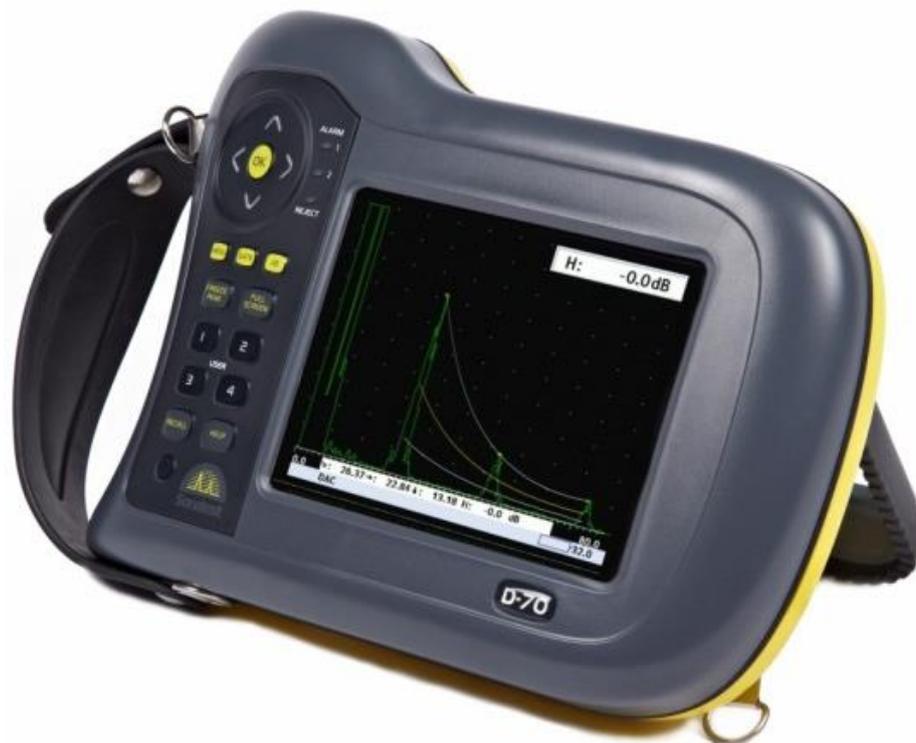




# Masterscan D-70

## User's Guide

17/09/2014



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## Disclaimers and Notices

The following information must be read and understood by users of the Sonatest Masterscan D-70 ultrasonic flaw detector and thickness gauge. Failure to follow these instructions can lead to serious errors in test results or damage to the flaw detector. Decisions based on erroneous results can lead to property damage, personal injury or death. Anyone using this instrument should be fully qualified by their organization in the theory and practice of ultrasonic testing, or under the direct supervision of such a person.

## General Warnings



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Proper use of the ultrasonic test equipment requires four essential elements:

- Knowledge of the specific tests or inspections and applicable test equipment.
  - Selection of the correct test equipment based on knowledge of the application.
  - Competent training of the instrument operator.
  - This user's guide provides instruction in the basic operation of the Masterscan D-70 flaw detector. In addition to the methods included, many other factors can affect the use of this flaw detector. Specific information regarding these factors are beyond the scope of this manual. The user should refer to appropriate textbooks on the subject of ultrasonic testing and thickness gauging for more detailed information.
- 

## Specific Warnings



- The Masterscan D-70 contains a high-energy, precision pulser allowing optimum test results to be obtained by matching the pulse width to the probe characteristics. This circuitry may be damaged by voltage spikes. It is recommended that the instrument be switched off, or the pulser stopped (by pressing the *[Freeze/Peak]* key) before changing probes.
- 

## Operator Training

- Operators must receive adequate training before using this ultrasonic flaw detector.
- Operators must be trained in general ultrasonic testing procedures, and in the set-up and performance required by each specific test or inspection. Operators must understand: Sound wave propagation theory.
- Must understand the effects of the velocity of sound in the test material.
- Must know the behaviour of the sound wave at the interface of two different materials.
- Must have an understanding of Sound wave spread and mode conversion.

More specific information about operator training, qualification, certification and test specifications can be obtained from technical societies, industry groups and government agencies.

## Testing Limitations

In ultrasonic testing, information is obtained only from within the confines of the sound beam as it propagates into the test material. Operators must exercise great caution when making inferences about the nature of the test material outside the limits of the sound beam. The condition of materials can vary significantly and the results can be erratic if operators don't exercise good judgment.

## Critical Operating Factors

The following procedures must be observed by all users of the Masterscan D-70 in order to obtain proper, accurate and consistent results.

## Calibration of the Sound Velocity

An ultrasonic flaw detector operates on the principle of measuring the time of flight of a burst of high frequency sound through the test piece, as well as evaluating the amplitude of reflected or transmitted echoes. The sound velocity of the test piece multiplies this time in order to obtain an accurate distance or thickness reading. Since the actual sound velocity in materials can vary from the published values, the best result is obtained when the instrument is calibrated on a reference block made from the same material as the test piece. This block should be flat, smooth and as thick as the maximum thickness expected of the test piece.

Users should also be aware that the sound velocity might not be constant throughout the test piece due to effects such as heat-treating. This must be taken into consideration when evaluating the results of ultrasonic thickness testing. The calibration should always be checked after testing to minimize errors.

## Transducer (Probe) Zero Procedure

The transducer calibration procedures must be performed as described in this manual. The calibration block must be clean, in good condition and free of noticeable wear. Failure to perform the transducer zero and calibration procedure will cause inaccurate thickness readings.

## Flaw Detection Calibration

When performing a flaw detection test, it is important to note that the amplitude of indications is not only related to the size of the discontinuity; the depth of a discontinuity below the test piece surface will also have an effect on the amplitude due to characteristics of the sound beam spread and near field zone of the transducer. In addition, the characteristics of the discontinuity such as orientation and classification can alter the expected amplitude response. For these reasons, calibration should be performed on test blocks made of the same material as the test piece with artificial discontinuities within the range of size and depth in the material to be detected. The user is again cautioned to refer to reference books which are beyond the scope of this manual.

## Effects of Temperature on Calibration

The sound velocity in test pieces and the transducer wear face changes with temperature variations. All calibrations should be performed on site with test blocks at or near the same temperature as that expected on the test piece, to minimize errors.

## Transducer Condition

The transducer used for testing must be in a good condition, without noticeable wear of the front surface. The specified range of the transducer must encompass the complete range of the thickness to be tested and/or the types of discontinuities to be investigated. The temperature of the material to be tested must be within the transducer's specified temperature range.

## Use of Couplant

Operators must be familiar with the use of ultrasonic couplant. Testing skills must be developed so that couplant is used and applied in a consistent manner to eliminate variations in couplant thickness which can cause errors and inaccurate readings. Calibration and actual testing should be performed under similar coupling conditions, using a minimum amount of couplant and applying consistent pressure to the transducer

## Disclaimer of Liability

All statements, technical information and recommendations contained in this manual or any other information supplied by Sonatest Limited in connection with the use, features and qualifications of the Masterscan D-70 are based on tests believed to be reliable, but the accuracy or completeness thereof is not guaranteed. Before using the product you should determine its suitability for your intended use based on your knowledge of ultrasonic testing and the characteristics of materials. You bear all risk in connection with the use of the product. You are reminded that all warranties as to merchantability and fitness for purpose are excluded from the contract under which the product and this manual have been supplied to you. The Seller's only obligation in this respect is to replace such quantity of the product proved to be defective.

Neither the seller nor the manufacturer shall be liable either in contract or in tort for any direct or indirect loss or damage (whether for loss of profit or otherwise), costs, expenses or other claims for consequential or indirect compensation whatsoever (and whether caused by the negligence of the company, its employees or agents or otherwise).

Your product package may include optional documentation, such as warranty flyers, that may have been added by your dealer. These documents are not part of the standard package.

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Specifications and information contained in this manual are furnished for informational use only, and are subject to change at any time without notice, and should not be construed as a commitment by Sonatest limited or its filial.

## Electromagnetic Compatibility

This product has been design to the following European Directives:

- Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS).
- Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE)
- Low Voltage Directive (LVD) 73/23/EEC
- CE Marking Directive 93/68/EEC
- EMC Directive 89/336/EEC. However, in order to ensure the equipment meets the requirements, the following should be read:



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This is a "CLASS A" product. In a domestic environment, this product may cause radio interference. In which case the user may be required to take adequate measures.

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This product should not be connected to cables (i.e. probe or encoder cable) longer than three (3) meters in length. If this is necessary, the installation may require further EMC testing to ensure conformity.

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The Masterscan D-70 also complies with EN 12668-1, non-destructive testing and verification of ultrasonic examination equipment – Part 1: Instruments. For any questions relating to the proper use of this product, please contact your distributor or Sonatest.



## About this guide

### How this guide is organised

This guide contains the following parts:

- Chapter 1: [Product Introduction](#)
- Chapter 2: [Detailed Menu Description](#)
- Chapter 3: [Flaw testing](#)
- Chapter 4: [Thickness Gauging](#)
- Chapter 5: [Standard Features](#)
- Chapter 6: [Interface connection](#)
- Chapter 7: [Optional Features](#)
- Chapter 8: [Accessories](#)
- Chapter 9: [Products Specifications](#)
- Chapter 10: [Warranty](#)
- Chapter 11: [Troubleshooting and Support](#)
- Chapter 12: [Maintenance](#)
- Chapter 13: [Index](#)

### Convention used in this guide

To ensure that you perform certain tasks properly, take note of the following symbols used throughout this manual.



**DANGER/WARNING:** information to prevent injury to yourself when trying to complete a task.



**NOTE:** Information to help you complete the task



**TIPS:** Additional information to help you complete a task

### Typography

text on screen	Refer to the name of the menu, Tab or sub-menu as it appears on the screen
<i>(Italics)</i>	<i>Used to emphasis comment during a procedure</i>
[keys/Menu]	Refer to the key/button to press on the unit

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## Chapter 1 : Product Introduction

### 1. Welcome!

Thank you for purchasing a Sonatest Masterscan D-70!

This manual provides information for the Sonatest Masterscan D-70 device. The information contained herein allows usage of the Masterscan to its full capability in order to take advantage of its numerous and user-friendly features.

The user guide has been designed so that people with good knowledge of basic ultrasonic non-destructive testing may understand how to operate the Masterscan. It is crucial that users understand the critical nature of ultrasonic non-destructive testing.

### 2. Features of the Masterscan D-70

The Masterscan D-70 is a user-friendly ultrasonic digital flaw detector and thickness gauge, which is simple to use and provides the experienced ultrasonic operator with a full-function device that incorporates many productivity enhancing features. All of the features of the Masterscan D-70 are accessed through a menu system using the front panel keypad.

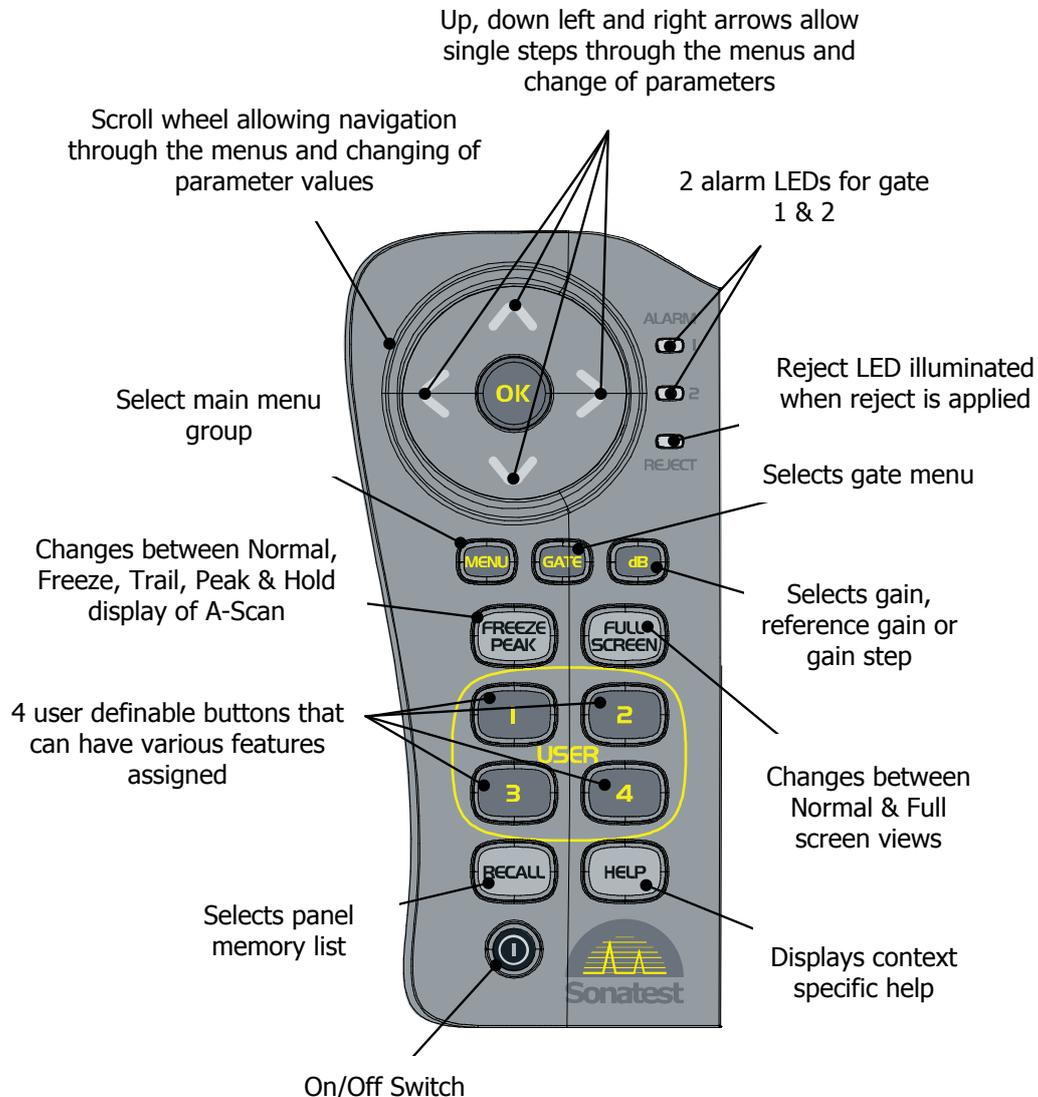
#### Functional Testing Methods

The **Masterscan D-70** supports the following ultrasonic testing methods:

- Pulse-Echo Flaw Detection
- Transmit-Receive Flaw Detection
- Time of flight measurement
- Contact or Immersion Methods
- Angle Beam (Shear Wave) Testing
- Angle Beam (Surface Wave) Testing
- Crack Diffraction Method
- Depth of Flaw Measurement
- Single Transducer Thickness Measurement
- Dual Transducer Thickness Measurement
- Indirect Measurement of Sound Velocity in Materials
- Phase change display in un-rectified mode
- Through transmission testing
- Creep wave testing
- Pitch and catch technique

### 3. Front Panel

The main control on the front of the unit is the scroll-wheel that is used to navigate through the menus and to adjust parameters this, along with the [OK] key in the middle of the wheel allows quick and intuitive navigation.



Moving your finger in a clockwise direction increases a selected parameter. Moving your finger in an anticlockwise direction decreases a selected parameter.

The [right] arrow key moves the tab menu selection right by one increment at a time, the [left] arrow key moves it left by one increment.

The [down] arrow key moves down the four parameter boxes on the right of the display while the [up] arrow key moves up.

After a parameter is selected, press shortly the [OK] button (*valid only for parameters with windows sign*) to open a list windows, [up] and [down] arrows keys will move up and down the drop-down list.

If a parameter is selected by holding the [OK] button down for more than 2 seconds then the [up] and [down] arrows keys change the value by small increments while the [right] and [left] arrows keys change the value by a bigger increment.

The remaining front panel controls consist of an array of sealed, pressure sensitive, tactile buttons that have specific functions assigned to them; the exception to this are the four "user" buttons that can be assigned to any menu item or a list of useful features. A more detailed description of each button is shown further [below](#).



- 
- The above picture is for reference only. The menu and the button layout may vary with models, nevertheless the key function remain the same.
  - When the term "highlighted" is used, it refers to text with a green background (blue in this manual) and Black letters (white letters) which is the selected item on your flaw detector.
-

## 4. Back Panel

The back panel is where the battery pack, the TX/RX and RX connectors (LEMO or BNC) are located. Additionally a quadrature encoder can be used with the unit when attach to the encoder connector. There is also a USB connector which allows a bi-directional connection between the unit and a PC via an adapter. For more details please read [Interface connection section](#).



- When connecting to a PC via the USB cable, firmware and software update can be updated.
- Post-analysis can done as well as other functions related to post test.
- For more information about the UT-lity software please refer to the manual.

## 5. Masterscan D-70 Memory

The settings of the Masterscan D-70 always remain in memory when the instrument is turned off, even if the battery pack is removed. That is, whatever the settings are just prior to turning the instrument off will be the settings in place the next time the instrument is turned on.

At times it may be desirable to start with default settings. This is especially true when beginning a new test procedure or going from flaw detection to a thickness gauging procedure. Otherwise, it may be necessary to go through all of the menus to reset various functions. A reset function is provided to facilitate the returning of all panel calibration settings to the factory defaults.

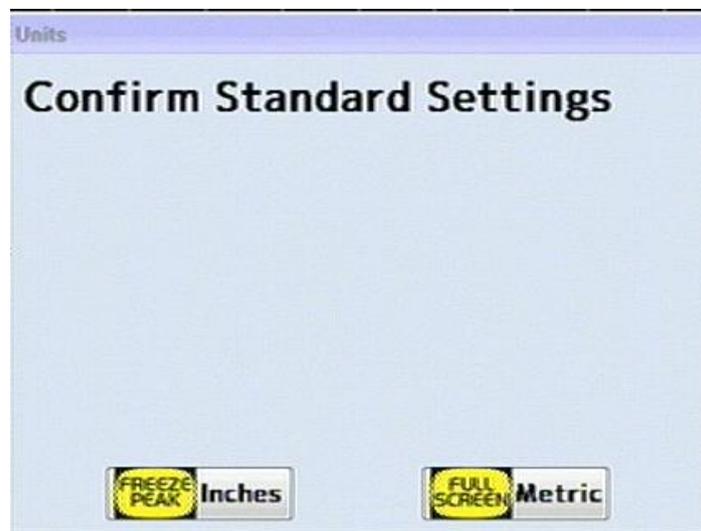
### Reset to factory defaults

1. Switch the instrument off.
2. Press the [Full Screen] button and hold while switching the instrument on until the confirmation display is seen.
3. Press the [OK] button to reset the instrument to factory defaults. alternatively press the [Menu] button to cancel factory reset.



Before performing this procedure, be sure to save any favourite settings to memory by using the procedure outlined in [Storage & Recall of Calibration Setups](#).

4. When resetting to factory default settings the following dialogue is displayed allowing the user to choose imperial or metric defaults:



## 6. Key Names and functions

Icon	Function Name	Short Function Description
	ON/OFF	Power on & off push button for switching the instrument on and off. Operates as a toggle.
	OK	This button operates in conjunction with the memory menus to accept a store or to accept a recall of a memory already in storage. In the print mode, [OK].
	Navigation Arrow button	Navigation arrows are parameter adjustment and navigation. These buttons move the highlighted cursor along the top of the screen left and right to the sub menu to be selected. These are momentary buttons with no repeat. The parameter boxes along the right hand side of the screen change as the sub menu is selected.
	Menu	The [MENU] button is used to display the 4 main menu levels (CAL, MEAS, UTIL and MEMORY) on the right hand side of the screen. The [MENU] button can be pressed at any time.
	Gate	This button takes you directly to the GATE Tab and turns on the gate in positive trigger mode and highlights the G1 START parameter box.
	dB	This button caused the GAIN parameter to be highlighted so that the scroll-wheel can then adjust the value. Pressing the button again highlights the REF parameter. Pressing for a third time selects the gain step size.
	Freeze/Peak	<p>Press this button once to select freeze mode for the A-Scan display. This is a useful feature for holding an echo for evaluation. When in this mode a box is highlighted showing <b>FREEZE</b> below the graticule.</p> <p>Pressing the button a second time selects the trail (persistence) mode which acts in a similar way to peak mode (see below) but instead of the envelope remaining on the display it disappears over time. The decay time of the envelope can be adjusted by selecting <b>TRAIL</b> in the <b>MISC</b> menu in the <b>UTIL</b> main menu only when the display is in trail mode.</p> <p>Pressing the button a third time selects peak mode, which holds and updates all echoes on the display during inspection. This feature allows an envelope or echo dynamic pattern to be drawn on the screen with the "live" signal shown within, which is useful for angle beam inspection to locate the peak signal.</p> <p>Pressing the key again invokes the Hold mode that captures the current A-Scan in white allowing a comparison to be made with the live A-Scan that is shown in green.</p> <p>Pressing the button a fourth time returns the A-Scan display to normal mode. This is a momentary button with no repeat action.</p> <p>Any of the freeze, peak or hold modes can be exited quickly by pressing and holding the [FREEZE/PEAK] key.</p>

	<b>Full screen button</b>	<p>The full screen button is used to toggle between showing the A-Scan on the full display and showing it with the menus and parameter boxes. Full display is useful for maximising the size of the A-Scan while performing inspections.</p> <p>While in full screen mode the user can still change the gain in the normal way and use the [Freeze/Peak] button; all other buttons are disabled.</p>
<div style="text-align: center;"> <span style="border: 1px solid black; border-radius: 50%; padding: 5px; display: inline-block; width: 30px; height: 30px; line-height: 30px;">1</span>        .        .  <span style="border: 1px solid black; border-radius: 50%; padding: 5px; display: inline-block; width: 30px; height: 30px; line-height: 30px;">4</span> </div>	<b>User buttons</b>	<p>These four "USER" buttons can be assigned to any parameter on the Masterscan D-70. To use this function simply select the parameter that you want to assign to the button and then hold down the user button until you see the following message:</p> <div style="text-align: center;">  </div> <p>In addition the following quick access functions can be assigned from the User-Keys tab's parameters in the UTILS menu: Panel, User, N/A, Auto 80%, QSave-A, WheelLK, +/- 6dB, Gain Up, Gain Dn, GainStp, Sngl/DbI, Clr TMin, Clr Peak, AWS Visible, API Visible and AutoZero.</p> <p>By default the user buttons are assign as follow:</p> <p><b>Button1</b> (Gain Up)  <b>Button2</b> (GainStp)  <b>Button3</b> (Gain Dn)  <b>Button4</b> (Sngl/DbI)</p>
<div style="border: 1px solid black; border-radius: 15px; padding: 5px; display: inline-block;">RECALL</div>	<b>Recall</b>	<p>This button is a shortcut to the PANEL storage list enabling the quick recall or saving of the current panel settings.</p>
<div style="border: 1px solid black; border-radius: 15px; padding: 5px; display: inline-block;">HELP</div>	<b>Help</b>	<p>This button selects the help menu which overlays the display.</p> <p>The Help Screen displays the Instrument serial number &amp; software version</p>
N/A	<b>Single/Double</b>	<p>This button toggles between single and double element transducers. The user should switch the unit off or stop the pulser by pressing the [Freeze/Peak] key before changing transducers.</p>
N/A	<b>Gain Step</b>	<p>Press to select the dB step value of amplifier gain as 0.1, 0.5, 1, 2, 6, 10, 14, or 20dB. The selected value is indicated at the top right-hand corner of the gain box, which is always located at the bottom right side of the screen. This will increase the gain step value.</p>
N/A	<b>Gain Up</b>	<p>Press to increment the gain value indicated in the gain box. This is always located at the bottom right side of the screen. This is a repeat button with</p>

		acceleration to facilitate quick changing of the value.
N/A	Gain Down	Press to decrement the gain value indicated in the gain box. This is always located at the bottom right side of the screen. This is a repeat button with acceleration to facilitate quick changing of the value.
N/A	Transmitter/Receiver	BNC or LEMO 1 connector is the transmitter and receiver socket used for single transducers or as the transmitter only, for twin or dual transducer operation.
N/A	Receiver	BNC or LEMO 1 connector is the receiver socket used for twin or dual transducer operation.
	USB	A socket to connect various USB devices such as the user's PC.
	Power supply/ Battery Charger	A socket used to connect the battery charger for recharging the battery pack. A red dot is provided on both the socket and plug to facilitate alignment. Refer to <a href="#">Power Supply</a> for information on power supplies and charging of the battery pack.

## Chapter 2 : Detailed Menu Description

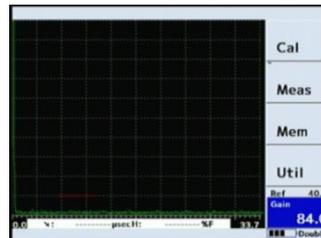
Before proceeding with this section, the user should be familiar with the front panel controls described in Chapter 1 ([Front Panel](#)). Furthermore it is assumed that the user has a good understanding of the theory and practice of ultrasonic testing.

### 1. Main Menu

When the Masterscan D-70 is switch on, the unit will perform an initial check test. And a similar screen will appear.



During that test the screen may flick momentarily. When the test is finished the following screen should appears:



As shown above the main menus are on the right hand side of the screen. To select a particular menu press the [up] or [down] navigation arrow keys. You can return to the main menu at any time by pressing the [Menu] button.

### Main Menu Selection

Cal	Select Cal menu to access the following items: Cal, Amp, Tx, Gate 1, Gate 2, Auto Cal and IFT
Meas	Select Meas menu to access the following items: : Meas, Trig, Probe, Sizing,(DAC,TCG,AVG,AWS,API) , BChart and T-Comp.
Mem	Select Mem menu to access the following items: Panel, A-Log, Ref, Bchart, TLogging,(Grid, Grid Plan) or T-Log.
Util	Select Util menu to access the following items: Menu, Waveform, Misc, Video, BEA, AGC, Encoder, Clock and User Keys
	The Ref/Gain box always appears at the bottom right of the screen and can be changed using the [Userkey 2] ( <i>factory setting</i> ) or press [dB] twice and the [Up]/ [Down] keys.

	Some sub-menu have a pop-up windows sign on the left hand side. If you push again the [OK] button after the sub-menu is highlighted, another window will appear.
---	--

## 2. CAL Menu

The CAL menu is the most used menu and contains those items that allow the Masterscan D-70 to be easily calibrated. For full instruction on how to perform a calibration see [Flaw Testing Calibration](#).



### CAL (Calibration) Tab

Probe zero >> <b>0.000</b>	Probe zero: Used to calibrate the screen and thickness readout for zero offsets that are inherently different for each transducer. Units are microseconds in both mm and inch modes.
Velocity >> <b>5930</b>	Velocity: Used to calibrate the screen and thickness span readout based on the velocity of sound in the test material. Units are meters per second in mm mode and inches per microsecond in inch mode.
Range >> <b>100.0</b>	Range: Used to set the full screen width of the horizontal A-Trace in mm, inches, or microseconds depending on the unit chosen in the UTIL menu. The range is 1mm to 20 meters (0.04 to 1574.8 inches).
Delay >> <b>0.00</b>	Delay: Used to set the delay or offset of the left side of the A-Trace for viewing of a portion of a signal. The range is 0mm to 20 meters (0 to 1574.8 inches).

### Amp (Amplifier) Tab

Filter MHz <b>3 - 8</b>	Filter: Used to set the filter frequency band of the amplifier to match the transducer.
Detect σ <b>FULL</b>	Detect: Used to set the display mode for the desired rectification of the signals from FULL (rectified full wave), RF ( un-rectified), -VE HW (negative half-wave) and +VE HW (positive half-wave)
Reject >> % <b>0</b>	Reject: Used to remove low level noise from the A-Trace. Reject is linear and is adjustable from 0 up to 80% of full screen height. The REJECT LED is lit when a reject is active
Mode σ <b>Single</b>	Mode: Used to select either single or double probe mode. This parameter has the same function as UserKeys 4 when configured at factory settings.

### Tx (Transmitter) Tab

Width >> <b>Spike</b>	Pulse Width: Adjusts the width of the square wave pulser to match the transducer. The width can be adjustable in 10 or 1ns steps from 30 to 2,500ns. Usually to match the transducer frequency at ½ its wavelength. To determine the pulse we use that formula $f = \frac{1}{(2 \cdot t)}$ Thus, the nominal settings would be: $f=200\text{kHz} \Rightarrow t=2,500\text{ns}$ or $f= 15 \text{ MHz}$ (WIDE) $\Rightarrow t=30\text{ns}$ (SPIKE). Adjust to optimize the shape and amplitude of echoes.
Damping σ <b>50Ω</b>	Damping: Allows you to switch between 50Ω or 450Ω damping resistor. Damping parameter is available when Pulse mode parameter in Misc tab in UTIL menu is set to Damping.
Tx Volts <b>200V</b>	<b>Edge:</b> Used to change ActiveEdge™ parameter from 0 to 400. Edge parameter is available when Pulse mode parameter in Misc tab in UTIL menu is set to Edge.
Max PRF >> <b>150</b>	Tx Volts: Allows switching between 100 and 450 Volts in 50 Volt steps. Note that in 400V operation the pulse width is limited to a minimum of 100ns Max PRF: Set the maximum pulse repetition frequency that may be reduced for large values of display range and delay. Selectable values are from 15 to 100 in 5Hz steps, from 100 to 1,000 in 50Hz steps and 1,000 to 5,000 in 100Hz steps. Lower values will reduce ghosting and noise echoes.

## Gate 1 & Gate 2 Tab

<b>G1 State</b>	Set the state of the gate as follows:
<b>On +VE</b>	OFF: Switches the gate off.
<b>G1 Start</b> >> mm	ON +VE: The alarm triggers when an echo in the gate exceeds the threshold level.
<b>89.25</b>	ON -VE: The alarm triggers when an echo in the gate falls below the threshold level. Usually used to monitor for loss of back wall echo.
<b>G1 Width</b> >> mm	G1/G2 Start: set the start position of the gate relative to the initial pulse. Units are mm or inches and range is from 0 to the full time base of the horizontal display.
<b>20.32</b>	G1/G2 Width: set the width of the gate. Units are mm or inches and range is from 0.15mm (0.001 inch), depending on the range selected, to the full time base of the horizontal display.
<b>G1 Level</b> >> %	G1/G2 Level: adjusts the alarm threshold level, which corresponds to the vertical height on the A-Trace. Adjustable in 0.5% or 2% steps from 0% to 100% full screen height.
<b>50</b>	

## Auto-CAL Tab

This menu provides automatic calibration of sound velocity and transducer zero. Gate 1 is used to select the reference echoes. See [Auto-Cal](#) for a full procedure.

<b>Dist 1</b> >> mm	Dist 1: Set the actual distance to the first or thinnest reference echo in the calibration block.
<b>25.40</b>	Dist 2: Set the actual distance to the second or thickest reference echo in the calibration block
<b>Dist 2</b> >> mm	Start: Used to adjust the start of the gate to assure that the first and second echoes are measured
<b>100.00</b>	Accept: After pressing [OK] to accept DIST1 and DIST2. Press [OK] when ACCEPT (CAL) is highlighted.
<b>G1 Start</b> >> mm	
<b>89.25</b>	
<b>Accept</b>	
<b>Dist 1</b>	

## Interface Trigger (IFT) Tab

This menu allows the Interface Trigger parameters to be configured. See [Interface Trigger](#) for a full description.

