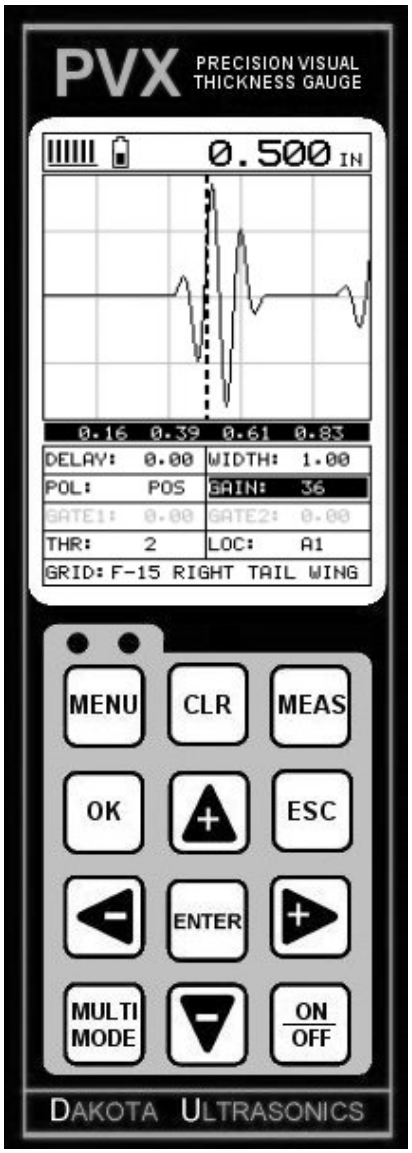
OPERATION MANUAL

DAKOTA ULTRASONICS

PVX

Precision A / B Scan Thickness Gauge



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CHAPTER ONE
INTRODUCTION

The Dakota Ultrasonics model ***PVX*** is a visual precision A / B scan ultrasonic thickness gauge. Based on the same operating principles as SONAR, the ***PVX*** is capable of measuring the thickness of various materials with accuracy as high as ± 0.0001 inches, or ± 0.001 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 Ultrasonics maintains a customer support resource in order to assist users with questions or difficulties not covered in this manual. Customer support may be reached at any of the following:

1.1 Disclaimer

The PVX is a full-featured scope that allows a great deal of control over the functionality and electronic performance of the instrument. However, as this provides the user greater control and versatility for a variety of applications, it also requires that the user be comfortable with operation and waveform interpretation of the instrument. It is strongly recommended that the contents of this manual be read in its entirety. It is also recommended that a sufficient amount of time be allocated to working with the instrument in a test environment prior to use in the field. Responsibility for proper use of the instrument and recognition of this phenomenon rest solely with the user of the instrument.

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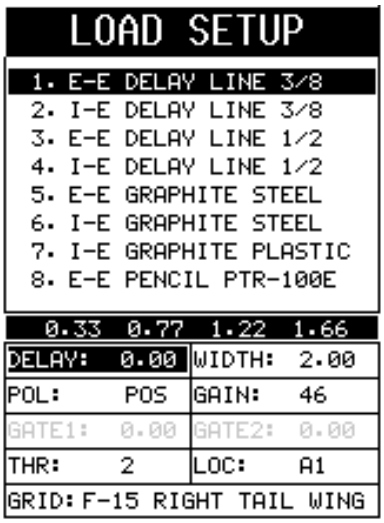
CHAPTER TWO
QUICK STARTUP GUIDE

Turn the ***PVX*** on and off using the switch located on the bottom right corner of the keypad. When ***PVX*** is initially turned on, a flash logo and blinking lights will be displayed prior to entering into the main measurement screen. Note: This section is primarily written as a basic startup guide only.

2.1 Selecting The Transducer Type

The first step in using the ***PVX*** is to select the transducer type stored in a setup. There are 14 factory setups containing different transducer types that can be loaded, modified and stored in a new setup location. By selecting the transducer type from a predefined setup list, the ***PVX*** can recall specific properties about the transducer, setup the display area and predefined scope settings. **Note:** Once the transducer has been selected, the ***PVX*** will store and recall this setup, containing the transducer type, every time the ***PVX*** is powered on/off. This setup will only change if the user physically selects another setup from the list. Therefore, if you have previously gone through this section and selected the appropriate setup, proceed to the next section. Use the following steps to select your setup (transducer type):

Selecting a Setup for use with a specific Transducer Type



1) Press the **MULTI MODE** key once to activate the load setup list containing the transducer types and settings.

2) Use the **UP** and **DOWN** arrow keys to scroll through the setup list until the target setup is highlighted.

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

4) Press the **OK** key to select the setup and return to the measure screen, or **ESC** to cancel the selecting a setup.

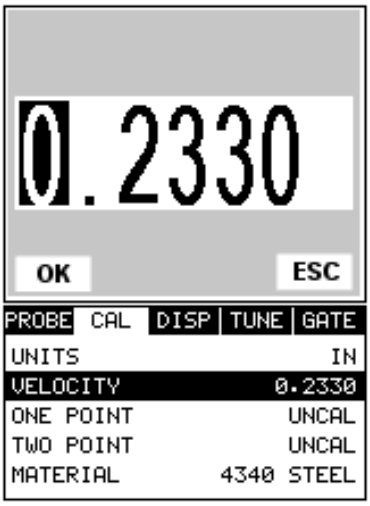
2.2 Calibration

The next step is to calibrate the ***PVX*** to the material and transducer being used. If a sound velocity is not known, the ***PVX*** can be calibrated to a known thickness sample. This demo will briefly explain each of possible calibration techniques. Read through the various calibration techniques and select one of the following:

Known Velocity

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

Using a Known Material Velocity



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

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

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

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

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

6) Repeat steps **4 & 5** until the 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 **MEAS** key to return to the measurement screen and begin taking readings.

Known Thickness

Sometimes the sound velocity of a material is not known. In this case a sample with a known thickness can be used to determine the sound velocity. It would be very handy to carry a set of mechanical calipers to use in conjunction with the ***PVX*** for calibration in the field:

Using a Known Thickness

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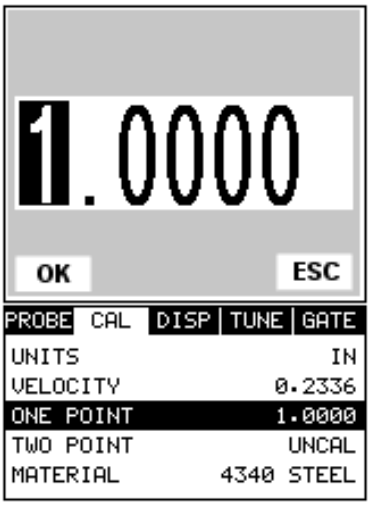

1) Physically measure an exact sample of the material or a location directly on the material to be measured using a set of calipers or a digital micrometer.

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

3) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ONE POINT** is highlighted.

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

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

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

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

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

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

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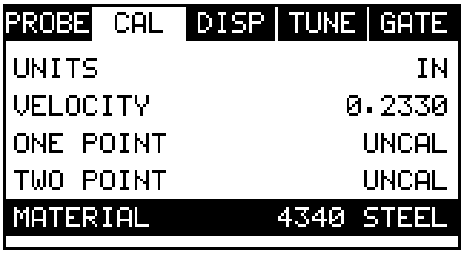
Basic Material Type

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 numbers. 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 **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **MATERIAL** is highlighted.
3) Press the **ENTER** key to display the list of material types.
4) Press the **UP** and **DOWN** arrow keys to scroll through the material list until the appropriate material is highlighted.
5) Press the **ENTER** key to display the confirmation screen.
6) Press the **OK** key to select the material and return to the menu screen, or **ESC** to cancel the material selection.
7) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

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2.3 Measure

The ***PVX*** is now ready to measure. There are four different measurement view options, each with a specific purpose. The steps below outline how to toggle between the different view mode options:

Selecting the Measurement View Option

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

RF: Is useful to see exactly what the signal looks like directly around the detect point. This view is the preferred view for precision measurements, as it allows the user to view smaller ranges (zoomed in) around the detection point (displayed as a vertical dashed line). This can be done manually by adjusting the delay and width settings. It also provides the user with the ability to view and select either the positive or negative polarity option.

RECTIFIED (RECT): Displays the entire range being scanned. This screen is useful to “get the big picture” when viewing wide ranges (zoomed out). The point which is triggering the digital thickness reading (called the detect) is displayed as a vertical dashed line.

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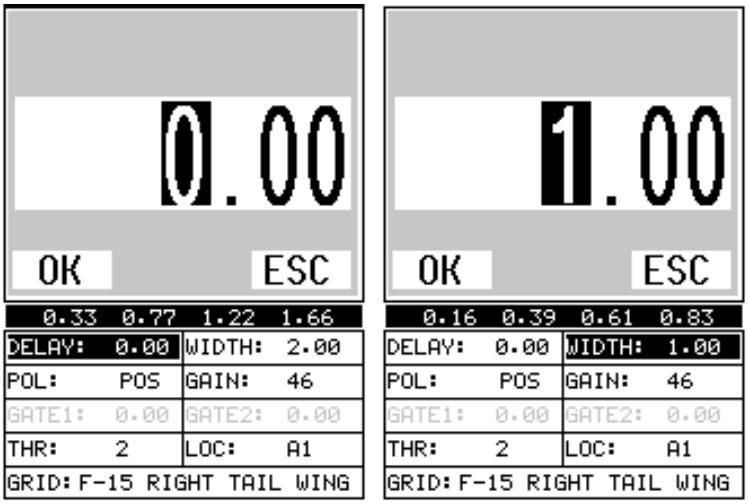
BSCAN: The Time Based B-Scan provides the user with a cross sectional view of the material being tested. This mode is useful when there is concern regarding the profile of the blind surface.

DIGITS: Displays the digital thickness value using a larger font size. This view is useful when the ***PVX*** is being used as a basic precision thickness gauge following the initial setup using the scope.

Once the view has been selected according to the application requirements, the **delay** and **width** of the screen will potentially need to be adjusted, if the view has been set to **RF**, **RECT**, or **BSCAN**. Use the following steps to adjust these settings directly from the measurement screen as follows:

Adjusting the Delay & Width



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

2) Use the **UP**, **DOWN**, **LEFT**, or **RIGHT** arrow keys to scroll the **DELAY** and **WIDTH** values.

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

Alternatively, the **DELAY** and **WIDTH** values can be changed using the **Digit Edit Box** as follows:

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

2) Press the **ENTER** key to display the digits edit box.

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

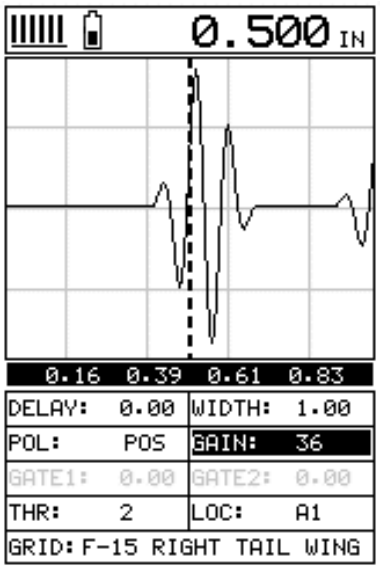
4) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.

5) Repeat steps **3 & 4** until the **DELAY** or **WIDTH** value is correctly displayed.

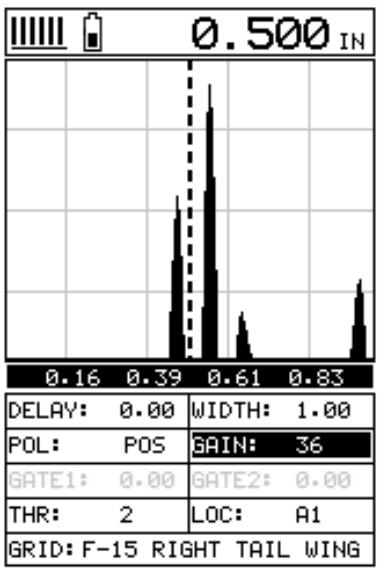
6) Press the **OK** key to set the **DELAY** and **WIDTH** value and return to the measure screen, or **ESC** to cancel entering the **DELAY** or **WIDTH** value.

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

Note: The **DELAY** & **WIDTH** can also be adjusted from the menu tab items. However, using the hot menu keys is the easiest method.



RF



RECTIFIED

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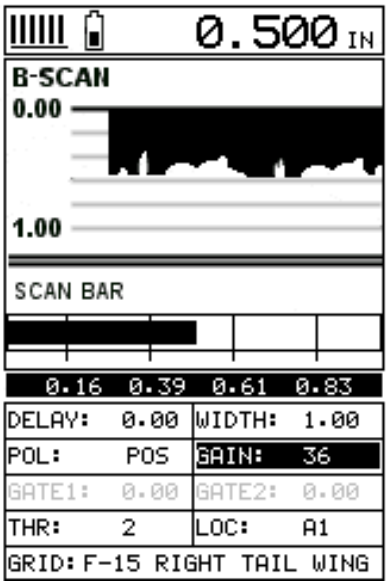
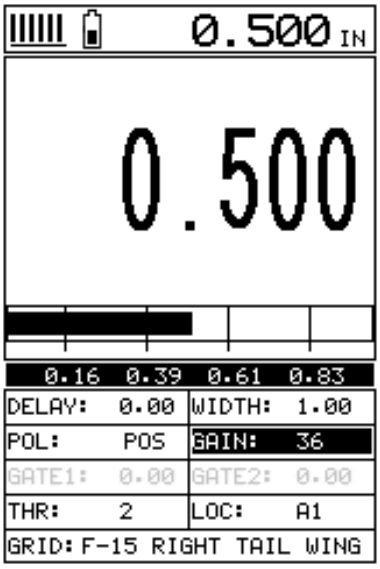


B-SCAN



DIGITS

In the upper left corner of each of the mode 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 ***PVX*** makes 4 measurements a second. In scan mode, the ***PVX*** makes 32 measurements a second. When the ***PVX*** is idle, only the left vertical bar and the underline will be displayed. However, when the ***PVX*** is making a measurement, five or six of the bars should be displayed on the repeatability indicator. If fewer than five bars are showing, the ***PVX*** is having difficulty achieving a stable measurement and the thickness value displayed is potentially be unstable. Another thing to note is the vertical broken line in the **RF** and **RECTIFIED** photos above. This line represents the actual point of detection. The ***PVX*** uses a zero crossing or flank detection method, and presents the actual point of measurement on the display.

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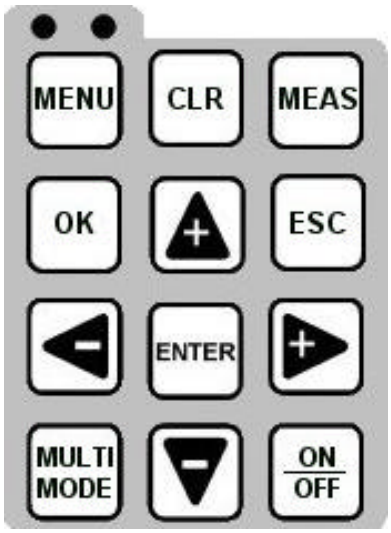
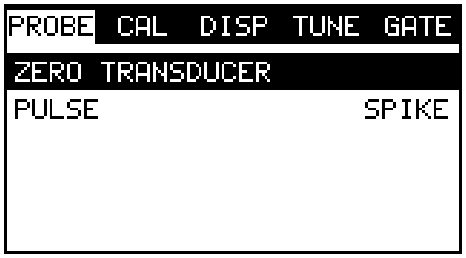
CHAPTER THREE
KEYBOARD, MENU, & CONNECTOR REFERENCE



3.1 Menu Key (Operation & Sub Menus)

The **Menu** key activates the primary menu structure containing 9 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



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

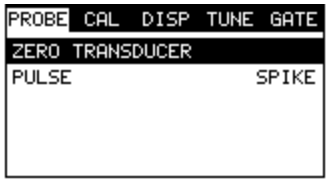
Now that your familiar with activating and moving amongst the tab groups, let's have a look at how to move around in the sub menu items as follows:

Getting Around in the Sub Menu Items

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

2) Depending on which function is highlighted, use the **LEFT**, **RIGHT**, and **Enter** keys to scroll the options or activate the **Digit Edit** and **List Box** options.

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



3.2 Probe – Menu

Zero: The **PVX** is zeroed in much the same way that a mechanical micrometer is zeroed. If the **PVX** is not zeroed correctly, all of the measurements made using the ***PVX*** may be in error by some fixed value. Refer to the section on page 33, for an explanation of this important procedure.

Note: This function is only used when using a contact style transducer with a pulse-echo contact setup selected. All the other transducer types use multiple echo modes, and the zero function is not needed.

