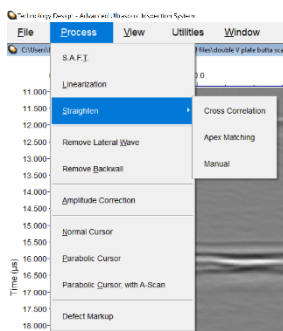
OK Cancel Help

Only two out of four parameters need to be entered, the software will automatically calculate the other two parameters. Tap OK to continue.



Straighten Image

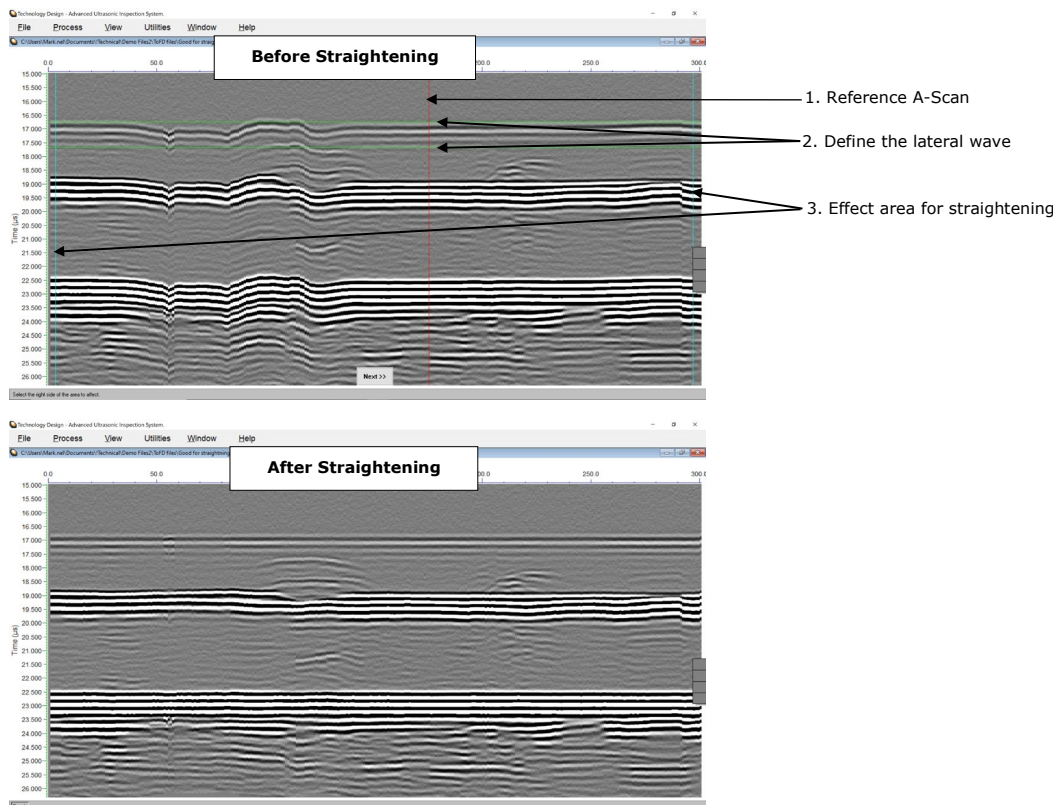
To reduce the effects of uneven surfaces, the image may be straightened by selecting *Process, Straighten* from the main menu and choosing one of the straightening procedures.



Cross Correlation	A statistical measure of proximity alignment between the A-scans. Used to vertically align the A-scans so that the image appears straight. (Note; this is the easiest straightening procedure to use. We also suggest that with 'difficult' data,	A series of vertical and horizontal cursors appear that allow operators to select a reference A-Scan, define the Lateral Wave and choose an area
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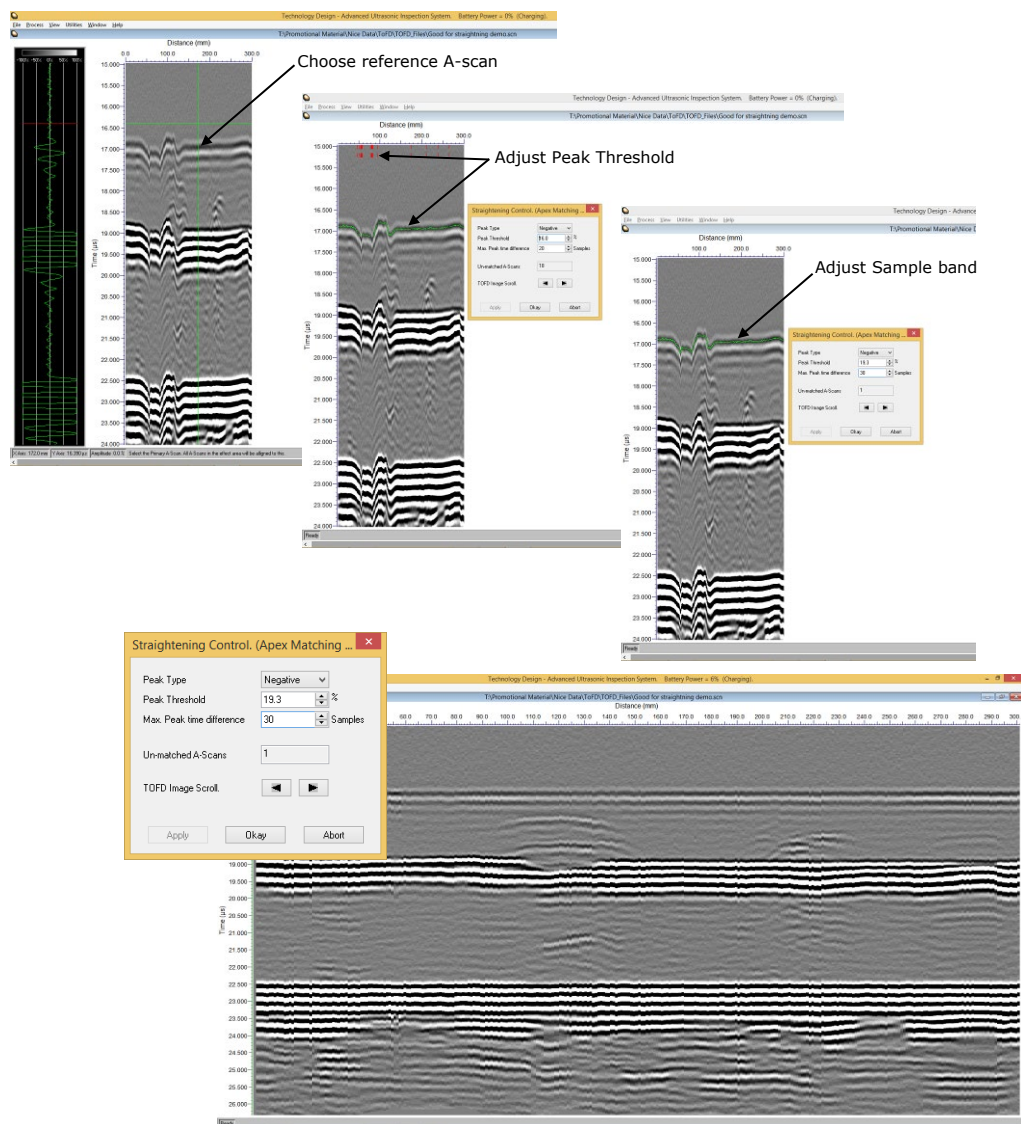
	straighten the data in manageable sections, then straighten the entire weld length,)	of interest. Instructions for using the cursors appear at the bottom of the Display.
Apex Matching	Compares A-scans above a reference amplitude and within a defined band of samples and then aligns them vertically to a reference A-scan	a) A series of crosshair cursors appear that allow operators to select a reference A-Scan and an area of interest. Instructions for using the cursors appear at the bottom of the Display. b) The <i>Straightening Control</i> dialogue then appears. See <i>Apex Matching</i> in Appendix B for detailed instructions.
Manual	Allows vertical adjustment of individual A-scans	

Straighten Image - Cross Correlation



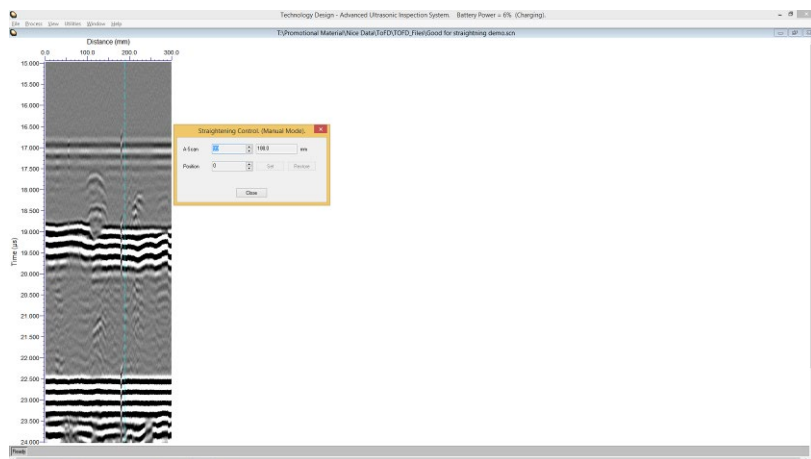
Straighten Image - Apex Matching

Peak Type	Refers to the signal phase that will be used for processing. There are 3 choices: Any , Positive or Negative .	We recommend using the negative phase.
Peak Threshold	The amplitude threshold above which peaks will be processed.	Setting this level too low or too high increases unmatched A-scans.
Max. Peak time difference	The band of samples within which peaks will be processed.	The band should be wide enough to encompass the same processed phase on each A-scan.
Unmatched A-Scans	Number of A-Scans within the selected area that do not fall within the selected thresholds	To achieve the minimum possible number of unmatched A-scans, a balance between Peak Threshold and Max. Peak Time Difference must be established through trial and error.
TOFD Image Scroll	Moves the viewable window left or right	Tap the left and right buttons to view that part of the image that is beyond the viewable window.



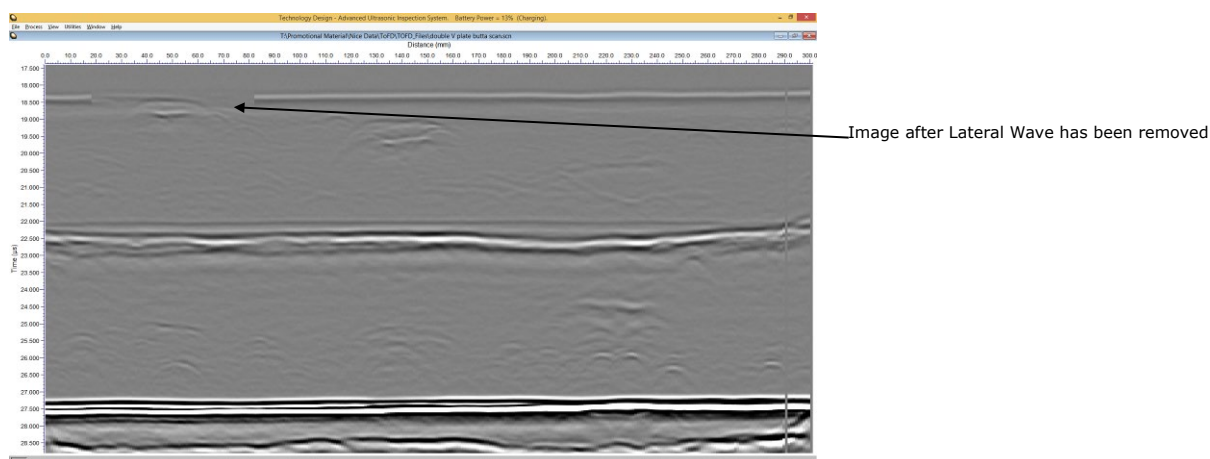
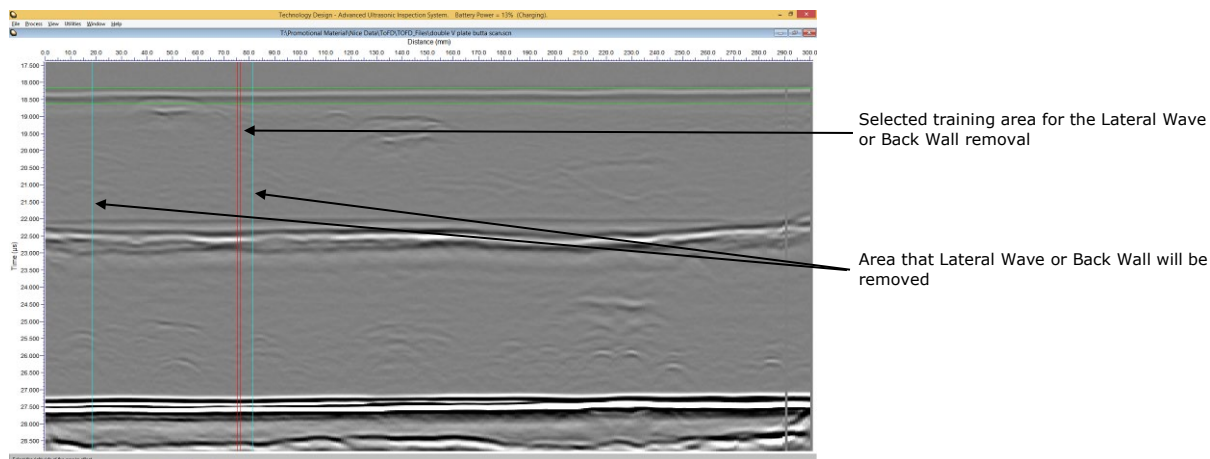
Straighten Image – Manual

A-Scan	Moves the dashed cursor left or right horizontally along the length of the data image.	Move this cursor using the left or right arrow keys to cover a single A-scan that is to be adjusted.
Position	Moves the A-Scan up or down vertically.	Move the selected A-Scan using the up or down arrow keys to the desired location.



Lateral Wave / Backwall Removal

To remove the Lateral Wave from the B/D-Scan image, select *Process, Remove Lateral Wave* from the main menu. A series of vertical and horizontal cursors appear which allow you to select a reference Lateral Wave area (training area) and an effect area. Instructions for using the cursors appear at the bottom of the display. The removal of the Lateral Wave allows detection of near surface cracks/defects which may have been obscured by the Lateral Wave itself.

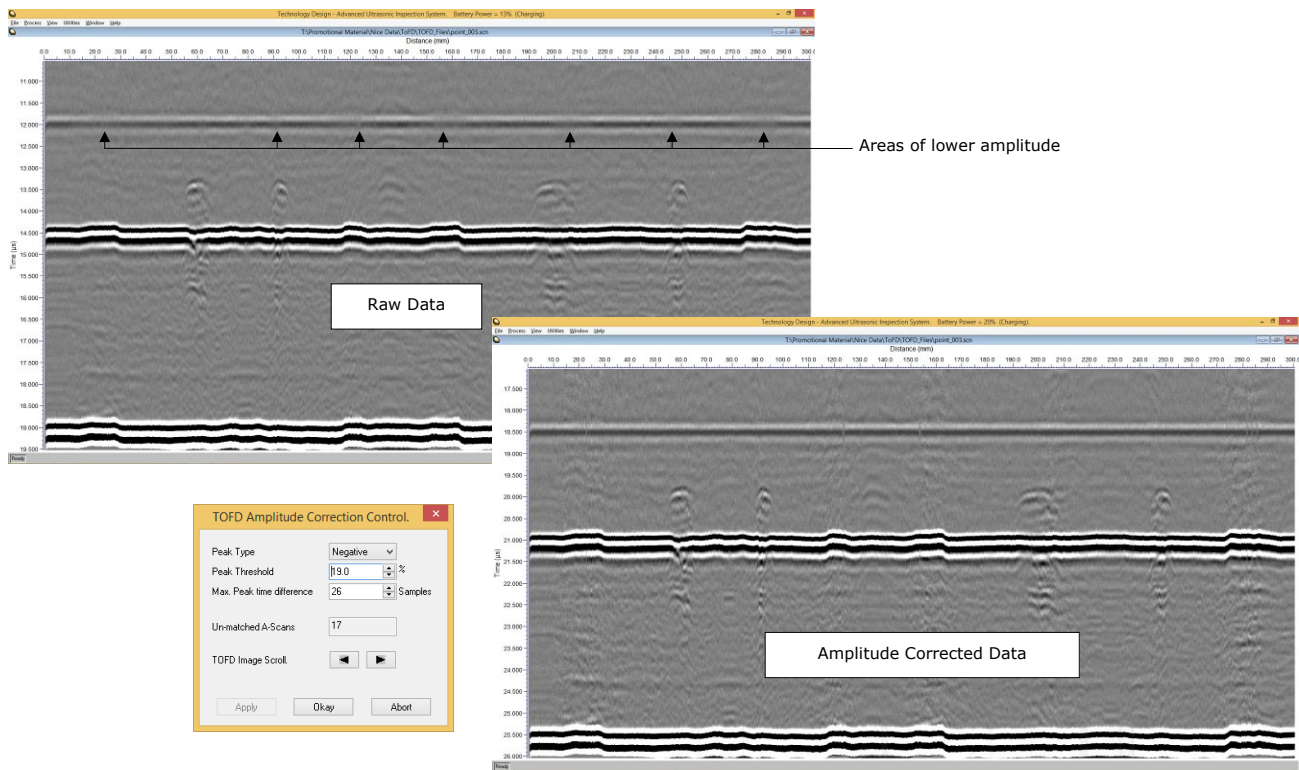


Amplitude Correction.

Amplitude correction is a process where low-level A-Scans are amplified so that constant lateral wave amplitude is maintained throughout the scan length.

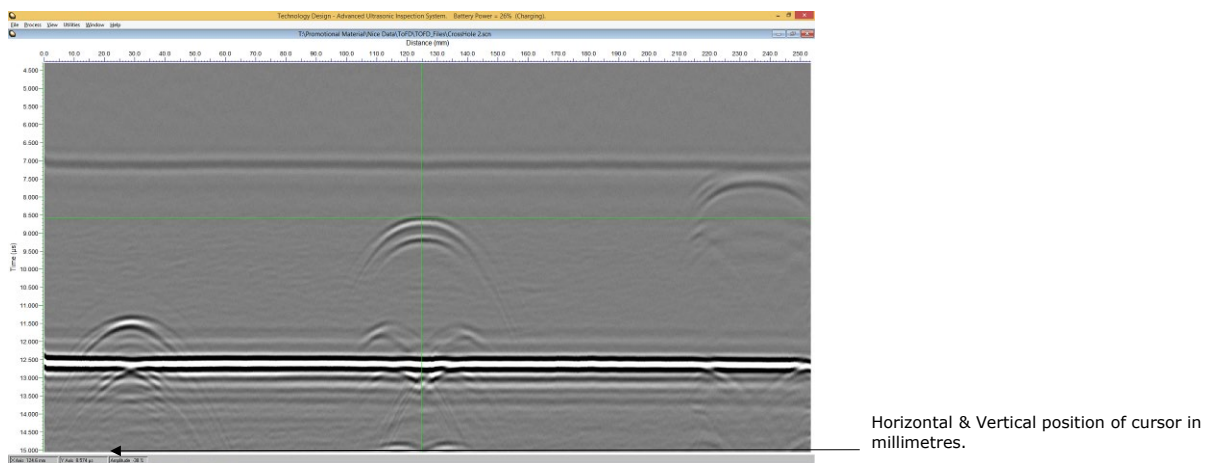
After selection of this option from the menu, the software displays the data in 1:1 mode and requests the entry of the primary A-Scan. This is the A-Scan that all other A-Scans will be amplified to. (**Tip: When selecting the primary A-Scan, select one with a strong lateral wave signal**). Next select the left & right sides of the affect area. Data outside of this area will not be amplitude corrected. The *TOFD Amplitude Correction Control* dialogue box now appears

Peak Type	Select either positive or negative Peak Type	
Peak Threshold	The amplitude threshold above which peaks will be processed.	If the number of Un-matched A-Scans is not zero, the values for Peak Threshold may need adjustment.
Max. Peak time difference	The band of samples within which peaks will be processed.	If the number of Un-matched A-Scans is not zero, the values for Max. Peak time difference may need adjustment.
Un-Matched A-Scans	Number of A-Scans within the selected area that do not fall within the selected thresholds	
TOFD Image Scroll	Moves the viewable window left or right	Tap the left and right buttons to view that part of the image that is beyond the viewable window.



Normal Cursor

The **Normal Cursor** appears as a crosshair on the B or D-Scan image that can be positioned by moving the mouse. The signal amplitude and X, Y position at the crosshair centre point is displayed at the bottom of the screen.



Parabolic Cursor

Parabolic Cursors allow defect sizing and depth determination.

TOFD Variables

Sample number at Lateral Wave: Use Cursor

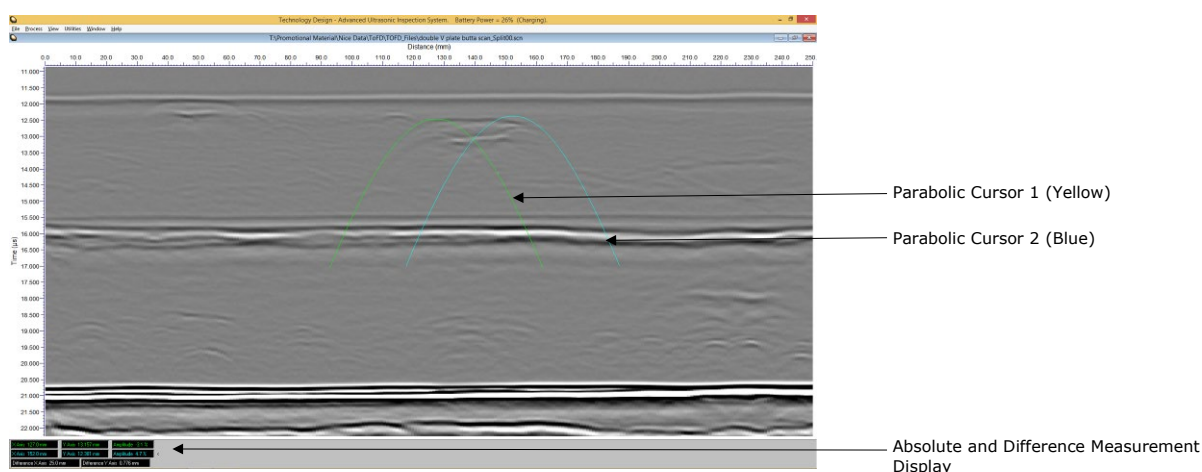
Sample number at Backwall: Use Cursor

Probe Delay: µs

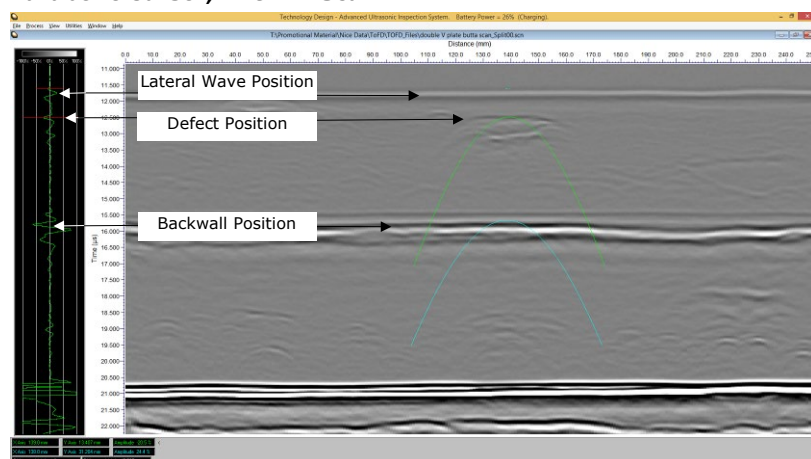
Ultrasonic Velocity: M/Sec

Sample number at Lateral Wave	Defines the sample number on the lateral wave from which zero will be referenced.	Enter the Lateral Wave sample number or use the cursor to define it.
Sample number at Back-wall	Defines the sample number that from which the backwall signal is referenced.	Enter the Nackwall sample number or use the cursor to define it.
Probe	Probe delay	Enter the probe delay in μs
Ultrasonic Velocity	Compression wave velocity in the test material	The velocity is entered automatically but may be enter user.

NOTE: Only two out of four parameters need to be entered, the software will automatically calculate the other two parameters. A blue and a yellow parabolic cursor are displayed which allow you to size defects and cracks. The absolute measurement and difference between the cursors is shown at the bottom of the display.



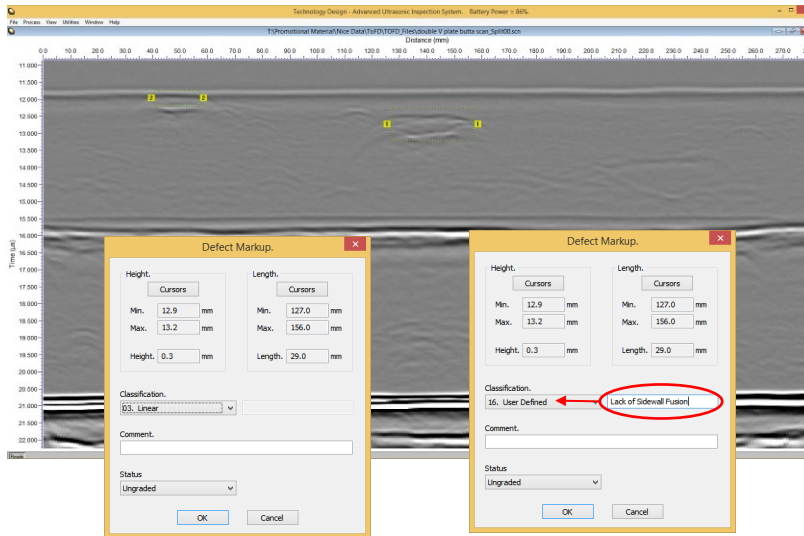
Parabolic Cursor, With A- Scan



The above image shows the **Parabolic cursors with A-Scan** display. This functionality is similar to the previously described **Parabolic cursors**. This feature has the addition of a vertical A-scan display and added ability to reposition the vertical location of the lateral wave. This feature is most useful when the lateral wave is not 100% straight. To reposition the lateral wave, press the mouse right button, place the mouse cursor over the A-Scan display, and press the mouse left button. Now, moving the mouse up/down moves the position of the lateral wave. Once the correct location has been achieved, pressing the mouse right button returns the mouse pointer.

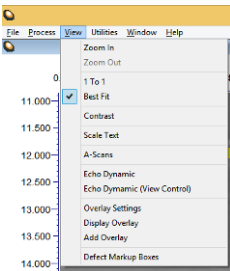
Defect Markup

Using the **Defect Markup** control allows the operator to define and record the characteristics of a defect. The recorded defect information may then be used to automatically populate a user defined report template. Defect information may be edited by *double Tapping* in the numbered boxes.



Height		
Cursors	Displays the <i>ToFD Variables</i> dialogue.	If parabolic cursors have already been defined in the current session, then these cursors will be displayed without the setup dialogue being displayed.
Min.	The time value at the cursor closest to the scan surface.	When in the desired position, <i>left Tap</i> to activate the other cursor.
Max.	The time value at the cursor closest to the backwall signal.	When in the desired position, <i>right Tap</i> to enter both cursor values and return to the Defect Markup dialogue.
Height	The <i>difference</i> between Min. and Max. values.	
Length		
Cursors	Displays the <i>ToFD Variables</i> dialogue.	If parabolic cursors have already been defined in the current session, then these cursors will be displayed without the setup dialogue being displayed.
Min.	The distance value at the first cursor.	When in the desired position, <i>left Tap</i> to activate the other cursor.
Max.	The distance value at the second cursor.	When in the desired position, <i>right Tap</i> to enter both cursor values and return to the Defect Markup dialogue.
Length	The <i>difference</i> between Min. and Max. values.	
Classification	Displays a drop-down list of defect types.	Select an item from the list. The <i>User Defined</i> item allows entry of any text in the box to the right.
Comment	Allows entry of additional comments.	
Status	Displays a drop-down list of selectable items: • Ungraded • Acceptable • Unacceptable • No Analysis Possible	

View menu options

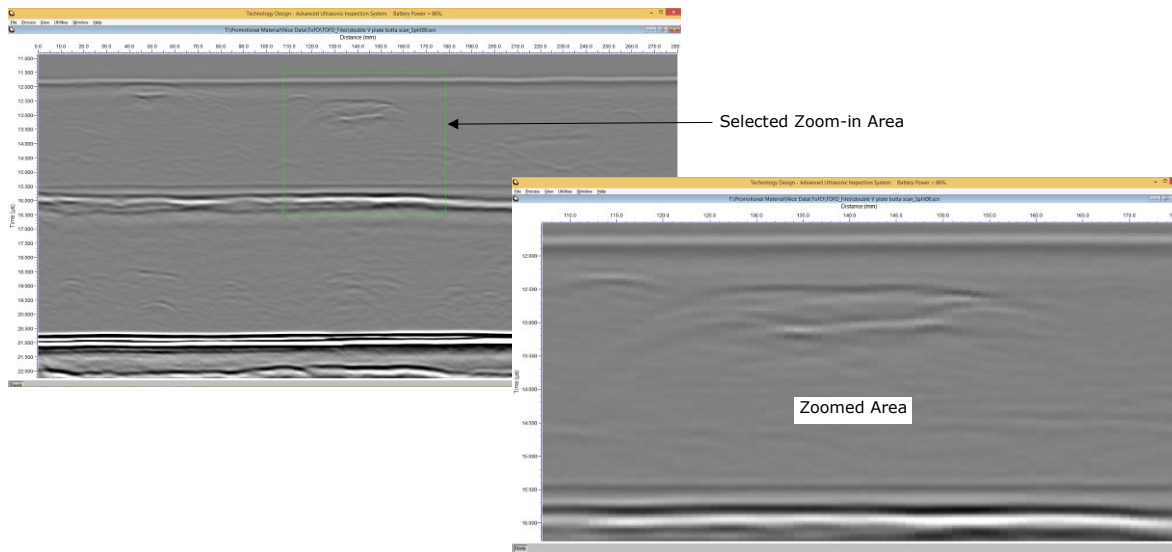


Zoom In	Activates a resizable selection box.	Allows the operator to select the top-left to bottom-right of the data they wish to see in the view area. To move around the Zoomed image, use the Vertical and Horizontal Scroll bars. If a cursor has been selected, moving
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		the cursor point will also allow you to scroll around the full image
Zoom Out	If not all of the data is currently displayed, this option displays more of the data in the display area.	Use to zoom out.
1 to 1	Sets the displayed data equal to the number of pixels in the image. - Number of samples = Number of Vertical pixels - Number of A-Scans = Number of Horizontal pixels.	The aspect ratio between width and length of scan is preserved.
Best Fit	This option fits all the data into the display area. If the data is compressed into the area, i.e. some samples are not displayed; the software shows the samples with the greatest amplitude.	
Contrast	Opens the contrast control dialog. The following keyboard shortcuts may also be used: Shift F5 = Contrast down & Shift F6 = Contrast up.	Used to make the image darker or lighter. Useful to improve the visibility between indications and the surrounding material.
Scale Text	Opens the scale text dialog, this allows the operator to select values for font size, number of decimal places, etc... (see below for details)	
A-Scans	Opens the A-Scan view.	Displays a crosshair and A-scan. Measurement values are: X = mm, Y = μ s & amplitude.
Echo Dynamic	Opens the Echo Dynamic view.	Project specific – not used for ToFD.
Echo Dynamic (View Control)	Opens the Echo Dynamic view control dialog box.	Project specific – not used for ToFD.
Overlay Settings	Allows the operator to set default setting for text & graphic overlays.	
Display Overlay	Turns text & graphic overlays on/off.	
Add Overlay	Allows the operator to insert text & graphic overlays into the TOFD data.	Useful for annotating data.
Defect Markup Boxes	Displays or hides the Defect Markup Boxes.	