<b>State</b>	IFT State: Turns the interface trigger ON, Set or OFF.
<b>Off</b>	
<b>Start</b> >> mm	IFT Start: Used to set the start position of the interface gate relative to the initial pulse.
<b>25.0</b>	
<b>Width</b> >> mm	IFT Width: Used to set the width of the interface gate. Units are mm or inches and range is from 0.15mm (0.001 inch), depending on the range selected, to the full time base of the horizontal display.
<b>25.0</b>	
<b>Level</b>	IFT Level: Used to adjust the threshold level, which corresponds to the vertical height on the A-Trace. Adjustable in 0.5% or 2% steps from 0% to 100% full screen height.
<b>80</b>	

### 3. MEAS Menu

The menus in this section allow the various measurement techniques to be configured; these include the general measurement set-up and specialist methods such as DAC, AVG, TCG, AWS and API.

Select the MEAS menu at any time by pressing the [MENU] button.



#### Meas (Measurement) Tab

In the measurement tab, the top selection box shows the selected measurement mode and the remaining three selection boxes vary depending on the mode selected as follows:

Meas Mode <b>Monitor</b>	Meas Mode (MONITOR): In this mode, gates 1 and 2 act as two independent monitor gates
-----------------------------	---

Meas Mode <b>Depth</b>	Meas Mode (DEPTH): In this mode, gate 1 functions as a depth or thickness monitor and displays the depth (D:) and height (H:) of the first signal after the start of the gate that reaches or exceeds the gate level threshold. Values are displayed in a highlighted box below the A-Trace.																																								
Trigger <b>Peak</b>	Trigger: Used to select the depth or thickness measurement to the FLANK ( <i>left edge</i> ) of the first echo after the start of the gate or the PEAK measurement within the gate i.e. the largest value in the gate.																																								
HUD <b>Off</b>	When Head Up Display (HUD) turned <b>ON</b> , provides a large, Head-Up Display of the depth or thickness reading at the top right of the A-Trace. The [Up] arrow navigation button sequences the selections as follows:																																								
T-Min <b>Off</b>	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>G1-G2</th> <th>E-E</th> <th>DEPTH</th> <th>TRIG</th> </tr> </thead> <tbody> <tr> <td>OFF</td> <td>OFF</td> <td>OFF</td> <td>OFF</td> </tr> <tr> <td>DIST</td> <td>DIST</td> <td>DIST</td> <td>DIST</td> </tr> <tr> <td>DIST +</td> <td>DIST +</td> <td>HEIGHT</td> <td>HEIGHT</td> </tr> <tr> <td></td> <td></td> <td>DIST +</td> <td>DIST +</td> </tr> <tr> <td></td> <td></td> <td>HEIGHT +</td> <td>HEIGHT +</td> </tr> <tr> <td></td> <td></td> <td></td> <td>↓</td> </tr> <tr> <td></td> <td></td> <td></td> <td>↓ +</td> </tr> <tr> <td></td> <td></td> <td></td> <td>↘</td> </tr> <tr> <td></td> <td></td> <td></td> <td>↘ +</td> </tr> </tbody> </table>	G1-G2	E-E	DEPTH	TRIG	OFF	OFF	OFF	OFF	DIST	DIST	DIST	DIST	DIST +	DIST +	HEIGHT	HEIGHT			DIST +	DIST +			HEIGHT +	HEIGHT +				↓				↓ +				↘				↘ +
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	When T-min is turned ON, the depth or thickness reading will freeze that last minimum or lowest value measured. To reset, toggle the function to OFF and then ON. Only available in DEPTH mode.																																								

Meas Mode <b>E-E</b>	Meas Mode (E-E): In this mode, the gate 1 functions as a thickness monitor and measures the thickness between the first signal in the gate and the second signal in the gate that reaches or exceeds the level threshold. A second bar is shown representing the blanking ( <i>see BLANK</i> )
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Meas Mode <b>Trig</b>	Meas Mode (TRIG): The Trigonometry mode is used with angle beam transducers for weld inspection to calculate the three important measurements based on the echo position: the Beam path distance (↘:), the Surface distance (→:), and the Depth distance (↓:) from the index point of the transducer.
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Meas Mode <b>G1-G2</b>	Meas Mode (G1-G2): This is similar in concept to E-E mode, but uses gates 1 & 2, allowing the thresholds for the two gate measurements to be completely independent.
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Meas Mode <b>F-F</b>	Meas Mode (F-F): In this mode gates 1 and 2 take measure from one Flank to another Flank.																																								
HUD <small>Ⓢ</small> <b>OFF</b>	When Head Up Display (HUD) turned <b>ON</b> , provides a large, Head-Up Display of the depth or thickness reading at the top right of the A-Trace. The [Up] navigation arrow button sequences the selections as follows:																																								
Blanking >> <b>AUTO</b>	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>G1-G2</th> <th>E-E</th> <th>DEPTH</th> <th>TRIG</th> </tr> </thead> <tbody> <tr> <td>OFF</td> <td>OFF</td> <td>OFF</td> <td>OFF</td> </tr> <tr> <td>DIST</td> <td>DIST</td> <td>DIST</td> <td>DIST</td> </tr> <tr> <td>DIST +</td> <td>DIST +</td> <td>HEIGHT</td> <td>HEIGHT</td> </tr> <tr> <td></td> <td></td> <td>DIST +</td> <td>DIST +</td> </tr> <tr> <td></td> <td></td> <td>HEIGHT +</td> <td>HEIGHT +</td> </tr> <tr> <td></td> <td></td> <td></td> <td>↓</td> </tr> <tr> <td></td> <td></td> <td></td> <td>↓ +</td> </tr> <tr> <td></td> <td></td> <td></td> <td>↘</td> </tr> <tr> <td></td> <td></td> <td></td> <td>↘ +</td> </tr> </tbody> </table>	G1-G2	E-E	DEPTH	TRIG	OFF	OFF	OFF	OFF	DIST	DIST	DIST	DIST	DIST +	DIST +	HEIGHT	HEIGHT			DIST +	DIST +			HEIGHT +	HEIGHT +				↓				↓ +				↘				↘ +
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	Blanking: This function sets the blanking distance, as a percentage of the total gate width, which is a blind zone after the first echo, after which a second echo can be measured. This helps to eliminate undesired noise in the first echo from being measured, as thickness but will limit the minimum thickness capability if set too large																																								

Meas Mode <b>Angle</b>	Meas Mode (Angle): Take into account the angle probe value.
Hole Dia >> <small>mm</small> <b>1.0</b>	Hole Dia (mm): Used to select the depth or thickness measurement to the FLANK ( <i>left edge</i> ) of the first echo after the start of the gate or the PEAK measurement within the gate i.e. the largest value in the gate.
HUD <small>Ⓢ</small> <b>OFF</b>	When Head Up Display (HUD) turned <b>ON</b> , provides a large, Head-Up Display of angle reading at the top right of the A-Trace.
Cntr Depth >> <small>mm</small> <b>1.0</b>	<b>Cntr Depth (mm):</b> From the flank

## Trig Tab

Surface <b>Concave</b>	Surface: allows you to choose <b>CONCAVE</b> for internal surfaces or <b>CONVEX</b> for external surfaces. For flat surface with no curvature this set this option <b>OFF</b>
1/2 Skip <b>OFF</b>	When 1/2 Skip is <b>ON</b> , this parameter is used as a quick way to turn on the 1/2 skip graticule which display dotted lines on the display representing half skip, full skip and skip and Half. If <b>ON + →</b> is selected then the calculated values are displayed at the top of the half skip lines.
Thickness >> <b>75.0</b> mm	Thickness: set the thickness of the material being tested to account for multiple skips of the angled sound beam in the test material.
Radius >> <b>100.0</b> mm	Radius: Select the radius of the curvature.

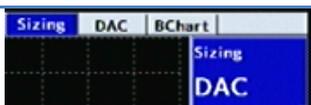
## Probe Tab

Angle >> <b>0.0</b>	Angle: Set to the nominal refracted angle of the transducer to calibrate the Surface and Depth measurements.
X_Offset >> <b>0.0</b> mm	X_Offset: Used to enter the distance from probe emission point to front of probe case. This is used by the TRIG function in <b>MEAS</b> menu to give the surface distance.
<b>AUTO</b> <b>Zero</b>	Auto Zero: option calculated automatically the zero probe, to calculate the zero probe, press [OK] button

## T-Comp (Temperature compensation) Tab

Mode <b>ON</b>	Mode (ON/OFF): Turn temperature compensation mode <b>ON</b> or <b>OFF</b> . <b>ON</b> activates temperature compensation mode.it replaces the Beam Path distance (↘) with a <b>(TC:)</b> in the measurement line with HUD.
Calib °C <b>25.0</b>	Calib °C: Set the value of the environment temperature of the calibration block. The units are either in metric (°C) or in imperial (°F).
Material °C <b>25.0</b>	Material °C: Set the value of the temperature for material under test. The units are either in °C metric or in °F imperial.
K <b>0.00000</b>	K: Set value for the K factor which derived during the calibration phase and used to calculate the depth of the defect. It can be set during the measurement phase and ID display for reference.

## Sizing Tab

		Sizing: can be set on None/DAC/ TCG/ AVG/ AWS/ API
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Depend on the sizing technique selected: a new tab will appear next to sizing tab **if** the option is installed.

## DAC (Distance Amplitude Correction) Tab

This menu is used to create DAC curves using a series of reference echoes. Once drawn, the DAC curve acts as an alarm threshold level for the gate where the level varies to match the attenuation and field characteristics of the transducer and test material combination. The DAC procedure is described fully in [DAC operation](#).

<b>DAC Mode</b> <small>5</small> <b>OFF</b>	DAC mode (OFF): Turns the DAC measurement mode off.
<small>Split</small> <b>ON</b>	Split: On or OFF the split DAC function where an additional DAC curve is generated if the signal drops below 20%. See further information on <a href="#">Split DAC</a>

<b>DAC Mode</b> <small>5</small> <b>Draw</b>	DAC mode (Draw): Used to create the DAC curve
<small>Cursor</small> >> <small>mm</small> <b>27.60</b>	Cursor (mm): Used to move the cursor over the reference echo for which a DAC point is being set.
<small>Point</small> <b>1</b>	Point: Display only. Shows the number of points created after pressing the [OK] button.
<small>Width</small> <small>5</small> <b>10%</b>	Width: Toggles the width of the selection cursor between 10% (25 pixels, <i>default</i> ) and 2% (5 pixels) for more accurate selection of peaks.

<b>DAC Mode</b> <small>5</small> <b>ON</b>	DAC mode (ON): Displays the DAC curve on the screen
<small>Curve</small> <b>DAC</b>	Curve (DAC): Used to display the DAC curve alone, the -2/-6/-10dB, -6/-14dB, JIS or custom reference curves.
<small>Trigger</small> <small>5</small> <b>DAC</b>	Trigger (DAC/Gate1/Curve1/Curve2/Curve3): Depend on how the parameters trigger is set, used to set the alarm threshold for the DAC curve, Curve 1/2/3 curve or gate 1 or +6dB.
<small>T-Loss</small> >> <small>dB</small> <b>0.0</b>	T-Loss (dB): Used to set the transfer loss in dB due to surface condition, poor coupling etc...

<small>DAC Mode</small> <small>5</small> <b>ON</b>	DAC mode (ON): Displays the DAC curve on the screen.
<small>Curve</small> <small>5</small> <b>Custom</b>	Curve (DAC, Gate 1, Cursor1,Cursor2 or Gate1): Used to display DAC curve,Gate1 or curve1/2/3 in dB as curve reference from -20 dB to + 20 dB
<small>DAC</small> <small>Gate 1</small> <small>Curve 1</small> <small>Curve 2</small> <small>Curve 3</small>	Trigger: Depend on how the parameters trigger is set, used to set the alarm threshold for the DAC curve, Curve 1/2/3 curve or gate 1.
<small>T-Loss</small> >> <small>dB</small> <b>0.0</b>	T-Loss (dB): Used to set the transfer loss in dB due to surface condition, poor coupling etc...

## TCG (Time Corrected Gain) Tab

This menu is used to create TCG curves using a series of reference echoes. Once drawn, the TCG curve acts as swept gain control on the amplifier to set different gain levels relative to distance. The TCG procedure is described fully in [TCG \(Time Corrected Gain\) Operation](#).

TCG Mode <b>Off</b>	TCG Mode (OFF): turn the TCG curve off
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TCG Mode 5 <b>Draw</b>	TCG Mode (Draw): Used to create the TCG curve. Cannot be drawn in RF display mode.
Cursor > mm <b>46.00</b>	Cursor: Used to move the cursor over the reference echo for which a TCG point is being set.
Point <b>6</b>	Point: Display only. Shows the last point created after pressing the [OK] button.
Width 5 <b>10%</b>	Width: Toggles the width of the selection cursor between 10% (25 pixels, <i>default</i> ) and 2% (5 pixels) for more accurate selection of peaks.

TCG Mode <b>ON</b>	TCG mode (ON): Display the TCG curve. Active the TCG curve to adjust the gain. Can be activated in TF or rectified display mode.
Curve 5 <b>OFF</b>	Curve (OFF/Amplification/Reference): When switched ON, the Amplification or reference TCG curve is displayed.
TCG Meas 5 <b>dB</b>	TCG Meas (dB/%FSH/%REF): Used to select between dB, %FSH and %REF for measurements
T-Loss >> dB <b>0.00</b>	T-loss (dB): Used to set the transfer loss in dB due to surface condition, poor coupling etc...

## AVG (Amplituden Vergleichs Größe) Tab

This menu is used to create a DGS/AVG curve allowing flaw sizing and distance compensation without requiring the reference standards for establishing a DAC curve or to set up a TCG correction. DGS/AVG is described fully in [DGS/AVG Operation](#).

AVG Mode 5 <b>OFF</b>	AVG Mode (Off): Initial mode. Turns off the display of the DGS/AVG curve.
Freq >> MHz <b>5.00</b>	Freq: Used to set the transducer frequency taken from its datasheet.
Probe type <b>L-Wave</b>	Probe type: Set the type of wave L-wave (longitude) or S-Wave (shear) the set the reference (test) block velocity Used to set the reference (test) block velocity in m/s.
ERS >> mm <b>3.2</b>	Equivalent Reflector Size (ERS): Used to set the Equivalent Reflector Size.

AVG Mode <b>Set PRB</b>	AVG Mode (Set PRB): Mode used to define curvature correction and probe delay
NFL <b>30</b>	NFL: Used to set the Near Field Length taken from the transducer datasheet
Delay <b>2700</b>	Delay: Used to set the probe delay material velocity in m/s and is used in conjunction with the probe zero and specimen velocity to calculate the sound field equivalent length.
PED <b>18.9</b>	PED: Calculated Probe Effective Diameter – This value is for information only and cannot be changed

AVG Mode <b>Set ATT</b>	AVG Mode (Set ATT): Used to set attenuation parameters for the AVG.
T-Loss <b>0.0</b>	T-Loss: Used to set the transfer loss in dB due to surface condition, poor coupling etc...
Ref dB/m <b>0.0</b>	Ref (dB/m): Used to set the reference material attenuation in dB/m
MAT dB/m <b>0.0</b>	MAT (dB/m): Used to set the test material attenuation in dB/m

AVG Mode <b>Set REF</b>	AVG Mode (Set REF): Used to define the various reference values
dVK <b>0.0</b>	dVK: Used to set the curvature correction factor in dB and is taken from the transducer datasheet.
Ref Type <b>BWE</b>	Ref Type: Used to select the reference reflector type: Flat Bottom Hole (FBH), Side Drilled Hole (SDH) or Back Wall Echo (BWE)
Ref Size <b>Infinite</b>	Ref Size: Used to define the size of the reference type. If <b>REF TYPE</b> is set to <b>BWE</b> , <b>REFSIZE</b> is set to <b>INFINITE</b>

AVG Mode <b>Set SIG</b>	AVG Mode (Set SIG): Mode used to perform calibration
Cursor > mm <b>17.48</b>	Cursor (mm): Select than use the [Up] and [Down] navigation arrow button to move the selection over the echo and press [OK]. The Masterscan D-70 will calculate the sensitivity and draw the curve on the screen.
Width <b>10%</b>	Width: Used to change the width of the cursor between 10% (25 pixels) and 2% (5 pixels).

AVG Mode <b>On</b>	AVG mode (On): Mode in which DGS/AVG is on.
Trigger <b>Gate</b>	Trigger: Used to select either the Gate or the Curve as the measurement reference
ERS <b>3.2</b>	ERS: Used to set the value of the Equivalent Reflector Size.
T-Loss <b>0.0</b>	T-Loss: Used to set the transfer loss in dB due to surface condition, poor coupling etc...

## API (American Petroleum Institute) Tab

This menu is used to assist users in performing tests according to the American Petroleum Institute (API) Recommended Practice for Ultrasonic Evaluation of Pipe Imperfections using the Amplitude Distance Differential Method (ADDM). Users are referred to the publication: "API Recommended Practice 5UE, Second Edition, June 2005" The API procedure is described in [Evaluation of Pipe Imperfection using API 5UE](#)

API Mode <b>OFF</b>	API Mode (OFF): Initial mode. Turns off the display of the API curve.
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API Mode <b>Calib</b>	API Mode (Cal): Used to set the initial calibration of the defect.
dr >> mm <b>0.80</b>	dr (mm): Depth of the reference indicator should be set by the user according to the size of the reference defect
G1 Start >> mm <b>44.85</b>	<b>G1 start:</b> Set the start position of the gate relative to the initial pulse. Units are mm or inches and range is from 0 to the full time base of the horizontal display.
Capture <b>Ref</b>	Capture (Ref/Accept/Peak): To accept calibration measure press [OK] key to accept the measure and press [OK] again to get the calculated K factor value. During the measurement Capture option will be set on Peak

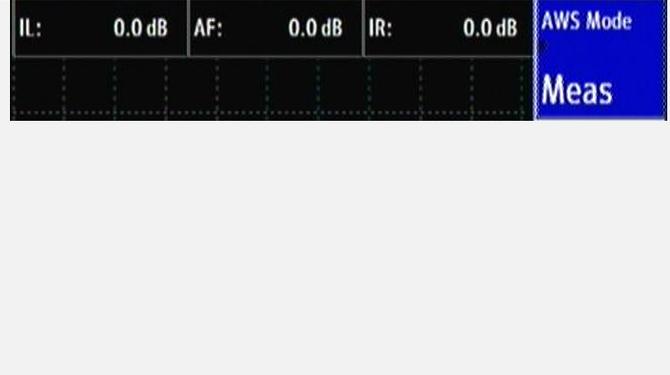
API Mode <b>Meas</b>	API Mode (Meas): Used to set the initial calibration of the defect.
G1 Start >> mm <b>44.85</b>	<b>G1 start:</b> Set the start position of the gate relative to the initial pulse. Units are mm or inches and range is from 0 to the full time base of the horizontal display.
G1 Level >> % <b>18</b>	<b>G1 start:</b> Adjusts the alarm threshold level, which corresponds to the vertical height on the A-Trace. Adjustable in 0.5% or 2% steps from 0% to 100% full screen height.
Capture <b>Peak</b>	Capture (Peak): During measurement Capture option will be set on Peak automatically

## AWS (American Welding Society) Tab

This menu is used when performing weld inspection in accordance with the American Welding Society's Structural Welding Code, ANSI/AWS D1.1-94. It provides a convenient method to automatically calculate the Indication Rating as defined in the code. The AWS procedure is described fully in [Weld Inspection Using the AWS Tab](#).

	<p>AWS mode (Off): Initial mode, AWS is turn off.</p>
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	<p>AWS mode (Set REF): Used to set up the AWS measurement mode for reference.</p> <p>Cursor (mm): Used to move the cursor over the reference echo to set the reference level.</p> <p>Ref (%): Used to set the Indication Level.</p> <p>Width: Toggles the width of the selection cursor between 25 pixels (default) and 5 pixels for more accurate selection of peaks.</p>
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	<p>AWS mode (Meas): Used to make measurements in accordance with the code.</p> <p>Indication level IL (dB): The dB required setting the indication to the reference level.</p> <p>Attenuation Factor AF (dB): The attenuation factor to correct for the depth of the indication.</p> <p>Indication Rating IR (dB): The indication rating calculated in accordance with the code. Also the difference the IL and the reference level with correction for attenuation.</p>
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## BChart Tab

<b>BChart Mod</b>  <b>OFF</b>	Bchart mod (Off/Timed/Encoded): Used to set up the AWS measurement mode.
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<b>BChart Mod</b>  <b>Timed</b>	BChart mod: When set in Timed the BChart is activates and begins collecting data to display the BChart based on time.
<b>LOS Mode</b> dB <small>Ⓢ</small> <b>OFF</b>	LOS (dB): This option allows the choice between STOP and CONTINUE, it determines what the Masterscan should do when a Loss Of Signal occurs. When set to stop the B-chart does not recorded "no reading" values. Whereas when set to continue it does.
<b>Speed</b> >> <small>Ⓢ</small> <b>1</b>	Speed: Allows the operator to select the update rate of the Bchart (1-50). This value loosely represents samples per second.
<b>No. of S.</b> >> <small>Ⓢ</small> <b>500</b>	N.O.S: Allows the operator to select the Number Of Samples (10-500) present in the BChart.

<b>BChart Mod</b>  <b>Encoded</b>	Bchart mode: When set in Encoded the Bchart will be activated in encoded mode. The masterscan must have an encoder attached to it of the data to de displayed.
<b>Encoder</b> <small>Ⓢ</small> <b>ON</b>	Encoder: Activate or deactivate the encoder port.
<b>Sample/cm</b> >> <b>10.0</b>	Sample/Cm: Set the number of sample (0-50) taken per cm.
<b>No. of S.</b> >> <small>Ⓢ</small> <b>500</b>	N.O.S: Allows the operator to select the Number Of Samples (10-500) present in the BChart.

## 4. MEMORY Menu

Press the [MENU] button then the [OK] button when the MEM Menu is highlighted to gain access to the tabs and sub-menus. These Tabs allow the user to save panel settings, A-Scans (A-Log), B-Scans (Bchart) and thicknesses (T-log) as well as recalling an A-Scan to be used as a reference (Ref).



### PANEL Tab

This menu provides storage and recall of up to 450K calibration settings. The use of this feature is described fully in [Storage and Recall Of Calibration Setups](#).

Save	Save Panel: Allow the user to save the panel configuration. By pressing the [up] or [down] button to highlight save Panel sub-menu then press [OK] button, a note window will open.
Load	Load Panel: Allow the user to save the panel configuration. By pressing the [up] or [down] button to Load Panel sub-menu then press [OK] button, a note window will open.
Edit	Edit Notes: Allow the user to save the panel configuration. By pressing the [up] or [down] button to Note Panel sub-menu then press [OK] button, a note window will open. Press [up] and [down] navigation arrow button to select the note.
Default All	Deafult All Panel: By pressing [OK] keys Panel settings will be reset to factory default

### A-LOG Tab

This menu provides storage and recall of up to 200K A-Scans with settings. The use of this feature is described fully in [A-Log, A-scan Storage](#).

Save	Save A-Log: Allow the user to save the A-log configuration. By pressing the [up] or [down] button to highlight save A-log sub-menu then press [OK] button, a note window will open.
Load	Load A-Log: Allow the user to load the A-log configuration. By pressing the [up] or [down] button to highlight Load A-log sub-menu then press [OK] button, a note window will open.
Edit	Edit Notes: Allow the user to edit notes associate with the A-log. By pressing the [up] or [down] button to highlight Edit Notes sub-menu then press [OK] button, a note window will open. Press [up] and [down] navigation arrow button to select the note.

## REF Tab

This menu allows a waveform stored in A-LOG memory to be displayed as a reference on the display. Before a waveform can be recalled, it must be stored in an A-LOG location as described above.

Load	Load Ref: Allow the user to load the A-log Ref. By pressing the [up] or [down] button to highlight Load Ref sub-menu then press [OK] button, a note window will open.
Ref	
Edit	Edit Notes: Allow the user to edit notes associate with the Reference. By pressing the [up] or [down] button to highlight Edit Notes sub-menu then press [OK] button, another window will open. Press [up] and [down] navigation arrow button to select the note.
Notes	
Visible	Visible (Off/ON/Opaque): Allow the user to display or not, the reference waveform associated with the A-log.
OFF	

## BChart Tab

Save	Save Bchart: Allow the user to save a Bchart related to B-scan By pressing the [up] or [down] button to highlight save Bchart sub-menu then press [OK] button, another window will open.
BChart	
Load	<b>Load Bchart:</b> Allow the user to load a BChart related to a B-scan. By pressing the [up] or [down] button to highlight Load Bchart sub-menu then press [OK] button, another window will open.
BChart	
Edit	Notes: Allow the user to write a note associate with a B-scan By pressing the [up] or [down] button to highlight Edit Notes sub-menu then press [OK] button, another window will open. Press [up] and [down] navigation arrow button to select the note.
Notes	

## TLogging Tab

Log Type	Log Type (Basic/Grid): Allow 2 different types of log which are TLog or Grid (optional feature which must be activated via code)
Basic	



Note that Tlogging Tab does not appears if the Corrosion and T-log option is not activated

## T-LOG Tab

Mode <b>Off</b>	Mode (off) : In this mode the T-log is disabled, it is possible to access the setup features of the grid T-log mode (if feature purchased)
--------------------	--

Mode <b>File</b>	T-Log Mode (file): When mode is set to file, it allows the user to save a thickness log in the same way an A-log or a B-log is saved.
Save <b>T-Log</b>	Save: Allow the user to save a T-Log, by pressing the [up] or [down] button to highlight save T-Log sub-menu then press [OK] button, another window will open.
Load <b>T-Log</b>	<b>Load:</b> Allow the user to load a T-log, by pressing the [up] or [down] button to highlight Load T-Log sub-menu then press [OK] button, another window will open.
Clear All <b>Table</b>	Clear All (Table): used to clear all the data in the table. Press [OK] key to clear the data. Confirm window will appear for confirmation.

Mode <b>Record</b>	Mode (record): This menu provides storage and recall of up to 8,000 thickness readings. Numeric and Sequential modes are available. This feature is described fully in Readings are stored under a three level code, starting with BLOCK (1-14), followed by Location (1-2000) and NO (1-2000).
Block <b>1</b>	Block : Used to select the block number (1-14), this value can also be set to ALL, location number is also set to ALL
Location <b>1</b>	Location: Used to select location number (1-2000) for storage or viewing of a thickness reading.
Number <b>1</b>	Number: The individual thickness reading number into which a thickness reading is stored. Increments automatically when storing a reading by pressing the [OK] button.

## Grid Tab

Mode <b>Off</b>	Mode (off): In this mode the Grid Log is disabled.
--------------------	--

Mode σ <b>File</b>	Mode (file): When mode is set to file it allows the user to save a thickness log in the same way an A-log or a B-log is saved.
Save <b>T-Log</b>	Save: Allow the user to save a T-Log grid, by pressing the [up] or [down] button to highlight save T-Log grid sub-menu then press [OK] button, another window will open.
Load <b>T-Log</b>	Load: Allow the user to load the T-log grid, by pressing the [up] or [down] button to highlight Load T-Log grid sub-menu, then press [OK] button to open the note window.
Edit <b>Notes</b>	Notes: Allow the user to write a note associate with a T-Log, by pressing the [up] or [down] button to highlight Edit Notes sub-menu then press [OK] button, another window will open. Press [up] and [down] navigation arrow button to select the note.

Mode <b>Logging</b>	Mode (logging): Used to switch on T-log mode and enable logging mode
Navigate <b>Store</b>	Navigate: Used to navigate the T-log grid.
Setup Note>> σ <b>0</b>	Set up Note: used to make a note about the setup used for the grid plan.
Clear All <b>Table</b>	Clear All (Table): used to clear all the data in the table. Press [OK] key to clear the data. Confirm window will appear for confirmation.

## Grid Plan Tab

Load <b>Grid Pla</b>	Load: Allow the user to load a T-log grid plan, by pressing the [up] or [down] button to highlight Load T-Log grid plan sub-menu then press [OK] button, another window will open.
Save <b>Grid Pla</b>	Save: Allow the user to save a T-Log, by pressing the [up] or [down] button to highlight save T-Log grid plan sub-menu then press [OK] button, another window will open.
Setup <b>Setup</b>	Setup: Used to configure the setup for the grid plan.
Store <b>Extra TL</b>	Store: Allow the user to store type log such as , TLog (thickness) ,T+Ascan (Thickness and A trace), T+BCh (thickness + B trace), Extra TLog (extra thickness log), ET+Asc (extra thickness log and A trace) and ET+ Bch (extra thickness log and B trace)

## 5. UTIL Menu

Press the [MENU] button followed by the [OK] button when UTIL menu is highlighted to select these menu options. The items in this section allow the user to configure features such as display preferences, waveform, alarm, sound, back wall echo attenuation (BEA), Amplitude gate correction (AGC), encoder as well as date and time settings.



### MENU Tab

Language 5	Language: Selects one of 6 built in languages or a user selectable language. The built in languages are selectable at time of ordering the Masterscan D-70.
Default	
Units 5	Units: Selects <b>INCHES</b> , <b>µs</b> , or <b>METRIC</b> measurement units. When in <b>µs</b> mode, the velocity is fixed at 2000 m/s (5000in/µs) and is not adjustable.
mm	
Customize	Customize Menu: This parameter allows the user to enable or disable some tab. By pressing the [up] or [down] button to highlight Customise sub-menu, then press [OK] button to open the note window.
Menu	
Install	InstOption: This Parameter allow you to see which options are installed, by pressing the [up] or [down] button to highlight Install Option sub-menu, then press [OK] button to open the note window.
Option	

### Waveform Tab

Contour	Contour: Used to contour the shape of the echo signals, adjustable from 0 to 6 or be set to Auto
0	
Smooth 5	Smooth (OFF/Smooth/Fill): When SMOOTH is selected the signal is displayed as an envelope. When FILL is selected the area under the trace is filled.
Smooth	
RejectType 5	Reject type (linear/suppress): Used to remove low level noise from the A-trace. Reject can be suppressive or linear.
Linear	
Fade Rate	Fade Rate (0-6): used to set the fate rate of the signal display on the screen. Fade Rate is adjustable from 0 to 6, where set on 0 the signal does not fade whereas set on 6 the signal fade away slowly which is useful for very small defect which are hard to catch.
1	

## User Keys Tab

<b>UserKey 1</b>	UserKey 1, UserKey 2, UserKey 3 and UserKey 4: these four USER buttons can be assigned to any parameter on the Masterscan.
<b>Gain Up</b>	The followings quick access functions can be assigned from any of the Userkey parameters:
<b>UserKey 2</b> <small>⚙</small>	
<b>GainStp</b>	<ul style="list-style-type: none"> <li>Panel: The button has been assigned to a panel – pressing the button for a short time recalls the panel, pressing for a longer time stores the panel.</li> </ul>
<b>UserKey 3</b> <small>⚙</small>	<ul style="list-style-type: none"> <li>User: The button has been defined by the user</li> </ul>
<b>Gain Dn</b>	<ul style="list-style-type: none"> <li>N/A: Not allocated</li> </ul>
<b>UserKey 4</b> <small>⚙</small>	<ul style="list-style-type: none"> <li>Auto 80%: Increases the signal crossing the gate to 80%</li> </ul>
<b>Sngl/Dbt</b>	<ul style="list-style-type: none"> <li>QSave-A: Performs a quick save of the current A-Log</li> </ul>
	<ul style="list-style-type: none"> <li>WheelLK: Locks the Scroll-Wheel</li> </ul>
	<ul style="list-style-type: none"> <li>+/- 6dB: 1st click increases the gain by 6dB the second click reduces the gain by 6dB</li> </ul>
	<ul style="list-style-type: none"> <li>Gain Up: Increments the gain by the gain step</li> </ul>
	<ul style="list-style-type: none"> <li>Gain Dn: Reduces the gain by the gain step</li> </ul>
	<ul style="list-style-type: none"> <li>GainStp: Scrolls through the available gain steps</li> </ul>
	<ul style="list-style-type: none"> <li>Sngl/Dbt: Switches between single and double transducers</li> </ul>
	<ul style="list-style-type: none"> <li>Clr TMin: Clears the T-MIN if set</li> </ul>
	<ul style="list-style-type: none"> <li>Clr Peak: Clears the peak wave form</li> </ul>
	<ul style="list-style-type: none"> <li>AWS Visible: Shows the HUD when in AWS mode</li> </ul>
	<ul style="list-style-type: none"> <li>API Visible : Shows the HUD when in API mode</li> </ul>
	<ul style="list-style-type: none"> <li>AutoZero: When T-COMP is active performs an auto probe zero</li> </ul>

## MISC Tab

<b>Tx Mode</b>	Pulse mode (damping/Act Edge): When Pulse Mode is set to damping. Damping parameter in Tx tab (From Cal main menu) will either be 50 or 400 Ohm.
<b>Damping</b>	
<small>🔊</small> <b>Click</b>	When set in to Act Edge, Edge parameter in Tx tab (From Cal main menu) can be set from 0 to 400.
<b>OFF</b>	Click (OFF/Keys/Wheel/both): When set other than OFF, a beep will sound to confirm each button press and/or the wheel.
<b>Alarm</b>	
<b>Mute</b>	Alarm (Mute/Audible): When set to audible, a buzzer sounds during any gate alarm.
<b>Keylock</b>	
<b>Inactive</b>	Keylock (active/Inactive): Allows the user to lock out the keys on the unit to stop inadvertent changes. When set to ACTIVE the [FULL SCREEN] button switches between freeze, peak, hold and keylock.