Pulse: The **PVX** has an adjustable pulse width for both high penetration and resolution applications. The pulse width refers to the duration of time the pulser is

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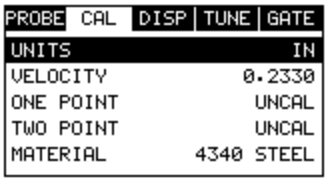
on. The options are **Spike**, **Thin**, and **Wide**. Refer to page 71 for a further explanation.

3.3 CAL – Menu



Units: Toggle between English or Metric units and low and hi resolutions. The readout will change from inches to millimeters (IN, IN HR, MM, MM HR). The high resolution options are indicated with HR following the units, and offer an additional decimal place of overall resolution (i.e. IN = .001" and IN HR = .0001").

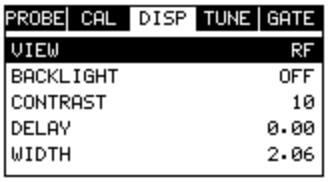
Velocity: Function to calibrate the PVX by setting the velocity to a known material velocity. Refer to page 35 for further info.

One Point: Performs a single point calibration. This option allows the user to automatically calculate the velocity by entering a known sample thickness. Refer to page 37 for further info.

Two Point: 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 38 for further info.

Material: 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 41 for further info.

3.4 DISP (display) – Menu



View: Selectable RF wave, RECT (rectified) wave, BSCAN (cross section), and DIGITS (large digits) views. Refer to page 43 for further info.

Backlight: Selectable OFF, ON, AUTO, or INVERT backlight option. The INVERT option is actually a screen inversion that toggles background and foreground colors.

Contrast: Adjustable display contrast for variable light conditions.

Delay: Provides the user the ability to change where the left side of the display window starts according to thickness, in inches or millimeters. Refer to page 53 for further info.

Width: Provides the user the ability to change the overall size of the viewable measurement area. It functions a lot like a zoom on a camera. Refer to page 50 for further info.

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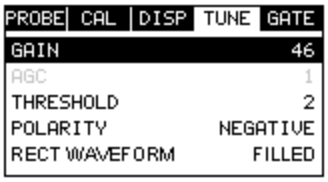
3.5 TUNE – Menu



Gain: Increases or decreases the overall amplitude of the signal. Much like turning the volume up or down on a stereo receiver. Refer to page 55 for further info.

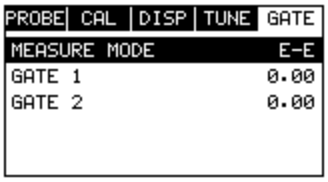
AGC: The **PVX** is equipped with an automatic gain control when operating in interface-echo and echo-echo modes only. This is much like turning the volume up or down on a stereo receiver. However, the ***PVX*** will automatically control how much the volume is turned up or down. Alternatively, the AGC can be manually controlled using the same procedures as GAIN described above. Refer to page 55 for further info.

Threshold: Enables the user to set the sensitivity level of the ***PVX***. The amplitude of the signal must reach and exceed the threshold level before a measurement is detected. Refer to page 58 for further info.

Polarity: The ***PVX*** 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 76 for further info.

Rect Waveform: 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 78 for further info.

3.6 GATE – Menu



Measure Mode: Used to select the measurement mode for different application requirements. The modes are P-E (pulse-echo), P-E GT(pulse-echo w/gate), and E-E(echo-echo). **Note:** I-E or Interface echo mode is also a multiple echo mode that uses two gates like E-E mode(echo-echo). Refer to page 23 for further info.

Gate 1: Gates allow the user to view areas or sections of the waveform and ignore others. Gate 1 can be used in both pulse-echo and echo-echo measurement modes. Refer to page 61 for further info.

Gate 2: Gates allow the user to view areas or sections of the waveform and ignore others. Gate 2 is only used in echo-echo (interface-echo) measurement modes. Refer to page 65 for further info.

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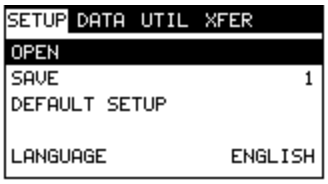


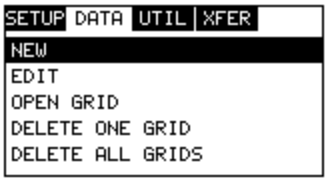
3.7 SETUP – Menu

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 99 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 101 for further info.

Default Setup: Loads a basic default setup. Use only as a last resort when the setups in the ***PVX*** have been corrupted and a computer is not accessible. Refer to page 104 for further info.

Language: Provides the user with three different language options: English, German, and Spanish.



3.8 DATA – Menu

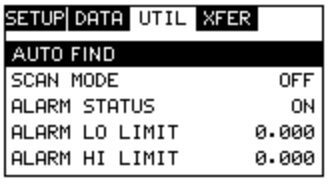
New: Allows the user the ability to create a new alpha numeric grid with custom parameters, rows, and columns depending on their application reporting requirements. Refer to page 81 for further info.

Edit: Gives the user the ability to change parameters of grid that have been previously saved. Note: Pre-defined coordinates cannot be changed once they have been created. Refer to page 94 for further info.

Open: This function provides the user with the ability to recall grids that currently exist in memory from a list of grids. Refer to page 96 for further info.

Delete One Grid: This function provides the user with the ability to delete one individual grid from a list of multiple grids previously saved in memory. Refer to page 92 for further info.

Delete All Grids: This function provides the user with the ability to delete all grids currently stored in memory. Refer to page 92 for further info.



3.9 UTIL (utilities) – Menu

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Auto Find: Automatically locates the detection point if the measurement is out of the viewable display area. Refer to page 72 for further info.

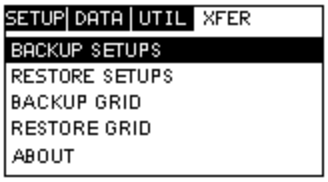
Scan Mode: This function enables a hi speed scan mode that increases the overall sample rate from the standard 4 measurements a second to 32 measurements a second. Refer to page 73 for further info.

Alarm Status: Toggles alarm mode on or off. Refer to page 74 for further info.

Alarm LO Limit: 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 75 for further info.

Alarm HI Limit: 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 76 for further info.

3.10 XFER (transfer) – Menu



Backup Setups: Enables the user the ability to backup the setups currently stored in the ***PVX*** to a PC via RS232 port. Refer the help section of the **DakView 3** or **PVXview** software for a complete electronic manual.

Restore Setups: Enables the user the ability to restore the setups currently saved on a PC to an ***PVX*** via RS232 port. Refer the help section of the **DakView 3** or **PVXview** software for a complete electronic manual.

Backup Grid: Enables the user the ability to backup grids currently stored in the ***PVX*** to a PC via RS232 port. Refer the help section of the **DakView 3** or **PVXview** software for a complete electronic manual.

Restore Grid: Enables the user the ability to restore grids currently saved on a PC to an ***PVX*** via RS232 port. Refer the help section of the **DakView 3** or **PVXview** software for a complete electronic manual.

About: Provides the user with Dakota Ultrasonics contact information and the ***PVX*** software version. Refer the help section of the **DakView 3** or **PVXview** software for a complete electronic manual.

3.11 CLR (clear) Key

The primary functions of the **CLR** key, is to clear a measurement from a grid cell location or set obstruct, and backspace in an **Alpha Edit Box**. If a user has already

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saved a measurement and waveform to a cell location, use this key to clear the measurement at any time.

3.12 MEAS (measurement mode) Key

The **MEAS** key puts the ***PVX*** into it's primary mode of operation. In this mode, the user has a complete view of the LCD, as well as control of the **Hot Menu Functions**. These hot functions provide the user with the ability to make crucial adjustments to the display, waveform settings, and grid storage locations without having to search through the menu and sub menu items. It's important to first get familiar with moving around in the hot functions as follows:

Getting Around in the Hot Menus

DELAY:	0.00	WIDTH:	2.00
POL:	POS	GAIN:	46
GATE1:	0.00	GATE2:	0.00
THR:	2	LOC:	A1
GRID: F-15 RIGHT TAIL WING			

1) Press the **MEAS** key at any time to return to the primarily measurement mode.
2) Press the **MEAS** key multiple times to tab right through the menu fields, and the **ESC** key multiple times to tab left through the menu fields, until the desired hot function is highlighted.

Now that you're familiar with activating and moving amongst the hot function fields, let's have a look at how to adjust or change the values of these fields:

Adjusting the Values of the Hot Menus

1) Use the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to increase and decrease the values of the hot function fields.
2) **Repeat step 1** until the desired value has been achieved.

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Alternatively, the delay, width, gain, and threshold hot function fields can be changed using the **Digit Edit Box** as follows:

1) Press the **ENTER** key to display the **Digits Edit Box**.
2) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
3) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
4) Repeat steps **2 & 3** until the delay, width, gain, or threshold number is correctly displayed.
5) Press the **OK** key to set and return to the measure screen, or **ESC** to cancel entering the delay, width, gain, or threshold value.

3.13 OK Key

The primary function of the **OK** key is confirmation of a change or selection. Also toggles display views (Rect, RF, Digits, B-Scan) while in a highlighted grid location.

3.14 ESC Key

The **ESC** key is used in the **MENU**, **MEAS**, and **EDIT** functions as a back or escape function. Also toggles display views (RECT, RF, DIGITS, or B-SCAN) while in a highlighted grid location. Note: If a B-SCAN was originally saved in grid location, only DIGITS view can be toggled in conjunction with the B-SCAN.

3.15 Arrow Keys

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

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3.16 ENTER key

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

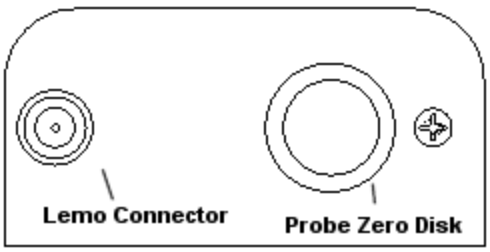
3.17 MULTI MODE Key

The **MULTI MODE** key activates the **Load Setup List** to select a factory or previously saved user setup for a variety of different transducer types and scope settings. This is a quick and efficient way to change modes and transducer types without having to manually adjust ***PVX***. The factory setups serve as the perfect starting point for immediate use or further fine-tuning.

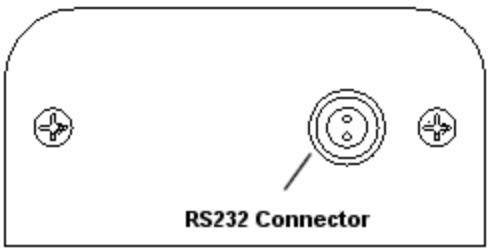
3.18 ON/OFF Key

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 saved prior to powering off.

3.19 Top & Bottom End Caps



Top End Cap



Bottom End Cap

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

Transducer Connectors

Refer to Diagram: The transducer connector and battery cover/probe zero disk are located on the ***PVX's*** top end cap. The transducer connector is of type Lemo "00".

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Probe Zero Disk & Battery Cover

Refer to Diagram: The Battery cover is the large round disk shown in the diagram. **Note:** This same disk is also used as a probe zero disk. Simply remove the cover when replacing the batteries (3 AA cells). When performing a probe zero function, simply place the transducer on the disk making firm contact.

Important: Be sure to follow the polarity labels located on the back label of the ***PVX***. **Note:** Rechargeable batteries can be used, however they must be recharged outside of the unit in a stand alone battery charger.

RS-232 Connector

Refer to Diagram: The **RS-232** connector, located on the bottom end cap, is a 2 pin female Lemo connector. It is designed to connect directly from the ***PVX*** to a standard AT serial port on a PC. The cable supplied with the ***PVX*** is a Lemo to 9 pin serial cable. **Note:** This connector is also used to upgrade the ***PVX*** with the latest version of firmware.

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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 9.999” 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

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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 650°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 mode has larger errors due to changes in temperature of the delay line. However, multi-echo techniques help to minimize these errors. The PVX operates in multi-echo modes for a variety of transducer types.

4.6 Measurement Modes

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

Pulse-Echo Mode (flaws & pits)

Pulse-echo mode measures from the initial pulse (sometimes referred to as an artificial zero) to the first echo (reflection). In this mode, the transducer is placed on a reference disk, located on top of the ***PVX***, and a key is pressed to establish a zero point for the particular transducer.

In pulse-echo 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.

Echo-Echo (Interface-Echo) Modes

The echo-echo modes measure between two reflections. This technique is commonly used to eliminate errors from surface coatings in echo-echo mode, as well as make measurements in multiple layered materials. The disadvantage is that two

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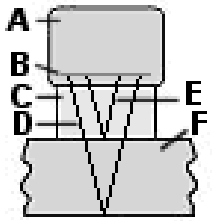
echoes are needed which requires a much stronger echo (reflection). In interface-echo mode, it moves the interface further out in time eliminating any noise that's close to the initial pulse.

Important: The primary difference between interface-echo and echo-echo mode, is interface-echo mode measures from the end of an interface (delay line), to the first return reflection of the test material. However, in echo-mode, the measurement is made between two return reflections (echoes). Although both modes use two gates and virtually look the same on the scope, they are measuring in different ways and are used to accomplish different application tasks. The diagrams below will offer an additional explanation of the differences in these modes as follows:



Delay Line Single Element Transducer in Interface-Echo mode

Diagram 1

Refer to diagram 1. This diagram illustrates the sound path being measured in interface-echo mode. (A) is the transducer. Point (B) is the piezoelectric crystal that emits the sound wave. (C) is the delay line, most commonly made of acrylic or graphite. The delay tip will act as the interface and the measurement will be made starting from the difference of the reflection off the end of the delay tip (E). The sound will also travel through the delay tip (C) and test material (F), and reflect back to the piezoelectric crystal off the back wall of the test material. The measurement will be made from the reflection off the end of the delay tip and back wall of the test material.

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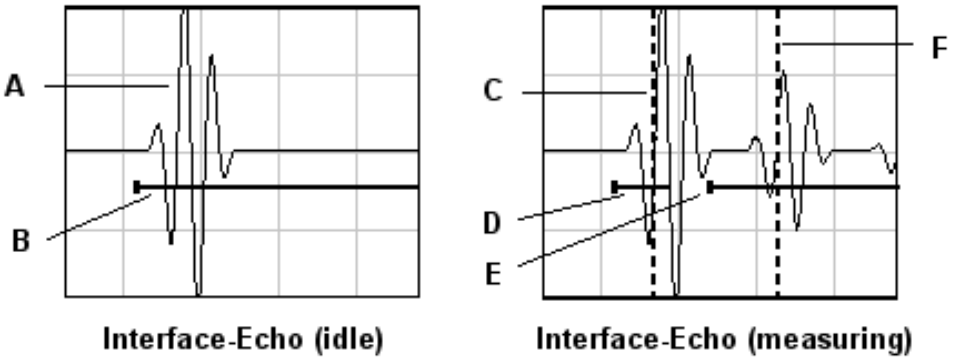

Diagram 2

Refer to diagram 2. Referring to (Idle), you'll notice that when the ***PVX*** is in interface-echo mode a waveform from the end of the delay line will always be displayed and active on the screen when idle (A). Since the gates are also used in interface-echo mode, they will be displayed (B). When measuring, two detects will be displayed between two waveforms at (C) & (F). The measurement starts at (C), the end of the delay line, and measures to the back wall of the test material at (F). Point (D) represents the gate 1 start position, and (E) the gate 2 hold-off. Notice that the start position of the gate 2 hold-off (E) has been adjusted to the right of the delay line waveform. This is done to avoid potential detection on the ring down of the delay line interface, and allow a detection to occur on the back wall of the test material at (F).

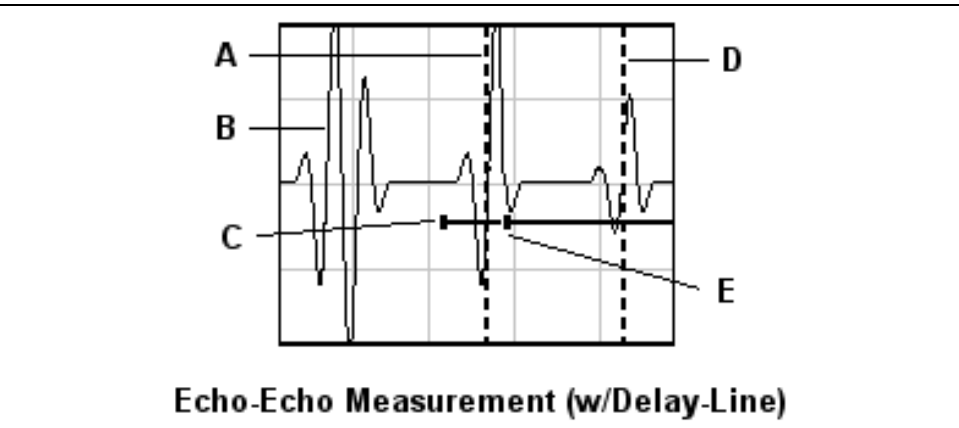

Diagram 2

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Refer to diagram 3. The above diagram illustrates a typical view of echo-echo mode using a delay line style transducer. The end of the interface or delay line is displayed at (B). However, unlike interface echo mode the measurement is occurring between two return reflections (A) and (B). Recall that in interface echo mode, the measurements occurred between the interface (B) and the first return reflection (A). This is the primary difference between the two modes. An important thing to note is that the ring down cycles from the transducer are much less than in interface echo mode. This allows the ***PVX*** to see much closer to the first return reflection making it possible to measure very thin materials. This mode is also used for thru-paint measurements. By measuring between two echoes, the thickness of paint & coatings will be eliminated completely. Therefore, any paint or coating on the surface of the test material will not be added to actual thickness of the test material.

