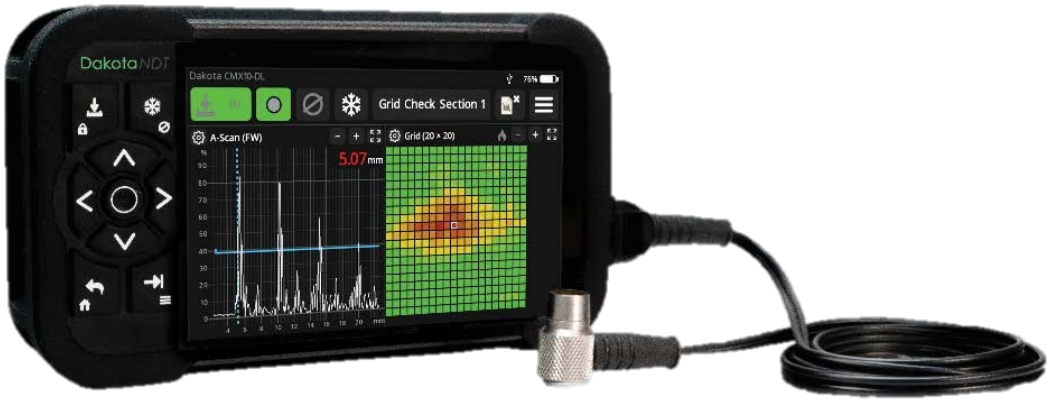
Dakota NDT

User Guide

Dakota CMX10-DL

Ultrasonic Full Wave Capture A-Scan Thickness Gauge



Contents

For the avoidance of doubt, please refer to the original English language version available via our website & QR Code.

This product is packed in a cardboard package. Please ensure that all packaging is disposed of in an environmentally sensitive manner. Consult your local Environmental Authority for further guidance.

Gauge Dimensions: 180 x 105 x 53mm (7.87 x 4.13 x 2.09”) - without transducer Gauge
Weight: 210g (7.4oz) - including batteries, without transducer

A Material Safety Data Sheet for the ultrasonic couplant supplied with the Dakota CMX10-DL and available as an accessory, is available to download via our website.

A copy of this Instruction Manual is available for download on our website via www.dakotandt.com

DakotaNDT is an Elcometer company.

1 INTRODUCTION

Thank you for purchasing this Dakota CMX10-DL Ultrasonic Full Wave Capture A-Scan Thickness Gauge. Welcome to DakotaNDT. With the purchase of this gauge you now have access to the worldwide service and support network of DakotaNDT. For more information visit our website at www.dakotandt.com.

1.1 ABOUT YOUR GAUGE

The CMX10-DL is an extremely versatile A-scan ultrasonic thickness gauge. It can measure both coating and material thickness simultaneously while maintaining the ability to detect pits, flaws, and defects within the material.

Based on operating principles similar to those of ultrasound, the gauge can measure the thickness of various materials with precision accuracy (accuracy is dependent on the material and transducer used).

The primary advantage of ultrasonic measurement over traditional methods is that it requires access to only one side of the material being measured. The CMX10-DL also features a built-in data logging memory, allowing readings to be stored in D-Logs before being uploaded to a computer via Bluetooth or USB.

The CMX10-DL is a measuring instrument for use in general industry. It is not a medical device and **MUST NOT BE USED FOR ANY MEDICAL APPLICATIONS.**

The gauge is supplied with a rechargeable lithium ion battery pack which can be re-charged either within the gauge or using an optional external battery charger, see “Spares & Accessories”. Only use battery packs recommended by DakotaNDT. Always dispose of batteries and battery packs in accordance with local environmental and legal regulations.

This user guide provides the reader with essential instructions on how to operate the Dakota CMX10-DL. Training in the use of any ultrasonic measuring device is recommended to ensure optimum measurement, accuracy and precision.

1.2 BOX CONTENTS

Each gauge is supplied with the following:

Description	Replacement Part Number
Power Supply with UK, EU and US Adapters for recharging the battery inside the gauge or for powering the gauge without the battery	T92033671
Rechargeable Smart Battery Pack Li-Ion 10.8V, 3.35Ah, 36.2Wh	T92033672
Ultrasonic Couplant, 120ml/4fl oz	T92015701
Hand Strap (x1) with Extension Pieces (x2) extension pieces convert the hand strap to a shoulder strap.	T92033670
Screen Protector (x1)	T92033669 (pack of 5)
USB-C Cable	T92033668
Transit Case	T92033673
Calibration Certificate	n/a
User Guide	n/a

As the ultrasonic transducer is dependent on the user's measurement application, a transducer is not supplied and must be ordered separately.

