OPERATOR'S MANUAL
SITESCAN 140

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See Disclaimers and Notices on Page 1

Certificate
No. Q5036
Sonatest Plc
Stock No. 147263

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.

1.1 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 knowledge of the application.

C. Competent training of the instrument operator.

This operating manual provides instruction in the basic operation of the Sitescan 140 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.

1.2 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

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).

1.3 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.

1.4 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 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 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 the range of size and depth in the material to be detected. The user is again cautioned

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 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/probe.

1.5 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 Sitescan 140 are based on test 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 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).

1.6 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.**

For any questions relating to the proper use of this product, please contact the manufacturer at the number indicated on the inside front cover copyright page.

listing the pertinent characteristics of the instrument and the various 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 Sitescan 140. 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 Sitescan 140 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 Sitescan 140 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
- 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
- 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

- 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

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. Some may also be reflected by 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 greater the impedance ratio, the more sound energy that will be reflected. The principle of ultrasonic testing is shown in Figure 1. It shows the ultrasonic energy in the test piece and the resulting instrument display.

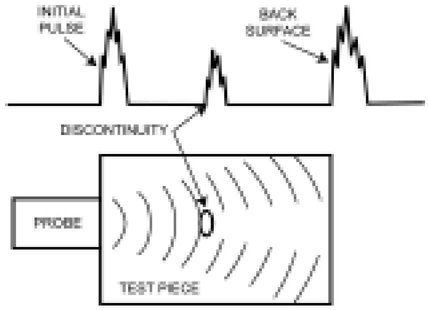


Figure 1 – Basic Ultrasonic Testing

Thickness gauging with the Sitescan 140 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

The size and geometric shape of the discontinuity relative 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 Sitescan 140'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 will 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 is 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 Sitescan 140. 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 medium, which in most cases is liquid, must be used between the transducer/probe and the test piece.

f

Where: λ = wavelength
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 path of a transducer or probe is characterized by a near field, and by a far field. The near field is the region directly in front of the transducer where the sound energy goes through a series of maxim and minim both axial and radial directions. Responses from small discontinuities in the near field can be irregular. The far field of the transducer 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

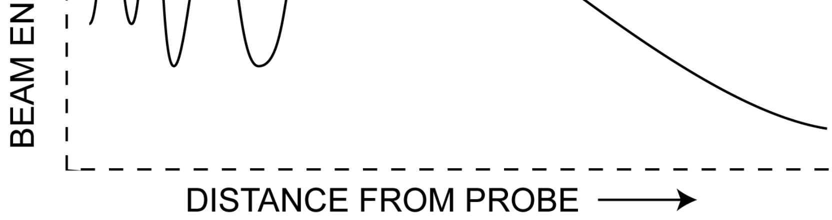


Figure 2 – Ultrasonic Energy Field Distribution

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:

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

Where: D = diameter of the transducer/probe element
f = frequency of the transducer/probe
c = velocity of sound in the material

Transducer/probes also exhibit a characteristic called beam spread. The sound beam tends to spread as a function of the distance from the transducer/probe

Figure 3 – Ultrasonic Beam spread and Half-Angle

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:

$$\text{Sin}\left(\frac{\alpha}{2}\right) = \frac{.514\,c}{f\,D}$$

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

It may be seen from this relationship that beam spread may be controlled, by selecting a transducer or probe with a combination of higher frequency or larger element diameter.

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 transducers are therefore, suitable for the thickness gauging of pitting and corrosion. Although dual element angle beam transducers are made for special situations, almost all are used for thickness gauging of corrosion.

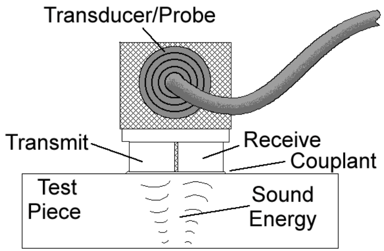


Figure 4 – Typical Dual Element Transducer/probe

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.

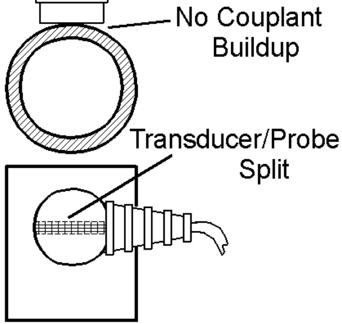


Figure 5 – Thickness Gauging on Pipe

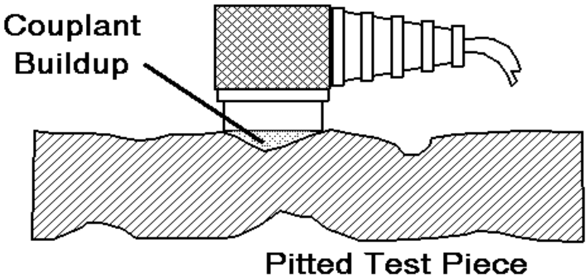


Figure 6 – Couplant use on Pitted Surfaces

Using a transducer/probe as shown in Figure 7. A shear wave is one 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.