## VIDEO Tab

Colour	Colour: Selects one of eight colour schemes (signal, Menu, highlight) for the display. The colour schemes are as follow:
G-B-B	- Green, Blue, Black (default)
Brightness	- Black, Black, White
10	- White, Black, White
Graticule	- Yellow, Black, Yellow
½ Skip	- Yellow, Black, White
	- Yellow, Yellow, Blue
	- Green, Green, Blue
	- White, Black, Blue
	Brightness (0-20): Controls the display brightness. The level selected affects the battery life. A value of 1 gives 16 hours, 10 gives 12½ hours and a value of 20 will give 9 hours of operation, assuming the battery is in good condition at 22°C.
	Graticule: Selects graticule options from the following choices:
	OFF: No graticule.
	ON: A complete 100% graticule
	SPARSE: A row of dots at 10% intervals.
	50%: Divisions at 50% full screen height.
	1/2 SKIP: Sparse with vertical dotted lines representing the ½ skip,
	1/2 SKIP+: Full skip and 1½ skip distances. Press [Up] navigation arrow again to get the ½ skip lines with calculated distances shown.
	SOLID: A complete 100% graticule with solid line instead of dot.

## BEA (Backwall Echo Attenuator) Tab

BEA Mode Off	BEA Mode (OFF): turn the Backwall Echo Attenuation mode OFF.
-----------------	--

BEA Mode Draw	BEA mode (Draw): set the Backwall echo attenuation in Draw mode.
Cursor 184.0	Cursor: In Draw mode, this is used to adjust the cursor so that it covers the area on the display that corresponds to the backwall. The cursor starts from the right hand side of the display and is made wider by using the [Down] navigation arrow button and made narrower by using the [Up] navigation arrow button. The attenuation is reduced by the selected ATTEN value for the width of the cursor.

BEA Mode On	BEA mode (ON): turn the Backwall Echo Attenuation mode ON
Atten 0.0	Atten: In ON mode this is used to select the level of attenuation to apply to the backwall. The value can be selected between 0dB and the REF gain value to a maximum of 40dB.
Curve OFF	Curve (OFF/Amplification/Reference): Used to display a line representing the amount of attenuation applied

## AGC (Automatic Gain Control) Tab

Automatic Gain Control feature is generally used in thickness logging. By setting a percentage of full screen height (% FSH – default 50%) and ensuring that the signal is breaking gate 1, the gain will be adjusted automatically to bring the signal height to the user defined value subject to an adjustable tolerance ( $\pm\%$  TOL).

AGC Mode <b>OFF</b>	AGC mode (ON/OFF): Turn AGC ON or OFF
% FSH <b>50</b>	% FSH: Choose the screen height, between 10% and 90%, to which the user wants the gain to be adjusted.
$\pm\%$ Tol <b>5</b>	$\pm\%$ Tol: Choose the tolerance on the % FSH to stop the AGC "hunting" due to signal height jitter. The range can be set between 5% and 20% FSH

### How to Use AGC?

- Set Gate 1 at on +ve, to a height about 10% or 20% FSH and ensure that the signal will cross the gate.
- Ensure that MEAS mode is anything but MONITOR
- Set the %FSH parameter to the signal height required.
- Enable AGC by changing AGC Mode to ON.
- For poor surface conditions, adjust the  $\pm\%$  TOL to increase the tolerance of variation in the signal before the gain is adjusted.
- When a signal is present in Gate 1 and a suitable measurement mode is selected the gain will be automatically adjusted to bring the signal to the specified height on the screen.



- 
- When the Masterscan D-70 is switched on the AGC is turned OFF.
  - The gain value that is last set by AGC remains when AGC is switched off.
  - If the gate level is above the user defined %FSH, AGC is internally inhibited.
-

## Encoder tab

Encoder 5 <b>Auto</b>	Encoder <b>Manual</b>	Encoder: When set in manual the user will be able to the selected value set the resolution of the encoder as well as the direction of the encoding. When set in Auto the encoder resolution will be set a 14.40 clicks and Bchart option has to be set on encoded.
EncoderCal	EncoderRes >>	EncoderCal: Allow the user to Calibrate the encoder.
<b>Start</b>	<b>14.40</b>	EncoderRes: The selected value set the resolution of the encoder.
Distance >> mm		Dist (mm): Scanning distance in mm or inch.
<b>100.0</b>		
Count 5	<b>FWD</b>	Count: count the distance travelled by the encoder.
<b>0</b>		Direction (FWD/BKWD): Set the scanning drection.

## CLOCK Tab

Clock <b>Set</b>	Clock (Set): Allow you to set the time or date, press the [OK] button to display the pop up window and access time or date parameters.
Display 5 <b>ON</b>	Display (Off/On): display <i>(or hide)</i> the time and date at the bottom of the screen.

Clock <b>Date</b>	Set (Date): Used to set the current date. <i>(Selected by pressing the [OK] button when SET is highlighted, then [Down] navigation arrow button)</i>
Date >>	Date: Used to set the current day.
<b>23</b>	
Month >>	Month: Used to set the current month.
<b>5</b>	
Year >>	Year: Used to set the current year.
<b>2013</b>	

SET <b>Time</b>	Set (Time): Used to set the current time. <i>(Selected by pressing the [OK] button when SET is highlighted, then [Down] navigation arrow button)</i>
Hours	Hours: Used to set the current hour in 24 hour format
<b>12</b>	
Mins	Mins: Used to set the current minutes.
<b>37</b>	

## 6. Storage & Recall of Calibration Setups

After the Masterscan D-70 has been properly calibrated for a particular testing scheme, it is possible to store all of the panel settings for subsequent recall when performing the same test at a later time.

Although the last panel settings are “remembered” by the Masterscan D-70’s memory, this feature is useful when the instrument is being used for many different tests requiring substantially different panel calibration settings.

In addition to the panel settings, a freeform note can be stored with the panel set that includes provision for a label, an operator name or number, a location identifier, and a transducer identifier.

It is possible to store up to 450K sets of panel settings, each assigned a set number.

### How to store a panel set?

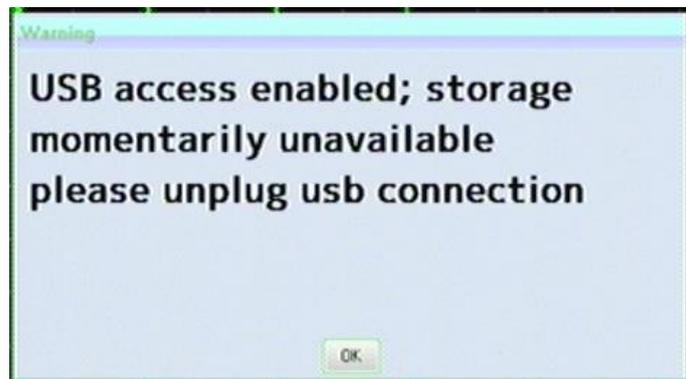
**Step 1:** Press [Menu] Button use [up] or [down] arrow key to highlight Mem menu then press [OK] key.

**Step 2:** Use the [left] or [right] arrow key to highlight the Panel Tab.



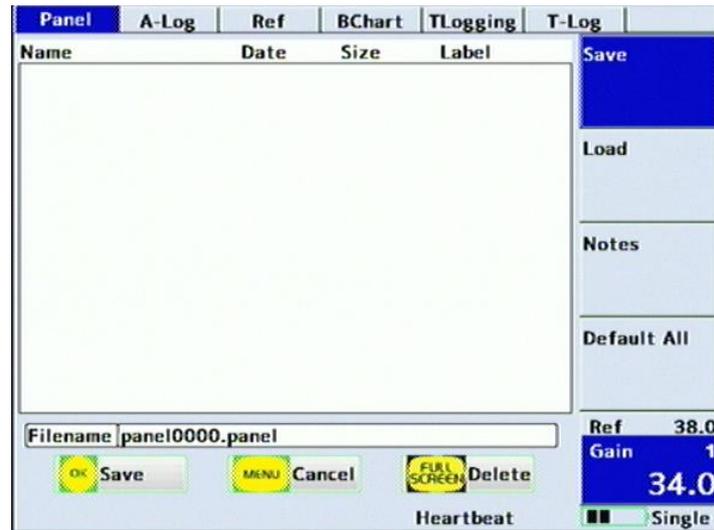
If it is desired to store Notes with the Panel settings, see the description for entering [notes](#).

**Step 3:** Select Save Panel sub-menu by pressing the [OK] button.



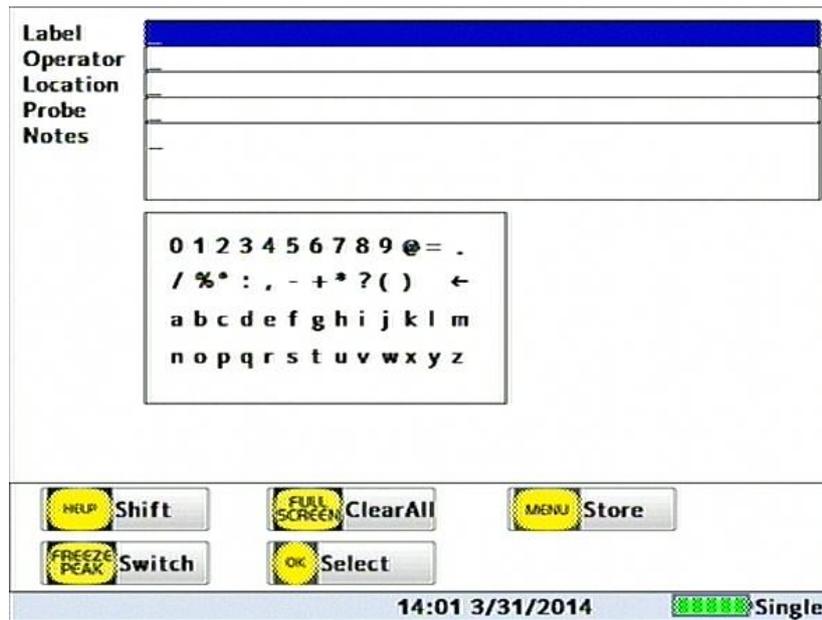
If the USB cable is connected to the PC, the storage will not be available as shown in the picture above.

**Step 4:** Once the [OK] button has been pressed a window will appear as shown below.



**Step 5:** Press the [OK] Button to create a new panel settings.

**Step 6:** The screen as shown below should appear. Enter the details for the panel to be saved.



- If you just want to update an existing panel, select the desired panel and press [OK] button.
- If a notes entry has been not record with the panel setting, create a note as described [below](#), then re-save the panel setting as describes [above](#).

## How to recall a panel set?

**Step 1:** Press [Menu] button then highlight Mem menu using [up] or [down] navigation arrow key. When Mem menu is highlighted press the [OK] button.

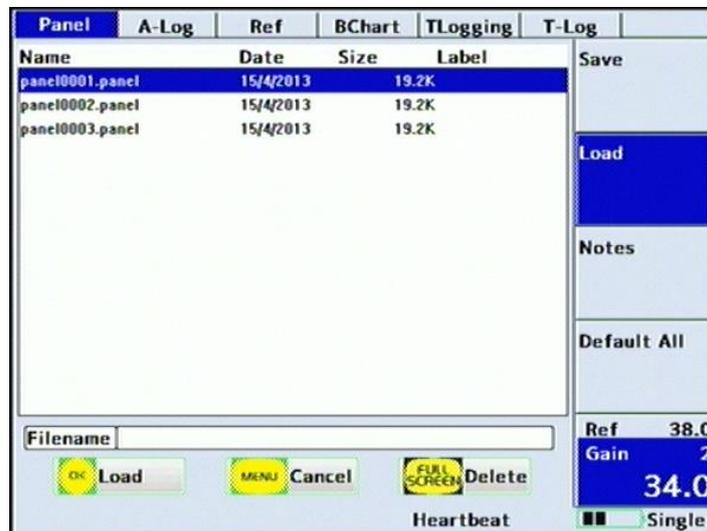
**Step 2:** Use the [left] and [right] navigation arrow buttons to highlight the Panel Tab.

**Step 3:** Select Load Panel sub-menu by pressing the [Up] and [Down] button, then press [OK] button.



If the USB cable is connected to the PC, the storage will not be available.

**Step 4:** Once the [OK] button has been pressed a window will appear as shown below.



**Step 5:** Use the [Up] and [Down] navigation arrow buttons to highlight the Panel configuration file.

**Step 6:** Press [OK] button to load the file.

## How to delete a panel set?

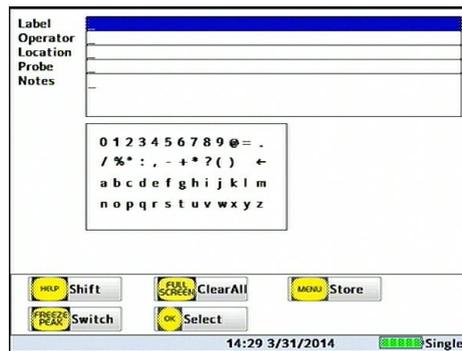
**Step 1:** Follow the step from 1 to 5 of [How to recall a panel set](#).

**Step 2:** Press [Fuel screen] button to delete the file.

## Adding NOTES to PANEL and A-LOG sets

When storing panel calibration settings or waveforms, it is often useful to add some notes to the set so it can later be identified, or to help the user recall the correct set. This is possible in the PANEL and A-LOG tabs by using the NOTES sub-menu.

When a panel calibration or waveform is to be stored, first calibrate the instrument as desired, or capture the waveform by pressing the [Freeze/Peak] button. Then select the NOTES sub-menu by using the [Up] and [Down] navigation arrows button and notice the window shown below overlays the display area.



The LABEL line is display in UT-lity program to allow quick identification. The OPERATOR, LOCATION, PROBE and NOTES lines can also be edited or modified.

The [left] and [right] navigation arrow buttons are used to move the cursor from right to left along a line of text when character editor is not active and the field is highlighted.

The [up] and [down] navigation arrow buttons are used to move between different fields (i.e. between OPERATOR, LOCATION, PROBE and NOTES).



- To delete a character position the cursor at the right hand side of the character you want to delete then use [freeze/peak] button to switch to edit mode. With [up], [down], [left] or [right] navigation arrow buttons select the backspace sign (<-) then push [OK] button.
- To insert a character/space, position the cursor between the characters then use [freeze/peak] button to switch to edit mode. With [up], [down], [left] or [right] navigation arrow buttons to select the character you want to insert then push [OK] button.



Please note that when you reach the maximum character allowance, the only way to erase any character will be to use the [full screen] button which will Clear all the characters.

Once the desired notes have been added or edited, press [Freeze/peak] button to exit the edit mode.

## Edit Notes Summary

The following sections provide a summary of the navigation techniques needed to edit notes using either the front panel keypad. In this case we assume the file note has already been saved

<b>Edit a NOTES:</b>	Press to bring up the editing boxes as follows: <ul style="list-style-type: none"> <li>• Use the [up] and [down] navigation arrow buttons to move the cursor vertically along the row.</li> <li>• If you are NOT in the character map press [freeze/peak] to Switch.</li> <li>• Use the [right], [left], [up] or [down] buttons to highlight a character from the map.</li> <li>• Press [OK] button to write a character to a line.</li> </ul>
<b>Select</b> [OK]	Allow you to select the character when highlighted
<b>shift</b> [Help]	Allow you to change between upper case and lower case letter
<b>Switch</b> [Freeze/peak]	Allow you to switch between lines and the character map
<b>clear all</b> [Full screen]	Erase the entire line
<b>EXIT</b> [Menu]	Exits back to the PANEL or A-LOG menu. Store the calibration set to save the notes.

## Chapter 3 : Flaw testing

### 1. Basic Operation

Reliable flaw detection requires three important considerations:

- ✓ Proper transducer selection
- ✓ An accurate reference block of the same material as that being tested with reference holes representing the orientation and sensitivity desired
- ✓ Proper calibration of the instrument.

Transducers used for flaw detection are usually of the narrow band variety to provide the best possible sensitivity to the anticipated discontinuities. In some cases, broadband varieties are chosen to optimize near or far surface resolution – the ability to separate discontinuities from the front surface or back surface echo. In either case, the frequency is chosen so that the wavelength in the material is optimized for the orientation and size of expected discontinuities. The single element contact transducer is used for general-purpose flaw detection. The angle beam transducer is used for weld inspection, which is covered in [Weld Inspection Using Trigonometry Mode](#). Other specialty transducers including dual and surface wave can be used but these topics are beyond the scope of the manual.

The next requirement for reliable flaw detection is a calibration or reference block. This block should be made of the same material as the parts to be inspected. In other words, it should have the same sound velocity and attenuation characteristics. The calibration block should have surfaces that mimic the parts to be inspected so that attenuation and sensitivity characteristic is similar. Most importantly, the calibration block should have a series of fabricated discontinuities representing those expected to found in the test piece. That is, the size and orientation of the fabricated discontinuities should match the expected natural discontinuities in the test piece. In some cases this may mean flat bottom holes perpendicular to the test surface, side drilled holes parallel to the testing surface, or in some cases, narrow notches representing planar surfaces parallel or perpendicular to the testing surface. Fabricated discontinuities must also be placed near the front and back surface of the calibration block to verify resolution of the transducer and instrument setting combination.

Finally, it is necessary to establish the proper calibration of the Masterscan D-70 in order to assure reliable flaw detection.

## 2. Flaw Tester Calibration

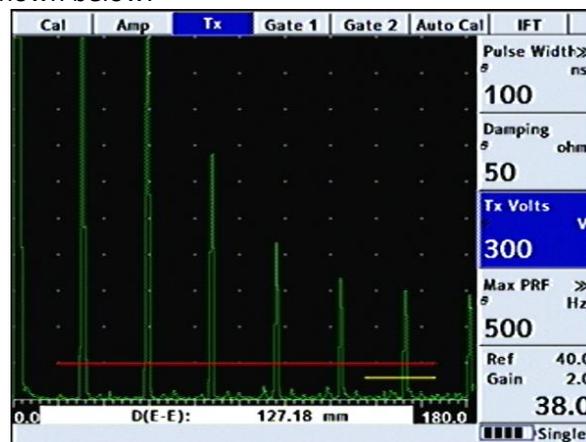
The essence of this calibration is to set the pulser, amplifier and gate parameters to provide the necessary sensitivity and resolution. The Masterscan D-70 has an automatic calibration technique that sets the necessary parameters by using a calibration block that has known thicknesses; see [Auto-Cal](#) for details.



Units shown in the procedure are in meters. For inch units, select IN in Units sub-menu located in Menu Tab from the UTIL menu and use the corresponding values for the parameters.

Alternatively a manual method can be used to perform the calibration and the following are the essential steps for basic flaw detection:

- Select the appropriate single element contact transducer and calibration block that matches the material and expected discontinuities under test.
- In the CAL Tab, select the proper Range and Delay so that several echoes from the expected material depth can be viewed.
- From the **AMP** Tab, set the **Filter** so that the nominal value of the transducer is within the filter band. Make sure mode is set to SINGLE and set the **DETECT** parameter to **FULL**.
- Couple the transducer to the calibration block and obtain an echo from a fabricated discontinuity or the back surface and adjust the **GAIN** to set the peak of the echo to about 80% screen height.
- Adjust the gain to set a reference echo from mid thickness of the calibration block to about 80% amplitude.
- From the **MEAS** menu, set the **Meas MODE** parameter (*in Meas Tab*) to **E-E** and the **TRIGGER** parameter to **PEAK**.
- From the Gate1 Tab, set the G1 state to ON +VE and adjust the parameters G1 Start, G1 **Width** and G1 **Level** so that the gate covers several echoes.
- From the Gate2 Tab, adjust Blanking parameter so that the 6th backwall is selected. For example a 25.4 mm thick calibration block was being used with the gate set on the first backwall echo and the blanking set so that the 6th backwall echo is selected giving a distance between them of 127 mm as shown below:

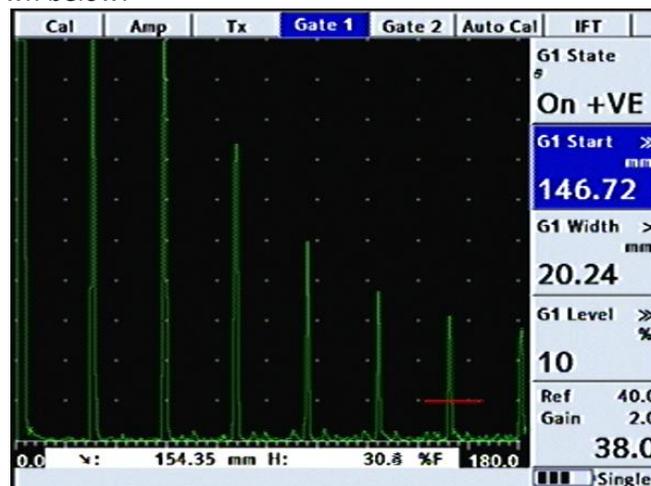


- The distance between the echoes is shown in the E-E measurement at the bottom of the display (in this case 127.18). It is unlikely that the value will be exactly correct as the velocity of sound in the material will not match one of the preset values. Select a velocity that is close to the material then adjust it so that the exact distance is obtained as shown below:



- To set any parameters manually such as velocity. Press and hold the [OK] button then use the wheel scroll to adjust manually the velocity or the range.
- By default the parameter setting is Coarse tuning (*represented by >>*), to set in fine tuning (*represented by >*) use the [up] arrow key.
- To put it back in coarse tuning use the [right] arrow key.

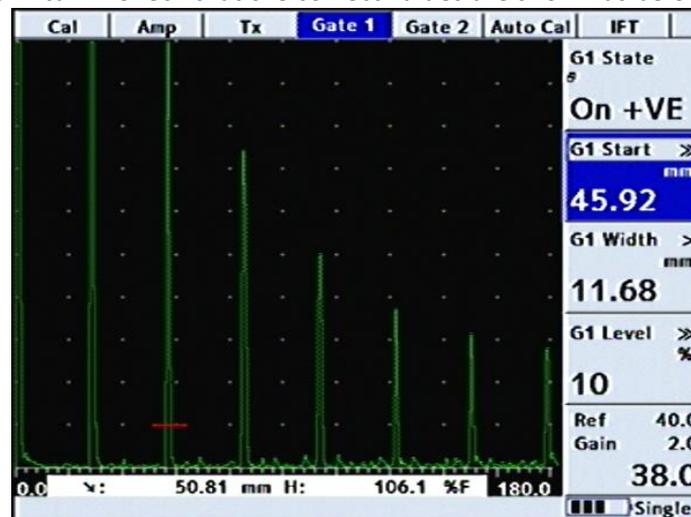
- Next the calibration needs to take account of the distance between the transducer crystal and the front face of the transducer by setting the correct Probe Zero value. From the **MEAS** menu change the Meas Mode to Depth.
- From the Gate1 tab change the G1 Start, G1 Width and G1 Level values so that the gate covers the 6<sup>th</sup> peak as shown below:



- The distance measurement is shown at the bottom of the display (*in this case 154.35*). From the **CAL** Tab adjust the **Probe Zero** value until the correct distance is shown as below:



- As a final check move the gate across the other echoes to ensure that the correct distances are shown; From the Gate 1 Tab adjust the G1 Start and G1 Level parameters so that the gate covers each echo in turn. Check that the correct values are shown as below:



Now that the Masterscan D-70 has been calibrated it can be used to perform inspections using any of the techniques described in the following sections.



- To set any parameters manually such as G1 start. Press and hold the [OK] button then use the wheel scroll to adjust manually the gate start or the width.
- By default the parameter setting is Coarse tuning (*represented by >>*), to set in fine tuning (*represented by >*) use the [up] arrow key.
- To put it back in coarse tuning use the [right] arrow key.

For weld inspection using an angle beam transducer, follow the instructions in [Weld Inspection Using Trigonometry Mode](#).

For storage and printing of A-Scans, refer to [A-LOG, A-scan Storage](#).

Perform the following steps to establish a basic flaw detection mode for the Masterscan D-70.

1. Select a suitable single element contact transducer, preferably a 5MHz, 10mm diameter narrow band and calibration block that matches the material and expected discontinuities under test.
2. In the CAL Tab, set the following parameters:
  - Probe Zero to 0.000
  - Velocity should be set the specimen material velocity.
  - Range to 125 (or other suitable value to cover the test range of interest).
  - DELAY to 0.000
  - GAIN to 50.0
3. In the AMP Tab, set the following parameters:
  - Filter to 3-8 MHz
  - Detect to FULL
  - Reject to 0
  - TX Mode to Single
4. In the TX Tab set the following parameters:
  - Width = 100
  - Damping = 50  $\Omega$
  - Max PRF to 150Hz
5. In the Gate 1 tab, set the following parameters:
  - G1 State to On +VE
  - G1 Start to 10.0
  - G1 Width to 50 or other suitable value to cover the test range of interest.
  - G1 Level to 50.0
6. In the MEAS tab, set the following parameters:
  - Meas Mode to Depth
  - Trigger to Flank
  - HUD to OFF
  - T-Min to OFF

The Masterscan D-70 is now configured for basic flaw detection. Using an appropriate calibration block, adjust the GAIN parameter to establish the correct sensitivity. Adjust other parameters as necessary to optimize the calibration.

## Chapter 4 : Thickness Gauging

### 1. Basic thickness Gauging

Accurate and reliable thickness gauging requires three important considerations:

- ✓ Proper transducer selection.
- ✓ An accurate reference block of the same material as that being tested.
- ✓ Proper calibration of the instrument.

There are three types of transducers used in ultrasonic thickness gauging, all employing the straight or longitudinal beam method. The single element contact transducer is used for general purpose thickness gauging where material thickness is generally expected to be above 2.5mm.

The delay line contact transducer is used for measuring thin material down to 0.5mm where the surfaces are clean and parallel.

The dual element contact transducer is used for moderately thin materials down to about 1.0mm where the surfaces may be irregular and not necessarily parallel. The dual transducer is most commonly used for corrosion thickness inspection where its ability to obtain echoes from a pitted surface is superior. Nevertheless, dual transducer inspection on corroded materials is nowhere near as accurate as single element and delay line inspection, due to the nature of the material under test. In addition, the dual element transducer usually incorporates a slight included angle on both the transmitter and receiver side, resulting in a small non-linearity of the measurements. For this reason, dual transducer thickness testing is usually calibrated and performed over a limited thickness range.

Regardless of the type of transducer used, it is important that it be specifically designed for thickness gauging. This means that it must have broadband or highly damped characteristics that provide a sharp leading edge. Otherwise, amplitude variations of the signals can cause half-wavelength errors due to smaller “build-up”.

The next requirement for thickness gauging is a calibration or reference block. This block should be made of the same material as the components to be inspected. In other words, it should have the same sound velocity and attenuation characteristics. The calibration block should have parallel machined surfaces representing the thickness range to be inspected. Although two thicknesses representing the minimum and maximum values are sufficient for calibration, it is recommended that the calibration block have four sections covering the range anticipated. This will allow for verification of the calibration.

It is possible to calibrate the Masterscan D-70 using a generic test block and only one known sample thickness of the material under inspection. This is a less desirable method because there is no way of verifying the calibration. With this method, the calibration would first be performed on the generic test block, which would have three to four sections covering the expected thickness range. Essentially, calibrating on the generic block would set the transducer zero point. Then the Masterscan D-70 Velocity would be adjusted on the known sample of the test material until the thickness readout matched the known thickness. This established the sound velocity for the test material.

## 2. Thickness Gauging Calibration

Finally, it is necessary to establish the proper calibration of the Masterscan D-70 in order to assure accurate and reliable thickness testing. The essence of this calibration is to set the pulser and amplifier characteristics to provide sharp leading edges on the echoes. The following are the essential steps for basic thickness gauging:

- Select the appropriate broadband transducer and calibration block that matches the material under test.
- In the CAL Tab, select the proper Range and Delay so those echoes from the range of thickness can be viewed.
- From the AMP Tab, set the **Filter** so that the nominal value of the transducer is within the filter band and set the detection mode to **RF**.
- From the **AMP** Tab select **Single** for delay line and single element transducers or **Double** for dual element transducers.
- Couple the transducer to a mid-range thickness section on the calibration block and obtain an echo.
- From the **AMP** tab, set the **Detect** parameter to either **-VE HW** or **+VE HW**, depending on which half of the RF provides the best half-cycle as determined above.
- Adjust the gain to set the echo at about 80 %FSH and increase the **Reject** parameter to remove any undesirable noise from the baseline.
- From the GATE1 Tab, set G1 state to ON +VE and adjust the G1 Start and G1 Width so that the gate encompasses the thickness range of interest. Place the transducer between the thin and thick area on the calibration block to verify proper coverage. Adjust the G1 Level parameter to about 30 %FSH.
- From the MEAS menu, set the Meas Mode parameter to Depth and the Trigger parameter to Flank.
- If desired, set the T-Min parameter to ON so that the thinnest reading obtained will be held in the display.
- If desired, set the HUD parameter to  to display the thickness in a large window at the top right of the display.
- To calibrate the Masterscan D-70 for thickness readings, follow the steps outlined in [Auto-Cal](#). Alternately, you can use an iterative process from the CAL menu of setting the Zero on the thinnest calibration block sample and the Velocity on the thickest sample. Using this technique, you must repeat Zero to Velocity several times until the two values are correct.



- To set any parameters manually such as G1 start. Press and hold the [OK] button then use the wheel scroll to adjust manually the gate start or the width.
  - By default the parameter setting is Coarse tuning (*represented by >>*), to set in fine tuning (*represented by >*) use the [up] arrow key.
  - To put it back in coarse tuning use the [right] arrow key.
-

When using a delay line transducer, there are two modes of measurement:

- Interface to first return echo.
- Multiple echo mode which usually measures from the first to the second return echoes after the interface echo.