Note: *Data can be transferred to and from the gauge using Dakota's DakMaster™ software available to download via DakotaNDT.com.*

2 GETTING STARTED

2.1 FITTING THE HAND & SHOULDER STRAPS

Once the connection loops are connected, clip on the hand strap. Unpeel the VELCRO® and adjust the hand strap to fit.

Connecting the shoulder strap extension: The shoulder strap extension converts the hand strap into a shoulder strap, connect one to each connection loop.

Note: *The connection loops can be attached on either side for left or right-handed use.*

2.2 FITTING THE BATTERY

1. Unscrew the battery compartment assembly using a screwdriver or coin.
2. Check the battery is charged by pressing the integrated battery status indicator.
3. Insert the battery ensuring the battery status indicator is facing outwards.
4. Reattach the battery compartment assembly.
5. Power on the gauge.

2.3 SWITCHING ON / OFF

To power on: Press and hold the power button until the welcome screen is displayed. Once the welcome screen is displayed release the power button.

To switch off: Press and hold the power button until the gauge beeps four times.

2.4 INITIAL GAUGE SET-UP

When switching on the gauge for the first time, after the regulatory information is displayed, the user will be asked to set up the generic settings of the gauge, which include:

Setting the Language: Select the language required from the list using the touch screen or gauge buttons.

Time and Date: The user can set up the time format, date format, current time and date by using the touch screen or buttons. Once adjusted the user can choose to display the time and date on the status bar.

Screen Brightness: The user can manually select a screen display brightness or select “Auto adjust” which allows the gauge to adjust the screen brightness in line with the ambient light conditions optimizing battery life.

Setup Display Layout: The user will be asked to set up the layout of the panel display.

1. Select the number of display panels from 1 to 4.
2. Select which display feature is to be shown in each panel. Choose from A-Scan, Reading Statistics, Live Reading and Grid.

3. Press the tick button to finish set-up or back button to return to the previous screen.

Alternatively, select the default setting button and amend accordingly.

Select Transducer: The user will now be asked to select the transducer to be used or connect an ODU “intelligent” transducer.

3 CONNECTING A TRANSDUCER

The CMX10-DL is designed to take a wide range of single and dual element transducers.

ODU “Intelligent” Transducers: Manufactured by Dakota and available in both single and dual element configurations, these transducers are automatically recognised by the gauge when connected. V-path correction is applied automatically.

Lemo Transducers: Single and dual element transducers with lemo connections can be connected to the gauge. Transducers manufactured by Dakota will automatically have a V- Path correction applied by the gauge. For transducers produced by other equipment manufacturers (OEMs), V-Path corrections vary by transducer and manufacturer therefore, the gauge cannot apply these corrections automatically.

V-Path Correction: Dual Element transducers are manufactured with two crystals - one crystal transmits the sound pulse, the other crystal receives the returning echo. Due to their construction, the sound waves travel in a ‘V’-shaped path, which is slightly longer than the direct path. This can lead to measurement errors unless corrected for. Dakota transducers connected to Dakota gauges have V-path correction applied automatically.

When using transducers not manufactured by Dakota, the V-Path effect on accuracy can be minimised by properly calibrating the gauge using calibration step blocks; choose two thicknesses during calibration which “bracket” the expected material thickness of the item under inspection.

3.1 CONNECTING AN ODU “INTELLIGENT” TRANSDUCER

When connected, “intelligent” transducers are automatically recognised by the gauge, detecting the frequency, diameter, serial number and crystal type (single or dual element) of the transducer.

1. Locate the ODU transducer gauge port located on the right hand side of the gauge.
2. With the red positioning dot on the ODU plug facing upwards, push the plug into the ODU gauge port until locked in place with a ‘click’.
3. The gauge will automatically identify the connected transducer and display it’s part number, serial number, element type (dual or single), probe frequency and crystal diameter.
4. Verify the transducer details and select continue.

The gauge will now ask if you wish to calibrate the transducer. Whilst the user has the option to select no, calibrating the transducer is recommended for greatest accuracy. Select yes and follow the on-screen probe zero wizard instructions.

⚠ To remove the transducer, pull back on the knurled collar of the ODU. Do not pull on the transducer cable as this may damage the cable.

3.2 CONNECTING A LEMO TRANSDUCER

1. Locate the lemo transducer port located on the right hand side of the gauge, labelled “O O”.
2. There are two lemo sockets identified as Tx (Transmit) and Rx (Receive)
    a. For single element transducers, insert the lemo plug into the socket marked Rx.
    b. For dual element transducers, insert the dual lemo plugs into the Rx and Tx sockets.
3. When connected, press the button to create a new transducer.

