# Instruction Manual

# Dakota FX81-DL (formerly DFX-8+) Flaw Detector, Transducers, Z-251-0001, Z-251-0003

## (Manual Part 1 & 2)



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# CHAPTER ONE
# INTRODUCTION

The Dakota NDT model ***FX-80*** is both, an ultrasonic thickness gauge, as well as a flaw detector. Since the ***FX-80*** is basically two gauges in a single package, we split the manual into two manuals, one for each gauge type. This manual will focus only on the thickness gauge portion of the gauge. The ***FX-80*** has the ability to simultaneously measure coatings and material thicknesses while maintaining the ability to locate pits, flaws and defects in the material. Based on the same operating principles as SONAR, the ***FX-80*** is capable of measuring the thickness of various materials with accuracy as high as ± 0.001 inches, or ± 0.01 millimeters. The principle advantage of ultrasonic measurement over traditional methods is that ultrasonic measurements can be performed with access to only one side of the material being measured.

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

## 1.1 General Disclaimer

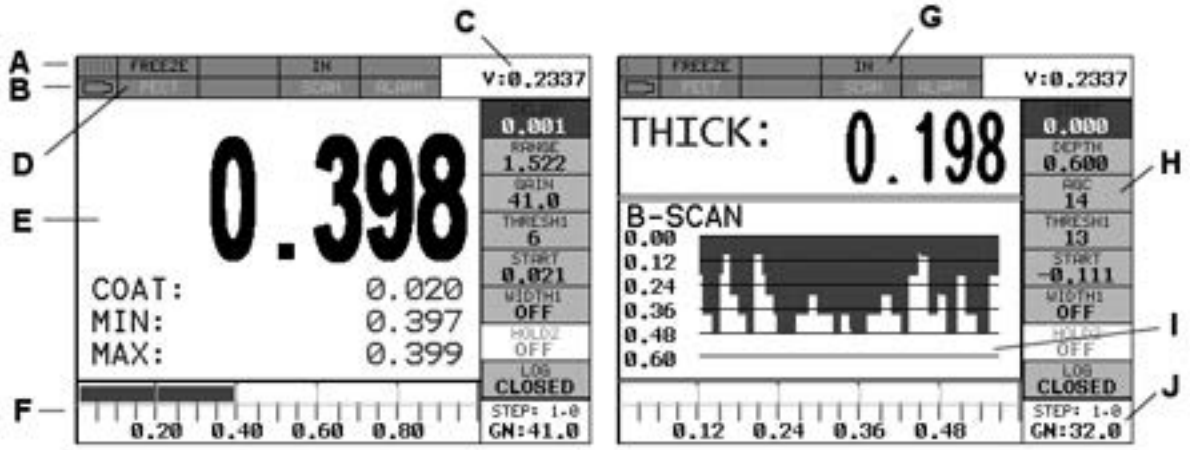
The manual should be read and understood prior to using the ***FX-80***. This operating manual provides the user with all the general information necessary to use and adjust the designed features. However, this manual is not a certified NDT training course, nor is it intended to be one. Training, according to company requirements, is recommended.

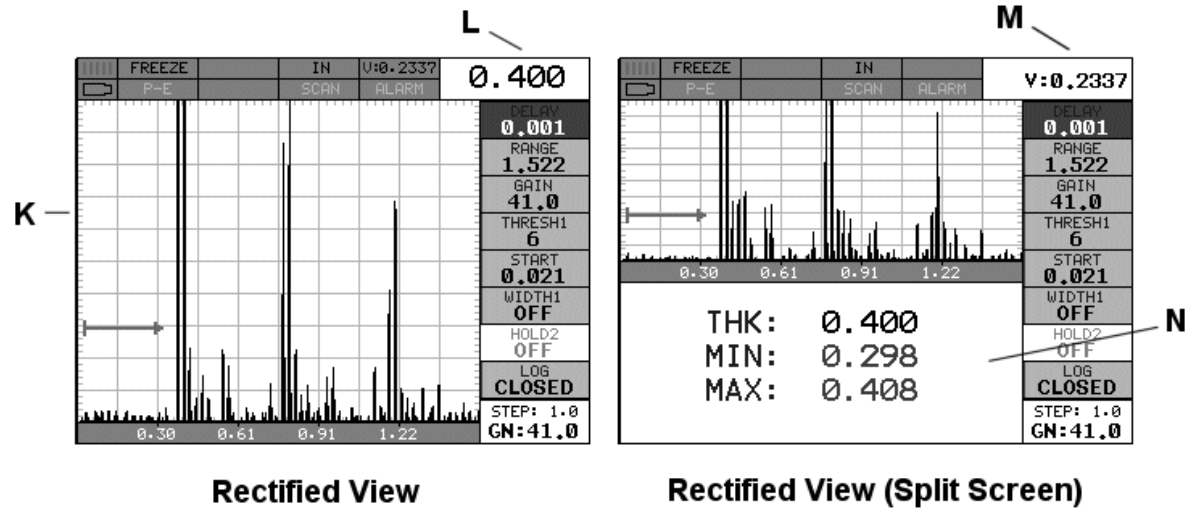
Inherent in ultrasonic thickness measurement is the possibility that the instrument will use the second rather than the first echo from the back surface of the material being measured. This may result in a thickness reading that is TWICE what it should be. Responsibility for proper use of the instrument and recognition of this phenomenon rest solely with the user of the instrument. Other errors may occur from measuring coated materials where the coating is insufficiently bonded to the material surface. Irregular and inaccurate readings may result. Again, the user is responsible for proper use and interpretation of the measurements acquired.

## CHAPTER TWO
## QUICK STARTUP GUIDE

Turn the ***FX-80*** on and off using the switch located on the bottom right corner of the keypad. When ***FX-80*** is initially turned on, a flash logo and blinking lights will be displayed, followed by attempting to identify the transducer (probe) currently plugged into the gauge. The ***FX-80*** is equipped with an "Auto Probe Recognition" feature that attempts to identify special transducers with this built in feature. If the ***FX-80*** doesn't find a transducer equipped with this feature, the user will be advanced to a list of transducers requiring the user to select a specific transducer type. The following sections outline each scenario. Note: This section is primarily written as a basic startup guide only.

### 2.1 FX-80 Overview



In order to understand how to operate the ***FX-80***, it's best to start off with an understanding of what it is we're looking at exactly. The ***FX-80*** 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 should be commonly used in conjunction with the digital thickness values displayed. When all the vertical bars are fully illuminated and the last digit on the digital thickness value is stable, the ***FX-80*** is reliably measuring the same value 3 to 200 times per second, depending on which measurement mode and features are enabled.

B. **Battery Icon** – Indicates the amount of battery life the ***FX-80*** has remaining.

C. **Velocity** – The material velocity value the ***FX-80*** is currently using or calibrated for. Displayed in both English or Metric units, depending on the what units the gauge is set for.

D. **Feature Status Bar** – Indicates the features currently enabled and in use in the following order:
   - Measurement Mode
   - Differential Mode
   - High Speed Scan Mode
   - Alarm Mode
   - Gain Setting

E. **Digital Material Thickness Values** – Depending on the measurement mode selected, the base material and coating thicknesses are displayed. If the scan feature is enabled, the minimum and maximum thickness value of the base material is displayed and updated simultaneously during the scan .

F. **Scan Bar** – Another view of material thickness in a deflection style horizontal bar. This is a visual tool that would enable the user the ability to see thickness changes during high speed scans from flaws and pits.

G. **Units** – The current measurement units being used (English, Metric).

H. **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  key at any time. The  key advances forward and the  key backwards to the next hot menu item. Alternatively, the , ,  and

 arrow keys on the left button wheel can be used to either scroll through the sub menu items, or advance to the next HOT MENU items list. There are 8 HOT MENU lists, that contain the most commonly adjusted items from the tabbed menus, and in the same order as the tabbed menus. Note: Some of the lists contain multiple tabbed menus in order to condense the number of HOT MENU lists.

I. **B-Scan Display** – Cross section view of the material. Provides the user with graphical view of the opposite/blind surface (i.e. inside pipe wall surface), to give the user some idea of the condition, or integrity of the material being tested.

J. **Gain & Step Size** – The gain and increment step size can be continuously used and adjusted at any time using the  and  arrow keys on the right button wheel to scroll the value, and the 

key to activate the **Digit Edit** screen to adjust the step size.

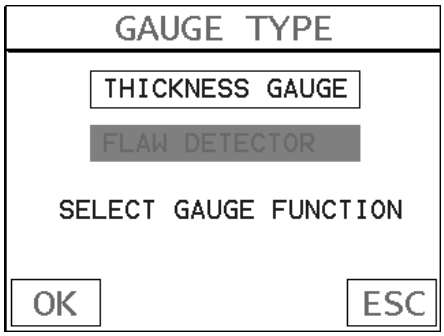
K. **Rectified A-Scan Display** – The actual sound wave reflection that is returned from the detection of the opposite surface of the material being measured. In this view, only half of the sine wave is being displayed (positive or negative). This view is commonly referred and used as a “flaw detection” mode.

L. **Reference Note** – When a full screen sound wave is being displayed, the material thickness value is displayed here.

M. **Reference Note** – In a split screen mode the material velocity is displayed here.

N. **Split Screen Display** – This display option ‘splits’ the screen in half, displaying the waveform/B-Scan and the thickness values concurrently.

## 2.2 Gauge Type




Power up the ***FX-80***, 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 thickness gauge portion of the ***FX-80***, use the / arrow keys to select "thickness gauge", followed by pressing the OK key start the ***FX-80*** in thickness mode.

## 2.3 Top & Submenu Reference

The following table is a quick menu reference guide. The ***FX-80*** has 15 top level menu titles, and multiple submenu items as illustrated below. The ***FX-80*** also has 8 'hot menu' subsets of the same menu structure. These are the most commonly adjusted submenu items from each of the top level menus. They can be quickly accessed from the main measurement screen by pressing the and arrow keys multiple times using the left button wheel, and pressing the and arrow keys on the left button wheel to select the appropriate submenu item. Refer to Chapter Three for additional definitions and information on the keypad and menu items.

| | |
|---|---|
| 1st Main Hot Menu | |
| Additional Hot Menus | |

**Note:** *"Log" is also listed in the 1st main Hot Menu, and is used to access data storage if no log file is currently open, or display log or grid file if open.*

**Start >>**

| PRB | CAL | DISP | TUNE | GT1 | GT2 | GT3 | SETUP |
|---|---|---|---|---|---|---|---|

| ZERO PROBE | MAT | VIEW | MEASURE MODE | START | GATE2 WIDTH | GATE3 WIDTH | OPEN |
|---|---|---|---|---|---|---|---|
| ZERO COATING | MATL 1PT | DELAY | POLARITY | GATE1 WIDTH | HOLDOFF 2 | HOLDOFF 3 | SAVE |
| TYPE | MATL 2PT | RANGE | PULSE | THRESHOLD 1 | THRESHOLD 2 | THRESHOLD 3 | DELETE |
| | VELOCITY | B-SCAN SPEED | PULSER VOLTAGE | | | | DEFAULT SETUP |
| | COATING 1PT | UNITS | DAMPING | | | | |
| | COATING 2PT | BRIGHTNESS | GAIN | | | | LANGUAGE |
| | COATING VEL | COLORS | AGC | | | | |
| | | DIM | TDG SLOPE | | | | |
| | | RECT WAVE | TDG START | | | | |
| | | DETECT MARK | | | | | |
| | | GRATICULE | | | | | |

**>> End**

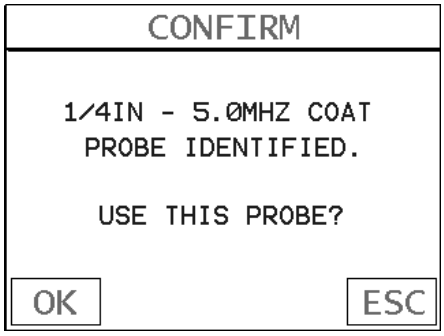
| DATA | UTILS | XFER |
|---|---|---|
| NEW | AUTO FIND | BACKUP SETUPS |
| EDIT | SCAN MODE | COPY DATA |
| OPEN | ALARM | COPY SCREENS |
| CLOSE | ALARM HIGH | UPGRADE GAUGE |
| DELETE ONE FILE | ALARM LOW | CAPTURE TO FILE |
| DELETE ALL DATA | DIFFERENTIAL | CAPTURE VIEWER |
| | GAUGE | STORAGE |
| | ANALOG OUTPUT | ABOUT |
| | SERIAL OUTPUT | |
| | DIGITIZER | |
| | KEY CLICK | |
| | SET DATE | |
| | SHOW DATE | |

**Note:** ***FX81*** *only*

## 2.4 Auto Probe Recognition

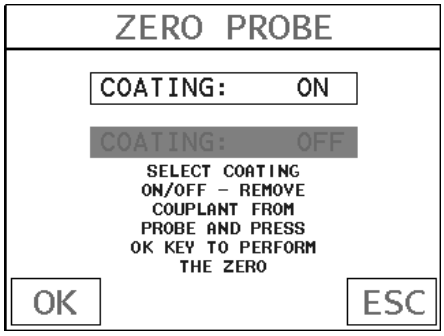
When the ***FX-80*** is initially powered up, the gauge will automatically check to see if the transducer plugged into the gauge can be recognized. The steps that follow assume the ***FX-80*** recognized the probe type:

## Probe Automatically Recognized




1) Press the OK key once to use the identified probe, or esc to display a list of optional transducers. **Note:** *if the **FX-80** recognizes a specific transducer, the user should always select* OK *to use the identified probe. The only time an alternative probe should be selected from a list is if the user switched probes following initial power up and recognition.*

2) Assuming the ***FX-80*** recognized the probe and the OK key was pressed, the ***FX-80*** will advance to a Zero Probe menu. If the transducer was identified as a special transducer capable of measuring coating thickness, a menu will be displayed allowing the user the ability to toggle the coating thickness display on/off as follows:



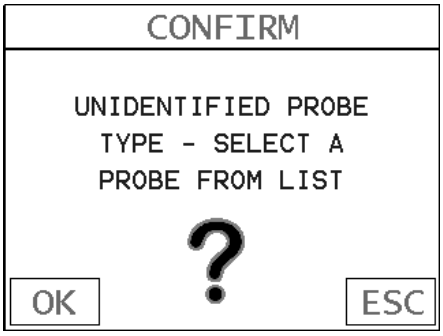

3) Press the ▲ and ▼ arrow keys on the left button wheel to toggle the coating option on/off.

4) Wipe all couplant from the transducer face and advance to the **Probe Zero & Calibration** section outlined below.

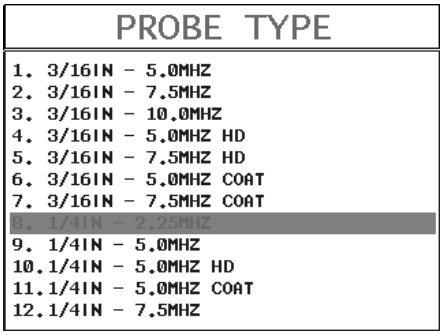
## 2.5 Selecting the Transducer Type

If the ***FX-80*** does not identify a specific transducer type on initial power up, the user will be required to select a type from a predefined list of types by diameter and frequency. By selecting a transducer type from a predefined list, the ***FX-80*** can recall specific properties about the transducer. **Note:** Once the transducer has been selected, the ***FX-80*** will store and recall this transducer type every time the ***FX-80*** is powered on/off. The type will only change if the user physically selects another transducer type from the list, or selects a previously saved setup. However, the ***FX-80*** will continue to take you through these steps each time the gauge is powered up. You'll notice that the probe type previously selected will be highlighted every time the probe type screen is displayed. Use the following steps to select your transducer type:

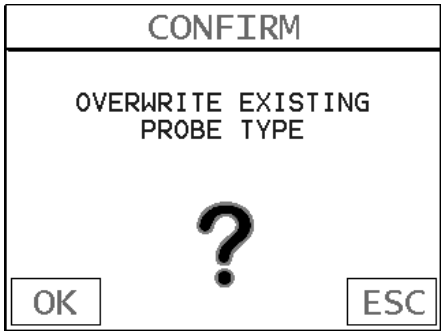
### Selecting the Transducer Type




1) Press the OK or ESC keys to display the factory list of transducer types (by diameter and frequency).



2) Press the  and  arrow keys on the left button wheel to scroll through the transducer list until the appropriate type is highlighted.




3) Press the  key to select the transducer type and display overwrite existing probe screen.

4) Press the  key to overwrite the existing probe type with the newly selected probe type. The zero probe screen will be displayed. Proceed to the zero probe section that follows.

## 2.6 Probe Zero & Calibration

The next steps are to perform a probe zero and calibrate the ***FX-80*** to the material and transducer being used. If the sound velocity is unknown, the ***FX-80*** can be calibrated to a known thickness sample. This demo will briefly explain both of these techniques.

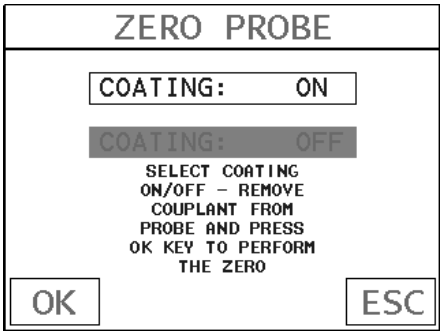
The ***FX-80*** is equipped with two zero options:

1) **Off Block Zero (Automatic Probe Zero)** – When this feature is enabled the ***FX-80*** will do an electronic zero automatically, eliminating the need for a zero disk or block.
2) **On Block Zero (Manual Probe Zero)** – When this feature is enabled the transducer must be placed on the probe zero disk (battery cover located on the top of the unit.

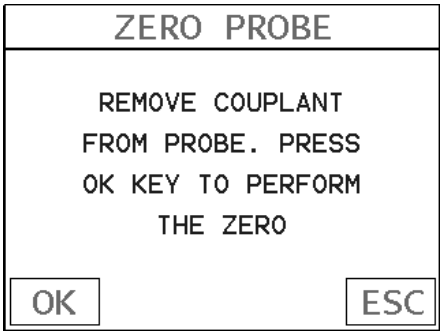
**Note:** *Transducers of the same type will have very slight mechanical and electrical variations. If it's discovered that the linearity is off following an initial auto probe zero and extreme accuracy is required, a manual zero should be performed followed by an auto zero. This will adjust and eliminate any error. This is only required if it's discovered the transducer is non-linear following an initial auto probe zero.*

The procedures are outlined as follows:

## Performing an Auto Probe Zero (Off Block)




***Coating Probe Identified***




***Coating Probe Not Identified***

1) Be sure all couplant has been removed from the face of the transducer.
2) Press the OK key to perform the automatic probe zero, or ESC key to cancel the zero operation.
3) The screens illustrated above will be briefly displayed followed by the main measurement screen. The ***FX-80*** is ready to be calibrated.

## Performing a Manual Probe Zero (On Block)



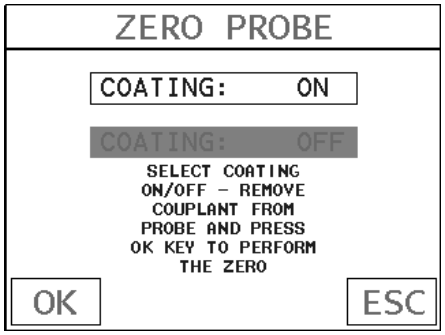

**Note:** *When the zero probe option is set to manual, the probe zero disk (battery cap) located on the top of the gauge, will be used as a zero standard and the warning screen illustrated above will be displayed.*

1) Press the OK or ESC keys to enter the main measurement screen and begin the manual zero process.

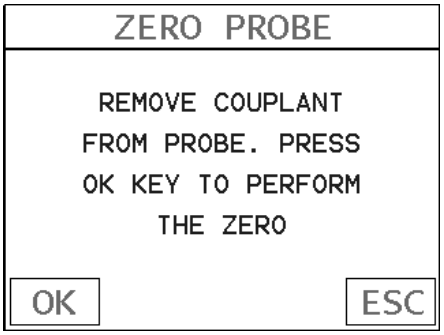
2) Apply a drop of couplant on the transducer and place the transducer in steady contact with the probe zero disk, and obtain a steady reading.

3) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the tabbed menus.

4) Press the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **ZERO PROBE** is highlighted.




***Coating Probe Identified***




***Coating Probe Not Identified***

5) Press the ↵ key to display the confirmation screen.

6) If a coating transducer was identified use the ▲ and ▼ arrow keys on the left button wheel to toggle coating on/off.

7) Press the OK key to complete the probe zero function, or ESC key to cancel the probe zero function.

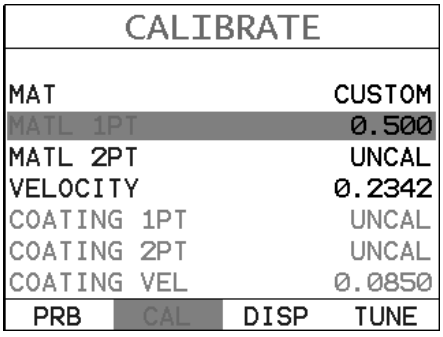
8) Remove the transducer from the probe zero disk, and proceed to the calibration section.

**Note:** *The value that is displayed will change depending on the current velocity setting in the **FX-80**. Disregard the number that is displayed. **It is not important**. What is important is accurately performing the steps outlined above to insure reliability of the probe zero calculation.*

## One Point Material Calibration

For the purposes of this quick start section, we'll only be covering the most common one point calibration option to determine the sound velocity of the test material. It would be very handy to carry a set of mechanical calipers to use in conjunction with the ***FX-80*** for calibration in the field:

### Using a Known Thickness



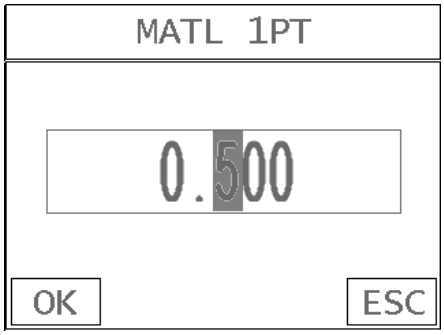

**Note:** *Be sure that the probe zero procedure has been performed prior to performing this calibration procedure.*

1) Physically measure an exact sample of the material or a location directly on the material to be measured using a set of calipers or a digital micrometer.

2) Apply a drop of couplant on the transducer and place the transducer in steady contact with the sample or actual test material. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the

display, is fully lit and stable. Press the key once to activate the menu items tab. Press the 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. Alternatively, press the and arrow keys multiple times using the left button wheel.

3) Use the and arrow keys on the left button wheel to scroll through the sub menu items until **MATL 1PT** is highlighted.




4) Press the key to display the **Digits Edit Box**.

5) Press the and arrow keys on the left button wheel to scroll the highlighted value.

6) Press the and arrow keys on the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.

8) Press the OK key to calculate the velocity and return to the menu screen, or esc to cancel the one point calibration.

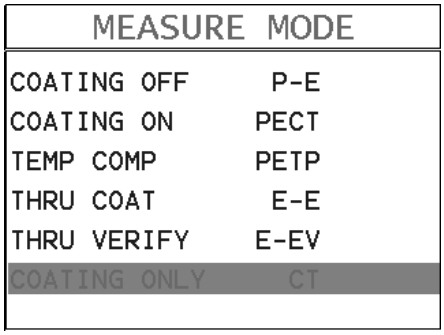
9) Finally, press the  key to return to the measurement screen and begin taking readings.

**Note:** ***CHECK YOUR CALIBRATION!*** *Place the transducer back on the calibration point. The thickness reading should now match the known thickness. If the thickness is not correct, repeat the steps above.*

## 2.7 Zero Coating

In order to account for very slight electronic differences in transducers of the same type, frequency, and diameter, the ***FX-80*** has been equipped with a "zero coating" feature. This enables the ***FX-80*** to obtain very accurate readings on coatings, eliminating potential errors incurred from slight differences in the manufacturing processes. The procedure is outlined below:

### Performing a Coating Zero




1) Press the 

key once to activate the measurement mode options.

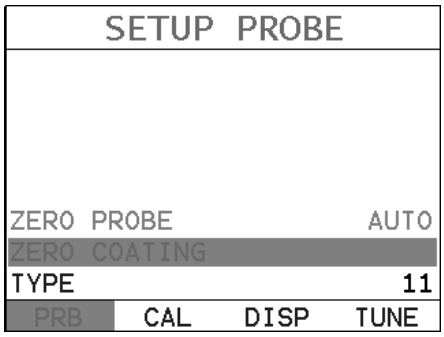
2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **Coating Only (CT)** mode is highlighted.

3) Press the  key to select the measurement mode and return to the measurement screen.

4) Apply a drop of couplant on the transducer and place the transducer in steady contact with one of the probe zero disks (emergency battery covers) and obtain a steady reading.

**Note:** *The coating measurement displayed will potentially be a value greater or less than 0.*

5) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.




6) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **ZERO COATING** is highlighted.

7) Press the ↵ key to display the confirmation screen.

8) Press the OK key to zero the coating and return to the **PRB** menu, or esc to cancel the coating zero process.

9) Press the mode key once to activate the measurement mode options.

10) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **Coating On (PECT)** is highlighted.

11) Press the  key to select the measurement mode and return to the measurement screen, and begin taking readings.

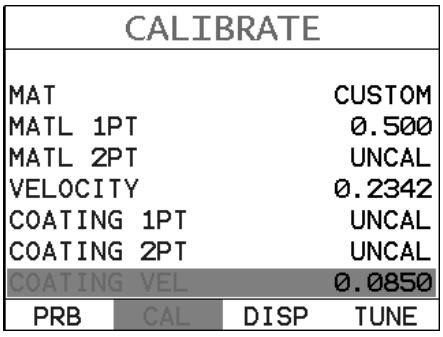
## 2.8 Coating Calibration

The ***FX-80*** has been preset to a default coating velocity of 0.0850 in/µsec (2159 m/sec). This will be very close to the most common coating material velocities used in the field. If the velocity of the coating is known, and different than the above default setting, the user can simply enter the coating velocity into the ***FX-80***. However, if the velocity is unknown, the ***FX-80*** can also be calibrated to a specific coating sample/type using the 1pt calibration option in PECT (pulse-echo coating) mode, or a two point calibration is **CT (coating only)** mode. For the purpose of this quick start section only the 1pt option **PECT (pulse-echo coating)** mode will be covered. Refer to the calibration section of the manual for a complete explanation on the coating calibration options. The following steps below outline the necessary steps to either set the velocity of the coating, or perform a one point calibration to calculate the coating velocity:

## Known Coating Velocity

If the coating velocity is known, the user may wish to simply enter the velocity number into the ***FX-80***, rather than have the ***FX-80*** calculate the velocity value using a known thickness on a coating sample. The steps for entering the velocity are outlined below:

### Using a Known Coating Velocity



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

2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **COATING VEL** is highlighted.

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

4) Press the  and  arrow keys to scroll the highlighted value.

5) Press the  and  arrow keys on the left button wheel to scroll the digit locations.

6) Repeat steps **4 & 5** until the velocity number is correctly displayed.

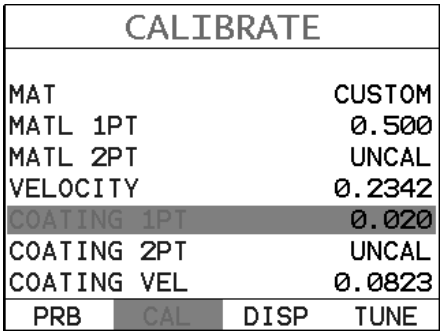
7) Press the  key to set the coating velocity and return to the menu screen, or  to cancel entering the coating velocity.

8) Finally, press the  key to return to the measurement screen and begin taking readings.

## Known Coating Thickness

When the exact velocity of a coating is unknown, the user has the option of performing a one point calibration on a sample of the coating with a known thickness to determine the sound velocity. It would be very handy to carry a set of mechanical calipers to use in conjunction with the ***FX-80*** for calibration in the field:

## Using a Coating Sample to Calibrate

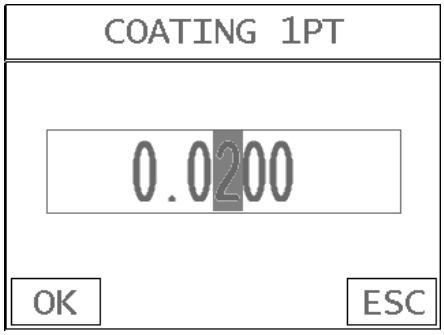



1) Physically measure a location on a coating sample using a set of calipers or a digital micrometer.

**Note:** *In **PECT** (pulse-echo coating) mode, the coating sample must be coupled to metal in order to calibrate successfully. Simply place a drop of couplant on a piece of metal, lay the coating sample over the couplant on the metal and proceed to step 2.*

2) Apply a drop of couplant on the transducer and place the transducer in steady contact with the coating (on metal) sample or actual test material. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable. Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

3) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **COATING 1PT** is highlighted.




4) Press the  key to display the **Digits Edit Box**.

5) Press the  and  arrow keys on the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys on the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.

8) Press the  key to calculate the coating velocity and return to the menu screen, or  to cancel the one point calibration.

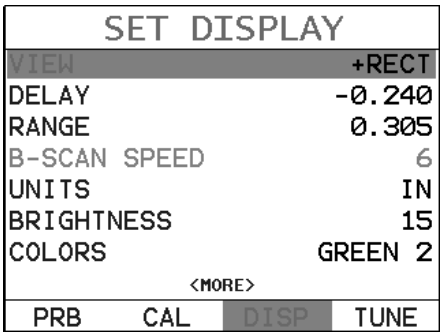
9) Finally, press the  key to return to the measurement screen and begin taking readings.

**Note:** ***CHECK YOUR CALIBRATION!*** *Place the transducer back on the calibration point. The coating thickness reading should now match the known coating thickness sample. If the thickness is not correct, repeat the steps above.*

## 2.9 Measure

The ***FX-80*** is now ready to measure. There are four different measurement view options, each with a specific purpose – Digits, RF, RECT, & B-Scan. The steps below outline how to toggle between the different view mode options:

### Selecting the Measurement View Option




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll the sub menu items until **VIEW** is highlighted.
3) Use the ◀ and ▶ arrow keys on the right button wheel to scroll the view options.
4) Once the view is displayed, press the ⌂ key to return to measurement mode.

**DIGITS:** Displays the digital thickness value using a large font size. This view is useful when the ***FX-80*** is being used as a basic thickness gauge.

**RF:** Displays the actual waveform signal, much like an oscilloscope, from the reflection of the opposite surface, pit, flaw, crack or void. This view shows both the positive and negative peaks, and is often used to fine tune the scope settings, prior to inspection.

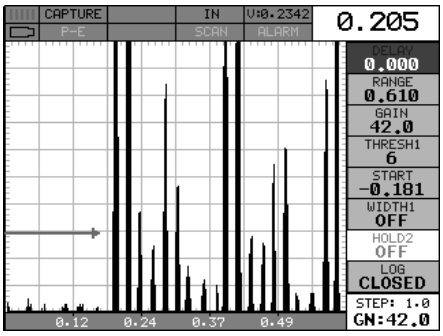
**RECT:** Displays a half waveform signal, either positive or negative, from the reflection of the opposite surface, pit, flaw, crack or void. The user can select the polarity or "phase" displayed. This is typically determined by first using RF view to select the most optimal polarity "phase", to fine tune the scopes settings. The RECT view is commonly used as the primary "flaw detection" view.

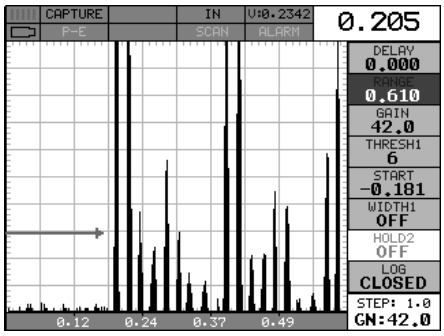
**BSCAN:** The Time Based B-Scan provides the user with a cross sectional view of the material being tested. This mode is useful when there is concern regarding the profile of the blind surface. This can also be a useful view when scanning for pits and flaws.

Once the view has been selected according to the application requirements, the **Delay** and **Range** of the screen will potentially need to be adjusted, if the view has been set to **RF** or **RECT**. Alternatively, if **BSCAN** was selected, the **B-Start** and **B-Depth** settings will need to be adjusted. These settings serve the same purpose, with only differences in terminology. The **Delay** the same as **B-Start**, and the **Range** is the same as **B-Depth**. Therefore, these items will be grouped together for the duration of this manual, as follows: **Delay (B-Start)** and **Range (B-Depth)**. Use the following steps to adjust these settings directly from the measurement screen as follows:

**Note:** *The **Delay (B-Start)** and **Range (B-Depth)** are also used to adjust the parameters of **Scan Bar**.*

## Adjusting Delay (B-Start) & Range (B-DEPTH)



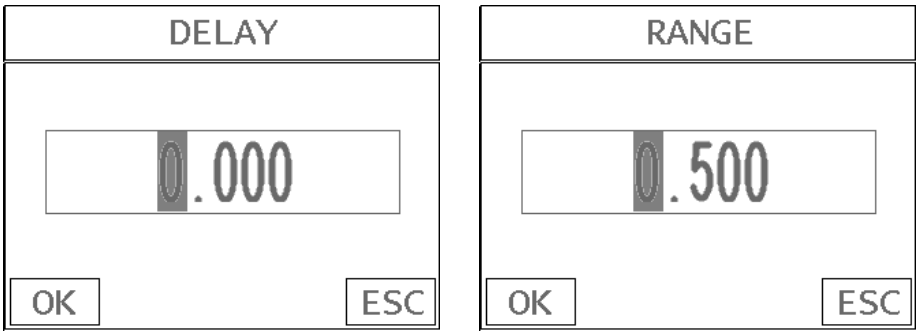

1) Press the  key once to activate the measure menu items. Press the  key multiple times to move right and the  key multiple times to move left, until the either the **DELAY (START)** or **RANGE (DEPTH)** cell is highlighted. Alternatively, use the  and  arrow keys on the left button wheel.

2) Use the  and  arrow keys on the right button wheel to scroll the **DELAY (START)** and **RANGE (DEPTH)** values.

3) Repeat steps **1 & 2** until the range is correctly being displayed.

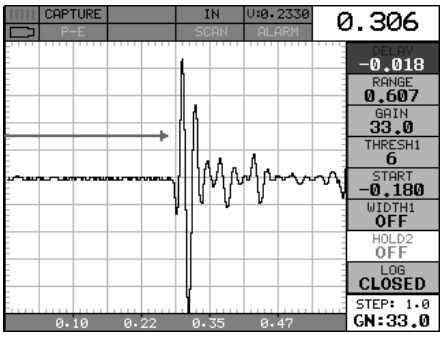
Alternatively, the **DELAY (START)** and **RANGE (DEPTH)** values can be changed using the **Digit Edit Box** as follows:

4) Press the  key once to activate measure menu items. Press the  key multiple times to move right and the  key multiple times to move left, until the either the **DELAY (START)** or **RANGE (DEPTH)** cell is highlighted. Alternatively, use the  and  arrow keys on the left button wheel.

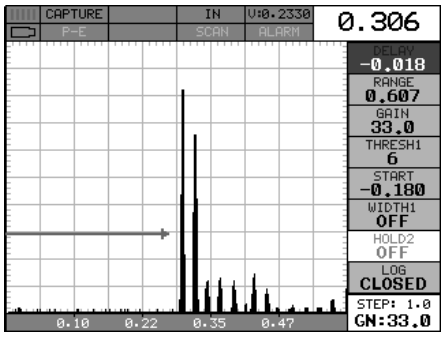



1) Press the ↵ key to display the digits edit box.
2) Press the ▲ and ▼ arrow keys to scroll the highlighted value.
3) Press the ▲ and ▼ arrow keys on the left button wheel to scroll the digit locations.
4) Repeat steps **2 & 3** until the **DELAY (START)** or **RANGE (DEPTH)** value is correctly displayed.
5) Press the OK key to set the **DELAY (START)** and **WIDTH (DEPTH)** value and return to the measure screen, or ESC to cancel entering the **DELAY (START)** or **WIDTH (DEPTH)** value.
6) Finally, press the ⌂ key to return to the measurement screen and begin taking readings.

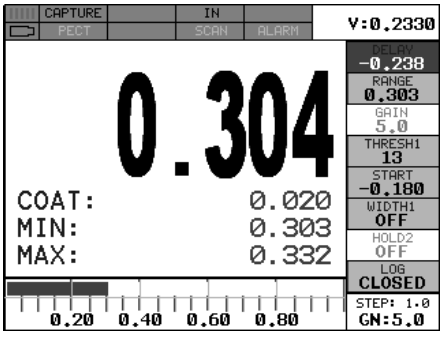
**Note:** *The **DELAY (START)** & **WIDTH (DEPTH)** can also be adjusted from the tabbed menu item **DISP**. However, using the hot menu keys is the easiest method.*



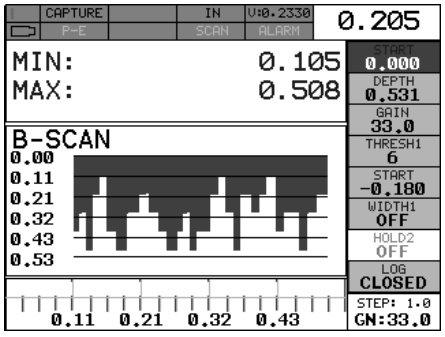

**RF View**




**Rectified (RECT) View**




**Digits View**




**B-Scan View**

In the upper left corner of each of the display photos above, is the repeatability indicator. The repeatability indicator is represented by six vertical bars and represents how repeatable the measurements are. In regular measurement mode, the ***FX-80*** makes 8 measurements a second. In scan mode, the ***FX-80*** makes 200 measurements a second. If the coating mode option is activated, the ***FX-80*** makes 3 measurements a second in regular measurement mode and 65 measurements a second in scan mode. When the ***FX-80*** is idle, only the left vertical bar will be displayed. However, when the ***FX-80*** is making a measurement, four or five of the bars should be displayed on the repeatability indicator. If fewer than four bars are showing, the ***FX-80*** is having difficulty achieving a stable measurement and the thickness value displayed is potentially unstable.

# CHAPTER THREE
# KEYBOARD, MENU, & CONNECTOR REFERENCE

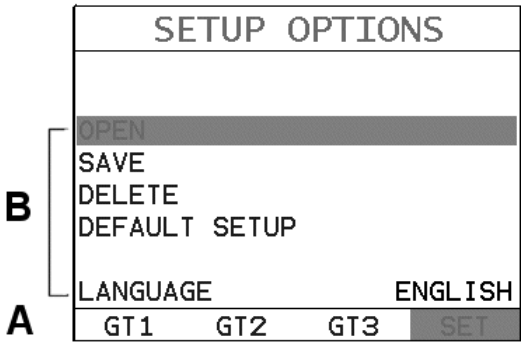



## 3.1 Menu Key (Operation & Sub Menus)



The **Menu** key activates the primary menu structure containing 10 menu tab groups. These tab groups then contain sub menu items, or functions. The sub menu items have been organized in 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 Getting Around in the Menu Items




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel. 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:

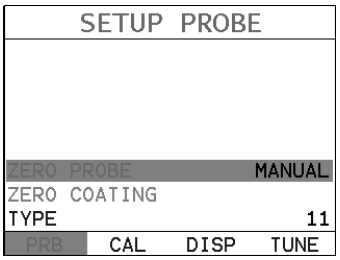
## Getting Around in the Sub Menu Items

1) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until the desired function is highlighted. The sub menu items are illustrated in the diagram above **(B)**.

2) Depending on which function is highlighted, use the ◀ and ▶ arrow keys on the right button wheel to scroll the options, or the ↵ key to 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

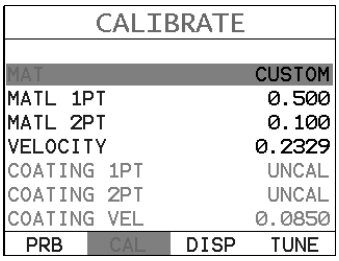



**ZERO PROBE:** The **FX-80** is zeroed in much the same way that a mechanical micrometer is zeroed. If the **FX-80** is not zeroed correctly, all of the measurements made using the ***FX-80*** may be in error by some fixed value. The ***FX-80*** is equipped with an optional automatic or manual zero feature. Refer to the section on page 50, for an explanation of this important procedure.

**ZERO COATING:** In order to account for very slight electronic differences in transducers of the same type, frequency, and diameter, the ***FX-80*** has been equipped with a "zero coating" feature. This enables the ***FX-80*** to obtain very accurate readings on coatings, eliminating potential errors incurred from slight differences in the manufacturing processes. Refer to the section on page 50, for a detailed explanation.

**TYPE:** Enables the user to select the type of transducer being used from a chart of transducer types. This provides increased linearity between transducers. Refer to page 47 for a further explanation.

## 3.3 CAL – Menu




**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 60 for further info.

**MATL 1PT:** Performs a single point calibration. This option allows the user to automatically calculate the velocity by entering a known sample thickness. Refer to page 56 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 58 for further info.

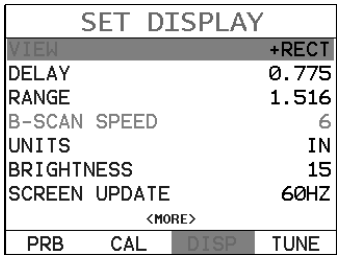
**VELOCITY:** Function to calibrate the ***FX-80*** by setting the velocity to a known material velocity. Refer to page 54 for further info.

**COATING 1PT:** Performs a single point coating calibration. This option allows the user to automatically calculate the velocity by measuring a known coating sample thickness. Refer to page 109 for further info.

**COATING 2PT:** Performs a two-point coating calibration. This option allows the user to automatically calculate the velocity by entering a second known coating sample thickness. Refer to page 109 for further info.

**COATING VEL:** Function to calibrate the ***FX-80*** to a specific coating material type by entering a coating velocity. Refer to page 16 or page 103 for further info.

## 3.4 DISP (display) – Menu




**VIEW:** Selectable **BSCAN** (cross section), and **DIGITS** (large digits) views. Refer to page 63 for further info.

**DELAY (B-START):** Provides the user the ability to change the start position of the B-SCAN view. Refer to page 72 for further info.

**RANGE (B-DEPTH):** Provides the user the ability to change the overall depth of the viewable measurement area. It functions a lot like a zoom on a camera. Refer to page 74 for further info.

**B-SCAN SPEED:** Controls the speed of the time based B-Scan with an arbitrary scale of 0-10, with 10 being the fastest scrolling speed. Default speed set at 6. Refer to page 76 for further info.

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

**BRIGHTNESS:** Blanview high speed color display. An arbitrary scale of 1-20 has been implemented, with the brightest setting at 20. Refer to page 121 for further info.

**COLOR:** Provides the user with 12 different color schemes to select from. There are two schemes for each main color option. Refer to page 122 for further info.

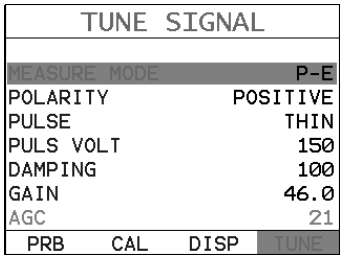
**DIM:** Allows the user to conserve battery life by diming the display after idle for a specific amount of time – OFF, 30, 60, 90, 120 seconds. Once dimmed, a single press of any key will restore the screen brightness. Refer to page 124 for further info.

**RECT WAVE:** This option provides the user an outlined or filled view option when the display setting is in RECT (rectified) wave mode only. Refer to page 126 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.

**GRATICULE:** Selectable graphics option for the A-Scan background (grid/segments) used as references to depth/thickness versus amplitude. The options are: Point, Line, Dots, Mix. Offers the user a graphics preference on how they prefer to view the A-Scan waveform area. Refer to page 128 for further info.

## 3.5 TUNE – Menu




**MEASURE MODE:** Toggles a variety of unique measurement modes for different application requirements: Coating Off (P-E), Coating On (PECT), Temp Comp (PETP), Thru Coat (E-E), Thru Verify (E-EV), Coating Only (CT). Refer to page 41 for further info.

**POLARITY:** The ***FX-80*** operates on a zero crossing detection principle. This feature toggles which stroke of the cycle the crossing detection uses, either positive or negative. Refer to page 130 for further info.

**PULSE:** The ***FX-80*** 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 132 for a further explanation.

**PULSER VOLTAGE:** This feature offers a 50 volt cut/boost to the pulser. The standard setting is 150 volts. This enables the ***FX-80*** to offer greater penetration for difficult material types, or increased resolution on noisy materials. Refer to page 133 for a further explanation.

**DAMPING:** Provides the user with multiple input impedances to match the impedance of the transducer, and optimized overall transducer performance. Refer to page 125 for further info.

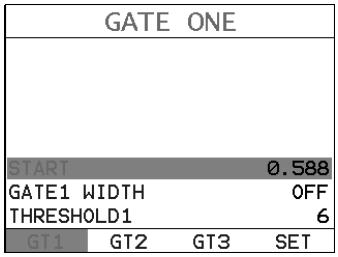
**GAIN:** The ***FX-80*** has 100dB gain range from (-30 to 70 dB), used in conjunction with the attenuator feature above. This feature is used to increase/decrease the power or amplitude of the signal. This might easily be considered as similar to turning the volume up or down on a stereo receiver. Refer to page 77 for further info.

**AGC:** This an automatic gain control used in E-E (echo-echo), and E-EV (echo-echo verify). The ***FX-80*** is equipped with an automatic gain control when operating in -E

(echo-echo), and E-EV (echo-echo verify) modes only. This feature automatically increases/decreases the power or amplitude of the signal, to an optimal input to output signal ratio. This might easily be considered as similar to turning the volume up or down on a stereo receiver. Alternatively, the AGC can be manually controlled. The ***FX-80*** is equipped with manual override, using an arbitrary range of 1-20 clicks. The higher the number the better the dynamic gain range, and visa versa. Refer to page 77 for further info.

**GAIN SLOPE (TIME DEPENDENT GAIN):** Similar to 'time corrected gain' but a linear gain ramp that increases the output of the ***FX80*** at a constant rate over time (dB per microsecond). Can be used in both pulse-echo (P-E) and echo-echo (E-E) modes to overcome attenuative materials. Refer to page 134 for further info.

## 3.6 GT1 – Menu

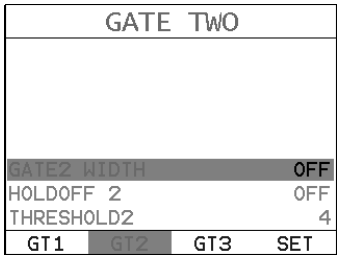



**GATE1:** Gates allow the user to view a specific measurement range, or sections of the waveform, and ignore others. The Gate1 feature adjusts the start of the gate, according to time/distance. Gate 1 can be used in all pulse-echo and echo-echo measurement modes. Refer to page 86 for further info.

**GATE1 WIDTH:** This feature allows the user to set the overall width of the gate, in terms of distance, from the starting value of Gate1. Refer to page 86 for further info.

**THRESHOLD1:** Enables the user to set the sensitivity level of Gate1. The amplitude of the signal must reach or exceed the threshold level before a measurement is detected. Refer to page 86 for further info.

## 3.7 GT2 – Menu



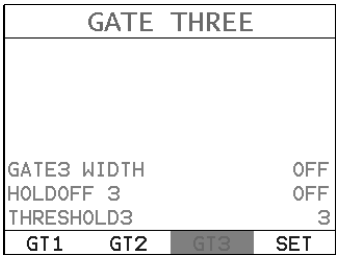

**GATE2 WIDTH:** This feature allows the user to set the overall width of the gate, in terms of distance, from the starting value of HoldOff2. Refer to page 86 for further info.

**HOLDOFF 2:** Provides the user with the ability to delay the starting point of Gate2, a specific distance from the first detection point found inside of the boundaries of the

Gate 1 settings. If no detection is found, the Gate1 width value is used as a starting value for Gate2. Refer to page 86 for further info.

**THRESHOLD2:** Enables the user to set the sensitivity level of Gate2. The amplitude of the signal must reach or exceed the threshold level before a measurement is detected. Refer to page 86 for further info.

## 3.8 GT3 – Menu

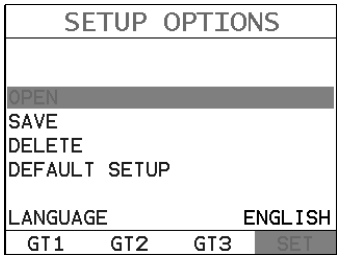



**GATE3 WIDTH:** This feature allows the user to set the overall width of the gate, in terms of distance, from the starting value of HoldOff3. Refer to page 86 for further info.

**HOLDOFF 3:** Provides the user with the ability to delay the starting point of Gate3, a specific distance from the first detection point found inside of the boundaries of the Gate 2 settings. If no detection is found, the Gate2 width value is used as a starting value for Gate3. Refer to page 86 for further info.

**THRESHOLD3:** Enables the user to set the sensitivity level of Gate3. The amplitude of the signal must reach or exceed the threshold level before a measurement is detected. Refer to page 86 for further info.

## 3.9 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 169 for further info.

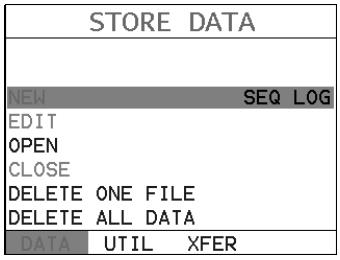
**SAVE:** Provides the user with the ability to save a custom setup that has been modified or created by the user. Refer to page 171 for further info.

**DELETE:** Provides the user with the ability to delete specific setups previously save in memory. Refer to page 174 for further info.

**DEFAULT SETUP:** Loads a basic default setup. Use only as a last resort when the setups in the ***FX-80*** have been corrupted and a computer is not accessible. Refer to page 176 for further info.

**LANGUAGE:** Provides the user the ability to select different languages for the ***FX-80***. Refer to page 178 for further info.

## 3.10 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 146 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 163 for further info.

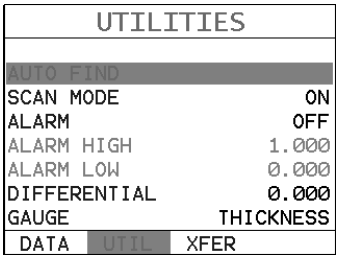
**OPEN:** This function provides the user with the ability to recall grids or sequential log files that currently exist in memory, from a list of grids. Refer to page 165 for further info.

**CLOSE:** Provides the user the ability to close a currently opened grid or sequential log file. Refer to page 167 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 160 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 162 for further info.

## 3.11 UTIL (utilities) – Menu




**AUTO FIND:** Automatically locates the detection point if the measurement is out of the viewable display area. Refer to page 115 for further info.

**SCAN MODE:** This function enables a hi speed scan mode that increases the overall sample rate from 65 to 200 measurements per second, depending on the current measurement mode used. Refer to page 115 for further info.

**ALARM:** Toggles alarm mode on, off, or audible. Refer to page 117 for further info.

**ALARM HIGH:** Gives the user the ability to set the HI limit parameter. If the measurement exceeds this value, a red light will illuminate and sound the internal beeper. Refer to page 117 for further info.

**ALARM LOW:** Gives the user the ability to set the LO limit parameter. If the measurement falls below this value, a red light will illuminate and sound the internal beeper. Refer to page 117 for further info.

**DIFFERENTIAL:** Gives the user the ability to set a nominal value and the ***FX-80*** will display +/- the difference from the nominal value entered. Refer to page 119 for further info.

**GAUGE:** Gives the user the ability to select between the two gauge types included in the ***FX-80***, thickness gauge or flaw detector. Refer to page 5 for further info.

**ANALOG OUTPUT:** Proportional output (thickness), 0-10 volts. Speed is determined by the **PRF** setting. Refer to page 136 for further info.

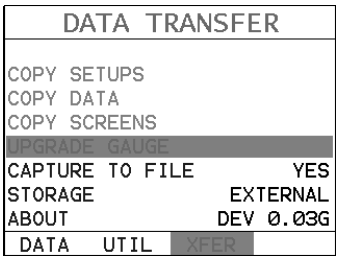
**SERIAL OUTPUT:** Proportional outputs (thickness), 0-10 volts. Speed is determined by the **PRF** setting. Refer to page 137 for further info.

**KEY CLICK:** Gives the user the ability to set the level of the key press beeper OFF, QUIET, or LOUD. Refer to page 138 for further info.

**SET DATE:** Gives the user the ability to set the internal date and time stamp in the ***FX-80***. Refer to page 139 for further info.

**SHOW DATE:** Gives the user the ability to display the date and time in the waveform area of the ***FX80***. The options are OFF, DATE, TIME, BOTH. Refer to page 141 for further info.

## 3.12 XFER (transfer) – Menu




**COPY SETUPS:** Copies setup files from either the internal or external SD memory card to the other memory card, depending on the current internal/external setting of **Storage** (current device being used to store data), located in the XFER menu. Refer to page 181 for further info.

**COPY DATA:** Enables the user to copy all, or individual grid/log files from either the internal or external SD memory card to the other memory card, depending on the current internal/external setting of **Storage** (current device being used to store data), located in the XFER menu. Refer to page 181 for further info.

**COPY SCREENS:** Copies screen capture (.tif's) files from either the internal or external SD memory card to the other memory card, depending on the current internal/external setting of **Storage** (current device being used to store data), located in the XFER menu. Refer to page 181 for further info.

**UPGRADE GAUGE:** Enables the user the ability to upgrade the ***FX-80*** to the most current firmware revision. Refer to page 183 for further info.

**CAPTURE TO FILE:** Enables the user the ability to enable screen captures to .tiff files, and used in conjunction with the 

key. Refer to page 141 for further info.

**CAPTURE VIEWER:** Enables the user to view all the captured (.tif) files stored in the ***FX-80*** on the gauge display. Refer to page 143 for further info.

**STORAGE:** Enables the user to select which SD memory card to use for storage. Note: if no card exists in the external reader slot, this option will be grayed out and inactive. Refer to page 180 for further info.

**ABOUT:** Provides the user with Dakota NDT contact information and the ***FX-80*** software version. Refer the Dakota NDT web site for information on the latest firmware versions available for download.

## 3.13 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, and backspace in an **Alpha Edit Box**. If a user has already saved a measurement and B-Scan to a cell location, use this key to clear the measurement at any time.

## 3.14 HOME (measurement mode) Key 

The **HOME** key puts the ***FX-80*** into it's primary mode of operation. In this mode, the user has a complete view of the LCD.

## 3.15 OK Key 


The primary function of the **OK** key is confirmation of a change or selection. The **OK** key also toggles the Hot Menu area, while in measurement mode, to a large digits display area. If the ***FX-80*** is displaying a grid log, the **OK** key toggles an advance to row number option.

## 3.16 ESC Key




The **ESC** key is used in conjunction with the , , and **EDIT** functions as a back or escape function. If the ***FX-80*** is displaying a grid or sequential log, the 

key toggles the display options: Digits, RF, RECT, and B-Scan views.

## 3.17 Wheel Keys





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

## 3.18 ENTER key



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

## 3.19 MULTI MODE Key




The MULTI MODE key opens a measurement mode screen, listing all the modes that are available to the transducer specifically selected, or auto detected. The modes can be all or a combination of the entire set of modes the ***FX-80*** offers, depending on which transducer is being used as follows: **Coating Off (P-E), Coating On (PECT), Temp Comp (PETP), Thru Coat (E-E), Thru Coat Verify (E-EV), and Coating Only (CT)**.

