DFX-625
User's Guide

Contents

1 How to Use This User's Guide

This user's guide has been designed so that a person with a good knowledge of the basics of ultrasonic non-destructive testing may understand the operation and use of the features offered by the DFX-625. The user is advised, however, of the important nature of ultrasonic non-destructive testing and is referred to Section 2 for important information on the proper use of this technology.

Section 1: How to Use This User's Guide is this section.

Section 2: Disclaimers and Notices contains important information that must be understood by users of the DFX-625

Section 3: 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 its features in detail.

Section: 4: Detailed Menu Description is an in-depth description of the menu items found in the DFX-625 with brief descriptions of each item.

Section 5: Flaw Testing gives guidelines on performing flaw testing with examples of how to calibrate the DFX-625 and how to set up the unit for DAC, TCG, DGS/AVG and how to use the A-Scan storage facilities.

Section 6: Thickness Gauging gives guidelines on performing thickness measurements including the calibration of the DFX-625, using TCG and how to use the thickness measurement memory functions.

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

Section 8: Interface Connections is for users who desire to operate the DFX-625 with ancillary equipment.

Section 9: Features of the DFX-625 is a quick reference listing the pertinent characteristics of the instrument and the various functional testing methods that may be used with the instrument.

The function keys are shown throughout this manual as shown in Section 3.1, Front Panel Controls.

1.1 Typographical Conventions

When describing front panel buttons the text is printed in this font.

When describing settings in the DFX-625 the text is. **printed in this font**

2 Disclaimers and Notices

The following information must be read and understood by users of the Dakota Ultrasonics DFX-625 ultrasonic flaw detector and thickness gauge. Failure to follow these instructions can lead to serious errors in test results or damage to the flaw detector. Decisions based on erroneous results can lead to property damage, personal injury or death. Anyone using this instrument should be fully qualified by their organization in the theory and practice of ultrasonic testing, or under the direct supervision of such a person.

2.1 Specific Warnings

The DFX-625 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 PEAK key) before changing transducers (probes).

2.2 General Warnings

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

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

This user's guide provides instruction in the basic operation of the DFX-625 flaw detector. In addition to the methods included, 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.

2.3 Operator Training

Operators must receive adequate training before using this ultrasonic flaw detector. Operators must be trained in general ultrasonic testing procedures and in the set-up and performance required by each specific test or inspection. Operators must understand:

- Sound wave propagation theory.
- Effects of the velocity of sound in the test material.
- Behaviour of the sound wave at the interface of two different materials.
- 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.

2.4 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 if operators don't exercise good judgment.

2.5 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.

2.5.1 Calibration of the Sound Velocity

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

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

2.5.2 Transducer (Probe) Zero Procedure

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

2.5.3 Flaw Detection Calibration

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

2.5.4 Effects of Temperature on Calibration

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

2.5.5 Transducer Condition

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

2.5.6 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.

2.6 Disclaimer of Liability

All statements, technical information and recommendations contained in this manual or any other information supplied by Dakota Ultrasonics in connection with the use, features and qualifications of the DFX-625 are based on tests believed to be reliable, but the accuracy or completeness thereof is not guaranteed. Before using the product you should determine its suitability for your intended use based on your knowledge of ultrasonic testing and the characteristics of materials. You bear all risk in connection with the use of the product.

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

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

2.7 Electromagnetic Compatibility

This product conforms to the following European Directives:

Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE)

Low Voltage Directive (LVD) 73/23/EEC

CE Marking Directive 93/68/EEC

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

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.

The DFX-625 also complies with EN 12668-1, Non-destructive testing and verification of ultrasonic examination equipment – Part 1: Instruments. For any questions relating to the proper use of this product, please contact the manufacturer at the number indicated on page i

3 Quick Start

3.1 Front Panel Controls & End Cap Connections

The front panel controls & end cap connections consist of a series sealed, pressure sensitive, tactile buttons that allow the instrument settings to be changed and the movement through the menus on the screen. An optional keyboard connected to the USB port can also be used to navigate through the menus and make changes to the parameter values. A more detailed description of each button is shown below followed by an overview of the front panel:

When the term "highlighted" is used, it refers to text with a bright background and dark letters which is the selected item.

Power on & off push button for switching the instrument on and off. Operates as a toggle.

N.B Random lines or characters may be displayed for a second or two after switch on, before the memory is initialized, this is normal.

The Menu button is used to display the 4 main menu levels (**CAL**, **MEAS**, **UTIL** and **MEMORY**) on the right hand side of the screen. The MENU button can be pressed at any time. To select the required sub-menu press the plain function button associated with it. Corresponds to the "ESC" key when using a keyboard.

These buttons move the highlighted cursor along the top of the screen left and right to the sub menu to be selected. These are momentary buttons with no repeat. The parameter boxes along the right hand side of the screen change as the sub menu is selected. Corresponds to left and right arrows (◄ and ►) when using a keyboard.

The four function 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. Pressing the button a second time will, on certain parameters, display a drop-down list with a selection of values that can be chosen by using the ↳ and ↴ buttons. When using a keyboard F1 to F4 correspond to the 4 white buttons.

This button operates in connection with the function buttons next to the parameter boxes to increase the value or step the selection in the positive direction. In the case of transducer **Zero** or **Delay**, it moves the signals to the right. This is a repeat button with acceleration to facilitate quick scrolling of the value. Corresponds to up arrow (▲) when using a keyboard.

This button operates in connection with the function buttons next to the parameter boxes to decrease the value or step the selection in the reverse direction. In the case of transducer **ZERO** or **Delay**, it moves the signals to the left. This is a repeat button with acceleration to facilitate quick scrolling of the value. Corresponds to down arrow (▼) when using a keyboard.

This button changes the size of the steps that are used to adjust the parameters; there are two sizes: small and large that are dependant on the parameter that is being changed. The button toggles between the two sizes and the current state is indicated by ▶ for small and by ▶▶ for the larger step in the parameter box that is being adjusted. Corresponds to the letter "l" when using the keyboard.

This button operates in conjunction with the memory menus to accept a store or to accept a recall of a memory already in storage. In the print mode, OK acts as the print button. Corresponds to "Enter" or the return key.

FREEZE PEAK — 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.

If key lock is enabled from within the **UTIL** menu, 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. Corresponds to the letter "F" when using the keyboard.

HELP — This button selects the help menu which overlays the display. The help menu explains how the DFX-615 operates with a choice of three options:

↳ Using the DFX-615

(OK) Description of the active menu

↰ 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. Corresponds to "F5" when using a keyboard.

FULL SCREEN — The full screen button is used to toggle between showing the A-Scan on the full display and showing it with the menus and parameter boxes. If split screen is enabled from the UTIL menu this button is used to display the A-Scan in the upper half of the display and parameters in the lower half.

STEP SIZE — Press to select the dB step value of amplifier gain as 0.1, 0.5, 1, 2, 6, 10, 14, or 20dB. The selected value is indicated at the top right-hand corner of the gain box, which is always located at the bottom right side of the screen. This is a momentary button with no repeat. Corresponds to the letter "X" when using a keyboard.

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 changing of the value. Corresponds to "Page Up" and "Page Down" when using a keyboard.

REF GAIN — Selects either reference or gain settings within the gain box. When reference is selected, the increment and decrement buttons will change both the reference and gain values together. This is a momentary button with no repeat. Corresponds to the letter "R" when using a keyboard.

SINGLE DOUBLE — This button toggles between single and double element transducers. The user should switch the unit off or stop the pulser by pressing the FREEZE/PEAK key before changing transducers. Corresponds to the letter "S" when using a keyboard.

Tx — 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. Refer to back label.

Rx — BNC or LEMO 1 connector is the receiver socket used for twin or dual transducer operation. Refer to back label.

— A socket to connect various USB devices such as a printer, keyboard or the user's PC. Refer to back label.

A socket used to connect the battery charger for recharging the battery pack. A red dot is provided on both the socket and plug to facilitate alignment. Refer to back label.

Refer to Power Supply for information on power supplies and charging of the battery pack.

3.2 Flaw Detection

Perform the following steps to establish a basic flaw detection mode for the DFX-625. Units shown are in inches. For metric units, select **METRIC UNITS** from the **UTIL** menu and use the corresponding values for the parameters.

1. Select a suitable transducer, preferably a 5MHz, half inch diameter narrow band.

2. When making a quick adjustment on a menu parameter, press the ≫ button until the double arrow appears next to the parameter name. This establishes the fast scroll using the ↳ and ↴ buttons.

3. In the **CAL** menu, set the following parameters:

    - **ZERO** to **0.000**
    - **VEL** should be set the specimen material velocity.
    - **RANGE** to**125** or other suitable value to cover the test range of interest.
    - **DELAY** to **0.000**
    - **GAIN** to **50.0**

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

    - **DETECT** to **FULL**
    - **PRF** to **150Hz**

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

    - **STATE** to **ON +VE**
    - **START** to **10.0**
    - **WIDTH** to **50** or other suitable value to cover the test range of interest.
    - **LEVEL** to **50.0**

6. In the **MEAS** menu, set the following parameters:

    - **MODE** to **DEPTH**
    - **TRIGGER** to **FLANK**
    - **HUD** to **OFF**
    - **T-MIN** to **OFF**

The DFX-625 is now configured for basic flaw detection. Using an appropriate calibration block, adjust the **GAIN** parameter to establish the correct sensitivity. Adjust other parameters as necessary to optimize the calibration. For more in-depth features of the DFX-625, see Flaw Testing on page 36.

3.3 Thickness Gauging

Perform the following steps to establish a basic thickness-gauging mode for the DFX-625. 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 broadband, 5MHz, with a 10mm diameter.

2. Select an appropriate calibration block with at least three known thickness sections covering the range to be inspected and made from the same material as the test piece.

3. When making a quick adjustment on a menu parameter, press the ≫ button until the double arrow appears next to the parameter name. This establishes the fast scroll using the ↱ and ↳ buttons.

4. In the **CAL** menu, set the following parameters:
    - **ZERO** can be left alone
    - **VEL** should be set to the specimen material velocity.
    - **RANGE** to **5"** or other suitable value to cover the test range of interest.
    - **DELAY** to **0.000**
    - **GAIN** to **50.0**

5. In the **AMP** menu, set the following parameters:
    - **DETECT** to **+VE HW**
    - **PRF** to **150Hz**

6. In the **GATE1** menu, set the following parameters:
    - **STATE** to **+VE**
    - **START** to **10**
    - **WIDTH** to **50** or other suitable value to cover the test range of interest.
    - **LEVEL** to **25.0**

7. In the **MEAS** menu, set the following parameters:
    - **MODE** to **DEPTH**
    - **TRIGGER** to **FLANK**
    - **HUD** to **ON**
    - **T-MIN** to **OFF**

8. Calibrate the thickness readout on the selected calibration block using the procedure in A-Cal on page 63.

The DFX-625 is now configured for basic thickness gauging. Adjust parameters as necessary to optimize the calibration. For more in-depth features of the DFX-625, see Thickness Gauging on page 61.

3.4 DFX-625 Memory

The settings of the DFX-625 always remain in memory when the instrument is turned off, even if the battery pack is removed. That is, whatever the settings are just prior to turning the instrument off will be the settings in place the next time the instrument is turned on.

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

3.4.1 Reset to factory defaults:

1. Switch the instrument off.

2. Depress the FULL SCREEN button and hold while switching the instrument on until the reset display is seen.

3. Press the ↳ button to reset the instrument to factory defaults

NOTE: Before performing this procedure, be sure to save any favourite settings to memory by using the procedure outlined in Storage & Recall of Calibration Setups on page 33.

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

NOTE: The video always defaults to PAL.

3.4.2 Clearing the Memory

The DFX-625's memory can store A-Scans, thicknesses and calibration set-ups. Erasing these values accidentally could have serious consequences and should only be done after suitable consideration. To erase the memory follow this sequence:

1. Switch the instrument off.

2. Depress the MENU button and hold while switching the instrument on until the reset display is seen.

3. Press the ↳ button to clear the DFX-625's memory

4 Detailed Menu Description

Before proceeding with this section, the user should be familiar with the front panel controls described in section 3.1 Front Panel Controls on page 6. It is also assumed that the user has a good understanding of the theory and practice of ultrasonic testing.

4.1 Menu Tree

This diagram represents the menu structure of the DFX-625; there are 4 main menu items with sub-menus below. The sub-menus are described in the following section.