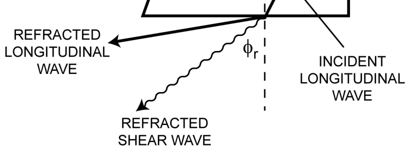


Figure 7 – Typical Angled Beam Transducer/probe

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

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 principle of angled beam weld testing.

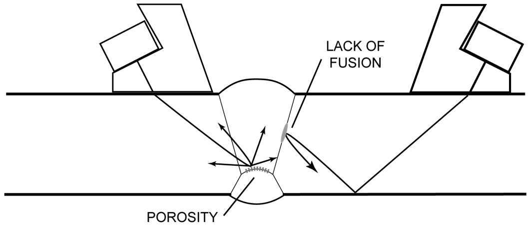


Figure 8 – Typical Weld Inspection

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: Angled 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.

improved sensitivity and reliability.

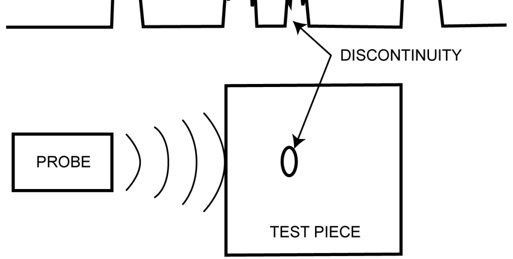


Figure 9 – Immersion Testing Method

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.

the
transducer/probe
to the test piece
surface:

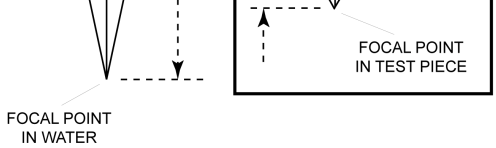


Figure 10 – Focusing in Immersion Testing

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

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

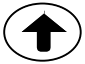
In addition to the refraction effect on the focal length, surface curvature can change the focusing distance. Concave surfaces tend to increase the focal distance and spread the sound beam. Convex surfaces tend to refract the sound beam even more and shorten the focal distance.

Figure 11 – Front Panel of the Sitescan 140

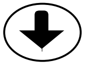
When the term “Highlighted” is used, it refers to text with a bright background and dark letters which is the selected item. (It is opposite for the LCD Display versions of the SS140) initialized, this is normal.

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.

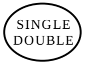


GAINU



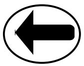
GAIND

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.

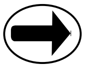


S/D

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

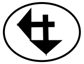


CURR

These buttons move the highlighted cursor along the top of the screen left and tight 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.

INC

the case of 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.

FZ/PK

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 FREEZE below the graticule.

Pressing the button a second 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 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

FN

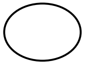
menu. The menus are described in Section **6.1** that follows. This is a momentary button with no repeat.

HELP

This button selects the help menu which overlays the display. The help menu explains how the Masterscan 340 operates with a choice of three options:

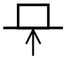
UP/RT	Using the SS140.
OK	Description of the active menu.
DN/LT	Calibration procedure.

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



YBLK

The four yellow buttons on the right side of the display are used to select the menu boxes, which appear on the right side of the A-Trace. When a menu box is selected, it will be highlighted. Some menu boxes contain a single or double arrow point indicating slow or fast adjustment mode. Press the button next to the selected box a second time to toggle between slow and fast modes.



Rx

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

CHARGE 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 140 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 thickness gauging. 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.

To reset panel settings to factory defaults:

1. Switch the instrument off.
2. Depress the yellow MEM button and hold while switching the instrument on until the reset display is seen.
3. Press the UP/RT button to reset the instrument to factory defaults.

Range: 100	Print: Off	Smooth: On
Delay: 0.00	Dist.1: 100.0	Colour: 0
Detect: Full	Dist.2: 200.0	Bright: 10
Reject: 0	Accept: CAL	Video: PAL
PRF: 1000 Hz	Start: 24.80	P_OP: Off
Gates: Off	DAC: Off	Clock: Off
Meas:	Curve: DAC	AWS: Off
MONITOR	Units: Metric	Mode: Single

Clearing the memory:
The Sitescan 140's memory is comprised of all the stored A-Logs, T-Logs and calibration set-ups. Erasing all of these values accidentally could have far reaching consequences. Should the occasion arise for a need to erase all of the memory, contact the factory for instructions.

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 to125 or other suitable value to cover the test range of interest.

   d) DELAY to 0.000

   GAIN to 50.0

4. In the AMP menu, set the following parameters:

   a) DETECT to FULL

   b) REJECT to 5

   c) PRF to 1000Hz

5. In the GATE1 menu, set the following parameters:

   a) STATE to ON +VE

   b) START to 10.0

   c) WIDTH to 50 or other suitable value to cover the test range of interest.

   d) LEVEL to 50.0

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 Sitescan 140, see Section 6.4, “Flaw Testing” on page 60.