## 3.20 DATA Key




The **DATA** key opens the tabbed data menu, allowing a user to efficiently create a new log/grid file for storage.

## 3.21 STORE Key




The **STORE** key displays the current log/grid opened in split screen mode. If no log/grid file is open, the **STORE** key will open the tabbed data menu in order create a new, or open an existing log/grid file for storage.

## 3.22 PEAK Key




The **PEAK** key is a feature used in the flaw detector portion of the ***FX-80***, and is not used in the thickness gauge.

## 3.23 FREEZE Key



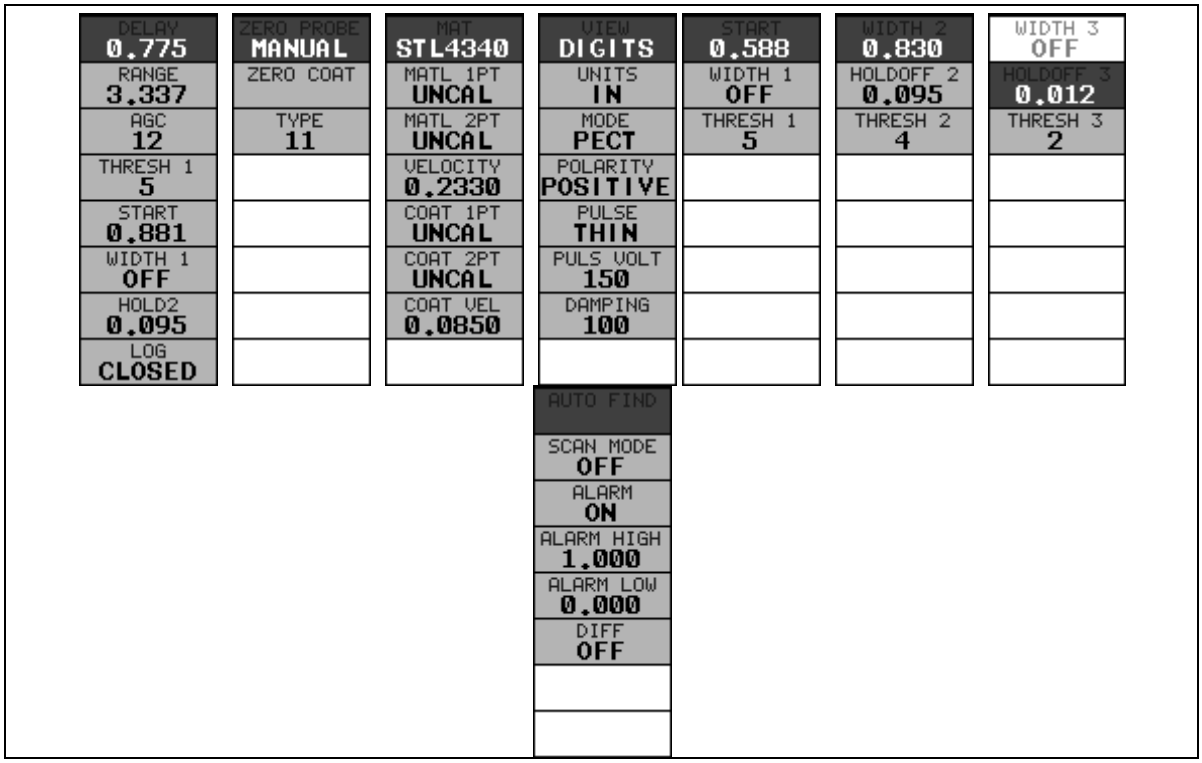

The **FREEZE** key is used to freeze the display for evaluation/review of what's currently on the display. It is also used in conjunction with the **CAPTURE** feature to save the current display to a .tif (tagged image) graphic file that can be opened using any graphics viewer.

## 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 Navigating the Hot Menus



The diagram above is a screenshot of all 8 “Hot Menus” in the ***FX-80***. The Hot Menu’s contain all the most regularly adjusted features from each tabbed menu, in the exact order of the tabbed menus themselves. Some of the menus have been combined into a single Hot Menu, in order to reduce the number of Hot Menus (i.e. GT1 & GT2 have been combined into a single Hot Menu). The primary purpose of the design was to provide the user with an efficient way to make adjustments on the fly, while continuing to have visibility of the A-Scan display. The following procedure outlines the steps to navigate and make adjustments as follows:

## Navigating Hot Menus

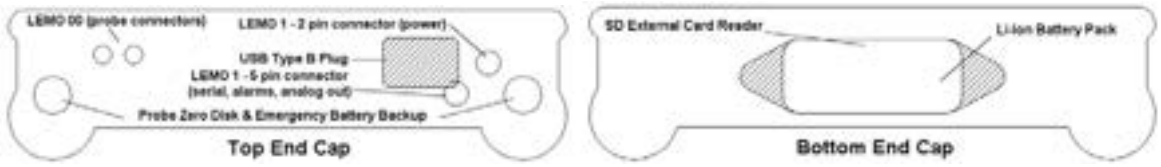
1) Using the left button wheel, press the  and  arrow keys to scroll through the 8 individual **Hot Menus**, and the  and  arrow keys to scroll through the **Hot Menu** items. Alternatively, the  **&**  keys can be used to scroll through the **Hot Menu** items.

2) Press the  and  arrow keys multiple times on the right button wheel 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. Pressing the*  *key will allow the user to enter a specific target value.*

***This procedure above is universal for navigating through and selecting all the features in the Hot Menus.***

## 3.26 Top & Bottom End Caps




The top & bottom end panels are where all connections are made to the ***FX-80***. The diagram above shows the layout and description of the connectors:

**Transducer Connectors**

Refer to Diagram: The transducer connectors, emergency battery backup channels/probe zero disks, power connector and auxiliary connector are located on the ***FX-80's*** top end cap. The transducer connectors are of type Lemo "00". Note: There is no polarity associated with connecting the transducer to the ***FX-80***.

**Probe Zero Disk & Battery Cover**

**Refer to Diagram:** The emergency battery backup disks are the large round disks 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) for each. When performing a manual probe zero function, simply place the transducer on disk making firm contact. **Important:** Be sure to follow the polarity label located on the back label of the ***FX-80***. **Note:** Rechargeable batteries can be used, however they must be recharged outside of the unit in a standalone battery charger.

**USB Type B Connector**

**Refer to Diagram:** The **USB** connector is a common type B connector found on a variety of electronic devices. This port will be used to transfer stored grid/log files, captured screen shots, etc. This connector will also be used to upgrade the ***FX-80*** with the latest version of firmware (gauge software). The cable supplied with the ***FX-80*** is USB type A to USB type B.

**RS-232 Serial Connection (LEMO 1 – 5 pin)**

**Refer to Diagram:** The **RS-232** connector is a 5 pin female Lemo 1 connector. It is designed to connect directly from the ***FX-80*** to a standard AT serial port on a PC, and will be used in conjunction with our proprietary java application software called "Remote Commander". The primary purpose of the Remote Commander software, will be for use in conjunction with a projector connected to a PC for classroom training programs and demonstration purposes. An accessory 9 pin female serial to Lemo 1 - 5 pin male cable will be required to use this feature, and is not included in the standard kit.

**Alarms Connection (LEMO 1 – 5 pin)**

**Refer to Diagram:** The **RS-232** connector is a 5 pin female Lemo 1 connector. This is used for connecting each alarm directly to an external source. An accessory 9 pin female serial to Lemo 1 - 5 pin male cable will be required to use this feature, and is not included in the standard kit.

**Power Connector (LEMO 1 – 2 pin)**

**Refer to Diagram:** The Lemo 1 2 pin connector is used for direct line power and charging the Li-Ion battery pack.

# CHAPTER FOUR
# PRINCIPALS OF ULTRASONIC MEASUREMENT

## 4.1 Time versus thickness relationship

Ultrasonic thickness measurements depend on measuring the length of time it takes for sound to travel through the material being tested. The ratio of the thickness versus the time is known as the sound velocity. In order to make accurate measurements, a sound velocity must be determined and entered into the instrument.

The accuracy of a thickness measurement therefore depends on having a consistent sound velocity. Some materials are not as consistent as others and accuracy will be marginal. For example, some cast materials are very granular and porous and as a result have inconsistent sound velocities.

While there are many different ultrasonic techniques to measure thickness, which will be discussed below, all of them rely on using the sound velocity to convert from time to thickness.

## 4.2 Suitability of materials

Ultrasonic thickness measurements rely on passing a sound wave through the material being measured. Not all materials are good at transmitting sound. Ultrasonic thickness measurement is practical in a wide variety of materials including metals, plastics, and glass. Materials that are difficult include some cast materials, concrete, wood, fiberglass, and some rubber.

## 4.3 Range of measurement and accuracy

The overall measurement capabilities, based on the wide variety of materials, is determined by the consistency of the material being measured

The range of thickness that can be measured ultrasonically depends on the material as well as the technique being used and the type of transducer. Thickness measurements can be made from a minimum of 0.010 inch to 100 feet in steel. However, the maximum attainable thickness is much less for more attenuative materials (materials that absorb sound).

Accuracy, is determined by how consistent the sound velocity is through the sound path being measured, and is a function of the overall thickness of the material. For example, the velocity in steel is typically within 0.5% while the velocity in cast iron can vary by 4%.

## 4.4 Couplant

All ultrasonic applications require some medium to couple the sound from the transducer to the test piece. Typically a high viscosity liquid is used as the medium. The sound frequencies used in ultrasonic thickness measurement do not travel through air efficiently. By using a liquid couplant between the transducer and test piece the amount of ultrasound entering the test piece is much greater.

## 4.5 Temperature

Temperature has an effect on sound velocity. The higher the temperature, the slower sound travels in a material. High temperatures can also damage transducers and present a problem for various liquid couplants.

Since the sound velocity varies with temperature it is important to calibrate at the same temperature as the material being measured.

### Normal temperature range

Most standard transducers will operate from 0°F to 180°F.

### High temperature measurements

Special transducers and couplants are available for temperatures above 180°F up to 900°F with intermittent contact. It is necessary to cool the transducer, by submerging the transducer in water between readings, when measuring high temperatures.

### Modes and temperature errors

In addition to errors caused by velocity changing with temperature, some modes (measurement techniques) are affected more than others. For example, dual element pulse-echo mode has larger errors due to changes in the temperature of the delay line. However, multi-echo techniques offer temperature compensation help to minimize these errors.

## *4.6* Measurement Modes

In this section we will discuss the different measurements modes the ***FX-80*** is capable of operating in, the transducers required, and the reasons for using specific modes:

### Pulse-Echo Mode (Flaw & Pit detection) – Coating Off (P-E)

Pulse-echo mode measures from the initial pulse (sometimes referred to as an artificial zero) to the first echo (reflection). In this mode, either an automatic or manual zero can be performed depending on the zero probe function setting. If the manual mode has been selected, the transducer is placed on a reference disk, located on top of the ***FX-80***, and a key is pressed to establish a zero point for the particular transducer. If the Auto Zero feature is enabled, a simple key press will perform an electronic zero to establish the same zero point.

In this mode errors result from surface coatings and temperature variations.

Since pulse-echo only requires one reflection, it is the most sensitive mode for measuring weak reflections (flaws) typically found when measuring heavily corroded metals.

### V-Path Correction

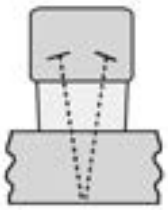
Dual element delay line transducers have two piezoelectric elements mounted at an angle on one end of the delay line. One element is used for transmitting sound, while the other element only receives sound. The two elements and their delay lines are packaged in a single housing but acoustically isolated from each other with a sound

barrier. This allows the transducer the ability to achieve very high sensitivity for detecting small defects. Also, the surface of the test material does not have to be as flat in order to obtain good measurements.

Dual element transducers are normally used in pulse-echo mode for finding defects, and in echo-echo mode for through coating measurements.

Dual element delay line transducers are usable over a range starting as thin as 0.025 inches and up, depending on the material, frequency, and diameter.

A limitation of dual element delay-line transducers is the V shaped sound path. Because the sound travels from one element to another, the time versus thickness relationship is non-linear. Therefore, a correction table in the instruments software is used to compensate for this error.



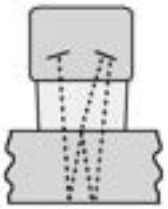
**Dual Element Transducer showing V-path of signal**

### Searching for small defects

Dual element delay line transducers are especially useful in searching for small defects. In the pulse-echo mode with high amplifier gain, very small defects can be measured. This is very useful during corrosion inspections overall. The dual element style transducer will find wall deterioration, pits, and any porosity pockets during tank and pipeline inspections.

### Echo-Echo Mode – Thru Coat (E-E)

The echo-echo mode measures between two reflections. This technique is commonly used to eliminate errors from surface coatings and also to make measurements in multiple layered materials. The disadvantage is that two echoes are needed which requires a much stronger echo (reflection).

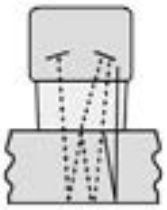


**Dual Element Transducer in Echo to Echo mode**

### Echo-Echo Verify Mode – Thru-Verify (E-EV)

The echo-echo verify mode measures between 3 reflections. Similar to E-E mode, this technique is commonly used to eliminate errors from surface coatings and also to make measurements in multiple layered materials. The primary benefit of this mode,

is that a comparison is made, between the 2nd and 3rd echoes, to verify that a peak jump has not occurred, providing an additional level of confidence to the measurement. The disadvantage is that 3 reflections are needed which requires the use of gates with controllable thresholds to adjust for sensitivity over a given measurement range.



**Dual Element Transducer in Echo to Echo mode**

**Pulse Echo Coating Mode – Coating On (PECT)**

A custom hybrid combination mode using properties from the basic modes along with a group of special techniques and theoretical wave phenomena's to measure coating and material thicknesses at the same time, while still retaining the ability to locate flaws and pits in materials. Therefore, the best description for this hybrid mode is Pulse-Echo Coating mode.

**Coating Mode – Coating Only (CT)**

Once again, this is a custom hybrid combination mode using special techniques to effectively measure the thickness of coatings that are either adhered to metallic surfaces or in standalone form. In this mode a two point calibration must be performed. If the user will be measuring coating that has been applied to a metal surface, the calibration must be performed using coating samples coupled to a metal surface when calibrating. To explain further, a drop of couplant must be applied in between the coating samples and metal surface. If the coating has not been applied to a metal surface, the calibration should be performed accordingly.

**Pulse-Echo Temperature Compensated Mode – Temp Comp (PETP)**

This is a custom mode that combines pulse-echo and electronic zero techniques to automatically adjust for temperature changes in the transducer as a result of an increasing/decreasing temperature gradient in the test material. Note: rough surface conditions can have an effect on the overall accuracy in this mode. If the surface condition is in question, the pulse-echo mode should be used in conjunction with performing an off block automatic zero as the temperature gradient changes.

# CHAPTER FIVE
# SELECTING THE MEASUREMENT MODE

## 5.1 The setup library

The ***FX-80*** contains 64 user configurable preset locations to store custom setups for easy recall. These setups can be optimized for the user's specific application needs and can also be stored on a PC and transferred bi-directionally using Dakota's PC interface software included with the instrument.

The setups supplied with the instrument cover some of the more typical applications commonly used with this type of instrument. These setups can be recalled, modified, and overwritten to one of 64 setup locations. Therefore, these factory setups can also be considered a good starting point to be modified for custom applications. The PC software includes a default setup file that can be uploaded to the gauge at any time to restore factory settings. However, it is recommended that the user consider saving modified setups to an empty location rather than overwriting the factory setups in the ***FX-80***. Once again, these factory settings are excellent starting points for custom setups.

## 5.2 Which mode & transducer do I use for my application?

### High penetration plastics and castings

The most common mode for these types of applications is pulse-echo. The FX-80 has been optimized for cast materials. Cast iron applications require 1 - 5MHz frequencies, and cast aluminum requires a 10MHz frequency. Plastics typically require lower frequencies depending on the thickness and make-up of the material. Larger diameters offer greater penetration power because of the crystal size, for difficult to measure materials.

### Corrosion & Pit Detection in steel and cast materials

Use pulse-echo mode whenever attempting to locate pits and flaws. Typically a 5MHz transducer, or higher, will be used for these types of applications. Use low frequencies for greater penetration and use higher frequencies for better resolution.

### Measuring Material & Coatings

The pulse-echo coating mode should be used when both material and coating thickness are required, while still requiring the ability to detect flaws and pits. A special coating style transducer is required for use in this mode. There are a variety of coating transducers in various frequencies available from Dakota.

### Thru Paint & Coatings

Often times, users will be faced with applications where the material will be coated with paint or some other type of epoxy material. Since the velocity of the coating is approximately 2.5 times slower than that of steel, pulse-echo mode will induce error if

the coating or paint is not completely removed. By using echo-echo mode, the user is able to successfully measure through both, the coating and steel, and completely eliminate the thickness of the paint or coating. Therefore, the steel can be measured without having to remove the coating prior to measuring. Users will often use pulse-echo mode and echo-echo mode in conjunction when performing inspections on coated materials.

Thru coating measurements require special high damped transducers. The most common transducers are the 3.5, 5, and 7.5MHz hi damped transducers. These transducers are suitable for use in both pulse-echo and echo-echo modes. This conveniently enables the user to accurately measure overall material thickness using the thru Coating mode, and then conveniently switch to pit detection mode without changing transducers. The ¼" 5MHz Hi damped transducer is the most commonly used transducer for standard thru coating applications.

### Coating Only

The coating only mode should be used when the application calls for coating measurements only and the user is not interested in the thickness of the material the coating has been applied to. This mode can also be used as a standalone coating thickness gauge, where the coating has not been applied to another material surface. An auto identified coating probe must be attached to the ***FX-80*** in order to enable this mode.

### Thin materials

Use pulse echo mode and a high frequency transducer for these types of applications. The most common transducers are the 7.5MHz and 10MHz models with extra resolution. The higher frequencies provide greater resolution and a lower minimum thickness rating overall.

### High temperature

Use and select a special 2.25MHz and 5 MHz High temperature transducer for these types of applications. Both pulse-echo and echo-echo modes will also work for these applications. However, echo-echo mode will eliminate error caused by temperature variations in the delay line of the transducer.

### Noisy Material

Materials such as titanium, stainless steel, and aluminum may have inherent surface noise issues. This is a signal that appears at the surface of the material when using a dual element delay line probe. Select a higher frequency transducer to reduce this noise – 7.5MHz and higher for better resolution.

### Restricted access

Measuring materials with extreme curvatures or restricted access, higher frequencies with smaller diameters should be considered. The smallest diameter uses 3/16" crystals with a contact area of .250". Custom transducers are available on request.

## 5.3 Factory Setup Chart

| Num | Name | Comment 1 | Gn/AGC | Velocity |
|---|---|---|---|---|
| 1 | Enter Custom Name | | | |
| 2 | … | | | |
| 3 | … | | | |
| 4 | … | | | |
| 5 | … | | | |
| 6 | … | | | |
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# CHAPTER SIX
# MAKING MEASUREMENTS

The steps involved in making measurements are detailed in this section. The following sections outline how to setup and prepare your ***FX-80*** for field use.

An automatic or manual zero must always be performed. The auto zero is an off block electronic zero that does not require a zero reference block. This will most always be the zero option of choice, as it makes the zeroing process very easy and convenient to perform. However, If the manual zero option is enabled, the probe zero must be measured on the reference disk (battery disk) attached to the top of the instrument. The zero compensates for variations in the transducer. In all modes the sound velocity must be determined. The sound velocity is used to convert the transit time to a physical length. The sound velocity can be selected from a material chart in the manual, selected from a material list in the ***FX-80***, or for greater precision determined from a sample of the test material that has been mechanically measured. To enter the velocity from a table, look up the material on the chart in the appendix of this manual and refer to the section below on Calibration to a Known Velocity. To determine the velocity of a single sample, refer to the Material Calibration section on page 56.

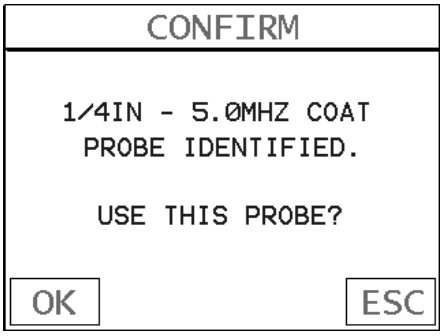
When measuring curved materials, it is more accurate to calibrate from two test points, one at the minimum limit of the target thickness and one at the maximum limit. In this case the reference disk mounted to the ***FX-80*** is not used. This is called two-point calibration and is described on page 58.

## 6.1 Auto Probe Recognition & Selecting the Transducer Type

The first step in using the ***FX-80*** is to plug the transducer into the gauge and power the unit up. The ***FX-80*** has a special built-in automatic probe recognition feature that will check to see if the probe plugged into the gauge is an auto recognized probe type. If so, the ***FX-80*** will display a message indicating the transducer type and ask the user for confirmation to use the identified probe. If the transducer is not an auto recognized probe, the ***FX-80*** will display a message indicating the transducer type has not been recognized, and force the user to select a transducer type from a list of transducers according to frequency and diameter. Whether the transducer is auto recognized or selected from a predefined list, the ***FX-80*** will recall specific properties about the transducer. **Note:** Once the transducer has been selected, the ***FX-80*** will store and recall this transducer type every time the ***FX-80*** is powered on/off. The type will only change if the user physically selects another type from the list, or selects a previously saved setup. Therefore, if you have previously gone through this section and selected the transducer you are using, proceed to the next section. Use the following steps to select your transducer type. **Note:** If the transducer is not identified on power up, be sure the transducer type selected is the same as the transducer plugged into the **FX-80. Failure to do this will result in erroneous measurements**:

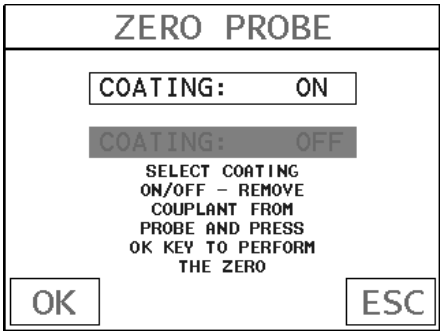
In this first example the transducer was automatically identified:

## Probe Automatically Recognized




1) Press the OK key once to use the identified probe, or ESC to display a list of optional transducers. *Note: if the **FX-80** recognizes a specific transducer, the user should always select* OK *to use the identified probe. The only time an alternative probe should be selected from a list is if the user switched probes following initial power up and recognition, or the **FX-80** has somehow identified the probe in error..*

2) Assuming the ***FX-80*** recognized the probe and the OK key was pressed, the ***FX-80*** will advance to a Zero Probe menu. If the transducer was identified as a special transducer capable of measuring coating thickness, a menu will be displayed allowing the user the ability to toggle the coating thickness display on/off as follows:

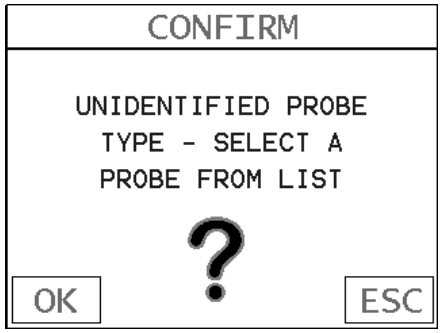



3) Press the ▲ and ▼ arrow keys on the left button wheel to toggle the coating option on/off.

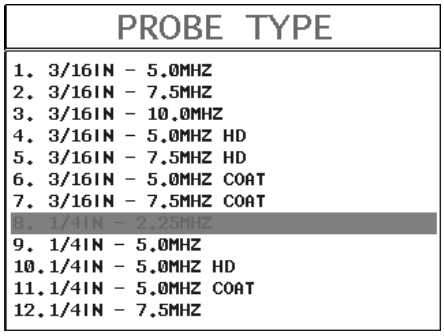
4) Wipe all couplant from the transducer face and proceed to the Probe Zero section that follows.

In this second example the transducer was not identified and will force the user to select the transducer type from a predefined list of transducers:

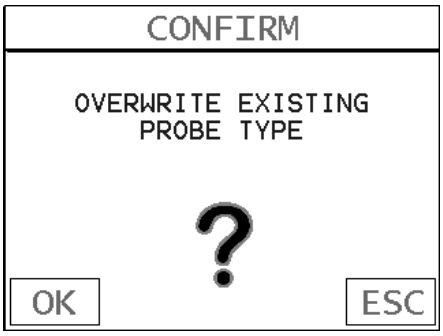
## Selecting the Transducer Type




5) Press the OK or esc keys to display the factory list of transducer types (by diameter and frequency).




6) Press the ▲ and ▼ arrow keys on the left button wheel to scroll through the transducer list until the appropriate type is highlighted.




7) Press the ↵ key to select the transducer type and display overwrite existing probe screen.

8) Press the OK key to overwrite the existing probe type with the newly selected probe type. The zero probe screen will be displayed. Proceed to the zero probe section that follows.

## 6.2 Probe zero

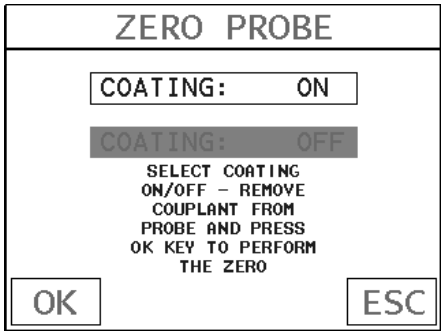
The next step is to perform a probe zero. The zero function is a very important and necessary function that must be done prior to calibration. It should be done on a regular basis. In fact, the ***FX-80*** has been programmed to force this issue at regular intervals during operation if it hasn't been done. If the ***FX-80*** is not zeroed correctly, all the measurements taken may be in error by some fixed value. When the ***FX-80*** is using the auto zero (electronic zero), the ***FX-80*** can be in any measurement mode. However, when the manual zero is being used, the ***FX-80*** must be in pulse-echo mode in order to perform the zero. The ***FX-80*** will also see to it that this occurs by simply forcing the gauge into this mode when zero. Therefore, if the ***FX-80*** is in the echo-echo measurement mode and a manual zero is being performed, the ***FX-80*** will put the gauge into pulse-echo mode automatically before performing the zero. While this is a very convenient feature of the ***FX-80***, the user should be sure to check the measurement mode following calibration to be sure the ***FX-80*** is in the desired mode. The following steps outline both of these techniques.

The ***FX-80*** is equipped with two zero options:

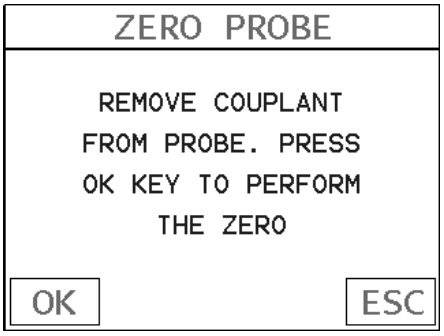
1) **Off Block Zero (Automatic Probe Zero)** – When this feature is enabled the ***FX-80*** will do an electronic zero automatically, eliminating the need for a zero disk or block.
2) **On Block Zero (Manual Probe Zero)** – When this feature is enabled the transducer must be placed on the probe zero disk (battery cover located on the top of the unit.

Both zero procedures are outlined as follows:

## Performing an Auto Probe Zero (Off Block)




*Coating Probe Identified*




*Coating Probe Not Identified*

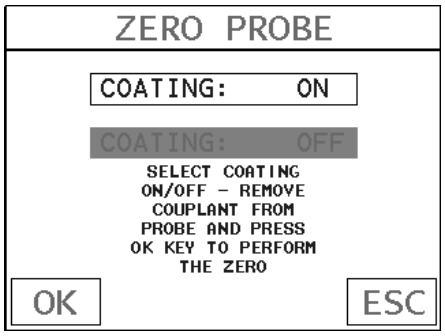
1) Be sure all couplant has been removed from the face of the transducer.
2) Press the OK key to perform the automatic probe zero, or ESC key to cancel the zero operation.
3) The screens illustrated above will be briefly displayed followed by the main measurement screen. The ***FX-80*** is ready to be calibrated.

## Performing a Manual Probe Zero (On Block)

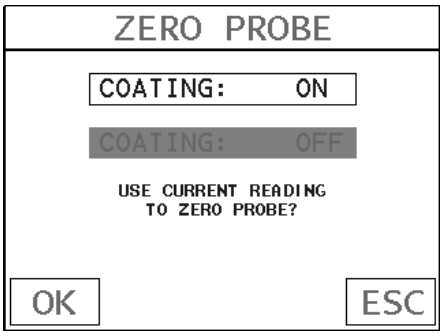



**Note:** *When the zero probe option is set to manual, the probe zero disk (battery cap) located on the top of the gauge will be used as a zero standard and the warning screen illustrated above will be displayed.*

1) Press the OK or ESC keys to enter the main measurement screen and begin the manual zero process.
2) Apply a drop of couplant on the transducer and place the transducer in steady contact with the probe zero disk and obtain a steady reading.
3) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
4) Press the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **ZERO PROBE** is highlighted.




*Coating Probe Identified*




*Coating Probe Not Identified*

5) Press the  key to display the confirmation screen.

6) If a coating transducer was identified use the  and  arrow keys on the left button wheel to toggle coating on/off.

7) Press the  key to complete the probe zero function, or  key to cancel the probe zero function.

8) Remove the transducer from the probe zero disk, and proceed to the calibration section.

**Note:** *The value that is displayed will change depending on the current velocity setting in the **FX-80**. Disregard the number that is displayed. **It is not important**. What is important is accurately performing the steps outlined above to insure reliability of the probe zero calculation.*

## 6.3 Material Calibration

In order for the ***FX-80*** to make accurate measurements, it must be set to the correct sound velocity of the material being measured. Different types of materials have different inherent sound velocities. For example, the velocity of sound through steel is about 0.233 inches per microsecond, versus that of aluminum, which is about 0.248 inches per microsecond. If the gauge is not set to the correct sound velocity, all of the measurements the gauge makes will be erroneous by some fixed percentage.

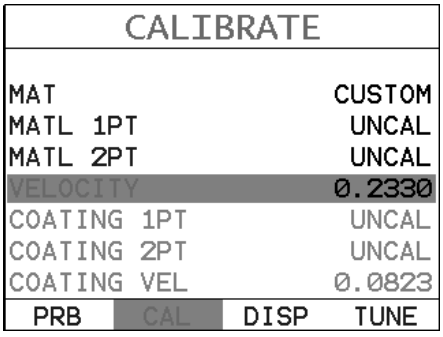
The **One Point** calibration is the simplest and most commonly used calibration method - optimizing linearity over large ranges. The **Two Point** calibration allows for

greater accuracy over small ranges by calculating the probe zero and velocity. The ***FX-80*** provides four simple methods for setting the sound-velocity outlined below:

## Known Velocity

If the material velocity is known, the user may wish to simply enter the velocity number into the ***FX-80***, rather than have the ***FX-80*** calculate the velocity value using a known thickness on a material sample. The steps for entering the velocity are outlined below:

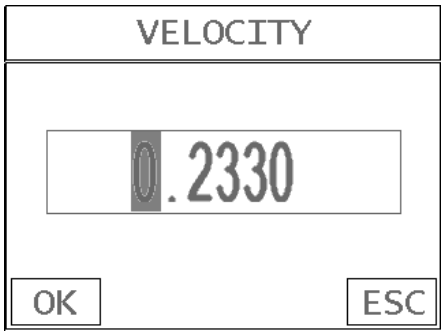
### Using a Known Material Velocity




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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.

   Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **VELOCITY** is highlighted.




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

4) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll the highlighted value.

5) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the digit locations.

6) Repeat steps **4 & 5** until the velocity number is correctly displayed.

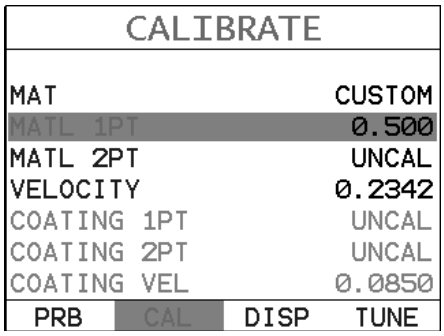
7) Press the OK key to set the velocity and return to the menu screen, or esc to cancel entering the velocity.

8) Finally, press the ⌂ key to return to the measurement screen and begin taking readings.

## Known Thickness

Sometimes the sound velocity of a material is unknown. In this case a sample with one or two known thicknesses can be used to determine the sound velocity. As previously discussed, the ***FX-80*** has a one or two point calibration option. The one point calibration option is most suited for linearity over large ranges, as noted above. The user should also consider calibrating on high side of the intended measurement range, when using the one point option, minimize overall error. For example, if the measurement range is .100" (2.54mm) to 1.0" (25.4mm), the user should calibrate on a known thickness sample close to 1.0" (25.4mm). Note: It's always handy to carry a set of mechanical calipers to use in conjunction with the ***FX-80*** for calibration in the field:

### One Point Calibration

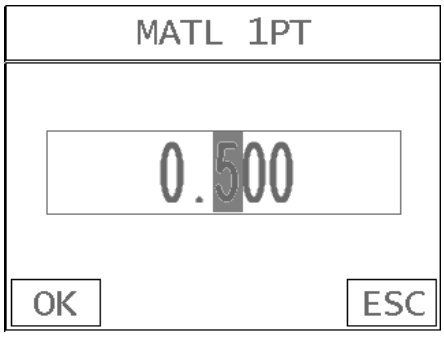



**Note:** *Be sure that the probe zero procedure has been performed prior to performing this calibration procedure.*

1) Physically measure an exact sample of the material or a location directly on the material to be measured using a set of calipers or a digital micrometer.
2) Apply a drop of couplant on the transducer and place the transducer in steady contact with the sample or actual test material. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable. Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

3) Press the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **MATL 1PT** is highlighted.




4) Press the  key to display the **Digits Edit Box**.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.

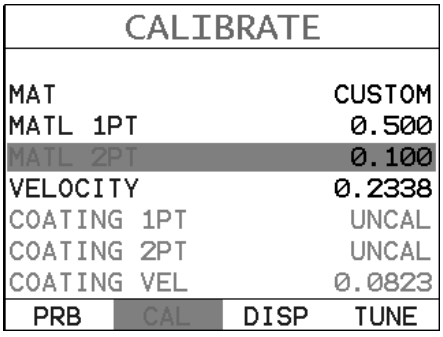
8) Press the  key to calculate the velocity and return to the menu screen, or  to cancel the one point calibration.

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

**Note:** ***CHECK YOUR CALIBRATION!*** *Place the transducer back on the calibration point. The thickness reading should now match the known thickness. If the thickness is not correct, repeat the steps above.*

At some point there may become a requirement for improved accuracy over a smaller measurement range. In this case, a two point calibration would be most suited for the job. For example, if the measurement range was .080" (2.03mm) to .250" (6.35mm), the user would perform a one point calibration on a known thickness sample close to .250" (6.35mm), followed by a two point calibration close to .080" (2.03mm). When a two point calibration is performed, the ***FX-80*** calculates the zero and the velocity. The following steps outline this procedure:

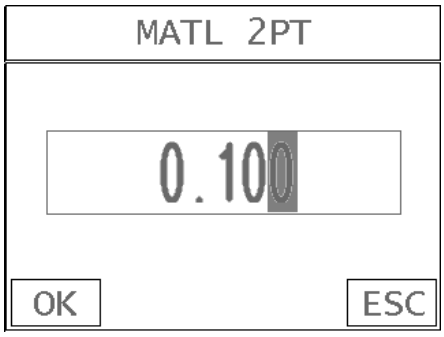
## Two Point Calibration




1) Physically measure an exact sample of the material or a location directly on the material to be measured using a set of calipers or a digital micrometer.
2) Apply a drop of couplant on the transducer and place the transducer in steady contact with the sample or actual test material. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable. Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

3) Press the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **MATL 2PT** is highlighted.




4) Press the  key to display the **Digits Edit Box**.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.

8) Press the  key to calculate the velocity and return to the menu screen, or  to cancel the one point calibration.

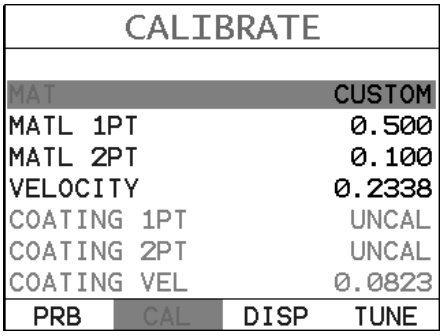
9) Finally, press the  key to return to the measurement screen and begin taking readings.

**Note:** ***CHECK YOUR CALIBRATION!*** *Place the transducer back on the calibration point. The thickness reading should now match the known thickness. If the thickness is not correct, repeat the steps above.*

## Basic Material Type

If the material velocity is unknown, and a sample thickness cannot be taken from the material, the user may opt to choose a basic material type from a list with approximate velocity values according to various material types. It's important to note that these velocities will not always be an exact representation of the material being tested. Use these values only if a close approximation is acceptable. Follow the steps below to select a basic material type:

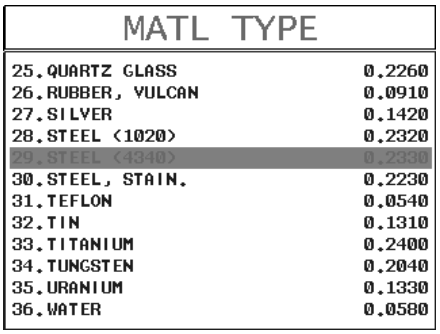
### Selecting a Basic Material Type




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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.

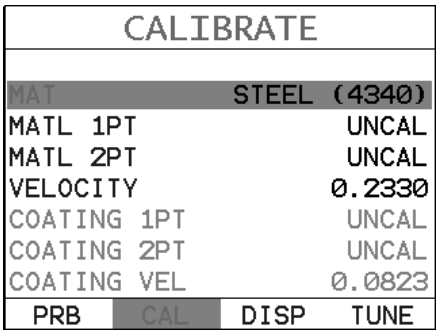
   Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **MAT** is highlighted.




3) Press the ↵ key to display the list of material types.

4) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the material list until the appropriate material is highlighted.




5) Press the ↵ key to overwrite the material type and display the menu items with the new material type selected.

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

To calibrate the ***FX-80*** for a specific type of coating using samples with known thicknesses, please refer to **chapter 9 – Pulse-Echo Coating (PECT) or Coating (CT)** for a complete explanation of using the ***FX-80*** for coating measurements.

## CHAPTER SEVEN
## USING THE DISPLAY OPTIONS

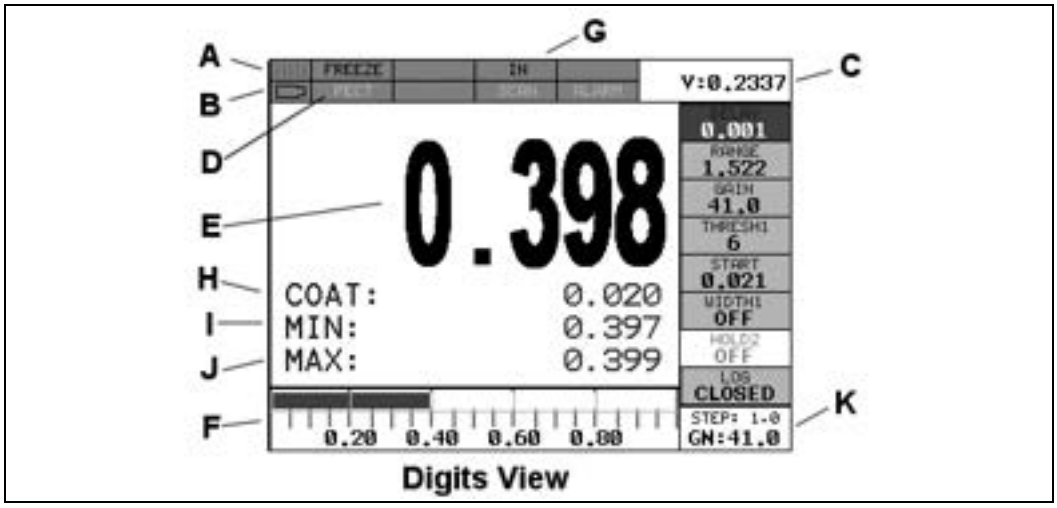
A key feature of the ***FX-80*** is the ability to toggle between four different display options; Digits, RF, RECT and B-Scan. All views provide a digital readout of base material and coating thickness measurements, while also displaying the alarm tolerances, if active. A key feature of the ***FX-80*** is the waveform display. The waveform is a graphical representation of the sound reflections returning to the transducer. Consider standing at the base of a canyon and screaming “Hello There”. After a brief delay, you will here multiple echoes, “Hello There’s” repeated back to you. The waveform display shows the amplitude of the signal received on the vertical (Y) axis and time (shown in units of thickness) on the horizontal (X) axis. The waveform display is very useful for viewing and adjusting the location of the gates. The gates are typically used to eliminate potential surface noise by adjusting the starting point in single echo modes, for multi echo measurement modes, as well as to adjust the threshold (sensitivity) in either mode. The waveform display is also very useful for locating pits and internal flaws in materials.

The B-Scan display is also very useful when scanning surfaces and viewing the cross section of the test material. It provides a convenient way of visually profiling, or drawing a picture of, the blind surfaces during a scan. The B-Scan display is also equipped with a scan bar representing the overall thickness. The scan bar gives the user a visual indication when a flaw or defect passed over during the scan process. The scan bar will deflect off of the defect and return back to the overall thickness. Visually, this is much easier to notice than watching for changes in the digital value displayed. The scan bar has also been included in the large digits display mode for the same purpose.

**Note:** *The following chapter outlines some of the fine adjustment features of the **FX-80**. The **FX-80** has four different display options **(RF A-Scan, Rectified A-Scan, B-Scan, and Large Digits)**. We’ll take a better look at these options in this chapter.*

**Note:** *In order to recall and use the new adjustments made to the **FX-80** at a later time, the user must save the modified settings in one of the setup locations prior to powering off the unit.* *Refer page 169 for more information on setups.*

## 7.1 Display Views




**DIGITS**

The Digits view is a basic digital thickness gauge look and feel. The larger digits make it much easier for the operator to monitor the thickness readings. The Scan Bar has also been added to the Digits view to provide the user with yet another visual tool for easily monitoring changes in thickness readings due to internal flaws or defects.

The following is a list of the viewable features on the display:

A. **Repeatability/Stability Indicator** – This indicator should be commonly used in conjunction with the digital thickness values displayed. When all the vertical bars are fully illuminated and the last digit on the digital thickness value is stable, the ***FX-80*** is reliably measuring the same value 3 to 200 times per second, depending on which measurement mode and features are enabled.

B. **Battery Icon** – Indicates the amount of battery life the ***FX-80*** has remaining.

C. **Velocity** – The material velocity value the ***FX-80*** is currently using or calibrated for. Displayed in English or Metric units, depending on the what units the gauge is set for.

D. **Feature Status Bar** – Indicates the features currently enabled and in use in the following order:

- Measurement Mode (P-E, PECT, PETP, E-E, E-EV, COAT)
- Differential Mode (ON/OFF)
- High Speed Scan Mode (ON/OFF)
- Alarm Mode (ON/OFF/AUDIBLE)
- Gain Setting (VLOW, LOW, MED, HI, VHI)

E. **Digital Material Thickness Value** – Extra large font size for viewing ease.

F. **Scan Bar** – Another view of material thickness in a deflection style horizontal bar. This is another visual tool that would enable the user the ability to see thickness changes during high speed scans from flaws and pits.

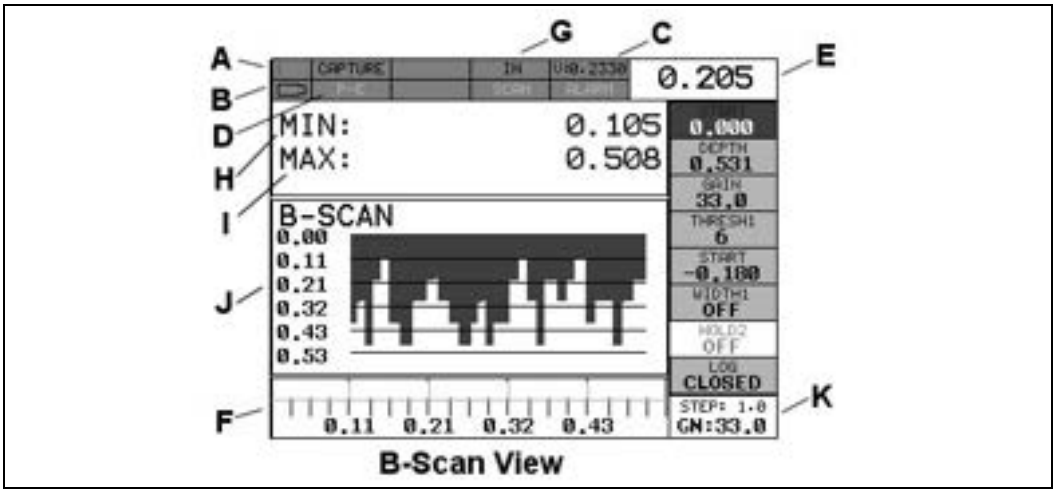
G. **Units** – The current measurement units being used (English, Metric).

H. **Coating Thickness Value** – Displays the actual thickness of any coating adhered to a metallic material surface (PECT Mode), or a coating adhered to a non-metallic surface (CT Mode).

I. **Minimum Material Thickness** – Part of the Alarm feature. Displays the minimum thickness value found during a scan.

J. **Maximum Material Thickness** – Part of the Alarm feature. Displays the maximum thickness value found during a scan.

K. **Gain & Step Size** – The gain and increment step size can be continuously used and adjusted at any time using the  and  arrow keys on the right button wheel to scroll the value, and the  key to activate the **Digit Edit** screen to adjust the step size.




B-Scan View

## B-Scan

The B-Scan displays a time based cross section view of test material. This view is commonly used to display the contour of the blind, or underside, surface of a pipe or tank application. It is very similar to a fish finder. If a flaw or pit is located during a scan, the B-Scan will draw the pit on the screen. The solid black rectangle in the diagram at location K represents the cross section, or side view of the material. The B-Scan view draws at a rate of 7 seconds per screen from right to left. Also notice at location K, the pits and corroded bottom surface of the material.

It's important to note that the measurement range on the display be set wide enough, so that the maximum thickness of the material can be viewed on the display. Using

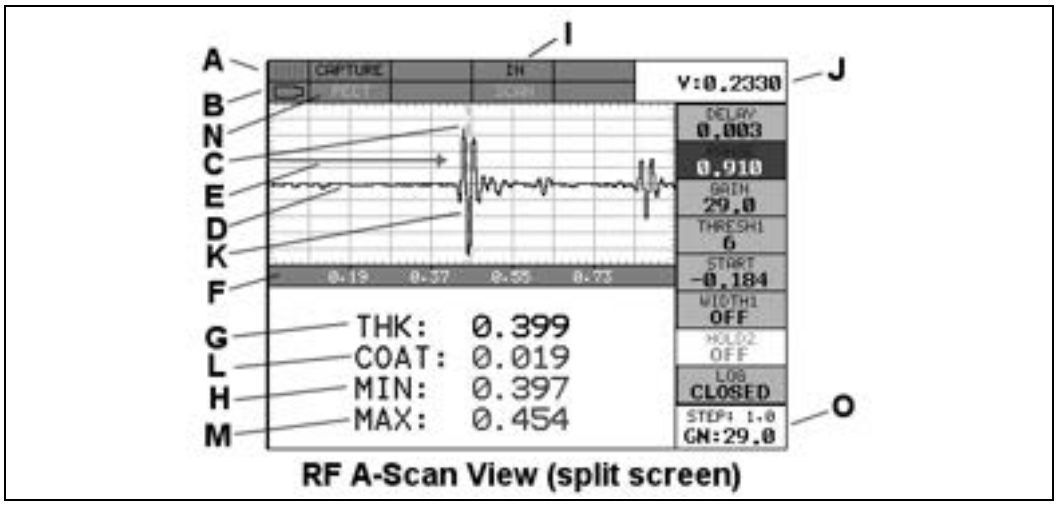
the diagram above, if the material thickness was actually 1.75”, the underside of the material would not be viewable according to the current range at 0.00” – 1.00”. All the user would see is a black screen from 0.00” – 1.00” with no view of the bottom contour at 1.75”.

The following is a list of the viewable features on the display:

A. **Repeatability/Stability Indicator** – This indicator should be commonly used in conjunction with the digital thickness values displayed. When all the vertical bars are fully illuminated and the last digit on the digital thickness value is stable, the ***FX-80*** is reliably measuring the same value 3 to 200 times per second, depending on which measurement mode and features are enabled.
B. **Battery Icon** – Indicates the amount of battery life the ***FX-80*** has remaining.
C. **Velocity** – The material velocity value the ***FX-80*** is currently using or calibrated for. Displayed in either English or Metric units, depending on the what units the gauge is set for.
D. **Feature Status Bar** – Indicates the features currently enabled and in use in the following order:
    - Measurement Mode (P-E, PECT, PETP, E-E, COAT)
    - Differential Mode (ON/OFF)
    - High Speed Scan Mode (ON/OFF)
    - Alarm Mode (ON/OFF/AUDIBLE)
    - Gain Setting (VLOW, LOW, MED, HI, VHI)
E. **Digital Material Thickness Value** – Smaller font size when the B-Scan display view is enabled.
F. **Scan Bar** – Another view of material thickness in a deflection style horizontal bar. This is another visual tool that would enable the user the ability to see thickness changes during high speed scans from flaws and pits.
G. **Units** – The current measurement units being used (English, Metric).
H. **Minimum Material Thickness** – Part of the Alarm feature. Displays the minimum thickness value found during a scan.
I. **Maximum Material Thickness** – Part of the Scan feature. Displays the maximum thickness value found during a scan.
J. **B-Scan Display** – Cross section view of the material. Provides the user with graphical view of the opposite/blind surface (i.e. inside pipe wall surface), to give the user some idea of the condition, or integrity of the material being tested.
K. **Gain & Step Size** – The gain and increment step size can be continuously used and adjusted at any time using the  and  arrow keys

on the right button wheel to scroll the value, and the 

key to activate the **Digit Edit** screen to adjust the step size.



RF A-Scan View (split screen)

## Radio Frequency (RF) A-Scan

The RF mode shows the waveform in a similar fashion to an oscilloscope. It shows both the positive and the negative peaks. The peak (either positive or negative) selected for measurement is shown in upper portion of the display.

It's important to note that a measurement must fall inside the displays viewable range in order to see the waveform. However, even if the waveform is outside of the viewable range of the display, a measurement can be taken and viewed on the digital readout. If the wave is outside of the display range, you can manually change the range by adjusting the **Delay** and **Width** values, or you can use the **Auto Find** feature located in the **UTIL** menu of the tabbed menu items. Refer to page 115 for additional information on the **Auto Find** feature.

The following is a list of the viewable features on the display:

A. **Repeatability/Stability Indicator** – This indicator should be commonly used in conjunction with the digital thickness values displayed. When all the vertical bars are fully illuminated and the last digit on the digital thickness value is stable, the ***FX-80*** is reliably measuring the same value 3 to 200 times per second, depending on which measurement mode and features are enabled.

B. **Battery Icon** – Indicates the amount of battery life the ***FX-80*** has remaining.

C. **Detect Indicator** – The broken vertical line displays the zero crossing detection point on the waveform where the measurement has been obtained. Notice that the digital thickness readout is the same as the location of the detect indicator according to the measurements labels F, also in the diagram.

D. **Baseline** - The horizontal trace across the A-scan presentation for a no signal condition. It represents time and is generally related to material distance or thickness.

E. **Gate** – An electronic feature that allows the user to monitor signals inside the boundaries of the gate settings. The height of the gate from the baseline is

known as the threshold, and controls the sensitivity of the reflections that trigger a detection from the opposite surface of the material.

F. **Measurement Scale** – Represents thickness values over a defined measurement range, and labeled at the calibrated hash marks on the display (X) axis.

G. **Digital Material Thickness Value** – The thickness of the base material.

H. **Minimum Thickness Value** – Dynamically updates the value during a scan, and displays the minimum thickness value found. Note: Only visible when high speed scan mode is enabled.

I. **Units** – The current measurement units being used (English, Metric).

J. **Velocity** – The material velocity value the ***FX-80*** is currently using or calibrated for. Displayed in either English or Metric units, depending on what units the gauge is set for.

K. **RF waveform** – The sine wave created by the reflected sound, or oscillation, from the material being measured. The both the positive and negative half cycles (full cycles) are displayed.

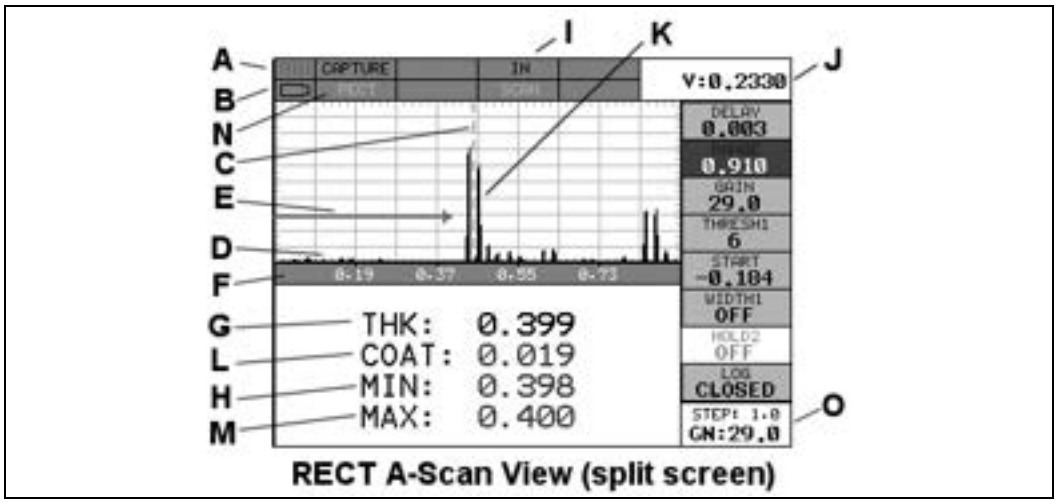
L. **Coating Thickness Value** – Displays the actual thickness of any coating adhered to a metallic material surface (PECT Mode), or a coating adhered to a non-metallic surface (CT Mode).

M. **Minimum Thickness Value** – Dynamically updates the value during a scan, and displays the minimum thickness value found. Note: Only visible when high speed scan mode is enabled.

N. **Feature Status Bar** - Indicates the features currently enabled and in use in the following order:

- Measurement Mode (P-E, PECT, PETP, E-E, COAT)
- Differential Mode (ON/OFF)
- High Speed Scan Mode (ON/OFF)
- Alarm Mode (ON/OFF/AUDIBLE)
- Gain Setting (VLOW, LOW, MED, HI, VHI)

O. **Gain & Step Size** – The gain and increment step size can be continuously used and adjusted at any time using the  and  arrow keys on the right button wheel to scroll the value, and the  key to activate the **Digit Edit** screen to adjust the step size.



RECT A-Scan View (split screen)

## Rectified (RECT) A-Scan

The RF mode shows the waveform in a similar fashion to an oscilloscope. It shows both the positive and the negative peaks. The peak (either positive or negative) selected for measurement is shown in upper portion of the display.

