Model FD800DL & FD800DL+

Corrosion and Flaw Gauge

Operating Instructions

This product meets the Electromagnetic Compatibility Directive.

The product is Class A, Group 1 ISM equipment according to CISPR 11.

Group 1 ISM product: A product in which there is intentionally generated and/or used conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself.

Class A product are suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Note: In the close presence of some radio transmitters, erroneous readings may be given. If this occurs tests should be repeated at another location.

These operating instructions are available for download on our website www.elcometerndt.com

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elcometer NDT

Material Safety Data Sheets for the ultrasonic couplant supplied with the FD800DL & FD800DL+ and available as an accessory, are available to download via our website:

Elcometer NDT Ultrasonic Couplant Material Safety Data Sheet:

www.elcometerndt.com/images/MSDS/elcometer_ultrasonic_couplant.pdf

www.elcometerndt.com/images/MSDS/elcometer_ultrasonic_couplant_blue.pdf

Elcometer NDT Ultrasonic Couplant Material Safety Data Sheet:

www.elcometerndt.com/images/MSDS/elcometer_ultrasonic_couplant_hi_temp.pdf

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Thank you for purchasing this Elcometer NDT product. Welcome to Elcometer NDT.

The FD800DL/FD800DL+ Corrosion and Flaw Gauge is a world beating product. With the purchase of this gauge you now have access to the worldwide service and support network of Elcometer. For more information visit our website at www.elcometer.com

SECTION : 1 ABOUT YOUR GAUGE

1 INTRODUCTION

The FD800DL/FD800DL+ Corrosion and Flaw Gauge are combined corrosion gauges and flaw detectors that measures with extreme versatility.

- When the GAUGE function is set to THICKNESS GAUGE, the FD800DL/FD800DL+ becomes a **Corrosion Gauge** which has the ability to measure coatings and material thickness simultaneously while maintaining the ability to locate pits, flaws and defects in the material. Based on the same operating principles as SONAR, the FD800DL/FD800DL+ Corrosion and Flaw Gauge is capable of measuring the thickness of various materials with accuracy as high as ± 1% or ± 0.1 millimetres (± 0.005 inches) whichever is the greater.
- When the GAUGE function is set to FLAW DETECTOR, the gauge becomes a **Flaw Detector** which has the ability to detect the size and position of flaws and to differentiate between flaw types in various materials and welded joints.

The principal advantage of ultrasonic thickness measurement over traditional methods is that ultrasonic measurements can be performed with access to only one side of the material being measured.

The gauges include a data-logging (memory) facility which allows readings and waveforms to be stored in batches before being downloaded to a computer.

1.1 STANDARDS

Your gauge can be used in accordance with the following Standards and test methods:

ASTM E 797, EN 14127 and EN 15317.

1.2 WHAT THIS BOX CONTAINS

FD800DL or FD800DL+, Ultrasonic Couplant 120 ml (4 fl oz), Carrying case, Test Certificate, Operating instructions, Universal charger, Mains lead (UK, EUR & US), RS232 cable and USB to serial converter.

Note: The box does **not** *include a transducer; these must be ordered separately. To order a transducer, contact Elcometer NDT or your local Elcometer NDT supplier.*

1.3 FEATURES OF THE GAUGE

- Two gauges in one: Corrosion (thickness) gauge and Flaw Detector
- Wide range of thickness measurement modes: Pulse-Echo, Echo-Echo, Echo-Echo Verify, Coating Only, Pulse-Echo with Temperature Compensation, and Pulse-Echo with Coating
- Automatic probe zero, probe recognition, and temperature compensation.
- Adjustable gain settings.
- Stores up to 64 custom setups for specific applications.
- High speed scan mode of up to 50 readings per second.
- Audible/visual alarm with high and low limit settings.

- Differential mode for QC inspections.
- Colour display.
- Radio frequency RF and RECT A-Scan displays.
- Time based B-Scan display for cross section material scans (thickness gauge).
- Measurement data storage formats: Alpha numeric grid and sequential with auto identifier. Data can be downloaded to a computer for analysis and storage.

To maximise the benefits of your new Elcometer NDT gauge, please take some time to read these Operating Instructions. Do not hesitate to contact Elcometer NDT or your Elcometer NDT supplier if you have any questions.

1.4 PACKAGING

The gauge is packed inside its carrying case within a cardboard box. Please ensure that the packaging is disposed of in an environmentally sensitive manner. Consult your Local Environmental Authority for further guidance.

2 THE KEYPAD

MENU	Activates the primary menu structure containing 15 menu tab groups. These tab groups then contain sub menu items, or functions. The sub menu items are organised in tab groups according to how closely they are related to the individual tab group names.
CLEAR	Clears a measurement from a grid or sequential log files cell location or set obstruct, and backspace in an Alpha Edit Box. If you have already saved a measurement and waveform to a cell location, use this key to clear the measurement at any time. In Flaw mode, clears a DAC reference point used to generate a curve.
MEAS	Press to start taking measurements. The readings are displayed on the screen. Also used to navigate forward through the hot menu.
OK	Press to confirm a change or selection. When in measurement mode, the gauge displays the DIGITS. If your gauge is displaying a grid log, this key toggles an advance to row number option.
ESC	In the MENU, MEAS, and EDIT functions this key acts as a back or escape function. If your gauge is displaying a grid or sequential log, the ESC key toggles the display options; RF, +RECT, -RECT, RECTFW, B-SCAN or DIGITS (display options depend upon gauge operating mode - Thickness Gauge / Flaw Detector).
	In the menus, scrolls through the menus, increases/decreases values, and toggles functions. Left wheel up/down scrolls through HOT MENU. LEFT/RIGHT changes menu list in HOT MENU. In Flaw Detector mode right wheel UP/DOWN changes GAIN VALUE. LEFT/RIGHT changes value/option in highlighted HOT MENU option.
	In MENU left wheel LEFT/RIGHT scrolls through menu tabs. UP/DOWN scrolls through menu screen. Right wheel LEFT/RIGHT scrolls through highlighted options.
ENTER	In menus this key activates list and edit boxes, displays and saves measurements to grid or sequential files locations. While making measurements, goes to Store Data Menu.
MULTI MODE	In Thickness mode, press to select measurement mode menu.
	Switches the gauge ON or OFF. *Note: The gauge will automatically switch off when idle for 5 minutes. All current settings are automatically saved prior to switching off.*
DATA	This key activates the DATA tab in the main menu. Takes the user directly to DATA menu when no log set up or stored data in log when log open.

	The STORE key displays the current log/grid open in split screen mode.
	The PEAK key is a feature used only in the FLAW detector portion of the gauge and is not used in the THICKNESS gauge.
	The FREEZE key is used to freeze the display for evaluation/review of the current display. It can also be used in conjunction with the CAPTURE feature to save the current display to a .tif (tagged image) graphic file that can be opened using any graphic viewer.

3 GETTING STARTED

3.1 FITTING BATTERIES

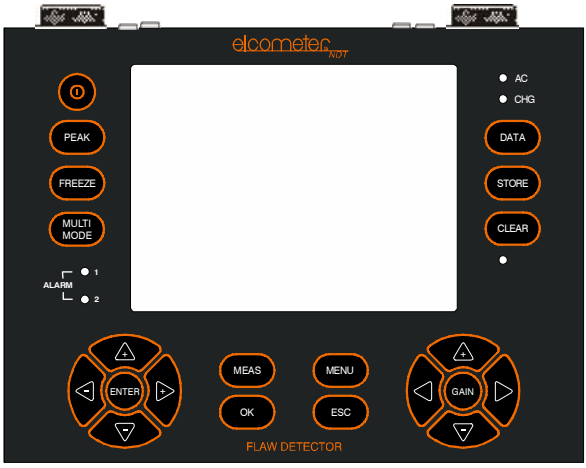
Your gauge is powered via the built-in Lithium Ion battery pack, however, emergency back-up batteries - 6 x 1.5V Alkaline 12V AA Nicad cells can be fitted.

When the battery voltage is low the entire display will start to flash. When this occurs the batteries should be replaced.

To fit or replace batteries:

1. Unscrew battery compartment cover.
2. Referring to battery polarity instructions on rear of gauge, insert batteries.
3. Replace battery compartment cover.

The built-in Lithium Ion battery pack is charged using the Universal charger and mains leads supplied.



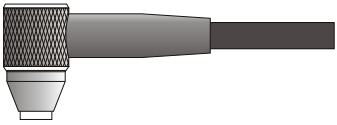
Note: Remove the batteries from the gauge if it is to remain unused for a long period of time. This will prevent damage to the gauge in the event of malfunction of the batteries.

3.2 CHOOSING THE TRANSDUCER

When you purchased your gauge you should have also purchased a suitable transducer for your application. If you have not yet done so, to help you identify the correct transducer type, contact Elcometer NDT, your local Elcometer NDT supplier or visit www.elcometerndt.com

3.3 FITTING THE TRANSDUCER

The transducer transmits and receives ultrasonic sound waves that the gauge uses to calculate the thickness of the material being measured.



The dual element transducer connects to the gauge via the attached cable, and two coaxial connectors. When using transducers manufactured by Elcometer, the orientation of the dual coaxial connectors is not critical; either plug may be fitted to either socket.

Single element transducers have separate cables and are connected to the gauge using the socket further away from the battery cap - as indicated on the label on the rear of the gauge.

3.4 SWITCHING ON/OFF

To switch on or off, press the on/off key .

The gauge will switch off automatically after 5 minutes of inactivity.

4 SELECTING GAUGE OPERATING MODE (THICKNESS GAUGE / FLAW DETECTOR)

Your gauge combines a thickness gauge and a flaw detector in one unit. To select operating mode:

1. Select MENU/UTIL/GAUGE and press ENTER.
2. Use UP and DOWN to select THICKNESS GAUGE, FLAW DETECTOR or REQUEST.
3. Press OK to confirm.
4. Press MEAS to return to the measurement screen.

Note: When set to REQUEST, the gauge will ask which mode is required whenever it is switched on.

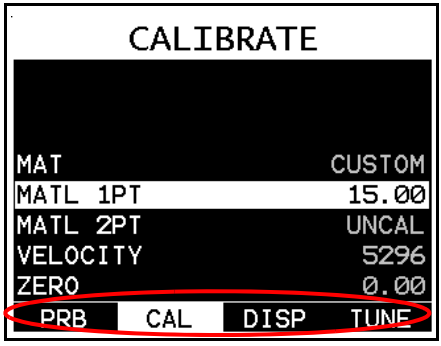
5 THE MENUS

Your gauge has two menu systems:

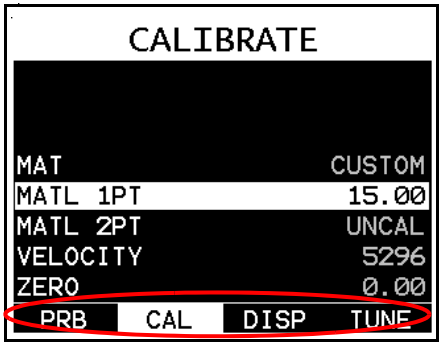
- Full menu - displays all the functions and settings of the gauge (see also page 58 and page 73.)
- Hot menu - displays a sub-set of functions and settings related to taking measurements.

5.1 FULL MENU

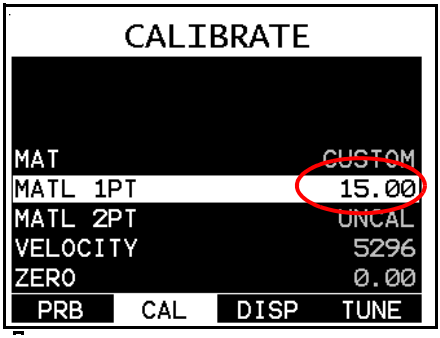
Press MENU once to access the menus. Then press MENU or RIGHT button on left wheel to scroll to the right along the sub menu bar and ESC or LEFT button on left wheel to scroll left to the sub menu you want.



Use UP and DOWN on the left wheel to scroll to the function you want within the sub menu.

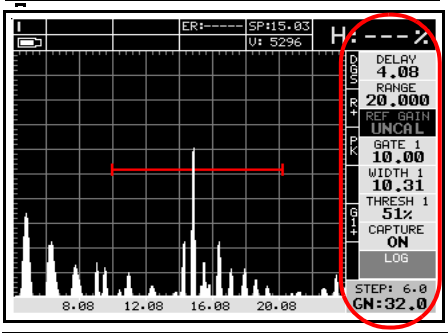


Then press enter or use LEFT and RIGHT on the right wheel to scroll to the option you want.

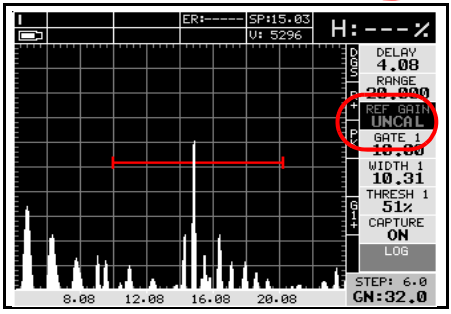


5.2 HOT KEY MENU

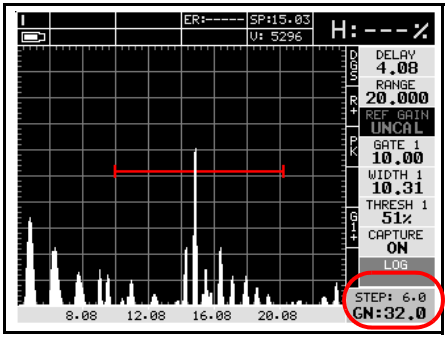
Press MEAS once to access the measurement screen. The hot menu functions are displayed on the right of the reading screen.



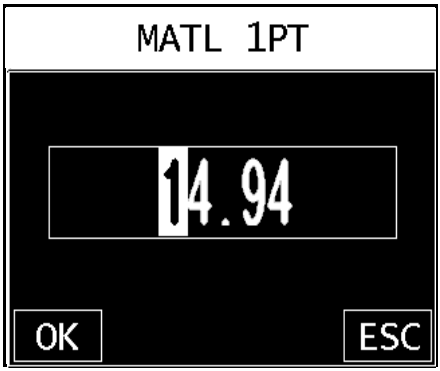
Press MEAS to scroll down along the hot menu functions and ESC to scroll up until the function you want is highlighted, or use the UP/DOWN on the LEFT wheel.



Use LEFT or RIGHT on RIGHT wheel to adjust the value of the function.



Alternatively, adjust values by pressing ENTER then use UP, DOWN, LEFT and RIGHT on either wheel to scroll and adjust values. Press OK when finished.



5.3 SELECTING MENU LANGUAGE

The menus can be displayed in English, Spanish, German and French.

1. Select MENU/SET/LANGUAGE.
2. Use LEFT and RIGHT on the right wheel to scroll the language options.
3. Once the desired language is displayed, press MEAS to return to the measurement screen.

5.4 ADJUSTING THE DISPLAY

Your gauge has an AMOLED display which you can customise to your preferences:

CHANGING THE DISPLAY BRIGHTNESS

To adjust the display brightness:

1. Select MENU/DISP/BRIGHTNESS.
2. Use LEFT and RIGHT on the right wheel to scroll to the value you require. The scale is an arbitrary scale from 0 to 20.
3. Press MEAS to return to the measurement screen.

CHANGING THE DISPLAY COLOUR SCHEME

Your gauge includes a range of display colour schemes. You can select one colour scheme from this range:

1. Select MENU/DISP/COLORS.
2. Press ENTER to access choose colour screen.

   The Choose Colour screen shows the range of colour schemes available. The current colour scheme is highlighted.
3. Use UP and DOWN to scroll to the required colour scheme.
4. Press ENTER to select the colour scheme.
5. Press OK to confirm your selection and return to the menu screen, or ESC to cancel.
6. Alternatively, use the LEFT and RIGHT on the right wheel to scroll through available colour schemes.
7. Press MEAS to return to the measurement screen.

CHANGING THE DISPLAY DIM TIME

Your gauge includes a DIM function which can be used to extend battery life. The DIM function is used to set the time delay in seconds between the last measurement and an automatic reduction in screen brightness that can save battery power.

Note: This function does not override the preset 5 minute idle power off feature.

To set the DIM time:

1. Select MENU/DISP/DIM.

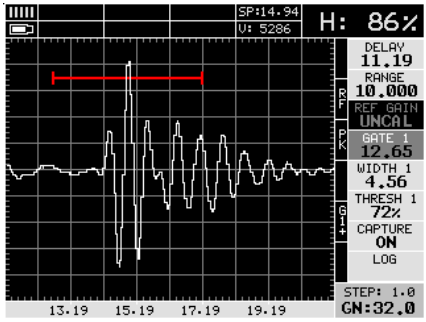
2. Use LEFT and RIGHT on right wheel to scroll to the value you require.
3. Press MEAS to return to the measurement screen.

CHANGING THE RECT WAVEFORM TYPE

The RECT waveform can be displayed FILLED or UNFILLED, as illustrated (screenshots taken with gauge set to FLAW mode).

To adjust the RECT WAVE setting:

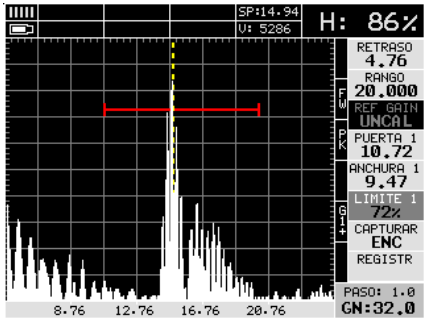
1. Select MENU/DISP/VIEW and RECT. Then select RECT WAVE.
2. Use LEFT and RIGHT on the right wheel to scroll to FILLED or OUTLINE.
3. Press MEAS to return to the measurement screen.



Unfilled

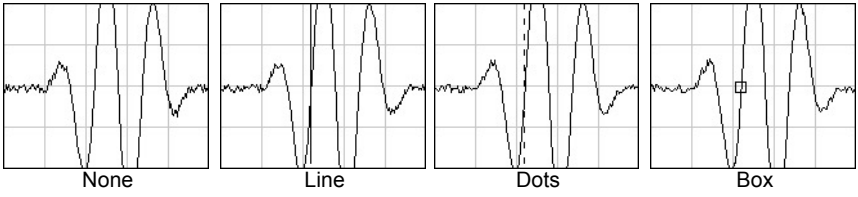
CHANGING THE DETECT MARK ON THE WAVEFORM

The type of detect mark on the waveform can be adjusted (NONE, LINE, DOTS or NONE), as illustrated. The detect mark is useful as it provides a clear indication to the user as to where a detect is taking place and what the thickness reading displayed in the top right of the thickness gauge display is derived from. The thickness reading shown by the flaw detector when "OK" is pressed is also shown with the detect mark.



Filled

To adjust the DETECT MARK setting:



1. Select MENU/DISP/DETECT MARK.
2. Use LEFT and RIGHT on the right wheel to locate the type of DETECT MARK.
3. Press MEAS to return to the measurement screen.