The Masterscan D-70 with Advanced Thickness provides two multiple echo measurement modes:

a) Echo – Echo (**E-E**)

- From the MEAS menu, set the Meas Mode to E-E for echo to echo measurement. You will notice that a second gate bar appears below gate 1 and that its start point is slightly to the right of gate 1. This is the blanking gate explained below.
- For measuring from interface to first echo, position the start of gate 1 before the interface echo. Using the Blanking parameter in the Gate 2 Tab, position the start of the second gate just after the interface echo but before the thinnest expected first echo.
- For measuring multiple echoes after the interface, position the start of gate1 just after the interface echo. Using the Blanking parameter in the Gate 2 tab menu, position the start of the second gate just after the first echo but before the thinnest expected second echo.
- The Blanking parameter determines the blanking or starting position of the second gate relative to the starting position of gate1. This prevents noise and spurious echoes associated with the interface or first echo from terminating the measurement and producing a false reading.

b) Flank – Flank (**F-F**)

- From the **MEAS** menu, set the Meas Mode to F-F for flank to flank measurement. You will notice that a second gate appears on the same level as Gate 1. The gate 2 has 3 parameters for controlling this automatic gate (*Start, G2 Width and Blanking*).
- For a correctly calibrated Masterscan, gate 1 can be positioned and with the Blanking parameter set to **AUTO**, gate 2 should position itself correctly over the second echo.
- It should be noted that the blanking parameter works differently to the blanking parameter in echo – echo mode. In flank – flank mode the blanking is measured in timebase units – as opposed to a percentage of gate 1 as in echo – echo mode.

For storage of thickness readings, refer to [Thickness Gauging](#).

Perform the following steps to establish a basic thickness-gauging mode for the Masterscan D-70.




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Units shown are in meters. For inch units, select IN in Units sub-menu located in Menu Tab from the UTIL menu and use the corresponding values for the parameters.

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1. Select a suitable transducer, preferably a broadband, 5MHz, with a 10mm diameter.
2. Select an appropriate calibration block with at least three known thickness sections covering the range to be inspected and made from the same material as the test piece.
3. In the CAL tab, set the following parameters:
  - Probe Zero can be left alone
  - Velocity should be set the specimen material velocity.
  - Range to 50 or other suitable value to cover the test range of interest.
  - Delay to 0.000
  - Gain to 50 . 0
4. In the AMP tab, set the following parameters:
  - Filter to 3-8 MHZ
  - Detect to +VE Half
5. In the Tx Tab, set PRF to 150Hz
6. In the GATE1 tab, set the following parameters:
  - G1 State to ON +VE
  - G1 Start to 10
  - G1 Width to 50 or other suitable value to cover the test range of interest.
  - G1 Level to 25.0
7. In the MEAS tab, set the following parameters:
  - Meas Mode to Depth
  - Trigger to **FLANK**
  - HUD to **↘**
  - **T-MIN** to **OFF**
8. Calibrate the thickness readout on the selected calibration block using the procedure in [Auto-Cal.](#)

The Masterscan D-70 is now configured for basic thickness gauging. Adjust parameters as necessary to optimize the calibration. For more in-depth features of the Masterscan D-70, see [Advanced Thickness Mode section.](#)

### 3. Auto-Cal

AUTO-CAL is an automated calibration feature for thickness gauging applications or when measuring depth to an indication in flaw testing.

In order to achieve proper calibration for measuring time-of-flight in ultrasonic testing, two factors must be known; the velocity of sound in the material under test, and the offset of the transducer caused by wear face and phase shifts.

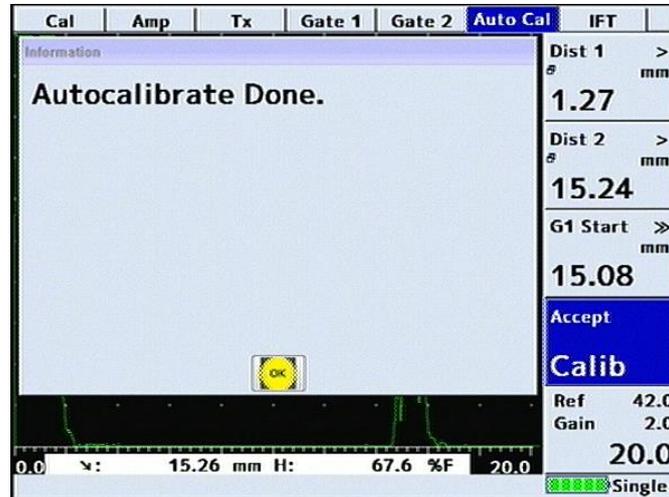
Conventional thickness calibration technique usually requires setting the zero (offset) and span (velocity) using an iterative technique. This means alternately placing the transducer on a thin sample to set the zero and a thick sample to set the span. This process is repeated several times until both readings are correct. The reason for this is that raising the span will also raise the zero.

The AUTO-CAL feature automates this process so that only two readings are required, one on the thin sample and one on the thick sample. The Masterscan D-70 then calculates the correct offset and span factors and sets the velocity and zero. Any time the test material is changed (velocity) or the transducer is changed (zero); this procedure must be repeated. Using this procedure will result in quicker calibration of the instrument and more accurate measurements.

The AUTO-CAL calibration procedure is as follows:

- Select a test block of the same material as that being inspected, with reference thickness covering the minimum to maximum thickness expected in the test parts. The difference between the thick sample and the thin sample should be no less than five to one.
- From the main menu, select CAL and adjust the RANGE and DELAY so that the thin and thick reference echoes show on the display.
- From the CAL menu, select GATE1 and place the STATE in ON +VE. Adjust the START and WIDTH of the gate to encompass the echoes from the thin and thick samples.
- From the main menu, select MEAS and place the MODE to DEPTH.
- From the CAL menu, select the AUTO-CAL menu.
- Select DIST1 using by pressing the [OK] button to list common thicknesses then use the Scroll-Wheel to select the desired value. If the required value is not shown in the list then select the value closest to it by pressing the [OK] key then press and hold down the [OK] key until the value is highlighted then use the Scroll-Wheel to change the value using the Scroll-Wheel; once the value is correct press the [OK] key again to exit from the DIST1 parameter. Repeat this for the DIST2 parameter.
- Place the transducer on the thin reference sample and obtain an echo. Adjust the gate start if necessary to obtain distance readout of the echo.
- Select the ACCEPT DIST1 parameter box and press [OK] twice to log the echo; the ACCEPT parameter box will show DIST2.
- Place the transducer on the thick reference sample and obtain an echo. Adjust the gate width if necessary to obtain distance readout of the echo.
- Press the [OK] button twice to log the echo; the ACCEPT parameter box will show CAL.
- Press the [OK] button. The transducer zero and velocity will now be adjusted.

The DIST1 and DIST2 values can be stored when the calibration information in PANEL and A-LOG functions are stored. This overcomes the need to set these values and gate positions every time a calibration is desired. Once established, all that is required is to obtain each echo and press [OK], and the instrument is calibrated.



If a delay transducer is used set DIST1 to 0.0 and use the interface echo as the thin reference echo. The instrument will then set the transducer zero to compensate for the delay line.

Once calibrated, it might be desirable to record the velocity and zero values from the CAL menu for future reference. Note that this is a convenient method for determining the velocity of sound in an unknown material. Once the Masterscan D-70 is calibrated on a known material, all that needs to be known is one fixed thickness point and the velocity can be determined.

#### 4. TCG for Reliable Gauging

As previously mentioned, reliable thickness gauging requires that the shape of the echoes be consistent with sharp leading edges. When measuring the thickness of material with higher than normal attenuation to ultrasonic energy or a wide thickness range, it is difficult to maintain proper characteristics of the echoes. One way to overcome this is to use the Time Corrected Gain feature of the Masterscan D-70. TCG can improve the reliability of thickness gauging by increasing the amplitude of echoes from thicker sections of the test material so as to maintain the correct detection threshold on the leading edge. The objective is to equalize the amplitude of echoes over the entire thickness range to be expected.

To set up the TCG feature, refer to [TCG operation](#).

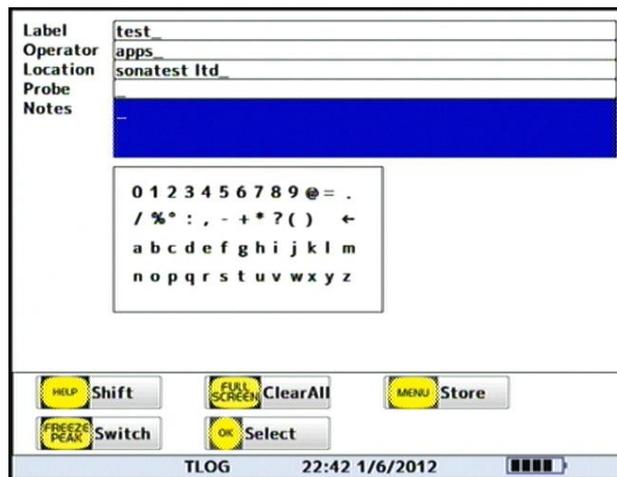
## 5. Thickness Logging Without Grid

A Masterscan D-70 without the Corrosion and Grid option will have certain options disabled.

It is not possible to load user specified notes, sequence text or old readings into the Masterscan. On top of this, it is not possible to store A-Scans with thickness readings.

It is however still possible to configure 1D and 2D grids within Utility software but no on the device. It's possible to input a PLAN NAME and PLAN DESCRIPTION, make adjustments to the grid size, increment direction and make use of the HIGH and LOW ALARMS.

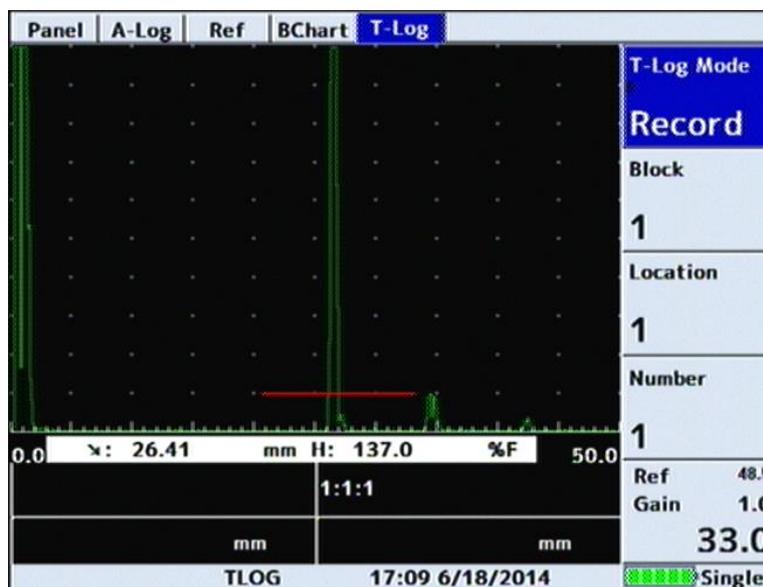
The T-LOG configuration panel with basic setting see [T-log](#) section for more details



### Record mode

Record mode is an extension of the 1D grid mode. It can only be configured using UT-lity as with previous readings the Masterscan requires the text to be downloaded to the DFD and does not provide any method of inputting sequence text on the DFD.

Once an inspection plan has been configured and sequence text downloaded to the Masterscan, T-LOG MODE can be switched to record. Below shows an example of the T-LOG record mode table:



## Chapter 5 : Standard Features

### 1. Distance Amplitude Correction (DAC)

Distance Amplitude Correction curves act as monitoring gate triggering thresholds to compensate for attenuation and sound beam characteristics. When properly established, the DAC curve will provide consistent alarming from discontinuities of equal relative size at different depths in the test piece. Functionality is provided to automatically draw 6dB and 14dB or 6dB and 12dB reference curves below the calibrated curve.

It should be noted that since the DAC function only provides a dynamic alarm threshold capability, the dynamic range is limited to about 16dB. Therefore, for materials that attenuate more than 16dB over the depth range of interest, DAC should not be used. Instead, the TCG function may be more applicable. See [TCG Operation](#) for the use of the Time Corrected Gain feature.

Proper use of the DAC feature requires a reference block made from the same material as that being examined, with flat-bottom or side-drilled holes of the desired size placed at depths covering the range to be inspected.

To establish a DAC curve, follow these instructions:

- Establish the basic calibration of the Masterscan D-70 using the desired transducer and the proper reference block. From the MEAS menu, go to Sizing tab to select the **DAC** feature.

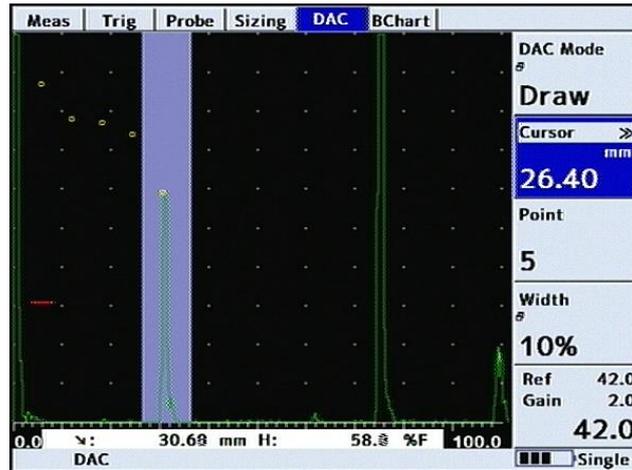


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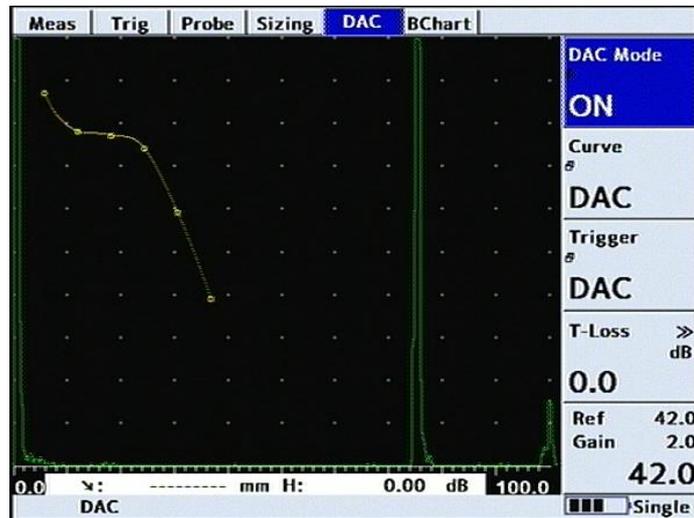
In Masterscan D-70, When choosing DAC feature in Sizing sub-menu from Sizing Tab, DAC tab will appear (See details [here](#))

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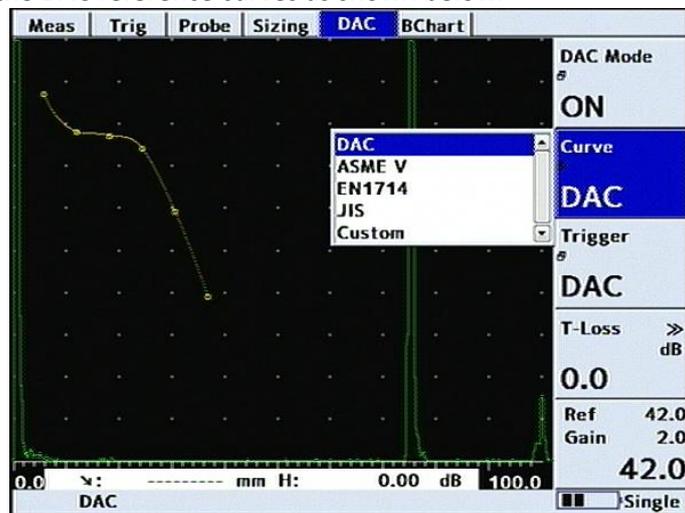
- Select the DAC Mode parameter by pressing the [OK] button then use the [up] and [down] keys to select the select Draw then press [OK] again to enter draw mode. The other parameters will now be Cursor and Point.
- The DAC system is now ready to accept reference points. Position the transducer to give a maximum echo from the first or topmost reference hole in the reference block. Be careful to use a consistent amount of coupling and transducer pressure.
- Use the Scroll-Wheel to position the bright cursor bar over the echo from the reference hole.
- Press the [OK] button twice to accept the point. The Point parameter will then increment to indicate the next point. A small square will appear as a reference point on the display showing the peak of the signal just recorded.
- Repeat steps 4 and 5 for each additional reference hole in the reference block, being careful to be consistent with the amount of coupling and transducer pressure. A maximum of 10 points can be recorded for a DAC curve.



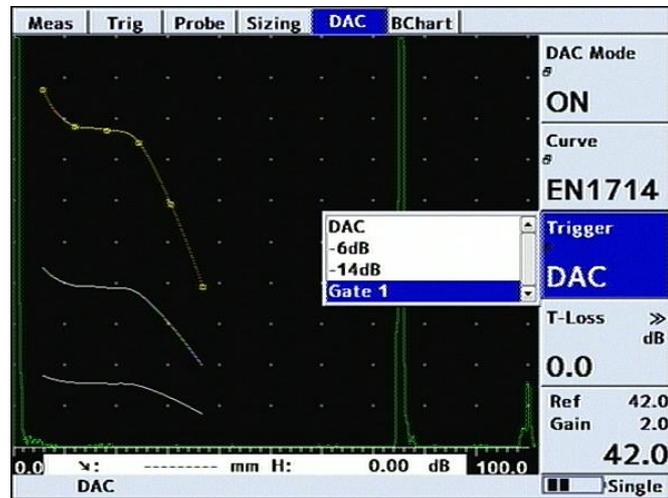
- Press [MENU] to come out of the adjust parameter then use the [Up] key to move to the DAC Mode box, use the [OK] button to display the drop down list then use the [Down] to select ON mode then [OK] again to actually turn DAC on. The DAC curve will now be displayed and the other parameters will change to Curve, Trigger and T-Loss.



- By highlighting Curve Parameter then push [OK] button, a drop-down list of available combinations of the DAC reference curves as shown below:



- These additional, automatically generated, reference curves provide a method for helping to evaluate discontinuities smaller than those in the reference block.
- Use the Trigger parameter to select the alarm trigger from Gate 1, the DAC curve, or any of the additional curves listed in the curve parameter above that are currently selected.



- The Transfer Loss (*T-Loss*) parameter allows an increase or decrease of gain without changing the main gain. This is useful when the transfer loss occurs due to surface condition, poor coupling, etc...
- To turn off the DAC feature, select the DAC Mode parameter from the DAC tab by pressing the [OK] button and displaying the drop-down list, then select OFF by using the [Up] or [Down] arrow key. Finally, press the [OK] button to turn the DAC off.

## 2. Temperature Compensation

### Over view

The Masterscan D-70 provides, as a standard option a “temperature compensation feature” (T-COMP) to enable measurements to be corrected for a temperature disparity between a calibration block and the actual material under test. This feature can be found under the MEAS menu group.

The temperature compensation feature does not operate in trigonometric measurement mode due to the correction required for change in refractive index of wedge material. It allows users to calibrate and measure accurately between -250 °C and 1000 °C.

### The Calculation

The calculation used to correct the beam path measurement in the Masterscan is shown below:

$$\text{Corrected\_Beam\_path} = \text{TOF} * V [1-K (T_1-T_0)]$$

Where:

- TOF is time of Flight
- V is the calibrated velocity
- K is the temperature coefficient of the material
- $T_0$  is the temperature at calibration
- $T_1$  is the measured

### Configuring Temperature compensation

Temperature compensation provides 3 configurable parameters (Cal °C, MAT °C and K). These must be set correctly to enable the feature to accurately compensate the measurements:

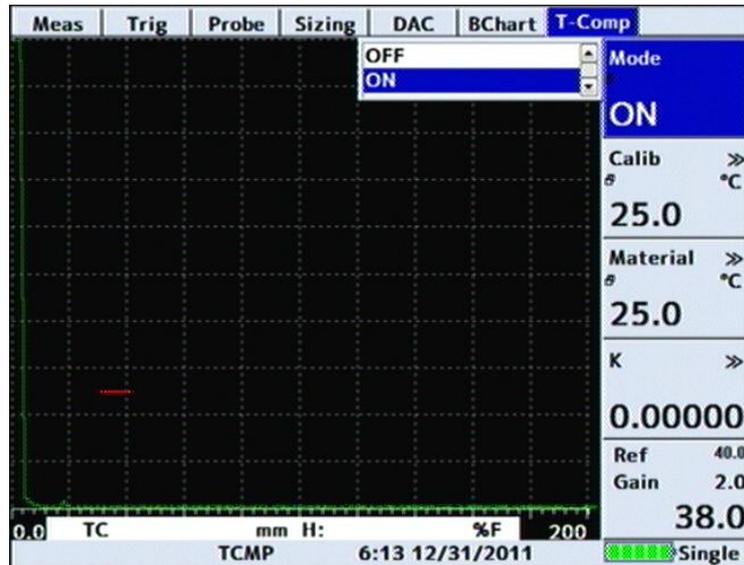


Both Temperature parameters and the coefficient parameter are converted when changing to imperial units (where temperature is assumed to be in Fahrenheit). A popup list containing values to quickly select temperature values are available.

Once this feature has been set up, measurements are automatically corrected and shown in both the measurement lines and the HUD.

### Using Temperature Compensation

Once the calibration procedure has been carried out, temperature compensation can be switched on. When temperature compensation mode is switched on it should be noted that a flag is placed in the information line to indicate to the user that Temperature Compensation is active.

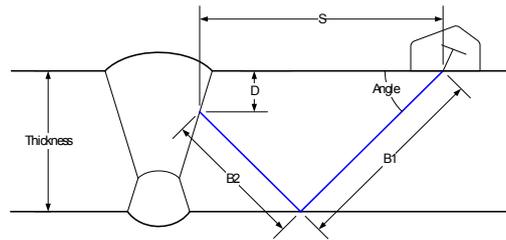


Additionally, as the beam path is corrected instead of the (-> :), TC is shown. This is again to highlight to the user that they are viewing temperature corrected values.



### 3. Weld Inspection Using Trigonometry Mode

The trigonometry mode provides a convenient method for measuring the location of discontinuities when inspecting welds with angle beam transducers. Essentially, the trigonometry mode uses the thickness gauging features of the Masterscan D-70 to calculate the surface distance and depth to a discontinuity from the actual beam path measured. This is accomplished by calibrating the trig mode with the actual refracted angle of the transducer being used. Additionally, the thickness of the test piece must be established in the menu in order to calculate depth and surface distance when using multiple skips in angle beam testing. The measurements being calculated are depicted in the following diagram:



These measurements are displayed below the A-Trace on the Masterscan D-70 as follows:

- ↘ Beam path distance B from the central exit point on the transducer to the discontinuity, the sum of B1 and B2 in double skip mode.
- Surface distance S from the central exit point on the transducer to a point directly above the discontinuity on the test piece. By entering the distance from the Front of the Probe to the emission point in the PROBE menu, this distance may be displayed relative to the front of the probe, which is usually more convenient.
- ↓ Depth distance D from the surface on which the transducer rests to the discontinuity.

Depending on the measurement technique being used there is an additional value displayed on the right of the measurement bar as shown below:

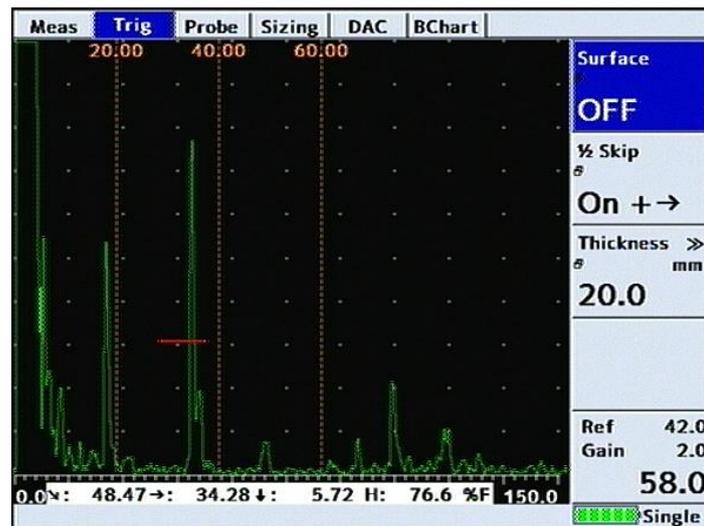
↘:146.13 →:103.33 ↓:96.67 H: 85%

The example shows above the normal height value as a percentage of full screen; in this case 85%. If DAC is being used then the user has the choice of displaying either dB, %FHS or %DAC. If DGS/AVG is being used then ERS is displayed in the right hand side.

It is important to note that discontinuities in welds can be discontinuous and can extend over a distance. The measurements made will, therefore, be close approximations to the discontinuity if the user properly calibrates the Masterscan D-70 and uses care to locate the desired peak amplitude signal to which a measurement is made.

To calibrate and use the trigonometry mode, follow the following instructions:

- Using a suitable IIW or other calibration block, measure and establish the central sound beam exit point and actual refracted angle for the transducer being used.
- Establish the zero and velocity (span) for the transducer and material under test using the Auto-CAL procedure described in [Auto-CAL](#). Use a suitable calibration block that has two drilled holes representing the thin to thick range of thickness expected in the test piece. In the Meas tab set the **Trigger** parameter to **Peak**. As in any ultrasonic thickness measuring method, it is important that the calibration be performed using a calibration block of the same material as that being inspected. Alternately, if you know the velocity of sound in the test piece, you may calibrate using the A-CAL method on a different material and then set the velocity parameter.
- From Meas main menu, go to Meas tab and select Meas Mode to Trig.
- In the Probe Tab select Angle parameter and set the refracted angle of the transducer measured in step 1 above by using the [Up] and [Down] arrow keys.
- In the Trig Tab select Thickness parameter to set the thickness of the test piece by using the [Up] and [Down] arrow keys. You may have to readjust this parameter if the test piece had varying thickness and you are using a multiple skip mode of angle beam testing.
- When measuring a discontinuity, position the transducer so as to obtain the maximum amplitude signal before recording the readings. A typical TRIG mode display is shown below:



## 4. Flank- Flank Measurement Mode

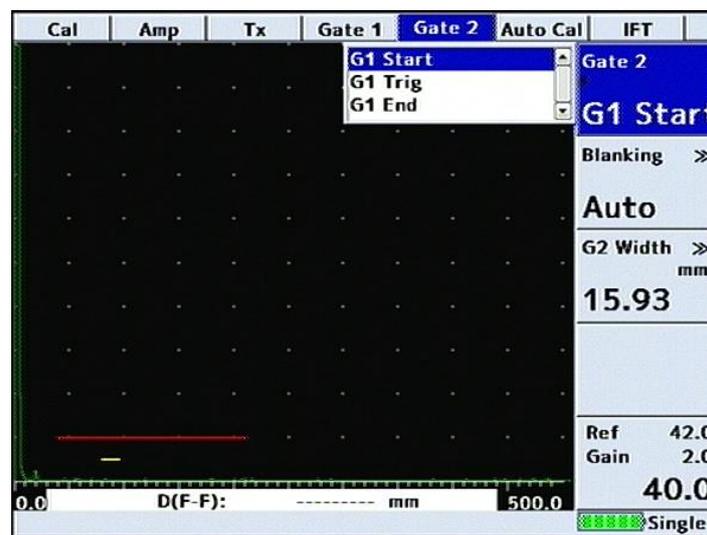
### Overview

This measurement mode, called Flank to Flank (F-F) measures the distance between the first rising flank through gate 1 and the second rising flank through gate 2. This mode is designed for use within the Thickness Measurement area of NDT.

### Setting up Flank - Flank Mode

In order to use the F-F Measurement Mode the user must first calibrate the Masterscan unit correctly. It is imperative that calibration is carried out before F-F Mode is used.

Gate 2 is controlled automatically by the Masterscan based on the initial calibration and the positioning of Gate 1 along with a couple of parameters described below:



The G2 start parameter is replaced with a choice of discrete options (*compared with the normal Gate Start parameter*). These options control where the BLANKING should start from.

The default is the start point of gate 1 (*G1 Start*).

The G2 width parameter is standard and simply defines the width of the gate.

The Blanking parameter refers to the number of millimetres of blanking required. It is possible to set this parameter to AUTO (*as shown above*); this allows the Masterscan to calculate where the gate should be positioned to capture the 'next' (repeat) echo.

Gate 2's level parameter is controlled automatically by the Masterscan. It is designed to be proportionally at same height that Gate 1 is to the echo passing through it.

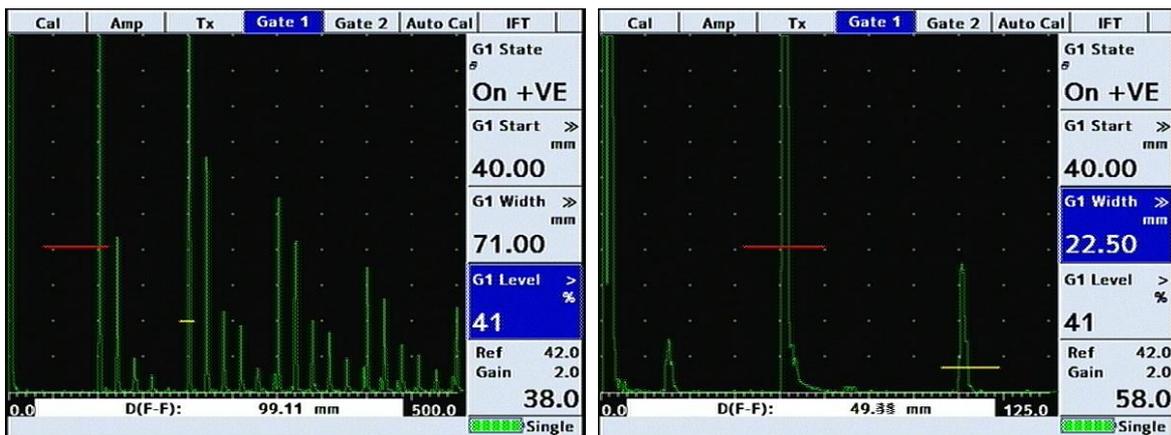
On a correctly calibrated unit it should be possible to draw Gate 1 across the whole screen and then to begin taking measurements between the first and second Backwall echoes. It is however more practical to position Gate 1 and set its width and height correctly according to the situation in hand.



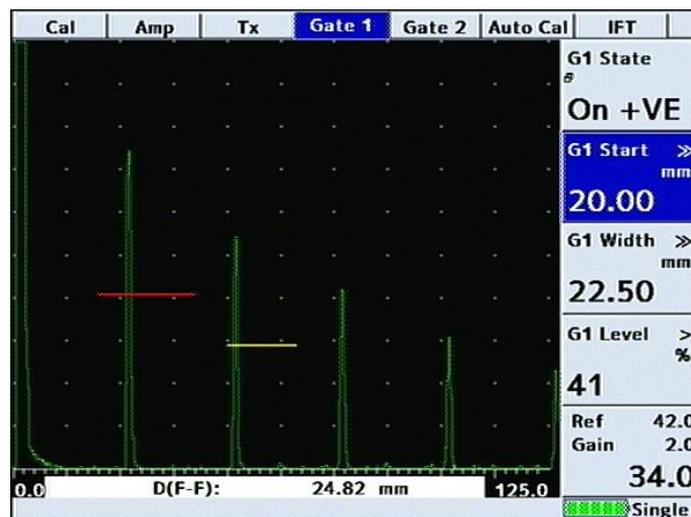
- It should be noted that automatic levelling of Gate 2 is dependent on the peak echo through Gate 1, thus if there is a number of echoes traversing Gate 1, the measurement will be taken from the first rising flank, but the amplitude (for calculating the correct height of Gate 2) will be taken from the peak within that gate (which might not be the same echo).
- Some user experience with NDT products is assumed when using this measurement mode.

