

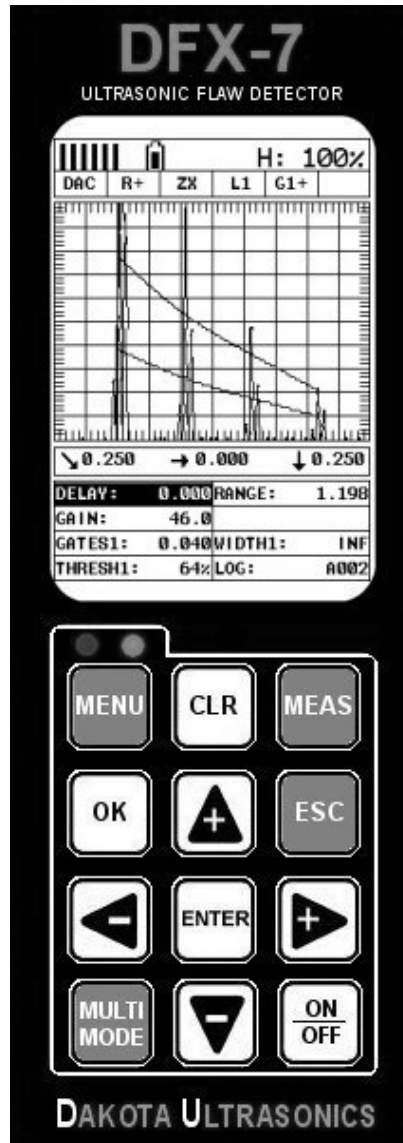
OPERATION MANUAL

DAKOTA ULTRASONICS

DFX-7

Ultrasonic Flaw Detector

(Manual 2 of 2)



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CHAPTER ONE INTRODUCTION

The Dakota Ultrasonics model **DFX-7** is both, an ultrasonic flaw detector, as well as an ultrasonic A/B Scan thickness scope, in a single unit. It's a combination of both our **CMX DL+**, as well as our new **DFX-7** flaw detector series. Why is this advantageous? Thickness gauge are specifically setup to very accurately measure thickness, locate pits, flaws and blind surface corrosion. All the linearity tables, correction curves for various types of longitudinal transducers and features are built with dimensional thickness as its primary focus. Flaw detectors are designed to detect, size, position, and differentiate between flaw types in various materials and welded joints. A flaw detector must be fast, in terms of its sample and screen refresh rate, as inspectors are generally scanning the surface of a part or test specimen at a relatively high speed, rather than looking for the thickness at a specific point or location. While flaw detectors can also measure material thickness with reasonable accuracy, they are not designed with precision thickness as their primary focus.

The **DFX-7** combines the two types of gauges into one powerful and full featured instrument, that's equipped with a number of comprehensive toolkits to provide the user the arsenal necessary to address a number of common field applications. In and effort to avoid complexity issues and differential between gauges types, this manual focuses only on the flaw detector portion of the **DFX-7**.

Dakota Ultrasonics maintains a customer support resource in order to assist users with questions or difficulties not covered in this manual. Customer support may be reached at any of the following:

Dakota Ultrasonics Corporation
1500 Green Hills Road, #107
Scotts Valley, CA 95066 USA
Telephone: (831) 431-9722
Facsimile: (831) 431-9723
www.dakotaultrasonics.com

1.1 General Disclaimer

The manual should be read and understood prior to using the **DFX-7**. This operating manual provides the user with all the general information necessary to use and operate the features of the **DFX-7**. However, this manual is not a certified NDT training course, nor is it intended to be one. Ultrasonic training for sound wave theory, flaw detection and interpretation of defects is highly recommended, and will be required by most companies and contract services. Contact the local NDT society in your area to inquire about training available in your locality.

1.2 Electrical Warning

The **DFX-7** contains a high voltage pulser. It's recommended that the gauge be powered off prior to connecting or disconnecting your transducer, to avoid damaging the **DFX-7**.

CHAPTER TWO QUICK START GUIDE

This section will cover a basic quick start guide to initially get up and running with the **DFX-7** for demonstration purposes only. However, in order to use the gauge and features for actual applications, a thorough review of this manual is recommended.

2.1 Gauge Type



Power up the **DFX-7**, by pressing the on/off key located in the bottom right corner of the keypad. During initial boot up, a flash screen and lights will be displayed, followed by a **GAUGE TYPE** selection screen. Since this manual will focus on the flaw detector portion of the **DFX-7**, use the **UP/DOWN** arrow keys to select “flaw detector”, followed by pressing the **OK** key start the **DFX-7** in flaw mode. If this is the first time the gauge has been used, a general startup configuration will automatically be loaded and the **DFX-7** is ready for general inspections. If this is not the first time the gauge has been used, and the user would like to reload the basic default setup parameters, refer to section 13.5 for further info.

Note: The default setup should only be considered as a basic setup. Proper calibration and parameter settings should be done prior to an actual inspection.

2.2 Basic Flaw Setup Reference

The following table lists all the settings for the basic flaw setup:

PRB	CAL	DISP	TUNE	GT1
Type: Single	Matl: Steel 1020	View: +Rect	Filters: Wide	Alarm 1: On

Pulse: Thin	Matl 1pt: Uncal	Delay: 0.000	Gain: 60	Detect: Above
Max PRF: 125	Matl 2pt: Uncal	Range: 5.011	Gain Step: 1.0	Gate 1: 0.484
Damping: 600	Velocity: .2320	Units: inches	Detect Mode: Z-Cross	Gate1 Width: INF
Pulser Volt: 200	Zero: 0.0	Brightness: 15		Threshold 1: 40%
		Screen Update: 60Hz		Polarity 1: Positive
		Colors: Green 2		
		Dim: Off		
		Rect Wave: Filled		
		Detect Mark: None		

Note: The following features are set to off: GT2, TRIG, AWS, TCG, DAC, DGS.

2.3 Top & Submenu Reference

The following table is a quick menu reference guide. The *DFX-7* has 15 top level menu titles, and multiple submenu items as illustrated below. Refer to Chapter Three for additional definitions and information on the keypad and menu items.

Start >>

PRB	CAL	DISP	TUNE	GT1	GT2	TRIG	AWS
TYPE	MAT	VIEW	FILTER	ALARM 1	ALARM	TRIG	AWS
PULSE	MATL 1PT	DELAY	GAIN	DETECT	DETECT	THICKNESS	REFERENCE GAIN
MAX PRF	MATL 2PT	RANGE	GAIN STEP	GATE 1	GATE2	PROBE ANGLE	SHOW CURVE
DAMPING	VELOCITY	UNITS	DETECT	GATE1 WIDTH	GATE 2 WIDTH	X-OFFSET	% SCRN HEIGHT
PULSER VOLTAGE	ZERO	BRIGHTNESS		THRESHOLD 1	THRESHOLD 2	CSC O.D.	
		COLORS		POLARITY 1	POLARITY 2	SHOW LEGS	
		LANDSCAPE					
		DIM					
		RECT WAVE					
		DETECT MARK					

>> End

TCG	DAC	DGS	SET	DATA	UTIL	XFER
TCG	DAC	DGS	OPEN	NEW	AUTO FIND	UPGRADE GAUGE
DRAW	DRAW	REF GAIN	SAVE	EDIT	COMPARE	ABOUT
SHOW CURVE	MEAS	TRIGGER CURVE	DELETE	OPEN	SET DATE	
% SCRN HEIGHT	SHOW CURVE	EFF PROBE DIA	DEFAULT SETUP	CLOSE	SHOW DATE	

	TRIGGER CURVE	PROBE FREQ	LANGUAGE	DELETE ONE FILE	KEY CLICK	
	DPOLARITY	CURV SIZE(ERS)		DELETE ALL DATA	GAUGE	
	FIT	ATTENUATION				
		DELAY VELOCITY				
		REF TYPE				
		REF SIZE				

2.4 Loading the Default Setup

If the **DFX-7** has previously been used, the basic default settings can be reloaded at any time, as outlined below:

Load Default Setup

SETUP OPTIONS

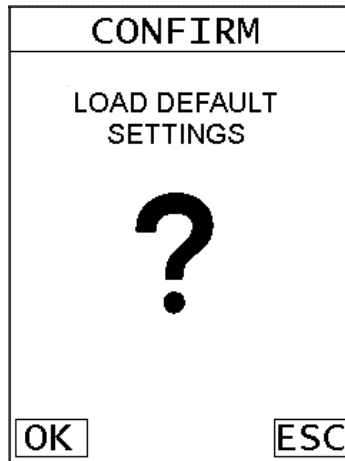
OPEN
SAVE
DELETE
DEFAULT SETUP

LANGUAGE ENGLISH
TCG DAC DGS **SET**

The following section assumes the gauge is powered up, the flaw detector option selected, and the main measurement screen is being displayed.

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **SET** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DEFAULT SETUP** is highlighted.

3) Press the **ENTER** key to display the confirmation screen.



4) Press the **OK** key to load the default setup and return to the measurement screen.

CHAPTER THREE KEYBOARD, MENU, & CONNECTOR REFERENCE



3.1 Menu Key (Operation & Sub Menus)

The **Menu** key activates the primary menu structure containing 15 menu tab groups. These tab groups then contain sub menu items, or functions. The sub menu items have been organized in the tab groups according to how closely they are related to the individual tab group names. Let's first get familiar with how to move around in these tabs before continuing on to the sub menu functions. This procedure is outlined below:

Activating and Navigation of the Menu Items

SETUP PROBE	
	TYPE SINGLE
	PULSE THIN
B	MAX PRF 125
	DAMPING 600
	PULSER VOLTAGE 200
A-	PRB CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left until the desired tab group is highlighted and displaying the submenu items. The tab groups are illustrated above **(A)**.

Now that you're familiar with activating and moving amongst the tab groups, let's have a look at how to move around in the sub menu items as follows:

- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until the desired function is highlighted. The sub menu items are illustrated in the diagram above **(B)**.
- 3) Depending on which function is highlighted, use the **LEFT**, **RIGHT**, and **Enter** keys to scroll the options or activate the **Digit Edit** and **List Box** options.

The sections to follow will provide the user with an explanation of the sub menu functions:

3.2 Probe – Menu

TYPE	SINGLE
PULSE	THIN
MAX PRF	333
DAMPING	600
PULSER VOLT	200
PRB	CAL DISP TUNE

TYPE: Enables the user to select the type of transducer being used, either Single or Dual.

PULSE: The *DFX-7* has an adjustable pulse width for both high penetration and resolution applications. The pulse width refers to the duration of time the pulser is on. The options are **Spike**, **Thin**, and **Wide**. Refer to page 84 for a further explanation.

MAX PRF: This feature controls the pulse repetition frequency of the *DFX-7*. The maximum frequency is 333 Hz. However, the *DFX-7* will automatically adjust the PRF according to what the current delay and range settings have been adjusted to. Larger the range, the slower the repetition frequency will automatically be set for. Refer to page 85 for a further explanation.

DAMPING: The ability to control the amplifiers output impedance to match the impedance of the transducer, and optimize overall transducer performance. Adjustable at: 50, 100, 300, 600, 1500 ohms. Refer to page 86 for further info.

PULSER VOLTAGE: Adjustable pulser voltage: 100, 150, and 200 volt. Refer to page 87 for a further explanation.

3.3 CAL – Menu

MATL	STEEL	0.000
MATL 1PT	UNCAL	
MATL 2PT	UNCAL	
VELOCITY	0.2330	
ZERO	0.000	
PRB	CAL	DISP TUNE

MAT: Select the material velocity from a chart of basic material types when a known sample thickness, or material velocity cannot be obtained. Refer to page 88 for a further explanation.

MATL 1PT: Performs a single point calibration. Used in conjunction with the MATL 2PT option for the calibration process. Refer to page 36 for further info.

MATL 2PT: Performs a two-point calibration. This option allows the user to automatically calculate the velocity by entering a second known sample thickness. Refer to page 36 for further info.

VELOCITY: Function to calibrate the *DFX-7* by setting the velocity to a known material velocity. Refer to page 89 for further info.

ZERO: Used to zero the transducer and calibrate the screen. The *DFX-7* is zeroed in much the same way that a mechanical micrometer is zeroed. If the *DFX-7* is not zeroed correctly, all of the measurements made using the *DFX-7* may be in error by some fixed value. Refer to the section on page 36 & 90 , for further info.

VIEW	RECTFW
DELAY	0.000
RANGE	5.000
UNITS	IN
BRIGHTNESS	20
COLORS	BLACK/WHITE
LANDSCAPE	RT HAND
DIM	240 SEC
RECT WAVE	FILLED
DETECT MARK	DOTS
PRB	CAL
DISP	TUNE

3.4 DISP (display) – Menu

VIEW: Selectable RF, +RECT, -RECT, RECTFW views. Refer to page 24 for further info.

DELAY: Provides the user the ability to change the start position of the A-SCAN views. Refer to page 25 for further info.

RANGE: Provides the user the ability to change the overall range/depth of the viewable measurement area. It functions a lot like a zoom on a camera. Refer to page 25 for further info.

UNITS: Toggle between English or Metric units. The readout will change from inches to millimeters.

BRIGHTNESS: AMOLED high speed color display. An arbitrary scale of 1-20 has been implemented, with the brightest setting at 20. Refer to page 92 for further info.

COLORS: Provides the user with a variety of different color schemes to select from. There are two schemes for each main color option. Refer to page 93 for further info.

LANDSCAPE: Displays the A-Scan waveform in landscape view for a larger viewable area, with either right or left hand option. Refer to page 95 for further info.

DIM: Allows the user to conserve battery life by dimming the display after idle for a specific amount of time – OFF, 30, 60, 90, 120 seconds. Once dimmed, a single press of any key will restore the screen brightness. Refer to page 95 for further info.

RECT WAVE: Provides the user an outlined or filled view option when the display setting is in RECT (rectified) wave mode only. Refer to page 97 for further info.

DETECT MARK: Selectable graphics option for the point of detection on the waveform: Line, Box, Dots, None. Offers the user a graphics preference on how they prefer to view the detection on the waveform. Refer to page 99 for further info.

FILTER	WTRF
MAX PRF	32
GAIN	40.0
DETECT MODE	Z-CROSS
PRB	CAL
DISP	TUNE

3.5 TUNE – Menu

FILTER: The *DFX-7* is a wide band flaw detector with a frequency range of 1.8 to 19 MHz (-3dB). The *DFX-7+* is additionally equipped with selectable narrow band filters at; 2, 5 & 10 MHz. Refer to page 100 for further info.

GAIN: The *DFX-7* has a 0-110dB gain range with 2dB resolution. This feature is used to increase/decrease the strength or amplitude of the signal. This might easily be considered as similar to turning the volume up or down on a stereo receiver. Refer to page 28 for further info.

GAIN STEP: Used to set the amount the GAIN is increased or decreased for each key press. Step options of 0.2, 0.4, 1.0, 2.0, 4.0 and 6.0. Refer to page 101 for further info.

DETECT: The *DFX-7* is equipped with optional detection modes; PEAK, FLANK, or Z-CROSS (zero crossing). This option allows the user to decide where the detection is acquired on the waveform. Refer to page 103 for further info.

ALARM	OFF
DETECT	ABOVE
GATE1	0.040
GATE1 WIDTH	INF
THRESHOLD1	40%
POLARITY	POSITIVE
GT1	GT2 TRIG AHS

3.6 GT1 – Menu

ALARM 1: Toggles the alarm function of gate 1; on, off, audible. The audible feature sounds a beeper when the waveform breaks the threshold level, either above or below, depending on the current DETECT setting. Refer to page 31 for further info.

DETECT: Enables the user to set the alarm detection to occur either above or below the gates threshold level. Refer to page 31 for further info.

GATE 1: Gates allow the user to view a specific inspection/measurement range, or specific regions of the waveform, while ignoring others. In order to detect on a waveform echo, and display the amplitude as a percentage of full screen height, the echo must be inside the boundaries of the gate settings. The **GATE1** feature adjusts where the gate begins, according to the depth/thickness. Refer to page 31 for further info.

GATE1 WIDTH: This feature allows the user to set the overall width of the gate, in terms of distance, from the **GATE1** setting. Refer to page 31 for further info.

THRESHOLD 1: Enables the user to set the sensitivity level of Gate1 to a calibrated screen height percentage. The threshold level will act as a starting point for the alarm trigger, and is directly associated with the **DETECT** setting outlined above. Refer to page 31 for further info.

POLARITY 1: The gates can be set to detect on either the positive or negative polarity, or stroke, of the half or full wave cycle. It should be noted that if the **VIEW** is set to positive, and the gate negative, the *DFX-7* will not display an amplitude percentage of full screen height. Refer to page 31 for further info.

ALARM	OFF
DETECT	OFF
GATE2	0.040
GATE2 WIDTH	INF
THRESHOLD2	30%
POLARITY	POSITIVE
GT1	TRIG AWS

3.7 GT2 – Menu

ALARM 2: Toggles the alarm function of gate 2; on, off, audible. The audible feature sounds a beeper when the waveform breaks the threshold level, either above or below, depending on the current DETECT setting. Refer to page 31 for further info.

DETECT: Enables the user to set the alarm detection to occur either above or below the gates threshold level. Refer to page 31 for further info.

GATE 2: Gates allow the user to view a specific inspection/measurement range, or specific regions of the waveform, while ignoring others. In order to detect on a waveform echo, and display the amplitude as a percentage of full screen height, the echo must be inside the boundaries of the gate settings. The GATE2 feature adjusts where the gate begins, according to the depth/thickness. Refer to page 31 for further info.

GATE2 WIDTH: This feature allows the user to set the overall width of the gate, in terms of distance, from the GATE2 setting. Refer to page 31 for further info.

THRESHOLD 2: Enables the user to set the sensitivity level of Gate2 to a calibrated screen height percentage. The threshold level will act as a starting point for the alarm trigger, and is directly associated with the DETECT setting outlined above. Refer to page 31 for further info.

POLARITY 2: The gates can be set to detect on either the positive or negative polarity, or stroke, of the half or full wave cycle. It should be noted that if the VIEW is set to positive, and the gate negative, the *DFX-7* will not display an amplitude percentage of full screen height. Refer to page 31 for further info.

TRIG	ON
THICKNESS	0.200
ANGLE	45.0
X-OFFSET	0.500
CSC OD	0.000
SHOW LEGS	ON
GT1	GT2 TRIG AWS

3.8 TRIG – Menu

TRIG: This feature toggles trigonometry feature on/off. This feature is used with angle beam transducers for the inspection of welds, to calculate three measurements: Beam path distance (↘), Surface distance (→), and Depth (↓) from the index point of the transducer. Refer to page 51 for further info.

THICKNESS: Used to set the thickness of the test material. The thickness will be used to determine which skip/leg the *DFX-7* is detecting on. Refer to page 51 for further info.

ANGLE: Used to set the angle of the transducer, and used in the calculations above. Refer to page 51 for further info.

X-OFFSET: This feature is used to calculate the surface distance in the trigonometry function, as is a physical measurement from the index point of the probe to the front of the wedge/can/shoe/case. Refer to page 51 for further info.

CSC OD: Curved surface correction to compensate for changing sound path distance and angle. This feature is used in conjunction with ‘thickness’ in order to calculate a correction factor. Refer to page 51 for further info.

SHOW LEGS: When this feature is enabled, the Legs or Skips will be displayed in the A-Scan area with alternating background striped areas for easy reference. Refer to page 55 for further info.

3.9 AWS – Menu

AWS	ON
REFERENCE GAIN	OFF
SHOW CURVE	OFF
% SCR N HEIGHT	80
GT1 GT2 TRIG AWS	

AWS: This feature toggles the AWS feature on/off. Used in the analysis of welds according to American Welding Society’s structural welding code D1.1-94, to calculate the Indication Rating (IR). Refer to page 56 for further info.

REFERENCE GAIN: The gain (in dB) required to set the indication level to a specific percentage of full screen height (FSH). This value will typically be set somewhere between 20%–90%. Refer to page 56 for further info.

SHOW CURVE: Toggles the AWS correction curve on/off, and the curve is displayed on the screen. Refer to page 56 for further info.

% SCR N HEIGHT: This feature enables the user to set the reference level of the TCG as a percentage of full screen height (FSH). Refer to page 56 for further info.

3.10 TCG – Menu

TCG	ON
DRAW	OFF
SHOW CURVE	OFF
% SCR N HEIGHT	80
TCG DAC DGS SET	

TCG: This feature toggles the TCG feature on/off. The Time Corrected Gain (TCG) feature displays reflectors of equal size at equal A-Scan amplitudes, regardless of the reflector’s depth in the test material. Refer to page 67 for further info.

DRAW: Toggles the DRAW mode on/off, and used to draw the TCG curve. Refer to page 67 for further info.

SHOW CURVE: Toggles the TCG correction curve on/off, and the curve is displayed on the screen. Refer to page 67 for further info.

% SCR N HEIGHT: This feature enables the user to set the reference level of the TCG as a percentage of full screen height (FSH). Refer to page 67 for further info.

DAC	ON		
DRAW	ON		
MEAS	≠DAC		
CURVE	-6DB / -12DB		
TRIGGER CURVE	-6DB		
DPOLARITY	POSITIVE		
FIT	SPLINE		
TCG	DAC	DGS	SET

3.11 DAC – Menu

DAC: Toggles the DAC feature on/off/audible. A Distance Amplitude Correction (DAC) curve is used to configure a variable threshold for the gate, using the same size reflector at different distances. Refer to page 61 for further info.

DRAW: Toggles the DRAW mode on/off/audible, and used to draw the DAC curve. Note: TCG curve cannot be drawn in RF view. Refer to page 61 for further info.

MEAS: Toggles the units displayed as a relationship of either the signal amplitude and DAC curve, or just the signal according to screen height. The units are as: %FSH, %DAC, and dB. Refer to page 61 for further info.

CURVE: Selectable signal or multi DAC curve options. The displayed curve options are: DAC, -2dB, -6dB, -10dB, (-6dB/-12dB), (-6dB/-14dB). Once the DAC curve has been generated, these options can be toggled at any time. Refer to page 61 for further info.

TRIGGER CURVE: Used to set the alarm threshold for the DAC curve. The options are; at DAC, -2dB, -6dB, -10dB, -12dB, -14dB, or using an independent gate. The list of trigger options will change according to which CURVE option has been selected. Refer to page 61 for further info.

DPOLARITY: Used to select the polarity of the DAC curves generated, either positive or negative. Refer to page 61 for further info.

FIT: This feature allows the user to select the kind of curve (fit) to use. There are two options; linear and spline. The linear fit uses a linear line to connect between each pair of calibrated points, while the spline fit uses a smooth proportional curve to connect all the calibrated points. Refer to page 63 for further info.

DGS	ON		
REF GAIN	OFF		
TRIGGER CURVE	DGS		
EFF PROBE DIA	0.500		
PROBE FREQ	2.250		
CURV SIZE(ERS)	0.200		
ATTENUATION	OFF		
DELAY VEL	0.1060		
REF TYPE	SDH		
REF SIZE	0.125		
TCG	DAC	DGS	SET

3.12 DGS – Menu

DGS: Toggles the DGS feature on/off. Distance Gain Size (DGS) curve is used to configure a variable threshold for the gate using a single reflector using an empirically derived set of curves. Refer to page 72 for further info.

REFERENCE GAIN: Toggles the DRAW mode on/off, and used to set the reference gain from a given reference standard. Refer to page 75 for further info.

TRIGGER CURVE: Used to set the alarm to detect on either the DGS curve, or independent GATE. Refer to page 75 for further info.

EFF PROBE DIAMETER: Used to set the effective probe diameter of either a round or square/rectangular crystal element, and used as a variable to calculate the near field length. Refer to page 73 for further info.

PROBE FREQUENCY: Used to set the center frequency of the probe/transducer. The frequency will either be scribed on the probe itself, and additionally listed on the transducer certificate. Refer to page 75 for further info.

CURVE SIZE (ERS): Used to select the Effective Reflector Size that will be used from the DGS/AVG chart. Refer to page 75 for further info.

ATTENUATION: Toggles the ATTENUATION on/off. The parameters in the sub menu are used to compensate for additional factors that affect the propagation of sound energy, based on the material, surface condition, and differences between the reference standards versus test material. Refer to page 76 for further info.

DVK: Used to correct for increases in gain based on a curved reference standard, to an actual back wall reflector. Refer to page 76 for further info.

MATERIAL LOSS: Used to correct for the loss of sound in attenuative materials and applications inspections where sound will travel long distances. Refer to page 76 for further info.

REFERENCE LOSS: Used to compensate for the loss of sound in the reference standard. Refer to page 76 for further info.

TRANSFER LOSS: Used to correct for the loss of sound based on the surface of the actual test material. Refer to page 76 for further info.