5.5 FRONT PANEL ALARM LIGHTS

The green light illuminates when the alarm mode is active and the measurement is within limits.

The red light illuminates when the alarm mode is active and the measurement is outside limits.

SECTION : 2 THICKNESS GAUGE

6 THE MEASUREMENT SCREEN

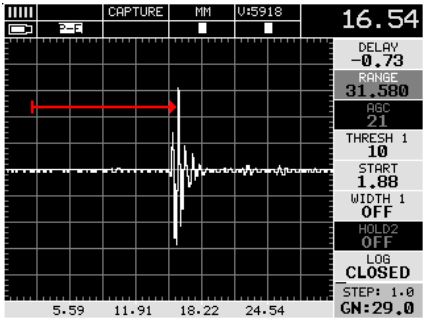
When the GAUGE function is set to THICKNESS GAUGE, the FD800DL/FD800DL+ Corrosion and Flaw Gauge becomes a corrosion gauge that measures with extreme versatility. It has the ability to measure coatings and material thickness simultaneously while maintaining the ability to locate pits, flaws and defects in the material.

Based on the same operating principles as SONAR, the FD800DL/FD800DL+ Corrosion and Flaw Gauge is capable of measuring the thickness of various materials with accuracy as high as 0.01 millimetres (0.001 inches). The principal 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.

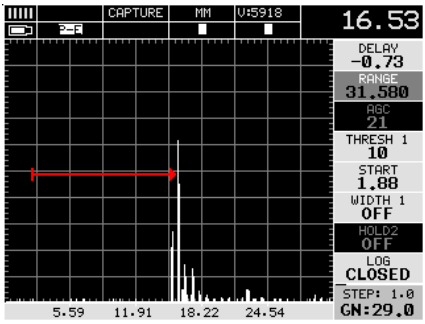
Your gauge has four types of measurement screen:

- A-Scan Waveform, RF
- A-Scan Waveform, RECT
- B-Scan
- Digits

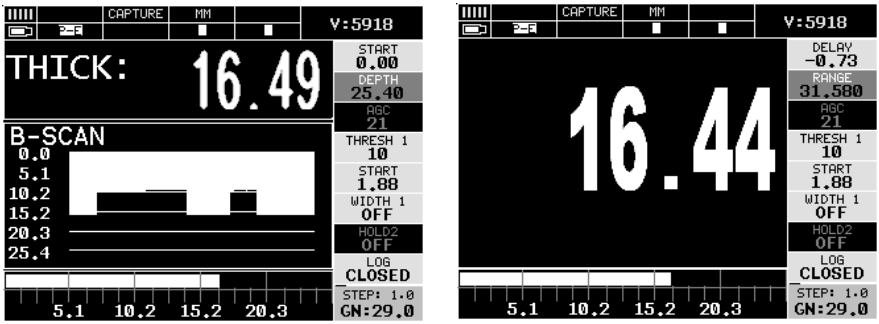
A-SCAN RF



A-SCAN RECT



B-SCAN **DIGITS**

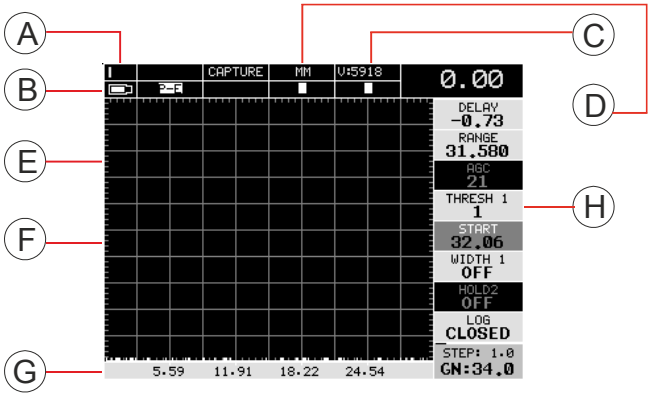


To see the measurement screen, press MEAS.

To select which measurement screen to use, press MENU/DISP/VIEW and then select RF, RECT, B-SCAN or DIGITS.

6.1 ITEMS COMMON TO ALL MEASUREMENT SCREENS

A number of items are common to all the measurement screens:



A	Repeatability/Stability Indicator	This indicator is used in conjunction with the digital thickness values displayed. When all the vertical bars are fully illuminated and the last digit on the digital thickness value is stable, your gauge is reliably measuring the value.
B	Battery Icon	Remaining battery life.
C	Material Thickness Value/ Material Velocity Value	The thickness or sound velocity of the material under the transducer (type depends upon measurement view).

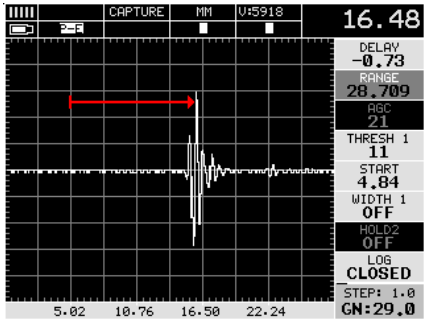
D	Units	The current measurement units (Metric/English).
E	Feature Status Bar	Indicates the features currently enabled and in use: • Measurement Mode (P-E, PECT, PETP, E-E, E-EV, CT) • Differential Mode (ON/OFF) • High Speed Scan Mode (ON/OFF) • Alarm Mode (ON/OFF/AUDIBLE) • Gain Setting (Displays the set value) See “Measurement - Modes” on page 18 etc for further information.
F	Measurement View Area	RF, RECT, B-SCAN or DIGITS view area.
G	Measurement Labels Bar	Displays the viewable range and are based on the values of DELAY/B-START and RANGE/B-DEPTH.
H	Hot Menu	The hot menu contains a selection of the most commonly used options, allowing you to conveniently adjust these to your needs while the graphical display is active.

6.2 RF A-SCAN MEASUREMENT SCREEN

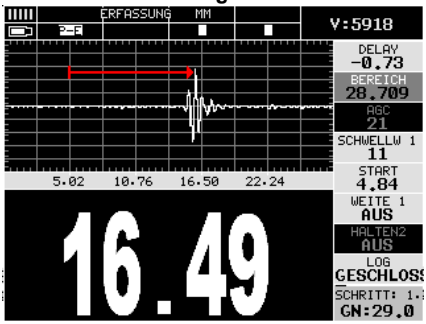
The RF view shows the full sound wave as received by the gauge. The vertical axis indicates the amplitude of the received wave and the horizontal position indicates the time it is received, which is converted into thickness units using the material velocity.

The point on the scan that is being used to calculate the digital thickness reading is displayed as the vertical dashed line (see section 9 on gates). The RF screen is used for gauge setup prior to inspection.

Full Screen Wave Only



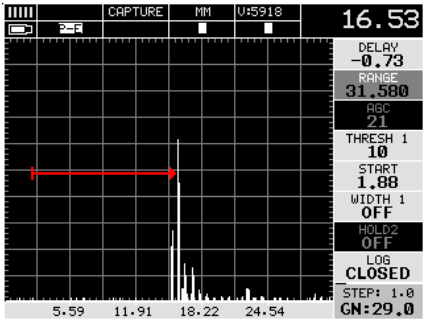
1/2 Wave 1/2 Digits

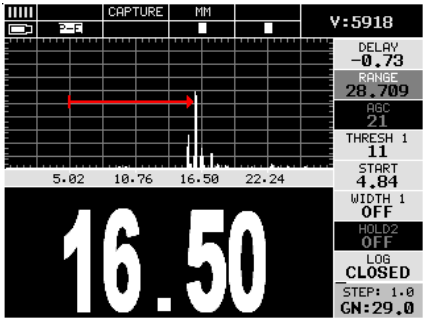


6.3 RECT A-SCAN MEASUREMENT SCREEN

The rectified view shows only half of the waveform, either the positive or negative half depending on the POLARITY selected.

The RECT display is the preferred view for flaw and pit inspections.





6.4 B-SCAN MEASUREMENT SCREEN

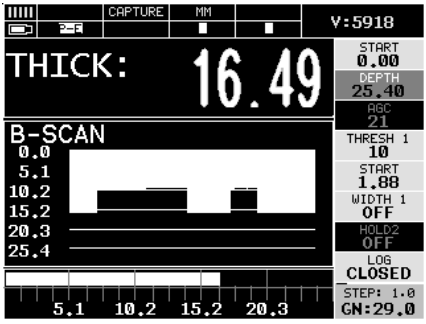
The time-based B-Scan display provides a cross sectional view of the material being tested. In this example, the top, or accessible side of the material is represented as 0.00 mm, and the bottom, or blind surface at 15.2 mm.

This mode is used when you need to inspect the profile of the blind surface. It can also be a useful view when scanning for pits and flaws.

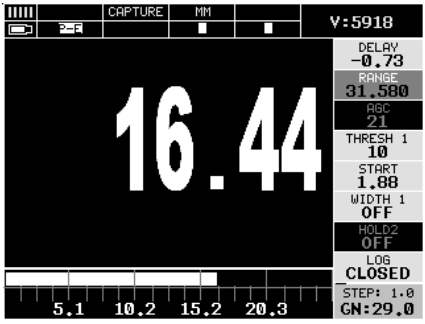
The B-Scan display is equipped with a scan bar representing the overall thickness. The scan bar gives the user a visual indication when a flaw or defect passed over during the scan process.

If you are scanning a pipe, for instance, and pass over a pit during the process, the scan bar will quickly deflect and alert you to go back and search for the defect.

B-SCAN



DIGITS



6.5 DIGITS MEASUREMENT SCREEN

The digits display shows the thickness as a value using a large font size. This view is used typically when the gauge is being used as a basic thickness gauge. The digits display includes the same scan bar as the B-Scan display.

6.6 CHANGING THE VIEWABLE RANGE

In RF view, RECT view and B-SCAN view, if the waveform around the detection point is not visible on the display, use one of the following methods to adjust the viewable range of the display:

- When in RF view or RECT view, change the values of the DELAY and RANGE functions until the measurement falls inside the viewable range of the display - see instructions below.
- When in B-SCAN view, change the values of the B-START and B-DEPTH functions until the measurement falls inside the viewable range of the display. B-START is the equivalent of DELAY and B-DEPTH is the equivalent of RANGE and the instructions for changing these values is identical to those for DELAY and RANGE - see instructions below.
- Use the Auto Find function - see “Auto Find” on page 27.

Note: Even if the waveform is outside of the viewable range of the display, a measurement can be taken and viewed using the DIGITS view.

DELAY AND RANGE

The Delay is the thickness value from which the A-Scan display starts on the left of the screen. The Range is used to adjust the value at the right side of the screen. Using these two parameters allows the user to zoom in to a specific measurement range and increase the level of detail on the display. For example, if a wall thickness was nominally 25mm and an operator was assessing for corrosion on this wall they might set the delay to 10mm and the range to 20mm to give a view from 10 to 30mm depth.

B-Start and B-Depth are analogous to Delay and Range for a B-Scan display respectively.

Delay and Range or B-Start and B-Depth may be adjusted in the hot menu or in the DISP section of the main menu.

ADJUSTING DELAY AND RANGE (OR B-START AND B-DEPTH)

The quickest way to adjust DELAY and RANGE is directly from the hot menu. Alternatively, adjust the values using the menus:

1. Select MENU/DISP/DELAY or RANGE and adjust using the LEFT and RIGHT on the right wheel or use the DIGITS EDIT BOX.
2. Press MEAS to return to the measurement.

6.7 ADJUSTING B-SCAN SCROLL SPEED

The scrolling speed of the time-based B-Scan can be adjusted to suit your measurement techniques.

To adjust the scroll speed:

1. Select MENU/DISP/BSCAN SPEED.
2. Choose a value between 1 and 10 (10 is fastest) using the right wheel or the DIGITS EDIT BOX.
3. Press MEAS to return to the measurement screen.

6.8 GAIN

The gain (the amplitude of the transmitted pulse) can be adjusted to suit a variety of applications. To obtain valid readings the gain must be set to the correct level to give reliable return echoes:

- Too much gain may result in erroneous measurements by detecting noise rather than the material back wall itself.
- Not enough gain may result in intermittent detection. It may also result in lack of detection on internal flaws, pits, or porosity.

The gain setting on your gauge can be compared to the volume control of a home stereo system. If you turn it up too much you cannot hear the music clearly. If it is turned down too much, you cannot hear it at all.

Note: When the echo-echo ThruPaint™ measurement mode is selected, the manual gain feature is disabled and greyed out in the menu items. In this mode, your gauge switches to an automatic gain mode (AGC) that optimises the gain setting automatically.

Your gauge has been optimised for a medium gain setting and for the majority of applications it can be used at this setting. Some applications however may require lower or higher gain settings:

- **Lower values** might be necessary for noisy or granular cast materials. If the reading becomes sporadic and will not settle down or resolve on a thickness value.
- **Higher values** may be necessary when trying to measure a material that is hard to penetrate (due to the material type, or the overall thickness of the material) and when locating fine pits or flaws. In these instances, increase the gain until the stability indicator reports a good measurement.

TO ADJUST THE GAIN VALUE

The quickest way to adjust GAIN is directly on the right wheel using the UP and DOWN functions. Alternatively, adjust the value using the menus:

1. Select MENU/TUNE/GAIN.
2. Adjust to suit the measurement application.
3. Press MEAS to return to the measurement screen.

6.9 THRESHOLD

The threshold is the level of signal amplitude required to trigger a gate and activate the digital thickness reading. Increasing the threshold value decreases the sensitivity of the gauge as a more powerful signal is required to trigger the gate. For example on the A-scan display it may be clear that there is a flaw in the material but the thickness reading is not taking this into account; lowering the threshold has the effect of increasing the sensitivity of the gauge to a level that the flaw can be detected. More information on thresholds can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

TO ADJUST THE THRESHOLD VALUE

The quickest way to adjust a threshold value is directly from the hot menu. Alternatively, adjust the values using the menus:

1. Press MENU/GT1/THRESHOLD1 (THRESHOLD2 and THRESHOLD3 are accessed and adjusted in the same way from the menus for GT2 and GT3 respectively).
2. Adjust to suit the measurement application.
3. Press MEAS to return to the measurement screen.

6.10 GATES

Your gauge is equipped with gates which control the time measurement process.

For instructions on how to use gates, see “Gates” on page 26.

7 MEASUREMENT - MODES

Your gauge has two basic measurement modes, Pulse-Echo and Echo-Echo, plus a number of variations on these modes for specific measurement tasks.

If an auto identified transducer is fitted to the gauge the appropriate mode will be automatically set. To select measurement mode manually, press MULTI MODE and then select the mode you want to use from the list displayed.

Note: The availability of the modes depends upon the type of transducer fitted to the gauge.

7.1 PULSE-ECHO MODE (P-E), COATING OFF

The standard measurement mode providing maximum sensitivity. This general purpose mode should be used for corrosion and flaw inspections and will measure the total thickness of a material.

7.2 PULSE-ECHO COATING MODE (PECT), COATING ON

Special mode that allows measurement of coating thickness and material thickness at the same time while retaining the capability to detect flaws.

7.3 PULSE-ECHO TEMPERATURE COMPENSATED MODE (PETP), TEMP COMP

This is a custom mode that combines pulse-echo and electronic zero techniques to automatically adjust for temperature changes in the transducer as a result of an increasing/decreasing temperature gradient in the test material.

Note: Rough surface conditions can have an effect on the overall accuracy in this mode. If the surface condition is in question, the pulse-echo mode should be used in conjunction with performing an off block automatic zero as the temperature gradient changes.

7.4 ECHO-ECHO MODE (E-E), THRUPAINT™

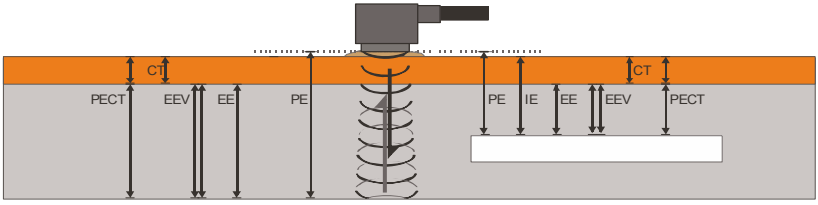
This special mode allows the user to measure the material thickness of a substrate underneath a coating while ignoring the coating thickness by using two echoes from the material back wall. This mode is useful when the coating thickness makes up a sizeable proportion of a material, but has the impact of reducing sensitivity so should not be used in pit and flaw inspections.

7.5 ECHO-ECHO VERIFY MODE (E-EV), THRU VERIFY

This mode uses a third echo to double check the measurement, increasing the reliability of a measurement even further from the E-E mode.

7.6 COATING ONLY MODE (CT), COATING ONLY

Note: Similar to the PECT mode but reports the coating thickness only.



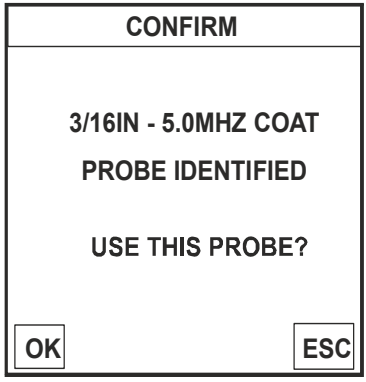
8 SETTING UP THE THICKNESS GAUGE

8.1 AUTOMATIC TRANSDUCER IDENTIFICATION

If using a coating thickness transducer, the gauge will ask you to confirm the transducer type.

1. Press OK to use the identified transducer.

   Note: Always select OK to use the identified transducer type.
2. Ensure that the wearface is clean and free of any couplant or debris then press OK to perform a probe zero.
3. Calibrate the gauge - see:
   - “Calibrating - for a Material” on page 22 and
   - “Calibrating - for a Coating” on page 24.

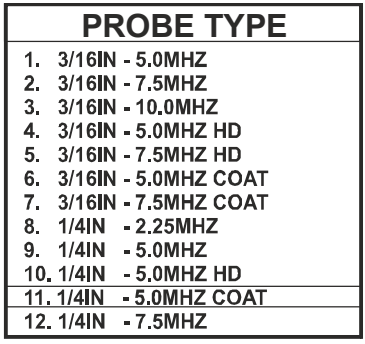


8.2 SELECTING THE TRANSDUCER TYPE MANUALLY

Note: If not using a coating thickness transducer, you will need to select a transducer type from the predefined list so that your gauge may recall specific transducer properties.