## Using Flank - Flank Mode

The screenshots below shows a measurements being taken between gates in Flank to Flank Mode on a piece of steel of different thicknesses.



The screenshots above show two distinctly different measurements, however the user has not had to adjust Gate 2 between the left and the right examples. It has been automatically moved into position – it can be noted here the difference in gate height. As described earlier the level of the Gate 2 is dependent on ratio the level of Gate 1 to the amplitude of the echo passing through the Gate 1 – this same ratio is used on the amplitude of the echo passing through Gate 2 to determine the level of gate 2.



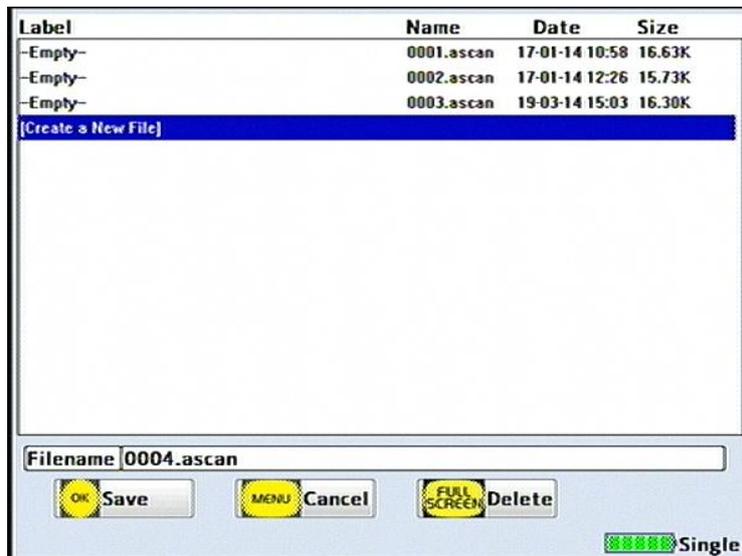
It is possible to use this measurement mode in TLOG mode.

## 5. A-LOG, A-scan Storage

The A-LOG feature provides for storage, recall and printing of A-Scans with all of the instrument settings. Up to 800 A-Scans and their settings can be stored. This feature is useful to record an indication for later review or for printing a hardcopy. In addition, recalling an A-Scan and its settings will allow for easy follow-up inspection of the same indication on the test piece. Simply unfreeze the display after recalling and the Masterscan D-70 is ready to repeat the same inspection. Be sure to use the same transducer that was used for the original recording.

### How to Store An A-Scan

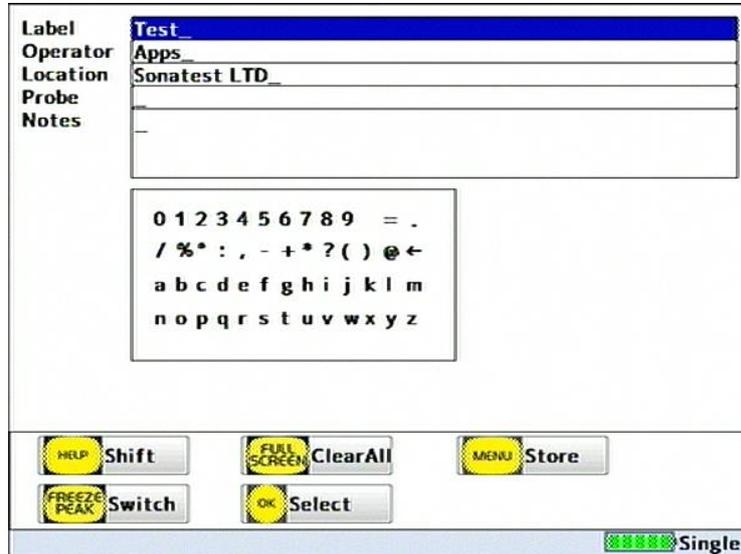
- Establish the basic calibration of the Masterscan D-70 using the desired transducer and the proper reference block.
- Obtain a desired echo from a discontinuity or reference block.
- Optionally press the [Freeze/Peak] button to freeze the display before storing it.
- From the MEM menu, select the A-Log Tab.
- In the A-Log Tab, select Save parameter by pressing the [OK] button. A window will pop with the list of already saved scan as shown below:



- Be careful not to store over a valid location unless you want to erase what is there and replace it with the current A-Scan and settings; if you do want to overwrite the previous A-scan the following dialogue is displayed:

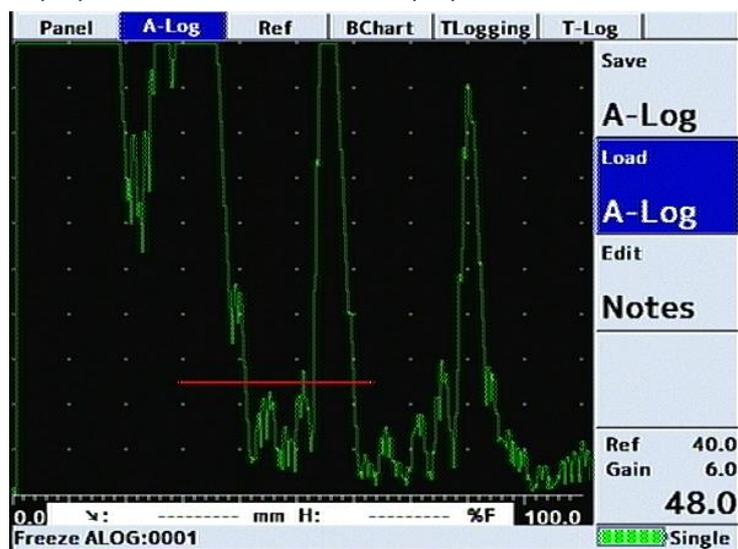


- Use the Scroll-Wheel to select the location to store the A-Scan.
- Pressing the [OK] button opens the **NOTES** window to allow the input of notes for the stored A-Scan and its settings.
- When finished adding notes, press the [Menu] button to save the A-Scan and return to A-Log tab.



## How to Recall an A-Scan

- From the MEM menu, go to the A-Log Tab then select the Load A-Log feature.
- A new window will appear with the list of available A-scans which is the same as for storing an A-Scan.
- Use the Scroll-Wheel to select the A-Scan to recall then press the [OK] button to load the scan. This may take a couple of seconds after which the display will be in FREEZE mode and the label of the A-LOG is displayed at the bottom of the display.



- To return to normal testing mode with recalled settings press the [Freeze/Peak] button.

## How to Delete a Stored A-Scan

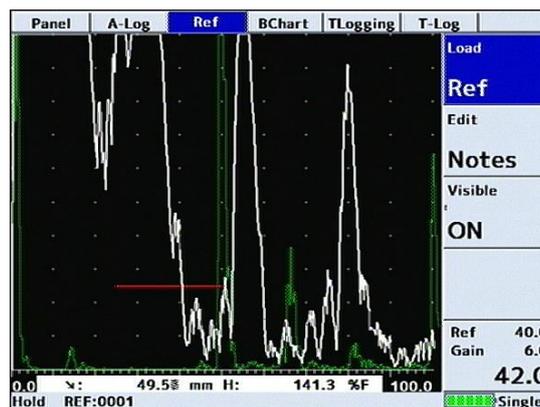
- From the **MEM** menu, go to A-Log Tab then select the Load A-Log feature.
- When Load A-log is highlighted press [OK] button. The list of available saved scan is the same as that for saving an A-Scan.
- Use the Scroll-Wheel to select the A-Scan to delete then press the [Full screen] button; a dialogue is displayed asking you to confirm the deletion:



## How to Recall an A-Scan as a Reference Waveform

This feature allows the user to select a waveform from one stored in the A-LOG menu, and to display this reference waveform on the display along with the real time waveform. This makes easy comparisons possible between an expected signal response (the reference waveform) and that obtained from the test piece. To recall a reference waveform:

- In order for a reference waveform to be recalled, the required trace must first be stored into an A-LOG store.
- From the **MEM** menu, go to Ref tab then select the **Load Ref** feature.
- When **Load Ref** is highlighted press the [OK] button. The list of available saved scan is the same as that for saving an A-Scan.
- Use the Scroll-Wheel to select the A-Scan to be used as a reference then press the [OK] button.
- The reference waveform will be a different colour as compared to the real time waveform, depending on which display colour is chosen.



- To remove the reference waveform, select Visible in Ref tab, set it to OFF and press the [OK] button.



When the reference is recalled, no setting parameters are changed. Therefore, if the Range, Velocity or Delay are changed, the reference signal will not match the real time waveform. This means that the Range, Velocity and Delay used for storing the reference waveform in A-LOG must match that used for the comparison of real time signals to the reference waveform.

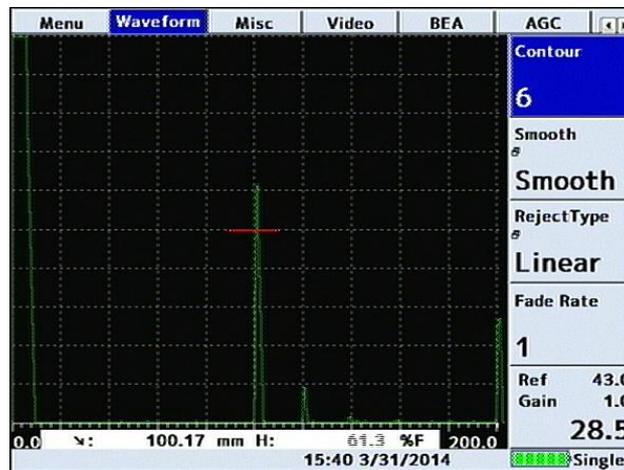
## 6. Contour, Peak Echo & Hold Dynamics

Contouring is a technique that enables the significant echoes to be enhanced by extending the trailing edge of the echoes thus making them appear wider than they actually are making the Masterscan D-70 operate more like an older analogue flaw detector. Only the trailing edge is modified so that depth measurements using FLANK and PEAK are not affected.

From the Waveform tab in Util main menu, select CONTOUR as shown below:



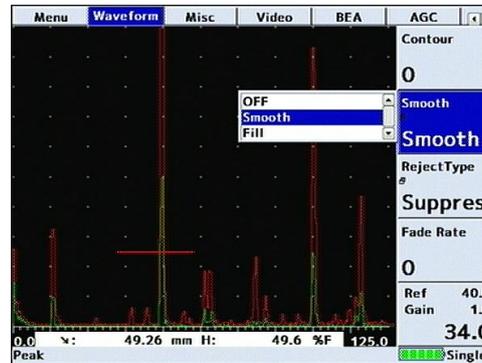
Change the value until the required shape is achieved, note how the measurement values do not change:



During flaw testing it is sometimes difficult to determine the exact peak of a discontinuity echo due to its geometry, coupling and surface anomalies and part geometry. The Masterscan D-70 incorporates a Peak feature that, while activated, stores all of the signal excursions on the display.

In addition to providing an effective method of capturing peak echo information, the Peak mode is useful for crack tip diffraction methods in angle beam weld inspection. In the case of crack tip diffraction, the extent of a crack type discontinuity can be inferred by the positional excursions of the signal as it reflects from both tips of a crack. Thus, as the transducer is moved past the indication, the signals will be “filled-in” on the display and the resultant width of the envelope or “echo dynamic pattern” will infer the crack length.

To use the echo dynamic pattern feature, position the transducer just off one side of the indication. Press the [FREEZE/PEAK] button three times to activate the Peak mode which is indicated by a box displaying Peak below the graticule. Move the transducer past the indication to display the envelope pattern. In the case of angle beam testing, it is advisable to rotate the transducer slightly and move it from side to side while moving forward past the indication. This will assure the capturing of all amplitude and distance information. An example of peak echo mode capture is shown below:

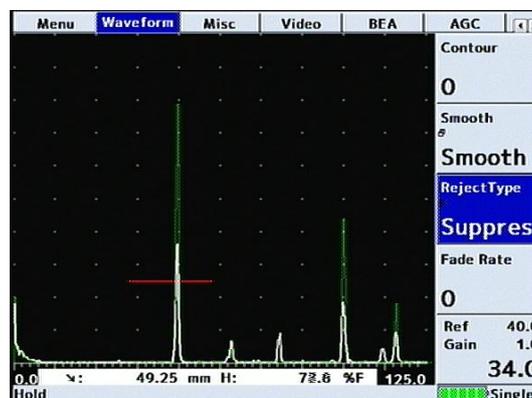


The envelope can be changed between outline as shown above and filled-in by selecting the SMOOTH parameter and switching between SMOOTH and FILL.

To return the display to normal mode, press twice the [Freeze/Peak] button. This will erase the envelope pattern and return the instrument to the instantaneous mode of display. While the display is showing the dynamic echo pattern, it is possible to record the A-Scan as indicated in [A-LOG, A-scan Storage](#).

Hold mode is similar to freeze mode except that it stores the currently displayed waveform as a reference trace and leaves the live waveform active. This is a quick and useful way to make comparisons between echoes.

Hold mode can be activated by pressing the [Freeze/Peak] button four times. Pressing the [Freeze/Peak] button again will return the Masterscan D-70 to its normal mode of operation.



## 7. B-Chart Measurement Technique

### Overview

The Masterscan D-70 provides B-chart functionality as an extension to the Grid thickness Logging mode. The Masterscan units do provide an encoder input, so the B-chart can be time-based or encoded bases.

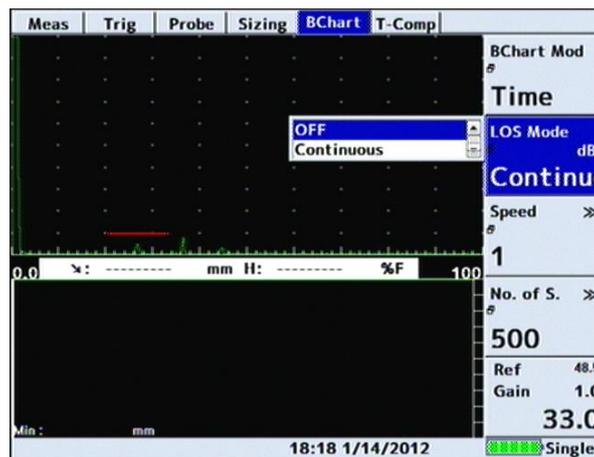
A B-chart can be used to graphically show an internal wall profile.

### Configuring B-Chart Measurement Mode

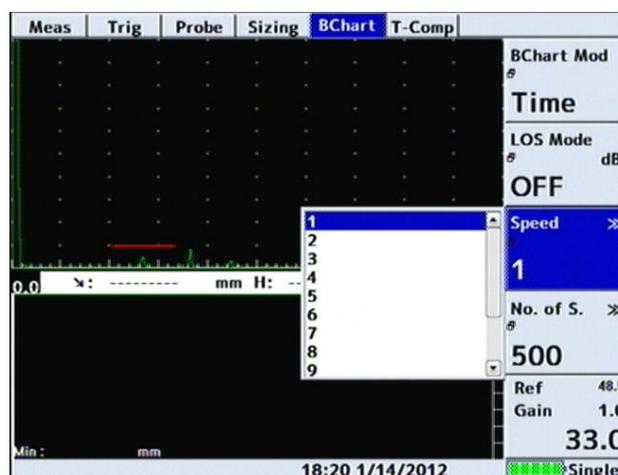
The B-Chart option can be found under the Meas menu group and provides 3 user configurable options:

When B-Chart Mode is setting up on Time: The LOS (Loss of Signal) Mode can be switched between OFF and Continuous. This parameter determines what happens when the signal is lost during acquisition. When set to Off the B-Chart stops collecting data and effectively pauses it.

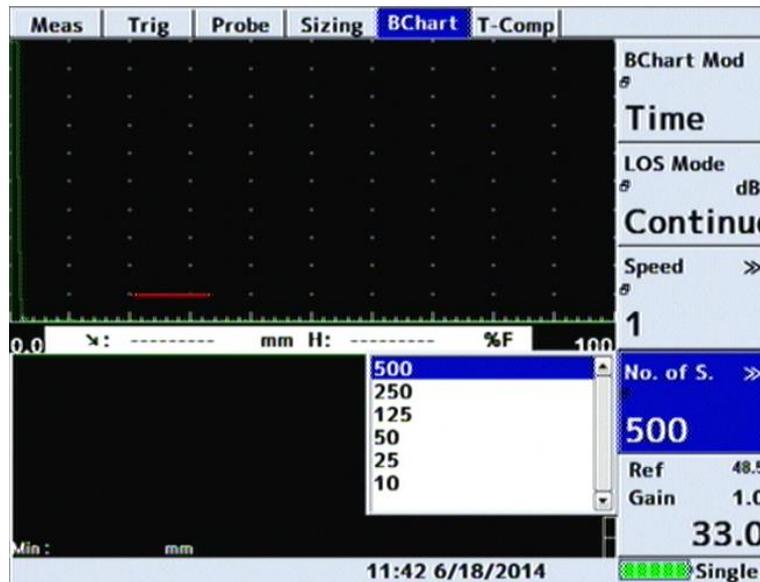
When set to Continuous and there is no signal present “No Reading” values are stored for that sample – leaving blanks in the B-Chart.



The speed parameter refers to the update rate (sample rate) of the B-Chart, measured in “Samples per Second”.



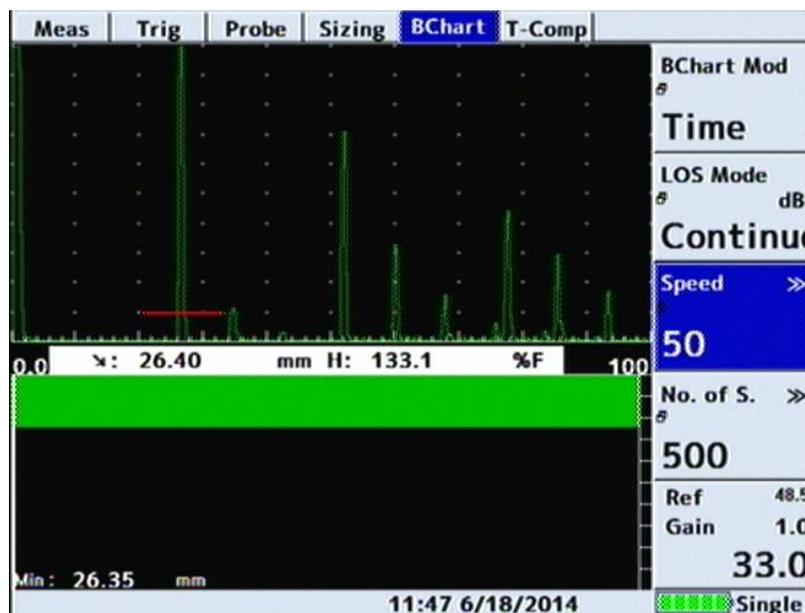
The N.O.S parameter refers to the “Number of Samples” stored in the B-Chart; 500 is the maximum, with one pixel line per sample.



Once the above parameters have been chosen, the B-chart will appear below if the transducer is set on the measured surface. It is possible to adjust the Speed and N.O.S with BChart mod switched on, however due to the B-Chart dependence on the values the B-Chart is cleared. The LOS Mode can be changed without clearing the B-Scan.

### Using B-Chart Mode

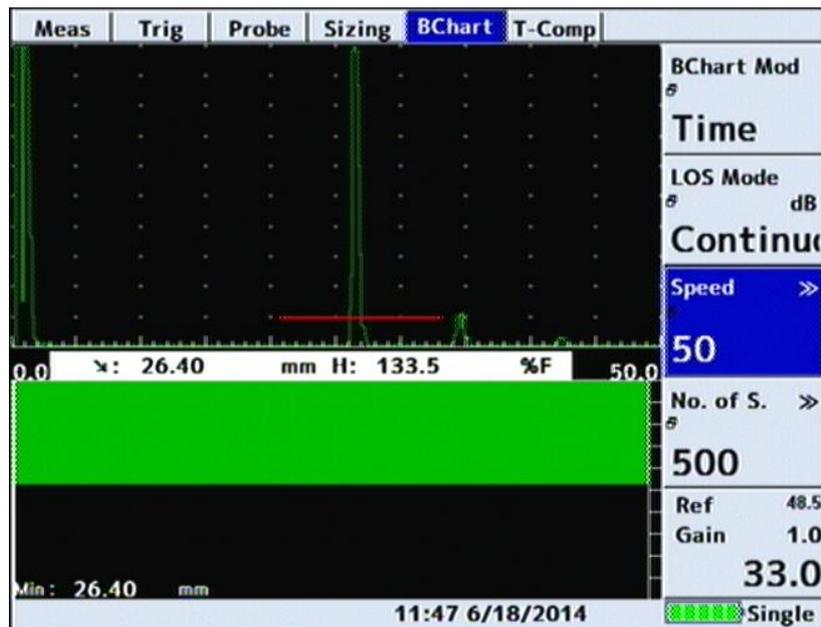
Switching BChart mod to Time or Encoded causes the screen to be resized, creating a half-size A-Scan and showing the B-Chart panel at the bottom. The B-Chart panel depth represents the range of the A-Scan, with the time-based aspect displayed across the width.



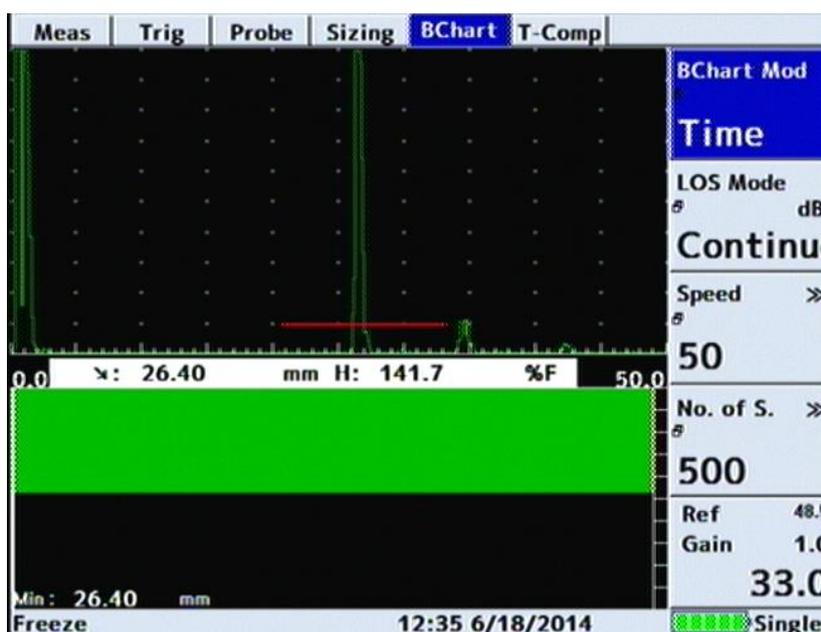
The minimum thickness (depth) in the currently shown B-Chart is displayed in the bottom left corner. Shown above is an example B-Chart. The user is expected to select an appropriate scanning speed related to the Speed parameter.

Setting the LOS MODE to Stop, when the user wants to stop or pause scanning, one should simply remove the transducer from the scanning surface.

Shown below is a scan of a similar surface with the range reduced to 50mm (compared to 100mm on the previous example). This shows a slightly more detailed B-Chart, highlighting the importance of a correct calibration and setup.



It is possible to use the FREEZE mode functionality to FREEZE the B-Chart as well as the A-Scan and measurements, as shown below:



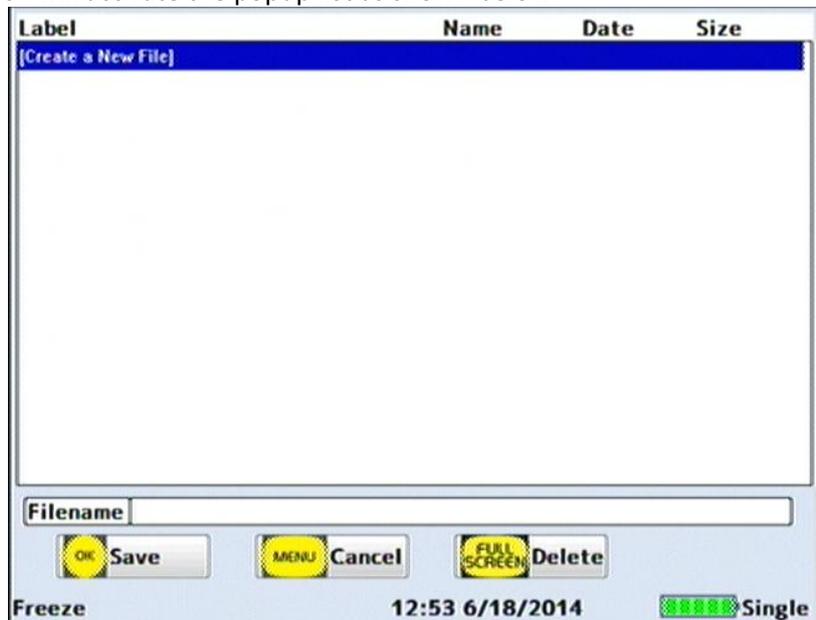
## 8. BChart, Bchart Storage

The storage functionality in the Masterscan D-70 has been extended to support the storage of B-Chart. The extended functionality has been implemented into Utility in order to allow the B-Chart to be read out and display, stored or added to a report.

The other B-Chart Tab, found under the Mem menu group, allows storage of B-chart in the same way that A-Scans are stored.

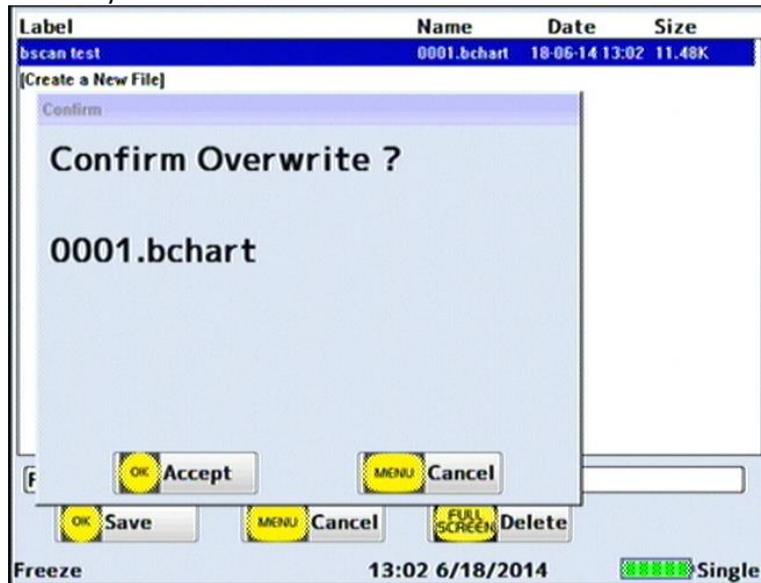


Simply FREEZE the display or make use of the LOS mode is set to OFF and remove the transducer from the scanning surface and navigate to the B-Chart tab. Press the [OK] key on the Save Bchart option item which will activate the popup list as shown below:



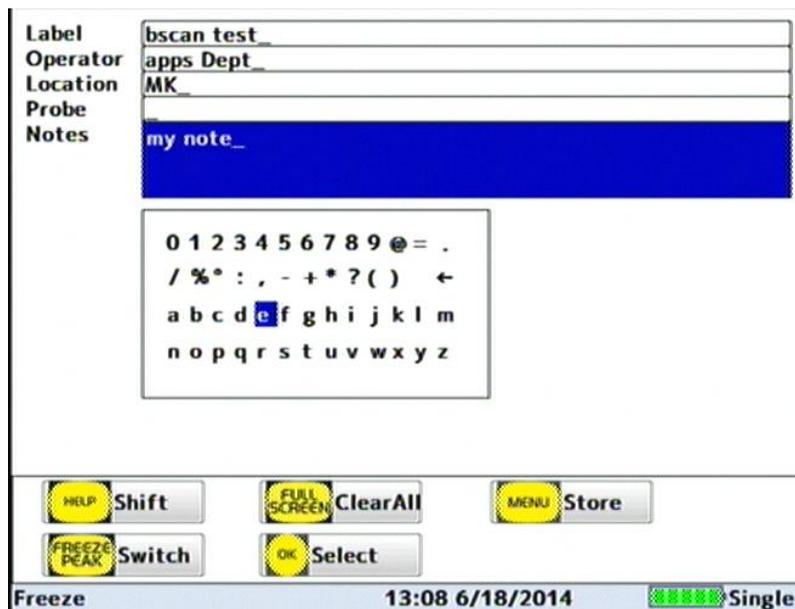
If you want to create a new file press [OK] to create and save a file (*the [MENU] key can be used to exit the list and cancel the store procedure*) when [create a new file] is highlighted.

It is possible to overwrite a location – the Masterscan will ask for confirmation from the user before writing the data to memory.



The [FREEZE/PEAK] key can be used to delete the currently selected store.

In accordance with the A-Scan storage functionality it is possible to store notes with each B-Chart, as shown below:



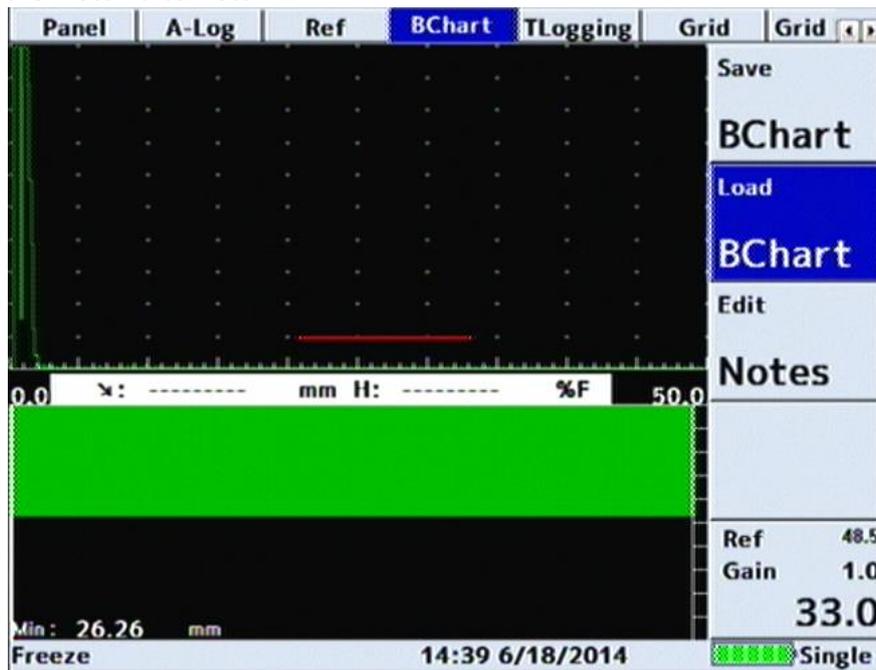
Once complete pressing the [Menu] key will store the B-Chart to the Masterscan memory.

The storage success can be checked by viewing the list of stores again:



It is also possible to review the stored B-Chart on the Masterscan in the same way that an A-Scan can be reviewed. It is not possible to load a B-Chart as a reference trace though and like the A-Scan review the B-Chart is lost once freeze mode is released.