4.7 Glossary of terms

Repetition Rate & Display Update

The repetition rate is how often the ***PVX*** generates a burst of ultrasound.

The ***PVX*** has a fixed repetition rate of 1 kHz, or 1000 times per second. The ***PVX*** updates the display 4 times per second in regular measurement mode and 32 times a second in hi speed scan mode. Therefore, the scan mode is most suitable for fast scans of a test piece at a lower resolution.

Variable Pulser Width

Transducers have a center frequency where they are most efficient at transmitting sound (i.e. they are resonant). The ***PVX*** has a variable width pulser with three setting options **(spike, thin, wide)**. These settings determine the period of time the pulser turned is on. High frequency applications, where resolution is a requirement, may require the spike or thin settings to achieve optimal results. Low frequency applications, where more penetration is a needed, may require the thin or wide settings, offering increased penetration. The variety of transducer frequencies and diameters used in conjunction with the pulser settings, enable users to fine tune the ***PVX*** for their application needs.

Gates

Gates control the time measurement process. They enable the user to select measurement regions and threshold levels (sensitivity). The ***PVX*** is equipped with two gates. In pulse-echo mode a single gate can be used to eliminate noise. In echo-echo (interface-echo) mode both gates are used. In this mode the second gate starts automatically after a signal is detected during the gates region, and after a user adjustable delay, sometimes called a hold-off.

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CHAPTER FIVE
SELECTING THE MEASUREMENT MODE

5.1 The setup library

The ***PVX*** contains 16 factory setups and 48 user definable 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 are optimized for specific transducer types and serve as a starting point for some of the typical applications commonly used with this type of instrument. These setups can be recalled, modified, and overwritten to one of 48 setup locations. The PC software includes a default setup file that can be uploaded to the gauge at any time to restore factory settings. Note: The first 16 setups cannot be overwritten. 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. Select a low frequency transducer. Depending on the thickness of the material, use a 2.25MHz or lower frequency transducer. Larger diameters offer greater penetration power because of the crystal size, for difficult to measure materials.

Thin Materials & Tough Access Areas

Use any of the delay-line transducers for materials under 1 inch. Tough access areas with minimal clearances, are perfect applications for our pencil style transducers. However, the pencil transducer have a very small thickness range and are only suitable for thin materials less than .300".

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.

Both the delay-line and contact transducers will work fine for thru coating measurements. When using contact style transducers, it's best to consider a high damped model for thinner materials to minimize the potential ring down noise of the transducer.

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Plastics

The ***PVX*** works extremely well on thin plastics using a delay line transducer and special graphite tip. Because the velocity of the standard acrylic tip has a similar velocity to most plastics, the ***PVX*** is unable to measure the material because it simply can't see it. By using the graphite tip in place of the acrylic tip, the velocity of the graphite tip allows an impedance mismatch to occur between materials, hence the plastic can successfully be measured.

When measuring thicker plastics, a lower frequency contact transducer should be used – typically 1 - 2.25MHz. Larger crystal diameters offer greater penetration capabilities. Therefore, for thicker and hard to penetrate plastics, use larger diameter transducers if possible.

High temperature

High temperature applications require a special delay line transducer using a high temperature delay tip with a very low temperature coefficient. In other words, the delay tip is not absorptive at high temperatures.

Noisy Material

Materials such as titanium, stainless steel, and aluminum may have inherent surface noise issues that appear close to the initial pulse, or near the surface. This can be avoided by using a delay style transducer in either echo-echo or interface-echo modes. However, when using a contact style transducer in pulse-echo mode, it's best to consider a higher frequency transducer. The ***PVX*** is also equipped with a single gate in pulse-echo mode. Enabling a single gate is also an effective tool for blocking unwanted surface noise. See the section Gate 1 on page 61 for more information.

Restricted access

In order to measure materials with lots of curvature or restricted access, the use of a delay line transducer with a cone delay tip or a pencil style transducer, can provide additional access.

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5.3 Factory Setup Chart

Num	Name	Comment 1	Gn/AGC	Velocity
1	E-E DELAY LINE 3/8		3	0.2330 in/uSec
2	I-E DELAY LINE 3/8		3	0.2330 in/uSec
3	E-E DELAY LINE 1/2		3	0.2330 in/uSec
4	I-E DELAY LINE 1/2		3	0.2510 in/uSec
5	E-E GRAPHITE STEEL		3	0.0940 in/uSec
6	I-E GRAPHITE STEEL		3	0.0940 in/uSec
7	I-E GRAPHITE PLASTIC		3	0.0920 in/uSec
8	E-E PENCIL PTR-100E		3	0.2330 in/uSec
9	I-E PENCIL PTR-100E		3	0.2330 in/uSec
10	E-E PENCIL PTR-300E		6	0.2330 in/uSec
11	I-E PENCIL PTR-300E		5	0.2330 in/uSec
12	E-E CONTACT STEEL		6	0.2330 in/uSec
13	P-E CONTACT STEEL		33	0.2330 in/uSec
14	P-E CONTACT PLASTIC		38	0.0920 in/uSec
15				
16				

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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 ***PVX*** for field use.

In pulse-echo modes, the probe zero must be measured on the reference disk (battery disk) attached to the top of the instrument. This compensates for variation 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 ***PVX***, 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 37.

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 ***PVX*** is not used. This is called two-point calibration and is described on page 38.

6.1 Selecting The Setup Based on Transducer Type

The first step in using the ***PVX*** is to select setup according to the type of transducer, and or delay tip length from the list of factory setups. There are delay tip lengths of 3/8" and ½". There are also two different pencil style transducer options: sphirical focused (PTR-100E) and flat (PTR-300E). The PTR-100E is the most common and popular option available. This option offers both a .060" and .125" diameter contact area tip. By selecting the setup associated with a specific transducer type, all the scope settings will also be loaded and setup. This will give the user an excellent place to start, requiring only minor adjustments of the delay and width, if any. **Note:** Once the setup has been selected, the ***PVX*** will store and recall this setup every time the ***PVX*** is powered on/off. If changes are made to the setup, they must be saved in a setup location in or to recall them at a later time. The setup will only change if the user physically selects another setup from the list. Therefore, if you have previously gone through this section and selected a setup, proceed to the next section:

Selecting a Setup for use with a specific Transducer Type

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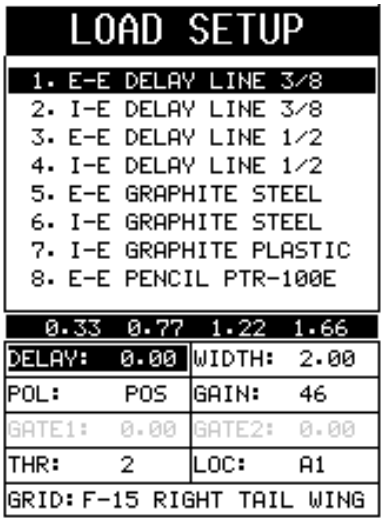
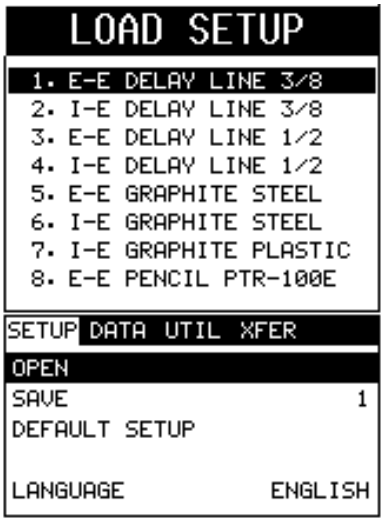


1) Press the **MULTI MODE** key once to activate the load setup list containing the transducer types and settings.

2) Use the **UP** and **DOWN** arrow keys to scroll through the setup list until the target setup is highlighted.

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

4) Press the **OK** key to select the setup and return to the measure screen, or **ESC** to cancel the selecting a setup.



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1) **Alternately**, the setups can be selected from the menu items. However, this is not as efficient. Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **SETUP** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **OPEN** is highlighted.
3) Press the **ENTER** key to display the list of stored setups.
4) Press the **UP** and **DOWN** arrow keys to scroll through the list of setups until the appropriate setup is highlighted.
5) Press the **ENTER** key to display the confirmation screen.
6) Press the **OK** key to select the setup and return to the menu screen, or **ESC** to cancel the selection process.
7) Press the **MEAS** key to return to the measurement screen.

Finally, in an effort to be sure that the user is aware of this option, the measurement mode can be manually selected from the menu items. **Important Note:** The only time this option should be considered, is if the user plans to manually setup and configure the ***PVX*** from scratch – the beginning. If the user decides to do a setup from scratch, all other settings must be tuned from scratch as well. This is not an effort to discourage the user from learning or choosing to setup the ***PVX*** from the beginning, however it's certainly the most time consuming option. The setups already contain the majority of the appropriate settings for the specific transducer, **MODE**, gates, gain, threshold, etc. Therefore, selecting a factory setup is a much easier option to start. Nevertheless, the measurement mode can be selected from the menu items as follows:

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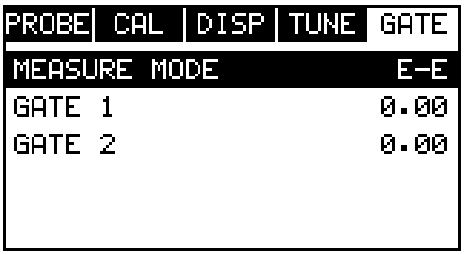
Selecting the Measure Mode Using The Tabbed Submenu Items



Note: The **E-E** mode should also be selected for setting up the ***PVX*** in **I-E** mode.

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

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

3) Use the **LEFT** and **RIGHT** arrow keys to scroll the mode options. Once the mode is displayed, press the **MEAS** key to return to the measurement mode screen.

6.2 Probe zero

A probe zero should only be done if a contact style transducer is being used in pulse-echo mode. As noted in chapter 3, the probe zero function is a very important and necessary function that must done prior to calibration. It should also be done on a regular basis. If the ***PVX*** is not zeroed correctly, all of the measurements taken may be in error by some fixed value. In order to perform a probe zero, the ***PVX*** must be in pulse-echo mode. If echo-echo mode was previously selected in the last section, skip this section and continue on to the next. **Note:** If you intend to switch between measurement modes simultaneously, setup up the ***PVX*** in pulse-echo mode, perform the probe zero as necessary, and save the setup to one of the empty setup locations. Once this is completed, the user can switch between modes toggling between two setups. The following steps outline the procedure for performing a probe zero:

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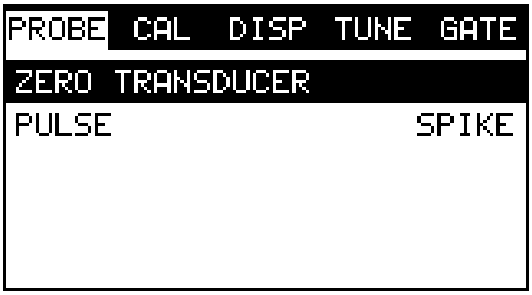
Performing a Probe Zero



1) Clean the surface of the **Probe Zero Disk**, located on top of the ***PVX*** (battery cover).

2) Apply a drop of couplant to the end of the transducer, or probe disk, and hold the transducer in steady contact with the reference disk.

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

4) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ZERO TRANSDUCER** is highlighted.

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

6) Press the **OK** key to zero the transducer and return to the menu screen, or **ESC** to cancel the zeroing process.

7) Remove the transducer from the probe zero disk.

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

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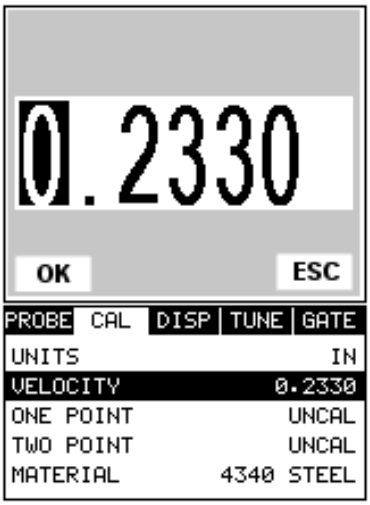
6.3 Material Calibration

In order for the ***PVX*** 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 ***PVX*** provides four simple methods for setting the sound-velocity outlined below:

Calibration to a known velocity



1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **CAL** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **VELOCITY** is highlighted.
3) Press the **ENTER** key to display the **Digits Edit Box**.
4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.

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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 **MEAS** key to return to the measurement screen and begin taking readings.

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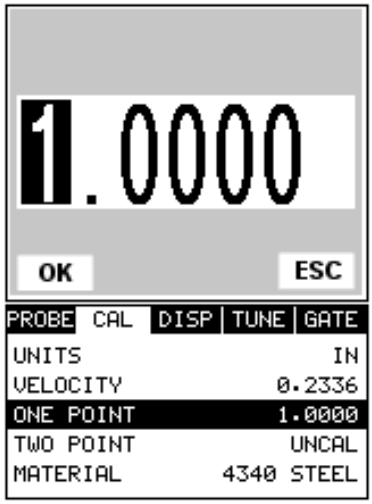
One Point Calibration



Note: Be sure that a probe zero has been done prior to performing this calibration procedure if a contact transducer in pulse-echo mode is being used.

1) **Physically measure** a location on the sample to be measured using a set of calipers or a digital micrometer. Note: It's always best to calibrate on thickest location on the sample, rather than on the thinnest location, as the percentage error is much less with respect to the ***PVX's*** resolution of +/- .0001" (0.001mm).

2) Apply a drop of couplant on the transducer. Place the transducer in steady contact on the known thickness location. Be sure that the reading is stable and the repeatability indicator, located in the top left corner of the display, is fully lit and stable. Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **CAL** menu is highlighted and displaying the submenu items.

3) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ONE POINT** is highlighted.

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

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

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

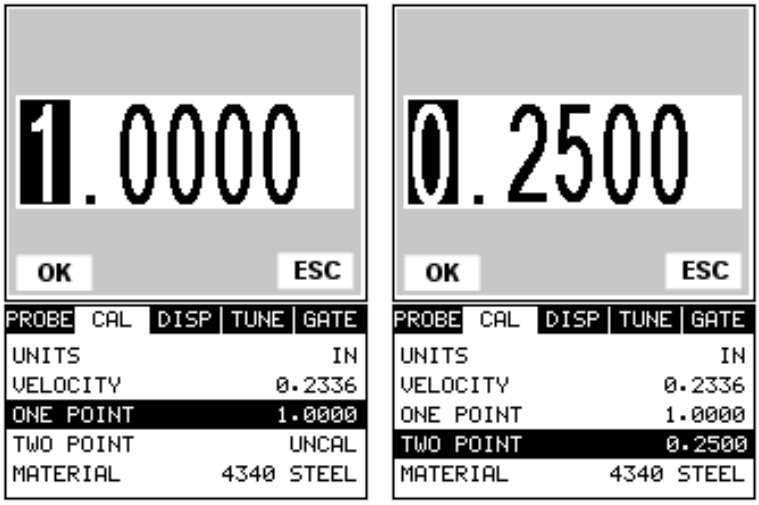
7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.

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

9) Finally, press the **MEAS** 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.

Two Point Calibration



Note: Be sure that a probe zero has been done prior to performing this calibration procedure, if a contact transducer in pulse-echo mode is being used.

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Note: If the user opted to do a setup from scratch for interface-echo (I-E) mode, a two point calibration must be performed to set the probe zero.

1) Using a set of calipers, physically measure two known thickness locations on the sample of material. **Note:** The two locations should represent the desired thickness range being measured. If the range is from .050" - .200", then the two known locations should represent this range, or be slightly outside or inside of this range. A typical example would be to find two locations at .063" and the other at .247". These thickness points will satisfy the required thickness range noted above.
2) Apply a drop of couplant on the transducer. Place the transducer in steady contact on thickest known location first. Be sure that the reading is stable and the repeatability indicator, located in the top left corner of the display, is fully lit and stable. Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **CAL** menu is highlighted and displaying the submenu items.
3) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ONE POINT** is highlighted.
4) Press the **ENTER** key to display the **Digits Edit Box**.
5) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
6) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
7) Repeat steps **5 & 6** until the known thickness value is correctly displayed.
8) Press the **OK** key to calculate the velocity for the **ONE POINT** calibration and return to the **CAL** menu screen, or press **ESC** to cancel entering the velocity.