5.4 Thickness Gauging

Perform the following steps to establish a basic thickness-gauging mode for the Sitescan 140. 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.
3. 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.
4. In the CAL menu, set the following parameters:
   a) ZERO can be left alone
   b) VEL can be left alone

c) 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 ON

   d) T-MIN to OFF

8. Calibrate the thickness readout on the selected calibration block using the procedure in Section 6.5.2, “A-Cal” on page 79.

You are now prepared to perform basic thickness gauging. Adjust parameters as necessary to optimize the calibration. For more in-depth features of the Sitescan 140, see Section 6.5, “Thickness Gauging” on page 74.

6.1 Basic Menu Functions

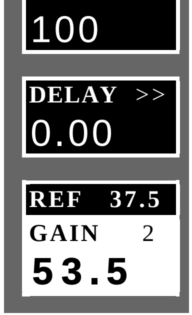
At power on, an information screen is displayed momentarily showing the instrument serial number, program rendition, and software version number while a self-test is performed. After the self-test, the Main menu is displayed above the A-Trace display and the CAL menu is highlighted. The CURL and CURR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

6.1.1 Main Menu

The Main menu is the power on default menu and can be reached from the Function menu and the Memory menu by pressing their respective buttons a second time.

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.

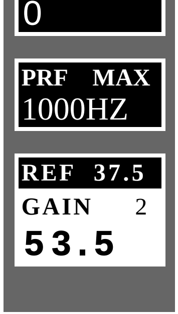


RANGE — Used to set the full screen width of the horizontal A-Trace in mm, inches, or microseconds depending on the Units chosen in the FN UTIL menu. The range is 5mm to 10 meters (.20”-400”).

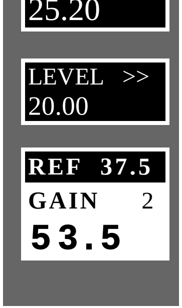
DELAY — Used to set the delay or offset of the left side of the A-Trace for viewing of a portion of a signal. The range is 0 to 10 meters (0-400”).

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 Pulse Repetition Frequency is the number of times the transmitter is triggered per second. Too high a PRF may cause ghost signals to appear on the A-scan display. Too low a PRF may affect the scanning speed of the probe. The thicker the material under test the lower the PRF should be.



EXPAND: Expands the gate width to fill the horizontal display width. Only applies to gate 1.
OFF: Switches the gate off.

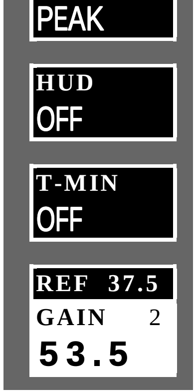


START — Used to set the start position of the gate relative to the initial pulse. Units are mm or inches and range is from 0 to the full time base of the horizontal display.

WIDTH — Used to set the width of the gate. Units are mm or inches and range is from 0.15mm (0.001in, 0.05µsec), 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 (fsh).

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.



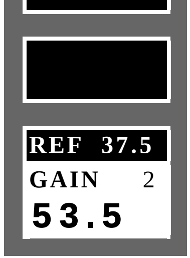
TRIGGER — Used to select the depth or thickness measurement to the FLANK (left edge) or PEAK of the first echo after the start of the gate.

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 too 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.

BLANK	This function sets the blanking distance, which is a blind zone after the first echo, after which a second echo can be measured. This help to eliminate undesired noise in the first echo from being measured, as thickness but will limit the minimum thickness capability if set too large. The value displayed is non-dimensional.
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.
TRIGGER	As in DEPTH mode
THICK	Set to the thickness of the material being tested to account for multiple skips of the angled sound beam in the test material.

TRIG function in MEAS menu to give the surface distance.



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

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

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, which is 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.

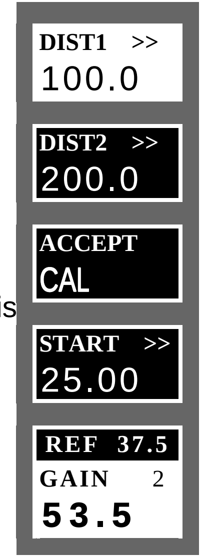
This menu provides automatic calibration of sound velocity and transducer/probe zero. Gate 1 is used to select the reference echoes. The calibration procedure is described fully in Section 6.5.2 on page 72.

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 — Used to record each measurement. Upon recording DIST2, the calibration is fixed.

START — Used to adjust the start of the gate to assure that the first or thinnest echo is measured.