DELAY VELOCITY: Used to set the longitudinal velocity of the transducer delay line, for both angle & straight beam probes, to account for the proportion of the near field length in the delay line. Refer to page 75 for further info.

REFERENCE TYPE: This option is used to set the type of reflector that will be used during the setup and calibration process. The options are Back Wall, Side Drilled Hole (SDH), or Flat Bottom Hole (FBH). Refer to page 75 for further info.

REFERENCE SIZE: If the reference type was set to SDH or FBH, the size of the reflector must be entered. Refer to page 75 for further info.

3.13 SETUP – Menu



OPEN: Displays a list of factory and user defined setups currently stored in memory. These setups can be recalled and used at any time. Refer to page 141 for further info.

SAVE: Provides the user with the ability to save a custom setup that has been modified or created by the user. Refer to page 143 for further info.

DELETE: Provides the user with the ability to delete specific setups previously save in memory. Refer to page 146 for further info.

DEFAULT SETUP: Loads a basic default setup. Use only as a last resort when the setups in the **DFX-7** have been corrupted and a computer is not accessible. Refer to page 148 for further info.

LANGUAGE: Provides the user the ability to select different languages for the **DFX-7**. Refer to page 150 for further info.



3.14 DATA – Menu

NEW: Allows the user the ability to create a new alpha numeric grid, or sequential log file with auto identifiers. It is equipped with custom parameters, rows, and columns depending on the user’s application reporting requirements. Refer to page 117 for further info.

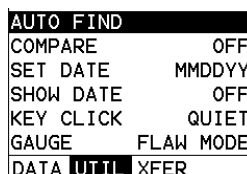
EDIT: Gives the user the ability to change parameters of grid or sequential file previously saved. Note: Pre-defined coordinates cannot be changed once they have been created. Refer to page 135 for further info.

OPEN: This function provides the user with the ability to recall grids or sequential log files that currently exist in memory, from a list of grids. Refer to page 137 for further info.

CLOSE: Provides the user the ability to close a currently opened grid or sequential log file. Refer to page 139 for further info.

DELETE ONE FILE: This function provides the user with the ability to delete one individual grid or sequential log file from a list of multiple grids/files previously saved in memory. Refer to page 132 for further info.

DELETE ALL DATA: This function provides the user with the ability to delete all files currently stored in memory. Refer to page 133 for further info.



3.15 UTIL (utilities) – Menu

AUTO FIND: Automatically locates the detection point if the measurement is out of the viewable display area, and automatically sets up the gauges scope settings. Refer to page 106 for further info.

COMPARE: Enables the user to freeze and drop a reference reflector or defect into the background, to compare against a live wave scan in the foreground. Compare is a variation of the peak feature and used in conjunction with the **PEAK** key when enabled. Refer to page 107 for further info.

SET DATE: Gives the user the ability to set the internal date and time stamp in the **DFX-7**. Refer to page 108 for further info.

SHOW DATE: Gives the user the ability to display the date and time in the waveform area of the **DFX-7**. The options are OFF, DATE, TIME, BOTH. Refer to page 110 for further info.

KEY CLICK: Gives the user the ability to set the level of the key press beeper OFF, QUIET, or LOUD. Refer to page 107 for further info.

GAUGE: Gives the user the ability toggle the **DFX-7** gauge type to either a flaw detector, or a thickness gauge. Refer to page 3 for further info.

3.16 XFER (transfer) – Menu

UPGRADE GAUGE	
ABOUT	DEV 0.50I
DATA UTIL	XFER

UPGRADE GAUGE: Enables the user the ability to upgrade the **DFX-7** to the most current firmware revision.

ABOUT: Provides the user with Dakota Ultrasonics contact information and the **DFX-7** software version. Refer to the Dakota Ultrasonics web site for information on the latest firmware versions available for download.



3.17 CLR (clear) Key

The primary functions of the **CLR** key, is to clear a measurement from a grid or sequential log files cell location or set obstruct, backspace in an **Alpha Edit Box**, or clear a DAC reference point used to generate a curve. Use this key to clear saved measurement & waveform.



3.18 MEAS (measurement mode) Key

The **MEAS** key puts the **DFX-7** into its primary mode of operation. In this mode, the user has a complete view of the LCD. When pressed multiple times, navigates the hot menu items.

3.19 OK Key



The primary function of the **OK** key is confirmation of a change or selection. Additionally, the **OK** key also toggles the Hot Menu area to a large digits display while in measurement mode, and rotates the display to a landscape view if the LANDSCAPE menu option is enabled. If the **DFX-7** is displaying a grid log, the **OK** key toggles an advance to row number option. Finally, when the TRIG feature has been activated, pressing the **OK** multiple times will toggle through sound path, surface distance, or depth and displayed in the Hot Menu area.

3.20 ESC Key



The **ESC** key is used in the **MENU**, **MEAS**, and **EDIT** functions as a back or escape function. If the **DFX-7** is displaying a grid or sequential log, the **OK** key toggles the display options: RF, +RECT, -RECT and RECTFW views.

3.21 Arrow Keys



The **Arrow Keys** are used to navigate through the menus, increase/decrease values, and toggle specific function keys.

3.22 ENTER key



The **ENTER** key is used in the overall menu selection process, to activate list and edit boxes, display and save measurements/waveforms to grid or sequential file locations.

3.23 MULTI MODE Key



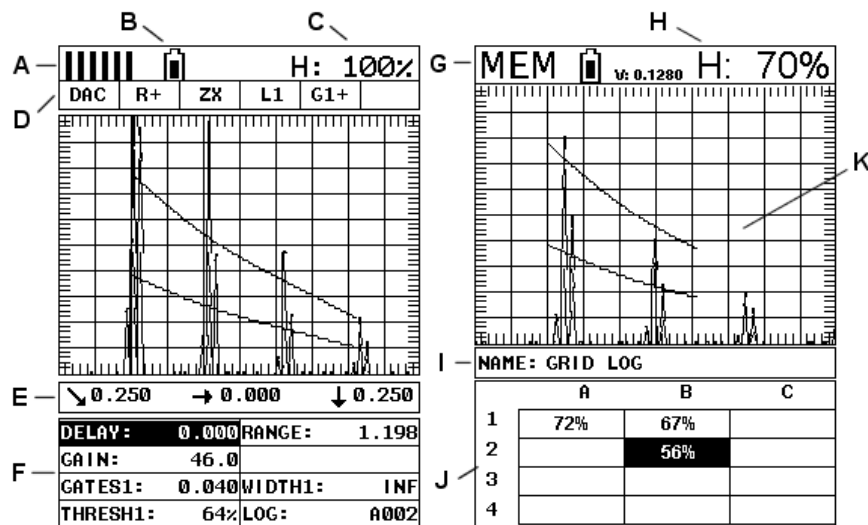
The **MULTI MODE** key provides the user with a set of flaw mode options: Normal, Peak, or Freeze. The normal mode is the standard flaw detector mode. The Peak mode draws, holds, and updates the waveform for the entire duration of the inspection. The Freeze mode ‘freezes’ the current waveform on the screen, allowing the user the time to analyze the wave. The CAPTURE TO FILE option is located at the bottom of the measure mode list.



3.24 ON/OFF Key

The **ON/OFF** key simply powers the unit either **ON** or **OFF**. Note: Unit will automatically power off when idle for 5 minutes. All current settings are automatically saved prior to powering off.

3.25 DFX-7 Overview



DFX-7 Screen Shots

In order to understand how to operate the **DFX-7**, it's best to start off with an understanding of what we're looking at. The **DFX-7** has a lot of great features and tools that will prove to be a huge benefit for the variety of applications you're constantly facing on a continual basis. Let's have a brief look at the screens you'll be looking at most often:

- A. **Repeatability/Stability Indicator** – This indicator shows the stability/repeatability of the sound path signal. When all the vertical bars are fully illuminated, the repeatability of the sound path is stable.

- B. **Battery Icon** – Indicates the amount of battery life the *DFX-7* has remaining.
- C. **Height** – Shows the signal amplitude height as a percent of 100% full screen height.
- D. **Feature Status Bar** – Indicates the features currently enabled and in use in the following order:
- Feature Toolkits
 - i. Trig – Trigonometry w/ Curved Surface Correction
 - ii. AWS – American Welding Society
 - iii. TCG – Time Corrected Gain
 - iv. DAC – Distance Amplitude Correction
 - v. DGS – Distance Gain Size
 - View
 - i. RF: Radio Frequency.
 - ii. R+: Rectified positive.
 - iii. R- : Rectified negative
 - iv. FW: Rectified full wave.
 - Detect
 - i. Zero crossing (ZX)
 - ii. Flank (FK)
 - iii. Peak (PK)
 - Leg – Skip leg reference, (L1...L4...)
 - High Speed Scan Mode
 - Alarm Mode
 - Gain Setting
- E. **Leg (skip leg)** – Indicates which skip/leg the detection in on. The thickness of the material is used to calculate the leg.
- F. **Hot Menu items** – We call this menu section our “hot menu”, as these items are the most commonly adjusted features, requiring quick access from the user. They can be displayed and scrolled by pressing the **MEAS** key at anytime. The **ESC** key is used in conjunction with **MEAS** key to reverse the direction scrolled.
- G. **Memory** – Indicates that the currently displayed measurement screen and values have been previous stored in memory. When MEM is displayed, all measurement functions are disabled until the user advances to an empty storage location, or the current measurement is cleared by pressing the CLR key.
- H. **Height** – Displays the amplitude of the signal as a percentage of full screen height. Depending on the quantity selected, this could also be displayed in dB, or D.
- I. **Grid or Seq Log Name** – References the name of the log file currently open.

- J. **Log File** – Shows the storage cells of the current log file open. Depending on the quantity currently selected, show either the %height or dB value stored.
- K. **A-Scan Display** – The actual echo reflections returned from the backwall or defect.

3.26 Navigating the Hot Menu

	0.20	0.40	0.60	0.80
DELAY:	0.000	RANGE:	1.000	
GAIN:	40.0			
GATES1:	0.140	WIDTH1:	0.696	
THRESH1:	40%	LOG:	B001	

The diagram above is a screenshot of the “Hot Menu” feature of the **DFX-7**. The Hot Menu’s contain all the most regularly adjusted features of the gauge. The primary purpose of the design, was to provide the user with an efficient way to make adjustments on the fly during inspections. The following procedure outlines the steps to navigate and make adjustments as follows:

Hot Menu

	0.20	0.40	0.60	0.80
DELAY:	0.000	RANGE:	1.000	
GAIN:	40.0			
GATES1:	0.140	WIDTH1:	0.696	
THRESH1:	40%	LOG:	B001	

Gate1

- 1) Press the **MEAS** key once to activate the **Hot Menu**. Press the **MEAS** key multiple times to advance the cell right, and the **ESC** key multiple times to advance the cell left, until the **WIDTH1** cell is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to toggle the value or status.

Note: This is a coarse adjustment. It's the fastest and easiest way to increment, decrement, or toggle the status, however it does so in coarse steps.

Set Detect

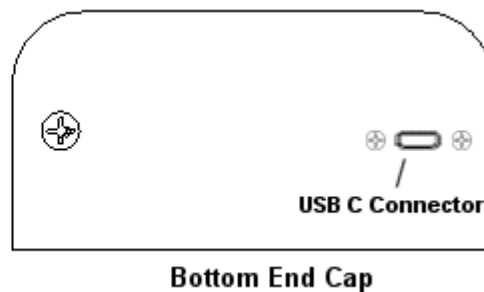
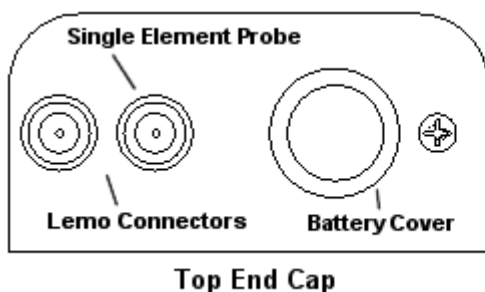
- 1) Press the **UP** and **DOWN** arrow keys until **DETECT** is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to toggle the **ABOVE** or **BELOW**.

Note: Above will trigger the alarm when a signal meets or exceeds the height of the gate, and below will detect on anything that meets or is below the height of the gate.

- 3) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 6) Repeat steps **4 & 5** until the start position is correctly displayed.
- 7) Press the **OK** key to set the **WIDTH1** position and return to the menu screen, or **ESC** to cancel entering the **WIDTH1** position.

Note: This procedure is universal for all the features in the Hot Menu cell locations.

3.27 Top & Bottom End Caps



The top & bottom end panels are where all connections are made to the **DFX-7**. The diagram above shows the layout and description of the connectors:

Transducer Connectors

Refer to Diagram: The transducer connectors, and battery cover/probe zero disk are located on the **DFX-7's** top end cap. The transducer connectors are of type LEMO "00". A single element transducer must be plugged into the inside LEMO jack as illustrated above. Note: There is no polarity associated with connecting a dual element transducer to the **DFX-7**.

Probe Zero Disk & Battery Cover

Refer to Diagram: The Battery cover is the large round disk shown in the diagram. **Note:** This same disk is also used as a probe zero disk. Simply remove the cover when replacing the batteries (3 AA cells). When performing a manual probe zero function, simply place the transducer on disk making firm contact. **Important:** Be sure to follow the polarity labels located on the back label of the **DFX-7**. Note: Rechargeable batteries can be used however they must be recharged outside of the unit in a stand-alone battery charger.

USB-C Connector

Refer to Diagram: The **USB-C** connector, located on the bottom end cap, is a mini type C female connector. It is designed to connect directly from the **DFX-7** to a standard USB type A port on a PC. The cable supplied with the **DFX-7** is a USB type C to a USB type A (pt# N-003-0330). **Note:** This connector is also used to upgrade the **DFX-7** with the latest version of firmware.

CHAPTER FOUR SETTING UP FOR MEASUREMENT

4.1 Selecting Display View

The **DFX-7** includes a variety of viewing options for the waveform display. There are three primary options waveform options with selectable polarity. These are all outline below as follows:

Radio Frequency (RF): Displays the entire sine wave signal, much like an oscilloscope, from a reflector or return echo. This view shows both the positive and negative peaks.

Rectified (RECT): Displays half sine wave signal, either positive or negative, from the reflector or return echo. The user can select the polarity or “phase” displayed. This is typically determined by first using **RF** view to select the most optimal polarity “phase”, to fine tune the scopes settings. The **RECT** view is commonly used as the primary “flaw detection” view.

Full Wave (RECTFW): Display entire sine wave signal in a rectified view. There is no polarity.

The following procedure outlines the steps to select the view:

<u>Display View</u>	
SET DISPLAY	
VIEW	+RECT
DELAY	0.000
RANGE	1.000
UNITS	IN
BRIGHTNESS	20
COLORS	NONE W/B
DIM	OFF
RECT WAVE	OUTLINE
DETECT MARK	DOTS
PRB	CAL DISP TUNE

1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items.

- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **VIEW** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to scroll the view options (**RF**, **+RECT**, **-RECT**, **RECTFW**).
- 4) Once the view is displayed, press the **MEAS** key to return to measurement mode.

4.2 Adjusting the display

This section will cover the procedures for adjusting the viewable range, or area, of the display, in terms of thickness. A basic overview example for this section would be as follows: Suppose we had a 50" widescreen television set. The left side of the television screen is considered the **Delay** for all view options. The right side of the television screen is the **Range + Delay**. By adjusting the left and right side of the television screen, to control the viewable area/range, we can zoom in and out of any part of the 50" screen we'd like, and focus on only the specific areas of the screen necessary.

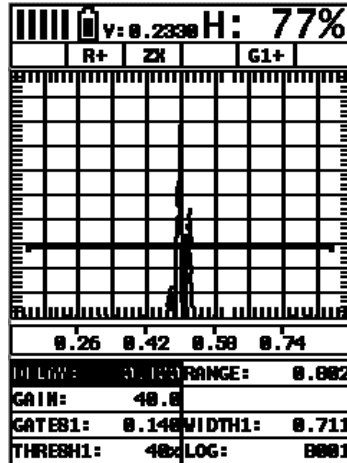
Setting Delay

The Delay represents the left side of the display, and can be adjusted to start at any thickness value within the overall range of the **DFX-7**.

Note: Once the delay is set, it will remain the same for the views: **RF**, **+RECT**, **-RECT**, **RECTFW**.

The procedures to adjust the **Delay** are outlined below:

Setting Delay

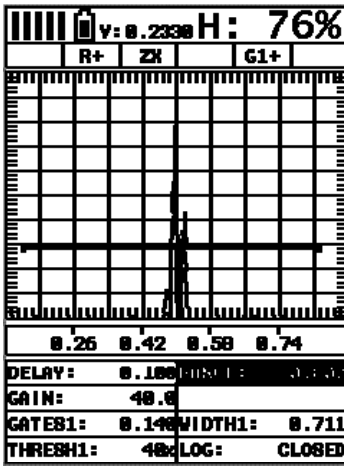


- 1) Press the **MEAS** key once to activate measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **DELAY** cell is highlighted.
- 2) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the highlighted value.
- 3) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 6) Repeat steps **4 & 5** until the **DELAY** value is correctly displayed.
- 7) Press the **OK** key to return to the measurement screen, or **ESC** to cancel entering the **DELAY**.
- 8) Finally, press the **MEAS** key to return to the measurement screen.

Setting Range

The **Range** is the distance from the delay that will be viewable on the screen. It can be adjusted to any value greater than the **Delay**. The procedures to adjust the range are outlined below:

Setting Range



- 1) Press the **MEAS** key once to activate measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **RANGE** cell is highlighted.
- 2) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the highlighted value.
- 3) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 6) Repeat steps **4 & 5** until the **RANGE** value is correctly displayed.
- 7) Press the **OK** key to return to the measurement screen, or **ESC** to cancel entering the **RANGE**.
- 8) Finally, press the **MEAS** key to return to the measurement screen.

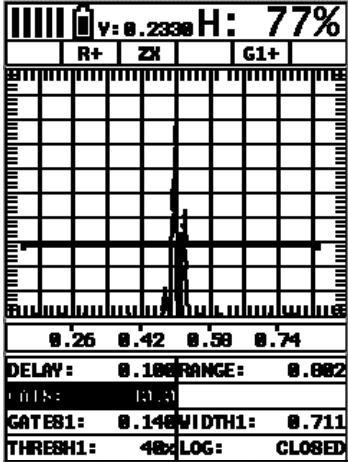
4.3 Gain

The gain feature of the **DFX-7** is used to adjust the signal amplitude to a predetermined reference height for the inspection process. The higher the gain the more the sound is amplified. The gain, or amplification of the return echoes, can be adjusted in the **DFX-7** to accommodate a variety of applications. The setting of the gain is crucial in order to obtain valid readings during the inspection process.

Too much gain may result in erroneous measurements, by detecting on noise rather than the actual reflector or defect. Not enough gain may result in intermittent detection. It may also result in lack of detection on internal flaws, pits, or porosity. The gain can easily be compared to the volume control of a home stereo system. If you turn it up too much, you can't hear the music clearly. If it's turned down too much, you can't hear it at all. The **DFX-7** commands a 110dB gain range using 3 stages of amplification. The overall range makes the DFX-7 extremely versatile regarding a variety of applications and material types.

The procedures to adjust the **Gain** are outlined below:

Adjusting Gain



The screenshot shows a waveform on a grid. At the top, it displays 'V: 0.2330 H: 77%'. Below the waveform, there are several rows of data:

R+	ZK	G1+
0.26	0.42	0.59
0.74		
DELAY:	0.188	RANGE:
		0.882
GATEB1:	0.148	WIDTH1:
		0.711
THRESH1:	48	LOG:
		CLOSED

- 1) Press the **MEAS** key once to activate measure menu items. Press the **MEAS** key multiple times to move right, and the **ESC** key multiple times to move left until the **GAIN** cell is highlighted.
- 2) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the highlighted value.
- 3) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.

- 4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 6) Repeat steps **4 & 5** until the **GAIN** value is correctly displayed.
- 7) Press the **OK** key to return to the measurement screen, or **ESC** to cancel entering the **GAIN**.

The user can also access and adjust the gain from the tabbed menus. However, this method is more tedious than making the adjustments using the **Hot Menu**. The procedure using the tabbed menu is outlined below:

Adjusting the Gain using the Tabbed Menu

TUNE SIGNAL	
FILTERS	WIDE
GAIN	40.0
DETECT MODE Z-CROSS	
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **TUNE** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **GAIN** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct **Gain** is being displayed, **proceed to step 8**.
- 4) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 5) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 6) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 7) Repeat steps **5 & 6** until the **Gain** value is correctly displayed.
- 8) Press the **OK** key to set the **Gain** and return to the menu screen, or **ESC** to cancel entering the **Gain**.

9) Finally, press the **MEAS** key to return to the measurement screen.

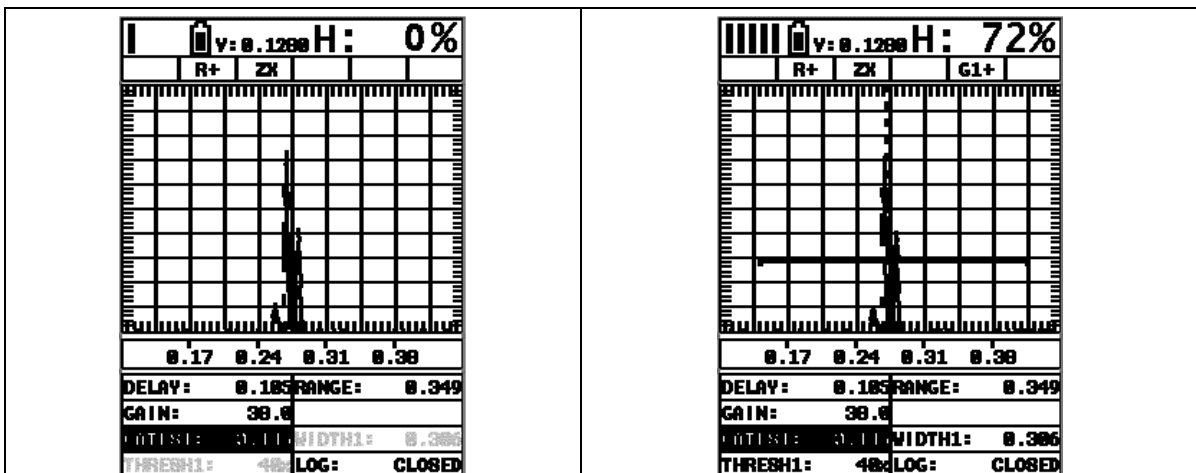
4.4 Gates

The gates are an important part of any ultrasonic device, in this case a flaw detector. The primary purpose of using a flaw detector is to “detect” and estimate the “size” of flaws according to calibrated reference standards or simulated defects. The gates play an important role in this process, as without them a detection/measurement isn’t possible. The height of a gate is also a threshold, or controls the level of sensitivity. They can be adjusted to a specific reference height, based a predetermined reflector, and set to act as an alarm during the inspection process.

The more flexible a gate is, the better the possibilities for the user to setup an application. For example, a test block with a target size and depth is optimized on the A-Scan display with a signal amplitude at 70% full screen height. The inspector wants to know of any defects during the inspection that are greater than or equal in size to the calibrated test specimen. A gate is then enabled and set to a reference height of 70%. The width and range are adjusted to cover the range tested, and the inspection is underway.

The **DFX-7** is equipped with 2 fully independent gates. Each gate has a start and stop or width, a threshold, a polarity switch, and a detect option. A gate can only detect on reflections that occur inside the boundaries of the gate. Anything outside of the start and range/width of the gate will be ignored. Both gates can be enabled and set for different detects, polarities, and positioned anywhere on the A-Scan display independent of one another. The following sections cover enabling and setting up gates:

4.5 Activating and Setting Up a Gate



No Gate	Gate On
----------------	----------------

The screenshots above show a rectified waveform with and without a gate enabled. The following steps outline how to enable a gate as follows:

Activating a Gate

GATE ONE	
ALARM	ON
DETECT	ABOVE
GATE1	0.600
GATE1 WIDTH	1.000
THRESHOLD1	20%
POLARITY	POSITIVE
GT1	GT2 TRIG AWS

Gate1

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **GT1** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ALARM** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to toggle **ALARM** to **ON**. The menu items should now become active and adjustable, as the gate is now active.

Set Detect

- 1) Press the **UP** and **DOWN** arrow keys until **DETECT** is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to toggle the **ABOVE** or **BELOW**.

Note: Above will trigger the alarm when a signal meets or exceeds the height of the gate, and below will detect on anything that meets or is below the height of the gate.