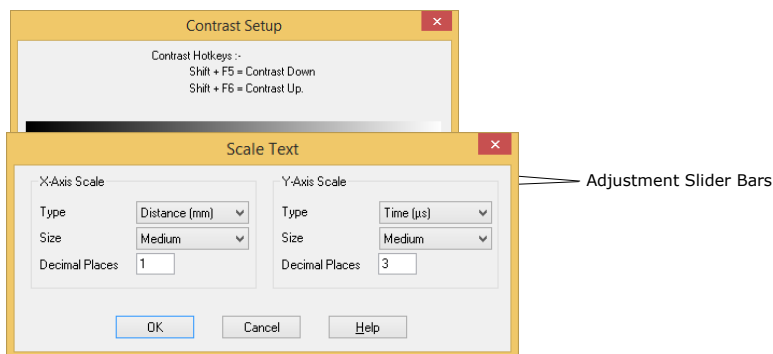
Zoom In.

To Zoom-in on an area of interest, select View, Zoom-in option. The Zoom area is shown by a green box that can be sized by moving the mouse. When the desired Zoom-in area has been selected, press the left mouse button. The image will then zoom to the selected area. Scrolling is achieved by moving the mouse pointer to the image edges or using the scroll bars.



Contrast Set-up

To enhance the grey-scale image, contrast and brightness may be adjusted by selecting View, Contrast from the main menu and moving the slider bars to adjust the image. When multiple TOFD images are displayed, the contrast adjustment is independent for each image.



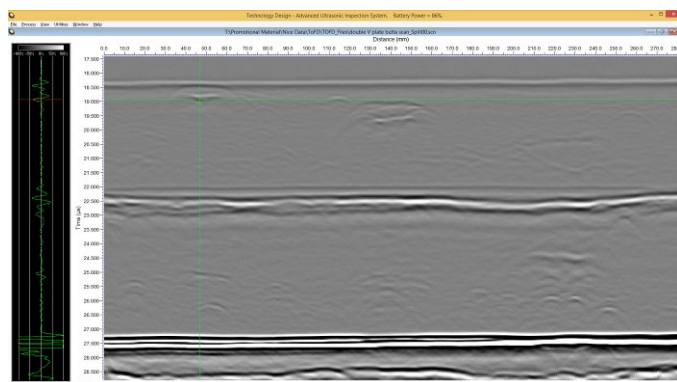
Scale Text

To select the X and Y image text function, size, and resolution; select View, Scale Text from the main menu.

X-Axis		
Type	Allows the operator to select between: A-Scans number of A-scans moved. Distance (mm) Measured distance moved.	
Size	Allows the distance scale text size to be selected, small , medium , or large .	
Decimal Places	Enter the number of decimal points of values displayed on the distance scale.	
Y-Axis		
Type	Allows the operator to select between: Samples Time(µs) Depth (mm)	The Depth (mm) item displays a ToFD Variables dialogue. This procedure linearizes (displays depth in mm) the time scale which makes estimating the depth of indications visually or with the A-scan crosshair cursor easier.
Size	Allows the time scale text size to be selected, small , medium , or large	
Decimal Places	Enter the number of decimal points of values displayed on the time scale.	

A-Scans

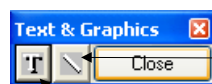
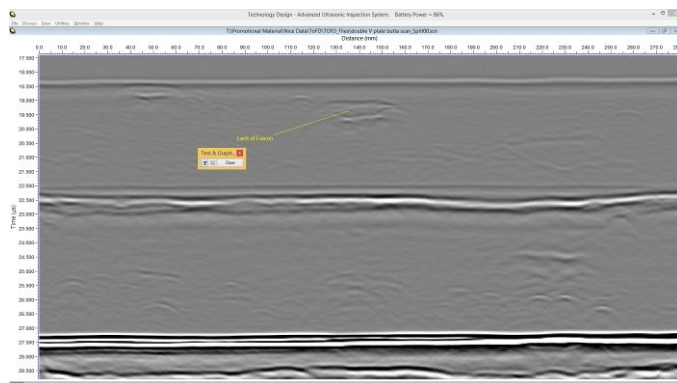
To enable A-Scan display, select **View, A-Scans** from the main menu. A cross hair will appear on the B/D-Scan image which can be positioned by moving the mouse. The signal amplitude and X, Y position at the crosshair centre point is displayed at the bottom of the screen.



Add Overlay.

On selecting **Add Overlay** from the menu, the Text & Graphics dialog box is displayed. Pressing either the **Add line** , or **Add text**  allows the addition of an overlay object.

Once an object has been added, its properties may be modified by placing the mouse cursor over the overlay object and pressing the mouse right button. To keep overlay objects the scan file must be saved.

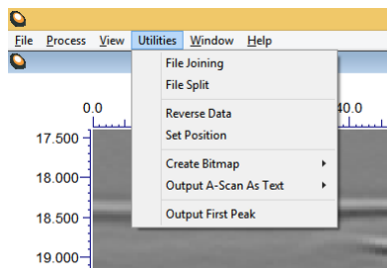


Add Line

Add Text

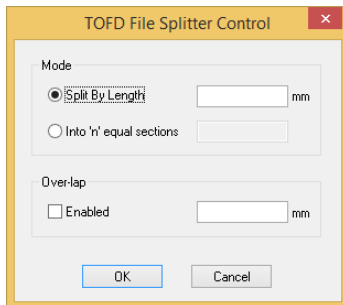
Utilities menu options

From the main menu select **Utilities**.



File Joining	Allows 2 or more TOFD images to be joined together.	Instructions are provided in Appendix B
File Split	Opens the ToFD File Splitter Control dialogue.	Splits a scan file into smaller files.
Reverse Data	Encoder positions may be reversed by selecting this option. Typically used if the geometry restrictions force the scan to be reversed.	
Set Position	Allows the encoder position to be reset to new value. Used if reference point used on a particular scan was incorrect or requires changing.	
Create Bitmap	Whole Window - Saves the data and vertical & horizontal scales for export to other Windows® packages using the BMP file format. Data Only - Saves the data only for export to other Windows® packages using the BMP file format.	An alternative is to press the <i>Print Screen</i> button and then use the <i>Paste</i> and <i>Crop</i> controls in Windows® programs.
Output A-Scan As Text	Outputs A-Scan data to a delimited text file.	Used for 3 rd party post processing of data.

File Split



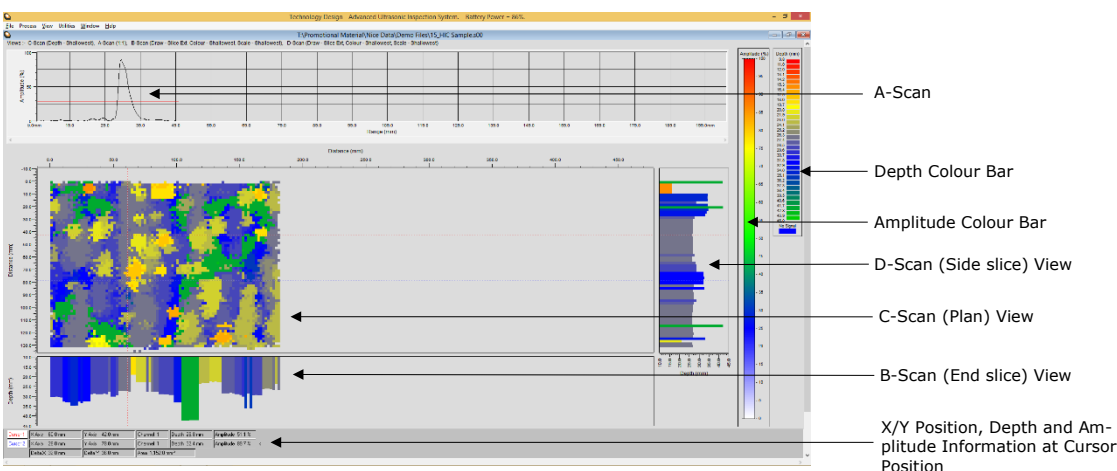
Each split section is saved to a separate file with the original name and an identification suffix, for example:

Original File file1.scan
 1st Split file1_Split00.scn
 2nd Split file1_Split01.scn

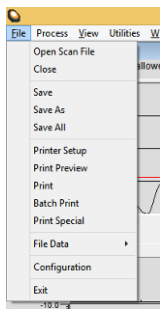
Mode		
Split By Length	Splits the scan data at the distance entered by the user.	If the scan is long enough it will split at equal lengths equal to the entered distance.
Into 'n' equal sections	Splits the scan data into the number of sections entered by the user.	Sections will be of equal size.
Over-lap		
Enabled	Adds user defined overlap amount to each split.	Overlaps are useful if significant indications lie across a split.

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

Typical PE/Corrosion map display



PE/Corrosion Mapping Offline Analysis - File menu options

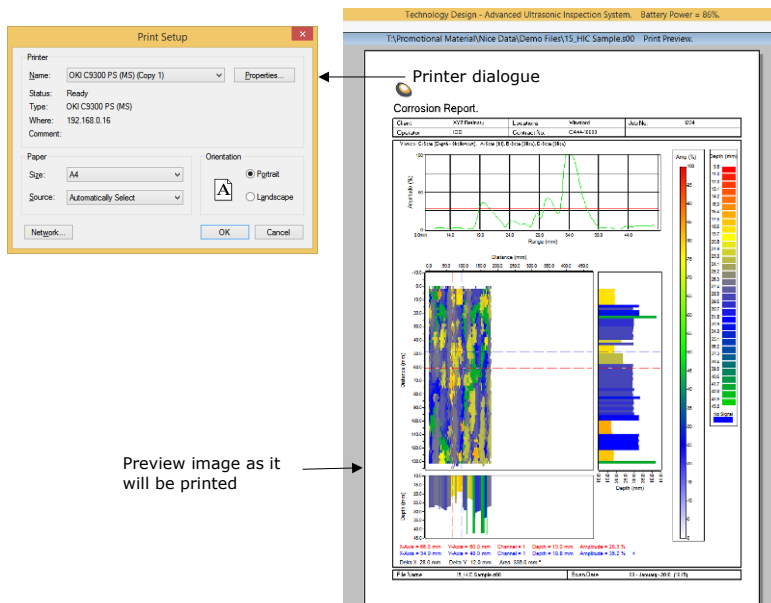


Open Scan File	Opens the Select Scan File(s) dialogue	Allows a any data file to be opened using Windows® Open File features
Close	Closes the file that is currently in the foreground	
Save	Saves the file that is currently in the foreground	
Save as	Opens the Select Scan File(s) dialogue	Allows the file 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 printout 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	

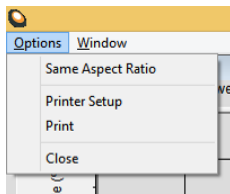
Print Preview and Print

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.

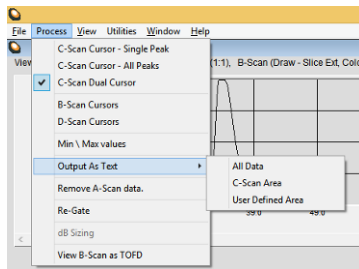


Options Menu



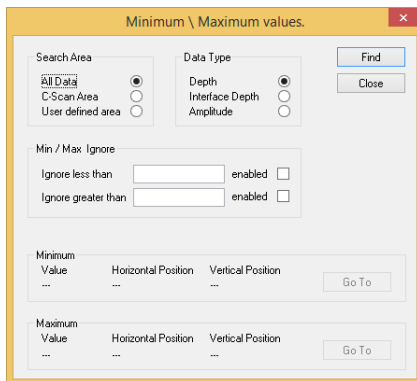
Same Aspect Ratio	Alters the aspect ratio of the image.	Tapping this control alternates between keeping the same aspect ratio as the original data and stretching the data to fit into the available space.
Print Setup	Displays the Print Setup dialogue.	
Print	Sends the document to the printer selected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

PE/Corrosion Mapping Offline Analysis - Process menu options



C-Scan Cursor - Single Peak	Enables a single crosshair cursor. Values for depth, amplitude, location etc. are taken from the data displayed in the C-Scan area for the position of the crosshair.	Allows the user to position a cursor over data in the C-Scan area.
C-Scan Cursor - All Peaks	Enables a single crosshair cursor and peak list. If multiple peaks are at the crosshair position, they are shown in the peak list window.	Allows the user to position a cursor over data within the C-Scan area.
C-Scan Cursor - Dual Cursor	Enables 2 crosshair cursors. Values for depth, amplitude, location, area & difference between cursors etc. are displayed in the C-Scan area.	Allows the operator to place 2 cursors over the C-Scan data.
B-Scan Cursors	Enables 2 crosshair cursors. Depth or amplitude and surface location values are displayed in flags & difference between cursors is displayed on the info bar.	Could also be described as an end or side view of a slice through the material at the location of the cursor.
D-Scan Cursors	Enables 2 crosshair cursors. Depth or amplitude and surface location values are displayed in flags & difference between cursors is displayed on the info bar.	Could also be described as an end or side view of a slice through the material at the location of the cursor.
Min/Max Values	Opens the Minimum \ Maximum values dialogue.	See below for further details.
Output As Text • All data • C-Scan Area • User Defined area	Output data in comma separated format for export to spreadsheets and statistical packages such as Excel®.	User Defined area allows the operator to drag a hatched box over the C-Scan data to define the area of interest.
Remove A-Scan data	Removes the raw A-Scan data from the file.	- File size will be reduced. - A-scan will not be available for display.
Re-Gate	Allows the operator to re-gate the data.	See below for further details.
dB Sizing	Currently not available	

Min/Max Values



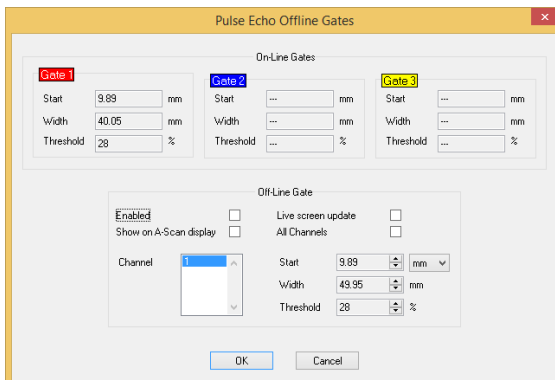
The dialog box is titled "Minimum \ Maximum values." It contains several sections: "Search Area" with radio buttons for "All Data", "C-Scan Area", and "User defined area"; "Data Type" with radio buttons for "Depth", "Interface Depth", and "Amplitude"; "Min / Max Ignore" with input fields for "Ignore less than" and "Ignore greater than", each with an "enabled" checkbox; and two sections for "Minimum Value" and "Maximum Value", each with input fields for "Value", "Horizontal Position", and "Vertical Position", and a "Go To" button.

To use the *Min/Max depth/amplitude analysis* feature, select **Process - Min/Max** from the main menu. The minimum and maximum depth, interface depth or signal amplitude values are automatically determined. By pressing the Go To buttons, the cursor will be automatically positioned at the position of the min/max value. The min/max ignore feature allows you to ignore spurious or unwanted depth/amplitude readings.

Search Area - All Data - C-Scan Area - User defined area	Select how the system determines the area to search.	User Defined area allows the operator to drag a hatched box over the C-Scan data to define the area of interest.
Data Type - Depth - Interface - Amplitude	Select what type of Min/Max data to process.	
Min/Max Ignore		
Ignore less than	Disregards the data below this value.	
Ignore greater than	Disregards data greater than this value.	
Enable	Enables or disables the control	
Minimum	Displays the <i>value</i> and <i>horizontal & vertical</i> position of the value that matches the <i>minimum</i> search criteria.	
Maximum	Displays the <i>value</i> and <i>horizontal & vertical</i> position of the value that matches the <i>maximum</i> search criteria.	
Go To	Displays a black crosshair cursor on the C-Scan display at the <i>minimum</i> or <i>maximum</i> position.	

Re-Gate

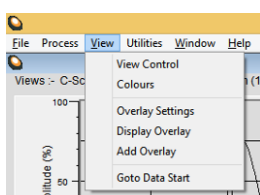
Data may be re-gated off-line however; the gate can only be adjusted within the original time/depth gate position.



The dialog box is titled "Pulse Echo Offline Gates". It has two main sections: "On-Line Gates" and "Off-Line Gate". The "On-Line Gates" section contains three gate configurations (Gate 1, Gate 2, Gate 3) with input fields for "Start", "Width", and "Threshold". The "Off-Line Gate" section has checkboxes for "Enabled", "Live screen update", and "Show on A-Scan display", a "Channel" dropdown menu, and input fields for "Start", "Width", and "Threshold".

Enabled	Enables the offline gate.	
Show on A-Scan display	Shows the modified gate on the A-Scan display.	
Channel	Allow the selection of a channel. The gate for this channel is modified.	
Live screen update	When enabled, modifications are shown in real time.	
Start	The new gate starts.	
End	The new gate ends.	
Threshold	The new gate threshold.	

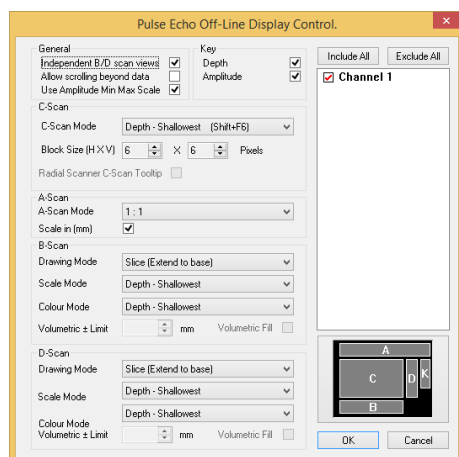
PE/Corrosion Mapping Offline Analysis - View menu options



View Control	Opens the view control dialog box. Allows selection of A -scan, C-scan, end/side views, turns channels on/off, view amplitude / depth, etc.	See next section for detailed explanation.
Colours	Opens the Pulse Echo colour editor.	See the step-by-step explanation in Appendix B
Overlay Settings	Sets the default setting for text & graphic overlays.	
Display Overlay	Enables/disables text & graphic overlay displays.	
Add Overlay	Allows the operator to insert text & graphic overlays into the data.	Useful for annotating data.
Goto Data Start	Sets the top left of the C-Scan area to the top left of the scan area.	

View Control

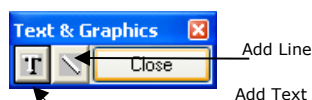
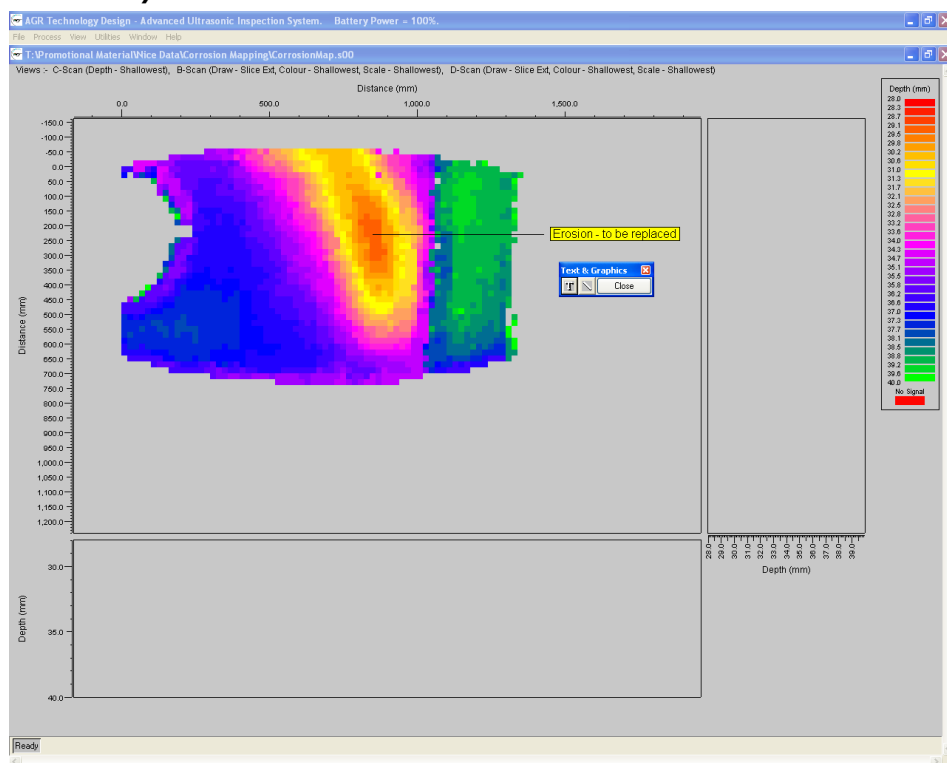
To change the PE/Corrosion Map view, select **View Control** from the main menu or *right-Tap* the mouse. The following dialogue box appears which allows you to configure the display modes.



General:		
Independent B/D scan views	Allows the end/side view images to be viewed as different data types to the C scan image. e.g., The C-Scan image may be displaying depth data, whilst the B and/or D scan image(s) display amplitude data.	
Allow scrolling beyond data	Allows scrolling the C-Scan image beyond the data collection area.	
Use Amplitude Min Max Scale	Uses the colour bar min max values to define the B, B & A scan scales.	Only useful when data is viewed as amplitude. Also known as 'Soft gain'.
Key:		
Depth	Shows the Depth colour key.	
Amplitude	Shows amplitude colour bar.	
C-Scan:		
C-Scan Mode	• Depth – Deepest • Depth – Shallowest • Depth – Interface • Amplitude – Largest • Amplitude – Smallest	Deepest peaks only (Shift + F5) Shallowest peaks only (Shift + F6) Depth to the Interface Echo (Shift + F7) Maximum amplitude peak of collected data (Shift + F8) Minimum amplitude peak of collected data (Shift + F9)
Block Size (HxV)	Defines pixel size for each positional step (1 x 1, 2 x 2, 4 x 4, etc.)	Zoom the data image in or out. The x & y values are applied independently.
A-Scan:		
A-Scan Mode	• Off • 1:1 • Best Fit	Turns the A-Scan display off. Shows each sample at one horizontal pixel position. If the whole A-Scan does not fit into the display area width, the scroll bar under the A-Scan display may be used to scroll the A-Scan left and right. If the A-Scan contains more samples than the A-Scan display area contains pixels (width), the A-Scan data is intelligently decimated to fit the width.
Scale in (mm)	Toggles the A-Scan scale between microseconds (µs) and millimetres. NOTE: The A-Scan scale is in <i>range</i> (beam path) not depth.	For 0° scanning the range and depth values are identical.
B-Scan:		
Drawing Mode	• Off..... • Slice..... • Depth (extend to base)..... • Volumetric (Full Data)..... • Volumetric (C-Scan area).....	No data is displayed. A thin bar for each encoder step is displayed representing the range of the signal in the colours represented by the colour scale. Slice with extension to base in the same colour. Volumetric view of all collected data. Volumetric view of C-Scan area only.

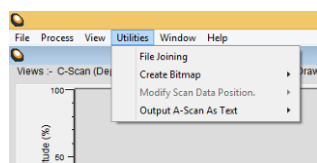
Volumetric (User Limits) A-Scans	The volumetric view is made from data at the cursor position $\pm$ the Volumetric Limit. Displays A-scans as amplitude. A-scan collection must be enabled, or this control is disabled.	Useful for analysing certain degradation mechanisms in the material volume, e.g. Hydrogen damage with stepwise cracking. Each encoder step is displayed in colours defined by the user in the <i>Peak Amplitude</i> colour palette.
Scale Mode	Enabled when Independent B/D scan views is enabled, this list box allows the selection of amplitude or depth data to be used for defining the B-Scan scales.	
Colour Mode	Enabled when Independent B/D scan views is enabled, this list box allows the selected amplitude or depth data to be used for defining the B-Scan colours.	
Volumetric $\pm$ Limit mm	Sets the area (vertical size) to use for the volumetric view. The tick marks on the vertical member of the crosshair show this dimension.	
Volumetric Fill	Fills the volumetric view.	
D-Scan:		
Drawing Mode Off..... Slice..... Slice (extend to base) Volumetric (Full Data) Volumetric (C-Scan area) Volumetric (User Limits) A-Scans	No data is displayed. A thin bar for each encoder step is displayed representing the range of the signal in the colours represented by the colour scale. Slice with extension to base with same colour Volumetric view of all collected data Volumetric view of C-Scan area only The volumetric view is made from data at the cursor position $\pm$ the Volumetric Limit Displays A-scans as amplitude. A-scan collection must be enabled or this control is disabled.	Useful for analysing certain degradation mechanisms in the material volume, e.g. Hydrogen damage with stepwise cracking. Each encoder step is displayed in colours defined by the user in the <i>Peak Amplitude</i> colour palette.
Scale Mode	Enabled when Independent B/D scan views is enabled, this list box allows the selection of amplitude or depth data to be used for defining the D-Scan scales.	
Colour Mode	Enabled when Independent B/D scan views is enabled, this list box allows the selection of amplitude or depth data to be used for defining the D-Scan colours.	
Volumetric $\pm$ Limit mm	Sets the area (Horizontal size) used for the volumetric view. The tick marks on the horizontal member of the crosshair show this dimension.	
Volumetric Fill	Fills the volumetric view.	
Channel List:		
Channel List	This is a list of all enabled Pulse Echo channels at the time the data was collected. Double Tapping with the mouse left button, toggles the display state for individual channels.	
Include All	Enables ALL channels for display.	
Exclude All	Disables ALL channels for display.	

Add Overlay.



On selecting *Add Overlay* from the menu, the Text & Graphics dialog box is displayed. Pressing either the *Add line* , or *Add text*  allows that addition of an overlay object.
Once an object has been added, its properties may be modified by placing the mouse cursor over the overlay object and pressing the mouse right button. To keep overlay objects the file must be saved.

PE/Corrosion Mapping Offline Analysis – Utilities menu options.



File Joining	Automatically join multiple PE/Corrosion mapping files together by using the cursor to select reference points on each selected image	Instructions are provided in Appendix B
Create Bitmap Whole Window Data Only	Creates a graphic image of the entire window in the BMP (bitmap) file format. Creates a bitmap of the data only.	To insert an image of the data into another application (e.g., MS Word®) an alternative method is to use the <i>copy</i> , <i>paste</i> and <i>crop</i> features.
Modify Scan Data Position	Currently inactive	
Output A-Scan As Text	Outputs A-Scan data to a delimited text file. There are 3 choices: Single A-scan – outputs data from a single user defined A-scan All Channels – outputs A-scan data from all active channels Single Channel – outputs A-scan data from a single user defined channel	Used for 3 rd party post processing of data.

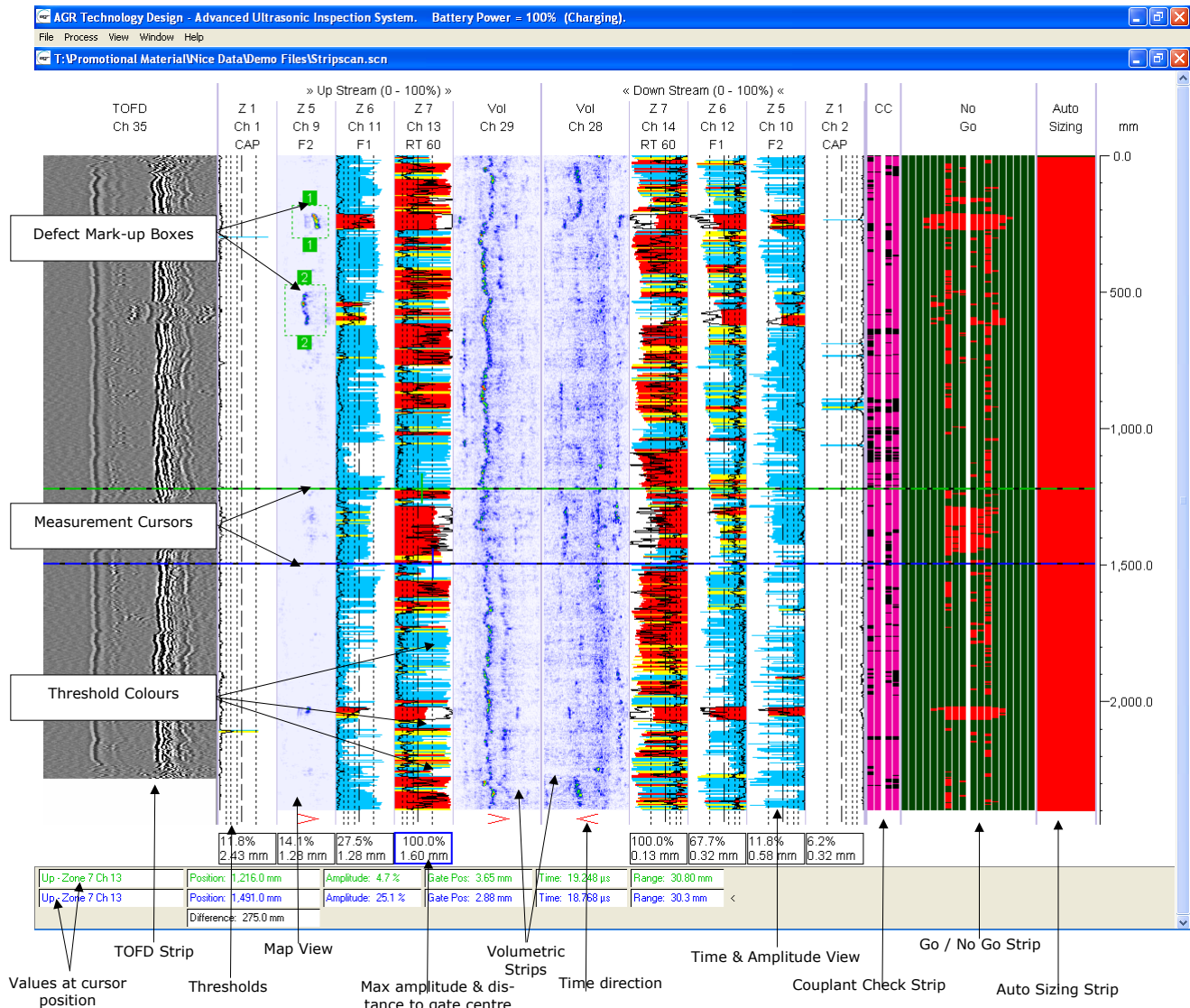
Phased Array Analysis – Offline Analysis

Phased array data is complex and may require special techniques to display data to its full potential. The SuperView software module in TDScan provides controls that make the complexities of displaying and analysing complex data easy. Although primarily used to display Phased array data, ToFD and Pulse echo data may also be displayed in Superview.

SuperView

StripScan - Off-Line Analysis.