    Note: *Single and dual element lemo transducers have passive connections and must therefore be identified manually by the user. When switching on the gauge for the first time, the user will be asked to select a transducer by the gauge setup wizard.*
4. Select the Transducer ID/Serial number box, and using the on-screen keyboard, type in a transducer ID and/or serial number.

    Note: *This ID/serial number should clearly identify the transducer.*
5. Select the transducer type – single or dual element - and press the key to continue.

Note: *For single element transducers, users will also have to identify if a delay line is to be used - if none, select "contact".*

A delay line is a small component that is attached to a single element transducer to increase the accuracy of measurements, especially on thin materials or materials with a high 'ring'.

Delay lines increase the time between the ultrasonic transmission pulse and the echo received, allowing the gauge to accurately measure the thickness of thin materials (where the signal returns very quickly). Delay lines can also slow down the sound pulse helping to reduce noise (ring), improving signal clarity of the return echoes.

Delay lines are made from a wide range of materials and are chosen based on the type of material being measured. Acrylic is used for steel, aluminum & titanium; graphite is used for thin plastics, for example.

6. Now select the transducer manufacturer - Dakota or OEM (for other equipment manufacturers), followed by the transducer's crystal frequency and diameter from the drop down lists.

   Note: *For Dakota manufactured transducers, there is an additional crystal setting type - select Standard, Highly Damped or Coatings as applicable.*

7. Press the button to continue.

The gauge will now ask the user to Calibrate or Zero the transducer. Once complete, the gauge is ready to take readings.

To remove the transducer, pull back on lemo transducer plugs. Do not pull on the transducer cable as this may damage the cable.

4.0 NAVIGATING THE GAUGE

4.1 MAIN MENU

The gauge has been designed to be incredibly user friendly. All functions and features of the gauge can be selected from the Menu icon.

"Menu/About" provides detailed information including:

- Gauge model, serial number and firmware version
- Measurement system details
- ODU transducer information (if connected)
- Storage memory - % free / % used
- DakotaNDT contact information
- Legal information including regulatory information & licensing

4.2 DATA (MENU/DATA)

The gauge has both internal storage and an external 'SD type' memory card for archiving data. Users can freely and easily move data to and from the archive memory card.

The gauge's data structure has been designed for easy filing and retrieval using a simple tree-type filing structure; Projects/, Folders and Data Logs. Projects & Folders are interchangeable but can be used to help retrieve Data Log files more easily. Data Log files store individual readings and can be saved in folders or projects.

4.2.1 Creating a new Project or Folder

To create a new project or folder in the internal gauge memory:

1. Go to Menu/Data and select internal storage.
2. Select the Project or Folder icon.
3. Using the keypad, name your project or folder.

4.2.3 Creating a New Data Log File

To create a new Data Log File in the internal memory:

1. Go to Menu/Data and select internal storage.
2. Select the Data Log icon from the drop-down list to open the New Data Log Wizard. The wizard will ask you to choose the selected set up or choose a stored setup.
3. Type the Log Name and insert an operator's name (optional).
4. The gauge wizard will now ask you to select the Log Type:

   Sequential Log: stores each reading in a linear, sequential file.

   Grid: Stores the reading in a spreadsheet format.

   If setting up a Grid Log file, the user will be asked to input the number of rows and columns and to define the collection order in which the readings will be taken.

5. The user can then define any measurement warning limits they wish to apply to the data log file. Choose from

   No Limits: no warning limits applied

Custom Limits: set up a new set of limit parameters from High, low and nominal values.

Warning threshold: where readings close to the limits are displayed with a warning prompt to the user.

Limit Memory: select from a previously defined limit saved within the Limit Memory.

Once complete the data log setup summary will be displayed, press the button to create and open the data log file and return to the measurement screen.

Note: The file structure (or breadcrumb) is displayed below the green heading. Each level is separated by a " · " eg. Level 1 · Level 2 · Level 3).

4.2.4 Rename a Project, Folder or Data Log File

1. Select the appropriate item to rename.
2. Select the Rename button.
3. Press the "item" box and rename using the on-screen keyboard.

Note: Only one Project, Folder or Data Log fille can be renamed at any time.

4.2.5 Move a Project, Folder or Data Log

4. Navigate to the relevant level within the file structure.
5. Select the relevant items to move.
6. Press the move button. A new file window will now display the top level of the memory storage structure.
7. Navigate to the new file structure location and press the button to move the selected items.