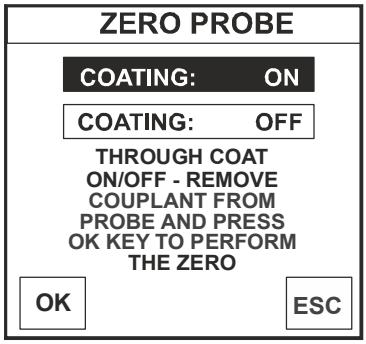
Follow these steps to select your transducer type:

1. When the CONFIRM screen displays the ‘UNIDENTIFIED PROBE TYPE’ message, press OK to display the predefined list of transducer types (by diameter and frequency on the left wheel).
2. Using UP or DOWN, scroll through the transducer list until the correct type is highlighted and then press ENTER.
3. Press OK to overwrite the existing transducer type with the newly selected transducer type.
4. Your gauge will automatically advance to the Zero Probe procedure.



8.3 TRANSDUCER - ZEROING

Setting the zero point for the transducer is important in the same way that it is important for a mechanical micrometer. Zeroing takes into account slight variations in the manufacturing process for maximum accuracy. If zeroing is not carried out correctly, the measurements taken by the gauge will be in error by some fixed value.



Your gauge has two zero probe options:

- **Off Block or Automatic Probe Zero -** The gauge conducts an electronic zero without the need for a zero block (All measurement modes).
- **On Block or Manual Probe Zero** - Requires use of the zero block on the top of the gauge (Pulse to echo mode only).

For most applications the Off Block Zero will be sufficient, however if it is found the gauge linearity is off and extreme accuracy is required an On Block Zero should be conducted followed by an Off Block Zero. This will adjust and eliminate any error.

These options may be accessed from MENU/PRB.

8.4 OFF BLOCK ZERO (AUTOMATIC PROBE ZERO)

1. When the ZERO PROBE screen is displayed, remove all couplant from the face of the transducer and check that the wearface of the transducer is clean and free of any debris.
2. Press OK (or ESC to cancel).

   When the automatic probe zero is completed the measurement screen is displayed.

Your gauge should now be calibrated.

8.5 ON BLOCK ZERO (MANUAL PROBE ZERO)

When this zero probe option is selected a warning screen is displayed informing you that you must zero the probe before taking measurements.

1. Press MEAS to display the measurement screen.
2. Remove all couplant from the face of the transducer and check that the wearface is clean and free of any debris.

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

   Note: Disregard the value displayed; it is not important. What is important is accurately performing these steps to ensure reliability of the zero calculation.

4. Press MENU, scroll to the PRB menu, scroll to the ZERO PROBE function and then press ENTER.

   The ZERO PROBE screen is displayed.

5. UP and DOWN toggle coating on/off.
6. Press OK (or ESC to cancel).

   When the manual probe zero is completed the measurement screen is displayed.

7. Remove the transducer from the probe zero disk.

8.6 TRANSDUCER - ZEROING FOR COATING ONLY MEASUREMENTS

Your gauge features an additional zero coating feature for use when measuring coatings to a high accuracy is required.

Note: For this procedure, a coating transducer must be fitted to the gauge.

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

   Note: Disregard the value displayed; it is not important. What is important is accurately performing these steps to ensure reliability of the zero calculation.

2. Select MENU/PRB/ZERO COATING and then press ENTER.

   A confirmation screen is displayed.

3. Press OK (or ESC to cancel).

   When the zero coating process is completed the measurement screen is displayed.

4. Press MULTI MODE, scroll to COATING ON (PECT) and press ENTER.

   The measurement screen is displayed.

You can now take readings.

8.7 CALIBRATING - FOR A MATERIAL

Sound travels through different materials at different speeds, and in order to measure these materials accurately the correct sound velocity must be programmed into the gauge. Your gauge features 3 different ways of doing this.

Known material calibration - The material to be measured is selected from a list in the gauge.

Known velocity calibration - If the material sound velocity is known this may be entered manually.

Known Thickness Calibration - A sample of the material to be inspected is measured using alternative means and then used to calibrate the gauge.

- **One Point** calibration is the simplest and most commonly used calibration procedure with best performance over large measurement ranges.
- **Two Point** calibration uses two samples of different thicknesses, with enhanced accuracy over small ranges close to the sample thicknesses used.

For the highest measurement accuracy use the known thickness calibration as this takes into account variation in material composition, temperature and a variety of other factors.

KNOWN MATERIAL CALIBRATION

If the material velocity is unknown, and a sample thickness cannot be taken from the material, you can choose a material type from a list stored in the gauge. For each material stored in the list there is a corresponding velocity value.

Note: These velocities will not always be an exact representation of the material being tested. Use these values only if a close approximation is acceptable.

1. Select MENU/CAL/MAT.
2. Press ENTER to display the list of material types.
3. Scroll through the material list until the appropriate material is highlighted, using the UP/DOWN on the left hand wheel.
4. Press ENTER to choose the material type.
5. Press OK to confirm the material type.
6. Press MEAS to return to the measurement screen.

KNOWN VELOCITY CALIBRATION

If the material velocity is known, you can enter the velocity value directly into the gauge. A list of the sound velocities of common materials is given at the end of this instruction manual.

1. Press MENU/CAL/VELOCITY.
2. Press ENTER to display the Digits Edit Box.
3. Adjust to match the material velocity.
4. Press OK.
5. Press MEAS to return to the measurement screen.

KNOWN THICKNESS CALIBRATION

If the sound velocity of a material is unknown, a sample with one or two known thicknesses can be used to determine the sound velocity.

Note: Although the gauge has a ThruPaint™/coating feature, known thickness calibration must be performed on material with the paint or coating removed.

ONE-POINT CALIBRATION - The one point calibration option is most suited for linearity over large ranges. You should always calibrate on high side of the intended measurement range. For example, if the measurement range is 2.54 mm to 25.4 mm (.100" to 1.0"), you should calibrate on a known thickness sample close to 25.4 mm (1.0").

Note: Before you start this calibration procedure, perform a probe zero.

1. Apply a drop of couplant on the transducer and place the transducer in steady contact with the sample or the material being tested. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable.
2. Select MENU/CAL/MATLIPT.
3. Press ENTER to display the Digits Edit Box.
4. Adjust to match the material thickness.
5. Press OK to calculate the velocity and return to the measurement screen, or ESC to cancel.

Note: Place the transducer back on the calibration point. The thickness reading should now match the known thickness but if outside tolerance, repeat the steps above.

TWO-POINT CALIBRATION - For improved accuracy over a smaller measurement range, conduct one-point calibration followed by a two-point calibration. For example, if the measurement range is 2.03 mm to 6.35 mm (.080" to 0.250"), perform a one point calibration on a known thickness sample close to 6.35 mm (.250"), followed by a two-point calibration close to 2.03 mm (.080").

Note: Before you start this calibration procedure, perform a probe zero.

Two - Point calibration

1. Conduct a one point calibration routine as described previously in this section. You should conduct this routine at the high end of the measurement range.
2. Repeat the routine with another sample at the low end of the measurement range, except this time enter the thickness into the MATL 2PT area in the CAL menu.

Note: CHECK YOUR CALIBRATION. Place the transducer back on both calibration points. If the thickness is out of tolerance repeat the steps above.

8.8 CALIBRATING - FOR A COATING

Your gauge comes pre-set with a coating velocity of 2159 m s^{-1} that has been found to be a good approximation of coatings found in the field.

Accuracy may be improved by calibrating for the coating in the same way that a material may be calibrated for, using either coating velocity or known coating thickness calibration.

- In PECT mode a one point calibration is required.
- In CT mode a 2 - point calibration is required.

KNOWN COATING VELOCITY

If the coating velocity is known, you can enter the velocity value into your gauge.

1. Press MENU/CAL/COATING VEL.
2. Press ENTER to display the Digits Edit Box.
3. Adjust to match the coating velocity.
4. Press OK.
5. Press MEAS to return to the measurement screen.

KNOWN COATING THICKNESS

One Point Calibration: Measure a sample of the coating and carry out the calibration using the same method as for a material, except enter the coating velocity into the “COATING 1PT" area of the CAL menu. Measure a coating sample on the high side of the measurement range.

Note: The coating sample must be coupled to metal in order to calibrate successfully. Place a drop of couplant on a piece of metal, lay the coating sample over the couplant on the metal and carry out the calibration.

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

Note: The coating sample must be coupled to metal in order to calibrate successfully. Place a drop of couplant on a piece of metal, lay the coating sample over the couplant on the metal and proceed to step 2.

2. Apply a drop of couplant on the transducer and place the transducer in steady contact with the coating (on metal) sample or actual test material. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable.
3. Press MENU/CAL/COATING 1PT function.
4. Press ENTER to display the Digits Edit Box.
5. Adjust to match the coating thickness.
6. Press OK to set the coating velocity and return to the measurement screen, or ESC to cancel.

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

TWO-POINT CALIBRATION - Use the minimum coating sample for the two point calibration.

1. Conduct a one point calibration routine as described previously in this section. You should conduct this routine at the high end of the measurement range.
2. Physically measure the thinner of the two samples of the coating, as close as possible to the minimum expected coating measurement range, using a set of calipers or a digital micrometer.

   Note: If coating measurements are to be made with the coating applied to a metal surface, the calibration must be done in the same manner, with the samples coupled to a metal surface. However, if the coating is to be measured as a stand alone material, the calibration must be performed the same way.
3. Apply a drop of couplant on the transducer and place the transducer in steady contact with the thinner of the two coating and samples. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable.
4. Press MENU/CAL/COATING 2PT.
5. Press ENTER to display the Digits Edit Box.
6. Press OK to set the coating velocity and return to the measurement screen, or ESC to cancel.

Note: CHECK YOUR CALIBRATION. Place the transducer back on both calibration points. If the coating thickness readings match the known thickness values of each sample calibration has been successful and you are now ready to take measurements. If the thickness is not correct, repeat the steps above.

9 MEASUREMENT - TAKING READINGS

Disclaimer: Inherent in ultrasonic thickness measurement is the possibility that the instrument will use the second rather than the first echo from the back surface of the material being measured. This may result in a thickness reading that is TWICE what it should be.

Responsibility for proper use of the instrument and recognition of this phenomenon rests solely with the user of the instrument.

Other errors may occur from measuring coated materials where the coating is insufficiently bonded to the material surface. Irregular and inaccurate readings may result. Again, the user is responsible for proper use and interpretation of the measurements acquired.

9.1 BEFORE YOU START

- Prepare the surface - further information on “Condition and Preparation of Surfaces” can be found on the Elcometer Knowledge Centre on website www.elcometerndt.com
- Ensure the correct transducer is selected and set in the gauge - see “Transducer - Setting Type Of” on page 33.
- Select the correct measurement mode (P-E, PECT, PETP, E-E, E-EV, CT) - see “Measurement - Modes” on page 18.
- Set the zero point of the transducer - see:
  - “Transducer - Zeroing” on page 20 and
  - “Transducer - Zeroing for Coating Only Measurements” on page 21.
- Calibrate the gauge - see:
  - “Calibrating - for a Material” on page 22 and

- "Calibrating - for a Coating" on page 24.
- Choose the measurement view (DIGITS, RF or RECT, or B-SCAN) - see "The Measurement Screen" on page 30.

9.2 PROCEDURE

1. **Apply couplant**

   For the gauge to work correctly there must be no air gap between the transducer and the surface of the material to be measured. This is achieved using a couplant.

   Before the transducer is placed on the surface, put a small amount of couplant supplied with the gauge on the surface of the material. Typically a single drop is sufficient.

2. **Place transducer onto the surface of the material to be measured**

   Press the transducer wearface into the couplant. Only moderate pressure is necessary to keep the transducer stationary and the wearface seated flat against the surface of the material.

3. **Read display**

   If six or seven bars of the stability indicator are showing, the display will be reading the correct thickness of the material directly beneath the transducer.

   If the stability indicator has fewer than five bars showing, or the numbers on the display seem erratic, check to make sure that there is an adequate film of couplant beneath the transducer, and that the transducer is seated flat against the material. If the condition persists, it may be necessary to:

   - adjust the gain, or
   - select a different transducer (size or frequency) for the material being measured.

   The gauge will perform a number of measurements every second when the transducer is in contact with the surface of the material. The display is updated as each reading is taken.

4. **Remove transducer from surface**

   The display will show the last measurement made.

Note: Occasionally, a small film of couplant will be drawn out between the transducer and the surface as the transducer is removed. When this happens, the gauge may perform a measurement through this couplant film. This phenomenon can be seen when one thickness value is observed while the transducer is in place, and another value is observed after the transducer is removed. If this happens, take the reading again using less couplant.

10 GATES

10.1 INTRODUCTION

Further information on gates may be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

10.2 ADJUSTING THE GATES

The quickest way to adjust the settings of the three gates is directly from the hot menu. Alternatively, adjust the values using the menus:

1. Press MENU, GT1, GT2 or GT3 menu and then highlight the setting you wish to adjust.
2. Adjust to suit the measurement application.
3. Press OK to set the value and return to the menu screen, or ESC to cancel.
4. Press MEAS to return to the measurement screen.

11 THRUPAINT™ MEASUREMENT TECHNIQUE

Your gauge is equipped with a ThruPaint™ measurement mode that uses a multiple echo technique to allow measurement of the material thickness beneath a coating. This is useful for checking the material thickness of a painted object.

ThruPaint™ capability is available in E-E and E-EV modes, to activate through paint operation select one of these measurement modes using the “MULTI MODE” key.

Further information may be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

12 MEASUREMENT - OPTIONS

12.1 AUTO FIND

When using a scan type display, the DELAY and RANGE (or B-START and B-DEPTH) must be set correctly for the waveform to be shown on the display. If these parameters are set up incorrectly nothing will be seen. The AUTO FIND function solves this problem by automatically adjusting these parameters so that the relevant part of the waveform is shown on the screen.

To use the AUTO FIND function place the transducer on the material to obtain a reading, select MENU/UTIL/AUTO FIND.

12.2 HIGH SPEED SCAN

Although your gauge excels at making single point measurements, it is sometimes desirable to examine a larger region, searching for the thinnest point. The gauge includes a feature, called Scan Mode, which allows it to do just that.

This mode increases the overall repetition rate to a maximum of 140 Hz with a high speed screen refresh rate of up to 120 times a second.

This feature enables the user to make scanned passes over an arbitrary length of the test material while still maintaining a reasonable representation of thickness over the scanned area or region. This feature can be used in conjunction with High and Low alarm limits features to keep track of both values dynamically.

To enable/disable the high speed Scan Mode:

1. Select MENU/UTIL/SCAN MODE.
2. Use the LEFT and RIGHT arrows of the right wheel to toggle the SCAN MODE on/off.
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

12.3 ALARM MODE

Your gauge includes an Alarm Mode. Set the limits, and if a measurement falls outside of these limits your gauge will signal an alarm (a red light on the front panel of the instrument and/or an audible beep).

This feature may be used for a variety of applications to verify the material is within the manufacturer specifications.

There are two limit values, ALARM LOW and ALARM HIGH. You can choose to activate both or just one of these values depending on your requirements.

To enable/disable Alarm Mode:

1. Select MENU/UTIL/ALARM.
2. Use the LEFT and RIGHT arrows of the right wheel to toggle the ALARM on/off/audible.

3. Press MEAS to return to the measurement screen, ready to begin taking readings.

To set the Alarm limits:

1. Select MENU/UTIL/ALARM.
2. Choose ALARM LOW or ALARM HIGH.
3. Press ENTER to display the Digits Edit Box.
4. Adjust to suit the measurement application.
5. Press OK to set the alarm value and return to the menu screen, or ESC to cancel.
6. Press MEAS to return to the measurement screen.

12.4 DIFFERENTIAL MODE

Your gauge includes a Differential Mode. Set the nominal value of thickness (based upon the expected thickness value), and the gauge measures the difference (+/-) from this nominal value.

This feature is typically used in QA incoming inspections on pipes, plate stock, coils, etc.

To enable/disable Differential Mode:

1. Select MENU/UTIL/DIFFERENTIAL.
2. Use the LEFT and RIGHT arrows of the right wheel to toggle the DIFFERENTIAL on.
   A value will appear to the right of DIFFERENTIAL.
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

To set the Differential value:

1. Enable Differential Mode (see steps above).
2. When DIFFERENTIAL has been enabled and a value is being displayed to the right of the DIFFERENTIAL label, press ENTER to display the Digits Edit Box.
3. Adjust to suit the measurement application.
4. Press OK to set the differential value and return to the menu screen, or ESC to cancel.
5. Press MEAS to return to the measurement screen.

12.5 POLARITY

The polarity that your gauge detects on can be set to either positive or negative to obtain the best detection results depending on the specific measurement conditions of your application. Polarity affects both the gate (above or below the x axis in the RF A-Scan) and the Rectified A-Scan display (whether the top or bottom half of the RF display is shown.

For further information refer to the Elcometer NDT Knowledge Hub www.elcometerndt.com

To adjust POLARITY:

Set the measurement screen view to RF. The option is found in MENU/TUNE/POLARITY.

12.6 PULSE WIDTH

Your gauge has an adjustable pulse width option. Pulse width refers to the duration of time the pulser is switched on. Pulse width determines the amount of energy transmitted into the material being tested.

There are three pulse width options:

SPIKE - The Spike option is used for high resolution and general applications and can be considered as the standard setting.

THIN - When additional energy is needed for more penetration, the Thin option may be necessary.

WIDE - When even more energy is needed for more penetration, the Wide option may be necessary.

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 requirement, may require the Thin or Wide settings, offering increased penetration. The variety of transducer frequencies and diameters used in conjunction with the pulse width setting, enable you to fine tune the gauge to your application needs.

To adjust the Pulse setting:

The option to adjust the PULSE WIDTH function is found in MENU/TUNE/PULSE.

12.7 PULSER VOLTAGE

Your gauge has a 200 V square wave pulser that can be adjusted for specific applications and transducers. The standard pulser setting is 150 V, and the Pulser Volt function allows you to increase or decrease this value by 50 V to give greater penetration for difficult material types, or increased resolution on noisy materials.

The option to adjust the Pulser Voltage setting is found in MENU/TUNE/PULSER VOLTAGE.

12.8 DAMPING

Your gauge has a damping function which adjusts the input impedance of the receiver. This enables you to optimise the gauge to suit the transducer for better signal quality at various frequencies. The damping settings are 50, 75, 100, 300, 600 and 1500 ohms.

The option to adjust the DAMPING setting is found in the MENU/TUNE/DAMPING.

13 TRANSDUCERS FOR THICKNESS MEASUREMENT

Further information on Transducers can be found on Elcometer NDT Knowledge Centre on www.elcometerndt.com

SECTION : 3 FLAW DETECTOR

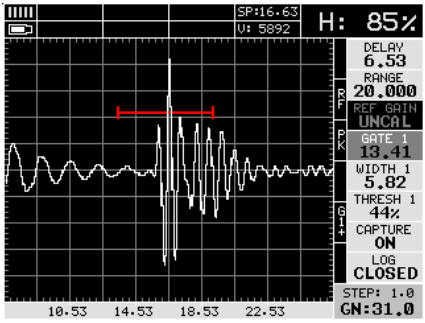
14 THE MEASUREMENT SCREEN

When the GAUGE function is set to FLAW DETECTOR, the FD800DL/FD800DL+ Corrosion and Flaw Gauge becomes a flaw detector with the ability to detect the size and position of flaws and to differentiate between flaw types in various materials and welded joints.