Typical Strip Scan display

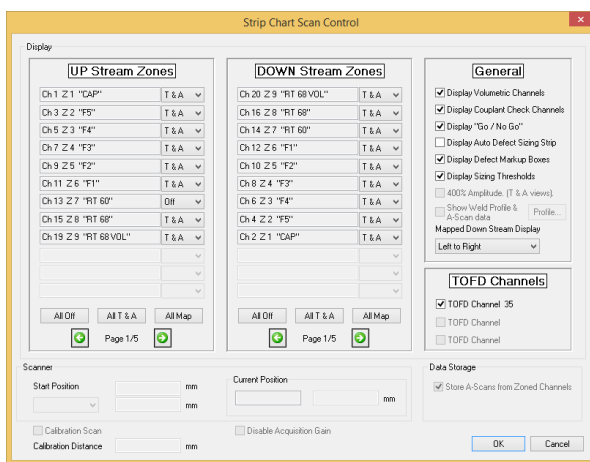


Strip Definitions

TOFD Strips	TOFD strips display TOFD data with the vertical axis in distance and the horizontal axis in time. A maximum of 3 TOFD channels may be enabled and displayed. Data may be analysed using all the tools usually available for ToFD analysis.	TOFD data may be analysed by double Tapping the ToFD image. The Image changes to a standard horizontal view with full analysis tools available. When analysis is complete close the window by Tapping the 'X' in the top left hand corner of the window to return to the Strip-Scan view.
Up/Down Stream Zone Strips (Time & Amplitude View)	The zone strip shows the highest amplitude (biggest) signal in the data collection gate as a solid line, and the time within the gate as a shaded area. A maximum of 100 zone strips are possible. (50 upstream, 50 downstream). The coloured shades of the TOF area represent the thresholds defined in the Defect Sizing controls on the StripScan page in Collection Hardware.	The coloured TOF trace may be used to manually evaluate data according to acceptance criteria. The colours allow fast visual evaluation.

Up/Down Stream Zone Strips (Map View)	Map views present A-Scan data as a D-Scan. This option is only available if A-Scan data for zoned channels is stored. The time direction of each strip is displayed as an arrow below the strip.	To switch between T&A and Map view, open the Strip Chart Scan Control dialog box (View – View Control) and select from the drop-down menus for each strip.
Volumetric Strips	Volumetric channels collect Peak and A-Scan data and present this data as stacked A-Scans (D-Scan). This method of data presentation is similar to TOFD data. A maximum of 2 volumetric strips are possible (1 up stream, 1 downstream).	This view may be used to display the full volume of unfocussed data collected from a designated channel.
Couplant Check Strips	Allows up to 4 couplant check strips (2 up stream, 2 downstream). When the signal is above the channel's threshold, the couplant check OK colour is used for drawing. If the signal falls below the threshold, the error colour is used.	Can be disabled or enabled in the Strip Scan Colours dialog box.
Go / No Go	Uses the data from zone channels to create its image. When the signal is above the channel's data collection gate threshold, the Go colour is used for drawing. If the signal falls below the threshold, the No Go colour is used.	Can be disabled or enabled in the Strip Scan Colours dialog box.
Auto Sizing	Displays colours representing accept/reject criteria derived from Defect Sizing and Grouping on the StripScan page in Collection Hardware. Colours are the same as the Go / No Go strips.	

Strip Scan Drawing Control.



Display:		
Up Stream Zones / Down Stream Zones	Allows selection of viewing options for Up/Down stream zoned channels. The options are: Off - Data for this channel is not displayed. T & A - Time & Amplitude view. Map - Data is displayed as a B-scan (Stacked A-Scan view). Only available to channels with A-Scan data collection enabled.	Map view displays a B-scan image focussed in the selected zone.
All Off	Sets all channels to display no data.	
All T & A	Sets all channels to display Time and Amplitude data.	
All Map	Sets all channels to Map View if the A-Scan data is available.	
Display Volumetric Channels	When selected, volumetric channels (if any) are displayed.	
Display Couplant Check Channels	Displays couplant check channels (if any).	
Display Go / No Go	Displays the go/no go strip.	
Display Defect Markup Boxes	Displays defect markup boxes (if any).	
TOFD Channel xx	Displays the TOFD channel xx to be displayed.	
Scanner:		
Start Position	The start position of the scan. (Online only).	
Current Position	The length of the scan. (Online only).	
Data Storage:		
Store A-Scans From Zoned Channels	Enables/Disables A-Scan storage from zoned channels.	
Calibration Scan		
	Disabled in analysis mode, only used online.	

Strip Scan - General

Simply moving the mouse cursor over a strip causes the status bar to display information regarding the information at that point within the strip.

Double Tapping the mouse left button on a TOFD, Zone, Map, or Volumetric strip causes the strip to be displayed in expanded (full screen width) mode. Double Tapping the mouse again returns the strip to its unexpanded view.

To scroll the image Up / Down, use the scroll bar at the right-hand side of the offline window, or **up / down** arrow keys, or **page up / down** keys. When using the keyboard to scroll, pressing the **<shift>** key causes scrolling to be quicker.

When using cursors; press the mouse left button to switch cursors. Also, pressing the mouse right button suspends cursor operation. Cursor operation may be reactivated by placing the mouse within the offline window, and pressing the mouse left button. To turn the cursors off, press the right mouse button, then select **Process – Cursors** from the menu.

Defect may be marked on strips by selecting **Process – Defect Mark-up** from the menu. Position a box around the defect and Tap the left mouse button, the following dialog box is shown:

Defect Mark-up.

Adding a defect mark-up box to a zoned strip

Select **Process – Defect Mark-up** from the menu, this now places the software into defect mark-up add mode.

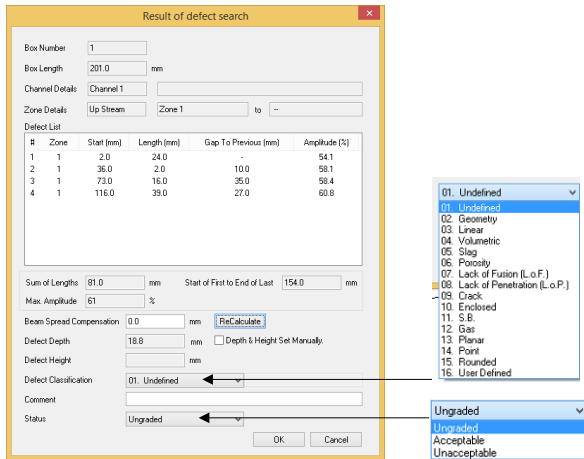
Move the mouse into a zoned strip (*Map or T&A view*), the mouse cursor changes to a cross.

Press the **left** mouse button to set the one corner of the defect mark-up box. Pressing the mouse right button aborts the operation.

Move the mouse to the opposite corner and press the mouse **left** button. Defect boxes may be defined across multiple zones.

The "Result of defect search" dialog box is now displayed.

Once the values in the above dialog box have been satisfactorily entered, press OK. This opens the file save dialog.



#	Zone	Start (mm)	Length (mm)	Gap To Previous (mm)	Amplitude (%)
1	1	2.0	24.0	-	54.1
2	1	36.0	2.0	10.0	58.1
3	1	72.0	16.0	36.0	58.4
4	1	116.0	39.0	27.0	60.8

Box Number	The number of the defect mark-up box.	
Box Length	The length of the defect mark-up box.	Linear area along weld axis that is being evaluated.
Channel Details	Displays channel identity information.	
Zone Details	Displays zone identity information.	Channel Number etc.
Defect List	A list of defects found within the mark-up box. Information includes: - Defect number. - Zone that defect is located in. - Start position of defect. - Length of defect. - Distance between separated defects. - Highest amplitude detected for the defect.	Stream, Numbers of 1 st zone and last zones that the box covers.
Sum Of Lengths	The sum of the individual defects contained within the mark-up box.	
Start of First to End of Last	The distance from the start of the first defect to the end of the last defect within the box.	
Max Amplitude	The maximum amplitude detected within the mark-up box.	All data within the box is evaluated for this value.
Beam Spread Compensation	A value that may be entered to account for beam spread.	Enter the horizontal <i>half</i> beam spread value. This will improve the accuracy of defect length measurement.
ReCalculate	Forces the software to recalculate defect lengths in the mark-up box. Use after modifying the <i>Beam Spread Compensation</i> value.	
Defect Depth	Defect depth will be calculated at the point of highest amplitude.	Automatic depth calculation requires channel calibration before data collection.
Defect Height	Operator entered value for the height of the defect.	To determine defect height accurately, advanced defect sizing techniques may have to be employed, e.g. ToFD. Using zone information exclusively, only an estimate can be made based on zone height.
Depth & Height Set Manually	Enables manual entry of <i>depth</i> and <i>height</i> by the operator.	
Defect Classification	Select a defect type from the list.	If <i>User Defined</i> is selected, an additional text box appears to the right where the operator may enter text.
Comment	Operator defined comment.	
Status	Select an acceptance status from the list.	Enter any additional comments here.

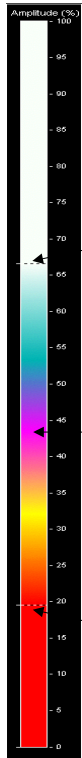
View / Modify Defect Mark-up.

Place the mouse cursor inside a defect mark-up box. Double Tapping the mouse left button, causes the software to re-open the above dialog.

Printing

If any defect mark-up boxes are printed, a second page containing a list of defects (and associated data) is also printed. An option to show/hide defect mark-up boxes exists in the view control dialog box.

Amplitude Colour Bar.



The maximum percentage tick mark can be dragged up and down. In the data views, any amplitude above the line will have the colour of the last colour in the colour bar; in the example it is white. Adjusting the colour bar in this way is often referred to as 'Soft Gain.'

256 Colours are defined between the min and max tick marks.

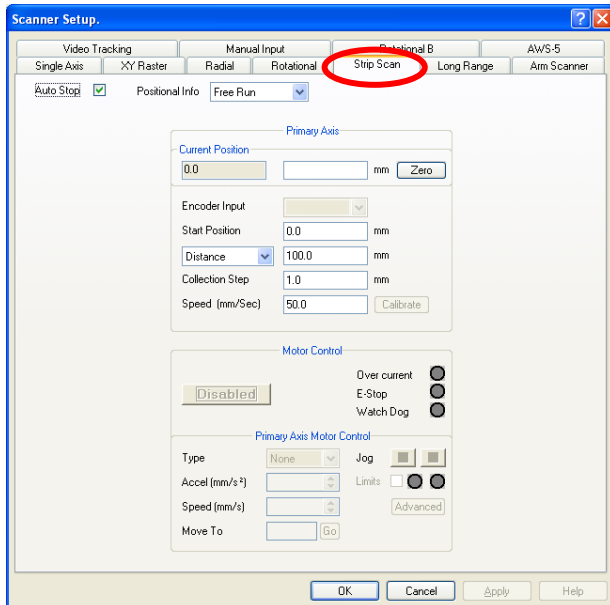
The minimum percentage tick mark can be dragged up and down. In the data views, any amplitude below the line will have the colour of the first colour in the colour bar; in the example it is red. This control is simulates 'reject' in analogue systems.

Appendix A

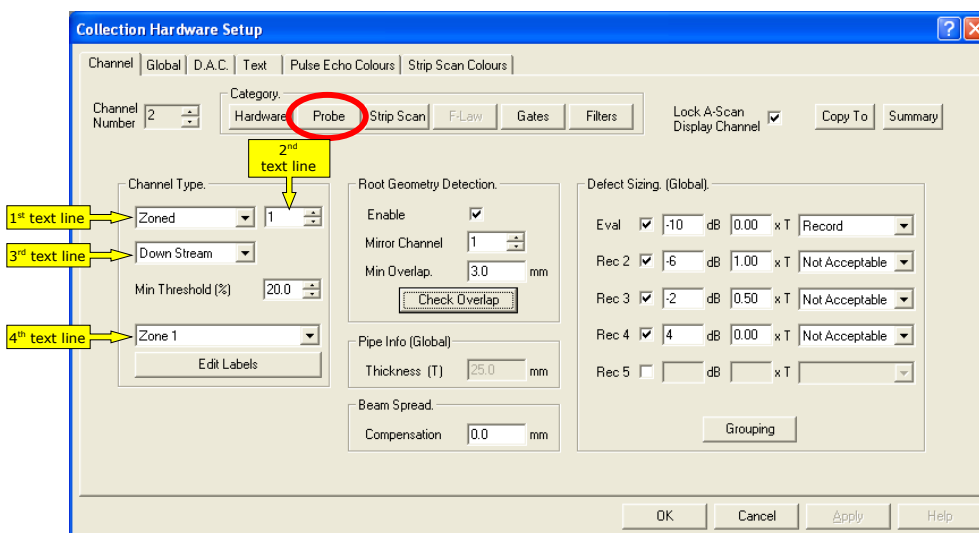
Setting up StripScan in the TD-Scan Software

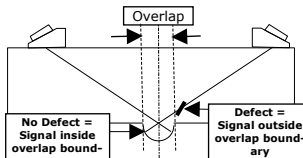
Note: The zonal discrimination technique is a complex operation that requires specific training in setup and analysis. This tutorial is not a substitute for thorough training by professionals in this field.

1. To enable StripScan, Tap **Setup-Collection Hardware-Scanners** and select the **StripScan** tab then Tap **OK**. The scanner can be setup in detail later. This action enables the **StripScan** tab in the *Collection Hardware Setup* dialogue.
2. The basic *ultrasonic* setup may be executed in one of two ways:
 - 2.1. **Manually** using the normal TD-Scan software controls for Phased array, ToFD and/or Pulse echo.
 - 2.2. **ESBeamTool Zonal®** import – after developing a 'scan plan' in ESBeamtool® using the Zonal add-on, the scan plan can be imported directly into the TD-Scan software.
3. Once the UT channels have been setup the zone setups can be established using the StripScan controls. To enable StripScan the **StripScan** tab must be selected in the **Scanner Setup** window.

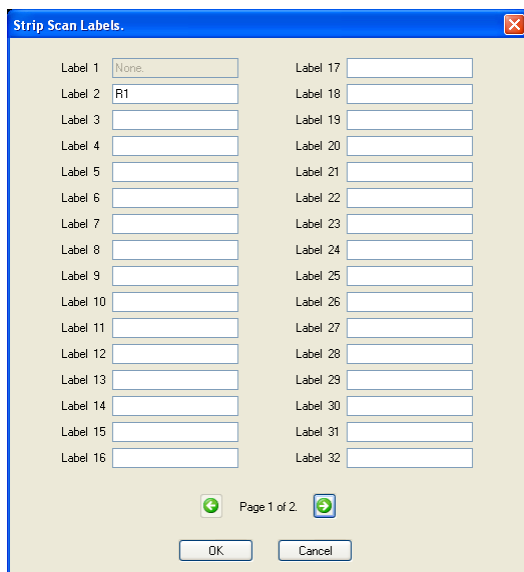


4. The **StripScan** controls are located in **Setup-Collection Hardware**. Tap the **StripScan** button on the **Channel** tab to display the controls. Each control is described below:
 - 4.1. **Collection Hardware Setup**



Strip Scan:		- PHASED ARRAY & PULSE ECHO CHANNELS ONLY. - Activated by selecting the <i>Strip Scan</i> tab in <i>Scanner Setup</i>.
Channel Type		
1 st Text Line (Zone Type)	Selects what the channel is used for: - Zoned - Volumetric - Couplant Check	Zoned: Displays strip data as either Time and Amplitude or Map view. Volumetric: Displays strip data as an amplitude B-scan - usually an unfocussed view of all zones. Couplant check: Displays data in additional strips as contrasting colours representing adequate or poor probe contact.
2 nd Text Line (Zone)	Zone number. Only applicable when the channel type is <i>zoned</i> . Each channel can only have one associated zone.	Each zone could however have multiple associated channels
3 rd Text Line (Stream)	Selects the location of data relative to the weld - Up Stream - Down Stream	Stream = Direction of product flow
Min Threshold (%)	Minimum threshold that triggers drawing of <i>time</i> (TOF) data in Time/Amplitude strips.	
4 th Text Line (Label)	Each zoned channel may have a user defined label that describes which part of the weld the channel is collecting data from.	
Edit Labels	Allows the operator to edit the table of label text.	
Root Geometry Detection		*This procedure does not have to be used and can be ignored
Enable	Enables/Disables root geometry detection.	Root geometry detection is effected by following the operator defined Minimum Overlap rule. The probe positions of the current channel and its mirror are fixed.
Mirror Channel	Specifies an identical channel that is aimed at the same zone from the opposite direction.	
Min Overlap	The distance by which the beam centre crosses the weld centre. Any signal that appears before or after the entered value is regarded as a defect	
Check Overlap	This button activates the <i>Root Geometry Overlap Check</i> dialogue box. (See <i>Root Geometry Overlap Check</i> subcategory below)	
Pipe Info (Global)		
Thickness (T)	Material wall thickness. May be automatically entered by the system or manually entered by the user.	If a Skip Correction value is entered in the Global tab, then this value is automatically displayed & the text box greyed. If not then the value may be entered manually. This value affects <i>all</i> channels.
Beam Spread		
Compensation	Specifies the defect <i>length</i> oversize value in millimetres. Defect length will be reduced by this value. <i>Specifying a value is optional</i> .	Only used for evaluation by the auto-sizing software. The oversize must be determined by the user: it is the difference between a known length defect and its measured length at the highest threshold.
Defect Sizing (Global)		
Eval	Enables an automatic data recording threshold to be established, expressed as: <i>Indication lengths relative to wall thickness then signal attenuation relative to an amplitude reference level (gate threshold).</i>	
REC x (x = 2 to 5)	Enables automatic data evaluation thresholds to be established expressed as: <i>Indication lengths relative to wall thickness then signal attenuation relative to an amplitude reference level.</i> The result of the evaluation may be designated Record or Not Acceptable .	
Grouping	This button activates the <i>Strip-Scan Indication Grouping</i> dialogue box. (See <i>Strip-Scan Indication Grouping</i> subcategory below)	

4.2. Edit Labels



Strip Scan Labels.

Label 1: None, Label 17:

Label 2: R1, Label 18:

Label 3: , Label 19:

Label 4: , Label 20:

Label 5: , Label 21:

Label 6: , Label 22:

Label 7: , Label 23:

Label 8: , Label 24:

Label 9: , Label 25:

Label 10: , Label 26:

Label 11: , Label 27:

Label 12: , Label 28:

Label 13: , Label 29:

Label 14: , Label 30:

Label 15: , Label 31:

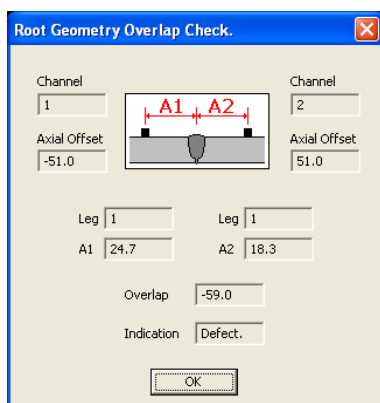
Label 16: , Label 32:

Page 1 of 2

OK Cancel

Label x	Enter zone labels	If X = Page 1 , labels are numbered 1 to 32 If X = Page 2 , labels are numbered 33 to 64
OK	Stores the labels for use in the zone setup	Tap the 4 th text line in the Strip Scan page to view labels.
Cancel	Cancels the operation & closes the dialogue.	

4.3. Root Geometry Overlap Check



Root Geometry Overlap Check.

Channel 1, Channel 2

Axial Offset -51.0, Axial Offset 51.0

Leg 1, Leg 1

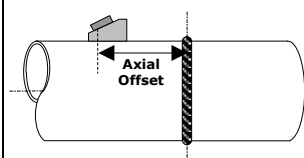
A1 24.7, A2 18.3

Overlap -59.0

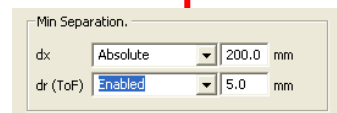
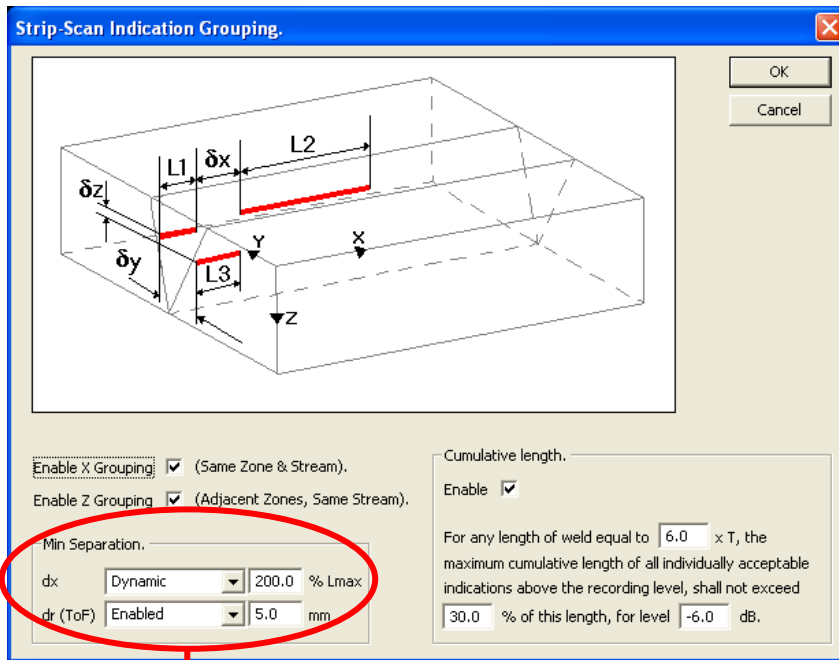
Indication Defect.

OK

This procedure does not have to be used and may be ignored.

Channel	The channel and its mirror that are being checked.	Pulse echo probe datum = the sound emission point Phased Array probe datum = position of the element at the lowest point on the wedge (either 1st or Last). 
Axial Offset	The distance from the test piece datum to the TX probe datum.	
Leg	Displays the reflected skip in which the signal is located	
A1, A2	Displays the range to the signal for each probe	
Overlap	Displays the distance of the amount by which the two opposite beams overlap.	
Indication	Displays either Defect or Root , based on the overlap criteria.	

5. Strip-Scan Indication Grouping



Enable X Grouping	Enables defect grouping in length evaluated within the same weld zone and on the same side of the weld.	
Enable Z Grouping	Enables defect grouping in length evaluated in adjacent weld zones and on the same side of the weld.	
Min Separation		
dx	Evaluates grouping criteria based on defect proximity using: • Dynamic • Absolute	Dynamic: Distance between adjacent defects based on a % of the length of the defects (% Lmax). Absolute: Distance between adjacent defects based on a fixed length (mm).
dr (ToF)	Evaluates grouping criteria based on defect proximity using beam path distance.	
Cumulative Length		
Enable	Enables/Disables cumulative length evaluation.	The acceptance criteria are entered into the three text boxes based on the <i>amplitude</i> and <i>length</i> of defect in a given length of weld.

6. StripScan Gate controls are accessed from **Setup-Collection Hardware** and Tap the **Gates** button on the **Channel** tab. There are different gate controls depending on the type of zone (Zoned, Volumetric or Couplant check).

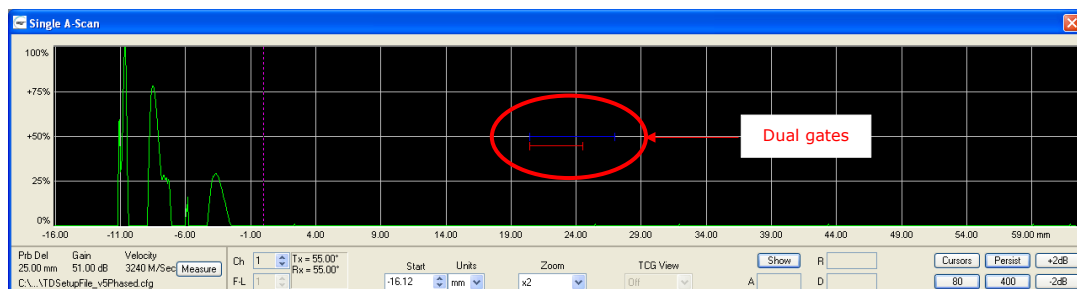
6.1. Zoned Channels

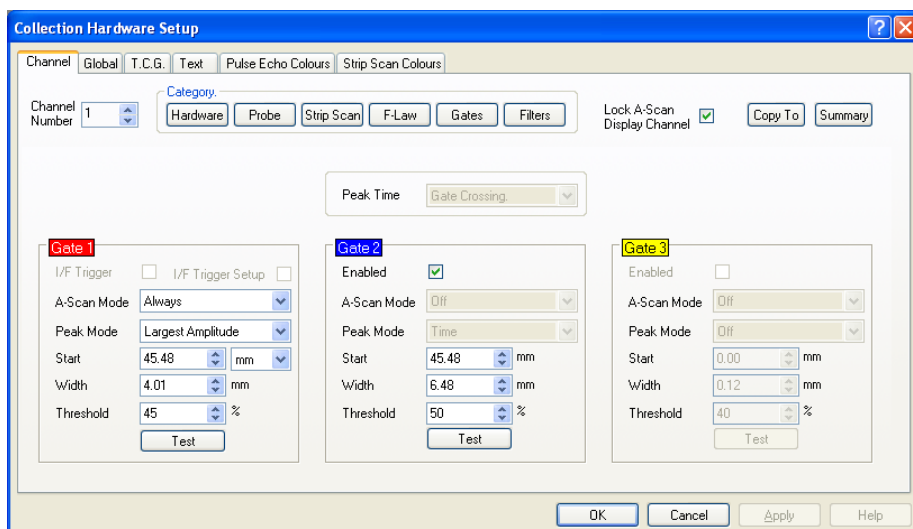
6.1.1. Dual Gate

A 'Dual Gate' system may be used in StripScan if the user wishes. The purpose of the dual gate is to provide a mechanism to define separate display criteria for the *amplitude* trace and *time (TOF)* bar in the T&A strips. It is not necessary to use a dual gate if the time and amplitude gate length are identical. Usually, the dual gates are only used in channels that are collecting data from the weld root. To limit the display of spurious signals generated by reflections from the root bead, the amplitude gate is adjusted to end before the root bead. The TOF gate is set to end beyond the root bead so that operational and root anomalies may be monitored, e.g. excess penetration, low root bead, meandering root and variations in axial stand-off caused by a poorly positioned scanner band.

6.1.2. Single Gate

A single gate (Gate 1) is used for channels where the time and amplitude collection length is identical; usually all zones except root zones.





The dialog box is titled "Collection Hardware Setup". It has tabs for Channel, Global, T.C.G., Text, Pulse Echo Colours, and Strip Scan Colours. The Channel tab is active, showing Channel Number 1. Below the tabs are buttons for Category (Hardware, Probe, Strip Scan, F-Law, Gates, Filters), Lock A-Scan Display Channel (checked), Copy To, and Summary. A Peak Time dropdown is set to "Gate Crossing". There are three gate configuration sections: Gate 1, Gate 2, and Gate 3. Gate 1 has I/F Trigger (unchecked), I/F Trigger Setup (unchecked), A-Scan Mode (Always), Peak Mode (Largest Amplitude), Start (45.48 mm), Width (4.01 mm), and Threshold (45 %). Gate 2 has Enabled (checked), A-Scan Mode (Off), Peak Mode (Time), Start (45.48 mm), Width (6.48 mm), and Threshold (50 %). Gate 3 has Enabled (unchecked), A-Scan Mode (Off), Peak Mode (Off), Start (0.00 mm), Width (0.12 mm), and Threshold (40 %). Each gate section has a Test button. At the bottom are OK, Cancel, Apply, and Help buttons.

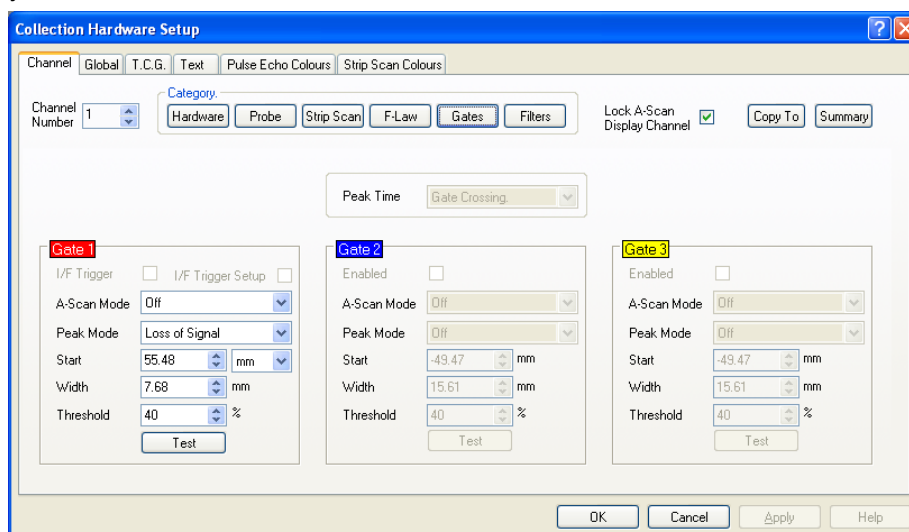
Amplitude Gate (Gate 1)	Provides all time and amplitude data.		Provides time and amplitude data regardless of whether the TOF gate is enabled.
TOF Gate (Gate 2)	Limits displayed time (TOF) data to the Gate 2 position and length.		Use only if there is a requirement to display time and amplitude data from different gate lengths.
Enabled	Enables/disables the gate Gate 2 and places the channel in 'Dual Gate' mode.		Only enable Gate 2 when dual gate is required. This gate is the TOF gate.
I/F Trigger	<i>*Not used in StripScan mode*</i>		
I/F Trigger Setup	<i>*Not used in StripScan mode*</i>		
A-Scan Mode	- Off - Always	A-Scan collection disabled. An A-Scan is collected each time the scanner moves by the collection step.	When <i>Always</i> is selected the A-Scan is collected regardless of its amplitude. Note: File size will be significantly larger with A-scan collection enabled.
Peak Mode	Largest Amplitude is the only choice.		
Start	This is the start of the data collection gate. (µS or mm)		
Width	This is the width of the data collection gate.(µS or mm)		
Threshold	Vertical position of the gate expressed as a percentage of A-scan screen height.		In StripScan, the height of this gate is not taken into account for any measurement or display.
Test	The test button opens the gate test dialog box.		Used for reference only. Provides a table that displays Time, Distance & Amplitude for each peak in the gate that breaks the threshold.

6.2. Volumetric Channels

A single gate (Gate 1) is used for channels designated as **volumetric**. The gate control is identical to *single gate* in the zoned channel section above, i.e., **Gate 1** enabled, and all other gates disabled.

6.3. Couplant Check Channels

Channels designated as **couplant check** display data in additional strips as contrasting colours representing adequate or poor probe contact. The gate is adjusted to cover the reference reflector.

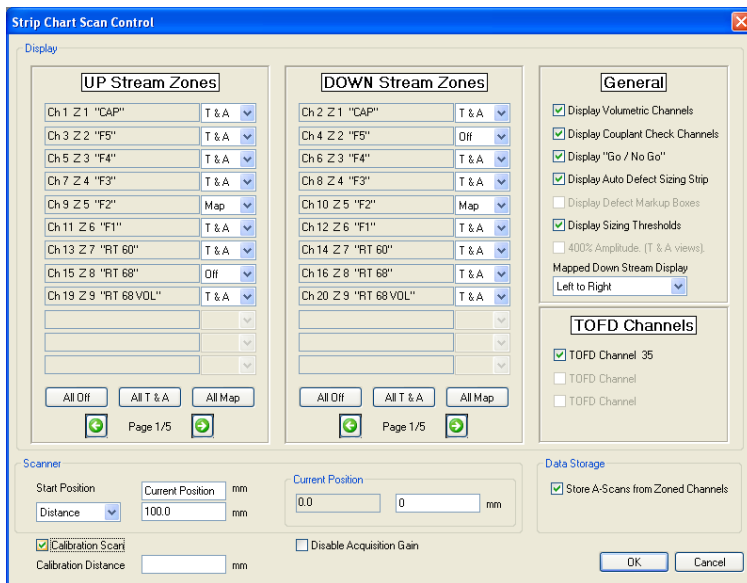


The dialog box is titled "Collection Hardware Setup". It has tabs for Channel, Global, T.C.G., Text, Pulse Echo Colours, and Strip Scan Colours. The Channel tab is active, showing Channel Number 1. Below the tabs are buttons for Category (Hardware, Probe, Strip Scan, F-Law, Gates, Filters), Lock A-Scan Display Channel (checked), Copy To, and Summary. A Peak Time dropdown is set to "Gate Crossing". There are three gate configuration sections: Gate 1, Gate 2, and Gate 3. Gate 1 has I/F Trigger (unchecked), I/F Trigger Setup (unchecked), A-Scan Mode (Off), Peak Mode (Loss of Signal), Start (55.48 mm), Width (7.68 mm), and Threshold (40 %). Gate 2 has Enabled (unchecked), A-Scan Mode (Off), Peak Mode (Off), Start (-49.47 mm), Width (15.61 mm), and Threshold (40 %). Gate 3 has Enabled (unchecked), A-Scan Mode (Off), Peak Mode (Off), Start (-49.47 mm), Width (15.61 mm), and Threshold (40 %). Each gate section has a Test button. At the bottom are OK, Cancel, Apply, and Help buttons.

