

OPERATOR'S MANUAL

SITESCAN 240



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1.1 Specific Warnings.

The SITESCAN 240 contains a high-energy, precision pulser allowing optimum testing 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 key) before changing probes

1.2 General Warnings

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

- A. Knowledge of the specific test or inspection application and applicable test equipment.
- B. Selection of the correct test equipment based on a knowledge of the application.
- C. Competent training of the instrument operator.

This operating manual provides instruction in the basic operation of the SITESCAN 240 flaw detector. In addition to the methods included herein, many other factors can affect the use of this flaw detector. Specific information regarding these factors is 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.

C. Behavior of the sound wave at the interface of two different materials.

D. 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. The user is referred to the American Society of Nondestructive Testing at (<http://www.anst.org>), and the American Welding Society at (<http://www.aws.org>).

1.4 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 in the absence of exercising good judgment.

1.5 Critical Operating Factors

The following procedures must be observed by all users of this ultrasonic flaw detector in order to obtain proper and accurate results.

A. 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

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.

B. Transducer/Probe Zero Procedure. The transducer/probe 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/probe zero and calibration procedure will cause inaccurate thickness readings.

C. Flaw Detection Calibration. When performing flaw detection, it is important to note that the amplitude of indications is not only related to just 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 transducer/probe. 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

errors.

- E. Transducer/probe Condition.** The transducer/probe used for testing must be in good condition, without noticeable wear of the front surface. The specified range of the transducer/probe 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/probe's specified temperature range.
- F. Use of Couplants.** Operators must be familiar with the use of ultrasonic couplants. 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/probe.

1.6 Disclaimer of Liability

All statements, technical information and recommendations contained in this manual or any other information supplied by Sonatest in connection with the use, features and qualifications of the Sitiescan 240 are based on test believed to be reliable, but the accuracy or completeness thereof is not guaranteed. Before using

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).

1.7 Electromagnetic Compatibility

This product conforms to the European Directive 89/336/EEC. However, in order to ensure the equipment meets the requirements, the following should be read:

Warning: 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.

Note: This Product Should Not Be Connected To Cables Greater Than Three (3) Meters In Length. If This Is Necessary, The Installation May Require Further EMC Testing To Ensure Conformity.

functional testing methods that may be used with the instrument.

Section 4 entitled *Fundamentals of Ultrasonic Testing*, will provide a user unfamiliar with the technology of ultrasonic testing a basis for seeking more training and understanding and is a good adjunct to the precautions mentioned in Section 1.

Section 5 entitled *Quick Start*, provides a user familiar with ultrasonic testing a means to operate the instrument's basic functions and to quickly achieve familiarity without having to understand all of it's features in detail.

Section 6 entitled *Detailed Operation Instruction*, is an in-depth tutorial describing all of the advanced features of the Sitiescan 240. A study of this section will allow the user to become adept at performing various ultrasonic testing methods with a higher level of productivity than is available with other, conventional ultrasonic flaw detectors.

Section 7 describes important aspects of using and caring for the battery power supply so as to get maximum battery duration time and life.

Section 8 is for users who desire to operate the Sitiescan 240 with ancillary equipment.

The function keys are shown throughout this manual with the mnemonics as shown in Section 5.1, "Front Panel Controls." A unique help button provides the user with a quick guide and description of the controls.

3.1 Instrument Characteristics

The main instrument characteristics of the Sitiescan 240 include:

- 110dB Gain Amplifier
- Broad Band Amplifier Testing
- Range From 5mm
- RF (unrectified) Display Mode
- Analogue Outputs
- RS232 Output
- Video Output
- Dual Independent Gates
- Context Sensitive Help Screens
- Calibration in Metric, English or Microseconds
- DAC (Distance Amplitude Correction) Curves
- Time Corrected Gain
- AWS/DGS system (option)
- Choice of Colour Display or LCD Display
- X- Offset
- Time and Date
- Notes Feature
- Trigonometric Weld Measurement Feature
- Peak Echo Dynamics Mode
- Echo Freeze Mode
- Depth & Thickness Measurement Modes
- Echo to Echo Measurement Mode
- Gate to Gate Measurement Mode
- Thickness Display & Logging
- Thickness Minimum Mode
- Panel Calibration Memories
- A-Scan Memories
- Self Check Feature
- Alpha-Numeric Labelling
- Auto Cal
- Reference Mode
- Signal Contouring
- Signal Smoothing

- Time of flight measurement
- Contact or Immersion Methods
- Angle Beam (Shear Wave) Testing
- Angle Beam (Surface Wave) Testing
- Crack Diffraction Methods
- Depth of Flaw Measurement
- Single Transducer/probe Thickness Measurement
- Dual Transducer/probe Thickness Measurement
- Indirect Measurement of Sound Velocity in Materials
- Time measurement in microseconds
- Phase change display in unrectified mode
- Through transmission testing
- Creep wave testing
- Pitch and catch techniques

High frequency sound waves are introduced into the test material from a transducer/probe that is usually coupled to the test part by water or other suitable liquid coupling. The transducer/probe converts the electrical impulses of the instrument into high frequency sound energy. A short burst of ultrasonic energy is introduced into the test material and some or all of the energy is reflected by discontinuities and/or the far surface of the test part. The reflection of sound energy is a function of the ratio between the acoustic impedance of the discontinuity and the base material. The acoustic impedance of a given material is the product of the density and the velocity of sound in the material. The higher the ratio, the more sound energy that will be reflected. The principle of ultrasonic testing is shown in Figure 1 which shows the ultrasonic energy in the test piece and the resulting instrument display.

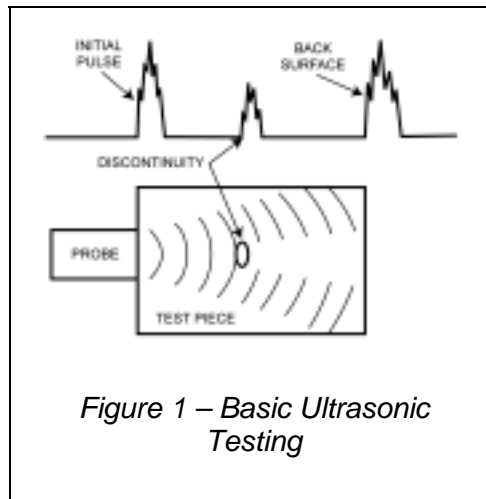


Figure 1 – Basic Ultrasonic Testing

Thickness gauging with the Sitescan 240 operates on the principle of time-of-flight of measurement. This principle utilizes the precise timing of the transit time of a short burst of high frequency sound energy through a material under test. The sound waves travel to the

sound beam size and directivity are also factors that affect the sensitivity of the test. As the sound beam enters the material, it spreads and becomes weaker. Therefore, discontinuities farther from the transducer or front surface of the test part produce a lower response from the system. This can be overcome by selectively adjusting the gain of the instrument as a function of distance traveled through the use of the Sitiescan 240's Time Corrected Gain feature. In addition, discontinuities which present their predominant planar surface to the axis of the sound beam will produce larger reflections than those which only present an edge to the sound beam. Some knowledge of these factors along with an understanding of how discontinuities are formed in the test part are important for the proper use and effectiveness of this instrument.

4.2 *Ultrasonic Transducer/probes & Sound Fields*

The transducer/probe comprises a piezoelectric ceramic material that generates short bursts of mechanical vibration or sound waves when it is excited by a short electrical pulse from the Sitiescan 240. The frequency of the generated sound waves is far beyond the range of human hearing and can be in the range of 0.1 to 20 MHz. Sound energy at these high frequencies does not travel well through air. For this reason, a coupling which in most cases is liquid, must be used between the transducer/probe and the test piece.

Higher frequency transducer/probes are more sensitive to small discontinuities due to their smaller wavelength. The wavelength if

- v = velocity of sound in the material
- f = frequency of the transducer/probe

In addition, higher frequency transducer/probes tend to have better resolution due to shorter energy bursts and the smaller wavelength. Resolution is the ability of a transducer/probe and instrument combination to give distinct and separate indications from discontinuities lying close to one another both laterally and axially. On the other hand, higher frequency sound energy attenuates more and tends to scatter in large grain material, causing a loss of sensitivity in thicker sections of material. Proper ultrasonic testing requires careful selection of the frequency to obtain a desired balance between sensitivity and penetration.

The sound field of a transducer/probe is characterized by a near field and a far field. The near field is the region directly in front of the transducer/probe where the sound energy goes through a series of maximum and minimum both axially and radially. Responses from small discontinuities in the near field can be irregular. The far field of the transducer/probe is a region of more regular sound energy variations beginning with the highest maximum and gradually declining to zero. The highest maximum point is known as the near field distance and is represented by N or Y_0^+ . This is also the natural focus point of the transducer/probe. Figure 2 below demonstrates the axial variations of a typical transducer/probe.

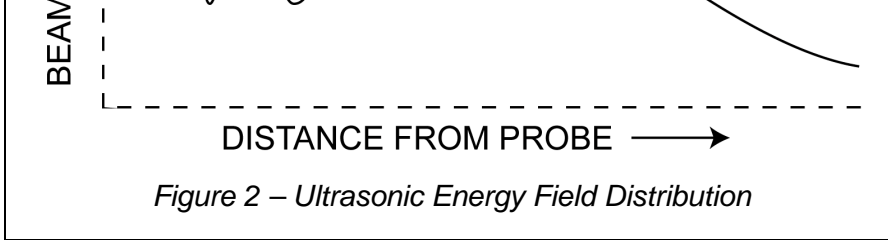


Figure 2 – Ultrasonic Energy Field Distribution

The near field distance is a function of the transducer/probe frequency, diameter, and the sound velocity in the test material according to the following equation:

Where: D = diameter of the transducer/probe element

$$Y_0^+ = \frac{D^2 f}{4c}$$

f = frequency of the transducer/probe

c = velocity of sound in the material



Figure 3 – Ultrasonic Beam Spread and Half-Angle

below.