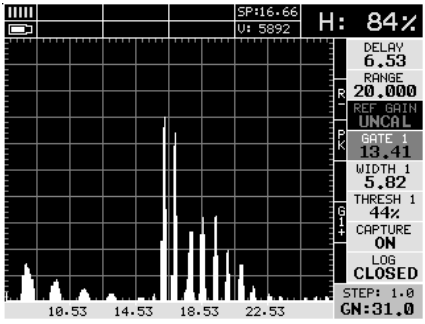
Your gauge has four types of measurement screen:

- RF (Radio Frequency)
- +RECT (Rectified Radio Frequency, positive polarity)
- -RECT (Rectified Radio Frequency, negative polarity)
- RECTFW (Full Wave Rectified Radio Frequency)

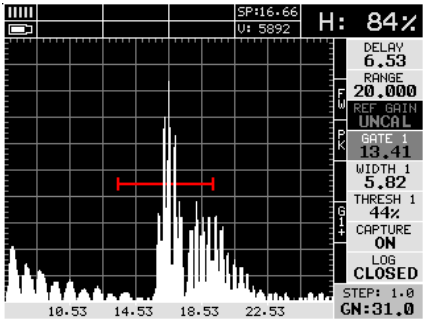
RF



RECT



RECTFW

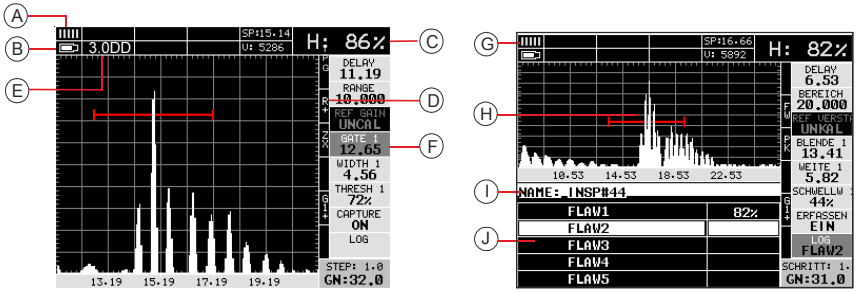


To see the measurement screen, press MEAS.

To select which measurement screen to use, select MENU/DISP/VIEW and then select RF, +RECT, -RECT or RECTFW.

14.1 ITEMS COMMON TO ALL MEASUREMENT SCREENS

A number of items are common to all the measurement screens:



A	Repeatability/Stability Indicator	When taking readings, this indicator shows the stability/repeatability of the sound path signal. When all the vertical bars are fully illuminated the repeatability of the sound path is stable.
B	Battery Indicator	Indicates the battery life remaining
C	Height	The signal amplitude height as a percentage of 100% full screen height. Depending on the quantity selected, this could be displayed in dB or D.
D	Feature Status Bar	Indicates the features currently enabled and in use: • Toolkits (TRIG, AWS, TCG, DAC, DGS) • View (RF, R+, R-, FW) • Detect (ZX, FK, PK) • Leg-Skip Leg reference (L1....L4....) • Alarm Mode (G1+, G2+) • Gain Setting
E	Leg (skip leg)	Indicates which skip/leg the detection is on. The thickness of the material is used to calculate the leg.
F	Hot Menu	The hot menu contains a selection of the most commonly used options, allowing you to conveniently adjust them to your needs while the graphical display is active. They can be displayed and scrolled by pressing the MEAS key at anytime. The ESC key is used in conjunction with MEAS key to reverse the direction scrolled.
G	Memory	Indicates that the currently displayed measurement screen and values have been previously stored in the memory. When MEM is displayed, all measurement functions are disabled until the user advances to an empty storage location, or the current measurement is cleared by pressing the CLR key.
H	A-Scan Display	The actual echo reflections returned from the backwall or defect.

I	Grid or Sequential Log Name	References the name of the log file currently open.
J	Log File	Shows the storage cells of the current log file open. Depending on the quantity currently selected, shows either the % height or dB value stored.

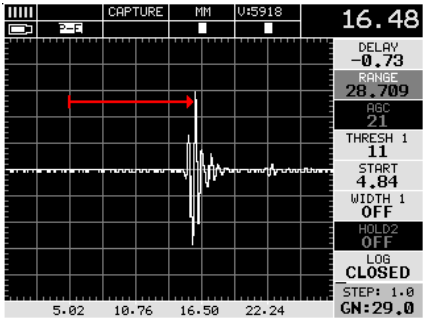
14.2 RF MEASUREMENT SCREEN

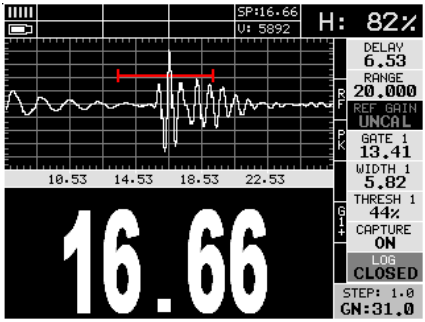
The RF view shows a graphical representation (similar to the trace of an oscilloscope) of the sound reflections returning to the transducer. The waveform display shows the amplitude of the signal received on the vertical (Y) axis and time (shown in units of thickness) on the horizontal (X) axis.

The RF waveform includes both the positive and the negative peaks.

The detection point is displayed on the waveform. The RF waveform view is typically used for fine tuning of the gauge prior to carrying out an inspection.

Press OK to also display digits on screen.

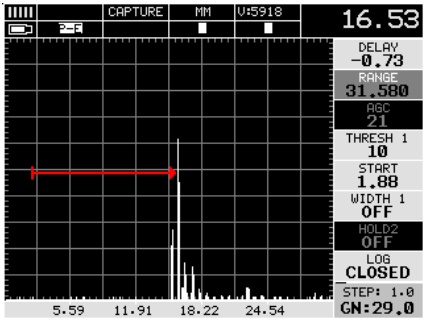


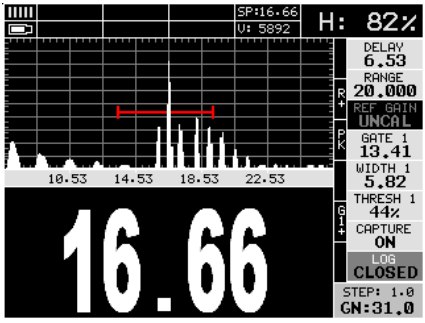


14.3 +RECT MEASUREMENT SCREEN

The +RECT view is similar to the RF display but shows only the positive half of the waveform.

The detection point is indicated on the waveform.



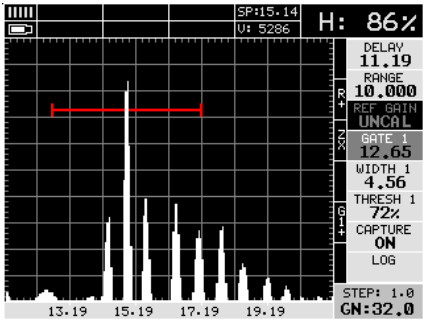


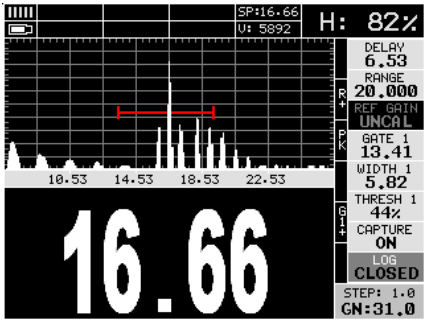
14.4 -RECT MEASUREMENT SCREEN

The -RECT view is the same as the +RECT view but shows only the negative half of the waveform.

14.5 RECTFW MEASUREMENT SCREEN

The RECTFW view shows the entire sine wave signal in a rectified view. There is no polarity.





15 SETTING UP THE FLAW DETECTOR

To set up the gauge ready to detect flaws you must first set the correct transducer type and then calibrate the gauge by adjusting the sound-velocity value to match the value of the material you are measuring. The zero value must also be set.

15.1 TRANSDUCER - SETTING TYPE OF

The gauge must be set to the correct transducer type (SINGLE element, or DUAL element):

1. Select MENU/PRB/TYPE.
2. Use LEFT and RIGHT of the right wheel to adjust the value of TYPE.
3. Press MEAS to return to the measurement screen.

Note: Once the transducer type has been selected, your gauge will store and recall this transducer type every time it is switched on. Use the above procedure to change the TYPE value if necessary.

15.2 ABOUT CALIBRATION

Different types of material have different sound-velocities. For example, the velocity of sound through steel is 5918 m/s (about 0.233 in/µs) and the velocity of sound through aluminium is 6350 m/s (about 0.248 in/µs).

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.

Note: The calibration procedures for the flaw detector and thickness gauge are different. The flaw detector does not use the same probe zero technique as the thickness gauge so for best thickness reading accuracy in flaw mode follow this guide carefully.

There are three methods of calibrating your gauge:

KNOWN MATERIAL CALIBRATION: The material you are measuring is selected from a list of materials stored in the gauge. After you have entered the material, you should check and if necessary adjust the zero value - see page 34 making this the preferred calibration method.

KNOWN VELOCITY CALIBRATION: The sound-velocity of the material being measured is entered directly into the gauge. After you have selected the sound-velocity of the material, you should check and if necessary adjust the zero value - see page 34.

KNOWN THICKNESS CALIBRATION: The gauge is calibrated by setting it to **two** known thicknesses - see page 35. The zero value is set automatically during this procedure.

For the highest measurement accuracy use the known thickness calibration, as this takes into account variation in material composition, temperature and a variety of other factors.

15.3 KNOWN MATERIAL CALIBRATION

If the material velocity is unknown, and a sample thickness cannot be taken from the material, you can choose a material type from a list stored in the gauge. For each material stored in the list there is a corresponding longitudinal velocity value and a shear velocity value.

Note: In order to display the chart containing the shear wave velocities, the TRIG mode must be enabled - see See "TRIG - Trigonometry Mode" on page 41.

Note: These velocities will not always be an exact representation of the material being tested. Use these values only if a close approximation is acceptable.

1. Press MENU/CAL/MAT and then press ENTER.
2. Scroll through the material list until the appropriate material is highlighted.
3. Press ENTER to choose the material type, then press OK.
   The material velocity and zero value are displayed in the CAL menu.
4. Press MEAS to return to the measurement screen.
5. Measure a calibration standard and, if necessary, adjust the zero value until the material thickness value matches the thickness of the calibration standard - see "Manually Adjusting the Zero Value" on page 34.

15.4 KNOWN VELOCITY CALIBRATION

If the material velocity is known, you can enter the velocity value directly into the gauge. A list of the sound velocities of common materials is given at the end of this instruction manual.

1. Select MENU/CAL/VELOCITY.
2. Press ENTER to display the Digits Edit Box.
3. Use the navigation buttons to adjust the value.
4. Press OK to set the velocity and return to the menu screen, or ESC to cancel.
   The material velocity and zero value are displayed in the CAL menu.
5. Press MEAS to return to the measurement screen.
6. Measure a calibration standard and, if necessary, adjust the zero value until the material thickness value matches the thickness of the calibration standard - see "Manually Adjusting the Zero Value" on page 34.

15.5 MANUALLY ADJUSTING THE ZERO VALUE

If you have calibrated the gauge by entering a material type or the velocity value of the material, you should check and if necessary adjust the zero value. This step requires a calibration block.

1. Place the transducer on step of known thickness.
2. Select MENU/CAL/ZERO.
3. Use the LEFT and RIGHT keys to scroll the value, or press ENTER to open the digits edit box and adjust the value using the navigation buttons.
4. Press OK to set the value and return to the menu screen, or ESC to cancel.
5. Press MEAS to return to the measurement screen.

15.6 KNOWN THICKNESS CALIBRATION

If the sound velocity of a material is unknown, a sample with two known thicknesses can be used to determine the sound velocity. If a sample is not available, calibration standards representing the minimum and maximum thickness of the overall inspection range intended are required. They must also be of the same material type as the intended application. The example of thickness calibration given in this section uses a 1” and a 4” standard for calibration.

Note: This section describes performing a calibration using a straight beam contact transducer. Single and dual element probes may be calibrated in this way. Further information can be found on the Elcometer NDT website on www.elcometerndt.com

LOAD THE DEFAULT SETUP

The gauge will require a few basic adjustments in order to get underway with the calibration process. For this example the default setup will be loaded as a starting point.

1. Select MENU/SETUP/DEFAULT SETUP.
2. Press ENTER.
3. Press OK.
4. Press MEAS to return to the measurement screen.

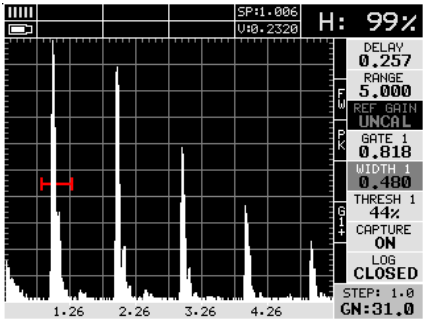
SET THE RANGE

Set the range so that peaks from the small and large calibration samples are visible on the display. Our calibration range for this example is 4”. Therefore setting a range of 5” will enable you to view the entire range on the display.

Use the hot menu to adjust the RANGE value to 5”.

ENABLE AND CONFIGURE GATE 1

In order to measure, a gate is required. The width of the gate should be small enough, in terms of its width, in order to select specific reflections to measure. The purpose of the gate is to allow the gauge to detect on a particular signal. To calibrate the gauge the user must ensure that the horizontal gate line and the signal peak of interest cross. You can use the GATE1 item in the hot menu with the navigation keys to move the gate over signal of interest. Enable the DETECT MARK to check the gauge is detecting on the correct peak. On z-crossing and flank detection modes (see page 11), the first peak the gate crosses will be used.



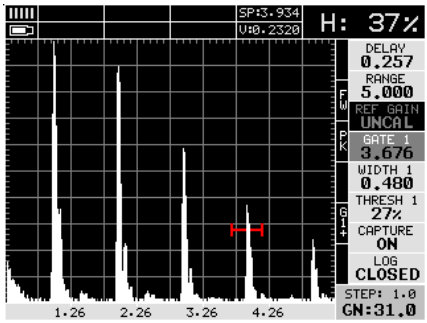
Gate for 1”
Calibration Standard

The screenshots show gates enabled to select the 1” calibration standard, and the 4” calibration standard.

To enable and configure Gate 1, follow the instructions given in “Gates” on page 39 and use the following suggested settings:

ALARM:	ON
DETECT:	ABOVE
GATE#:	A value less than 1”
GATE# WIDTH:	A value greater than 1”
THRESHOLD#:	20%
POLARITY:	POSITIVE

Note: The settings given above are for this particular example calibration. You should always use settings which meet the requirements of your applications.

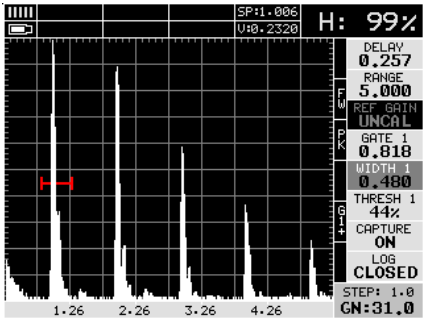


Gate for 4”
Calibration Standard

CALIBRATING TO THE FIRST POINT (ON THE THIN CALIBRATION STANDARD)

1. Apply a drop of couplant on the transducer and place the transducer in steady contact with the 1” thin calibration standard. Be sure that the reading is stable and the repeatability indicator, in the top left corner of the display, is fully lit and stable. Also, be sure there is sufficient signal amplitude in order to avoid peak jumping or missing the first cycle.
2. Press MEAS to view the measurement screen.
3. In the hot menu, scroll to GATE1.
4. Use LEFT and RIGHT on the right wheel to move the gate over the peak of the waveform to be measured, as shown in the screenshot.

   Note: In order to trigger on a signal, the waveform must be inside the boundaries of the gate.
5. Select MENU/CAL/ MATL 1PT.
6. Press ENTER to display the Digits Edit Box.

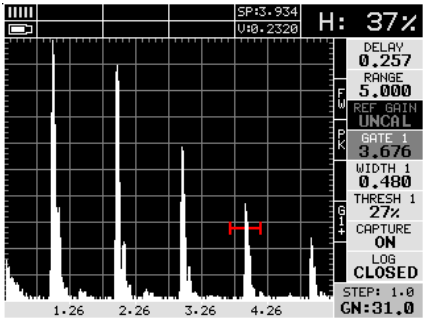


7. Use LEFT and RIGHT to scroll the value, or press ENTER to open the digits edit box and adjust the value using the navigation buttons.
8. Press MEAS to calculate the material velocity and return to the menu screen, or ESC to cancel.

CALIBRATING TO THE SECOND POINT (ON THE THICK CALIBRATION STANDARD)

1. Repeat the steps given in section above, but this time:
   - Use the 4” calibration standard (instead of the 1” calibration standard).
   - Adjust GATE1 over the waveform - as shown in this screenshot.
   - Adjust the value of MATL 2PT to match the length of the 4” calibration standard (instead of MATL 1PT).

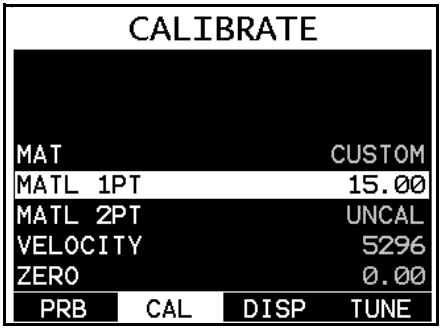
   The material velocity and zero value are calculated and displayed as shown.
2. Press MEAS to return to the measurement screen.



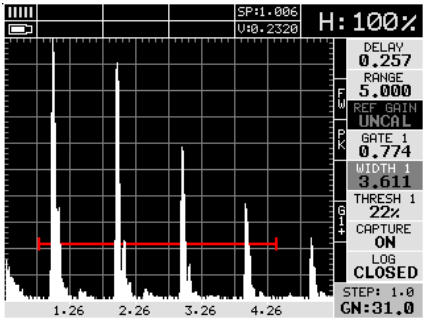
ADJUSTING THE GATE TO THE CALIBRATED RANGE

In order to trigger on anything that is detected in the calibrated range, the boundaries of the gate must be adjusted to include the entire range.

Note: Caution: in both z-cross & flank detection settings, the first signal to cross the gate will be triggered on. However, if the peak detection setting has been enabled, the signal with the most amplitude will be detected.