I/F Trigger	<i>*Not used in StripScan mode*</i>	
I/F Trigger Setup	<i>*Not used in StripScan mode*</i>	
A-Scan Mode	Off is the only choice. No A-Scans are stored.	
Peak Mode	Loss of Signal is the only choice.	
Start	This is the start of the data collection gate. (µS or mm)	
Width	This is the width of the data collection gate.(µS or mm)	
Threshold	Vertical position of the gate expressed as a percentage of A-scan screen height.	Signals above the threshold amplitude will be displayed in the strips as a different colour to signals below the threshold.
Test	The test button opens the gate test dialog box.	Provides a table that displays Time, Distance & amplitude for each peak in the gate that breaks the threshold for reference only.

7. Further controls specific to the current scan are accessed after the **Start** scan control is activated. These controls are described below:

7.1. Strip Scan Display Control.



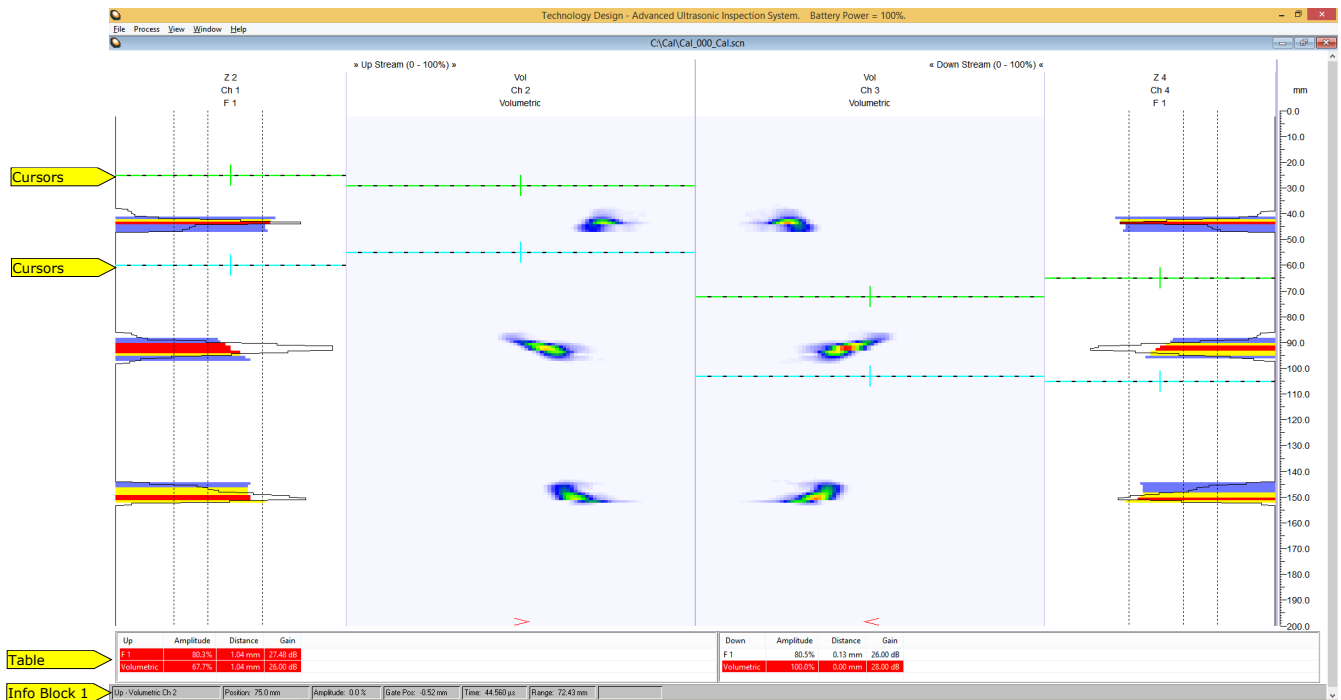
Display		
UP Stream Zones / DOWN Stream Zones	Allows selection of viewing options for Up/Down stream zoned channels. The options are: Off - Data for this channel is not displayed. T&A - Time & Amplitude view. Map - Data is displayed as a D-scan. Only available to channels with A-Scan data collection enabled.	T&A view displays data as: • a continuous line representing signal amplitude and distance along weld length. • Shaded vertical bar. The height of the bar represents TOF. The shading colours are a visual representation of the amplitude of the signal. • Map view displays the strip as a D-scan image (side view along length of weld) usually focussed at the fusion face of the selected zone.
All Off	Sets all channels to display no data.	
All T & A	Sets all channels to display Time and Amplitude data.	
All Map	Sets all channels to Map View if the A-Scan data is available.	To ensure A-Scans are collected, set the A-Scan Mode to Always in the Gates Page during initial setup.
General		
Display Volumetric Channels	When selected, volumetric channels (if any) are displayed.	Displays strip data as an amplitude D-scan - usually an unfocussed view of the full volume of the weld.
Display Couplant Check Channels	Displays couplant check channels (if any).	Displays data in additional strips as contrasting colours representing coupling go/no-go.

Display Go / No Go	Displays the go/no go strip.	Displays data in additional strips as contrasting colours representing signal amplitude above or below the gate amplitude.
Display Auto Defect Sizing Strip	Displays the auto sizing strip.	Automatic data evaluation is performed when sizing rules are defined by the user on the StripScan tab in the Collection Hardware window. Data is evaluated and colours displayed after the collection is completed.
Display Defect Markup Boxes	Displays defect mark-up boxes (if any).	Defect mark-up boxes are defined manually by the user.
Display Sizing Thresholds	Displays thresholds as dashed lines.	Thresholds are determined by the user defined sizing rules on the StripScan tab in the Collection Hardware window.
400% Amplitude (T&A views)	Displays T&A strips with an upper amplitude limit of 400% FSH.	Only available when the digitiser control is set to 14bits per sample. Signals will saturate at 400% FSH.
Mapped Down Stream Display	Displays the down-stream Mapped strips in either a 'Left-to-Right' or 'Right-to-Left' orientation.	The up-stream strips remain in the ' <i>Left-to-right</i> ' (surface nearest the left) orientation. Up-stream strip orientation may be changed to suit the users' preference.
TOFD Channels		
TOFD Channel xx	Displays the TOFD channel designated.	Up to 3 ToFD channels may be displayed as non-parallel D-Scans.
Scanner		
Start Position	The start position of the scan. (online only).	Only available at the start of a scan before data collection. Greyed out after data collection.
Current Position	The length of the scan. (online only).	Only available at the start of a scan before data collection. Greyed out after data collection.
Data Storage		
Store A-Scans From Zoned Channels	*This control is obsolete and awaiting removal*	
Other Controls		
Calibration Scan	Enables Calibration mode (online only)	- Switches controls on in the file for fine adjustment of gain when analysing the calibration - Appends the word 'cal' to the end of the file name. - Identifies the file as a calibration file – can be included or excluded from auto reports.
Calibration Distance	Length of calibration scan	
Disable acquisition gain	Disables the Acquisition Gain control for a calibration scan.	The Acquisition Gain control can be used to apply additional gain, when a scan is started, that may be required by a specification/code as a visual aid while scanning. This control excludes this correction from calibration scans.

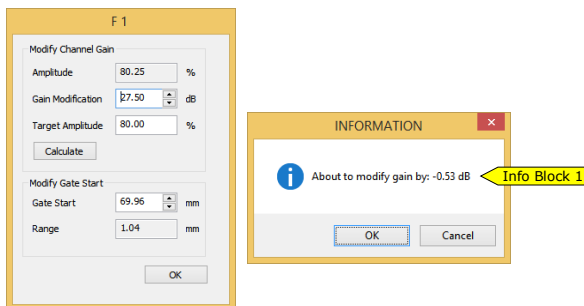
8. Calibration adjustment tools are provided when a designated **calibration scan is opened for analysis.**

8.1. Strip Scan Calibration Control.

Calibration scans may be analysed and adjusted using special sensitivity controls that allow fine gain adjustments of +2dB to -2dB in 0.1dB steps that may be applied to the channel gain. To enable these controls, open a calibration scan and Tap the **Process** drop-down menu, select **Check Calibration**. Two individual horizontal cursors for each strip will appear that can be moved to encompass signals. A table will also appear at the bottom of the page with a list of each upstream and downstream zone or volumetric¹ channel with columns for *amplitude*, *gain* and *distance*. The values displayed in the columns are for the highest amplitude signal between each set of cursors. Double Tapping a line in the table will activate a control window allowing the channel gain to be adjusted.



Cursors	Used to define calibration signals	Move cursors by dragging with the mouse pointer. Placing a cursor on either side of a signal displays the <i>amplitude</i> , <i>distance</i> from gate centre and <i>gain</i> values of the highest amplitude point between cursors in the calibration table.
Table	Displays a table of values for the highest amplitude signal between the dual cursors.	- Only available in calibration scans. - Activated by Tapping the Process menu and selecting Check Calibration - Double Tap any line in the table to display a gain adjustment control window for that zone.
Info Block 1	Values at the position of the mouse pointer (not used for calibration adjustment)	



Modify Channel Gain		
Amplitude	Amplitude of Signal	Changes with gain adjustment
Gain Modification	Fine controls the channel gain	Channels gain can be adjusted in 0.1dB steps to a maximum of +2dB to -2dB from the gain set for the calibration scan
Target Amplitude	% Screen height of calibration reference.	
Calculate	Calculates the required channel gain adjustment	Displays a second Information window with this value.
Information		
Info Block 1	Displays amount by which channel gain will be adjusted.	
OK	Executes gain adjustment	Channel gain (Hardware setup) will be adjusted by the amount displayed in Info Block 1

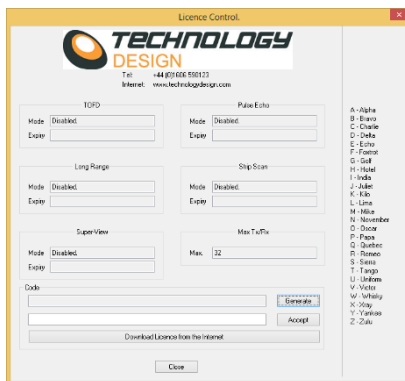
Appendix B

i. Apex Matching (ToFD straightening)

- Open a ToFD file. If you wish to use **Apex Matching** to straightening the data, follow the instructions below:
- Select **Apex Control** from the **Process – Straighten** menu.
- A vertical A-Scan window appears on the left side of the data area and a crosshair appears in the data area.
- Select an A-scan by moving the crosshair to an appropriate point on the data. To choose an A-Scan we recommend using the negative (black) phase; choose a strong unsaturated signal by left Tapping the mouse.
- Move the crosshair to the left side of the area to be processed and left Tap the mouse.
- Move the crosshair to the right side of the area to be processed and left Tap the mouse.
- The **Straightening Control** dialogue box appears.
- From the **Peak Type** drop-down menu, choose **Negative**.
- Adjust the **Peak Threshold** value until the **Unmatched A-scans** value reaches a minimum. A visual indication of amount of unmatched A-scans can also be seen in the red bars at the top of the data area. As the unmatched A-scans reduce, the red bars are transferred as a green trace to the effected samples on the image. The idea is to get as many green dots following the pattern of the negative phase image as possible.
- When the minimum above has been reached, then adjust the **Max. Peak time difference** to include more or less samples in the area to be processed. If the file is particularly skewed the default sample value may not include the entire lateral wave image.
- Unmatched A-scans** value will probably reach a new minimum with this adjustment. Tap **OK**.
- The image will be aligned (straightened) however the data image will probably display a measure of unevenness, we recommend that you now use the **Cross Correlation** method to finally straighten the image.

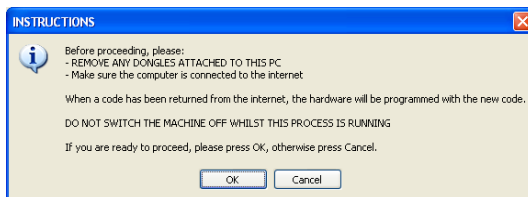
ii. Applying a Licence

Licences for the TD-Scan software and systems may be activated by using the Internet activation facility in the **Licence Control** page. If no Internet access is available, licences may also be issued *manually* by e-mail or telephone.

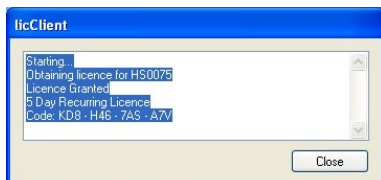


Internet Method

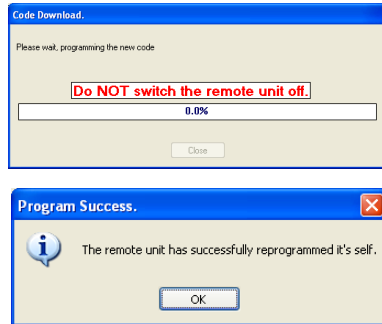
- Ensure that your system has an active Internet connection.
- Run the TD-Scan software.
- Open the licence generator by Tapping **Setup-Licence Control**
- Tap the **Download Licence from the Internet** button. An instructions window will appear. Please read the instructions and Tap either **OK** to continue or **Cancel** to return to the licence generator.



- If you Tapped **OK** and a licence scheme has been approved by Technology Design, the **licClient** window will appear and the software will attempt to connect to the secure licence server across the Internet. Wait until the licence type and code are displayed in the dialogue box then Tap **Close**. If the **LicClient** window disappears it may be brought forward by Tapping on its button on the Windows® task bar.



- The licence will be transferred to the TD system. Progress is displayed in the **Code Download** window and when complete the **Program Success** information window will appear. Tap **OK**.



- g. The current licence status of the individual modules is displayed in the Licence generator.

Manual Methods

Telephone

- Switch system and TD software on.
- Contact Technology Design on +44 (0)1606590123 and state that you need a licence code. The operator will transfer you to an authorised licence issuer.
- Open the licence generator by Tapping **Setup-Licence Control**
- Tap the **Generate** button. A code will appear in the dialogue box to the left of the button.
- Read this code when asked to do so by the operator. Please use the phonetic alphabet provided as this is clearer for the operator to understand.
- The operator may ask you certain questions regarding the licence required and will then provide a return code.
- Using the on-screen keyboard, type the return code into the lower dialogue box to the left of the **Accept** button.
- Tap the **Accept** button.
- Tap the **Close** button.
- Wait for a few seconds and a progress bar will appear with a warning. **DO NOT SWITCH POWER OFF TO THE SYSTEM WHILE THE LICENCE IS BEING TRANSFERRED OR THE SYSTEM WILL BE RENDERED INOPERABLE.** Please heed this warning.
- After the licence transfer is complete the TD Software will shut down automatically.
- The software can now be restarted and used within the new licence scheme. To check the licence, open the licence generator (**Setup-LicenceControl**). The current active scheme will be displayed.

Email

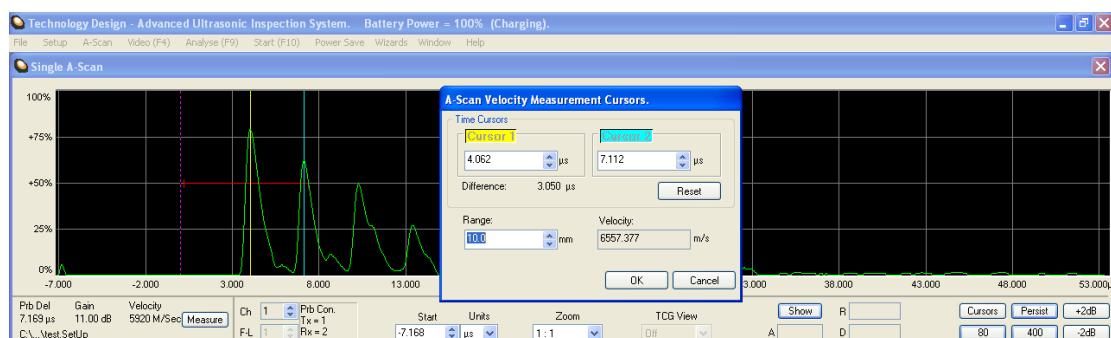
Send an email to tdsupport@technologydesign.com with the licence code you have generated using the steps below and also state the TD system's serial number.

- Open the licence generator by Tapping **Setup-Licence Control**
- Tap the **Generate** button. A code will appear in the dialogue box to the left of the button. Email this code to Technology Design Ltd. **NB Do not** leave the licence page until an activation code is emailed back and applied.
- TD will generate the appropriate return code and email it back to the same address.
- Using the on-screen keyboard, type the return code into the lower dialogue box to the left of the **Accept** button.
- Tap the **Accept** button.
- Tap the **Close** button.
- Wait for a few seconds and a progress bar will appear with a warning. **DO NOT SWITCH POWER OFF TO THE SYSTEM WHILE THE LICENCE IS BEING TRANSFERRED OR THE SYSTEM WILL BE RENDERED INOPERABLE.** Please heed this warning.
- After the licence transfer is complete the TD Software will shut down automatically.
- The software can now be restarted and used within the new licence scheme. To check the licence, open the licence generator (**Setup-LicenceControl**). The current active scheme will be displayed.

iii. Velocity Measurement

Automated Method

- Close all open windows leaving only the **A-Scan** window open.
- Set the system up with an appropriate basic setup.
- Tap 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:

$$\frac{Range \times 1000}{Difference \text{ between repeat signals}} \times 1000$$

Example:

Range=100mm

Difference between repeat signals = 61.47 µs

$$\frac{100}{61.47} \times 1000 = 3253 \text{m/s}$$

iv. Calculate Probe Centre Separation (PCS)

- On the **Probe** page, Tap 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.
- Tap **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°

$$\begin{aligned} &2(25 \times \tan 60) \\ &2(25 \times 1.73) = 86.6 \text{mm (PCS)} \end{aligned}$$

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).
- Tap **Setup – Collection Hardware – Probe**.
- Clear the value in the **Delay** text box then Tap **Apply**.
- Tap 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.
- Tap 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, Tap 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 Tap 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:

- Tap 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.
- Tap **Setup – Collection Hardware – Probe – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.
- Tap **Setup – Collection Hardware – TCG – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.

vi. Element Balancing

- Before enabling Element Balancing do the following:**
 - Place the transducer without a wedge on a calibration block with parallel near and far sides and no intermediate reflectors.
 - Set the number of elements within the transducer (*Geometry Page*).
 - Set the number of Tx/Rx active elements to any arbitrary value, say 16 (*Focal Law Page*).
 - Set the gain so a backwall signal can be clearly seen (*Hardware Page* or *A-scan Display* window).
 - Set gate 1 start/width to cover the backwall signal (*Gates Page*).

b. Now enable *Element Balancing*.

- i. The *Element Balancing Procedure* dialog box opens,
- ii. Tap the *Start* button. The gain on each element is automatically adjusted so that an 80% full scale signal is achieved in the gate. Once gain values for each element have been determined, the gain differences for each element are calculated and stored and displayed in a table.
- iii. The table may be saved as a delimited text file by Tapping the *Save* button. Values in the saved file may be imported into a spreadsheet and displayed as a graph.

vii. Wedge Database - Editing

The wedge database may be edited or wedges added as needed.

- a. Using Windows® Explorer, browse to *C:\Documents and Settings\All Users\Application Data\TDS\Scan* and open the *WedgeData.txt* file in Notepad. **Note:** If you cannot see the *All-Users* folder, disable hidden files in Windows®. For instructions on how to disable hidden files go to Windows® *Help and Support* and type 'hidden files' into the search engine.
- b. The wedge data is displayed in columns. Enter the new wedge data into the appropriate columns (the data sheet supplied by the wedge manufacturer will provide this information).
- c. **Important:** A Tilde (~) character must be placed before the wedge identifier in column 1 and if wedge data is added in the last row then the *Enter* key must be pressed after the entry in the last column for new wedge data to be displayed in the Wedge Selector window.
- d. Existing wedge data may also be edited.
- e. When editing is complete, save the file and close it.

viii. Manual Ray Tracing

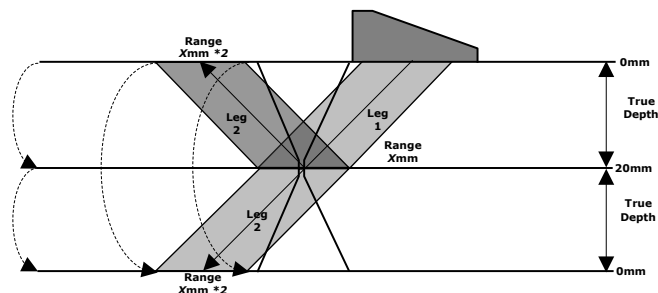
Use this procedure if no computerised beam plotting software is available. Before scanning a test item it is advisable to determine the extent of coverage by the ultrasonic beam. Current semi-automated and automated scanning techniques often require the transducer to be moved in a straight line relative to a datum point, e.g., a weld centreline, for the length of the scan. To determine the optimum distance of the transducer from the datum, a beam plot may be drawn on a transparency and placed over a 1:1 scale drawing of the area of interest in the test material.

Determining and plotting the beam shape

- a. Configure the software for either a sectorial or electronic scan and calibrate the probe.
- b. Tap the *Angle / EP Override* button. The *Beam Angle / Emission Point Override* dialogue is displayed.
- c. Take note of the first and last value in the **Offset** column corresponding to the current channel.
- d. Draw a straight horizontal line near the top of a transparency.
- e. Draw a mark on the line that represents the lowest element on the probe.
- f. Measure along the horizontal line on the sheet from the mark in *point iv* above and make a mark at each of the *offset* distances noted above in *point iii*.
- g. Using a protractor to draw a line, corresponding to the angle of the relevant focal law, down from each of the *offset* points.
- h. The beam shape has now been established from the centre of the 1st focal law to the centre of the last focal law and can be used to determine the probe position and gate location.
- i. **Note:** On a sheet of graph paper, draw a 1:1 scale sketch of the test item in the same plane as the sound beam. Place the horizontal line on the transparency over the contact surface of the test piece sketch and move it so that the beam sketch covers the area of interest optimally. When working after the first *half skip*, simply draw mirror images of the test item on the graph paper.

ix. Skip Correction

Skip correction is a method of measuring and displaying multiple skip legs as a linear plot. The software recognises the skips and then plots the depth correctly in relation to the range as a mirror image.



How to use Skip Correction & Weld Overlays in TD Super-View

To display the skips in Super-View correctly the scan setup must first be configured correctly:

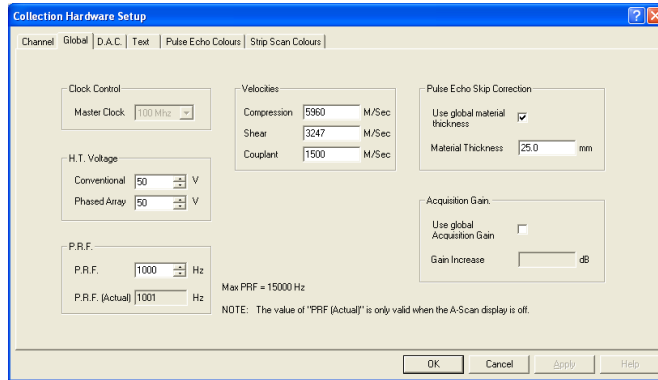
Essential Actions

- Enable Skip Correction before scanning (it can also be enabled offline)
- Set the Horizontal Offset correctly before scanning – this ensures that the overlay is positioned correctly in relation to the weld centre (centre=0).
- We recommend that you enable Pre-scan Free Run (Setup-Configuration-Misc). This will allow you to easily enable and view the Skip Correction and Overlay in a 'live' environment before the scan actually starts.

Scan Setup

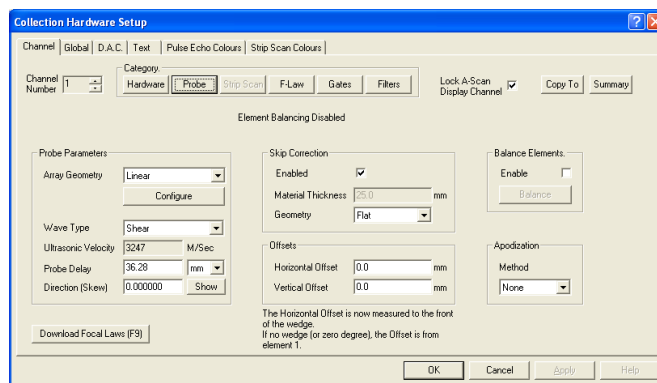
In the **Collection Hardware Setup** dialogue (**Setup – Collection Hardware**) do the following:

- a. Tap the **Global** tab



The 'Collection Hardware Setup' dialog box is shown with the 'Global' tab selected. It contains several configuration sections: 'Clock Control' with a 'Master Clock' set to 100 MHz; 'H.T. Voltage' with 'Conventional' and 'Phased Array' both set to 50 V; 'P.R.F.' with 'P.R.F.' set to 1000 Hz and 'P.R.F. (Actual)' set to 1001 Hz; 'Velocities' with 'Compression' at 5960 M/Sec, 'Shear' at 3247 M/Sec, and 'Couplant' at 1500 M/Sec; 'Pulse Echo Skip Correction' with 'Use global material thickness' checked and 'Material Thickness' at 25.0 mm; and 'Acquisition Gain' with 'Use global Acquisition Gain' unchecked and 'Gain Increase' at 0 dB. A note at the bottom states: 'NOTE: The value of "PRF (Actual)" is only valid when the A-Scan display is off.'

- b. Enable **Use global material thickness**.
c. Enter the correct value into **Material Thickness** then Tap **Apply**.
d. Tap the **Channel** tab.
e. Tap the **Probe** button.



The 'Collection Hardware Setup' dialog box is shown with the 'Channel' tab selected. It contains several configuration sections: 'Channel Number' set to 1; 'Category' with 'Hardware', 'Probe', 'Strip Scan', 'F-Law', 'Gates', and 'Filters' buttons; 'Lock A-Scan Display Channel' checked; 'Copy To' and 'Summary' buttons; 'Element Balancing Disabled'; 'Probe Parameters' with 'Array Geometry' set to 'Linear', 'Wave Type' set to 'Shear', 'Ultrasonic Velocity' at 3247 M/Sec, 'Probe Delay' at 36.28 mm, and 'Direction (Skew)' at 0.000000; 'Skip Correction' with 'Enabled' checked, 'Material Thickness' at 25.0 mm, and 'Geometry' set to 'Flat'; 'Balance Elements' with 'Enable' unchecked; 'Offsets' with 'Horizontal Offset' and 'Vertical Offset' both at 0.0 mm; and 'Apodization' with 'Method' set to 'None'. A note at the bottom states: 'The Horizontal Offset is now measured to the front of the wedge. If no wedge (or zero degree), the Offset is from element 1.'

- f. Tap the **Enable** checkbox in the **Skip Correction** area.

This procedure will ensure that the **Skip Correction** lines are displayed correctly when enabled in the data views. Note that if this procedure was not followed before data collection, the saved file can be corrected during analysis as described in below.

Enabling Skip Correction in saved files

If skip correction was not enabled prior to scanning it may be enabled in analysis mode as follows:

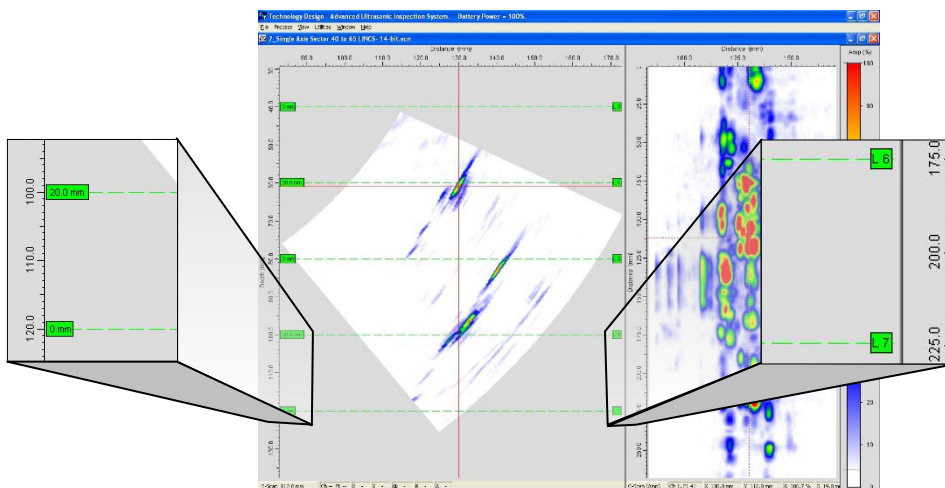
- Open the desired scan file.
- Select **File Data** then **Hardware Setup** from the **File** drop-down menu. The **Collection Hardware Setup** window appears.
- From the **Channel** tab Tap the **Probe** button to display the probe setup dialogue page.
- In the **Skip Correction** dialogue area Tap the **Enabled** check box.
- The material thickness may already be displayed in the **Material Thickness** text box; this will be the case if **Pulse Echo Skip Correction** was enabled in the **Global** tab either prior to scanning or off-line. If not, enter the correct material thickness.
- Tap **OK**

Note: All active channels must have the same material thickness entered.

Displaying Skip Correction in data files

Skips may be displayed as an overlay on a B or a Sector scan. The Leg number and depth will be displayed as green flags on lines corresponding to the scan surface and backwall of the material. To display the skip lines:

- Right Tap in the B or S scan view.
- Select **Show Skip** from the contextual menu. The skip lines appear on the image.

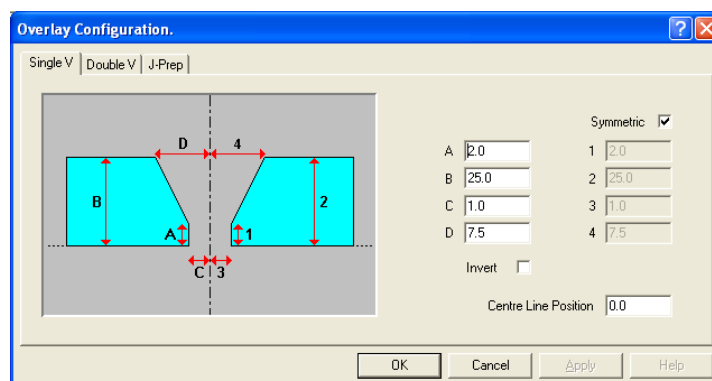


Weld Overlay

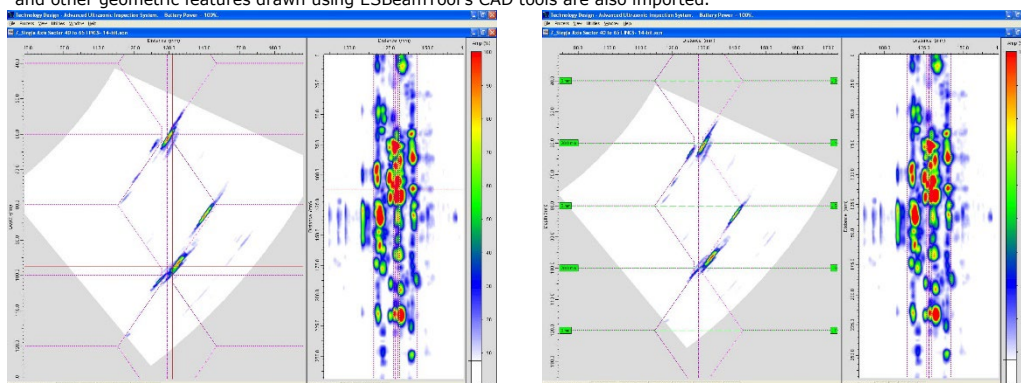
- Weld overlays are graphic representations of standard weld preparation geometries superimposed onto the data image. Weld overlays may be displayed on B, C and Sector scan images. **NOTE:** To ensure that the overlay is positioned correctly over the data image (i.e., weld centre = 0), Ensure that the **Horizontal Offset** is correctly in the **Hardware Setup** dialogue.