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

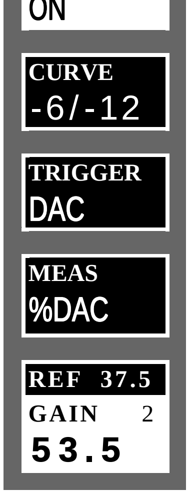
TRIGGER — Used to select alarm level threshold for the DAC curve, or the -6dB curve or the -14/-12 dB curve or the gate.

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

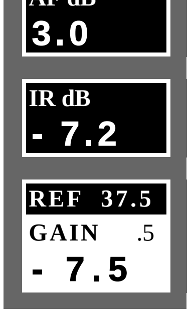
DRAW MODE: — Used to create the DAC curve.

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.



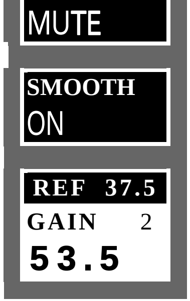
calibration procedure is described fully in Section 6.4.4 on page 68.



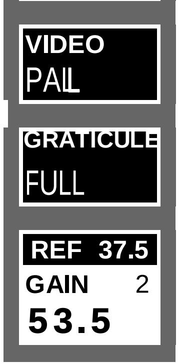
SET MODE:	Used to set up the AWS measurement mode.
REF	Used to set the Indication Level.
CURSOR	Used to move the cursor over the reference echo to set the reference level.
MEAS MODE:	Used to make measurements in accordance with the code.
IL dB	The dB required to set the indication to the reference level.
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.

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.



	increases power consumption, 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

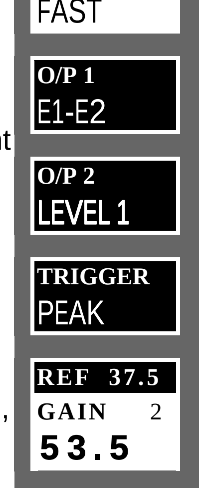


FAST MODE Outputs updated at 100-120 Hz, depending on Video mode selected. When selected, the signal resolution and measurement accuracy is reduced.

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.

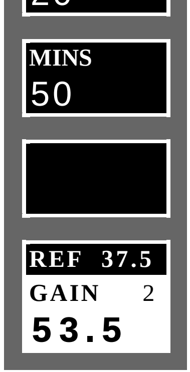
TRIGGER Sets the depth output to trigger on echo PEAK or echo FLANK, the same as for measurement readout.



➡ When highlighted, this cursor allows a second FN menu to be selected by pressing the CURR button.

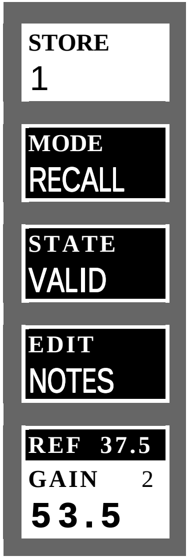
⬅ When highlighted, this cursor allows return to the first FN menu by pressing the CURL button.

	hour format.
MINS	Used to set the current minutes.
DATE MODE:	Used to set the current date.
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.

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.

	keyboard 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 after the position where the cursor is currently on.
DELETE CHARACTER	Press the Back-Space KEY to delete the previous character to the position where 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 ↓ KEY to move the cursor down.
LEFT ARROW	Press ← KEY to move the cursor left.

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

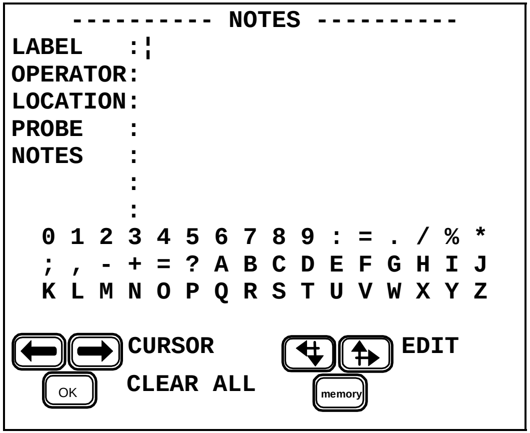
line and press MEM to clear all text.

NEXT LINE — Press to scroll through and select a line for editing.

INSERT CHAR — Inserts a blank character space before the one the cursor is currently on.

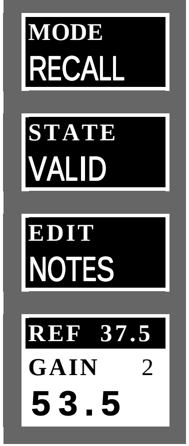
DELETE CHAR — Deletes the character under the cursor.

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)

MODE: 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.

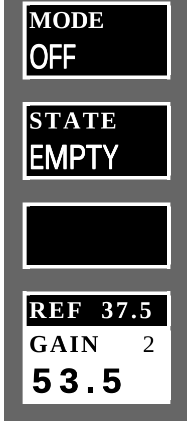
LIST MODE: Shows the notes associated with the stored A-Scan and its settings. Pressing OK will recall the calibration set at which time the Notes can be edited.

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.