It's important to note that a measurement must fall inside the displays viewable range in order to see the waveform. However, even if the waveform is outside of the viewable range of the display, a measurement can be taken and viewed on the digital readout. If the wave is outside of the display range, you can manually change the range by adjusting the **Delay** and **Width** values, or you can use the **Auto Find** feature located in the **UTIL** menu of the tabbed menu items. Refer to page 115 for additional information on the **Auto Find** feature.

The following is a list of the viewable features on the display:

A. **Repeatability/Stability Indicator** – This indicator should be commonly used in conjunction with the digital thickness values displayed. When all the vertical bars are fully illuminated and the last digit on the digital thickness value is stable, the ***FX-80*** is reliably measuring the same value 3 to 200 times per second, depending on which measurement mode and features are enabled.

B. **Battery Icon** – Indicates the amount of battery life the ***FX-80*** has remaining.

C. **Detect Indicator** – The broken vertical line displays the zero crossing detection point on the waveform where the measurement has been obtained. Notice that the digital thickness readout is the same as the location of the detect indicator according to the measurements labels F, also in the diagram.

D. **Baseline** - The horizontal trace across the A-scan presentation for a no signal condition. It represents time and is generally related to material distance or thickness.

E. **Gate** – An electronic feature that allows the user to monitor signals inside the boundaries of the gate settings. The height of the gate from the baseline is

known as the threshold, and controls the sensitivity of the reflections that trigger a detection from the opposite surface of the material.

F. **Measurement Scale** – Represents thickness values over a defined measurement range, and labeled at the calibrated hash marks on the display (X) axis.

G. **Digital Material Thickness Value** – The thickness of the base material.

H. **Minimum Thickness Value** – Dynamically updates the value during a scan, and displays the minimum thickness value found. Note: Only visible when high speed scan mode is enabled.

I. **Units** – The current measurement units being used (English, Metric).

J. **Velocity** – The material velocity value the ***FX-80*** is currently using or calibrated for. Displayed in either English or Metric units, depending on what units the gauge is set for.

K. **RECT waveform** – The half cycle, either positive or negative, of the RF sine wave, created by the reflected sound, or oscillation, from the material being measured. This view is typically considered as “flaw” view.

L. **Coating Thickness Value** – Displays the actual thickness of any coating adhered to a metallic material surface (PECT Mode), or a coating adhered to a non-metallic surface (CT Mode).

M. **Minimum Thickness Value** – Dynamically updates the value during a scan, and displays the minimum thickness value found. Note: Only visible when high speed scan mode is enabled.

N. **Feature Status Bar** - Indicates the features currently enabled and in use in the following order:

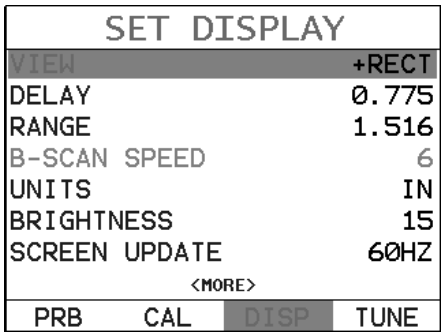
- Measurement Mode (P-E, PECT, PETP, E-E, COAT)
- Differential Mode (ON/OFF)
- High Speed Scan Mode (ON/OFF)
- Alarm Mode (ON/OFF/AUDIBLE)
- Gain Setting (VLOW, LOW, MED, HI, VHI)

O. **Gain & Step Size** – The gain and increment step size can be continuously used and adjusted at any time using the  and  arrow keys on the right button wheel to scroll the value, and the  key to activate the **Digit Edit** screen to adjust the step size.

## 7.2 Changing Display Options

The following procedure outlines how to select or toggle display options:

### Changing Display Options




**Color VGA**

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **VIEW** is highlighted.
3) Press the ◀ and ▶ arrow keys on the right button wheel to scroll the view options. Once the appropriate view is displayed, press the ⌂ key to return to the measurement screen and begin taking measurements.

## 7.3 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 of this section would be as follows: Suppose we had a 50” widescreen television set. Assume that you’re watching the television for rest of this explanation. The left side of the television screen is considered the **Delay** for all view options other than B-Scan. In B-Scan view, it’s called **B-Start**. Therefore, **Delay (B-Start)** are ***identical***, with the exception of the terminology used, and represent the left side of the television screen.

The right side of the television screen is considered the **Range + Delay**, in all view options with the exception of B-Scan, once again. In B-Scan view, it would be considered **B-Depth + B-Start**. Therefore, the following should be considered: **Delay (B-Start) + Range (B-Depth) = right side of the screen**, depending on what view option is active.

Now, 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 we need to. Therefore, if I am measuring a part, and am only interested in viewing the thickness range/area from .500” – 1.0”, and I’d like to zoom in a bit to get a close up look at things, I’d set my Delay (B-Start) to .500” and my Range (B-Depth) to .500”. This would make the left side of my screen start at .500”, and the right side of the screen at 1.0”.

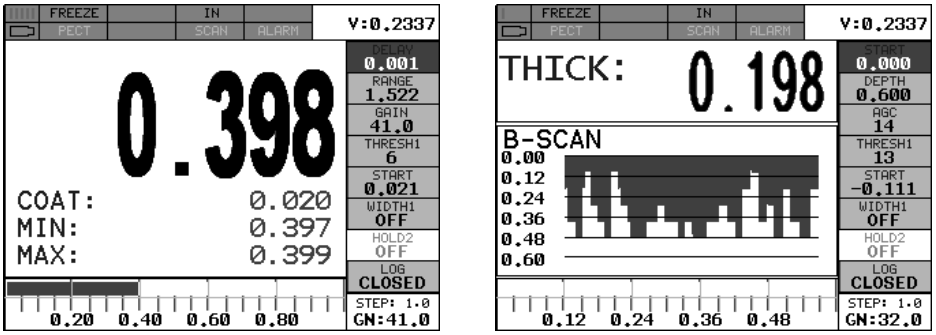
## Setting the Delay (B-Start)

The Delay (B-Start) represents the left side of the display, and can be adjusted to start at any thickness value within the overall range of the ***FX-80***. The value the Delay (B-Start) is set too, is the minimum thickness value that will be displayed on the screen.

**Note:** Once the delay is set, it will remain the same for the views: Digits, RF, RECT. However, in B-Scan view, the B-Start is an independent setting from Delay, and allow the user to store two independent settings respectively.

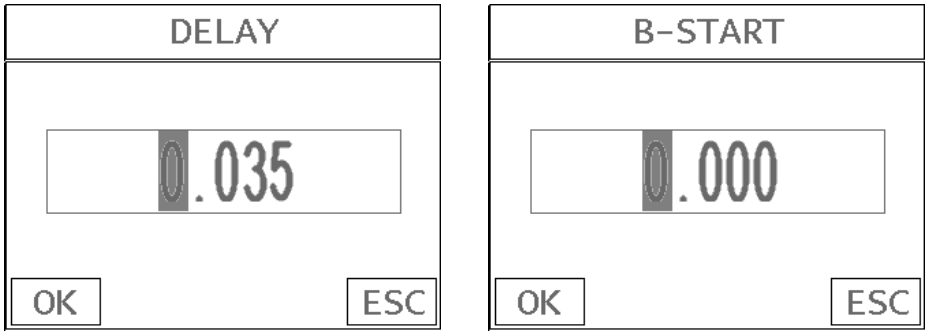
The procedures to adjust the **Delay (B-Start)** are outlined below:

## Adjusting Delay (B-Start) using the Hot Menus




1) Press the key once to activate measure menu items. Press the key multiple times to move right and the key multiple times to move left, until the **DELAY** cell is highlighted. Alternatively, press the and arrow keys multiple times using the left button wheel.

2) Press the and arrow keys on the right button wheel to scroll the highlighted value.




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

4) Press the and arrow keys multiple times using the left button wheel to scroll the highlighted value.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

6) Repeat steps **4 & 5** until the **DELAY** value is correctly displayed.

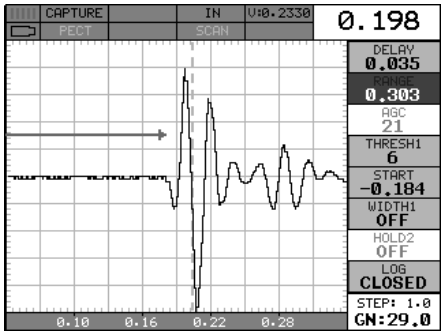
7) Press the  key to return to the measurement screen, or  to cancel entering the **DELAY**.

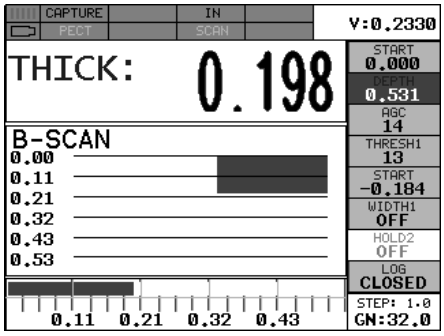
8) Finally, press the  key to return to the measurement screen and begin taking readings.

## Adjusting the Range (B-Depth)

Once again, just to reiterate, the **Range (B-Depth) + Delay (B-Start) equals the right side of the screen**. Therefore, the Range (B-Depth) is the overall area, from the delay, that will be viewable on the screen. The ***FX-80*** digitizer will round up from the Range (B-Depth) that's entered. Therefore, if the Range (B-Depth) is set at 1.0", the digitizer will round this value up to the next adjustment available. The procedures to adjust the overall thickness range viewed Range (B-Depth) are outlined below:

### Adjusting the Range (B-Depth) using the Hot Menus

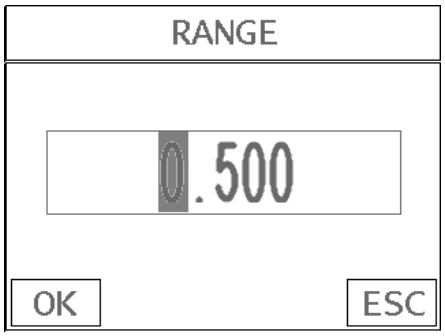


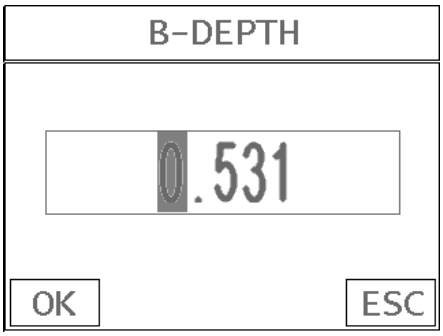




1) Press the  key once to activate measure menu items. Press the  key multiple times to move right and the  key multiple times

to move left, until the **WIDTH** cell is highlighted. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Press the  and  arrow keys on the right button wheel to scroll the highlighted value.




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

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

6) Repeat steps **4 & 5** until the **WIDTH** value is correctly displayed.

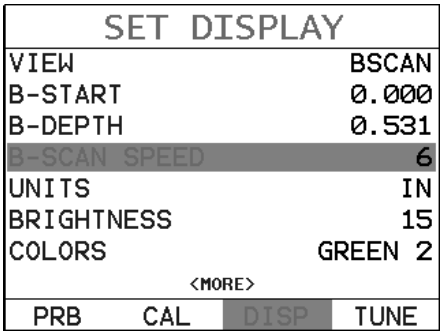
7) Press the  key to return to the measurement screen, or  to cancel entering the **RANGE**.

8) Finally, press the  key to return to the measurement screen and begin taking readings.

## Adjusting the B-Scan Speed

The ***FX-80*** has the capability to adjust the scrolling speed of the time based B-Scan displayed in the gauge. The procedures to adjust the speed are outlined below:

### Adjusting the B-Scan Speed




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **B-SCAN SPEED** is highlighted.
3) Use the ◀ and ▶ arrow keys on the right button wheel to scroll the speed from 0-10. Note: 10 representing the fastest scroll time. Once the appropriate speed is displayed, press the ⌂ key to return to the measurement screen and begin the B-Scan process.
4) **Alternatively**, press the ↵ key to display the **Digits Edit Box**.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

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

8) Press the  key to set the speed and return to the **DISP** menu., followed by pressing the  key to begin the B-Scan process.

9) Finally, press the  key to return to the measurement screen and begin the scanning process.

## 7.4 Gain & Step Increment

The gain, or amplification of the return echoes, can be adjusted in the **FX-80** to accommodate a variety of applications. The setting of the gain is crucial in order to obtain valid readings during the measurement process. Too much gain may result in erroneous measurements, by detecting on noise rather than the actual material back wall itself. 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 ***FX-80*** has 110dB gain range, but has been limited to a 60dB gain range (-10 to 50 dB), for thickness gauge applications. The common starting point for standard thickness gauge applications is 46dB. This feature is used to increase/decrease the power or amplitude of the signal. When used in conjunction with the attenuator feature, it has a limited overall gain range of -30dB to 70dB.

The gain can be adjusted to accommodate a variety of material types. Having this feature available, provides the user with a great deal of flexibility. Some applications may require the lower or higher gain settings. When? The low settings may be necessary for noisy or granular cast materials. How do I know when to lower the gain? If the reading becomes sporadic and won't settle down or resolve on a thickness value, the user can assume that the material is either very noisy aluminum,

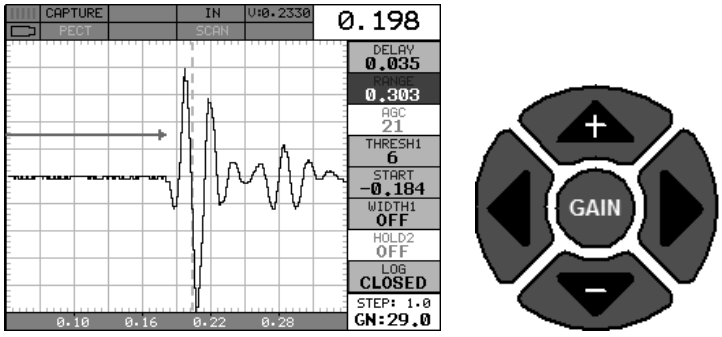
or granular cast iron. This would be a good time to change the ***FX-80*** to lower gain setting and see if the reading settles down and become stable.

How do I know when to increase the gain? Often times the user will be trying to measure a material that is hard to penetrate or pass sound through. This may be due to the material type, or overall thickness of the material. When a material is hard to pass sound through because of the thickness or general make-up, it would be a good time to consider increasing the ***FX-80*** to a higher gain setting. Another example might be the need to increase overall sensitivity for locating fine pits or flaws. In any case, the adjustable gain feature offers the user some additional options to resolve and overcome application issues.

**Note:** When the echo-echo thru-paint, or echo-echo-verify measurement modes are selected, the manual gain feature is disabled and grayed out in the menu items. In this mode, the ***FX-80*** switches to an automatic gain mode **(AGC)** that optimizes the gain setting automatically in the hardware of the ***FX-80***.

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

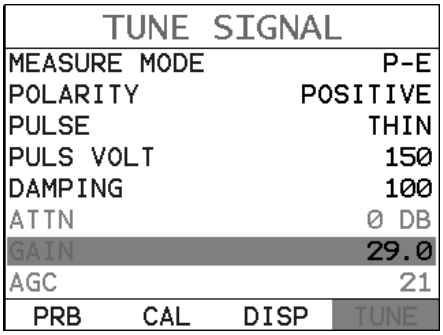
## Adjusting the Gain Quickly




1) Press the  and  arrow keys using the right button wheel to increase/decrease the gain value at any time.

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 right button wheel approach. The procedure using the tabbed menus is outlined below:

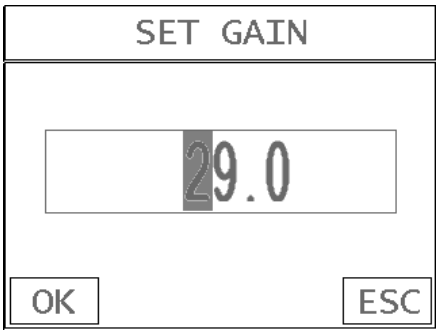
## Adjusting the Gain using the Tabbed Menus




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until gain is highlighted.

3) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the value. When the correct **Gain** is being displayed, **proceed to step 8**.




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

5) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll the highlighted value.

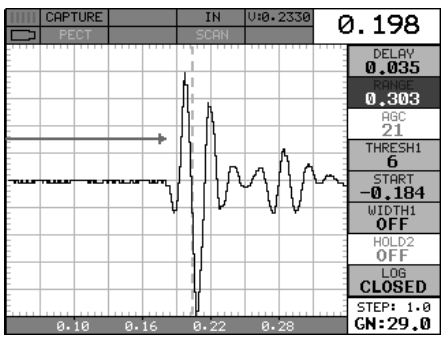
6) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the digit locations.

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 ⌂ key to return to the measurement screen and begin taking readings.

## Setting the Gain Increment Step Size






1) Press the gain dB key once to display the **Digits Edit Box**. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.




2) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll the **Step** size.

3) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the digit locations.

4) Repeat steps **2 & 3** until the **Step** size is correctly displayed.

5) Press the OK key to set the **Step** size and return to the measurement screen, or esc to cancel entering the **Step** size.

## 7.5 Threshold

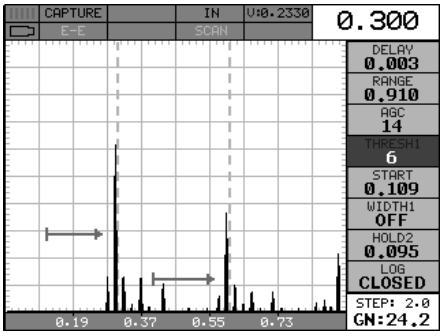
The **Threshold** is the level (sensitivity) of the signal amplitude required to trigger the thickness reading. This level can be used in conjunction with the gain. Example: suppose the user can visually see a potential flaw on the display, but the ***FX-80*** is not detecting on the flaw because the **Gain** is too low, or the **Threshold** to high. The **Threshold** level can be decreased (lower sensitivity) in order to detect signals with

lower amplitudes. This will allow the amplitude from the reflection of the flaw to reach and exceed the **Threshold** level, and enable the ***FX-80*** to detect on the flaw or defect. This can also be accomplished by increasing the **Gain**, allowing the signal to exceed the current **Threshold** level. Lowering the **Threshold** (increases sensitivity), and raising the **Threshold** decreases the sensitivity respectively.

The ***FX-80*** is equipped with 3 independent gates, each with an adjustable threshold level. All three gates can be enabled in any of the pulse echo modes, and in echo-echo verify mode, and the thresholds set at varying levels of sensitivity. The allows the user to create a pseudo make-shift “time corrected gain” function, by increasing the sensitivity of each gate at different thickness values. A visual example would be an upside down stair case, where each step represented a separate gate, for a specific thickness range.

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

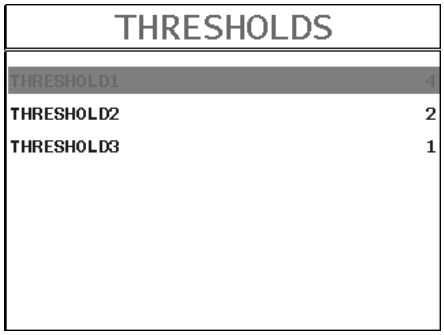
## Adjusting the Thresholds using the Hot Menus




1) Press the  key once to activate measure menu items. Press the  key multiple times to move right and the  key multiple times to move left, until the **THRESH(1-3)** cell is highlighted. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) If the correct **Threshold** is being displayed, press the  and  arrow keys on the right button wheel to scroll the highlighted value.

3) **Alternatively**, if the correct **Threshold** is not being displayed, press the  key to display the **List Box**.




**Note:** *The number of thresholds listed will depend on the current measurement mode selected.*

4) Press the  and  arrow keys multiple times using the left button wheel to scroll and highlight a specific **Threshold (1-3).**

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

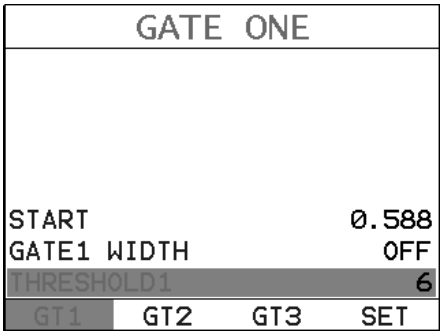
6) Press the  key to set the edited **Threshold** value, and return to the measurement screen. The **Threshold** edited will now be displayed in your **Hot Menu** items.

**Note:** *Alternatively, the **Digit Edit Box** can be displayed, and the value edited using the*  */* *and*  */* *arrow keys on the left button wheel by simply pressing the*  *key following **step 4** above.*

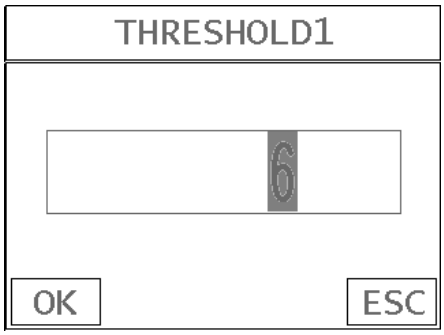
7) Repeat steps **3-6** until all the **THRESH** values are correctly adjusted.

The Thresholds can also be accessed and adjusted from the tabbed menus. However, this method is more tedious than making adjustments using the **Hot Menus**. The procedure for using the tabbed menus is outlined below:

## Adjusting the Thresholds using the Tabbed Menus




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **THRESHOLD1** is highlighted.
3) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the value. When the correct threshold is being displayed, **proceed to step 8**.




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

5) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the digit locations.

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

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

9) Repeat steps **1-8** to set any additional **Threshold** levels.

10) Finally, press the ⌂ key to return to the measurement screen and begin taking readings.

## 7.6 Understanding the features of the Gate

**Important:** It is recommended to spend some time in this section. The sections that follow are procedures for using the features associated with the Gates, in some way. There are 3 gates in the ***FX-80***, and as a result, operating and setting them up can become somewhat convoluted, to say the least. However, a thorough understanding of the functionality presented in this section, will reveal how easy they actually are to operate overall. The following diagrams illustrate the features of all 3 gates, according to the measurement mode selected:

**Note:** This is a general overview and should be referred to in conjunction with the detailed feature sections that follow.

| Modes | # Gates | Gate # | Start | HoldOff | Width | Threshold |
|---|---|---|---|---|---|---|
| PE | 1,2,or 3 | 1 | √ | | √ | √ |
| | | 2 | | | √ | √ |
| | | 3 | | | √ | √ |
| PECT | 1,2,or 3 | 1 | √ | | √ | √ |
| | | 2 | | | √ | √ |
| | | 3 | | | √ | √ |
| PETP | 1,2,or 3 | 1 | √ | | √ | √ |
| | | 2 | | | √ | √ |
| | | 3 | | | √ | √ |
| EE | 2 | 1 | √ | | | √ |
| | | 2 | | √ | √ | √ |
| | | 3 | | | | |
| EEV | 3 | 1 | √ | | | √ |
| | | 2 | | √ | | √ |
| | | 3 | | √ | | √ |
| CT | None | None | None | None | None | None |

**Diag. 1 Gate Features vs Modes**

In **diagram 1**, the gates have been associated with the measurement modes, along with the features available to every gate. For example, echo-echo mode (EE) has 2 gates available, while echo-echo verify (EEV) has 3. These gates have been designed to work in order, from 1 to 3, and cannot be used any other way. Therefore, the user must be using gate 2 before they can activate and use gate 3. ***Note:*** *Gate 1 is on at all times, as a gate must be activated to get a measurement.* Each gate has a given set of features to fine adjust the settings of the gate. Let's have a look at the feature set:

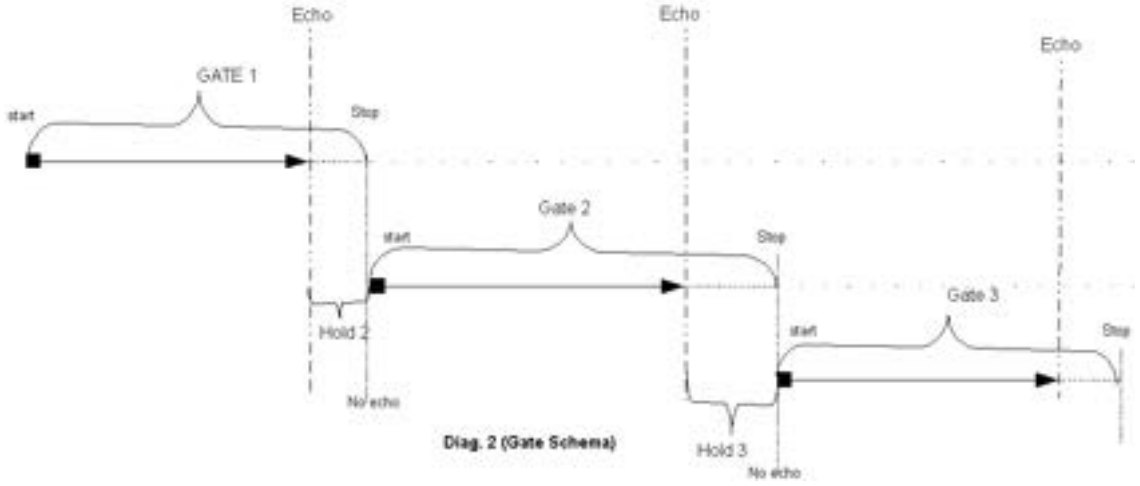
**Start (Gate1):** This feature is only available to gate 1, and determines the start value of the left side of the gate. For example, if there's a great deal of noise from the initial

pulse, or in the material, the gate can be moved to the right of the noise and block the unwanted noise. Gates 2 and 3 will automatically start from the end of gate 1, or from a detection found inside of the boundaries of gate 1. Therefore, we use a hold-off delay as a start feature for gates 2 and 3. See Diagram 2.

**Hold-Off:** The hold-off is the starting point of the left side of gates 2 & 3, and is used only if a detection is found inside the previous gate. It should be considered a delay from the detection point of the previous gate. When the hold-off is off, or 0, the gate will start at the point of detection from the previous gate. As the value of the hold-off is increased, it is further delaying the start of the gate to the right of the detection of the previous gate. **Note:** Although we've used the terminology of hold-off for gate 3, it is actually a "hold-back" from the detection of the second echo. Therefore, as the value is increased, the "hold-back" moves closer to the second detection. It's just the opposite of the operation of gate 2 hold-off. See diagram 2.

**Width:** The width determines the physical length of the gate. Therefore, the width – start (hold-ff) equals the length of the gate, as the start (hold-off) value is not equal to zero. If no detection is located inside the boundaries of a gate, the width value is used to start the next available gate. ***Key point:*** *When the width is activated for a gate, giving it a value, the next available gate is also activated. Therefore, activating width1 of gate1, activates gate2, and activating width2 of gate2, activates gate3.* See diagram 2.

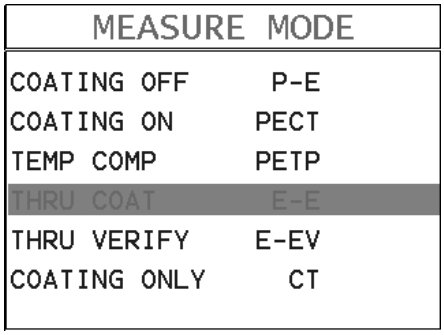
**Thresh:** The threshold controls the level of sensitivity of the signal amplitude required to trigger a detection, or measurement. It is represented by the distance from the baseline, and displayed as the vertical position of a gate. The further the vertical position is from the baseline, the less sensitive the threshold is, and visa versa. This allows the user to have further control over the size of the defects considered critical, or the ability to get a detection, from the opposite surface, in very attenuative materials. This feature is used in conjunction with gain. Increasing the threshold has a similar effect of decreasing the gain, and visa versa.



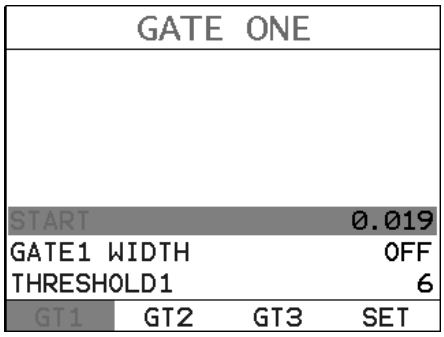

**Diag. 2 (Gate Schema)**

**Activating the gates:**

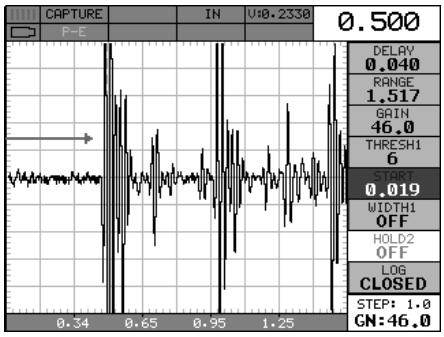
- **Automatically:** *The gates are automatically activated, when a measurement mode is selected. Gate1 is active in all measurement modes.* These modes have been internally setup at the Dakota factory. Therefore, if the user selects the **Thru Coat (E-E)** option, an internal setup will be loaded, and 2 gates will automatically be activated. This setup will work fine for the majority of all common applications. The user has the ability to fine adjust the gates settings, which will be further explained in the sections that follow.




- **Manually**: The gates can also be activated manually by using the Hot or Tabbed menus. For example: If any of the pulse echo modes (PE, PECT, PETP) had been selected in diagram 1, only gate 1 will have been activated from the factory setup. However, the user may have a requirement to activate and utilize more than one gate, depending on the application.




**Tabbed Menu**




**Hot Menu**

## 7.7 Gates

The ***FX-80*** is equipped with 3 gates, as explained in the previous section. One gate is active at all times in every measurement mode, with the exception of coating mode. These gates are full featured and completely adjustable. They can be fine tuned by the user to accommodate a variety of application scenarios. Diagram 1 in the previous section outlines the gates and features available for all measurement modes. Refer to the previous section for additional information. These features are described in more detail below:

**Note:** *In order to adjust the gates they must be activated. The gates are automatically activated depending upon the measurement mode selected. If a gate is inactive, it will be grayed out in the hot and tabbed menus. The explanations that follow, assume that the proper measurement mode has been selected. Refer to page 44 for more information on selecting measurement modes.*

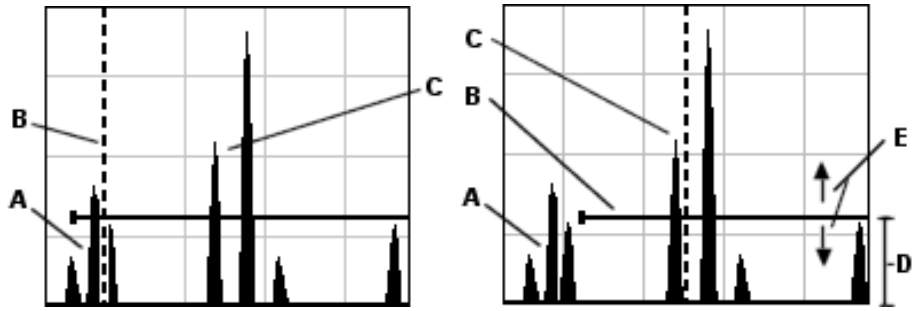
### Gate 1

Is used in all measurement modes, and has the following features assigned to it; start, width, and threshold. A gate can be used to overcome a great deal of application scenarios. Surface noise, for instance, close to the initial pulse can cause the erroneous measurements as the transducer receives reflections from the noise. By adjusting the start position of the gate, the noise can be blocked and eliminated. This is typical in aluminum, stainless steel, and titanium. This can also be a function of using a low frequency transducer, which are known to be inherently noisy off the initial pulse. The start feature of the gate is also used in multiple echo modes to control measurements between 2 or more echoes. As we saw in previous section, the threshold can be used to control the sensitivity level, and used in combination with the width, control the sensitivity over a specific range.

### Gate 2 & 3

These gate options will most commonly be used for multiple echo measurement modes, to measure between 2 or more echoes (E-E and E-EV). They are also handy to use in a stand pulse echo mode, to create a pseudo time corrected gain feel. As the thickness of the material increases, the signal amplitude of the reflection decreases. Why not just turn up the gain? Well, this is certainly something to consider, but is not always the best answer. As the gain is increased, the noise level is also increased. At some point, increasing the gain provides little or no benefit to the quality of the signal, and the additional noise introduced makes things worse. By activating another gate, optimizing the gain level, setting the thresholds, and adjusting the widths of the gates to cover specific thickness ranges, a tough application might not be so bad after all. These gates have the following features set assigned to them; holdoff (delay), width, and threshold.

**Example of Surface or Transducer Noise**




**Noise** **Blocked**

The diagrams above illustrate a typical surface noise condition. Refer to the **Noise** diagram: **(A)** refers to the noise in front of the actual back wall signal **(C)**. Notice the start position of the gate. As a result, the ***FX-80*** is detecting on the noise **(A)** as shown at point **(B)**. However, the true measurement should be taken at point **(C)**. Given the start, threshold, and gain levels, the amplitude from the noise is sufficient enough to cause the ***FX-80*** to detect, or measure the noise rather than the true back wall thickness **(C)**. Therefore, the ***FX-80*** is making an incorrect reading at point **(B)**.

Now refer to the **Block** diagram. The horizontal line at the top of **(D)**, is **GATE1**. The start of **GATE1** has been moved just beyond the noise **(A)** to block the noise and detect on the correct signal **(C)**. Note: the ***FX-80*** will only detect on signals that are located inside the dimensions of **GATE1 (B)**. Therefore, the ***FX-80*** cannot see **(A)** at all, with respect to the starting point of **(B)**. Also notice, the position of the threshold level with respect to the baseline **(D)**, which represents the sensitivity setting of the threshold. Extreme sensitivity is indicated by the bottom of the range **(D)** at the baseline, and less sensitivity indicated by the top of the range at **(D)**. Therefore, the vertical height of **GATE1** from the baseline, is the threshold level. The threshold level can be increased to decrease sensitivity, or visa versa.

If the threshold level was increased in the **Noise** diagram, so that the vertical position of **GATE1** was higher than the amplitude of the noise **(A)**, the ***FX-80*** would have detected on the true back wall **(C)**. Alternatively, if the gain level was decreased, the signal amplitude of the noise **(A)** would have decreased below the threshold level, and the ***FX-80*** would have also detected the true back wall **(C)**. This example brings all the fine adjustments into consideration, and demonstrates the versatility of having a fully functional scope rather than a basic digital thickness gauge.

The procedures to adjust all of the features associated with the **Gates** are outlined below:

**Note:** *This is a combined procedure that works the same for any of the features associated with the gates, regardless of which feature and gate number that is being adjusted.* ***Therefore (Ж) = Gate1, Hold-Off, and Width respectively****. Finally, the illustrations may not be applicable to the exact feature being adjusted, but the concepts relevant.*

## Adjusting the Features of the Gates Using the Main Hot Menu




Gate



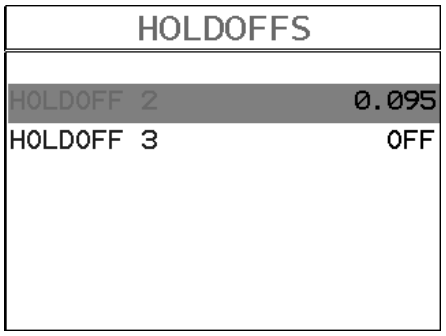

Holdoff‘s




Width’s

1) Press the  key once to activate measure menu items. Press the  key multiple times to move right and the  key multiple times to move left, until the **(Ж)** cell is highlighted. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) If the correct **(Ж)** is displayed, press the  and  arrow keys on the right button wheel to scroll the highlighted value.



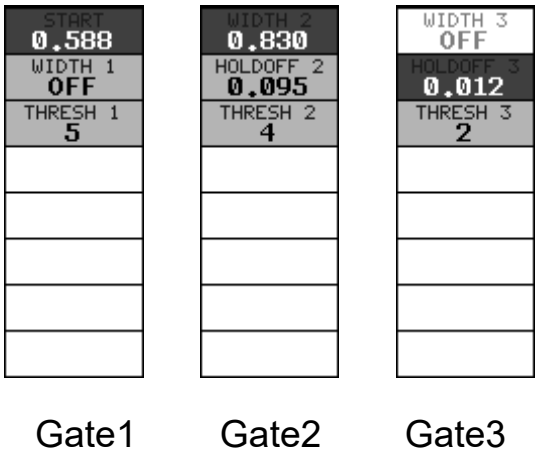

3) **Alternatively**, if the correct **(Ж)** is not being displayed, press the key to display the **List Box**.

4) Use the and arrow keys multiple times using the left button wheel to scroll through the **List Box** items until the correct **(Ж)** is highlighted.

5) Press the and arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Repeat steps **3-5** until all the **(Ж)** values are correctly adjusted.

## Adjusting the Features of the Gates Using Multiple Hot Menus



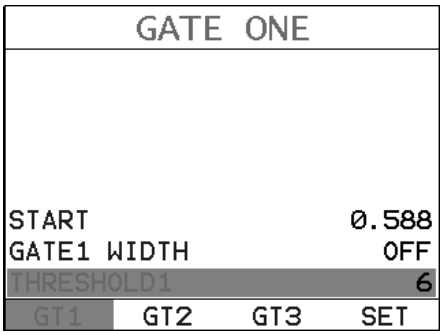
1) Using the left button wheel, press the  and  arrow keys to scroll through the 8 individual **Hot Menus**, and the  and  arrow keys to scroll through the **Hot Menu** items. Alternatively, the  **&** keys can be used to scroll through the **Hot Menu** items.

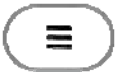
2) Press the  and  arrow keys multiple times on the right button wheel to toggle the value or status.

**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. Pressing the*  *key will allow the user to enter a specific target value.*

The user can also access and adjust the **(Ж)** from the tabbed menus. However, this method is more tedious than making the adjustments using **the Hot Menus**. The procedure for using the tabbed menus is outlined below:

## Adjusting the Features of the Gates using the Tabbed Menus

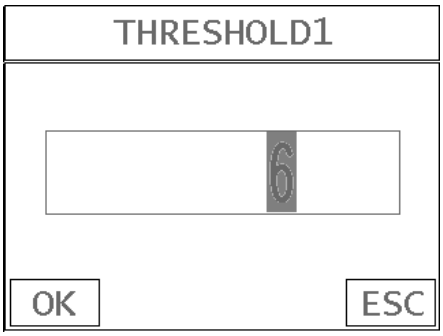



1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right, and the  key multiple times

to tab left, until the **(Ж)** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **(Ж)** is highlighted.

3) Press the  and  arrow keys on the right button wheel to scroll the value. When the correct **(Ж)** is being displayed, **proceed to step 10**.




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

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

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

8) Press the  key to set the **(Ж)** and return to the menu screen, or  to cancel entering the **(Ж)**.

9) Repeat steps **1-8** to set any additional **(Ж)** level.

10) Finally, press the  key to return to the measurement screen and begin taking readings.

# CHAPTER EIGHT
# THRU PAINT MEASUREMENT TECHNIQUE

## 8.1 Introduction to Thru Paint Measurement

The principle behind thru paint measurement is by measuring the time between two backwall echoes returning from the test material. Since both of these backwall echoes travel the same path through the paint or coating, the thickness of the coating is subtracted out of the measurement so that only the actual material thickness can be measured. This feature saves the user a great deal of time scraping and removing the coating from tanks and pipes during the inspection process.

The ***FX-80*** also has a special echo-echo verify option, or triple echo mode. This measurement mode is identical to the echo-echo mode described above, with an additional third echo measurement performed to verify the measurement between the first 2 echoes. By doing this, the ***FX-80*** can confirm that a peak jump has not occurred, and the measurement made is stable and correct. This mode is only suitable for thin materials and coatings, as the ability to achieve 3 reflections is not always possible.

The primary purpose of thru paint measurement is to determine actual or overall material thickness by eliminating the coating thickness. Thru paint mode cannot be used for flaw or pit detection. Therefore, inspectors may need to use echo-echo thru paint mode in conjunction with the standard pulse-echo flaw detection mode for some applications. The combination of using both modes is ideal for the advanced inspectors needs.

## 8.2 Using Thru Paint Mode

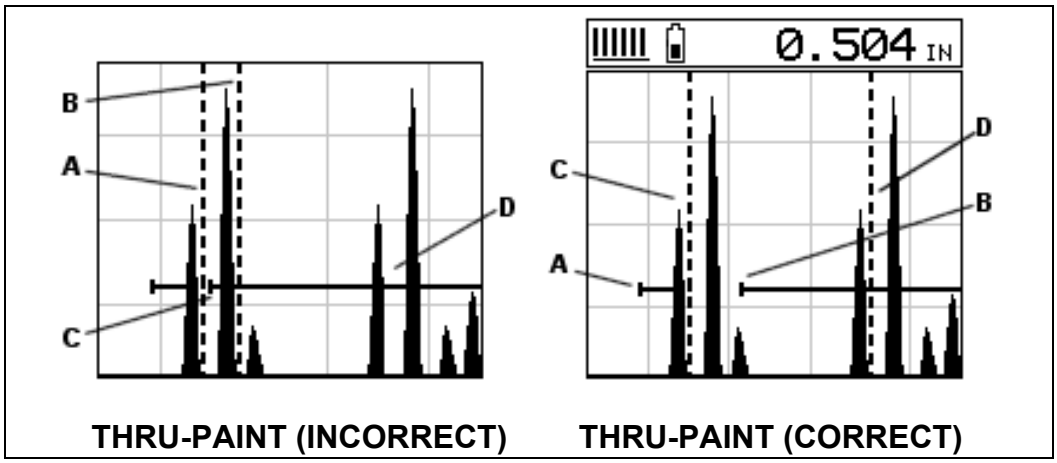
The first thing to note in this section is by selecting the transducer type from the list of probes stored in the ***FX-80***, a basic echo-echo thru paint configuration is recalled from memory. Each of the transducers in the list contains pre-configured echo-echo settings. However, fine adjustments may be necessary in order to be suitable for your specific applications. These configurations are general setups only. Once the transducer has been selected, or auto detected, and the appropriate calibration procedure completed, the ***FX-80*** can toggle between **pulse-echo** (flaw & pits), and **echo-echo** (thru-paint) modes by simply pressing the 

key located on the keypad. The standard transducer that will be used for common steel applications is a ¼" 5MHz high damped transducer **(1/4IN – 5.0MHZ HD or CT)**. However, any of the transducers with the **HD** label have been optimized for echo-echo thru paint applications. Any of the auto recognition coating transducers are also high damped transducers, and will work in echo-echo mode as well.

**Note:** *When a transducer is selected for use, all of the measurement modes available for use with this transducer can easily be determined by pressing the multi-*

*mode button on the keypad. The **FX-80** has been programmed to identify the modes available to a specific transducer.*

When configuring the ***FX-80*** for specific thru paint applications, all of the scope parameters will potentially be needed. The delay, range, gain (AGC), thresholds, gates, and hold-offs will be subject to change. For this reason, they have all been added to **Hot Menu** fields located directly beneath the A-Scan display for quick and easy access. **Note:** Once the values of the fields have been changed or modified, these changes must be saved to a setup location prior to powering the ***FX-80*** off. **Failure to do so will result in losing your changes**. Refer to page 169 for additional information on setups.




**THRU-PAINT (INCORRECT)** **THRU-PAINT (CORRECT)**

Refer to the incorrect diagram above. Point **(A)** represents the detection on the first back wall echo. The true, second back wall, reflection should be detecting at point **(D)**. However, the hold-off **(C)** is setup incorrectly and the ***FX-80*** is detecting the ring down noise of the transducer, on the first reflection, rather than the true second back wall reflection shown at **(D)**.

Before we look at the diagram with the correct configuration, let's consider all of our options on how to fix the problem beforehand. Our **delay** and **Range** will simply change the view options of the screen – not needed in this example. Will a **gain (AGC)** or **threshold** adjustment fix the problem? Unfortunately not. Why? Notice the amplitude of the cycle just to the left of **(B)**. If we tried to increase the threshold level above the height of the cycle, we would lose our detection for both echoes resulting in no reading at all. If we decrease our **gain (AGC)**, reducing the signal amplitudes, we would also lose our detection of both back wall echoes.

Notice that the amplitude of the cycle just to the left of **(C)**. The amplitude of the cycle, at **(C)**, is less than the amplitude of the cycle at **(B)**, in terms of overall height. If we decreased our **gain (AGC)**, we would lose the first cycle **(C)** long before losing the second cycle **(B)**. Therefore, adjusting the **gain (AGC)** or **threshold** levels will not help us in this example. Our final option is adjusting the **GATE2** hold-off, shown at point **(C)** in the incorrect diagram, to point **(B)** in the correct diagram. If we adjust

the **GATE2** hold-off further to the right of the first reflection, the ring down noise from the first back wall echo no longer interferes with the true detection **(D)**, shown in the correct diagram.

The adjustment considerations in the example above will typically be used for all thru paint applications respectively. In some applications the hold-off may be sufficient, while a **gain (AGC)** or **thresholds** adjustment will solve the problem. A similar process of elimination should be considered for all thru paint applications.

# CHAPTER NINE
# PULSE-ECHO COATING & COATING TECHNIQUES

## 9.1 Introduction to Pulse-Echo Coating Measurement (PECT)

In the previous sections we've discussed the need for detecting pits and flaws (pulse-echo) in materials, along with the requirement to measure through and eliminate errors caused by coated materials (echo-echo). Until now, both modes were needed in order accomplish both tasks. Pulse-echo mode was used for flaw detection, and echo-echo mode was used to eliminate the coating thickness and provide a nominal material thickness only. With this in mind, it often became cumbersome toggling between both modes respectively.

In a majority of applications involving coated materials, inspectors are often interested in monitoring both the thickness of the material, as well as the thickness of the coating. Therefore, the ***FX-80*** has been designed to provide the user with the ability to measure the material and coating thicknesses simultaneously, while maintaining the ability to detect flaws and pits all in a single mode called **Pulse-Echo Coating (PECT)**. This is accomplished by using a custom hybrid combination mode utilizing properties from the basic modes along with a group of special techniques and theoretical wave phenomena's.

The ***FX-80*** is preset to a coating velocity of 0.0850 in/µsec (2159 m/sec) from the factory. This velocity is a very close approximation of the common coating velocities found in the field. However, the ***FX-80*** also has a built-in one and two point calibration options to calibrate to coating samples with a known thicknesses.

There are two coating modes built into the ***FX-80***:

1) **Pulse-Echo Coating (PECT)** – used during inspections where both the material and coating thicknesses are required.
2) **Coating Only (CT)** – used during inspections where only the coating thickness is required.

## 9.2 Enabling Pulse-Echo Coating Mode (PECT) & Coating (CT)

When the ***FX-80*** is initially powered up, the gauge will automatically check to see if the transducer plugged into the gauge can be recognized. All Dakota NDT coating enabled transducers are equipped with the auto recognition feature. If the ***FX-80*** doesn't recognize that a special coating enabled transducer is plugged into the gauge, the coating feature will be disabled entirely. There are a number of coating enabled transducers available from Dakota. Please contact us with your application requirements for additional information on frequencies and diameters currently offered.

**The coating modes can be enabled in three different ways:**

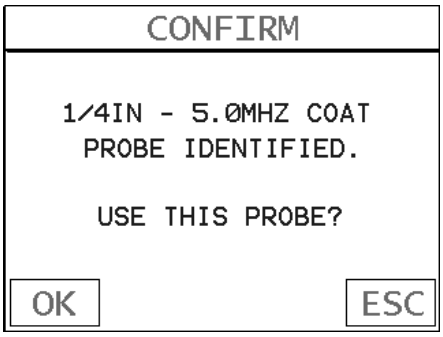
1) On Power up and probe recognition.
2) By pressing 

keypad.

3) From the tabbed menus under **TUNE, MEASURE MODE**.

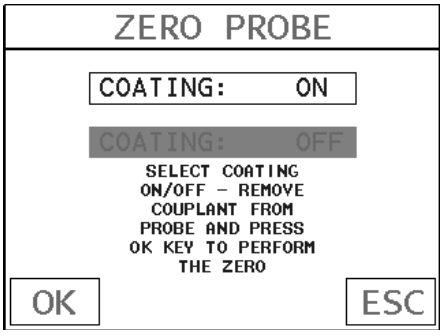
The steps that follow will demonstrate all three methods in the order listed above:

## Probe Automatically Recognized (PECT only)



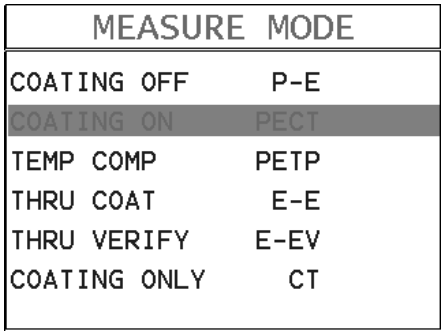

1) Press the OK key once to use the identified probe, or ESC to display a list of optional transducers. **Note:** *if the **FX-80** recognizes a specific transducer, the user should always select* OK *to use the identified probe. The only time an alternative probe should be selected from a list is if the user switched probes following initial power up and recognition.*

2) Assuming the ***FX-80*** recognized the probe and the OK key was pressed, the ***FX-80*** will advance to a Zero Probe menu. If the transducer was identified as a special transducer capable of measuring coating thickness, a menu will be displayed allowing the user the ability to toggle the coating thickness display on/off as follows:

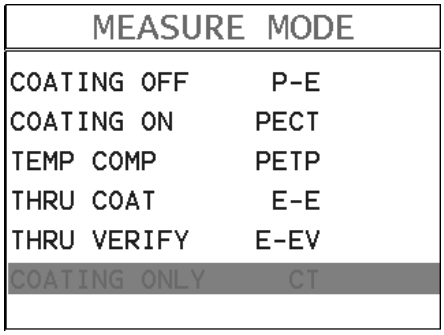


3) Press the  and  arrow keys using the left button wheel to toggle the coating option on/off.

## Multi Mode Key Pressed (PECT & CT)




**Applied to Metals**



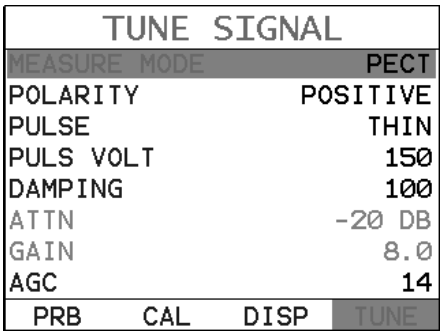

**Not Applied to Metals**

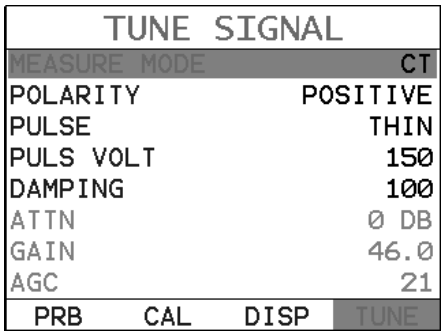
1) Press the  key located on bottom left of the keypad to display the **URE MODE** options menu.

2) Press the  and  arrow keys multiple times using the left button wheel to highlight the **COATING ON (PECT)** or **COATING ONLY (CT)** menu option.

3) Press the  key to enable the coating option and return to the main measurement screen, or  to cancel.

## Measure Mode (Tabbed Menus) – (PECT & CT)



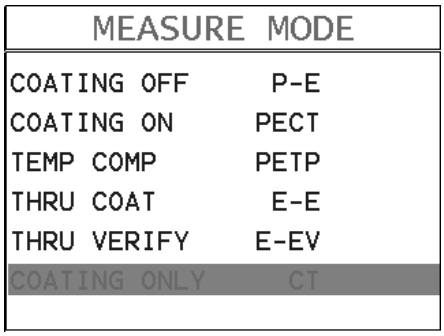

**Applied to Metals** **Not Applied to Metals**

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys using the left button wheel to scroll through the sub menu items until **MEASURE MODE** is highlighted.
3) Press the ◀ and ▶ arrow keys multiple times on the right button wheel to scroll the modes.
4) When the correct **MODE** is being displayed, press the ⌂ key to return to the measurement screen and begin taking readings.

## 9.3 Zero Coating

In order to account for very slight electronic differences in transducers of the same type, frequency, and diameter, the ***FX-80*** has been equipped with a "zero coating" feature. This enables the ***FX-80*** to obtain very accurate readings on coatings, eliminating potential errors incurred from slight differences in the manufacturing processes. The procedure is outlined below:

### Performing a Coating Zero




1) Press the 

key once to activate the measurement mode options.

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **Coating Only (CT)** mode is highlighted.

3) Press the  key to select the measurement mode and return to the measurement screen.

4) Apply a drop of couplant on the transducer and place the transducer in steady contact with the probe zero disk (battery cover) and obtain a steady reading.

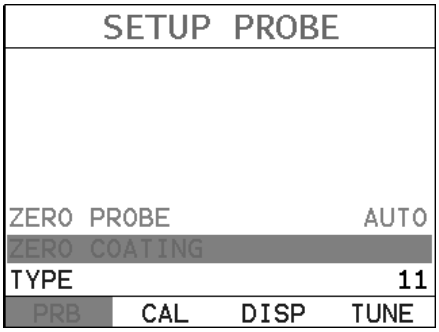
**Note:** *The coating measurement displayed will potentially be a value greater or less than 0.*

5) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the 

key multiple times to

tab left until the **PRB** menu is highlighted and displaying the submenu items.

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




6) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **ZERO COATING** is highlighted.

7) Press the  key to display the confirmation screen.

8) Press the  key to zero the coating and return to the **PRB** menu, or  to cancel the coating zero process.

9) Press the  key once to activate the measurement mode options.

10) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **Coating On (PECT)** is highlighted.

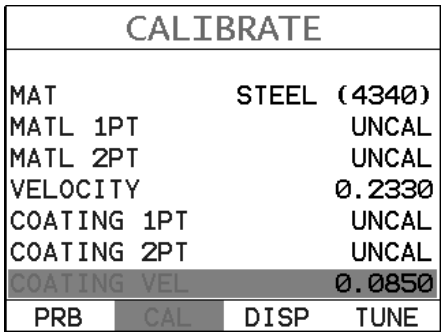
11) Press the  key to select the measurement mode and return to the measurement screen, and begin taking readings. Proceed to the coating calibration section.

## 9.4 Coating Calibration (PECT)

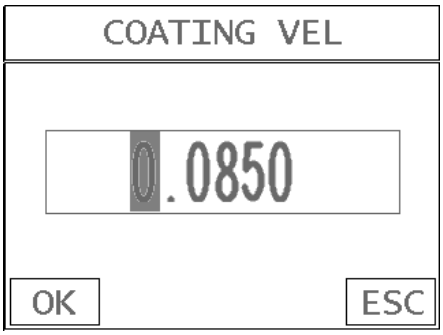
### Known Velocity

If the coating velocity is known, the user may wish to simply enter the velocity number into the ***FX-80***, rather than have the ***FX-80*** calculate the velocity value using a known thickness on a coating sample(s). The steps for entering the velocity are outlined below:

**Using a Known Material Velocity**




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **COATING VEL** is highlighted.




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

4) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the highlighted value.

5) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the digit locations.

6) Repeat steps **4 & 5** until the velocity number is correctly displayed.

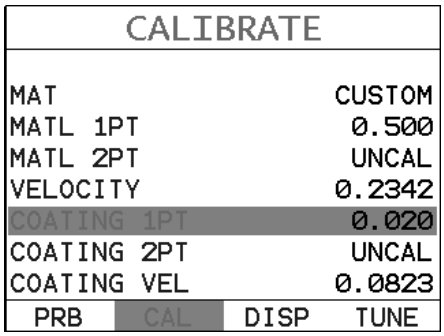
7) Press the OK key to set the velocity and return to the menu screen, or esc to cancel entering the velocity.