Set Gate1 Start

- 1) Press the **UP** and **DOWN** arrow keys until **GATE1** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct start position is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the start position is correctly displayed.
- 6) Press the **OK** key to set the **GATE1** start position and return to the menu screen, or **ESC** to cancel entering the **GATE1** start position.

Note: This where the gate first turn on relative to the horizontal axis or depth. Sets the left boundary of the gate, or where it turns on.

Set Gate1 Width

- 1) Press the **UP** and **DOWN** arrow keys until **GATE1 WIDTH** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct width is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the width is correctly displayed.

- 6) Press the **OK** key to set the **GATE1 WIDTH** and return to the menu screen, or **ESC** to cancel entering the **GATE1 WIDTH**.

Note: This sets the overall width of the gate in terms of the horizontal axis or depth. Sets the right boundary of the gate, or where it turns off.

Set Threshold1 Level

- 1) Press the **UP** and **DOWN** arrow keys until **THRESHOLD1** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct threshold level is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the threshold level is correctly displayed.
- 6) Press the **OK** key to set the **THRESHOLD1** level and return to the menu screen, or **ESC** to cancel entering the **THRESHOLD1** level.

Note: This sets the overall sensitivity level of the gate which is the threshold.

Select Gate Polarity

- 1) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **POLARITY1** is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to toggle the **POLARITY** feature positive or negative.
- 3) Press the **MEAS** key to return to the measurement screen.

Note: The **GATE1** and **WIDTH1** values can now be adjusted or tuned directly from the Hot Menus on the main measurement screen.

Note: Sets where the detection will occur, on the negative or positive going echoes.

CHAPTER FIVE CALIBRATION

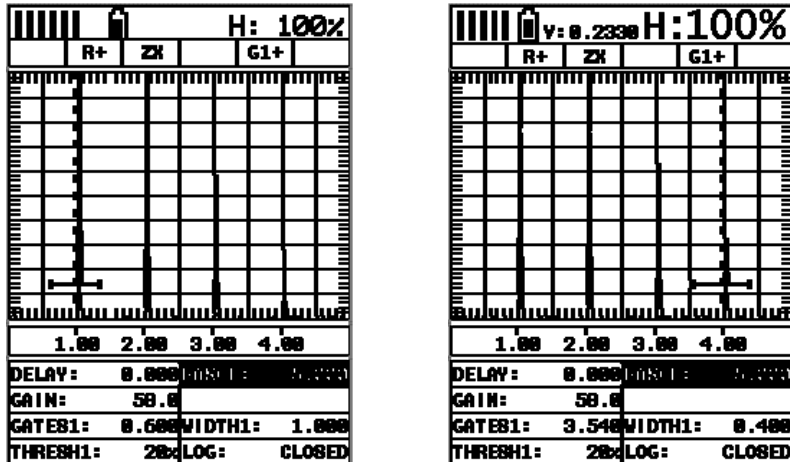
In this section we'll focus on calibrating the **DFX-7**. There are a number of ways to go about performing a calibration, but we'll be focusing on the simplest and most accurate method, which is performing a two point calibration. This method is very convenient, as it will automatically calculate the material velocity and zero using a minimum and maximum calibration standard of know thickness and material type. The **DFX-7** can certainly be manually calibrated by adjusting the velocity and zero features, but this is a tedious and redundant process overall.

The two point calibration method can be used for both straight and angle beam transducers. A number of certified calibration standards are available to address inspection code requirements, specifications, and applications. It should be noted again that the **DFX-7** has virtually 2 gauges built into a single gauge; a flaw detector, and a thickness gauge. Therefore, while the flaw detector option can be calibrated for straight beam contact and angle beam style transducers, the thickness gauge option contains a number of tools for using single and dual element style transducers with linearity tables and v-path correction curves. In addition, it should also be noted that the thickness gauge option has a fully functional scope with the same precision linearity as the flaw detector option. Therefore, the user should consider the current application to determine which gauge option will produce the best results. The following sections outline how to setup and calibrate your **DFX-7** for field use, given a specific range and material type.

5.1 Setting Up For Calibration

This section covers performing a two point automatic calibration using a single element straight beam contact transducer with a range from 1 to 4 inches. In order to accomplish this, a set of calibration standards covering range is required. The steps are outlined as follows:

DFX-7 Setup



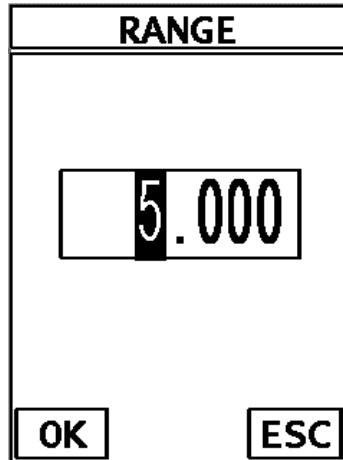
The gauge will require a few basic adjustments in order to get underway with the calibration process. For this example, in order to avoid multiple steps for setting the gauge features/options, the default setup will be loaded as a starting point. However, the user should invest the necessary time getting to know the features and options included in the *DFX-7*, as well as gaining a good understanding of their function:

Loading Default Setup

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **SEUTP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DEFAULT SETUP** is highlighted.
- 3) Press the **ENTER** key to display the **CONFIRM** screen.
- 4) Press the **OK** key to load the **DEFAULT SETUP**.

Setting the Range

- 1) Press the **MEAS** key once to activate the measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **RANGE** cell is highlighted.



- 2) Press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the desired range value is displayed.
- 6) Press the **OK** key to set the value and return to the **GT1** menu.

Note: Our range calibration range for this example is 4 inches. Therefore setting a range of 5 inches will enable the user to view the entire range on the display.

Enabling and Setting Up a Gate

Refer to the illustrations above. In order to measure, a gate is required. The width of the gate should be small enough, in terms of its width, in order to select specific reflections to measure. The screenshot above shows a gate enabled to select the 1 inch calibration standard, and in the second the 4 inch calibration standard.

GATE ONE	
ALARM	ON
DETECT	ABOVE
GATE1	0.600
GATE1 WIDTH	1.000
THRESHOLD1	20%
POLARITY	POSITIVE
GT1	GT2 TRIG AWS

Activating a Gate

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **GT1** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ALARM** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to toggle the gate **ON**.

Setting the Detect

- 1) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DETECT** is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to toggle the option **ABOVE**.

Gate1 Start

- 1) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **GATE1** is highlighted.
- 2) Press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.

5) Repeat steps **3 & 4** until the desired **GATE1** value is displayed.

Note: In our example, a value less than 1 inch should be selected.

6) Press the **OK** key to set the value and return to the **GT1** menu.

Gate1 Width

1) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **GATE1 WIDTH** is highlighted.

2) Press the **ENTER** key to display the **Digits Edit Box**.

3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.

4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.

5) Repeat steps **3 & 4** until the desired **GATE1 WIDTH** value is displayed.

Note: In our example, a value greater than 1 inch should be selected.

6) Press the **OK** key to set the value and return to the **GT1** menu.

Threshold Level

1) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **THRESHOLD1** is highlighted.

2) Press the **ENTER** key to display the **Digits Edit Box**.

3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.

4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.

5) Repeat steps **3 & 4** until the desired **THRESHOLD1** value is displayed.

Note: In our example, a value of 20% has been selected. However, the user should set a value that will be close enough to the baseline to avoid a “Peak Jump”, or missing the first cycle.

6) Press the **OK** key to set the value and return to the **GT1** menu.

Setting Polarity

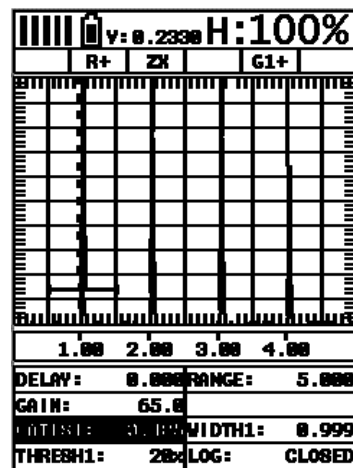
- 1) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **POLARITY1** is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to toggle the polarity **POSITIVE**.
- 3) Press the **MEAS** key to return to the measurement screen and get started with the two point calibration.

5.2 Straight Beam Calibration

Now that the *DFX-7* is setup with a valid range and a gate enabled, we're ready to perform a two point, calibration using a single element contact style transducer, as follows:

Two Point Calibration – Straight Beam

CALIBRATE	
MAT	CUSTOM
MATL 1PT	1.000
MATL 2PT	4.000
VELOCITY	0.2330
ZERO	4.300
PRB	CAL DISP TUNE



Note: Calibration standards representing the minimum and maximum thickness of the overall inspection range intended are required. They must also be of the same material type as the intended application. For our example, we'll be using a 1 and 4 inch standard for calibration.

Coupling to the 1" Cal Standard (1st Point)

Apply a drop of couplant on the transducer and place the transducer in steady contact with the 1" calibration standard. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable. Also, be sure there is sufficient signal amplitude in order to avoid 'peak jumping' or missing the first cycle.

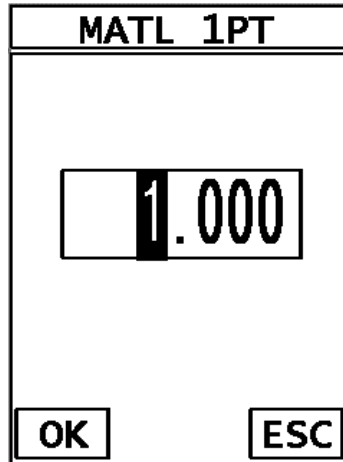
Adjusting the Gate

- 1) Press the **MEAS** key once to activate the measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **GATE1** cell is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to move the gate over the waveform to be measured, as demonstrated in the screen shot above.

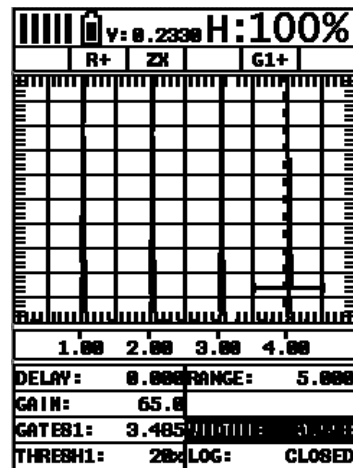
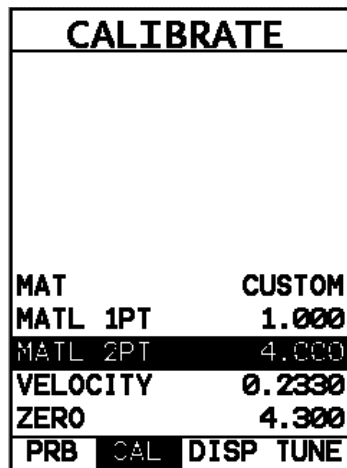
Note: In order to trigger on a signal, the waveform must be inside the boundaries of the gate.

Calibrating the First Point

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items, as shown in the screenshot above.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **MATL 1PT** is highlighted.



- 3) Press the **ENTER** key to display the **Digits Edit Box**.
- 4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 6) Repeat steps 4 & 5 until the known thickness value is correctly displayed.
- 7) Press the **OK** key to calculate the velocity and return to the menu screen, or **ESC** to cancel the one point calibration.



Apply a drop of couplant on the transducer and place the transducer in steady contact with the 4" calibration standard. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and

stable. Also, be sure there is sufficient signal amplitude in order to avoid 'peak jumping' or missing the first cycle.

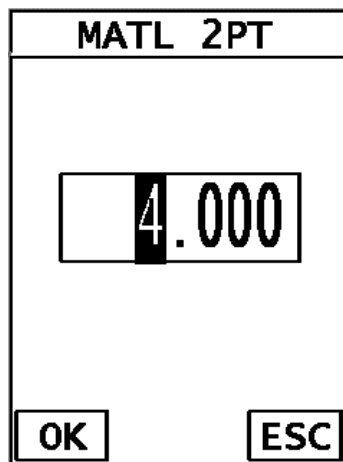
Adjusting the Gate

- 1) Press the **MEAS** key once to activate the measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **GATE1** cell is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to move the gate over the waveform to be measured, as demonstrated in the screen shot above.

Note: In order to trigger on a signal, the waveform must be inside the boundaries of the gate.

Calibrating the Second Point

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items, as shown in the screenshot above.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **MATL 2PT** is highlighted.



- 3) Press the **ENTER** key to display the **Digits Edit Box**.

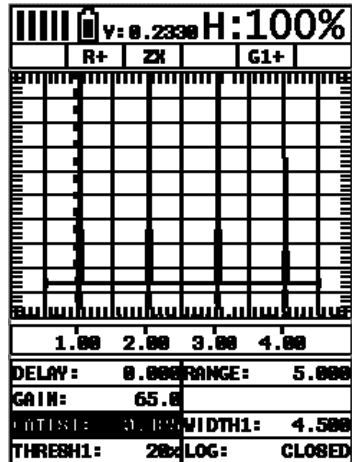
- 4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 6) Repeat steps **4 & 5** until the known thickness value is correctly displayed.
- 7) Press the **OK** key to calculate the velocity and return to the menu screen, or **ESC** to cancel the one point calibration.

CALIBRATE	
MAT	CUSTOM
MATL 1PT	1.000
MATL 2PT	4.000
VELOCITY	0.2330
ZERO	4.300
PRB	CAL DISP TUNE

Note: A velocity and zero value will be calculated and displayed in the fields a shown above.

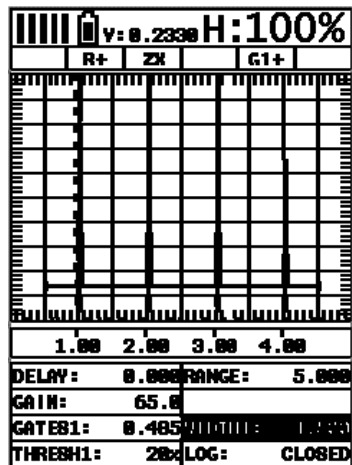
- 8) Finally, press the **MEAS** key to return to the measurement screen.

In order to trigger on anything that's detected in the calibrated range, the boundaries of the gate must be adjusted to include the entire range. **Caution:** in both z-cross & flank detection settings, the first signal to cross the gate will be triggered on. However, if the **peak** detection setting has been enabled, the signal with the most amplitude will be detected.



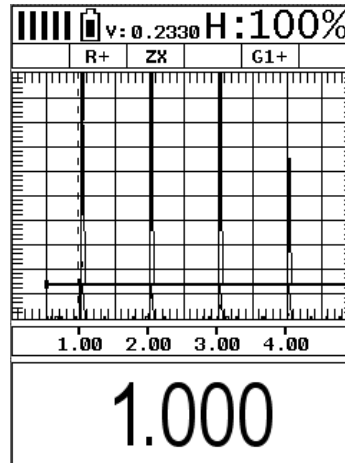
Adjusting the Gate to Calibrated Range

- 1) Press the **MEAS** key once to activate the measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **GATE1** cell is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to move the gate start to a position less than 1 inch.



- 3) Press the **MEAS** key once to highlight the **WIDTH1** cell.
- 4) Press the **LEFT** and **RIGHT** arrow keys to move the gate start to a position greater than 4 inches.

Note: CHECK YOUR CALIBRATION! Place the transducer back on the one inch point, and any others in the given range, to confirm linearity. If the velocity and zero values we calculated correctly, the thickness reading will match the known thickness of the calibration standards. If the thickness is not correct, repeat the steps above.



5) Press the **OK** key once to display the thickness, or the **MEAS** key to return to the hot menus at any time.

5.3 Angle Beam Calibration

In the first example we demonstrated how to perform a two point calibration using a single element straight beam contact transducer. With the exception of a handful of additional comments, calibration using an angle beam transducer is virtually identical in the scope of the overall step by step process. To avoid copying the procedures from the previous section, we'll focus only on the additional comments. Refer to section 5.1 and 5.2, regarding the procedures to setup and calibrate the **DFX-7**. The following are a list of additional items to consider when using an angle beam transducer, as follows:

Calibration Standards:

There are a number of calibration block options available in a variety of common material types, and according to specific code requirements. The user should consider the application, codes applicable, and purchase the necessary calibration standards.

Shear versus Longitudinal Velocity:

Unlike the previous straight beam calibration, which uses a longitudinal wave, an angle beam transducer uses a shear wave. The following is a brief review of the waves:

- **Longitudinal –**
 - Particle motion is parallel to the direction of wave travel.
 - Travels in solids, liquids, and gasses.
 - Fastest mode of vibration.
- **Shear –**
 - Particle motion is perpendicular to the direction of wave travel.
 - Travels only in solids.
 - Is approximately $\frac{1}{2}$ the velocity of longitudinal waves.
 - Has a shorter wavelength than a longitudinal at the same frequency.

Therefore, a two point calibration using an angle beam transducer will result in a velocity approximately $\frac{1}{2}$ the speed of the velocity calculated from the straight beam calibration in the previous section.

Gain and Amplitude Ratio:

During an angle beam calibration the overall amplitude height of the waveform is critical for “peaking up”. Therefore the maximum amplitude of the waveform must be visible on the display in order to correctly position the transducer on the calibration standard. The user should select a screen height and gain level that will enable the entire waveform to be visible on the display.

Peaking Up the Signal Amplitude:

During an angle beam calibration, it's important to peak up the overall amplitude of the waveform to its maximum potential. The primary purpose is to be sure the transducer is positioned properly on the calibration standard, that's producing return echoes at different distances. **For example:** If the operator is using a DSC block to calibrate the velocity and zero, a DSC block will produce echoes at 3 & 7 inches. The operator then positions the transducer on an index point, moves the transducer in both directions forward and backward, rotates it side to side, and watches the signal amplitude to find the maximum potential. At the maximum potential, the transducer is correctly positioned to measure both multiple echoes at the correct distances, and ready to proceed with the calibration.

Selecting the Material Type:

The user can also select a material type directly from a table built into the **DFX-7** with shear wave values. This would only get the user close, in terms of velocity, to the calibration standards material type. In order to display the material chart with shear

wave values, the **TRIG** mode must be enabled. The following outlines the steps to enable the shear wave velocity table and select a material type from the chart:

Selecting the Material Type

TRIGONOMETRY	
TRIG	ON
THICKNESS	0.200
ANGLE	45.0
X-OFFSET	0.500
CSC OD	0.000
SHOW LEGS	ON
GT1	GT2
	TRIG
	AWS

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **TRIG** menu is highlighted and displaying the submenu items.
- 2) Press the **LEFT** and **RIGHT** arrow keys to toggle **TRIG** mode **ON**.
- 3) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items.
- 4) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **MAT** is highlighted.
- 5) Press the **ENTER** key to display the list of material types.
- 6) Press the **UP** and **DOWN** arrow keys to scroll through the material list until the appropriate material is highlighted.

- 7) Press the **ENTER** key to select the material type and initiate the overwrite confirmation screen.
- 8) Press the **OK** key to confirm the material selection, or **ESC** key to cancel changing the material type.

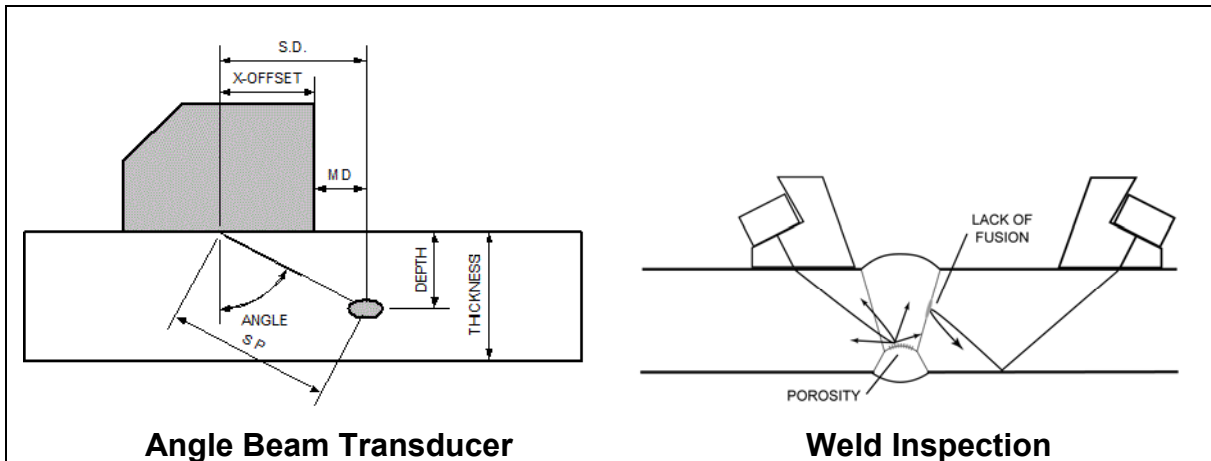
CHAPTER SIX TRIGONOMETRY MODE

6.1 Introduction to TRIG

Trig mode is most commonly used for inspecting welded joints using an angle beam transducer. Based on the location, orientation, and geometry of the weld, a straight beam transducer is typically not suitable for inspection. As a result, a transducer emitting sound at a given angle will allow the operator to position the transducer away from the actual weld, and “skip” into the weld at a given angle. Therefore, in order to determine the location of a defect, given a specific angle, the trigonometry mode is used. This section will cover the steps to setup and utilize trigonometry mode.

6.2 Additional Comments

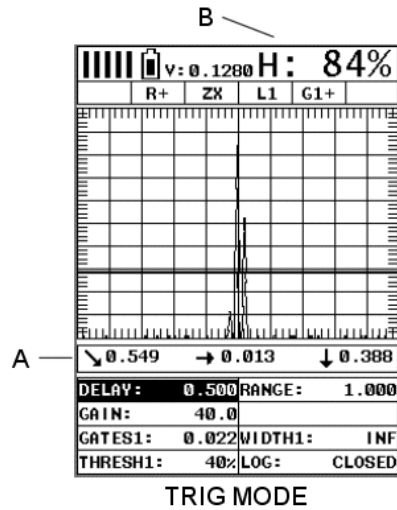
Prior to proceeding on to the next section outlining how to enable and setup the **TRIG** mode, a few additional items should be clarified:



Refer to the Angle Beam Transducer diagram above:

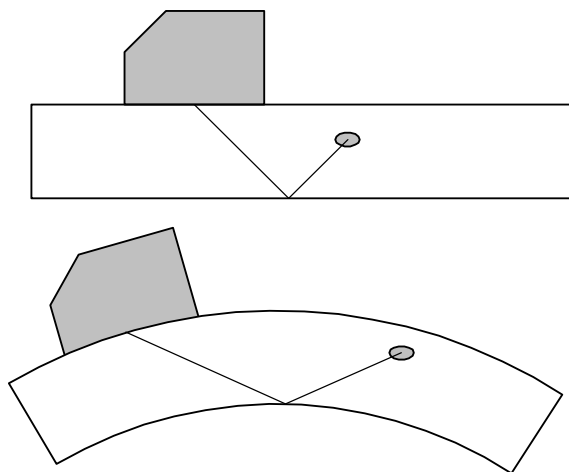
SP – Sound Path	X-Offset – Front of wedge less Index
Angle – Transducer Angle	SD – Surface Distance
Thickness – Material Thickness	Depth – Depth of flaw from surface

Screenshot Trig mode:



When **TRIG** mode is enabled, the calculated measurements will be displayed below the waveform display area at (A), and the signal amplitude as a percentage of full screen height at (B).

Curved Surface Correction:



The **DFX-7** will also compensate for convex curved surfaces of longitudinally welded pipes. A curved surface will produce a greater sound path than a flat surface will, using a transducer with a given angle. The user should consider the angle used on curved surfaces, with respect to the material thickness, in order to be sure a reflection will occur from the opposite surface of the test material. In order to utilize the curved surface compensation, the outside diameter must be entered into the **DFX-7**.

6.3 Setup Trigonometry Mode

This section provides a step by step procedure to enable and setup the **TRIG** mode. **Note:** A two point calibration should be done prior to proceeding. Refer to Chapter Five for the calibration procedures.

Activating & Setting the Parameters

TRIGONOMETRY	
TRIG	ON
THICKNESS	0.200
ANGLE	45.0
X-OFFSET	0.500
CSC OD	0.000
SHOW LEGS	ON
GT1	GT2
TRIG	AWS

Activate Trig Mode

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **TRIG** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **TRIG** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to toggle the **TRIG** feature **ON**. The menu items should now become active and adjustable, as illustrated above.

Enter Material Thickness

- 1) Press the **UP** and **DOWN** arrow keys until **THICKNESS** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct thickness is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.

- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the thickness is correctly displayed.
- 6) Press the **OK** key to set the **THICKNESS** and return to the menu screen, or **ESC** to cancel entering the **THICKNESS**.