Note: *When moving a Project or Folder, all Projects, Folders and Data Log files within that Project or Folder.*

4.2.6 Clearing a Data Log File

To clear all readings from an existing data log file, leaving data log file settings, ready for new measurements to be saved:

1. Navigate to the relevant Data Log file within Menu/Data.
2. Select the relevant data log file(s) to clear.
3. Press the Clear button.

If the selected Data Log file is currently open, the gauge will ask if you wish to continue before clearing the Data Log file.

4.2.7 Deleting Projects, Folders or Data Log Files

1. Navigate to the relevant Project, Folder or Data Log file within Menu/Data.
2. Select the relevant Project, Folder or Data log file(s) to delete.
3. Press the Delete button.

If the selected Project, Folder or Data Log file is currently open, the gauge will ask if you wish to continue before deleting.

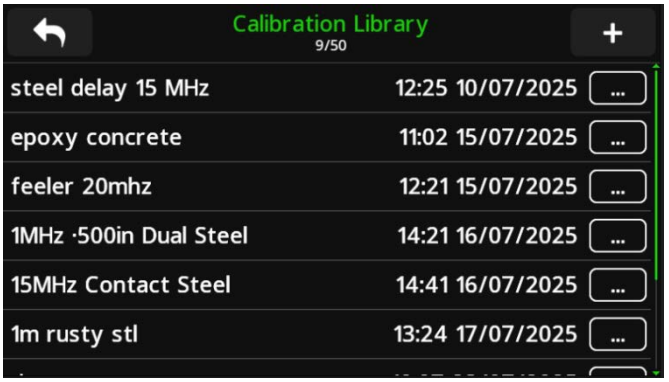
Note: When deleting a Project or Folder, all Projects, Folders and Data Log files stored within the Project or Folder will also be deleted.

4.3 CALIBRATION, LIMIT, TRANSDUCER & READING SETUP LIBRARIES

To simplify the user experience during setup, the gauge has been developed to enable you to store up to 50 previously created calibrations, limits, transducers & reading setups which can be selected when creating a new data log file.

4.3.1 Calibration Library & New Calibration Wizard

The calibration library allows you to store, recall and inspect all the calibrations performed on the gauge to keep a good record of the processes followed when preparing the gauge for accurate measurement.



Tapping the [+] icon on the top right corner of the Calibration Library screen will open the New Calibration Wizard.

This is how all calibrations on the gauge are performed and consists of a number of stages that can change depending on the type of calibration.

Depending on the settings chosen in Type, the gauge will guide you through a selection of the following panels:

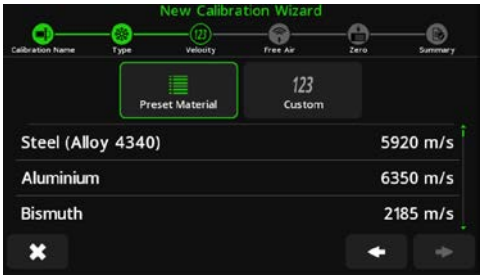
Calibration Name: Enter a unique name for the calibration record to identify it. You can also enter up to 40 characters of notes.

Tap the [->] icon to move to the next panel once a unique name has been entered.

Type: The transducer already registered with the gauge will appear at the top of this panel.

Select the required calibration type from the list, and then (if One or Two Point) select the measurement mode to be used for the calibration.

Velocity (For Known Velocity Calibrations): Select a preset material from the list or tap Custom to enter a known material velocity manually.



Free Air: Ensure the transducer face is clean of couplant and then hold it in free air making sure not to couple it to any objects.

Tap the [Measure] icon or softkey to set the initial gate positions based on the transducer's baseline waveform.

Zero: Apply a drop of couplant to the transducer and couple it firmly to the gauge's integrated zero disc on the back cover.

When the signal is stable, tap the [Measure] icon or soft-key and the gauge will calculate the transducer's zero offset.

Material / Low Point / High Point: Couple the transducer to your known thickness standard or calibration block.

Enter the known thickness value using the on-screen keypad.

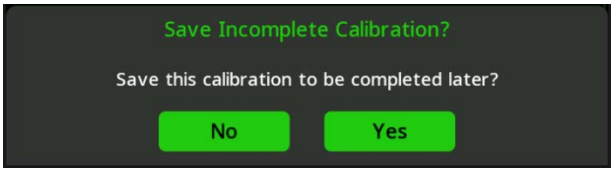
Tap the [Measure] icon or softkey to calculate the material velocity. If Two Point calibration mode has been selected, the Low Point and then the High Point will need to be entered.