8) Finally, press the ⌂ key to return to the measurement screen and begin taking readings.

## Known Thickness

Sometimes the sound velocity of a coating material is unknown. In this case a sample with a known thickness can be used to determine the sound velocity of the coating. As previously discussed, the ***FX-80*** offers a one point calibration option for coating in **PECT** measurement mode. It is also import to reiterate that the coating sample must be coupled to a metallic material in order to perform the calibration. The calibration should also consider calibrating on high side of the intended measurement range, when using the one point option, minimize overall error. For example, if the measurement range of the coating will be from .040" - .080" (1.0mm 2.3mm), a coating closest to .080 (2.0mm) should be used. Note: It's always handy to carry a set of mechanical calipers to use in conjunction with the ***FX-80*** for calibration in the field:

### One Point Calibration




**Note:** *Be sure that the probe zero procedure has been performed prior to performing this calibration procedure.*

1) Physically measure an exact sample of the coating using a set of calipers or a digital micrometer.

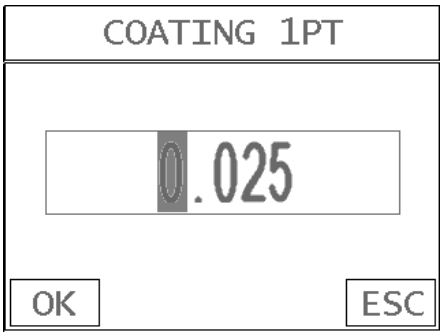
**Note:** *The coating sample must be coupled to a metallic material in order to be calibrated.*

2) Apply a drop of couplant on a piece of metal and place the coating sample on the metal over the couplant. Apply a drop of couplant on the transducer and place the transducer in steady contact with the coating and sample or actual test material. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable. Press the

key once to activate the menu items tab. Press the key multiple times to tab right and the key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items.

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

3) Use the and arrow keys multiple times using the left button wheel to scroll through the sub menu items until **COATING 1PT** is highlighted.




4) Press the key to display the **Digits Edit Box**.

5) Press the and arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Press the and arrow keys multiple times using the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.

8) Press the key to calculate the velocity and return to the menu screen, or to cancel the coating one point calibration.

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

**Note:** ***CHECK YOUR CALIBRATION!*** *Place the transducer back on the calibration point. The coating thickness reading should now match the known thickness. If the thickness is not correct, repeat the steps above.*

## 9.5 Introduction to Coating Measurement (CT)

In the previous sections we've discussed how to setup and use the coating feature for use in conjunction with material thickness for flaw and pit detection. The ***FX-80*** also has the capability to be used for general coating measurements. This measurement mode is called Coating (CT) and can be enabled using the same methods as described in a previous section above.

When the Coating Only (CT) mode is enabled, a two point calibration on the coating samples ***must*** be performed. This is to ensure linearity over the coating measurement range will be achieved. **Important note:** If coating measurements will be made with the coating applied to a metal surface, the calibration must be done in the same manner, with the samples coupled to a metal surface. However, if the coating will be measured as a standalone material, the calibration must be performed the same way.

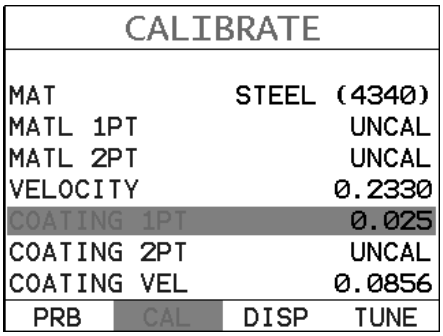
## 9.6 Two Point Coating Calibration (CT)

### Known Thickness

The following section will demonstrate the two point coating calibration procedure. This example demonstrates a coating thickness range of .040" - .120" (1 – 3 mm) as follows:

Note: It's always handy to carry a set of mechanical calipers to use in conjunction with the ***FX-80*** for calibration in the field:

## One Point Calibration



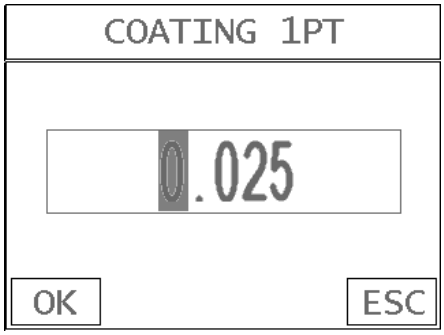

**Note:** *Use the maximum coating sample for the one point calibration first.*

1) *Physically measure the thicker of the two samples of coating, as close as possible to the maximum expected coating measurement range, using a set of calipers or a digital micrometer.*

***Very Important:*** *If coating measurements will be made with the coating applied to a metal surface, the calibration must be done in the same manner, with the samples coupled to a metal surface. However, if the coating will be measured as a standalone material, the calibration must be performed the same way.*

2) Apply a drop of couplant on the transducer and place the transducer in steady contact with the thicker of the two coating and samples fist. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable. Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

3) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **COATING 1PT** is highlighted.




4) Press the  key to display the **Digits Edit Box**.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

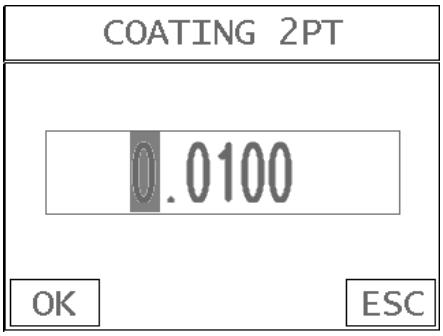
6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.

8) Press the  key to calculate the velocity and return to the menu screen, or  to cancel the coating one point calibration.

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

## Two Point Calibration



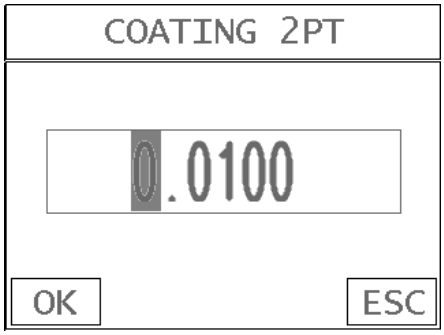

**Note:** *Use the minimum coating sample for the two point calibration.*

1) Physically measure the thinner of the two samples of the coating, as close as possible to the minimum expected coating measurement range, using a set of calipers or a digital micrometer.

**Very Important:** *If coating measurements will be made with the coating applied to a metal surface, the calibration must be done in the same manner, with the samples coupled to a metal surface. However, if the coating will be measured as a stand alone material, the calibration must be performed the same way.*

2) Apply a drop of couplant on the transducer and place the transducer in steady contact with the thinner of the two coating and samples. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable. Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

3) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **COATING 2PT** is highlighted.




4) Press the  key to display the **Digits Edit Box**.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.

8) Press the  key to calculate the velocity and return to the menu screen, or  to cancel the coating one point calibration.

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

**Note:** ***CHECK YOUR CALIBRATION!*** *Place the transducer back on both calibration points. The coating thickness readings should now match the known thickness values of each sample. If the thickness is not correct, repeat the steps above.*

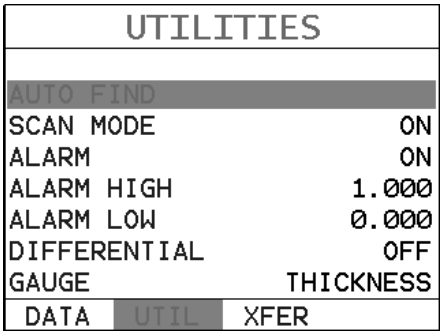
# CHAPTER TEN
# ADDITIONAL FEATURES OF THE FX-80

## 10.1 Auto Find

The ***FX-80*** is equipped with a very handy feature for locating the detection point of a back wall echo that is not currently in the viewable region of the display. Suppose the ***FX-80*** is currently setup with a delay of 0.0" and a width of 1.0", and the user is measuring material thickness of 2.5". The ***FX-80*** will make the correct measurement and display it digitally. However, the waveform will not show up at all in both A-Scan views, and incorrectly in the B-Scan view without adjusting the range of the **Delay** and **Width** accordingly.

The **AUTO FIND** feature is a convenient way to let the ***FX-80*** find the detection point and bring the waveform signal into view automatically. The user can then make small adjustments to the range once the signal is displayed on the screen. The procedure to use the **AUTO FIND** feature is outlined below:

### Using Auto Find




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **AUTO FIND** is highlighted.

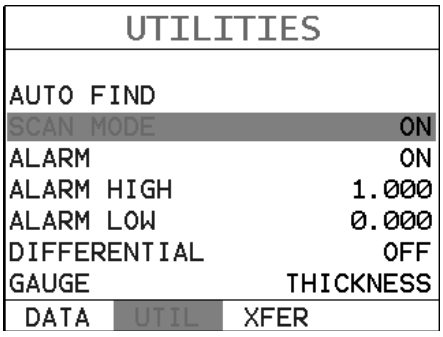
3) Place the transducer on the test material and obtain a reading.
4) Press the ↵ key to display the confirmation dialog box “set delay and width values”.
5) Press the OK key to automatically adjust the display settings and bring the waveform into view.

## 10.2 High Speed Scan

The High Speed Scan feature of the ***FX-80*** increases the overall repetition rate to a maximum of 140Hz with a high speed screen refresh rate of 25 times a second. This feature enables a user to make scanned passes over an arbitrary length of the test material, while still maintaining a reasonable representation of thickness over the scanned area or region. This feature can be used in conjunction with High and Low alarm limits features to dynamically keep track of both values. The feature is typically used to provide a better representation of the area scanned, by taking more readings at a faster rate repetition rate.

The procedure to use the **SCAN MODE** feature is outlined below:

### Using the Scan Mode




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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.

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

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **SCAN MODE** is highlighted.

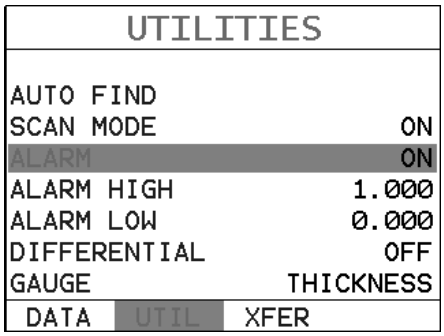
3) Use the  and  arrow keys multiple times on the right button wheel to toggle the **SCAN MODE** on/off.

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

## 10.3 Alarm Mode

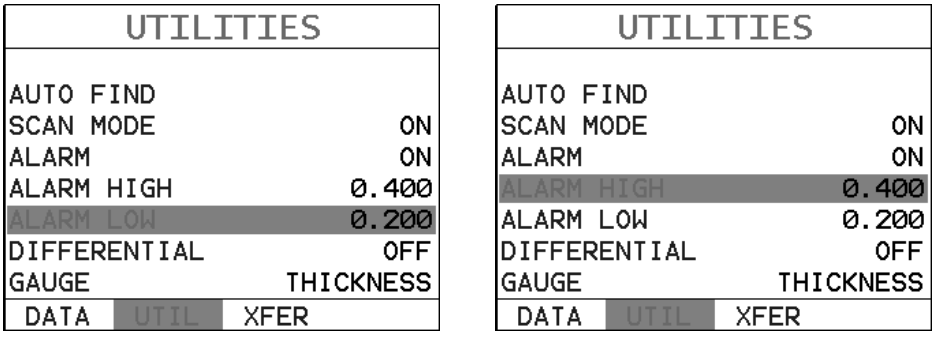
The **Alarm Mode** feature of the ***FX-80*** provides the user with a method of setting tolerances, or limits, for a particular application requirement. This feature may be used for a variety of applications to verify the material is within the manufacturer specifications. There are two limits, or alarm values, that can be setup in the ***FX-80*** – **ALARM LOW** and **ALARM HIGH** limits. However, the user may choose to activate and utilize only one of the limit values, depending on their specific application requirements. The procedures to use the **ALARM MODE** feature are outlined below:

**Toggle Alarm (on/off)**



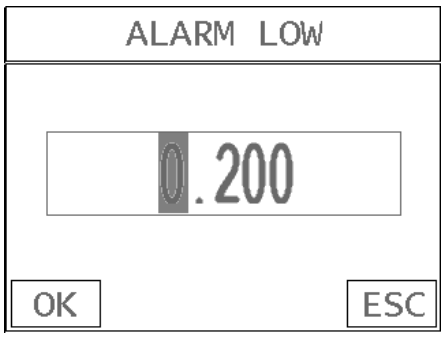
1) Press the ≡ key once to activate the menu items tab. Press the ≡ key multiple times to tab right, and the esc key multiple times to tab left, until the **UTIL** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **ALARM** is highlighted.
3) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle the **ALARM** on/off/audible.
4) Continue on to the next section **"Setting the Alarm Low Limit"**.

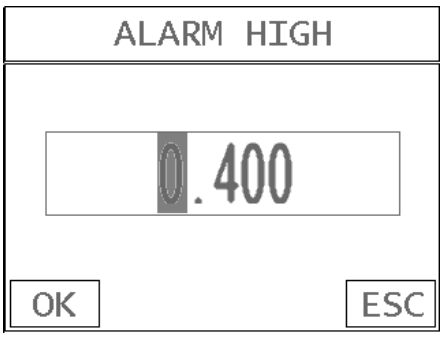
## Setting the Alarm Low Limit




1) Assuming the **ALARM** is **ON**, the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **ALARM LOW** is highlighted.

2) Press the  and  arrow keys multiple times on the right button wheel to scroll the value. When the correct alarm value is being displayed, **proceed to step 7**.




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

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

6) Repeat steps **4 & 5** until the **ALARM LOW** value is correctly displayed.

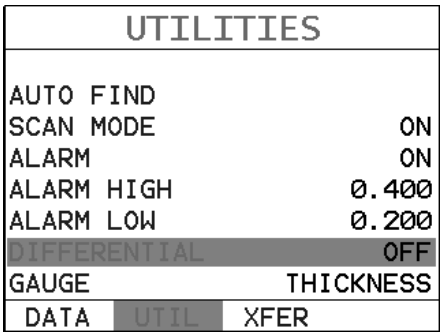
7) If only one limit will be used, press the  key to return to the measurement screen and begin taking readings. Otherwise, repeat the step outlined above to set the **ALARM HIGH** limit.

## 10.4 Differential Mode

The **Differential Mode** of the ***FX-80*** provides the user with the ability to set a nominal value, according to what the expected thickness should be, and measure the +/- difference from the nominal value entered. This feature is typically used in QA

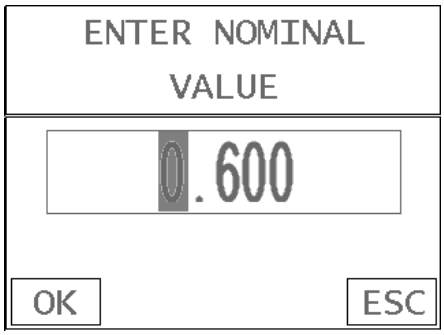
incoming inspections on pipes, plate stock, coils, etc. The steps below outline how to enable and enter the nominal value to use this feature:

## Toggle Differential (on/off)




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **DIFFERENTIAL** is highlighted.
3) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle the **DIFFERENTIAL** on. A value will appear to the right of **DIFFERENTIAL**.
4) Continue on to the next section **"Setting the Differential Value"**.

## Setting the Differential Value

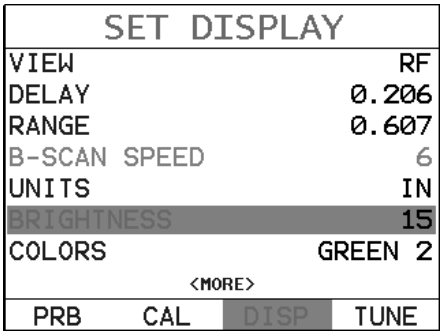



1) Assuming **DIFFERENTIAL** has been enabled and a value is being displayed to the right of the **DIFFERENTIAL** label, press the key to display the **Digits Edit Box**.
2) Press the and arrow keys multiple times using the left button wheel to scroll the highlighted value.
3) Press the and arrow keys multiple times using the left button wheel to scroll the digit locations.
4) Repeat steps **2 & 3** until the **DIFFERENTIAL** value is correctly displayed.
5) Press the key to set the **DIFFERENTIAL** value and return to the menu screen.
6) Finally, press the key to return to the measurement screen and begin taking readings.

## 10.5 Brightness

The ***FX-80*** 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

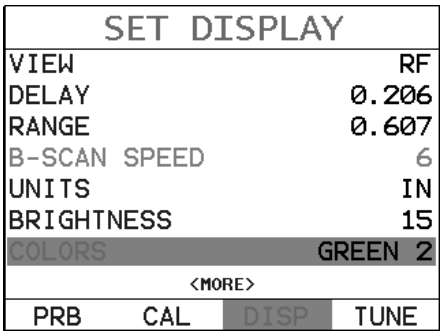



1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the ESC key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to scroll the **BRIGHTNESS** value.
3) Finally, press the ⌂ key to return to the measurement screen and begin taking readings.

## 10.6 Color

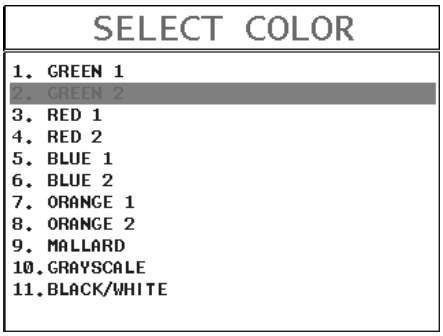
The ***FX-80*** has a variety of display color options to select from. These will change the look and feel of the according to the users preference. The procedures for changing the **COLOR**, are outlined below:

## Selecting a Color Scheme




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **COLOR** is highlighted.




3) Press the ↵ key to display a list of the color scheme options.

4) Press the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the material list until the appropriate material is highlighted.

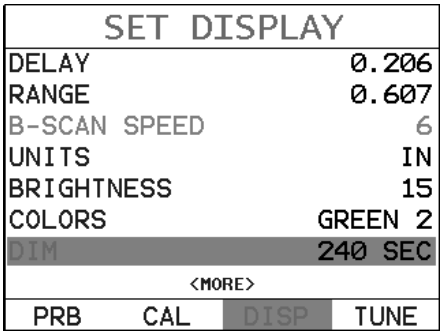
5) Press the ↵ key, followed by pressing the OK key to overwrite the existing color scheme with the selected scheme.

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

## 10.7 DIM

The ***FX-80*** 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 ***FX-80*** 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**




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **DIM** is highlighted.

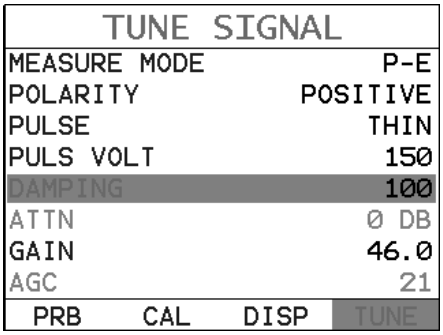
3) Press the  and  arrow keys multiple times on the right button wheel to scroll the **DIM** time.

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

## 10.8 Damping

The ***FX-80*** has a built-in damping feature to control the impedance input of the receiver. This enables the user the ability to match and optimize the transducer for better signal quality at various frequencies. The available settings are 50, 75, 100, 300, 600 and 1500 ohms. The procedures below outline the steps for selecting an impedance setting, as follows:

### Setting the Damping Value




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

items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **DAMPING** is highlighted.

3) Use the  and  arrow keys multiple times on the right button wheel to scroll through the **DAMPING** values until the correct value is displayed to the right of the **DAMPING** menu item.

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

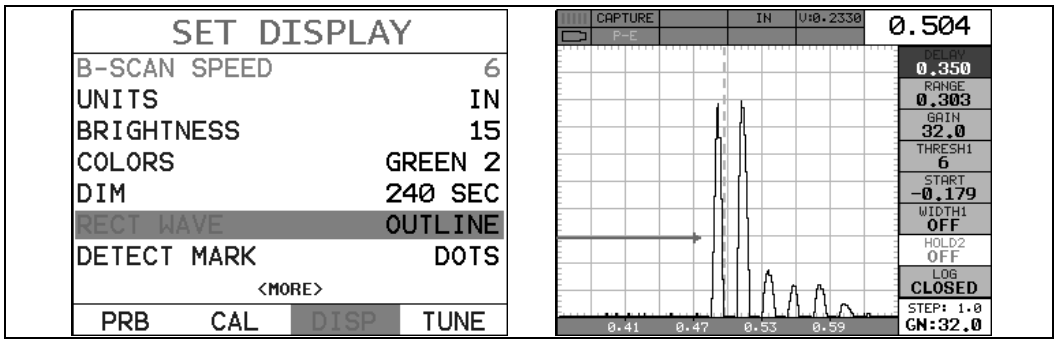
## 10.9 Graphics Options (look & feel)

We've added a couple of graphic interface features to the ***FX-80*** , accommodate customer requests we've received in the past. These features only serve as cosmetic items, and do not change the functionality of the ***FX-80*** in any way.

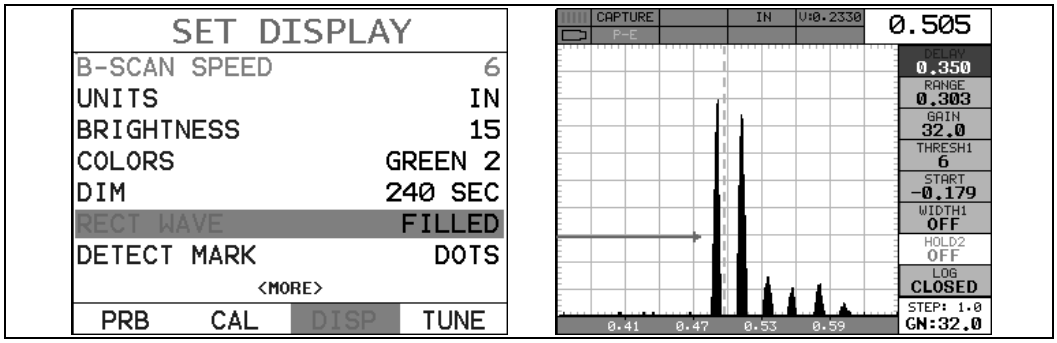
**RECT Wave:**

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.

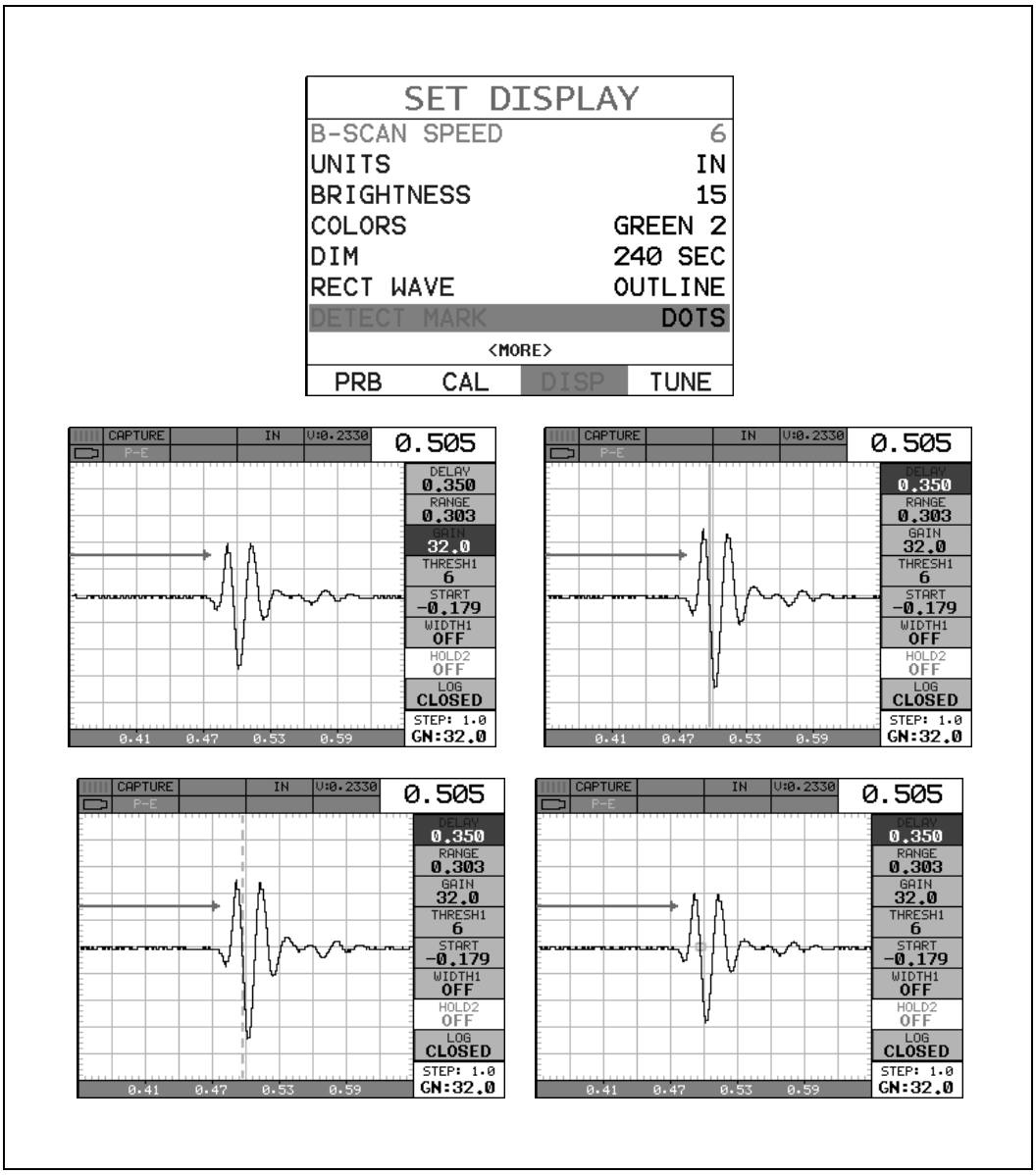



**Filled** – Draws a filled version of the waveform.



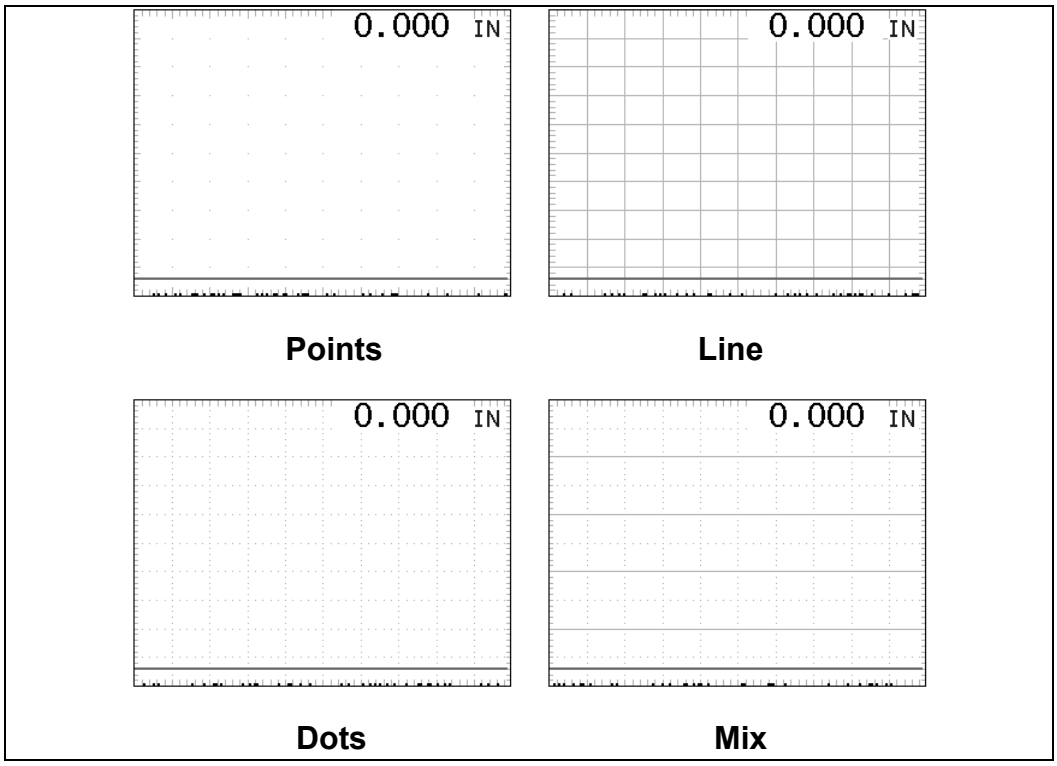

**Detect Mark:**

The detect mark is another look and feel option for displaying the detection indicator.

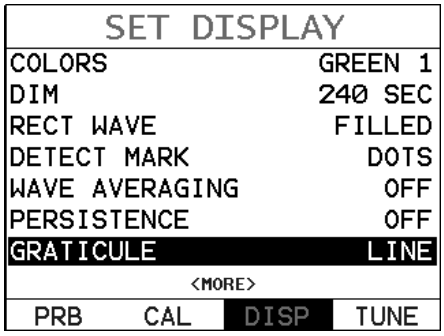



## 10.10 Graticule (A-Scan Background)

The graticule markers in the background of the A-Scan waveform area provide measurement references for depth/thickness versus amplitude. There are multiple options for the user to select an A-Scan background grid/segments to satisfy their graphics preference or 'look and feel'. The procedure to select one of the options is outline below:




## Selecting Graticule Option




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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.

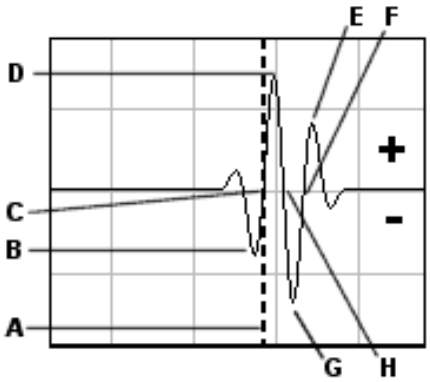
2) Use the  and  arrow keys to scroll through the sub menu items until **GRATICULE** is highlighted.

3) Use the  and  arrow keys to scroll the **GRATICULE** options.

4) Once the desired “look & feel” is displayed, press the  key to return to the measurement screen.

## 10.11 Polarity

The ***FX-80*** is equipped with an option to select the polarity, or phase +/-, for the purpose of detection. The phase can be a very valuable feature to have when the signal returning from the test material is marginal, a low frequency transducer is being used, and the user has a very weak positive or negative cycle, while trying to measure very thick materials. There is a possibility that signal will become so weak that it falls below the threshold, and peak jumps to the next cycle altogether. This peak jump represents a shift of the detection further out in time, resulting incorrect measurements. The material being measured will appear thicker than it actually is. Refer to the diagram below:

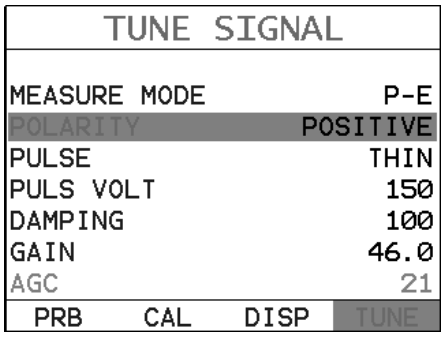



Notice the +/- positions in the diagram. The positive phase is everything above the horizontal center line, and the negative everything below the center line. The ***FX-80*** uses a **zero crossing method for detection**. Therefore, the detect line **(A)** is represented by the broken vertical dotted line, and is currently detecting on the negative portion of the waveform **(B)** at the zero crossing **(C)**. The signal amplitude **(B)** is shown as the negative vertical height at **(B)** in the diagram. Refer to the height of the second negative peak at **(G)**. It’s clear that the amplitude of **(G)** is much greater than that of **(B)**. Therefore, if the user was measuring thick attenuative

material, and the amplitude of **(B)** decreased substantially, the ***FX-80*** would lose the first cycle **(B)** and peak jump to the second cycle **(F)**. The detect **(A)**, would move to **(F)**, resulting in incorrect measurements.

If the user were to select the positive phase in the diagram above, the detect would measure at **(H)**. **(A)** would move to **(H)**. Notice the height of **(D)** with respect to the height of **(E)** in the diagram. If the user was measuring thick attenuative material using this phase, the signal **(E)** will certainly be lost long before **(D)**. Therefore, the positive phase is a much better choice in the diagram above.

## Toggle Polarity (+/-)




**Note:** Before toggling the **Polarity**, the ***FX-80*** should be set to the **RF** display view option. The **RF** view will give the user the best opportunity to correctly view the positive and negative cycles of the waveform. Please refer to page 63 for information on selecting the **Display Views**.

1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **POLARITY** is highlighted.

3) Use the  and  arrow keys multiple times on the right button wheel to toggle the **POLARITY** negative or positive.

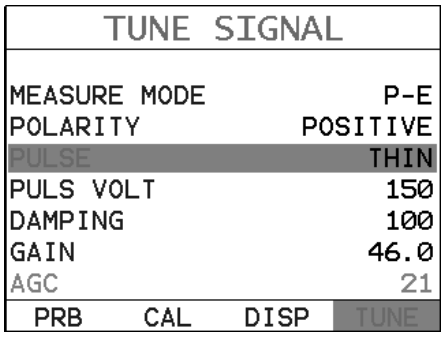
4) Press the  key to return to the measurement screen and begin taking readings.

**Important:** *Be sure to do a Probe Zero after changing the polarity!*

## 10.12 Pulse Width

The ***FX-80*** has an 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. This can be considered the normal or standard setting. When additional energy is needed, more penetration, the **THIN** and **WIDE** options may be necessary. The procedure to change the pulse width is outlined below:

### Selecting the Pulse Width

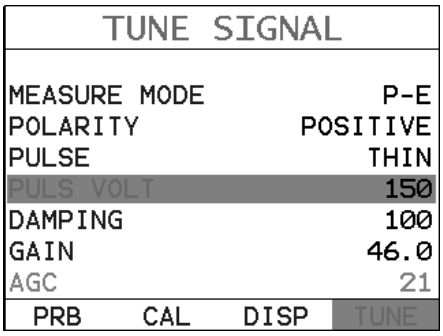


1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to tab left until the **TUNE** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.
2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **PULSE** is highlighted.
3) Use the  and  arrow keys multiple times on the right button wheel to scroll the **Pulse** options.
4) Once the **Pulse** is displayed, press the  key to return to the measurement screen.

## 10.13 Pulser Voltage

The ***FX-80*** has a 200 volt square wave pulser that can be adjusted for specific applications and transducers. The Pulser Volt feature offers a 50 volt cut/boost option to the user. The standard setting is 150 volts. This enables the ***FX-80*** to offer greater penetration for difficult material types, or increased resolution on noisy materials. The procedure to change the pulser voltage is outlined below:

**<u>Changing the Pulser Voltage</u>**




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **PULSER VOLT** is highlighted.
3) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to scroll the **Pulser Voltage** options.
4) Once the desired **Pulser Voltage** is displayed, press the ⌂ key to return to the measurement screen.

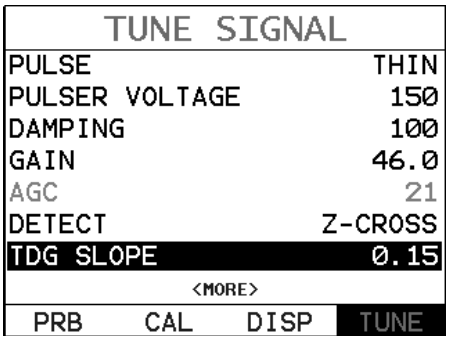
## 10.14 GAIN SLOPE (TDG)

The ***FX80*** has a gain slope feature that is similar to a basic linear time corrected gain function, or “time dependent gain” **TDG**. The slope can be adjusted from .1-20 decibels per inch depth. It can be used in both pulse-echo (PE) and echo-echo (E-E) measurement modes. In pulse-echo mode the start can be configured, and in echo-echo mode starts at the first return echo and ramps the gain at the slope setting

selected, until 'max gain' is reached. TDG has a maximum adjustable gain boost of +40 dB. A very useful feature for improving sensitivity and overall output according to depth.

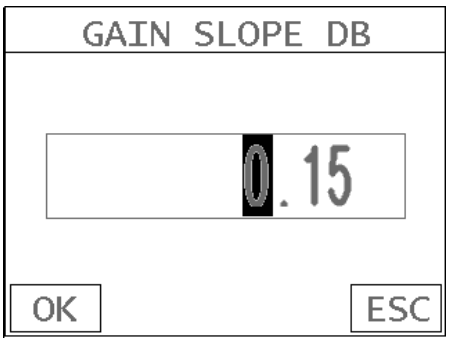
The procedures below outline the steps to enable and set the gain slope, as follows:

## Gain Slope




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ▲ and ▼ arrow keys to scroll through the sub menu items until gain **SLOPE** is highlighted.




3) Use the ▲, ▼, ◀ **&** ▶ arrow keys to set the target value.

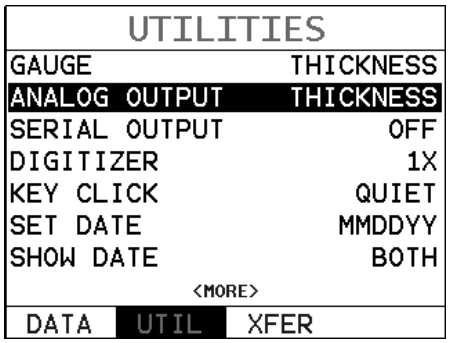
4) Press the OK key to set the value and return to the ☰ screen.

5) Finally, press the ⌂ key to return to the measurement screen and begin taking readings.

## 10.15 Analog Output

The analog output sends a voltage proportional to the thickness of the material being measured. The minimum thickness setting corresponds to the 0 voltage reference, while the maximum thickness sets the 10 volt reference. These can be fine tuned to match the data acquisition system being used. There are three voltage calibration settings CAL (MIN, MID, MAX). Each can be used to generate an output voltage of 0, 5, 10 volts, to calibrate the data acquisition system.

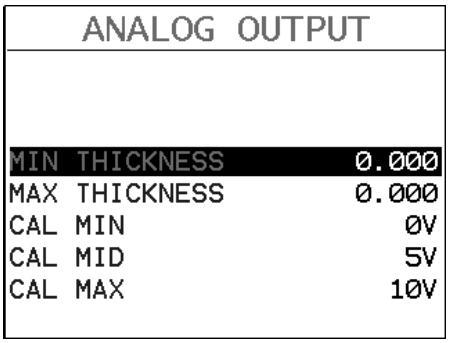
### Analog Output




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

2) Use the ▲ and ▼ arrow keys to scroll through the sub menu items until **ANALOG OUTPUT** is highlighted.

3) Use the ◀ and ▶ arrow keys to toggle the **ANALOG OUTPUT** ⏻.



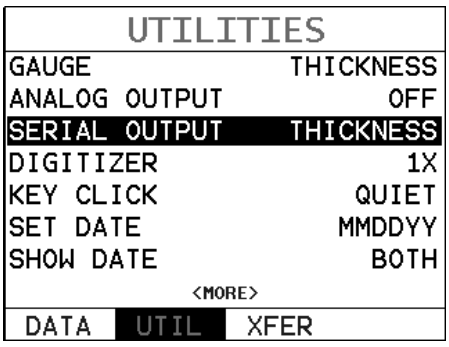

4) Press the key to display the **ANALOG OUTPUT** menu.
5) Use the and arrow keys to scroll through the sub menu items.
6) Press the key to set the desired values.
7) Finally, press the key to return to the measurement screen and begin taking readings.

## 10.16 Serial Output

The **SERIAL OUTPUT** can be enabled to continuously send thickness measurements to the serial port for data acquisition and reporting. The baud rate is fixed at 9600.

The procedures below outline the steps to enable the serial output, as follows:

**Serial Output**

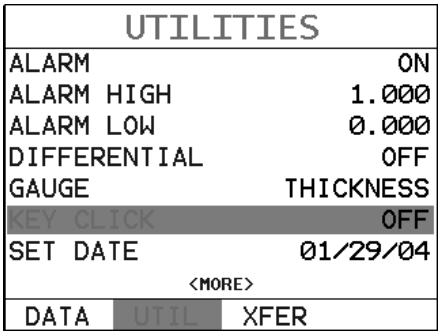


1) Press the key once to activate the menu items tab. Press the key multiple times to tab right, and the key multiple times to tab left, until the **UTILS** menu is highlighted and displaying the submenu items.
2) Use the and arrow keys to scroll through the sub menu items until **SERIAL OUTPUT** is highlighted.
3) Use the and arrow keys to toggle the **SERIAL OUTPUT** .
4) Finally, press the key to return to the measurement screen and begin taking readings.

## 10.17 Key Click

When a key is pressed on the ***FX-80*** keypad, the user can control whether or not an audible beep is sounded and at what volume level, if any. The procedure for this feature/preference is outlined below:

### Setting the Key Click




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

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

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **KEY CLICK** is highlighted.

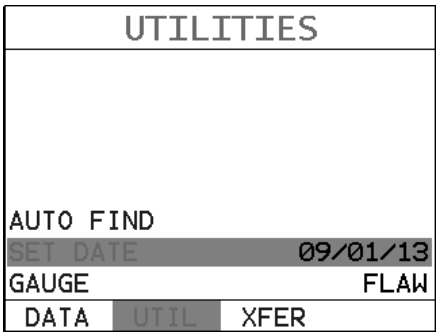
3) Use the  and  arrow keys multiple times on the right button wheel to toggle the **KEY CLICK** loud/quiet/off.

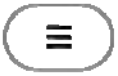
4) Press the  key to return to the measurement screen.

## 10.18 Date & Time

The ***FX-80*** 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:

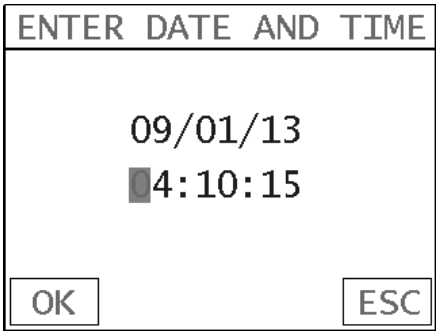
### Setting Date & Time




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

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

2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **SET DATE** is highlighted.




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

4) Press the , , , **&**  arrow keys on the left button wheel, to scroll the field locations.

5) Press the  and  arrow keys multiple times on the right button wheel to scroll the value.

6) Repeat steps **4 & 5** until the **Time & Date** is correctly displayed.

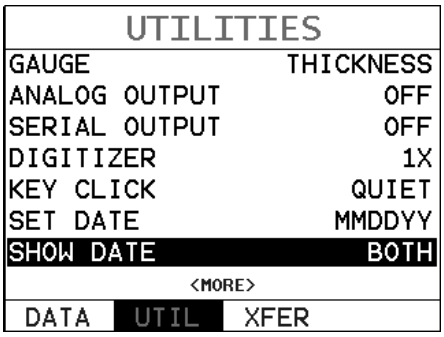
7) Press the  key to set the **Time & Date** and return to the menu screen, or  to cancel entering the **Time & Date**.

8) Finally, press the  key to return to the measurement screen and begin taking readings.

## 10.19 Show Date & Time

The ***FX80*** 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:

**Live Time & Date**



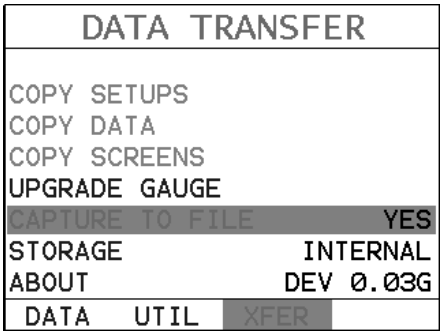

1) Press the ≡ key once to activate the menu items tab. Press the ≡ key multiple times to tab right and the ESC key multiple times to tab left until the **UTIL** menu is highlighted and displaying the submenu items.
2) Use the ▲ and ▼ arrow keys to scroll through the sub menu items until **SHOW DATE** is highlighted.
3) Press the ◀ and ▶ arrow keys multiple times to scroll the options (Date, Time, Both, Off).
4) Finally, press the ⌂ key to return to the measurement screen and begin taking readings.

## 10.20 Freeze & Capture

The ***FX-80*** 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 ***FX-80***, and additional external SD card

reader, 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) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to tab left until the **XFER** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **CAPTURE TO FILE** is highlighted.

3) Use the  and  arrow keys multiple times on the right button wheel to toggle the **CAPTURE** on/off. Note: Capture will be displayed in a toolbar cell on the active display, indicating the feature is enabled.

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

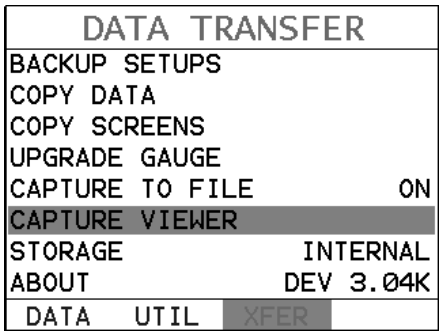
5) To capture a file, press the freeze key to freeze the screen, followed by pressing it a second time to display the alpha numeric edit box to name and save the screen shot. Note: if capture is not enabled, the freeze key toggles freeze on/off.

## 10.21 Capture Viewer

The capture viewer enables a user to view any of the saved screen captures on the SD card, using the ***FX-80***. This is handy if a PC isn't available, but the user has a need to review the screen shots captured.

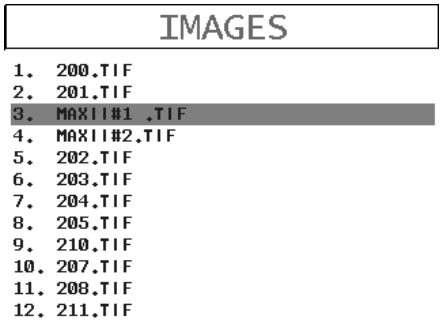
The procedure to capture the last screen displayed is outlined below:

### Capturing Screen Shots




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **CAPTURE VIEWER** is highlighted.




3) Press the  key to display the list of images (.tif) currently stored on the internal or external SD card.

4) Use the  and  arrow keys multiple times using the left button wheel to scroll through the list of images until the desired image is highlighted.

5) Press the  key to display the highlighted image, and the  key to close the image and return to the list of images.

6) Repeat steps 4-5 as needed.

7) Finally, press the  key to close the **VIEWER** and return the measurement screen.

# CHAPTER ELEVEN
# DATA STORAGE – SETUP, EDIT, & VIEW FILES

## 11.1 Introduction to Grid and Sequential file formats

The ***FX-80*** 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 ***FX-80*** and the log created, the ***FX-80*** 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:

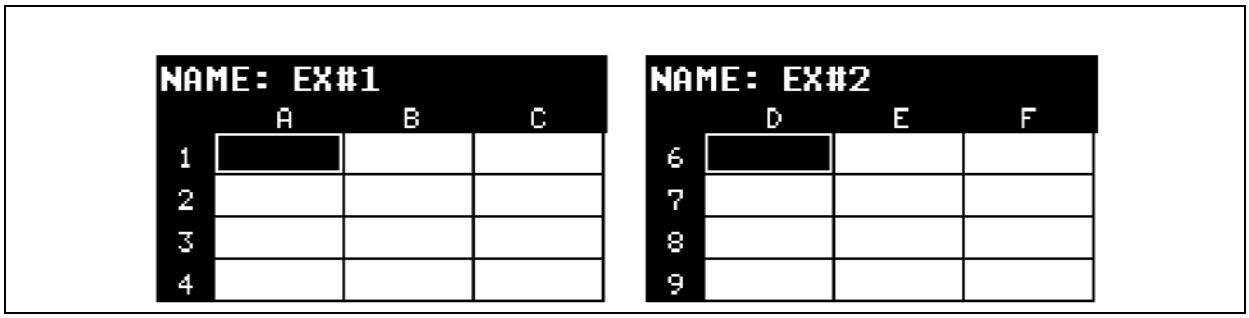
**Numeric characters:** 0 – 9 **Alpha Characters:** A – Z
**Special Characters:** ! ‘ _ # space / . – ( )

Multiple grids can be created and stored until the ***FX-80***’s memory is full. If the user attempts to store a new file in the ***FX-80*** and the size of the file exceeds the capacity of memory, the ***FX-80*** will respond with an error message indicating that the memory is unable to store the new file.

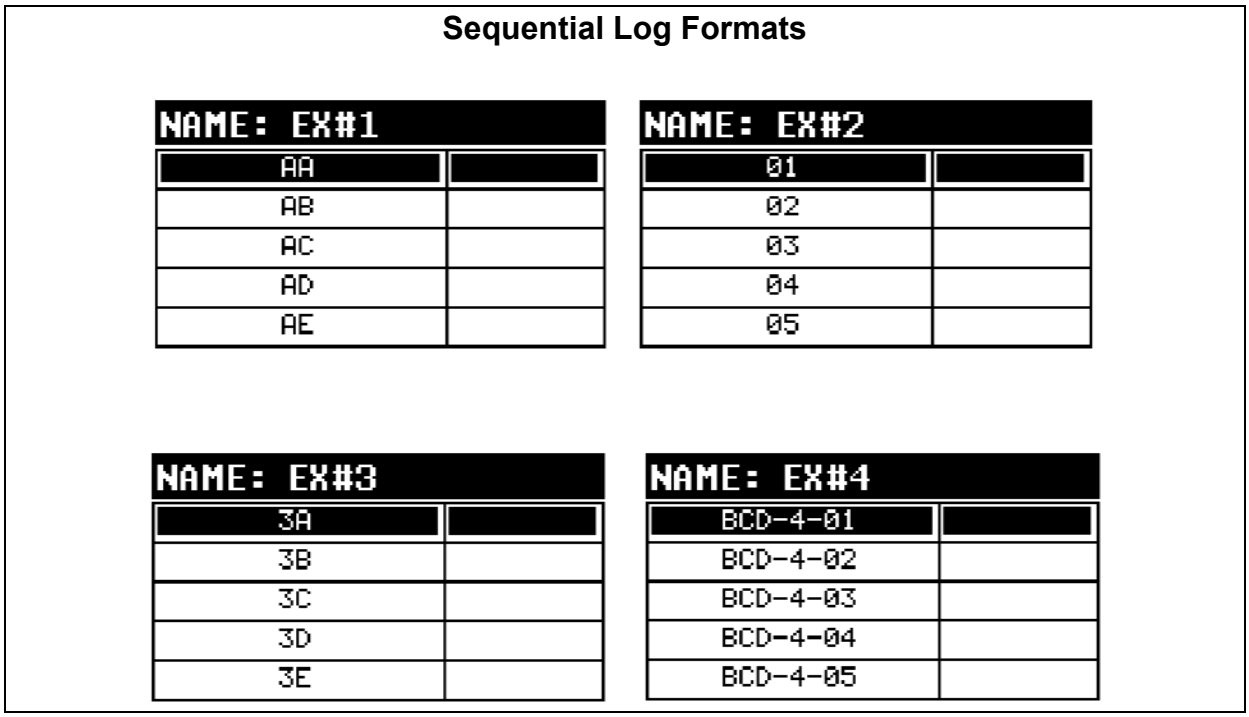
The ***FX-80*** has a very large potential storage capacity, and depending on the configuration of SD card sizes versus data, setups and screen capture images, can store limitless amount of data. The ***FX-80*** has an internal SD of 4 gigabytes, and an external slot reader that has been successfully tested with a 64 gigabyte card. Therefore, available memory will not be an issue.

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** |
|---|




**Sequential Log Formats**




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

## 11.2 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**

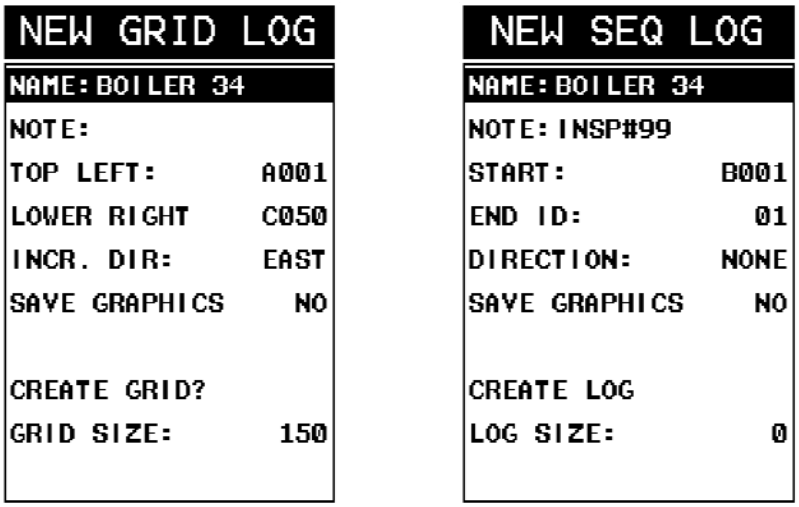



**Sequential Log**

1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **NEW** is highlighted.

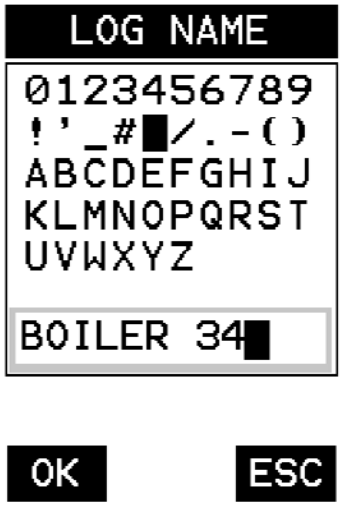
3) Press the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle the data formats – **GRIG LOG** & **SEQ LOG**.




**Grid Log** **Sequential Log**

4) Press the ↵ key to display the new **Grid** or **Seq Edit Box**.

5) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **NAME** is highlighted.




6) Press the ↵ key to activate the **Alpha Edit Box**.

7) Use the ▲, ▼, ◀, **&** ▶ arrow keys on the left button wheel to highlight the appropriate alpha characters.

8) Press the ↵ key to select a character and advance to the next field of the **Grid** or **Seq Name**.

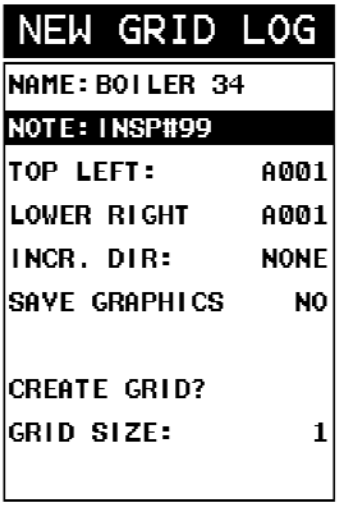
9) Use the dr key to backspace if necessary.

10) Repeat steps **6 - 9** until the **Grid** or **Seq Name (File Name)** is completed.

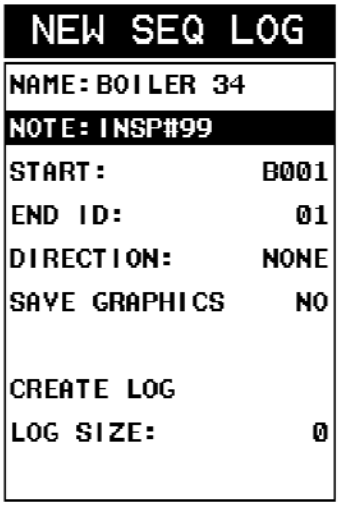
11) Press the OK key to save the **Grid** or **Seq Name** and return to the **Grid** or **Seq List Items** menu, or esc to cancel entering the **Grid** or **Seq Name (File Name)**.