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9) Apply a drop of couplant on the transducer and place the transducer in steady contact with the sample or actual test material on the thinnest, or second known thickness location. Be sure that the reading is stable and the repeatability indicator, located in the top left corner of the display, is fully lit and stable.

10) Use the **UP** and **DOWN** arrow keys to highlight the **TWO POINT** calibration submenu item.

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

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

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

14) Repeat steps **12 & 13** until the known thickness value is correctly displayed.

15) Press the **OK** key to calculate the velocity for the **TWO POINT** calibration and return to the **CAL** menu screen, or press **ESC** to cancel entering the velocity.

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

Note: CHECK YOUR CALIBRATION! Place the transducer back on both calibration points. The thickness readings should now match the known thickness locations. If they are not correct, repeat the steps above.

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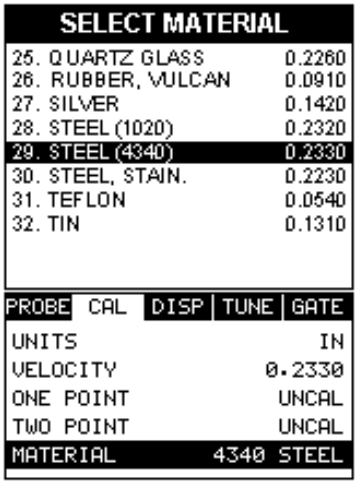
Built in Material Selection



1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **CAL** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **MATERIAL** is highlighted.
3) Press the **ENTER** key to display the list of **Material Types**.
4) Press the **UP** and **DOWN** arrow keys to scroll through the material list until the appropriate material is highlighted.
5) Press the **ENTER** key to display the confirmation screen.
6) Press the **OK** key to select the material and return to the menu screen, or press **ESC** to cancel the material selection.
7) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

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CHAPTER SEVEN
USING THE A-SCAN & B-SCAN DISPLAYS

A key feature of the ***PVX*** 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 internal flaws in materials, and is almost mandatory for use with pencil style transducers.

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 profiling 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 is 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 ***PVX***. The ***PVX*** 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 ***PVX*** 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 99 for more information on setups.

7.1 Selecting a Display Option

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

Changing Display Options

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

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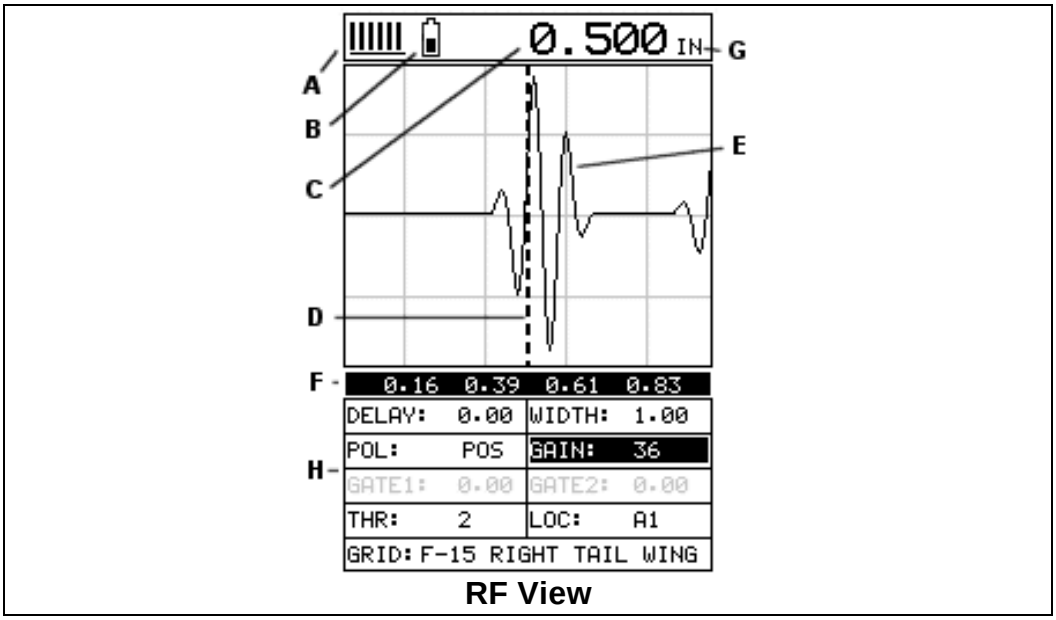
7.2 Display Views



RF View

RF

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. This is the preferred mode for thin precision measuring modes, using delay line and pencil style transducers.

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 72 for additional information on the **Auto Find** feature.

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

A) **Stability of Reading Indicator** – Indicates the stability of the return echo on a scale of 1 to 6 – the solid bars displayed in the figure above indicate a repeatable signal. If the ***PVX*** is displaying a reading from memory, the repeatability indicator will be replaced by the text **"MEM"**.

B) **Battery life Indicator** – Fully charged batteries will appear filled in solid. Note: The diagram shows the batteries at approximately 50%.

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C) **Thickness Reading** – Digital readout of thickness (inches or millimeters).

D) **Detect Indicator** – The broken vertical line displays the zero crossing (flank) 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.

E) **Echo Signal** – Graphical full waveform representation of the echo signal displayed as an amplitude (vertical or "Y" axis) plotted against time (horizontal or "X" axis), this time is then converted to a physical measurement and displayed according.

F) **Measurement Labels** – The measurement labels are calculated and displayed based on where the left side of the display has been set **(Delay)**, and the overall viewable area **(Width)** of the display. Note: The gray hash marks break the display up into 5 segments, or quadrants. The measurement labels correspond to the measurement at each hash mark.

G) **Units Label** - Displays the current units of measurement (inches or millimeters).

H) **Hot Menus** - Each of the fields located under the waveform display are called the **Hot Menu Fields**. These fields allow quick control of some of the fine adjustments needed to control the display settings, measurement modes, and grid memory control. All of these fields can be adjusted without having to activate the tabbed menu items and searching through a variety of menus to make adjustments.

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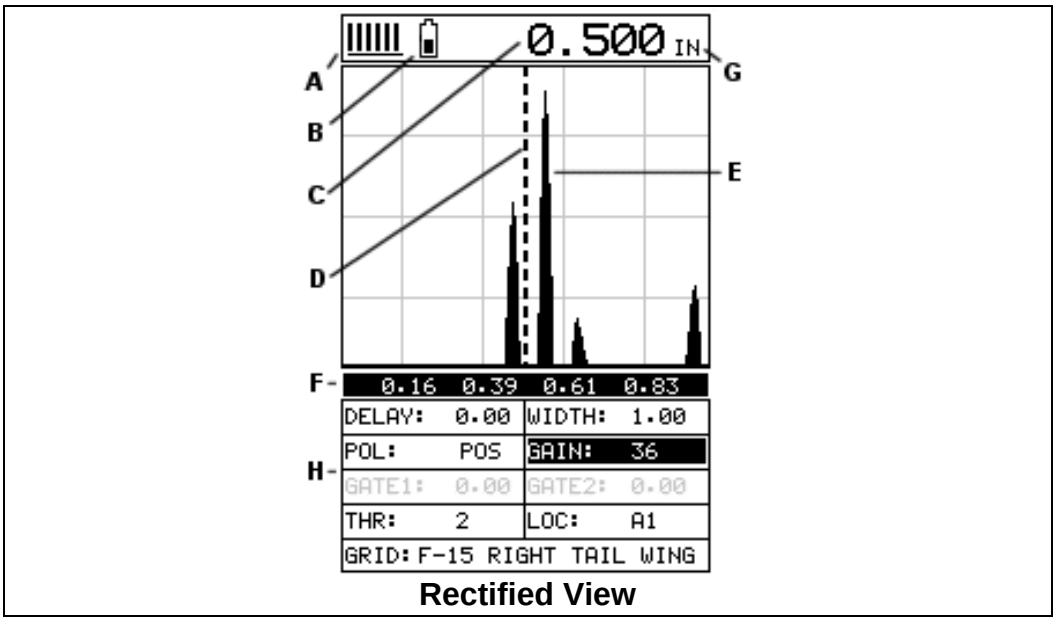

Rectified View

Rectified

The rectified A-Scan mode shows half of the waveform. Either the positive or negative peaks are displayed, depending on the polarity selected. This is the preferred display view for flaw detection applications.

It's important to note that a measurement must fall inside the viewable display range in order to see the waveform. However, even if the waveform is outside of the viewable area, a measurement can be taken and viewed on the digital readout. If the waveform 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 in the tabbed menu items. Refer to page 72 for additional information on the **Auto Find** feature.

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

A) **Stability of Reading Indicator** – Indicates the stability of the return echo on a scale of 1 to 6 – the solid bars displayed in the figure above indicate a repeatable signal. If the ***PVX*** is displaying a reading from memory, the repeatability indicator will be replaced by the text **"MEM"**.

B) **Battery life indicator** – Fully charged batteries will appear filled in solid. Note: The diagram shows the batteries at approximately 50%.

C) **Thickness reading** – Digital readout of thickness (inches or millimeters).

D) **Detect Indicator** – The broken vertical line displays the zero crossing (flank) 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.

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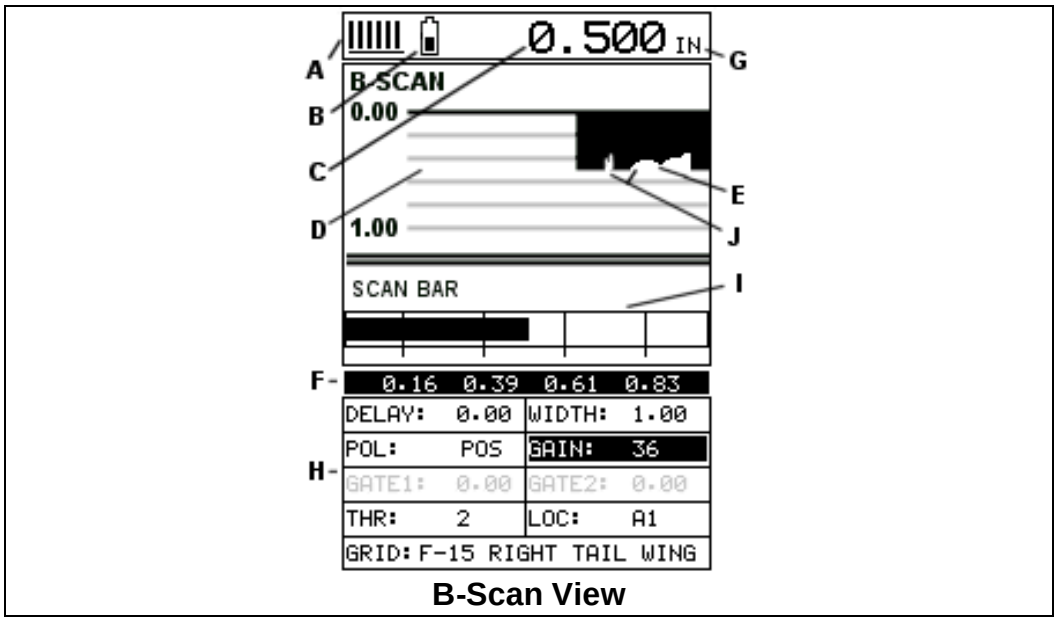
E) **Echo Signal** – Graphical full waveform representation of the return echo displayed as an amplitude (vertical or "Y" axis) plotted against time (horizontal or "X" axis), this time is then converted to a physical measurement.

F) **Measurement Labels** – The measurement labels are calculated and displayed according to where the left side of the display has been set **(Delay)**, and the overall viewable area **(Width)** of the display. Note: The gray hash marks break the display up into 5 segments, or quadrants. The measurement labels correspond to the measurement at each hash mark.

G) **Units Label** - Displays the current units of measurement (inches or millimeters).

H) **Hot Menus** - Each of the fields located under the waveform display are called the **Hot Menu Fields**. These fields allow quick control of some of the fine adjustments needed to control the display settings, measurement modes, and grid memory control. All of these fields can be adjusted without having to activate the tabbed menu items and searching through a variety of menus to make adjustments.



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 the material being tested. It is very similar to a fish finder. If a flaw is located during a scan, the B-Scan will draw the flaw on the screen. The solid black rectangle in the diagram at location E represents the cross section, or side view of the material. You will notice that the overall thickness of the material is .500", and the display range is 0.00" to 1.00" respectively. The B-Scan view draws at a rate of 15 seconds per

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screen from right to left. Also notice at location J, the contour thickness changes of the 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) **Stability of Reading Indicator** – Indicates the stability of the echo signal on a scale of 1 to 6 – the solid bars displayed in the figure above indicate a repeatable signal. If the ***PVX*** is displaying a reading from memory, the repeatability indicator will be replaced by the text **"MEM"**.

B) **Battery life indicator** – Fully charged batteries will appear filled in solid. Note: The diagram shows the batteries at approximately 50%.

C) **Thickness reading** – Digital readout of thickness (inches or millimeters).

D) **B-Scan Display Area** – This is the area representing where the B-Scan will be drawn. Notice the range of the area in the diagram at 0.00" – 1.0" respectively.

E) **Displayed B-Scan** – Graphical presentation of the cross section, or side view of the test material. The top, or accessible side of the material represented as 0.00", and the bottom, or blind surface at .500". You will notice the contour in the B-Scan, indicating a very irregular bottom surface. The B-Scan is displayed from right to left at a rate of 15 screens per second.

F) **Measurement Labels** – The measurement labels are calculated and displayed based on where the left side of the display has been set **(Delay)**, and the overall viewable area **(Width)** of the display. Note: The gray hash marks break the display up into 5 segments, or quadrants. The measurement labels correspond to the measurement at each hash mark.

G) Units Label - Display's the current unit of measurement (inches or millimeters).

H) Hot Menus - Each of the fields located under the B-Scan display are called the **Hot Menu Fields**. These fields allow quick control of some of the fine adjustments needed to control the display settings, measurement modes, and grid memory control. All of these fields can be adjusted without having to activate the tabbed menu items and searching through a variety of menus to make adjustments.

I) Scan Bar – The scan bar corresponds directly with thickness represented by the horizontal labels on the on the display. As you can see from the diagram above, the filled horizontal bar is displayed at .500". This display can be very useful when scanning materials in either B-Scan or Digits display views. It is much easier to watch and notice deflections for flaws and pits using the scan bar, rather than trying to notice changes in digital values. If the user is scanning a material,

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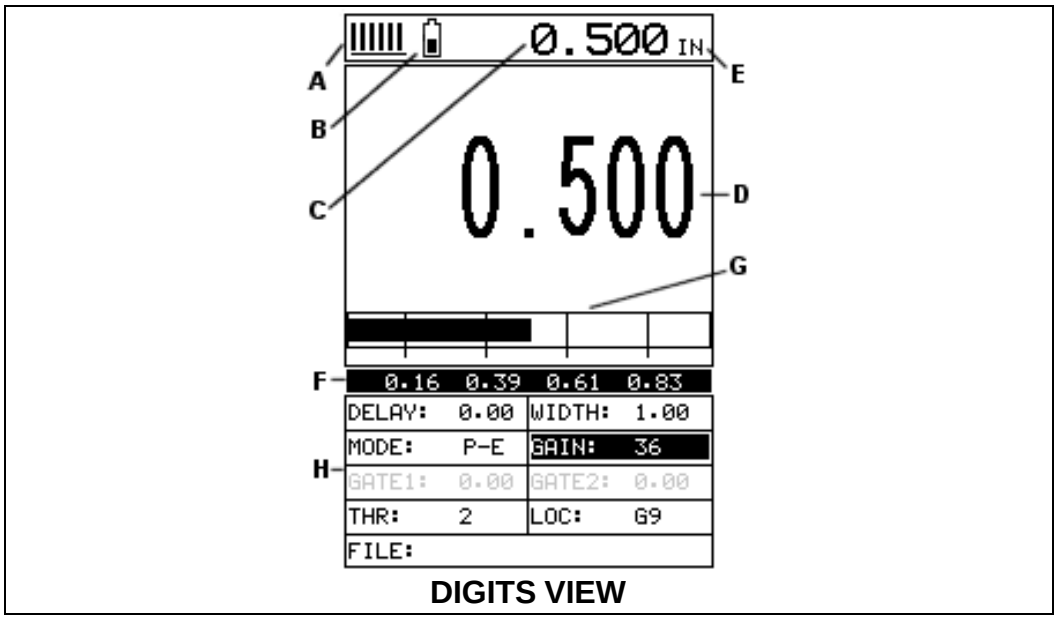
for instance, and passes over a flaw in the process, the scan bar will quickly deflect and alarm the user to go back and search for the defect.

J) **Contour (blind surface) –** A view of the B-Scan displaying the blind side surface contour of the material.