CAL
- CAL: ZERO, VEL, RANGE, DELAY
- AMP: FREQ, DETECT, REJECT, PRF MAX
- GATE1: STATE, START, WIDTH, LEVEL
- GATE2: STATE, START, WIDTH, LEVEL
- A_CAL: DIST1, DIST2, ACCEPT, START

MEAS
- MEAS MODE:
  - MONITOR: DEPTH, TRIGGER, HUD, T-MIN
  - E-E: TRIGGER, HUD, BLANK
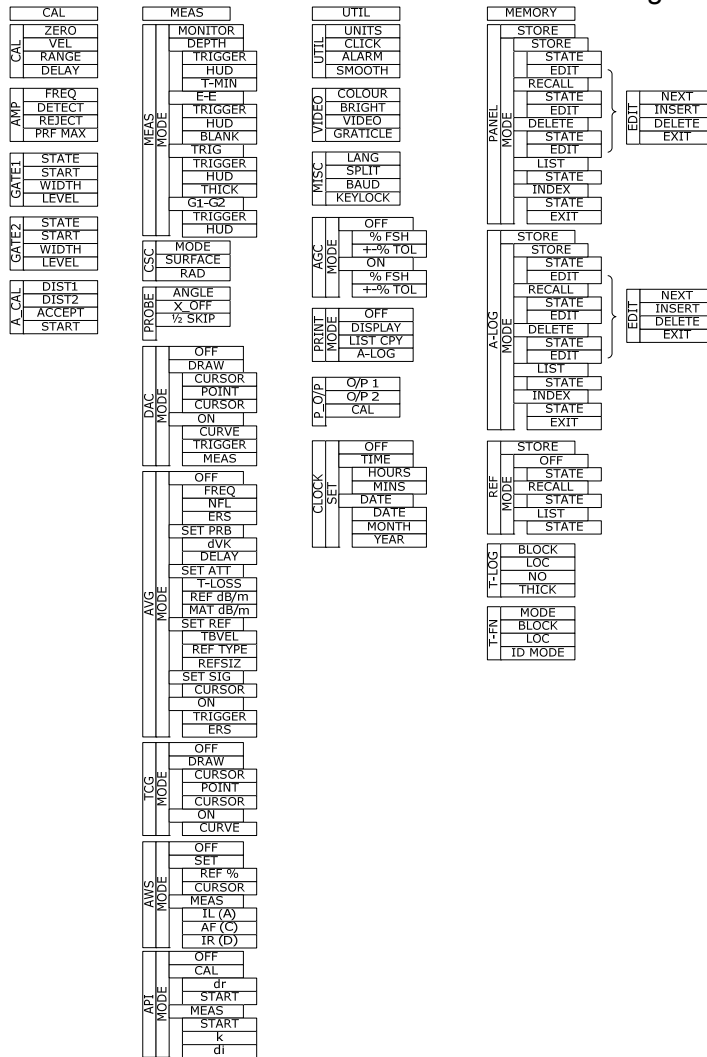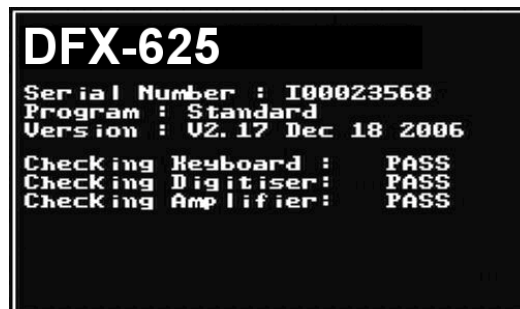 - TRIG: TRIGGER, HUD, THICK
  - G1-G2: TRIGGER, HUD
- CSC: MODE, SURFACE, RAD
- PROBE: ANGLE, X_OFF, ½ SKIP
- DAC MODE: OFF, DRAW, CURSOR POINT, CURSOR ON, CURVE, TRIGGER, MEAS
- AVG MODE: OFF, FREQ, NFL, ERS, SET PRB, dVK, DELAY, SET ATT, T-LOSS, REF dB/m, MAT dB/m, SET REF, TBVEL, REF TYPE, REFSIZ, SET SIG, CURSOR, ON, TRIGGER, ERS
- TCG MODE: OFF, DRAW, CURSOR POINT, CURSOR ON, CURVE
- AWS MODE: OFF, SET, REF %, CURSOR, MEAS, IL (A), AF (C), IR (D)
- API MODE: OFF, CAL, dr, START, MEAS, START, k, di

UTIL
- UTIL: UNITS, CLICK, ALARM, SMOOTH
- VIDEO: COLOUR, BRIGHT, VIDEO, GRATICLE
- MISC: LANG, SPLIT, BAUD, KEYLOCK
- AGC MODE: OFF, % FSH, +-% TOL, ON, % FSH, +-% TOL
- PRINT MODE: OFF, DISPLAY, LIST CPY, A-LOG
- P_O/P: O/P 1, O/P 2, CAL
- CLOCK SET: OFF, TIME, HOURS, MINS, DATE, DATE, MONTH, YEAR

MEMORY
- PANEL MODE:
  - STORE: STORE, STATE, EDIT
  - RECALL: STATE, EDIT, DELETE, STATE, EDIT — EDIT: NEXT, INSERT, DELETE, EXIT
  - LIST: STATE
  - INDEX: STATE
  - EXIT
- A-LOG MODE:
  - STORE: STORE, STATE, EDIT
  - RECALL: STATE, EDIT, DELETE, STATE, EDIT — EDIT: NEXT, INSERT, DELETE, EXIT
  - LIST: STATE
  - INDEX: STATE
  - EXIT
- REF MODE:
  - STORE: OFF, STATE
  - RECALL: STATE
  - LIST: STATE
- T-LOG: BLOCK, LOC, NO, THICK
- T-FN: MODE, BLOCK, LOC, ID MODE

When The DFX-625 is switched on, an information screen is displayed momentarily showing the instrument serial number and software version number while a self-test is performed as shown below:

```
DFX-625
Serial Number : I00023568
Program : Standard
Version : V2.17 Dec 18 2006

Checking Keyboard :    PASS
Checking Digitiser:    PASS
Checking Amplifier:    PASS
```

4.2 Main Menu

After the information screen disappears the main menu selections are shown on the right hand side of the screen. To select a particular menu press the function button to the right of it. You can return to the main menu selection at any time by pressing the MENU button.

4.2.1 Main Menu Selection

CAL Used to select the Calibration menu items: **CAL**, **AMP**, **GATE1**, **GATE2** and **A_CAL**

MEAS Used to select the Measurement menu items: **MEAS**, **CSC**, **PROBE**, **DAC**, **AVG**, **TCG**, **AWS** and **API**

UTIL Used to select the Utilities menu items: **UTIL**, **VIDEO**, **MISC**, **AGC**, **PRINT**, **P_O/P** and **CLOCK**

MEMORY Used to select the Memory menu items: **PANEL**, **A-LOG**, **REF**, **T-LOG** and **T-FN**

Note: The **REF**/**GAIN** box always appears at the bottom right of the screen and can be changed using the STEP, REF/GAIN and the $\wedge$ and $\vee$ keys.

Throughout the menus there are parameter boxes that have a thick line underneath them as shown here:

Pressing the grey button next to one of these parameter boxes produces a drop-down list as shown here:

Press the grey button again to remove the drop-down list after the required value has been selected.
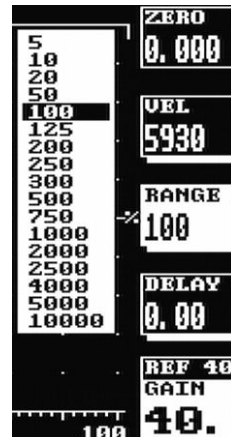
4.3 CAL Menu

The CAL menu is the most used menu and contains those items that allow the DFX-625 to be easily calibrated. For full instruction on how to perform a calibration see Flaw Testing Calibration on page 37

4.3.1 Calibration Menu

ZERO   Used to calibrate the screen and thickness readout for zero offsets that are inherently different for each transducer. Units are microseconds in both mm and inch modes.

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 **UTIL** menu. The range is 1mm to 20 meters (0.05 to 800 inches).

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 20 meters (0 to 800 inches).

4.3.2 Amplifier Menu

FREQ   Used to set the centre frequency band of the amplifier to match the transducer. Ranges are 1, 2.5, 5 & 10MHz narrow bands and 1.5 – 15MHz wide band.

DETECT   Used to set the display mode for the desired rectification of the signals from **FULL** (rectified full wave), **RF** (un-rectified), **-VE HW** (negative half-wave) and **+VE HW** (positive half-wave)

REJECT   Used to remove low level noise from the A-Trace. Reject is linear and is adjustable from 0 up to 50% of full screen height. The REJECT LED is lit when a reject is active.

PRF MAX   Used to set the maximum pulse repetition frequency. Selectable values are from 35 to 100 in 5Hz steps, from 100 to 1,000 in 50Hz steps. Lower values will reduce ghosting and noise echoes.
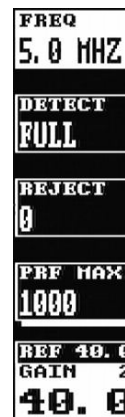
4.3.3 GATE1 & GATE2 Menus

There are two gates available in the DFX-625 with slightly different options depending on the gate and the measurement mode chosen. The following describes the available settings for each gate with the differences between the gates stated. The gates can be identified by the fact that gate 1 has the number "1" above the line and gate 2 has the number "2" above it.

STATE   Set the state of the gate as follows:

> **+VE:**   The alarm triggers when an echo in the gate exceeds the threshold level.
>
> **-VE:**   The alarm triggers when an echo in the gate falls below the threshold level. Usually used to monitor for loss of back wall echo.
>
> **EXPAND:** Expands the gate width to fill the horizontal display width. Only applies to gate 1.
>
> **OFF:**   Switches the gate off.
>
> **-VE DLY:** (Gate 2 only) This fourth state on gate two implements a gate to alarm delay of 600 milliseconds. This requires that the signal be lost from the gate for a continuous period of 600 milliseconds before the alarm is activated. This is implemented for the alarm LED, buzzer and external alarm output via the proportional output connector.

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 (0.001 inch), 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.

4.3.4 A-CAL Menu

This menu provides automatic calibration of sound velocity and transducer zero. Gate 1 is used to select the reference echoes. See A-Cal on page 63 for a full procedure.

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

4.4 MEAS Menu

The menus in this section allow the various measurement techniques to be configured; these include the general measurement set-up and specialist methods such as DAC, AVG, TCG, AWS and API. Select the **MEAS** menu at any time by pressing the MENU button.

4.4.1 Measurement Menu

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

MODE: **MONITOR**	In this mode, gates 1 and 2 act as two independent monitor gates	

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

TRIGGER   Used to select the depth or thickness measurement to the **FLANK** (left edge) of the first echo after the start of the gate or the **PEAK** measurement within the gate i.e. the largest value in the gate.

HUD   When turned **ON**, provides a large, Head-Up Display of the depth or thickness reading at the top right of the A-Trace. The ↳ button sequences the selections as follows:

G1-G2	E-E	DEPTH	TRIG
OFF	**OFF**	**OFF**	**OFF**
DIST	**DIST**	**DIST**	**DIST**
DIST +	**DIST +**	**HEIGHT**	**HEIGHT**
		DIST +	**DIST +**
		HEIGHT +	**HEIGHT +**
			↓
			↓ +
			↘
			↘ +

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.

MODE: **E-E**   In this mode, gate 1 functions as a thickness monitor and measures the thickness between the first signal in the gate and the second signal in the gate that reaches or exceeds the level threshold. A second bar is shown representing the blanking (see BLANK)

BLANK

This function sets the blanking distance, as a percentage of the total gate width, which is a

blind zone after the first echo, after which a second echo can be measured. This helps to eliminate undesired noise in the first echo from being measured, as thickness but will limit the minimum thickness capability if set too large

MODE: G-G   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.

MODE: TRIG   The Trigonometry mode is used with angle beam transducers for weld inspection to calculate the three important measurements based on the echo position: the Beam path distance (↘:), the Surface distance (→:), and the Depth distance (↓:) from the index point of the transducer.

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

4.4.2 CSC (Curved Surface Correction)

This menu allows the user to configure the Curved Surface Correction (CSC) parameters. This feature normally used when testing pipes and other curved surfaces. In order for the correction to be made the correct wall thickness must be selected in the **THICK** option when **TRIG** is selected in the **MEAS** menu.

MODE   Turn CSC **ON** or **OFF**.

Surface   Choose CONCAVE for internal surfaces or CONVEX for external surfaces

RAD   Select the radius of the curvature.

4.4.3 PROBE Menu

ANGLE   Set to the nominal refracted angle of the transducer to calibrate the Surface and Depth measurements

X-OFFSET   Used to enter the distance from probe emission point to front of probe case. This is used by the TRIG function in MEAS menu to give the surface distance.

1/2 SKIP   Used as a quick way to turn on the ½ skip graticule.
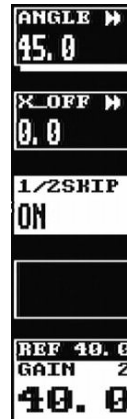
4.4.4 Distance Amplitude Correction (DAC) Menu

This menu is used to create DAC curves using a series of reference echoes. Once drawn, the DAC curve acts as an alarm threshold level for the gate where the level varies to match the attenuation and field characteristics of the transducer and test material combination. The DAC procedure is described fully in DAC Operation on page 40.

MODE:
ON   Displays the DAC curve on the screen

CURVE   Used to display the DAC curve alone, the -6/-12dB, -6/-14dB, -2/-6/-10dB, -2dB, -6dB or -10dB reference curves.

TRIGGER Used to set the alarm threshold for the DAC curve, -2dB, -6dB, -10dB, -12dB or -14dB curve or the gate.

MEAS   Used to select the measurement value in dB, % Full Screen Height (FSH) or %DAC for any signal that is in the curve or gate.

MODE:
DRAW   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 number of points created after pressing the OK button.

4.4.5 DGS/AVG

This menu is used to create a DGS/AVG curve that allows flaw sizing and distance compensation without requiring the reference standards that would be required for establishing a DAC curve or to set up a TCG correction. The DGS/AVG procedure is described fully in DGS/AVG Operation on page 50.