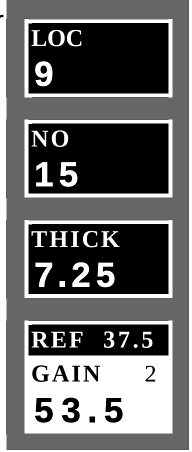
STATE Display only. VALID indicates that the store location is used. EMPTY indicates that it is not used. To change VALID to EMPTY, use the DELETE function.

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

MODE:	and display it. Press OK to recall.
LIST MODE:	Shows 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.



LOC	Used to select the location number for storage or viewing of a thickness reading.
NO	The actual 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 number.

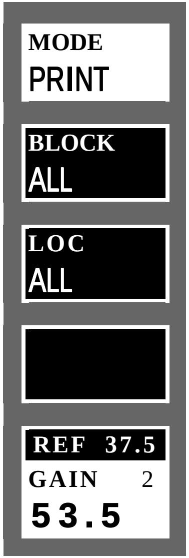


PRINT MODE: Set the mode to PRINT to print the selected blocks and locations to the printer on the RS232 port.

DELETE MODE: Set the mode to DELETE to delete the selected blocks and locations. Press OK again after the confirmation prompt.

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.



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

MEM	PANEL	STORE	↓MODE↓		
			STORE	STATE	EDIT*
			RECALL	STATE	EDIT*
			DELETE	STATE	EDIT*
			LIST	STATE	
	A-LOG	STORE	↓MODE↓		
			STORE	STATE	EDIT*
			RECALL	STATE	EDIT*
			DELETE	STATE	EDIT*
			LIST	STATE	
	REF	STORE	↓MODE↓		
			RECALL	STATE	
			OFF	STATE	
			LIST	STATE	
	T-LOG	BLOCK	LOC	NO	THICK
	T-FN	↓MODE↓			
		PRINT	BLOCK	LOC	
		DELETE	BLOCK	LOC	
	*EDIT Function	NEXT LINE	INSERT CHAR	DELETE CHAR	EXIT

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.
6. Press the blue OK button to store the panel settings.
7. If you forgot to enter Notes, create the Notes as described below and the re-save the panel settings starting at step 5 above.

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.

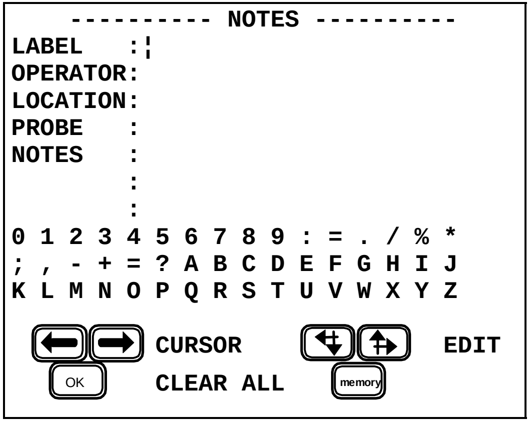
The blue CURL and CURR buttons are used to move the cursor from right to left along a line of text. The yellow button adjacent to the NEXT LINE box is used to advance the cursor down to the next line. When the cursor is at the bottom line, the NEXT LINE function moves it back to the top line.

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.

guidelines for accurate flaw detection but the user is referred to Section 1.2 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 4.5 on page 18 and Section 6.4.3 on page 65. 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 fabricated discontinuities should match the expected natural discontinuities in the test piece. In some cases this may mean flat essence of this calibration is to set the transmitter, amplifier and gate parameters to provide the necessary sensitivity and resolution. The following are the essential steps for basic flaw detection:

1. Select the appropriate single element contact transducer/probe and calibration block that matches the material and expected discontinuities under test.
2. In the CAL menu, select the proper Range and Delay so those echoes from the expected material depth can be viewed.
3. From the AMP menu, set the detection mode to FULL.
4. Set the Mode to Single.
5. Couple the transducer/probe 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.
6. 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.
7. Adjust the gain to set a reference echo from mid thickness of the calibration block to about 80% amplitude.
8. From the GATE1 menu, set the gate to ON +VE and adjust the Start and Width so that the gate encompasses the full testing range of interest. Place the transducer/probe over the near and

6.4.2 DAC Operation

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.

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 Sitescan 140 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

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.