DIGITS VIEW

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) **Stability of Reading Indicator** – Indicates the stability of the return echo on a scale of 1 to 6 – the solid bars displayed in the figure above indicate a repeatable signal. If the ***PVX*** is displaying a reading from memory, the repeatability indicator will be replaced by the text **"MEM"**.

B) **Battery life indicator** – Fully charged batteries will appear filled in solid. Note: The diagram shows the batteries at approximately 50%.

C) **Thickness reading** – Digital readout of thickness (inches or millimeters).

D) **Large Digits** – Large readout of thickness (inches or millimeters).

E) **Units Label** – Display's the current unit of measurement (inches or millimeters).

F) **Measurement Labels** – The measurement labels are calculated and displayed based on where the left side of the display has been set **(Delay)**, and the overall viewable area **(Width)** of the display. Note: The gray hash marks break the

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display up into 5 segments, or quadrants. The measurement labels correspond to the measurement at each hash mark.

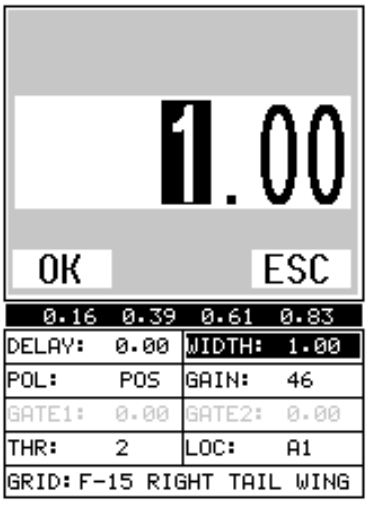
G) Scan Bar – The scan bar corresponds directly with thickness represented by the horizontal labels on the on the display. As you can see from the diagram above, the filled horizontal bar is displayed at .500". This display can be very useful when scanning materials in either B-Scan or Digits display views. It is much easier to watch and notice deflections from flaws and general changes in thickness using the scan bar, rather than trying to notice changes in the digital value. If the user is scanning a material, for instance, and passes over a flaw during the process, the scan bar will quickly deflect and alarm the user to go back and search for the defect.

H) Hot Menus - Each of the fields located under the display are called the **Hot Menu Fields**. These fields allow quick control of some of the fine adjustments needed to control the display settings, measurement modes, and grid memory control. All of these fields can be adjusted without having to activate the tabbed menu items and searching through a variety of menus to make adjustments.

7.3 Adjusting the screen

The width refers to the overall viewable range, with respect to depth, being displayed on the screen. The starting depth is displayed at the lower left side of the screen, and the ending depth is shown at the lower right hand side of the screen. The difference between these values is called the **Width**. The procedures to adjust the **Width** are outlined below:

Adjusting the Width using the Hot Menus



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

The user can also access and adjust the width from the tabbed menus. However, this method is a more tedious process than making the adjustments using the Hot Menus. The procedure using the tabbed menus is outlined below:

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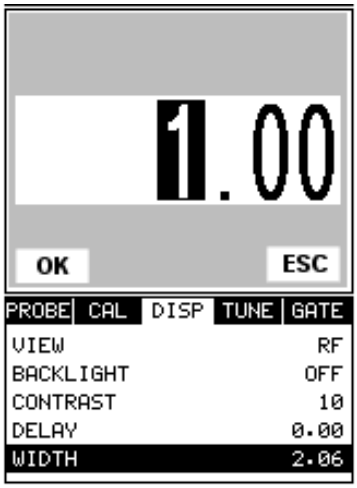
Adjusting the Width using the Tabbed Menus



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

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

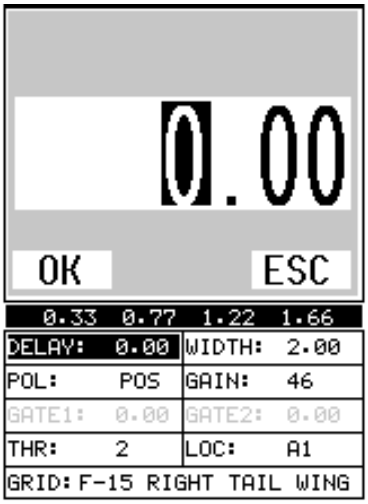
Starting delay

The starting **DELAY**, or starting depth, is the value displayed on the bottom lower left side of the display in both **RF** and **RECT** (Rectified) views. The **DELAY** will also be represented in both the **BSCAN** and **DIGITS** (Scan Bar) views, as the starting thickness depth. The starting depth is the minimum thickness value that can be viewed on the display. In **DIGITS** view, the delay will only affect the starting depth of the **Scan Bar**.

Note: Once the range is set, it will remain the same for all the views respectively.

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

Adjusting the Delay using the Hot Menus



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

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

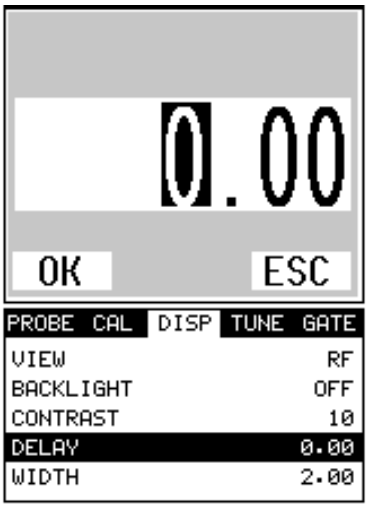
5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.

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

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

The user can also access and adjust the delay from the tabbed menus. However, this method is a more tedious process than making the adjustments using the Hot Menus. The procedure using the tabbed menus is outlined below:

Adjusting the Delay using the Tabbed Menus



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

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

3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct **Delay** is being displayed, **proceed to step 8**.

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4) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
5) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
6) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
7) Repeat steps **5 & 6** until the **Delay** number is correctly displayed.
8) Press the **OK** key to set the **Delay** and return to the menu screen, or **ESC** to cancel entering the **Delay**.
9) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

7.4 Gain

The gain, or amplification of the return echoes, can be adjusted over a wide range. 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. Too little gain may result in detection on an undesirable section of the waveform. It may also result in lack of detection on internal flaws or other specific applications using pencil style transducers. 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 procedures to adjust the **Gain** are outlined below:

Adjusting the Gain using the Hot Menus

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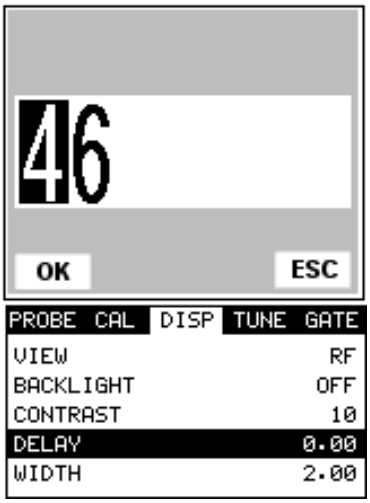

1) Press the **MEAS** key once to activate measure menu items. Press the **MEAS** key multiple times to move right, and the **ESC** key multiple times to move left until the **GAIN** cell is highlighted.
2) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the highlighted value.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

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

Adjusting the Gain using the Tabbed Menus

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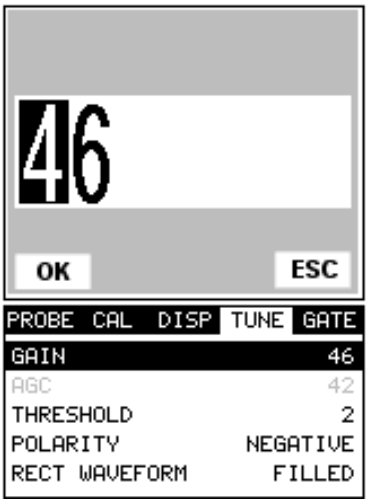

1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **TUNE** menu is highlighted and displaying the submenu items.

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

3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct **Gain** is being displayed, **proceed to step 8**.

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

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

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

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

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

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

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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 the waveform they need to detect on, but the ***PVX*** is not detecting 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 waveform to reach and exceed the **Threshold** level, and enable the ***PVX*** to detect on the proper return echo. 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 procedures to adjust the **Threshold** are outlined below:

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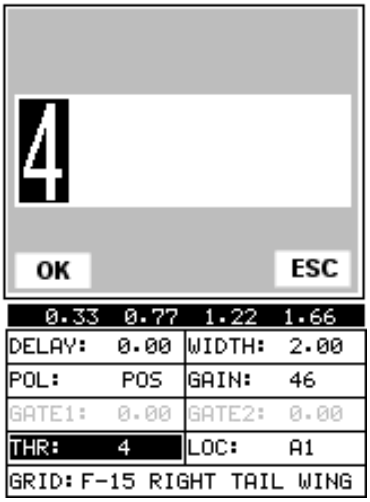
Adjusting the Threshold using the Hot Menus



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

The user can also access and adjust the **Threshold** 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:

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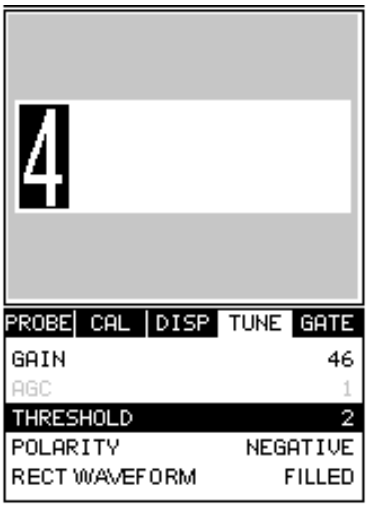
Adjusting the Threshold using the Tabbed Menus



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

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

3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct threshold is being displayed, **proceed to step 8**.

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

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

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

7) Repeat steps **5 & 6** until the **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) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

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7.6 Gates

The ***PVX*** is equipped with two gates that can be adjusted by the user to measure a specific region or area on and between waveforms. In pulse - echo, only a single gate can be used. The single gate has a threshold and a start point. In echo – echo (interface-echo) mode, two gates are used. The same threshold level is associated with both gates. The first gate has a starting point and threshold, and the second gate has a start time that is determined by adding an adjustable **HOLD OFF**, or delay, to the return echo measured by the first gate. These features are described in more detail below:

Note: In order to adjust the gates they must be activated. The gates will only be active if the measurement mode is set to P-E GT (pulse – echo w/gate1), or E-E (echo – echo/interface-echo w/ gates 1&2). If the gates are not active, they will be grayed out in the tabbed menus. Note: The setups contain the proper modes according specific transducer types. The explanations that follow assume that the proper measurement mode has been selected by selecting a specific setup. Refer to page 27 for additional information on selecting a setup for the transducer being used, which contains the correct measurement mode setting.

Gate 1

GATE 1 is used in both pulse-echo and echo-echo (interface-echo) modes. It has a threshold and a start time. The purpose of **GATE 1** is to prevent the ***PVX*** from measuring unwanted surface noise in pulse-echo mode. This is accomplished by changing the start time of **GATE 1**. It may be advantageous to activate a gate when measuring aluminum, titanium, and stainless steel using lower frequency transducers. However, if a high frequency transducer is being used, the gate may not be necessary. Aluminum sometimes has an inherent surface noise problem that can cause erroneous readings from the noise just following the initial pulse. By blocking the surface noise with **GATE 1** this error is eliminated. **GATE 1** is also used in echo - echo and interface-echo mode to force the ***PVX*** to measure between the first and second back wall echoes or from the end of an interface (delay line), by moving the start to the first back wall reflection of the test material.

The procedures to adjust **Gate 1** are outlined below:

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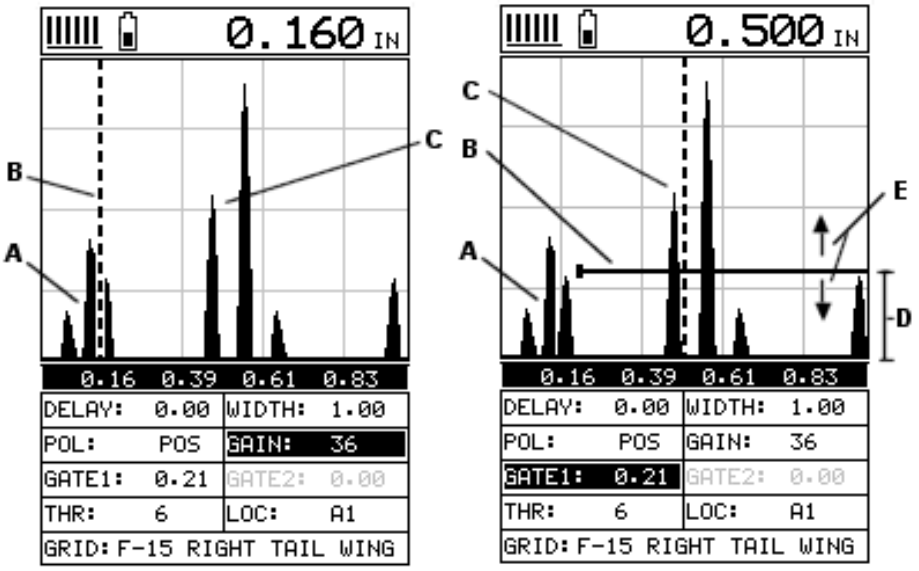
SURFACE NOISE PROBLEM



NO GATE **W/GATE**

The diagrams above illustrate a typical surface noise condition. Refer to the **NO GATE** diagram: **(A)** refers to the noise in front of the actual back wall signal **(C)**. Notice that without a gate activated, the ***PVX*** is detecting on the noise **(A)** as shown at point **(B)**. However, the true measurement should be taken at point **(C)**. Given the threshold and gain levels the ***PVX*** is currently set to in the **NO GATE** diagram, the amplitude from the noise is sufficient enough to cause the ***PVX*** to detect, or measure the noise rather than the true back wall thickness **(C)**. Therefore, the ***PVX*** is making an incorrect reading at point **(B)**.

Now refer to the **W/GATE** diagram. The horizontal line at the top of **(D)**, is **GATE1**. The start point of **GATE1** has been adjusted to just beyond the noise **(A)** so that the ***PVX*** ignores the noise and detects the true back wall **(C)**. Note: the ***PVX*** will only detect on signals that are located inside the dimensions of **GATE1 (B)**. Therefore, the ***PVX*** cannot see **(A)** at all, with respect to the starting point of **(B)**. Also notice, the **THR** (threshold) level is the height of the distance **(D)** from the baseline. Zero threshold is indicated by the bottom of the range **(D)**, and **THR: 6** (threshold) is indicated at the top of the range at **(D)**. Therefore, the vertical height of **GATE1** is the **THR** (threshold) level. The threshold level can be increased to decrease sensitivity, or decreased to increase sensitivity.

If the threshold level was increased in the **NO GATE** diagram, so that the level was higher than the amplitude of the noise **(A)**, the ***PVX*** would have detected on the true back wall **(C)**. Alternatively, if the gain level was decreased, the signal amplitude of

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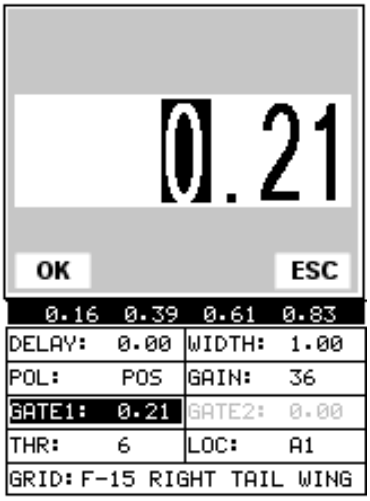
the noise **(A)** would have decreased below the threshold level, and the ***PVX*** would have also detected the true back wall **(C)**. This example brings all the fine adjustments into consideration, and demonstrates the versatility of having fully functional scope rather than a basic digital thickness gauge.

Adjusting Gate1 using the Hot Menus



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

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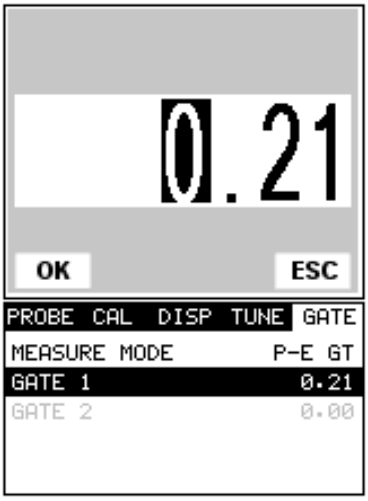
The user can also access and adjust the gate from the tabbed menus. However, this method is more tedious than making the adjustments using the **Hot Menus**. The procedure using the tabbed menus is outlined below:

Adjusting Gate1 using the Tabbed menus



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

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

3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct gate is being displayed, **proceed to step 8**.

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

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

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

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

8) Press the **OK** key to set the **Gate 1** value and return to the menu screen, or **ESC** to cancel entering the **Gate 1** value.