Note: Thickness is used to calculate the depth.

Transducer Angle

- 1) Press the **UP** and **DOWN** arrow keys until **ANGLE** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct angle is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the angle is correctly displayed.
- 6) Press the **OK** key to set the **ANGLE** and return to the menu screen, or **ESC** to cancel entering the **ANGLE**.

X-Offset

- 1) Press the **UP** and **DOWN** arrow keys until **X-OFFSET** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct X-Offset is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the X-Offset is correctly displayed.

- 6) Press the **OK** key to set the **X-OFFSET** and return to the menu screen, or **ESC** to cancel entering the **X-OFFSET**.

Note: The **X-Offset** is used for purposes of marking, and is physically measured with a ruler from the index point to the front edge of the transducer.

Curved Surface Outside Diameter

- 1) Press the **UP** and **DOWN** arrow keys until **CSC OD** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct **CSC OD** is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the **CSC OD** is correctly displayed.
- 6) Press the **OK** key to set the **CSC OD** and return to the menu screen, or **ESC** to cancel entering the **CSC OD**.

Note: The **CSC OD** value is only used for curved surfaces of longitudinally welded pipes.

Show Legs (Skips)

- 1) Press the **UP** and **DOWN** arrow keys until **SHOW LEGS** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to toggle on/off.

Note: When **SHOW LEGS** is enabled the background of the A-Scan area will display strips with alternating color for an easy reference of the leg.

CHAPTER SEVEN

AWS – WELD INSPECTION

7.1 Introduction to AWS

AWS provides a toolkit for evaluating defects according to the American Welding Society D1.1 welding code. The code offers inspectors a method to classify discontinuities by calculating and Indication Rating (IR) using ultrasonics. This toolkit can be used in conjunction with **TRIG** mode, outlined in the previous chapter, to simultaneously display the sound path (SP), surface distance (SD), and depth (D). The following sections provide an outline for using the **AWS** feature.

7.2 Additional Comments

Since the *DFX-7* is a gain controlled instrument, the following formula applies:

$$A - B - C = D$$

Where:

A = Discontinuity Indication Rating (DI)

B = Reference Indication Level (IL)

C = Attenuation Factor (AF); or $2(SP - 1)$

SP = sound path in inches (2dB loss per inch of material thickness)

D = Indication Rating (IR)

Note: all values are in dB.

Calibration Standards & Calibration:

In order to use the **AWS** feature, the operator must have calibration standards made with the same size reflector at different distances within the testing range. The standards should also be made of the same material type as the material to be inspected.

AWS D1.1 Standard:

There are specific transducers that are required by the D1.1 standard. The frequency specified by the standard is 2-2.5MHz. The user should refer to the standard for further information.

7.3 Setup AWS

This section provides a step by step procedure to enable and setup the **AWS** feature.

Note: A two point calibration should be done prior to proceeding. Refer to **Chapter Five** for the calibration procedures. The **TRIG** mode will also be used for weld

inspection, and should additionally be setup prior to enabling the **AWS** feature. Refer to **Chapter Six** for instructions on setting up **TRIG** mode.

Activating & Setting AWS

AWS SETTINGS	
AWS	ON
REFERENCE GAIN	OFF
SHOW CURVE	OFF
% SCRN HEIGHT	80
GT1 GT2 TRIG	AWS

Activating AWS Mode

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **AWS** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **AWS** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to toggle the **AWS** feature **ON**. The menu items should now become active and adjustable, as illustrated above.

Enter % Screen Height

- 1) Press the **UP** and **DOWN** arrow keys until **% SCRN HEIGHT** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct height is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.

- 3) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the height is correctly displayed.
- 6) Press the **OK** key to set the % **SCRN HEIGHT** and return to the menu screen, or **ESC** to cancel entering the % **SCRN HEIGHT**.

Note: % Screen Height is an arbitrary level, and is not specified by the AWS D1.1. The user should set a value that will optimize viewing defects that are larger and smaller than the reference level. Typically this level is set between 50%-80% full screen height.

Setting the Reference Gain

- 1) Press the **UP** and **DOWN** arrow keys until **SET REF HEIGHT** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to toggle the feature **ON**.
- 2) Press the **MEAS** key once to activate measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **GATE1** cell is highlighted.

Note: A gray cursor should be visible in the waveform area of the display. Also, since the **DFX-7** has been previous calibrated and the **TRIG** feature has been setup, a gate should be enabled and active.

Peak Up on the Reflector

- 1) Apply couplant on the calibration standard, place the transducer in the correct area in position with the reflector, and slide the transducer around to locate the maximum amplitude.

- 2) Press the **LEFT** and **RIGHT** arrow keys to position the start of **GATE1** to trigger on the waveform.
- 3) Optionally, press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **WIDTH1** cell is highlighted.
- 4) Press the **LEFT** and **RIGHT** arrow keys to adjust the size or width of **GATE1**.

Note: When the signal is in the gate, the height indicator will detect and display the % full screen height.

Setting the Level

- 1) Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **AWS BOX:** cell is highlighted.
- 2) Press the **LEFT** and **RIGHT** arrow keys to position the cursor box over the waveform.
- 3) Press the **ENTER** key to set the **REFGN** (reference gain).

Note: This process can be repeated and reset multiple times, or until the **SET REF GAIN** feature is toggled **OFF**.

- 4) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **AWS** menu is highlighted and displaying the submenu items.
- 5) Press the **UP** and **DOWN** arrow keys until **SET REF GAIN** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to toggle **OFF**.
- 6) Finally, press the **MEAS** key to return to the main measurement screen, followed by pressing the **OK** key to display the **AWS** screen.

Note: The **AWS** screen can be toggle on by pressing the **OK** key while in the main measurement screen. Equally, the Hot **Menu** can be toggled by pressing the **MEAS** at any time.

CHAPTER EIGHT

DISTANCE AMPLITUDE CORRECTION (DAC)

8.1 Introduction to DAC

A **DAC** curve is a gate with a variable threshold to compensate for a given reflector type and size measured at different depths. Unlike a standard gate, which typically has a fixed threshold level regardless of the depth, the **DAC** curve is more representative of the reflector size at different depths. In order to generate a **DAC** curve, calibration standards must be made with the same material being inspected, the representative reflector size, and over a given thickness range. The **DAC** curve is then used as an alarm to inform the user about the size of any given reflector at any depth during the inspection process.

Once the **DAC** curve has been established, the user can display; -2dB, -6dB, -10dB, -12dB, -6/-12dB, -6/-14dB, DAC or GATE at any time. The initial **DAC** curve generated is always displayed in conjunction with any of the above **CURVE** options. Additionally, the alarm can be set to **TRIGGER** on any of the curve options displayed. Therefore, if the -6/-12dB curve option has been selected, the user can toggle the **TRIGGER** options: GATE, DAC, -6dB, or -12dB.

Note: Based on the screen resolution of the **DFX-7**, the dynamic range of the **DAC** is approximately 18dB. As a result, inspection of any materials that attenuate more than 18dB over the inspection range, the **DAC** feature should not be used, and **TCG** (Time Corrected Gain) should optionally be considered.

8.2 Additional Comments

Prior to proceeding onto the next section to create a **DAC** curve, a few additional items will help with the user's selection process in the menu items:

- Up to 8 points can be used to generate a **DAC** curve.
- 3 or more points must be used in order to draw a **DAC** curve.
- All the **DAC** curve or gate combinations only detect when the amplitude of the signal is 'at' or 'above' the selected trigger option.
- Any of the **DAC** curves or gate displayed, can be set as the trigger alarm option.
- The measure (meas) options are as follows:
 - dB –
 - %DAC – At the **DAC** curve represents 100%. Any signal generating an amplitude below the **DAC** curve is less than 100%, and any above greater than 100%.

%FSH – The top of the waveform display represents 100% full screen height. Any waveform amplitudes generated greater than 100% full screen height will not be displayed. 100% is the greatest value that can be displayed.

Note: The **MEAS** option selected is overridden with %FSH while the **DAC** curve is in **DRAW** mode. Once the **DRAW** mode is turned off, the select **MEAS** option will be displayed.

- The **MEAS**, **CURVE**, and **TRIGGER** options can be changed at any time once the **DAC** curve has been created.
- In order to move the highlighted cursor over a waveform to use as a point in generating the **DAC** curve, the “**DAC BOX:**” hot menu item in the main measurement screen must be highlighted.

8.3 Creating a DAC Curve

This section provides a step by step procedure to create a **DAC** curve. Note: a two point calibration should be done prior to proceeding. Refer to Chapter Five for the calibration procedures. Also, if the **TRIG** function will be used, it should be setup prior to proceeding. Refer to **Chapter Six** for the setup procedure.

Activating & Setting the Parameters

DAC SETTINGS	
DAC	ON
DRAW	ON
MEAS	%DAC
CURVE	-6DB / -12DB
TRIGGER CURVE	-6DB
DPOLARITY	POSITIVE
FIT	SPLINE
TCG	DAC
DGS	SET

Activating DAC

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **DAC** menu is highlighted and displaying the submenu items.

- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DAC** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to toggle the **DAC** feature **ON** or **AUDIBLE**. The menu items should now become active and adjustable, as illustrated above.

Activating Draw Mode

- 1) Press the **UP** and **DOWN** arrow keys until **DRAW** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys until **ON** is displayed.

Quantity Displayed

- 1) Press the **UP** and **DOWN** arrow keys until **MEAS** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to toggle and select **dB**, **%FSH**, or **%DAC**.

Selecting the Curve(s)

- 1) Press the **UP** and **DOWN** arrow keys until **CURVE** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to toggle and select **DAC**, **-2**, **-4**, **-6**, **-10**, **(-6/-12)**, or **(-6/-14)** curve options. The **CURVE** option can be changed at any time after the **DAC** curve has been created.

Setting the Curve(s) Trigger

- 1) Press the **UP** and **DOWN** arrow keys until **TRIGGER** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to toggle and select which curve or gate to use as the alarm trigger. The options displayed will vary according to which **CURVE** option has been selected above: **DAC**, **-2**, **-4**, **-6**, **-10**, **(-6/-12)**, or **(-6/-14)** curve options. The Trigger option can be changed at any time after the **DAC** curve has been created.

Selecting the Fit

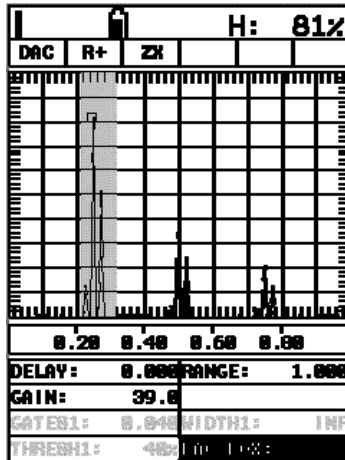
- 1) Press the **UP** and **DOWN** arrow keys multiple times until **FIT** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to select **SPLINE** or **LINEAR**.
- 2) Proceed to the next section – Drawing the **DAC**.

Drawing the DAC

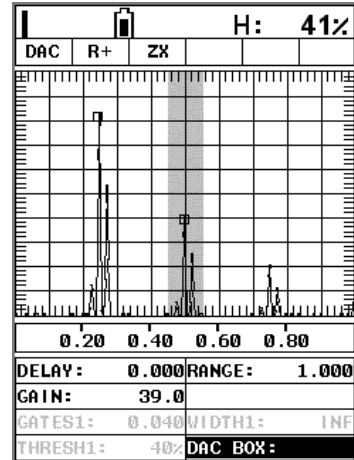
DAC SETTINGS	
DAC	ON
DRAW	ON
MEAS	∅DAC
CURVE	-6DB / -12DB
TRIGGER	-6DB
TCG	DAC
DGS	SET

- 1) With all the parameters set in the previous section, press the **MEAS** key once to return to the main measurement screen.

Note: The user should now see a highlighted cursor displayed in the waveform area, starting at the left most side of the display area.



ex. 1

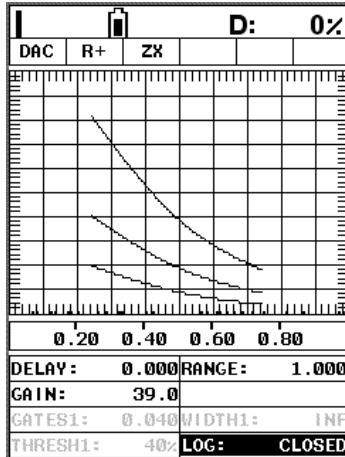


ex. 2

- 2) Press the **MEAS** key multiple times to move right, and the **ESC** key multiple times to move left until the **DAC BOX:** cell is highlighted. Now that the **DAC BOX:** cell is highlighted, the cursor can be controlled by moving the **LEFT** and **RIGHT** arrow keys.
- 3) Couple the transducer to the first calibration standard, and peak up on the reflector, adjusting the gain to keep the signal height within the boundaries of the waveform display area, and at a suitable height to allow for attenuation at greater depths in the overall range to be tested.
- 4) Press the **LEFT** and **RIGHT** arrow keys to move the cursor over the waveform to be used as the first point in the **DAC** curve, and press the **ENTER** key to set the first point. Illustrated in ex.1 above.
- 5) **Repeat steps 3 & 4** to set multiple points as is necessary. Illustrated in ex.2 above.

Note: The **DAC** curve will be displayed after 3 points have been set/recorded, and will continue to be redrawn/updated for each additional point added, with a maximum of 8 points allowed.

- 6) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **DAC** menu is highlighted and displaying the submenu items.



- 7) Press the **UP** and **DOWN** arrow keys until **DRAW** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys until **OFF** is displayed. The **DAC** curves are now set and ready to be used for inspection.

CHAPTER NINE

TIME CORRECTED GAIN (TCG)

9.1 Introduction to TCG

The **TCG** feature increases gain as distance increases, in order to achieve an overall level of sensitivity for the same reflector at different distances. It is very similar to the **DAC** feature noted in a previous chapter. However, while a **DAC** curve plots points at given amplitudes and distances, generating a variable threshold, the **TCG** feature increases the gain at various distances to adjust the signal amplitude to a predetermined level of full screen height. Therefore, the amplitude of all signals at various distances will be displayed at the same reference level.

Note: One of the advantages of the **TCG** feature over the **DAC** option is the dynamic range. The **TCG** feature has a maximum dynamic range of 50dB, while the **DAC** option is approximately 18dB. Therefore the **TCG** feature is a better solution for any materials that attenuate more than 18dB over the inspection range, and should be considered.

9.2 Additional Comments

Prior to proceeding onto the next section to create a **DAC** curve, a few additional items will help with the users selection process in the menu items:

- Up to 8 points can be used to generate a **TCG** curve.
- 3 or more points must be used in order to draw a **TCG** curve.
- The gain will be adjusted at each point to display the signal amplitude at a predetermined reference level.
- In order to move the highlighted cursor over a waveform to use as a point in generating the **TCG** curve, the “**TCG BOX:**” hot menu item in the main measurement screen must be highlighted.

9.3 Creating a TCG Curve

This section provides a step by step procedure to create a **TCG** curve. Note: a two point calibration should be done prior to proceeding. Refer to **Chapter Five** for the calibration procedures. Also, if the **TRIG** function will be used, it should be setup prior to proceeding. Refer to **Chapter Six** for the setup procedure.

Setting TCG Parameters

TCG SETTINGS	
TCG	ON
DRAW	ON
CURVE	OFF
% SCRN HEIGHT	70
TCG	DAC DGS SET

Activating TCG

- 4) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **TCG** menu is highlighted and displaying the submenu items.
- 5) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **TCG** is highlighted.
- 6) Press the **LEFT** and **RIGHT** arrow keys to toggle the **TCG** feature **ON**. The menu items should now become active and adjustable, as illustrated above.

Enter % Screen Height

- 7) Press the **UP** and **DOWN** arrow keys until **% SCRN HEIGHT** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct height is displayed, proceed to the next setting.
- 7) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 8) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 9) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 10) Repeat steps **3 & 4** until the height is correctly displayed.

- 11) Press the **OK** key to set the % **SCRN HEIGHT** and return to the menu screen, or **ESC** to cancel entering the % **SCRN HEIGHT**.

Activating Draw Mode

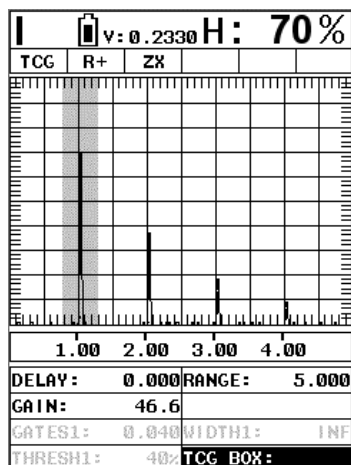
- 4) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DRAW** is highlighted.
- 5) Press the **LEFT** and **RIGHT** arrow keys to toggle the **DRAW** feature **ON**.
- 6) Proceed to the next section – Drawing the **TCG** curve.

Drawing the TCG

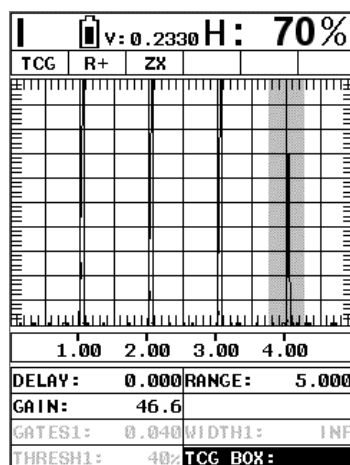
DAC SETTINGS	
DAC	On
DRAW	ON
MEAS	∕DAC
CURVE	-6DB / -12DB
TRIGGER	-6DB
TCG	DAC DGS SET

- 1) With all the parameters set in the previous section, press the **MEAS** key once to return to the main measurement screen.

Note: The user should now see a highlighted cursor displayed in the waveform area, starting at the left most side of the display area.

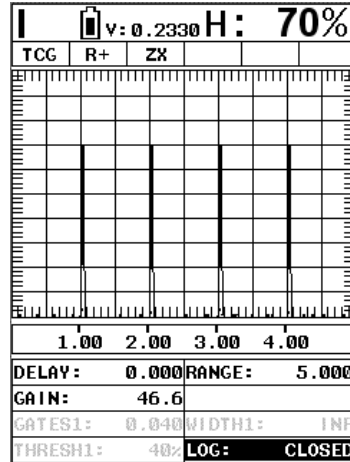


ex. 1



ex. 2

- 2) Press the **MEAS** key multiple times to move right, and the **ESC** key multiple times to move left until the **TCG BOX:** cell is highlighted. Now that the **TCG BOX:** cell is highlighted, the cursor can be controlled by moving the **LEFT** and **RIGHT** arrow keys.
 - 3) Couple the transducer to the first calibration standard, and peak up on the reflector to achieve maximum signal amplitude.
 - 4) Press the **LEFT** and **RIGHT** arrow keys to move the cursor over the waveform to be used as the first point in the **TCG** curve, and press the **ENTER** key to set the first point. Illustrated in ex.1 above.
 - 5) **Repeat steps 3 & 4** to set multiple points as is necessary. Illustrated in ex.2 above.
- Note:** You must set 3 points to draw a **TCG** curve. Any point can be cleared by pressing the **CLR** key when **DRAW** is active.
- 6) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **TCG** menu is highlighted and displaying the submenu items.



- 7) Press the **UP** and **DOWN** arrow keys until **DRAW** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys until **OFF** is displayed. The TCG curve is now set.
- 8) Optionally, the **TCG** curve can be displayed by pressing the **UP** and **DOWN** arrow keys until **CURVE** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys toggle **ON**.
- 9) Press the **MEAS** key to display the main measurement screen, and the **TCG** curve will be displayed.

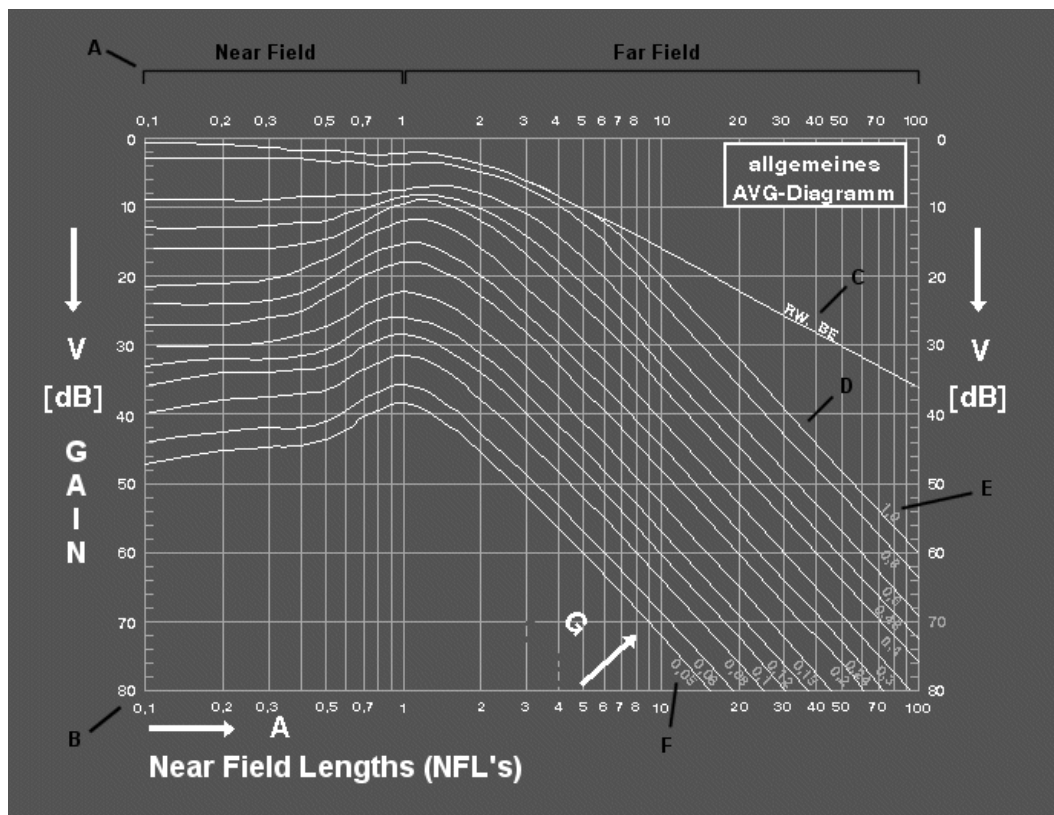
CHAPTER TEN

DISTANCE, GAIN, SIZE (DGS)

10.1 Introduction to DGS (AVG)

The **DGS** (Distance, Gain, Size) method was introduced in 1958 as a way to standardize the process of evaluating and sizing defects, also referred to by the German acronym **AVG**. This method uses a combined empirical and mathematical model to eliminate the need for a large range of reference standards, generally required when using the **DAC** or **TCG** methods. **DGS** can be thought of as a mathematically derived **DAC** curve, and used as an alternative replacement for **DAC**.

The concept of the **DGS** method is to compare the amplitude/gain of similar reflectors at different distances and sizes, to mathematically approximate the size of the defect using the effective probe diameter, frequency and near field length (NFL). The reference to 'similar reflectors' assumes that the orientation of the reflector is the same for all sizes, which is unrealistic to assume during actual field testing. The diagram below illustrates the mathematically derived set of curves used for **DGS**:



Considerations:

- Should only be used with single element probes.
- The effective diameter must be estimated for standard transducers not certified for **DGS**.
- Center frequency clarity is required. Highly damped transducers can sometimes produce a broadband frequency range, and should not be used.

10.2 DGS Diagram

In order to get familiar with the **DGS** diagram, let's take a look at some of the general concepts. The near and far fields are referenced at point **(A)**. In the near field the wave front is not as uniform or consistent as the far field. As a result, the evaluation of flaws/defects are optimized in the far field when the wave front becomes uniform. Evaluating defects less than .7 NFL's is marginal at best.

The **DGS** diagram uses a logarithmic scale for both the Gain (dB) y axis, and near field length (NFL) distance at **(B)**. The curve at **(C)** is the back wall reflector. It's important to note that when the distance is doubled, the sound energy decreases by 1/2 (-6dB). However, a defect/reflector that's less than or equal to the effective diameter of the transducer, doubling the distance decreases the sound energy by 1/4 (-12dB), at **(D)**.

The curve at **(E)** represents a defect that is equal to 100% the effective diameter of the transducer, while 5% the effective diameter at **(F)**. As an example for using this diagram to determine a reflector size, consider the following: If I set my gauge for 80% screen height on a back wall reflector at 5 NFL's, and found a defect also at 5 NFL's, but at 80% ($1/10^{\text{th}} = 20\text{dB}$), the ERS would be 30% of the effective diameter.