Beam spread is an important consideration when inspecting discontinuities that may be close to geometric features of the test piece such as corners and fillets. Such geometric features can cause erroneous indications at distances where the beam spread is a factor. For flat or non-focused transducer/probes, beam spread is defined as the angle of the -6dB pulse-echo energy response according to the following equation:

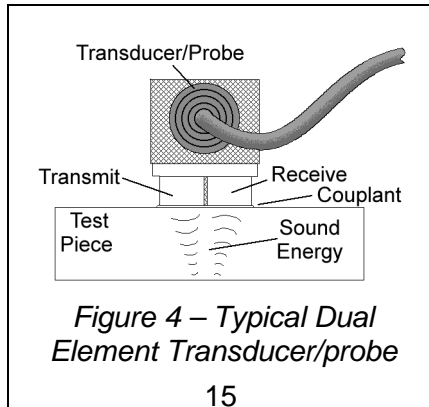
$$\sin\left(\frac{\alpha}{2}\right) = \frac{.514c}{fD}$$

Where: α = angle of beam spread at -6dB
 c = velocity of sound in the material
 f = frequency of the transducer/probe
 D = diameter of the transducer/probe element

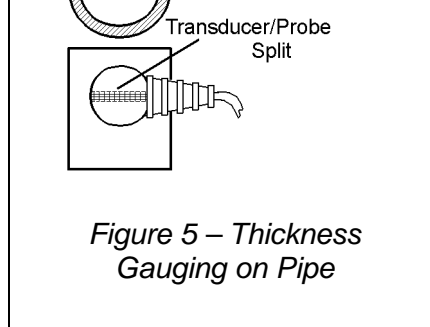
particle motion is in the same direction as the propagation of the wave. Straight beam testing is used for most flaw detection and thickness gauging.

4.4 Dual Element Testing

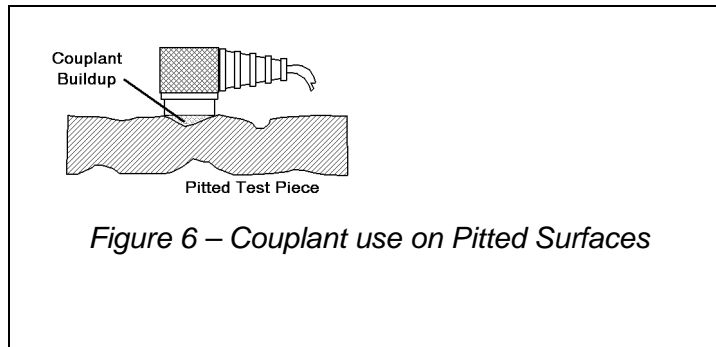
Dual element transducer/probes contain separate transmitting and receiving elements as shown in Figure 4, usually mounted on delay lines with a slight included angle. This design improves near surface resolution by separating the initial pulse from the received echoes and by providing a slight focus of the sound beam. Dual transducer / probes are therefore, suitable for the thickness gauging of pitting and corrosion. Although dual element angle beam transducer/probes are made for special situations, almost all dual element transducer/probes are used for thickness gauging of corrosion.



actual. This is because the couplant can add to the measured value. When measuring small diameter piping, always place the split in the transducer/probe across the pipe and use only enough couplant to obtain the reading as shown in Figure 5.



The same precautions are true for pitted front surfaces as shown in Figure 6.



in which the particle motion is perpendicular to the direction of propagation. Shear waves have lower velocities and correspondingly larger wavelengths than the longitudinal wave. In fact, the velocity of shear waves is almost half that of the longitudinal wave in most materials.

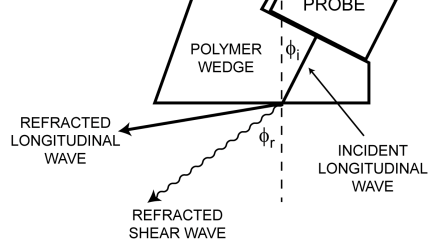


Figure 7 – Typical Angle Beam Transducer/probe

The incident angle necessary to produce a desired refracted wave can be calculated from Snell's Law as indicated in the following equation:

$$\frac{\sin \theta_i}{C_i} = \frac{\sin \theta_r}{C_r}$$

- Where:
- θ_1 = incident angle of the transducer/probe wedge
 - θ_2 = desired refracted angle
 - C_i = sound velocity in the wedge
 - C_r = sound velocity of a shear wave in the test material

for the inspection of welds. The reason for this is to be able to position the transducer/probe away from the weld bead yet

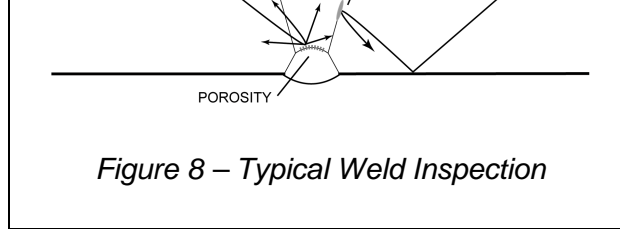


Figure 8 – Typical Weld Inspection

propagate energy into the weld zone. Another reason to use angle beam testing on welds is to position the sound beam more normal to the expected discontinuities since the flaws in welds are usually perpendicular to the test surface with the exception of porosity. Figure 8 shows the principles of angle beam weld testing.

Depending on the incident angle, refracted sound beams can also produce components of longitudinal energy, surface wave energy and Lamb wave energy. Although these advanced topics are beyond the scope of this manual, it is important to know that multiple modes can occur simultaneously which may lead to spurious indications. Surface wave inspection can be used to detect cracks on the surface of materials.

NOTE: Angle beam testing is a more advanced ultrasonic testing method. The user is advised to seek training and/or supervision in the use of these methods for weld inspection.

factors can lead to improved sensitivity and reliability.

Most immersion testing uses single element transducer/probes with a focusing lens applied to the front face. This has the effect of concentrating the sound energy for improved sensitivity and resolution. The

focal length of an immersion transducer/probe is usually expressed in water distance. The focal length of a given transducer/probe is limited to the near field distance described previously. When the sound beam strikes a test piece, however, the energy is usually focused more sharply, resulting in a reduction of the focal length. The reason for this is the same principle of refraction as described above for angle beam transducer/probes. This re-focusing effect is shown in Figure 10.

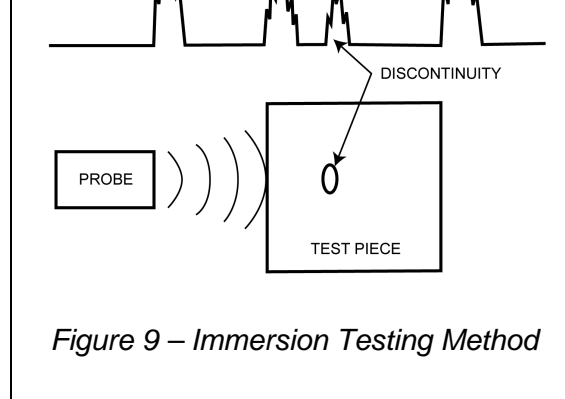


Figure 9 – Immersion Testing Method

transducer/probe
to the test piece
surface:

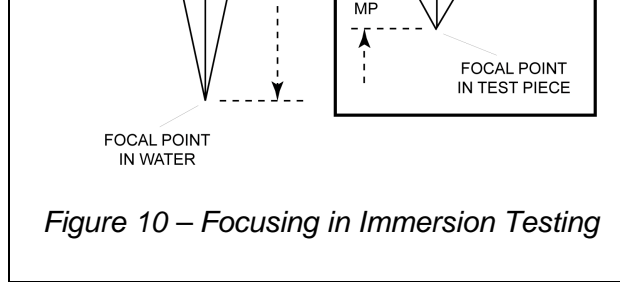


Figure 10 – Focusing in Immersion Testing

$$WP = F - MP \left(\frac{C_m}{C_w} \right)$$

Where: WP = water path
MP = metal path
F = focal length in water
 C_m = sound velocity in the test material
 C_w = sound velocity in water

In addition to the refraction effect on the focal length, surface curvature can change the focusing distance. Concave surfaces tend to increase the focal distance and spread the sound beam. Convex surfaces tend to refract the sound beam even more and shorten the focal length

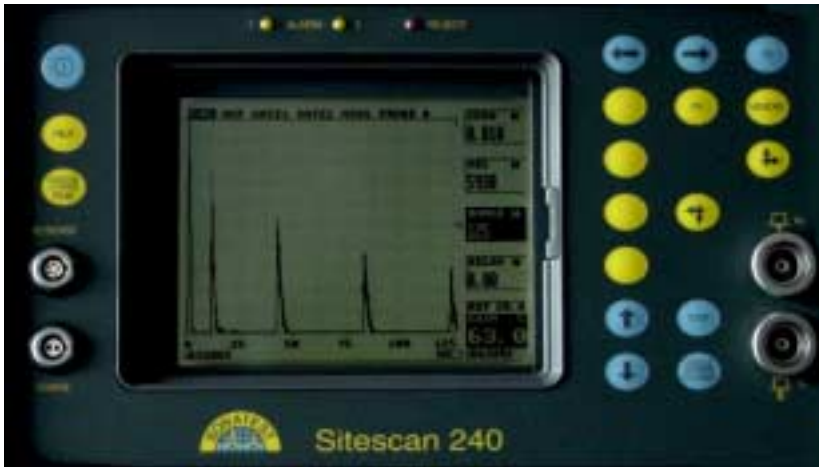


Figure 11 – Front Panel of the SITESCAN 240

When the term “Highlighted” is used, it refers to text with a bright background and dark letters which is the selected item. (Opposite for LCD Display)



STEP

Press to select the dB step value of amplifier gain as 0.5, 2, 6, 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 is a momentary button with no repeat.



GAINU

Press to increment or 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 scrolling of the value.