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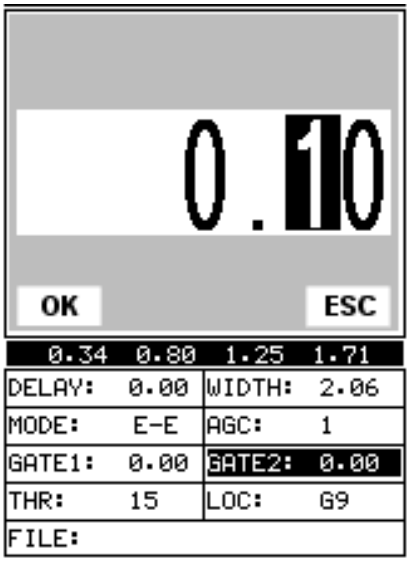
9) Finally, press the **MEAS** key to return to the measurement screen and begin taking readings.

Gate 2

The **GATE 2 HOLDOFF** is only used in the echo-echo (interface-echo) mode. Note: The ***PVX*** must be in **E-E** (echo-echo) mode to be activated. **GATE 2** is sometimes called a **Hold-Off** or **Delay**. The function of the **GATE HOLDOFF** is to prevent the second gate from triggering on noise associated with ring down of the first echo. The **GATE 2 HOLDOFF** is visible as the distance from the end of **GATE 1** at the first detect, to the start of **GATE 2** as display by the horizontal bars on the display. A further explanation suggests the **HOLDOFF** is a time delay that simply extends the end of **GATE 1** further out in time to prevent **GATE 2** from starting. This is commonly used to avoid detecting interface noise or transducer ring down. The diagrams below provide a visual example of the gates, followed by the procedures to adjust the gates for different applications:

Adjusting Gate2 using the Hot Menus



1) Press the **MEAS** key once to activate measure menu items. Press the **MEAS** key multiple times to move right and the **ESC** key multiple times to move left, until the **GATE2** cell is highlighted.

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2) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the highlighted value.

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

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

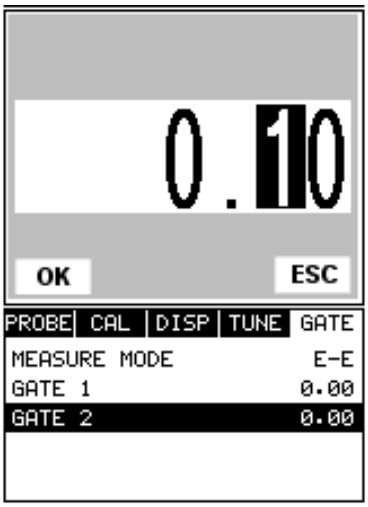
5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.

6) Repeat steps **4 & 5** until the **GATE2** value is correctly displayed.

7) Press the **OK** key to return to the measurement screen, or **ESC** to cancel entering the **GATE 2** value.

Alternatively, **Gate 2** can be selected from the menus and adjusted as follows:

Adjusting the Gate 2 from the Menu Items



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

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

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3) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct gate value is being displayed, **proceed to step 8**.

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

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

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

7) Repeat steps **5 & 6** until the **GATE 2** value is correctly displayed.

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

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

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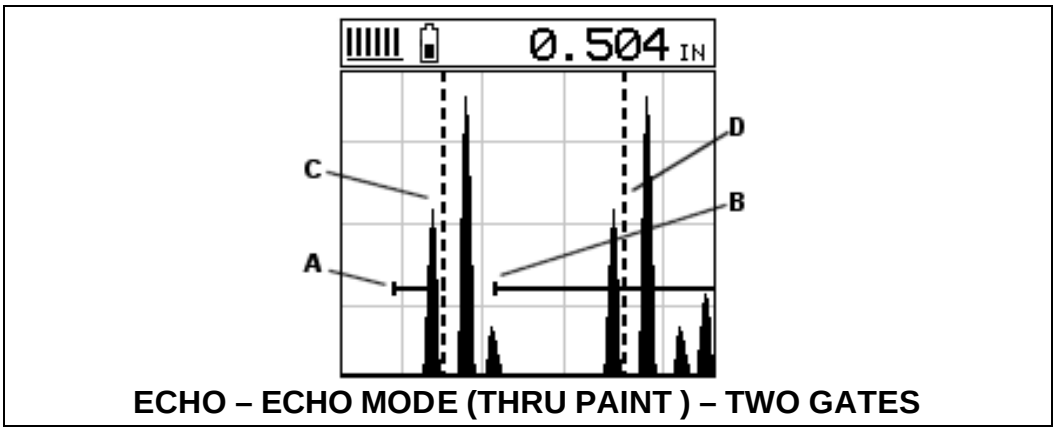
CHAPTER EIGHT
THRU PAINT MEASUREMENT TECHNIQUE

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 various test materials during the inspection process. The primary purpose of thru paint measurement is to determine actual or overall material thickness by eliminating the coating thickness.



ECHO – ECHO MODE (THRU PAINT) – TWO GATES

Refer to the diagram above. This is a typical example of an echo-echo mode setup commonly used for a through paint or coatings application. Once again, the definition of an echo-echo measurement, is a measurement taken between to return echoes, rather than from the initial pulse to a single echo. Therefore, the measurement is taken between the first and second echo reflections. Point **(C)** represents the detection on the back wall of the first reflection. Notice that **GATE1** has been has been set up so that the ***PVX*** can only see the first back wall reflection **(C)**, and cannot see anything before the first reflection. Remember that the ***PVX*** can only see those signals inside the dimensions of the gate.

GATE2 (hold-off) has been set at point **(B)**, so that the transducer ring down noise following the first detection **(C)** can't interfere with the second back wall reflection **(D)**. The distance from point **(C)**, which is the end of the first gate **(A)**, to the start of **GATE2 (B)**, is the hold-off time or delay. This type of setup allows the user to eliminate the paint or coating, and measure only metal the thickness of the metal.

8.2 Setting Up Thru Paint Mode

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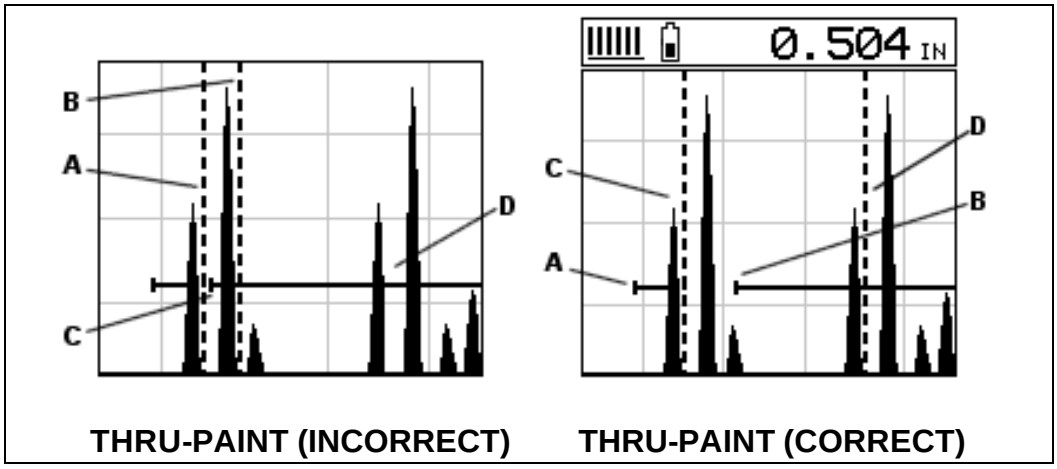
The most straight forward way of setting up the ***PVX*** for thru paint measurements is to select a factory setup with a corresponding transducer type from the list of setups included with the ***PVX***. These setups will serve as a good starting point for setting customized applications. However, fine adjustments may be necessary in order to be suitable for your specific applications. These configurations are general setups only, but have been setup and optimized for the majority of common measurement. Once a setup has been selected and the appropriate calibration procedure completed, the user can make any fine adjustments to the setup and begin taking measurements.

When configuring the ***PVX*** for specific thru paint applications, all of the scope parameters will potentially be needed. The delay, width, gain, threshold, gate1, and gate2 features 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 ***PVX*** off. **Failure to do so will result in losing your changes**.



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 ***PVX*** 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 **width** will simply change the view options of the screen – not needed in this example. Will a **gain** 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**, reducing the signal amplitudes, we would also lose our detection of both back wall echoes.

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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**, we would lose the first cycle **(C)** long before losing the second cycle **(B)**. Therefore, adjusting the **gain** 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. These examples are true of all potential echo-echo setups with the ***PVX***. In some applications the hold-off may be sufficient, while a **gain** or **threshold** adjustment will solve the problem. A similar process of elimination should be considered for all thru paint and general echo-echo applications.

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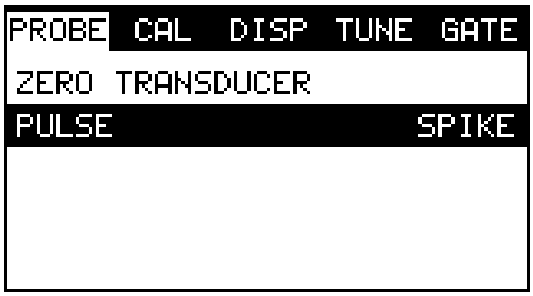
CHAPTER NINE
ADDITIONAL FEATURES OF THE PVX

9.1 Pulse Width

The ***PVX*** has an adjustable pulse width option, located as a submenu item in the **PROBE** tab group. 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 **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right and the **ESC** key multiple times to tab left until the **PROBE** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **PULSE** is highlighted.
3) Use the **LEFT** and **RIGHT** arrow keys to scroll the **Pulse** options.
4) Once the **Pulse** is displayed, press the **MEAS** key to return to measurement screen.

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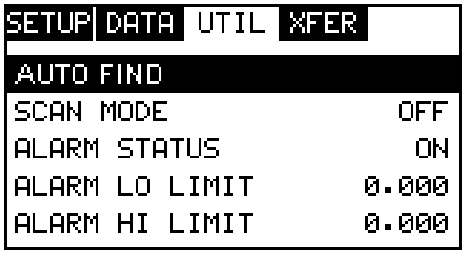
9.2 Auto Find

The ***PVX*** 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 ***PVX*** is currently setup with a delay of 0.0" and a width of 0.500", and the user is measuring material thickness of .625". The ***PVX*** 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 ***PVX*** 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 **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **UTIL** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **AUTO FIND** is highlighted.
3) Place the transducer on the test material and obtain a reading.
4) Press the **ENTER** key to automatically adjust the display settings and bring the waveform into view.
5) Once the signal is displayed, press the **MEAS** key to return to measurement mode.

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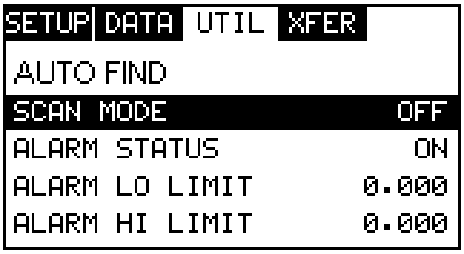
9.3 High Speed Scan

The High Speed Scan feature of the ***PVX*** increases the overall sample rate from the standard 4 measurements a second to 32 measurements 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. The display will continue to be updated during the scan process, and when the transducer is removed, the ***PVX*** will display the minimum reading found. The procedure to use the **SCAN MODE** feature is outlined below:

Using the Scan Mode



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

9.4 Alarm Mode

The **Alarm Mode** feature of the ***PVX*** provides the user with a method of setting tolerances, or limits, for a particular application requirement. This feature may be used for incoming material inspections to verify the material received is within the manufacturer specifications. There are two limits, or alarm values, that can be setup in the ***PVX*** – **ALARM LO LIMIT** and **ALARM HI LIMIT**. 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:

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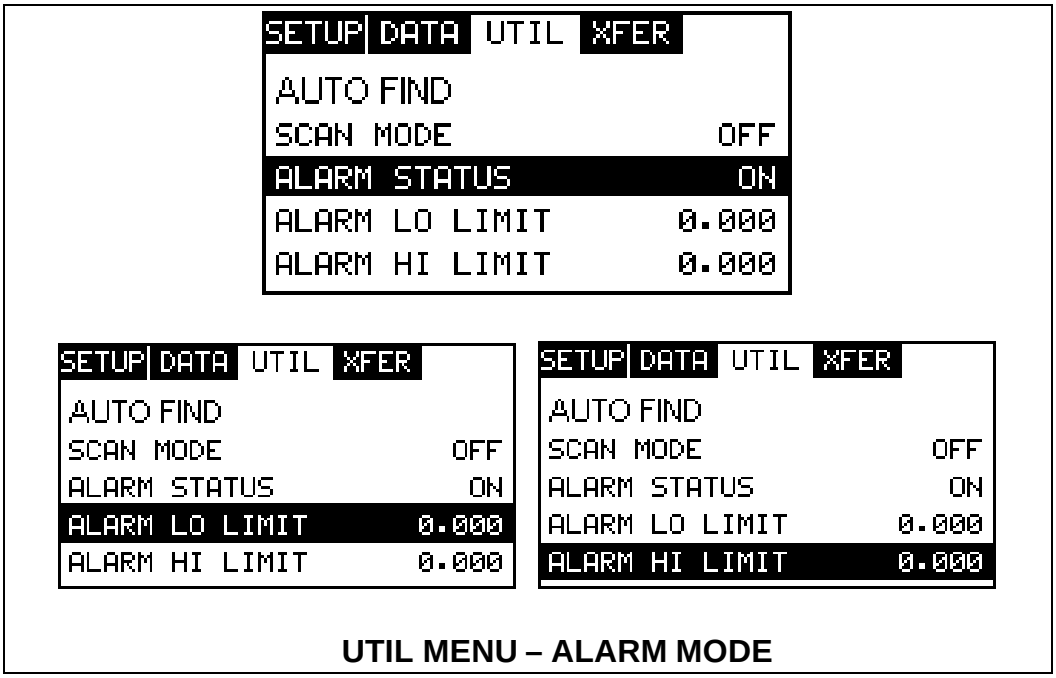
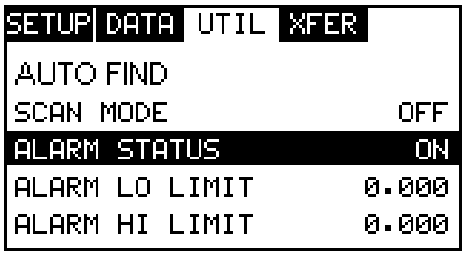


UTIL MENU – ALARM MODE

Toggle Alarm Status (on/off)



1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **UTIL** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ALARM STATUS** is highlighted.
3) Use the **LEFT** and **RIGHT** arrow keys to toggle the **ALARM STATUS** on/off/audible.

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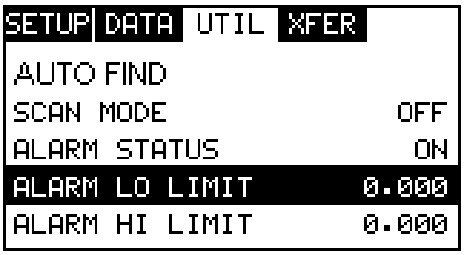
4) Continue on to the next section **"Setting the Alarm Lo Limit"**.

Setting the Alarm LO Limit



1) Assuming the **ALARM STATUS** is **ON**, use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ALARM LO LIMIT** is highlighted.
2) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct alarm value is being displayed, **proceed to step 7**.
3) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
6) Repeat steps **4 & 5** until the **ALARM LO** value is correctly displayed.
7) If only one limit will be used, press the **MEAS** key to return to the measurement screen and begin taking readings. Otherwise, continue on to set the **ALARM HI LIMIT**.

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Setting the Alarm HI Limit

1) Assuming the **ALARM STATUS** is **ON**,use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **ALARM HI LIMIT** is highlighted.
2) Press the **LEFT** and **RIGHT** arrow keys to scroll the value. When the correct alarm value is being displayed, **proceed to step 8**.
3) **Alternatively**, press the **ENTER** key to display the **Digits Edit Box**.
4) Press the **UP** and **DOWN** arrow keys to scroll the highlighted value.
5) Press the **LEFT** and **RIGHT** arrow keys to scroll the digit locations.
6) Repeat steps **4 & 5** until the **ALARM HI** value is correctly displayed.
7) Press the **OK** key to set the **ALARM HI** value and return to the menu screen, or **ESC** to cancel entering the **ALARM HI** value.
8) Press the **MEAS** key to return to the measurement screen and begin taking readings.