MODE: OFF	Initial mode. Turns off the display of the DGS/AVG curve	
FREQ	Used to set the transducer frequency taken from its datasheet.	
NFL	Used to set the Near Field Length taken from the transducer datasheet	
ERS	Used to set the Equivalent Reflector Size.	
MODE: SET PRB	Mode used to define curvature correction and probe delay	
dVK	Used to set the curvature correction factor in dB and is taken from the transducer datasheet.	
DELAY	Used to set the probe delay material velocity in m/s and is used in conjunction with the probe zero and specimen velocity to calculate the sound field equivalent length.	
MODE: SET ATT	Used to set attenuation parameters	
T-LOSS	Used to set the transfer loss in dB due to surface condition, poor coupling etc…	
REF dB/m	Used to set the reference material attenuation in dB/m	
MAT dB/m	Used to set the test material attenuation in dB/m	
MODE: SET REF	Used to define the various reference values	
TBVEL	Used to set the reference (test) block velocity in m/s	
REF TYPE	Used to select the reference reflector type: Flat Bottom Hole (**FBH**), Side Drilled Hole (**SDH**) or Back Wall Echo (**BWE**)	
REFSIZ	Used to define the size of the reference type. If **REF TYPE** is set to **BWE**, **REFSIZE** is set to **INFINITE**	
MODE: SET SIG	Mode used to perform calibration	
CURSOR	Select than use the ↳ and ↰ keys to move the selection over the echo and press **OK**. The DFX-625 will calculate the sensitivity and draw the curve on the screen	
MODE:	Mode in which DGS/AVG is on.	

ON

TRIGGER   Used to select either the **GATE** or the **CURVE** as the measurement reference

ERS   Used to set the Equivalent Reflector Size.

4.4.6 TCG Time Corrected Gain Menu

This menu is used to create TCG curves using a series of reference echoes. Once drawn, the TCG curve acts as swept gain control on the amplifier to set different gain levels relative to distance. The TCG procedure is described fully in TCG Operation on page 42

MODE: ON   Activates the TCG curve to adjust the gain. Can be activated in RF or rectified display modes.

CURVE   When switched ON, the TCG curve is displayed.

MODE: DRAW   Used to create the TCG curve. 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.
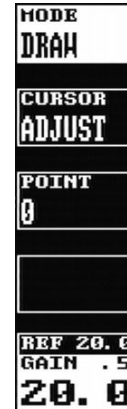
4.4.7 AWS Menu

This menu is used when performing weld inspection in accordance with the American Welding Society's Structural Welding Code, ANSI/AWS D1.1-94. It provides a convenient method to automatically calculate the Indication Rating as defined in the code. The AWS procedure is described fully in Weld Inspection Using the AWS Menu on page 46

MODE: SET	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.
MODE: MEAS	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.

4.4.8 API Menu

This menu is used to assist users in performing tests according to the American Petroleum Institute (API) Recommended Practice for Ultrasonic Evaluation of Pipe Imperfections using the Amplitude Distance Differential Method (ADDM). Users are referred to the publication: "API Recommended Practice 5UE, Second Edition, June 2005" The API procedure is described in Evaluation of Pipe Imperfections using API 5UE on page 48

MODE: CAL	Used to set the initial calibration of the defect.	MODE **CAL**
dr	Depth of the reference indicator; should be set by the user according to the size of the reference defect.	dr **0.81**
START	The position of the gate that is used to set the calibration	START **40.12**
MODE: MEAS	Used once the calibration has been done to make comparative measurements.	
START	Used to position the start of the gate used for making measurements	REF 40.0 GAIN 2 **18.0**
k	The k factor, derived during the calibration phase and used to calculate the depth of the defect. It can't be changed during the measurement phase and id displayed for reference.	
di	Imperfection depth calculated by the DFX-625	

4.5 UTIL Menu

Press the MENU button followed by the function key next to **UTIL** to select these menu options. The items in this section allow the user to configure features such as units, display preferences, language, print options, proportional output configuration and date and time settings.

4.5.1 UTIL Menu

UNITS Selects **INCHES**, **µs**, or **METRIC** measurement units.

When in **µs** mode, the velocity is fixed at 2000 m/s (5000in/µs) 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 **SMOOTH** is selected the signal is displayed as an envelope. When **FILL** is selected the area under the trace is filled.

```
UNITS
METRIC

CLICK
OFF

ALARM
MUTE

SMOOTH
OFF

REF 20.0
GAIN  .5
20. 0
```

4.5.2 VIDEO Menu

COLOR Selects one of eight color schemes for the display

BRIGHT Controls the display brightness. The level selected will affect the battery duration. A value of 1 gives about 16 hours, the default of 10 gives about 12½ hours whereas a value of 20 will give about 9 hours of operation, assuming the battery is in good condition and at room temperature.

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 graticule options from the following choices:
   OFF: No graticule.
   ON : A complete 100% graticule
   SPARSE : A row of dots at 10% intervals.
   50%: Divisions at 50% full screen height.
   1/2 SKIP: Sparse with vertical dotted lines representing the ½ skip, full skip and 1½ skip distances.

```
COLOUR
0

BRIGHT
10

VIDEO
PAL

GRATICLE
1/2SKIP

REF 20.0
GAIN  .5
20. 0
```

4.5.3 MISC Menu

LANG Selects one of 6 built in languages or a user selectable language. The built in languages are selectable at time of ordering the DFX-625.

SPLIT Allows the user to display a vertically

```
LANG
GB

SPLIT
ACTIVE
```

compressed A-Scan in the upper half of the screen and a sub-set of the menus in the lower half. When set to ACTIVE the FULL SCREEN button switches between normal, full and split screen views.

BAUD   Allows the user to select a Baud rate for the serial port to operate at. The choices are: 9,600 (**9K6**), 19,200 (**19K2**), 38,400 (**38K4**), 57,600 (**57K6**) or 115,200 (**115K2**).

KEYLOCK   Allows the user to "lock out" the keys of the unit to stop inadvertent changes. When set to ACTIVE the ⬭(FREEZE PEAK) button toggles between freeze, peak and keylock.

4.5.4 AGC (Automatic Gain Control)

Automatic Gain Control feature is generally used in thickness logging.

By setting a percentage of full screen height (**% FSH** – default 50%) and ensuring that the signal is breaking gate 1, the gain will be adjusted automatically to bring the signal height to the user defined value subject to an adjustable tolerance (**+–% TOL**).

AGC MODE   Turn AGC **ON** of **OFF**

% FSH   Choose the screen height to which the user wants the gain to be adjusted.

+-% TOL   Choose the tolerance on the % FSH to stop the AGC "hunting" due to signal height jitter. The range can be set between 5% and 20% FSH

```
AGC MODE
ON

% FSH
50

+-% TOL
5


REF 20.0
GAIN  .5
20.0
```
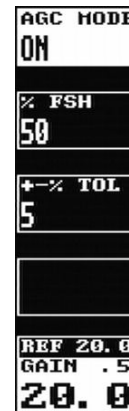
To Use:

- Set Gate 1 +ve, to a height of, say 10% or 20% FSH.

- Ensure that Measurements are enabled

- In the AGC menu: Set the %FSH parameter to the signal height required.

- Enable AGC by changing AGC Mode to ON.

- For poor surface conditions, adjust the +-% BAND to increase the tolerance of variation in the signal before the GAIN is adjusted

- When a signal is present in Gate 1, and Measurements are ON the Gain will be automatically adjusted to bring the signal back to the specified height on the screen.

NOTES:

- AGC defaults to OFF.

- %FSH setting is retained.

- The parameters are reset to default values on power up.

- The PRF is reduced to 250Hz to maintain consistency of internal processing.

- If the Gate level is above the user defined %FSH, AGC is internally inhibited.

- AGC is not compatible with AVG or AWS. If either AVG or AWS is selected they will turn AGC off.

4.5.5 PRINT Menu

This menu allows printing of information to a suitable USB printer connected to the USB port on the DFX-625. Please note that this requires a printer with a USB port from the Dakota Ultrasonics certified list of printers.

OFF   The print mode is switched OFF

DISPLAY   With the print mode in **Display**, the screen display will be sent to the printer when the OK button is pressed.

LIST CPY With the print mode in **LIST CPY**, all the calibration settings, the screen and all notes in the edit feature will be sent to the printer 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 800 A-Scans are stored.

4.5.6 P_O/P Proportional Output Control Menu

This menu controls the analogue 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 and are updated at the PRF.

O/P 1   **DEPTH1**: (Gate1)

DEPTH2: (Gate2)

E1-E2:   Distance between the two depth measurements

ALARM 1: Voltage output when alarm 1 is active

O/P 2   **LEVEL1**: (Gate1)

LEVEL2: (Gate2)

L1-L2:   The difference between the two amplitudes

ALARM 2: Voltage output when alarm 2 is active

CAL   Allows the user to change the voltage on the proportional outputs between 0V and 10.1V
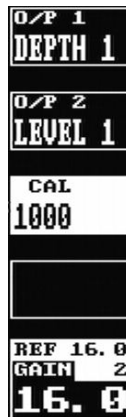
4.5.7 CLOCK Menu

SET OFF   Do not display the time at the bottom of the display

SET TIME   Used to set the current time.

          NOTE: Be sure to press OK to save the new time and again to save the date.

HOURS   Used to set the current hour in 24 hour format

MINS   Used to set the current minutes.

SET DATE   Used to set the current date.(Selected by pressing the function button next to **SET** , then ↳)

DATE   Used to set the current day.

MONTH   Used to set the current month.

YEAR   Used to set the current year.

4.6 MEMORY Menu

Press the MENU button then the function button next to the **MEMORY** option to access the Memory menu. These menus allow the user to save panel settings, A-Scans and thicknesses as well as recalling an A-Scan to be used as a reference.

4.6.1 PANEL Memory Menu

This menu provides storage and recall of up to 100 calibration settings.
The use of this feature is described fully in Storage & Recall of Calibration Setups on page 33

STORE	Used to select a storage location (1-100).
MODE: RECALL	Used to recall a stored calibration set to the active memory. Press OK to recall
MODE: DELETE	Used to delete a **VALID** (used) calibration set. Press OK to delete. Press OK again after the confirmation prompt
MODE: LIST	Shows the notes associated with the stored calibration set. Pressing OK will recall the calibration set at which time the Notes can be edited.
MODE: STORE	Stores the current calibration settings in memory to the selected Store set. Press OK to store. Press OK again after the confirmation prompt.
MODE: INDEX	Lists all memories, use ↳ & ↰ to change 'page'. Cancelled by scrolling past the end
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.

STORE
1

MODE
RECALL

STATE
VALID

EDIT
NOTES

REF 20.0
GAIN .5
20.0

4.6.2 A-LOG Memory Menu

This menu provides storage and recall of up to 800 A-Scans with settings. The use of this feature is described fully in A-LOG, A-Scan Storage on page 57

STORE   Used to select a storage location(1-800)

MODE:
RECALL   Used to recall a stored A-Scan and settings to the active memory. Press OK to recall. The A-Scan is displayed in FREEZE mode. Press (FREEZE PEAK) to remove.

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

MODE:
LIST   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.

MODE:
INDEX   Lists all memories, use ↳ & ↱ to change 'page'. Cancelled by scrolling past the end.

MODE:
STORE   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 Adding NOTES to PANEL and A-LOG sets on page 33.)

4.6.3 REF Menu

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

STORE	Used to select an A-LOG storage location (1-800)
MODE: RECALL	Used to recall the stored A-Scan and display it. Press OK to recall.
MODE: LIST	Shows the notes associated with the: stored A-Scan. Pressing OK will recall the waveform.
MODE: OFF	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.

```
STORE
7

MODE
RECALL

STATE
EMPTY


REF 20.0
GAIN  .5
20. 0
```

4.6.4 T-LOG Menu Numeric Mode

This menu provides storage and recall of up to 8,000 thickness readings. Numeric and Sequential modes are available as selected in the T-FN menu. This feature is described fully in T-LOG Thickness Storage on page 65

Readings are stored under a three level code, starting with BLOCK (1-14), followed by Location (1-8000) and NO (1-8000).

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.

```
BLOCK
1

LOC
3

NO
10

THICK
26.64

REF 16.0
GAIN   2
16. 0
```

4.6.5 T-LOG Menu Sequential Mode

Readings are stored by location (1-8000) number only. In this mode location and historical thickness data can be downloaded to the DFX-625 from a computer, a fixed series of four notes can be added to a location, and any of the 100 PANEL store settings can be assigned to a location. This feature is described fully in T-LOG Thickness Storage (Sequential & Download) on page 66.

Note: The HUD is on automatically in sequential mode.

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 DFX-625 can then be automatically calibrated to one of 100 panel settings for selected sequence numbers.

4.6.6 T-FN Menu

MODE: PRINT	Set the mode to PRINT to print the selected blocks and locations to the printer on the RS232 port.
MODE: DELETE	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.
MODE: ID	Select NUMERIC or SEQUENCE Mode for Data logging

4.7 Storage & Recall of Calibration Setups

After the DFX-625 has been properly calibrated for a particular testing scheme, it is possible to store all of the panel settings for subsequent recall when performing the same test at a later time. Although the last panel settings are "remembered" by the DFX-625's memory, this feature is useful when the instrument is being used for many different tests requiring substantially different panel calibration settings. In addition to the panel settings, a freeform note can be stored with the panel set that includes provision for a label, an operator name or number, a location identifier, and a transducer identifier. It is possible to store up to 100 sets of panel settings; each assigned a set number from 1 to 100. 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.