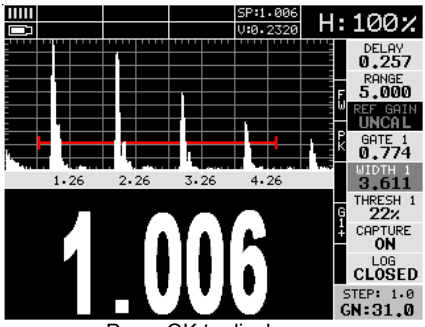


1. Press MEAS to view the measurement screen.
2. In the hot menu, scroll to GATE1.
3. Move the gate start to a position less than 1”.
4. In the hot menu, scroll to WIDTH1.
5. Adjust the width of the gate until its right hand end is at a position greater than 4”.
6. Place the transducer back on the calibration points (1” and/or 4”).
7. Press OK to display the thickness.



WIDTH1 adjusted

The thickness reading should now match the known thickness. If the thickness is not correct, repeat the calibration procedure.



Press OK to display thickness

15.7 CALIBRATION FOR ANGLE BEAM TRANSDUCERS

Further information on Calibration for Angle Beam Transducers can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

16 MEASUREMENT - DETECTING FLAWS

Disclaimer: Inherent in ultrasonic measurement is the possibility that the instrument will use the second rather than the first echo from the back surface of the material being measured. This may result in a incorrect readings.

Responsibility for proper use of the instrument and recognition of this phenomenon rests solely with the user of the instrument.

Other errors may occur from measuring coated materials where the coating is insufficiently bonded to the material surface. Irregular and inaccurate readings may result. Again, the user is responsible for proper use and interpretation of the measurements acquired.

16.1 BEFORE YOU START

- Prepare the surface - further information on “Condition and Preparation of Surfaces” can be found on the Elcometer Knowledge Centre on website www.elcometerndt.com
- Set transducer type, calibrate and set the zero - see “Setting Up The Flaw Detector” on page 33.
- Set up the Gate or Gates - see “Gates” on page 39.
- Choose the measurement view - see “The Measurement Screen” on page 30.

16.2 PROCEDURE

17 ADJUSTING THE WAVEFORM DISPLAY

If the waveform around the detection point is not visible on the display, use one of the following methods to adjust the viewable range of the display:

- Use the Auto Find function - see “Auto Find” on page 27. This is the preferred method and provides a quick and easy method of adjusting the viewable range.
- Change the values of the DELAY and RANGE functions until the measurement falls inside the viewable range of the display - see instructions below.

17.1 AUTO FIND

Your gauge includes a function for locating the detection point of a back wall echo that is not currently in the viewable region of the display. Suppose the gauge is currently setup with a delay of 0.0 and a width of 1.0, and you are measuring material with a thickness of 2.5. The gauge will make the correct measurement and display it digitally, however, the waveform will not be visible without adjusting the values of Delay and Width.

The AUTO FIND function solves this problem by letting the gauge find the detection point and bring the waveform signal into view automatically. If necessary you can then make small adjustments to the range once the signal is displayed on the screen.

To use the AUTO FIND function:

1. Place the transducer on the test material and obtain a reading.
2. Press MENU/UTIL menu and then highlight the AUTO FIND function.
3. Press ENTER.
4. Press OK. This will adjust the settings automatically and the waveform is brought into view on the measurement screen.
5. Press MEAS to return to the measurement screen, ready to begin taking readings.

17.2 DELAY & RANGE

See “DELAY AND RANGE” on page 16.

17.3 ADJUSTING DELAY AND RANGE

See “Adjusting DELAY and RANGE (or B-START and B-DEPTH)” on page 16.

17.4 GAIN

See Section “Gain” on page 16.

17.5 TO ADJUST THE GAIN VALUE

See “To Adjust the Gain Value” on page 17.

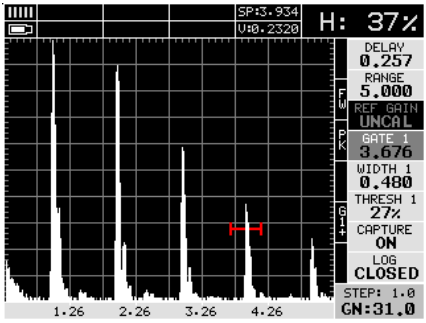
18 GATES

Your gauge is equipped with two gates which control the time measurement process and which play an important role in the detection and measurement of a flaw. Detections are only made within the boundaries of a gate. Anything outside of the start and range/width of the gate will be ignored. The height of a gate is also a threshold, and controls the level of sensitivity. The gates can be adjusted to a specific reference height, based on a predetermined reflector, and set to act as an alarm during the inspection process.

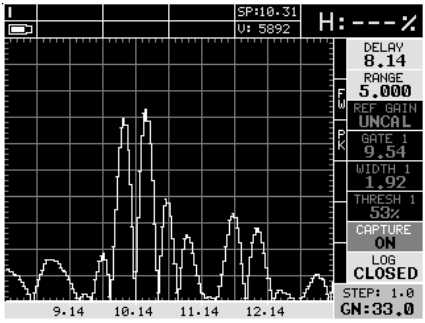
Using gates to adjust the time measurement process allows you to measure a specific region on and between waveforms. For example, a test block with a target size and depth is optimised on the display with a signal amplitude at 70% full screen height. The inspector wants to know about any defects during the inspection that are greater than or equal in size to the calibrated test specimen. A gate is then enabled and set to a reference height of 70%. The width and range are adjusted to cover the range tested, and you are then ready to conduct the inspection.

The two gates are fully independent. Each gate has a start and stop or width, a threshold, a polarity switch, and a detect option. Both gates can be enabled and set for different detects and polarities, and can be positioned anywhere on the display independent of one another.

The screenshots show a rectified waveform without a gate (disabled) and with a gate enabled. The enabled gate is shown as a horizontal line on the display.



Gate Enabled



Gate Disabled

Each gate has the following settings:

Setting	Values	Function
ALARM	ON	Enables the gate and flashes the red light on the front of the gauge when the waveform breaks the threshold level, either above or below, depending on the current DETECT setting.
	OFF	Disables the gate. When disabled, all the other menu items are greyed out.
	AUDIBLE	Has the same function as ON, but sounds a beeper as well as flashing the red light.
DETECT	ABOVE	Triggers the alarm when a signal is equal to or greater than the height of the gate.
	BELOW	Triggers the alarm when a signal is equal to or less than the height of the gate.
GATE#	Numerical value	Sets the start position of the gate relative to the horizontal axis or depth (this is the left boundary of the gate, or where it turns on).

Setting	Values	Function
GATE# WIDTH	Numerical value	Sets the width of the gate relative to the horizontal axis or depth (this sets the right boundary of the gate, or where it turns off).
THRESHOLD#	%	Sets the sensitivity of the gate (its height).
POLARITY	POSITIVE	Sets detection to occur on the positive going echo.
	NEGATIVE	Sets detection to occur on the negative going echo.

Some settings can be adjusted from the hot menu but all settings are found to adjust any of these settings:

1. Select MENU/GT1 or GT2 and highlight the desired setting.
2. Use the LEFT and RIGHT keys of the right wheel to scroll the value, or press ENTER to open the digits edit box and adjust the value using the navigation buttons.
3. Press OK to set the value and return to the menu screen, or ESC to cancel.
4. Press MEAS to return to the measurement screen.

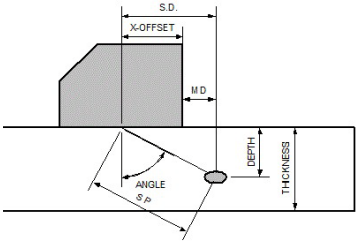
19 TRIG - TRIGONOMETRY MODE

19.1 ABOUT TRIGONOMETRY MODE

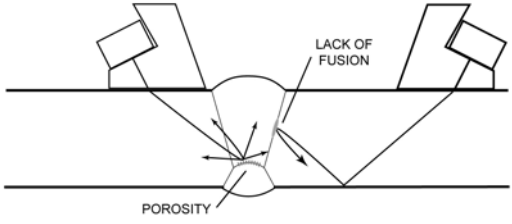
Trig mode is most commonly used for inspecting welded joints using an angle beam transducer. Due to the location, orientation, and geometry of the weld, a straight beam transducer is typically not suitable for inspection. As a result, a transducer emitting sound at a given angle will allow the operator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

This section describes the steps you need to take to setup and use trigonometry mode.

ANGLE BEAM TRANSDUCERS FOR WELD INSPECTION



Angle Beam Transducer



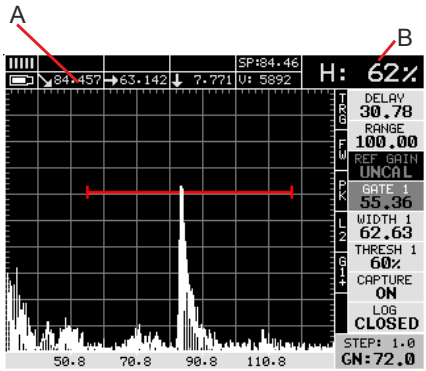
Weld Inspection

where:

SP = Sound path
Angle = Transducer angle
Thickness = Material thickness
X-Offset = Front of wedge less Index
SD = Surface distance
Depth = Depth of flaw from surface

TYPICAL TRIG MODE MEASUREMENT SCREEN

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

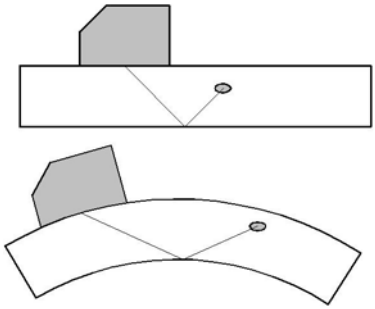


CURVED SURFACE CORRECTION

The gauge will also compensate for convex curved surfaces of longitudinally welded pipes.

For a given transducer, a curved surface results in a longer sound path than a flat surface. You should consider the angle used on curved surfaces, with respect to the material thickness, in order to be sure a reflection will occur from the opposite surface of the test material.

In order to use the curved surface compensation function, the outside diameter must be entered into the gauge.



19.2 SETTING UP TRIGONOMETRY MODE

TRIG MODE SETTINGS

Setting	Values	Function
TRIG	ON	Enables Trig Mode.
	OFF	Disables Trig Mode. When disabled, all the other menu items are greyed out.
THICKNESS	Numerical value	The thickness of the material being scanned for flaws.
ANGLE	Numerical value	The angle of the transducer.
X-OFFSET	Numerical value	The X-Offset is used for purposes of marking, and is physically measured with a ruler from the index point to the front edge of the transducer.
CSC OD	Numerical value	Curved Surface Outside Diameter. This value is only used when scanning the curved surfaces of longitudinally welded pipes.

ADJUSTING TRIG MODE SETTINGS:

1. Select MENU/TRIG then the desired function.
2. Use the LEFT and RIGHT keys of the right wheel to scroll the value, or press ENTER to open. the digits edit box and adjust the value using the navigation buttons.

3. Press OK to set the value and return to the menu screen, or ESC to cancel.
4. Press MEAS to return to the measurement screen.

20 AWS - WELD INSPECTION

20.1 ABOUT AWS

Further information on AWS - Weld Inspection can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

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

20.2 SETTING UP THE AWS FUNCTION

Before setting up and using the AWS function you must:

1. Conduct a two point calibration - see “Known Thickness Calibration” on page 35.
2. Set up TRIG mode - see “Setting up Trigonometry Mode” on page 40.

AWS SETTINGS

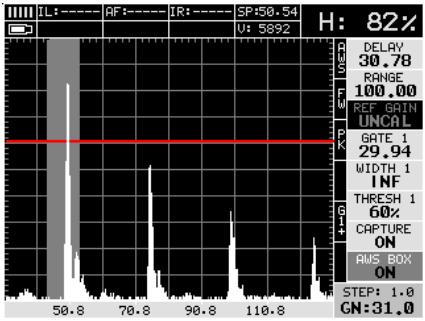
Setting	Values	Function
AWS	ON	Enables the AWS function.
	OFF	Disables the AWS function. When disabled, all the other menu items are greyed out.
SET REF GAIN	ON	Enables reference gain.
	OFF	Disables reference gain.
% SCRN HEIGHT	Numerical value	% Screen Height is an arbitrary level, and is not specified by the AWS D1.1. Set a value that will optimise viewing defects that are larger and smaller than the reference level. Typically this level is set between 50% to 80% of full screen height.

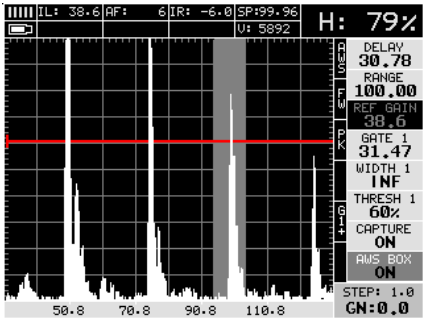
ADJUSTING AWS SETTINGS

1. Select MENU/AWS then the desired function.
2. Use the LEFT and RIGHT keys of the right wheel to switch on or off, or to select value.
3. Press MEAS to return to the measurement screen.

20.3 USING AWS

1. Couple the transducer to the first calibration standard and peak up on the reflector to achieve maximum signal amplitude.





2. Enable the AWS function and adjust the AWS settings to your requirements (see “Adjusting TCG Settings” on page 45). Ensure that the value of DRAW is set to ON.

   A highlighted cursor is displayed in the waveform area, starting at the left most side of the measurement screen.
3. In the hot menu, scroll to GATE1.

   Because you have already calibrated the gauge and set up the TRIG function, the gate is already enabled and a grey cursor is visible in the waveform area of the measurement screen.
4. Use LEFT and RIGHT to position the start of GATE1 to trigger on the waveform.
5. *Optional:* In the hot menu:
   - Scroll to WIDTH1.
   - Use LEFT and RIGHT to adjust the value of WIDTH1 until the signal is in the gate.

   When the signal is in the gate, the height indicator will detect and display the % full screen height.
6. In the hot menu, scroll to AWS BOX.
7. Use LEFT and RIGHT keys of the right wheel to position the cursor box over the waveform and then press ENTER to set the REF GN (reference gain) value.

   Note: This process can be repeated and reset multiple times, or until the SET REF GAIN function is toggled OFF.
8. Press MENU, scroll to the AWS menu and then highlight the SET REF GAIN function.
9. Use LEFT and RIGHT to scroll the value of SET REF GAIN to OFF.
10. Press MEAS to return to the measurement screen.
11. Press OK to view the AWS screen.

21 TCG - TIME CORRECTED GAIN

The TCG function increases gain as distance increases in order to achieve an overall level of sensitivity for the same reflector at different distances. The gain is adjusted at each selected point to display the signal amplitude at a predetermined reference level.

Further information can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

21.1 SETTING UP THE TCG FUNCTION

Before setting up and using the TCG function you must:

1. Conduct a two point calibration - see “Known Thickness Calibration” on page 35.
2. If you are going to use the TRIG mode, set it up before using the TCG function - see “Setting up Trigonometry Mode” on page 40.

TCG SETTINGS

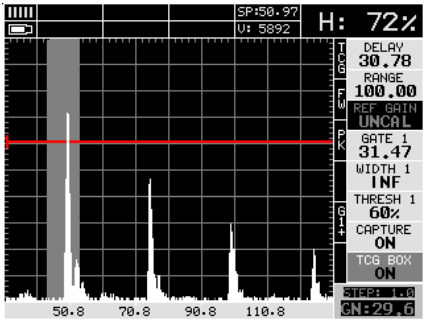
Setting	Values	Function
TCG	ON	Enables the TCG function.
	AUDIBLE	Enables audible signal.
	OFF	Disables the TCG function. When disabled, all the other menu items are greyed out.
DRAW	ON	Enables draw mode.
	OFF	Disables draw mode.
CURVE	ON	Enables TCG correction curve and displays the curve on the measurement screen.
	OFF	Disables TCG correction curve.
% SCRN HEIGHT	Numerical value	Sets the reference level of the TCG as a percentage of full screen height (FSH).

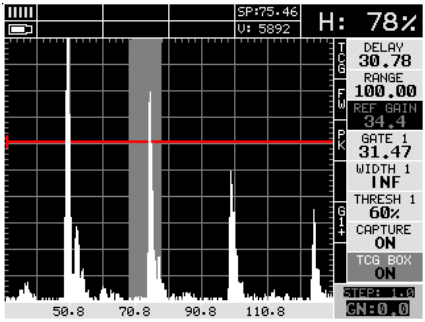
ADJUSTING TCG SETTINGS

1. Select MENU/TCG.
2. Use the LEFT and RIGHT keys of the right wheel to scroll the value, or press ENTER to open the digits edit box and adjust the value using the navigation buttons.
3. Press OK to set the value and return to the menu screen, or ESC to cancel.
4. Press MEAS to return to the measurement screen.

21.2 DRAWING A TCG CURVE

1. Couple the transducer to the first calibration standard and peak up on the reflector to achieve maximum signal amplitude.





2. Enable the TCG function and adjust the TCG settings to your requirements (see “Adjusting TCG Settings” on page 45). Ensure that the value of DRAW is set to ON.

   A highlighted cursor is displayed in the waveform area, starting at the left most side of the measurement screen.
3. In the hot menu, scroll to TCG BOX.
4. Use LEFT and RIGHT of the right wheel to move the cursor over the section of the waveform to be used as the first point in the TCG curve and then press ENTER to set the first point of the curve.
5. Repeat step 4 multiple times to set other points of the curve.

   The TCG curve is displayed after three points have been set/recorded, and will continue to be redrawn/updated for each additional point added.

   Note: A TCG curve can contain a maximum of eight points.
   Note: Any point can be cleared by pressing CLR *when the value of DRAW is set to ON.*
6. Press MENU, scroll to the TCG menu and then highlight the DRAW function.
7. Use LEFT and RIGHT keys of the right wheel to scroll the value of DRAW to OFF.

   The TCG curves are now set and ready to be used for inspection.

22 DAC - DISTANCE AMPLITUDE CORRECTION

22.1 ABOUT DAC

A DAC curve is a gate with a variable threshold to compensate for a given reflector type and size measured at different depths.

Further information can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

Note: Based on the gauge screen resolution, the dynamic range of the DAC is approximately 18 dB. As a result, inspection of any materials that attenuate more than 18 dB over the inspection range, the DAC feature should not be used, and TCG should be considered (see “TCG - Time Corrected Gain” on page 45).

22.2 SETTING UP THE DAC FUNCTION

Before setting up and using the DAC function you must:

1. Conduct a two point calibration - see “Known Thickness Calibration” on page 35.
2. If you are going to use the TRIG mode, set it up before using the DAC function - see “Setting up Trigonometry Mode” on page 40.