## 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.




**Grid Log**




**Sequential Log**

1) Assuming the **Grid** or **Seq** List Items are displayed, use the ▲ and ▼ arrow keys using the left button wheel to scroll through the new **Grid** or **Seq List Items** until **NOTE** is highlighted.

2) Press the ↵ key to activate the **Alpha Edit Box**.




3) Use the ▲, ▼, ◄, **&** ► arrow keys on the left button wheel to highlight the appropriate alpha characters.

4) Press the ↵ 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**.

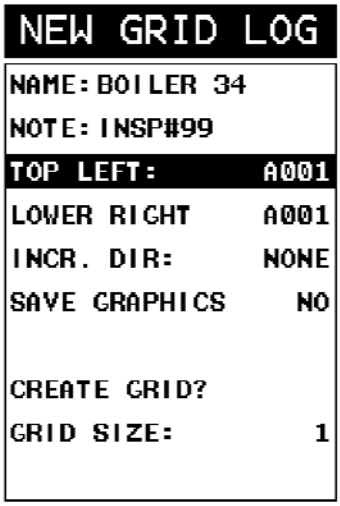
## Setting the Coordinates or Start & Stop ID's

**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

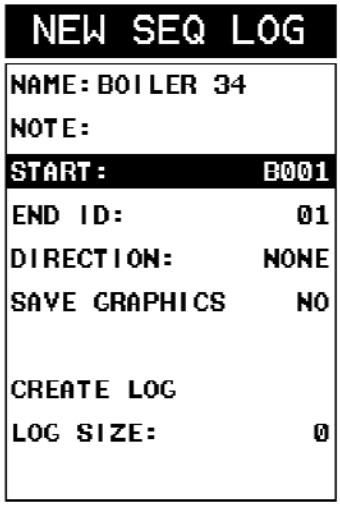
top, and numeric coordinates are vertical down the side. Therefore, to define the top left corner of the grid, there will be an (X,Y) coordinate. Where X is an alpha column location across the top and Y is a numeric row location down the side. Use the same logic when choosing the lower right corner. 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 ***FX-80*** and the log created, the ***FX-80*** will automatically generate all the identifiers within that range.

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



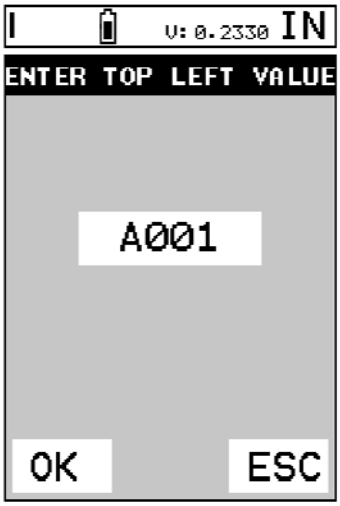

**Grid Log**



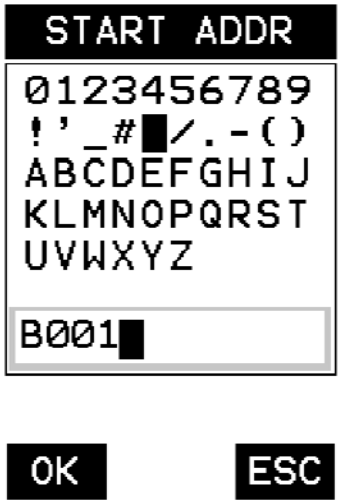

**Sequential Log**

1) Use the  and  arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **TOP**  or **START ID** is highlighted.

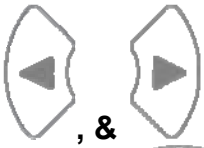
2) Press the  key to activate the **Coordinate** or **Start ID Edit Box**.

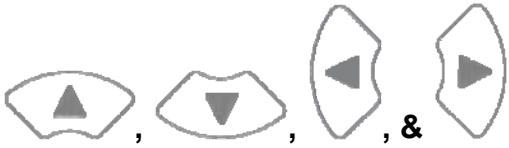



**Grid Log**



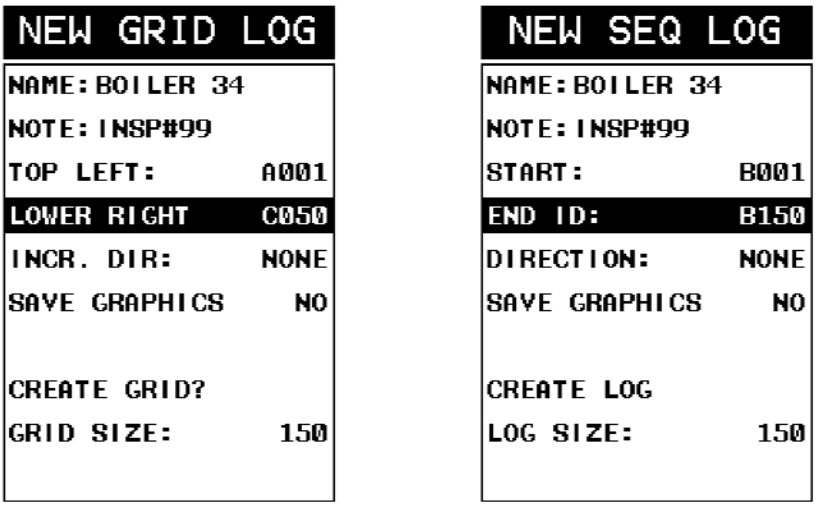

**Sequential Log**

3) **GRID LOG:** Use the  **, &** arrow keys on the left button wheel to scroll the **Columns**, and the  **,** arrow keys on the left button wheel to scroll the **Rows**.

**SEQ LOG:** Use the  **, , , &** arrow on the left button wheel keys to highlight the appropriate alpha characters. Press the  key to select character and advance to the next character field, in conjunction with using the  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.

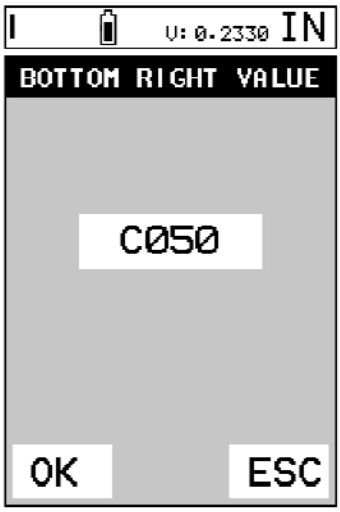
## Setting the Bottom Right(Grid) or End ID(Seq)

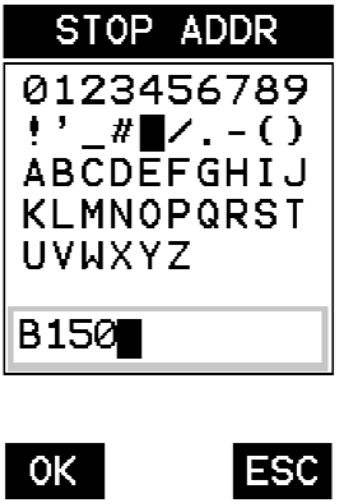



**Grid Log** **Sequential Log**

1) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **LOWER** or **END ID** is highlighted.

2) Press the ↵ key to activate the **Coordinate** or **End ID Edit Box**.




**Grid Log** **Sequential Log**

3) **GRID LOG:** Use the , & arrow keys on the left button wheel to scroll the **Columns**, and the , arrow keys to scroll the **Rows**.

**SEQ LOG:** Use the , , , & arrow keys on the left button wheel to highlight the appropriate alpha characters. Press the key to select a character and advance to the next character field, in conjunction with using the clr key to backspace if necessary.

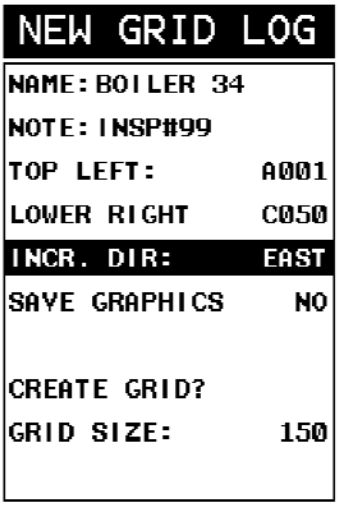
4) Press the OK key to select the coordinate or end ID and return to the **Grid** or **Seq List Items** screen, or esc to cancel the selection and return to the **Grid** or **Seq List Items** menu.

**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*

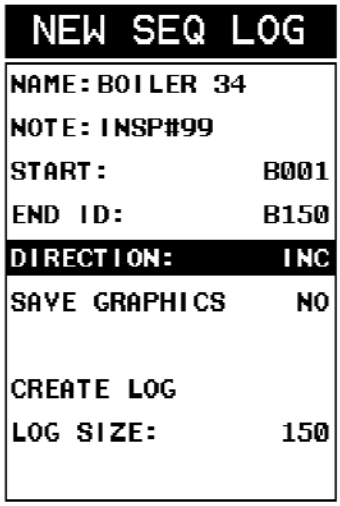
*the*  *or*  *key to return to the* ***Grid*** *or* ***Seq List Items*** *menu. It may be necessary to free some memory in the* ***FX-80*** *at this time. Refer to page 160 for more information on* ***Deleting a File****.*

## 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.

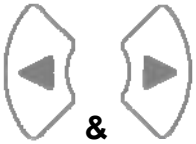



**Grid Log**




**Sequential Log**

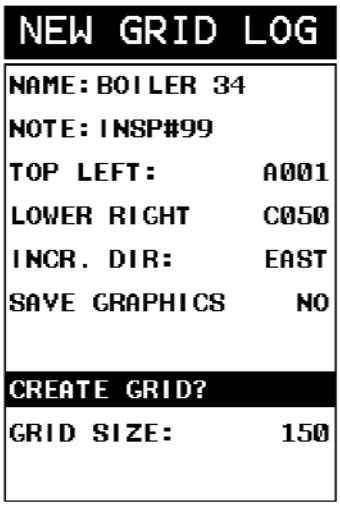
5) Use the  and  arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **INCR. DIR** or **DIRECTION** is highlighted.

6) Use the  **&** arrow keys on the left button wheel to toggle the **Increment** direction **NONE, NORTH, EAST, SOUTH, or WEST** for a grid, or **INC, DEC** for a sequential log.

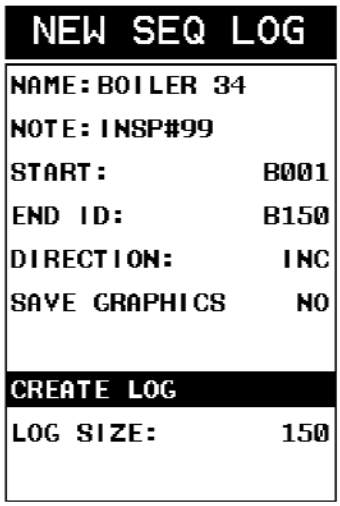
7) When the correct **Increment** direction is displayed, continue on to the next section **"Graphics"**.

## Saving a Grid

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

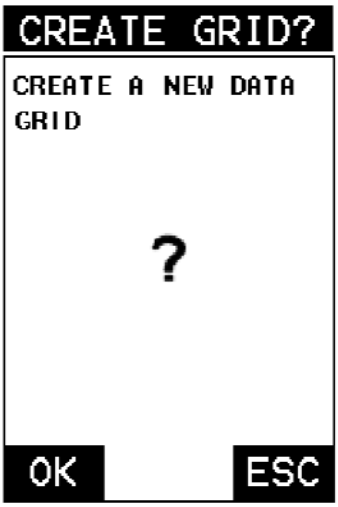



**Grid Log**

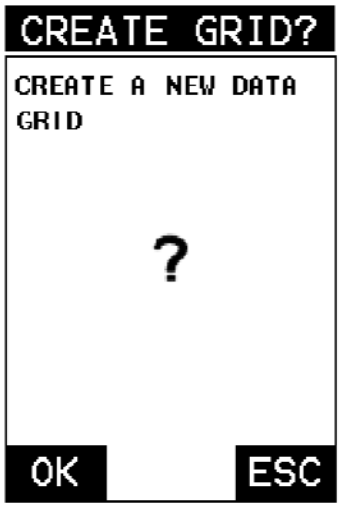



**Sequential Log**

1) Use the  and  arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **CREATE GRID or LOG?** is highlighted.
2) Press the  key to accept the grid or seq log parameters and activate the confirmation screen.




**Grid Log**




**Sequential Log**

3) 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.

4) Press the key to return to the measurement screen and begin storing readings.

## 11.3 Storing a reading

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

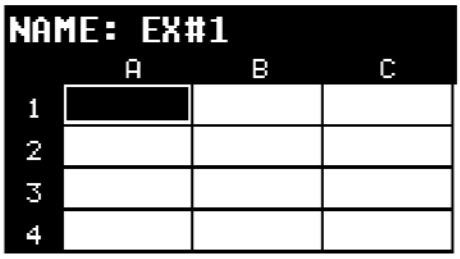
**Storing a Reading**

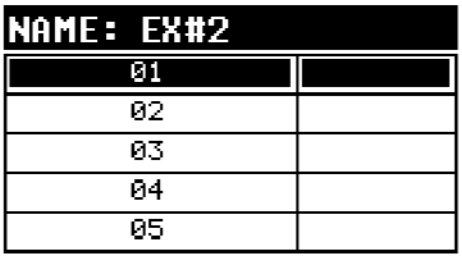
**Note:** *Once the gird or sequential log has been created it will automatically be displayed following the create confirmation screen. It is located at the bottom of the measurement screen, and can be left open for the duration of the inspection process. This section assumes the grid or sequential 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 **FX-80** is displaying a **"grid log"**, pressing the OK key will initiate an advance to row number option. Use the **Left, Right,** , and arrow keys on the left button wheel 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 **FX-80** is displaying a **"grid log"**, pressing the esc key multiple times, will toggle through the display options: **DIGITS, RF, RECT,** and **B-SCAN** views.




**Grid Log** **Sequential Log**

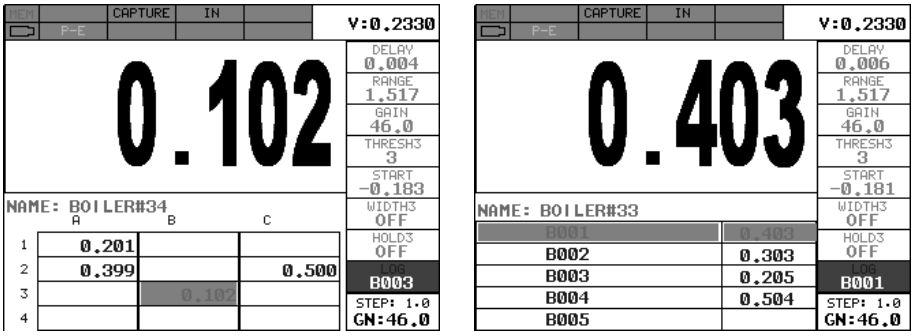
1) Press the , , , and arrow keys on the left button wheel to scroll the target cell cursor to the desired storage location.
2) Press the key to save the current reading in the highlighted cell location. It's as simple as that!
3) Press the key to hide the **GRID/SEQ View Box**, or to display it as necessary.

**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* ***FX-80*** *will automatically open the file when powered on. Simply press the* ↵ *key to display the file from the measurement screen.*

## 11.4 Viewing stored readings

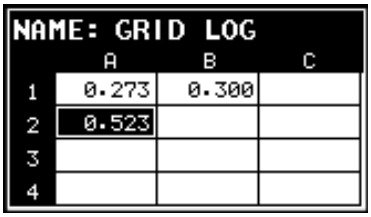
It is sometimes necessary to go back and view the stored readings and B-Scans using the ***FX-80*** without a PC. The following procedures outline this process:

### Viewing Stored Readings & A/B Scans




**Grid Log** **Sequential Log**

1) Press the 🏠 key once to activate measure menu items. Press the 🏠 key multiple times to move right and the esc key multiple times to move left until the **LOG** cell is highlighted. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.




2) Press the ↵ key to display the **Grid Log Box**.

3) Press the ▲, ▼, ◀, and ▶ arrow keys on the left button wheel 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 ↵ key to save the new reading.

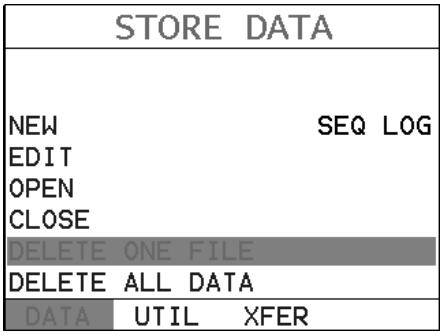
5) Abort the **Grid/Seq Log View Box** by pressing the ⌂ key at any time.

## 11.5 Deleting Grids (Files)

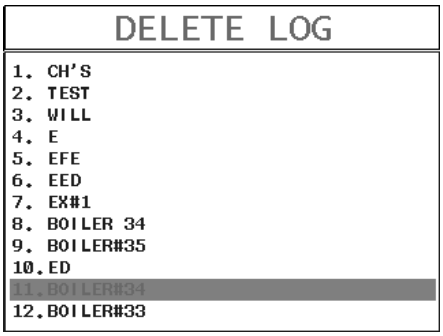
**Deleting One or All Files from Memory**

**Deleting One File**

1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.




2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **DELETE ONE FILE** is highlighted.




3) Press the ↵ key to display the **File List Box**.

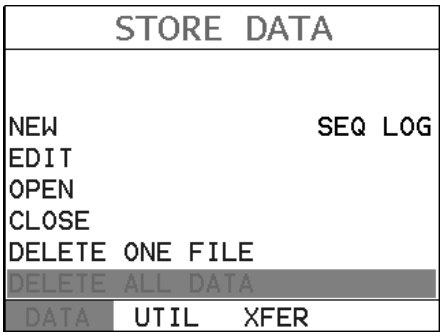
4) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the stored **Files** until the target **File** to delete is highlighted.

5) Press the OK key to delete the **File**.

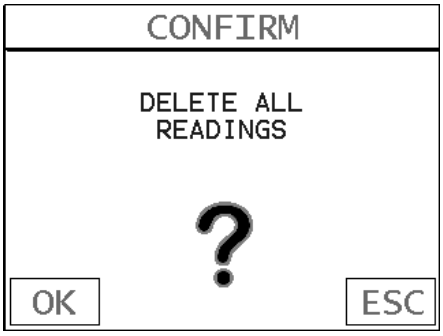
6) Press the ⌂ key to return to the measurement screen.

## Deleting All Data

1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.




2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **DELETE ALL** data is highlighted.




3) Press the ↵ key to activate the confirmation screen.

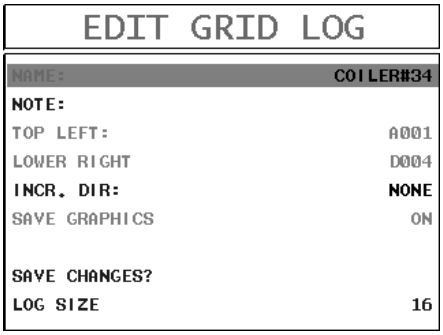
4) Press the OK key to delete **All Files** from memory, or the esc key to abort.

5) Press the  key to return to the measurement screen.

## 11.6 Editing a Grid (File)

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

### Editing a Grid




1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to tab left until the  menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **EDIT** is highlighted.

3) Press the  key to display the **Edit List Box**.

4) Use the  and  arrow keys on the left button wheel to scroll through the **Edit** options until **NAME**, **NOTE** or **INCR. DIR** is highlighted.

**Note:** *If editing the **INCR. DIR**, simply press the*  *and*  *arrow keys using the left button wheel to scroll **NONE, NORTH, EAST, SOUTH, WEST** for a Grid, or **INC, DEC** for a Seq Log.* ***Proceed to step 10****.*



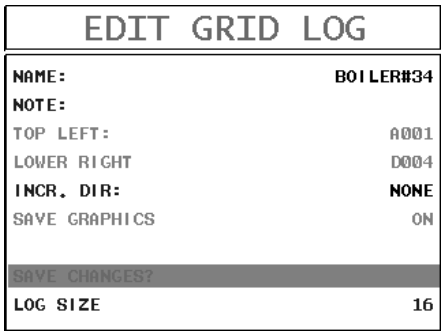

5) Press the  key to activate the **Alpha Edit box – Only used when editing the NOTE**.

6) Use the , , , **&**  arrow keys on the left button wheel to highlight the appropriate alpha characters.

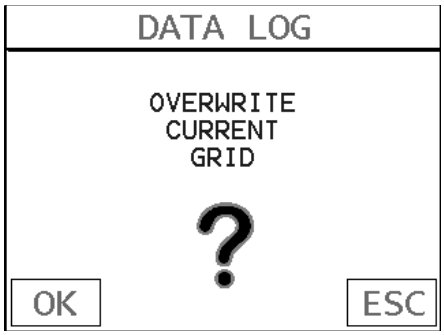
7) Press the  key to select a character and advance to the next field of the **Comments**.

8) Use the  key to backspace if necessary.

9) Repeat steps **6 - 8** until the **Comments** are completed.




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



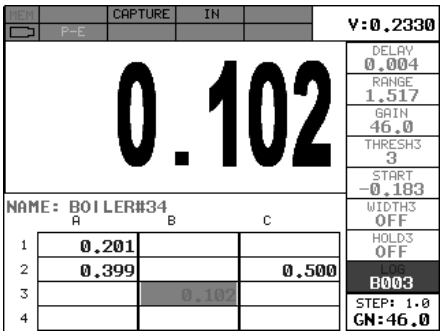

11)Press the  key to save the changes or the  key to cancel editing the file parameters.

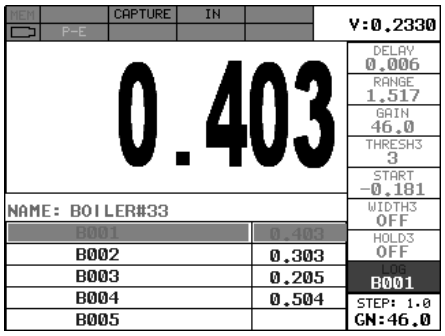
12)Press the  key to return to the measurement screen.

## 11.7 Changing the active File - Open

The user may have transferred grid/seq templates from a PC to the ***FX-80***, or setup grids/seq using the ***FX-80*** 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:

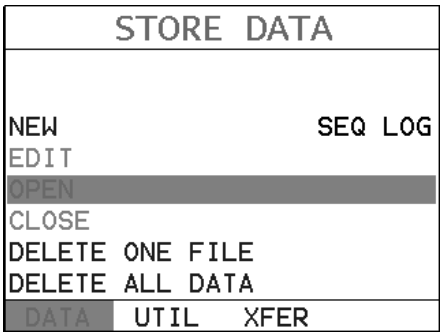
**<u>Changing the Active File</u>**



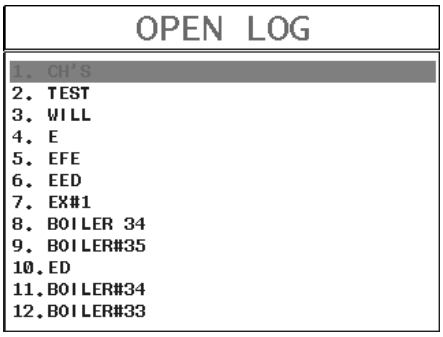




**Grid Log** **Sequential Log**

1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

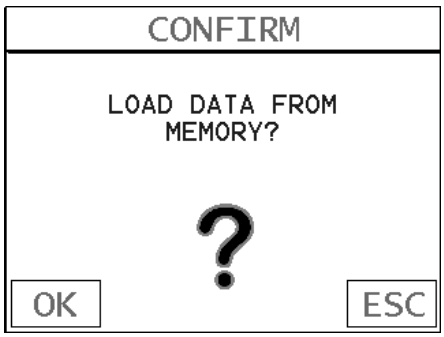



2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **OPEN** is highlighted.



3) Press the key to display the **Grid/Seq List Box**.

4) Use the and arrow keys on the left button wheel to scroll through the grids until the target grid is highlighted.




5) Press the key to activate the confirmation screen.

6) Press the key to load the file from memory.

7) Press the key to return to the measure screen.

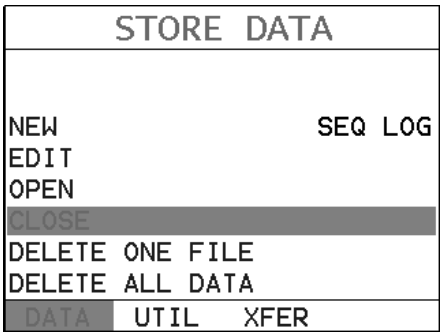
## 11.8 Closing an active File - Close

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:

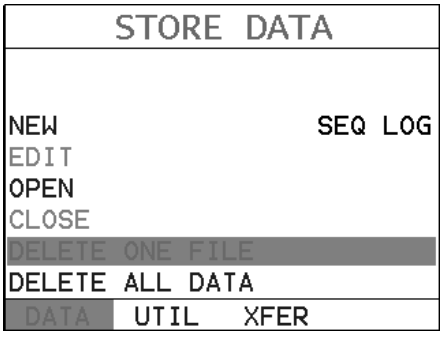
**Closing an Active File**

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

items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.




2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **CLOSE** is highlighted.




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

# CHAPTER TWELVE
# SETUPS – CREATE, STORE, EDIT, & RECALL

## 12.1 Introduction to Setups

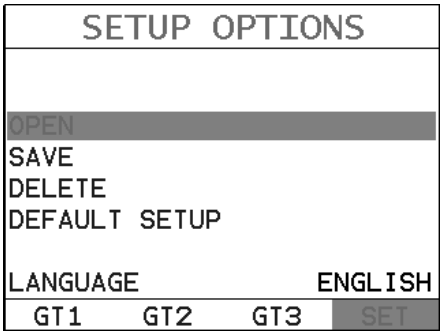
Often times, users are faced with a variety of tasks and applications that are sometimes similar, but often times very different. With a standard thickness gauge, the user would have to recalibrate for each individual application respectively. With all the features of the ***FX-80***, the number of potential applications also increases based on ability alone. This is primarily in reference to the addition of those very difficult applications, where a standard thickness gauge would not be feasible, or capable of accomplishing the tasks.

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 ***FX-80*** has been equipped with the ability to save these setups to memory and be recalled at any time. The ***FX-80*** 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.

## 12.2 Opening a Setup

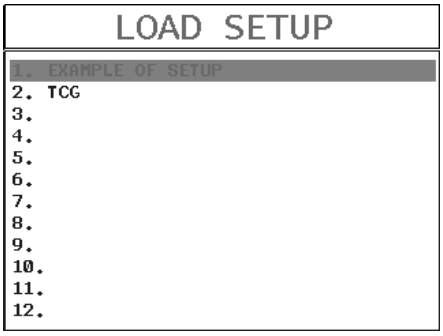
The ***FX-80*** is loaded with a number of setups from the factory. These setups can be opened, edited, and saved to any one of **64 setup locations**. If a factory setup is written over, the user can simply reload the default factory setups at anytime using the utility software included with the ***FX-80***. 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



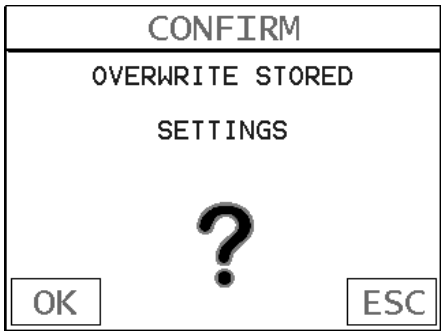

1) Press the ≡ key once to activate the menu items tab. Press the ≡ key multiple times to tab right and the ESC key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **OPEN** is highlighted.




3) Press the ↵ key to display the **Setup List Box**.

4) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the setups until the target setup is highlighted.




5) Press the ↵ key to activate the confirmation screen.

6) Press the OK key to load the setup from memory.

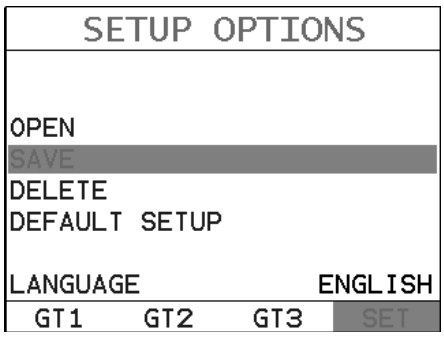
7) Press the ⌂ key to return to the measure screen.

## 12.3 Saving a Setup

Once the ***FX-80*** parameters and features have be adjusted for an application, the user may elect to save these setting to a specific setup location for future use. This can potentially save time and reduce error between users.

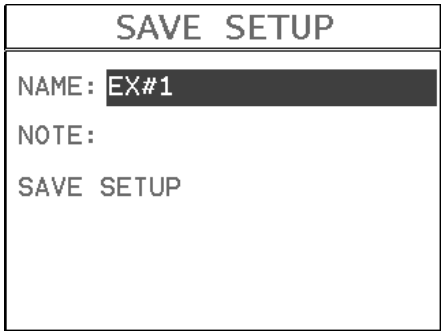
It is sometimes necessary to rename a previously saved setup, or add additional comments about a particular setup. The setup name may have been entered incorrectly, or the user needs to use the setup for a completely different project. An inspector's name or other comments about the project may also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

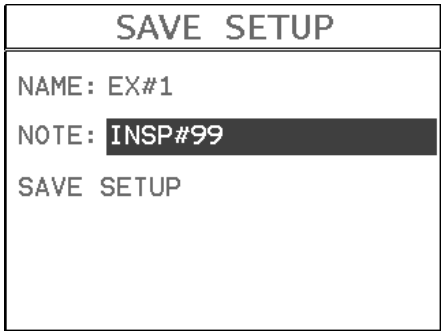
**Saving a Setup**



1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **SAVE** is highlighted.




3) Press the ↵ key to display the **Save Setup Parameters List Box**.

4) Press the ▲ and ▼ arrow keys on the left button wheel to scroll the **Name** and **Note** parameters.



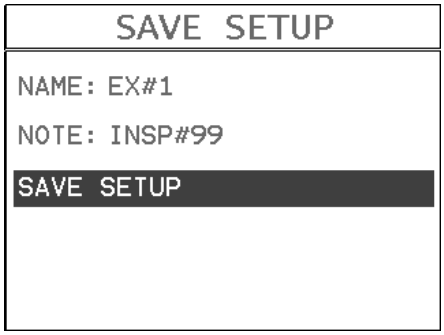



5) When the parameter to edit is highlighted, press the key to activate the **Alpha Edit Box**.

6) Use the , , , & arrow keys on the left button wheel to scroll through the characters, the key to select characters, and the clr key to backspace through the characters, until the **Name** or **Note** fields have been edited.

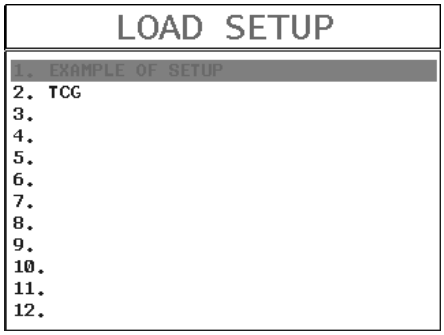
7) Press the OK key to return to the **Save Setup Parameters List Box**.

8) If both parameters will be edited, **repeat steps 4 – 7**.

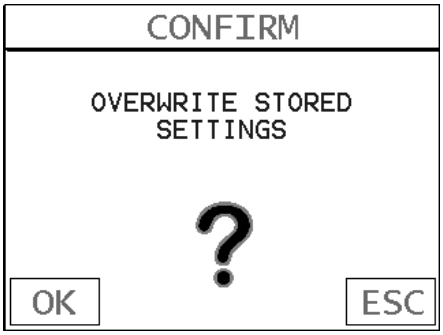



9) Use the and arrow keys on the left button wheel to scroll to and highlight **SAVE SETUP**.

10) Press the key to activate the **Setup List Box**.



11)Use the  and  arrow keys on the left button wheel to scroll through the setups until the target location to save the **Setup** is highlighted.




12)Press the  key to activate the confirmation screen.

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

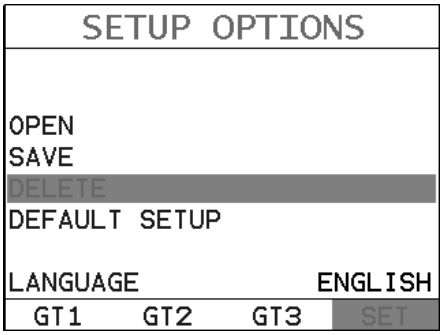
14)Finally, press the  key to return to the measurement screen.

**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**.

## 12.4 Deleting a Saved Setup

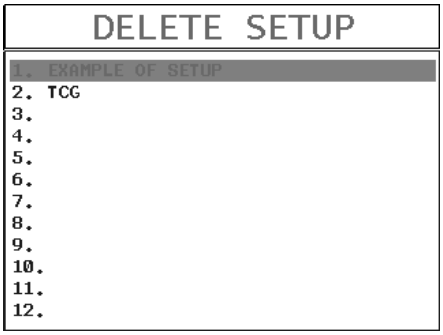
This option allows a user to delete setup files that were previously saved and no longer needed. It's a simple feature to allow the user to do a bit of "house cleaning".

**Deleting a Setup**



1) Press the key once to activate the menu items tab. Press the key multiple times to tab right and the key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items. Alternatively, press the and arrow keys multiple times using the left button wheel.

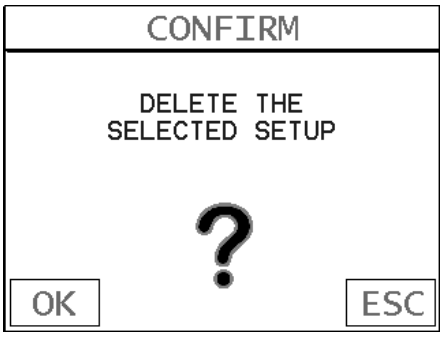
2) Use the and arrow keys on the left button wheel to scroll through the sub menu items until **DELETE** is highlighted.




3) Press the key to display the **Setups List**.

4) Press the and arrow keys on the left button wheel to scroll to the **Setup Name**.

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



6) Press the OK key to delete the **Setup File**.

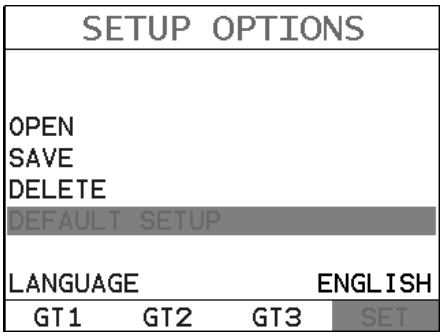
7) Finally, press the key to return to the measurement screen.

## 12.5 Using the Default Setup

The default setup feature was added to the ***FX-80*** 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 ***FX-80*** was somehow corrupted, and the user does not have access to a computer to re-load the factory setups back into the ***FX-80***. 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 key once to activate the menu items tab. Press the 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. Alternatively, press the and arrow keys multiple times using the left button wheel.

2) the  and  arrow keys on the left button wheel to scroll through the sub menu items until **DEFAULT SETUP** is highlighted.

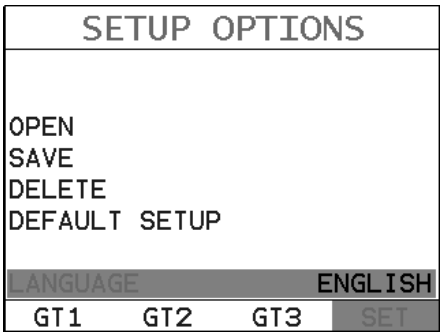
3) Press the  key to load default **DEFAULT SETUP**.

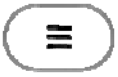
4) Finally, press the  key to return to the measurement screen.

## 12.6 Selecting a Language

The ***FX-80*** is equipped with a language option. Currently, only a few languages supported. However, be sure to update your gauge firmware often, to check for language additions. The steps to select a language are outlined as follows:

### Selecting a Language




1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **LANGUAGE** is highlighted.

3) Press the  and  arrow keys multiple times on the right button wheel to toggle the language options.

4) Once the desired language is displayed, press the  key to return to the measurement screen.

# CHAPTER THIRTEEN
# SOFTWARE, FILE TRANSFER, & UPGRADES

## 13.1 Computer System Requirements

**DakView** will run on many different operating systems: Windows XP, Windows 2000 Professional, Windows 2000 Server, Windows 2000, Vista, Windows 7, or Windows 8 Advanced Server operating systems running on Intel or AMD hardware.

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**.

### USB Type1 to Type 2 Cable

If a replacement cable is needed, contact Dakota NDT (pt# N-606-0530).

## 13.2 Installing DakView

**DakView** comes on a CD-ROM with an automatic installer program. Place the CD in your computer's CD tray and close the door. Open the CD-ROM by double clicking on the My Computer ICON, then double click on the CD. Finally, double click on the **SETUP** icon to begin the installation.Refer to the help section in **DakView** software for the complete operating manual, setup, and operation.

## 13.3 Communicating with FX-80

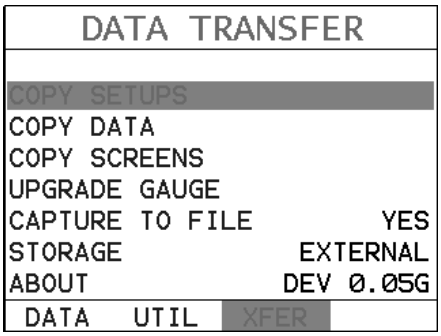
**DakView** will not directly communicate with the ***FX-80*** series gauges. The ***FX-80*** is equipped with USB, acting as a Thumb Drive (external storage device) when connected to a computer and powered on. Therefore, the SD memory card(s) can be opened as a drive with *directory structure, similar to the C: on your computer. The files stored on the internal S*D, or external SD reader, can be simply copied (dragged) into any folder on your PC and opened using **DakView**. The PC software will function on as a file viewer for the ***FX-80*** series gauges.

Refer to the help section in **DakView** software for the complete operating manual, setup, and operation.

## 13.4 Using the XFER menu (*FX-80*)

The **XFER** menu of the ***FX-80*** will be used in conjunction with the **DakView** PC software. The steps below outline the procedure for accessing the **XFER** menu and basic operation as follows:

### Accessing and Using the XFER Menu



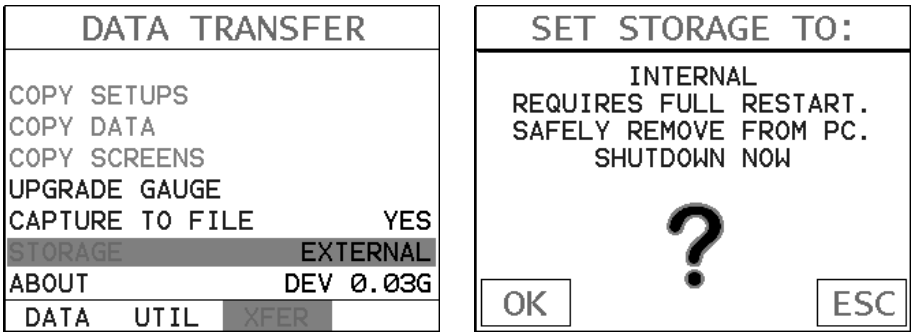

1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right, and the esc key multiple times to tab left, until the **XFER** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until the desire option is highlighted.
3) Press the ↵ key to activate the option selected.

## 13.5 Selecting Storage Device

The ***FX-80*** has two storage device options available. The ***FX-80*** is shipped from the factory with a 4 gig internal SD memory card on the board itself, and additionally has an external SD card reader. The SD reader is located above the Li-Ion battery pack, under the battery cover. The **STORAGE** utility simply selects which card is currently being used as the primary storage device. This storage switch is also used in conjunction with all the copy utilities found in the **XFER** menu. For example; if the

storage switch is set to internal as the primary storage device, all the copy routines will copy from the internal to the external reader, or visa versa. The procedure to set the storage device is outlined below:

## Selecting Storage Device

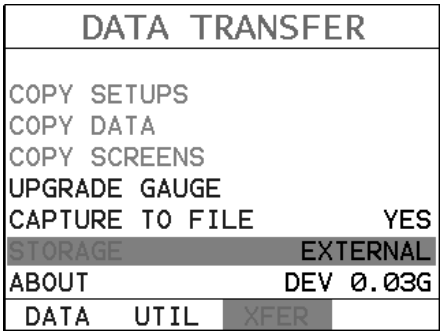



1) Press the ≡ key once to activate the menu items tab. Press the ≡ key multiple times to tab right and the ESC key multiple times to tab left until the **XFER** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **STORAGE** is highlighted.
3) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle **STORAGE** internal/external. Note: Capture will be displayed in a toolbar cell on the active display, indicating the feature is enabled.

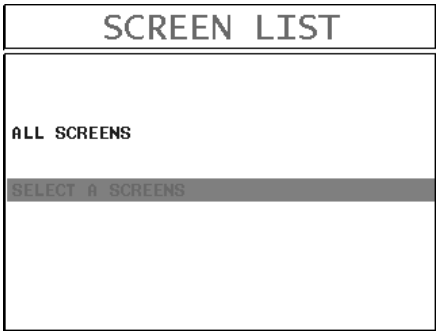
## 13.6 Copying Files (Setups, Data, & Screenshots)

The ***FX-80*** can store a number of setup, data and screenshot files to either the internal or external SD memory cards. All the copy routines will copy files from the currently selected storage device to the other. Therefore, if the current storage device is set to 'internal', the copy routines will transfer files directly to the external device. Note: If the ***FX-80*** is powered up without an external SD card inserted in the slot, the copy routines in the **XFER** menu will be inactive. The steps below outline the procedure for copying files from one storage device to the other as follows:

## Copying Files Between Storage Devices

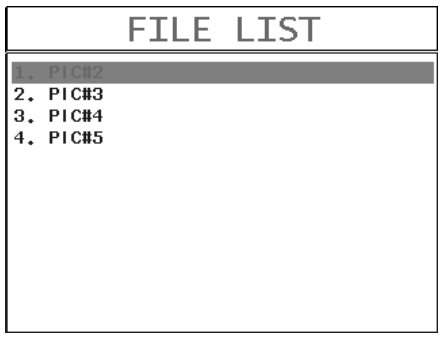



1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the ESC key multiple times to tab left until the **XFER** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until the desired **COPY** option is highlighted.



3) Press the ↵ key to display the **Setups/Data/Sceens List**.

4) Use the ▲ and ▼ arrow keys on the left button wheel to highlight the desired **List Box** option.




5) Press the ↵ key to either transfer **ALL** files, or display the **Individual List** of files.

6) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the list of files and select the specific file to copy.

7) Press the ↵ key to complete the **Copy** process, followed by pressing the OK key to display the **List Box**.

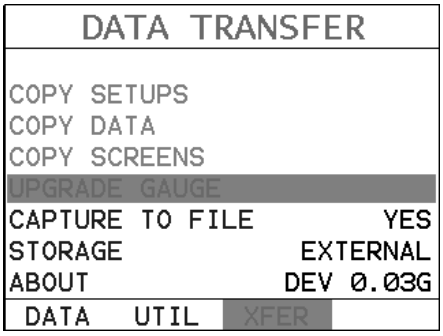
8) Repeat steps **6 & 7** to copying additional individual files.

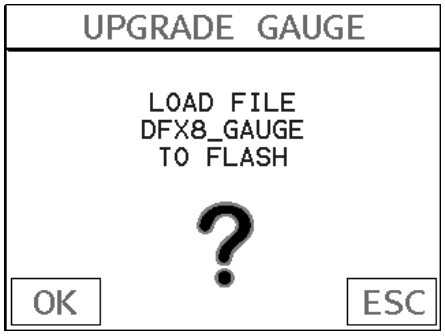
9) Finally, press the ⌂ key to return to the measurement screen.

## 13.7 Upgrading the FX-80

The ***FX-80*** can be upgraded to the latest revision of firmware at any time. Simply download the latest version posted on the Dakota NDT website, copy the upgrade file to the main drive directory ***FX-80***, 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 ***FX-80*** is outlined below:

## Upgrading the Firmware




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Press the ↵ key to display the upgrade confirmation screen, followed by pressing OK key to start the upgrade process. Note: The ***FX-80*** will power down during the upgrade process, and restart when completed.

## APPENDIX A - VELOCITY TABLE

| Material | sound velocity in/us | | sound velocity m/s |
|---|---|---|---|
| | | | |
| Aluminum | 0.2510 | | 6375 |
| Beryllium | 0.5080 | | 12903 |
| Brass | 0.1730 | | 4394 |
| Bronze | 0.1390 | | 3531 |
| Cadmium | 0.1090 | | 2769 |
| Columbium | 0.1940 | | 4928 |
| Copper | 0.1830 | | 4648 |
| Glass (plate) | 0.2270 | | 5766 |
| Glycerine | 0.0760 | | 1930 |
| Gold | 0.1280 | | 3251 |
| Inconel | 0.2290 | | 5817 |
| Iron | 0.2320 | | 5893 |
| Cast Iron | 0.1800 | (approx) | 4572 |
| Lead | 0.0850 | | 2159 |
| Magnesium | 0.2300 | | 5842 |
| Mercury | 0.0570 | | 1448 |
| Molybdenum | 0.2460 | | 6248 |
| Monel | 0.2110 | | 5359 |
| Nickel | 0.2220 | | 5639 |
| Nylon | 0.1060 | (approx) | 2692 |
| Platinum | 0.1560 | | 3962 |
| Plexiglas | 0.1060 | | 2692 |
| Polystyrene | 0.0920 | | 2337 |
| PVC | 0.0940 | | 2388 |
| Quartz glass | 0.2260 | | 5740 |
| Rubber vulcanized | 0.0910 | | 2311 |
| Silver | 0.1420 | | 3607 |
| Steel (1020) | 0.2320 | | 5893 |
| Steel (4340) | 0.2330 | | 5918 |
| Steel Stainless" | 0.2230 | | 5664 |
| Teflon | 0.0540 | | 1372 |

| | | | |
|---|---|---|---|
| **Tin** | **0.1310** | | **3327** |
| **Titanium** | **0.2400** | | **6096** |
| **Tungsten** | **0.2040** | | **5182** |
| **Uranium** | **0.1330** | | **3378** |
| **Water** | **0.0580** | | **1473** |
| **Zinc** | **0.1660** | | **4216** |
| **Zirconium** | **0.1830** | | **4648** |

## APPENDIX B -
## SETUP LIBRARY

| Num | Name | Comment 1 | Gn/AGC | Velocity |
|---|---|---|---|---|
| 1 | Enter Custom Name | | | |
| 2 | … | | | |
| 3 | … | | | |
| 4 | … | | | |
| 5 | … | | | |
| 6 | … | | | |
| … | … | | | |
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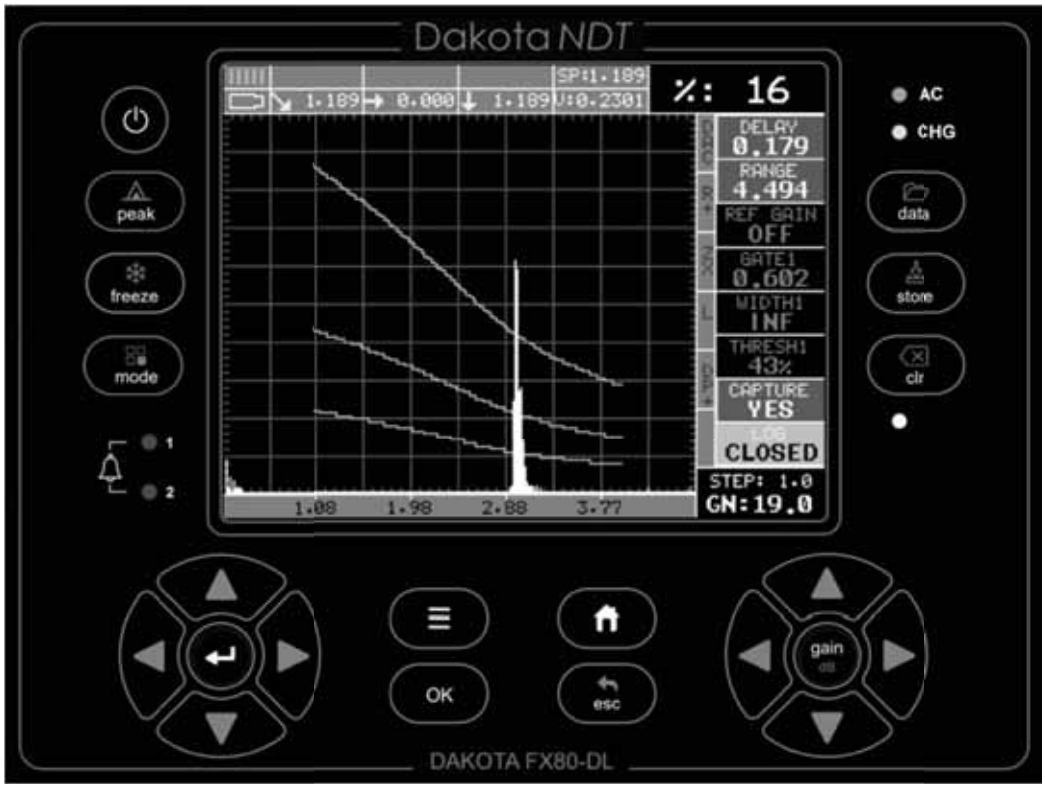
# OPERATION MANUAL

Dakota NDT

## FX80 Series

Ultrasonic Flaw Detectors

(Manual 2 of 2)




P/N P-250-0007

Rev 1.00, January 2024

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# CHAPTER ONE
# INTRODUCTION

The Dakota NDT model ***FX80*** 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 Series***, as well as our new ***FX80*** 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 ***FX80*** 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 ***FX80***.

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

## 1.1 General Disclaimer

The manual should be read and understood prior to using the ***FX80***. This operating manual provides the user with all the general information necessary to use and operate the features of the ***FX80***. 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.

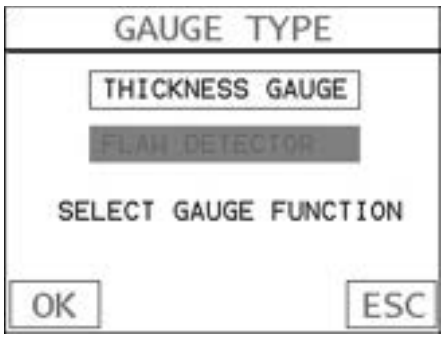
## 1.2 Electrical Warning

The ***FX80*** series gauges contain high voltage pulsers.  It's recommended that the gauge be powered off prior to connecting or disconnecting your transducer, to avoid damaging the instrument.

# CHAPTER TWO
# QUICK START GUIDE

This section will cover a basic quick start guide to initially get up and running with the ***FX80*** 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 ***FX80***, 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 ***FX80***, use the / arrow keys to select "flaw detector", followed by pressing the OK key start the ***FX80*** in flaw mode. If this is the first time the gauge has been used, a general startup configuration will automatically be loaded and the ***FX80*** 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

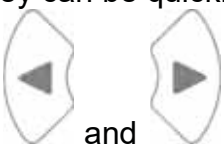
The following table lists all the settings for the basic flaw setup:

| PRB | CAL | DISP | TUNE | GT1 |
|---|---|---|---|---|
| Type: Single | Matl: Steel 1020 | View: +Rect | Filters: Wide | Alarm: On |
| Pulse: Thin | Matl 1pt: Uncal | Delay: 0.000 | Gain: 65 | Gate1: 0.484 |
| Max PRF: 66 | Matl 2pt: Uncal | Range: 5.011 | Detect Mode: Z-Cross | Thresh1: 40% |
| Damping: 600 | Velocity: .2320 | Units: inches | | Width1: INF |
| Pulser Volt: 200 | Zero: 0.0 | Brightness: 15 | | Detect: Above |

| | | | | |
|---|---|---|---|---|
| | | Color: Green 1 | | Polarity: Pos |
| | | 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 ***FX80*** has 15 top level menu titles, and multiple submenu items as illustrated below. The ***FX80*** also has 9 'hot menu' subsets of the same menu structure. These are the most commonly adjusted submenu items from each of the top level menus. They can be quickly accessed from the main measurement screen by pressing the  arrow keys multiple times using the left button wheel, and pressing the  and  arrow keys on the left button wheel to select the appropriate submenu item. Refer to Chapter Three for additional definitions and information on the keypad and menu items.

| | |
|---|---|
| 1st Main Hot Menu | |
| Additional Hot Menus | |
| FX-81 Only | |

**Note:** *Gate1* & *Box* have been added to multiple Hot Menus for the purpose of quick adjustment.

**Start >>**

| PRB | CAL | DISP | TUNE | GT1 | GT2 | TRIG | AWS |
|---|---|---|---|---|---|---|---|
| TYPE | MAT | VIEW | FILTERS | ALARM | ALARM | TRIG | AWS |
| PULSE | MATL 1PT | DELAY | GAIN | DETECT | DETECT | THICKNESS | SET REF GAIN |
| MAX PRF | MATL 2PT | RANGE | GAIN STEP | GATE1 | GATE2 | ANGLE | SHOW CURVE |
| DAMPING | VELOCITY | STEP | DETECT MODE | GATE1 WIDTH | GATE2 WIDTH | X-OFFSET | % SCRN HEIGHT |
| PULSER VOLTAGE | ZERO | UNITS | | THRESHOLD1 | THRESHOLD2 | CSC O.D. | |
| | | BRIGHTNESS | | POLARITY1 | POLARITY1 | LEGS | |
| | | COLORS | | | | | |
| | | DIM | | | | | |
| | | RECT WAVE | | | | | |
| | | DETECT MARK | | | | | |
| | | WAVE AVERAGING | | | | | |
| | | PERSISTENCE | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | GRATICULE | | | | | |

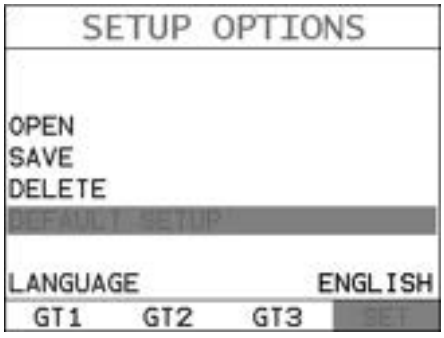
**>> End**

| TCG | DAC | DGS | SET | DATA | UTIL | XFER |
|---|---|---|---|---|---|---|
| TCG | DAC | DGS | OPEN | NEW | COMPARE | BACKUP SETUPS |
| DRAW | DRAW | REF GAIN | SAVE | EDIT | ANALOG OUTPUT | COPY DATA |
| CURVE | HOME | TRIGGER CURVE | DELETE ONE FILE | OPEN | SERIAL OUTPUT | COPY SCREENS |
| % SCRN HEIGHT | CURVE | EFF PROBE DIAMETER | DEFAULT SETUP | CLOSE | DIGITIZER | UPGRADE GAUGE |
| | TRIGGER | PROBE FREQUENCY | LANGUAGE | DELETE ONE FILE | SET DATE | CAPTURE TO FILE |
| | DPOLARITY | CURVE SIZE (ERS) | | DELETE ALL DATA | SHOW DATE | CAPTURE VIEWER |
| | FIT | ATTENUATION | | | KEY CLICK | STORAGE |
| | | DELAY VELOCITY | | | GAUGE | ABOUT |
| | | REFERENCE TYPE | | | | |

## 2.4 Loading the Default Setup

If the ***FX80*** has previously been used, the basic default settings can be reloaded at any time, as outlined below:

### Load Default Setup




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

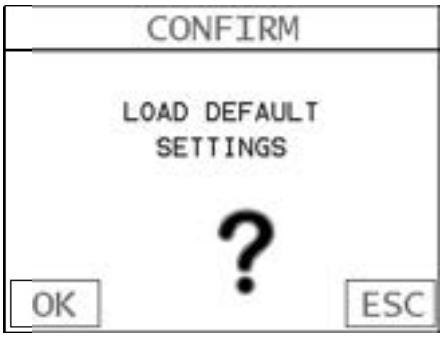
1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the esc key multiple times to

tab left until the **SET** menu is highlighted and displaying the submenu items.