4.7.1 To store a panel set:

- Press the MENU button followed by the function button next to the **MEMORY** option to access the Memory menu.
- Use the 〈 and 〉 buttons to highlight the PANEL menu.
- If it is desired to store Notes with the panel settings, see the description for entering notes below.
- Select the STORE box and, using the ↳ and ↲ buttons, select a desired STORE number from 1 to 100. Note that as the STORE number is changed, the STATE parameter indicates if the number is used (VALID) or EMPTY.
- Select the MODE box and using the ↳ and ↲ buttons, select the STORE mode.
- Press the OK button to store the panel settings.
- If you forgot to enter Notes, create the Notes as described below and the re-save the panel settings starting at step 5 above.

4.7.2 To recall a panel set:

Follow the above procedure but set the MODE parameter to RECALL and then press the OK button.

4.7.3 To delete a panel set:

Follow the above procedure but set the MODE parameter to DELETE and press the OK button.

4.7.4 Adding NOTES to PANEL and A-LOG sets

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

When a panel calibration or waveform is to be stored, first calibrate the instrument as desired, or capture the waveform by pressing the (FREEZE PEAK) button. Then select the **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 WinDFX PC program to allow quick identification. The **OPERATOR**, **LOCATION** and **PROBE** lines are 25 characters each, while the three **NOTES** lines allow up to 75 characters.

The ‹ and › buttons are used to move the cursor from right to left along a line of text. The function 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 function button adjacent to the **DELETE CHAR** box.

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

To select a character from the character map below the Notes lines, use the ↳ and ↴ buttons to move the highlight through the map. The press the OK button to add the character to the **NOTES** at the position of the cursor.

Once the desired notes have been added or edited, press the function button adjacent to the **EXIT** box. The text is now entered 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.

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

The following shows a completed notes window:

4.7.5 Edit Notes Summary

The following sections provide a summary of the navigation techniques needed to edit notes using either the front panel keypad or the optional USB keyboard:

4.7.5.1 Using the Front Panel Keypad

EDIT NOTES: Press to bring up the editing boxes as follows: Use the ‹ and › buttons to move the cursor horizontally along a text line. Use the ↳ and ↴ buttons to highlight a character from the map. Press OK to write a character to a line.

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.

4.7.5.2 Using the Optional Keyboard

Keyboard Function Connect the optional keyboard to the USB socket on the front panel of the set. Press **EDIT NOTES** from the keypad to enter the keyboard function.

Small Character & Numbers Press any key on the keyboard to edit the characters, the same applies to numbers.

Capital Character & Signs Press SHIFT + the wanted character or sign.

Insert a Space Press the space bar to insert a blank character at the position the cursor is currently on.

Delete Character Press the backspace to delete the previous character to the position the cursor is currently on.

Delete Character Press Delete to delete the character under the cursor

Up Arrow Press ↑ to move the cursor up.

Down Arrow Press ↓ to move the cursor down.

Left Arrow Press ← to move the cursor left

Right Arrow Press → to move the cursor right

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

5 Flaw Testing

5.1 Basic Flaw Testing

Reliable flaw detection requires three important considerations:

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

Transducers used for flaw detection are usually of the narrow band variety to provide the best possible sensitivity to the anticipated discontinuities. In some cases, broadband varieties are chosen to optimize near or far surface resolution – the ability to separate discontinuities from the front surface or back surface echo. In either case, the frequency is chosen so that the wavelength in the material is optimized for the orientation and size of expected discontinuities. The single element contact transducer is used for general-purpose flaw detection. The angle beam transducer is used for weld inspection, which is covered in Weld Inspection Using Trigonometry Mode on page 44. Other specialty transducers including dual and surface wave can be used but these topics are beyond the scope of the manual.

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

Finally, it is necessary to establish the proper calibration of the DFX-625 in order to assure reliable flaw detection.

5.2 Flaw Testing Calibration

The essence of this calibration is to set the pulser, amplifier and gate parameters to provide the necessary sensitivity and resolution. The DFX-625 has an automatic calibration technique that sets the necessary parameters by using a calibration block that has known thicknesses; see A-Cal on page 63 for details.

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

1. Select the appropriate single element contact transducer and calibration block that matches the material and expected discontinuities under test.

2. In the **CAL** menu, select the proper **RANGE** and **DELAY** so that several echoes from the expected material depth can be viewed.

3. From the **AMP** menu, set the **DETECT** parameter to **FULL**.

4. Use the ⬭ button to set the transducer to **SINGLE**.

5. Couple the transducer to the calibration block and obtain an echo from a fabricated discontinuity or the back surface and adjust the **GAIN** to set the peak of the echo to about 80% screen height.

6. Adjust the gain to set a reference echo from mid thickness of the calibration block to about 80% amplitude.

7. From the **MEAS** menu, set the **MODE** parameter to **G1-G2** and the **TRIGGER** parameter to **PEAK**.

8. From the **GATE1** menu, set the gate to **ON +VE** and adjust the **START**, **WIDTH** and **LEVEL** so that the gate covers the first echo. From the **GATE2** menu set the gate to **ON +VE** and adjust the **START**, **WIDTH** and **LEVEL** so that it covers an echo that is a known multiple of echoes from the first. For instance if a 25mm thick calibration block was being used the first gate would be set on the first backwall echo and the second gate on the 6th backwall giving a distance between them of 125mm as shown below:
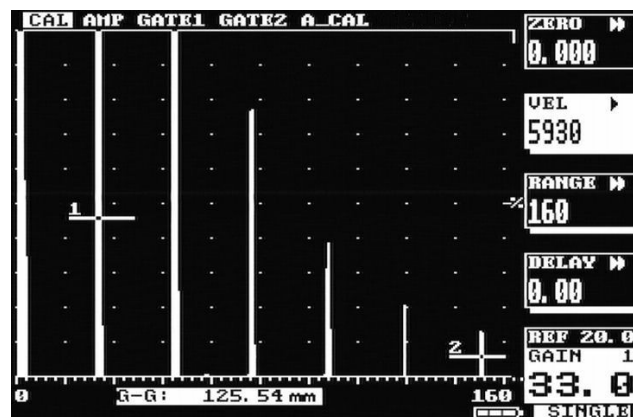
9. The distance between the echoes is shown in the G-G measurement at the bottom of the display (in this case 125.54). It is unlikely that the value will be exactly correct as the velocity of sound in the material will not match one of the preset values. Select a velocity that is close to the material then adjust it so that the exact distance is obtained as shown below:
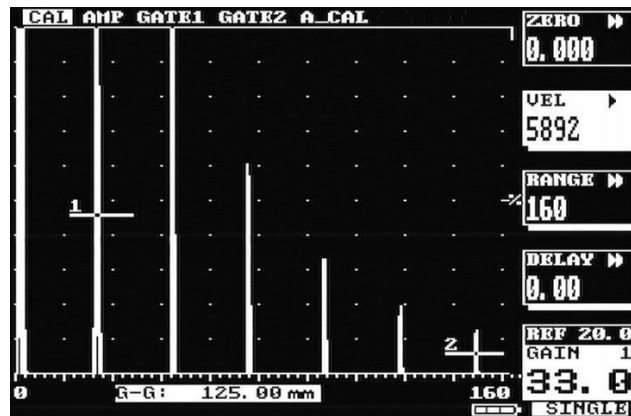
10. Next the calibration needs to take account of the distance between the transducer crystal and the front face of the transducer by setting the correct **ZERO** value: From the **MEAS** menu change the **MODE** to **DEPTH**.

11. From the **GATE2** menu change the **MODE** to **OFF**, from the **GATE1** menu change the **START**, **WIDTH** and **LEVEL** values so that the gate covers the 6th peak as shown below:
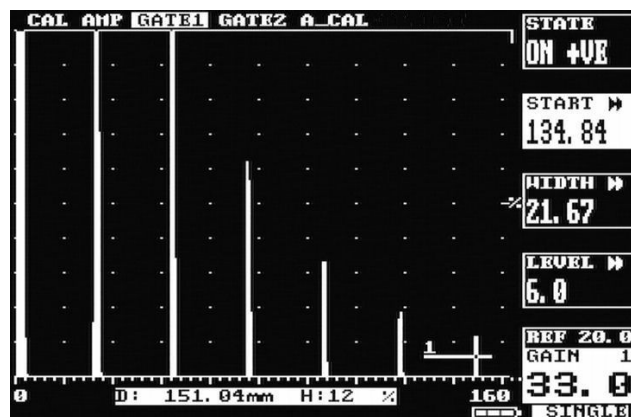
12. The distance measurement is shown at the bottom of the display (in this case 151.04). From the **CAL** menu adjust the **ZERO** value until the correct distance is shown as below:
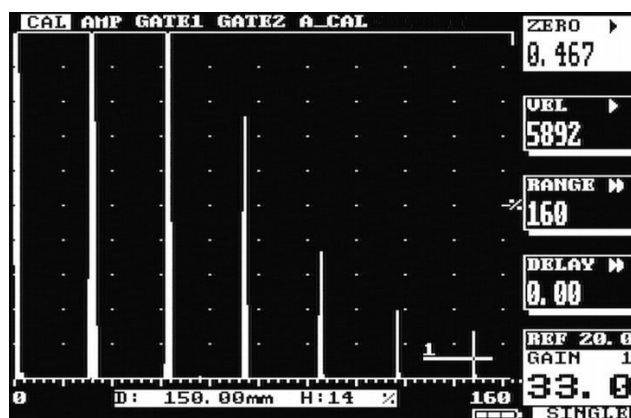
13. As a final check move the gate across the other echoes to ensure that the correct distances are shown; From the **GATE1** menu adjust the **START** and **LEVEL** parameters so that the gate covers each echo in turn. Check that the correct values are shown as below:
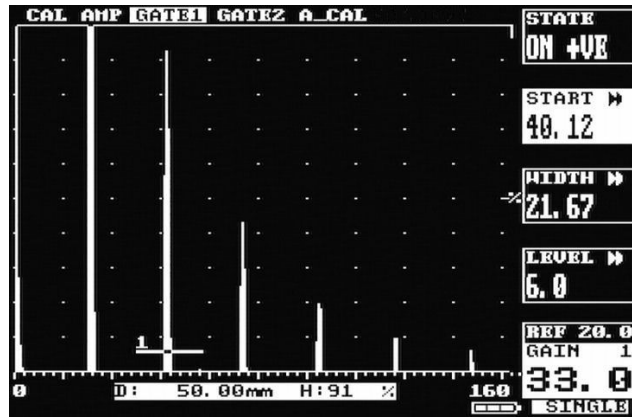
Now that the DFX-625 has been calibrated it can be used to perform inspections using any of the techniques described in the following sections.

For weld inspection using an angle beam transducer, follow the instructions in Weld Inspection Using Trigonometry Mode on page 44.

For storage and printing of A-Scans, refer to A-LOG, A-Scan Storage on page 57

5.3 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.

It should be noted that since the DAC function only provides a dynamic alarm threshold capability, the dynamic range is limited to about 16dB. Therefore, for materials that attenuate more than 16dB over the depth range of interest, DAC should not be used. Instead, the TCG function may be more applicable. See TCG Operation on page 42 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 DFX-625 using the desired transducer and the proper reference block. From the **MEAS** menu, select the **DAC** feature.

2. Select the **MODE** parameter by pressing the function button next to it and use the ↳ button to select **DRAW**. The other parameters will now be **CURSOR** and **POINT**. Note: When in the **MODE** parameter, only press the ↰ button to turn the DAC off. This will erase any logged echoes.

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

4. Use the ↳ and ↰ buttons to position the bright cursor bar over the echo from the reference hole.

5. Press the OK button to accept the point. A small square will appear as a reference point on the display showing the peak of the signal just recorded.

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

7. Press the function button adjacent to **MODE** and use the ↰ button to select **ON** mode. The DAC curve will now be displayed and the other parameters will change to **CURVE** and **TRIGGER**

8. Use the **CURVE** parameter and the ↳ button to select just the DAC reference curve, the DAC curve along with the -6dB and -12dB curves, or the DAC curve along with the -6dB and -14dB curves. These additional, automatically generated reference curves provide a means for evaluating discontinuities smaller than those in the reference block.

9. Use the **TRIGGER** parameter to establish the alarm trigger from the DAC curve, the -6dB curve, or the -12dB/-14dB curve. The latter being whichever one is selected in the **CURVE** parameter.
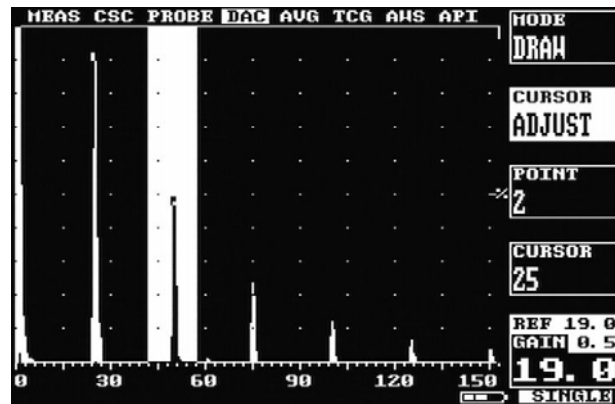
If depth measurement is switched on with the DAC feature, the depth mode display below the A-Trace will show the distance to the echo peak and the relative amplitude to the DAC reference curve in dB. Note that the relative dB display is dependent on the REF gain setting, but not the **GAIN** setting.