GAIND



S/D

Selects either Single or Double transducer operation. The mode selected is displayed in a highlighted box below the Gain box at the lower right of the display. This is a momentary button with no repeat



CURL

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 on the right of the screen change as the sub menu is selected.



CURR

INC

Transducer/probe Zero or Delay, it moves the signals to the right. This is a repeat button with acceleration to facilitate quick scrolling of the value.



DEC

This button operates in connection with the plain yellow buttons next to the parameter boxes to decrease the value or step the selection in the reverse direction. In the case of Transducer/probe Zero or Delay, it moves the signals to the left. This is a repeat button with acceleration to facilitate quick scrolling of the value.



MEM

This button selects between the two main menus at the top of the screen. The menus are described in Section 6.1 that follows. This is a momentary button with no repeat.

inspection. This feature allows an envelope or cone dynamic pattern to be drawn on the screen which is useful for angle beam inspection to locate the peak signal. When in this mode, a box is highlighted showing PEAK below the graticule.

Pressing the button a third time selects KEYLOCK mode, preventing accidental changing of parameters

Pressing the button a fourth time returns the A-Trace display to normal mode. This is a momentary button with no repeat action.



FN

The Function button selects a menu along the top of the display with additional functions not on the start-up menu. The menus are described in Section 6.1 that follows. This is a momentary button with no repeat.



HELP

This button selects the help menu which overlays the display. The help menu explains how the Sitiescan 240 operates with a choice of three options:

- UP/RT Using the SS240.
- OK Description of the active menu.
- DN/LT Calibration procedure.

Pressing the HELP button again at any point in the help screens returns the display to normal mode. The Help Screen also displays the Instrument serial number & software version



BNC or Lemo 1 connector is the receiver socket used for twin or dual transducer operation.

Rx



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.

Tx

AUX

A socket to connect various devices such as an external alarm or other client requirement.

CHARGE

A two-pin 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 Section 7 for information on power supplies and charging of the battery pack.

5.2 ***Panel Calibration Memory***

The panel calibration settings of the SITESCAN 240 always remain in memory when the instrument is turned off, even if the battery pack is removed. That is, whatever the calibration settings are just prior to turning the instrument off will be the settings in place the next time the instrument is again turned on.

At times, it may be desirable to start with a “fresh palette” of 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

3. Press the UP/RT button to reset the instrument to factory defaults.

NOTE: Before performing this procedure, be sure to save any favorite panel calibration settings to memory by using the procedure outlined in Section 6.3 on page 57.

NOTE: Resetting the panel settings restores the instrument to metric measurement mode and PAL video output mode.

Factory default values:

Zero: 0.000		
Velocity: 5930	Print: Off	Smooth: Off
Range: 100	Dist.1: 100.0	Colour: 0
Delay: 0.00	Dist.2: 200.0	Bright: 10
Freq: 5.0 MHz	Accept: CAL	Video: PAL
Detect: Full	Start: 24.80	Graticule: Full
Reject: 0	DAC: Off	P_OP: Off
PRF: 1000 Hz	Curve: DAC	Clock: Off
Gates: Off	TCG: Off	DGS: Off**
Meas: MONITOR	AWS: Off	Mode: Single
Angle: 45	Ref %: 80	
X_OFF: 0.0	Units: Metric	
	Click: On	
	Alarm: Mute	

** **DGS** is optional and may not be fitted

Perform the following steps to establish a basic flaw detection mode for the Sitiescan 240. Units shown are in mm. For inch units, select INCH UNITS from the UTIL menu and use the corresponding values for the parameters.

1. Select a suitable transducer/probe, preferably a 5MHz, half inch diameter narrow band.
2. When making a quick adjustment on a menu parameter, press the adjacent yellow button until the double arrow appears next to the parameter name. This establishes the fast scroll using the INC and DEC buttons.
3. In the CAL menu, set the following parameters:
 - a) ZERO to 0.000
 - b) VEL can be left as it is.
 - c) RANGE to 125 or other suitable value to cover the test range of interest.
 - d) DELAY to 0.00
GAIN to 50.0
4. In the AMP menu, set the following parameters:
 - a) FREQ to 5.0 Mhz
 - b) DETECT to FULL
 - c) REJECT to 5
 - d) PRF to 1000Hz

6. In the GATEZ menu, set the STATE to OFF
7. In the MEAS menu, set the following parameters:
 - a) MODE to DEPTH
 - b) TRIGGER to FLANK
 - c) HUD to OFF
 - d) T-MIN to OFF
8. In the Function/DAC menu, set the MODE parameter to OFF

You are now prepared to perform 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. For more in-depth features of the Sitiescan 240, see Section 6.4, “Flaw Testing” on page 61.

5.4 Thickness Gauging

Perform the following steps to establish a basic thickness-gauging mode for the Sitiescan 240. Units shown are in metric. For inch units, select INCHES from the UTIL menu and use the corresponding values for the parameters.

1. Select a suitable transducer, preferably a 5MHz, half inch diameter broadband type.
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 that of the test piece.

- c) RANGE to 125 or other suitable value to cover the test range of interest.
 - d) DELAY to 0.00
 - e) GAIN to 50.0
5. In the AMP menu, set the following parameters:
- a) FREQ to 5.0 MHz
 - b) DETECT +VE HW
 - c) REJECT to 25 (If required for noise removal.)
 - d) PRF to 1000Hz
6. In the GATE1 menu, set the following parameters:
- a) STATE to +VE
 - b) START to 10
 - c) WIDTH to 50 or other suitable value to cover the test range of interest.
 - d) LEVEL to 25.0
7. In the MEAS menu, set the following parameters:
- a) MODE to DEPTH
 - b) TRIGGER to FLANK
 - c) HUD to DIST

6. Detailed Operation Instruction

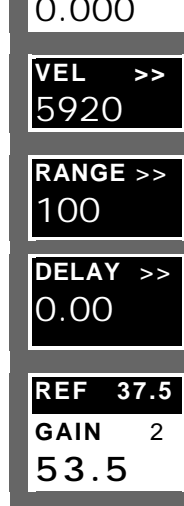
Before proceeding with this section, the user should be familiar with the front panel controls described in Section 5.1 on page 21. It is also assumed that the user has a good understanding of the theory and practice of ultrasonic testing.

6.1 *Basic Menu Functions*

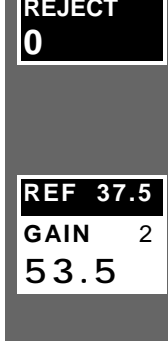
At power on, an information screen is displayed momentarily showing the instrument serial number, program rendition, and software version number while a self-test is performed. After the self-test, the Main menu is displayed above the A-Trace display and the CAL menu is highlighted. The CURL and CURR buttons can be used to move the highlighted cursor through the menu selections.

To the right of the A-Trace are four parameter boxes for the highlighted submenu and the REF/GAIN box that always appears at the bottom right.

- offsets that are inherently different for each transducer/probe. Units are microseconds in both mm and inch modes.
- VEL** 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** Used to set the full screen width of the horizontal A-Trace in mm, inches, or microseconds depending on the Units chosen in the FN UTIL menu. The range is 5mm to 10 meters (.20"-400").
- 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 0 to 10 meters (0-400").



DETECT	Used to set the video detection and display mode for the desired rectification of the signals from RF, -VE HW (negative half-wave), +VE HW (positive half-wave), and FW (full-wave).
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.
PRF MAX	Used to set the maximum pulse repetition frequency that may be reduced for large values of display range and delay. Selectable values are 35, 63, 150, 250, 500, and 1,000Hz. Lower values will reduce ghosting and noise echoes.

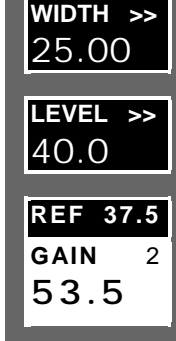


threshold level. Usually used to monitor for loss of back wall echo.
EXPAND: Expands the gate width to fill the horizontal display width.
Only applies to gate 1.
OFF: Switches the gate off.

START Used to 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.

WIDTH Used to set the width of the gate. Units are mm or inches and range is from 0.15mm (0.001in, 0.05 μ sec), depending on the range selected, to the full time base of the horizontal display.

LEVEL Used to adjust 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.

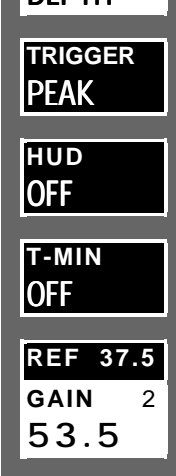


DEPTH MODE: In this mode, gate 1 functions as a depth or thickness monitor and displays the depth (D:) and height (H:) of the first signal after the start of the gate that reaches or exceeds the gate level threshold. Values are displayed in a highlighted box below the A-Trace.

TRIGGER Used to select the depth or thickness measurement to the **FLANK** (left edge) or **PEAK** of the first echo after the start of the gate.

HUD When turned ON, provides a large, Head-Up Display of the depth or thickness reading at the top right of the A-Trace. Only available in DEPTH and E-E modes. In DEPTH mode, the amplitude is also displayed up to 100%. The INC button sequences the selection from distance to amplitude to off.

T-MIN When 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 the DEPTH mode.



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.

TRIG
MODE: The TRIGonometry mode is used with angle beam transducer/probes 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/probe.

THICK Set to the thickness of the material being tested to account for multiple skips of the angled sound beam in the test material.

G1-G2
MODE 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,

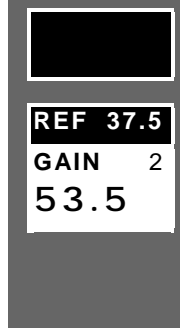
probe case. This is used by the TRIG function in MEAS menu to give the surface distance.



When highlighted, this cursor allows main menu to be selected by pressing the CURR control.



When highlighted, this cursor allows the first main menu by pressing the control.



the screen display will be sent to the printer when the OK button is pressed.

LIST CPY With the Print mode in List Copy, all the calibration settings, the screen and all notes in the Edit feature will be sent to the printer display when the OK button is pressed.