Below shows the B-Scan after recall:



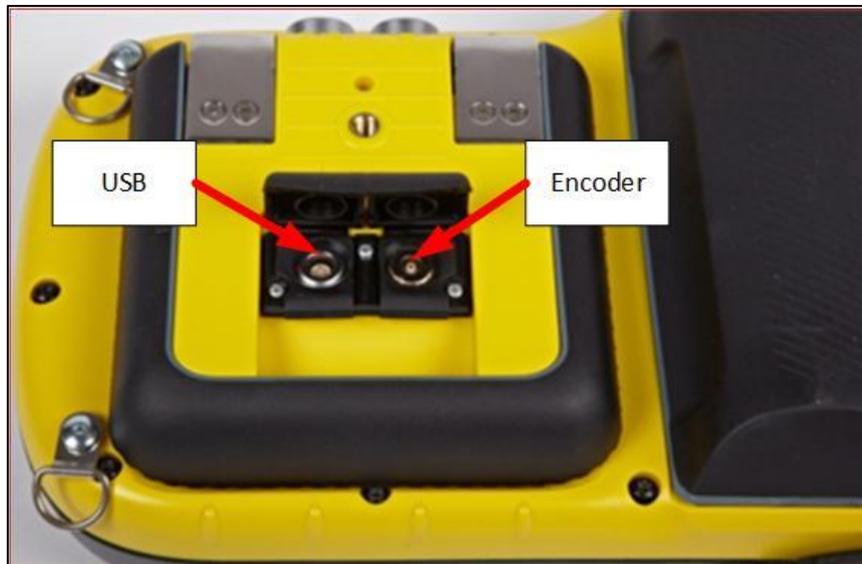
It should also be noted that the waveform is blank – no waveforms are stored with the B-Scan. Once freeze mode is released the B-Scan is cleared and the A-Scan waveform is re-enabled.

See section [Configuring B-Chart Measurement Mode](#) for details on setting up the B-chart measurement mode.

## Chapter 6 : Interface Connection

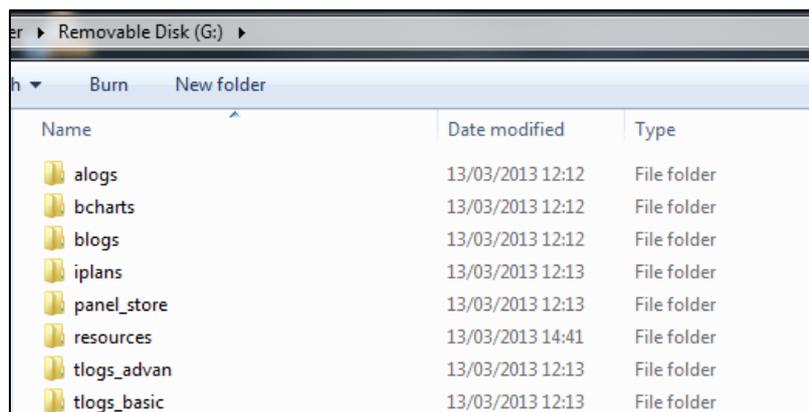
### 1. USB connector

There is a 6-pins connector under the black cover on the rear of the Masterscan D-70 as shown below:



This connector is used to connect the flaw detector to a PC using a modified USB cable; this allows information to be transferred to the computer using Sonatest's program UTility. For more information about how to purchase UTility please, contact Sonatest using the details inside the front cover of this guide.

If the software is not installed but the drivers are installed and the Masterscan is connected, it's possible to have access to the unit's content via window.



### 2. Encoder

Adjacent to the USB connector is a 4-pin connectors used for connecting the Masterscan D-70 with a standard quadrature encoder.

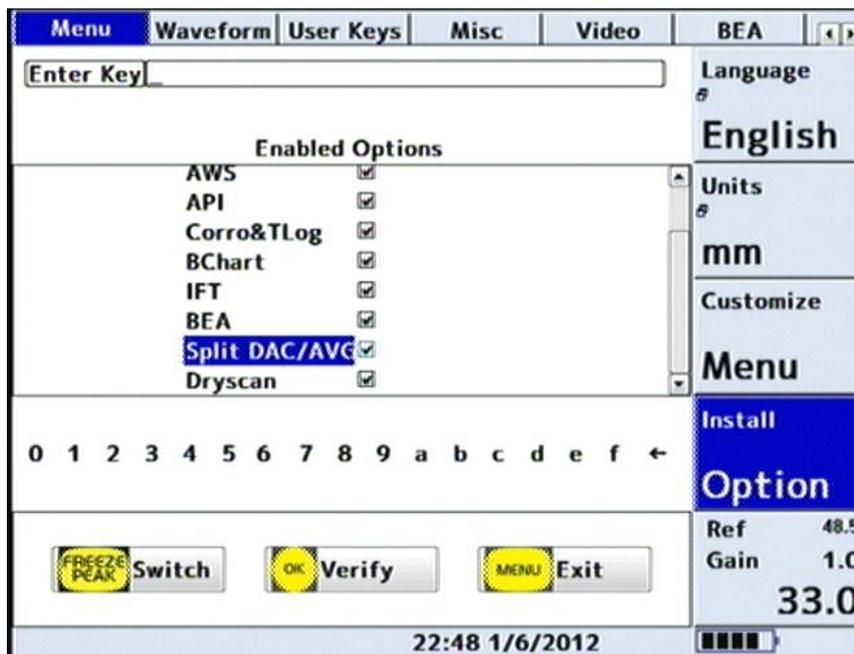
## Chapter 7 : Optional Features

### 1. Entering License Key to Activate Options

The Masterscan software contains the optional features as standard but require a license key in order to enable them.

License keys can be obtained for the (paid for) optional features by contacting your local distributor.

The Install Option Sub-menu can be found under the **UTIL** menu. Pressing the [OK] button on the Install Option parameter will activate the license key entry panel as shown below:



Use the scroll wheel to select characters from the key map, pressing the [OK] key to add to the currently selected character to the license key entry field.

Pressing the [MENU] key when complete will exit the license key entry panel displaying a confirmation message whether the license key was accepted or not. If the license key is accepted the Masterscan will return the main menu and the new option will be available in the menu system.

The Middle section of the license key entry panel shows the options that are currently enabled.

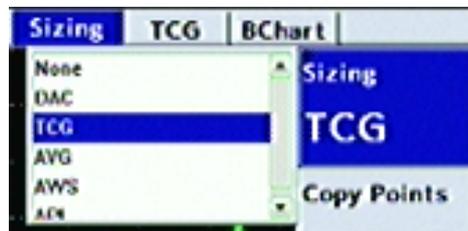
## 2. Time Correction Gain (TCG)

The Time Corrected Gain feature provides a means of creating an attenuation curve that sets the gain in a swept manner as a function of transit time. A properly constructed TCG curve will compensate for material attenuation and sound beam characteristics so that discontinuities of equal relative size at different depths in the test piece will give an equal amplitude response on the display.

Proper use of the TCG feature requires a reference block made from the same material as that being examined, with flat-bottom or side-drilled holes of the desired size placed at depths covering the range to be inspected. To establish a TCG curve, follow the following instructions:

**Step 1:** Establish the basic calibration of the Masterscan D-70 using the desired transducer and the proper reference block.

**Step 2:** From the MEAS menu go to Sizing Tab, select the TCG feature in Sizing sub-menu by pressing [OK] key.



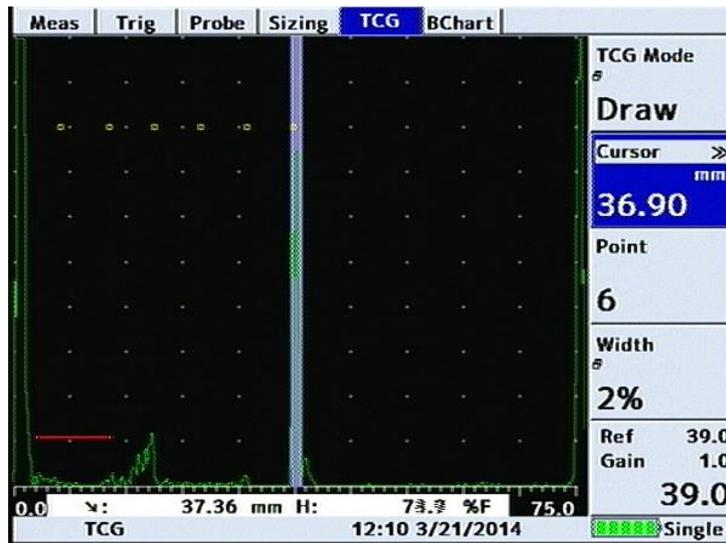
In Masterscan D-70, When choosing TCG feature in Sizing sub-menu from Sizing Tab, TCG tab will appear (See similar DAC example [here](#))

**Step 3:** Go to TCG tab then select the TCG Mode parameter by pressing the [OK] button then use the [up] and [down] arrow keys to select the select DRAW then press [OK] again to enter draw mode, the other parameters will now be CURSOR and POINT.

**Step 4:** The TCG system is now ready to accept reference points. Position the transducer to give a maximum echo from the first or topmost reference hole in the reference block. Be careful to use a consistent amount of coupling and transducer pressure.

**Step 5:** Use the Scroll-Wheel to position the bright cursor bar over the echo from the reference hole.

**Step 6:** Press the [OK] button to accept the point. The POINT parameter will then increment to indicate the next point. As each point is entered, the gain will change to place the echoes at about 80% amplitude as shown below:



**Step 7:** Repeat steps 5 and 6 for each additional reference hole in the reference block, being careful to be consistent with the amount of coupling and transducer pressure. A maximum of 10 points can be recorded for a TCG curve.

**Step 8:** Press [MENU] key to come out of the adjust parameter then use the [up] arrow key to move to the TCG Mode sub-menu, use the [OK] button to display the drop down list then use the [down] arrow key to select ON mode then [OK] key again to actually turn TCG on.

**Step 9:** Use the curve parameter to display the TCG curve.

**Step 10:** Use the Meas parameter to display the echo height relative to Full screen height (FSH), Percentage of TCG reference (%REF) or dB relative to TCG reference



A TCG curve cannot be drawn while in RF display mode. It should be noted that the range of TCG is limited by the dynamic range of 40dB.

### 3. Distance Gain Size (DGS)/Amplituden Vergleichs Größe (AVG)

The DGS (Distance Gain Size) method, often known by its German acronym AVG (Amplituden Vergleichs Größe), allows a theoretical model to be used for assessment of ultrasonic echoes.

The DGS/AVG method allows flaw sizing and distance compensation without requiring the large range of reference standards for each test which would be required in order to establish a measured DAC curve, or to set up a TCG correction.

The relative response from 'Equivalent reflectors' of different sizes at different distances can be predicted mathematically from the probe effective diameter, frequency and near field length (a function of the first two). Probe sensitivity can be calibrated from a single measurement (usually the back wall echo)

DGS/AVG has several limitations:

- It is a predicative method, so only works in 'standard' configurations where the mathematical model is valid
- It must be applied with care using non-circular probe elements as we have to approximate an 'effective diameter'
- It does not work well on broadband probes, where the frequency is not well defined.
- It should only be applied to single element probes, as dual element probes have an inherent focus.

Corrections may be required for several factors:

- Internal time delays within the probe
- Attenuation with distance, both within the material to be tested and the reference block, if significant over the distances involved.
- Transfer correction, e.g. if the tested material has a significantly rougher surface than the reference block
- When using an angle probe and calibrating on a curved reflector (e.g. V1 or V2 Block) a correction must be applied.



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DGS/AVG to work accurately the probe zero must be set correctly.

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## Theory

For a naturally focussed probe of given frequency and size, the general beam profile can be defined in terms of a 'normalised' standard curve, scaled by the Probe 'effective diameter' and near field length.

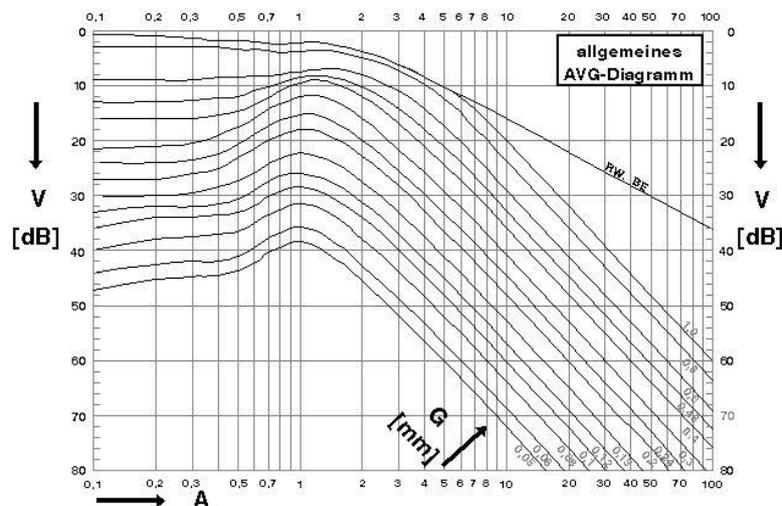
The near field length is defined by the equation: 
$$N = \frac{D_{EFF}^2 - \lambda^2}{(4\lambda)}$$

Where  $D_{EFF}$  is the probe effective diameter and  $\lambda$  is the wavelength (Velocity/Frequency)

The echo height from a small (much less than sound field width) reflector will be proportional to its size.

The echo height from a given reflector in the far field (distance from the probe greater than 2-3 Near Field Lengths (NFL)) will be inversely proportional to the square of its distance from the probe.

It is therefore possible to define a standard relationship, knowing the basic probe parameters, which only need be corrected for the sensitivity of the probe by measuring the response from a known reflector.



The picture shows a 'general' DGS/AVG diagram plotted on logarithmic scales, relative gain in dB, distance as a multiple of Near Field Lengths, The various curves represent the signal from an Equivalent Reflector Size (ERS) expressed as a multiple of the effective probe diameter.



The signal from the back wall echo ('infinite' reflector) falls off with distance, rather than with the square of distance.

## DGS/AVG Frequency, NFL and ERS

- Highlight and select MEAS menu (*press [Menu] button then [OK] when highlighted*).
- From Sizing tab select AVG, AVG Tab should appear next to it.
- Select the AVG tab, its AVG MODE sub-menu should be OFF .
- Set FREQ and Probe type sub-menu when AVG mode sub-menu is set to OFF.
- Set NFL sub-menu and DELAY sub-menu when SET PRB is selected in AVG mode sub-menu.



It is recommended that figures from specific probe test results, rather than generic data sheets, be used where possible, as typical manufacturing variations are sufficient to affect the accuracy of the results.

- The desired test sensitivity (ERS) may also be set now according to the probe use. (Also this can be adjusted later).

### DELAY – Probe Delay Velocity, in meters per second

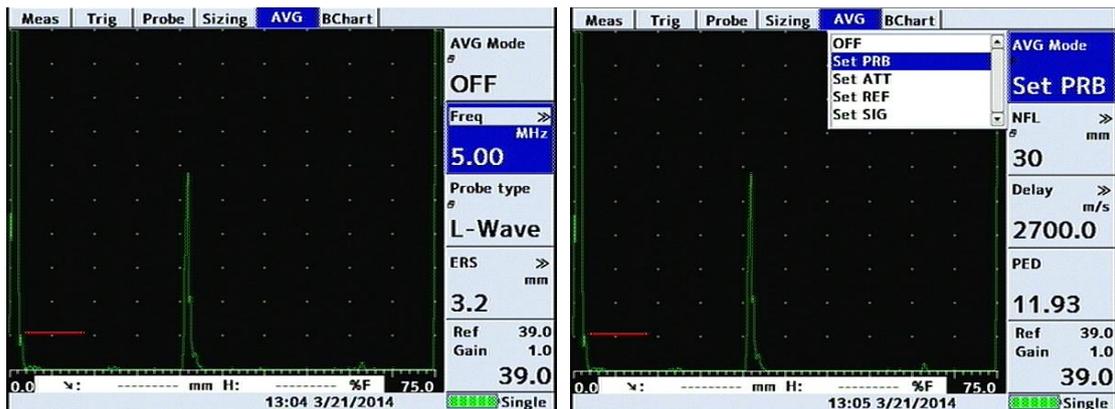


This is the velocity of compressive sound waves in the material of the probe wedge. It is used mostly in angle probes but also in zero degree compression probes which have a delay line. This wedge material is typically Perspex, which has a compressive sound wave velocity of 2700 m/s.

### Probe Type – Longitude wavelength or surface wavelength



- Set the type of wavelength for the velocity, in meters per second. This parameter is used internally. It will take the same range of values as the Velocity parameter in Cal Tab.
- This parameter MUST be entered. The Wavelength, which is calculated from this velocity and the Probe frequency, is critical to the DGS/AVG calculations.



- By default the parameter setting is Coarse tuning (*represented by >>*), to set in fine tuning (*represented by >*) use the [up] arrow key.
- To put it back in coarse tuning use the [right] arrow key.

## DGS/AVG T-Loss, Ref dB and Mat dB

Change AVG MODE sub-menu to 'SET ATT'. This menu allows the operator to enter attenuation parameters relating to the materials of the Calibration Block and the item under test, these parameters being:

T-LOSS – Transfer Loss, in dB.



This is the loss due to surface roughness, poor coupling etc between the probe and the object under test. Generally it can be assumed that the Reference block will have a clean surface, but this may not apply to the object under test, methods exist for measuring this, experienced based 'rules of thumb' are also commonly used.

REF dB/m – Reference Material Attenuation, in dB per meter

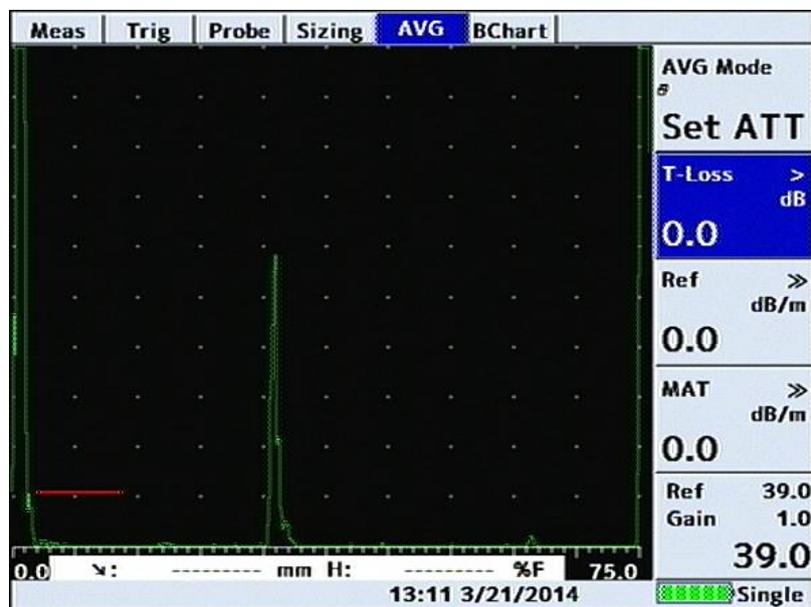
Attenuation of ultrasound in the Reference (Calibration) block material in dB per Meter.

MAT dB/m – Test Material attenuation, in dB per meter

Attenuation of Ultrasound in the material of the object under test in dB per Meter



The REF dB/m and MAT dB/m are used where the ultrasound attenuation in these materials is such that it would cause a disparity in signal heights between similar reflectors in these materials. At long path lengths these factors become very important.



## DGS/AVG dVK, REF TYPE and REFSIZE

Change MODE to SET REF

dVK ( $\Delta V_K$ ) – Curvature Correction Factor in dB

This value allows the use of a curved surface to provide a back wall echo for use as a reference signal, thus the same reference block can be used irrespective of probe angle.

The amplitude correction factor shows by how many dB the echo from the cylindrical surface is larger or smaller than the echo from a flat backwall, normal to the probe field axis at the same distance.

This value is subtracted from the gain to compensate for the focusing effect of the curved reference reflector. It should be entered as a positive or negative value as expressed in the probe data sheets.

Probe datasheets typically express this value as  $\Delta V_{K1}$ , for use with the K1/V1 calibration block, or  $\Delta V_{K2}$  for use with the K2/V2 calibration block. These calibration blocks are specified in standards EN12223 / DIN54122 / BS2704

It is used, in conjunction with the probe zero and the specimen velocity, to calculate the Sound field equivalent length, this being the effective distance of the crystal to the test piece/wedge interface.

Ref Type – Reference Reflector Type

The user can select one of a number of different reference reflectors. In this implementation, these have been derived from EN 583-2:2001 Annex B. These reflector types are:

- BWE – Back Wall Echo
- FBH – Flat Bottom Hole
- SDH – Side Drilled Hole

Reference type SDH is converted internally to the equivalent DSR diameter according to the formulae in EN 583-2:2001 Annex B.

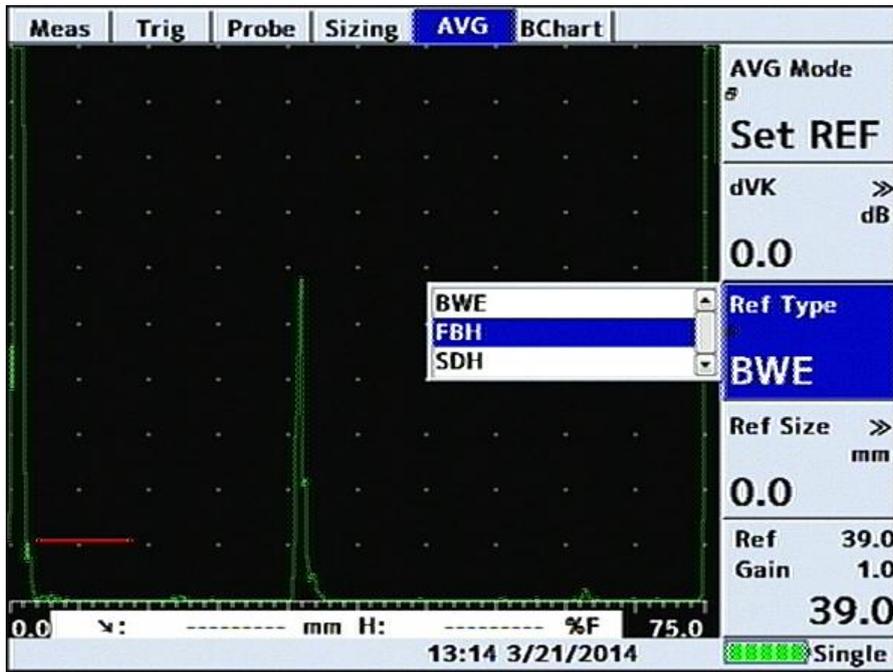
When using reference reflectors of type SDH, it is essential to select the correct Wavelength (L-wave or S-wave). This is because the calculations for the equivalent DSR use the wavelength of sound that is calculated from the Calibration Block velocity and the probe frequency.

Ref Size – Reference Reflector Size, diameter in mm.

The Reference Reflector Size parameter allows the user to enter the diameter of the reference reflector. The reflector type is set using the Ref Type parameter above.

The set will automatically compensate for the varying 'reflectivity' of different reflector types as specified by the Ref Type parameter. Thus a 3 mm side drilled hole should be entered as Ref Type=SDH and Ref Size=3.0

In this implementation, a diameter of 0 (zero) is used to represent a reflector of infinite size and is expressed as BACKWALL or INFINITE.



## DGS/AVG Calibration (SET SIG)

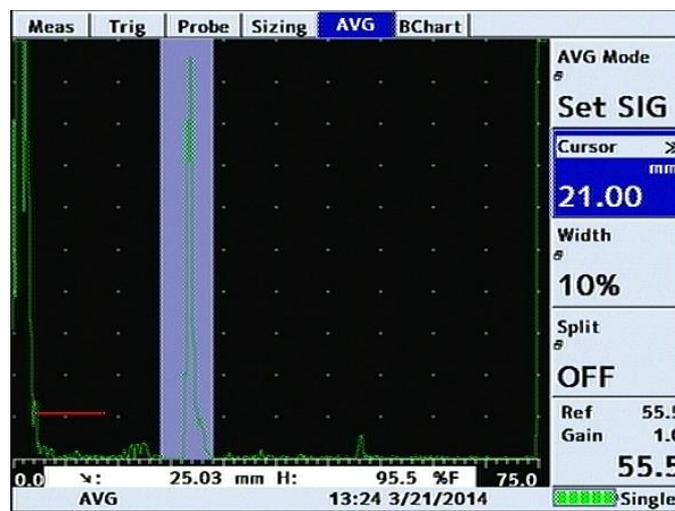
The calibration of the DGS/AVG system sets the Probes 'absolute sensitivity' based on the response from the reference block.



Changing any parameters relating to the reference echo will invalidate the calibration, which must then be repeated. The current version of the software does not enforce this – it is the responsibility of the operator.

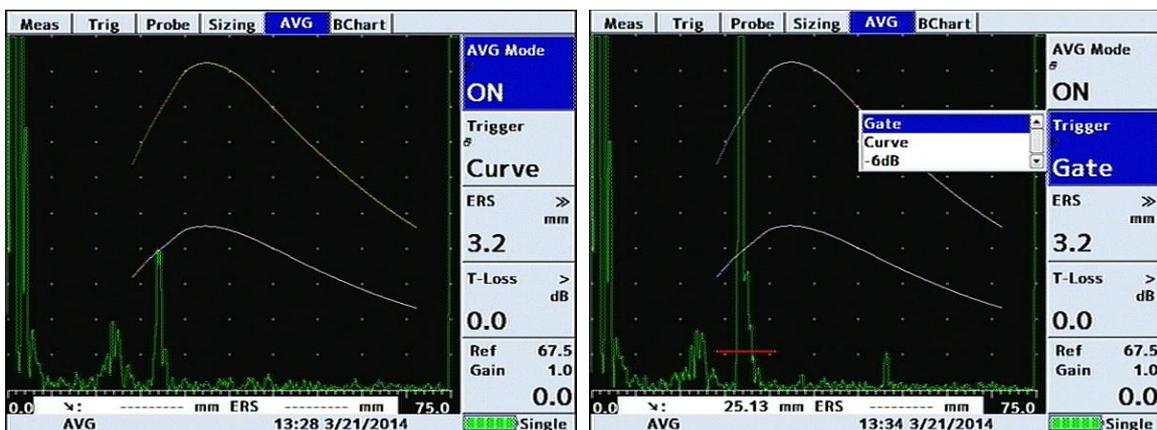
Set MODE to SET SIG

Place probe on reference block and maximise echo, select Cursor parameter and use scroll wheel to centre the selection bar over the echo. Press the [OK] key to accept the echo.



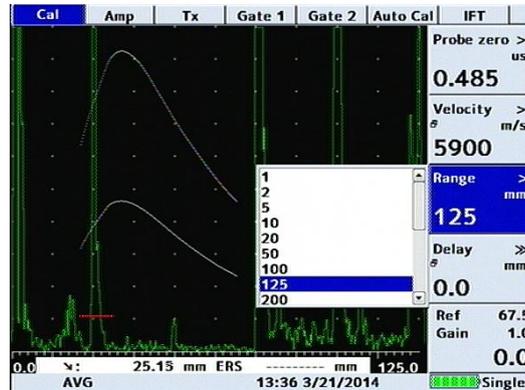
The instrument will adjust gain as necessary to get a good echo reference and then perform the necessary sensitivity calculations; the curve will then be drawn and DGS/AVG will automatically be switched on.

Once DGS/AVG has been switched on it is possible to adjust the curve ERS level (*the instrument will redraw the curve, but a new calibration is not required*) and select the Curve, -6dB or Gate as the measurement reference. It is also possible to make adjustments to the transfer loss parameter (T-LOSS).



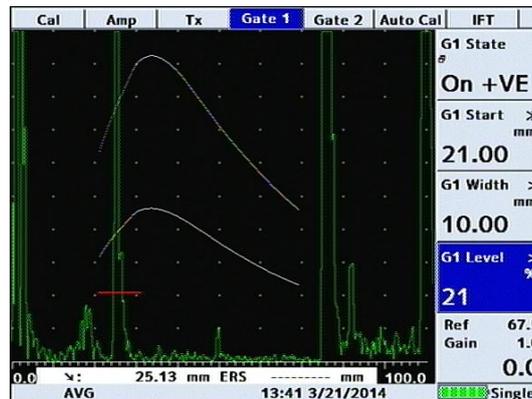
## Adjustment

When the DGS/AVG has been calibrated it is possible to leave the DGS/AVG menus and adjust other settings of the instrument, for example range and gate settings.

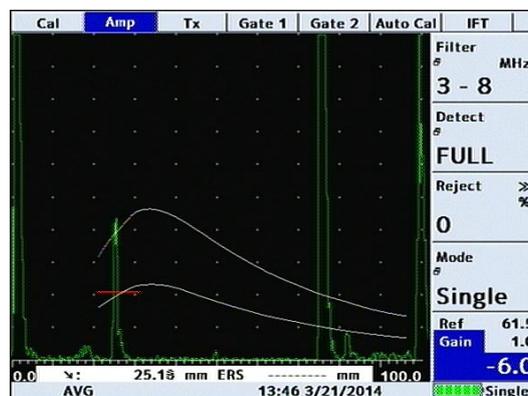


Gain may be adjusted with understanding – Changing the Gain setting will remove the correlation with the DGS/AVG curve, so should only be done in accordance with a specification, for example to compensate for varying material conditions (*better done with the T-LOSS function*).

If it is desired to change the gain to give a larger signal (*for example at long range*) the REF gain should be adjusted. This will change the curve by an equivalent amount and preserve the measurement accuracy.



Increasing Ref Gain by 6dB moves curve and preserves measurement.



Decreasing Gain by 6dB returns to original height, but loses measurement.

The Reference gain may be selected by pressing the [dB] Button. (DGS/AVG is only appropriate for Single probe mode)

When the display Range or Ref Gain is changed the DGS/AVG curve will recalculate at each step. If the settings must be changed by more than one or two steps it may be more convenient to switch DGS/AVG off, Change Ref gain and Range etc as needed, and then switch DGS/AVG on again. This will not invalidate the curve provided the following are not changed:

Freq, NFL, dVK, Delay, Ref (dB/m), Ref Type, Probe Type, Ref Size, (new REFERENCE Entered), Probe Zero, Filter, Contour or Probe Angle.




---

The following **should not** be used in DGS/AVG Mode:

- Detect Modes other than Full Wave
  - non-zero REJECT
  - Dual probe mode
  - Smoothing
  - AUTO-CAL (other than for initial setup before using DGS/AVG)
  - DAC
  - AWS
  - API or AGC
- 

## Measurement

Having set up the DGS/AVG system, it is possible to use the measurement system to calculate an Equivalent Reflector Size for the flaw.

This is achieved by using Gate 1 to identify the flaw indication and the DEPTH measurement mode to calculate its equivalent size. This Equivalent Size is calculated as the Test Sensitivity (*ERS value*) multiplied by the Ratio of the Signal height to the DGS/AVG curve height at that distance. It is displayed in place of the signal amplitude (%FSH) as a diameter, in mm.

It is also possible to 'size' the flaw in terms of dB with respect to the DGS/AVG curve. This is achieved by increasing, or decreasing, the set gain until the peak of the flaw signal lies on the DGS/AVG curve. The difference in Gain required can then be read directly from the displayed Gain Value.