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

2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **DEFAULT SETUP** is highlighted.

3) Press the  key to display the confirmation screen.




4) Press the 

key to load the default setup and return to the measurement screen.

# CHAPTER THREE
# KEYBOARD, MENU, & CONNECTOR REFERENCE

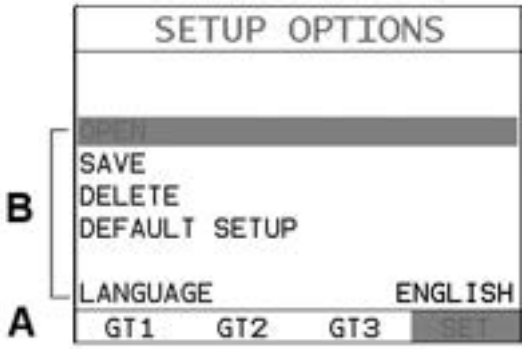



## 3.1 Menu Key (Operation & Sub Menus)



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




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel. The tab groups are illustrated above **(A)**.

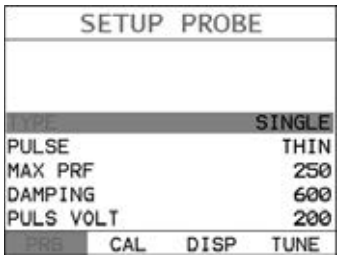
Now that you're familiar with activating and moving amongst the tab groups, let's have a look at how to move around in the sub menu items as follows:

2) Use the ▲ and ▼ arrow keys on the left button wheel 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 ◀ and ▶ arrow keys on the right button wheel to scroll the options, or the ↵ key to 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:** Enables the user to select the type of transducer being used, either Single or Dual.

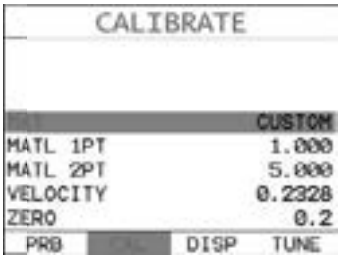
**PULSE:** The ***FX80*** has an adjustable pulse width for both high penetration and resolution applications. The pulse width refers to the duration of time the pulser is on. The options are **Spike**, **Thin**, and **Wide**. Refer to page 96 for a further explanation. ***The FX-81*** has a special tone burst style pulser with options Spike, Thin, Wide, HV Spike, HV Thin, HV Wide, TB 10MHz, TB 5MHz, TB 2MHz, and TB 1MHz. Refer to page 96 for a further explanation.

**MAX PRF:** This feature controls the pulse repetition frequency of the ***FX80***. The maximum frequency is 333 Hz. However, the ***FX80*** 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.

**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 98 for further info.

**PULSER VOLT:** The ***FX80*** has an adjustable pulser voltage: 100, 150, and 200 volts. Refer to page 100 for a further explanation. The ***FX-81*** has a special tone burst pulser: 100, 150, 200, 300, 400 volts. Refer to page 100 for a further explanation.

## 3.3 CAL – Menu




**MAT:** Select the material velocity from a chart of basic material types when a known sample thickness, or material velocity cannot be obtained.

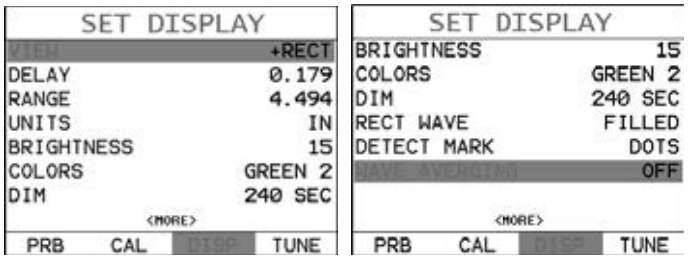
**MATL 1PT:** Performs a single point calibration. This calibration option is used in conjunction with the MATL 2PT option for the calibration process. Refer to page 40 for further info.

**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 40 for further info.

**VELOCITY:** Function to calibrate the ***FX80*** by setting the velocity to a known material velocity. Refer to page 102 for further info.

**ZERO:** Used to zero the transducer and calibrate the screen. The **FX80** is zeroed in much the same way that a mechanical micrometer is zeroed. If the **FX80** is not zeroed correctly, all of the measurements made using the ***FX80*** may be in error by some fixed value. Refer to the section on page 40, for further info.

## 3.4 DISP (display) – Menu




**VIEW:** Selectable RF, +RECT, -RECT, RECTFW views. Refer to page 27 for further info.

**DELAY:** Provides the user the ability to change the start position of the A-SCAN views. Refer to page 28 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 28 for further info.

**STEP:** When scrolling a range or value using the arrow keys, it can be done using the 'coarse' or 'fine' setting options for large or small adjustments.

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

**BRIGHTNESS:** TFT high speed color display. An arbitrary scale of 1-20 has been implemented, with the brightest setting at 20. Refer to page 106 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 107 for further info.

**DIM:** Allows the user to conserve battery life by diming 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 108 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 109 for further info.

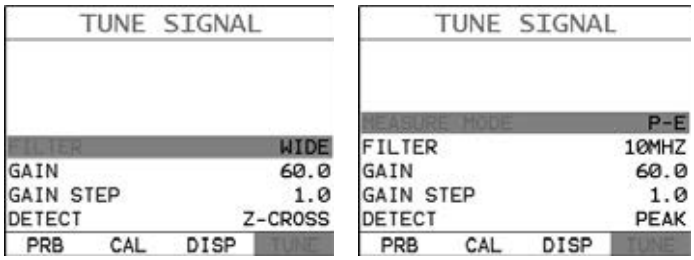
**DETECT MARK:** Selectable graphics option for the point of detection on the waveform: Line, Box, Dots, None. Offers the user a graphics preference on how they prefer to view the detection on the waveform.

**WAVE AVERAGING:** The ***FX-81*** is equipped with wave averaging to eliminate noise for a clear waveform image. Not recommended for high speed scanning. Refer to page 112 for further info.

**PERSISTENCE:** The ***FX-81*** is equipped with wave averaging to eliminate noise for a clear waveform image. Not recommended for high speed scanning. Refer to page 112 for further info.

**GRATICULE:** Selectable graphics option for the A-Scan background (grid/segments) used as references to depth/thickness versus amplitude. The options are: Point, Line, Dots, Mix. Offers the user a graphics preference on how they prefer to view the A-Scan waveform area. Refer to page 114 for further info.

## 3.5 TUNE – Menu

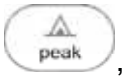



**MEASURE MODE:** This menu item is only included in our ***FX-81***. Toggles a variety of measurement modes for different application requirements: Currently pulse echo (P-E) and Immersion (IM) for water path correction. Refer to page 116 for further info.

**FILTERS:** The ***FX80 Series*** have both a wide band frequency range of 1.8 to 19 MHz (-3dB), as well as narrow band filter options at; 2, 5 & 10 MHz. The ***FX-81*** includes two additional filters at 0.5 kHz and 15 MHz. Refer to page 112 for further info.

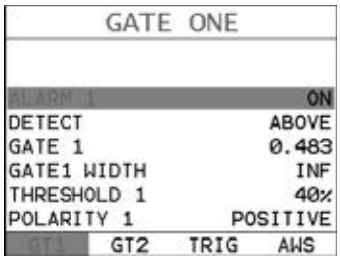
**GAIN:** The ***FX80*** has a 0-110dB gain range with 2dB resolution. This feature is used to increase/decrease the strength or amplitude of the signal. Similar to turning the volume up or down on a stereo receiver. Refer to page 31 for further info.

**GAIN STEP:** This feature allows the user to control the increment step size of the gain. Once the step size is set, each time the  or  button is pressed on the right button wheel, the gain is incremented or decremented by the gain step setting. Refer to page 31 for further info.

**DETECT MODE:** The ***FX80*** is equipped with optional detection modes; 

, FLANK, or Z-CROSS (zero crossing). This option allows the user to decide where the detection is acquired on the waveform echo. Refer to page 121 for further info.

## 3.6 GT1 – Menu




**ALARM1:** 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 34 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 34 for further info.

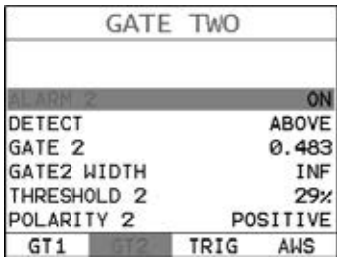
**GATE1:** Gates allow the user to view a specific inspection/measurement range, or specific regions of the waveform, while ignoring others. In order to detect on a waveform echo, and display the amplitude as a percentage of full screen height, the echo must be inside the boundaries of the gate settings. The **GATE1** feature adjusts where the gate begins, according to the depth/thickness. Refer to page 34 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 34 for further info.

**THRESHOLD1:** 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 34 for further info.

**POLARITY1:** 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 ***FX80*** will not display an amplitude percentage of full screen height. Refer to page 34 for further info.

## 3.7 GT2 – Menu




**ALARM2:** 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 34 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 34 for further info.

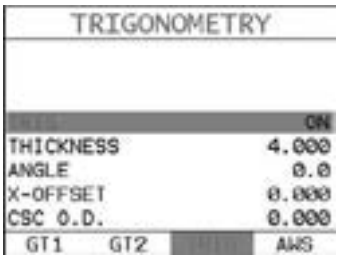
**GATE2:** Gates allow the user to view a specific inspection/measurement range, or specific regions of the waveform, while ignoring others. In order to detect on a waveform echo, and display the amplitude as a percentage of full screen height, the echo must be inside the boundaries of the gate settings. The GATE2 feature adjusts where the gate begins, according to the depth/thickness. Refer to page 34 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 34 for further info.

**THRESHOLD2:** 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 34 for further info.

**POLARITY2:** 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 ***FX80*** will not display an amplitude percentage of full screen height. Refer to page 34 for further info.

## 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 57 for further info.

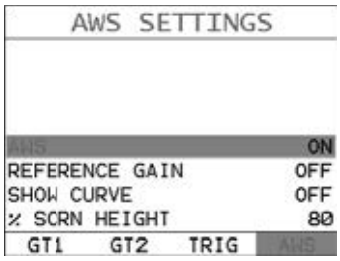
**THICKNESS:** Used to set the thickness of the test material. The thickness will be used to determine which skip/leg the ***FX80*** is detecting on. Refer to page 57 for further info.

**ANGLE:** Used to set the angle of the transducer, and used in the calculations above. Refer to page 57 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 57 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 57 for further info.

## 3.9 AWS – Menu



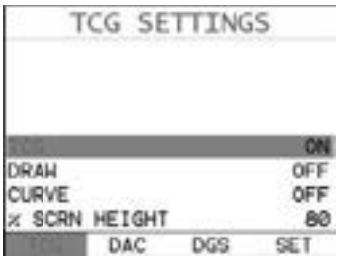

**AWS:** This feature toggles the AWS feature on/off. Used in the analysis of welds according to American Welding Society's structural welding code D1.1-94, to calculate the Indication Rating (IR). Refer to page 64 for further info.

**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 64 for further info.

**SHOW CURVE*:*** Toggles the AWS correction curve on/off. Refer to page 64 for further info.

***% SCRN 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 64 for further info.

## 3.10 TCG – Menu



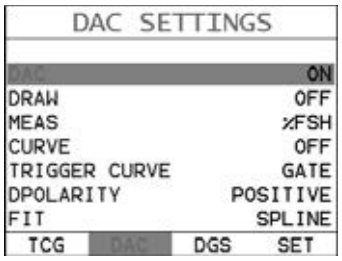

**TCG:** This feature toggles the TCG feature on/off. The Time Corrected Gain (TCG) feature displays reflectors of equal size at equal A-Scan amplitudes, regardless of the reflector's depth in the test material. Refer to page 78 for further info.

**REFERENCE GAIN:** Toggles the DRAW mode on/off, and used to draw the TCG curve. Refer to page 78 for further info.

**CURVE:** Toggles the TCG correction curve on/off, and the curve is displayed on the screen. Refer to page 78 for further info.

**% SCRN 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 78 for further info.

## 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 71 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 71 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 71 for further info.

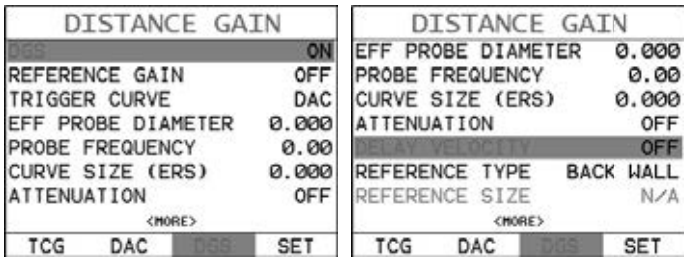
**CURVE:** Selectable signal or multi DAC curve options. The displayed curve options are: DAC, -2dB, -6dB, -10dB, (-6dB/-12dB), (-6dB/-14dB). Once the DAC curve has been generated, these options can be toggled at any time. Refer to page 71 for further info.

**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 71 for further info.

**DPOLARITY:** Used to select the polarity of the DAC curves generated, either positive or negative. Refer to page 71 for further info.

**FIT:** Creates either a linear (straight line) or spline (nice curve) fit between calibrated reference points. Refer to page 71 for further info.

## 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 84 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 87 for further info.

**TRIGGER CURVE:** Used to set the alarm to detect on either the DGS curve, or independent GATE. Refer to page 87 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 85 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 87 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 87 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 88 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 88 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 88 for further info.

**REFERENCE LOSS:** Used to compensate for the loss of sound in the reference standard. Refer to page 88 for further info.

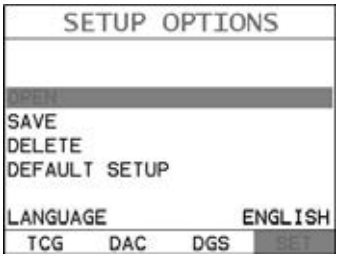
**TRANSFER LOSS:** Used to correct for the loss of sound based on the surface of the actual test material. Refer to page 88 for further info.

**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 87 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 87 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 87 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 164 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 166 for further info.

**DELETE:** Provides the user with the ability to delete specific setups previously save in memory. Refer to page 166 for further info.

**DEFAULT SETUP:** Loads a basic default setup. Use only as a last resort when the setups in the ***FX80*** have been corrupted and a computer is not accessible. Refer to page 171 for further info.

**LANGUAGE:** Provides the user the ability to select different languages for the ***FX80***. Refer to page 173 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 141 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 157 for further info.*

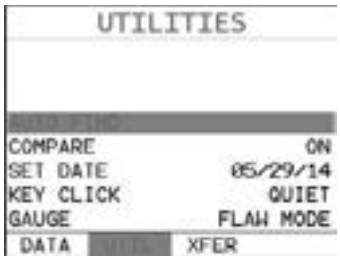
**OPEN:** This function provides the user with the ability to recall grids or sequential log files that currently exist in memory, from a list of grids. Refer to page 157 for further info.

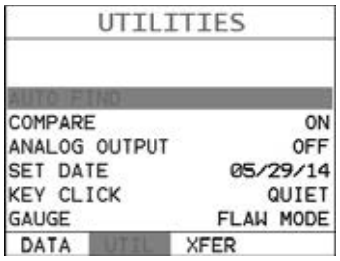
**CLOSE:** Provides the user the ability to close a currently opened grid or sequential log file. Refer to page 160 for further info.

**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 154 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 156 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 125 for further info.

**ANALOG OUTPUT:** ***FX-81*** only. Proportional outputs (amplitude or distance), 0-10 volts. Speed is determined by the **PRF** setting. Refer to page 127 for further info.

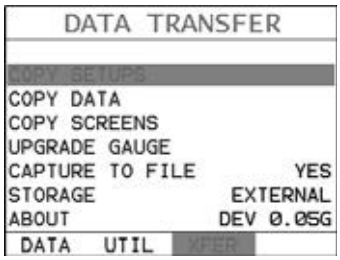
**SET DATE:** Gives the user the ability to set the internal date and time stamp in the ***FX80***. Refer to page 125 for further info.

**SHOW DATE:** Gives the user the ability to display the date and time in the waveform area of the ***FX80***. The options are OFF, DATE, TIME, BOTH. Refer to page 133 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 133 for further info.

**GAUGE:** Gives the user the ability toggle the ***FX80*** gauge type to either a flaw detector, or a thickness gauge. Refer to page 3 for further info.

## 3.16 XFER (transfer) – Menu




**COPY SETUPS:** Copies setup files from either the internal or external SD memory card to the other memory card, depending on the current internal/external setting of **Storage** (current device being used to store data), located in the XFER menu. Refer to page 176 for further info.

**COPY DATA:** Enables the user to copy all, or individual grid/log files from either the internal or external SD memory card to the other memory card, depending on the

current internal/external setting of **Storage** (current device being used to store data), located in the XFER menu. Refer to page 176 for further info.

**COPY SCREENS:** Copies screen capture (.tif's) files from either the internal or external SD memory card to the other memory card, depending on the current internal/external setting of **Storage** (current device being used to store data), located in the XFER menu. Refer to page 176 for further info.

**UPGRADE GAUGE:** Enables the user the ability to upgrade the ***FX80*** to the most current firmware revision. Refer to page 179 for further info.

**CAPTURE TO FILE:** Enables the user the ability to enable screen captures to .tiff files, and used in conjunction with the Multi Mode key. Refer to page 134 for further info.

**CAPTURE VIEWER:** Enables the user the ability to enable screen captures to .tiff files, and used in conjunction with the Multi Mode key. Refer to page 135 for further info.

**STORAGE:** Enables the user to select which SD memory card to use for storage. **Note:** *if no card exists in the external reader slot, this option will be grayed out and inactive. Refer to page 175 for further info.*

**ABOUT:** Provides the user with Dakota NDT contact information and the ***FX80*** firmware & FPGA versions. Refer the Dakota NDT 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 HOME (measurement mode) Key



The **HOME** key puts the ***FX80*** 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. The **OK** key also toggles the Hot Menu area, while in measurement mode, to a large digits display area. If the ***FX80*** is displaying a grid log, the **OK** key toggles an advance to row number option.

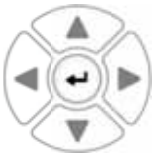
## 3.20 ESC Key




The **ESC** key is used in the , , and **EDIT** functions as a back or escape function. If the ***FX80*** is displaying a grid or sequential log, the 

key toggles the display options: RF, +RECT, -RECT and RECTFW views.

## 3.21 Wheel 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 is only used in the thickness gauge portion of the ***FX80***.

## 3.24 DATA Key



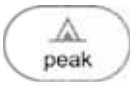

The **DATA** key opens the tabbed data menu, allowing a user to efficiently create a new log/grid file for storage.

## 3.25 STORE Key




The **STORE** key displays the current log/grid opened in split screen mode. If no log/grid file is open, the **STORE** key will open the tabbed data menu in order create a new, or open an existing log/grid file for storage.

## 3.26 PEAK Key




The **PEAK** key is a feature used in the flaw detector portion of the ***FX80***, and is not used in the thickness gauge. It is also used to activate the **COMPARE** feature located in the **UTIL** menu

## 3.27 FREEZE Key




The FREEZE key is used to freeze the display for evaluation/review of what's currently on the display. It is also used in conjunction with the **CAPTURE** feature to save the current display to a .tif (tagged image) graphic file that can be opened using any graphics viewer.

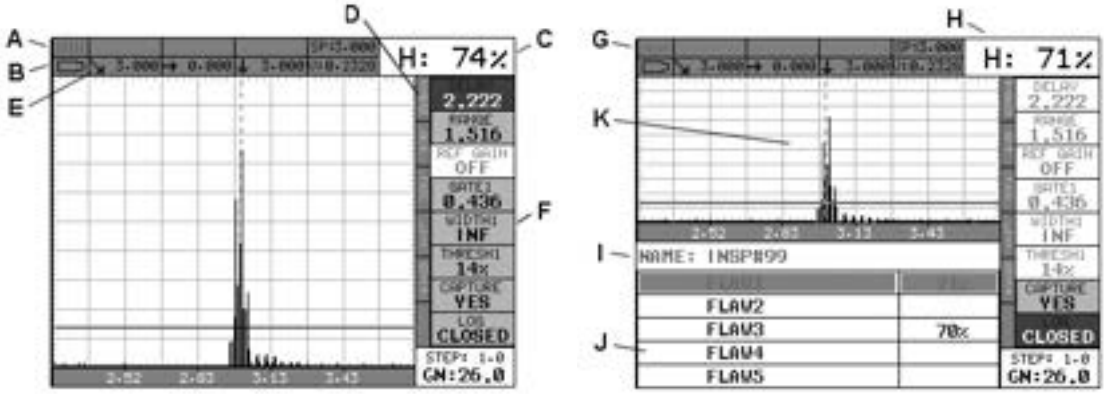
## 3.28 ON/OFF Key



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.*

**Note:** *If the **FX80** fails and is in a state where none of the keys are responding, pressing the **ON/OFF** key continuously with repetition will force an auto system shutdown. The user can then power the unit back up.*

## 3.29 FX80 Overview




**FX80 Screen Shots**

In order to understand how to operate the ***FX80***, it's best to start off with an understanding of what we're looking at. The ***FX80*** 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 ***FX80*** 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  key at anytime. The 

key is used in conjunction with  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 

key.

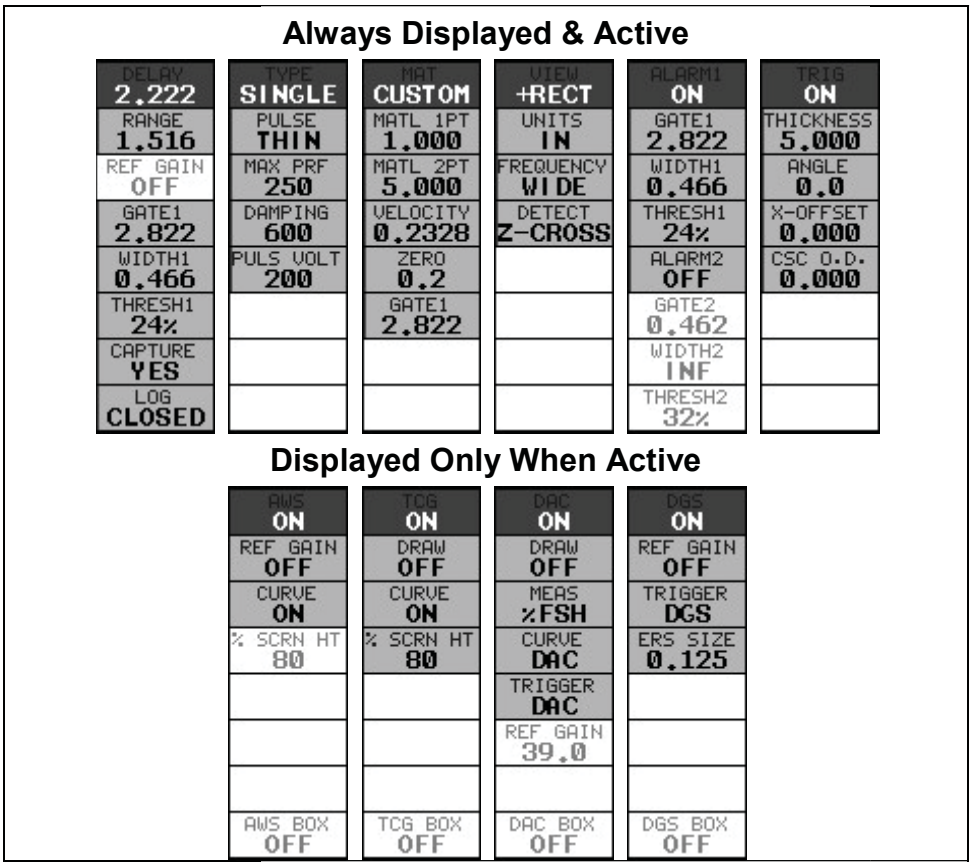
H. **Height** – Displays the amplitude of the signal as a percentage of full screen height. Depending on the quantity selected, this could also be displayed in dB, or D.

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.

## 3.30 Navigating the Hot Menus




The diagram above is a screenshot of all 10 “Hot Menus” in the **FX80**. The Hot Menu’s contain all the most regularly adjusted features from each tabbed menu, in

the exact order of the tabbed menus themselves. Some of the menus have been combined into a single Hot Menu, in order to reduce the number of Hot Menus (i.e. GT1 & GT2 have been combined into a single Hot Menu). Additionally, the toolboxes (AWS, TCG, DAC, DGS) will only appear as a Hot Menu when activated and only one toolbox can be active at a time. Therefore, a total of 6 Hot Menus will always be active, plus an optional toolbox. The primary purpose of the design was to provide the user with an efficient way to make adjustments on the fly, while continuing to have visibility of the A-Scan display. The following procedure outlines the steps to navigate and make adjustments as follows:

## Navigating Hot Menus

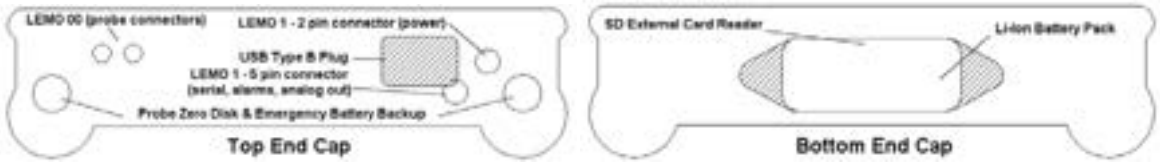
1) Using the left button wheel, press the  and  arrow keys to scroll through the 9 individual **Hot Menus**, and the  and  arrow keys to scroll through the **Hot Menu** items. Alternatively, the  **&**  keys can be used to scroll through the **Hot Menu** items.

2) Press the  and  arrow keys multiple times on the right button wheel 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. Pressing the*  *key will allow the user to enter a specific target value.*

***This procedure above is universal for navigating through and selecting all the features in the Hot Menus.***

## 3.31 Top & Bottom End Caps




The top & bottom end panels are where all connections are made to the ***FX80***. The diagram above shows the layout and description of the connectors:

**Transducer Connectors**

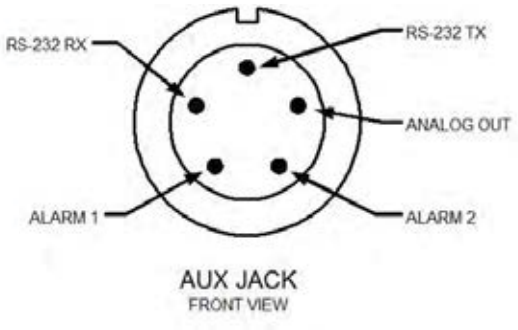
Refer to Diagram: The transducer connectors, emergency battery backup channels/probe zero disks, power connector and auxiliary connector are located on the ***FX80's*** top end cap. The transducer connectors are of type Lemo "00". **Note:** *There is no polarity associated with connecting the transducer to the* ***FX80****.*

**Probe Zero Disk & Battery Cover**

**Refer to Diagram:** The emergency battery backup disks are the large round disks 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) for each. When performing a manual probe zero function, simply place the transducer on disk making firm contact. **Important:** Be sure to follow the polarity label located on the back label of the ***FX80***. **Note:** *Rechargeable batteries can be used, however they must be recharged outside of the unit in a standalone battery charger.*

**USB Type B Connector**

**Refer to Diagram:** The **USB** connector is a common type B connector found on a variety of electronic devices. This port will be used to transfer stored grid/log files, captured screen shots, etc. This connector will also be used to upgrade the ***FX80*** with the latest version of firmware (gauge software). The cable supplied with the ***FX80*** is USB type A to USB type B.



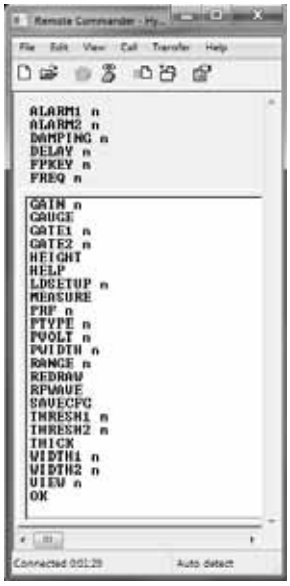

**RS-232 Serial Connection (LEMO 1 – 5 pin)**

**Refer to Diagram:** The **RS-232** connector is a 5 pin female Lemo 1 connector. It is designed to connect directly from the ***FX-81*** to a standard AT serial port on a PC, and works in conjunction with the integrated "remote commander" feature built for system

integration in the ***FX-81*** “only”. A standard terminal software program must be installed and configured, like HyperTerminal from Windows, in order to use this feature. Basic commands can be sent from a PC keyboard to the ***FX-81*** through the serial portion of the connector to remote control the gauge. An accessory 9 pin female serial to Lemo 1 - 5 pin male cable will be required to use this feature, and is not included in the standard kit.

Terminal settings for serial communication and a list of the current set of commands available in remote commander are shown in the diagrams below. They can be displayed at any time by typing ‘help’ in the PC terminal window, followed by pressing the enter key. You’ll notice that some of the commands have an ‘n’ next to them. These require either a number to change the value for the given parameter, or a ‘?’ to report back to the user the current value of the parameter.




**Analog Output (LEMO 1 – 5 pin)**

**Refer to Diagram:** The ***FX-81*** is also equipped with analog outputs 0-10volt, and is updated at the same rate as the PRF. There is 100 ohm output impedance which will vary the voltage slightly and should therefore be calibrated to the device connected.

**Alarms Connection (LEMO 1 – 5 pin)**

**Refer to Diagram:** This is used for connecting each alarm directly to an external source. The alarm pins are an open collector, 20 MA at 12v. Typically a 4.7K “pull up” resistor is required. An accessory 9 pin female serial to Lemo 1 - 5 pin male cable will be required to use this feature, and is not included in the standard kit.

**Power Connector (LEMO 1 – 2 pin)**

**Refer to Diagram:** The Lemo 1 2 pin connector is used for direct line power and charging the Li-Ion battery pack.

# CHAPTER FOUR
# SETTING UP FOR MEASUREMENT

## 4.1 Selecting Display View

The **FX80** 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:

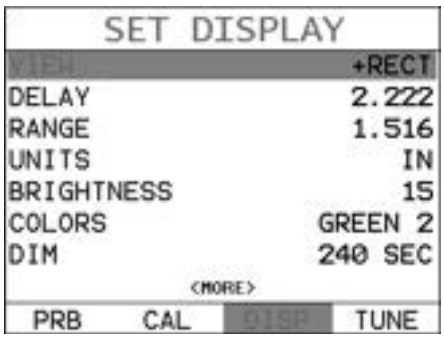
**Radio Frequency (RF):** Displays the entire sine wave signal, much like an oscilloscope, from a reflector or return echo. This view shows both the positive and negative peaks.

**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:

**Display View**




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times

using the left button wheel. *For quick access and editing, refer to navigating the Hot Menus page 23.*

2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **VIEW** is highlighted.

3) Use the  and  arrow keys on the right button wheel to scroll the view options **(RF, +RECT, -RECT, RECTFW)**.

4) Once the desired view is displayed, press the  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.

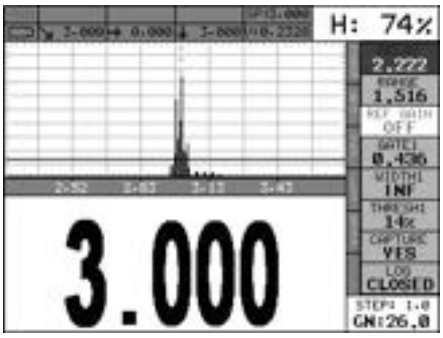
## Setting Delay

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 ***FX80***.

**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) Using the left button wheel, press the  and  arrow keys to scroll through the 9 individual Hot Menus, and the  and  arrow keys to scroll through the Hot Menu items to highlight **DELAY**. Alternatively, the  **&**  keys can be used to scroll through the Hot Menu items.

2) Press the  and  arrow keys multiple times on the right button wheel to scroll the highlighted value.

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

4) Press the  and  arrow keys on the left button wheel to scroll the highlighted value.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

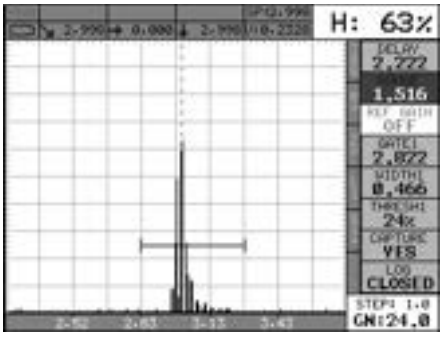
6) Repeat steps **4 & 5** until the **DELAY** value is correctly displayed.

7) Press the OK key to return to the measurement screen, or esc to cancel entering the **DELAY**.

## 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) Using the left button wheel, press the ◀ and ▶ arrow keys to scroll through the 9 individual Hot Menus, and the ▲ and ▼ arrow keys to scroll through the Hot Menu items to highlight **RANGE**.
   Alternatively, the 🏠 **&** esc keys can be used to scroll through the Hot Menu items.

2) Press the ▲, ▼, ◀, and ▶ arrow keys to scroll the highlighted value.

3) **Alternatively**, press the ↵ key to display the **Digits Edit Box**.

4) Press the  and  arrow keys on the left button wheel to scroll the highlighted value.

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

6) Repeat steps **4 & 5** until the **RANGE** value is correctly displayed.

7) Press the  key to return to the measurement screen, or  to cancel entering the **RANGE**.

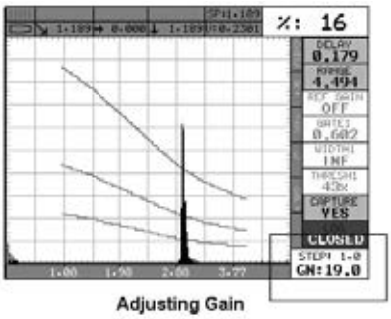
## 4.3 Gain

The gain feature of the **FX80** 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 **FX80** 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 ***FX80*** commands a 110dB gain range using 3 stages of amplification. The overall range makes the FX80 extremely versatile regarding a variety of applications and material types.

The **Gain** can be quickly adjusted at any time, as the ***FX80*** has dedicated buttons on the keypad for this purpose. The procedure to adjust the **Gain** are outlined below:

**Gain**




Adjusting Gain




1) Press the  and  arrow keys on the right button wheel to adjust the  setting.




2) Additionally, the increment **GAIN STEP** size can be adjusted at any time by pressing the  button and displaying the **Digits Edit Box**.

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

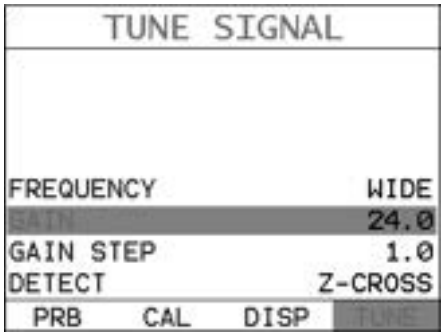
4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

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

6) Press the  key to return to the measurement screen, or  to cancel entering the  **STEP**.

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 Menus**. The procedure using the tabbed menus is outlined below:

## Adjusting the Gain using the Tabbed Menus




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until gain is highlighted.

3) Press the ◀ and ▶ arrow keys on the right button wheel to scroll the value. When the correct **Gain** is displayed, **proceed to step 8**.

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

5) Press the  and  arrow keys multiple times using the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys multiple times on the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the **Gain** value is correctly displayed.

8) Press the 

key to set the **Gain** and return to the menu screen, or 

to cancel entering the **Gain**.

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

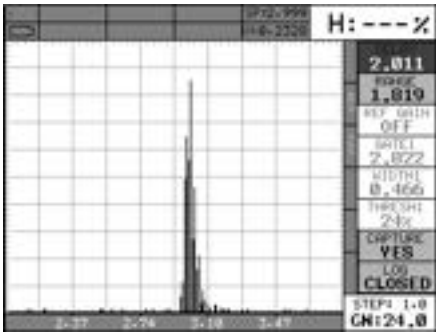
## 4.4 Gates

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 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.

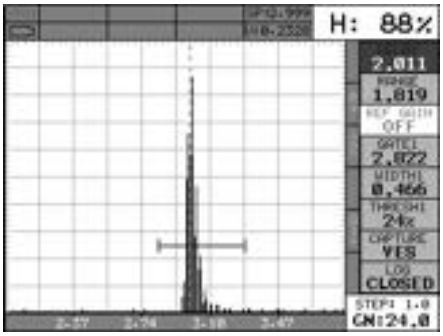
The more flexible a gate is, the better the possibilities for the user to setup an application. For example, a test block with a target size and depth is optimized on the A-Scan display with a signal amplitude at 70% full screen height. The inspector wants to know of any defects during the inspection 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 ***FX80*** 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



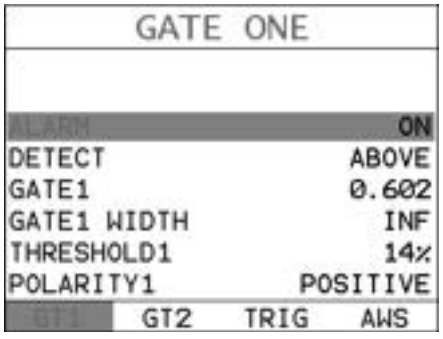

**No Gate**




**Gate On**

The screenshots above show a rectified waveform with and without a gate enabled. The commonly adjusted features of the gates can also be accessed using the Hot Menus. *For quick access and editing, refer to navigating the Hot Menus page 23.* The following steps outline how to enable a gate as follows:

### Activating a Gate




**Gate1**

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **ALARM** is highlighted.

3) Press the  and  arrow keys on the right button wheel to toggle **ALARM** to **ON**. The menu items should now become active and adjustable, as the gate is now activated.

**Set Detect**

1) Press the  and  arrow keys on the left button wheel until **DETECT** is highlighted.

2) Press the  and  arrow keys on the right button wheel 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  and  arrow keys multiple times on the left button wheel until **GATE1** is highlighted, followed by pressing the  and

 arrow keys on the right button wheel to scroll the value. When the correct start position is displayed, proceed to the next menu item setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the start position is correctly displayed.

6) Press the  key to set the **GATE1** start position and return to the menu screen, or  to cancel entering the **GATE1** start position.

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

**<u>Set Gate1 Width</u>**

1) Press the  and  arrow keys multiple times on the left button wheel until **GATE1 WIDTH** is highlighted, followed by pressing the  and  arrow keys multiple times using the left button wheel to scroll the value. When the correct width is displayed, proceed to the next menu item setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the **Width** is correctly displayed.

6) Press the  key to set the **GATE1 WIDTH** and return to the menu screen, or  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  and  arrow keys multiple times on the left button wheel until **THRESHOLD1** is highlighted, followed by pressing the  and  arrow keys multiple times using the left button wheel to scroll the value. When the correct threshold level is displayed, proceed to the next menu item setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the threshold level is correctly displayed.

6) Press the 

key to set the **THRESHOLD1** level and return to the menu screen, or 

to cancel entering the **THRESHOLD1** level.

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

**<u>Select Gate Polarity</u>**

1) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **POLARITY1** is highlighted.

2) Press the  and  arrow keys multiple times using the left button wheel to toggle the **POLARITY** feature positive or negative.

3) Press the  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

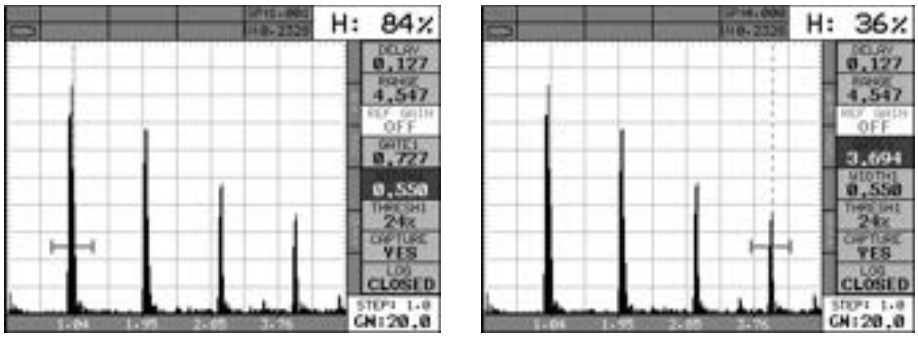
In this section we'll focus on calibrating the ***FX80***. There are a number of ways to go about performing a calibration, but we'll be focusing on the simplest and most accurate method, which is performing a two point calibration. This method is very convenient, as it will automatically calculate the material velocity and zero using a minimum and maximum calibration standard of know thickness and material type. The ***FX80*** 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 ***FX80*** 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 ***FX80*** 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:

**FX80 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 ***FX80***, as well as gaining a good understanding of their function:

## Loading Default Setup

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **DEFAULT SETUP** is highlighted.
3) Press the ↵ key to display the **CONFIRM** screen.
4) Press the OK key to load the **DEFAULT SETUP**.

## Setting the Range

1) Using the left button wheel, press the  and  arrow keys to scroll through the 8 individual Hot Menus, and the  and  arrow keys to scroll through the Hot Menu items, until the RANGE cell is highlighted. Alternatively, the  **&**  keys can be used to scroll through the Hot Menu items.




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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

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

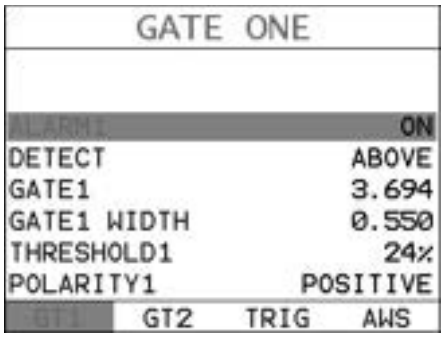
6) Press the 

key to set the value and return to the measure screen.

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

**<u>Enabling and Setting Up a Gate</u>**

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. *For quick access and editing, refer to navigating the Hot Menus page 23.*




**Activating a Gate**

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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.

   Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **ALARM1** is highlighted.

3) Press the ◀ and ▶ arrow keys on the right button wheel to toggle the gate **ON**.

**Setting the Detect**

1) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **DETECT** is highlighted.

2) Press the  and  arrow keys on the right button wheel to toggle the option **ABOVE**.

**Gate1 Start**

1) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **GATE1** is highlighted.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel 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  key to set the value and return to the **GT1** menu.

**Gate1 Width**

1) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **GATE1 WIDTH** is highlighted.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel 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  key to set the value and return to the **GT1** menu.

**<u>Threshold Level</u>**

1) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **THRESHOLD1** is highlighted.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel 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 ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **POLARITY1** is highlighted.

2) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to toggle the polarity **POSITIVE**.

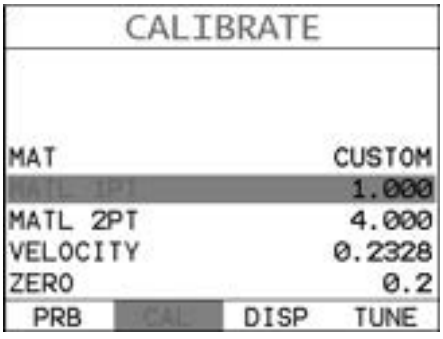
3) Press the 🏠 key to return to the measurement screen and get started with the two point calibration.

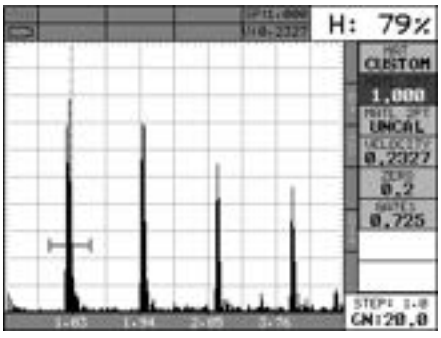
## 5.2 Straight Beam Calibration

Now that the ***FX80*** 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:

*For quick access and editing, refer to navigating the Hot Menus page 23.* In the screenshot below, notice the Hot Menu representing the CAL menu is being displayed on the right side of the display.

**Two Point Calibration – Straight Beam**



**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**

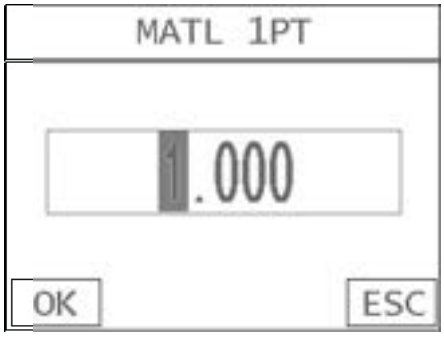
1) Using the left button wheel, press the  and  arrow keys to scroll through the 9 individual Hot Menus, and the  and  arrow keys to scroll through the Hot Menu items, until the **GATE1** cell is highlighted. Alternatively, the  **&**  keys can be used to scroll through the Hot Menu items.

2) Press the  and  arrow keys on the right button wheel to move the gate over the waveform to be measured, as demonstrated in the screen shot above.

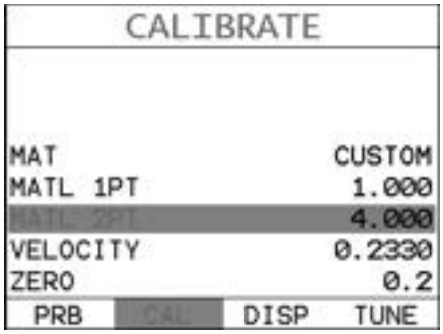
**Note:** *In order to trigger on a signal, the waveform must be inside the boundaries of the gate.*

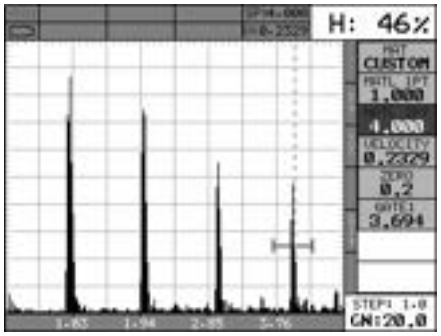
**Calibrating the First Point**

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **MATL 1PT** is highlighted.




3) Press the ↵ key to display the **Digits Edit Box**.
4) Press the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll the highlighted value.
5) Press the ◀ and ▶ arrow keys multiple times using the left button wheel 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.
8) Finally, press the ⌂ key to return to the Measurement screen.




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**

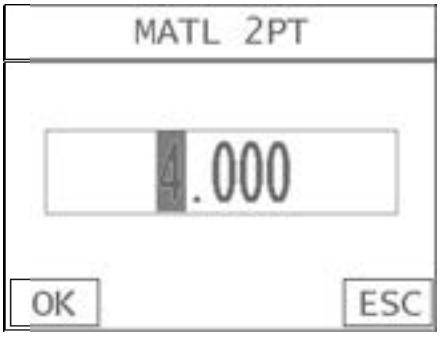
1) Press the key once to activate the measure menu items. Press the key multiple times to move right and the esc key multiple times to move left, until the **GATE1** cell is highlighted. Alternatively, press the and arrow keys multiple times using the left button wheel.

2) Press the and arrow keys on the right button wheel to move the gate over the waveform to be measured, as demonstrated in the screen shot above.

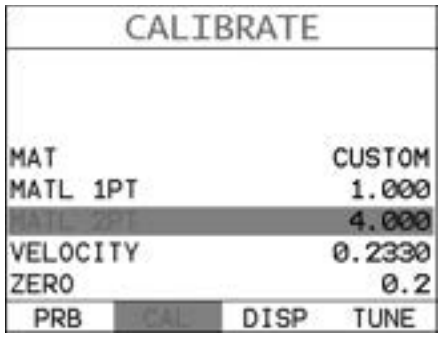
**Note:** *In order to trigger on a signal, the waveform must be inside the boundaries of the gate.*

**Calibrating the Second Point**

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **MATL 2PT** is highlighted.



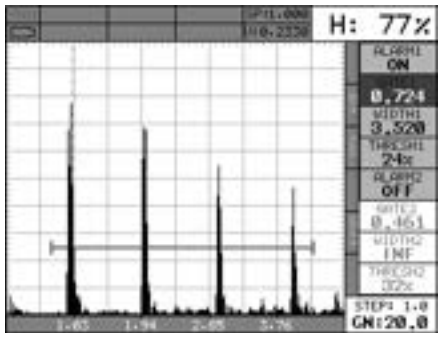

3) Press the ↵ key to display the **Digits Edit Box**.
4) Press the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll the highlighted value.
5) Press the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the digit locations.
6) Repeat steps **4 & 5** until the 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.




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

8) Finally, press the  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.

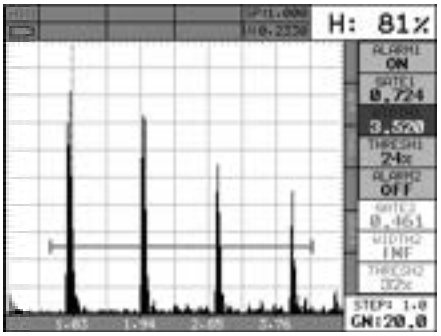



**<u>Adjusting the Gate to Calibrated Range</u>**

1) Using the left button wheel, press the  and  arrow keys to scroll through the 9 individual Hot Menus, and the  and  arrow keys to scroll through the Hot Menu items until the **GATE1** cell is

highlighted. Alternatively, the  **&**  keys can be used to scroll through the Hot Menu items.

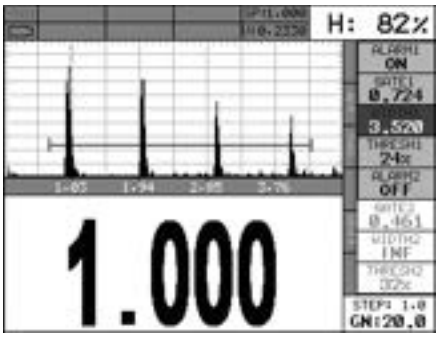
2) Press the  and  arrow keys on the right button wheel to move the gate start to a position less than 1 inch.




3) Press the  key once to highlight the **WIDTH1** cell. Alternatively, use the  and  arrow keys on the left button wheel

4) Press the  and  arrow keys on the right button wheel 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 split screen with the thickness value.

## 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 ***FX80***. 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 ½ 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 ½ 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:**

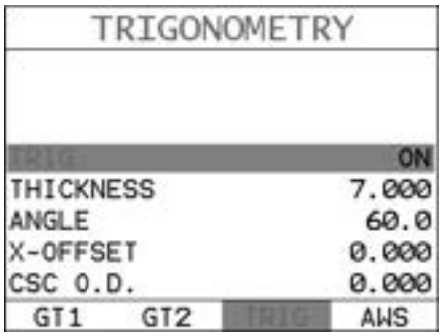
During an angle beam calibration, it's important to peak up the overall amplitude of the waveform to its maximum potential. The primary purpose is to be sure the transducer is positioned properly on the calibration standard, that's producing return echoes at different distances. **For example:** If the operator is using a DSC block to calibrate the velocity and zero, a DSC block will produce echoes at 1 & 5, or 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.

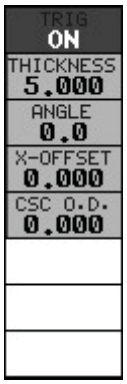
**Selecting the Material Type:**

The user can also select a material type directly from a table built into the ***FX80*** 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:

*For quick access and editing, refer to navigating the Hot Menus page 23.*

## Selecting the Material Type




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Press the ◀ and ▶ arrow keys on the right button wheel to toggle **TRIG** mode **ON**.

3) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

4) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **MAT** is highlighted.

5) Press the  key to display the list of material types.

6) Press the  and  arrow keys multiple times on the left button wheel to scroll through the material list until the appropriate material is highlighted.

7) Press the  key to select the material type and initiate the overwrite confirmation screen.

8) Press the 

key to confirm the material selection, or 

key to cancel changing the material type.

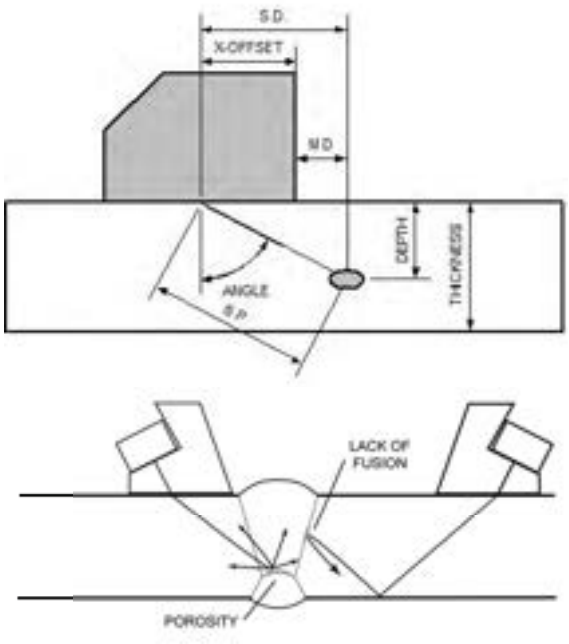
# CHAPTER SIX
# TRIGONOMETRY MODE

## 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:

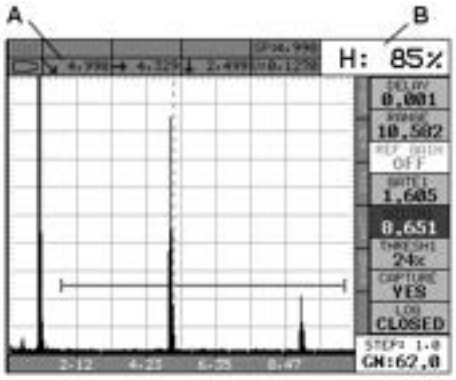



**Angle Beam Transducer** **Weld Inspection**

Refer to the Angle Beam Transducer diagram above:

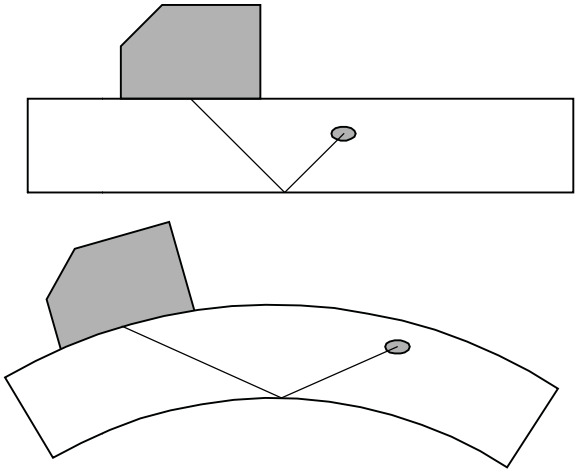
| | |
|---|---|
| SP – Sound Path | X-Offset – Front of wedge less Index |
| Angle – Transducer Angle | SD – Surface Distance |
| Thickness – Material Thickness | Depth – Depth of flaw from surface |

**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:**



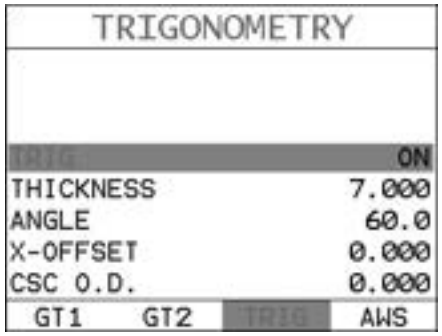
The ***FX80*** will also compensate for convex curved surfaces of longitudinally welded pipes. A curved surface will produce a greater sound path than a flat surface will, using a transducer with a given angle. The user should consider the angle used on curved surfaces, with respect to the material thickness, 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 ***FX80***.