A_LOG In the A-Log print mode, all of the stored A-Scans that are valid will be printed when the OK button is pressed, along with the calibration settings and notes. This can take considerable time if all 100 A-Scans are stored.



and transducer/probe zero. Gate 1 is used to select the reference echoes. The calibration procedure is described fully in Section 6.5.2 on page 83.

- DIST1** The actual distance to the first or thinnest reference echo in the calibration block.
- DIST2** The actual distance to the second or thickest reference echo in the calibration block.
- ACCEPT** After pressing OK to accept DIST1 and DIST2. Press OK when ACCEPT CAL is highlighted
- START** Used to adjust the start of the gate to assure that the first and second echoes are measured.



ON Displays the DAC curve on the screen.

MODE:

CURVE Used to display the DAC curve alone or with -6/-12 dB reference curves or -6/-14 dB reference curves.

TRIGGER Used to select alarm level threshold for the DAC curve, or the -6dB curve or the -14/-12 dB curve or the gate.

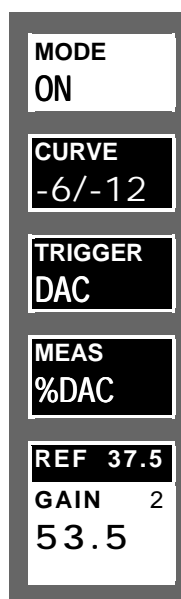
MEAS Used to select the measurement value in dB, % fsh or %DAC for any signal that is in the curve or gate.

DRAW Used to create the DAC curve.

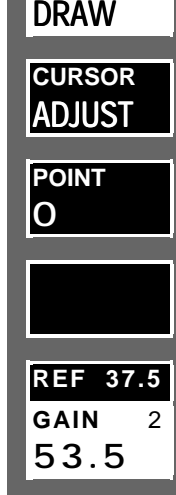
MODE:

CURSOR Used to move the cursor over the reference echo for which a DAC point is being set.

POINT Display only. Shows the last point created after pressing the OK button.



- MODE:** the gain. Can be activated in filtered or rectified display modes.
- CURVE** When switched ON, the TCG curve is displayed.
- DRAW** Used to create the TCG curve.
MODE: Cannot be drawn in RF display mode.
- CURSOR** Used to move the cursor over the reference echo for which a TCG point is being set.
- POINT** Display only. Shows the last point created after pressing the OK button.



SET MODE: Used to set up the AWS measurement mode.

REF Used to set the Indication Level.

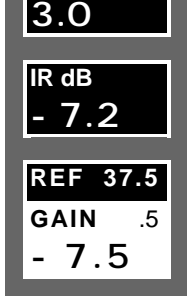
CURSOR Used to move the cursor over the reference echo to set the reference level.

MEAS MODE: Used to make measurements in accordance with the code.

IL dB The dB required setting the indication to the reference level.

AF dB The attenuation factor to correct for the depth of the indication.

IR dB The indication rating calculated in accordance with the code. Also the difference the IL and the reference level with correction for attenuation.



DGS / AVG

For information on use of the DGS method and associated menus refer to the supplemental manual supplied with this option

when in μ s mode, the velocity is fixed at 2000 m/s (5000 in/ μ s) and is not adjustable.

CLICK When on, a beep will sound to confirm each button press.

ALARM When set to AUDIBLE, a buzzer will sound during any gate alarm.

SMOOTH When switched on the signal is displayed as an envelope, this can help interpretation on long ranges.

MUTE

**SMOOTH
ON**

REF 37.5

**GAIN 2
53.5**

reducing battery life

BRIGHTness
(Colour
Display

Controls the display brightness. The level selected will affect the battery duration. A value of 1 gives about 10 hours, whereas a value of 20 will give about 5 hours of operation, assuming the battery is in good condition and at room temperature.

CONTRAST
(LCD)

Adjusts the display contrast for best visibility

VIDEO

Select NTSC (USA) or PAL (UK/Europe) composite video output modes. The screen update rate is 50Hz in PAL and 60Hz in NTSC. NTSC mode will be slightly brighter.

GRATICULE

Selects different graticules from **OFF**-no graticule. **FULL** - a complete 100% graticule. **SPARSE** - a row of dots at 10% intervals. **50%** - divisions at 50% full screen height. **50%+** - larger 10% width divisions. **50%++** even larger 10% width divisions



This menu controls the analog and digital proportional outputs. Two outputs are provided one for depth and one for amplitude. The outputs are active when the associated gate is triggered. Switching on the outputs will reduce battery duration. Set to OFF when not being used.

Note: On the Colour model, a right facing carat shows a further menu CLOCK.

- MODE: OFF Outputs switched off

- MODE: O/P Outputs updated at 50-100 Hz, 60 or 120 Hz; depending on Video mode selected. When selected, the signal resolution and measurement accuracy is reduced.

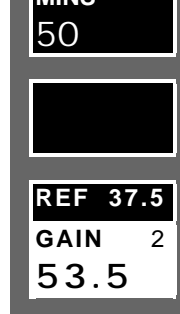
- O/P 1 Select depth output for DEPTH1 (Gate1), DEPTH2 (Gate2), or E1-E2, the distance between the two depth measurements.

- O/P 2 Select the amplitude output for LEVEL1 (Gate1), LEVEL2 (Gate2), or L1-L2, the difference between the two amplitudes.

- TRIGGER Sets the depth output to trigger on echo PEAK or echo FLANK, the same as for measurement readout.



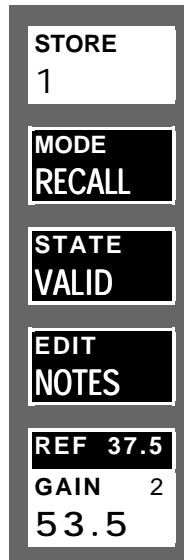
SET Used to set the current date.
DATE: (Selected by pressing TIME key,
then DEC)
DATE Used to set the current day
number.
MONTH Used to set the current month
number.
YEAR Used to set the current year.



NOTE: Be sure to press OK to save the new CLOCK settings.

setting. The use of this feature is described fully in Section 6.3 on page 57.

- STORE** Used to select a storage location (1-20).
- RECALL MODE:** Used to recall a stored calibration set to the active memory. Press OK to recall.
- DELETE MODE:** Used to delete a VALID (used) calibration set. Press OK to delete. Press OK again after the confirmation prompt.
- LIST MODE:** Shows the notes associated with the stored calibration set. Pressing OK will recall the calibration set at which time the Notes can be edited.
- INDEX MODE** Lists all memories, use INC & DEC to change 'page'. Cancelled by scrolling past the end
- STORE MODE:** Stores the current calibration settings in memory to the selected Store set. Press OK to store. Press OK again after the confirmation prompt.
- STATE** Display only. VALID indicates that the store location is used. EMPTY indicates that it is not used. To change VALID to EMPTY, use the DELETE function.



CAPITAL CHARACTER & NUMBERS Press any key on the keyboard to edit the capital characters, the same applies to numbers.

SMALL CHARACTER & SIGNS Press SHIFT + the wanted character or sign.

INSERT A SPACE Press the SPACE KEY to insert a blank character at the position the cursor is currently on.


DELETE CHARACTER Press the Back-Space KEY to delete the previous character to the position the cursor is currently on.

DELETE CHARACTER Press DEL KEY to delete the character under the cursor

NEXT LINE Press ENTER KEY to move cursor to the next line.

UP ARROW Press the  KEY to move the cursor up.

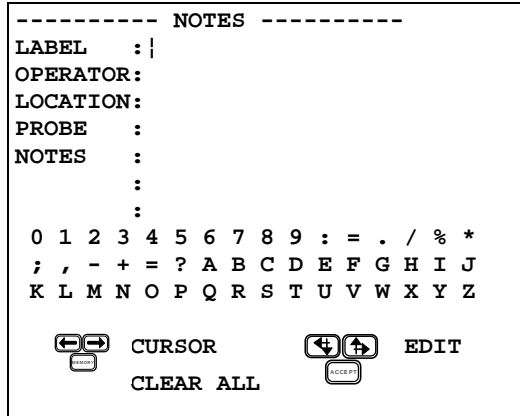
DOWN ARROW Press the  KEY to move the cursor down.

LEFT ARROW Press the  KEY to move the cursor left.

EXIT

Press the **Esc** KEY to exit back to the PANEL or A-LOG menu. Store the calibration set to save the notes.

- INSERT CHAR Inserts a blank character space before the one the cursor is currently on.
- DELETE CHAR Deletes the character under the cursor.
- EXIT Exits back to the PANEL or A-LOG menu. Store the calibration set to save the notes.



Edit Notes Window

(Typical for the PANEL and A-LOG menu)

RECALL
MODE: Used to recall a stored A-Scan and settings to the active memory. Press OK to recall. The display comes up in FREEZE mode. Press FZ/PK to remove.

DELETE
MODE: Used to delete a VALID (used) A-Scan and its settings. Press OK to delete. Press OK again after the confirmation prompt.

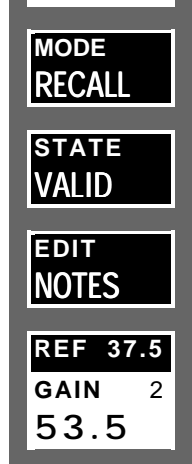
LIST
MODE: Shows the notes associated with the stored A-Scan and its settings. Pressing OK will recall the calibration set at which time the Notes can be edited.

INDEX
MODE Lists all memories, use INC & DEC to change 'page'. Cancelled by scrolling past the end

STORE
MODE: Stores the current A-Scan and its settings in memory to the selected Store set. Press OK to store. Press OK again after the confirmation prompt.

STATE Display only. VALID indicates that the store location is used. EMPTY indicates that it is not used. To change VALID to EMPTY, use the DELETE function.