8. Press the yellow button adjacent to MODE and use the DEC

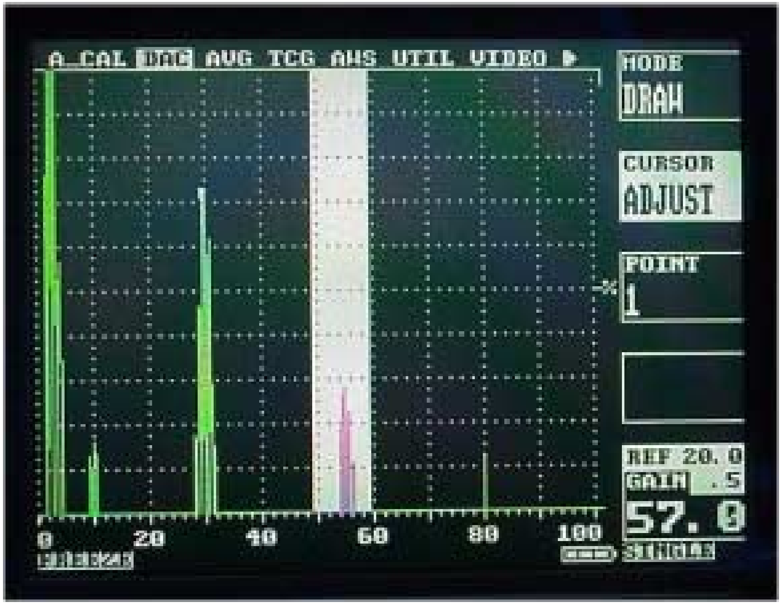


Figure 12 – Cursor Selection of Echoes for DAC

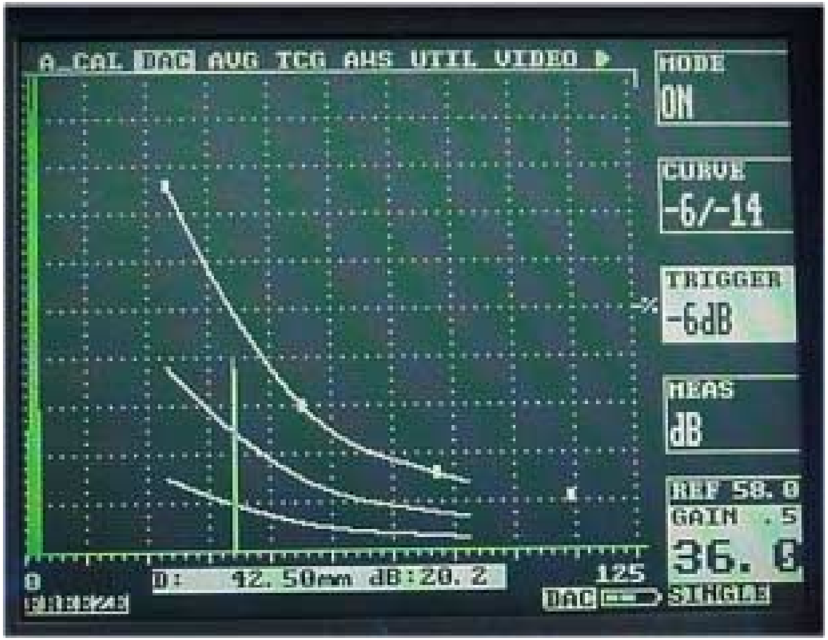


Figure 13 – DAC Curve and -6dB/-14dB Curves

discontinuities smaller than those in the reference block.

10. Use the TRIGGER parameter to establish the alarm trigger from the DAC curve, the -6dB curve, or the -12dB/-14dB

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

6.4.3 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 Sitescan 140 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/probe being used. Additionally, the thickness of the test piece must be established in the menu in

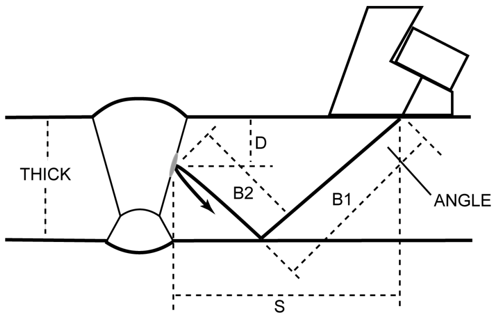


Figure 14 – Trigonometry Mode Measurements

→ Surface distance S from the central exit point on the transducer/probe to a point directly above the discontinuity on the test piece.

↓ Depth distance D from the surface on which the transducer/probe rests to the discontinuity.

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 Sitescan 140 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:

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 79. 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

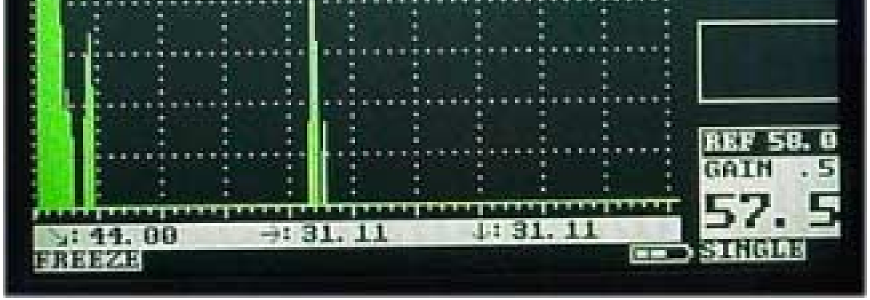


Figure 15 – Trigonometry Mode Measurements

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. Select the ANGLE parameter and using the INC and DEC buttons, set the refracted angle of the transducer/probe measured in step 1 above.
7. Select the THICK parameter and using the INC and DEC buttons dial in the thickness of the test piece. You may have to

6.4.4 Weld Inspection Using the AWS Menu

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

To set up the AWS measurements, perform the following:

1.Calibrate the Sitescan 140 for weld testing and set up the trigonometry mode by following the steps in Section 6.4.3 on page 65.