Before displaying a weld overlay, the weld preparation geometry must be defined:

- Open the desired scan file.
- Select **Overlay Control** from the **View** drop-down menu. The **Overlay Configuration** window appears.



- Select the appropriate weld prep from the tabs. The left and right side of the weld prep may be defined independently or Tap the **Same** check box if the geometry is symmetrical.
- Fill in the dimensions in the appropriate text boxes. **TIP:** to define a **K-prep**, use the **Single V** tab and define one side with the thickness in text box 2 only.
- The **Centre Line Position** text box should have a value of 0 (zero).
- Tap **OK**.
- The weld overlay is displayed. If **Skip correction** is enabled, the weld overlay is displayed as a fold-out (mirror) image on B and S scan images and a plan view on C scan images. If skip correction is enabled and displayed, the skip correction lines should match the top and bottom of the weld prep images (see illustrations). The lateral position of weld overlays can be adjusted by dragging the centre line left or right.
- Note:** If a setup is imported from ESBeamTool®, the weld overlay is also imported. Complex sketches that contain curves, circles and other geometric features drawn using ESBeamTool's CAD tools are also imported.



x. Time Corrected Gain (TCG)

Manual Method

- a. Select **ON** from the **T.C.G. Curve** drop-down menu (**Setup - Collection Hardware - Channel - Hardware**).
- b. Select the zoom factor from **TCG View** on the A-Scan window.
- c. Tap the **T.C.G.** tab in the **Collection Hardware** window.
- d. Select the curve to view from the **Channel** drop-down menu. Any values already in the dialogue may be removed by Tapping the **Clear All** button or values may be imported from a delimited file.
- e. Select the units (mm or μ s).
- f. Tap 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.
- h. Drag the first TCG marker to the base of the signal and adjust the gain using the **Gain (dB)** up/down arrow control to position the apex of the signal at the reference amplitude. The marker may also be moved by Tapping on the **mm/ μ s** and **Gain** up/down arrow control.
- i. Tap 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. Tap the **Wizards** menu and select one of the **PA wizards** 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. Tap **Setup – Collection Hardware – Probe – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.
- c. Tap **Setup – Collection Hardware – TCG – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.
- a. Tap **Setup – Collection Hardware – TCG – Calibration Wizard**. Enters the phased array wizard at the *calibration* and *TCG* section by-passing the setup section.

xi. Focal Law Balancing

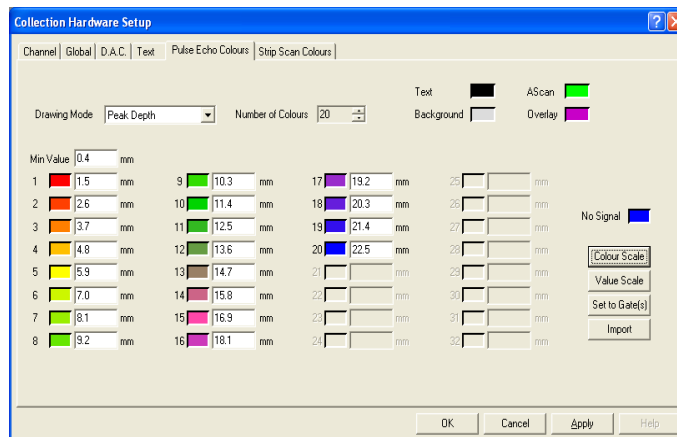
Manual method

- a. **Note:** Focal Law Balancing can be applied to S-scans or E-scans.
- b. First complete probe delay calibration.
- c. TCG (Time Corrected Gain) may be setup prior to Focal Law Balancing but not essential.
- d. Tap **Setup – Collection Hardware**, the Collection Hardware Setup window appears.
- e. Tap the **F-Law** button located on the **Channel** tab.
- f. Tap the **F-Law Balance** button, the **Focal Law Balance Setup** window appears.
- g. Move the probe so that the target reflector is visible in the scan area and ensure that the target is registered by every focal law. If not, exit the procedure and adjust the gate accordingly then re-open the procedure as before.
- h. Ensure that the signal is not saturated or too low. If necessary, it is adjust the gain using the +2dB and -2dB menu buttons.
- i. Move the red and blue horizontal delimiters above and below the target signal. **Important:** the target reflector *must* be isolated from other reflectors that may impinge between the delimiters. If other reflectors are simultaneously registered between the delimiters, incorrect amplitude correction will result.
- j. Move the probe so that the target signal moves out of the data image and Tap **Reset**. This removes the amplitude histogram and the amplitude correction curve if present.
- k. Move the probe slowly over the target keeping a constant pressure until the target signal has passed through each focal law and moves out of the image. As the target moves through the sound beam the echo-dynamic pattern appears as a green histogram representing the amplitude of each focal law. This echo-dynamic pattern will have a curved shape.
- l. Tap the **Calculate** button. A dashed curve appears representing the amount of gain correction that will be applied to each focal law.
- m. Move the probe so that each focal law passes over the target. Each focal law should now be a similar a height in the echo-dynamic histogram.
- n. Tap the **Stop** button. The **F-Law Balance** button on the **F-law** tab will now display the word **Enabled**.
- o. To de-activate Focal Law Balancing open the **Focal Law Balance Setup** window, Tap **Reset** then **Close**. The window will close and the **F-Law Balance** button on the **F-law** tab will now display the word **Disabled**.

Phased Array Wizard

- a. When using the phased array wizard, focal law balancing (angle corrected gain) is achieved as a result of executing the **Time Corrected Gain** procedure. The **TCG** wizard ensures that each focal law is amplitude corrected across the range of interest.

xii. Colour & Depth Adjustment



a. Peak Depth and Interface Depth

The **colour/depth scale** may be either imported from an external scan file or defined manually.

i. Import (Import button)

1. Tap the **Import** button. The *Select Scan File* dialogue appears.
2. Browse to and select a suitable existing scan file and either double Tap the file or Tap the **Open** button. The **colour/depth scale** from the selected file is imported.

ii. Define individual colours.

(For visual defect sizing in *StripsScan* follow points 2 to 5 below.)

1. Define the number of colours desired using the *Number of Colours* up/down arrow control.
2. Tap on the colour box at position no. **1**. The *Edit RGB Index xx* window appears.
3. Move the red, green & blue slider controls to adjust the colour or Tap the *More Colours* button to select colours from a predefined pallet.
4. Tap **OK**. The colour in the colour box changes to the colour selected in step c.
5. Repeat the process for each colour position.

iii. Define a colour scale automatically (Colour Scale button)

Note: It is visually most efficient to define several colour scales across the depth range.

1. Apply the procedure above (points **a. ii. 2 to 4**) to the **first & last** positions and **evenly spaced** positions in between, across the depth range, e.g., with 20 colours selected, define position **1=red, 5=yellow, 10=green, 15=pink, 20=blue**.
2. Tap the **Colour Scale** button. The *Select Scale Ends* dialogue appears.
3. Enter the appropriate number in the *First colour in scale* text box, e.g., **1**.
4. Enter the appropriate number in the *Last colour in scale* text box, e.g., **5**.
5. Tap **OK**. Each colour position between the defined positions is automatically assigned a colour to form an even colour 'ramp'.
6. Repeat the procedure above at the other positions, e.g., **5-10, 10-15, 15-20**. **Note:** that each scale overlaps the next. This ensures continuous colour transitions as seen in the illustration on the left.

iv. Adjusting Depth

The depth scale may be defined by entering each value **individually** or by using one of two **automatic** methods:

1. **Using the Gate range (Set to Gate(s) button)**
 - a. Tap the **Set to Gate(s)** button. Each active depth position will be automatically defined at evenly spaced intervals covering the range of the *Gate*.
2. **Defining end points (Value Scale button)**
 - a. Enter the shallowest depth desired for recording in the *Depth* text box no. **1**.
 - b. Enter the deepest depth desired for recording (usually the backwall) in the **last** active *Depth* text box.
 - c. Tap the **Value Scale** button. The *Select Scale Ends* dialogue appears.
 - d. Enter the appropriate number in the *First value in scale* text box, e.g., **1**.
 - e. Enter the appropriate number in the *Last value in scale* text box, e.g., **20**.
 - f. Tap **OK**. An even depth 'ramp' is automatically defined between the **first and last** entry positions.

b. Peak Amplitude

The **colour/amplitude scale** may be either imported from an external scan file or defined manually.

i. Import scale (Import button)

1. Tap the **Import** button. The *Select Scan File* dialogue appears.
2. Browse to and select a suitable existing scan file and either double Tap the file or Tap the **Open** button. The **colour/depth scale** from the selected file is imported.

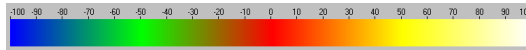
ii. Default scale (Default button)

1. Tap the **Edit** button. The *Pulse Echo - Amplitude Colour Scale* window appears.
2. Tap the **Default** button.
3. The **default colour scale** replaces the current scale.
4. Tap **OK**.

iii. Manual scale setup (Edit button)

1. Tap the **Edit** button. The *Pulse Echo - Amplitude Colour Scale* window appears.
2. It is optional to Tap the **Clear** button which will clear the current colour scale.
3. Place the mouse over a point on the colour bar you wish to set the colour of and press the mouse left button. (A numerical amplitude guide is located directly below the colour bar)
4. The *Edit RGB Index xx* window appears.
5. Move the red, green & blue slider controls to adjust the colour or Tap the *More Colours* button to select colours from a predefined pallet.
6. Tap **OK**. The defined colour appears as a thin vertical line in the colour bar.
7. Repeat the process for each amplitude/colour position. **Note:** It is visually most efficient to define several colour changes points across the amplitude range; e.g. define **0%=red, 25%=yellow, 50%=green, 75%=pink, 100%=blue**.
8. Tap the **Scale Auto** button.

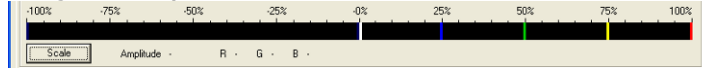
9. A continuous colour scale with the main four colour transitions appears in the colour bar.



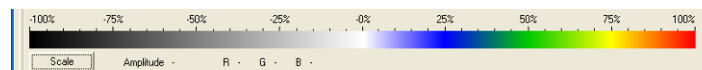
10. Tap OK.

c. StripScan Colours (Map & Volumetric Strips)

1. Place the mouse over a point on the colour bar you wish to set the colour of and press the mouse left button. (A numerical amplitude and RGB guide is located directly below the colour bar)
2. The *Edit RGB Index xx* window appears.
3. Move the red, green & blue slider controls to adjust the colour or Tap the *More Colours* button to select colours from a predefined pallet.
4. Tap OK. The defined colour appears as a thin vertical line in the colour bar.
5. Repeat the process for each amplitude/colour position. **Note:** It is visually most efficient to define several colour change points across the amplitude range; e.g. define -100%=black, 0%=white, 25%=blue, 50%=green, 75%=yellow, 100%=Red.



6. Tap the *Scale* button. The **Colour Modifier Box** opens below the Map and Volumetric colour scales.
7. Enter the appropriate number in the *First colour in scale* text box, e.g. -100.



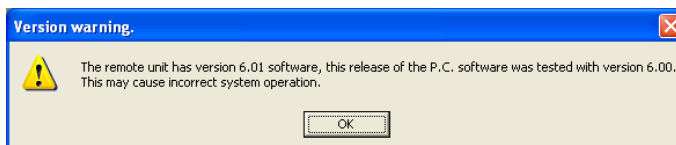
8. Enter the appropriate number in the *Last colour in scale* text box, e.g. 0.
9. Tap OK. An even colour scale is automatically defined between the amplitude positions defined in steps 7 & 8.
10. Repeat the procedure above at the other positions, e.g. 0%-25%, 25%-50%, 50%-75%, 75%-100%. **Note:** that each scale overlaps the next. This ensures continuous colour transitions as seen in the illustration above.

xiii. Encoder Calibration

- a. This procedure is similar for all the scanner interfaces that allow positional encoding.
- b. Tap the **Calibrate** button.
- c. The **Encoder Calibration** dialogue opens.
- d. Enter a measured distance in the **Distance** text box. (e.g. 300mm)
- e. Hold the encoder still at the beginning of the measured distance and Tap the **Clear Count** button. The **Encoder Count** value is set to zero.
- f. Move the encoder the length of the measured distance and hold the encoder still.
- g. Tap the **OK** button.
- h. The **Encoder Calibration** dialogue closes automatically.
- i. The value in the **Pulses per millimetre** text box is automatically corrected. If the correct pulses per millimetre value for the encoder being used is known, then this value may be entered manually without using the calibration procedure. Note if the encoder is measuring in a negative direction after calibration, the sign (+ or -) of the pulses per millimetre value may be changed to reverse the measurement direction.
- j. Calibration may be verified by *Tapping* the **Zero** button and observing the **Current Position** value while moving the encoder a measured distance.
- k. For a **two axis (XY) scanner**, the above procedure is repeated for both axes.

xiv. Reprogramming the Remote Unit (manual)

If the *Version warning* message is encountered after switching between versions of the TD-Scan software or after installing a new version, this procedure will be done automatically however it can be done manually by selecting **Setup – Advanced – Flash Reprogram Remote Unit** then follow the instructions below:



- a. When using a Pocket-Scan, connect the remote unit to the PC and switch on the power. For other TD units simply switch them on.
- b. Run the TD-Scan software.
- c. Once the A-Scan display window has been opened, from the main menu select **Setup – Reprogram Remote Unit**.
- d. Double Tap the appropriate ".prg" file, e.g. "C:\TDScan_Release11.00\PRG Files\xxxxx.prg" from the PRG folder of the version currently open. *Note:* From Version 19:00 onward the PRG folder will open after step C automatically, simply double Tap the **.PRG** file.
- e. Once the file has been selected it is downloaded to the remote unit.
- f. After the file has been downloaded, the remote unit starts to re-program its self.
- g. On completion the software automatically shuts down, this allows the remote unit to re-boot.

WARNING:

When the remote unit is re-programming its self, **DO NOT** disconnect the power supply. Doing so will render the unit inoperative.

xv. TD CommsBridge

- a. Make sure that the remote PC and the TD unit can communicate across your network. If you do not have a network available, create a workgroup so that the two PC's can communicate (you may have to ask your IT department for help). The PC's can communicate through a network switch/hub or a direct cross-over Ethernet cable.
- b. If not already present, install TDCommsBridge onto the TD Unit from the TDCommsBridge folder on the TD installation CD. (If you do not have the installation CD, we can email this small software app to you).
- c. On the TD unit, run the CommBridge software by double Tapping on the TDCommsBridge icon on the Widows® desktop (do **not** run the TD-Scan software in this unit). CommsBridge will automatically detect the name of this TD unit (Host). If the Port number is

blank, type in the number **123** and Tap the **Connect** button. This causes the TD unit to broadcast messages to the network that it is available.

- d. Run the TD-Scan software on the remote PC and Tap the **Reset Ethernet Configuration** button in **Setup-Configuration-System**. Shut down the TD-Scan software and restart it (do *not* reboot the PC). When the TD-Scan software starts again the **Socket Settings** dialogue box will appear, fill in as follows:
 - i. IP Addressing = *Automatic*
 - ii. Remote Unit = *fill in the name of the TD unit*. This is the same as the Host name mentioned in point c above.
 - iii. Port = **123**
- e. Tap the **OK** button. The software will now attempt to find the TD unit on the network. When initialization is complete after a few seconds, you should see a live A-scan on the remote PC. You can now control the TD unit from this PC – all image processing is done locally so the TD unit is free to use its processor power for UT.

xvi. Tuning the PID

Whilst there is no rule to tuning the PID values, we suggest the following (rather simple) approach:

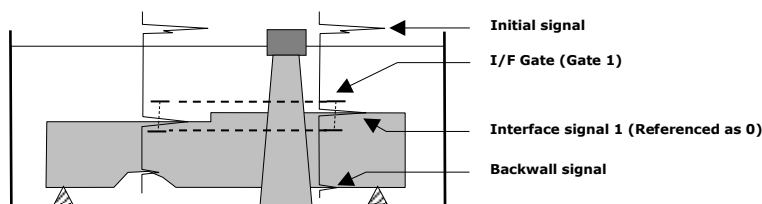
- a. In the Advanced Motor Control dialog, un-check the PID Enabled field, and set the Max Voltage, Max Current, & Timeout values, press the OK button to close.
- b. Enable the motor drive circuit (press the Disabled button in the motor control section of the Scanner Setup dialog).
- c. Calibrate the encoder's Pulses per millimetre value.
- d. In the Advanced Motor Control dialog, set D = 0, I = 0, P = 100, and tick the PID Enable box.
- e. The Sample Rate needs to be set with consideration of the pulses/mm given by the encoder.
 - i. Less than 50 pulses/mm - 50Hz
 - ii. Less than 500 pulses/mm - 100Hz
 - iii. Less than 1000 pulses/mm - 500Hz
 - iv. Any other value - 1000Hz
- f. Set the required Speed and Acceleration; say 25mm/s. (we normally set the two values the same).
- g. In the Scanner Setup dialog, set the Current Position to 0 (press the Zero button).
- h. In the Move To field set a position you want the scanner to move to (e.g. 500), and press the Enter key.
- i. The scanner will now move to the commanded position. However because of the initial small P term, and I = 0, the move will probably under-shoot.
- j. Note: If the scanner moves-off at high speed, you will need to toggle the Reverse Motor Drive field in the Advanced Motor Control dialog.
- k. Move the scanner back to zero, increase the P term by 50, and repeat steps 7 through 10 until the under-shoot is less than 1mm or the P term reaches 1000.
- l. The I term is used to dial out the under-shoot. Start with a value of say 20 and repeat moving the scanner, increasing I (by 10 or 20 each time) until you are happy.
- m. If the value of I is too large it can cause oscillation, so we suggest a maximum value of 300, or 60% of P, whichever is the smallest.
- n. Note: Most controllers do not have a D term, so its value may be left at zero. If however you wish to use it, we suggest making it 50% to 70% of P.

Pressing **F6** on the keyboard opens a dialog that displays some details of the PID operation; the operator may find it useful.

The blue line is the *current error* value (there is a multiplier on the bottom left of the dialog so small values can be seen), and the green line is the *motor drive* value.

xvii. Interface Trigger Setup

- a. Enter all the setup parameters in the **Collection Hardware Setup** windows.
- b. Ensure that the velocities (including the couplant velocity) are correct. See **How to Measure Velocity in Appendix B** for guidance if required.
- c. Tap the **Gates** button on the **Channel Tab**.
- d. Place the transducer in position on the wedge (for contact testing), in a 'water-box' probe housing, or immerse in the couplant without a wedge for immersion testing.
- e. Place **Gate 1** over the *wedge/sample* signal (contact testing) or the *couplant/sample* signal (immersion). **NOTE:** If the near surface of the test item in an immersion bath is uneven, ensure that the interface gate (**Gate 1**) encompasses all these signals. The interface signal can be verified by measuring the path between repeat signals in the water path or repeat wedge signals by enabling the **I/F Trigger Setup** check box: this changes the A-scan measurement from **Test Piece Velocity** to the **Couplant Velocity**.
- f. Now enable the **I/F Trigger** check box. The first signal that breaks the Interface gate threshold is referenced as **zero**. If the signal drops below the gate threshold, a warning message, **Interface Not Detected**, appears in the A-Scan window.
- g. When **Gate 1** is designated as the **Interface Trigger** (**IF** box checked), **Gate 2** automatically becomes the normal measurement gate.
- h. Any signal that now appears between the interface signal (Zero) and the backwall signal will be measured correctly in range.



xviii. Connecting a Pocket-Scan PS45 to a Laptop PC

Entering a fixed IP address into the laptop & creating a network

1. Connect the PS45 to the Laptop using the **Cross-over** Ethernet cable provided and ensure that the PS45 is powered.
2. Assuming you are using Window7®, Tap the Windows icon on the taskbar to open **Start** menu.
3. Tap **Control Panel – Network and Sharing Centre**.
4. Tap on **Local Area Connection**.
5. Tap **Properties**.
6. Double Tap **Internet Protocol Version 4 (TCP/IPv4)**
7. Tap **Use the following IP address** and enter **192.168.000.199** in the **IP address** text box.
8. Tap in the **Subnet mask** text box and the value **255.255.255.0** will be entered automatically.
9. Tap **OK** and close all other open windows by Tapping **OK** or **Close**.
10. You can test the link using the following procedure:
 - i) Open the **Start Menu**.
 - ii) Type **cmd** into the **Search Box** then press enter. The **Command** window opens.

- iii) Type **ping 192.168.0.200** and press the **Enter** key (all PS45's have this IP address). Three text replies from the IP address *192.168.0.200* should appear in the Command window. If the message **Request timed out** appears (x3) then there is no communication between the PS45 and Laptop – seek advice from a network engineer, competent person or contact Technology Design Ltd.

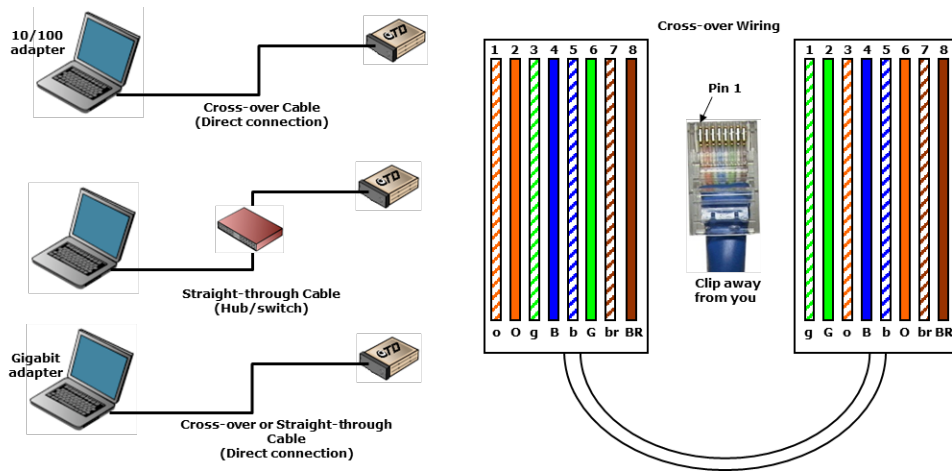
Starting the TD-Scan software & controlling the PS45

1. Start the TD-Scan software on the laptop PC.
2. The communication window will display a message that **Communication has not started**.
3. Tap **Setup – Configuration – System – Reset Ethernet Configuration**.
4. Tap **OK**.
5. Shut the TD-Scan software down and restart it. The **Socket Settings** window will appear.
6. Select **Manual** from the **IP Addressing** menu.
7. Enter **192.168.000.200** into the **Remote Unit** text box.
8. Enter **123** into the **Port** text box.
9. Tap **OK**. A warning may appear if no licence is detected. Close the warning window; the licence can be activated later.
10. The A-Scan screen should display a live A-scan trace. If no A-scan is visible, seek advice from Technology Design.

Note: Once the fixed IP address has been established on the PC and the TD-Scan software is communicating with the PS45, the links will be made automatically when the software is restarted, or the laptop is restarted. If the fixed IP address is removed, this procedure will have to be repeated.

xix. Cross-over Ethernet Cable for PS45

1. Pocket-Scan PS45 units are supplied with a **Cross-over** Ethernet cable. This cable looks identical to a normal straight-through Ethernet cables but is wired differently and may be required for direct network connections where no hub or network switch is used. If the Laptop/Desktop PC is equipped with a Gigabit (10/1000) network adapter, a cross-over cable is not required and a straight-through cable will suffice.



xx. Importing a Setup from ESBeamTool®

1. Create the setup/scan plan in ESBeamTool. **NB.** Ensure that the scan plan can actually be achieved by the TD unit, e.g. it is possible in ESBeamtool to define a beam that strikes the front of the wedge so that the beam or part thereof does not exit the wedge. When attempting to import this defective setup into the TD software, error messages will be generated. Versions of the TD-Scan software prior to 19.00 will simply fail to import the setup.



2. Save the scan plan as a work file, it will have an **.ebwk** extension. In older versions of ESBeamTool an exchange file (**.tdsx**) must be generated as follows: **File – Export – Export to TD-Scan**
3. To import the file data generated in point 2 above into the TD-Scan software Tap **File – Import ESBeamTool Settings**.
4. Browse to and select the desired **.EBWK** file. Double Tap or select and Tap **Open**. The setup and piece (overlay) drawing will be imported into the TD-Scan software. In older versions, browse to the appropriate **.TDSX** file and follow the same procedure as above.
5. **Note** – ESBeamTool is not 'live' ultrasonic software and generates purely theoretical data, therefore the following procedures need to be executed in the TD-Scan software after the import is complete:
 - i) **Delay calibration** - using a wizard or manual process.
 - ii) **Time Corrected Gain** - using a wizard or manual process.
 - iii) **Focal Law Balancing (only when setting TCG up manually)** – When the wizard is used TCG and Focal Law Balancing are handled simultaneously per focal law.
6. For the same reason noted in point 5, various other settings may need to be adjusted for practical accuracy.

xxi. Joining files

File joining is only available in the **ToFD** and **Corrosion Mapping** software. File joining is not available in **SuperView**.

ToFD

1. Open the *Master* (first) file.
2. Tap **Utilities – File Joining**. A file browser window opens.
3. Select and open the *Slave* (second) file in the join sequence.

4. A green crosshair cursor appears in the *Slave* file data area. Move the crosshair with the mouse or arrow keys to a point where you wish the first file to join to the second file and left Tap or press Enter.
5. A green crosshair now appears in the *Master* data area. Move the crosshair with the mouse or arrow keys to a point where you wish the first file to join to the second file and left Tap or press Enter.
N.B. The *Master* file data will always overwrite the *Slave* file data; therefore, if the joining point (i.e. where the green crosshair was Taped) on either the *Slave* or *Master* is not at the leading edges of the data, the *Master* data will overwrite the *Slave* data by the distance from the leading edge to the crosshair.
6. The data will join creating a new unified file and a file browser window will appear. In the **File Name** text box, a filename will be entered automatically with a unique file extension. Tap **Save** or change the filename and/or file extension then Tap **Save**. **Note:** the original scan files will be left intact for future reference unless you change the filename and extension to the same as the original whereupon the new data will overwrite the original data after accepting the pop-up warning to this effect.

Corrosion mapping

1. Open the *Master* (first) file.
2. Tap **Utilities – File Joining**. A file browser window opens.
3. Select and open the *Slave* (second) file in the join sequence.
4. A black crosshair cursor appears in the *Slave* file data area. Move the crosshair with the mouse or arrow keys to a point where you wish the first file to join to the second file and left Tap or press Enter.
5. A black crosshair now appears in the *Master* data area. Move the crosshair with the mouse or arrow keys to a point where you wish the first file to join to the second file and left Tap or press Enter.
N.B. The *Master* and *Slave* file data will be overlaid. The overlaid data points will be displayed in the B and D scan views however the C-scan will display the data that match the **Peak Mode** rules.
6. The data will join creating a new unified file and a file browser window will appear. In the **File Name** text box, a filename will be entered automatically with a unique file extension. Tap **Save** or change the filename and/or file extension then Tap **Save**. **Note:** the original scan files will be left intact for future reference unless you change the filename and extension to the same as the original whereupon the new data will overwrite the original data after accepting the pop-up warning to this effect.

xxii. Speed-up options for Phased array scans

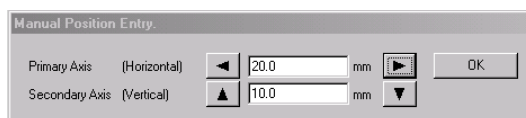
First you must understand that because there is so much calculation to be done when doing phased array and displaying the data as B, C, D & S scans, the computer processor is being highly stressed. Therefore, you need to be aware of this and apply practices that will limit the processor's workload - this is true for all phased array systems. Here are a few tips:

- a) Enable **Online Max speed** in **Setup – Configuration – Misc**. This will display the C-Scan as a *non-volume corrected view during data collection* – when the file is opened for analysis the view will automatically be corrected and displayed as a true depth C-scan – this saves significant processor workload. This control will make certain changes to the data display during data collection in order to optimize system efficiency, e.g. data from only one channel will be displayed and image filtering will be disabled.
- b) Enable **Data Limits (Samples)** in **Setup – Configuration – Misc**. and choose 150, 300 or 600 samples (300 is recommended). This will limit the maximum amount of displayed data samples to the chosen value regardless of what the digitization frequency is set to. This control also reduces processor workload significantly and dramatically increases the speed at which you can scan. **Data Limits (Samples)** will reduce the displayed data resolution (but probably within an acceptable range - please check procedure requirement)
- c) Display as little data on the screen during data collection as possible – perhaps only a C-22scan and an A-scan and then change this to a more complex view later for data analysis.
- d) Keep the gate to the minimum length required.
- e) Be mindful of the number of focal laws being generated and keep these to a minimum, the more focal laws, the more the processor workload.
- f) Increase the PRF. If during a scan, a significant number of 'missed' scan lines are noticed, we suggest that the operator check the PRF before taking any other action.
- g) Switch image filtering off during data collection – this will be done automatically if **Online Max Speed** is enabled.
- h) Do not set the digitization frequency too high – it is usual to use 5 times the probe frequency for PA and 100Mhz for ToFD. The digitization frequency may be lowered with acceptable results but be mindful of code requirements.
- i) Do not use averaging for PA – it is not usually needed (only for ToFD).

xxiii. Corrosion Mapping - Manual Input

There may be times when a corrosion mapping C-scan is required when an encoded scanner or video tracking system is not available or the test item geometry precludes the use of scanners. An effective C-scan may be achieved by manually capturing the data at discreet gauge points plotted on the test surface.

- a) Draw a grid onto the test surface corresponding to the desired collection step interval.
- b) Switch Super View® off.
- c) Setup and calibrate a 0° probe.
- d) Select the **Manual Input** tab from the **Scanner Setup** menu. Enter the appropriate start and end positions
- e) Enter the desired collection step for both X and Y axis.
- f) Start the scan. When the scan window opens, the **Manual Position Entry** control window appears. Tapping the arrows allows you to tab through the grid reference points (collection steps) defined previously.
- g) Place the probe on the grid position corresponding to the co-ordinates shown in the **Primary & Secondary Axis** text boxes.
- h) Tap **OK** to execute data capture for that grid position.
- i) Repeat steps F to H for other grid positions. In this way you can manually cover the area of interest as desired.