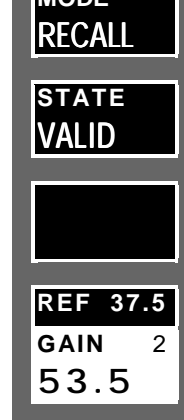
EDIT: (See notes editing summary in PANEL above.)



LIST MODE: Shows the notes associated with the stored A-Scan. Pressing OK will recall the waveform.

OFF MODE: Used to remove a Reference waveform. Set MODE to OFF, and press OK.

STATE Display only. VALID indicates that the store location is used. EMPTY indicates that it is not used.



BLOCK Used to select the block number (1-14) for storage or viewing of a thickness reading.

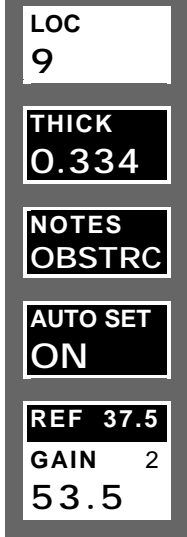
LOC Used to select the location number for storage or viewing of a thickness reading.

NO The individual thickness reading number into which a thickness reading is stored. Increments automatically when storing a reading by pressing the OK button.

THICK The thickness reading stored in the BLOCK-LOC-NO. If blank, there is no stored thickness in that particular three level code.



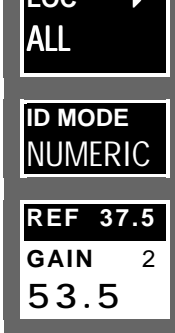
LOC	Used to select the location number for storage or viewing of a thickness reading.
THICK	The thickness reading stored in the LOC. If blank, there is no stored thickness in that number.
NOTES	One of four notes can be selected or blank. OBSTRC for obstruction, PITTING, POOR S/C for poor signal or Couplant, and NO BWE for no back wall echo.
AUTO SET	Allows selection of the auto calibration feature if the downloaded sequence contains PANEL store numbers. The Sitiescan 240 can then be automatically calibrated to one of twenty panel settings for selected sequence numbers.



BLOCK Used to select the block number for printing or deletion. Decrement below 1 to select ALL blocks for printing or deletion.

LOC Used to select the location number for printing or deletion. Decrement below 1 to select ALL locations for printing or deletion.

ID MODE Select NUMERIC or SEQUENCE Mode for Data logging



	MEASurement	↓MODE↓			
		MONITOR			
		DEPTH	TRIGGER	HUD	T-MIN
		E-E	TRIGGER	HUD	BLANK
		TRIG	TRIGGER	THICK	
		G-G	TRIGGER	HUD	
	PROBE	ANGLE	X_OFFSET		
	PRINT	↓MODE↓			
		DISPLAY			
		LIST CPY			
		A-LOG			
FN	A-CAL	DIST1	DIST2	ACCEPT	START
	DAC	↓MODE↓			
		ON	CURVE	TRIGGER	MEAS
		DRAW	CURSOR	POINT	
	TCG	↓MODE↓			
		OFF	REF		
		SET	REF	CURSOR	
		MEAS	IL dB	AF dB	IR dB
	AWS	↓MODE↓			
		ON	CURVE		
		DRAW	CURSOR	POINT	

		DATE	DATE	MONTH	YEAR
MEM	PANEL	STORE	↓MODE↓		
			STORE	STATE	EDIT*
			RECALL	STATE	EDIT*
			DELETE	STATE	EDIT*
			LIST	STATE	
			INDEX	STATE	
	A-LOG	STORE	↓MODE↓		
			STORE	STATE	EDIT*
			RECALL	STATE	EDIT*
			DELETE	STATE	EDIT*
			LIST	STATE	
			INDEX	STATE	
	REF	STORE	↓MODE↓		
			RECALL	STATE	
			OFF	STATE	
			LIST	STATE	
	T-LOG (NUM)	BLOCK	LOC	NO	THICK
	T-LOG (SEQ)	LOC	THICK	NOTES	AUTOSET
	T-FN	↓MODE↓			
		PRINT	BLOCK	LOC	NUM/SEQ
		DELETE	BLOCK	LOC	NUM/SEQ

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 SITESCAN 240’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/probe identifier. It is possible to store up to twenty sets of panel settings; each assigned a set number from one to twenty. A set of panel settings can be printed after the set is recalled to active memory by using the LIST CPY function in the PRINT menu.

To store a panel set:

1. Press the MEM button to access the Memory menu.
2. Use the CURL and CURR buttons to highlight the PANEL menu.
3. If it is desired to store Notes with the panel settings, see the description for entering notes below.
4. Select the STORE box and, using the UP/RT and DN/LT buttons, select a desired STORE number from one to twenty. Note that as the STORE number is changed, the STATE parameter indicates if the number is used (VALID) or EMPTY.
5. Select the MODE box and using the UP/RT and DN/LT buttons, select the STORE mode.

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 menus by using the NOTES feature.

When a panel calibration set or waveform is to be stored, first calibrate the instrument as desired, or capture the waveform by pressing the yellow FZ/PK button. Then select the EDIT NOTES box in the menu and notice that the window shown below overlays the display area.

The LABEL line is 8 characters long, and is used by the WAVESTORE interface program as a file name for storing to disk. The OPERATOR, LOCATION and PROBE lines are 25 characters each, while the three NOTES lines allow up to 75 characters.

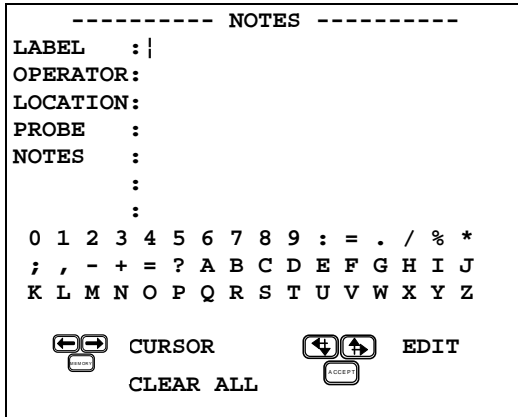
The blue CURL and CURR buttons are used to move the cursor from right to left along a line of text. The yellow button adjacent to the NEXT LINE box is used to advance the cursor down to the next line. When the cursor is at the bottom line, the NEXT LINE function moves it back to the top line.

To delete a character, position the cursor over it and press the yellow button adjacent to the DELETE CHAR box. To clear all of the text in the NOTES window, press the yellow MEM button.

To insert a character space, position the cursor to the right of the desired insert location and press the yellow button adjacent to the INSERT CHAR box.

but not stored. It is now necessary to store the notes using the methods outlined in the PANEL and A-LOG sections.

If a stored PANEL or A-LOG is recalled, its notes will be loaded into the window. The notes can then be viewed and edited using the same procedure detailed above.



*Edit Notes Window
(Typical for the PANEL and A-LOG menu)*

NOTE: When notes are displayed, the menu cursor buttons are disabled. Exit the Notes window to change to another menu.

calibration of the instrument. The following are the basic guidelines for accurate flaw detection but the user is referred to Section 1.3 on Operator Training for advice on seeking in-depth training.

Transducer/probes 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/probe is used for general-purpose flaw detection. The angle beam transducer/probe is used for weld inspection, which is covered in Section 6.4.4 on page 69, and Section 6.4.4 on page 69. Other specialty transducer/probes 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

1. Detect parameter to FW and the Contour parameter to a value to obtain the desired “filling” of the echo. Set the Reject parameter to zero or some small value up to 10 to eliminate noise from the baseline. Do not set the Reject parameter so high as to preclude the detection of small echoes from discontinuities.

For weld inspection using an angle beam transducer/probe, follow the instructions in Section 6.4.4 on page 69.

For storage and printing of A-Scans, refer to Section 6.4.6, A-LOG, A-SCAN Storage on page 77.

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 Section 6.4.3 on page 66 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 the following instructions:

1. Establish the basic calibration of the Sitiescan 240 using the desired transducer/probe and the proper reference block.
2. From the FN menu, select the DAC feature.
3. Select the MODE parameter by pressing the yellow button next to it and use the INC button to select DRAW. The other parameters will now be CURSOR and POINT. Note: When in the MODE parameter, only press the DEC button to turn the DAC off. This will erase any logged echoes.
4. The DAC system is now ready to accept reference points. Position the transducer/probe 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/probe pressure.

(10) points can be recorded for a DAC curve.

8. Press the yellow button adjacent to MODE and use the DEC button to select ON mode. The DAC curve will now be displayed and the other parameters will change to CURVE and TRIGGER

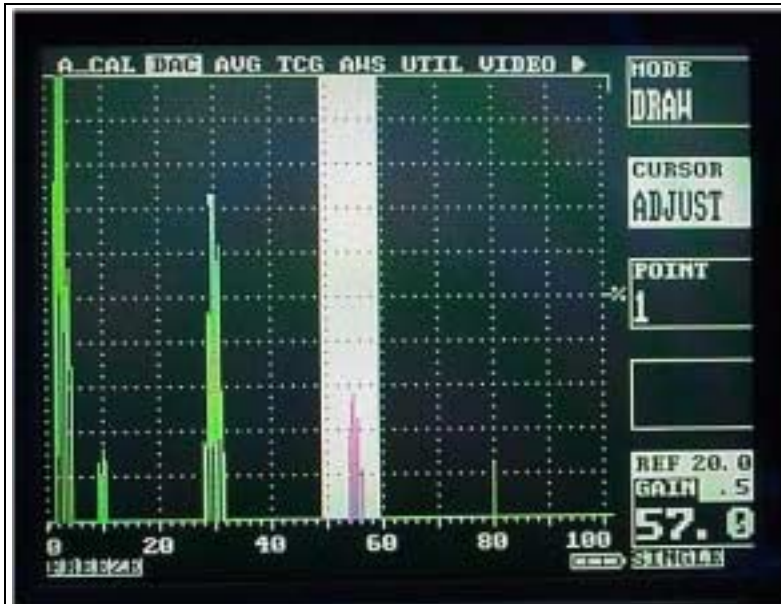


Figure 12 – Cursor Selection of Echoes for DAC

curve. The latter being whichever one is selected in the CURVE parameter.