To turn off the DAC feature, select the **MODE** parameter from the **DAC** menu and press the ↳ button until **OFF** is indicated.
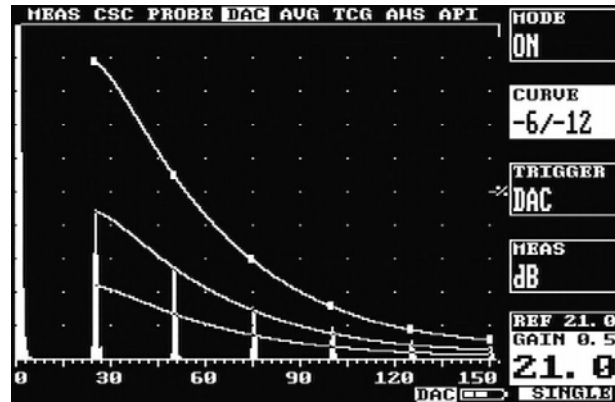
5.4 TCG Operation

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.

To establish a TCG curve, follow the following instructions:

1. Establish the basic calibration of the DFX-625 using the desired transducer and the proper reference block.

2. From the **MEAS** menu, select the **TCG** feature.

3. Select the **MODE** parameter by pressing the function button next to it and use the ↵ button to select **DRAW**. The other parameters will now be **CURSOR** and **POINT**.

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

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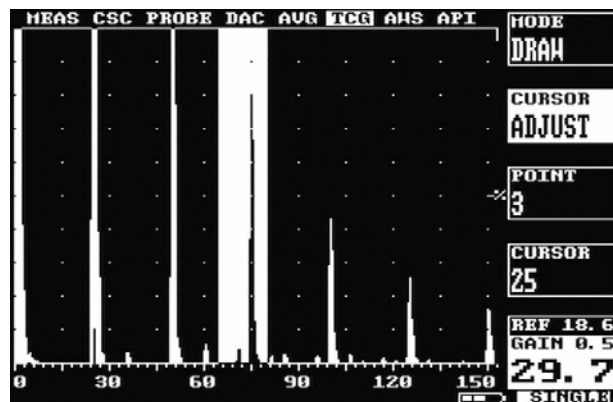
7. Repeat steps 5 and 6 for each additional reference hole in the reference block, being careful to be consistent with the amount of coupling and transducer pressure. A maximum of 10 points can be recorded for a TCG curve.

8. Press the function button adjacent to **MODE** and use the ↵ button to select **ON** mode. The TCG curve will now be displayed, the amplifier gain will now swept, and the other parameters will change to **CURVE**.

9. Use the **CURVE** parameter and the ↳ button to select ON or OFF for the display of the TCG curve.
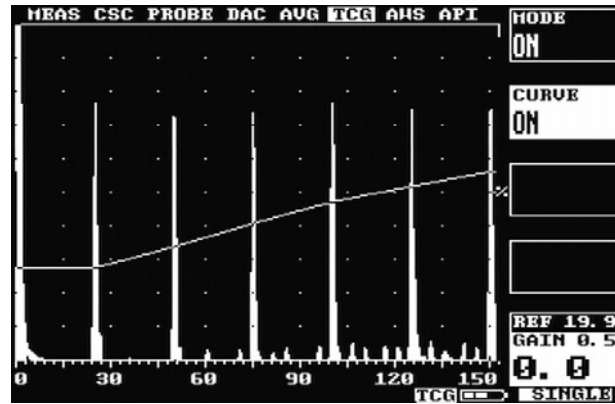
NOTE: A TCG curve cannot be drawn while in RF display mode (**AMP** menu, **DETECT** parameter, **RF** value), but can be activated. Therefore, if TCG is desired in RF display mode, draw the curve in rectified mode first and then switch to RF. It should be noted that the range of TCG is limited only by the dynamic range of 40dB.

5.5 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 DFX-625 to calculate the surface distance and depth to a discontinuity from the actual beam path measured. This is accomplished by calibrating the trig mode with the actual refracted angle of the transducer being used. Additionally, the thickness of the test piece must be established in the menu in order to calculate depth and surface distance when using multiple skips in angle beam testing. The measurements being calculated are depicted in the following diagram:
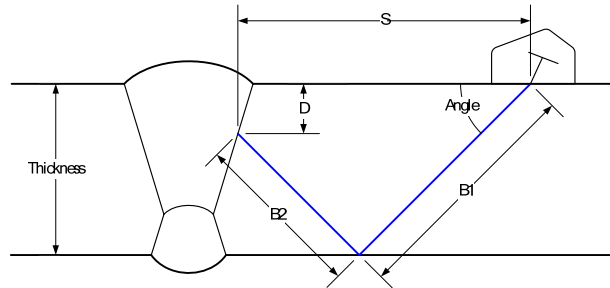
These measurements are displayed below the A-Trace on the DFX-625 as follows:

⬊   Beam path distance B from the central exit point on the transducer to the discontinuity, the sum of B1 and B2 in double skip mode.

➔   Surface distance S from the central exit point on the transducer to a point directly above the discontinuity on the test piece. By entering the distance from the Front of the Probe to the emission point in the PROBE menu, This distance may be displayed relative to the front of the probe, which is usually more convenient.

⬇   Depth distance D from the surface on which the transducer rests to the discontinuity.

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

⬊:146.13   ➔:103.33   ⬇:96.67   H: 85%

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

It is important to note that discontinuities in welds can be discontinuous and can extend over a distance. The measurements made will, therefore, be close approximations to the discontinuity if the user properly calibrates the DFX-625 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 being used.

2. Establish the zero and velocity (span) for the transducer and material under test using the A-CAL procedure described in A-Cal on page 63. 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 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. Select the **ANGLE** parameter and using the ↳ and ↴ buttons, set the refracted angle of the transducer measured in step 1 above.

7. Select the **THICK** parameter and using the ↳ and ↴ buttons dial in the thickness of the test piece. You may have to readjust this parameter if the test piece had varying thickness and you are using a multiple skip mode of angle beam testing.

8. When measuring a discontinuity, position the transducer so as to obtain the maximum amplitude signal before recording the readings. A typical TRIG mode display is shown below.
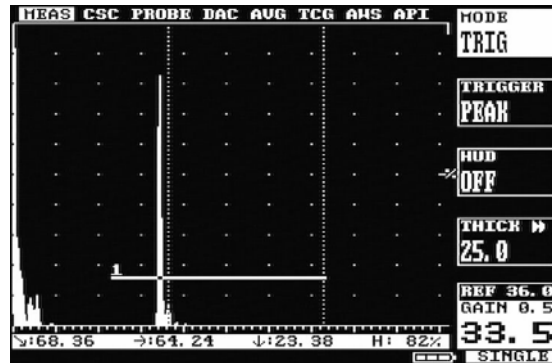
5.6 Weld Inspection Using the AWS Menu

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 which 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 DFX-625 for weld testing and set up the trigonometry mode by following the steps in .

2. From the **MEAS** 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 **CURSOR ADJUST** and using the ↳ and ↰ arrow keys.

6. With the signal maximized, press the OK key.

The DFX-625 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**.

2. Ensure that the gate and measurement (**TRIG**) function are operative and properly adjusted.

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

It is not necessary to bring the indication to the reference level to obtain the correct measurement information as the DFX-625 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.

5.7 Evaluation of Pipe Imperfections using API 5UE

The DFX-625 is able to assist the user in making measurements in accordance with the American Petroleum Institute (API) Recommended Practice for Ultrasonic Evaluation of Pipe Imperfections using the Amplitude Distance Differential Method (ADDM). Users are referred to the publication: "API Recommended Practice 5UE, Second Edition, June 2005"

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

The first step is to perform a standardisation using a reference indicator such as a notch of a known depth or a through drilled hole. It is assumed that the Masterscan had been setup with the correct values for the transducer and specimen being used for the inspection.

First turn on **GATE1** from the **CAL** menu and position it on the display so that it will cover the signal that will be produced by the reference indicator; the height of the gate is not important. Ensure that the signal will be between 5% and 100% of full screen height. Select **API** from the **MEAS** menu and select **PEAK** by pressing the (FREEZE PEAK) button twice then capture the reference signal and the following display should be shown:

Once the desired signal is obtained press the OK button and the k factor (a derived factor for calculating depth) is calculated and displayed as shown:

The DFX-625 automatically goes into **FREEZE** mode. Pressing the OK button again puts the API facility into measurement mode as shown below. The k value is displayed but cannot be changed while in measurement mode.
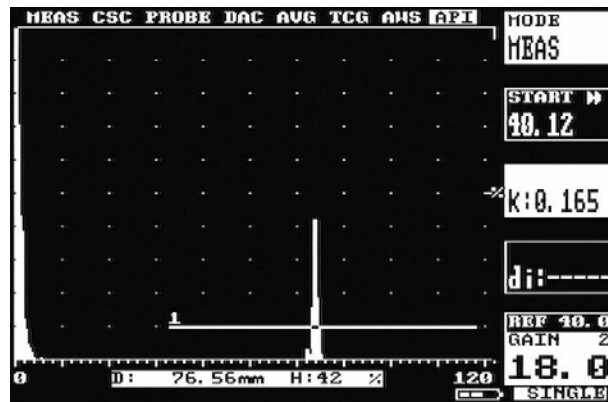
To take measurements select **PEAK** mode by pressing the (FREEZE PEAK) button twice and capture the echo dynamic signal; once the desired signal has been captured press the OK button. The di value is calculated and displayed as shown below:

Once the measurement has been made, pressing the OK button clears the current reading.

To take the next measurement select peak mode by pressing the (FREEZE PEAK) button twice.

5.8 DGS/AVG Operation

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

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

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

DGS/AVG has several limitations:

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

Corrections may be required for several factors:

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

5.8.1   Theory

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

The near field length is defined by the equation:

$$N = \frac{D_{EFF}^2 - \lambda^2}{(4\lambda)}$$

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

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

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

It is therefore possible to define a standard relationship, knowing the basic probe parameters, which only need be corrected for the sensitivity of the probe by measuring the response from a known reflector.
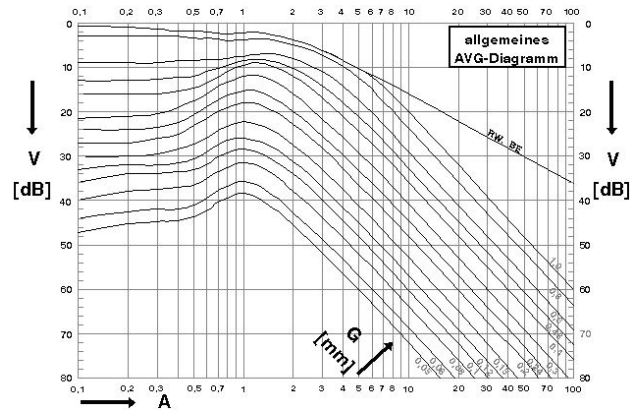
The picture shows a 'general' DGS/AVG diagram plotted on logarithmic scales, Relative gain in dB, Distance as a multiple of Near Field Length, The various curves represent the signal from an Equivalent Reflector Size (ERS) expressed as a multiple of the effective probe diameter.

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

5.8.2 DGS/AVG Frequency, NFL and ERS

Press MENU then the function button next to **MEAS** and select the **AVG** menu, **MODE** should be **OFF**

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

Desired test sensitivity (**ERS**) may also be set now. (This can be adjusted later)
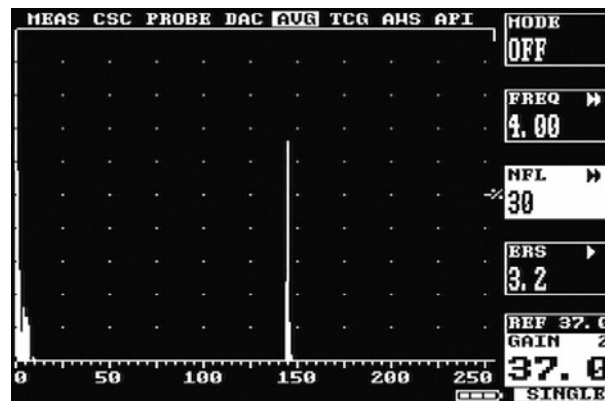
5.8.3 DGS/AVG dVK, Delay

Set **MODE** to **SET PRB**

dVK (V_K) – Curvature Correction Factor in dB

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

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

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

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

DELAY – Probe Delay Velocity, in meters per second

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

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

NOTE: For DGS/AVG to work accurately the probe zero must be set correctly.
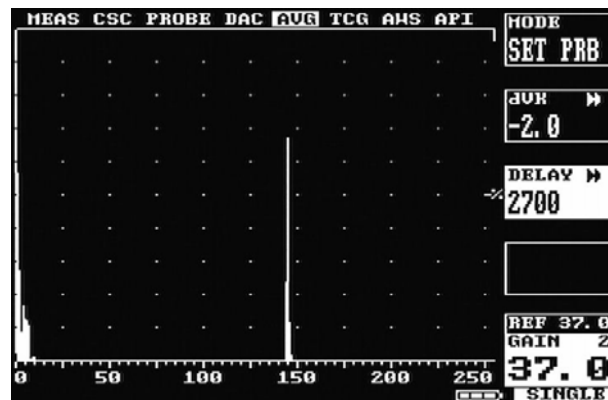
5.8.4 DGS/AVG T-Loss, Ref dB and Mat dB

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

T-LOSS – Transfer Loss, in dB.