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 OK key.

9.When the AWS menu is selected and a signal is in the gate, the sub-menu boxes will show the resulting AWS measurements as follows:

$$IR = IL - RG - AF$$

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

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 ½ 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 140 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 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 Sitescan 140 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 Sitescan 140 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.
6. 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).
7. Press the OK button to store the waveform and instrument settings. At the CONFIRM prompt, press the OK button again

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.

To delete a stored A-Scan, follow the steps above but set the MODE parameter to DELETE and then press the OK button. At the CONFIRM prompt, press the OK button again to delete the A-Scan or press the INC button to continue without deleting the A-Scan.

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 compared to the real time waveform, depending on which colour is chosen.
6. To remove the reference waveform, set the MODE to OFF and press the OK button.

NOTE: When the reference is recalled, no setting parameters are changed. Therefore, if the RANGE or DELAY are subsequently changed, the reference signal will not match the real time surface anomalies and part geometry. The Sitescan 140 incorporate 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. It 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 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 in Figure 16.

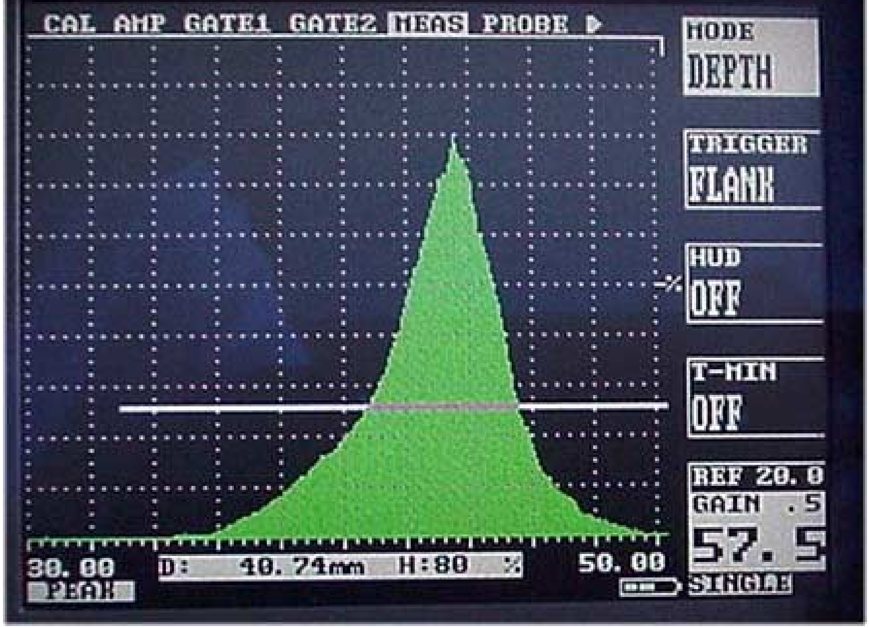


Figure 16 – Peak Echo Dynamics

6.5 Thickness Gauging

6.5.1 Basic Thickness Gauging

Accurate and reliable thickness gauging requires three important considerations: a) proper transducer/probe selection, b) an 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 transmitter and receiver 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.

Figure 17 – Broadband Echo

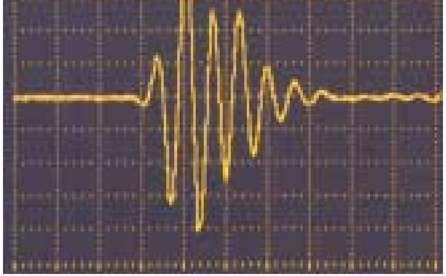


Figure 18 – Narrow band Echo

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 the thickness representing the minimum and maximum values is 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 Sitescan 140 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.

echoes. The following are the essential steps for basic thickness gauging:

1. Select the appropriate broadband transducer/probe and calibration block that matches the material under test.
2. In the CAL menu, select the proper Range and Delay so those echoes from the range of thickness can be viewed.
3. 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.
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.

steps outlined in Section 6.5.2 below. 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.

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 1-10 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

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 140 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 Sitescan 140 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 T-LOG Thickness Storage

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. Each thickness reading is stored under a three level code. The top level is the BLOCK number that can be 1 to 14. The next level is the LOCation number that maybe set between 1 and 2,000. Lastly is the reading number (NO) itself which may also be between 1 and 2,000.