The image shows a screenshot of the 'Manual Position Entry' dialog box. It has a title bar with the text 'Manual Position Entry'. Inside, there are two rows of controls. The first row is for the 'Primary Axis (Horizontal)' and contains a left arrow button, a text input field with '20.0', a unit dropdown set to 'mm', a right arrow button, and an 'OK' button. The second row is for the 'Secondary Axis (Vertical)' and contains an up arrow button, a text input field with '10.0', a unit dropdown set to 'mm', and a down arrow button.

xxiv. Lateral Wave Position Estimation

In ToFD it is sometimes useful to calculate where the lateral wave signal should appear on the A-scan, for example when you are unsure of which signal is the actual lateral wave or the signal-to-noise ratio may be such that it is indistinguishable from the 'grass' on the base line. It is important to remember that the PCS is *not* the full lateral wave travel path: the ultrasound passage through the wedges should also be taken into account. Use the following formula to calculate the lateral wave position in microseconds (μ s).

Note: For simplicity and practicality in the field, the compression velocity of sound in the test material has been used for both wedge and test material therefore the lateral wave position is an approximation.

$$l_t = l_d \div V$$

Where:

l_t = Lateral wave position in μ s

l_d = Lateral wave sound path in mm
(a+b+c as per sketch below)

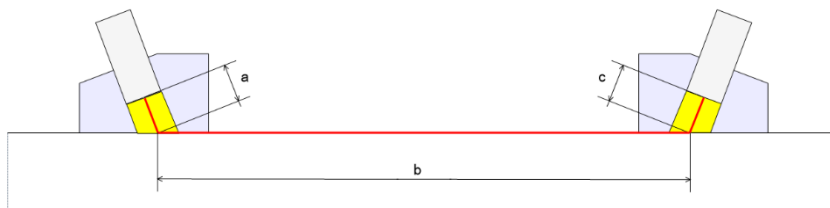
V = Material sound velocity in mm/ μ s

Example:

$$l_d = 7 + 86 + 7 = 100 \text{ mm}$$

$$V = 5.92 \text{ } \mu\text{s/mm (5920 m/s)}$$

$$\therefore l_t = 100 \div 5.92 = 16.89 \text{ } \mu\text{s}$$



xxv. Installing ARCNET to USB Driver

The legacy PCMCIA version of the Pocket-Scan can be easily connected to a USB port instead of a card slot. PCMCIA slots are no longer supplied with standard laptops; therefore, TD supplies a converter to address this issue. The adapter is a small hardware device that replaced the PCMCIA card and plugs into the same D-connector on the Pocket-Scan and a USB port on the PC. Before the adapter can be used, a driver appropriate to the version of Windows® must be installed. The drivers are located on the TD-Scan installation CD.

- Window 7 32-Bit \\USB_T0_Arcnet\DriversForWindows_7\32_Bit
- Window 7 64-Bit \\USB_T0_Arcnet\DriversForWindows_7\64_Bit
- Window 8 64-Bit \\USB_T0_Arcnet\DriversForWindows_7\64_Bit

- a) If it is the first time the adapter is connected, it will appear in the *Device Manager* as **Unknown device** under **Other devices**. **NOTE:** Connect the converter directly to a USB port on the PC and *not* through a USB hub. USB hubs vary and some can reduce bandwidth and/or fail to provide adequate power to the converter hardware.
- b) Right-Tap on the **Unknown device** and select **Update Driver Software....**
- c) Tap on **Browse my computer for driver software** and select the location of the *USB-ARCNET* driver and Tap **OK**.
- d) Tap **Next** and when prompted by *Windows Security*, Tap on **Install this driver software anyway**.
- e) The following message will appear, **Windows has successfully updated your driver software**.
- f) The USB-ARCNET Adapter will now be ready for use.

xxvi. Using 14-bit and 8-bit

The FocusScan and HandyScan TD products allow the user to choose between 8- or 14-bit processing. 8-Bit represents 100% FSH and 14-bit represents 400% FSH. In TD systems the A-scan may be displayed in 100% or 400% amplitude windows. 14-bit processing provides a useful increase in dynamic amplitude range that allows the user to use the traditional 100% scale but with the ability to leverage the additional headroom for amplitude sizing if needed. Below is a useful method of displaying data.

- a) Set the system to 14-bit during setup.
- b) Set the TCG between 0 and 100% FSH.
- c) When acquiring and analysing data, set the A-scan and amplitude colour scale to 100% FSH.
- d) During data analysis, if a defect peak exceeds 100%, tap and hold the colour bar, then choose **Range 400%** from the context menu, then Choose **Reset** from the same context menu.
- e) Tap and hold on the A-scan sub-panel to reveal the context menu and choose **Follow Colour Bar**, the Amplitude scale will change to 400%. Immediately then deselect **Follow Colour Bar** to prevent the A-scan scale from changing if the colour bar is manually adjusted.

To explain how the software can display amplitude greater than 100%, we must consider the number of output data bits on the ADC (Analogue to Digital Converter) and the numeric range that can be represented by these bits.

$$\text{Range Calculation: } R = \pm (2^n / 2)$$

$$R = \text{Range}$$

$$n = \text{Number of bits.}$$

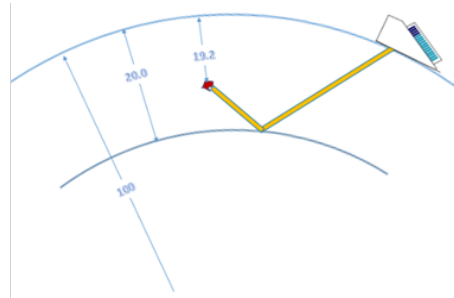
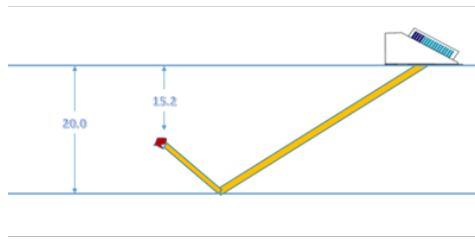
Historically, digital ultrasound equipment used 8-bit ADC's. This gives a numeric range of $2^8 / 2 = \pm 128$ (the reality is +127, -128). Thus, the percentage value of the LSB (Least Significant Bit) is $100/127 = 0.787\%$.

So, with better resolution ADCs (we use 14-bits), the numeric range is $2^{14} / 2 = \pm 8192$. In this case the LSB percentage value is $100/8192 = 0.01221\%$.

This is much finer resolution than is required, so it would be advantageous to shift this range by 2-bits, effectively multiplying the percentage range by 4. So, we can say that the percentage value of the LSB is not 0.01221% but is 0.04883% (which is still much finer than 8-bit). This gives a percentage range of:

$$0.04883\% \times 8196 = 400\%$$

xxvii. Curved Surface Correction (CSC)



This option is configured in the **TD Super-View Display Control** dialog. From the menu select **Setup, TD Super-View Panel Layout**, and set the **Surface Correction** field to the required option.

1. **None:** No correction is applied.
2. **Display Only:** All images are not CSC corrected, only the displayed text (axes, cursors, and status bars) show the corrected value of depth (radial depth). Distance is not corrected.
3. **Image Enabled:** Correction is carried out during the image construction stage, both depth and distance are corrected and the displayed text reveal the true values.

Notes:

These options are available only when test piece geometry is set to **Curved** prior data acquisition.

You cannot do CSC when the geometry has already been set to **Flat**.

The geometry setting can be changed later offline along with other parameters.

The **Geometry** field can be found in the **Probe** setup page. Also the **Internal Diameter** field must be set which is also in the **Probe** setup page.

Dual-linear array

Only side-by-side arrangement is supported, and it's assumed the phased arrays and wedges of TX and RX are symmetrical. Therefore, only one set of parameters, i.e., for TX, is needed.

First element separation:

Separation between centres of first element of two linear arrays. Here the first elements refer to the elements with biggest separation between them if squint angle is greater than 0.

Squint (angle):

Half of the angle between the two wedges.

Roof (angle):

The angle that the phased array rotates around its central line. When facing the front of the wedge, the TX array is assumed at right, and the roof angle will be positive if the phased array rotates clockwise, which is always the case as the arrays should face each other so that beams can cross at certain point.

Probe Direction (angle):

The angle between the symmetrical plane of TX/RX array and the secondary scan axis, similar to 1D array. Only 0/180 degree is allowed.

Offset:

The horizontal and vertical offsets are relative to TX unit, i.e., the 1st element when 0°wedge or no wedge is used, or the front of wedge when a non-0° wedge is used, similar to 1D array.

To setup dual-linear PA, just do it using the same procedure for setting up a single PA. The parameters for TX and RX control should be identical except Element 1 Connection. When no wedge is used, **Squint angle** and **1st Element-Separation** are available; while with wedge in use, in addition to those two angles, **Roof angle** is available as well. Other wedge parameters are those of the TX unit.

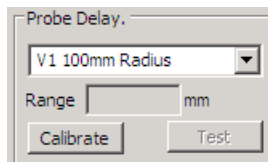
Appendix C

Wizards

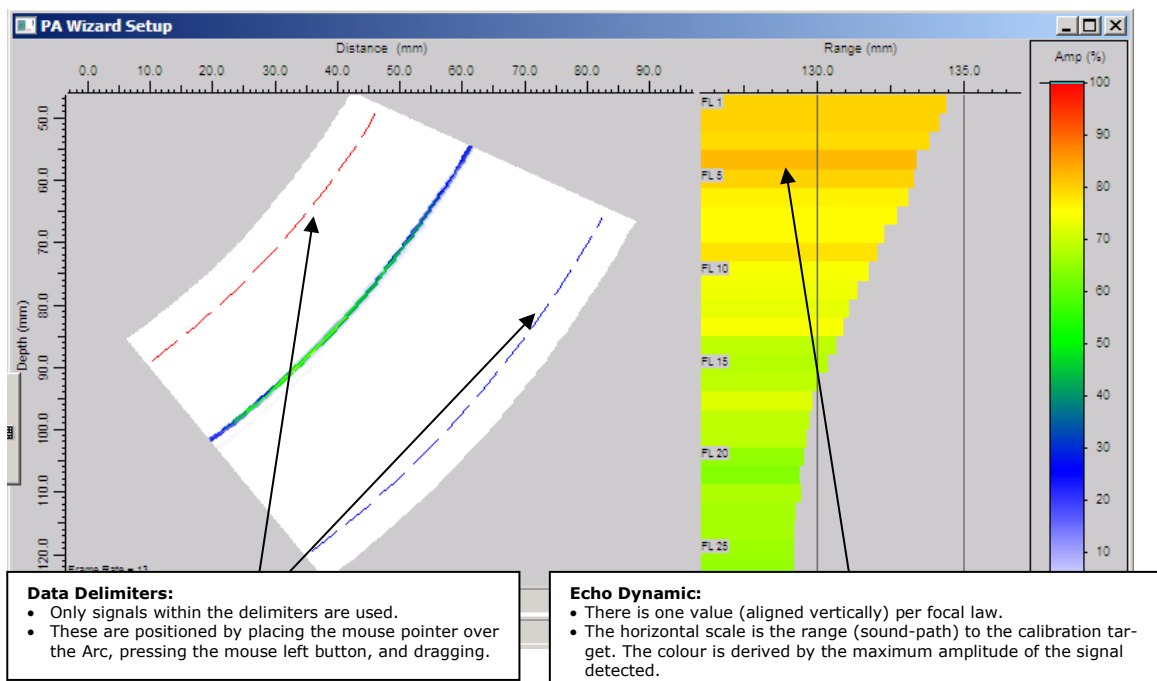
1. Phased Array Calibration Wizard

Probe Delay Calibration – Radius.

1. Select the radius you wish to calibrate at (e.g. V1 100mm Radius), and press the <Calibrate> button.

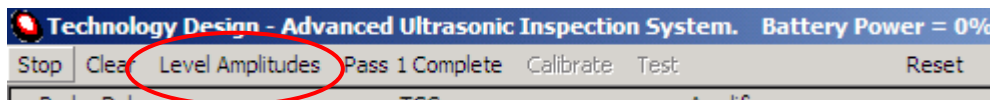


2. Move the probe across the calibration block so that each focal law sees the calibration target.



- a. Move the data delimiters to encapsulate the data from the target radius.
- b. Use the gain controls to obtain a reasonably large signal. (80% FSH approx).
- c. If the amplitude is too large the data for that focal law will be drawn in Red/White stripes. If this happens reduce the gain.

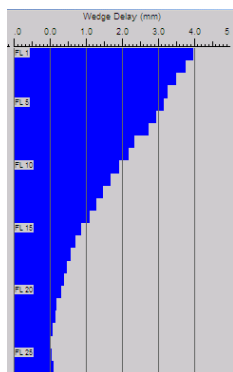
3. Select the menu option <Level Amplitudes>.



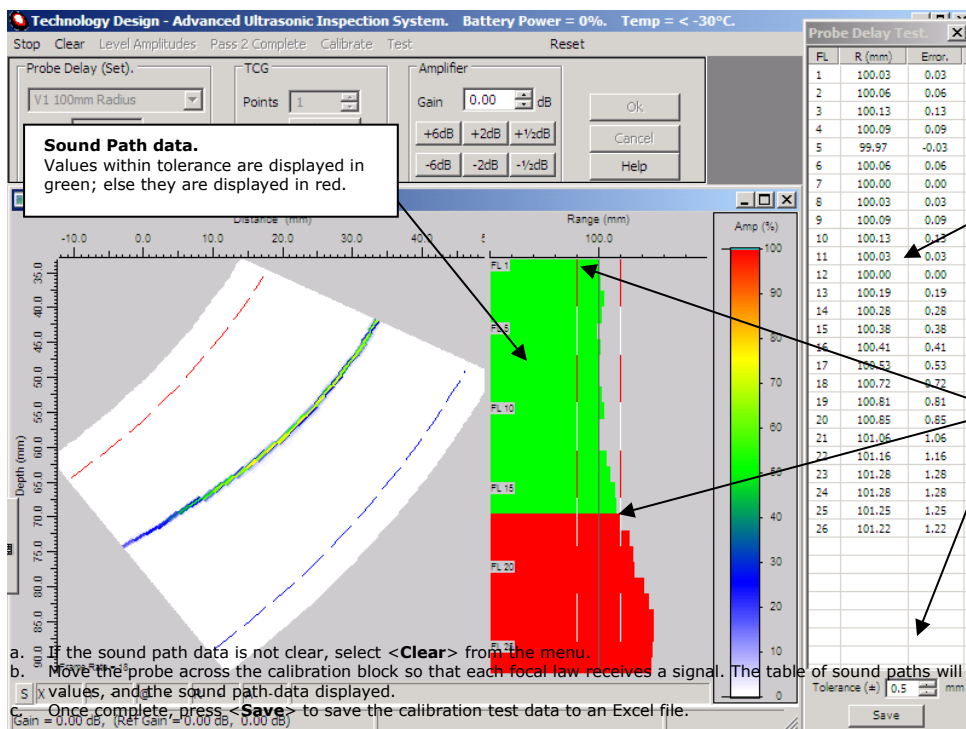
4. Ensure that the Echo Dynamic is clear, select <Clear> from the menu if not. Move the probe so that each focal law sees the calibration target. Once complete, select <Pass 1 Complete> from the menu.
5. Repeat for pass 2.
If the sound path values for the respective focal laws are within 0.1mm between pass 1 and 2, passes 3 and 4 will be skipped, and the menu option <Calibrate> will become enabled. If not repeat for passes 3 and 4, then the menu option <Calibrate> will become enabled.

NOTE: If the data for any given pass appears to be of poor quality (may be bad coupling), the echo dynamic can be reset by selecting <Clear> from the menu.

- Once all passes have been completed, the **<Calibrate>** menu option will become enabled. On selecting **<Calibrate>**, the per focal law probe delay values will be computed and displayed.



- At this point the calibration may be tested by selecting the **<Test>** menu option (this stage is optional).

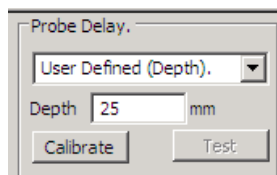


2			
3	Date	26/03/2013	
4	Time	15:04	
5	Channel	1	
6	Tolerance	0.5mm	
7			
8			
9			
10	Probe Delay Calibration Results.		
11	F-Law	Target (100.0mm)	
12		Range	Error
13	1	100.00	0.00
14	2	100.03	0.03
15	3	100.06	0.06
16	4	100.03	0.03
17	5	99.94	-0.06
18	6	100.06	0.06
19	7	99.94	-0.06
20	8	100.16	0.16

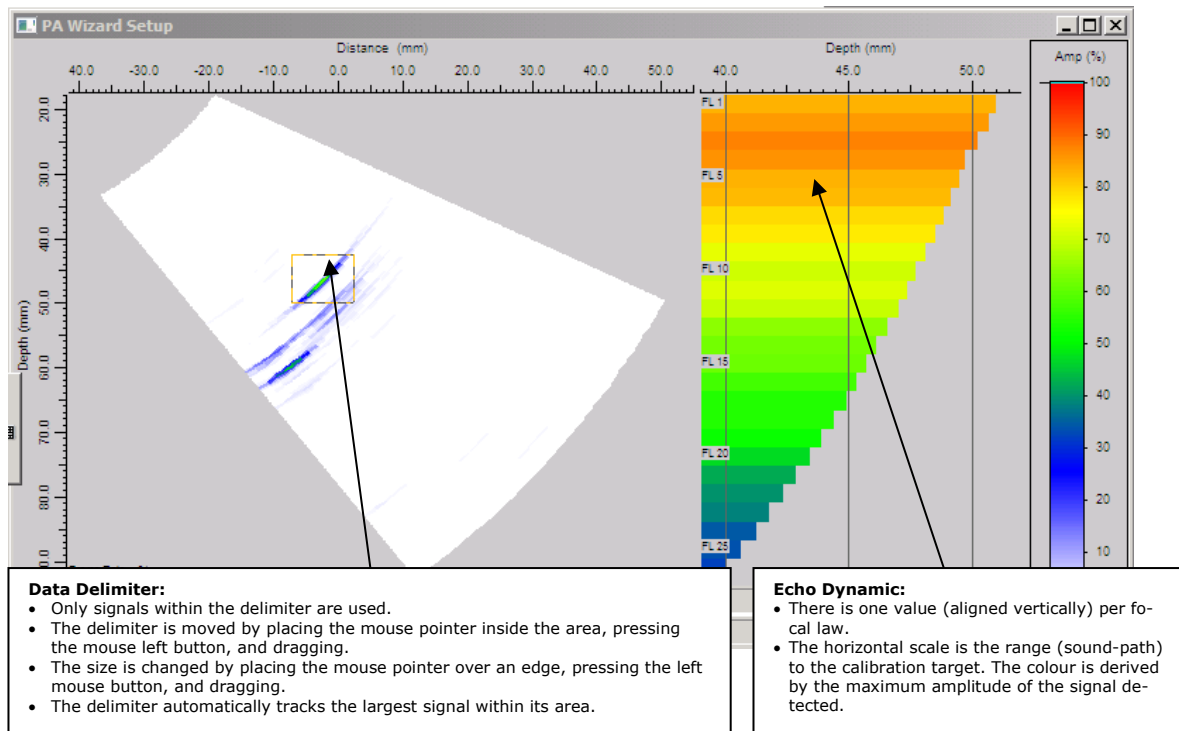
- To stop the calibration press **<Stop>** on the menu.

Probe Delay Calibration – Side Drilled Hole.

- Select the option **<User Defined (Depth)>**, and enter the depth of the Side Drilled Hole you wish to calibrate at. Then press the **<Calibrate>** button.



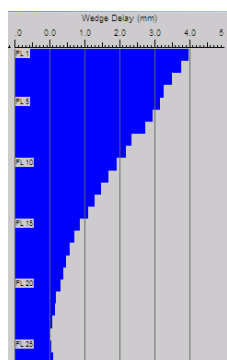
2. Move the probe across the calibration block so that each focal law sees the calibration target.
- 3.



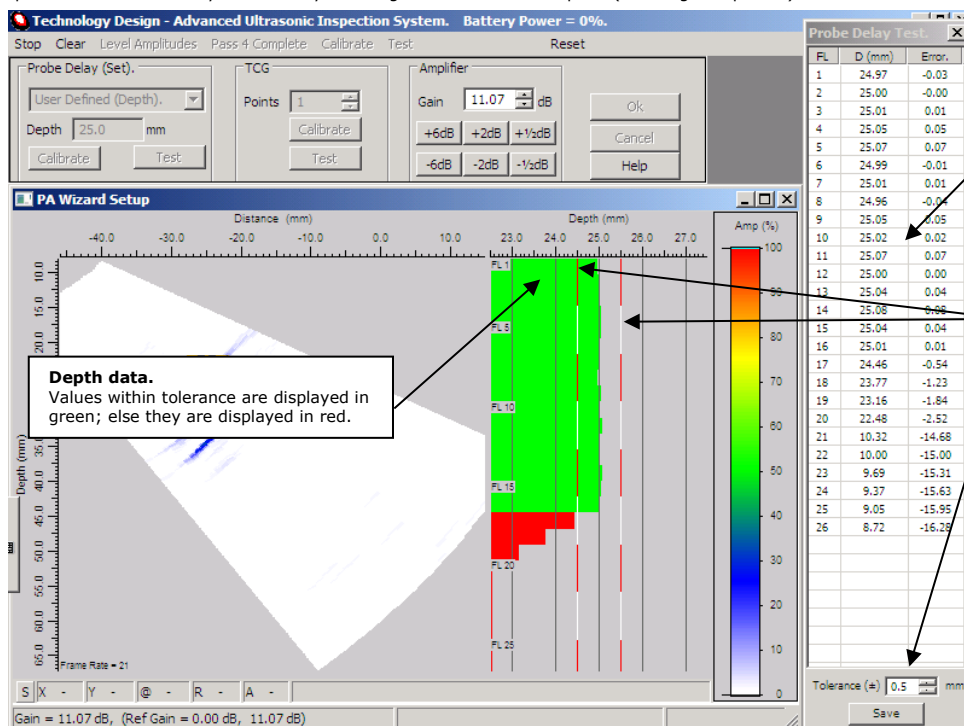
4. Select the menu option **<Level Amplitudes>**.



5. Ensure that the Echo Dynamic is clear, select **<Clear>** from the menu if not. Move the probe so that each focal law sees the calibration target. Once complete, select **<Pass 1 Complete>** from the menu.
 6. Repeat for pass 2.
If the sound path values for the respective focal laws are within 0.1mm between pass 1 and 2, passes 3 and 4 will be skipped, and the menu option **<Calibrate>** will become enabled. If not repeat for passes 3 and 4, then the menu option **<Calibrate>** will become enabled.
- NOTE: If the data for any given pass appears to be of poor quality (may be bad coupling), the echo dynamic can be reset by selecting **<Clear>** from the menu.
7. Once all passes have been completed, the **<Calibrate>** menu option will become enabled. On selecting **<Calibrate>**, the per focal law probe delay values will be computed, and displayed.



8. At this point the calibration may be tested by selecting the **<Test>** menu option (this stage is optional).



- b. Move the probe across the calibration block so that each focal law receives a signal. The table of depths will be populated with these values, and the depth data displayed.
- c. Once complete, press **<Save>** to save the calibration test data to an Excel file.

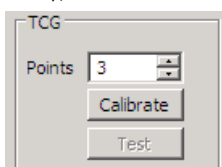
A	B	C	D
2			
3			
4			
5	Date	27/03/2013	
6	Time	08:49	
7	Channel	1	
8	Tolerance	0.5mm	
9			
10	Probe Delay Calibration Results.		
11	F-Law	Target (25.0mm)	
12		Depth	Error
13	1	25.06	0.06
14	2	25.02	0.02
15	3	25.01	0.01
16	4	25.05	0.05
17	5	25.02	0.02
18	6	25.02	0.02
19	7	25.03	0.03
20	8	25.11	0.11

Example Excel file.

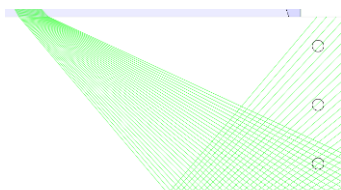
9. To stop the calibration press **<Stop>** on the menu.

TCG Calibration.

1. Firstly, select the number of points in the TCG curve, and then press **<Calibrate>**.



2. Enter the Depth and Leg for each TCG point.
The software will arrange the targets in shortest beam path 1st.

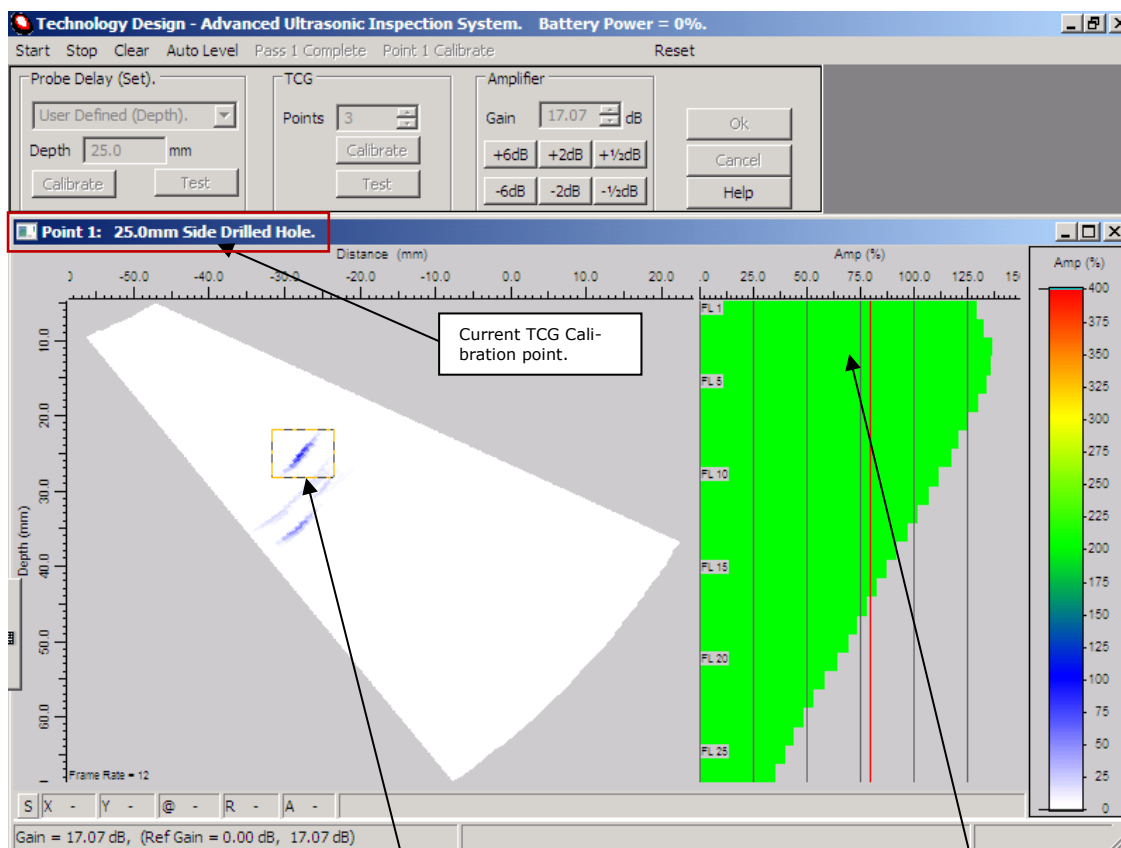


TCG Calibration Targets.			
Type	Side Drilled Hole		
	Target		Leg
1	5 mm	2	
2	15 mm	2	
3	25 mm	1	

TCG Calibration Targets.			
Type	Side Drilled Hole		
	Target		Leg
1	25.0 mm	1	
2	15.0 mm	2	
3	5.0 mm	2	

3. Move the probe across the calibration block so that each focal law sees the calibration target.

block so that each focal



Data Delimiter:

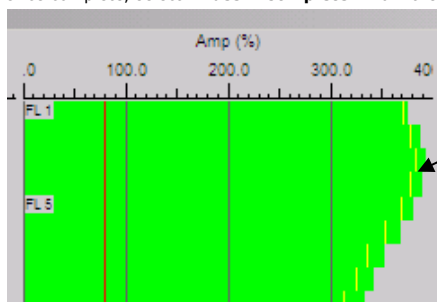
- Only signals within the delimiter are used.
- The delimiter is moved by placing the mouse pointer inside the area, pressing the mouse left button, and dragging.
- The size is changed by placing the mouse pointer over an edge, pressing the left mouse button, and dragging.
- The delimiter automatically tracks the largest signal within its area.

Echo Dynamic:

- There is one value (aligned vertically) per focal law.
- The horizontal scale is in amplitude.

- TCG calibration is performed with 14-bit data, therefore the dynamic signal range is to 400% FSH.
- Use the gain controls to adjust the signal amplitudes. Aim for the minimum response being greater than 25% FSH (if possible).
- Saturated signals are drawn in Red/White strips. In this case the gain must be reduced.
- Once all focal laws have 'seen' the calibration target select **<Auto Level>** from the menu. This will set the gain to give a 350% FSH signal for the largest response.

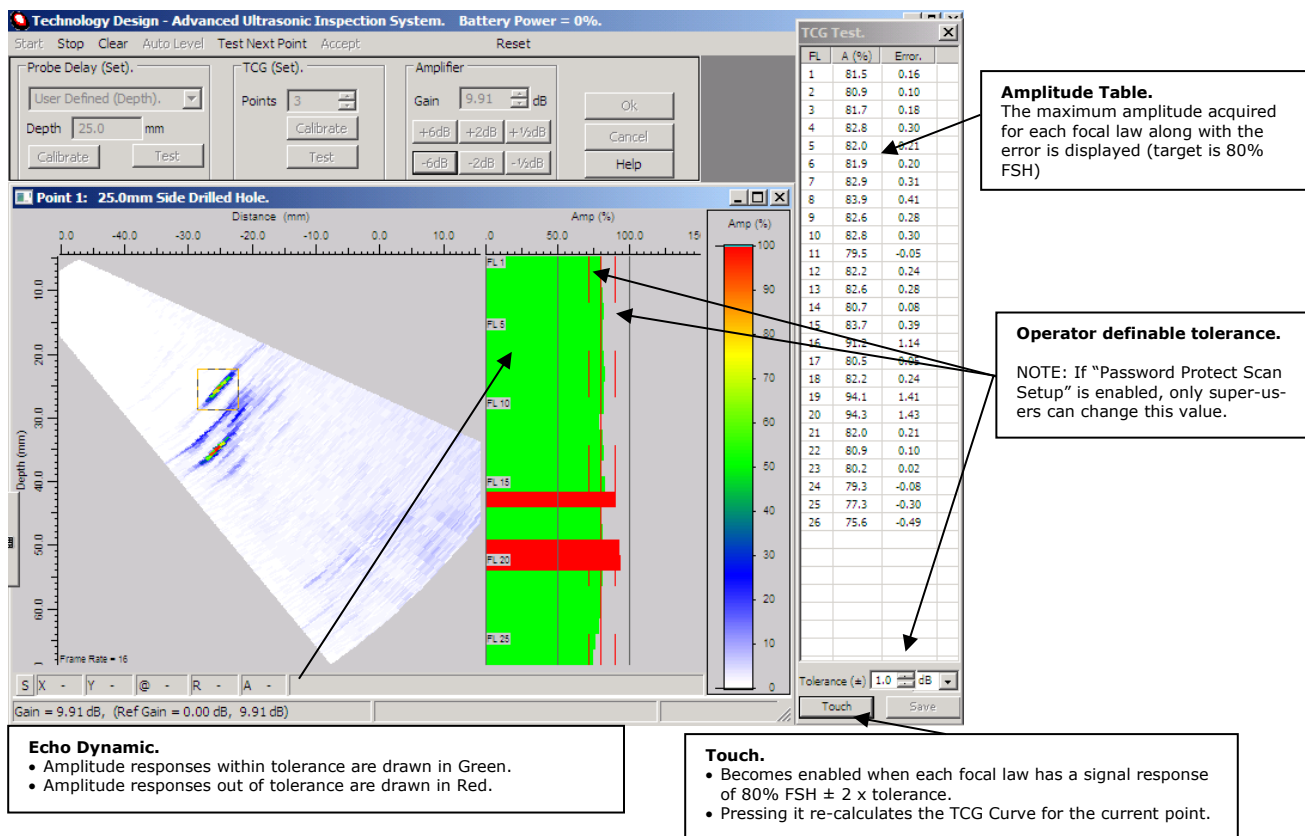
- Ensure that the Echo Dynamic is clear, select **<Clear>** from the menu if not. Move the probe so that each focal law sees the calibration target. Once complete, select **<Pass 1 Complete>** from the menu. Repeat for pass 2.