10.3 Estimating Effective Diameter

There are a number of transducers that are specially documented as **DGS/AVG** transducers. What this typically infers is that the effective diameter, near field length, and center frequency have been determined and documented on the transducer certificate. If **DGS/AVG** transducers are being used, the values for effective diameter and frequency can simply be entered into the **DFX-7**. However, if a standard transducer will be used and has a standard transducer certificate, the effective diameter must be estimated in order to determine the near field length (NFL).

Calculating NFL

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

Where:

N = Near Field Length

D_{EFF} = Effective Diameter

λ = Wave Length (velocity/frequency)

In order to approximate the effective diameter, the shape of the crystal must be taken into account. Transducers are either round or square/rectangular in shape, and can be approximated as follows:

Round Crystal (D_{EFF})

$$D_{EFF} = (Dia.)(.97)$$

Where:

D_{EFF} = Effective Diameter

Dia. = Diameter of the crystal

0.97 = Fixed ratio

Square/Rectangle (D_{EFF})

$$K = 0.6935 \left(\frac{B}{A}\right)^3 - 0.3753 \left(\frac{B}{A}\right)^2 + 0.0661 \left(\frac{B}{A}\right) + 0.9863$$

Where:

K = Aspect Ratio

A = Largest Dimension

B = Smallest Dimension

$$D_{EFF} = 0.97(\sqrt{K})(A)$$

Where:

D_{EFF} = Effective Diameter

K = Aspect Ratio

A = Largest Dimension

0.97 = Fixed Ratio

Calculated results can also be compared to the following table:

Ratio of the sides	
B/A	K
1.0	1.37
0.9	1.25
0.8	1.15
0.7	1.09
0.6	1.04
0.5	1.01
0.4	1.00
0.3	0.99
0.2	0.99
0.1	0.99

10.4 Parameter Definitions DGS(AVG)

This section outlines the parameters in the DGS/AVG toolbox, and provides a brief definition of each parameter:

DISTANCE GAIN	
DGS	ON
REF GAIN	OFF
TRIGGER CURVE	DGS
EFF PROBE DIA	0.500
PROBE FREQ	2.250
CURV SIZE(ERS)	0.200
ATTENUATION	OFF
DELAY VEL	0.1060
REF TYPE	SDH
REF SIZE	0.125
TCG	DAC
DGS	SET

DGS: Activate the DGS on/off.

Reference Gain: Activated to set the reference gain using a given reflector from a calibration standard.

Trigger Curve: Enables the user to set the detection curve to either **DGS** or **GATE**. This will be the curve used to trigger the alarms and display the effective reflector size (ERS) during the inspection process.

Effective Probe Diameter: A variable used to calculate the near field length of a given transducer, and determine the defect size. The effective diameter will be noted on the transducer calibration certificate for a standard DGS transducer. However, this can be estimated using the formulas outlined in section 10.3.

Probe Frequency: Refers to the center frequency of the transducer being used, and used in the calculation of the near field length.

Curve Size (ERS): Used to select which curve will be used, based on the reflector size, from the DGS(AVG) chart in section 10.1. If the value entered is not an exact curve value represented in the diagram, the **DFX-7** will compare and interpolate between the two closest curves, and mathematically derive a curve for that value.

Attenuation: Used to additionally compensate other factors leading to the loss of sound/energy. Refer to section 10.5 for more information on the attenuation parameters. If all the attenuation values are set to zero, the attenuation feature will display off.

Delay Velocity: The longitudinal velocity of the delay line, most commonly used with angle beam style probes, but also used with 90 degree compression probes. It's important to note that in order for this to be accurate, the 'probe zero' must be accurate. This is easily accomplished performing a two point calibration (auto cal).

Reference Type: This option enables the user to select the type of reflector that will be used during calibration and setup. The options are Back Wall, Flat Bottom Hole (FBH), or Side Drilled Hole (SDH).

Reference Size: Assuming the reference type selected is either FBH or SDH, the user will be required to enter the size of the reference reflector.

10.5 Attenuation Parameters

The attenuation section is setup to accommodate additional factors that can affect the accuracy of the amplitude or sound energy, considering different application scenarios. The following parameters are outline below:

DGS ATTENUATION	
DVK	0.6
MATERIAL LOSS	1.2
REFERENCE LOSS	0.2
TRANS LOSS	0.4
TCG DAC	DGS SET

DVK (Curvature Correction): If a V1/K1 or V2/K2 (A2/A4, IIW/Kidney) calibration standard is used as a reference reflector, the curved surface offers additional focus normally resulting in greater signal output. **DVK** is a correction to the gain, in order to simulate the amplitude generated from a flat back wall. This will typically result in an overall gain increase.

Material Loss: Used to correct for the attenuation (loss) of sound energy in the test material; in units of dB/in. or dB/meter. Should be considered during inspections where the sound has to travel long distances, or the material is very attenuative.

Reference Loss: Used to correction for the attenuation (loss) of sound energy in the calibration/reference standard; in units of dB/in. or dB/meter.

Transfer Loss: Correction factor to account for the loss of sound energy from surface condition/roughness or inadequate coupling between the transducer and test specimen. The surface condition of calibration/reference standards and actual material being tested in the field will typically vary. This is generally approximated based on the inspectors experience in the field. Units are dB/in., or dB/meter.

10.6 Creating a DGS Curve

This section provides a step by step procedure to create a **TCG** curve. Note: a two point calibration should be done prior to proceeding. Refer to **Chapter Five** for the calibration procedures. Also, if the **TRIG** function will be used, it should be setup prior to proceeding. Refer to **Chapter Six** for the setup procedure.

Setting DGS Parameters

DISTANCE GAIN	
DGS	ON
REF GAIN	OFF
TRIGGER CURVE	DGS
EFF PROBE DIA	0.500
PROBE FREQ	2.250
CURV SIZE(ERS)	0.200
ATTENUATION	OFF
DELAY VEL	0.1060
REF TYPE	SDH
REF SIZE	0.125
TCG DAC DGS SET	

Activating DGS

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **DGS** menu is highlighted and displaying the submenu items.
- 2) Press the **UP** and **DOWN** arrow keys multiple times to scroll through the submenu items until **DGS** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to toggle the **DGS** feature **ON**. The menu items should now become active and adjustable, as illustrated above.

Trigger Curve

- 1) Press the **UP** and **DOWN** arrow keys multiple times until **TRIGGER CURVE** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the curve options. When the correct curve is displayed, proceed to the next setting.

Effective Diameter

- 1) Press the **UP** and **DOWN** arrow keys multiple times until **EFF PROBE DIAMETER** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct diameter is displayed, proceed to the next setting.

- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys multiple times to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys multiple times to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the diameter is correctly displayed.
- 7) Press the **OK** key to set the **EFF PROBE DIAMETER** and return to the menu screen, or **ESC** to cancel entering the **EFF PROBE DIAMETER**.

Probe Frequency

- 1) Press the **UP** and **DOWN** arrow keys multiple times until **PROBE FREQUENCY** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct frequency is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys multiple times to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys multiple times to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the frequency is correctly displayed.
- 6) Press the **OK** key to set the **PROBE FREQUENCY** and return to the menu screen, or **ESC** to cancel entering the **PROBE FREQUENCY**.

Curve Size (ERS)

- 2) Press the **UP** and **DOWN** arrow keys multiple times until **ERS** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct **ERS** is displayed, proceed to the next setting.
- 2) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 3) Press the **UP** and **DOWN** arrow keys multiple times to scroll the highlighted value.
- 4) Press the **LEFT** and **RIGHT** arrow keys multiple times to scroll the digit locations.
- 5) Repeat steps **3 & 4** until the **ERS** is correctly displayed.
- 6) Press the **OK** key to set the **ERS** and return to the menu screen, or **ESC** to cancel entering the **ERS**.

Attenuation (All Parameters)

- 1) Press the **UP** and **DOWN** arrow keys multiple times until **ATTENUATION** is highlighted, followed by pressing the **ENTER** key to enter the **ATTENUATION** sub menu.
- 2) Press the **UP** and **DOWN** arrow keys multiple times to scroll the correct attenuation parameter is highlighted.
- 3) Press the **UP** and **DOWN** arrow keys multiple times until the desire attenuation parameter is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct value is displayed, proceed to the next parameter.
- 4) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 5) Press the **UP** and **DOWN** arrow keys multiple times to scroll the highlighted value.

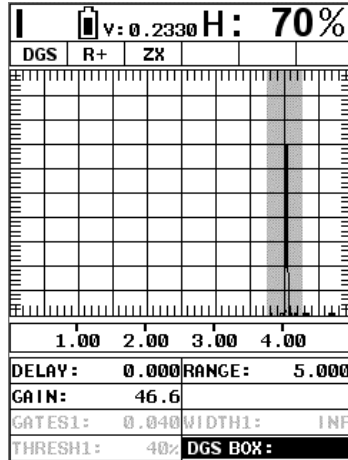
- 6) Press the **LEFT** and **RIGHT** arrow keys multiple times to scroll the digit locations.
- 7) Repeat steps **5 & 6** until the parameter value is correctly displayed.
- 8) Press the **OK** key to set the value and return to the **ATTENUATION** sub menu screen, or **ESC** to cancel entering the parameter value.

Drawing the DGS Curve

DISTANCE GAIN	
DGS	ON
REF GAIN	ON
TRIGGER CURVE	DGS
EFF PROBE DIA	0.500
PROBE FREQ	2.250
CURV SIZE(ERS)	0.200
ATTENUATION	OFF
DELAY VEL	0.1060
REF TYPE	SDH
REF SIZE	0.125
TCG DAC	DGS SET

- 1) Press the **UP** and **DOWN** arrow keys multiple times until **REFERENCE GAIN** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to toggle on. With all the parameters set in the previous section, press the **MEAS** key to return to the main measurement screen.

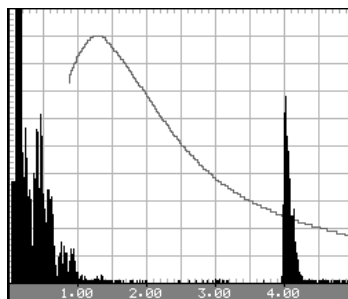
Note: The user should now see a highlighted cursor displayed in the waveform area, starting at the left most side of the display. Also note that the **DGS BOX** will be highlighted in the hot menus on the right of the display.



- 2) Couple the transducer to the first calibration standard, and peak up on the reflector, adjusting the gain to keep the signal height within the boundaries of the waveform display area, and at a suitable height to allow for attenuation at greater depths in the overall range to be tested.
- 3) Press the **LEFT** and **RIGHT** arrow keys to move the cursor over the waveform that will be used to set the **REFERENCE GAIN** and draw the **DGS** curve.

Note: The **DGS** curve uses 16 points to plot the curve.

- 4) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **DGS** menu is highlighted and displaying the submenu items. Alternatively, press the **LEFT** and **RIGHT** arrow keys multiple times using the left button wheel.



5) Press the **UP** and **DOWN** arrow keys multiple times until **REFERENCE GAIN** is highlighted, followed by pressing the **LEFT** and **RIGHT** arrow keys to toggle **OFF**. The **DGS** curve is now set and ready to be used for inspection.

CHAPTER ELEVEN ADDITIONAL FEATURES OF THE DFX-7

11.1 Pulse Width

The **DFX-7** has a square wave pulser with adjustable pulse width option. Pulse width, refers to the duration of time the pulser is left on. This time results in increased energy sent into the test material. There are three width options (**SPIKE**, **THIN**, and **WIDE**). The **SPIKE** setting may be desirable for high resolution and general applications to decrease the overall noise. When additional energy is needed, more penetration, the **THIN** and **WIDE** options may be necessary. The standard setting is **THIN**. The procedure to change the pulse width is outlined below:

Selecting the Pulse Width

SETUP PROBE	
TYPE	SINGLE
PULSE	THIN
MAX PRF	333
DAMPING	600
PULSER VOLT	200
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **TUNE** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **PULSE** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to scroll the **Pulse** options.
- 4) Once the **Pulse** is displayed, press the **MEAS** key to return to the measurement screen.

11.2 Pulse Repetition Frequency (PRF)

The **DFX-7** is equipped an adjustable pulse repetition rate, with adjustable settings of 8, 16, 32, 66, 125, 250, and 333Hz. The primary purpose is to control how fast the pulser is firing. The repetition rate is tied into the alarm LEDS. Therefore, when scanning at higher speeds, a higher repetition rate will make the alarm trigger more responsive. It's important to note that since the screen has a maximum refresh rate of 120Hz, or draws at 120 times a second, any **PRF** settings over this maximum will not be visible on the display. In fact, the human eye has a response rate of less than 60Hz.

The **PRF** setting will automatically be overridden according to the range set by the user. Long range settings will slow the **PRF** down automatically. Slower **PRF** settings will save on battery life. Therefore, if your current application doesn't call for fast scanning speeds, you can save battery life by selecting a slower **PRF**. The procedure to change the **MAX PRF** setting is outlined below:

Setting the Max PRF

SETUP PROBE	
TYPE	SINGLE
PULSE	THIN
MAX PRF	333
DAMPING	600
PULSER VOLT	200
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **PRB** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **MAX PRF** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to scroll the **PRF** options.

- 4) Once the desired **PRF** is displayed, press the **MEAS** key to return to the measurement screen.

11.3 Damping

The **DFX-7** has an adjustable damping feature, enabling the user to select from a variety of settings according to the transducer frequency and overall output. The range of the damping feature is 50-1500 ohms. The available steps are 50, 75, 100, 300, 600 and 1500 ohms. Lower frequency transducers require less damping because they typically have higher impedance and distort. The reverse is true for higher frequency transducers. Nevertheless, trial and error with this feature will enable you to find the optimal signal response and setting for your transducer. The procedure to change the **DAMPING** is outlined below:

Selecting the Damping

SETUP PROBE	
TYPE	SINGLE
PULSE	THIN
MAX PRF	125
DAMPING	600
PULSER VOLT	200
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **PRB** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DAMPING** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to scroll the **DAMPING** options.

- 4) Once the desired **DAMPING** is displayed, press the **MEAS** key to return to the measurement screen.

11.4 Pulsar Voltage

The **DFX-7** has a 200 volt square wave pulser that can be adjusted for specific applications and transducers. The Pulsar Volt feature offers a 50 volt cut/boost option to the user. The standard setting is 200 volts. This enables the **DFX-7** to offer greater penetration for difficult material types, or increased resolution on noisy materials. The procedure to change the pulser voltage is outlined below:

Changing the Pulsar Voltage

SETUP PROBE	
TYPE	SINGLE
PULSE	THIN
MAX PRF	333
DAMPING	600
PULSER VOLT	200
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **TUNE** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **PULSER VOLT** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to scroll the **PULSER VOLT** options.
- 4) Once the desired **Pulsar Voltage** is displayed, press the **MEAS** key to return to the measurement screen.

11.5 Material Velocity Charts

The **DFX-7** has two material velocity charts built into the gauge with both longitudinal and shear material velocities. It should be noted that in order to display the chart containing the shear wave velocities the **TRIG** mode must be activated, as we've assumed an angle beam transducer will be used for the inspection process. The procedure is listed below:

Selecting a Basic Material Type

CALIBRATE	
MAT	STEEL (1020)
MATL 1PT	UNCAL
MATL 2PT	UNCAL
VELOCITY	0.2320
ZERO	0.000
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **MAT** is highlighted.

MATL TYPE	
17. MOLYBDENUM	0.2460
18. MONEL	0.2110
19. NICKEL	0.2220
20. NYLON	0.1860
21. PLATINUM	0.1560
22. PLEXIGLASS	0.1860
23. POLYSTYRENE	0.0920
24. PYC	0.0940
25. QUARTZ GLASS	0.2260
26. RUBBER, VULCAN	0.0910
27. SILVER	0.1420
28. STILL IRON	0.2330
29. STEEL <4340>	0.2330
30. STEEL, STAIN.	0.2230
31. TEFLON	0.0540
32. TIN	0.1310
< MORE >	

- 3) Press the **ENTER** key to display the list of material types.
- 4) Press the **UP** and **DOWN** arrow keys to scroll through the material list until the appropriate material is highlighted.
- 5) Press the **ENTER** key to overwrite the material type and display the menu items with the new material type selected.
- 6) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

11.6 Material Velocity

The **DFX-7** has a built in feature to manually adjust the material velocity to a know value in the calibration section of the **DFX-7**. It should be noted that this does not calculate the zero value like the two point calibration option does. Therefore, if the material velocity is changed you should check the calibration. The procedures for adjusting the velocity are outlined below:

Adjusting Velocity

CALIBRATE	
MAT	STEEL (4340)
MATL 1PT	UNCAL
MATL 2PT	UNCAL
VELOCITY	0.2330
ZERO	0.000
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **VELOCITY** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct velocity value is being displayed, **proceed to step 8**.
- 4) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 5) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 6) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 7) Repeat steps **5 & 6** until the velocity value is correctly displayed.
- 8) Press the **OK** key to set the velocity and return to the menu screen, or **ESC** to cancel entering the velocity.
- 9) Finally, press the **MEAS** key to return to the measurement screen.

11.7 Zero

The **DFX-7** has a feature to manually adjust the electronic zero. This feature used in conjunction with manually adjusting the velocity, are the primary features necessary

to perform a 'crude' manual screen calibration. The procedure for adjusting the zero is listed below:

Adjusting Zero

CALIBRATE	
MAT	STEEL (1020)
MATL 1PT	UNCAL
MATL 2PT	UNCAL
VELOCITY	0.2320
ZERO	0.000
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ZERO** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct zero value is being displayed, **proceed to step 8**.
- 4) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 5) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
- 6) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
- 7) Repeat steps **5 & 6** until the zero value is correctly displayed.

- 8) Press the **OK** key to set the zero and return to the menu screen, or **ESC** to cancel entering the zero.
- 9) Finally, press the **MEAS** key to return to the measurement screen.

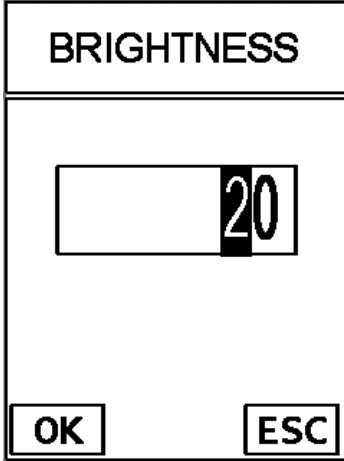
11.8 Brightness

The **DFX-7** is equipped with a brightness feature to adjust the display visibility and optimize battery life. It has an arbitrary scale with a values from 1-20, with 20 representing the brightest setting. The procedures for adjusting the brightness are outlined below:

Adjusting Brightness

SET DISPLAY	
VIEW	DIGITS
DELAY	0.730
RANGE	1.820
B-SCAN SPEED	6
UNITS	IN HR
BRIGHTNESS	20
COLORS	BLACK/WHITE
LANDSCAPE	LT HAND
DIM	240 SEC
RECT WAVE	FILLED
DETECT MARK	DOTS
PRB	CAL
DISP	TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **BRIGHTNESS** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct brightness value is being displayed, **proceed to step 8**.



4) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.

5) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.

6) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.

7) Repeat steps **5 & 6** until the brightness number is correctly displayed.

8) Press the **OK** key to set the brightness and return to the menu screen, or **ESC** to cancel entering the brightness.

9) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

11.9 Color Scheme

The **DFX-7** has a variety of display color options to select from. These will change the look and feel of the according to the users preference. The procedures for changing the **VIEW**, are outlined below:

Selecting a Color Scheme

SET DISPLAY	
VIEW	+RECT
DELAY	0.129
RANGE	0.229
UNITS	IN
BRIGHTNESS	20
COLORS	NONE W/B
DIM	OFF
RECT WAVE	OUTLINE
DETECT MARK	LINE
PRB	CAL
DISP	TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **VIEW** is highlighted.

SELECT COLOR	
1.	GREEN 1
2.	GREEN 2
3.	RED 1
4.	RED 2
5.	BLUE 1
6.	BLUE 2
7.	YELLOW 1
8.	YELLOW 2
9.	PURPLE 1
10.	PURPLE 2
11.	PURPLE 3
12.	NONE B/W
13.	NONE W/B

- 3) Press the **ENTER** key to display a list of the color scheme options.
- 4) Press the **UP** and **DOWN** arrow keys to scroll through the material list until the appropriate material is highlighted.
- 5) Press the **ENTER** key, followed by pressing the **OK** key, to overwrite the current color scheme with the selected scheme.

- 6) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

11.10 Landscape

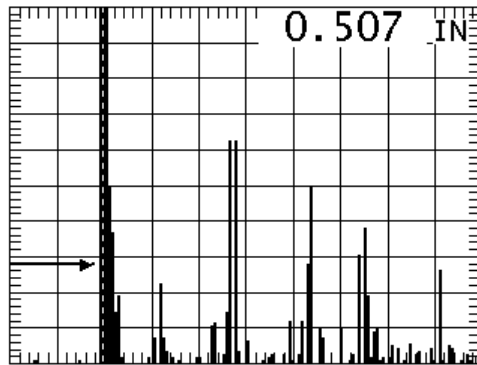
The **DFX-7** is a very portable and compact gauge with a 2.7" AMOLED display that is used in a portrait mode as standard. In order to maximize the viewable A-Scan area of the display, the orientation of the display can be rotated to a landscape view for either right or left hand use. Just the A-Scan waveform portion will be expanded to include the entire 2.7" AMOLED display, improving the overall visibility during inspections. The procedures for enabling **LANDSCAPE** and toggling between portrait and landscape views are outlined below:

Setting Landscape Option

SET DISPLAY	
VIEW	RF
DELAY	0.730
RANGE	1.820
B-SCAN SPEED	6
UNITS	IN HR
BRIGHTNESS	20
COLORS	BLACK/WHITE
LANDSCAPE	LT HAND
DIM	240 SEC
RECT WAVE	FILLED
DETECT MARK	DOTS
PRB	CAL
DISP	TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **LANDSCAPE** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to scroll the **LANDSCAPE ON/RT HAND/LT HAND** options.

- 4) Press the **MEAS** key to return to the measurement screen in standard portrait view.



- 5) Press the **OK** key to rotate the screen to **LANDSCAPE** view.

Note: Portrait and Landscape modes are quickly toggled by using the **OK** and **MEAS** keys. If a measurement mode with multiple values is enabled, like PECT, more than one measurement value is typically displayed in portrait mode. However in **LANDSCAPE** view, only one value will be displayed to avoid too much interference with the A-Scan waveform. Pressing the **OK** key multiple times will toggle through all of the measurement available for display.

11.11 DIM

The **DFX-7** has a built-in **DIM** feature to manage power more effectively. This feature has adjustable time durations, until the power of the display is dimmed and current draw reduced. The timer is constantly reset while the user is making measurements, and is only activated when the gauge is idle for the duration of time the **DIM** value is set for. This feature does not override the preset 5 min idle power off feature in any way. However, if the gauge is turned on, set for a DIM of 120sec, and then left idle for 5 minutes, the **DFX-7** will dim in 2 minutes, then power off in 5 minutes. The procedures for adjusting the **DIM** time are outlined below:

Setting a DIM time

SET DISPLAY	
VIEW	RECTFW
DELAY	0.000
RANGE	5.000
UNITS	IN
BRIGHTNESS	20
COLORS	BLACK/WHITE
LANDSCAPE	RT HAND
DIM	90 SEC
RECT WAVE	FILLED
DETECT MARK	DOTS
PRB CAL	DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DIM** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to scroll the **DIM** time.
- 4) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

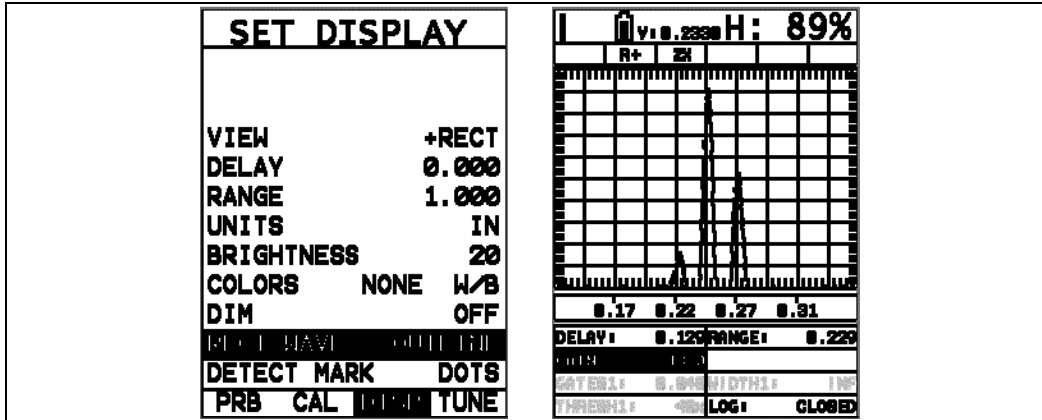
11.12 Graphics Options (look & feel)

The **DFX-7** includes a couple of cosmetic features for user preference when viewing the waveform. These features only serve as cosmetic items, and do not change the functionality of the **DFX-7** in any way.