## 4. American Welding Society (AWS)

The American Welding Society (AWS) menu provides a means for evaluating discontinuities when inspecting welds in accordance with the American Welding Society's Structural Welding Code, ANSI/AWS D1.1-94. The user is referred to the AWS standard for full details of the method.

The AWS menu provides a convenient method of automatically calculating the "Indication Rating" (IR) as defined by the standard. The AWS menu can be used in conjunction with the trigonometry mode which will simultaneously indicate beam path, surface distance and depth distance at the bottom of the graticule.

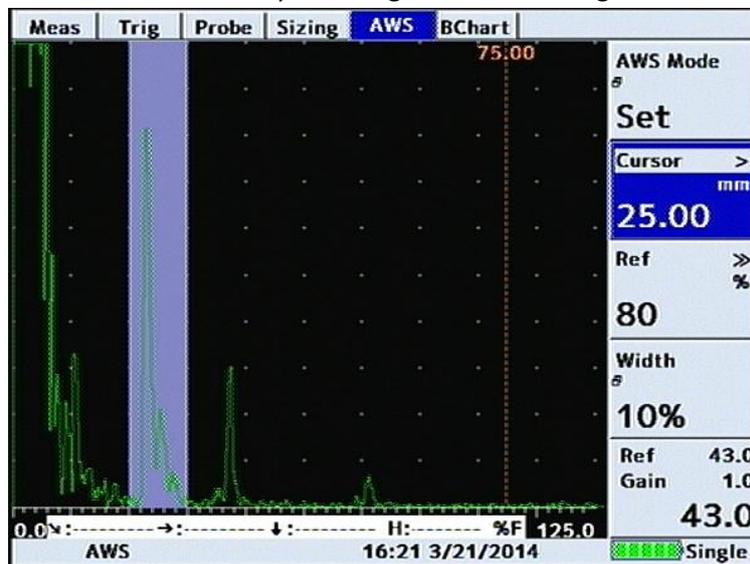


The AWS menu will not operate with any of the following mode switched on:

- TCG
- AVG
- T-LOG
- DAC
- API or AGC

To set up the AWS measurements, perform the following:

1. Calibrate the Masterscan D-70 for weld testing and set up the trigonometry mode by following the steps in [Weld Inspection Using Trigonometry Mode](#).
2. From the MEAS menu, select AWS in Sizing Tab and place the AWS MODE to Set.
3. Highlight REF % on the sub-menu and set to the desired reference level, usually 80% of full screen height.
4. Place the probe on the test block and obtain the maximum signal from the reference indication.
5. Place the cursor over the indication by selecting Cursor and using the scroll-wheel.

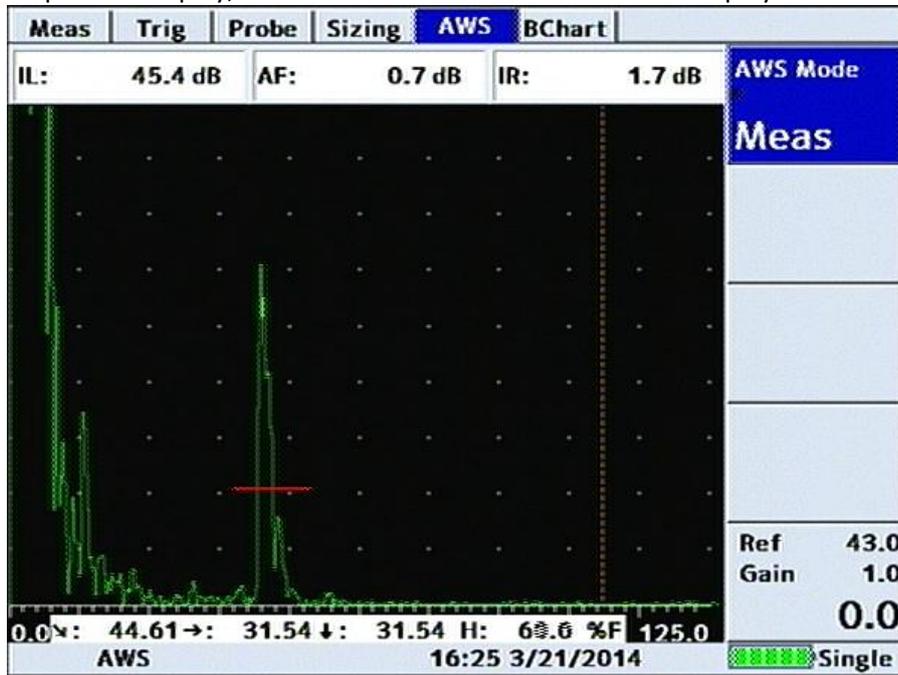


6. With the signal maximized, press the [OK] key whilst the Cursor parameter is highlighted (*the signal and the gain will be adjusted*).

The Masterscan D-70 is now calibrated to make Indication Rating measurements in accordance with AWS D1.1-94.

To use the AWS mode, do the following:

1. On the AWS Tab, highlight AWS Mode and select Meas. Switching AWS on will enable the AWS HUD at the top of the display, where the live measurements will be displayed.



2. Ensure that the gate and measurement (TRIG) function are operative and properly adjusted.
3. When the AWS menu is selected and a signal is in the gate, the HUD will show the resulting AWS measurements as follows:  $IR = IL - RG - AF$

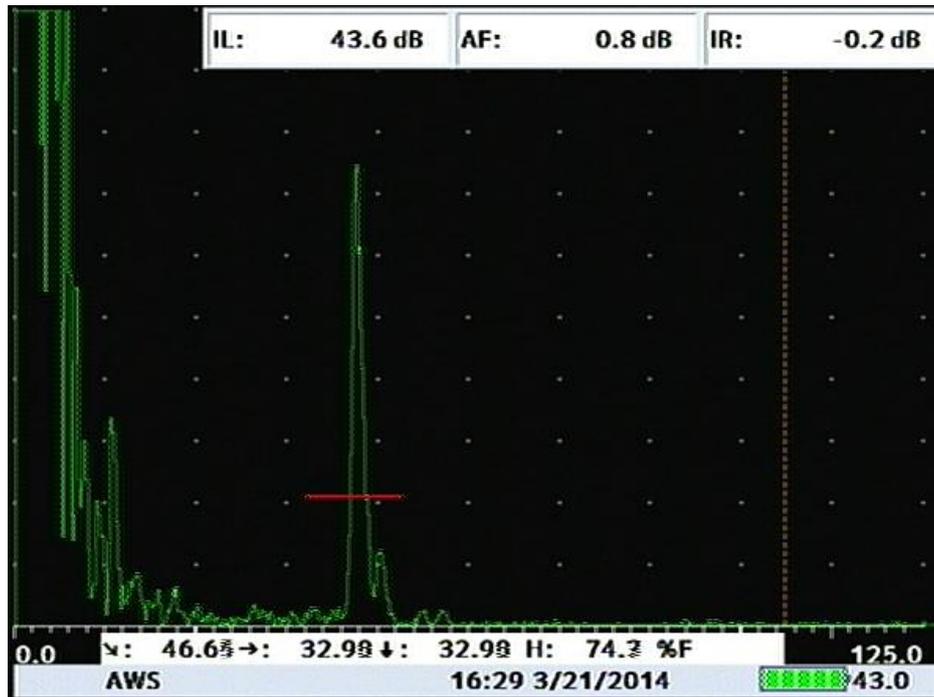
(Indication Rating = Indication level – Reference Gain – Attenuation Factor)

Where:

- IL: Indication Level      The dB setting required to bring an indication to the reference level.
- RG: Reference Gain      The dB setting of the calibrated reference indication as a function of the reference standard and probe being employed.
- AF: Attenuation Factor      The attenuation factor required by the AWS standard and is: Depth in inches minus 1, multiply by 2 and then rounded to the nearest ½ dB.
- IR: Indication Rating      The difference in dB between the indication and the reference gain with attenuation factor correction.

It is not necessary to bring the indication to the reference level to obtain the correct measurement information as the Masterscan D-70 adjusts for gain offset. However, to ensure the best accuracy of calculation, it is advised to adjust the indication to be above 40% and below 100% of full screen height. In addition, in the AWS mode, gain offset is shown as +/- dB from reference as opposed to absolute gain.

Once AWS has been switched to ON mode it is no longer possible to adjust the reference gain. AWS can be operated in full screen mode, as shown below:



With AWS active it is possible to maximise the screen height by pressing and holding the [FULL SCREEN] key, this will remove the HUD but leave AWS active. It is possible to toggle the screen mode in both normal and full screen modes.

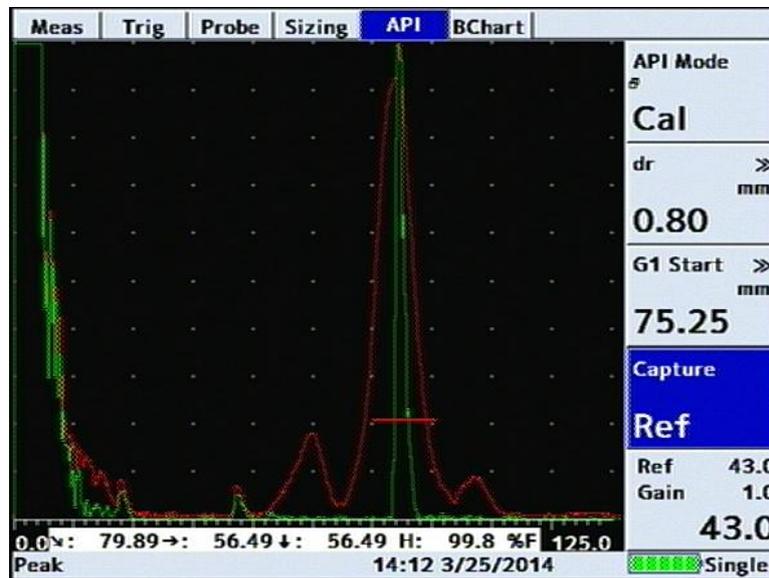
## 5. Evaluating Pipe Imperfections using American Petroleum Institute (API) 5UE

The Masterscan D-70 is able to assist the user in making measurements in accordance with the American Petroleum Institute (API) Recommended Practice for Ultrasonic Evaluation of Pipe Imperfections using the Amplitude Distance Differential Method (ADDM). Users are referred to the publication: "API Recommended Practice 5UE, Second Edition, June 2005"

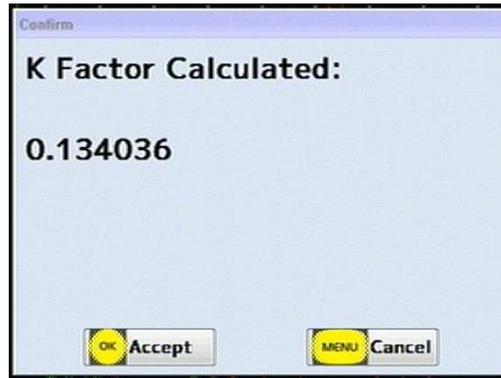
The ADDM employs a combination of amplitude comparison and 6dB drop techniques to determine the radial depth of an imperfection. The technique is based on the premise that radial depth of an imperfection affects both the amplitude of the received echo signal and the differential time of flight of the transmitted ultrasonic wave as it passes over the imperfection.

The first step is to perform 'standardisation' using a reference indicator such as a notch at a known depth or a through drilled hole. It is assumed that the Masterscan D-70 has been setup with the correct values for the transducer and specimen under inspection.

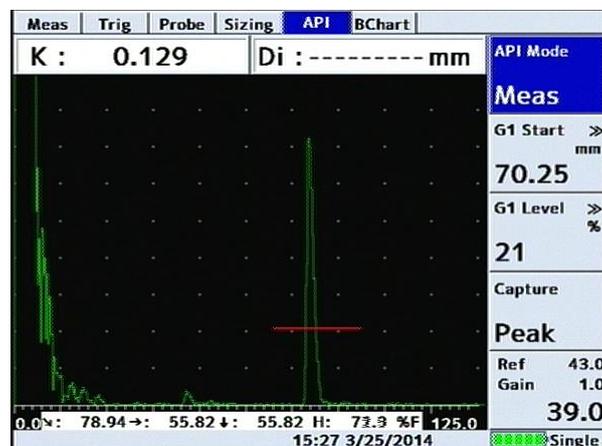
From the CAL menu, turn ON G1 State in Gate 1 tab and position it on the display so that it will cover the signal that will be produced by the reference indicator; the height of the gate is not important. Ensure that the signal will be between 5% and 100% of full screen height. In MEAS menu go to Sizing Tab Select API from the Sizing sub-menu and select PEAK MODE by pressing the [FREEZE/PEAK] button two times then capture the reference signal and the following display should be shown:



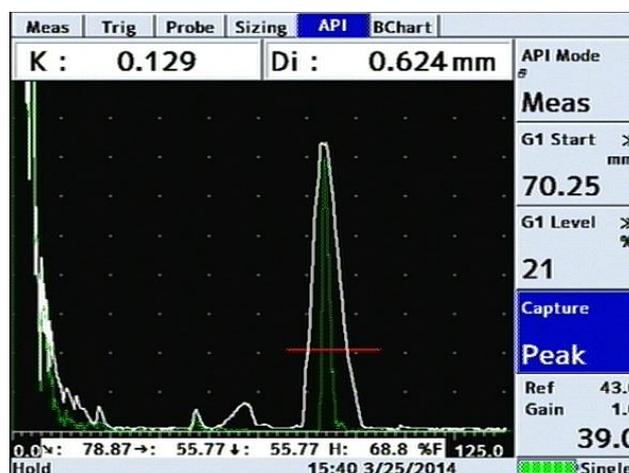
Once the desired signal is obtained press the [OK] button twice whilst the Capture parameter is highlighted and the K factor (*a derived factor for calculating depth*) is calculated and displayed as shown:



Pressing the [MENU] button will cancel the calibration and return to previous screen – this will also clear the peak envelope. Pressing the [OK] button will accept the K Factor that has been calculated and automatically switch the API MODE parameter to Meas and puts the API facility into measurement mode as shown below. The K Factor value is displayed but cannot be changed.



To take measurements select PEAK mode by pressing the [FREEZE/PEAK] button three times (*you should see Peak on the low left corner*), highlight Capture parameter then press [OK] button once (*should change from Peak to Accept*) and capture the echo dynamic signal; once the desired signal has been captured press the [OK] button whilst the Capture: Accept parameter is highlighted. The Imperfection Depth (di) value is calculated and displayed as shown below:



The Masterscan D-70 is automatically put into Hold mode once a measurement has been taken. The resulting **di** value is shown highlighted in the HUD – if it was unable to calculate the di value, dashes are shown. Once the measurement has been taken, pressing the [OK] button releases Hold mode. To take the next measurement select PEAK mode by pressing the [FREEZE/PEAK] button and repeat the above process.

It is possible to operate API when in FULL SCREEN mode. Whilst in the API menu press the [FULL SCREEN] button; the [FREEZE/PEAK] button and the [OK] button work as expected.



With API active it is possible to maximise the screen height by turn the HUD off in meas tab, this will remove the HUD but leave API active.



It is possible to toggle the screen mode in both normal and full screen modes. If the table is not shown taking a measurement will show the table in order to see the result of the measurements, once freeze mode is released the HUD will disappear again.

## 6. Grid Thickness Logging

Please see separate manual for details

## 7. Interface Trigger IFT

The Masterscan D-70 has an interface trigger allowing the unit to be used for immersion testing, testing using a water jet as a couplant or testing using water filled wheel probes. The interface trigger is an additional gate that is dedicated to the interface trigger functionality.

### Immersion Testing

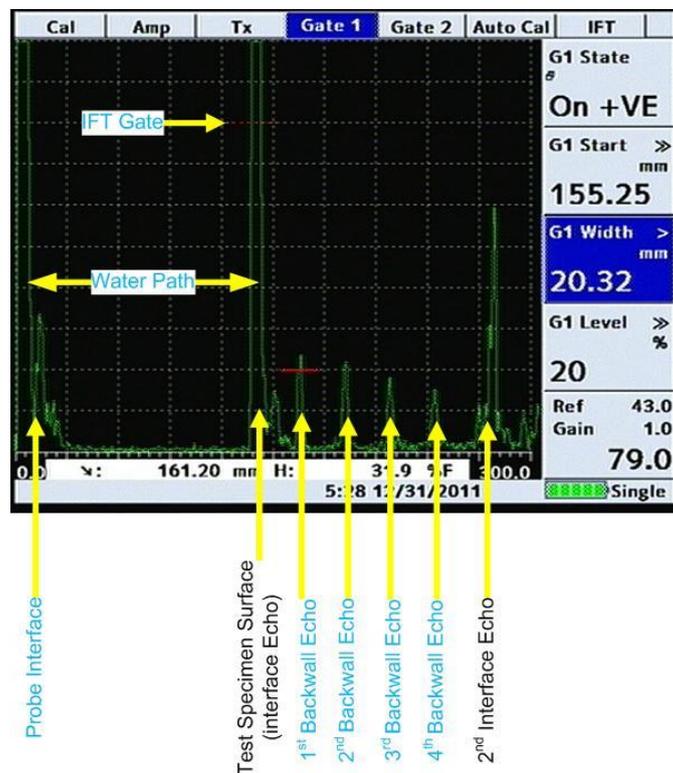
A major disadvantage in contact testing is the difficulty in maintaining constant coupling when scanning the probe across a test surface as well as the need for couplant to be spread across the specimen. When amplitude methods of flaw size estimation are being used this can lead to fluctuation in amplitude of flaw echoes of  $\pm 2$  dB even under the best contact conditions during scanning.

Where a critical test is required, constant coupling can only be achieved by using the immersion method, where the test specimen is immersed in a tank of water or by use of water filled wheel probes.

In both cases a longitudinal probe is immersed in the water so that the sound travels from the probe through the water and into the test specimen (via a rubber tyre in the case of the water filled wheel probe).

### Problems associated with immersion testing

With the ultrasonic flaw detector calibrated for steel, the display is typically as below:



as the speed of sound in water is 1483 m/sec, it is approximately 4 times slower in water than in steel; so that the first interface echo will appear on the screen at 4 times the actual water gap, followed by repeat echoes of this water gap later in time (water multiples).

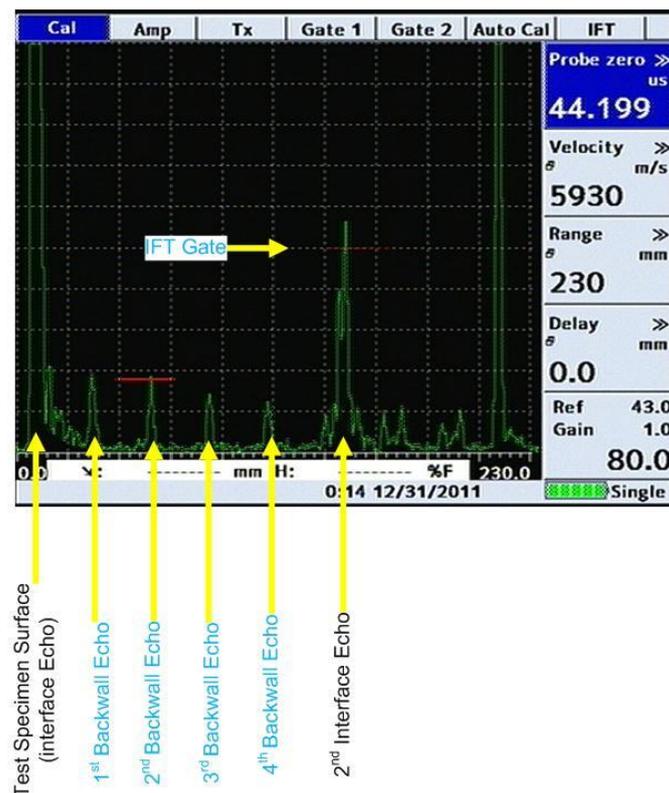
It is therefore essential that the water gap chosen be over a 1/4 of the steel test specimen's maximum thickness to ensure that the water / steel interface echo does not repeat before the first back wall echo from the specimen.

It should also be realised that the near zone is 4 times longer in water than in steel. Where possible to avoid near zone fluctuations it is advisable to test at a sufficient water gap which will fully contain the near zone fluctuation, giving more dependable far zone beam characteristics within the test specimen.

Any slight up and down movement of the probe is quadrupled in effect on the screen of the flaw detector so that the echoes move right and left alarmingly when the probe is hand held. The increased directionality of the beam in water results in large amplitude variations when the beam is the slightest bit off normal to the test surface.

Because of this the probe is always held in a manipulator, usually on a vertical column which can be moved across the tank mechanically, attached to a bridge which is moved along the tank length.

If the probe is scanned at a fixed distance from the test specimen surface, the water path can be delayed off screen leaving the material thickness only, on the screen for observation as show below:



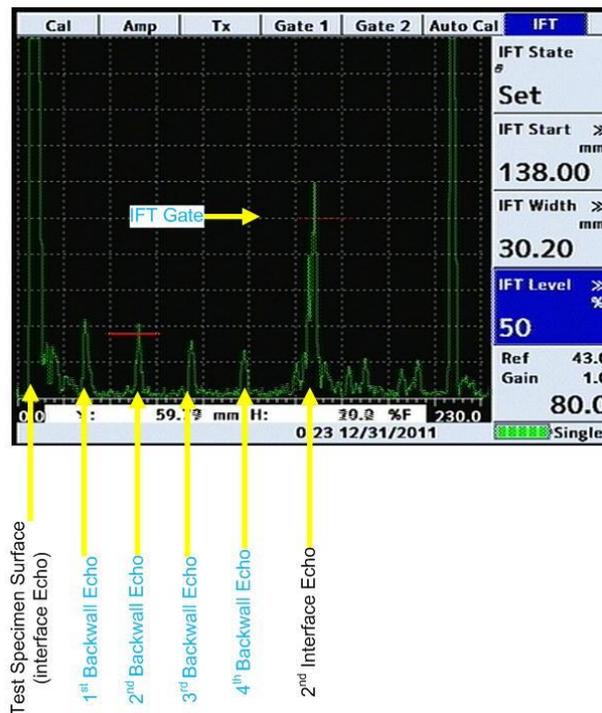
A gate can then be placed between the Interface Echo and the 1<sup>st</sup> Backwall Echo, to monitor for flaws in the material.

This system only works if the test specimen surface is flat and perfectly horizontal to the bridge, but should the test surface slope or change in height, further delay adjustment is necessary due to the increase or decrease in the water gap. A similar problem occurs if the wheel probe is pressed against the test specimen with different forces as this deforms the tyre and changes the length of

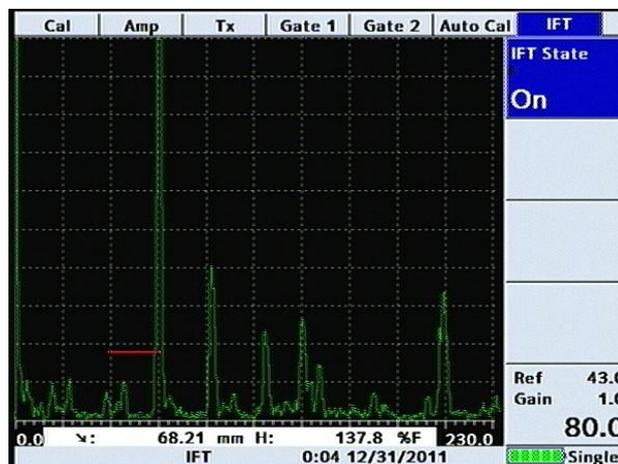
the water path. This is extremely time consuming and is very difficult to ensure that the test specimen is flat and only allows the testing of very simple specimens; this is where Interface Trigger comes in.

To overcome unwanted gate triggering during testing caused by fluctuation in the water gap, an interface trigger is incorporated into the Masterscan D-70.

The user is able to set the gate in terms of position in time, amplitude and width; once these settings have been made the user can switch IFT on and off at will. The gate is typically set across the spike that is the interface echo whilst there is no delay, so that the probe interface, interface echo and the back wall is displayed as shown below:



Once IFT has been switched on, the display will begin at the rising flank of the signal at the position that it crosses the gate and as it is a dynamic gate it takes into account the fluctuations due to differing water path lengths and irregularities in the surface of the test specimen. The display below shows IFT in an active mode and triggered:



If the interface trigger is lost for any reason for instance moving beyond the end of the test specimen or lifting the wheel probe off the specimen the trigger stops, the trace freezes and a message is displayed on the screen as shown below:



When IFT state is ON, "IFT" is displayed in the lower side of the screen.

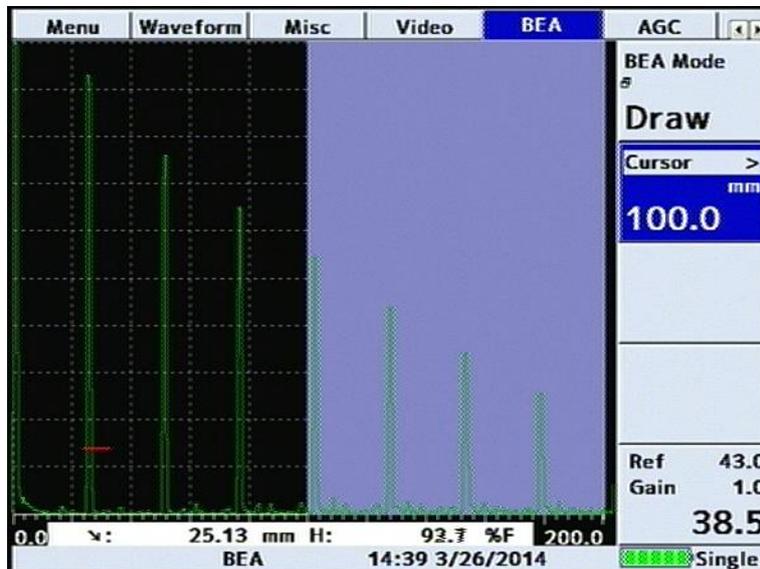
To un-freeze the display the signal selected for the interface trigger must exceed the gate or IFT could be turned off.

## 8. Backwall Echo Attenuator (BEA)

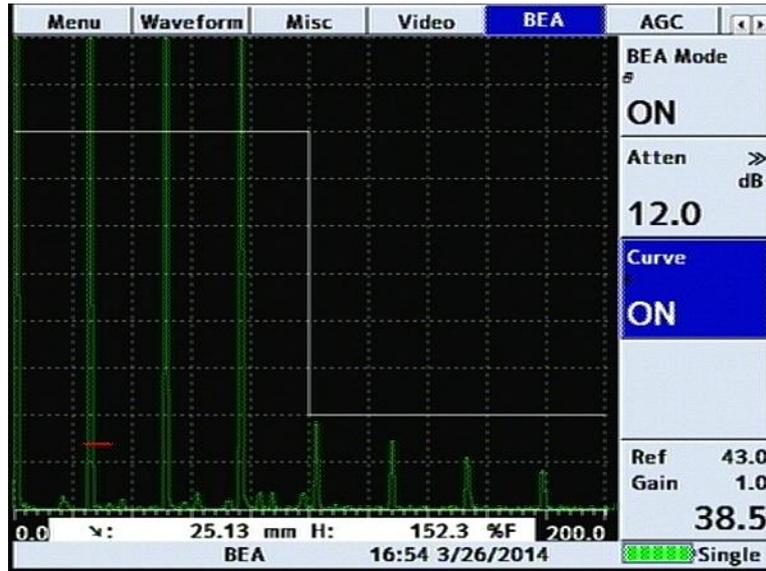
The backwall echo attenuator allows the gain to be independently adjusted over a defined area of the A-Scan. To enable the backwall echo attenuator, select the UTIL main menu followed by the BEA tab. By changing the BEA Mode to Draw displays a solid block on the right hand side as shown below:



Select Cursor and use the [Up] and [Down] navigation arrow buttons to select the area over which the attenuator will be applied as shown below:



Once the required area has been selected, change the MODE to ON. The attenuator is switched on and a line is drawn on the screen showing where the attenuator becomes active as shown below:



Once the backwall Echo attenuator is ON the size of the attenuator can be changed by adjusting the ATTEN parameter. The maximum area over which the backwall attenuator can be active is 50% and the maximum attenuation is the same as the available gain up to a maximum of 40dB.

## 9. Split Distance Amplitude Correction (Split DAC)

Distance Amplitude Correction curves act as monitoring gate triggering thresholds to compensate for attenuation and sound beam characteristics. When properly established, the DAC curve will provide consistent alarming from discontinuities of equal relative size at different depths in the test piece. Functionality is provided to automatically draw 6dB and 14dB or 6dB and 12dB reference curves below the calibrated curve.

It should be noted that since the DAC function only provides a dynamic alarm threshold capability, the dynamic range is limited to about 16dB. Therefore, for materials that attenuate more than 16dB over the depth range of interest, DAC should not be used. Instead, the TCG function may be more applicable. See [TCG Operation](#) for the use of the Time Corrected Gain feature.

Proper use of the DAC feature requires a reference block made from the same material as that being examined, with flat-bottom or side-drilled holes of the desired size placed at depths covering the range to be inspected.

To establish a Split DAC curve, follow the instructions:

- Establish the basic calibration of the Masterscan D-70 using the desired transducer and the proper reference block. From the MEAS menu, go to Sizing tab to select the **DAC** feature.
- Set **Split** parameter to ON allowing up to 3 DAC curves, complying with EN 583-2:2001



- Select the DAC Mode parameter by pressing the [OK] button then use the [up] and [down] keys to select the select Draw then press [OK] again to enter draw mode. The other parameters will now be Cursor and Point.
- The DAC system is now ready to accept reference points. Position the transducer to give a maximum echo from the first or topmost reference hole in the reference block. Be careful to use a consistent amount of coupling and transducer pressure.
- Use the Scroll-Wheel to position the bright cursor bar over the echo from the reference hole.
- Press the [OK] button twice to accept the point. The Point parameter will then increment to indicate the next point. A small square will appear as a reference point on the display showing the peak of the signal just recorded.

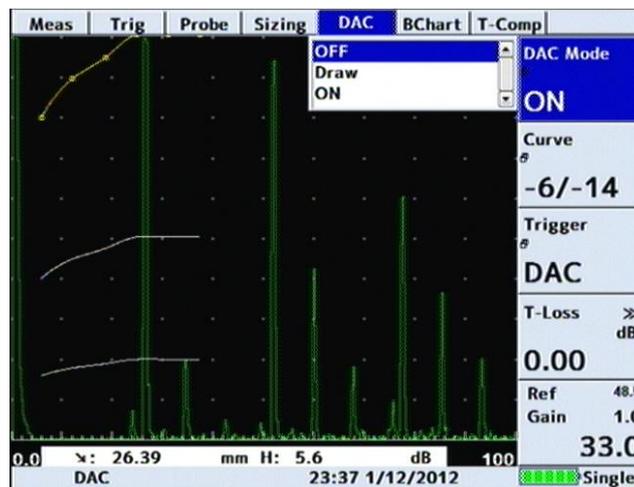
- Repeat steps 4 and 5 for each additional reference hole in the reference block, being careful to be consistent with the amount of coupling and transducer pressure. A maximum of 10 points can be recorded for a DAC curve.
- Use the curve parameter and [up] or [down] arrow to select the DAC reference curve, the DAC curve along -2/-6/-10 or -6/-14 curves or custom curves. These additional curves are automatically generated; references curves provide a method for helping to evaluate discontinuities smaller than those in reference block.



- Use the trigger parameter to select the alarm trigger from Gate 1, the DAC curve or any additional curves listed in the curve parameter above that are currently selected.
- If Depth measurement is switched on with the DAC feature, the depth mode display below the A-trace will show the distance to the echo peak and the relative amplitude to the DAC reference curve in dB.