Yellow indicators show the per focal law amplitude response from the 1st pass. The 2nd pass should be similar to the 1st. If not select **<Clear>** from the menu and re-try.

NOTE: Good and consistent coupling is required.

- When the 2nd pass is complete, select **<Pass 2 Complete>**. The menu now changes to give the options **<Reject>** and **<Accept>**. If you are satisfied with the result select **<Accept>** to move to the next TCG calibration point, else select **<Reject>** to repeat the current point.
- Repeat until all TCG Calibration points are complete.
 - For the 1st pass on any given TCG Calibration point, the gain controls are enabled.
 - If saturated signals are acquired, reduce the gain.
 - If very small amplitude signals are acquired (less than 25% FSH) increase the gain.
 - The gain may be adjusted by ± 6 dB during TCG Calibration.
 - After each point is complete a partial TCG Curve is generated and used.
- Once all TCG Calibration points are complete, the software automatically enters TCG Calibration test.



8. Once all points have been tested, the **<Save>** button becomes enabled. Pressing **<Save>** produces an Excel file of the TCG Calibration test results.

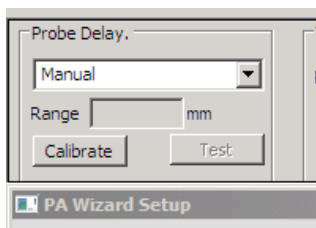
A	B	C	D	E	F	G	H
2							
3							
4							
5	Date	27/03/2013					
6	Time	11:28					
7	Channel	1					
8	Tolerance	1.0dB					
9							
10							
11	TCG Calibration Results.						
F-Law	Point 1 (25.0mm)		Point 2 (15.0mm)		Point 3 (5.0mm)		
	Amp	Error (dB)	Amp	Error (dB)	Amp	Error (dB)	
13	1	79.6	-0.04	81.2	0.13	77.6	-0.26
14	2	81.9	0.20	82.0	0.21	78.4	-0.18
15	3	82.4	0.26	82.7	0.29	78.2	-0.20
16	4	82.5	0.27	84.8	0.51	79.3	-0.08
17	5	82.3	0.25	84.7	0.50	79.9	-0.01
18	6	82.7	0.29	85.9	0.62	80.2	0.02
19	7	83.1	0.33	80.8	0.09	80.6	0.06
20	8	83.2	0.34	83.0	0.32	79.0	-0.11

Example Excel file.

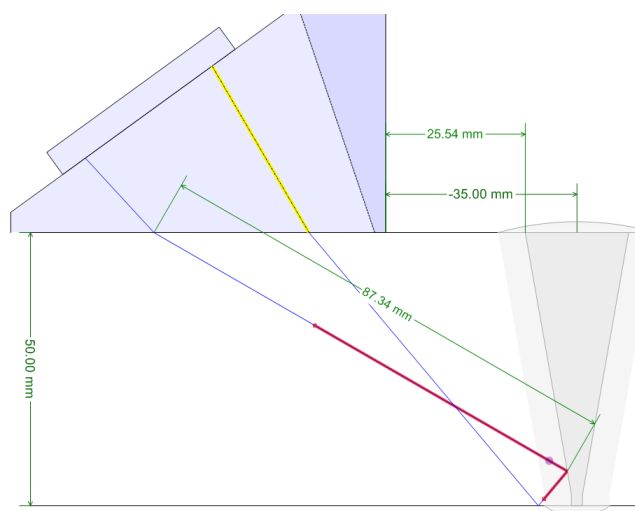
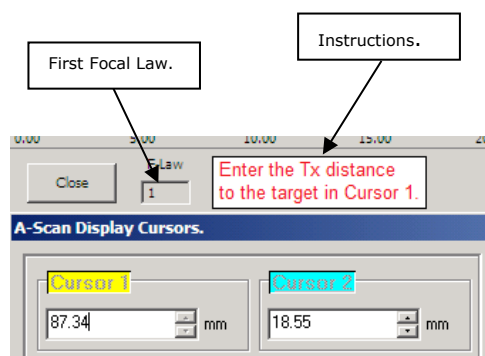
10. To stop the calibration press **<Stop>** on the menu.

Phased Array Calibration Wizard (Pitch Catch)

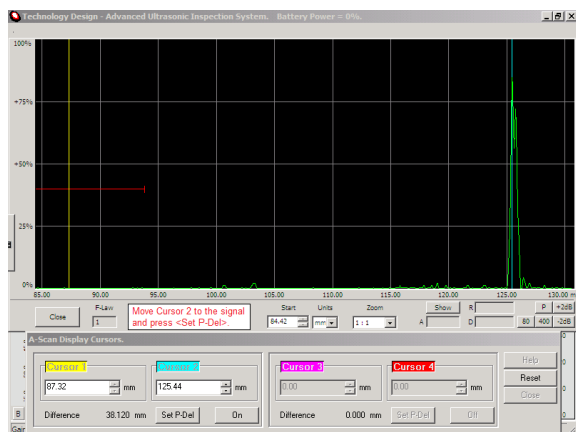
1. To calibrate the probe delay for a multi focal law channel (pitch catch mode); from the main menu select <Wizards>, <PA Calibration Wizard>.
2. In the <Probe Delay> group, select <Manual> and press the <Calibrate> button.



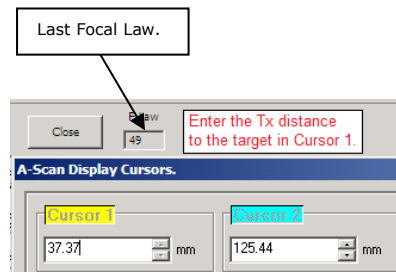
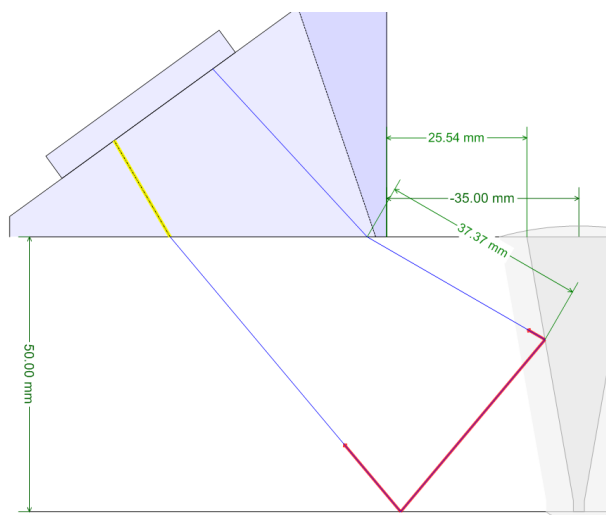
3. Enter the transmit distance to the calibration target in cursor 1 (the <Enter> key must be pressed for the value to be entered). In this case the distance is 87.34mm as seen in the drawing. Note: this is for the 1st Focal Law.



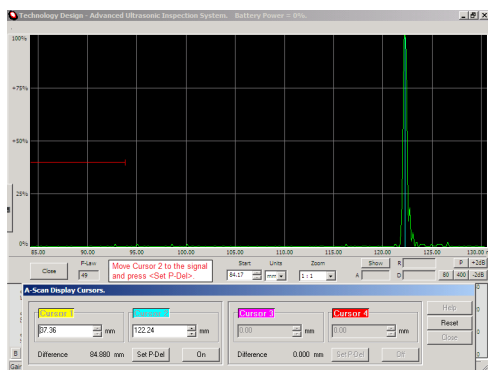
4. Now move Cursor 2 to where the actual signal appears on the A-Scan Display and press the <Set P-Del> button in the Cursors dialog box.



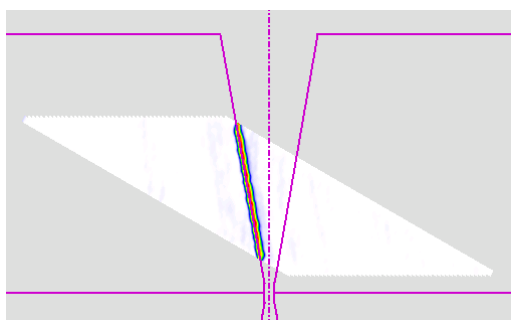
5. The A-Scan display now automatically switched to the channel's last Focal Law. Again, enter the transmit distance to the calibration target. In this case 37.37mm 1 (again the <Enter> key must be pressed for the value to be entered).



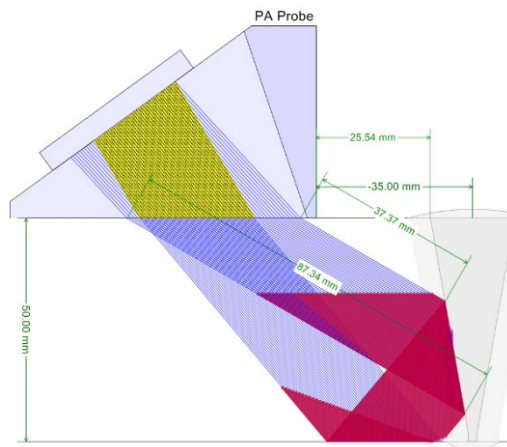
6. Again, move Cursor 2 to where the actual signal appears on the A-Scan Display, and press the <Set P-Del> button in the Cursors dialog box.



Screen shot of B-Scan image after calibration.



Screen shot inspection plan created in BeamTool.



Appendix D

SuperView® User Instructions

Overview

TD Super-View® (SuperView) is a powerful, feature-rich and versatile ultrasonic data presentation and analysis software package by Technology Design Ltd. SuperView is closely integrated with Technology Design's TD-Scan ultrasonic acquisition software; therefore, working with the various TD-Scan modules and SuperView is seamless. SuperView is available for all versions of TD-Scan software from Version 16.00 onward and is bundled with all new software distributions. The software is primarily aimed at phased array and pulse echo applications but certain other advanced features have been incorporated, for example: Rastered ToFD. Conventional ToFD line scans can also be viewed in SuperView and a combination of ToFD & Phased Array or Pulse Echo can be viewed simultaneously.

SuperView is fully customisable, allowing the operator to rearrange data on-screen in many different views with or without weld overlay sketches. Data can be presented in A, B, C, D & Sector scan format in any combination. Data can also be presented from individual channels or indeed as a composite view of several channels.

SuperView features powerful tools to make data analysis easier and more comfortable. Whether it is distance, depth, amplitude, angle or beam path measurement, SuperView makes code compliant decision making easier and more efficient.

1. Configuration

SuperView is enabled from the **Misc.** tab on the **Setup – Configuration** drop-down menu.

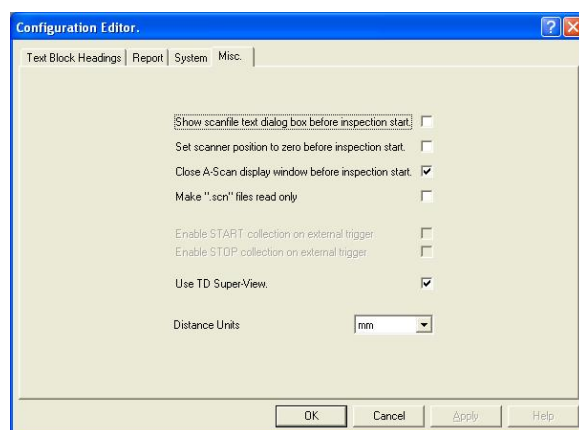


Fig. 1

Note: If SuperView is disabled, the data presentation and analysis options will revert to the original viewing and analysis tools offered by the TDScan software, commonly referred to as the Corrosion Mapping software. Certain data analysis tools are not available in SuperView i.e., StripScan & Long-Range Corrosion Mapping. Therefore, SuperView must be disabled during these operations. Conventional ToFD analysis tools can be easily accessed from within SuperView using the contextual menu accessed by right clicking in any ToFD B or D scan view.

SuperView must be configured prior to commencement of data acquisition, however, it may be re-configured in analysis mode after acquisition. The CPU & RAM are heavily loaded during data acquisition, especially when multiple channels or focal laws are defined. It is therefore good practice to limit the amount of data displayed during acquisition to a minimum.

When SuperView is enabled, the full waveform is captured allowing the software to be reconfigured offline to display the desired views.

To display the configuration menu, click **SuperView Panel Layout** from the **Setup** drop-down menu. (For a view of the practical result of configuration see Fig 12.)

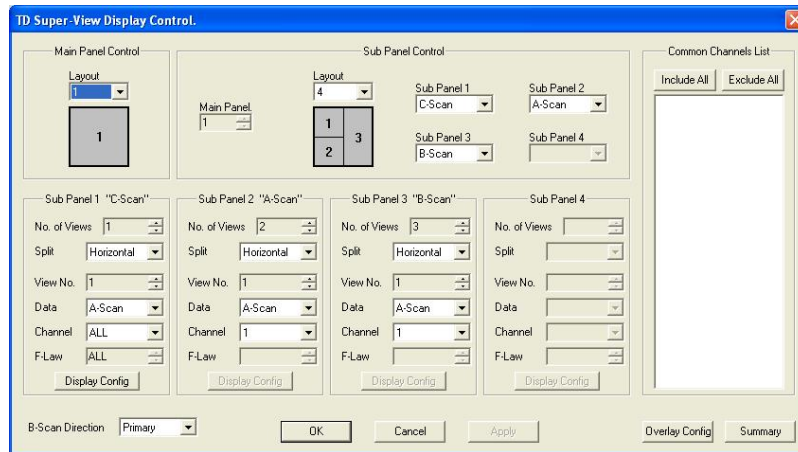


Fig. 2

Main Panel Control

The purpose of the **Main Panel Control** is to display comparative data from different UT modes e.g. Phased array & ToFD. 10 Different templates may be defined in the **Main Panel**.

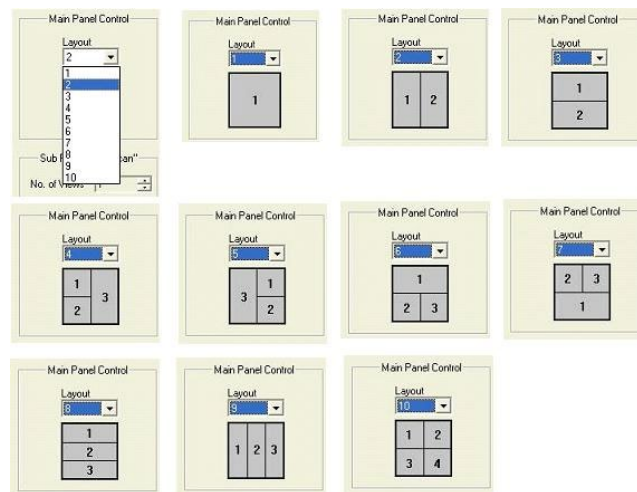
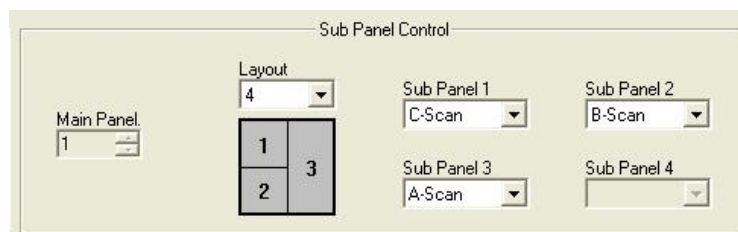


Fig 3

1.1. Sub Panel Control

- 1.1.1. The purpose of the **Sub Panel Control** is to display different data presentations simultaneously, e.g. A, B, C, D & S scan. Each **Main Panel** may be divided into 10 different **Sub Panels**.



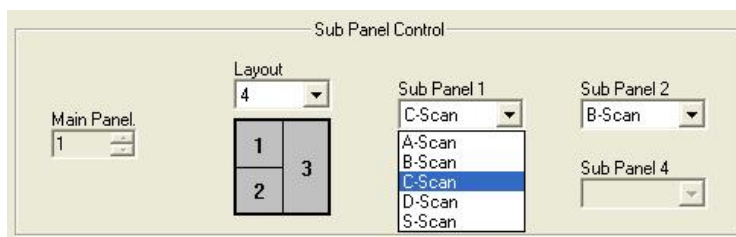


Fig. 4

1.2. Views

1.2.1. The purpose of the **Views Control** is to display data from different channels individually or combined as an overlay. Each **Sub Panel** may be divided into 5 different **Views** (screen resolution below 1024x768 may be limited to 3 views). **Views** are displayed either horizontally or vertically, controlled from the **Split** combo box.

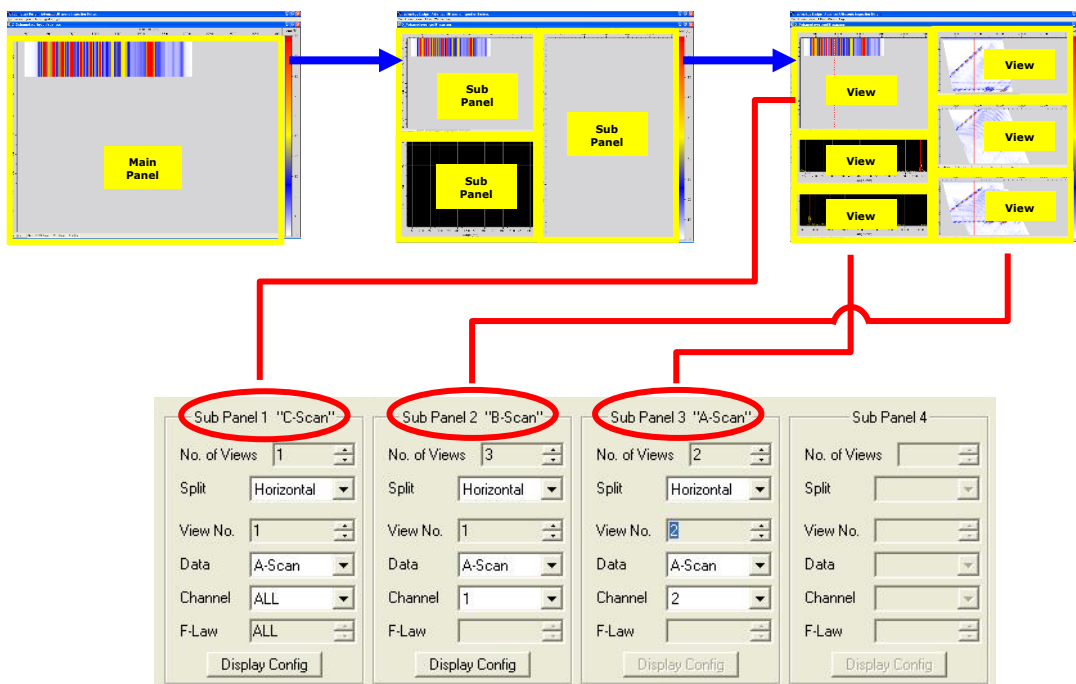
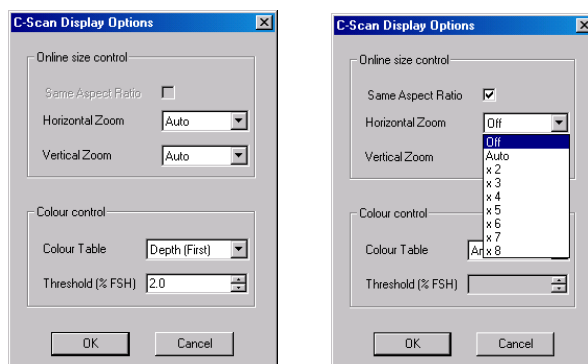


Fig. 5

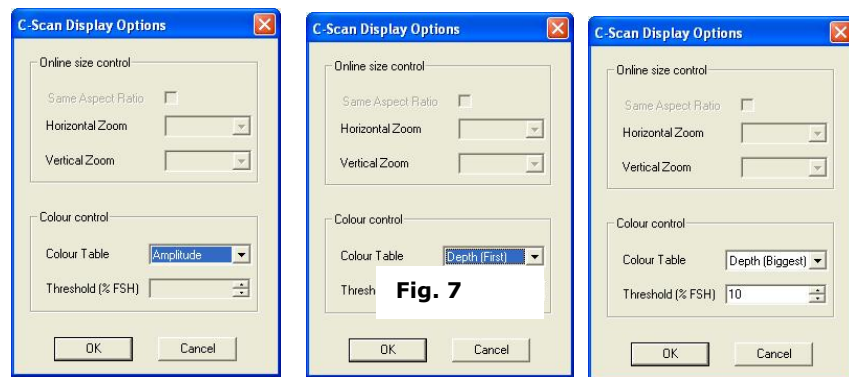
1.2.2. Display Config

The **Display Config** button activates the **C-Scan Display Option** dialogue box. The dialogue box is divided into two areas:

1.2.2.1. **Online size control** – As the name suggests, this control is only available for online use and cannot be adjusted offline. The **Online size control** allows adjustment of the number of pixels that cover an area (no. of encoder steps), e.g. If **Horizontal Zoom** = 8 and **Vertical Zoom** = 6 then each encoder step will cover 8 pixels by 6 pixels.



- 1.2.2.2. **Colour control** – provides the choice of three modes for displaying the colours in the C-scan sub panel.
- 1.2.2.2.1. **Amplitude** – The colours represent the amplitude/colour combination derived from the amplitude colour bar (see section 5.5).
- 1.2.2.2.2. **Depth (First)** – The colours represent the depth/colour combination derived from the depth colour bar. The colour in each pixel represents the depth of the first A-scan to cross the amplitude threshold within the scan area the pixel covers. Set the desired amplitude threshold in the **Threshold (%FSH)** text box.
- 1.2.2.2.3. **Depth (Biggest)** – The colours represent the depth/colour combination derived from the depth colour bar. The colour in each pixel represents the depth of the highest amplitude A-scan within the scan area the pixel covers. The amplitude entered in the **Threshold (%FSH)** text box will exclude all signals below this threshold to ensure that no noise is included in the C-scan.



1.3. B-Scan Direction

- 1.3.1. The **B-Scan Direction** control has 2 choices: **Primary** or **Secondary**. B-Scan direction refers to the creation of a B-scan image in relation to direction of probe movement, e.g. if **Primary** is chosen for the B-scan direction, then the secondary movement axis will trigger the creation of a D-scan (Fig. 8).

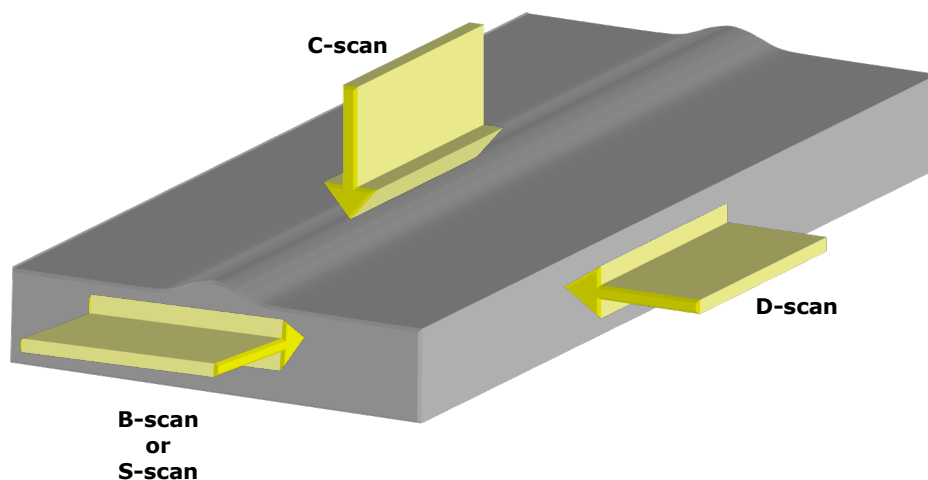


Fig. 8
View Orientation in Relation to a Weld

2. Opening Data Files

The actions taken to display data vary dependant on the type of data presented

- 2.1.1. Data is displayed by opening the data file in one of two methods:

- 2.1.1.1. Press **F9** or click the **Analyse** menu and select the required data file or files.

- 2.1.1.2. Click the **Open Scan File** from the **File** menu and select the required data file or files. Additional data files can be opened using this option after a data file is opened for analysis.

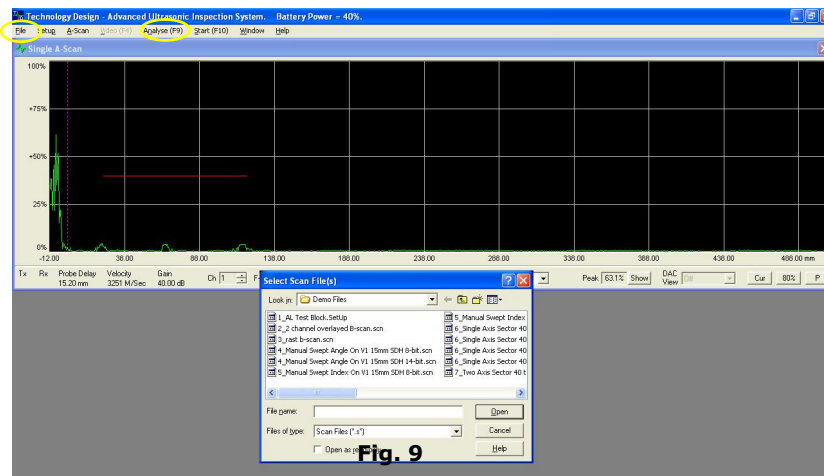


Fig. 9

3. Customising the Workspace

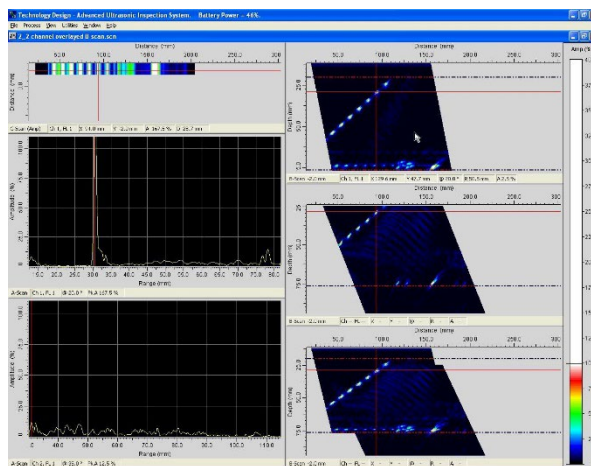


Fig. 10

3.1. Resizing Main Panels, Panels & Views

Main Panels (multiple), **panels & views** can be resized at any time. Resizing a panel or view will automatically adjust other displayed workspace areas to fit the available main panel space.

- 3.1.1. Place mouse pointer over the division between panels or views. The mouse pointer will change to a **double arrow**.
- 3.1.2. Left-click, hold and drag the division to the desired position and release.

3.2. Resizing images

- 3.2.1. **C-scan** – There are 4 menu choices for resizing a C-scan image and several keyboard shortcuts (Table 1). Right-click in the C-scan sub-panel to activate the contextual menu.
 - 3.2.1.1. **Best Fit** – image fills the available workspace in relation to the originally defined scan size.
 - 3.2.1.2. **View 1:1** – image is displayed in the relationship of 1 collection step = 1 screen pixel.
 - 3.2.1.3. **Zoom Out** – reduces image size.
 - 3.2.1.4. **Zoom In** – enlarges image size by activating a rubber box. Drag the rubber box to cover the desired zoom area.
- 3.2.2. **B-scan** – B-scan views within the same sub-panel are linked to each other as well as to the C-scan image, therefore adjusting the size of the B-scan image will automatically resize any other B-scan views as well as the C-scan view. To resize a B-scan:
 - 3.2.2.1. Place the mouse pointer in the **View** space.
 - 3.2.2.2. Press the **+** or **-** keys repeatedly to increase or decrease the image. Holding the **Shift** key simultaneously increases the adjustment step. (Table 1 for detailed zoom information).
- 3.2.3. **D-scan** – There are currently no zoom controls for D-scan images.
- 3.2.4. **S-scan** – A Sector scan is a side view 'snap-shot' of a slice through the volume of the material. A Sector scan may be part of a wider area scan of the material or a view from a static probe position on the material surface. If the C-scan sub-panel is activated, by default, the associated S-scans are linked to the C-scan and are subject to limited size adjustment by resizing the C-scan image. To de-activate this link:
 - 3.2.4.1. Right-click while the mouse pointer is in the S-scan sub-panel to activate the contextual menu

- 3.2.4.2. Select **Follow C-scan**.
- 3.2.4.3. To re-activate the link between C-Scan & S-scan repeat the previous two steps.
- 3.2.5. **A-scan** – An A-scan can be zoomed in two directions:
 - 3.2.5.1. **Horizontal** – Press the **+** or **-** keys to increase or decrease the image width. Holding the **Shift** key simultaneously increases the adjustment step. The A-scan image can be moved horizontally by holding the left mouse button and moving the mouse pointer to the desired position.
 - 3.2.5.2. **Vertical** – Hold the **CTRL** key and press the **+** or **-** keys to increase or decrease the image height. Holding the **Shift** key simultaneously increases the adjustment step. The A-scan peak may be viewed up to 400% in 14-bit and 100% in 8-bit mode.

4. Data Display

The following sections are aimed primarily at offline use for analysing saved data. The principles of usage are however basically the same for online or offline operation. To display ultrasonic data in SuperView, the software must be activated prior to data collection. Data collected while SuperView is deactivated can **only** be displayed in the legacy formats of the TD-Scan software.

In this section it is assumed that the user has followed the instructions in **Section 2** and has configured SuperView® to display the required data

4.1. Sectorial Scans

A sector scan is essentially a multi-angular side view of a slice through the test material viewed perpendicular to the direction of sound propagation. When viewed off-line, sector scans can be viewed as single images (snap-shot) or as multiple stacked scans.

- 4.1.1. To view a sector scan open the required file (section 3.1). The image is displayed in the **S-Scan** sub-panel. If an **A-scan** sub-panel is configured, no A-scan data is displayed until a focal law is selected:
 - 4.1.1.1. While holding the **Shift** key, move the mouse pointer over the S-scan image.
 - 4.1.1.2. As the mouse pointer moves over each angle or focal law, the A-scan for each corresponding focal law (angle) will be displayed in turn giving the appearance of a live A-scan display and thus recreating the echo dynamic pattern of the defined angular range sweeping across the area of interest. Releasing the **Shift** key fixes the A-scan image of the active focal law.

An alternative method:

- 4.1.1.3. Select **Cursors** from the contextual menu by right-clicking inside the S-scan sub-panel.
- 4.1.1.4. Move the crosshair across the S-scan image. Each A-scan for the corresponding focal law (angle) will be displayed in turn.
- 4.1.1.5. Select an angle/focal law with the crosshair. Right click to deactivate the crosshair cursor. The A-scan for the selected angle or focal law will remain displayed.
- 4.1.2. As the mouse pointer or crosshair cursor are moved over the image, channel, focal law, X position, Y position, angle, range or depth and amplitude are displayed in the information tray below the scan image or in coloured flags in the view space.
- 4.1.3. To improve the visual appearance of the image, a smoothing filter may be accessed from the **Image Filter** item on the contextual menu by right clicking in the S-scan view. Select either the **Smoothing (Low)** or **Smoothing (High)** option.