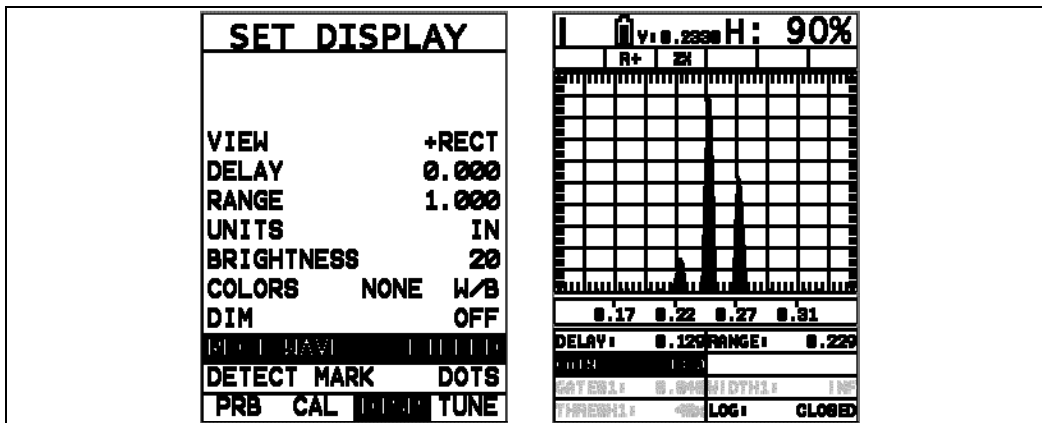
RECT Wave:

The rectified wave feature, is only functional when using **RECT** wave view, and provides the user the following display options:

Outline – Draws the unfilled outline of the waveform.



Filled – Draws a filled version of the waveform.



The procedure to select the look and feel option is outlined below:

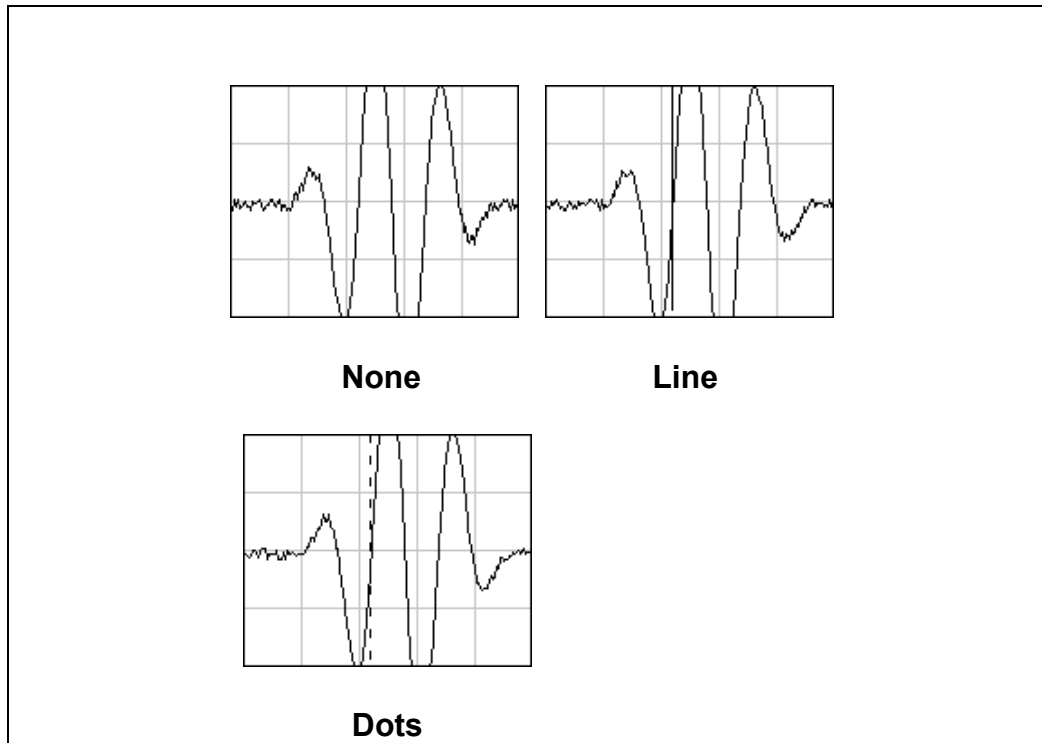
Setting the Look & Feel

SET DISPLAY	
VIEW	RECTFW
DELAY	0.000
RANGE	5.000
UNITS	IN
BRIGHTNESS	20
COLORS	BLACK/WHITE
LANDSCAPE	RT HAND
DIM	90 SEC
RECT WAVE	OUTLINE
DETECT MARK	DOTS
PRB CAL	DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **RECT WAVE** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to scroll the **RECT WAVE** options.
- 4) Once the **RECT WAVE** is displayed, press the **MEAS** key to return to the measurement screen.

11.13 Detect Mark

Another look and feel option of the **DFX-7** is the **DETECT MARK** feature. The detect mark give the user the option to select: **none**, **line**, **dots**, or **box**. Depending on the select made, an indication will be displayed on the waveform, showing where the detection is occurring. It should be noted that the “box” option will only be visible in **RF** view. The following screenshots illustrate the above selection options:



11.14 Filters (Wide & Narrow Bands)

There are two versions of the **DFX-7** series: **DFX-7** and **DFX-7+**. The **DFX-7** is a wide band only gauge, which includes a single wide band filter with a range of **1.8MHz** to **19MHz**. The **DFX-7+** includes the same wide band filter, but also includes a few narrow band filter options at **2MHz**, **5MHz** and **10MHz**. The wide band option is responsive to all signals within the given frequency range. However, narrow band filters eliminate signals outside of the target filter frequency, and focus on the output of the transducer at the specified frequency. The procedure to change the **DAMPING** is outlined below:

Selecting the Damping






TUNE SIGNAL	
FILTERS	2MHz
GAIN	40.0
GAIN STEP	1.0
DETECT MODE Z-CROSS	
PRB	CAL DISP TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **TUNE** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **FILTERS** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to scroll the **FILTERS** options.
- 4) Once the desired **FILTERS** is displayed, press the **MEAS** key to return to the measurement screen.

11.15 Gain Step Size

Adjusting Gain Step Size

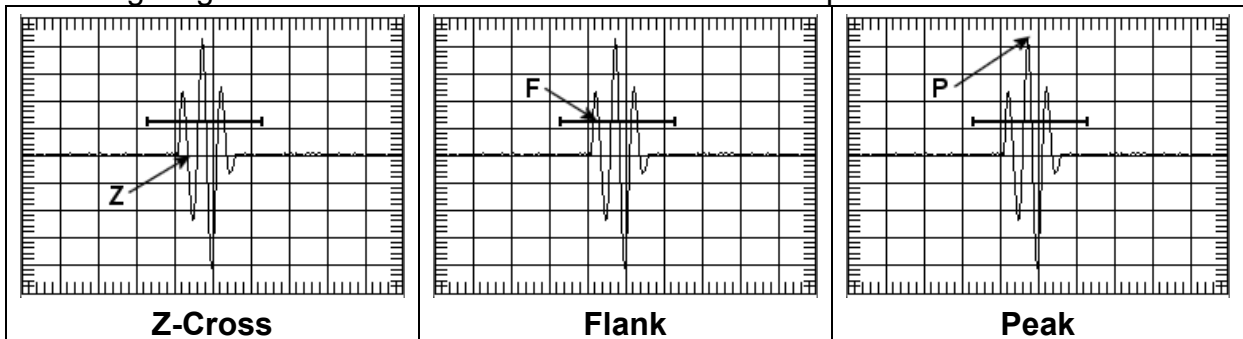
TUNE SIGNAL	
FILTER	2MHZ
GAIN	40.0
GAIN STEP	1.0
DETECT MODE	Z-CROSS
PRB CAL DISP	TUNE

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **TUNE** menu is highlighted and displaying the submenu items.
Alternatively, press the  **LEFT** and **RIGHT** arrow keys multiple times using the left button wheel.
- 2) Use the  **UP** and **DOWN** arrow keys multiple times on the left button wheel to scroll through the sub menu items until **GAIN STEP** is highlighted.
- 3) Press the  **LEFT** and **RIGHT** arrow keys multiple times using the left button wheel to scroll the value. When the correct step size is being displayed, **proceed to step 8**.
- 4) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
- 5) Press the  **UP** and **DOWN** arrow keys multiple times on the left button wheel to scroll the highlighted value.
- 6) Press the  **LEFT** and **RIGHT** arrow keys multiple times using the left button wheel to scroll the digit locations.
- 7) Repeat steps **5 & 6** until the zero value is correctly displayed.
- 8) Press the **OK** key to set the gain step and return to the menu screen, or **ESC** to cancel entering the gain step.

9) Finally, press the **MEAS** key to return to the measurement screen.

11.16 Detect Modes

The **DFX-7** has three selectable modes of detection: Z-Cross, Flank, and Peak. The following diagram illustrates the difference between the options:



Refer to the diagrams above. The current polarity is positive, as shown by the position of the gate above the baseline:

Z-Cross: The detection occurs as the first positive half cycle crosses the baseline and goes negative.

Flank: The detection occurs as the first half cycle left edge rises and breaks the threshold.

Peak: The detection occurs at the highest peak in the gate.

The procedure to select the **DETECT MODE** is outlined below:

Selecting the Detect

TUNE SIGNAL

FILTERS **WIDE**

GAIN **40.0**

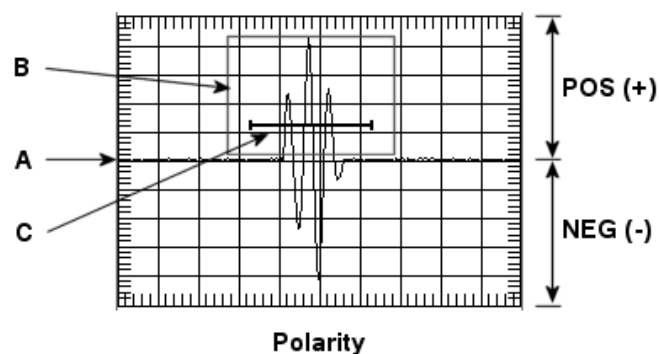
DETECT MODE **Z-CROSS**

PRB **CAL** **DISP** **TUNE**

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **TUNE** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DETECT MODE** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to scroll the **DETECT** options.
- 4) Once the **DETECT** is displayed, press the **MEAS** key to return to the measurement screen.

11.17 Polarity

The **DFX-7** has a number of features and views that offer selectable polarity. The important thing to note is the polarity view is entirely different than the polarity selection of a gate. If a polarity view of **+RECT** is selected, only the positive portion of the waveform will be shown on the screen. If a positive polarity is then selected for **GT1**, not only will the gate be displayed on the screen, it will only detect on the positive going cycles of the waveform. Polarity is selectable according to the **VIEW**, **GT1**, **GT2**, and **DAC**. Again, view corresponds only to what portion of the waveform is displayed, positive or negative, and the other three options are primarily associated with where the detect occurs. Finally, if the view is set to **RF**, the entire waveform cycle will be displayed, both positive and negative. Refer to the diagram below:



The diagram above is an **RF** view, showing both the positive and negative going cycles for purposes of explanation. Notice the +/- positions in the diagram. The positive phase is everything above the horizontal center line, and the negative

everything below the center line. The baseline is found at position **(A)**, and considered zero dB. If **+RECT** was selected as the view, only the positive portion of the waveform would be displayed. Equally, if the gate polarity was set to positive, as in the diagram at **(C)**, it would also appear on the display. However, if it was set to negative, would not appear on the display. In the example above, the gate is set to positive and will detect on the positive going waveform cycles shown in the box **(B)**.

Toggle Polarity (+/-)

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th colspan="2" style="text-align: center;">SET DISPLAY</th></tr> <tr><td colspan="2" style="text-align: center;">VIEW</td></tr> <tr><td>DELAY</td><td style="text-align: right;">0.000</td></tr> <tr><td>RANGE</td><td style="text-align: right;">1.000</td></tr> <tr><td>UNITS</td><td style="text-align: right;">IN</td></tr> <tr><td>BRIGHTNESS</td><td style="text-align: right;">20</td></tr> <tr><td>COLORS</td><td style="text-align: right;">NONE W/B</td></tr> <tr><td>DIM</td><td style="text-align: right;">OFF</td></tr> <tr><td>RECT WAVE</td><td style="text-align: right;">OUTLINE</td></tr> <tr><td>DETECT MARK</td><td style="text-align: right;">DOTS</td></tr> <tr><td>PRB CAL</td><td style="text-align: right;">TUNE</td></tr> </table>	SET DISPLAY		VIEW		DELAY	0.000	RANGE	1.000	UNITS	IN	BRIGHTNESS	20	COLORS	NONE W/B	DIM	OFF	RECT WAVE	OUTLINE	DETECT MARK	DOTS	PRB CAL	TUNE	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th colspan="2" style="text-align: center;">DAC SETTINGS</th></tr> <tr><td colspan="2" style="text-align: center;">DAC</td></tr> <tr><td>DRAW</td><td style="text-align: right;">OFF</td></tr> <tr><td>MEAS</td><td style="text-align: right;">xDAC</td></tr> <tr><td>CURVE</td><td style="text-align: right;">DAC</td></tr> <tr><td>TRIGGER</td><td style="text-align: right;">DAC</td></tr> <tr><td colspan="2" style="text-align: center;">POLARITY</td></tr> <tr><td>TCG</td><td style="text-align: right;">DGS SET</td></tr> </table>	DAC SETTINGS		DAC		DRAW	OFF	MEAS	xDAC	CURVE	DAC	TRIGGER	DAC	POLARITY		TCG	DGS SET
SET DISPLAY																																							
VIEW																																							
DELAY	0.000																																						
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POLARITY																																							
GT1	GT2 TRIG AWS																																						

Note: The screenshots above show where all the possible locations for polarity selection are found in the *DFX-7*. For more information on the above, refer to the sections on **VIEW**, **DAC**, **GT1**, & **GT2**.

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left,

until the **DISP**, **DAC**, **GT1**, or **GT2** menu is highlighted and displaying the submenu items.

- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **VIEW**, **DPOLARITY**, **POLARITY1**, or **POLARITY2** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to toggle the **VIEW**, **DPOLARITY**, **POLARITY1**, or **POLARITY2** negative or positive.
- 4) Press the **MEAS** key to return to the measurement screen and begin taking readings.

11.18 Auto Find

The **DFX-7** is equipped with a very handy feature for locating the detection point of a return echo that is not currently in the viewable region of the display. The **AUTO FIND** feature is a convenient way to automatically bring the detected echo into view on the display. Once the echo is in the viewable area, the user can then make small adjustments to the delay and range accordingly. The procedure to use the **AUTO FIND** feature is outlined below:

Using Auto Find

UTILITIES	
AUTO FIND	
COMPARE	OFF
SET DATE	MMDDYY
SHOW DATE	OFF
KEY CLICK	QUIET
GAUGE	FLAW MODE
DATA	UTIL XFER

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **UTIL** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **AUTO FIND** is highlighted.
- 3) Place the transducer on the test material and obtain a reading.
- 4) Press the **ENTER** key to automatically adjust the display settings and bring the waveform into view.
- 5) Once the signal is displayed, press the **MEAS** key to return to measurement mode.

11.19 Compare

Activating and Using Compare

UTILITIES	
AUTO FIND	
COMPARE	OFF
SET DATE	MMDDYY
SHOW DATE	OFF
KEY CLICK	QUIET
GAUGE	FLAW MODE
DATA	UTIL XFER

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **UTIL** menu is highlighted and displaying the submenu items.

2) Use the **UP** and **DOWN** arrow keys to scroll through the submenu items until **COMPARE** is highlighted.

3) Use the **LEFT** and **RIGHT** arrow keys to toggle **COMPARE** on/off.

Note: The **COMPARE** feature now overrides the **PEAK** multi-mode submenu item and its functions while activated.

4) Press the **MEAS** key to return to the measurement screen.

5) Acquire the waveform of the sample flaw on the display and press the **MULTI MODE** key to display the submenu items.

6) Use the **UP** and **DOWN** arrow keys to scroll through the submenu items until **PEAK** is highlighted.

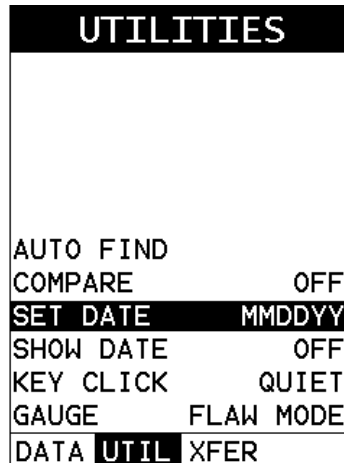
7) Press the **ENTER** key to freeze and send it to the background on the display in another color.

Note: Pressing **MULTI MODE** followed by **ENTER** again will clear the display.

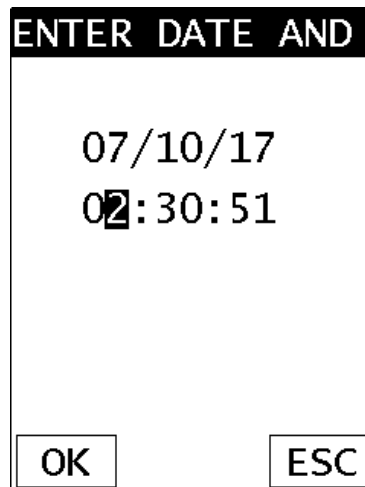
11.20 Set Date & Time

The **DFX-7** is equipped with an internal clock to time and date stamp the log, setup and screen capture files for reporting/documentation purposes. The procedures for setting the time and date are outlined below:

Setting Date & Time



- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **UTIL** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **SET DATE** is highlighted.



- 3) Press the **ENTER** key to display the **Digits Edit Box**.
- 4) Press the **UP, DOWN, LEFT, & RIGHT** arrow keys to scroll the field locations.
- 5) Press the **LEFT** and **RIGHT** arrow keys multiple times to scroll the value.
- 6) Repeat steps **4 & 5** until the **Time & Date** is correctly displayed.

- 7) Press the **OK** key to set the **Time & Date** and return to the menu screen, or **ESC** to cancel entering the **Time & Date**.
- 8) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

11.21 Show Date & Time

The **DFX-7** can be configured to show the date & time in the active A-Scan window as needed or preferred (off/date/time/both). The procedure for activating and displaying the above options are outlined below:

<u>Live Time & Date</u>	
UTILITIES	
AUTO FIND	
SCAN MODE	OFF
ALARM	OFF
ALARM HIGH	1.000
ALARM LOW	0.000
DIFFERENTIAL	OFF
GAUGE THICKNESS	
KEY CLICK	QUIET
SET DATE	MMDDYY
SHOW DATE	BOTH
DATA UTIL XFER	

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **UTIL** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **SHOW DATE** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys multiple times to scroll the options (Date, Time, Both, Off).

- 4) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

11.22 Key Click

Selecting the Detect

UTILITIES	
AUTO FIND	
COMPARE	OFF
SET DATE	MMDDYY
SHOW DATE	BOTH
KEY CLICK	QUIET
GAUGE	FLAW MODE
DATA	UTIL XFER

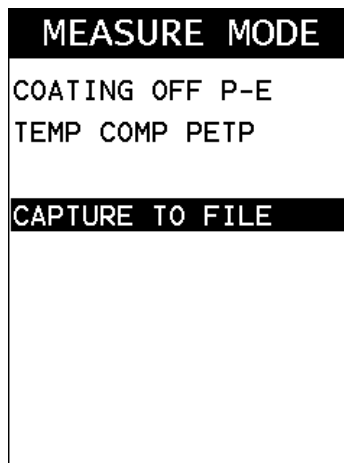
- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **UTIL** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **KEY CLICK** is highlighted.
- 3) Use the **LEFT** and **RIGHT** arrow keys to toggle the **KEY CLICK** loud/quiet/off.
- 4) Press the **MEAS** key to return to the measurement screen.

11.23 Freeze & Capture

The **DFX-7** freeze feature enables a user to immediately freeze what's currently being displayed on the screen for further review or analysis. The freeze feature used

in conjunction with the capture feature enables a user to save the entire screen shot directly to a .tif (tagged image) file format that can be opened using any graphics viewer. With the storage capacity of the **DFX-7** the user can store as many screens shots as needed. It should also be mentioned that this feature is immediately activated on boot up. Therefore all the menus items, list boxes and edit screens can also be captured for presentation or training purposes. The procedure to freeze and capture the display is outlined below:

Capturing Screen Shots



- 1) To capture a file, press the **MULT MODE** key to freeze the screen and enter the measure mode menu.
- 2) Press the **UP** and **DOWN** arrow keys multiple times until **CAPTURE TO FILE** is highlighted.

CAPTURE NAME

0123456789
 !' _# / . - ()
 ABCDEFGHIJ
 KLMNOPQRST
 UVWXYZ

CAPTURE

OK ESC

3) Press the **ENTER** key to display the alpha numeric edit box to name and save the screen shot.

4) Press the **MEAS** key to return to the measurement screen.

11.24 Peak Hold

The **DFX-7** includes a peak hold feature that draws and saves the maximum waveform amplitude on the screen. This allows an inspector to move the transducer in all directions, in an effort to “peak up” on a signal, and locate the maximum amplitude. The following procedure outlines the steps to activate and use the **PEAK** hold feature:

Activating Peak

FLAW MODE

1. NORMAL
2. PEAK
 3. FREEZE

- 1) Press the **MULTI MODE** key located in the bottom left corner of the keypad to display the mode options.
- 2) Use the **UP** and **DOWN** arrow keys **PEAK** is highlighted.
- 3) Press the **MEAS** key to return to the measurement screen.

Clearing Current Wave Draw

Note: At any point during a **PEAK** scan the operator may opt to clear the wave drawing and start over.

- 1) Press the **CLR** key at any time to clear the currently displayed waveform, and continue the scanning process.

Disabling PEAK

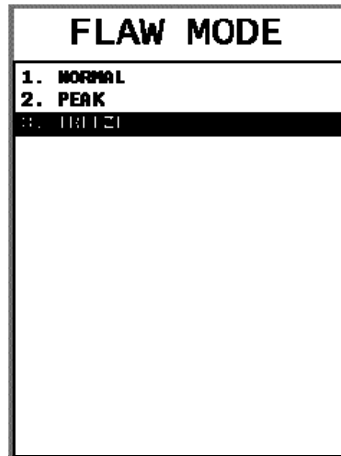
Note: In order to deactivate the **PEAK** hold feature.

- 1) Press the **MULTI MODE** key located in the bottom left corner of the keypad to display the mode options.
- 2) Use the **UP** and **DOWN** arrow keys **NORMAL** is highlighted.
- 3) Press the **ENTER** key to set the mode and automatically return to the measurement screen.

11.25 Freeze Waveform

The **DFX-7** also includes a **FREEZE** feature that allows an operator the ability to freeze the current waveform being display on the screen at anytime. Once the operator freezes the waveform, the transducer can be removed from the test material. The following procure outlines the steps to activate and use the **FREEZE** feature:

Activating Freeze



Note: Assuming the operator currently has a waveform that they'd like to freeze on the display.

- 1) Press the **MULTI MODE** key located in the bottom left corner of the keypad to display the mode options.
- 2) Use the **UP** and **DOWN** arrow keys **FREEZE** is highlighted.
- 3) Press the **ENTER** key to set the mode and automatically return to the measurement screen.

Disabling Freeze

Note: In order to deactivate the **FREEZE** feature.

- 3) Press the **MULTI MODE** key located in the bottom left corner of the keypad to display the mode options.
- 4) Use the **UP** and **DOWN** arrow keys **NORMAL** is highlighted.
- 5) Press the **ENTER** key to set the mode and automatically return to the measurement screen.