DAC SETTINGS

Setting	Values	Function
DAC	ON	Enables the DAC function.
	AUDIBLE	Enables audible signal.
	OFF	Disables the DAC function. When disabled, all the other menu items are greyed out.
DRAW	ON	Enables draw mode.
	OFF	Disables draw mode.
MEAS	DB %FSH %DAC	Sets the quantity to be displayed when in the DAC function is enabled: • dB - decibels • %FSH - The top of the waveform display represents 100% full screen height. Any waveform amplitudes generated greater than 100% full screen height will not be displayed. 100% is the greatest value that can be displayed. • %DAC - All the DAC curve represents 100%. Any signal generating an amplitude below the DAC curve is less than 100%, and any above greater than 100%. *Note: The MEAS option selected is overridden with %FSH when DRAW is set to ON.* *Note: This option can be changed at any time after the DAC curve has been created.*
CURVE	DAC, -2, -6, -10, (-6/-12), (-6/-14) dB	Selects curve type. DAC or DAC less a number of decibels. *Note: This option can be changed at any time after the DAC curve has been created.*
TRIGGER	DAC, -2, -6, -10, (-6/-12), (-6/-14) dB	Select which curve or gate to use as the alarm trigger. Any of the DAC curves or gate displayed can be set as the trigger alarm option. The TRIGGER values available vary according to which CURVE type is selected. All the DAC curve or gate combinations only detect when the amplitude of the signal is at or above the selected trigger option. *Note: This option can be changed at any time after the DAC curve has been created.*

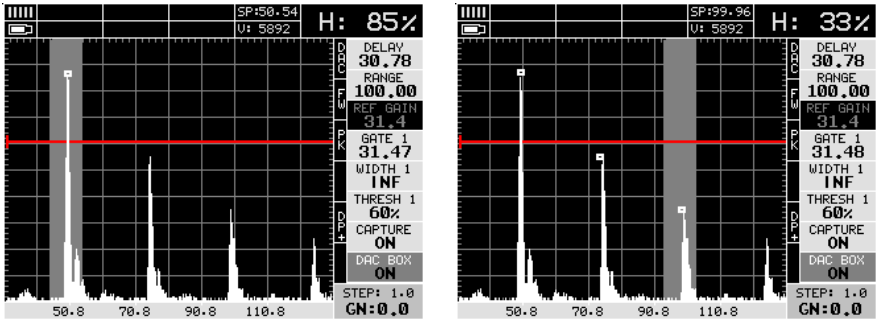
ADJUSTING DAC SETTINGS

1. Select MENU/DAC then the desired function.
2. Use LEFT and RIGHT keys of the right wheel to scroll the value until the correct value is being displayed.

3. Press OK to set the value and return to the menu screen, or ESC to cancel.
4. Press MEAS to return to the measurement screen.

22.3 DRAWING A DAC CURVE

1. Couple the transducer to the first calibration standard and peak up on the reflector, adjusting the gain to keep the signal height within the boundaries of the waveform display area, and at a suitable height to allow for attenuation at greater depths in the overall range to be tested.



2. Enable the DAC function and adjust the DAC settings to your requirements (see “Adjusting DAC Settings” on page 47). Ensure that the value of DRAW is set to ON.

   A highlighted cursor is displayed in the waveform area, starting at the left most side of the measurement screen.
3. In the hot menu, scroll to DAC BOX.
4. Use LEFT and RIGHT keys of the right wheel to move the cursor over the section of the waveform to be used as the first point in the DAC curve and then press ENTER to set the first point of the curve.
5. Repeat step 4 multiple times to set other points of the curve.

   The DAC curve is displayed after three points have been set/recorded, and will continue to be redrawn/updated for each additional point added.

   Note: A DAC curve can contain a maximum of eight points.
   Note: Any point can be cleared by pressing CLR *when the value of DRAW is set to ON.*
6. Press MENU, scroll to the DAC menu and then highlight the DRAW function.
7. Use LEFT and RIGHT keys of the right wheel to scroll the value of DRAW to OFF.

   The DAC curves are now set and ready to be used for inspection.

23 DGS (AVG) DISTANCE, GAIN, SIZE

23.1 ABOUT DGS

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

Further information can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

23.2 DGS SETTINGS

Setting	Values	Function
DGS	On	Enables the DGS function.
	Audible	Enables audible signal.
	Off	Disables the DGS function. When disabled, all the other menu items are greyed out.
REFERENCE GAIN	On	Enables the reference gain using a given reflector from a calibration standard.
	Off	Disables reference gain mode.
TRIGGER CURVE	On	Select DGS or GATE as detection curve.
EFFECTIVE PROBE DIAMETER	Numerical Value	Input probe diameter calculated using formulas as detailed on page 50.
PROBE FREQUENCY	Numerical Value	Input probe frequency details.
CURVE SIZE (ERS)	Numerical Value	Input number of curve to be used.
ATTENUATION	DVK Mat & Ref Loss, Trans Loss	Input numerical values as required.
DELAY VELOCITY	Numerical Value	Input delay velocity as required.
REFERENCE TYPE	FBH SDH Backwall	Select the type of reflector to be used.
REFERENCE SIZE	Numerical Value	Input the size of the chosen reference reflector - FBH or SDH.

23.3 ADJUSTING DGS SETTINGS

1. Select MENU/Distance Gain then the desired function.
2. Use LEFT and RIGHT keys of the right wheel to scroll the value until the correct value is being displayed.
3. Press OK to set the value and return to the menu screen, or ESC to cancel.
4. Select TUNE/DETECT and set to PEAK, Z-CROSS or FLANK as required.

   Note: *The Gate can be adjusted in the usual manner as necessary.*

23.4 DRAWING A DGS CURVE

1. Enable the DGS function and adjust the DGS settings to your requirements leaving the REFERENCE GAIN off see ‘‘Adjusting DGS settings” detailed above.
2. Once all settings have been adjusted, switch REFERENCE GAIN on and then press MEAS.
3. Couple the transducer to the reference sample and peak up on the desired reflector.
4. Use LEFT and RIGHT keys of the right wheel to move the cursor over the peaked up echo and then press ENTER.
5. Press MENU and switch off REFERENCE GAIN.
6. Press MEAS and the curve will appear on the measurement screen.

23.5 ESTIMATING EFFECTIVE DIAMETER

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

Calculating NFL

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

Where:
N = Near Field Length
D_{EFF} = Effective Diameter
λ = Wave Length (velocity/frequency)

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

Square/Rectangle DEFF)

$$K = 0.6935\left(\frac{B}{A}\right)^3 - 0.3753\left(\frac{B}{A}\right)^2 + 0.0661\left(\frac{B}{A}\right) + 0.09863$$

Where:
K = Aspect
A = Largest Dimension
B = Smallest Dimension

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

Round Crystal (DEFF)

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

Where:
DEFF = Effective Diameter
Dia. = Diameter of the crystal
0.97 = Fixed ratio

Calculated results can also be compared to the following table:

Ratio of the sides	
B/A	**K**
1.0	1.37
0.9	1.25
0.8	1.15
0.7	1.09

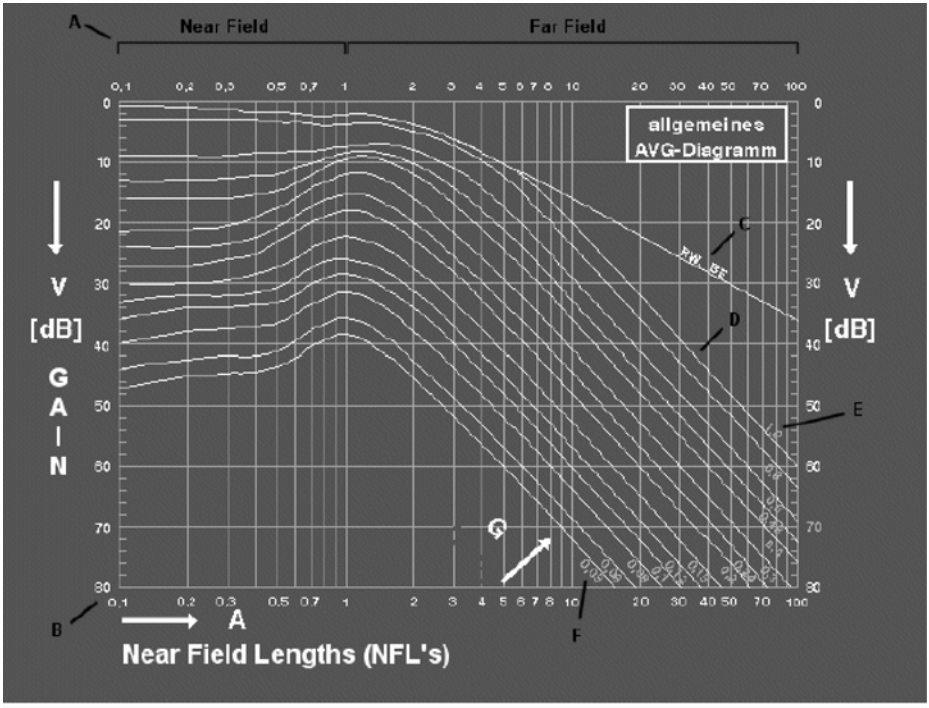
Ratio of the sides	
0.6	1.04
0.5	1.01
0.4	1.00
0.3	0.99
0.2	0.99
0.1	0.99

B = Smallest Dimension

A = Largest Dimension

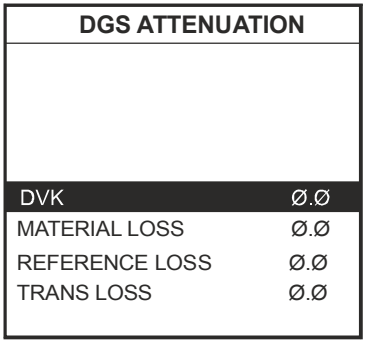
K = Aspect Ratio

23.6 NEAR FIELD LENGTHS DIAGRAM



23.7 ATTENUATION PARAMETERS

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



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

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

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

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

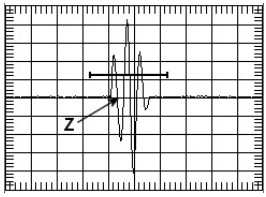
24 MEASUREMENT - OPTIONS

Further information can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

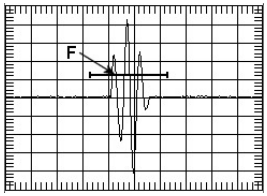
The Polarity function is used in the same way for the flaw detector as it is for the thickness gauge. Polarity is selectable depending on the VIEW, GT1, GT2 and DAC settings.

24.1 DETECT MODE

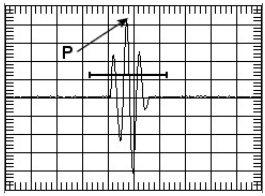
Your gauge has three detection modes; Z-Cross, Flank, and Peak. The following diagrams illustrate the difference between the options:



Z-Cross



Flank



Peak

In the diagrams, the current polarity is positive (as shown by the position of the gate - above the baseline).

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

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

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

To adjust the Detect Mode setting:

1. MENU/TUNE/DETECT MODE.
2. Use LEFT and RIGHT keys of the right wheel to select the correct DETECT MODE.
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

24.2 PULSE WIDTH

See “Pulse Width” on page 28.

24.3 PULSER VOLTAGE

Your gauge has a 200 V square wave pulser that can be adjusted for specific applications and transducers. The standard pulser setting is 150 V, and the Pulser Volt function allows you to increase or decrease this value by 50 V to give greater penetration for difficult material types, or increased resolution on noisy materials.

To adjust the Pulser Voltage setting:

See “Pulser Voltage” on page 29.

24.4 PULSE REPETITION FREQUENCY (PRF)

Your gauge has an adjustable pulse repetition rate (8 Hz, 16 Hz, 32 Hz, 66 Hz, 125 Hz, 250 Hz, 333 Hz, 1000 Hz and 2000 Hz). This setting determines how fast the pulser fires. The repetition rate is tied into the alarm LEDS. Therefore, when scanning at higher speeds, a higher repetition rate will make the alarm trigger more responsive. It is important to note that since the screen has a maximum refresh rate of 120Hz, any PRF settings over this maximum will not be visible on the display (in fact, the human eye has a response rate of less than 60 Hz).

The PRF setting will automatically be overridden according to the value of RANGE you have set. Long RANGE settings will slow down the PRF automatically.

Note: Slower PRF settings use less electrical power, therefore if your current application does not need fast scanning speeds, selecting a slower PRF will help conserve battery life.

To adjust the Pulse Repetition Frequency setting:

1. MENU/PRB/MAX PRF.
2. Use LEFT and RIGHT to adjust the value of MAX PRF.
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

24.5 DAMPING

Your gauge has a damping function which adjusts the input impedance of the receiver. This enables you to optimise the gauge to suit the transducer for better signal quality at various frequencies. The damping settings are 50, 75, 100, 300, 600 and 1500 ohms.

To adjust the DAMPING setting:

1. Press MENU/PRB/DAMPING.
2. Use LEFT and RIGHT to adjust the value of DAMPING.
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

24.6 FILTERS *(Frequency - labelled wide)*

Your gauge has a range of filters; one wide band filter of 1.8 MHz to 19 MHz and narrow band filters at 1 MHz, 2 MHz, 5 MHz and 10 MHz. The wide band option is responsive to all signals within the given frequency range. Narrow band filters eliminate signals outside of the target filter frequency, and focus on the output of the transducer at the specified frequency.

To adjust the FREQUENCY setting:

1. MENU/TUNE/FREQUENCY.
2. Use LEFT and RIGHT of the right wheel to adjust the value of FREQUENCY.
3. Press MEAS to return to the measurement screen, ready to begin taking readings.

24.7 PEAK HOLD

Your gauge has a function which draws and saves the maximum waveform amplitude on the measurement screen. This allows you to locate the maximum signal amplitude more easily while you move the transducer over the surface in all directions.

To use the PEAK HOLD function while you are searching for flaws:
Press PEAK
To cancel PEAK HOLD:
Press CLEAR.

24.8 FREEZE WAVEFORM

Your gauge has a function which takes a snapshot of the waveform currently being displayed on the screen. When the snapshot has been taken and the waveform is frozen on the measurement screen, you can then safely remove the transducer from the test material without losing the current waveform. This enables you to study the waveform in more detail. The waveform can be saved in the internal memory of the gauge.

To FREEZE the waveform currently being displayed:
Press FREEZE.
The measurement screen displays the snapshot of the waveform.
To cancel FREEZE:
When asked for capture name, either name and save or press ESC to cancel FREEZE.

25 TRANSDUCERS FOR FLAW DETECTION

Further information on Transducers can be found on Elcometer NDT Knowledge Centre on www.elcometerndt.com

SECTION : 4 FUNCTIONS & FEATURES COMMON TO ALL GAUGES

26 MEASUREMENT - RECORDING YOUR READINGS

Your gauge is equipped with a data logger -. With a data file open, all your measurements are saved into the file for later review and download to PC.

26.1 ABOUT THE DATA LOGGER

With a data file open, as you take measurements, the measurement data is stored in files in the gauge memory.

DATA LOGGER FILE FORMAT

You have a choice of two different file formats:

- *Grid format*: Similar to a spreadsheet format in which each cell is used to store a reading. Cells are referenced by the row number (1 to 999) and the column label (A to ZZ).
- *Sequential format*: A single column of up to 512 possible rows (readings), and a column of corresponding identifiers associated with each individual reading. The identifier can be a combination of up to 10 alphanumeric/special characters (see below), however it must not start or end with a special character. Once a start and end ID are entered into the gauge and the log created, the gauge automatically generates all the identifiers within that range.

DATA LOGGER FILENAME CHARACTER SETS

Any combination of the following characters can be used for file names and sequential format identifiers:

- Numeric characters: 0 - 9
- Alpha Characters: A - Z
- Special Characters: ! ' _ # space / . - ( )

WHAT MEASUREMENT DATA IS SAVED

When a measurement is taken (irrespective of log file format), the following information is saved:

- The reading value.
- A screenshot, the nature of which will depend on what view the gauge was in at the time the reading was taken. For example, if the view was in B-SCAN, then a B-SCAN screenshot will be saved with the reading. This 'Save Graphics' option can be toggled on/off.

MEMORY CAPACITY

You can create and save as many data files as required up to the maximum capacity of the gauge memory (32 Mbit). If you try to create a new file which exceeds the memory capacity, the gauge will display an error message. Saved data must be deleted in order to make the space available.

Save Graphics Option	Memory Capacity (readings)
On	16 000 +
Off	210 000 +

26.2 CREATING A NEW DATA LOGGER FILE - GRID FORMAT

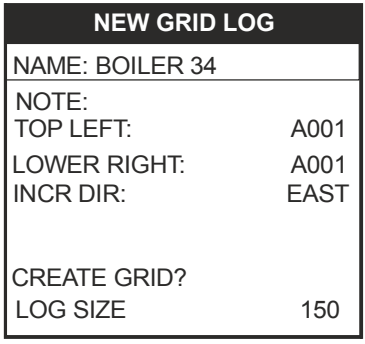
To create a GRID log data file:

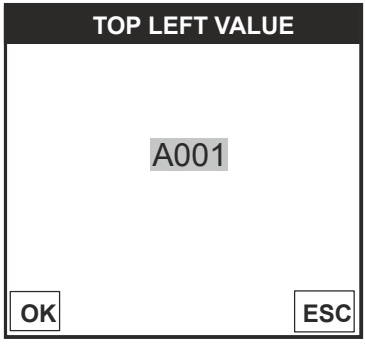
1. Select MENU/DATA/NEW.
2. Use (LEFT) or (RIGHT) keys of the right wheel to choose between grid and sequential log types.
3. Press ENTER to continue.
4. Fill in a name and a note (if desired) for your data logger file.
5. Select the size of the grid. Grid positions are denoted by a number and a letter, where the letter is the column and the number is the row.

   Use TOP LEFT and LOWER RIGHT to define the size of the grid. For example, a with the TOP LEFT set to A001 and LOWER RIGHT C003 would produce a 3x3 grid.

   The grid can have a maximum of 52 columns and 999 rows.
6. Set the Auto Increment direction. This option allows you to select which direction the cursor moves after a reading is stored in terms of compass points. For example NORTH would move the cursor up a row, and WEST would move a column left.
7. Finally create the log by scrolling to CREATE LOG, pressing ENTER and then OK to confirm.

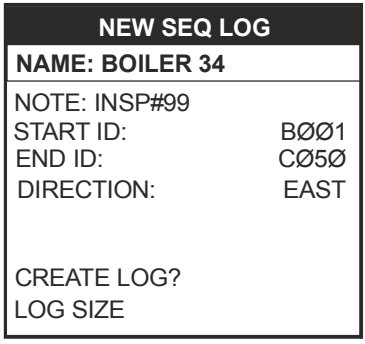
The measurement grid is now displayed along with the grid name on screen.