## 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.*

*For quick access and editing, refer to navigating the Hot Menus page 23.*

## Activating & Setting the Parameters




### Activate Trig Mode

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **TRIG** is highlighted.
3) Press the ◀ and ▶ arrow keys on the right button wheel to toggle the **TRIG** feature **ON**. The menu items should now become active and adjustable, as illustrated above.

### Enter Material Thickness

1) Press the  and  arrow keys multiple times on the left button wheel until **THICKNESS** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to scroll the value. When the correct thickness is displayed, proceed to the next setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the thickness is correctly displayed.

6) Press the  key to set the **THICKNESS** and return to the menu screen, or  to cancel entering the **THICKNESS**.

**Note:** *Thickness is used to calculate the depth.*

**<u>Transducer Angle</u>**

1) Press the  and  arrow keys multiple times on the left button wheel until **ANGLE** is highlighted, followed by pressing the  and  arrow keys multiple times using the left button wheel to scroll the value. When the correct angle is displayed, proceed to the next setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the angle is correctly displayed.

6) Press the  key to set the **ANGLE** and return to the menu screen, or  to cancel entering the **ANGLE**.

**X-Offset**

1) Press the  and  arrow keys multiple times on the left button wheel until **X-OFFSET** is highlighted, followed by pressing the  and  arrow keys multiple times using the left button wheel to scroll the value. When the correct X-Offset is displayed, proceed to the next setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the X-Offset is correctly displayed.

6) Press the 

key to set the **X-OFFSET** and return to the menu screen, or 

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  and  arrow keys multiple times on the left button wheel until **CSC OD** is highlighted, followed by pressing the  and  arrow keys multiple times using the left button wheel to scroll the value. When the correct **CSC OD** is displayed, proceed to the next setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the **CSC OD** is correctly displayed.

6) Press the 

key to set the **CSC OD** and return to the menu screen, or 

to cancel entering the **CSC OD**.

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

# 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 an 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 ***FX80*** 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:**

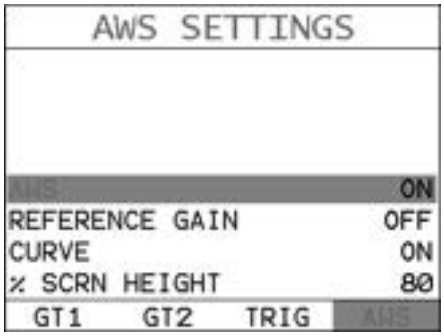
There are specific transducers that are required by the D1.1 standard. The frequency specified by the standard is 2-2.5MHz. The user should refer to the standard for further information.

## 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.*

*For quick access and editing, refer to navigating the Hot Menus page 23.*

## Activating & Setting AWS




### Activate Trig Mode

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **AWS** is highlighted.
3) Press the ◀ and ▶ arrow keys on the right button wheel to toggle the **AWS** feature **ON**. The menu items should now become active and adjustable, as illustrated above.

### Toggle Curve On/Off

1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right, and the  key multiple times to tab left, until the **AWS** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **CURVE** is highlighted.

3) Press the  and  arrow keys on the right button wheel to toggle the **CURVE** feature . The menu items should now become active and adjustable, as illustrated above.

**<u>Enter % Screen Height</u>**

1) Press the  and  arrow keys multiple times on the left button wheel until **% SCRN HEIGHT** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to scroll the value. When the correct height is displayed, proceed to the next setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the height is correctly displayed.

6) Press the  key to set the **% SCRN HEIGHT** and return to the menu screen, or  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  and  arrow keys multiple times on the left button wheel until **SET REF HEIGHT** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to toggle the feature **ON**.

2) Using the left button wheel, press the  and  arrow keys to scroll through the 9 individual Hot Menus, and the  and  arrow keys to scroll through the Hot Menu items until the **GATE1** cell is highlighted. Alternatively, the  **&**  keys can be used to scroll through the Hot Menu items.

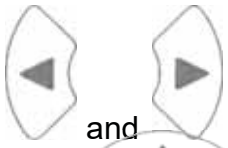
**Note:** *A gray cursor should be visible in the waveform area of the display. Also, since the **FX80** has been previous calibrated and the **TRIG** feature has been setup, a gate should be enabled and active.*

**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  and  arrow keys on the right button wheel to position the start of **GATE1** to trigger on the waveform.
3) Optionally, press the left button wheel, press the  and  arrow keys to scroll through the 9 individual Hot Menus, and the  and  arrow keys to scroll through the Hot Menu items until the **WIDTH1** cell is highlighted. Alternatively, the  **&**  keys can be used to scroll through the Hot Menu items.
4) Press the  and  arrow keys multiple times on the right button wheel 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**

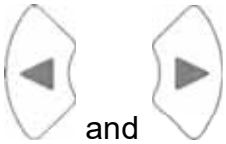
1) Press the left button wheel, press the  and  arrow keys to scroll through the 9 individual Hot Menus, and the and arrow keys to scroll through the Hot Menu items until the **AWS BOX:** cell is highlighted. Alternatively, the  **&**  keys can be used to scroll through the Hot Menu items.

2) Press the  and  arrow keys multiple times on the right button wheel, to position the cursor box over the waveform.

3) Press the  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  key once to activate the menu items tab. Press the  key multiple times to tab right, and the  key multiple times to tab left, until the **AWS** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

5) Press the  and  arrow keys multiple times on the left button wheel until **SET REF**  is highlighted, followed by pressing the  and arrow keys to toggle **OFF**.

6) Finally, press the  key to return to the main measurement screen.

# 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 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 **FX80**, 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 users selection process in the menu items:

- Up to 16 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.*

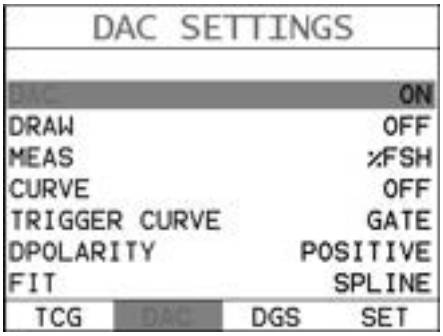
- The **MEAS**, **CURVE**, and **TRIGGER** options can be changed at any time once the **DAC** curve has been created.
- In order to move the highlighted cursor over a waveform to use as a point in generating the **DAC** curve, the **"DAC BOX:"** hot menu item in the main measurement screen must be highlighted.

## 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.*

*For quick access and editing, refer to navigating the Hot Menus page 23.*

### Activating & Setting the Parameters




#### Activating DAC

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **DAC** is highlighted.

3) Press the  and  arrow keys on the right button wheel 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  and  arrow keys multiple times on the left button wheel until **DRAW** is highlighted, followed by pressing the  and  arrow keys on the right button wheel until **ON** is displayed.

**Quantity Displayed**

1) Press the  and  arrow keys multiple times on the left button wheel until  is highlighted, followed by pressing the  and  arrow keys on the right button wheel to toggle and select **dB**, **%FSH**, or **%DAC**.

**Selecting the Curve(s)**

1) Press the  and  arrow keys multiple times on the left button wheel until **CURVE** is highlighted, followed by pressing the  and  arrow keys on the right button wheel 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**

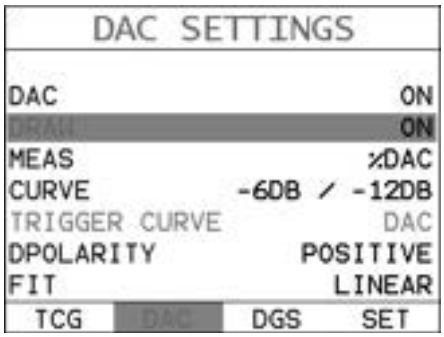
1) Press the  and  arrow keys multiple times on the left button wheel until **TRIGGER** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to toggle and select which curve or gate to use as the alarm trigger. The options displayed will vary according to which **CURVE** 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  and  arrow keys multiple times on the left button wheel until **FIT** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to select **SPLINE** or **LINEAR**.

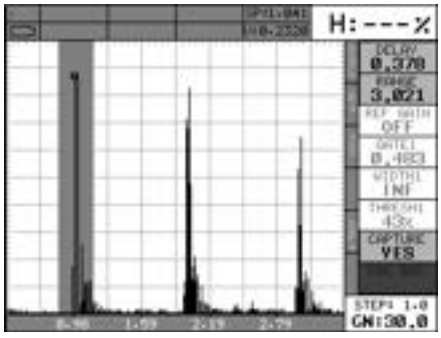
2) Proceed to the next section – Drawing the **DAC**.

## Drawing the DAC

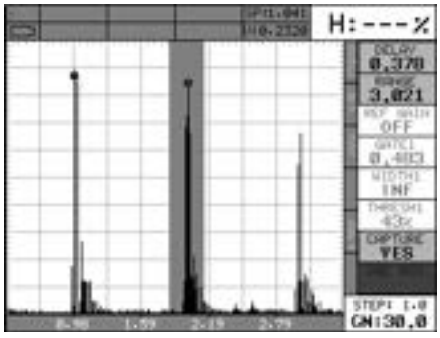



1) With all the parameters set in the previous section, press the  key to return to the main measurement screen.

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




ex. 1




ex. 2

2) Press the left button wheel, press the  and  arrow keys to scroll through the 9 individual Hot Menus, and the  and  arrow keys to scroll through the Hot Menu items until the **DAC BOX** cell is

highlighted. Now that the **DAC BOX** cell is highlighted, the cursor can be controlled by moving the  and  arrow keys on the right button wheel.

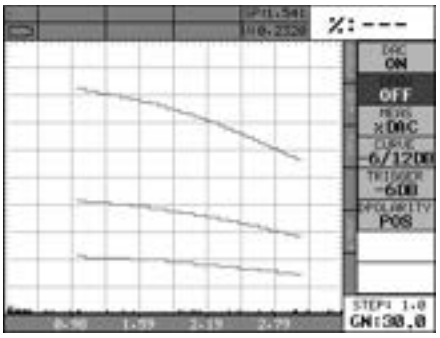
3) Couple the transducer to the first calibration standard, and peak up on the reflector, adjusting the gain to keep the signal height within the boundaries of the waveform display area, and at a suitable height to allow for attenuation at greater depths in the overall range to be tested.

4) Press the  and  arrow keys on the right button wheel to move the cursor over the waveform to be used as the first point in the **DAC** curve, and press the  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 16 points allowed.*

6) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right, and the  key multiple times to tab left, until the **DAC** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.




7) Press the  and  arrow keys multiple times on the left button wheel until **DRAW** is highlighted, followed by pressing the  and  arrow keys on the right button wheel 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 **TCG** curve, a few additional items will help with the user selection process in the menu items:

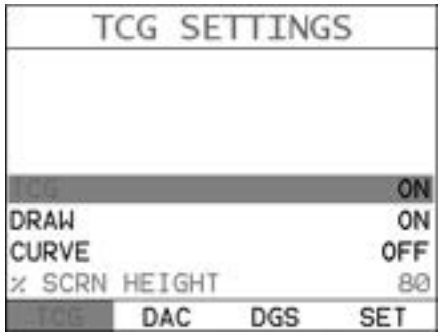
- Up to 16 points can be used to generate a **TCG** curve.
- 3 or more points must be used in order to draw a **TCG** curve.
- The gain will be adjusted at each point to display the signal amplitude at a predetermined reference level.
- In order to move the highlighted cursor over a waveform to use as 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.*

*For quick access and editing, refer to navigating the Hot Menus page 23.*

### Setting TCG Parameters

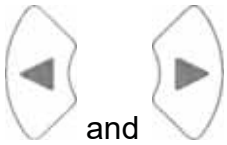



**Activating TCG**

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **TCG** is highlighted.
3) Press the ◀ and ▶ arrow keys on the right button wheel to toggle the **TCG** feature **ON**. The menu items should now become active and adjustable, as illustrated above.

**Enter % Screen Height**

1) Press the ▲ and ▼ arrow keys multiple times on the left button wheel until **% SCRN HEIGHT** is highlighted, followed by pressing the

 and arrow keys on the right button wheel to scroll the value. When the correct height is displayed, proceed to the next setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the height is correctly displayed.

6) Press the  key to set the **% SCRN HEIGHT** and return to the menu screen, or  to cancel entering the **% SCRN HEIGHT**.

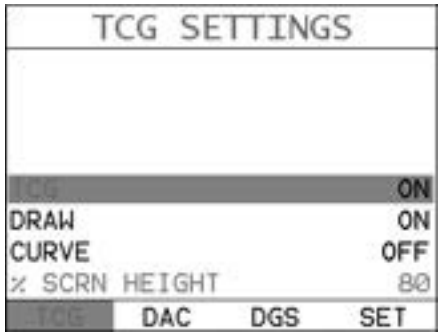
**<u>Activating Draw Mode</u>**

4) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **DRAW** is highlighted.

5) Press the  and  arrow keys on the right button wheel to toggle the **DRAW** feature **ON**.

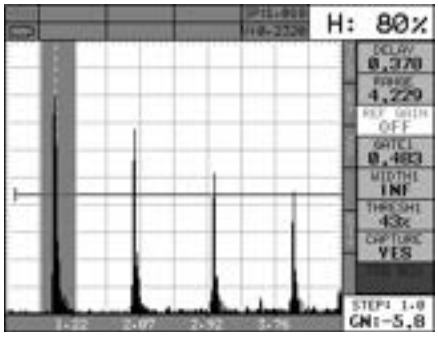
6) Proceed to the next section – Drawing the **TCG** curve.

## <u>Drawing the TCG</u>

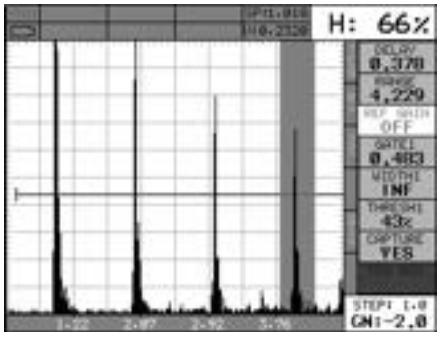



1) With all the parameters set in the previous section, press the key once to return to the main measurement screen.

**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 left button wheel, press the and arrow keys to scroll through the 9 individual Hot Menus, and the and arrow keys to scroll through the Hot Menu items until the **TCG BOX:** cell is highlighted. Now that the **TCG BOX:** cell is highlighted, the cursor can be controlled by moving the and arrow keys on the right button wheel.

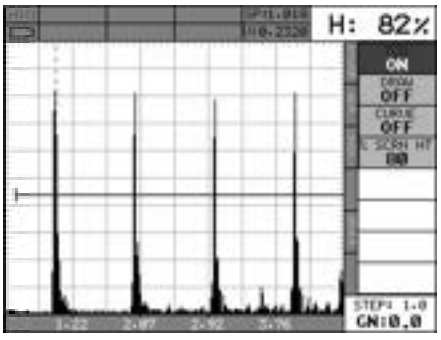
3) Couple the transducer to the first calibration standard, and peak up on the reflector to achieve maximum signal amplitude.

4) Press the  and  arrow keys on the right button wheel to move the cursor over the waveform to be used as the first point in the **TCG** curve, and press the  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, and a total of 16 points can be set. Any point can be cleared by pressing the*  *key when **DRAW** is active.*

6) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right, and the  key multiple times to tab left, until the **TCG** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.



7) Press the  and  arrow keys multiple times on the left button wheel until **DRAW** is highlighted, followed by pressing the  and  arrow keys on the right button wheel until **OFF** is displayed. The **TCG** curve is now set.

8) Optionally, the **TCG** curve can be displayed by pressing the  and  arrow keys multiple times on the left button wheel until **CURVE** is highlighted, followed by pressing the  and  arrow keys on the right button wheel toggle **ON**.

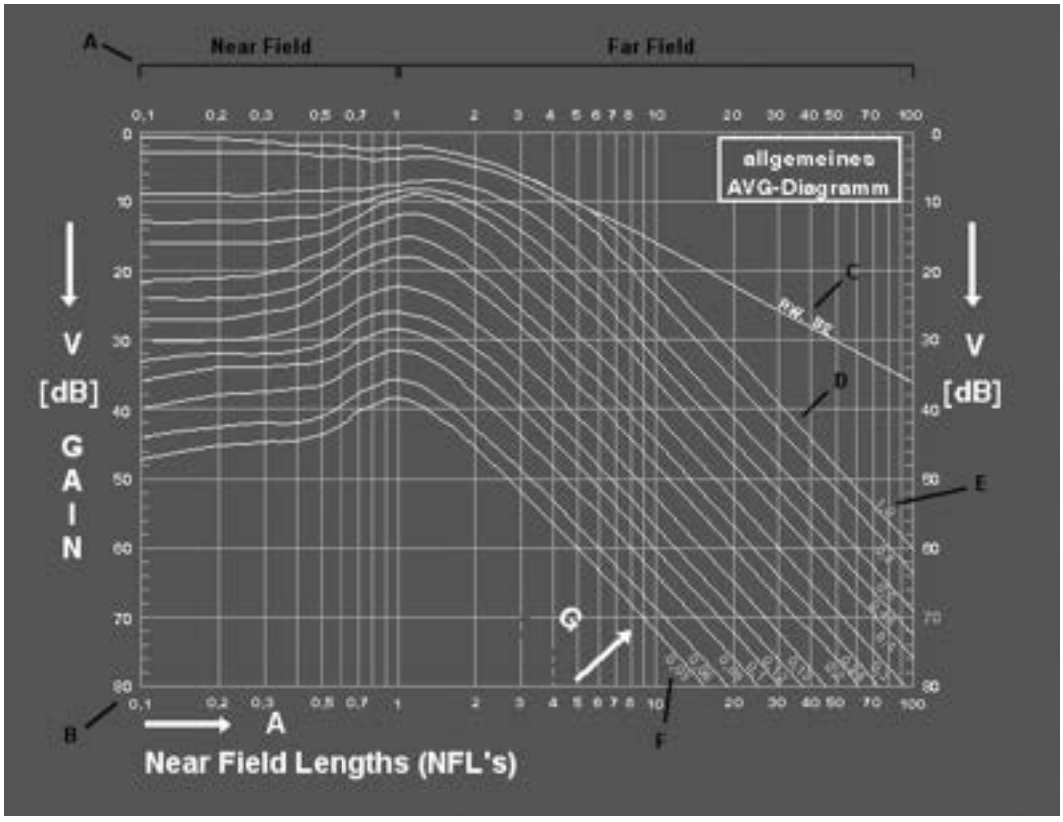
9) Press the  key to display the main measurement screen, and the **TCG** curve will be displayed.

# 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% ($1/10^{th}$ = 20dB), 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 ***FX80***. 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**

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

Where:
N = Near Field Length
$D_{EFF}$ = Effective Diameter
$\lambda$ = 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

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

Where:
$D_{EFF}$ = Effective Diameter
K = Aspect Ratio

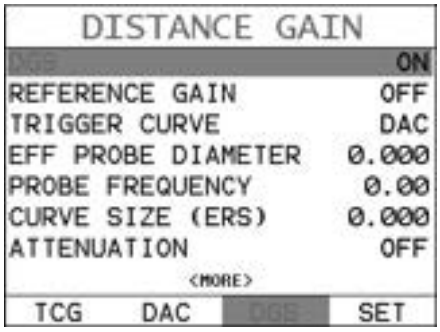
A = Largest Dimension
0.97 = Fixed Ratio

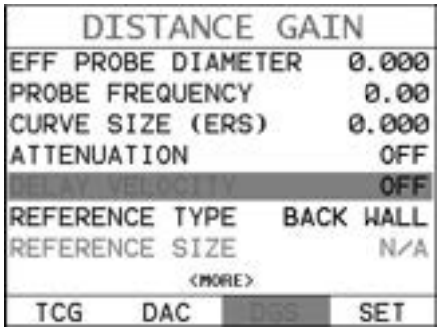
Calculated results can also be compared to the following table:

| 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:




**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 ***FX80*** 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.

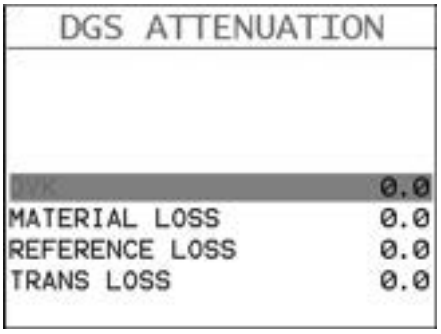
**Delay Velocity:** The longitudinal velocity of the delay line, most commonly used with angle beam style probes, but also used with 90 degree compression probes. It's important to note that in order for this to be accurate, the 'probe zero' must be accurate. This is easily accomplished performing a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




**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 correct for the attenuation (loss) of sound energy in the calibration/reference standard; in units of dB/in. or dB/meter.

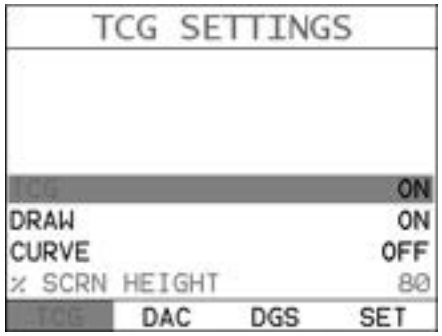
**Transfer Loss:** Correction factor to account for the loss of sound energy from surface condition/roughness or inadequate coupling between the transducer and test specimen. The surface condition of calibration/reference standards and actual material being tested in the field will typically vary. This 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.*

*For quick access and editing, refer to navigating the Hot Menus page 23.*

### Setting DGS Parameters




#### Activating DGS

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **DGS** is highlighted.

3) Press the  and  arrow keys on the right button wheel to toggle the **DGS** feature **ON**. The menu items should now become active and adjustable, as illustrated above.

**Trigger Curve**

1) Press the  and  arrow keys multiple times on the left button wheel until **TRIGGER CURVE** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to scroll the curve options. When the correct curve is displayed, proceed to the next setting.

**Effective Diameter**

1) Press the  and  arrow keys multiple times on the left button wheel until **EFF PROBE DIAMETER** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to scroll the value. When the correct diameter is displayed, proceed to the next setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the diameter is correctly displayed.

7) Press the  key to set the **EFF PROBE DIAMETER** and return to the menu screen, or  to cancel entering the **EFF PROBE DIAMETER**.

**<u>Probe Frequency</u>**

1) Press the  and  arrow keys multiple times on the left button wheel until **PROBE FREQUENCY** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to scroll the value. When the correct frequency is displayed, proceed to the next setting.

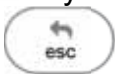
2) **Alternatively**, press the  key to display the **Digits Edit Box**.

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the frequency is correctly displayed.

6) Press the 

key to set the **PROBE FREQUENCY** and return to the menu screen, or 

to cancel entering the **PROBE FREQUENCY**.

**Curve Size (ERS)**

2) Press the  and  arrow keys multiple times on the left button wheel until **ERS** is highlighted, followed by pressing the  and  arrow keys on the right button wheel to scroll the value. When the correct **ERS** is displayed, proceed to the next setting.

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

3) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

4) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

5) Repeat steps **3 & 4** until the **ERS** is correctly displayed.

6) Press the 

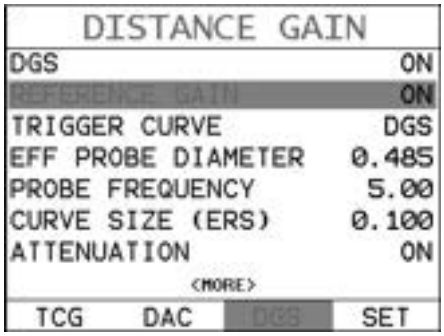
key to set the **ERS** and return to the menu screen, or 

to cancel entering the **ERS**.

**Attenuation (All Parameters)**

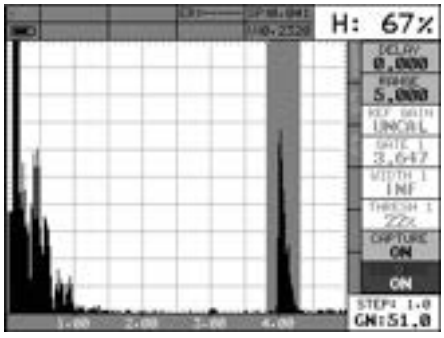
1) Press the  and  arrow keys multiple times on the left button wheel until **ATTENUATION** is highlighted, followed by pressing the  key on the left button wheel to enter the **ATTENUATION** sub menu.
2) Press the  and  arrow keys multiple times on the left button wheel to scroll the correct attenuation parameter is highlighted.
3) Press the  and  arrow keys multiple times on the left button wheel until the desire attenuation parameter is highlighted, followed by pressing the  and  arrow keys on the right button wheel to scroll the value. When the correct value is displayed, proceed to the next parameter.
4) **Alternatively**, press the  key to display the **Digits Edit Box**.
5) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.
6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.
7) Repeat steps **5 & 6** until the parameter value is correctly displayed.
8) Press the  key to set the value and return to the **ATTENUATION** sub menu screen, or  to cancel entering the parameter value.

## Drawing the DGS Curve




1) Press the ▲ and ▼ arrow keys multiple times on the left button wheel until **REFERENCE** gain is highlighted, followed by pressing the ◀ and ▶ arrow keys on the right button wheel to toggle on. With all the parameters set in the previous section, press the home 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.*

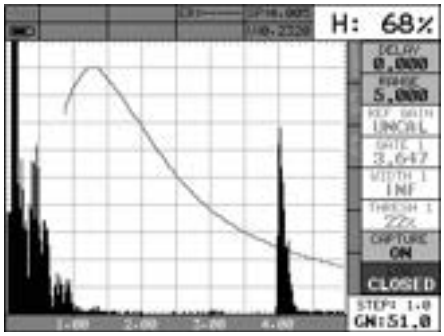



2) Couple the transducer to the first calibration standard, and peak up on the reflector, adjusting the gain to keep the signal height within the boundaries of the waveform display area, and at a suitable height to allow for attenuation at greater depths in the overall range to be tested.

3) Press the ◀ and ▶ arrow keys on the right button wheel 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 ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.




5) Press the ▲ and ▼ arrow keys multiple times on the left button wheel until **REFERENCE** gain is highlighted, followed by pressing the ◀ and ▶ arrow keys on the right button wheel to toggle **OFF**. The **DGS** curve is now set and ready to be used for inspection.

# CHAPTER ELEVEN
# ADDITIONAL FEATURES OF THE FX80

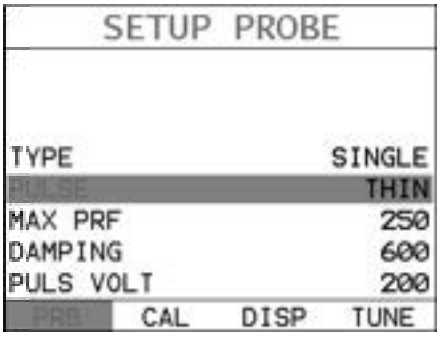
## 11.1 Pulse Width

The ***FX80*** 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 ***FX80+*** is equipped with a "Tone Burst" style pulser, and supplies a constant amplitude pulse to the transducer for a set amount of time, which is adjustable. The key advantage using this type of pulser is that the frequency of the generated pulse can be tuned to the frequency of the transducer, the bursts can be adjusted/optimized, a clean narrow band ultrasonic wave produced, and exceptional output at a given voltage. Therefore, the output of a general square wave pulser at 400V is approximately 12dB less than a tuned 400V tone burst style pulser. The options for the ***FX80+*** pulse width settings are; **Spike, Thin, Wide, HV Spike, HV Thin, HV Wide, TB 10MHz, TB 5MHz, TB 2MHz, and TB 1MHz**. Depending on the setting selected, the pulser voltage options will include the applicable settings/options (i.e. if Thin is selected, the max output voltage option is 200V. However if HV Thin is selected, the max output voltage option is 400V – HV or high voltage, etc.). Once the pulse width option has been selected, refer to the pulser voltage menu option to adjust the desired voltage. The procedure to change the pulse width is outlined below:

*For quick access and editing, refer to navigating the Hot Menus page 23.*

**Selecting the Pulse Width**



1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to tab left until the **TUNE** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.
2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **PULSE** is highlighted.
3) Use the  and  arrow keys on the right button wheel to scroll the **Pulse** options.
4) Once the **Pulse** is displayed, press the  key to return to the measurement screen.

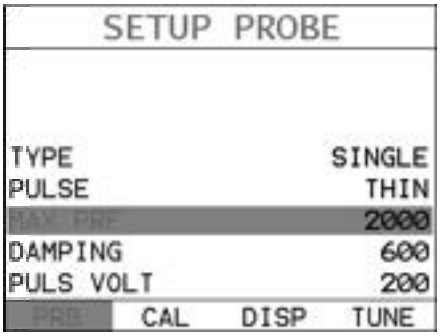
## 11.2 Pulse Repetition Frequency (PRF)

The ***FX80*** 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 60Hz, or draws at 60 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:

*For quick access and editing, refer to navigating the Hot Menus page 23.*

## Setting the Max PRF




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **MAX PRF** is highlighted.
3) Use the ◀ and ▶ arrow keys on the right button wheel to scroll the **PRF** options.
4) Once the desired **PRF** is displayed, press the ⌂ key to return to the measurement screen.

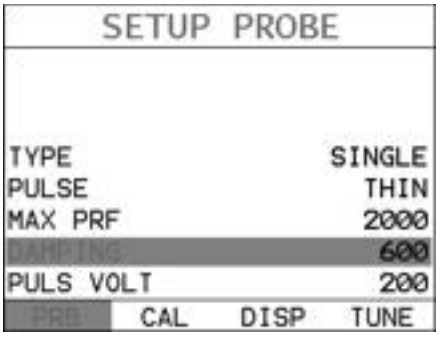
## 11.3 Damping

The ***FX80*** has an adjustable damping feature, enabling the user to select from a variety of settings according 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:

*For quick access and editing, refer to navigating the Hot Menus page 23.*

## Selecting the Damping




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **DAMPING** is highlighted.
3) Use the ◀ and ▶ arrow keys on the right button wheel to scroll the **DAMPING** options.
4) Once the desired **DAMPING** is displayed, press the 🏠 key to return to the measurement screen.

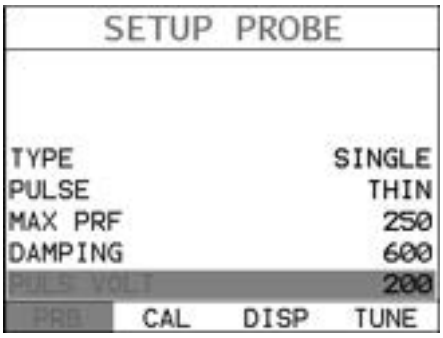
## 11.4 Pulser Voltage

The ***FX80*** has a 200 volt square wave pulser that can be adjusted for specific applications and transducers. The Pulser Volt feature offers a 50 volt cut/boost option to the user. The standard setting is 200 volts. This enables the ***FX80*** to offer greater penetration for difficult material types, or increased resolution on noisy materials.

The ***FX80+*** is equipped with a "Tone Burst" style pulser, and supplies a constant amplitude pulse to the transducer for a set amount of time, which is adjustable. The key advantage using this type of pulser is that the frequency of the generated pulse can be tuned to the frequency of the transducer, the bursts can be adjusted/optimized, a clean narrow band ultrasonic wave produced, and exceptional output at a given voltage. Therefore, the output of a general square wave pulser at 400V is approximately 12dB less than a tuned 400V tone burst style pulser. The options for the ***FX80+*** pulse width settings are; Spike, Thin, Wide, HV Spike, HV Thin, HV Wide, TB 10MHz, TB 5MHz, TB 2MHz, and TB 1MHz. Depending on the setting selected, the pulser voltage options will include the applicable settings/options (i.e. if Thin is selected, the max output voltage option is 200V. However if HV Thin is selected, the max output voltage option is 400V – HV or high voltage, etc.). **Note:** *The Pulser Voltage menu option is used in conjunction with the Pulse Width menu option. Refer to the Pulse Width menu options to select the desired voltages intended.* The procedure to change the pulser voltage is outlined below:

*For quick access and editing, refer to navigating the Hot Menus page 23.*

### Changing the Pulser Voltage




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **PULSER VOLT** is highlighted.

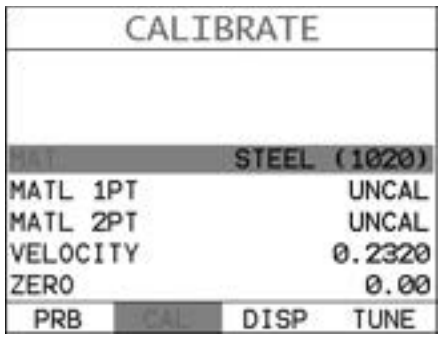
3) Use the  and  arrow keys on the right button wheel to scroll the **PULSER VOLT** options.

4) Once the desired **Pulser Voltage** is displayed, press the  key to return to the measurement screen.

## 11.5 Material Velocity Charts

The ***FX80*** 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:

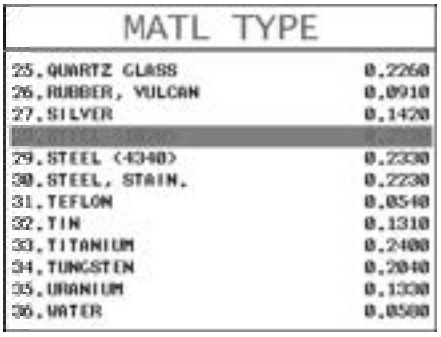
### Selecting a Basic Material Type



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

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

2) Use the and arrow keys multiple times on the left button wheel to scroll through the sub menu items until **MAT** is highlighted.




3) Press the key to display the list of material types.

4) Press the and arrow keys multiple times on the left button wheel to scroll through the material list until the appropriate material is highlighted.

5) Press the key to overwrite the material type and display the menu items with the new material type selected.

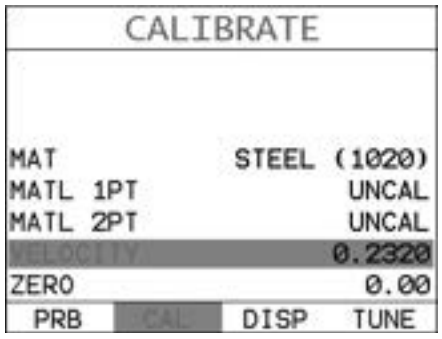
6) Finally, press the key to return to the measurement screen and begin taking readings.

## 11.6 Material Velocity

The ***FX80*** has a built in feature to manually adjust the material velocity to a known value in the calibration section of the ***FX80***. 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:

*For quick access and editing, refer to navigating the Hot Menus page 23.*

## Adjusting Velocity




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **VELOCITY** is highlighted.
3) Press the ◀ and ▶ arrow keys on the right button wheel to scroll the value. When the correct velocity value is being displayed, **proceed to step 8**.

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

5) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

7) Repeat steps **5 & 6** until the velocity value is correctly displayed.

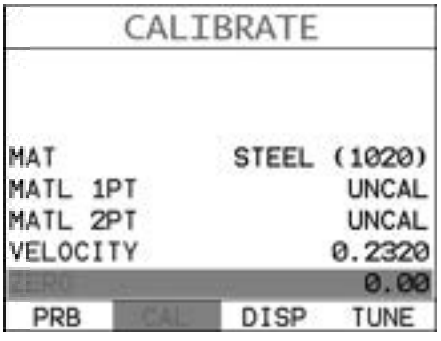
8) Press the  key to set the velocity and return to the menu screen, or  to cancel entering the velocity.

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

## 11.7 Zero

The ***FX80*** 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:

**<u>Adjusting Zero</u>**



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

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

2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **ZERO** is highlighted.

3) Press the  and  arrow keys multiple times using the left button wheel to scroll the value. When the correct zero value is being displayed, **proceed to step 8**.

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

5) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

6) Press the  and  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.

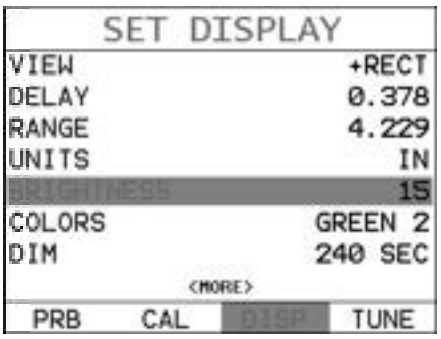
8) Press the  key to set the zero and return to the menu screen, or  to cancel entering the zero.

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

## 11.8 Brightness

The ***FX80*** is equipped with a brightness feature to adjust the display visibility and optimize battery life. It has an arbitrary scale with values from 1-20, with 20 representing the brightest setting. The procedures for adjusting the brightness are outlined below:

### Adjusting Brightness

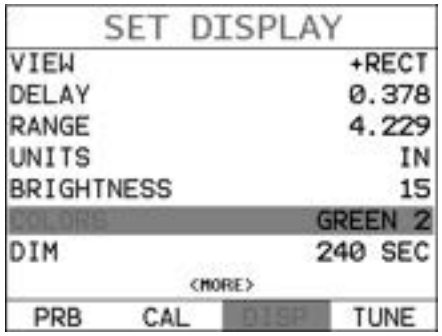



1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the esc key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **BRIGHTNESS** is highlighted.
3) Press the ◀ and ▶ arrow keys on the right button wheel to scroll the value.
4) Press the ⌂ key to return to the measurement screen and begin taking readings.

## 11.9 Color Scheme

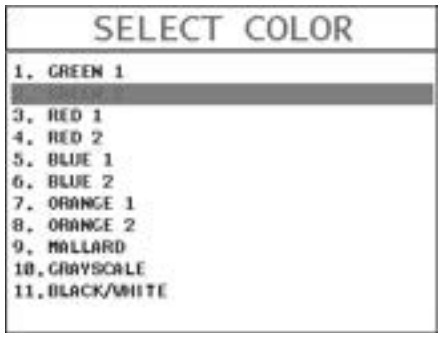
The ***FX80*** has a variety of display color options to select from. These will change the look and feel of the according to the users preference. The procedures for changing the **VIEW**, are outlined below:

### Selecting a Color Scheme




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **VIEW** is highlighted.



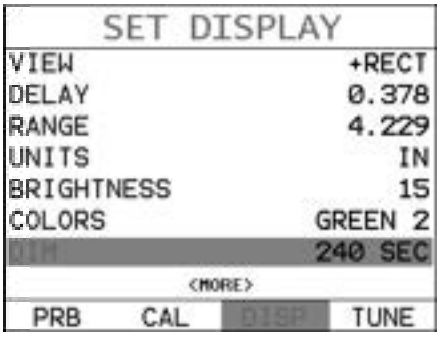
3) Press the ↵ key to display a list of the color scheme options.
4) Press the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the material list until the appropriate material is highlighted.
5) Press the ↵ key, followed by pressing the OK key, to overwrite the current color scheme with the selected scheme.
6) Finally, press the ⌂ key to return to the measurement screen and begin taking readings.

## 11.10 DIM

The ***FX80*** 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 ***FX80*** will dim in 2 minutes, then power off in 5 minutes. The procedures for adjusting the **DIM** time are outlined below:

*For quick access and editing, refer to navigating the Hot Menus page 23.*

**Setting a DIM time**



1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.
2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **DIM** is highlighted.
3) Press the  and  arrow keys on the right button wheel to scroll the **DIM** time.
4) Finally, press the  key to return to the measurement screen and begin taking readings.

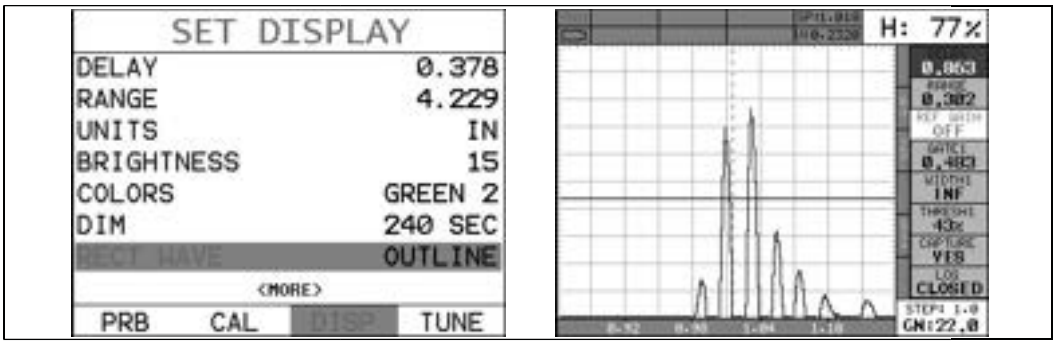
## 11.11 Graphics Option (look & feel)

The ***FX80*** 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 ***FX80*** in any way.

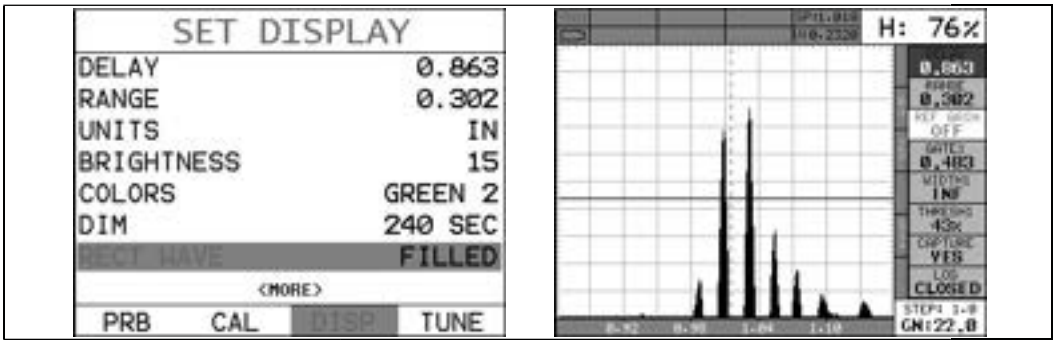
**RECT Wave:**

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.

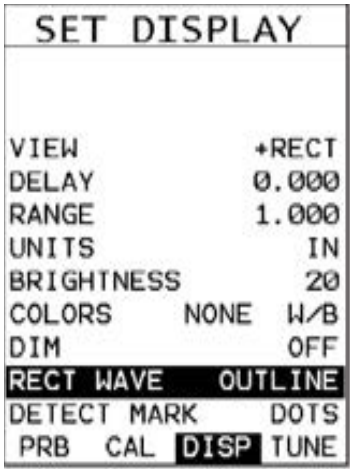



**Filled** – Draws a filled version of the waveform.




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

## Setting the Look & Feel




1) Press the ≡ key once to activate the menu items tab. Press the ≡ 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. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

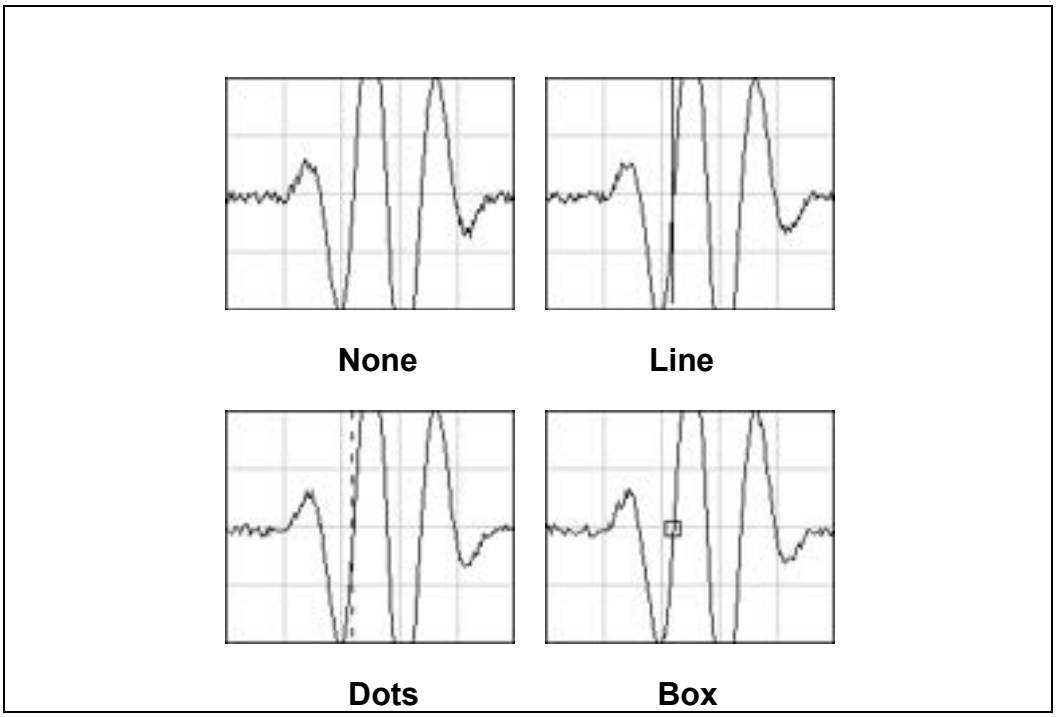
2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **RECT WAVE** is highlighted.

3) Use the  and  arrow keys on the right button wheel to scroll the **RECT WAVE** options.

4) Once the **RECT WAVE** is displayed, press the  key to return to the measurement screen.

## 11.12 Detect Mark

Another look and feel option of the ***FX80*** 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:




## 11.13 Wave Averaging

The ***FX-81*** has a wave averaging feature to improve the resolution or clarity of the waveform by averaging multiple shots/bangs and eliminating random noise. This feature is 'not' recommended for high speed scanning, as it slows down the screen redraw speed based on the number of averaging shots/bangs selected (OFF, 2, 4, 8, 16, 32, 64, 128). The procedure to change the averaging is outlined below:

### Setting Wave Averaging



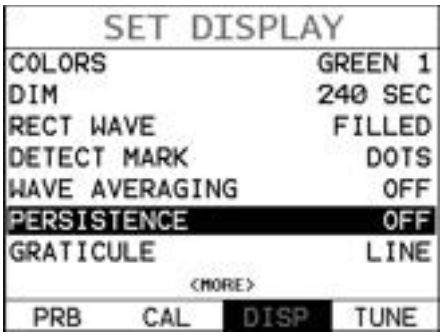
1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to tab left until the **DISP** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.
2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **WAVE AVERAGING** is highlighted.
3) Use the  and  arrow keys on the right button wheel to scroll the **WAVE AVERAGING** options.
4) Once the desired **WAVE AVERAGING** value is displayed, press the  key to return to the measurement screen.

## 11.14 Persistence

The ***FX-81*** has a persistence feature that is specifically used when connected to a multiple channel multiplexor and in Rectified display setting. The display is cleared based on the option selected, representing the overall number of bangs, to control the screen jitter. The setting options are (OFF, 15, 60, 240).

The procedures for selecting persistence are outlined below:

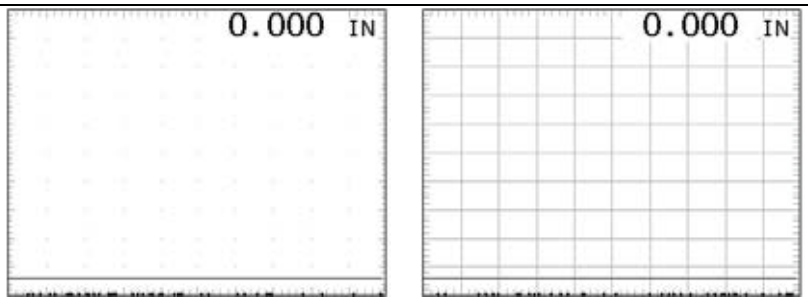
**Persistence**




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **PERSISTENCE** is highlighted.
3) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle **PERSISTENCE** (Off, 15, 60, 240).
4) Press the ⌂ key to return to the measurement screen.

## 11.15 Graticule (A-Scan Background)

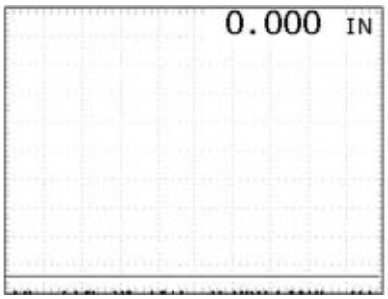
The graticule markers in the background of the A-Scan waveform area provide measurement references for depth/thickness versus amplitude. There are multiple options for the user to select an A-Scan background grid/segments to satisfy their graphics preference or 'look and feel'. The procedure to select one of the options is outline below:



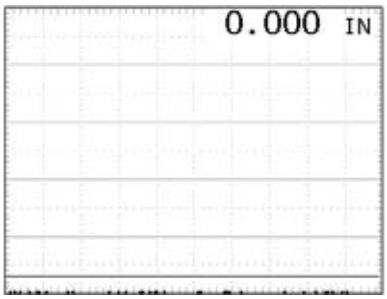

**Points**




**Line**

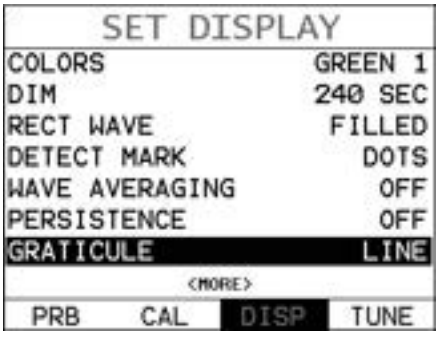



**Dots**




**Mix**

## Selecting Graticule Option




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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  and  arrow keys to scroll through the sub menu items until **GRATICULE** is highlighted.

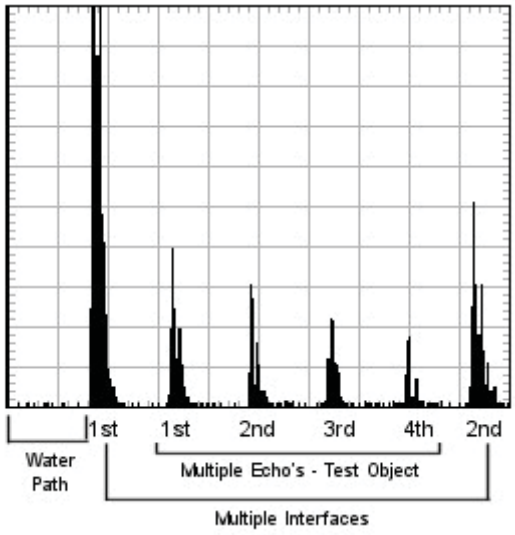
3) Use the  and  arrow keys to scroll the **GRATICULE** options.

4) Once the desired “look & feel” is displayed, press the  key to return to the measurement screen.

## 11.16 Auto Interface Gate – Immersion Testing (IM)

Immersion testing generally consists of a tank of water with the test object and transducers submerged in the tank with the transducer focused on the object, or using a “bubbler” with a constant water source and path. This procedure is advantageous in achieving a constant coupling during the scanning process, unlike standard manual contact scanning methods, and provides better control over amplitude fluctuations while attempting to estimate the size of a given reflector/flaw.

The ***FX-81*** is equipped with an additional gate to detect/trigger on the water path interface during the immersion inspection process. The start position, width and threshold of the gate can be configured for the interface echo to allow for deviations in the water path distance due to the surface condition, position and unwanted interface detections from the test object. The **IM** measure mode is similar to the standard interface-echo (I-E) mode generally found in precision thickness gauges to account for the length of the acrylic delay line material, when using a delay line style transducer.




**Immersion Testing**

**Considerations:**

- There is a significant difference between sound traveling in water versus steel, for example. The longitudinal velocity of sound traveling through water is approximately 0.058 in/µs, while 0.2320 in/µs in steel. Since the ***FX80+*** has been setup and calibrated for a steel test object, this would find the water path interface at approximately 4", considering an actual 1" water path, or 4 times the depth/distance on the calibrated display.

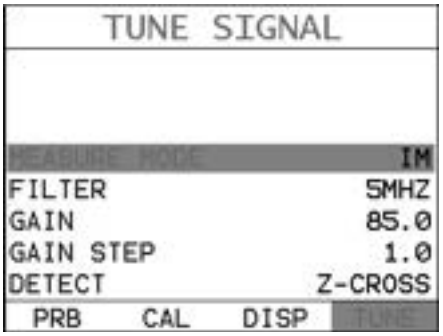
- It is recommended that the water path be greater than 25% of the thickness of the test object, and that the water path is long enough to keep the flaw evaluation process beyond the "near zone" and entirely in the "far zone" where sound has achieved the most uniform wave front (near zone will be contained in the water path).

- Additionally, any movements of the transducer or test object that change the water path distance are then compounded by a factor of 4x. Therefore, a mechanical fixture or carriage is typically used on the top side of the tank in order to maintain the positioning of the transducer to the test object.

- Changes in the targets angle and water path distance will reduce the amplitude/output, and should be considered during the evaluation of a flaw. Obviously, the optimal evaluation would be a perfectly fixed transducer position with a perfectly parallel reflector and water path distance.

The procedures for enabling and adjusting the IM measurement mode are outlined below:

## Activating the (IM) Mode




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **MEASURE MODE** is highlighted.
3) Use the ◀ and ▶ arrow keys on the right button wheel to toggle the **MEASURE MODE**.
4) Once the desired **MEASURE MODE** is displayed , press the ⌂ key to return to the measurement screen.

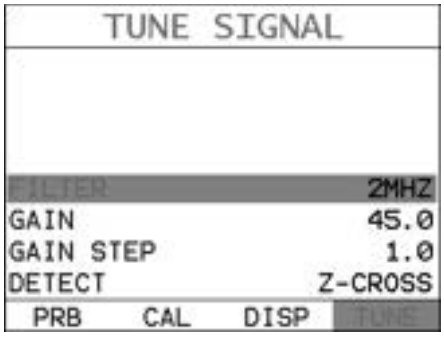
**Note:** *Two gates will be enabled and can be adjusted using the Hot or Tabbed Gate menu items. Refer to section 4.4 to adjust and configure the postion of the gates.*

## 11.17 Filters (Wide & Narrow Bands)

The ***FX80*** includes a wide band filter with a range of **1.8MHz** to **19MHz**, as well as narrow band filters at **1MHz**, **2MHz**, **5MHz** and **10MHz**. The ***FX80+*** has two additional narrow band filter at **0.5MHz** and **15MHz**. 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 **FILTER** is outlined below:

*For quick access and editing, refer to navigating the Hot Menus page 23.*

### Selecting the Filter




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.

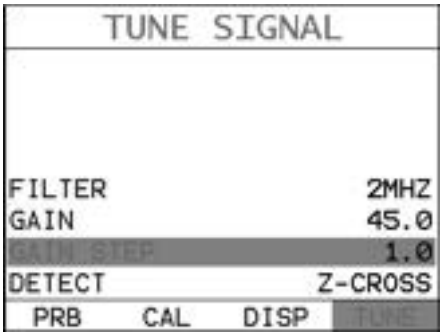
2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **FILTER** is highlighted.

3) Use the  and  arrow keys on the right button wheel to scroll the **FILTER** options.