CHAPTER TWELVE

DATA STORAGE – SETUP, EDIT, & VIEW FILES

12.1 Introduction to Grid and Sequential file formats

The **DFX-7** is equipped with two data file format options, **GRID LOG** and **SEQ LOG**. The **GRID** file format is very similar to a spreadsheet format found in popular software programs like Excel. A **GRID** is simply a table of readings. A location in a grid is specified by giving a row and column coordinate. The rows are numbered from 1 to 999 and the columns are labeled from A to ZZ (999 Rows & 52 Columns). The sequential file format can be viewed as a file as a single column of up to 512 possible rows (readings), and a column of corresponding identifiers associated with each individual reading. The identifier can be a combination of up to 10 numeric, alpha, or special characters listed above, while the file name can consist of a combination of up to 20 of the same character set. Note: *The identifier cannot start or end with a special character.* Once a start and end ID are entered into the **DFX-7** and the log created, the **DFX-7** will automatically generate all the identifiers within that range.

The following character set listed below are all the allowable characters that will be used for both file formats: **GRID & SEQ LOG**. Any combination of these characters can be used for creating a Name and Note regardless of the selected format. The allowable characters are as follows:

Numeric characters: 0 – 9 **Alpha Characters:** A – Z

Special Characters: ! ' _ # space / . - ()

Multiple grids can be created and stored until the **DFX-7**'s memory is full. If the user attempts to store a new file in the **DFX-7** and the size of the file exceeds the capacity of memory, the **DFX-7** will respond with an error message indicating that the memory is unable to store the new file.

The **DFX-7** is equipped with a 4Gb internal SD card and capable of storing a great deal of data/setup files, as well as screen captures. Each measurement is stored with a with a corresponding screenshot of the **RF** or **RECT** views with every reading, as well as all the **DFX-7** settings for every individual reading. The snapshot stored with the reading will depend on what view the **DFX-7** was in at the time it was saved. For example, if the view was in **RECT**, then a **RECT** will be saved with the reading.

In the sections that follow, the procedures for creating, using, and editing **GRID's** and **SEQ LOG's** have been combined together for the purpose of similarity in overall functionality and structure. The illustrations below are snapshots of typical **GRID** and **SEQ LOG** file formats:

Grid File Formats

NAME: EX#1				NAME: EX#2			
	A	B	C		D	E	F
1				6			
2				7			
3				8			
4				9			

Sequential Log Formats

NAME: EX#1		NAME: EX#2	
AA		01	
AB		02	
AC		03	
AD		04	
AE		05	

NAME: EX#3		NAME: EX#4	
3A		BCD-4-01	
3B		BCD-4-02	
3C		BCD-4-03	
3D		BCD-4-04	
3E		BCD-4-05	

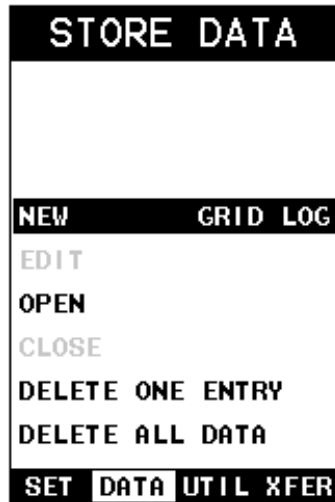
Important Note: For the duration of this chapter, all references to **GRIDS** and **SEQ LOGS** should be considered synonymous with references to **FILES**.

12.2 Creating a new Grid or Sequential Log (File)

Important Note: This entire section is a step by step guide to successfully create a grid or sequential log. The instructions must be used in the sequential order specified, as follows:

Creating a Name

Grid/Seq Log Name : Can contain a combination of up to 20 numeric, alpha, or special characters listed in the first section of this chapter.



Grid Log



Sequential Log

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **DATA** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **NEW** is highlighted.
- 3) Press the **LEFT & RIGHT** arrow keys to toggle the data formats – **GRIG LOG & SEQ LOG**.

NEW GRID LOG	
NAME: BOILER 34	
NOTE:	
TOP LEFT:	A001
LOWER RIGHT	C050
INCR. DIR:	EAST
SAVE GRAPHICS	NO
CREATE GRID?	
GRID SIZE:	150

Grid Log

NEW SEQ LOG	
NAME: BOILER 34	
NOTE: INSP#99	
START:	B001
END ID:	01
DIRECTION:	NONE
SAVE GRAPHICS	NO
CREATE LOG	
LOG SIZE:	0

Sequential Log

- 4) Press the **ENTER** key to display the new **Grid** or **Seq Edit Box**.
- 5) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid** or **Seq List Items** until **NAME** is highlighted.

LOG NAME
0123456789
! ' _ # / . - ()
ABCDEFGHIJ
KLMNOPQRST
UVWXYZ
BOILER 34

OK

ESC

- 6) Press the **ENTER** key to activate the **Alpha Edit Box**.
- 7) Use the **UP**, **DOWN**, **LEFT**, & **RIGHT** arrow keys to highlight the appropriate alpha characters.
- 8) Press the **ENTER** key to select a character and advance to the next field of the **Grid** or **Seq Name**.

- 9) Use the **CLR** key to backspace if necessary.
- 10) Repeat steps **6 - 9** until the **Grid** or **Seq Name (File Name)** is completed.
- 11) Press the **OK** key to save the **Grid** or **Seq Name** and return to the **Grid** or **Seq List Items** menu, or **ESC** to cancel entering the **Grid** or **Seq Name (File Name)**.

Creating a Note

Grid/Seq Log Note: Can contain a combination of up to 20 numeric, alpha, or special characters listed in the first section of this chapter.

NEW GRID LOG	
NAME: BOILER 34	
NOTE: INSP#99	
TOP LEFT:	A001
LOWER RIGHT	A001
INCR. DIR:	NONE
SAVE GRAPHICS	NO
CREATE GRID?	
GRID SIZE:	1

Grid Log

NEW SEQ LOG	
NAME: BOILER 34	
NOTE: INSP#99	
START:	B001
END ID:	01
DIRECTION:	NONE
SAVE GRAPHICS	NO
CREATE LOG	
LOG SIZE:	0

Sequential Log

- 1) Assuming the **Grid** or **Seq** List Items are displayed, use the **UP** and **DOWN** arrow keys to scroll through the new **Grid** or **Seq List Items** until **NOTE** is highlighted.
- 2) Press the **ENTER** key to activate the **Alpha Edit Box**.

LOG NOTE

0123456789
 ! ' _ # █ / . - ()
 ABCDEFGHIJ
 KLMNOPQRST
 UVWXYZ

INSP#99 █

OK

ESC

- 3) Use the **UP, DOWN, LEFT, & RIGHT** arrow keys to highlight the appropriate alpha characters.
- 4) Press the **ENTER** key to select a character and advance to the next field of the **Grid** or **Seq Note**.
- 5) Use the **CLR** key to backspace if necessary.
- 6) Repeat steps **3** through **5** until the **Grid** or **Seq Note** is completed.
- 7) Press the **OK** key to save the **Grid** or **Seq Note** and return to the **Grid** or **Seq List Items** menu, or **ESC** to cancel entering the **Grid** or **Seq Note**.

Setting the Coordinates or Start & Stop ID's

Grid: A grid is defined by using coordinates to define the **Top Left** and the **Bottom Right** corners of the grid. Alpha coordinates are horizontal across the top, and numeric coordinates are vertical down the side. Therefore, to define the top left corner of the grid, there will be an (X,Y) coordinate. Where X is an alpha column location across the top and Y is a numeric row location down the side. Use the same logic when choosing the lower right corner. An individual grid can be up to 999 rows and 52 columns.

Sequential: The sequential file format can be viewed as a file as a single column of up to 512 possible rows (readings), and a column of corresponding identifiers associated with each individual reading. The identifier can be a combination of up to 10 numeric, alpha, or special characters listed above, while the file name can consist of a combination of up to 20 of the same character set. Note: *The identifier cannot start or end with a special character.* Once a start and end ID are entered into the **DFX-7** and the log created, the **DFX-7** will automatically generate all the identifiers within that range.

Setting the Top Left(Grid) or Start ID(Seq)

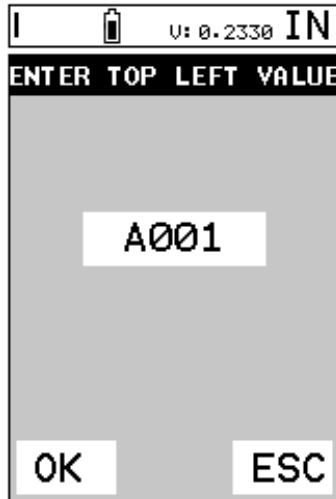
NEW GRID LOG	
NAME:	BOILER 34
NOTE:	INSP#99
TOP LEFT:	A001
LOWER RIGHT	A001
INCR. DIR:	NONE
SAVE GRAPHICS	NO
CREATE GRID?	
GRID SIZE:	1

Grid Log

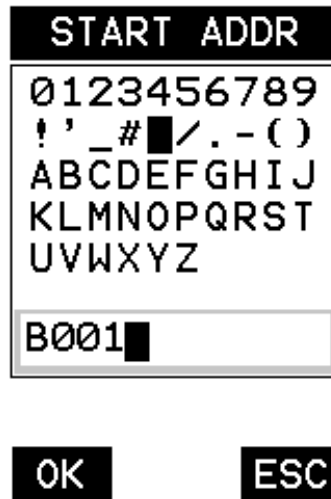
NEW SEQ LOG	
NAME:	BOILER 34
NOTE:	
START:	B001
END ID:	01
DIRECTION:	NONE
SAVE GRAPHICS	NO
CREATE LOG	
LOG SIZE:	0

Sequential Log

- 1) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid** or **Seq List Items** until **TOP LEFT** or **START ID** is highlighted.
- 2) Press the **ENTER** key to activate the **Coordinate** or **Start ID Edit Box**.



Grid Log



Sequential Log

- 3) **GRID LOG:** Use the **LEFT, & RIGHT** arrow keys to scroll the **Columns**, and the **UP, DOWN** arrow keys to scroll the **Rows**.

SEQ LOG: Use the **UP, DOWN, LEFT, & RIGHT** arrow keys to highlight the appropriate alpha characters. Press the **ENTER** key to select a character and advance to the next character field, in conjunction with using the **CLR** key to backspace if necessary.

- 4) Press the **OK** key to select the coordinate or start ID and return to the **Grid** or **Seq List Items** screen, or **ESC** to cancel the selection and return to the **Grid** or **Seq List Items** menu.

Setting the Bottom Right(Grid) or End ID(Seq)

NEW GRID LOG	
NAME:	BOILER 34
NOTE:	INSP#99
TOP LEFT:	A001
LOWER RIGHT	C050
INCR. DIR:	NONE
SAVE GRAPHICS	NO
CREATE GRID?	
GRID SIZE:	150

Grid Log

NEW SEQ LOG	
NAME:	BOILER 34
NOTE:	INSP#99
START:	B001
END ID:	B150
DIRECTION:	NONE
SAVE GRAPHICS	NO
CREATE LOG	
LOG SIZE:	150

Sequential Log

- 1) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid** or **Seq List Items** until **LOWER RIGHT** or **END ID** is highlighted.
- 2) Press the **ENTER** key to activate the **Coordinate** or **End ID Edit Box**.

BOTTOM RIGHT VALUE	
C050	
OK	ESC

Grid Log

STOP ADDR	
0123456789	
! ' _ # / . - ()	
ABCDEFGHIJ	
KLMNOPQRST	
UVWXYZ	
B150	
OK	ESC

Sequential Log

- 3) **GRID LOG:** Use the **LEFT, & RIGHT** arrow keys to scroll the **Columns**, and the **UP, DOWN** arrow keys to scroll the **Rows**.

SEQ LOG: Use the **UP, DOWN, LEFT, & RIGHT** arrow keys to highlight the appropriate alpha characters. Press the **ENTER** key to select a character

and advance to the next character field, in conjunction with using the **CLR** key to backspace if necessary.

- 4) Press the **OK** key to select the coordinate or end ID and return to the **Grid** or **Seq List Items** screen, or **ESC** to cancel the selection and return to the **Grid** or **Seq List Items** menu.

Note: If there is not enough memory available to create the grid or sequential log, an error message box “**NOT ENOUGH MEMORY**“ will be displayed. Press the **OK** or **ESC** key to return to the **Grid** or **Seq List Items** menu. It may be necessary to free some memory in the **DFX-7** at this time. Refer to page 132 for more information on **Deleting a File**.

Selecting the Auto Increment Direction

The **Auto Increment** feature gives the user the ability to specify which direction to advance the cursor after storing a reading.

NEW GRID LOG	
NAME:	BOILER 34
NOTE:	INSP#99
TOP LEFT:	A001
LOWER RIGHT	C050
INCR. DIR:	EAST
SAVE GRAPHICS	NO
CREATE GRID?	
GRID SIZE:	150

Grid Log

NEW SEQ LOG	
NAME:	BOILER 34
NOTE:	INSP#99
START:	B001
END ID:	B150
DIRECTION:	INC
SAVE GRAPHICS	NO
CREATE LOG	
LOG SIZE:	150

Sequential Log

- 5) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid** or **Seq List Items** until **INCR. DIR** or **DIRECTION** is highlighted.
- 6) Use the **LEFT & RIGHT** arrow keys to toggle the **Increment** direction **NONE, NORTH, EAST, SOUTH, or WEST** for a grid, or **INC, DEC** for a sequential log.
- 7) When the correct **Increment** direction is displayed, continue on to the next section "**Graphics**".

Saving Graphics

The **DFX-7** provides the user with the ability to save a snapshot of the display screen and all the current settings of the **DFX-7** with every reading, or just save the reading only. Saving the graphics might be advantageous to the user when the A-Scan views will be used to graphically save a picture of the scanned areas for reporting purposes. It might also come in handy when user requires backup of all the current **DFX-7** parameters for each reading. However, if neither of these requirements are necessary, this option should be disabled in order make more efficient use to the **DFX-7** storage capacity.

NEW GRID LOG	
NAME:	BOILER 34
NOTE:	INSP#99
TOP LEFT:	A001
LOWER RIGHT	C050
INCR. DIR:	EAST
SAVE GRAPHICS	NO
CREATE GRID?	
GRID SIZE:	150

Grid Log

NEW SEQ LOG	
NAME:	BOILER 34
NOTE:	INSP#99
START:	B001
END ID:	B150
DIRECTION:	INC
SAVE GRAPHICS	NO
CREATE LOG	
LOG SIZE:	150

Sequential Log

- 1) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid** or **Seq List Items** until **SAVE GRAPHICS** is highlighted.
- 2) Use the **LEFT & RIGHT** arrow keys to toggle the **Increment** direction to **YES** or **NO**.
- 3) Continue on to the next section "**Saving a Grid or Seq File**".

Saving a Grid

Once all the parameters are set, the user has the option of saving or canceling the new grid.

NEW GRID LOG	
NAME: BOILER 34	
NOTE: INSP#99	
TOP LEFT: A001	
LOWER RIGHT C050	
INCR. DIR: EAST	
SAVE GRAPHICS NO	
CREATE GRID?	
GRID SIZE: 150	

Grid Log

NEW SEQ LOG	
NAME: BOILER 34	
NOTE: INSP#99	
START: B001	
END ID: B150	
DIRECTION: INC	
SAVE GRAPHICS NO	
CREATE LOG	
LOG SIZE: 150	

Sequential Log

- 4) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid** or **Seq List Items** until **CREATE GRID** or **LOG?** is highlighted.
- 5) Press the **ENTER** key to accept the grid or seq log parameters and activate the confirmation screen.

CREATE GRID?	
CREATE A NEW DATA GRID	
?	
OK	ESC

CREATE GRID?	
CREATE A NEW DATA GRID	
?	
OK	ESC

Grid Log**Sequential Log**

- 6) Press the **OK** key to save the **New Grid** or **Seq Log**, or the **ESC** key to cancel the **New Grid** or **Seq Log** setup and return to the **DATA** menu.
- 7) Press the **MEAS** key to return to the measurement screen and begin storing readings.

12.3 Storing a waveform

Now that a grid or sequential log has been created, it's time to make some store some waveforms. The following procedures outline this process:

Storing a Waveform

Note: Once the grid or sequential log has been created it will automatically be displayed following the create confirmation screen. It is located at the bottom of the measurement screen, and can be left open for the duration of the inspection process. This section assumes the grid or sequential log was just created. Refer to the section on "opening a grid or seq log" if the file was created at another time.

Key Feature: When the **DFX-7** is displaying a "grid log", pressing the **OK** key will initiate an advance to row number option. Use the **Left, Right, UP,** and **DOWN** arrow keys to enter the row number. Once the row number is correctly displayed, press the **OK** key to advance directly to that row number in the grid log.

Key Feature: When the **DFX-7** is displaying a "grid log", pressing the **ESC** key multiple times, will toggle through the display options: **RF** and **RECT** views.

NAME: BOILER 34			
	A	B	C
1			
2			
3			
4			

Grid Log

NAME: BOILER 34	
B001	
B002	
B003	
B004	
B005	

Sequential Log

- 1) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the target cell cursor to the desired storage location.
- 2) Press the **ENTER** key to save the current reading in the highlighted cell location. It's as simple as that!
- 3) Press the **MEAS** key to hide the **GRID/SEQ View Box**, or **ENTER** to display it as necessary.

Note: Once the file is open, it will remain open until it's closed or another file is opened by the user. If the gauge is powered off, the **DFX-7** will automatically open the file when powered on. Simply press the **ENTER** key to display the file from the measurement screen.

12.4 Viewing stored readings

It is sometimes necessary to go back and view the stored waveforms using the **DFX-7** without a PC. The following procedures outline this process:

Viewing Stored Waveforms

NAME: BOILER 34			
	A	B	C
1	0.250	0.500	0.750
2	0.200	0.300	
3			
4			

Grid Log

NAME: BOILER 34	
B001	0.250
B002	0.500
B003	0.750
B004	1.000
B005	

Sequential Log

DELAY:	0.000	RANGE:	1.000
GAIN:	40.0		
GATES1:	0.040	WIDTH1:	INF
THRESH1:	40%	LOG:	BOILER 34

- 1) Press the **MEAS** key once to activate measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left until the **LOG** cell is highlighted.

NAME: GRID LOG			
	A	B	C
1	0.273	0.300	
2	0.523		
3			
4			

- 2) Press the **ENTER** key to display the **Grid Log Box**.
- 3) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the stored readings and corresponding display view. Notice as the cursor is moved to a different cell, the display will be updated with the display view saved with the reading. Readings stored in memory are indicated by displaying a **MEM** in the top left corner of the measurement screen.
- 4) The user may opt to clear a specific reading and save a new one at any time. Press the **CLR** key in the appropriate cell location to clear the reading, take a new measurement, and press the **ENTER** key to save the new reading.

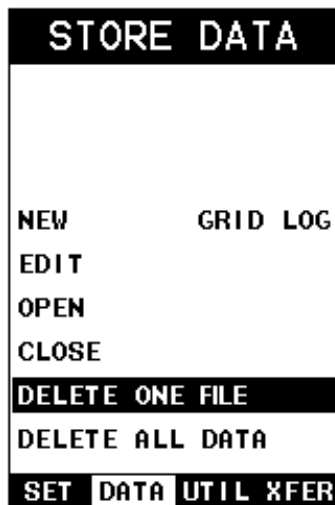
- 5) Abort the **Grid/Seq Log View Box** by pressing the **MEAS** key at any time.

12.5 Deleting Grids (Files)

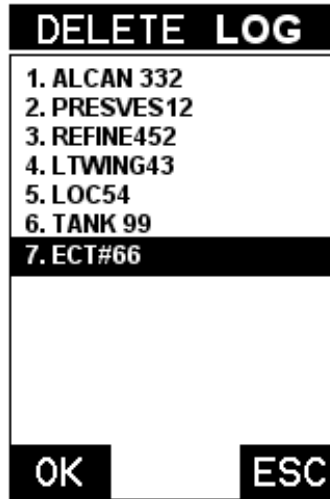
Deleting One or All Files from Memory

Deleting One File

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DATA** menu is highlighted and displaying the submenu items.



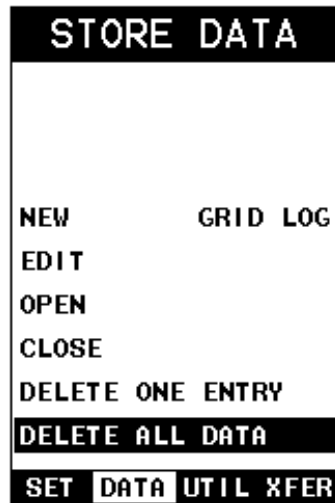
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DELETE ONE FILE** is highlighted.



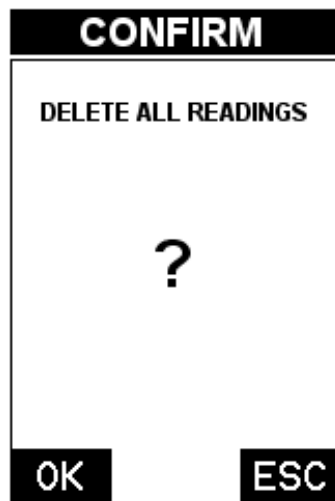
- 3) Press the **ENTER** key to display the **File List Box**.
- 4) Use the **UP** and **DOWN** arrow keys to scroll through the stored **Files** until the target **File** to delete is highlighted.
- 5) Press the **OK** key to delete the **File**.
- 6) Press the **MEAS** key to return to the measurement screen.

Deleting All Data

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DATA** menu is highlighted and displaying the submenu items.



- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DELETE ALL DATA** is highlighted.



- 3) Press the **ENTER** key to activate the confirmation screen.
- 4) Press the **OK** key to delete **All Files** from memory, or the **ESC** key to abort.
- 5) Press the **MEAS** key to return to the measurement screen.

12.6 Editing a Grid (File)

Once a grid has been created and saved to memory, the user can edit the **Comments** or **Increment Direction** at a later time. The following procedures outline this process:

Editing a Grid

EDIT GRID LOG

NAME: BOILER 34

NOTE:

TOP LEFT: A001

LOWER RIGHT: C050

INCR. DIR EAST

SAVE GRAPHICS: OFF

SAVE CHANGES?

LOG SIZE 150

OK **ESC**

EDIT GRID LOG

NAME: BOILER 34

NOTE:

TOP LEFT: A001

LOWER RIGHT: C050

INCR. DIR EAST

SAVE GRAPHICS: OFF

SAVE CHANGES?

LOG SIZE 150

OK **ESC**

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DATA** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **EDIT** is highlighted.
- 3) Press the **ENTER** key to display the **Edit List Box**.
- 4) Use the **UP** and **DOWN** arrow keys to scroll through the **Edit** options until **NOTE** or **INCR. DIR** is highlighted.

Note: If editing the **INCR. DIR**, simply use the **LEFT** or **RIGHT** arrow keys to scroll **NONE**, **NORTH**, **EAST**, **SOUTH**, **WEST** for a Grid, or **INC**, **DEC** for a Seq Log. **Proceed to step 10.**

LOG NOTE

0123456789
 ! ' _ # █ / . - ()
 ABCDEFGHIJ
 KLMNOPQRST
 UVWXYZ

 INSP#99 █

OK

ESC

- 5) Press the **ENTER** key to activate the **Alpha Edit box – Only used when editing the NOTE.**
- 6) Use the **UP, DOWN, LEFT, & RIGHT** arrow keys to highlight the appropriate alpha characters.
- 7) Press the **ENTER** key to select a character and advance to the next field of the **Comments.**
- 8) Use the **CLR** key to backspace if necessary.
- 9) Repeat steps 6 - 8 until the **Comments** are completed.

EDIT GRID LOG

NAME: BOILER 34
 NOTE:
 TOP LEFT: A001
 LOWER RIGHT: C050
 INCR. DIR EAST
 SAVE GRAPHICS: OFF

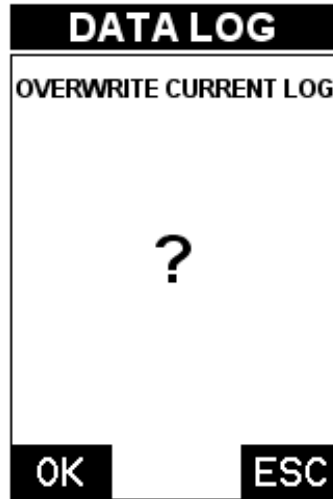
SAVE CHANGES?

 LOG SIZE 150

OK

ESC

10) Press the **UP** or **DOWN** arrow key to highlight **SAVE CHANGES**, and the **OK** key to activate the confirmation screen.



11) Press the **OK** key to save the changes or the **ESC** key to cancel editing the file parameters.

12) Press the **MEAS** key to return to the measurement screen.