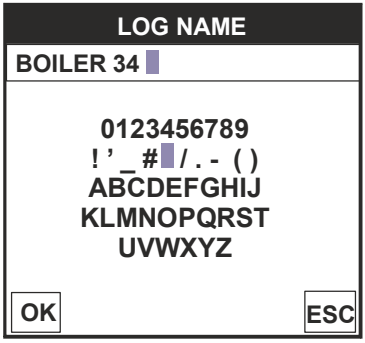




26.3 CREATING A NEW DATA LOGGER FILE - SEQUENTIAL FORMAT

1. To create a SEQ log data file:
2. Scroll to the DATA section of the main menu.
3. Select NEW and use the (LEFT) and (RIGHT) keys of the right wheel to choose between grid and sequential log types.
4. Press ENTER to continue.
5. Fill in a name and a note (if desired) for your data logger file. Press OK when complete.
6. Choose a START ID (see section 26.1).
7. Choose a END ID (see section 26.1).
8. Scroll to DIRECTION and select NONE, INCrement or DECrement to not move or move either right or left through the sequential log automatically when a reading is saved.
9. Finally create the log by scrolling to CREATE LOG, pressing ENTER and then OK to confirm.





26.4 HANDLING LOGGER FILES

Once created, logger files may be opened or closed using the functions "OPEN" and "CLOSE".

Closing logger files places the gauge in immediate mode and will prevent accidental saving of data into an inappropriate log.

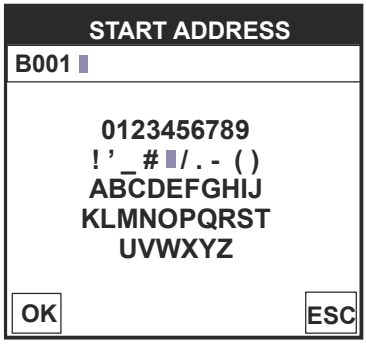
26.5 STORING READINGS IN A DATA LOGGER FILE

1. Create a new data logger file or open an existing file.

   The grid or sequential file is displayed in the lower half of the measurement screen.

   Note: Once the file is open, it will remain open until it is closed or another file is opened. If the gauge is switched off, the file will be opened automatically when the gauge is switched on again. Press ENTER to display the file from the measurement screen.
2. If you want to save the reading to a particular cell location, scroll to the desired cell.

   Note: The cell location must be empty. If it already contains a reading and you want to save a new reading to the same location, refer to the instructions given in "Viewing and Deleting readings" on page 59.



3. Take a reading and then press STORE or ENTER.

   The reading value is saved in the file at the location selected and the cursor advances to the next cell according to the rules set for the data logger file:

   - Grid log data file only: If INCR. DIR is set to NORTH, EAST, SOUTH or WEST, the cursor will advance one cell in the chosen direction. When the cursor reaches the last cell in the row or column it will return to the other end of the row or column.

- Sequential log data file only: If DIRECTION is set to INC or DEC, the cursor will advance one cell in the chosen direction. When the cursor reaches the last cell in the column it will return to the other end of the column.

Note: If you try to save a reading into a cell location which already contains a reading value, a warning message is displayed (see Deleting a reading).

4. Grid log data file only: To advance to a specific row number, press OK enter the row number. Press OK to advance directly to that row number in the grid log.
5. To toggle the display between DIGITS view, RF view and B-SCAN view, press ESC.
6. If you are unable to take a measurement due to the measurement location being physically inaccessible, press CLR.

   The cell location in the data file is marked OBST (Obstruct).
7. The display of the log data file on the measurement screen can be switched on and off:
   - To switch off, press MEAS.
   - To switch on, press ENTER.

26.6 VIEWING AND DELETING READINGS

With a data file open:

1. Use the arrows of the left wheel to scroll through the cells in the data file.

   As the cursor is moved to a different cell, the display is updated with the display view saved with the reading (if SAVE GRAPHICS was set to YES). Readings stored in memory are indicated by MEM in the top left corner of the measurement screen (in place of the bars of the stability indicator).
2. To delete a reading, scroll to the cell location, press CLR and then OK (or ESC to cancel).

   The reading is deleted and if you wish you can now take another measurement and save the reading in this cell location.

26.7 EDITING A DATA LOGGER FILE

You can edit the following fields of data files:

- Grid files: NAME, NOTE, and INCRement DIRection.
- Sequential files: NAME, NOTE, DIRECTION and LOG SIZE.

To edit a file:

1. Open the data file.
2. MENU/DATA/EDIT and press ENTER.

   The EDIT GRID LOG (or EDIT SEQ LOG) screen is displayed and lists all the fields which can be edited.
3. Scroll to the field you want to edit, press ENTER and then adjust the contents of the field using the techniques previously described to create a data file - see page 57.
4. When finished, scroll to SAVE CHANGES, press ENTER and then OK (or ESC to cancel).

26.8 DELETING A DATA LOGGER FILE

1. Select MENU/DATA/DELETE ONE FILE.
2. Press ENTER.

   The OPEN LOG screen is displayed and lists all the data files stored in your gauge memory.
3. Scroll through the list until the data file you want to delete is highlighted.
4. Press OK (or ESC to cancel).

The file is deleted.

26.9 DELETING ALL DATA LOGGER FILES

Note: This will delete all the data logger files in gauge memory - use with caution.

1. Select MENU/DATA/DELETE ALL DATA.
2. Delete all readings displayed.
3. Press ENTER and then OK to confirm (or ESC to cancel).

The data logger memory is erased - all files are deleted.

27 GAUGE SETUPS

Your gauge contains 64 configurable preset locations in which you can store custom gauge setups, each one optimised for a specific measuring application.

These gauge setups can save time when conducting routine inspections of the same job or project. This feature also helps to eliminate error between two or more users during the setup and calibration process.

The setups store:

- Measurement mode
- Transducer type
- Gain setting
- Scan mode setting
- Alarm settings
- Differential settings
- Display type setting

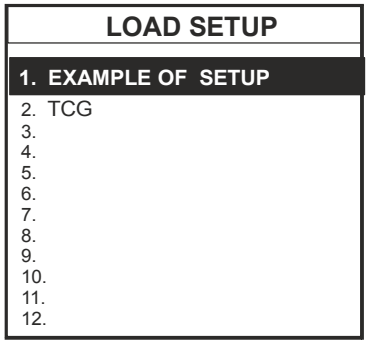
As well as storing the setups in your gauge, you can also store the setups on a computer and transfer them bi-directionally using the PC interface software included with the gauge.

The factory supplied setups stored in the gauge cover some of the more typical applications commonly used with this type of instrument and may be modified freely by the user.

The PC interface software includes a default setup file that can be uploaded to the gauge at any time to restore factory settings. However, you should consider saving modified setups to an empty location rather than overwriting the factory setups in your gauge.

27.1 OPENING A SETUP

1. Select MENU/SET/OPEN.
2. Press ENTER to display the SETUP LIST BOX.
3. Scroll through the list of setups until the required setup is highlighted.
4. Press ENTER to activate the confirmation screen.
5. Press OK to load the setup from memory.
6. Press MEAS to return to the measurement screen.



27.2 SAVING AND EDITING A SETUP

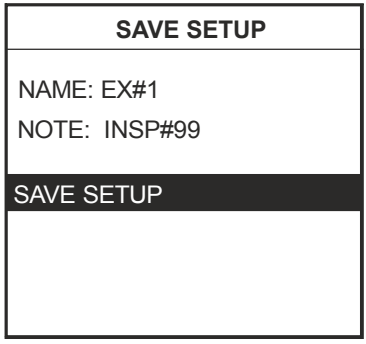
Once the parameters and features have been adjusted for an application, you can save these settings to a specific setup location for future use.

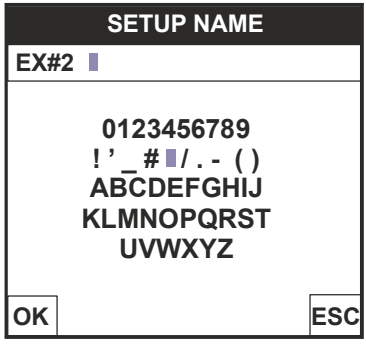
It is sometimes necessary to rename a previously saved setup, or add additional comments about a particular setup. The other comments about the project may also be required for additional documentation purposes.

The following procedures outline the necessary steps for saving and editing a setup:

1. Press MENU, SET and SAVE.
2. Press ENTER to display the Save Setup edit box.
3. Scroll to NAME and then press ENTER to edit its value:
   - When you have finished, press OK to enter the value.
4. If you want to add a note, repeat step 3 for NOTE.
5. When you have finished, scroll to SAVE SETUP and press ENTER.

   The setup list screen is displayed.
6. Scroll through the list of setups until the required location to save the setup is highlighted.
7. Press OK to activate the confirmation screen.
8. Press OK to save the Setup, or ESC to cancel.





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

27.3 DELETING A SAVED SETUP

This option deletes a setup file from your gauge (for example, if it is no longer needed).

1. Press MENU, scroll to the SET menu and then highlight the DELETE function.
2. Press ENTER to display the SETUP LIST BOX.
3. Scroll through the list of setups until the required setup is highlighted.
4. Press ENTER to activate the confirmation screen.
5. Press OK to delete the setup from memory.

27.4 USING THE DEFAULT SETUP

Your gauge includes a default setup which you can use if there are no other setups stored in the gauge and you need to reset it to factory settings. This gives you the ability to load and modify a basic setup as follows:

1. Press MENU, scroll to the SET menu and then highlight the DEFAULT SETUP function.
2. Press ENTER to activate the confirmation screen.
3. Press OK to confirm.

28 DATA TRANSFER SOFTWARE

Software is available which allows data to be transferred from your gauge to a PC. Presently Elcometer supplies ElcoMaster™ software for this purpose.

To set-up other types of communications software:

1. Start the communications software.
2. Configure the software using the following parameters:

   Data Bits - 8, **Parity - None**, **Stop Bits - 1**, **Baud Rate 1200 (to print a report), or 9600 to transfer data file**.

   Note: A report can be printed to a communications program (i.e. HyperTerminal), or printed to a serial printer using A4 or 8.5" x 11" paper.
3. Set the communications software COM port to the port number that the gauge is connected to.

28.1 TRANSFERRING MEASUREMENT DATA TO YOUR COMPUTER

RS-232 CONNECTOR

The RS-232 connector, located on the bottom end cap of the gauge, is a 2 pin female Lemo connector. It is designed to connect directly from the gauge to a standard AT serial port on a PC. A Lemo to 9 pin serial cable is supplied with the gauge.

Note: This connector is also used to upgrade the gauge with the latest version of firmware.

USB TO SERIAL CONVERTER

New laptop computers do not have standard serial ports. In this case, use the USB to Serial converter supplied with the gauge.

COMPUTER SYSTEM REQUIREMENTS

ElcoMaster™ is compatible with any Windows computer system running Windows XP or above.

USING THE XFER MENU

The XFER menu of your gauge is used in conjunction with ElcoMaster™. The steps below outline the procedure for accessing the XFER menu and basic operation as follows:

1. Scroll to the XFER section of the main menu.
2. Press ENTER to activate the option selected.
3. Once the Backup or Restore function has been completed, press MEAS once to return to the menu items, or twice to return to the measurement mode.

29 STORAGE

Your gauge has a Liquid Crystal Display. If the display is heated above 50°C (120°F) it may be damaged. This can happen if the gauge is left in a car parked in strong sunlight.

Always store the gauge in its case when it is not being used.

If the gauge is to remain unused for long periods of time, remove the batteries and store them separately. This will prevent damage to the gauge in the event of malfunction of the batteries.

30 MAINTENANCE

You own one of the finest corrosion gauges in the world. If looked after, it will last a lifetime.

30.1 FAULTS

Your gauge is designed to give many years reliable service under normal operating and storage conditions. The gauge does not contain any user-serviceable components. In the unlikely event of a fault, the gauge should be returned to your local Elcometer NDT supplier or directly to Elcometer NDT. The warranty will be invalidated if the instrument has been opened.

30.2 TRANSDUCER

The transducer will wear with repeated use. Transducer life depends on the number of measurements taken and the manner in which readings are taken. To extend transducer life, always set the transducer down so that it is perpendicular to the panel surface. Dragging the transducer along the surface will reduce the life of the transducer. Replacement transducers are available from your local Elcometer NDT supplier or directly from Elcometer NDT.

31 TECHNICAL SPECIFICATION

31.1 PERFORMANCE

Range	Pulse-Echo P-E	0.63 mm to 30.48 m (0.025” to 100 ft)
	Pulse-Echo Coating PECT	Material: 0.63 mm to 30.48 m (0.025” to 100 ft) Coating: 0.01 mm to 2.54 mm (0.001” to 0.100”)
	Pulse-Echo Temp Comp PETP	0.63 mm to 30.48 m (0.025” to 100 ft)
	Echo-Echo E-E	1.27 mm to 102 mm (0.050” to 4.0”) Range will vary +/- depending on the coating.
	Echo-Echo Verify E-EV	1.27 mm to 25.4 mm (0.050” to 1.0”) Range will vary +/- depending on the coating.
	Coating Only CT	0.0127 mm to 2.54 mm (0.0005” to 0.100”) Range will vary +/- depending on the coating.
Resolution		0.01 mm (0.001")
Velocity Range		254.9 m/s to 16000 m/s (0.01 in/µs to 0.63 in/µs)

31.2 PHYSICAL

Weight (including batteries)	2040 g (4.5lbs)
Dimensions (W x H x D)	216 mm x 165 mm x 70 mm (8.5” x 6.5” x 2.5”)
Gauge Operating Temperature	-10°C to 60°C (14°F to 140°F)
Case	Aluminium case design with gasket sealed end caps, waterproof membrane keypad.
Data Output	Bi-directional RS232 serial port. Windows PC interface software. USB1.1
Display	QVGA TPT colour display (320 x 240 pixels). 60 Hz screen refresh rate. Viewable area 115.2 x 86.4mm (4.54 x 3.40”) 144.78 (5.7”) diagonal. Adjustable brightness, colour scheme and auto dim time.
Power Source	Lithium Ion pack 10.8V, 2 amp hrs, typical operation 18 hours. Battery backup life: Six 1.5V Alkaliine 12 hours, Nicad 5 hours and NI-MH 12 hours, with default settings. *Note: Alkaline cells must be disposed of carefully to avoid environmental contamination. Please consult your local environmental authority for information on disposal in your region. Do not dispose of any cells in fire.*

32 WARRANTY

Elcometer NDT warrants your gauge against defects in materials and workmanship for a period of two years from receipt by the end user.

Additionally, Elcometer NDT warrants transducers and accessories against such defects for a period of 90 days from receipt by the end user. If Elcometer NDT receives notice of such defects during the warranty period, Elcometer NDT will either, at its option, repair or replace products that prove to be defective. The warranty will be invalidated if the instrument has been opened.

32.1 EXCLUSIONS

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

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

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

32.2 OBTAINING SERVICE DURING WARRANTY PERIOD

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

For products that require servicing, Elcometer NDT may use one of the following methods:

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

32.3 AFTER THE WARRANTY PERIOD

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

33 SPARES & ACCESSORIES

33.1 TRANSDUCERS

Elcometer NDT gauges are **not** supplied with a transducer as standard - this must be ordered separately.

The transducers listed below are the most commonly used however, Elcometer NDT offer a wide range of other transducers to suit various applications.

Further information on the transducers available and their applications can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

Description	Sales Part No.
2.25 MHz 1/2” Lemo Single Element Contact High Wear Transducer, Medium Damped	TF2M25EM-2
5.00 MHz 3/4” x 3/4” Microdot Standard Shear Wave Transducer, High Gain	TF5M00GGG-2
3.50 MHz 3/4” BNC Single Element Contact High Wear Composite Transducer, Medium Damped	TF3M50GM-1
2.25 MHz 1/4” Microdot Side Mini Angle Beam Transducer, 45 Degree	TF2M25C45M

5.00 MHz 3/8” Microdot Side Mini Angle Beam Transducer, 60 Degree	TF5M00D60M
10 MHz 3/16” Microdot Side Mini Angle Beam Transducer, 70 Degree	TF10M0B70M-

33.2 CALIBRATION BLOCKS

Elcometer NDT offer a comprehensive range of calibration blocks to suit a wide range of applications and standards.

Selecting the correct calibration block for the application is essential to ensure accurate evaluation. The form, shape and material of the calibration block should be appropriate for the material being inspected. Any artificially induced flaw should closely resemble that of the actual flaw being tested for.

The calibration blocks listed below are a selection of those available - details of the full range can be found on www.elcometerndt.com

Description	Sales Part No.
Calibration Block: 8 Step; 1 - 8mm	TW-24005-*
Calibration Block: 10 Step; 2 - 20mm	TW-24006-*
Calibration Block: 10 Step; 2.5 - 25mm	TW-24007-*

Replace * with S1018 = 1018 Steel Block; A = Aluminium Block; SS = Stainless Steel Block; T = Titanium Block.

33.3 ULTRASONIC COUPLANT

Each gauge is supplied with a 120ml (4oz) bottle of standard ultrasonic couplant. Replacement bottles and couplant for high temperature applications are available from your local Elcometer NDT supplier or directly from Elcometer NDT.

Description	Sales Part No.
Ultrasonic Couplant, 120 ml (4 fl oz)	TC-24034-1
Ultrasonic Couplant, 360 ml (12 fl oz)	TC-24034-2

Note: A wide range of other transducers and accessories is available - see www.elcometerndt.com for details.