9.5 Polarity

The ***PVX*** is equipped with an option to select the polarity, or phase +/-, for the purpose of detection. The phase is 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. This feature is also critical for thin measurements where accuracy is required. Once again, if the phase is not properly selected, a peak jump can occur making the test material appear to be thicker than it actually is. Refer to the diagram below:

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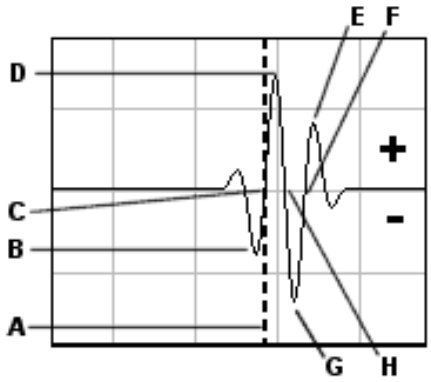

Notice the +/- positions in the diagram. The positive phase is everything above the horizontal center line, and the negative everything below the center line. The ***PVX*** uses a **zero crossing (flank) method for detection**. Therefore, the detect line **(A)** is represented by the broken vertical 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 ***PVX*** 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 (+/-)

PROBE	CAL	DISP	TUNE	GATE
GAIN				46
AGC				1
THRESHOLD				2
POLARITY				NEGATIVE
RECT WAVEFORM				FILLED

Note: Before toggling the **Polarity**, the ***PVX*** should be set to the **RF** display view option. The **RF** view will give the user the best opportunity to correctly

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view the positive and negative cycles of the waveform. Please refer to page 43 for information on selecting the **Display Views**.

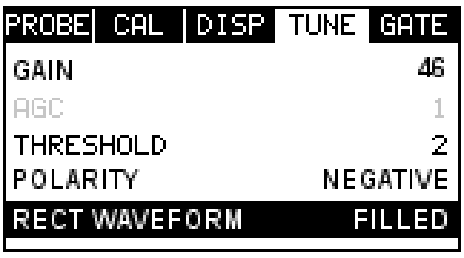
1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **TUNE** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **POLARITY** is highlighted.
3) Use the **LEFT** and **RIGHT** arrow keys to toggle the **POLARITY** negative or positive.
4) Press the **MEAS** key to return to the measurement screen and begin taking readings.

Important: If a contact transducer is being used in pulse-echo mode, be sure to do a Probe Zero after change the polarity.

9.6 Rectified Waveform (Filled/unfilled)

The ***PVX*** has yet another feature primarily included for user personal viewing preference. When the ***PVX*** is in the **Rectified Display View**, the waveform can be completely filled in black, or simply outlined. The procedures to toggle this feature, are outlined below:

Toggle Rect Wave (filled / Unfilled)



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Note: Before toggling the **Rect Wave**, the ***PVX*** should be set to the **RECT** display view option. Please refer to page 43 for information on selecting the **Display Views**.

1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **TUNE** menu is highlighted and displaying the submenu items.
2) Use the **UP** and **DOWN** arrow keys to scroll through the sub menu items until **RECT WAVEFORM** is highlighted.
3) Use the **LEFT** and **RIGHT** arrow keys to toggle the **RECT WAVEFORM** filled or unfilled.
4) Press the **MEAS** key to return to the measurement screen and begin taking readings.

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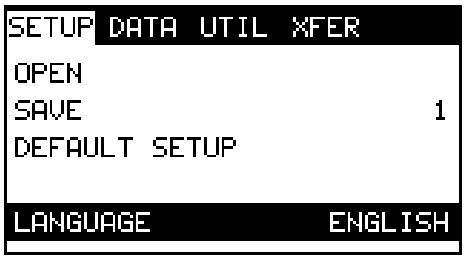
9.7 Language Selection

The PVX is equipped with a multi language selection feature. This is an added feature for to accommodate everyone. The procedures are outlined below:

Selecting the Language using the Tabbed Menus



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

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

3) Press the **LEFT** and **RIGHT** arrow keys to scroll the available language options.

4) Press the **OK** key to set the **Language** and return to the menu screen, or **ESC** to cancel selecting the **Language**.

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

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CHAPTER TEN
DATA STORAGE – SETUP, EDIT, & VIEW GRIDS

10.1 Introduction to Grid (spreadsheet) format

Data is stored in the ***PVX*** in a spreadsheet like format called a **GRID**. A **GRID** is simply a table of readings. The location in a grid is specified by giving a row and column coordinate. The rows are numbered from 1 to 99 and the columns are labeled from A to Z, then AA to ZZ giving a maximum of 52 possible columns.

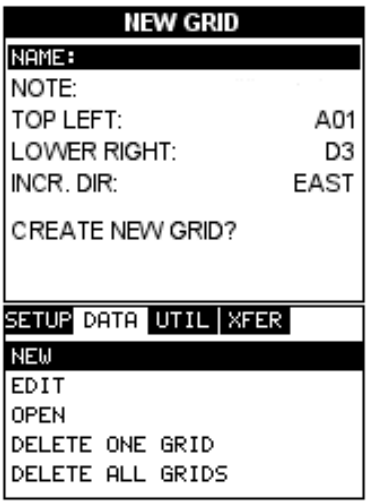
The largest grid that can be held in the ***PVX*** is limited by the total memory of the ***PVX***. Multiple grids can be created and stored until the ***PVX***'s memory is full. If the user attempts to store a grid in the ***PVX*** when the memory is full, the ***PVX*** will respond with an error message indicating that the memory is unable to store the new grid.

The ***PVX*** can store a total of **12,000 readings** with a corresponding waveform stored with every reading. The waveform stored with the reading will depend on what view the ***PVX*** was in at the time it was saved. For example, If the view is **RECT**, then a rectified waveform will be saved with the reading.

10.2 Creating a new Grid

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

Creating a Grid Name



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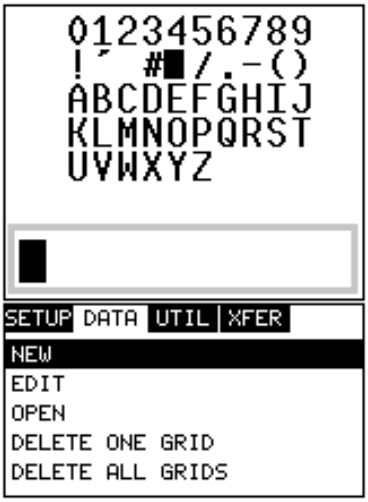
1) Press the **MENU** key once to activate the menu items tab. Press the **MENU** key multiple times to tab right, and the **ESC** key multiple times to tab left, until the **DATA** menu is highlighted and displaying the submenu items.

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

3) Press the **ENTER** key to display the new **Grid Edit Box**.

4) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid List Items** until **NAME** is highlighted.

5) Press the **ENTER** key to activate the **Alpha Edit Box**.



6) Use the **UP, DOWN, LEFT, & RIGHT** arrow keys to highlight the appropriate alpha characters.

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

8) Use the **CLR** key to backspace if necessary.

9) Repeat steps **6 - 8** until the **Grid Name** is completed.

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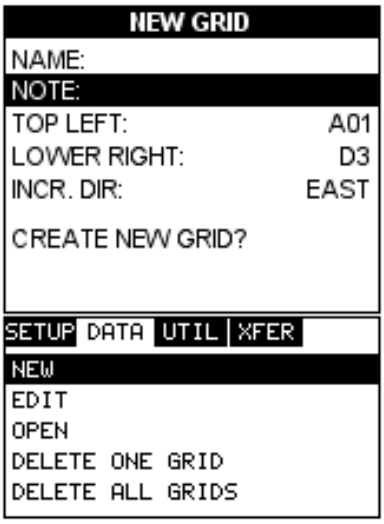
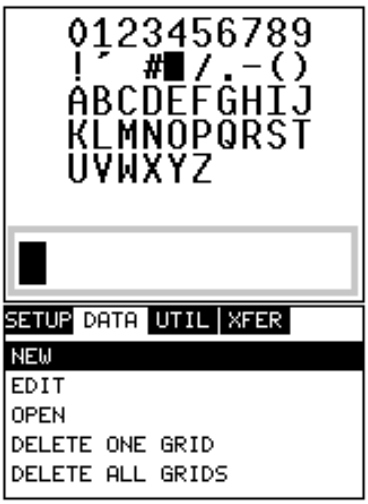
10) Press the **OK** key to save the **Grid Name** and return to the **Grid List Items** menu, or **ESC** to cancel entering the **Grid Name**.

Creating a Grid Note



1) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid List Items** until **NOTE** is highlighted.

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



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

Setting the Coordinates of the Grid

Note: 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.

Setting the Top Left Coordinate

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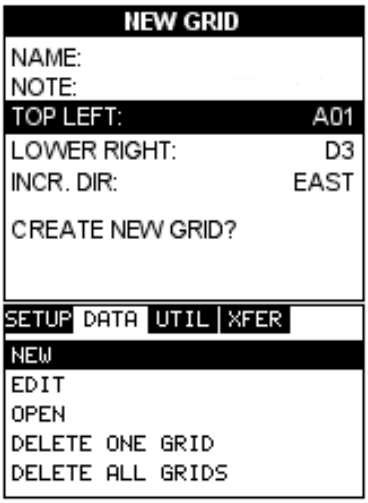
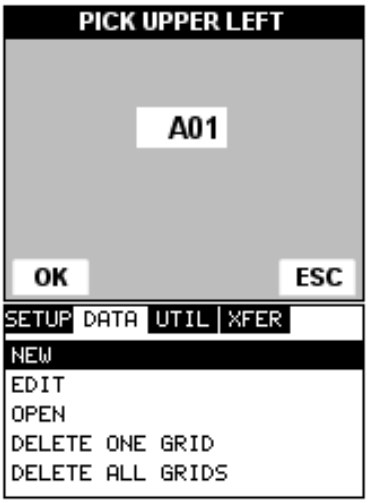


1) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid List Items** until **TOP LEFT** is highlighted.

2) Press the **ENTER** key to activate the **Coordinate Edit Box**.



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

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

Setting the Lower Right Coordinate

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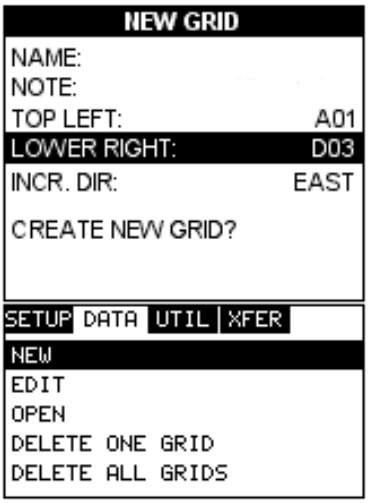
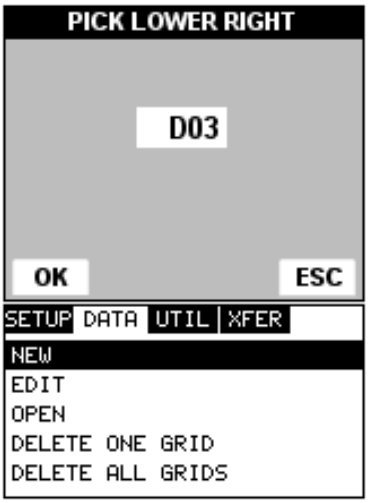


1) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid List Items** until **LOWER RIGHT** is highlighted.

2) Press the **ENTER** key to activate the **Coordinate Edit Box**.



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

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

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Note: If there is not enough memory available to create the grid, an error message box **"NOT ENOUGH MEMORY"** will be displayed. Press the **OK** or **ESC** key to return to the **Grid List Items** menu. It may be necessary to free some memory in the ***PVX*** at this time. Refer to page 92 for more information on **Deleting a Grid**.

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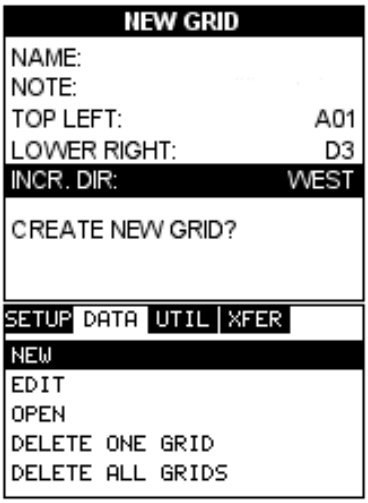
Selecting the Auto Increment Direction

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



5) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid List Items** until **INCR. DIR** is highlighted.

6) Use the **LEFT & RIGHT** arrow keys to toggle the **Increment** direction **NONE, NORTH, EAST, SOUTH, or WEST**.

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

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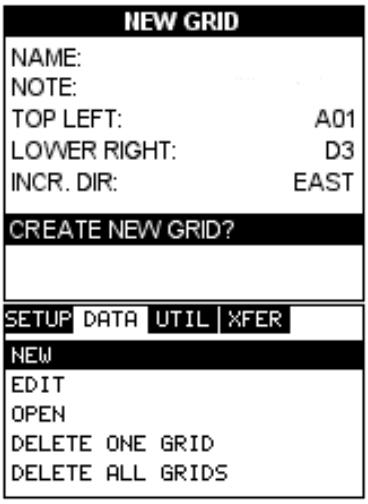
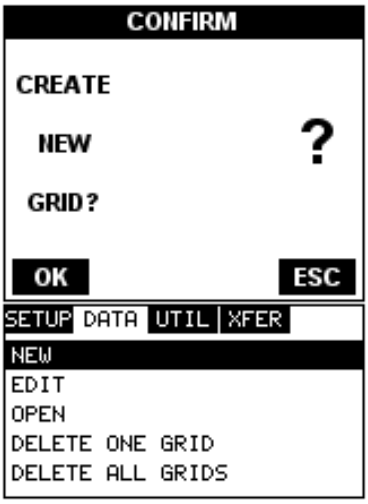
Saving the Grid

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



1) Use the **UP** and **DOWN** arrow keys to scroll through the new **Grid List Items** until **CREATE NEW GRID?** is highlighted.

2) Press the **ENTER** key to accept the grid parameters, and activate the confirmation screen.



3) Press the **OK** key to save the **New Grid**, or the **ESC** key to cancel **the New Grid** setup and return to the **DATA** menu.

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

10.3 Storing a reading

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

Storing a Reading

DELAY:	0.00	WIDTH:	2.06
MODE:	P-E	GAIN:	46
GATE1:	0.00	GATE2:	0.00
THR:	2	LOC:	A1
FILE:			

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

	A	B	C
1	0.027	0.027	0.027
2	0.027	0.999	0.027
3	0.027	0.027	0.196
4	0.027	0.027	0.027

2) Press the **ENTER** key to display the **Grid View Box**.

3) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the target cell cursor to the desired storage location.

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5) Press the **ENTER** key to save the current reading in the highlighted cell location.

6) Abort the **Grid View Box** by pressing the **MEAS** key at any time.

Note: Every time a reading is saved to memory, a picture of the display is automatically saved with the reading.

10.4 Viewing stored readings and waveforms

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

Viewing Stored Readings & Waveforms

DELAY:	0.00	WIDTH:	2.06
MODE:	P-E	GAIN:	46
GATE1:	0.00	GATE2:	0.00
THR:	2	LOC:	A1
FILE:			

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

	A	B	C
1	0.027	0.027	0.027
2	0.027	0.999	0.027
3	0.027	0.027	0.196
4	0.027	0.027	0.027

2) Press the **ENTER** key to display the **Grid View Box**.

3) Press the **UP**, **DOWN**, **LEFT**, and **RIGHT** arrow keys to scroll the stored readings and corresponding display view. Notice as the cursor is moved to

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a different cell, the display will be updated with the display view saved with the reading.

Note: The user can also toggle the display view between **RF, RECT, DIGiTS** if previously saved in one of the listed modes, or **B-SCAN** and **DIGITS** if saved in B-Scan Mode, by pressing the **ESC** and **OK** keys while a location is highlighted.

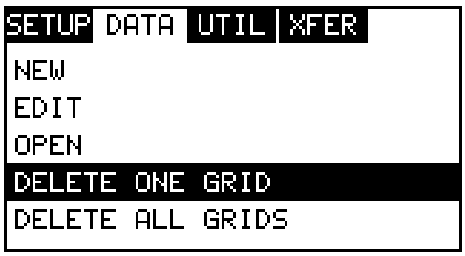
4) The user may opt to clear a specific reading and save a new one at any time. Press the **CLR** key in the appropriate cell location to clear the reading, take a new measurement, and press the **OK** key to save the new reading.

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

10.5 Deleting a grid

Deleting One or All Grids from Memory

Deleting One Grid



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

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

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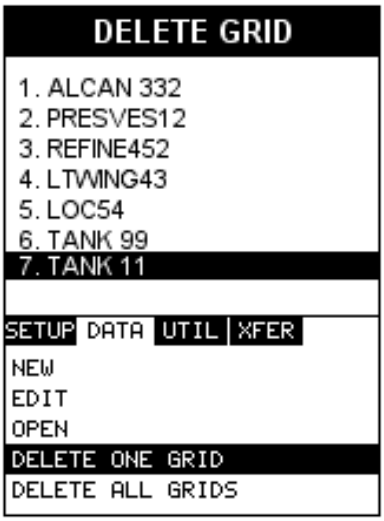


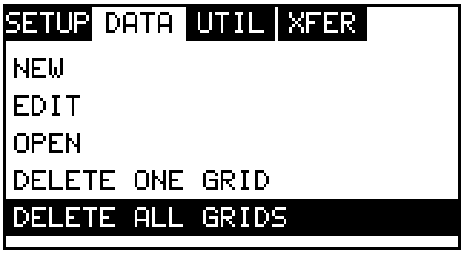
3) Press the **ENTER** key to display the **Grid List Box**.