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. Note that the relative dB display is dependent on the REF gain setting, but not the GAIN setting.

To turn off the DAC feature, select the MODE parameter from the DAC menu and press the DEC button until OFF is indicated.

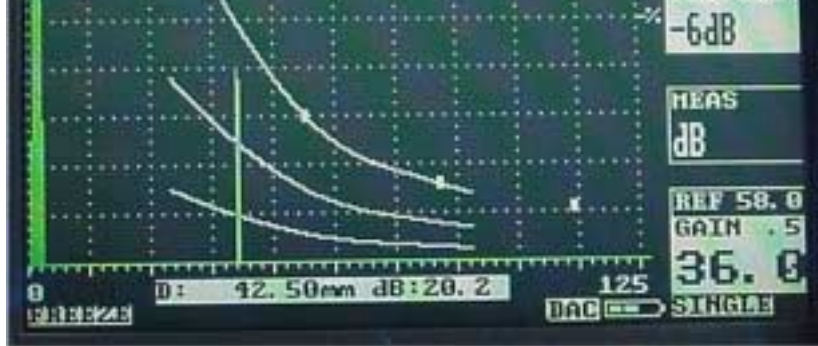


Figure 123 – DAC Curve and -6dB/-14dB Curves

6.4.3 TCG Operation

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.

4. The TCG system is now ready to accept reference points. Position the transducer/probe 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/probe pressure.
5. Use the INC and DEC buttons to position the bright cursor bar over the echo from the reference hole.
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 echo at about 80% amplitude.
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/probe pressure. A maximum of ten (10) points can be recorded for a DAC curve.

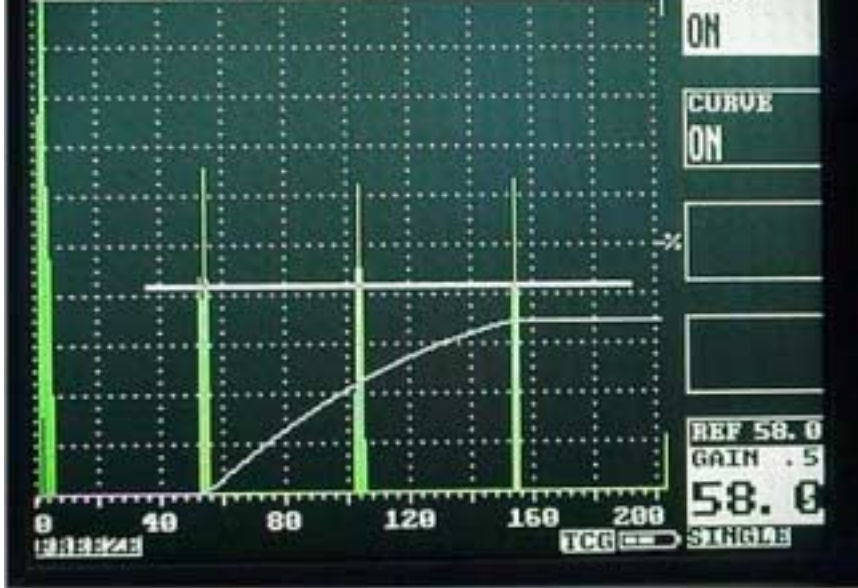


Figure 134 – Equalization of Echoes Using TCG

9. Use the CURVE parameter and the INC button to select ON or OFF for the display of the TCG curve.

NOTE: A TCG curve cannot be drawn while in RF display mode (DETECT-RF), but can be activated. Therefore, if TCG is desired in RF display mode, draw the curve in rectified mode first and then switch to RF. It should be noted that the range of TCG is limited only by the dynamic range of 40dB.

transducers. Essentially, the trigonometry mode uses the thickness gauging features of the Sitiescan 240 to calculate the surface distance and depth to a discontinuity from the actual beam path measured. This is

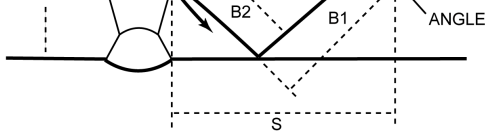


Figure 145 – Trigonometry Mode Measurements

accomplished by calibrating the trig mode with the actual refracted angle of the transducer/probe 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 Figure 14.

These measurements are displayed below the A-Trace on the Sitiescan 240 as follows:

- ↘ Beam path distance B from the central exit point on the transducer/probe to the discontinuity, the sum of B1 and B2 in double skip mode.
- Surface distance S from the central exit point on the transducer/probe 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.

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

1. Using a suitable IIW or other calibration block, measure and establish the central sound beam exit point and actual refracted angle for the transducer/probe being used.
2. Establish the zero and velocity (span) for the transducer and material under test using the A-CAL procedure described in Section 6.5.2 on page 83. 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 menu (Section 6.5.2 paragraph 4), 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.
3. Set the START and WIDTH of Gate1 to encompass the desired testing region.
4. From the Main menu, select MEAS and place the MODE to TRIG.
5. Set the TRIGGER parameter to PEAK.
6. From the MAIN MENU, select PROBE to choose the ANGLE parameter and using the INC and DEC buttons, set the refracted angle of the transducer/probe measured in step 1 above.

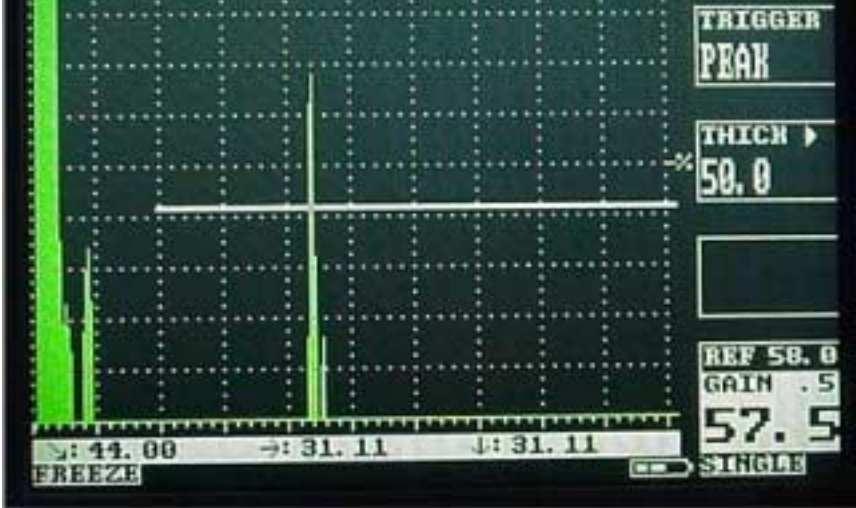


Figure 156 – Trigonometry Mode Measurements

- and you are using a multiple skip mode of angle beam testing.
8. When measuring a discontinuity, position the transducer/probe so as to obtain the maximum amplitude signal before recording the readings. A typical TRIG mode display is shown in Figure 15 above.

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 that will simultaneously indicate beam path, surface distance and depth distance at the bottom of the graticule. The AWS menu will not operate with either the DAC or TCG switched on.

To set up the AWS measurements, perform the following:

1. Calibrate the SITESCAN 240 for weld testing and set up the trigonometry mode by following the steps in Section 6.4.4 on page 69.
2. From the FN menu, select AWS and place the MODE to SET.
3. Highlight REF on the 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 ADJUST CURSOR and using the INC and DEC arrow keys.
6. With the signal maximized, press the ACCEPT key.

The SITESCAN 240 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 menu, highlight MODE and select MEAS.

where:

- IL: Indication Level is the dB setting required to bring an indication to the reference level.
- RG: Reference Gain is the dB setting of the calibrated reference indication as a function of the reference standard and probe being employed.
- AF: Attenuation Factor is the attenuation factor required by the AWS standard and is: Depth in inches minus 1, multiply by 2 and then rounded to the nearest $\frac{1}{2}$ dB.
- IR: Indication Rating is 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 SITESCAN 240 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.

unfreeze the display after recording and the Sitiescan 240 is ready to repeat the same inspection. Be sure to use the same transducer that was use for the original recording.

To store an A-Scan:

1. Establish the basic calibration of the Sitiescan 240 using the desired transducer/probe and the proper reference block.
2. From the MEMORY menu, select the A-LOG feature.
3. Select the STORE parameter by pressing the yellow button next to it and use the INC and DEC buttons to select a store location. The STATE parameter shows whether the store location is VALID (used) or EMPTY. Be careful not to store over a valid location unless you desire to erase what is there and replace it with the current A-Scan and settings.
4. Select the MODE parameter by pressing the yellow button next to it and use the DEC button to select STORE.
5. Obtain a desired echo from a discontinuity or reference block.

Optionally press the FZ/PK button to freeze the display before storing it. If you regularly use the FZ/PK button to freeze the display before storing it, you can obtain the echo first (Step 5) and then go to the A-LOG menu and select the location and function (Steps 2-4).

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.

6. To use the echo dynamic pattern feature, position the transducer/probe just off one side of the indication. Press the

desired notes for the stored A-Scan and its settings. See the section *Adding NOTES to PANEL and A-LOG sets* on page 59. When finished adding notes, press the yellow button next to the STORE parameter to return A-LOG menu.

To recall an A-Scan:

1. From the MEMORY menu, select the A-LOG feature.
2. Select the STORE parameter by pressing the yellow button next to it and use the INC and DEC buttons to select the desired store location to be recalled. The STATE parameter shows whether the store location is VALID (used) or EMPTY.
3. Select the MODE parameter by pressing the yellow button next to it and use the DEC button to select STORE.
4. Press the OK button to recall the waveform and instrument settings. This may tack a couple of seconds at which time the instrument will return to the main menu and the display will be in Freeze mode. To return to normal testing mode with the recalled settings, press the FZ/PK button twice.
5. Alternately, you may review the notes pages stored with each A-LOG to determine which set you want to recall. Set the MODE to LIST and using the STORE parameter, move through each one to view the Notes page. When the desired A-LOG is found, press the OK button to recall it. To remove the notes review window, set the MODE back to STORE, RECALL or DELETE.