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

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

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

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

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

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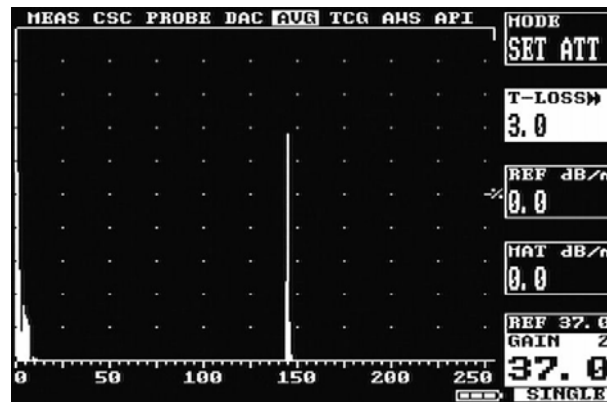
5.8.5 DGS/AVG ~ TBVEL, REF TYPE and REFSIZE

Change **MODE** to **SET REF**

TBVEL – Reference (Calibration) Block Velocity, in meters per second

Reference (Calibration) Block Velocity, in meters per second. This parameter is used internally.

It will take the same range of values as the Velocity parameter.

NOTE: This parameter MUST be entered. The Wavelength, which is calculated from this velocity and the Probe frequency, is critical to the DGS/AVG calculations.

REF TYPE – Reference Reflector Type

The user can select one of a number of different reference reflectors.

In this implementation, these have been derived from EN 583-2:2001 Annex B.

These reflector types are:

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

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

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

REFSIZ – Reference Reflector Size, diameter in mm

Allows the user to enter a diameter, in mm, for a reflector. The reflector type is set using the **REF. TYPE** parameter above.

The set will automatically compensate for the varying 'reflectivity' of different reflector types as specified by the **REF TYPE** parameter. Thus a 3 mm side drilled hole should be entered as **REF TYPE: SDH** and **REFSIZ: 3.0**

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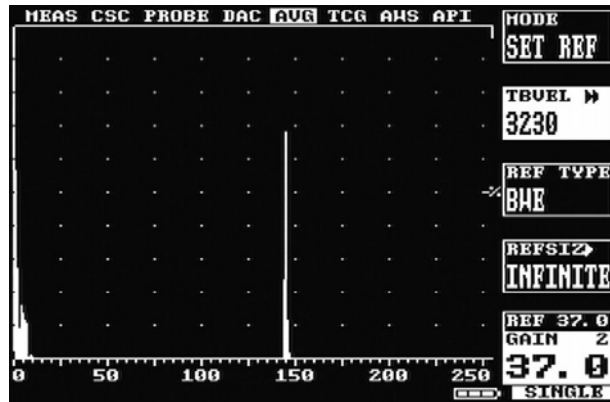
5.8.6 DGS/AVG Calibration

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

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

Set **MODE** to **SET SIG**

Place probe on reference block and maximise echo, select **CUSROR ADJUST** and use up/down keys to centre the selection bar over the echo. Check echo still maximise and Press OK.
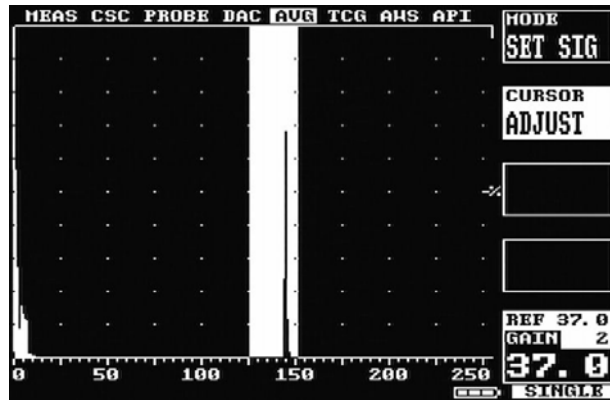
The instrument will adjust gain as necessary to get a good echo reference and then perform the necessary sensitivity calculation; the curve will then be drawn.
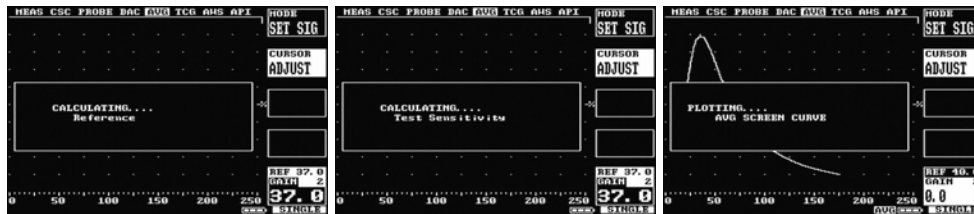
DGS/AVG is now on. In this screen it is possible to adjust the curve ERS level (the instrument will redraw the curve, but a new calibration is not required) and select either the Curve or Gate as the measurement reference.
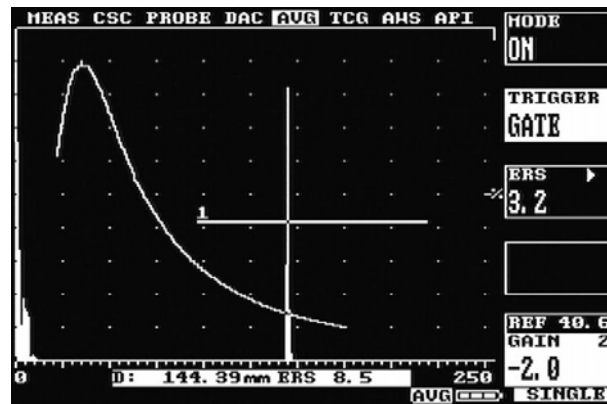
5.8.6.1 Adjustment

When the DGS/AVG has been calibrated it is possible to leave the DGS/AVG menus and adjust other settings of the instrument, for example range and gate settings.
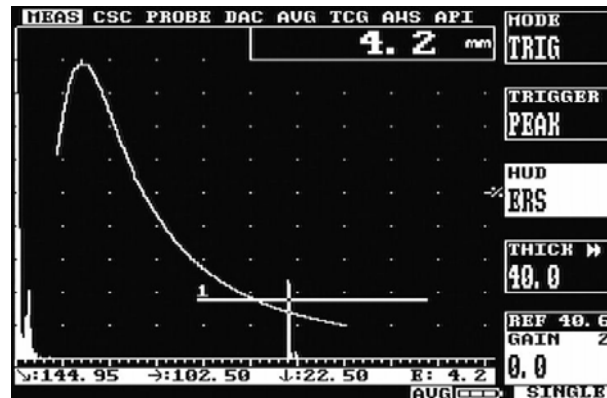
Gain may be adjusted with understanding – Changing the Gain setting will remove the correlation with the DGS/AVG curve, so should only be done in accordance with a specification , for example to compensate for varying material conditions (better done with the T-LOSS function). If it is desired to change the gain to give a larger signal (for example at long range) the REF gain should be adjusted. This will change the curve by an equivalent amount and preserve the measurement accuracy.
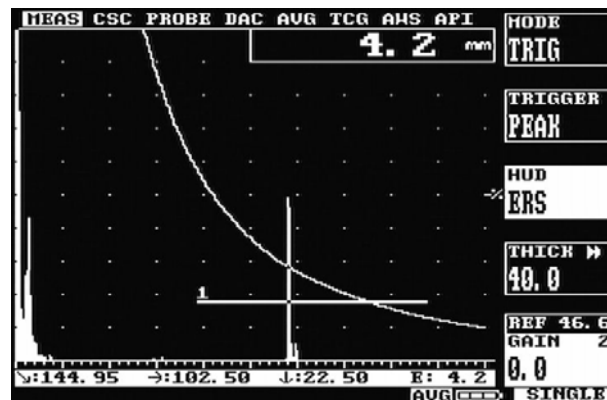
Increasing REF Gain by 6dB moves curve and preserves measurement
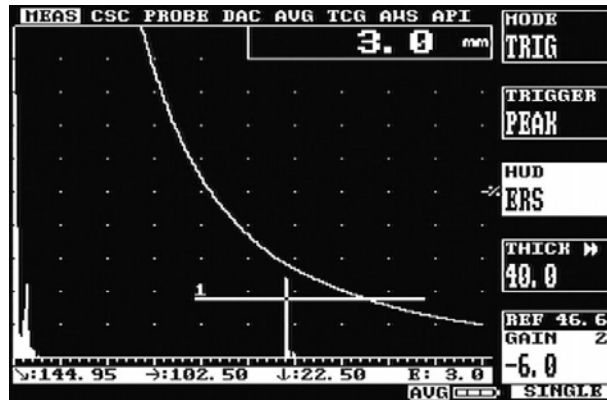
Decreasing Gain by 6dB returns to original height, but loses measurement

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

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

FREQ, **NFL**, **dVK**, **DELAY**, **REF dB/m**, **TBVEL**, **REF TYPE**, **REFSIZ**, (new **REFERENCE** Entered), Probe Zero, Filter, Contour, TX Parameters (Width or Voltage,) or Probe Angle.

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

Detect Modes other than Full Wave, non-zero REJECT, Dual probe mode, Smooth,

A_CAL (other than for initial setup before using DGS/AVG), DAC, TCG, AWS,

5.8.7 Measurement

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

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

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

5.9 A-LOG, A-Scan Storage

The A-LOG feature provides for storage, recall and printing of A-Scans with all of the instrument settings. Up to 800 A-Scans and their settings can be stored. This feature is useful to record an indication for later review or for printing a hardcopy. In addition, recalling an A-Scan and its settings will allow for easy follow-up inspection of the same indication on the test piece. Simply unfreeze the display after recalling and the DFX-625 is ready to repeat the same inspection. Be sure to use the same transducer that was use for the original recording.

5.9.1 To Store An A-Scan:

1. Establish the basic calibration of the DFX-625 using the desired transducer and the proper reference block.

2. From the **MEMORY** menu, select the **A-LOG** feature.

3. Select the **STORE** parameter by pressing the function button next to it and use the ↳ and ↴ 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 function button next to it and use the ↴ button to select **STORE**.

5. Obtain a desired echo from a discontinuity or reference block.
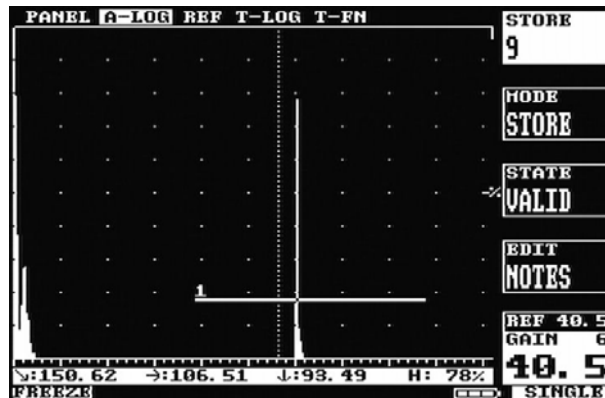
Optionally press the (FREEZE PEAK) button to freeze the display before storing it.

6. Press the OK button to store the waveform and instrument settings; the display will show a dialogue box:

7.   At the **CONFIRM** prompt, press the OK button again to store the A-Scan or press the ↳ button to continue without storing the A-Scan.

8. After pressing the OK button a second time, the **NOTES** window opens automatically to allow the creation of any desired notes for the stored A-Scan and its settings. See the section Adding NOTES to PANEL and A-LOG sets on page 33. When finished adding notes, press the function button next to the STORE parameter to return A-LOG menu.

5.9.2 To Recall an A-Scan:

1. From the **MEMORY** menu, select the **A-LOG** feature.

2. Select the **STORE** parameter by pressing the function button next to it and use the ↳ and ↴ 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 function button next to it and use the ↴ button to select **RECALL**.

4. Press the OK button to recall the waveform and instrument settings. This may take a couple of seconds at which time the display will be in **FREEZE** mode and the number of the A-LOG is displayed at the bottom of the display. To return to normal testing mode with the recalled settings, press the (FREEZE/PEAK) button.

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**.

5.9.3 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 ↳ button to continue without deleting the A-Scan.

To edit notes in an A-LOG, press the function button next to the **EDIT NOTES** parameter and then follow the instructions in the section on Adding NOTES to PANEL and A-LOG sets on page 33.

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

5.9.4 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.

5.9.5 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 function button next to it and use the ↳ and ↴ 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 function button next to it and use the ↴ or ↳ 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 color as compared to the real time waveform, depending on which display color 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 changed, the reference signal will not match the real time waveform. This means that the **RANGE** and **DELAY** used for storing the reference waveform in A-LOG must match that used for the comparison of real time signals to the reference waveform. The reference waveform cannot be displayed in video colors 0 and 1 (All white and all yellow).

5.9.6 Contour & Peak Echo Dynamics

Contouring is a technique that enables the significant echoes to be enhanced by extending the trailing edge of the echoes thus making them appear wider than they actually are making the DFX-625 operate more like an older analogue flaw detector. Only the trailing edge is modified so that depth measurements using FLANK and PEAK are not effected. Contouring is automatically optimised in the DFX-625:
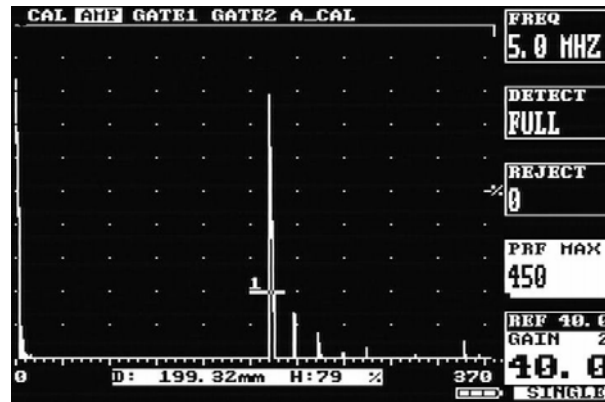
During flaw testing it is sometimes difficult to determine the exact peak of a discontinuity echo due to its geometry, coupling and surface anomalies and part geometry. The DFX-625 incorporates a Peak feature that, while activated, stores all of the signal excursions on the display using a fill technique.