4) Use the **UP** and **DOWN** arrow keys to scroll through the stored **Grids** until the target **Grid** to delete is highlighted.

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

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

Deleting All Grids



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

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

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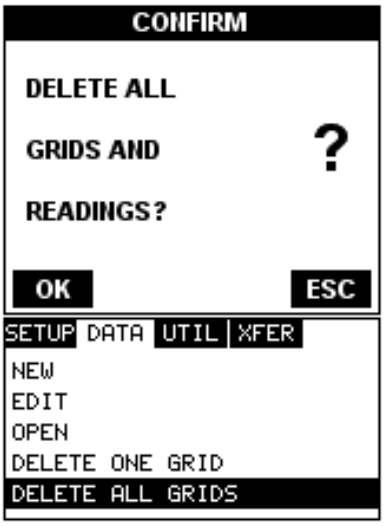


3) Press the **ENTER** key to activate the confirmation screen.

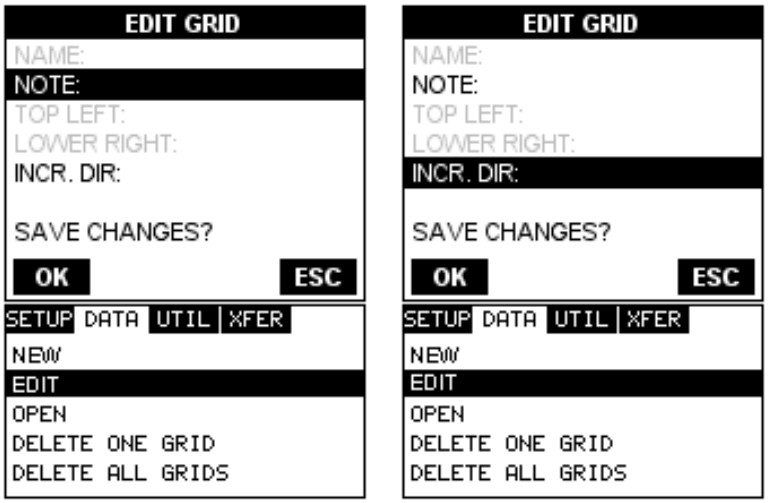
4) Press the **OK** key to delete **All Grids** from memory, or the **ESC** key to abort.

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

10.6 Editing a grid

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

Editing a Grid



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

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

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

4) Use the **UP** and **DOWN** arrow keys to scroll through the **Edit** options until **NOTE** or **INCR. DIR** is highlighted.

Note: If editing the **INCR. DIR**, simply use the **LEFT** or **RIGHT** arrow keys to scroll **NONE, NORTH, EAST, SOUTH,** or **WEST**. **Proceed to step 10**.

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

6) Use the **UP, DOWN, LEFT, & RIGHT** arrow keys to highlight the appropriate alpha characters.

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

8) Use the **CLR** key to backspace if necessary.

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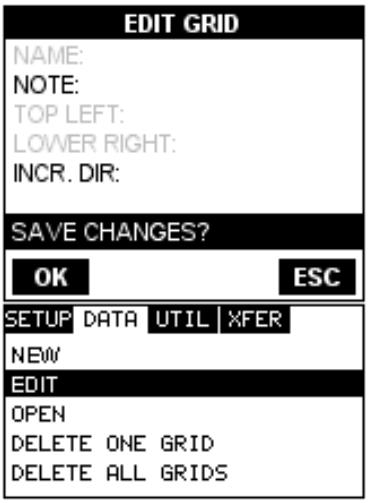
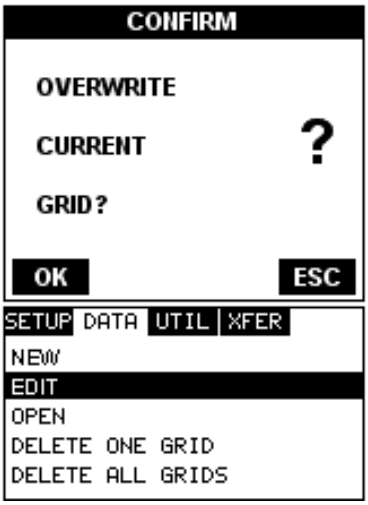
9) Repeat steps **6 - 8** until the **Comments** are completed.



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



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

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

10.7 Changing the active grid (Open)

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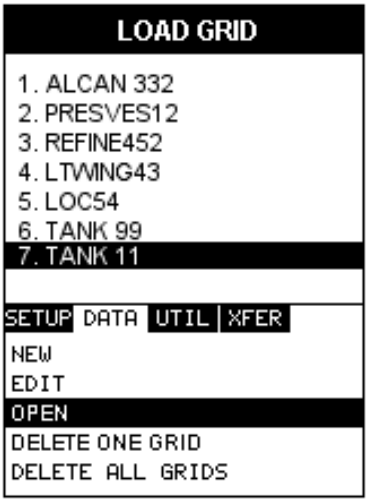
The user may have transferred grid templates from a PC to the ***PVX***, or setup grids using the ***PVX*** at an earlier time. The name of the currently active grid is always displayed at the bottom of the **Hot Menu Items** in measurement mode. It's not only important to recognize what grid is currently active, but also be able to change the active grid at any time. The following procedures outline this process:

Changing the Active Grid



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

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

3) Press the **ENTER** key to display the **Grid List Box**.

4) Use the **UP** and **DOWN** arrow keys to scroll through the grids until the target grid is highlighted.

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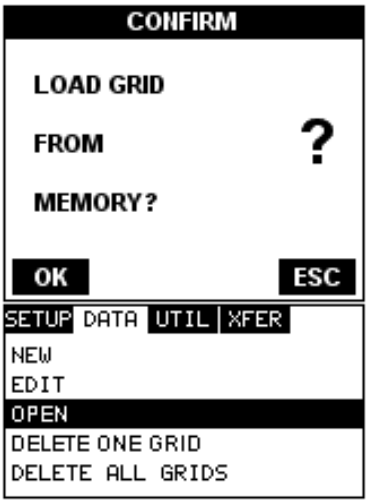

5) Press the **ENTER** key to activate the confirmation screen.

6) Press the **OK** key to load the grid from memory.

7) Press the **MEAS** key to return to the measure screen.

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

11.1 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 ***PVX***, 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 ***PVX*** has been equipped with the ability to save these setups to memory and be recalled at any time. The ***PVX*** has **16 factory setups** and can store **48 custom** user defined 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 of the individual applications. 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.

11.2 Opening a Setup

The ***PVX*** is loaded with a number of setups from the factory. These setups can be opened, edited, and saved to any one of **48 setup locations**. The 16 factory setups are read only and can be opened and modified, but must be save to one of the 48 custom locations. A default factory setups file is also included with the **PVXview** software. It can be restored to the ***PVX*** at anytime using the utility software included with the ***PVX***, should the factory setups become corrupted in any way. The factory setups are general setups only, but have been optimized for used with the most common applications. They will serve as an excellent starting point, requiring only minor adjustments to work for custom applications. The following procedures outline how to open factory and custom setups:

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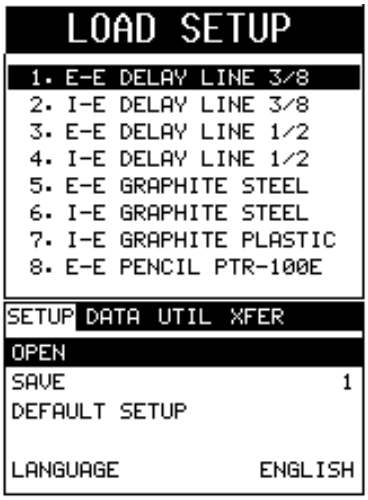
Opening a Setup



Note: The setups can be loaded at any time by simply pressing **the MULTI MODE** key.

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

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

3) Press the **ENTER** key to display the **Setup List Box**.

4) Use the **UP** and **DOWN** arrow keys to scroll through the setups until the target setup is highlighted.

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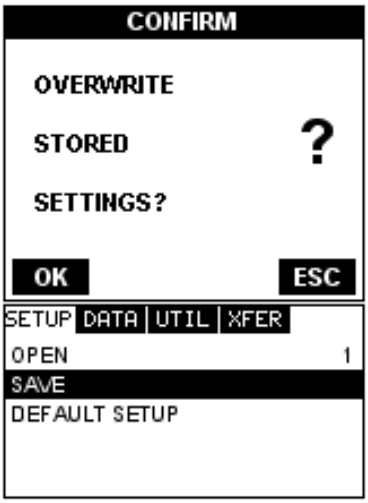

5) Press the **ENTER** key to activate the confirmation screen.

6) Press the **OK** key to load the setup from memory.

7) Press the **MEAS** key to return to the measure screen.

11.3 Saving a Setup

Once the ***PVX*** 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 inspectors 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:

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Saving the Setup

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

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

3) Press the **ENTER** key to display the **Save Setup Parameters List Box**.

4) Press the **UP** and **DOWN** arrow keys to scroll the **Name** and **Note** parameters.

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5) When the parameter to edit is highlighted, press the **ENTER** key to activate the **Alpha Edit Box**.

6) Use the **UP, DOWN, LEFT,** and **RIGHT** arrow keys to scroll through the characters, the **ENTER** key to select characters, and the **CLR** key to backspace through the characters, until the **Name** or **Note** fields have been edited.

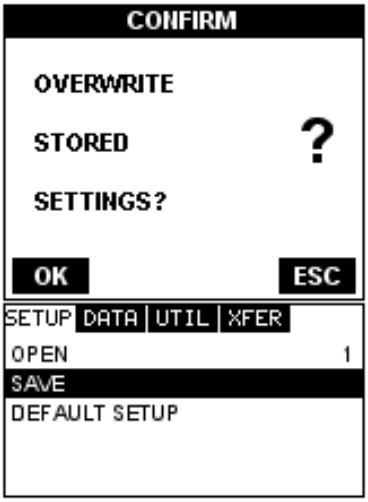
7) Press the **OK** key to return to the **Save Setup Parameters List Box**.

8) If both parameters will be edited, **repeat steps 4 – 7**.

9) Use the **UP** and **DOWN** arrow keys to scroll to and highlight **SAVE SETUP**.

10) Press the **ENTER** key to activate the **Setup List Box**.

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



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

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

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

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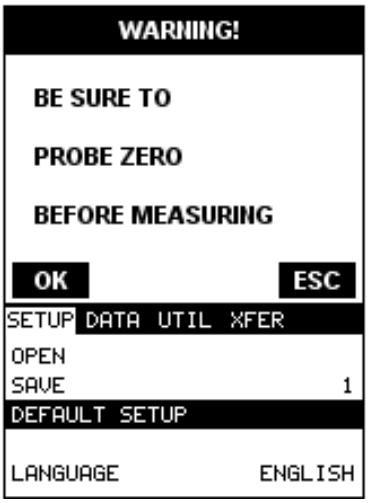
Note: The **Name** and **Comments** of the **Setup** can be edited at any time by simply repeating the **Save Setup** routine described above. Therefore, **the Save Setup** function can also be considered an **Edit Function**.

11.4 Using the Default Setup

The default setup feature was added to the ***PVX*** 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 ***PVX*** was somehow corrupted, and the user does not have access to a computer to re-load the factory setups back into the ***PVX***. This gives the user the ability to load and modify a basic setup as follows:

Using the Default Setup



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

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

3) Press the **ENTER** key to load the Default Setup and display the **Warning Message Box**.

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Important Note: Remember to perform a probe zero function prior to measuring. The default setup clears the probe zero value.

Important Note: If interface-echo or echo-echo modes are being used, be sure to do a two-point calibration, which also sets the probe zero before measuring.

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

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CHAPTER TWELVE
USING THE UTILITY SOFTWARE

12.1 Computer System Requirements

DakView 3 or PVXview will run on many different operating systems: Windows 95, Windows 98 (1st or 2nd edition), Windows NT 4.0 with Service Pack 5, Windows ME, Windows XP, Windows 2000 Professional, Windows 2000 Server, or Windows 2000 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 3 or PVXview**.

DakView 3 or PVXview requires an available communications port in order to transfer data to and from the ***PVX***. **DakView 3 or PVXview** supports COM1, COM2, COM3, and COM4.

USB to Serial Converter

Some newer laptop computers do not have standard serial ports. In this case it is possible to use a USB to Serial converter. If a serial to USB cable is needed, Contact Dakota Ultrasonics (pt# N-402-0510).

12.2 Installing DakView 2.X

DakView 3 or PVXview 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 3** or **PVXview**, for the complete operating manual, setup, and operation.

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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

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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**

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APPENDIX B -
SETUP LIBRARY

Num	Name	Comment 1	Gn/AGC	Velocity
1	E-E DELAY LINE 3/8		3	0.2330 in/uSec
2	I-E DELAY LINE 3/8		3	0.2330 in/uSec
3	E-E DELAY LINE 1/2		3	0.2330 in/uSec
4	I-E DELAY LINE 1/2		3	0.2510 in/uSec
5	E-E GRAPHITE STEEL		3	0.0940 in/uSec
6	I-E GRAPHITE STEEL		3	0.0940 in/uSec
7	I-E GRAPHITE PLASTIC		3	0.0920 in/uSec
8	E-E PENCIL PTR-100E		3	0.2330 in/uSec
9	I-E PENCIL PTR-100E		3	0.2330 in/uSec
10	E-E PENCIL PTR-300E		6	0.2330 in/uSec
11	I-E PENCIL PTR-300E		5	0.2330 in/uSec
12	E-E CONTACT STEEL		6	0.2330 in/uSec
13	P-E CONTACT STEEL		33	0.2330 in/uSec
14	P-E CONTACT PLASTIC		38	0.0920 in/uSec
15				
16				

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MATERIAL SAFETY DATA SHEET

N/A = not applicable or not available (To comply with 29 CFR 1910.1200) Effective Date: 2/1/04

SECTION 1 – PRODUCT IDENTIFICATION

Product Name: **SOUNDSAFE®**
Generic Name: Ultrasonic Couplant
Manufacturer: Sonotech, Inc.

NFPA Hazardous Materials Identification System (est)
Health……0
Flammability……0
Reactivity……0

SECTION 2 – HAZARDOUS INGREDIENTS

This material does not contain any ingredients having known health hazards in concentrations greater than 1%.

This material does not contain any known or suspected carcinogens.

SECTION 3 – PHYSICAL DATA (nominal)

Boiling Point: >220°F
Freezing Point: <20°F
Vapor Pressure: N/A
Evaporation Rate: N/A
pH: 7.35 – 7.9
Acoustic Imp.: 1.726×10^6
Vapor Density: N/A
Specific Gravity: >1.02
Solubility in Water: complete
Appearance and Odor: water white, opaque gel; bland odor

SECTION 4 – FIRE AND EXPLOSION HAZARD DATA

Flash Point: none
Upper Exposure Limit: none
Lower Exposure Limit: none
Special Fire Fighting Procedures: N/A
Extinguishing media: N/A
Unusual Fire and Explosion Hazards: none

SECTION 5 – REACTIVITY DATA

Stability: Stable
Conditions to Avoid: none
Incompatibility (Materials to Avoid): none known
Hazardous Polymerization: will not occur
Hazardous Decomposition or Byproducts: none known

SECTION 6 – HEALTH HAZARD AND FIRST AID DATA

Routes of Entry:[1]
Skin: not likely
Eyes: not normally
Ingestion: not normally
Inhalation: no
Effects of Overexposure: *Acute*: May cause temporary eye irritation
Chronic: none expected

First Aid Procedures:
Skin: Remove with water if desired.
Eyes: Flush with water for 15 minutes.
Ingestion: For large quantities, induce vomiting and call a physician.
Inhalation: N/A

SECTION 7 – STORAGE AND HANDLING INFORMATION

Precautions to be taken in handling and storage: Store between 20°F and 120°F. Spills are slippery and should be cleaned up immediately.
Steps to be taken in case material is released or spilled: Pick up excess for disposal. Clean with water.
Waste disposal method: Dispose of in accordance with federal, state, and local regulations.

SECTION 8 – CONTROL MEASURES

Respiratory Protection: not required
Ventilation: not required
Protective Gloves: on individuals demonstrating sensitivity to SOUNDSAFE®
Eye Protection: as required by working conditions
Other Protective Equipment: not required

[1]**SOUNDSAFE®** contains only food grade and cosmetic grade ingredients.

SONOTECH, INC.

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