NOTE: When notes are displayed, the menu cursor buttons are disabled. Switch off list mode to change to another menu.

6.4.7 REF, Reference Waveform Comparisons

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 graticule 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 an A-Scan as a reference waveform:

1. In order for a reference waveform to be recalled, the required trace must first be stored into an A-LOG store.
2. From the MEMORY menu, select the REF feature.
3. Select the STORE parameter by pressing the yellow button next to it and use the INC and DEC buttons to select a store location. The STATE parameter shows whether the store location is VALID (used) or EMPTY.
4. Select the MODE parameter by pressing the yellow button next to it and use the DEC or INC button to select RECALL. If set to LIST, the note associated with the reference waveform will be displayed.
5. Press the OK button to display the reference waveform on the graticule. The reference waveform will be a different colour as

storing the reference waveform in A-LOG must match that used for the comparison of real time signals to the reference waveform. The reference waveform cannot be displayed in video colours 0 and 1 (All white and all yellow).

6.4.8 *Contour & Peak Echo Dynamics*

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 Sitiescan 240 incorporates a unique Peak feature that, while activated, stores all of the signal excursions on the display using a fill technique.

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/probe 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/probe just off one side of the indication. Press the FZ/PK button twice to activate the Peak mode which is indicated by a box displaying PEAK below the graticule. Move the transducer/probe past the indication to fill-in the envelope pattern. In the case of angle beam testing, it is advisable to rotate the transducer/probe slightly and move it from side to side while

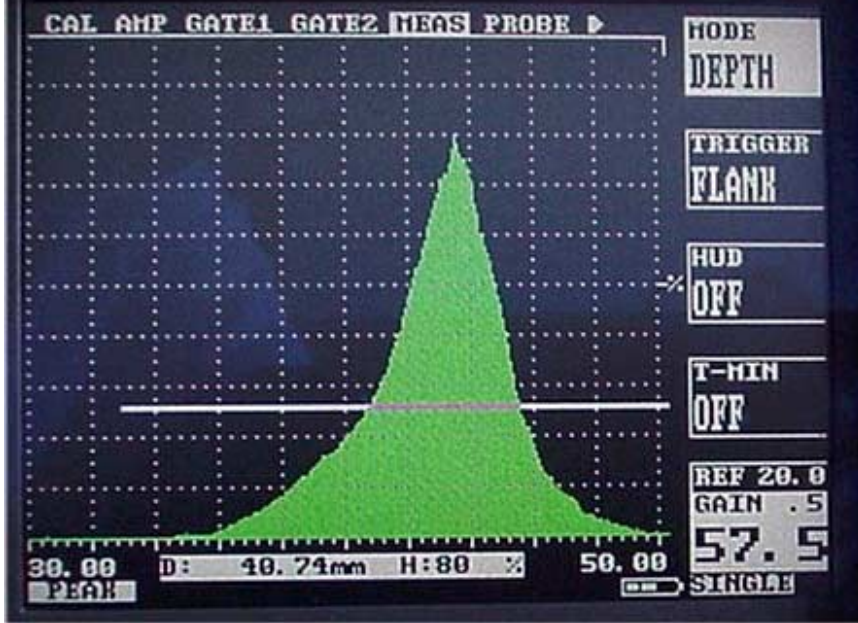


Figure 167 – Peak Echo Dynamics

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 Section 6.4.6 on page 74.

seeking in-depth training.

There are three types of transducer/probes used in ultrasonic thickness gauging, all employing the straight or longitudinal beam method. The single element contact transducer/probe is used for general purpose thickness gauging where material thickness is generally expected to be above 2.5mm. The delay line contact transducer/probe is used for measuring thin material down to 0.5mm where the surfaces are clean and parallel. The dual element contact transducer/probe is used for moderately thin materials down to about 1.0mm where the surfaces may be irregular and not necessarily parallel. The dual transducer/probe is most commonly used for corrosion thickness inspection where its ability to obtain echoes from pitting is superior. Nevertheless, dual transducer/probe 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/probe usually incorporates a slight included angle on both the transmit and receive side, resulting in a small non-linearity of the measurements. For this reason, dual transducer/probe thickness testing is usually calibrated and performed over a limited thickness range.

Regardless of the type of transducer/probe 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" echoes as shown in Figure and Figure .



Figure 18 – Broadband Echo



Figure 19 – Narrowband Echo

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 Sitiescan 240 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/probe zero point. Then the Sitiescan 240 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. In the CAL menu, select the proper Range and Delay so those echoes from the range of thickness can be viewed.
3. From the AMP menu, set the Frequency to the nominal value of the transducer/probe and set the detection mode to RF.
4. Set the Mode to Single for delay line and single element transducer/probes and to Double for dual element transducer/probes.
5. Couple the transducer/probe to a mid-range thickness section on the calibration block and obtain an echo.
6. From the AMP menu, set the Detect parameter to either -VE or +VE, depending on which half of the RF provides the best half-cycle. Ideally, one side of the RF echo should have a first half-cycle which is higher in amplitude than the remaining half-cycles.
7. Adjust the gain to set the echo at about 80% amplitude and increase the Reject parameter to remove any undesirable noise from the baseline.
8. From the GATE1 menu, set the gate to ON +VE and adjust the Start and Width so that the gate encompasses the thickness range of interest. Place the transducer/probe between the thin and thick area on the calibration block to verify proper coverage. Adjust the Level parameter to about 30% of full screen.
9. From the MEAS menu, set the Mode parameter to DEPTH and the Trigger parameter to FLANK.

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.

When using a delay line transducer/probe, there are two modes of measurement: a) Interface to first return echo, and b) multiple echo mode which usually measures from the first to the second return echoes after the interface echo.

1. Follow steps 1-7 above.
2. From the MEAS menu, set the Mode to E-E for echo to echo measurement. You will notice that a second gate bar appears below Gate1 and that its start point is slightly to the right of Gate1. This is the Blocking gate explained below.
3. For measuring from interface to first echo, position the start of Gate1 before the interface echo. Using the Blank parameter in the MEAS menu, position the start of the second gate just after the interface echo but before the thinnest expected first echo.
4. For measuring multiple echoes after the interface, position the start of Gate1 just after the interface echo. Using the Blank parameter in the MEAS menu, position the start of the second gate just after the first echo but before the thinnest expected second echo.
5. The Blank 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

A-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/probe caused by wearface 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/probe 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 A-CAL feature automates this process so that only two readings are required, one on the thin sample and one on the thick sample. The SITESCAN 240 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/probe is changed (zero); this procedure must be repeated. Using this calibration function results in faster calibration of the instrument and more accurate measurements.

The A-CAL calibration procedure is as follows:

1. 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

4. From the Main menu, select MEAS and place the MODE to DEPTH.
5. From the FN menu, select the A-CAL menu.
6. Select DIST1 using the adjacent yellow button. Adjust the value using the INC and DEC buttons to the known thickness of the thin sample.
7. Place the transducer/probe on the thin reference sample and obtain an echo. Adjust the gate start if necessary to obtain distance readout of the echo.
8. Press the OK button to log the echo.
9. Select DIST2 using the adjacent yellow button. Adjust the value using the INC and DEC buttons to the known thickness of the thick sample.
10. Place the transducer/probe on the thick reference sample and obtain an echo. Adjust the gate width if necessary to obtain distance readout of the echo.
11. Press the OK button to log the echo.
12. Select ACCEPT CAL using the adjacent yellow button.
13. Press the OK button. The transducer/probe 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

is a convenient method for determining the velocity of sound in an unknown material. Once the Sitiescan 240 is calibrated on a know material, all that needs to be know is one fixed thickness point and the velocity can be determined.

6.5.3 *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 Sitiescan 240. 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 Section 6.4.3 on page 66.

6.5.4 *T-LOG Thickness Storage (Numeric)*

The T-LOG menu provides a convenient method to store thickness readings for record keeping and analysis. The maximum number of readings that can be stored is 2,000. When using the default *Numeric* mode selected from the T-FN menu, each thickness reading is stored under a three level code. The top level is the BLOCK number which can be 1 to 14. This is followed by

To store readings, follow these simple steps:

1. Set up the instrument for the thickness measuring mode as described in Section 6.5.1 on page 79.
2. From the MEMORY menu, select the T-LOG menu.
3. Use the corresponding yellow buttons to select BLOCK, LOC, and NO in turn and INC or DEC the value to obtain the desired location number for storing the thickness.

Note: If a value shows in the THICK box, then a reading has already been stored in that location. Continuing will overwrite that value with the new thickness reading.

4. Obtain the desired thickness reading and press the blue OK button to log the reading. Notice that the NO value automatically increments to the next reading number.
5. To review a reading, select the desired BLOCK, LOC and NO to identify the location. The value in the THICK box shows the reading stored for that location. To print or delete readings, use the T-FN menu.

6.5.5 T-LOG Thickness Storage (Sequential & Download)

The Sequential mode of thickness storage allows readings, locations and notes to be transferred between a computer and the SITESCAN 240.

Typically, the user would create a thickness location sequence on the computer and download it to the SITESCAN 240, which can then

To use the Sequence/Download mode, follow these steps:

1. Using suitable software or text editor, generate a location sequence on the host computer. Each location is comprised of a location number (1 to 2000) and a text string of 32 characters. The text strings of 32 characters are subsequently displayed on the SITESCAN 240 as two lines of 16 characters each in a window at the top left of the screen, when the SITESCAN 240 is in the Sequence mode. Generally, the first 16 characters are used to identify the location so as to direct the operator to the proper point for a thickness reading. The second 16 characters are for general use and can be used for the historical readings or baseline readings if this is the first inspection of the component. Character position 23 is reserved for and identifies the PANEL store (1 to 20) to RECALL if AUTO-SET mode is ON.