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 is moved past the indication, the signals will be "filled-in" on the display and the resultant width of the envelope or "echo dynamic pattern" will infer the crack length.

To use the echo dynamic pattern feature, position the transducer just off one side of the indication. Press the (FREEZE PEAK) button twice to activate the Peak mode which is indicated by a box-displaying PEAK below the graticule. Move the transducer past the indication to fill-in the envelope pattern. In the case of angle beam testing, it is advisable to rotate the transducer slightly and move it from side to side while moving forward past the indication. This will assure the capturing of all amplitude and distance information. An example of peak echo mode capture is shown below:
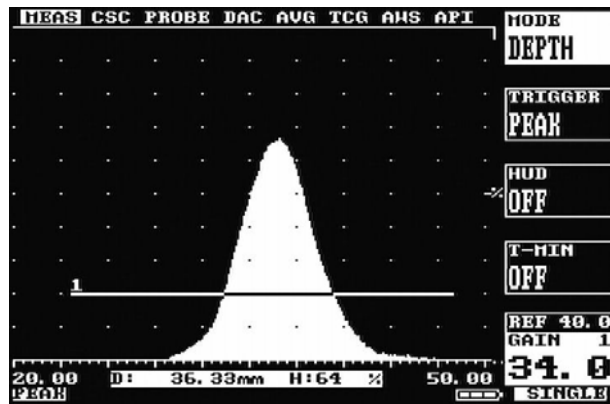
To return the display to normal mode, press the (FREEZE PEAK) button a third time. This will erase the envelope pattern and return the instrument to the instantaneous mode of display. While the display is showing the dynamic echo pattern, it is possible to record the A-Scan as indicated in A-LOG, A-Scan Storage on page 57.

6 Thickness Gauging

6.1 Basic Thickness Gauging

Accurate and reliable thickness gauging requires three important considerations:

a) Proper transducer selection

b) An accurate reference block of the same material as that being tested, and

c) Proper calibration of the instrument.

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

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

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

It is possible to calibrate the DFX-625 using a generic test block and only one known sample thickness of the material under inspection. This is a less desirable method because there is no way of verifying the calibration. With this method, the calibration would first be performed on the generic test block, which would have three to four sections covering the expected thickness range. Essentially, calibrating on the generic block would set the transducer zero point. Then the DFX-625 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.

Finally, it is necessary to establish the proper calibration of the DFX-625 in order to assure accurate and reliable thickness testing. The essence of this calibration is to set the pulser and amplifier characteristics to provide sharp leading edges on the echoes. The following are the essential steps for basic thickness gauging:

1. Select the appropriate broadband transducer 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. From the **AMP** menu, set the **FREQ** to the nominal value of the transducer and set the detection mode to **RF**.

4. Use the ⬭(SINGLE/DOUBLE) button to select **SINGLE** for delay line and single element transducers and **DOUBLE** for dual element transducers.

5. Couple the transducer to a mid-range thickness section on the calibration block and obtain an echo.

6. Adjust the gain to set the echo at about 80% amplitude and increase the **REJECT** parameter to remove any undesirable noise from the baseline.

7. 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 between the thin and thick area on the calibration block to verify proper coverage. Adjust the **LEVEL** parameter to about 30% of full screen.

8. From the **MEAS** menu, set the **MODE** parameter to **DEPTH** and the **TRIGGER** parameter to **FLANK**.

9. If desired, set the **T-MIN** parameter to **ON** so that the thinnest reading obtained will be held in the display. Reset by using the ↳ or ↰ buttons.

10. If desired, set the **HUD** parameter to **ON** to display the thickness in a large window at the top right of the graticule.

11. To calibrate the DFX-625 for thickness readings, follow the steps outlined in A-Cal on page 63. 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, 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 gate 1 and that its start point is slightly to the right of gate 1. This is the Blocking gate explained below.

3. For measuring from interface to first echo, position the start of gate 1 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 with the interface or first echo from terminating the measurement and producing a false reading.

For storage and printing of thickness readings, refer to T-LOG Thickness Storage on page 65 and T-FN Thickness Log Editing and Printing on page 68.

6.2 A-Cal

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 caused by wear face and phase shifts.

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

The 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 DFX-625 then calculates the correct offset and span factors and sets the velocity and zero. Any time the test material is changed (velocity) or the transducer is changed (zero); this procedure must be repeated. Using this 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 between the thick sample and the thin sample should be no less than five to one.

2. From the main menu, select **CAL** and adjust the **RANGE** and **DELAY** so that the thin and thick reference echoes show on the display.

3. From the **CAL** menu, select **GATE1** and place the **STATE** in **ON +VE**. Adjust the **START** and **WIDTH** of the gate to encompass the echoes from the thin and thick samples.

4. From the main menu, select **MEAS** and place the **MODE** to **DEPTH**.

5. From the **CAL** menu, select the **A-CAL** menu.

6. Select **DIST1** using the adjacent function button. Adjust the value using the ↳ and ↴ buttons to the known thickness of the thin sample.

7. Place the transducer on the thin reference sample and obtain an echo. Adjust the gate start if necessary to obtain distance readout of the echo.

8. Press the OK button to log the echo.

9. Select **DIST2** using the adjacent function button. Adjust the value using the ↳ and ↴ buttons to the known thickness of the thick sample.

10. Place the transducer on the thick reference sample and obtain an echo. Adjust the gate width if necessary to obtain distance readout of the echo.

11. Press the OK button to log the echo.

12. Select **ACCEPT CAL** using the adjacent function button.

13. Press the OK button. The transducer zero and velocity will now be adjusted.

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

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

Once calibrated, it might be desirable to record the velocity and zero values from the CAL menu for future reference. Note that this is a convenient method for determining the velocity of sound in an unknown material. Once the DFX-625 is calibrated on a known material, all that needs to be known is one fixed thickness point and the velocity can be determined.

6.3 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 DFX-625. TCG can improve the reliability of thickness gauging by increasing the amplitude of echoes from thicker sections of the test material so as to maintain the correct detection threshold on the leading edge. The objective is to equalize the amplitude of echoes over the entire thickness range to be expected.

To set up the TCG feature, refer to TCG Operation on page 42.

6.4 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 8,000. When using the default **NUMERIC** mode selected from the **T-FN** function on the **MEMORY** 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 the **LOC** (location) number which can be set between 1 and 8,000. Last is the reading number (**NO**) itself which can also be between 1 and 8,000.

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 combination of 8,000.

To store readings, follow these simple steps:

1. Set up the instrument for the thickness measuring mode as described in Basic Thickness Gauging on page 61.

2. From the **MEMORY** menu, select the **T-LOG** menu.

3. Use the corresponding function buttons to select **BLOCK**, **LOC**, and **NO** in turn and ↳ or ↩ the value to obtain the desire 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 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 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 DFX-625.

Typically, the user would create a thickness location sequence on the computer and download it to the DFX-625, which can then be used to guide the operator when collecting thickness readings. The collected readings could then be uploaded to the computer for further analysis and storage, releasing the DFX-625 to collect readings from another component. When a component is re-inspected, the historical readings can be downloaded to the DFX-625, providing the operator with an instant check of thickness variation while collecting new readings. The new readings can then be downloaded back to the computer for analysis, storage and printing.

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 8,000) and a text string of 32 characters. The text strings of 32 characters are subsequently displayed on the DFX-625 as two lines of 16 characters each in a window at the top left of the screen, when the DFX-625 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**.

2. Turn on the sequence mode by selecting the **T-FN** function from within the **MEMORY** menu using the arrow buttons, pressing the function select button next to the **ID MODE** option, and using the ↳ button to select the **SEQUENCE** mode. Once selected, the graticule will reduce in size and a window is drawn on the top left of the screen next to the HUD window which is automatically switched on. The location and thickness data will be shown in the window if any data has been downloaded to the DFX-625. Alternately, the Sequence mode can be turned on by a command from the host computer.

3. Set up the instrument for the thickness measuring mode as described in Basic Thickness Gauging on page 61.

4. From the **MEMORY** menu, select the **T-LOG** menu.

5. If auto calibration is desired, press the function select button next to the **AUTO SET** option, and using the ↳ 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 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 function select button next to the **NOTES** option, and using the ↳ or ↴ 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.

9. Once all of the readings for a component have been taken, they can be uploaded to the computer for further analysis and storage. The location data transferred is the 32 character string associated with the location, the thickness value, the units of measure, and the notes. Locations with a blank note will contain the characters "OK."

6.6 T-FN Thickness Log Editing and Printing

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.

6.6.1 To print a single Location:

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

2. Select the **T-FN** menu from the **MEMORY** menu.

3. Select the **MODE** parameter by pressing the function button next to it and pressing the ↳ button to select **PRINT** mode.

4. Select the desired block number by pressing the function button next to the **BLOCK** parameter and using the ↳ or ↶ buttons.

5. Select the desired Location number by pressing the function button next to the **LOC** parameter and using the ↳ and ↶ buttons.

6. Press the OK button to print the thickness reading for the selected Location.

6.6.2 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.

2. Select the **T-FN** menu from the **MEMORY** menu.

3. Select the **MODE** parameter by pressing the function button next to it and pressing the ↳ button to select **PRINT** mode.

4. Select the desired block number by pressing the function button next to the **BLOCK** parameter and using the ↳ or ↶ buttons.

5. Set the Location number to **ALL** by pressing the function button next to the **LOC** parameter and using the ↶ button if not already selected.

6. Press the OK button to print the thickness reading for the selected block.

6.6.3 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 function button next to it and pressing the ↳ button to select **PRINT** mode.

4. Set the Block number to ALL by pressing the function button next to the **BLOCK** parameter and using the ↶ 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**.

7 Power Supply

The DFX-625 is powered by a Lithium-Ion battery pack, which is shown below. The battery pack slides into a compartment located on the bottom of the DFX-625 and connects via a standard smart battery connector.

7.1 Lithium-Ion Battery Pack

7.1.1 Battery Cautions

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

⚠ DANGER! Use and charge only the specified Dakota Ultrasonics battery pack with the DFX-625. Only the Dakota Ultrasonics battery pack is tested and approved for use with the DFX-625. Using third-party or counterfeit battery packs may cause smoke, fire, or cause the battery to burst.

⚠ DANGER! DO NOT hammer or otherwise impact the battery. Do not use the battery if it has been severely impacted or dropped, or if the battery has been subjected to heavy pressure. Battery damage may not be visible on the outside of the case. Even if the surface of the battery does not show cracks or any other damage, the cells inside the battery may rupture or catch fire.

⚠ DANGER! NEVER use or leave battery pack in areas with temperatures above +60°C. High temperature build-up in the battery, such as could occur near fires or stoves, inside a sun-heated car, or by setting the battery in direct sunlight may cause the battery to rupture or catch fire. Excessive temperatures may also degrade battery performance or shorten battery life.

⚠ DANGER! DO NOT expose the battery to rain, snow, seawater, or any other liquids. Do not charge or use a wet battery. If the battery gets wet, be sure to wipe it dry before using. The battery by itself is not waterproof.

⚠ DANGER! NEVER incinerate a used battery pack since internal battery gas may cause a rupture or explosion.

⚠ DANGER! NEVER solder the battery terminals, or modify the battery pack. This may cause heat generation, and the battery may rupture, emit smoke or catch fire.

⚠ DANGER! Use the battery only with the DFX-625 for which it is specified. Never use a battery with any other equipment, or for any purpose that is not specified in this instruction manual.

⚠ DANGER! If fluid from inside the battery gets in your eyes, blindness can result. Rinse your eyes with clean water, without rubbing them, and see a doctor immediately.

⚠ WARNING! Immediately stop using the battery if it emits an abnormal odour, heats up, or is discolored or deformed. If any of these conditions occur, contact Dakota Ultrasonics.

⚠ WARNING! Immediately wash, using clean water, any part of the body that comes into contact with fluid from inside the battery.

⚠ WARNING! NEVER put the battery in a microwave oven, high-pressure container, or in an induction heating cooker. This could cause overheating, a fire, or cause the battery to rupture.

• CAUTION! Always use the battery within the specified temperature range for the DFX-625 (-10°C to +55°C) and the battery itself (-20°C to +60°C). Using the battery out of its specified temperature range will reduce the battery's performance and battery life. Please note that the specified temperature range of the battery may exceed that of the DFX-625. In such cases, the DFX-625 may not work properly because it is out of its operating temperature range.

• CAUTION! Shorter battery life could occur if the battery is left fully charged, completely discharged, or in an excessive temperature environment (above +45°C) for an extended period of time. If the battery must be left unused for a long time, it must be detached from the DFX-625 after discharging. You may use the battery until the battery indicator shows half-capacity, and then keep it safely in a cool dry place with the temperature between -20°C to +25°C. If the battery pack is not going to be used for a long time it must be periodically charged every 4 months; failure to do so will render the battery inoperable and it will need to be returned to Dakota Ultrasonics for re-charging. If a number of spare battery packs are in use the easiest way to main optimum conditions is to rotate the battery packs so that when one is discharged it is swapped with a fully charged one.

7.2 Battery Charging

7.2.1 Charging Caution

⚠ DANGER! Only use the supplied AC adaptor to charge the battery. Using any other charger may cause smoke, fire, or cause the battery to burst.