33.4 MISCELLANEOUS

Description	Sales Part No.
RS232 Cable USB to Serial Converter	TL-24031

34 CONDITION AND PREPARATION OF SURFACES

Further information on Transducers can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

35 APPLICATION

Further information on Applications can be found on the Elcometer NDT Knowledge Centre on www.elcometerndt.com

36 SOUND VELOCITIES OF COMMON MATERIALS

Material	L-Wave Velocity in/µs)	L-Wave Velocity m/s	S-Wave Velocity in/µs)	Sound Velocity m/s
Aluminium	0.250	6375	0.124	3130
Beryllium	0.580	12903	0.305	8880
Brass	0.173	4394	0.083	2120
Bronze	0.139	3531	0.088	2235
Cadmium	0.109	2769	0.059	1500
Columbium	0.194	4928	0.083	2100
Copper	0.183	4648	0.089	2260
Glass (Plate)	0.227	5766	0.135	3430
Glycerine	0.076	1930	-	-
Gold	0.128	3251	0.047	1194
Inconel	0.229	5817	0.119	3020
Iron	0.232	5893	0.127	3230
Iron (Cast)	0.180	4572	0.087 - 0.126	2200-3220
Lead	0.085	2159	0.028	700
Magnesium	0.230	5842	0.120	3050
Mercury	0.057	1448	-	-
Molybdenum	0.246	6248	0.132	3350
Monel	0.211	5359	0.107	2720
Nickel	0.222	5639	0.117	2970
Nylon	0.106	2692	0.043	1090
Platinum	0.156	3962	0.066	1670
Plexiglas	0.106	2692	0.050	1270
Polystyrene	0.092	2337	-	-
PVC	0.094	2388	0.042	1060
Quartz Glass	0.226	5740	0.087	2210
Rubber, Vulcanised	0.091	2311	-	-
Silver	0.142	3607	0.036	1590
Steel (1020)	0.232	5893	0.128	3240
Steel (4340)	0.233	5918	0.128	3240
Steel, Stainless	0.223	5664	0.123	3120
Teflon	0.054	1372	0.250	6350
Tin	0.131	3327	0.066	1670
Titanium	0.240	6096	0.123	3120
Tungsten	0.204	5182	0.113	2870
Uranium	0.133	3378	0.078	1980
Water	0.058	1473	-	-
Zinc	0.166	4216	0.095	2410
Zirconium	0.183	4648	0.089	2250

37 THE MENU COMMANDS - THICKNESS GAUGE

Menu (Thick.)	Function	Description
PRB (PROBE)	ZERO PROBE	Zeros your gauge in much the same way that a mechanical micrometer is zeroed. If your gauge is not zeroed correctly, all of the measurements made may be in error by some fixed value. You can choose between automatic zero or manual zero.
	ZERO COATING	In order to account for very slight electronic differences in transducers of the same type, frequency, and diameter, your gauge includes this "zero coating" feature. This feature enables your gauge to obtain very accurate readings on coatings, eliminating potential errors incurred from slight differences in the transducer manufacturing processes.
	TYPE	Use this function to select the type of transducer being used from a chart of transducer types. This provides increased linearity between transducers.
CAL (CALIBRA-TION)	MAT	Select the material velocity from a chart of basic material types when a known sample thickness, or material velocity cannot be obtained.
	MATL 1PT	Performs a single point calibration. This function allows you to automatically calculate the velocity by entering a known sample thickness.
	MATL 2PT	Performs a two-point calibration. This function allows you to automatically calculate the velocity by entering a second known sample thickness.
	VELOCITY	This function calibrates your gauge by setting the velocity to a known material velocity.
	COATING 1PT	Performs a single point coating calibration. This function allows you to automatically calculate the velocity by measuring a known coating sample thickness.
	COATING 2PT	Performs a two-point coating calibration. This function allows you to automatically calculate the velocity by entering a second known coating sample thickness.
	COATING VEL	This function calibrates your gauge to a specific coating material type by entering a coating velocity.

Menu (Thick.)	Function	Description
DISP (DISPLAY)	VIEW	Choose between RF wave, RECT (rectified) wave, BSCAN (cross section), and DIGITS (large digits) views.
	DELAY (B-START)	Adjust where the left side of the display window starts according to thickness, in inches or millimetres.
	RANGE (B-DEPTH)	Set the overall depth of the viewable measurement area. It functions a lot like a zoom on a camera.
	B-SCAN SPEED	Adjusts the scroll speed of the B-Scan. Scale is 0-10 where 10 is the fastest. Default setting: 6.
	UNITS	Toggle between Metric (millimetres) or English (inches) units.
	BRIGHTNESS	Adjusts the brightness of the display. Scale is 0-20 where 20 is the brightest.
	COLORS	Choose the display colour scheme (from a choice of 12).
	DIM	Conserve battery life by dimming the display after idle for a specific amount of time: OFF, 30, 60, 90, 120 seconds. Pressing any key will restore the screen brightness.
	RECT WAVE	Toggles between an outlined or filled view option when the display setting is in RECT (rectified) wave mode.
	DETECT MARK	Choose the format of the vertical line on the RF and RECT measurement screens which shows the detection point: Line, Box, Dots, None.
TUNE	MEASURE MODE	Choose which measurement mode to use.
	POLARITY	The gauge operates on a zero crossing detection principle. This feature toggles which stroke of the cycle the crossing detection uses, either positive or negative.
	PULSE	Your gauge has adjustable pulse width (SPIKE, THIN, or WIDE) for both high penetration and resolution applications. The pulse width refers to the duration of time the pulser is on.
	PULSER VOLT	Provides a 50 V cut/boost to the pulser. The standard setting is 150 V. Provides greater penetration for difficult material types, or increased resolution on noisy materials.
	DAMPING	Provides multiple input impedances to match the impedance of the transducer and therefore optimise transducer performance.
	GAIN	Increases or decreases the overall amplitude of the signal. Gain is similar to the volume control on a stereo receiver.
	AGC	When operating in E-E or E-EV mode, the gauge adjusts the gain automatically. Alternatively, the AGC can be manually controlled.

Menu (Thick.)	Function	Description
GT1 (GATE 1)	START	Sets the start of the gate, according to time/distance.
	GATE1 WIDTH	Sets the overall width of the gate, in terms of distance, from the starting value of Gate1
	THRESHOLD1	Sets the sensitivity level of Gate1. The amplitude of the signal must reach or exceed this threshold level before a measurement is detected.
GT2 (GATE 2)	GATE2 WIDTH	Sets the overall width of the gate, in terms of distance, from the starting value of HOLDOFF 2.
	HOLDOFF 2	Delay the starting point of Gate2 a specific distance from the first detection point found inside of the boundaries of the Gate 1 settings. If no detection is found, the value of GATE1 WIDTH is used as a starting value for Gate2.
	THRESHOLD2	Sets the sensitivity level of Gate2. The amplitude of the signal must reach or exceed this threshold level before a measurement is detected.
GT3 (GATE 3)	GATE3 WIDTH	Sets the overall width of the gate, in terms of distance, from the starting value of HOLDOFF 3.
	HOLDOFF 3	Delay the starting point of Gate3 a specific distance from the first detection point found inside of the boundaries of the Gate2 settings. If no detection is found, the value of GATE2 WIDTH is used as a starting value for Gate3.
	THRESHOLD3	Sets the sensitivity level of Gate3. The amplitude of the signal must reach or exceed this threshold level before a measurement is detected.
SET (SETUP)	OPEN	Displays a list of factory and user-defined setups currently stored in memory. These setups can be recalled and used at any time.
	SAVE	Save a custom setup that you have modified or created.
	DELETE	Delete specific setups previously saved in memory.
	DEFAULT SETUP	Loads a basic default setup. Use only as a last resort if the setups in your gauge have been corrupted and a computer is not accessible.
	LANGUAGE	Select the menu language.

Menu (Thick.)	Function	Description
DATA	NEW	Creates a new alpha numeric grid, or sequential log file with auto identifiers. You can customise the grid or sequential log file according to your requirements.
	EDIT	Modify the parameters of grid or sequential files previously saved. *Note: Predefined coordinates cannot be changed once they have been created.*
	OPEN	Recalls existing grids or sequential log files from gauge memory.
	CLOSE	Closes a currently opened grid or sequential log file.
	DELETE ONE FILE	Deletes a selected grid or sequential log file from memory.
	DELETE ALL DATA	Deletes all files currently stored in memory.
UTIL (UTILITIES)	AUTO FIND	Automatically locates the detection point if the measurement is out of the viewable display area.
	SCAN MODE	Enables a high speed scan mode that increases the overall sample rate from 65 to 200 measurements per second, depending on the current measurement mode used.
	ALARM	Toggles alarm mode ON, OFF, or AUDIBLE.
	ALARM HIGH	Sets the HI limit parameter. If the measurement exceeds this value, a red light will illuminate and the alarm will sound.
	ALARM LOW	Sets the LOW limit parameter. If the measurement falls below this value, a red light will illuminate and the alarm will sound.
	DIFFERENTIAL	Sets a nominal value and your gauge will display +/- the difference from this nominal value.
	GAUGE	Set gauge type; THICKNESS GAUGE, FLAW DETECTOR or REQUEST. When set to REQUEST, the gauge will ask which mode is required whenever it is switched on.
	KEY CLICK	Sets the volume of beeps occurring with each key press.
	SET DATE	Allows date to be changed.

Menu (Thick.)	Function	Description
XFER (transfer)	BACKUP SETUPS	Allows you to backup the setups currently stored in your gauge to a computer via the RS232 port.
	COPY DATA	Allows you to transfer data to an external sd card if installed.
	COPY SCREEN	Allows you to transfer a screen shot to an external sd card if installed.
	UPGRADE GAUGE	Allows you to upgrade firmware via the Elcometer Website, www.elcometerndt.com
	CAPTURE TO FILE	Allows you to save data to internal memory.
	STORAGE	Allows you to choose internal or external memory storage.
	ABOUT	Displays information covering the instrument Firmware details, Serial Number and FPGA version.

38 THE MENU COMMANDS - FLAW DETECTOR

Menu (Flaw Det.)	Function	Description
PRB (Probe)	TYPE	Select the type of transducer being used (SINGLE or DUAL).
	PULSE	Your gauge has adjustable pulse width for both high penetration and resolution applications. The pulse width refers to the duration of time the pulser is on. The options are SPIKE, THIN, and WIDE.
	MAX PRF	Controls the gauge pulse frequency. The maximum frequency is 333 Hz, however, the gauge automatically adjusts the PRF according to the delay and range settings; the larger the range, the slower the pulse frequency will be.
	DAMPING	Provides multiple input impedances to match the impedance of the transducer and therefore optimise transducer performance.
	PULSER VOLTAGE	Provides a 50 V cut/boost to the pulser. The standard setting is 150 V. Provides greater penetration for difficult material types, or increased resolution on noisy materials.
CAL (Calibration)	MAT	Select the material velocity from a chart of basic material types when a known sample thickness or material velocity cannot be obtained.
	MATL 1PT	Performs a single point calibration. This function allows you to automatically calculate the velocity by entering a known sample thickness.
	MATL 2PT	Performs a two-point calibration. This function allows you to automatically calculate the velocity by entering a second known sample thickness.
	VELOCITY	This function calibrates your gauge by setting the velocity to a known material velocity.
	ZERO	Zeros the transducer and calibrates the screen (similar to zeroing a mechanical micrometer).

Menu (Flaw Det.)	Function	Description
DISP (Display)	VIEW	RF, +RECT, -RECT or RECTFW.
	DELAY	Adjust where the left side of the display window starts according to thickness, in inches or millimetres.
	RANGE	Set the overall depth of the viewable measurement area. It functions a lot like a zoom on a camera.
	UNITS	Toggle between Metric (millimetres) or English (inches) units.
	BRIGHTNESS	Adjusts the brightness of the display. Scale is 0-20 where 20 is the brightest.
	COLORS	Choose the display colour scheme (from a choice of 12).
	DIM	Conserve battery life by dimming the display after idle for a specific amount of time: OFF, 30, 60, 90, 120 seconds. Pressing any key will restore the screen brightness.
	RECT WAVE	Toggles between an outlined or filled view option when the display setting is in RECT (rectified) wave mode.
	DETECT MARK	Choose the format of the vertical line on the RF and RECT measurement screens which shows the detection point: Line, Box, Dots, None.
TUNE	FREQUENCY	The gauge is a wide band flaw detector with a frequency range of 1.8 MHz to 19 MHz (-3dB). The gauge also has selectable narrow band filters at 2 MHz, 5 MHz and 10 MHz.
	GAIN	Increases or decreases the overall amplitude of the signal. Gain is similar to the volume control on a stereo receiver.
	GAIN STEP	Increases or decreases the gain size.
	DETECT MODE	Sets the detection mode; PEAK, FLANK or Z-CROSS (zero crossing).

Menu (Flaw Det.)	Function	Description
GT1 (Gate 1)	ALARM 1	Toggles the alarm function of Gate1; ON, OFF or AUDIBLE. The audible feature sounds a beeper when the waveform breaks the threshold level, either above or below, depending on the current DETECT setting.
	DETECT	Set the alarm detection to occur either ABOVE or BELOW the gate THRESHOLD value.
	GATE1	Sets the start of the gate, according to depth/thickness.
	GATE1 WIDTH	Sets the overall width of the gate, in terms of distance, from the starting value of Gate1.
	THRESHOLD1	Sets the sensitivity level of Gate1. Used in conjunction with the DETECT setting, THRESHOLD acts as the trigger point for the alarm.
	POLARITY	The gates can be set to detect on either the positive or negative polarity (stroke) of the half or full wave cycle. *Note: If VIEW is set to positive, and the gate negative, the gauge will not display an amplitude percentage of full screen height.*
GT2 (Gate 2)	The GT2 functions are the same as those for GT1.	
TRIG (Trigonometry)	TRIG	Toggles trigonometry function ON or OFF. This function is used with angle beam transducers for the inspection of welds, to calculate three measurements: Beam path distance, Surface distance and Depth from the index point of the transducer.
	THICKNESS	Sets the thickness of the test material. The thickness will be used to determine which skip/leg the gauge is detecting on.
	ANGLE	Sets the angle of the transducer. This value is used in the calculations above.
	X-OFFSET	Calculates the surface distance in the trigonometry function, as a physical measurement from the index point of the probe to the front of the wedge/can/shoe/case.
	CSC OD	Curved surface correction value to compensate for changing sound path distance and angle. This value is used in conjunction with the THICKNESS value in order to calculate a correction factor.

Menu (Flaw Det.)	Function	Description
AWS (American Welding Society)	AWS	Toggles AWS function ON or OFF. This function is used in the analysis of welds according to the American Welding Society's structural welding code D1.1-94 to calculate the Indication Rating (IR).
	REF GAIN	The gain (in dB) required to set the indication level to a specific percentage of full screen height (FSH).
	% SCRN HEIGHT	Set the reference level of the AWS as a percentage of full screen height. This value will typically be set somewhere between 20% to 90%.
TCG (Time Corrected Gain)	TCG	Toggles TCG function ON or OFF. This function displays reflectors of equal size at equal A-Scan amplitudes, regardless of the depth of the reflector in the test material.
	DRAW	Toggles DRAW mode ON or OFF and used to draw the TCG curve.
	CURVE	Toggles drawing of the TCG correction curve on the screen ON or OFF.
	% SCRN HEIGHT	Set the reference level of the TCG as a percentage of full screen height.
DAC (Distance Amplitude Correction)	DAC	Toggles DAC function ON, OFF or AUDIBLE. A Distance Amplitude Correction (DAC) curve is used to configure a variable threshold for the gate, using the same size reflector at different distances.
	DRAW	Toggles DRAW mode ON or OFF and used to draw the TCG curve.
	MEAS	Toggles the units displayed as a relationship of either the signal amplitude and DAC curve, or just the signal according to screen height. The units are %FSH, %DAC, and dB.
	CURVE	Selectable signal or multi DAC curve options. The displayed curve options are: DAC, -2dB, -6dB, -10dB, (-6dB/-12dB), (-6dB/-14dB). Once the DAC curve has been generated, these options can be toggled at any time.
	TRIGGER	Used to set the alarm threshold for the DAC curve. The options are; at DAC, -2dB, -6dB, -10dB, -12dB, -14dB, or using an independent gate. The list of trigger options will change according to which CURVE option has been selected.
	POLARITY	Select the polarity of the DAC curves generated, either positive or negative.

Menu (Flaw Det.)	Function	Description
DGS (Distance, Gain Size)	DGS	Toggles DGS function ON or OFF. This function is used to provide an effective defect size of a detected defect within a test object.
	REFERENCE GAIN	Enables the reference gain using a given reflector from a calibration standard.
	TRIGGER CURVE	Enables the User to set the detection curve to either DGS or GATE. This will be the curve used to trigger the alarms and display the effective reflector size (ERS) during the inspection process.
	EFFECTIVE PROBE DIAMETER	A variable used to calculate the near field length of a given transducer, and determine the defect size. The effective diameter will be noted on the transducer calibration certificate for a standard DGS transducer. However, this can be estimated using the formulas outlined in section “Estimating effective diameter” on page 50.
	PROBE FREQUENCY	Refers to the centre frequency of the transducer being used, and used in the calculation of the near field length.
	CURVE SIZE (ERS)	Used to select which curve will be used, based on the reflector size, from the DGS(AVG) chart on page 52. If the value entered is not an exact curve value represented in the diagram, the gauge will compare and interpolate between the two closest curves, and mathematically derive a curve for that value.
	ATTENUATION	Used to additionally compensate other factors leading to the loss of sound/energy. Refer to section “Attenuation Parameters” on page 53for more information on the attenuation parameters. If all the attenuation values are set to zero, the attenuation feature will display off.
	DELAY VELOCITY	The longitudinal velocity of the delay line, most commonly used with angle beam style probes, but also used with 90 degree compression probes. It is important to note that in order for this to be accurate, the 'probe zero' must be accurate. This is easily accomplished by performing a two point calibration (auto calibration).
	REFERENCE TYPE	This option enables the user to select the type of reflector that will be used during calibration and setup. The options are Back Wall, Flat Bottom Hole (FBH), or Side Drilled Hole (SDH).
	REFERENCE SIZE	Assuming the reference type selected is either FBH or SDH, the User will be required to enter the size of the reference reflector.

Menu (Flaw Det.)	Function	Description
SET (Setup)	OPEN	Displays a list of factory and user-defined setups currently stored in memory. These setups can be recalled and used at any time.
	SAVE	Save a custom setup that you have modified or created.
	DELETE	Delete specific setups previously saved in memory.
	DEFAULT SETUP	Loads a basic default setup. Use only as a last resort if the setups in your gauge have been corrupted and a computer is not accessible.
	LANGUAGE	Select the menu language.
DATA	NEW	Creates a new alpha numeric grid, or sequential log file with auto identifiers. You can customise the grid or sequential log file according to your requirements.
	EDIT	Modify the parameters of grid or sequential files previously saved. *Note: Predefined coordinates cannot be changed once they have been created.*
	OPEN	Recalls existing grids or sequential log files from gauge memory.
	CLOSE	Closes a currently opened grid or sequential log file.
	DELETE ONE FILE	Deletes a selected grid or sequential log file from memory.
	DELETE ALL DATA	Deletes all files currently stored in memory.
UTIL (UTILITIES)	AUTO FIND	Automatically locates the detection point if the measurement is out of the viewable display area.
	SET DATE	Allows date to be changed.
	KEY CLICK	Sets the volume of beeps occurring with each key press.
	GAUGE	Set gauge type; THICKNESS GAUGE, FLAW DETECTOR or REQUEST. When set to REQUEST, the gauge will ask which mode is required whenever it is switched on.
	COMPARE	The compare feature enables an operator the ability to locate and establish a reference waveform from a flaw in an existing or manufactured sample and send it to the background on the display in a colour other than the active waveform colour. The reference waveform will remain in the background for the duration of inspection process, or until cleared. This feature can be useful when inspecting for a common flaw in a specific object, location and position.

Menu (Flaw Det.)	Function	Description
XFER (transfer)	BACKUP SETUPS	Allows you to backup the setups currently stored in your gauge to a computer via the RS232 port.
	COPY DATA	Allows you to transfer data to an external sd card if installed.
	COPY SCREEN	Allows you to transfer a screen shot to an external sd card if installed.
	UPGRADE GAUGE	Allows you to upgrade firmware via the Elcometer Website, www.elcometerndt.com
	CAPTURE TO FILE	Allows you to save data to internal memory.
	STORAGE	Allows you to choose internal or external memory storage.
	ABOUT	Displays information covering the instrument Firmware details Serial Number and FPGA version.