Note: The protocol for the location sequence and methods for transferring the data to the SITESCAN 240 are fully described in the Communications Manual, stock number 147239.

Note: A software program is available from Sonatest to perform the programming of sequences and the uploading and downloading of data to the SITESCAN 240.

2. Turn on the Sequence mode by pressing the MEM button, selecting the T-FN menu using the blue arrow buttons, pressing the yellow select button next to the ID MODE option, and using the INC button to select the SEQUENCE mode. Once selected, the graticule will reduce in size and a window

4. From the MEMORY menu, select the T-LOG menu.
5. If Auto Calibration is desired, press the yellow select button next to the AUTO SET option, and using the INC button, select ON. AUTO SET can only be used if the downloaded location data contains a PANEL store value (A to T) at character position 23 in the data text string, corresponding to a PANEL store location (1 to 20).

Note: If a value shows in the THICK box, then a reading has already been stored in that location. Continuing will overwrite that value with the new thickness reading.

6. Obtain the desired thickness reading and press the blue OK button to log the reading. Notice that the LOC value automatically increments to the next reading number. Any historical reading downloaded from the computer will show in the window on the screen for comparison purposes.
7. To attach one of the four available notes with the reading, press the yellow select button next to the NOTES option, and using the INC or DEC buttons, select OBSTRC (obstruction), PITTING, POOR S/C (poor signal/couplant), or NO BWE (no backwall echo).
8. To review a reading, select the desired LOC number to identify the location. The value in the THICK box shows the reading stored for that location. To print or delete readings, use the T-FN menu.

The T-FN menu provides capability for the printing and deletion of thickness reading stored with the T-LOG feature. With the T-FN feature, it is possible to print or delete a single Location reading, all Locations within a Block, or all Blocks.

To print a single Location:

1. Make sure that the printer is properly connected to the serial port, turned on and on-line.
2. Select the T-FN menu from the MEMORY menu.
3. Select the MODE parameter by pressing the yellow button next to it and pressing the INC button to select PRINT mode.
4. Select the desired Block number by pressing the yellow button next to the BLOCK parameter and using the INC or DEC buttons.
5. Select the desired Location number by pressing the yellow button next to the LOC parameter and using the INC and DEC buttons.
6. Press the OK button to print the thickness reading for the selected Location.

To print all Locations in a single Block:

1. Make sure that the printer is properly connected to the serial port, turned on and on-line.

5. Set the Location number to ALL by pressing the yellow button next to the LOC parameter and using the DEC button if not already selected.
6. Press the OK button to print the thickness reading for the selected Block.

To print all Blocks and all Locations:

1. Make sure that the printer is properly connected to the serial port, turned on and on-line.
2. Select the T-FN menu from the MEMORY menu.
3. Select the MODE parameter by pressing the yellow button next to it and pressing the INC button to select PRINT mode.
4. Set the Block number to ALL by pressing the yellow button next to the BLOCK parameter and using the DEC button if not already selected. The Location number will be automatically set to ALL
5. Press the OK button to print the thickness reading for all of the Blocks and Locations.

To delete any or all Locations or Blocks, follow the instructions above for printing except set the MODE function to DELETE instead of PRINT.



Figure 170 – Lithium-Ion Battery Box

7.1 Lithium-Ion Battery Pack

When fully charged, the battery pack should enable the unit to be operated for 8 hours, (Significantly longer with the LCD display) under typical operating conditions. The battery pack can be charged while mounted to the Sitescan 240 by use of

The Sonatest CH700 battery charger shown in Figure 181 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 Y-04.



Figure 181 – Battery Charger

WARNING – CHARGER ONLY - The CH700 is a battery charger only. Any attempt to use it to power a DFD Lite, without a battery fitted, **WILL** damage your CH700.



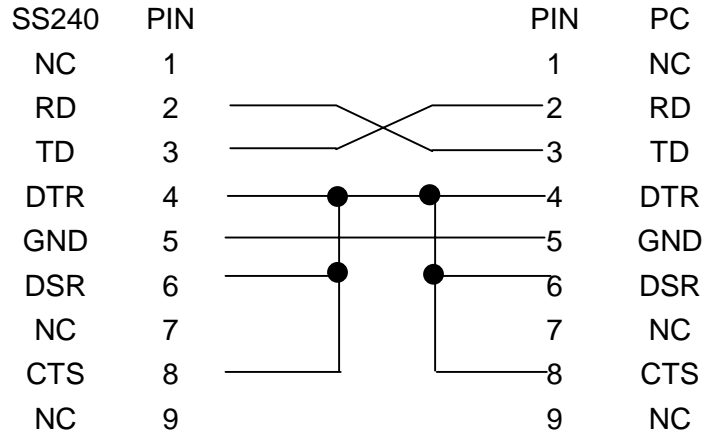
Figure 192 – Interface Connections

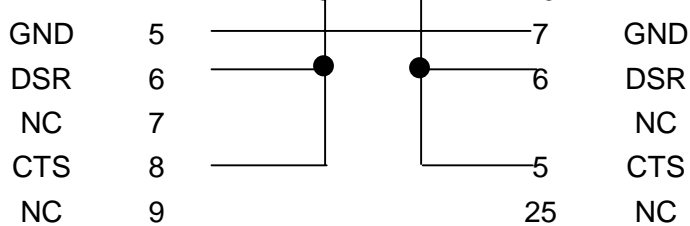
parameters current value. The Action commands provide special functions such as waveform and thickness logging transfer. It is the D-shaped connector at the bottom.

The communication handshake is as follows:

Baud rate 9600
 Parity None
 Data Bits 8
 Stop Bits 1
 Handshake Hardware

The cable connections for a 9-pin RS232 port are as follows:





A 9-pin to 9-pin communications cable is available from Sonatest Plc under part number 152120.

No cable is available for the 25-pin RS232 port.

A separate Communications manual part number 147239 is available that describes all of the protocol in detail.

8.2 Composite Video

The composite video output is for displaying the A-Trace on a compatible television monitor. The output is either NTSC (USA/Japan) or PAL (UK/Europe), depending on the selection in the Video menu inside the FN menu. The screen update rate is 50Hz in PAL and 60Hz in NTSC. The screen will be slightly brighter in the NTSC mode.

It is the second connector from the top with one center pin.

Delay:	Calibrated delay from 0mm to 10,000mm in 0.05mm steps at steel velocity (0-400in. in 0.002in steps).
Gain:	0 to 110dB. Adjustable in 0.5, 2, 6, 14 and 20dB steps. Direct access to gain control at all times.
Test Modes:	Pulse echo and transmit/receive.
Pulser:	Square-wave pulse 185V peak amplitude 40ns –250ns linked to frequency
P.R.F.	Selectable between 35, 63, 150, 250, 500, & 1,000Hz.
Update Rate:	60Hz (NTSC Mode); 50Hz (PAL Mode).
Rectification:	Full wave, positive or negative halfwave and unrectified rf.
Frequency Range:	Four (4) narrow bands centered at 1 MHz, 2MHz, 5MHz and 10MHz. Wide band 1.5 to 15 MHz (-6dB) .

Display:

Colour: High brightness Colour TFT LCD panel. Eight (8) Colour scheme options. Brightness variable up to 350cd/m^2

LCD: monochrome Liquid crystal display, with switchable backlight.

A-Scan area 255 x 200 pixels. Total display area 102.7 x 77.0mm, 320 x 234 pixels.

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 visual and audible alarms.

path, surface distance and depth of indication.

Mode 6 - Gate to Gate

Resolution to 0.01mm (0.001in) for distance measurement, or 1% FSH for amplitude measurement. Large display of measurement at top of A-Scan display. Measurement mode selectable between peak and flank. All measurement functions available in unrectified rf mode.

**Gate
Expansion:**

Expands range to width of Gate 1.

**A-Scan
Memory:**

Maximum of 100 waveforms stored with complete panel settings. Waveforms may be recalled on display, printed or transferred via RS232 serial interface.

**Panel
Memories:**

Twenty (20) stores for retaining calibrations.

and printed as required.

- Auto-Cal:** Provides automatic calibration from two echoes.
- DAC:** DAC curves may be entered and digitally drawn on the display. Reference, -6dB, -12dB, -14dB curves may be selected. DAC curve selected acts as gate for alarm outputs and height measurement in DAC +dB. DAC parameters stored with Panel Memory. Curves comply with ASME and European Standards.
- TCG** Time Corrected Gain curves may be entered and digitally drawn on the display. The dynamic range of the T.C.G. is 40dB. T.C.G. parameters are stored in panel, A-Log and memory.
- AWS** The AWS mode is used when inspecting welds in accordance with the American Welding Society's Structural Welding Code, ANSI/AWS D1.1-94 to automatically calculate the Indication Rating as defined by the code.

X-Offset:	Allows the surface distance to be calculated from the front of the probe with X-offset being the distance from the index point to the front of the probe.
Special Functions:	Display freeze for capturing current A-Scan image. Peak memory for echo-dynamic pattern determination in accordance with BS3923. Help key for instant operator guidance on using the Sitiescan 240.
Help Key:	For instant operator guidance on using the Sitiescan 240
Waveform Smoothing:	Gives a smooth signal envelope similar to the video filtering in analogue equipment.
Outputs:	Full bi-directional serial interface to transfer parameters, thickness readings and waveform memories. Composite video, full PAL or NTSC compatibility. Analogue proportional output for connection to X-Y plotter or other external equipment. Proportional outputs programmable to distance or amplitude of signal.

Sockets:

Temperature: Operating: -10 to +55°C (14 to 131°F)
Survivable: -20 to +70°C (-4 to 158°F)
Storage: -40 to +75°C (-40 to 167°F)

Environment: To IP67

Size: 255 x 145 x 145mm (10.0 x 5.7 x 5.7in)

Weight: 2.5 Kgs (5.5 lbs.) with Li-ION Cells.

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.

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