⚠ DANGER! NEVER charge the battery pack in areas with extremely high temperatures, such as near fires or stoves, inside a sun-heated car, or in direct sunlight. In such environments, the safety/protection circuit in the battery will activate, causing the battery to stop charging.

⚠ WARNING! DO NOT charge or leave the battery in the battery charger beyond the specified time for charging. If the battery is not completely charged by the specified time, stop charging and remove the battery from the battery charger. Continuing to charge the battery beyond the specified time limit may cause a fire, overheating, or the battery may rupture.

⚠ WARNING! NEVER insert the battery charger into the DFX-625 or battery if it is wet or soiled. This could corrode the battery charger terminals or damage the charger. The charger is not waterproof.

• CAUTION! DO NOT charge the battery outside of the specified temperature range: O°C to +40°C. Dakota Ultrasonics recommends charging the battery at +20°C. The battery may heat up or rupture if charged out of the specified temperature range. Additionally, battery performance or battery life may be reduced.

When fully charged, the battery pack should enable the unit to be operated for 16 hours when the brightness is at level 1 in the VIDEO menu under UTIL, for 12½ hours with a brightness of 10 (the default) or for 9 hours with a brightness of 20. The battery pack can be charged while mounted to the DFX-625 by use of the connector on the front panel. Alternately, the battery pack can be charged separate from the DFX-625 by using its own connector shown above allowing continued operation of the DFX-625 with the use of multiple battery packs.

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

The Dakota Ultrasonics battery charger shown below is suitable for use with main supply from 100 to 240 volts AC. The LED on the charger illuminates to indicate power on. When the battery is charging the LED will blink. When the battery level is full the LED glows green. The output voltage from the charger is 24 Volts DC. The output current when charging is a constant 3.3 Amps.

⚠ WARNING – This is a battery charger only, and cannot be connected to the DFX-625 to power the unit.

8 Interface Connections

There is a 6-pin connector on the Top end cap of the DFX-625 as shown below:
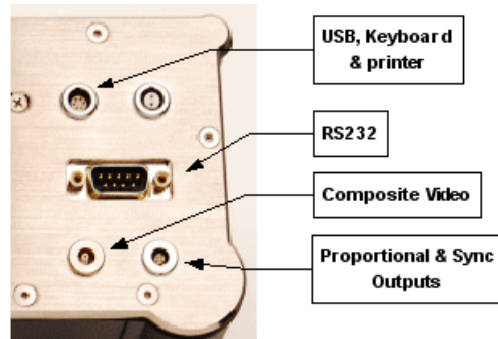
 This connector is used to connect the flaw detector to a PC using a modified USB cable; this allows information to be transferred to the computer using Dakota Ultrasonic's program WinDFX. For information on how to purchase WinDFX please contact Dakota Ultrasonics using the details inside the front cover of this user's guide. The USB connector also allows a USB keyboard to be connected and used for data entry in the notes fields. A printer can also be connected allowing information to be printed directly from the DFX-625. Please contact Dakota Ultrasonics for a list for a list of supported printers.

Also located on the top end cap of the DFX-625 there are various interface connections. The connections are shown below and described in the sections that follow:

8.1 RS232

The RS232 port on the DFX-625 allows for bi-directional communication between the instrument and a personal computer. Various control commands are available within three general categories; Write parameter values, Read parameter values, and Action commands. The Write and Read parameters allow the computer to set a parameter and to read parameters current value. The Action commands provide special functions such as waveform and thickness logging transfer. The RS232 port is the D-shaped connector at the bottom.

The communication handshake is as follows:

Baud rate: 9,600, 19,200, 38,400, 57,600 or 115,200

Parity: None

Data Bits: 8

Stop Bits: 1

Handshake: Hardware

The cable connections for a 9-pin RS232 port are as follows:
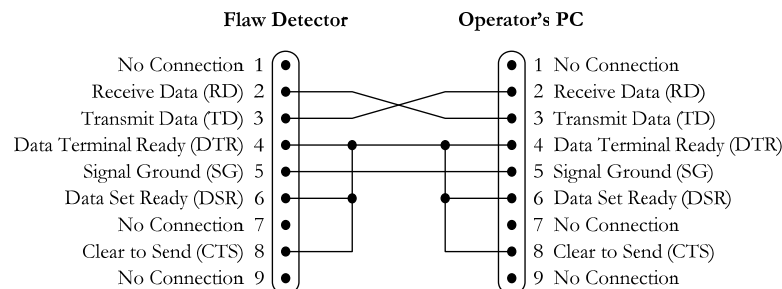
The cable connections for a 25-pin RS232 port are as follows:

Flaw Detector   Operator's PC

No Connection 1   1 No Connection
Receive Data (RD) 2   2 Transmit Data (TD)
Transmit Data (TD) 3   3 Receive Data (RD)
Data Terminal Ready (DTR) 4   4 No Connection
Signal Ground (SG) 5   5 Clear to Send (CTS)
Data Set Ready (DSR) 6   6 Data Set Ready (DSR)
No Connection 7   7 Signal Ground (SG)
Clear to Send (CTS) 8
No Connection 9   20 Data Terminal Ready (DTR)
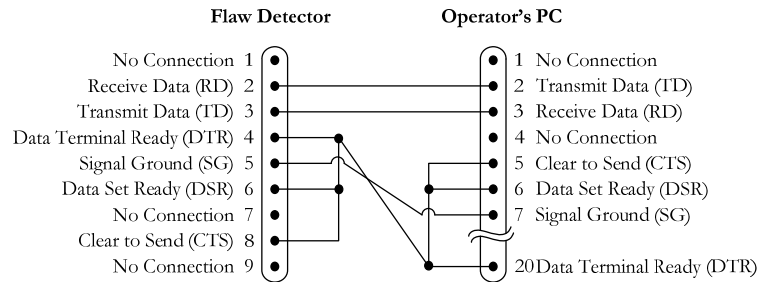
A 9-pin to 9-pin communications cable is available from Dakota Ultrasonics.

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

8.2 Composite Video

The composite video output is for connecting the DFX-625 to a compatible video monitor or projector. The output is either NTSC (USA/Japan) or PAL (UK/Europe), depending on the VIDEO selection in the UTIL menu. The screen update rate is 50Hz in PAL and 60Hz in NTSC. The composite video connector is the second connector from the top with one centre pin.

8.3 Proportional Outputs

Proportional output 1 (P1) can be used to give the following readings: Depth 1 (Gate1), Depth 2 (Gate2), E1–E2 (the distance between the measurements) Alarm 1 (voltage out when the alarm is active).

Proportional output 2 (P2) can be used to give the following readings: Level 1 (Gate1) Level 2 (Gate2) L1–L2 (the difference between the two amplitudes) Alarm 2 (voltage out when the alarm is active).

The choice of which reading to output is made using the **O/P 1** and **O/P 2** parameters in the **P_O/P** feature in the **UTIL** menu. The proportional outputs are updated at the currently selected PRF.

The voltage of the outputs is controlled by the **CAL** parameter in the **P_O/P** feature in the **UTIL** menu. This allows the voltage to be varied between 0V and 10.0V. The voltage applies to all proportional outputs.

It is the small upper connector with 4 pins; the top 2 pins are used for the proportional outputs. The ground is achieved using the outer case of the connector.

8.4 Synchronisation Outputs

The DFX-625 provided two synchronisation outputs on the small 4 pin connector: S1 and S2.

S1 is synchronised with the TX pulse so that it goes high (3v3) for 50ns, at the start of the TX signal to the analogue board.

S2 goes high (3.3V) for the duration of the acquisition period.

9 Features of the DFX-625

The DFX-625 is a user-friendly ultrasonic digital flaw detector and thickness gauge, which is simple to use and provides the experienced ultrasonic operator with a full-function device that incorporates many productivity enhancing features. All of the features of the DFX-625 are accessed through a menu system using the front panel keypad.

9.1 Functional Testing Methods

The DFX-625 supports the following ultrasonic testing methods:

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

10 Specifications

Feature	Details
Test Range	0 - 5mm (0.2in) up to 0 – 10,000 mm (400 in.) at steel velocity. Variable in 1mm &10mm steps
Velocity	1,000 to 9,999m/s continuously variable.
Probe Zero	0 to 999.999 µs, continuously variable.
Delay	Calibrated delay from 0 -10,000mm in 0.05 mm steps at steel velocity (0-400in. in 0.002 in. steps).
Gain	0 to 110dB. Adjustable in 0.5, 1, 2, 6, 10, 14 and 20dB steps. Direct access to gain control at all times.
Test Modes	Pulse echo and transmit/receive.
Pulser	-200V square wave pulser. Pulse width from 30 to 250ns duration linked to filter band. rise/fall times <10ns into 50 ohms
P.R.F	Selectable 35 to 100 Hz in 5 Hz steps, 100 to 1,000 in 50Hz steps.
Update Rate	60Hz (NTSC Mode); 50Hz (PAL Mode).
Rectification	Full wave, positive or negative halfwave and unrectified rf.
Frequency Range	6 narrow bands centred at1MHz, 2.25MHz, 5MHz and 10MHz. Broad band at 1.5 MHz to 15MHz (-6dB).
System Linearity	Vertical = 1% Full Screen Height (FSH). Amplifier Accuracy ± 0.1dB. Horizontal ±0.4% Full Screen Width (FSW).
Reject	50% linear reject. LED warning light when selected.
Units	Metric (mm), inch (in) or time (µs).
Display Color Transflective TFT	Display area 111.4 x 83.5 mm (4.39 x 3.29 in) 320 x 240 pixels. A-Scan Area 255 x 200 pixels (315 x 200 expanded), 8 color options and variable brightness.
Gate Monitor	Two fully independent gates for echo monitoring and thickness measurement. Start and width adjustable over full range of unit, amplitude variable from 0 to 100% FSH. Bar presentation. Positive or negative triggering for each gate with audible and visual alarms.
Gate Expansion	Expands range to width of Gate 1.
Gate Monitor Delay	Selectable 0.6 seconds delay on gate 2 negative monitor tracking.

Feature	Details
Measurement Modes	
Mode 1	Signal Monitor
Mode 2	Depth and amplitude of first signal in gate.
Mode 3	Echo-to-Echo distance measurement. (single gate)
Mode 4	Trigonometric display of beam path, surface distance and depth of indication, curve surface correction and X-OFFSET for probe index. Half skip indication on screen.
Mode 5	Gate to Gate distance measurement. (Independent gates).
Mode 6	T-Min mode for holding minimum thickness reading.
Resolution	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.
A-Scan Memory	800 waveforms can be printed or transferred to a PC using optional WinDFX software.
Panel Memory	100 stores for retaining calibrations.
Thickness Logging	Storage for 8,000 thickness readings configured either by Block/Location/Number mode or pre-programmable work sheets in sequential mode. Readings can be exported to MS Excel using optional software.
AGC	Automatic Gain Control automatically sets the signal to a level between 10-90% FSH with tolerance between 5-20% accuracy.
DAC	DAC defined by up to 10 points and digitally drawn on screen. DAC curves meet requirements of EN 1714, JIS and ASME standards, selectable between -2, -6, -10, -12 and -14dB. Amplitude read out selectable between % DAC or relative dB.
TCG	Time Corrected Gain, also known as Swept Gain. 40dB dynamic range greater than 30dB per microsecond and up to 10 points may be used, setting all signals initially to 80% FSH.
AWS	Built in software for evaluation of defect indications in accordance with AWS D1.1 structural weld code.
AVG/DGS	Automatic calculation from probe data.
API	Flaw sizing complying with API 5UE

Feature	Details
Auto-Cal	Provides automatic calibration from two echoes.
Clock	Sets time and date.
Reference Waveform	This menu displays a waveform from one of the A-log stores as a reference or fingerprint display in a color different from the active display highlighting differences from the reference.
Notes	Alphanumeric labelling for panel and A-log allows the user to enter Notes for storage with panel settings and A-scans.
Display Freeze	For capturing the current A-scan image.
Peak Memory	For echodynamic pattern determination.
Keylock	Prevents accidental alteration of parameters.
Help Key	For instant operator guidance on using the Masterscan Series.
Language Support	Supports 6 simultaneous languages, user selectable.
Waveform Smoothing	Gives a smooth signal envelope, simulating analogue equipment.
Outputs	Full bi-directional serial interface to transfer parameters, thickness readings and waveform memories. Composite video, PAL or NTSC compatibility. Analogue proportional outputs programmable to distance or amplitude of signal in the gate. Transmitter sync output
USB	For connection to printers, keyboards and PC.
Printers	Supports any printer with PCL support including HP Deskjet and Epson.
Power	Lithium Ion battery pack 14.4V, 5.0 amp hours, gives up to 16 hours duration from a fully charged pack. Indication of low battery status. Recharge time 3-4 hrs.

11 Warranty

Warranty/Defects after Delivery: Immediately upon receipt of the goods the buyer is required to check the goods carefully and thoroughly. In order to benefit from the guarantee, any defect in the product should be immediately reported in writing to Dakota Ultrasonics. Dakota Ultrasonics will make good by repair or by the supply of a replacement or by equivalent adjustment of the price at our sole option, any defects which under proper use appear in the goods within the period of twenty-four (24) calendar months after the goods have been delivered and which arise solely from faulty design, material or workmanship, provided that the goods are carefully packed and promptly returned by you, free of charge, to the Dakota Ultrasonics 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 Dakota Ultrasonics free of charge.

Save as in this Clause herein before expressed Dakota Ultrasonics 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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