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

## 11.18 Gain Step Size

**Adjusting Gain Step Size**




1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to tab left until the **TUNE** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until  **STEP** is highlighted.

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

5) Press the  and  arrow keys multiple times on the left button wheel to scroll the highlighted value.

6) Press the  and  arrow keys multiple times using the left button wheel to scroll the digit locations.

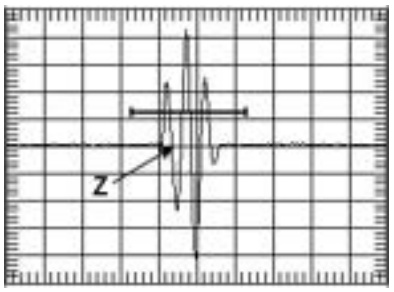
7) Repeat steps **5 & 6** until the zero value is correctly displayed.

8) Press the  key to set the gain step and return to the menu screen, or  to cancel entering the gain step.

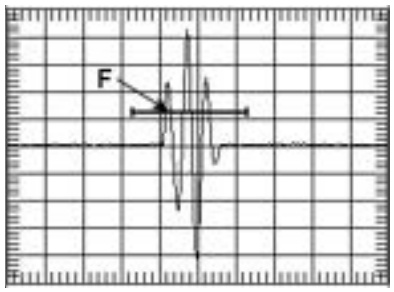
9) Finally, press the  key to return to the measurement screen.

## 11.19 Detect Modes

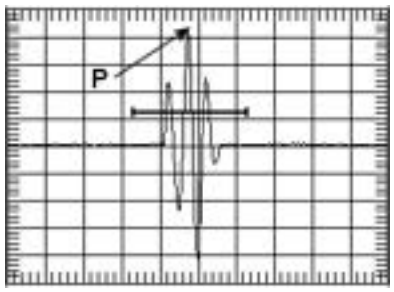
The ***FX80*** has three selectable modes of detection: Z-Cross, Flank, and Peak. The following diagram illustrates the difference between the options:




**Z-Cross**




**Flank**




**Peak**

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.

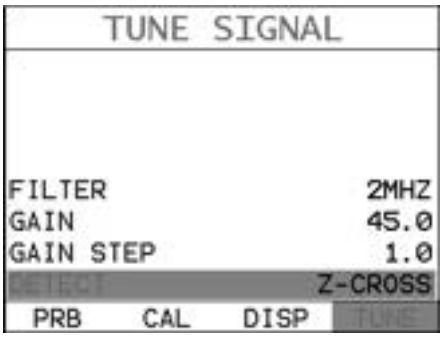
**Flank:** The detection occurs as the first half cycle left edge rises and breaks the threshold.

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

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

*For quick access and editing, refer to navigating the Hot Menus page 23.*

## Selecting the Detect




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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  and  arrow keys multiple times using the left button wheel.

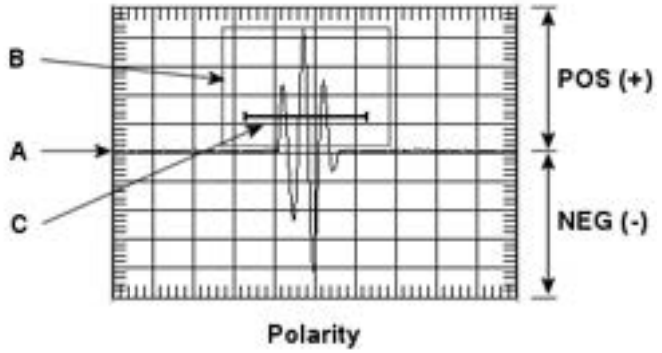
2) Use the  and  arrow keys multiple times on the left button wheel to scroll through the sub menu items until **DETECT MODE** is highlighted.

3) Use the  and  arrow keys multiple times using the left button wheel to scroll the **DETECT** options.

4) Once the **DETECT** is displayed, press the  key to return to the measurement screen.

## 11.20 Polarity

The ***FX80*** 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:

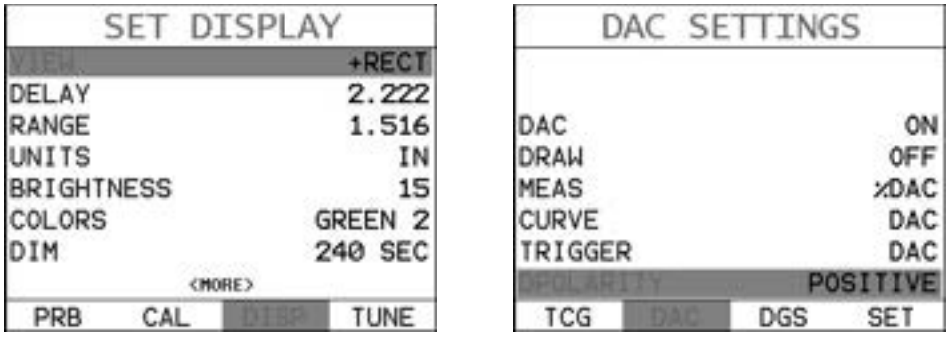


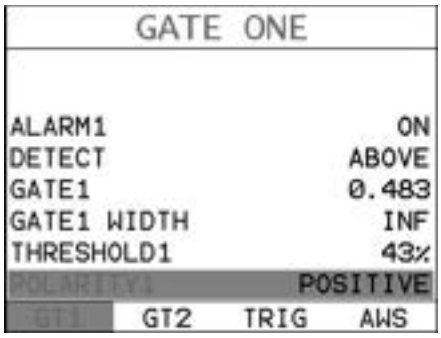

Polarity

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)**.

*For quick access and editing, refer to navigating the Hot Menus page 23.*

## Toggle Polarity (+/-)









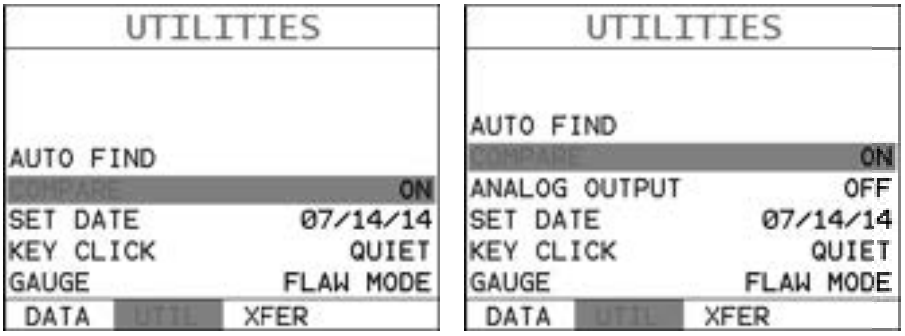
**Note:** *The screenshots above show where all the possible locations for polarity selection are found in the **FX80**. For more information on the above, refer to the sections on **VIEW**, **DAC**, **GT1**, & **GT2**.*

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **VIEW**, **DPOLARITY**, **POLARITY1,** or **POLARITY2** is highlighted.
3) Use the ◀ and ▶ arrow keys on the right button wheel to toggle the **VIEW**, **DPOLARITY**, **POLARITY1,** or **POLARITY2** negative or positive.
4) Press the ⌂ key to return to the measurement screen and begin taking readings.

## 11.21 Compare

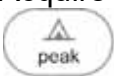
The compare feature enables an operator the ability to locate and establish a reference waveform from a flaw in an existing or manufactured sample and send it to the background on the display in a color other than the active waveform color. The reference waveform will remain in the background for the duration of inspection process, or until cleared. This feature can be useful when inspecting for a common flaw in a specific object, location, and position. The procedures for activating and using the compare feature are outlined below:

## Activating and Using Compare




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **COMPARE** is highlighted.
3) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle **COMPARE** on/off. **Note:** *The **COMPARE** feature now overrides the* peak *key and its functions while activated.*

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

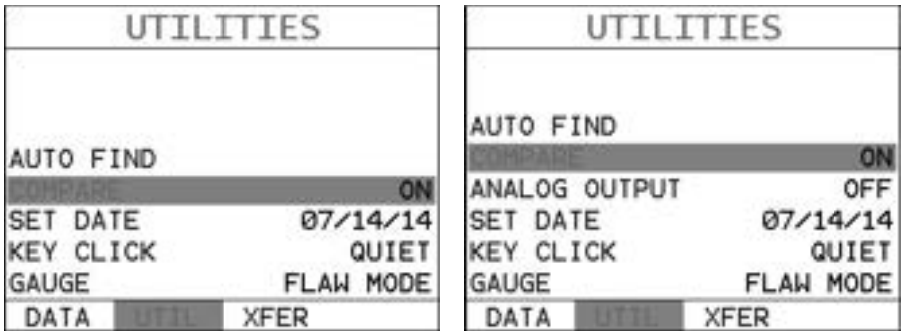
5) Acquire the waveform of the sample flaw on the display, and press the  key to freeze and send it into the background on the display in another color. Pressing the  key a second time to will clear the waveform.

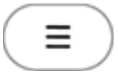
6) Finally, repeat steps **1 – 3** to disable the **COMPARE** feature.

## 11.22 Analog Output

The ***FX-81*** is also equipped with an analog outputs to send a 0-10 volt electrical signal to an external device to control a system process to respond in a different manner considering the voltage measured. The outputs are updated at the same rate as the PRF (pulse repetition frequency) setting. There is 100 ohm output impedance which will vary the voltage slightly and should therefore be calibrated to the device connected. The output options are amplitude or distance. Refer to the Top & Bottom end caps or connections on page 24 for further info on the pins used on the Lemo 1 5 pin connector. The procedures for activating and selecting amplitude or distance are outlined below:

### Activating Analog Out




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

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

6) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **ANALOG OUTPUT** is highlighted.

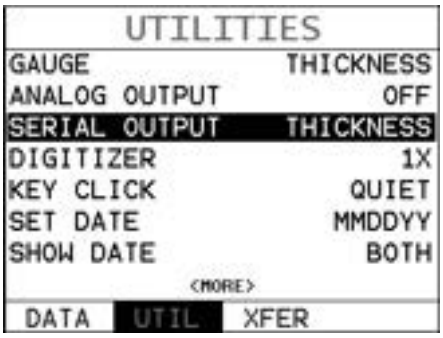
7) Use the  and  arrow keys multiple times on the right button wheel to toggle **ANALOG OUTPUT** thickness/amplitude.

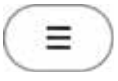
8) Press the  key to return to the measurement screen.

## 11.23 Serial Output

The ***FX-81*** is also equipped with a serial output that continuously sends the measurements to serial output port at a baud rate of 9600.
The procedure for activating the serial output are outlined below:

**Activating Serial Out**




1) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to

tab left until the **UTIL** menu is highlighted and displaying the submenu items.

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

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **SERIAL OUTPUT** is highlighted.

3) Use the  and  arrow keys multiple times on the right button wheel to toggle **SERIAL OUTPUT** – off/thickness.

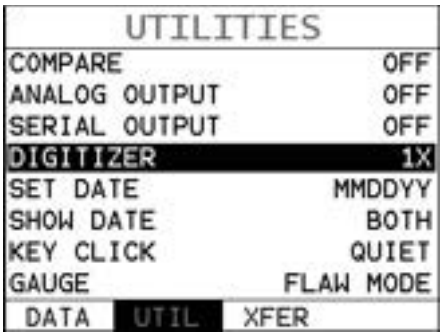
4) Press the  key to return to the measurement screen.

## 11.24 Digitizer

The ***FX-81*** is equipped with a selectable digitizer for additional resolution options. The 1x setting has the fastest update rate and lowest resolution, while the 4x option has 4 times the resolution and the slowest update rate.

The procedure for selecting the digitizer setting is outlined below:

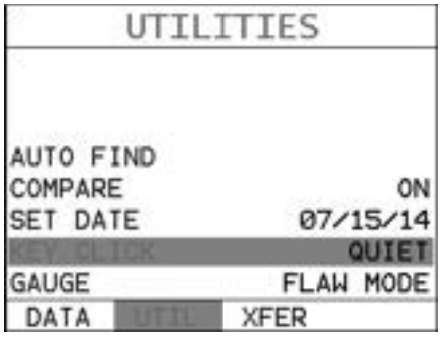
**Selecting Digitizer Rate**

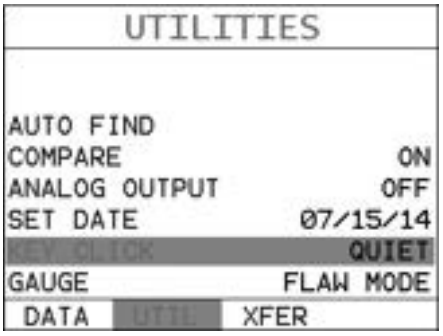



1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the esc key multiple times to tab left until the **UTIL** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **DIGITIZER** is highlighted.
3) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle the **DIGITIZER** (1x, 2x, 4x).
4) Press the ⌂ key to return to the measurement screen.

## 11.25 Key Click

**<u>Selecting the Detect</u>**




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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.

   Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **KEY CLICK** is highlighted.

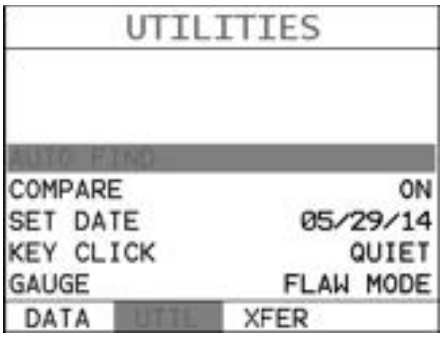
3) Use the ◀ and ▶ arrow keys multiple times using the left button wheel to scroll the **KEY CLICK** options.

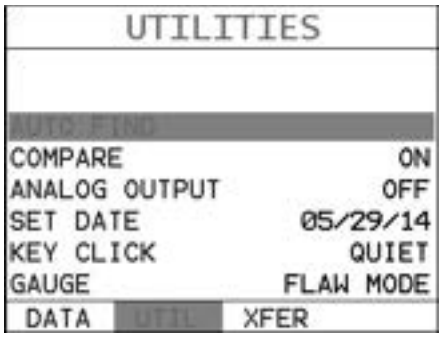
4) Once the desired **KEY CLICK** is displayed, press the ⌂ key to return to the measurement screen.

## 11.26 Date & Time

The ***FX80*** 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 ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys multiple times on the left button wheel to scroll through the sub menu items until **SET DATE** is highlighted.




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

4) Press the ▲ , ▼ , ◀ , & ▶ arrow keys on the left button wheel, to scroll the field locations.

5) Press the  and  arrow keys multiple times on the right button wheel to scroll the value.

6) Repeat steps **4 & 5** until the **Time & Date** is correctly displayed.

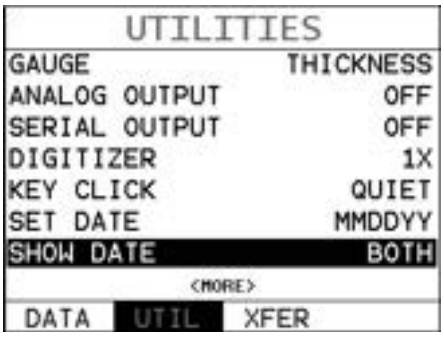
7) Press the  key to set the **Time & Date** and return to the menu screen, or  to cancel entering the **Time & Date**.

8) Finally, press the  key to return to the measurement screen and begin taking readings.

## 11.27 Show Date & Time

The ***FX80*** 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:

**Live Time & Date**




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

2) Use the  and  arrow keys to scroll through the sub menu items until **SHOW DATE** is highlighted.

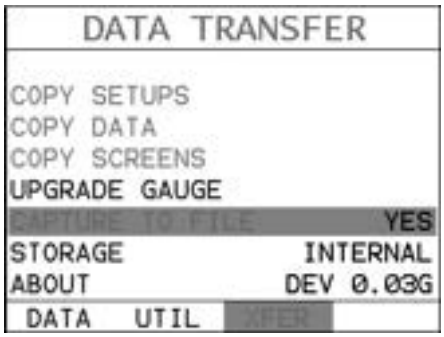
3) Press the  and  arrow keys multiple times to scroll the options (Date, Time, Both, Off).

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

## 11.28 Freeze & Capture

The ***FX80*** 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 ***FX80***, and additional external SD card reader, 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) Press the  key once to activate the menu items tab. Press the  key multiple times to tab right and the  key multiple times to

tab left until the **XFER** menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

2) Use the  and  arrow keys multiple times using the left button wheel to scroll through the sub menu items until **CAPTURE TO FILE** is highlighted.

3) Use the  and  arrow keys multiple times on the right button wheel to toggle the **CAPTURE** on/off. **Note:** *Capture will be displayed in a toolbar cell on the active display, indicating the feature is enabled.*

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

5) To capture a file, press the 

key to freeze the screen, followed by pressing it a second time to display the alpha numeric edit box to name and save the screen shot. **Note:** *if capture is not enabled, the* 

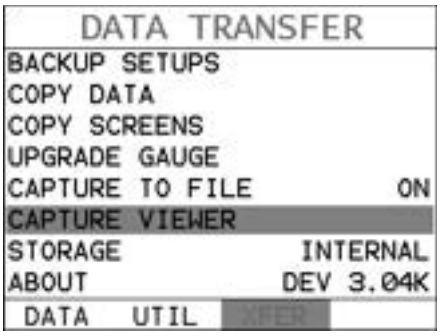
*key toggles freeze on/off.*

## 11.29 Capture Viewer

The capture viewer enables a user to view any of the saved screen captures on the SD card, using the ***FX80***. This is handy if a PC isn't available, but the user has a need to review the screen shots captured.

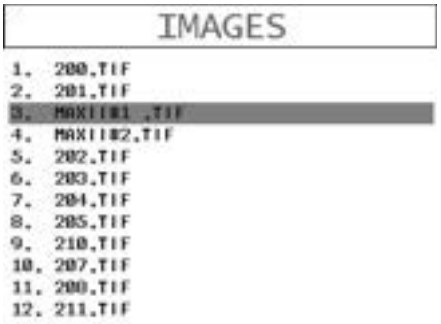
The procedure to capture the last screen displayed is outlined below:

**Capturing Screen Shots**




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **CAPTURE VIEWER** is highlighted.




3) Press the ↵ key to display the list of images (.tif) currently stored on the internal or external SD card.

4) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the list of images until the desired image is highlighted.

5) Press the  key to display the highlighted image, and the  key to close the image and return to the list of images.
6) Repeat steps 4-5 as needed.
7) Finally, press the  key to close the **VIEWER** and return the measurement screen.

## 11.30 Peak Hold

The ***FX80*** 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 procure outlines the steps to activate and use the  hold feature:

### Activating Peak



1) Press the  key located in the upper left corner of the keypad to activate the feature.
2) Press the  key again at any time to toggle this feature OFF.

### 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  key at any time to clear the currently displayed waveform, and continue the scanning process.

### Disabling PEAK

1) Press the peak key at any time to disable the feature.

**Note:** *The peak key is also used in conjunction with the **COMPARE** feature. When the compare feature is enabled, it takes control over the normal **PEAK** functionality.*

## 11.31 Freeze Waveform

The ***FX80*** also includes a **FREEZE** mode that allows an operator the ability to freeze a 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

freeze

**Note:** *Assuming the operator currently has a waveform on the display that they'd like to freeze and have a closer look.*

1) Press the freeze key located in the upper left corner of the keypad to activate the feature.
2) Press the freeze key again at any time to toggle this feature OFF.

**Note:** *If the **CAPTURE** feature has been activated, pressing the freeze key a second time will capture the screenshot, and display the **File Edit Box** enabling the user to name the captured file. The screen shot will be captured as a "tagged interface format" (.tif), which can be opened directly with any graphics file viewer.*

# CHAPTER TWELVE
# DATA STORAGE – SETUP, EDIT, & VIEW FILES

## 12.1 Introduction to Grid and Sequential file formats

The ***FX80*** 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 ***FX80*** and the log created, the ***FX80*** 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:

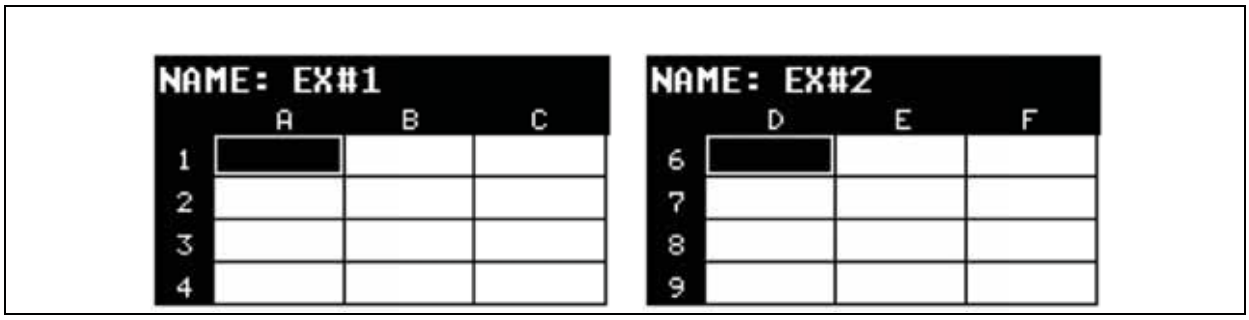
**Numeric characters:** 0 – 9 **Alpha Characters:** A – Z
**Special Characters:** ! ‘ _ # space / . – ( )

Multiple grids can be created and stored until the ***FX80***’s memory is full. If the user attempts to store a new file in the ***FX80*** and the size of the file exceeds the capacity of memory, the ***FX80*** will respond with an error message indicating that the memory is unable to store the new file.

The ***FX80*** has a very large potential storage capacity, and depending on the configuration of SD card sizes versus data, setups and screen capture images, can store limitless amount of data. The ***FX80*** has an internal SD of 4 gigabytes, and an external slot reader that has been successfully tested with a 64 gigabyte card. Therefore, available memory will not be an issue.

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** |
|---|




**Sequential Log Formats**

| NAME: EX#1 | |
|---|---|
| AA | |
| AB | |
| AC | |
| AD | |
| AE | |

| NAME: EX#2 | |
|---|---|
| 01 | |
| 02 | |
| 03 | |
| 04 | |
| 05 | |

| NAME: EX#3 | |
|---|---|
| 3A | |
| 3B | |
| 3C | |
| 3D | |
| 3E | |

| NAME: EX#4 | |
|---|---|
| BCD-4-01 | |
| BCD-4-02 | |
| BCD-4-03 | |
| BCD-4-04 | |
| 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**

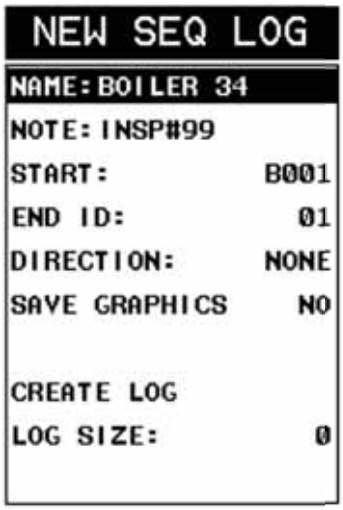
1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right, and the esc key multiple times to tab left, until the data menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **NEW** is highlighted.

3) Press the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle the data formats – **GRIG LOG** & **SEQ LOG**.




**Grid Log**




**Sequential Log**

4) Press the ↵ key to display the new **Grid** or **Seq Edit Box**.

5) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **NAME** is highlighted.




6) Press the ↵ key to activate the **Alpha Edit Box**.

7) Use the ▲, ▼, ◀, & ▶ arrow keys on the left button wheel to highlight the appropriate alpha characters.

8) Press the ↵ 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.

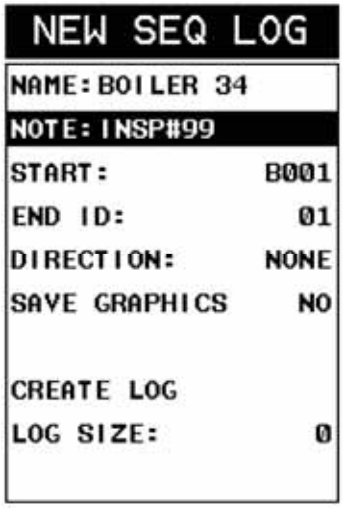
11) Press the OK key to save the **Grid** or **Seq Name** and return to the **Grid** or **Seq List Items** menu, or esc to cancel entering the **Grid** or **Seq Name (File Name)**.

## 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.*




**Grid Log**




**Sequential Log**

1) Assuming the **Grid** or **Seq** List Items are displayed, use the ▲ and ▼ arrow keys using the left button wheel to scroll through the new **Grid** or **Seq List Items** until **NOTE** is highlighted.

2) Press the  key to activate the **Alpha Edit Box**.




3) Use the , , , **&**  arrow keys on the left button wheel to highlight the appropriate alpha characters.

4) Press the  key to select a character and advance to the next field of the **Grid** or **Seq Note**.

5) Use the  key to backspace if necessary.

6) Repeat steps **3** through **5** until the **Grid** or **Seq Note** is completed.

7) Press the  key to save the **Grid** or **Seq Note** and return to the **Grid** or **Seq List Items** menu, or  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 ***FX80*** and the log created, the ***FX80*** will automatically generate all the identifiers within that range.

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




**Grid Log**




**Sequential Log**

1) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **TOP** ◄ or **START ID** is highlighted.

2) Press the ↵ key to activate the **Coordinate** or **Start ID Edit Box**.




**Grid Log**




**Sequential Log**

3) **GRID LOG:** Use the ◄ **, &** ► arrow keys on the left button wheel to scroll the **Columns**, and the ▲ **,** ▼ arrow keys on the left button wheel to scroll the **Rows**.

**SEQ LOG:** Use the ▲ **,** ▼ **,** ◄ **, &** ► arrow on the left button wheel keys to highlight the appropriate alpha characters. Press the ↵ key to select 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)




**Grid Log**




**Sequential Log**

1) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **LOWER** ▶ or **END ID** is highlighted.

2) Press the ↵ key to activate the **Coordinate** or **End ID Edit Box**.







**Grid Log** **Sequential Log**

3) **GRID LOG:** Use the , & arrow keys on the left button wheel to scroll the **Columns**, and the , arrow keys to scroll the **Rows**.

**SEQ LOG:** Use the , , , & arrow keys on the left button wheel to highlight the appropriate alpha characters. Press the 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 **FX80** at this time. Refer to page 154 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.

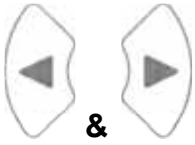



**Grid Log**




**Sequential Log**

5) Use the  and  arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **INCR. DIR** or **DIRECTION** is highlighted.

6) Use the  **&** arrow keys on the left button wheel 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 a Grid

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




**Grid Log**




**Sequential Log**

1) Use the  and  arrow keys on the left button wheel to scroll through the new **Grid** or **Seq List Items** until **CREATE GRID or LOG?** is highlighted.

2) Press the  key to accept the grid or seq log parameters and activate the confirmation screen.






**Grid Log** **Sequential Log**

3) 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.

4) Press the key to return to the measurement screen and begin storing readings.

## 12.3 Storing a waveform

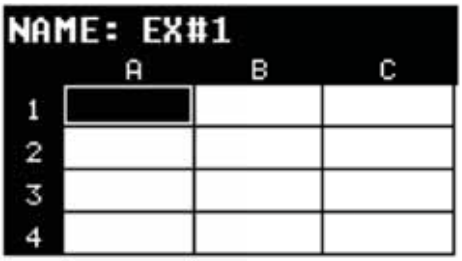
Now that a grid or sequential log has been created, it's time to make some measurements and store the readings. The following procedures outline this process:

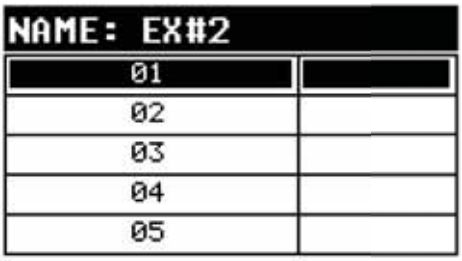
**Storing a Reading**

**Note:** *Once the gird 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 **FX80** is displaying a **"grid log"**, pressing the OK key will initiate an advance to row number option. Use the **Left, Right,** , and arrow keys on the left button wheel 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 **FX80** is displaying a **"grid log"**, pressing the esc key multiple times, will toggle through the display options: **DIGITS, RF, RECT,** and **B-SCAN** views.




**Grid Log** **Sequential Log**

1) Press the , , , and  arrow keys on the left button wheel to scroll the target cell cursor to the desired storage location.
2) Press the  key to save the current reading in the highlighted cell location. It's as simple as that!
3) Press the  key to hide the **GRID/SEQ View Box**, or  to display it as necessary.

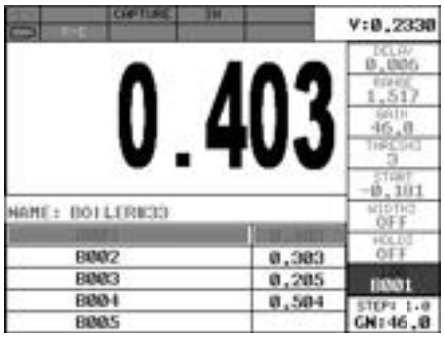
**Note:** *Once the file is open, it will remain open until it's closed or another file is opened by the user. If the gauge is powered off, the* ***FX80*** *will automatically open the file when powered on. Simply press the*  *key to display the file from the measurement screen.*

## 12.4 Viewing stored readings

It is sometimes necessary to go back and view the stored readings and B-Scans using the ***FX80*** without a PC. The following procedures outline this process:

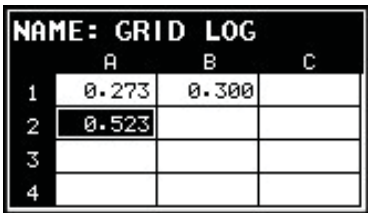
## Viewing Stored Readings & A/B Scans




**Grid Log** **Sequential Log**

1) Press the key once to activate measure menu items. Press the key multiple times to move right and the esc key multiple times to move left until the **LOG** cell is highlighted. Alternatively, press the and arrow keys multiple times using the left button wheel.




2) Press the key to display the **Grid Log Box**.

3) Press the , , , and arrow keys on the left button wheel 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 ↵ key to save the new reading.

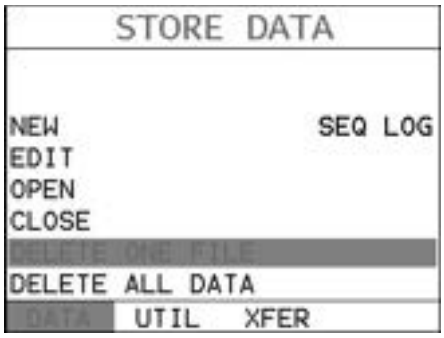
5) Abort the **Grid/Seq Log View Box** by pressing the key at any time.

## 12.5 Deleting Grids (Files)

### Deleting One or All Files from Memory

### Deleting One File

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.




2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **DELETE ONE FILE** is highlighted.




3) Press the ↵ key to display the **File List Box**.

4) Use the ▲ and ▼ arrow keys on the left button wheel 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 ⌂ key to return to the measurement screen.

## Deleting All Data

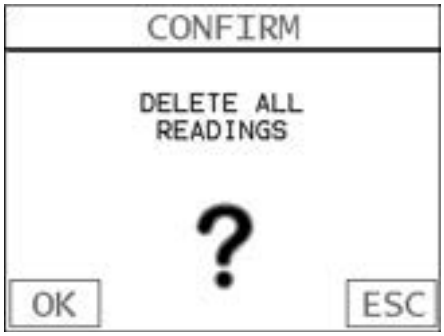
1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the esc key multiple times to tab left until the data menu is highlighted and displaying the submenu

items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.




2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **DELETE ALL** 

is highlighted.




3) Press the  key to activate the confirmation screen.

4) Press the 

key to delete **All Files** from memory, or the 

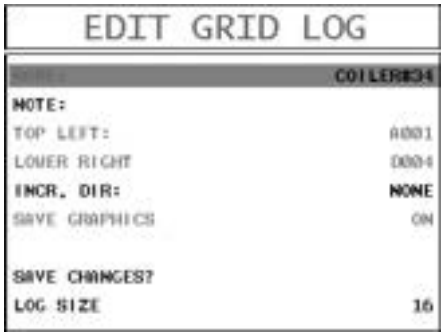
key to abort.

5) Press the  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 **Name**, **Comments**, or **Increment Direction** at a later time. The following procedures outline this process:

## Editing a Grid




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **EDIT** is highlighted.
3) Press the ↵ key to display the **Edit List Box**.
4) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the **Edit** options until **NAME**, **NOTE** or **INCR. DIR** is highlighted.

**Note:** *If editing the **INCR. DIR**, simply press the ◀ and ▶ arrow keys using the left button wheel to scroll **NONE, NORTH, EAST, SOUTH, WEST** for a Grid, or **INC, DEC** for a Seq Log. **Proceed to step 10**.*



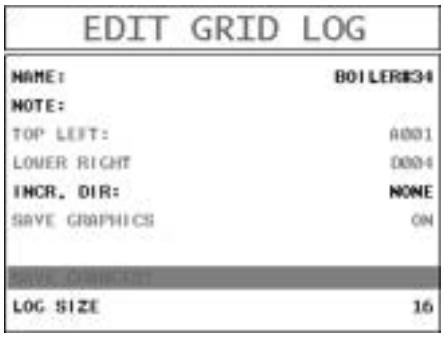

5) Press the ↵ key to activate the **Alpha Edit box – Only used when editing the NOTE**.

6) Use the ▲, ▼, ◀, & ▶ arrow keys on the left button wheel to highlight the appropriate alpha characters.

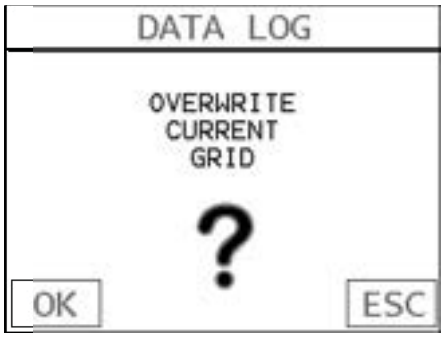
7) Press the ↵ key to select a character and advance to the next field of the **Comments**.

8) Use the clr key to backspace if necessary.

9) Repeat steps **6 - 8** until the **Comments** are completed.




10) Press the ▲ or ▼ 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.

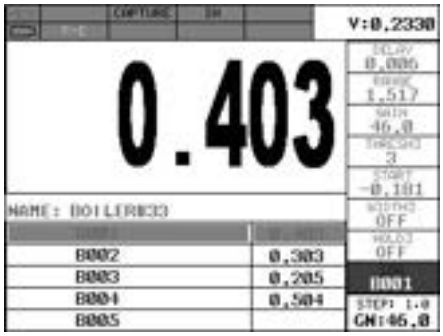
12)Press the key to return to the measurement screen.

## 12.7 Changing the active File - Open

The user may have transferred grid/seq templates from a PC to the ***FX80***, or setup grids/seq using the ***FX80*** 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**



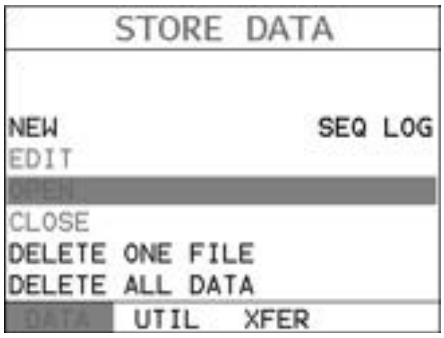




**Grid Log** **Sequential Log**

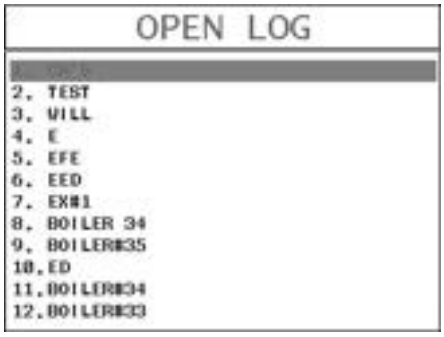
1) Press the key once to activate the menu items tab. Press the key multiple times to tab right and the esc key multiple times to

tab left until the 

menu is highlighted and displaying the submenu items. Alternatively, press the  and  arrow keys multiple times using the left button wheel.

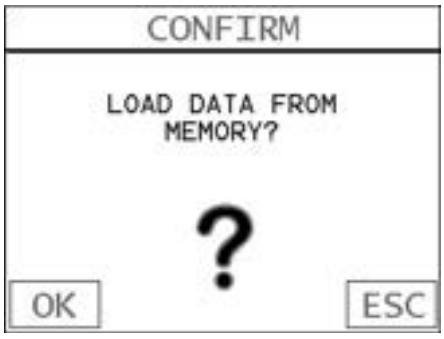



2) Use the  and  arrow keys on the left button wheel to scroll through the sub menu items until **OPEN** is highlighted.




3) Press the  key to display the **Grid/Seq List Box**.

4) Use the  and  arrow keys on the left button wheel to scroll through the grids until the target grid is highlighted.



5) Press the ↵ key to activate the confirmation screen.

6) Press the OK key to load the file from memory.

7) Press the ⌂ key to return to the measure screen.

## 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:

**Closing an Active File**

1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.




2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **CLOSE** is highlighted.




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

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

## 13.1 Introduction to Setups

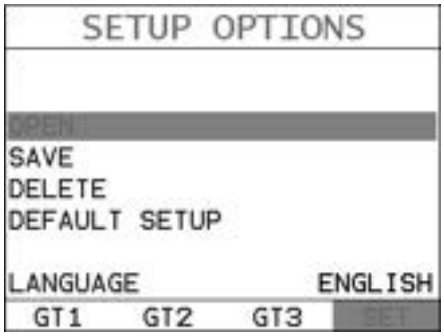
Often times, users are faced with a variety of tasks and applications that are sometimes similar, but can also be very different. Without the ability to save the individual calibrations and setups, the user would have to repeat the setup process on a regular basis for each individual application. This 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 ***FX80*** has been equipped with the ability to save these setups to memory and be recalled at any time. The ***FX80*** 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

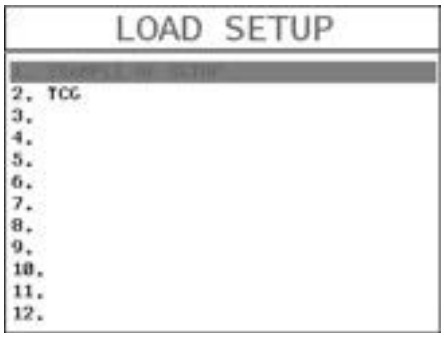
The ***FX80*** is loaded with a number of setups from the factory. These setups can be opened, edited, and saved to any one of **64 setup locations**. If a factory setup is written over, the user can simply reload the default factory setups at anytime using the utility software included with the ***FX80***. 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**



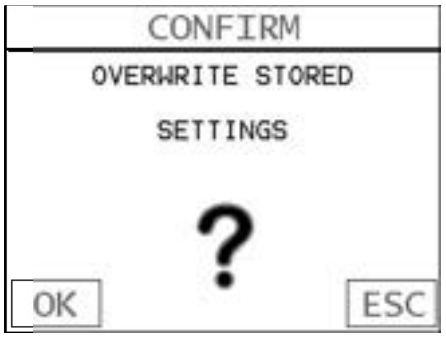

1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the esc key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **OPEN** is highlighted.




3) Press the ↵ key to display the **Setup List Box**.

4) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the setups until the target setup is highlighted.




5) Press the ↵ key to activate the confirmation screen.

6) Press the OK key to load the setup from memory.

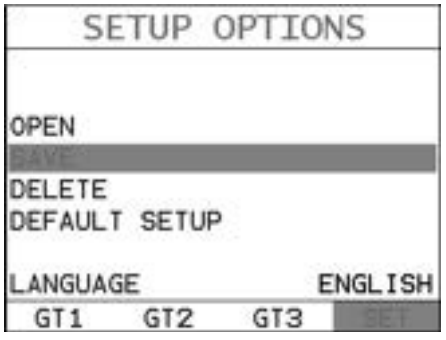
7) Press the ⌂ key to return to the measure screen.

## 13.3 Saving a Setup

Once the ***FX80*** parameters and features have be adjusted for an application, the user may elect to save these setting to a specific setup location for future use. This can potentially save time and reduce error between users.

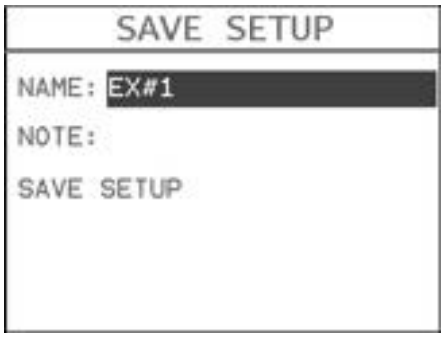
It is sometimes necessary to rename a previously saved setup, or add additional comments about a particular setup. The setup name may have been entered incorrectly, or the user needs to use the setup for a completely different project. An inspector's name or other comments about the project may also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

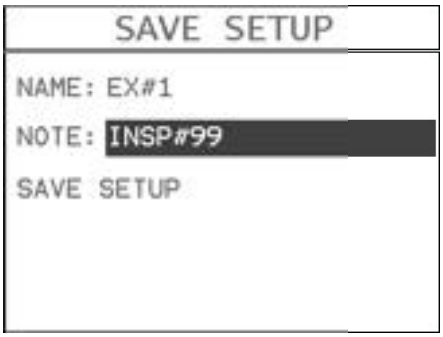
**Saving a Setup**



1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **SAVE** is highlighted.




3) Press the ↵ key to display the **Save Setup Parameters List Box**.

4) Press the ▲ and ▼ arrow keys on the left button wheel to scroll the **Name** and **Note** parameters.





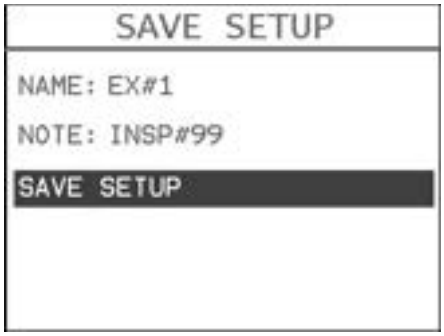


5) When the parameter to edit is highlighted, press the ↵ key to activate the **Alpha Edit Box**.

6) Use the ▲, ▼, ◄, & ► arrow keys on the left button wheel to scroll through the characters, the ↵ key to select characters, and the clr key to backspace through the characters, until the **Name** or **Note** fields have been edited.

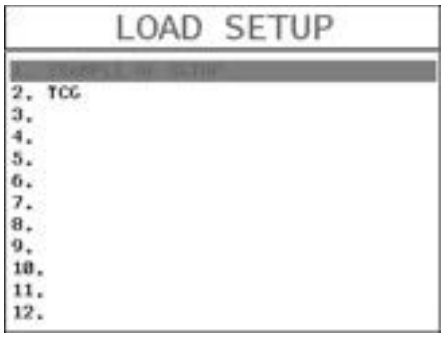
7) Press the OK key to return to the **Save Setup Parameters List Box**.

8) If both parameters will be edited, **repeat steps 4 – 7**.

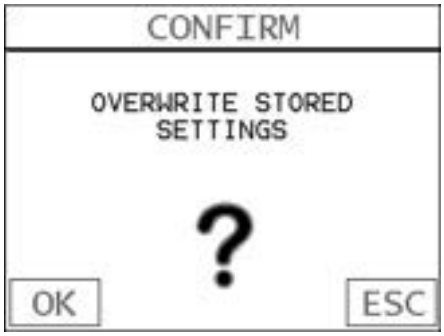



9) Use the ▲ and ▼ arrow keys on the left button wheel to scroll to and highlight **SAVE SETUP**.

10)Press the ↵ key to activate the **Setup List Box**.




11)Use the ▲ and ▼ arrow keys on the left button wheel 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**.

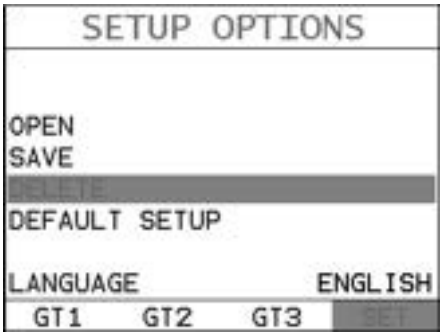
14)Finally, press the ⌂ key to return to the measurement screen.

**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 ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **DELETE** is highlighted.




3) Press the ↵ key to display the **Setups List**.

4) Press the ▲ and ▼ arrow keys on the left button wheel to scroll to the **Setup Name**.

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




6) Press the OK key to delete the **Setup File**.

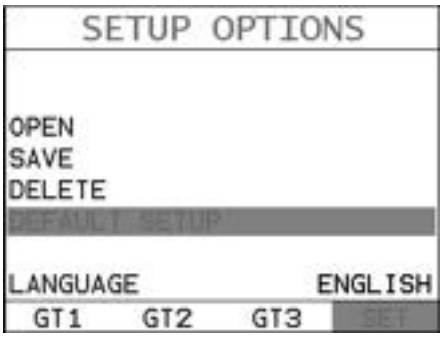
7) Finally, press the ⌂ key to return to the measurement screen.

## 13.5 Using the Default Setup

The default setup feature was added to the ***FX80*** 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 ***FX80*** was somehow corrupted, and the user does not have access to a computer to re-load the factory setups back into the ***FX80***. 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

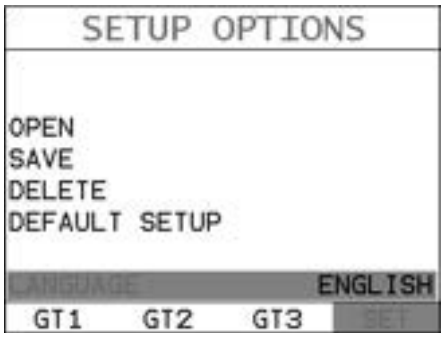



1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the esc key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **DEFAULT SETUP** is highlighted.
3) Press the ↵ key to load default **DEFAULT SETUP**.
4) Finally, press the ⌂ key to return to the measurement screen.

## 13.6 Selecting a Language

The ***FX80*** is equipped with a language option. Currently, only a few languages supported. However, be sure to update your gauge firmware often, to check for language additions. The steps to select a language are outlined as follows:

### Selecting a Language




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until **LANGUAGE** is highlighted.

3) Press the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle the language options.

4) Once the desired language is displayed, press the ⌂ key to return to the measurement screen.

# CHAPTER FOURTEEN
# SOFTWARE, FILE TRANSFER, & UPGRADES

## 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, or Windows 8 Advanced Server operating systems running on Intel or AMD hardware.

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**.

### USB Type1 to Type 2 Cable

If a replacement cable is needed, contact Dakota NDT (pt# N-606-0530).

## 14.2 Installing DakView

**DakView** comes on a CD-ROM with an automatic installer program. Place the CD in your computer's CD tray and close the door. Open the CD-ROM by double clicking on the My Computer ICON, then double click on the CD. Finally, double click on the **SETUP** icon to begin the installation.Refer to the help section in **DakView** software for the complete operating manual, setup, and operation.

## 14.3 Communicating with FX80

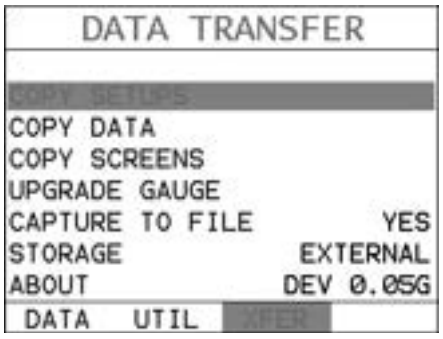
**DakView** will not directly communicate with the ***FX80*** series gauges. The ***FX80*** is equipped with USB, acting as a Thumb Drive (external storage device) when connected to a computer and powered on. Therefore, the SD memory card(s) can be opened as a drive with *directory structure, similar to the C: on your computer. The files stored on the internal S*D, or external SD reader, can be simply copied (dragged) into any folder on your PC and opened using **DakView**. The PC software will function on as a file viewer for the ***FX80*** series gauges.

Refer to the help section in **DakView** software for the complete operating manual, setup, and operation.

## 14.4 Using the XFER menu (*FX80*)

The **XFER** menu of the ***FX80*** will be used in conjunction with the **DakView** PC software. The steps below outline the procedure for accessing the **XFER** menu and basic operation as follows:

### Accessing and Using the XFER Menu



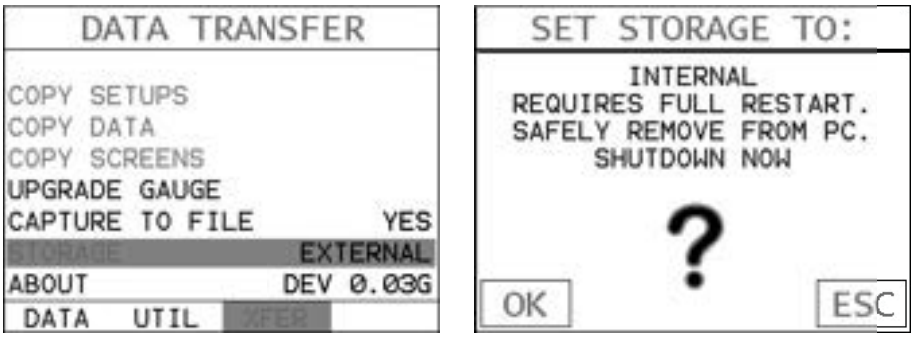

1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right, and the esc key multiple times to tab left, until the **XFER** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until the desire option is highlighted.
3) Press the ↵ key to activate the option selected.

## 14.5 Selecting Storage Device

The ***FX80*** has two storage device options available. The ***FX80*** is shipped from the factory with a 4 gig internal SD memory card on the board itself, and additionally has an external SD card reader. The SD reader is located above the Li-Ion battery pack, under the battery cover. The **STORAGE** utility simply selects which card is currently being used as the primary storage device. This storage switch is also used in conjunction with all the copy utilities found in the **XFER** menu. For example; if the

storage switch is set to internal as the primary storage device, all the copy routines will copy from the internal to the external reader, or visa versa. The procedure to set the storage device is outlined below:

**Selecting Storage Device**

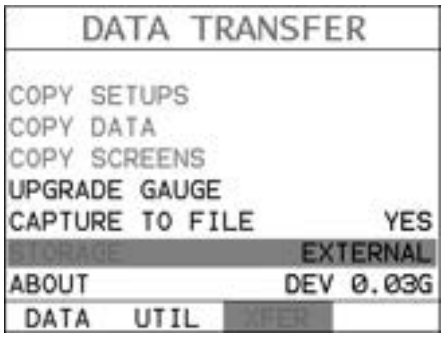



1) Press the ☰ key once to activate the menu items tab. Press the ☰ key multiple times to tab right and the esc key multiple times to tab left until the **XFER** menu is highlighted and displaying the submenu items. Alternatively, press the ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys multiple times using the left button wheel to scroll through the sub menu items until **STORAGE** is highlighted.
3) Use the ◀ and ▶ arrow keys multiple times on the right button wheel to toggle **STORAGE** internal/external. **Note:** *Capture will be displayed in a toolbar cell on the active display, indicating the feature is enabled.*

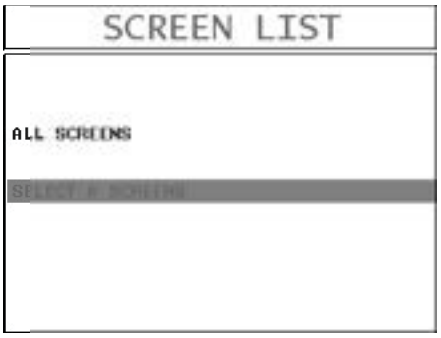
## 14.6 Copying Files (Setups, Data, & Screenshots)

The ***FX80*** can store a number of setup, data and screenshot files to either the internal or external SD memory cards. All the copy routines will copy files from the currently selected storage device to the other. Therefore, if the current storage device is set to 'internal', the copy routines will transfer files directly to the external device. Note: *If the **FX80** is powered up without an external SD card inserted in the slot, the copy routines in the **XFER** menu will be inactive.* The steps below outline the procedure for copying files from one storage device to the other as follows:

## Copying Files Between Storage Devices




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.
2) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the sub menu items until the desired **COPY** option is highlighted.




3) Press the ↵ key to display the **Setups/Data/Sceens List**.

4) Use the ▲ and ▼ arrow keys on the left button wheel to highlight the desired **List Box** option.




5) Press the ↵ key to either transfer **ALL** files, or display the **Individual List** of files.

6) Use the ▲ and ▼ arrow keys on the left button wheel to scroll through the list of files and select the specific file to copy.

7) Press the ↵ key to complete the **Copy** process, followed by pressing the OK key to display the **List Box**.

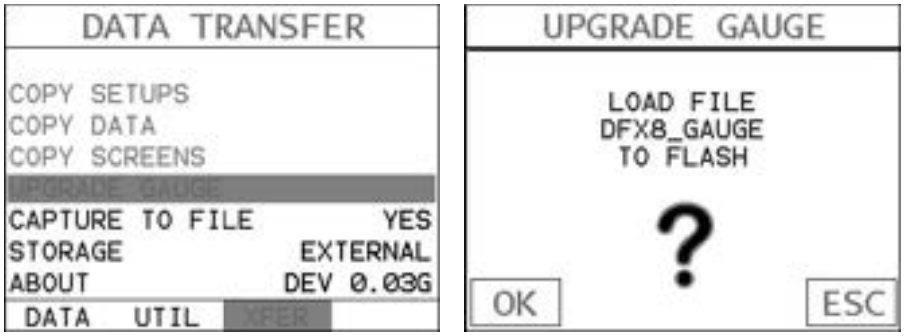
8) Repeat steps **6 & 7** to copying additional individual files.

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

## 14.7 Upgrading the FX80

The ***FX80*** can be upgraded to the latest revision of firmware at any time. Simply download the latest version posted on the Dakota NDT website, copy the upgrade file to the main drive directory ***FX80***, 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 ***FX80*** is outlined below:

### Upgrading the Firmware




1) Press the ☰ key once to activate the menu items tab. Press the ☰ 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 ◀ and ▶ arrow keys multiple times using the left button wheel.

2) Press the ↵ key to display the upgrade confirmation screen, followed by pressing OK key to start the upgrade process. **Note:** *The **FX80** 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** |

## APPENDIX B - SETUP LIBRARY

| Num | Name | Comment 1 | Gn/AGC | Velocity |
|---|---|---|---|---|
| 1 | Enter Custom Name | | | |
| 2 | … | | | |
| 3 | … | | | |
| 4 | … | | | |
| 5 | … | | | |
| 6 | … | | | |
| … | … | | | |
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**Web:** https://www.abqindustrial.net **E-mail:** info@abqindustrial.net

# WARRANTY INFORMATION

## • Warranty Statement •

Dakota NDT warrants the ***FX-80*** against defects in materials and workmanship for a period of two years from receipt by the end user. Additionally, Dakota NDT warrants transducers and accessories against such defects for a period of 90 days from receipt by the end user. If Dakota NDT receives notice of such defects during the warranty period, Dakota NDT will either, at its option, repair or replace products that prove to be defective.

Should Dakota NDT 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 NDT makes no other warranty, either express or implied, with respect to this product. Dakota NDT 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 NDT and arrange for servicing of the product. Retain proof of purchase in order to obtain warranty service.

For products that require servicing, Dakota NDT 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 NDT for details of the services available, and to arrange for non-warranty service.



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