The relative dB display is the dependent on the Ref gain setting, but not the Gain setting



With the split DAC mode active, if the reference echoes drop below 20% FSH another DAC curve will be generated at that point boosting the gain by 14 dB each time, for up to 3 split DAC curves.

To turn the DAC feature, select DAC mode from the DAC tab with [Up] and [Down] arrow then press [OK] chose OFF as shown above.

## 10. Dryscan

The dry coupling ultrasonic flaw detection technique uses individual transmitting and receiving transducers, which are coupled acoustically to the test specimen via a plastic tip or tyre. This method of ultrasonic testing has proved highly successful in a large number of applications where use of a coupling fluid would have been impractical due to contamination problems. The dry coupling testing technique can be used in either the through transmission mode or by working from one side of the specimen.

Dry coupling, when correctly applied, has a number of advantages over conventional pulse echo techniques:

- No couplant is required to connect the transducers acoustically to the test material.
- Many of the geometrical considerations used in conventional ultrasonic methods can be ignored. The transducers need not be aligned in fact they can be used with the transducer and receiver oriented at 100° to each other. This factor, plus the fact that the probe tips can be as small as 4mm diameter, enables testing problems to be solved which cannot be accomplished by conventional means.
- The system is highly reliable for fault detection.
- The method can be used for many materials as a GO/NO GO system either manually or fully automatic.
- In many cases, material surface preparation is not required.

### Dry Coupling

In ultrasonic non-destructive testing, transmission of acoustic energy through the material under test is accompanied by losses at the interface with the probe. It is this mismatch between the acoustic energy transmission properties of a gas (air) and a solid (test specimen) which makes it possible to detect flaws by the use of ultrasonic sound waves.

With normal pulse echo techniques, an acoustic coupling medium, eg a liquid paste, is required to couple the specimen acoustically to the transducer, which is transmitting and receiving the ultrasonic energy. With the dry coupling method, ultrasonic energy is coupled between the transducer and the material under test via small plastic pads which form an integral part of the probe, thus eliminating the need for a separate coupling medium.

The dry coupling is achieved by the use of a Polymer type material as the probe tip. For inspecting large areas, a roller type probe is available with a tyre made of the same contact material. The plastic material is soft enough to give good acoustic coupling to the specimen surface, but displaces only slightly when under the correct load. The probe material will operate throughout a temperature range of 20° C to 150° C whilst maintaining sufficient rigidity to prevent wear problems caused by surface friction when using roller probes.



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For reliable ultrasonic testing it is important that the acoustic coupling transmission characteristics remain constant during the inspection process. It is therefore recommended that, once an inspection procedure has been written, a jig or manipulator is designed to hold the probes.

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## Transducer Characteristics

Both the soft tip and the roller transducer incorporate crystal elements designed to emit a broad range of frequencies. A short transient electrical pulse generated by the flaw detector results in the transducer's crystal oscillating over a wide spectrum of frequencies with the peak frequency being determined by the crystal characteristics.

It is essential that the crystal generates a broad band of frequencies and therefore the transducers are specially constructed in such a way that the crystals are allowed to ring with diminishing amplitude until they come to rest. No damping slug is applied to the back of the crystal

On the plastic faced probe, the electrical connection is made directly to the crystal via a sprung steel stud. The stud rests lightly on the top surface of the crystal, which in turn rests on a thin metal earthing strip, which itself rests on top of the plastic contact tip.

The roller type transducer comprises a central stainless steel hub mounted on a spring loaded piston, which can be held at a constant angle in relation to the material surface. The crystal is mounted on a flat face in the hub with the electrical connection being made through a hole within the transducer's axle. A Perspex rim encircles the crystal and acoustic contact is made by means of a vacuum sealed oil chamber. A soft plastic tyre, in turn, makes acoustic contact between the Perspex rim and the material under test.

## How the System Works

Dry coupling transmission is basically similar to that of the pulse echo method. Ultrasonic energy is introduced to the material under test by the transmitter. This energy in turn travels through the material as a sound wave and can be detected by the receiver probe, which can be placed adjacent to or opposite to the transmitting probe depending on the test procedure. Comparison of the difference in received energy levels and the time delay between the transmitted signal and the received signal indicates the presence or absence of defects within the specimen.

In addition to transmitted sound, the dry coupling technique is sensitive to redirected sound energy, which may propagate through the material in a different manner from the directly transmitted sound. This may best be described by a simple analysis of the sound beam as it enters and propagates through the material under examination.

After a short transit time through the probe pad, the incident beam strikes the material surface, at which point part of the energy is reflected. The remaining energy enters the material and undergoes refraction. When the refracted beam strikes a reflective interface, eg a flaw within the material, further energy partition occurs.

Thus for detecting small flaws, a short wavelength must be selected, the lower limit being determined by the accompanying increase in absorption and the thickness of the test material.

The dry coupling system is able to measure relative to a constant two factors: the change in intensity of a received sound signal and the change in time between transmitting and receiving the signal. When correctly adjusted, the display will show a displacement in time between the transmitted signal and a series of transmission cycles over a known time. When used in the Dryscan mode, the Masterscan D-70 can only be used for comparative measurement, as the beam path does not necessarily travel at a known velocity or in a straight line from transmitter to receiver.

When inspecting composite, laminar or highly attenuated materials, either or both of the two factors may change with the presence or absence of a flaw within the material. In this way the Masterscan

D-70 can be used as a comparative tool to rapidly diagnose whether the structure under test has changed since its original design parameters were established.

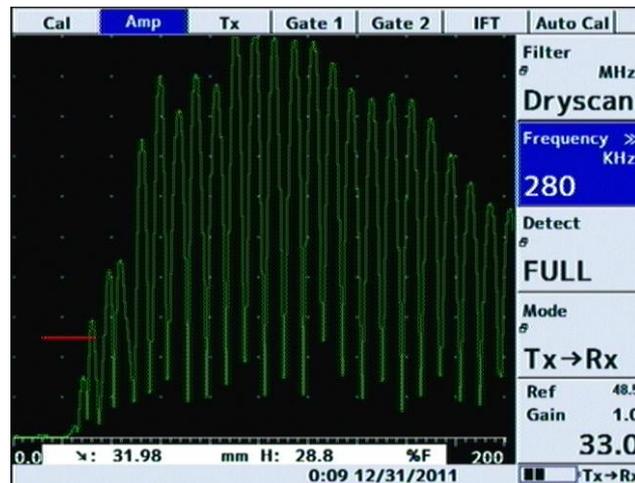


The dry coupling system is designed for comparative analysis. It can be misleading if attempts are made to produce finite measurements when using this system.

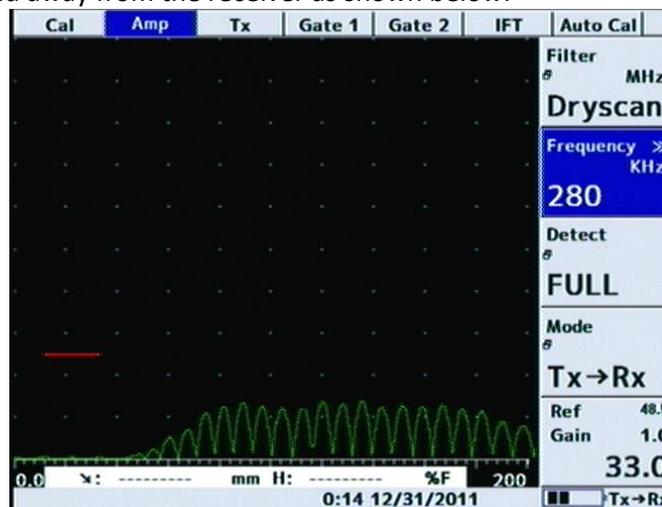
## Interpretation of the Results

With the dry coupling transducer, the received signals have a typical pulse repetition pattern. The first group of this pattern usually contains from seven to twenty cycles. The condition of the material is decided on the basis of: the displacement or the starting point of the first half cycle of this wave on the timebase, and the shape of the displayed interference pattern.

When setting the instrument, an acceptance level is established from a known test piece. Normally, if a test piece is considered to be good the controls of the Masterscan D-70 are adjusted until the first group of signals reaches full scale with a specified dB value, that the repetition pattern looks normal, ie the first group comprises between 7 and 20 cycles as shown below:



If when the probes are applied to a materials sample other than the test piece the signals appear as described above but are of lower amplitude, this pattern indicates a change in the structure of the material which may be interpreted as a flaw lying within the beam area causing some of the beam energy to be redirected away from the receiver as shown below:



A complete loss of signal can be interpreted as a crack or lamination which runs between the transmitter and receiver probes thus preventing any signal from being transmitted from one probe to another as shown below:



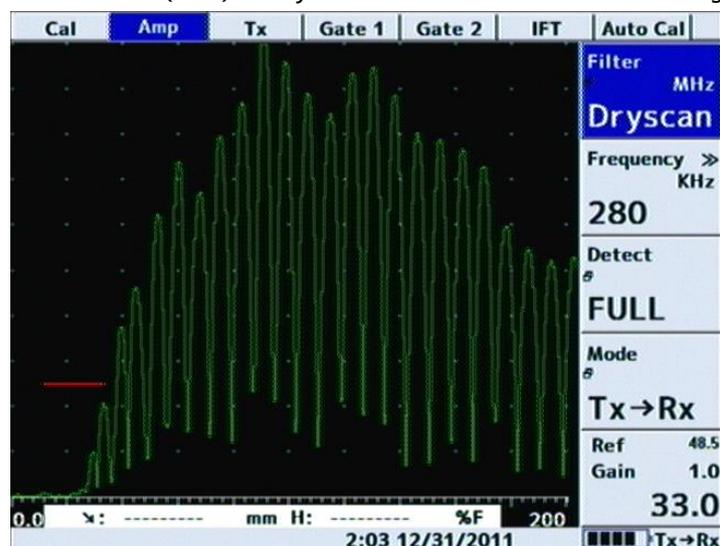
The signal start may be displaced, this is indicated by a shift to the right of the pulse repetition pattern. This is caused by an increase in wave path length between the transmitted and the receiver probes. A reduction of signal amplitude usually accompanies this movement and means that the wave path has been lengthened owing to the energy travelling around a void which lies between the transmitter and receiver probe.

### Setting up a Dry Coupling

Due to the differences between conventional pulse echo and dry coupling NDT examination, it is essential that the Masterscan D-70 should be set up properly prior to use to avoid any unnecessary confusion.

When using the dry coupling technique the following procedure should be adopted although the settings below are quoted as an example for explanation purposes only it should be noted that these settings will give a good starting point for any inspection procedure whether using the through transmission or signal side operating modes.

- In the AMP tab set the Filter (Mhz) to Dryscan. When selected the menus change as shown below:





---

there is now a new option (Frequency kHz) and that the Mode option has changed to TX=>RX

---

- Choose approximately 250 KHz as a starting point.
- In Cal Tab ensure that **Delay** is set to **0.00**, the Range is 100 and the VEL is 5930.
- Select either the soft plastic faced hand held transducer probes or plastic tyred roller probes according to the application. Both types of probe incorporate crystal elements having a nominal thickness frequency of 1.25MHz. They are used, however, at other high or lower frequencies related to radial modes of oscillation.



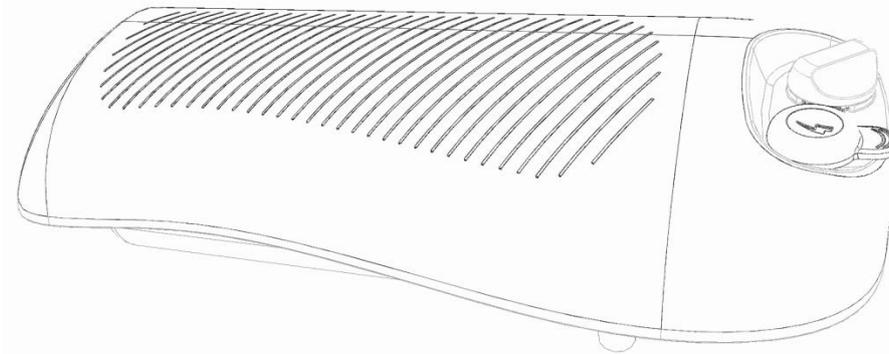
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For additional information on how to use the Dryscan function with an Ultrasonic Flaw Detector. Please refer to this Youtube video: [http://www.youtube.com/watch?v=lr3I\\_Rs2vW0](http://www.youtube.com/watch?v=lr3I_Rs2vW0)

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## Chapter 8 : Accessories

### Lithium-Ion Battery Pack



#### Battery Cautions

Misuse of Lithium-ion batteries may result in the following hazards: smoke, fire, or battery rupture. Misuse can also cause other battery damage or degradation of battery performance



- Use and charge only the specified Sonatest battery pack with the Masterscan D-70. Only the Sonatest battery pack is tested and approved for use with the Masterscan D-70. Using third-party or counterfeit battery packs may cause smoke, fire, or cause the battery to burst.
- Use and charge only the specified Sonatest battery pack with the Masterscan D-70. Only the Sonatest battery pack is tested and approved for use with the Masterscan D-70. Using third-party or counterfeit battery packs may cause smoke, fire, or cause the battery to burst.
- DO NOT hammer or otherwise impact the battery. Do not use the battery if it has been severely impacted or dropped, or if the battery has been subjected to heavy pressure. Battery damage may not be visible on the outside of the case. Even if the surface of the battery does not show cracks or any other damage, the cells inside the battery may rupture or catch fire.
- NEVER use or leave battery pack in areas with temperatures above +60°C. High temperature build-up in the battery, such as could occur near fires or stoves, inside a sun-heated car, or by setting the battery in direct sunlight may cause the battery to rupture or catch fire. Excessive temperatures may also degrade battery performance or shorten battery life.
- DO NOT expose the battery to rain, snow, seawater, or any other liquids. Do not charge or use a wet battery. If the battery gets wet, be sure to wipe it dry before using. The battery by itself is not waterproof.
- NEVER incinerate a used battery pack since internal battery gas may cause a rupture or explosion.
- NEVER solder the battery terminals, or modify the battery pack. This may cause heat generation, and the battery may rupture, emit smoke or catch fire.
- Use the battery only with the Masterscan D-70 for which it is specified. Never use a battery with any other equipment, or for any purpose that is not specified in this instruction manual.



- If fluid from inside the battery gets in your eyes, blindness can result. Rinse your eyes with clean water, without rubbing them, and see a doctor immediately.
- Immediately stop using the battery if it emits an abnormal odour, heats up, or is discoloured or deformed. If any of these conditions occur, contact Sonatest.
- Immediately wash, using clean water, any part of the body that comes into contact with fluid from inside the battery.
- NEVER put the battery in a microwave oven, high-pressure container, or in an induction heating cooker. This could cause overheating, a fire, or cause the battery to rupture.
- Always use the battery within the specified temperature range for the Masterscan D-70 (-10°C to +55°C) and the battery itself (-20°C to +60°C). Using the battery out of its specified temperature range will reduce the battery's performance and battery life. Please note that the specified temperature range of the battery may exceed that of the Masterscan D-70. In such cases, the Masterscan D-70 may not work properly because it is out of its operating temperature range.
- Shorter battery life could occur if the battery is left fully charged, completely discharged, or in an excessive temperature environment (above +45°C) for an extended period of time. If the battery must be left unused for a long time, it must be detached from the Masterscan D-70 after discharging. You may use the battery until the battery indicator shows half-capacity, and then keep it safely in a cool dry place with the temperature between -20°C to +25°C. If the battery pack is not going to be used for a long time it must be periodically charged every 4 months; failure to do so will render the battery inoperable and it will need to be returned to Sonatest for re-charging. If a number of spare battery packs are in use the easiest way to maintain optimum conditions is to rotate the battery packs so that when one is discharged it is swapped with a fully charged one.

## Battery Charging

### Charging Caution



- Only use the CH700-P charger to charge the battery. Using any other charger may cause smoke, fire, or cause the battery to burst.
- NEVER charge the battery pack in areas with extremely high temperatures, such as near fires or stoves, inside a sun-heated car, or in direct sunlight. In such environments, the safety/protection circuit in the battery will activate, causing the battery to stop charging.
- DO NOT charge or leave the battery in the battery charger beyond the specified time for charging. If the battery is not completely charged by the specified time, stop charging and remove the battery from the battery charger. Continuing to charge the battery beyond the specified time limit may cause a fire, overheating, or the battery may rupture.
- NEVER insert the battery charger into the Masterscan D-70 or battery if it is wet or soiled. This could corrode the battery charger terminals or damage the charger. The charger is not waterproof.
- DO NOT charge the battery outside of the specified temperature range: 0°C to +40°C. Sonatest recommends charging the battery at +20°C. The battery may heat up or rupture if charged out of the specified temperature range. Additionally, battery performance or battery life may be reduced.

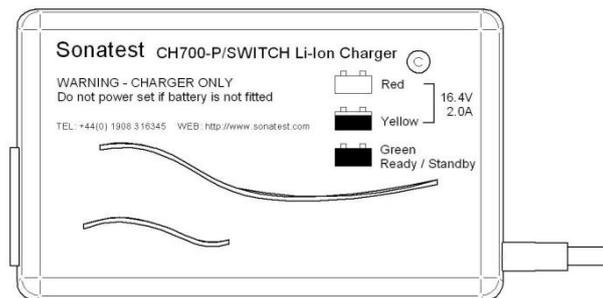


When fully charged, the battery pack should enable the unit to be operated for 16 hours when the brightness is at level 1 in the VIDEO tab under UTIL menu, for 12½ hours with a brightness of 10 (the default) or for 9 hours with a brightness of 20. The battery pack can be charged while mounted to the Masterscan D-70 by use of the connector on the front panel. Alternately, the battery pack can be charged separate from the by using its own connector shown above allowing continued operation of the Masterscan D-70 with the use of multiple battery packs.

## Battery Charger

When shipped the battery has only a nominal charge and must be fully charged before being used for the first time.

The Sonatest CH700-P battery charger shown below is suitable for use with main supply from 100 to 240 volts AC. The LED on the charger illuminates to indicate power on. When the battery level is low the LED will glow red. When the battery level is almost full the LED will glow yellow. When the battery level is full the LED glows green. The output voltage from the charger is 16.4 Volts DC. The output current when charging is a constant 2.0 Amps. The part number for a battery pack is 212173.



The CH700-p is a battery charger only. Any attempt to use it to power a Masterscan D-70, without a battery fitted, WILL damage your CH700-P battery charger.

## Chapter 9 : Products Specifications

(Subject to change without notice)

Features	Details	
<b>Enclosure</b>	Size	H=172mm x W=238mm x D =70 mm (6.77 in x 9.37 in x 2.75 in)
	Weight	1.7 Kg (3.7 Lbs) with battery
<b>Environmental</b>	Operating Temperature	-10 degree C to 55 degree C (-14 degree F to 131 degree F)
	Storage Temperature	-25 degree C to 75 degree C (-13 degree F to 167 degree F)
	Relative Humidity	5 to 95%, non-condensing
	IP rating	Designed to meets IP67
<b>Data acquisition</b>	Pulse rate Frequency (P.R.F)	Adjustable 15 to 5000 Hz (selectable in 5 Hz steps).External sync also available
	Resolution	Up to 0.01 mm (0.001 in) for distance or 1% FSH for amplitude measurement. Large display of measurement at top of A-Scan display. Measurement mode selectable between peak and flank.
	Test range	0 - 1mm (0.05 in) up to 0 - 20000 mm (800 in) at steel velocity (5930 m/s or 19455f/s). Variable in 1,2,5 sequence or continuously in 1mm.
	Velocity	256 to 16000m/s continuously variable.
	Probe zero	0 to 999.999 $\mu$ s, continuously variable.
	Delay	Calibrated delay from 0 -20000 mm in 0.05 mm steps (0-787.4in. in 0.002 in steps).at steel velocity
	Backwall Echo Attenuation (option)	0- 40dB attenuation.
	Reject (Selectable)	Up to 80% linear reject (removes baseline noise without affecting indication amplitude). OR Up to 50% suppress reject (increase zero offset and reduces amplitude of all echoes). LED warning light when selected.
	Measurement Units	metric (mm), Inch (in) or time ( $\mu$ s)
	<b>Measurement Modes</b>	Mode 1
Mode 2		Depth and amplitude of the 1st signal gate
Mode 3		Echo-to-Echo distance measurement (single gate)
Mode 4		Trigonometric display of beam path, surface distance and depth of indication from the inspection surface together with echo amplitude, curved surface correction for convex and concave, X-OFFSET for probe index. Half skip indication on screen.
Mode 5		Gate to Gate distance measurement. (Independent gates).
Mode 6		Flank to Flank
Mode 7		Beam Angle calculated from beam path, hole radius and hole centre depth
<b>System Linearity</b>	Vertical linearity	1% Full Screen Height (FSH).
	Horizontal linearity	$\pm$ 0.4% Full Screen Width (FSW).

	Amplifier Accuracy	± 0.1dB
<b>Others features</b>	ActiveEdge™	Used to improve the pulse shape and improve near-surface resolution.
	Rectification	Full wave, positive or negative half-wave and unrectified RF.
	Gate Monitor	Two fully independent gates for echo monitoring and thickness measurement. Start and width adjustable over full range of unit, amplitude variable from 0 to 100% FSH. Bar presentation. Positive or negative triggering for each gate with audible and visual alarms. Gate resolution is 5 ns
	Gate Expansion	Expands range and delay to cover the area set by Gate 1 start and width controls.
	Gate Monitor Delay	Selectable 0.6 seconds delay on gate 2 negative monitor tracking.
	Display Freeze	For capturing the current waveform (A-scan) image for off-line processing.
	Active Peak Memory	Retains all the A-scan on screen for echo dynamic pattern determination, with active A-scan display in separate colour.
	Waveform smoothing	Gives a smooth signal envelope, simulating analogue equipment. 3 options available (None, fill and smooth)
	Contour	Trailing-Edge slew rate control to reduce half cycles in rectified modes. Selectable from 1 of 6 levels
	AGC	<b>A</b> utomatic <b>G</b> ain <b>C</b> ontrol automatically sets the signal to a level between 10-90% FSH with tolerance between 5-20% accuracy.
	DAC	<b>D</b> istance <b>A</b> mplitude <b>C</b> urve defined by up to 10 points and digitally drawn on screen. DAC curves meet requirements of EN 1714, JIS and ASME standards, selectable between -2, -6, -10, -12 and -14dB. Amplitude read out selectable between % DAC or relative dB.
	TCG (option)	Time Corrected Gain, also known as Swept Gain. 40dB dynamic range greater than 30dB per microsecond and up to 10 points may be used, setting all signals initially to 80% FSH.
	AWS (option)	Built in software for evaluation of defect indications in accordance with AWS D1.1 structural weld code.
	AVG/DGS (option)	Automatic calculation from probe data.
	API (option)	Flaw sizing complying with API 5UE
	Interface Trigger (IFT)- (option)	Unlock the interface trigger gate controls, which hold off the A-scan acquisition and display until an interface echo is detected with a specific range
	Auto-Cal	Provides automatic calibration from two echoes.
	Notes	Alphanumeric labelling for panel and A-log allows the user to enter Notes for storage with panel settings and A-scans.
	Keylock	Prevents accidental alteration of parameters.
	Help Key	For instant operator guidance on using the Masterscan Series. Shows software and hardware information
Reference Waveform	This menu displays a waveform from one of the A-log stores as a reference or fingerprint display in a colour different from the active display highlighting differences from the reference.	

	persistence	Cause previous A-scan to fade out at a user determined rate (1 to 6).
	Clock	Sets time and date. Built in battery-backed RTC keeps time and date. Visible on status line, always store with Panels, A-logs, etc
	Internal memory	4 GByte storage available
<b>Receiver</b>	Connector type	BNC or LEMO 1 (factory option)
	gain range	0 to 110 dB, adjustable in 0.1, 0.5,1,2,6,10,14 and 20dB steps. Direct access to gain control at all times
	Input Impedance	50 or 400 Ohm damping selectable
	Filters bands	- Narrow bands centred at 0.25MHz,0.5 MHz, 1MHz, 2MHz, 5MHz, 10MHz and 15MHz/wide. - Broadband at 2Mhz to 22Mhz (6 dB) and 1Mhz to 35Mhz.
<b>Pulser</b>	Connector type	BNC or LEMO 1 (factory option)
	Number of channel	1
	Test mode	Pulse echo and transmit/receive. Single crystal, Double crystal and Pitch and catch
	Pulse voltage	100V - 450V
	Pulse shape	-VE spike and Square wave
	Pulse width	From 30 to 2,500 ns duration
	Rise/fall times	<5ns into 50 Ohms at 200V (width adjustable in 2% of nominal width. Min=1 ns, Max=40ns)
	Thickness Logging	Can store up 440,000 thickness readings configured either by Block/Location/Number mode or pre-programmable work sheets in sequential mode. Readings can be exported to MS Excel using optional software.
	Panel memory	Can store up to 450,000 panels for retaining calibrations.
	A-scan memory	200,000 waveforms can be printed or transferred to a PC using optional SDMS software.
<b>Display</b>	Size	116.16 x 87.2 mm (4.57 x 3.43 in)
	screen resolution	640 x 480 pixels (VGA) TFT
	A-scan resolution	400 x 510 Pixels (460 x 620 Pixels in Full screen)
	Update rate	60 Hz
	Colour	9 colours options with variable brightness.
<b>I/O ports</b>	Video output	Factory option
	Analogue proportional outputs	Programmable to distance or amplitude of the signal in the gate
	Front USB	compatible with 1.1 version, Type A
	Encoder Connection	Lemo 4-pin connector
<b>Battery &amp; Power supply</b>	Battery Type	Lithium Ion battery pack
	Number of battery	1
	battery Life	16 hours typical
	Recharge time	3-4 hours (battery can be charge separately)
	Output power	14.4V - 5A/hours

	Charger	100-240 V AC, 50-60 Hz
<b>Language Support</b>	User selectable	Dutch, English, French, German, Russian, Spanish (other available on request)
<b>Calibration standard</b>		EN12668-1 2010

## Chapter 10 : Warranty

**Warranty/Defects after Delivery:** Immediately upon receipt of the goods the buyer is required to check the goods carefully and thoroughly. In order to benefit from the guarantee, any defect in the product should be immediately reported in writing to Sonatest.

Sonatest will make good by repair or by the supply of a replacement or by equivalent adjustment of the price at our sole option, any defects which under proper use appear in the goods within the period of twenty four (24) calendar months after the goods have been delivered and which arise solely from faulty design, material or workmanship, provided that the goods are carefully packed and promptly returned by you, free of charge, to the Sonatest works unless otherwise arranged. Said goods should be covered while in transit to us and must be accompanied by a written statement detailing the precise nature of the fault and the operating conditions under which the fault occurred. The repaired goods will be returned by Sonatest free of charge.

Save as in this Clause herein before expressed Sonatest shall not be under any liability in respect of defects in goods delivered or for any injury damage or loss resulting from such defects and our liability under this Clause shall be in lieu of any warranty or condition implied by law as to the quality, fitness or merchantability for any particular purpose of such goods.

You are reminded that all warranties as to merchantability and fitness for purpose are excluded from the contract under which the product and this manual have been supplied to you. The sellers' only obligation in this respect is to replace such quantity of the product proven to be defective.

Neither the seller nor the manufacturer shall be liable either in contract or in tort for any direct or indirect loss or damage (whether for loss of profit or otherwise), costs, expenses or other claims for consequential or indirect compensation whatsoever (and whether caused by the negligence of the company, its employees or agents or otherwise).

## Chapter 11 : Troubleshooting and Support

### Q1 – My Masterscan Unit does not start when press [Power] button?



- 
- Make sure the battery is fully charged and connected to the Masterscan.
  - If the battery is flat or not fully charge connect the charger which came with the unit.
  - Remove and refit battery then try to turning ON and Off again.
  - If the above does not work send it back for repair.
- 

### Q2 – When the unit is turned off the led on the charger is Red/amber slid. What does this means?



- 
- The battery is charging
- 

### Q2 – My battery life is very short despite having charge it for 3-4 hours?



- 
- When you received the unit for the first time, it is strongly recommended to complete a full charge and discharge cycle.
  - Try if applicable to charge the battery with another CH700-P charger
  - If you do not have a spare charger, try with another battery. If the battery life is longer, the battery is faulty.
- 

### Q3 – Why my battery will not lasting very long after only few months of use?



- 
- Apart from the obvious reasons (it too old or has been mistreated), the other reason may be in the way you charge it.
  - If a battery is never allowed to fully charge then discharge, it will become "uncalibrated". To prevent that, ensure that every month or so, you should fully charge and then fully discharge the battery.
- 

### Q4 – The scroll-wheel will not work correct?



- 
- In the new Masterscan the scroll wheel sensitivity cannot be set. If the [OK] key sill working, try to turn the unit off then on again.
  - If after turning the unit off and on again the scroll-wheel does not work, call your distributor or Sonatest.
- 

### Q5 – There is a warning or error messages display on the screen?



---

Most of the warning messages and some error messages are a result of incorrect method of operation or trying to use incompatible ranges or features. If that's not the case try a factory reset.

---

**Q6 – Memory does not store or recall data?**

- 
- Using the CLOCK tab check the time settings. If it incorrect then set the time and Date.
  - If the time and date will not keep when the unit is switch off or you get DATA error message try restoring factory defaults.
  - If factory default does not work, send the unit to back for repair.
- 

**Q7 – I have a permanent or Intermittent freeze (no reponse) ?**

- 
- Try a factory reset.
  - If factory default does not work, send the unit to back for repair.
- 

**Q8 – I have a Low level or no signal with the A-scan?**

- 
- Try a different cable and probe.
  - Is the single/double mode correct?
  - Does the probe is connected to TX?
  - Try a factory reset.
  - If factory default does not work, send the unit to back for repair.
- 

**Q9 – Nothing, faint or faulty (snowy) display?**

- 
- Try a factory reset.
  - Connect the unit to a PC and reprogram the unit using **UTILITY**.
  - If factory default and reprogramming the unit do not work, send the unit to back for repair.
- 

**Q10 – I need more support where and how can I contact you?**

- 
- Please contact your local distributor for additional support or training
  - Additionally you can visit our website: [www.sonatest.com](http://www.sonatest.com)
  - Or can e-mail us at [sales@sonatest.com](mailto:sales@sonatest.com)
  - For more details please see contact [details](#) page
-

## Chapter 12 : Maintenance

### Casing

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- **Do not** put the Masterscan near a source of electromagnetic noise, which could disrupt data acquisition.
  - If you have carpets in your work place, be careful about electrostatics shocks.
  - Clean the Masterscan as often as possible and make sure that oils, dust or couplant do not damage the unit. Do not use abrasive or chemical cleaning agents which will damage the surface of the instrument.
  - Protect the unit from adverse weather conditions.
- 

### Screen

---



- **Do not** use an abrasive cloth or brush to wash the screen, instead use a clean, lint-free cloth.
  - **Do not** use a sharp object (pen, pencil) to point flaws or details on the screen.
  - **Do not** store or leave the unit where the screen will be exposed to direct sunlight for a long period of time.
- 

### Traveling

---



- Make sure the unit is not subject to excessive shocks or impact while travelling.
  - If you are going abroad with the unit, make sure to have the battery fully charged or the power adapter handy, as some airport administrations may ask you to power on the unit in front of them.
  - Do not travel with a probe or any external peripherals connected to it
  - Make sure the unit is compatible with the voltage/current in the country you are travelling to.
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