12.7 Changing the active File - Open

The user may have transferred grid/seq templates from a PC to the **DFX-7**, or setup grids/seq using the **DFX-7** at an earlier time. The name of the currently active file is always displayed at the top of the **Grid/Seq Box** in measurement mode (refer to photo below). It's not only important to recognize what file is currently active, but also be able to change the active file at any time. The following procedures outline this process:

Changing the Active File

NAME: BOILER 34			
	A	B	C
1	0.250	0.500	0.750
2	0.200	0.300	
3			
4			

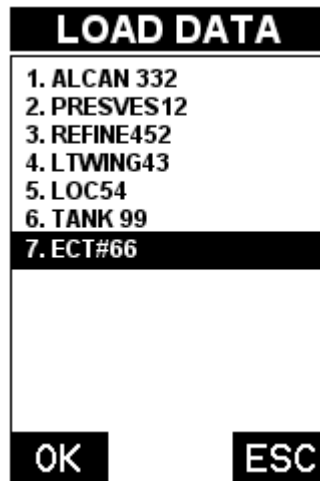
NAME: BOILER 34	
B001	0.250
B002	0.500
B003	0.750
B004	1.000
B005	

Grid Log**Sequential Log**

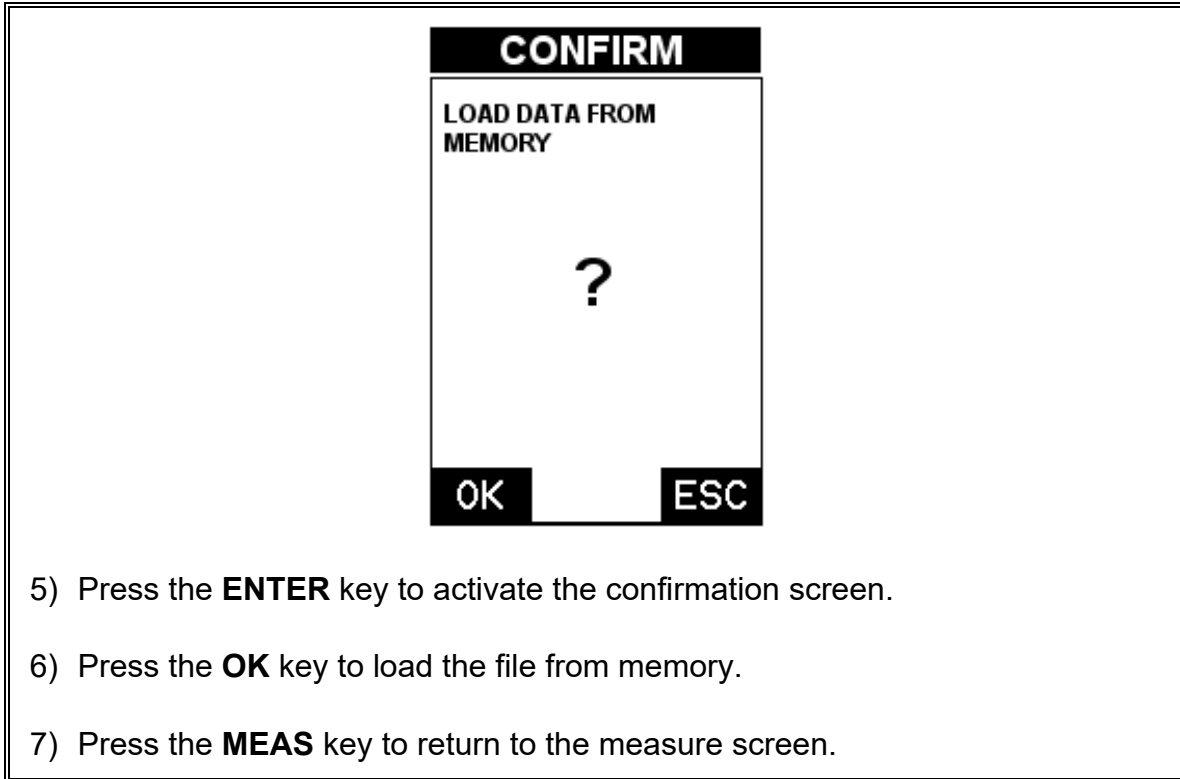
- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **DATA** menu is highlighted and displaying the submenu items.



- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **OPEN** is highlighted.

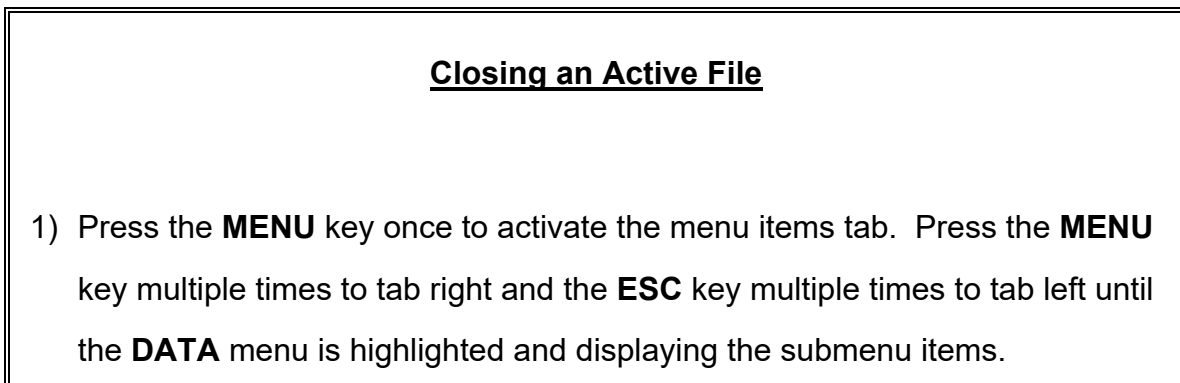


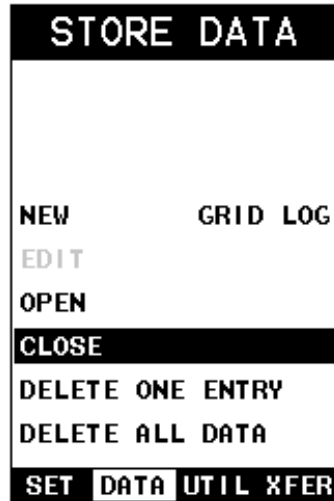
- 3) Press the **ENTER** key to display the **Grid/Seq List Box**.
- 4) Use the **UP** and **DOWN** arrow keys to scroll through the grids until the target grid is highlighted.



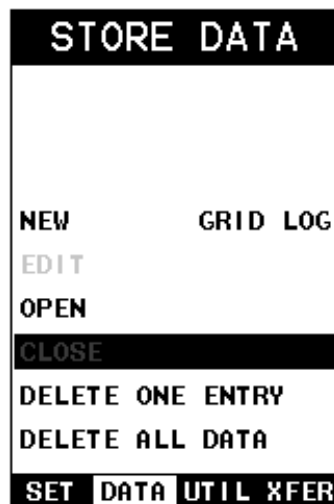
12.8 Closing an active File - Close

A user might not have a current requirement to store measurements, but a file is currently open or active and needs to be closed. The following procedures outline how to close an open or active file:





- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **CLOSE** is highlighted.



- 3) Press the **ENTER** key to close the active file. **Note:** Following the key press, the **CLOSE** text will be grayed out indicating the file has been close and is no longer active.

CHAPTER THIRTEEN SETUPS – CREATE, STORE, EDIT, & RECALL

13.1 Introduction to Setups

Often times, users are faced with a variety of tasks and applications that are sometimes similar, but can also be very different. Without the ability to save the individual calibrations and setups, the user would have to repeat the setup process on a regular basis for each individual application. This would become tedious rather quickly, especially considering the number of applications and potential calibration requirements for setup.

The increased number of features and parameters also adds to the overall setup time, or amount of time to set up marginal applications with perfection and understanding. Because of the additional time involved, the **DFX-7** has been equipped with the ability to save these setups to memory and be recalled at any time. The **DFX-7** can store up to **64 custom setups**. These setups can be bi-directionally transferred to and from a PC. Therefore, the user can save as many setups as necessary for all their individual applications requirements. This saves a great deal of time and knowledge for future inspections of the same job or project. This feature also eliminates error between two or more users during the setup and calibration process.

13.2 Opening a Setup

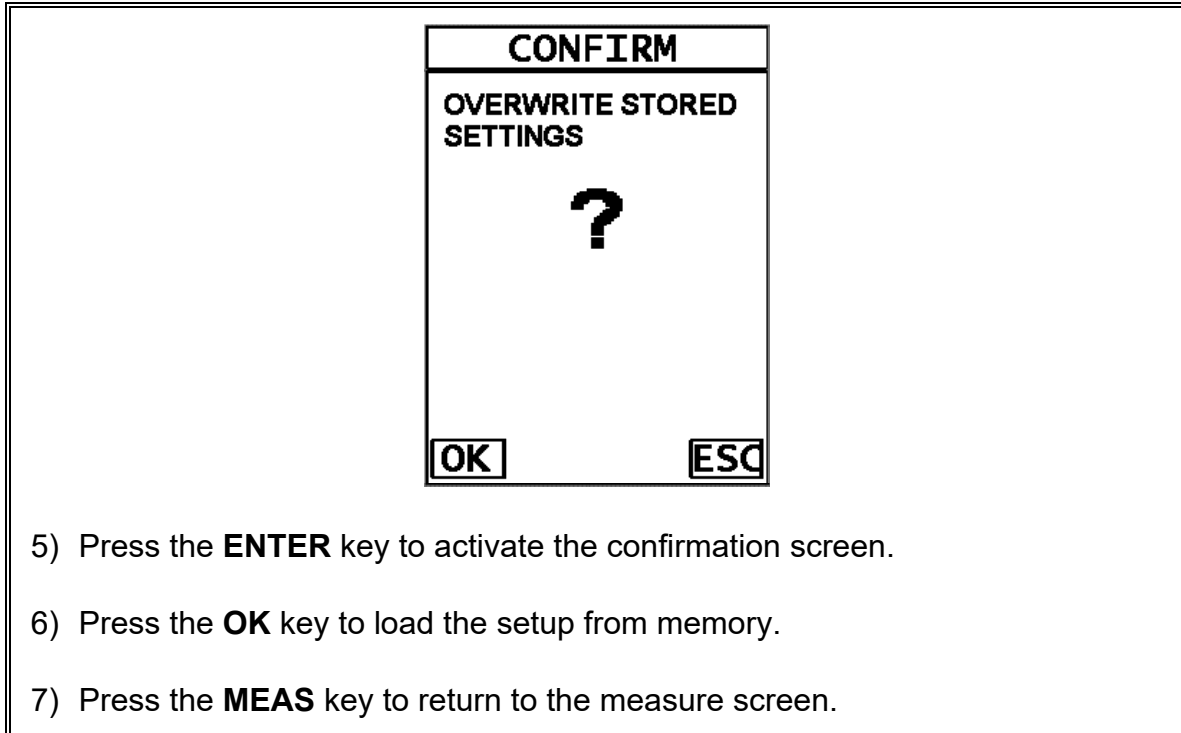
The **DFX-7** is loaded with a number of setups from the factory. These setups can be opened, edited, and saved to any one of **64 setup locations**. If a factory setup is written over, the user can simply reload the default factory setups at anytime using the utility software included with the **DFX-7**. The factory setups are general setups **Only**. However, they may serve as an excellent starting point, requiring only minor adjustments to work for custom applications. It is recommended that user customized setups be saved to an empty location, and save the factory setups for the purpose of a general starting point. The following procedures outline how to open factory and custom setups:

Opening a Setup

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **OPEN** is highlighted.



- 3) Press the **ENTER** key to display the **Setup List Box**.
- 4) Use the **UP** and **DOWN** arrow keys to scroll through the setups until the target setup is highlighted.



13.3 Saving a Setup

Once the **DFX-7** parameters and features have been adjusted for an application, the user may elect to save these settings to a specific setup location for future use. This can potentially save time and reduce error between users.

It is sometimes necessary to rename a previously saved setup, or add additional comments about a particular setup. The setup name may have been entered incorrectly, or the user needs to use the setup for a completely different project. An inspector's name or other comments about the project may also be required for additional documentation purposes. The following procedures outline the necessary steps for saving and editing a setup:

Saving a Setup

SETUP OPTIONS	
OPEN	
SAVE	
DELETE ONE FILE	
DEFAULT SETUP	
LANGUAGE	ENGLISH
TCG DAC DGS	SET

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **SAVE** is highlighted.

SAVE SETUP	
NAME:	EX#1
NOTE:	
SAVE SETUP	

SAVE SETUP	
NAME:	EX#1
NOTE:	I:ISP#39
SAVE SETUP	

- 3) Press the **ENTER** key to display the **Save Setup Parameters List Box**.
- 4) Press the **UP** and **DOWN** arrow keys to scroll the **Name** and **Note** parameters.

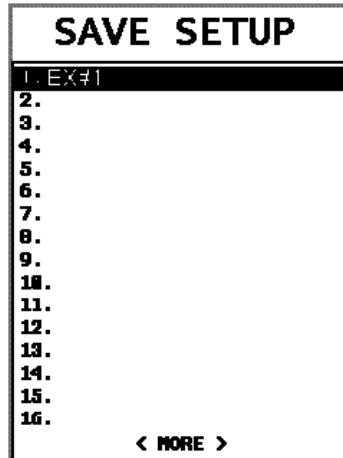
SETUP NAME
0123456789 !'_#■/.-() ABCDEFGHIJ KLMNOPQRST UVWXYZ
EX#1■
OK ESC

SETUP NOTE
0123456789 !'_#■/.-() ABCDEFGHIJ KLMNOPQRST UVWXYZ
INSP#99■
OK ESC

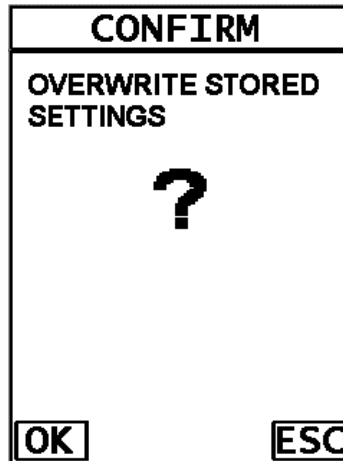
- 5) When the parameter to edit is highlighted, press the **ENTER** key to activate the **Alpha Edit Box**.
- 6) Use the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll through the characters, the **ENTER** key to select characters, and the **CLR** key to backspace through the characters, until the **Name** or **Note** fields have been edited.
- 7) Press the **OK** key to return to the **Save Setup Parameters List Box**.
- 8) If both parameters will be edited, **repeat steps 4 – 7**.

SAVE SETUP
NAME: EX#1
NOTE: INSP#99
SAVE SETUP

- 9) Use the **UP** and **DOWN** arrow keys to scroll to and highlight **SAVE SETUP**.
- 10) Press the **ENTER** key to activate the **Setup List Box**.



11) Use the **UP** and **DOWN** arrow keys to scroll through the setups until the target location to save the **Setup** is highlighted.



12) Press the **OK** key to activate the confirmation screen.

13) Press the **OK** key to save the **Setup**, or **ESC** to cancel saving the **Setup**.

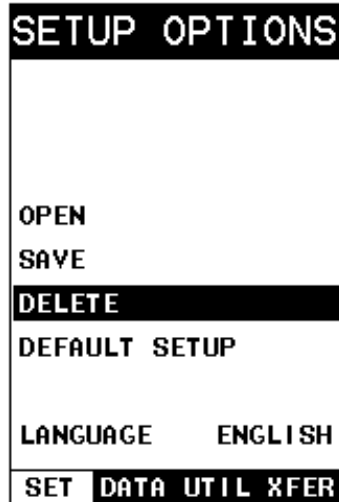
14) Finally, press the **MEAS** key to return to the measurement screen.

Note: The **Name** and **Comments** of the **Setup** can be edited at any time by simply repeating the **Save Setup** routine described above. Therefore, the **Save Setup** function can also be considered an **Edit Function**.

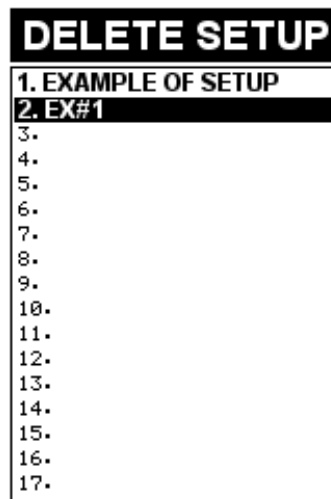
13.4 Deleting a Saved Setup

This option allows a user to delete setup files that were previously saved and no longer needed. It's a simple feature to allow the user to do a bit of "house cleaning".

Deleting a Setup

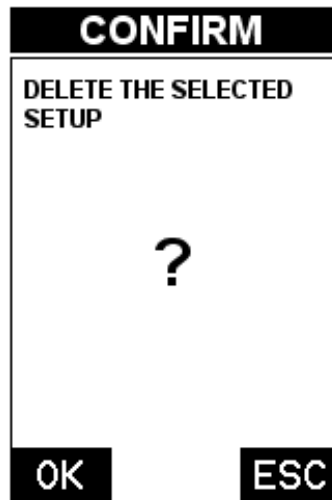


- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DELETE** is highlighted.



- 3) Press the **ENTER** key to display the **Setups List**.
- 4) Press the **UP** and **DOWN** arrow keys to scroll to the **Setup Name**.

- 5) When the **Setup Name** is highlighted, press the **ENTER** key to display the confirmation screen.



- 6) Press the **OK** key to delete the **Setup File**.
- 7) Finally, press the **MEAS** key to return to the measurement screen.

13.5 Using the Default Setup

The default setup feature was added to the **DFX-7** to use, as a last resort, if there are no setups stored in the gauge –factory or otherwise. The only time this might possibly occur is if the setup file in the **DFX-7** was somehow corrupted, and the user does not have access to a computer to re-load the factory setups back into the **DFX-7**. This gives the user the ability to load and modify a basic setup as follows:

Note: The default file contains no probe zero data. Therefore, a zero must be performed after loading. Also, the default setup can be loaded when using the flaw mode feature, to eliminate the probe zero delay value, and start at the initial pulse or zero.

Using the Default Setup



- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **DEFAULT SETUP** is highlighted.

13.6 Selecting a Language

The **DFX-7** is equipped with a language option. Currently, the only languages supported are English, Spanish, and German. The steps to select one of these languages are outlined as follows:

Selecting a Language

SETUP OPTIONS

OPEN
SAVE
DELETE ONE FILE
DEFAULT SETUP

LANGUAGE ENGLISH
TCG DAC DGS SET

- 1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items.
- 2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **LANGUAGE** is highlighted.
- 3) Press the **LEFT** and **RIGHT** arrow keys to toggle the language options.
- 4) Once the desired language is displayed, press the **MEAS** key to return to the measurement screen.

CHAPTER FOURTEEN USING THE UTILITY SOFTWARE

14.1 Computer System Requirements

DakView will run on many different operating systems: Windows XP, Windows 2000 Professional, Windows 2000 Server, Windows 2000, Vista, Windows 7, 8, 10, or advanced Server operating systems running on Intel or AMD hardware. Additionally there is a version for the Mac OSX platform.

A Pentium 166MHz or faster processor with at least 32 megabytes of physical RAM is required. You should have 40 megabytes of free disk space before attempting to install **DakView**.

File transfer is standard USB connectivity, using a USB-C to USB transfer cable (pt# N-003-0330).

14.2 Installing DakView

DakView is available directly from our website for download free of charge. Stay current by periodically checking the website for the latest version. Simply download the .exe file from our website to your computer, and double click the icon to begin installation.

Refer to the online help section in **DakView** for operating instructions.

14.3 Communicating with the DFX-7

DakView will not directly communicate with the **DFX-7** series gauges. The **DFX-7** is equipped with USB, acting as a Thumb Drive (external storage device) when connected to a computer and powered on. Therefore, the SD memory card can be opened as a drive with *directory structure, similar to the C: on your computer*. The files stored on the internal SD can be simply copied (dragged) into any folder on your PC and opened using **DakView**. The PC software will function as a file viewer for the **DFX-7** series gauges.

14.4 Upgrading the DFX-7

The **DFX-7** can be upgraded to the latest revision of firmware at any time. Simply download the latest version posted on the Dakota Ultrasonics website, copy the upgrade file to the main drive directory **DFX-7**, and use the upgrade utility located in the **XFER** menu. The process is very easy and convenient, allowing our users to stay current with updated feature additions and bug fixes. The procedure to upgrade your **DFX-7** is outlined below:

Upgrading the Firmware

UPGRADE GAUGE	
ABOUT	DEV 0.50I
DATA UTIL	XFER

UPGRADE GAUGE	
LOAD FILE DFX7U_GAUGE.BCH TO FLASH	
?	
OK	ESC

1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **XFER** menu is highlighted and displaying the submenu items.

Alternatively, press the **LEFT** and **RIGHT** arrow keys multiple times using the left button wheel.

- 2) Press the **ENTER** key to display the upgrade confirmation screen, followed by pressing **OK** key to start the upgrade process. Note: The **DFX-7** will power down during the upgrade process and restart when completed.

**APPENDIX A -
VELOCITY TABLE**

Material	L-Wave velocity in/μs	L-Wave velocity m/s	S-Wave Velocity in/μs	S-Wave Velocity in/μs
Aluminum	0.2510	6375	.1240	3130
Beryllium	0.5080	12903	.3500	8880
Brass	0.1730	4394	.0830	2120
Bronze	0.1390	3531	.0880	2235
Cadmium	0.1090	2769	.0590	1500
Columbium	0.1940	4928	.0830	2100
Copper	0.1830	4648	.0890	2260
Glass (plate)	0.2270	5766	.1350	3430
Glycerine	0.0760	1930	-	-
Gold	0.1280	3251	.0470	1194
Inconel	0.2290	5817	.1190	3020
Iron	0.2320	5893	.1270	3230
Cast Iron	0.1800	4572	.0870-.1260	2200-3220
Lead	0.0850	2159	.0280	700
Magnesium	0.2300	5842	.1200	3050
Mercury	0.0570	1448	-	-
Molybdenum	0.2460	6248	.1320	3350
Monel	0.2110	5359	.1070	2720
Nickel	0.2220	5639	.1170	2970
Nylon	0.1060	2692	.0430	1090
Platinum	0.1560	3962	.0660	1670
Plexiglas	0.1060	2692	.0500	1270
Polystyrene	0.0920	2337	-	-
PVC	0.0940	2388	.0420	1060
Quartz glass	0.2260	5740	.0870	2210
Rubber vulcanized	0.0910	2311	-	-
Silver	0.1420	3607	.0360	1590
Steel (1020)	0.2320	5893	.1280	3240
Steel (4340)	0.2330	5918	.1280	3240

Steel Stainless"	0.2230	5664	.1230	3120
Teflon	0.0540	1372	.2500	6350
Tin	0.1310	3327	.0660	1670
Titanium	0.2400	6096	.1230	3120
Tungsten	0.2040	5182	.1130	2870
Uranium	0.1330	3378	.0780	1980
Water	0.0580	1473	-	-
Zinc	0.1660	4216	.0950	2410
Zirconium	0.1830	4648	.0890	2250

WARRANTY INFORMATION

• Warranty Statement •

Dakota Ultrasonics warrants the *DFX-7* against defects in materials and workmanship for a period of two years from receipt by the end user. Additionally, Dakota Ultrasonics warrants transducers and accessories against such defects for a period of 90 days from receipt by the end user. If Dakota Ultrasonics receives notice of such defects during the warranty period, Dakota Ultrasonics will either, at its option, repair or replace products that prove to be defective.

Should Dakota Ultrasonics be unable to repair or replace the product within a reasonable amount of time, the customer's alternative exclusive remedy shall be refund of the purchase price upon return of the product.

• Exclusions •

The above warranty shall not apply to defects resulting from: improper or inadequate maintenance by the customer; unauthorized modification or misuse; or operation outside the environmental specifications for the product.

Dakota Ultrasonics makes no other warranty, either express or implied, with respect to this product. Dakota Ultrasonics specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. Some states or provinces do not allow limitations on the duration of an implied warranty, so the above limitation or exclusion may not apply to you. However, any implied warranty of merchantability or fitness is limited to the five-year duration of this written warranty.

This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state or province to province.

• Obtaining Service During Warranty Period •

If your hardware should fail during the warranty period, contact Dakota Ultrasonics and arrange for servicing of the product. Retain proof of purchase in order to obtain warranty service.

For products that require servicing, Dakota Ultrasonics may use one of the following methods:

- Repair the product
- Replace the product with a re-manufactured unit
- Replace the product with a product of equal or greater performance
- Refund the purchase price.

• After the Warranty Period •

If your hardware should fail after the warranty period, contact Dakota Ultrasonics for details of the services available, and to arrange for non-warranty service.