This hierarchy of coding for a thickness reading allows readings to be associated with physical characteristics of the component under inspection. Thus, it is up to the user to devise a scheme of assigning blocks, locations and readings to the inspection, keeping in mind the maximum combinations of 2,000.

To store readings, follow these simple steps:

1. Set up the instrument for the thickness measurement mode as described in Section 6.5.1 on page 74.
2. From the MEMORY menu, select the T-LOG menu.

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.

6.5.4 T-FN Thickness Log Editing and Printing

The T-FN menu provides capability for the printing and deletion of thickness readings 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.

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. 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 19 – Lithium-Ion Battery Box

7.1 Battery Pack

When fully charged, the battery pack should enable the unit to be operated for 8 hours, under typical operating conditions. The battery pack can be charged while mounted to the Sitescan 140 by use of the connector on the front panel. Alternately, the battery pack can be charged separate from the Sitescan 140 by using its own connector shown in *Figure 19* above thereby allowing continued operation of the Sitescan 140 with the use of multiple battery packs.

Figure 20 – Battery Charger

The part number for a replacement battery pack is Y-04

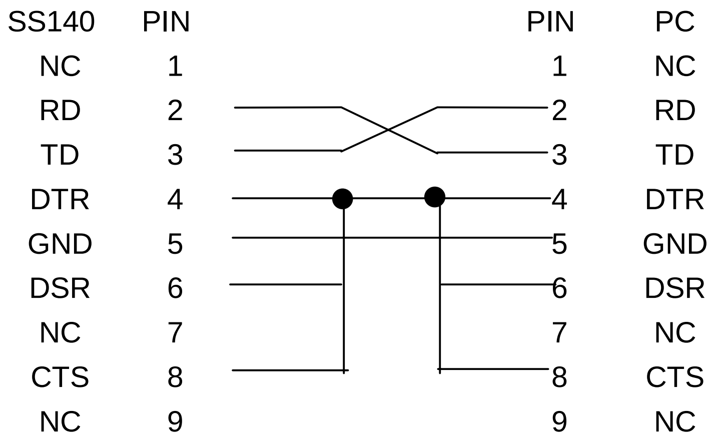
Figure 21 – Interface Connections

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 can be ordered from Sonatest under part number 152120.

DSR	6	6	DSR
NC	7		NC
CTS	8	5	CTS
NC	9	25	NC

The above is given for information only. No cable is available from Sonatest Plc.

A separate Communications manual (part number 147239) is available which 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.

8.3 Proportional Output

An analogue proportional output 0 to 10 volts dc, for distance and amplitude of the signal in the gate. It is the upper connector with two center pins. For further information on Proportional Outputs contact our Factory

Delay: Calibrated delay from 0mm to 5000mm in 0.1mm steps at steel velocity (0-200in. in 0.05in 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: Fixed square-wave pulse of 100ns duration. 185V peak amplitude with rise/fall times<20ns into 50 ohms. Pulse width adjustable in 1 or 10ns steps

P.R.F. Selectable between 35, 63, 150, 250, 500, & 1,000Hz.

Update Rate: 60Hz (NTSC Mode). Or 50Hz (PAL Mode).

Rectification: Full wave, positive or negative half wave and unrectified rf.

Frequency Range: 0.5MHz to 20MHz broadband

System Linearity: Vertical ±1% Full Screen Height (FSH). Amplifier accuracy ±0.1dB. Horizontal ±0.4% Full Screen Width (FSW).

Reject: 50% suppressive reject. LED warning light when selected.

Units: Metric (mm), inches (in) or microseconds (μs). Selected from menu.

Display: High brightness Colour TFT LCD panel. A-Scan area 255 x 200 pixels. Total display area 102.7 x 77.0mm, 320 x 240 pixels. Eight Colour scheme options. Brightness variable up to 300cd/m^2

distance and depth of indication.
Mode 5 - T-Min mode for holding minimum thickness reading.
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.
<u>All measurement functions available in unrectified rf mode.</u>

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.
Thickness Logging:	Storage for 2,000 thickness readings configured into Block/Location/Number. Calibration settings stored with each Block. Maximum number of Blocks is 14. Unlimited Location/Number values, maximum combination of 2,000 readings. Readings may be reviewed, edited and printed as required.
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, JIS, and European Standards.

from the active display highlighting differences from the reference.

Notes: Alphanumeric-labeling for panel and A-Log allows the user to enter Notes for storage with A-Scans.

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 Sitescan 140.

Help Key: For instant operator guidance on using the Sitescan 140

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 outputs programmable to distance or amplitude of signal in the gate.

Power Lithium Ion battery pack 14.4Vac, 5.0 Ampere-hours, gives 8 hours duration from a fully charged pack. Indication of low battery status. Recharge time is two hours.

Charger: Two types for mains input of 110 or 140 volts ac.

Software Two systems available WAVESTORE and WINDFD.

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. Sonatest, free of charge, will return the repaired goods.

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.