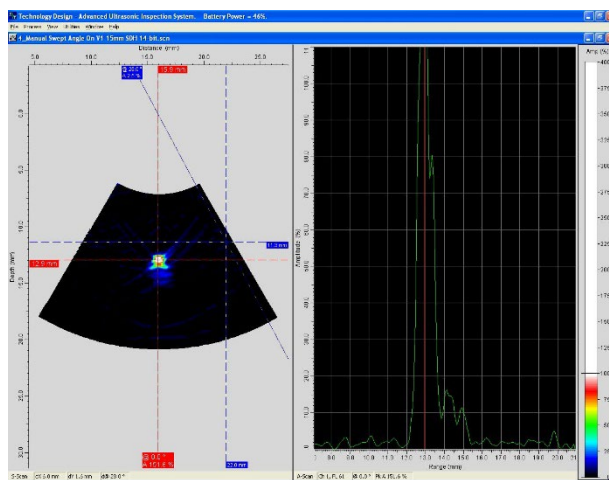


Fig.

4.2. C-scans

A C-scan is a plan-view of the test area from the scan surface of the material. C-scans are made up from individual A-scans stacked together to form a composite image of the entire scan area.

The C-scan is used to measure position in the length and width of the scan and also to activate B, D & S scan views. As the mouse pointer or crosshair cursor are moved over the image, channel, focal law, X position, Y position, amplitude and volume corrected depth are displayed in the information tray below the C-scan image or in coloured flags in the view space. To display any of the associated views, a **Single Cursor** is activated in the C-scan sub-panel. By moving the cursor across the C-scan image, individual B, D or S scans will be displayed in the appropriately configured sub-panels related to the position of the cursor.

- 4.2.1. To activate the Cursor:
 - 4.2.1.1. Right-click while the mouse pointer is in the C-scan sub-panel to activate the contextual menu
 - 4.2.1.2. Select **Single Cursor**.
 - 4.2.1.3. To de-activate cursor, repeat the previous step.

An alternative to activating the single cursor is to press **Shift** while moving the mouse pointer over the C-scan image, the A, B and D scans will be displayed in relation to the mouse pointer position. Releasing **Shift** will fix the position of the A, B and D scans.

4.3. B-Scans

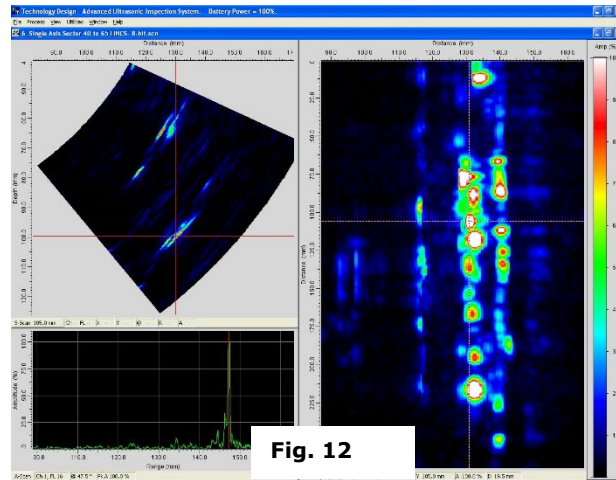
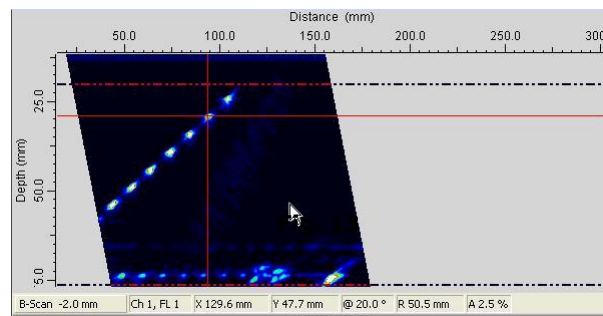


Fig. 12

A B-scan is a side view (slice) of the diagnostic area viewed at 90° to the direction of sound propagation. B-scans can be formed from stacked single-angle A-scans. (A sector scan is in effect a multi-angled B-scan)

To improve the visual appearance of the image, a smoothing filter may be accessed from the **Image Filter** item on the contextual menu by right clicking in the S-scan view. Select either the **Smoothing (Low)** or **Smoothing (High)** option.

As the mouse pointer or crosshair cursor are moved over the image, channel, focal law, X position, Y position, angle, range or depth and amplitude are displayed in the information tray below the C-scan image or in coloured flags in the view space.



4.4. A-Scans

A-scans are the C-scan or B-scan. Additional control is the A-scan view panel and activating a contextual menu:

- 4.4.1. **Follow Colour Bar** – This control causes the visible A-scan amplitude to re-adjust when the Colour Bar to the right of the workspace is adjusted manually.
- 4.4.2. **Time Base in Range** – This control changes the time base scale to millimetres. When the control is disabled the timebase scale is displayed in micro-seconds.

activated by moving a cursor across either scan image of the appropriate channel. achieved by right clicking the mouse while in

4.5. Amplitude Colour Palette

The colour ramp on the right of the workspace may be used to alter the contrast of the B, C, D & S-scan images and zoom of the A-scan image by moving the upper limit of the colour bar up or down. It allows the user to define the upper and lower amplitude level to which the colour pallet will be applied:

- 4.5.1. Move the mouse pointer over the black line at the upper limit of the colour bar. The mouse pointer will change to a double arrow.
- 4.5.2. Hold the left mouse button and move the colour bar up or down. The sub-panel image colours will adjust according to the redefined colour bar setting.
- 4.5.3. **'Reject'** can also be simulated:
- 4.5.4. Move the mouse pointer over the black line at the lower limit of the colour bar. The mouse pointer will change to a double arrow.
- 4.5.5. Hold the left mouse button and move the colour bar up or down. The sub-panel image colours will adjust according to the redefined colour bar setting.

5. Additional Analysis Tools

There are several tools provided in the software designed to make data analysis easier and more efficient.

5.1. Echo Dynamics

To activate the echo dynamic:

- 5.1.1. Right click while the mouse pointer is in a B or S scan sub-panel to activate the contextual menu.
- 5.1.2. Highlight **Echo dynamics**.
- 5.1.3. A sub-menu appears. Choose either **Horizontal** to activate the box below or **Vertical** to activate the box to the right of the sub-panel.
- 5.1.4. Activate the crosshair cursors in the sub-panel by right clicking in the sub-panel and choosing cursors from the contextual menu.

- 5.1.5. Move the cursors over the image to display the echo dynamic. The echo dynamic is essentially an amplitude envelope of the cursor line through the image.

To measure size from the echo dynamic:

- 5.1.6. Place a crosshair cursor over the highest amplitude of the indication of interest in the sub-panel image.
- 5.1.7. The corresponding echo dynamic is displayed in the echo dynamic box.
- 5.1.8. Right click in the echo dynamic box and select the desired amplitude boundary/s. 6dB or 20dB boundaries may be selected for display independently or simultaneously. Choose a scaling factor that will ensure the highest amplitude peak is visible.
- 5.1.9. Move the **red** line to the highest amplitude on the echo dynamic by dragging the line with the mouse. Fine control is achieved by holding the left mouse button down while the mouse pointer is over the line. Note the black dashed line/s will correspond to the amplitude boundary/s defined in 6.1.8 and cross the echo dynamic at the amplitude stated on the corresponding flag.
- 5.1.10. Position the left and right **blue** lines at the point where they bisect the amplitude boundary line and the edge of the echo dynamic. *TIP: Try to match the values on the blue and black flags as closely as possible.*
- 5.1.11. The defect size is displayed in the **dY** flag in the upper left or right corner of the echo dynamic box.

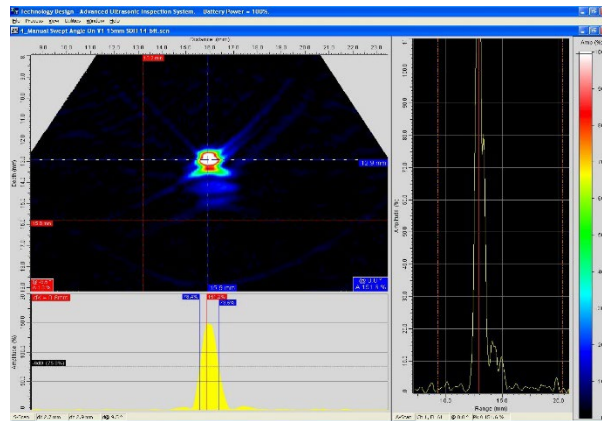
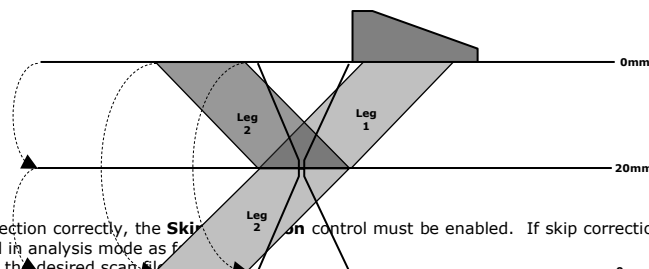


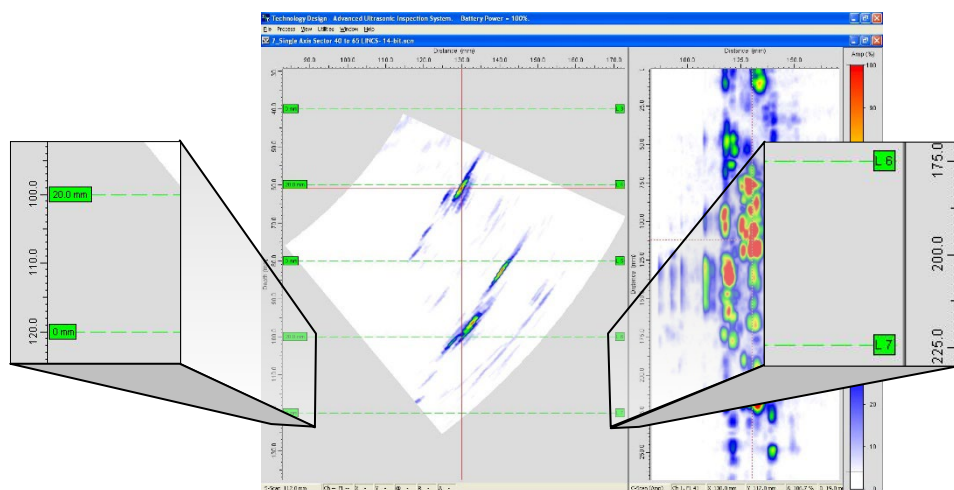
Fig. 14

5.2. Skip Correction

Skip correction is a method of displaying multiple skip legs as a linear plot (Fig 13). The software recognises the skips and plots the depth correctly according to the range (Fig 14).



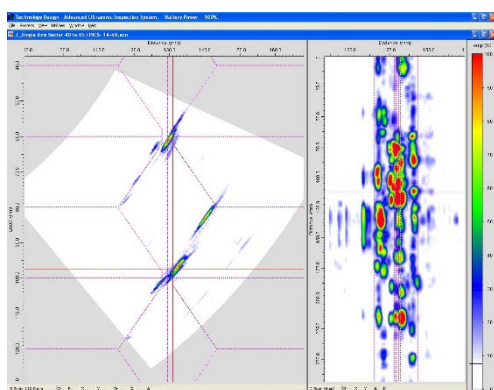
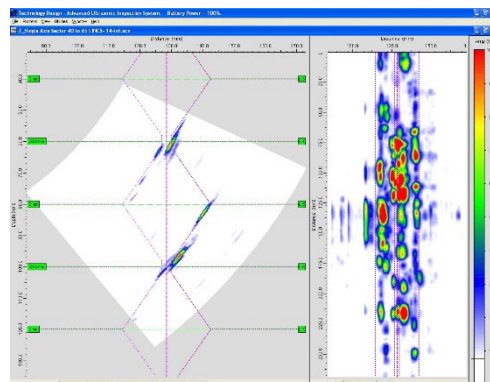
- 5.2.1. To display skip correction correctly, the **Skip Correction** control must be enabled. If skip correction was not enabled prior to scanning it may be enabled in analysis mode as follows:
 - 5.2.1.1. Open the desired scan file.
 - 5.2.1.2. Select **File Data** then **Hardware Setup** from the **File** drop-down menu. The **Collection Hardware Setup** window appears.
 - 5.2.1.3. From the **Channel** tab click the **Probe Setup** button to display the probe setup dialogue page.
 - 5.2.1.4. In the **Skip Correction** dialogue box, ensure the **Enabled** check box is checked.
 - 5.2.1.5. The material thickness may already be displayed in the **Material Thickness** text box; this will be the case if **Pulse Echo Skip Correction** was enabled in the **Global** tab either prior to scanning or off-line. If not, enter the correct material thickness.
 - 5.2.1.6. Click **OK**.
 - 5.2.1.7. **Note:** All active channels must have the same material thickness entered.
- 5.2.2. Skips may be displayed as an overlay on a B or Sector scan. The **Leg** number and depth will be displayed as flags on lines corresponding to the scan surface and backwall of the material. To display the skip lines:
 - 5.2.2.1. Right click in the B or S scan view.
 - 5.2.2.2. Select **Show Skip** from the contextual menu. The skip lines appear on the image.



5.3. Weld Overlay
Weld overlays are graphic representations of standard weld preparation geometries superimposed onto the data image. Weld overlays

may be displayed on B, C and Sector scan images. Before displaying a weld overlay, the weld preparation geometry must be defined:

- 5.3.1. Open the desired scan file.
- 5.3.2. Select **Overlay Control** from the **View** drop-down menu. The **Overlay Configuration** window appears.
- 5.3.3. Select the appropriate weld prep from the tabs. The left and right side of the weld prep may be defined independently or click the **Same** check box if the geometry is symmetrical.
- 5.3.4. Fill in the dimensions in the appropriate text boxes. **TIP** – to define a **K-prep**, use the **Single V** tab and define one side with the thickness in text box 2 only.
- 5.3.5. Fill in the **Centre Line Position** text box. This dimension is the distance from the bottom element on the wedge to the datum (usually the centre of the weld) and will ensure that the overlay is positioned correctly over the data image.
- 5.3.6. Click **OK**.
- 5.3.7. The weld overlay is displayed. If **Skip correction** is enabled, the weld overlay is displayed as a fold-out image on B and S scan images and a plan view on C scan images. If skip correction is enabled *and* displayed, the skip correction lines should match the top and bottom of the weld prep images (Fig 16). The lateral position of weld overlays can be adjusted by dragging the centre line left or right.



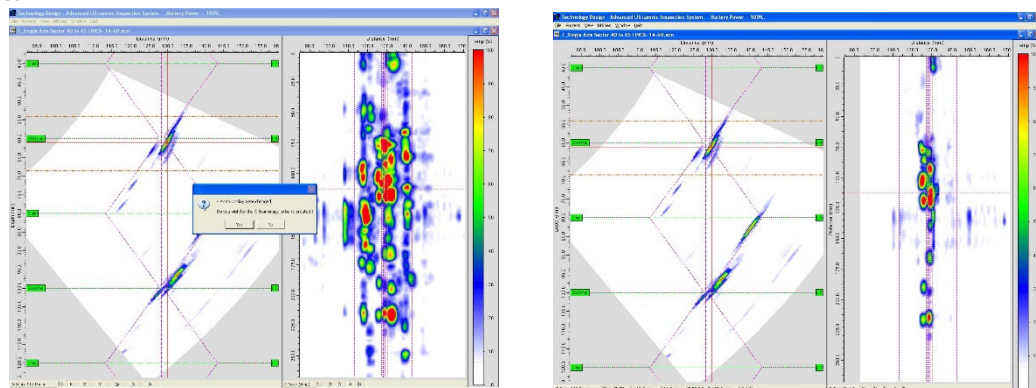
5.4. C-scan Cursors

C-scan cursors provide a means to define a selected plane through the test material thickness that is viewed in plan view. To operate:

- 5.4.1. Right click in a B or S scan view. A contextual menu appears.
- 5.4.2. Select **C-scan Display Gate** to activate. Two red, parallel double-dotted dashed lines appear. If the lines are not visible, zoom into the image until they are visible.

- 5.4.3. Drag the lines individually to the desired position on the image. After each movement of a line, a dialogue box appears. If you want to refresh the C-scan to reflect the new settings, click **Yes** in the dialogue box. **Tip:** click **No** until the desired position of both C-scan cursors has been set before clicking **Yes**. The C-scan is now recreated and only the volume defined by the C-scan cursors is displayed in the C-scan view.

5.5. Soft Gain



Soft gain allows the user to increase or reduce gain artificially. It should be noted that it is not possible to accurately change the gain artificially of a saturated signal.

- 5.5.1. Select the **View** menu, then **Soft Gain**. The Soft Gain window will appear.
 5.5.2. Activate the control by clicking the **Disabled** button.
 5.5.3. Change gain using the six gain buttons or select the gain value box and type the required gain value.
 5.5.4. Click the **Re-Draw** button to refresh the data images.
 5.5.5. The Soft Gain window may be closed using the **Close** button with or without disabling the applied gain.

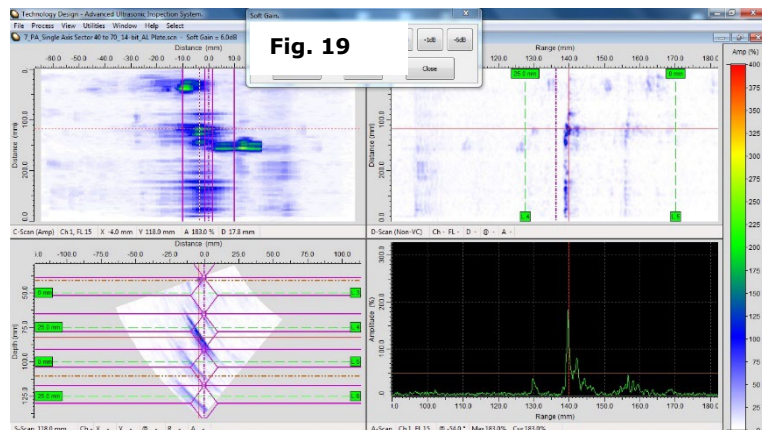


Fig. 19

Fig. 20

Table1

Zoom Control Key							
View Mode	+ Key (zoom in)	- Key (zoom out)	Shift Key (larger step)	Arrows (move image)		Shift Key (larger step)	
				↑↓	←→	↑↓	←→
B	✓	✓	✓	-	-	-	-
C	✓	✓	-	✓	✓	✓	✓
D	-	-	-	-	-	-	-
S	✓	✓	✓	✓	-	✓	-
A	✓Time Base	✓Time Base	-	✓	✓Left/Right	-	✓
	Ctrl +	Ctrl -					
	✓Amplitude	✓Amplitude	-	-	-	-	-

Appendix E

Technical Specifications

FocusScan RXII

System Options		A-Scan Digitisation	
128/16/16	128 Elements, 16 Active, 16 Conventional	A-Scan Points Per Channel	8000
128/32/16	128 Elements, 32 Active, 16 Conventional	Sampling delay	0 -10ms, in 10ns steps @ 100MHz sampling rate
128/64/16	128 Elements, 64 Active, 16 Conventional	Number Of Gates Per Channel	3 hardware Gates
General		Gate Start/Width	User definable in 10 ns steps
Number Of Elements	Up to 128 Elements + 8 Conventional	Gate Reference Points	Transmit Pulse or Material Interface Echo
Number Of Active Channels	Up to 128	Storage Modes Per Gate	A-Scans, Peak Depth and Amplitude
Number Of Focal Laws	890	Data Storage Rates	6MByte/sec
Dynamic Depth Focusing	Yes	Signal Averaging	
Digitisation		Number Of Channels	All
A/D Sampling Frequency	Phased Array = 8 Bit & 14 Bit	Averaging Performance	100 million points per second
	Conventional = 8 Bit & 14 Bit	Averaging Rates	Real-time averaging 1-256, user definable
System Bandwidth	(-3dB) Phased Array = 0.25MHz to 25MHz	Peak Processing	
	Conventional = 0.25MHz to 25MHz	Peak Storage Modes	All Peaks, First Peak, Largest Peak/s, Loss Of Signal
Pulse Repetition Frequency	Up to 10KHz	Thickness Measurement Modes	Thinnest/Thickest/Between Peaks
Pulser		Threshold Setup	5 to 100% in 1% steps per hardware Gate
Pulser Delays	0us to 20us in 2.5nS steps	Number Of Peaks Per Gate	16
Output Impedance	6 Ohms	Scanner Interface Ports	
HT Pulse Shape	Negative square wave	Input Type	Encoder, Potentiometer, Video Camera, Temperature
HT Pulse Voltage	Phased Array = 50 to 200V in 5V Steps	Number Of Axis	2 TTL compatible
	Conventional = 50 to 200V in 5V steps	Number Of Limit Inputs	4, TTL compatible
HT Pulse Width Range	20ns to 500ns in 2.5nS steps	Encoder Interface	TTL compatible, 5V @ 1A, 12V @ 0.4A
Rise/fall time	< 5nS	Temperature Inputs	RTD, 2 or 4 wire
		Potentiometer Interface	0 to 2.5V, sampled at 100Hz
		Video Input	1Vpp Composite
		Motor Drive (Internal)	
Receiver		Motor Types	DC Servo, 12Volts or 24Volts
Number Of Receivers	16 / 32 / 64 / 128	Current Drive	2Amps (Continuous) Up to 4Amps (Peak)
Number Of Active Receivers	1 to 128	Current Limit	Software definable
Receiver Delays	0us to 20/40us in 1nS steps	PC (Internal)	
Signal Bandwidth (-3dB)	Phased Array = 0.25MHz -25MHz	Operating System	Windows XP Professional
	Conventional = 0.25MHz -50MHz	Processor	Celeron 1GHz
Gain Range	0dB to 100dB's controllable in 0.1dB steps	Memory	2GByte
Gain Linearity	0.5dB (typical)	Display Colour	TFT (Industrial type)
Input Noise Level	2nV/(Hz) 1/2 (typical) across full system band width	TFT Display Resolution	1024 x 768
Input Impedance	50 Ohms	Storage SSD	60GBytes
Dynamic Depth Focussing		Ports	4 x USB, 1 x 10/100 Ethernet, 1 x Video
Operation	Dynamically optimises receive focus delays	Size, Weight & Environmental	
Range Of Operation	User specified depth/range in mm or us	Unit Dimensions	360mm x 300mm x 86mm
Performance	100MHz real time	Weight	7Kg
Time Corrected Gain (TCG)		Rating	IP54
Number Of Curves	1 to 8	Temperature	0°C to 40°C operating, -25°C to 85°C storage
Gain Range	0 to 80dB in 0.1dB steps	Colour	Unit supplied in white as standard
Rate Of Gain Change	Up to 40dB/µs	Power Requirements	
Analogue Signal Filtering		DC Input	20V to 24VDC @ 40W (Operating), 100W
High Pass Filters	(-3dB) 0.25, 0.5, 0.75, 1.0, 2.5, 5, 10	AC Input	90 to 260VAC @ 40 to 60Hz
Low Pass Filters	(-3dB) 1, 2.5, 5.0, 7.5, 10, 15, 20, 25, 30, 35, 40, 50	3rd Party Software	
Post Rectification Filters	(-3dB) No filter, 1, 2, 3, 4, 5, 6, 7MHz	Norton Antivirus®	
		ESBeam Tool®	From Eclipse Scientific Inc.

TD Handy-Scan Rx

System Options				
64 Elements (D Type 78 way)	64 Elt, 32 Active, 8 Conventional (Lemo 00)			
General				
Number Of Focal Laws	1700 max			
Dynamic Depth Focusing	Yes			
Digitization				
A/D Sampling Frequency	Phased Array = 8Bit & 14Bit @ 100MHz Conventional = 8Bit & 14Bit @ 100MHz			
System Bandwidth(-3dB)	Phased Array = 0.75MHz to 25MHz Conventional = 0.75MHz to 25MHz			
Max Pulse Repetition Frequency	Variable up to 5KHz			
Pulser				
Number Of Pulsers	64			
Number Of Active Pulsers	1 to 32			
Pulser Delays	0µs to 20µs in 2.5ns steps			
Output Impedance	6 Ohms			
HT Pulse Shape	Square wave			
HT Pulse Voltage	Phased Array = 5 to 200V in 1V Steps Conventional = 5 to 200V in 1V steps			
HT Pulse Width Range 2	0ns to 500ns in 2.5ns steps			
Rise/fall time	< 5ns			
Receiver				
Number Of Receivers	64			
Number of Active Receivers	1 to 32			
Receiver Delays	0µs to 20µs in 1ns steps			
Gain Range	P/E=0 to 90dB in 0.1dB steps, P/A=0 to 72dB in 0.1dB steps			
Input Noise Level	2.5nV/(Hz) ½ across full system bandwidth			
Input Impedance	50 Ohms			
Dynamic Depth Focusing				
Operation	Dynamically optimizes receive focus delays			
Range Of Operation	User specified depth/range in mm or µs			
Performance	100MHz real-time			
Receiver DAC Curves				
Number Of Curves	1 to 8			
Rate Of Gain Change	Up to 40dB/ µs			
Digital Signal Filtering				
	Probe Frequency (MHz)	Narrow Band (MHz)	Wide Band (MHz)	Broad Band (MHz)
	1	0.75 - 1.5	0.75 - 4.0	0.75 - 25.0
	2	1.0 - 3.0	0.75 - 4.0	0.75 - 25.0
	4	2.0 - 6.0	0.75 - 8.0	0.75 - 25.0
Band Pass Filters(-3dB)	5	2.5 - 7.5	0.75 - 10.0	0.75 - 25.0
	7.5	1.5 - 11.25	0.75 - 15.0	0.75 - 25.0
	10	5.0 - 15.0	2.5 - 20.0	0.75 - 25.0
	15	10.0 - 20.0	5.0 - 25.0	0.75 - 25.0
	20	15.0 - 25.0	0.75 - 25.0	0.75 - 25.0
Post Rectification Filters (-3dB)	No filter, 1-15MHz in 1MHz steps			
A-Scan Points Per Channel	8000 samples per channel			
Number Of Gates Per Channel	3 overlapping hardware Gates			
Gate Start/Width	User definable in 40ns steps			
Gate Reference Points	Transmit Pulse or Material Interface Echo			
Storage Modes Per Gate	A-Scans, Peak Depth and Amplitude, both			
Number Of Channels	All (128 software channels)			
Averaging Rates	Real-time averaging 2 - 256, user definable			
Peak Storage Modes	All Peaks, First Peak, Largest Peak/s, Loss of Signal, Between			
Threshold Setup	5 to 100% in 1% steps per hardware Gate			
Number Of Peaks Per Gate	16 max			
Input Type	Encoder, Potentiometer, Video Camera			
Number of Axis	2 axis, TTL compatible			
Encoder Interface	TTL compatible, 5V @ 1A, 12V @ 0.4A			
Potentiometer Interface	0 to 2.5V, sampled at 100Hz			
Video Input	1Vpp Composite			
Operating System	Windows® 7			
3rd Party Software	AVG Antivirus® ESBeamTool® (Eclipse Scientific)			
Processor	Intel Atom N270			
Memory	2GB			
Display Colour	TFT (Industrial type) 8.4"			
TFT Display Resolution	800 x 600 - Sunlight Readable Screen			
Storage	60GB SSD			
Ports	2 x USB, 1 x 10/100 Ethernet, 1 x Video			
Unit Dimensions	270 x 300 x 110mm			
Weight	5Kg			
Rating	Designed to IP65			
Temperature	0°C to 40°C operating, -25°C to 85°C storage			
Operating Time	4 Hours (approx.)			
DC Input	19V			
AC Input	90 to 260VAC @ 40Hz to 60Hz			

Pocket-Scan PS45

General		Rectification	
Number Of Probe Inputs	8/16	Type	Unrectified, Full Wave, +1/2 Wave, -1/2 Wave
Number Of Software Channels	128	Linearity	Better than 1% full Scale
Digitisation		A-Scan Digitisation	
Main Sampling Frequency	100MHz@8 bit	A/D Converter	100MHz@8 bit
System Bandwidth(-3dB)	0.25MHz to 30MHz	Number Of A-Scan Points/Channel	8000 points per channel
Pulse Repetition Frequency	Up to 10KHz	Sampling delay	0 - 10ms, in 25ns steps @ 100MHz sampling rate
Pulser		Signal Averaging	
Number Of Pulsers	8/16	Number Of Channels	All
Single/Twin Crystals	Yes	Averaging Performance	100 million points per second
Output Impedance	6 Ohms	Averaging Rates	Real-time averaging 1- 256, user definable
HT Pulse Shape	Negative square wave	Peak Processing	
HT Pulse Voltage steps of 5V	50 - 200V user definable	Peak Storage Modes	All Peaks, First Peak, Largest Peak/s, Loss Of
HT Pulse Width Range	20ns to 500ns in 2ns steps with < 5ns rise/fall time	Thickness Measurement Modes	Thinnest/Thickest/Between Peaks
Receiver		Threshold Setup	5 to 100% in 1% steps per hardware Gate
Number Of Receivers	8/16	Number Of Peaks Per Gate	64
Signal Bandwidth (-3dB)	0.25MHz - 30MHz	Scanner Interface	
Gain Range	0dB to 100dB's in 0.1dB steps	Input Type	Encoder, Potentiometer or Video Camera
Gain Linearity	0.25dB (typical)	Number Of Axis	2, TTL compatible
Input Noise Level	1.4nV/(Hz) 1/2 (typical) across full system bandwidth	Number Of Limit Inputs	2, TTL compatible
Input Impedance	50 Ohms	Encoder Interface	TTL compatible, 5V @ 250mA(max), 100KHz max
Time Corrected Gain (TCG)		Potentiometer Interface	0 to 2.5V, sampled at 100Hz
Number Of Curves	8	Video Camera Input	1Vpp Composite Video (PAL, RS-170)
Gain Range	0 to 100dB in 0.1dB steps on each element	PC & Operating System	
Rate Of Gain Change	Up to 40dB/μs	Computer Type	Notebook or Desktop
DAC Time resolution	Automatically controlled using gate Parameters	Operating System	Windows 7 Pro® 32-bit & 64-bit
DAC Start reference	Transmit Pulse or material i/f echo, user selectable	Processor	Pentium 600 (min)
Analogue Signal Filtering		Memory	512MBytes (min), 2Gbyte recommended
High Pass Filters (-3dB)	0.25, 0.5, 0.75, 1.0, 2.5, 5, 10MHz	Hard Disk/Storage	5 Gbyte(min)
Low Pass Filters (-3dB)	1, 2.5, 5.0, 7.5, 10, 15, 20, 30MHz	PS45/PC Link	Ethernet
Post Rect. Smoothing Filters (-3dB)	No filter, 1, 2, 3, 4, 5, 6, 7MHz, all filters selectable	Size, Weight & Environmental	
Filter Roll-Off Performance	60dB per decade	Unit Dimensions	8 Channel - 175 x 120 x 53mm
Filter Type	6dB Transitional, minimal distortion		16 Channel - 175 x 120 x 73mm
Power Requirement		Weight	8 Channel - 450g / 16 Channel - 600g
DC Input	6V to 12.5V @ 5Watts (approx.)	Rating	Designed to IP54
AC Input	90 to 260VAC @ 40 to 60Hz	Temperature	0°C to 40°C operating, -25°C to 85°C storage