Summary: Check through all the information collected by the wizard and tap the [✓] icon to save and apply the calibration.

If anything needs adjustment, you can go back through the steps to redo them using the [<-] arrow.

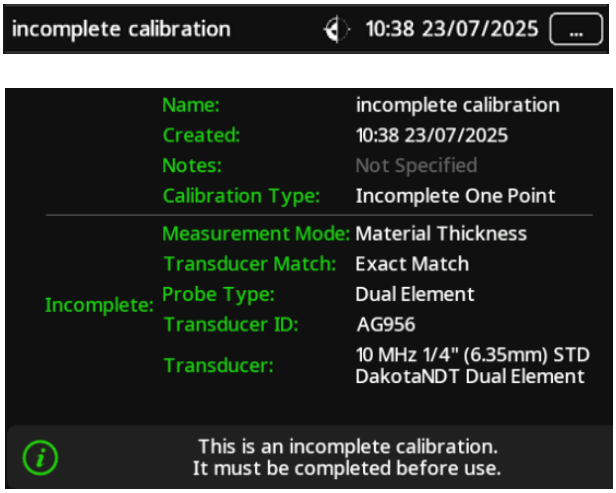
4.3.1.1 Saving Incomplete Calibrations

When exiting an in-progress calibration routine, the gauge will ask if you want to save the incomplete calibration file to finish later.



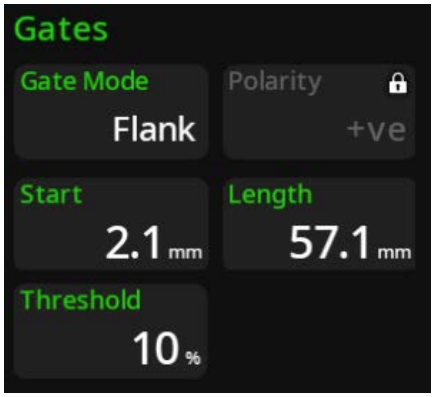
When you return to the calibration library, the incomplete calibration will have an icon next to its entry to indicate its status.

When checking the details, a note will appear to tell you the calibration is incomplete and must be finalised before use in a data log.



4.3.1.2 Adjust Reading Parameters in the Calibration Wizard

On stages where a reading is required from the transducer, you can use the setup tab to adjust the A-Scan and Gate settings to enable measurement.



This may be necessary when calibrating on large, noisy or very attenuative objects.

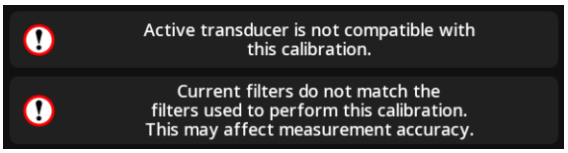
While in the Setup tab, the measurement gates can be moved and adjusted by dragging on the A-Scan screen.

4.3.1.3 Calibration Details Screen

Tap on the small icon next to a calibration record to open the calibration details screen.

From left to right, the icons let you Edit, Delete or Apply a valid calibration that matches the currently chosen transducer.

If there are problems with applying the calibration, the [✓] icon will be greyed out to prevent selection, and notices will appear at the bottom of the details screen to explain the cause.



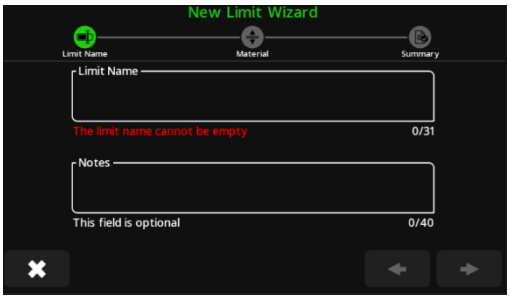
4.3.2 Limit Library & Limits

Limits are a convenient and reusable way to explicitly outline acceptance and rejection criteria for thickness inspections by setting different limits for individual measurements within a data log.

All created Limits are stored in the Limit Library and can be applied when creating a new data log file, see section 4.2.3 Creating a New Data Log File.

4.3.2.1 Creating a Limit File

Tap the [+] icon to create a new Limit file.



In the Limit Name panel, set a unique name for the Limit and add any relevant notes.

In the Material panel, you can set a High, Low, Nominal & Threshold value.

- ***High:*** the maximum value a measurement can be before the limit is triggered.
- ***Low:*** the minimum value a measurement can be before the limit is triggered.
- ***Nominal:*** not currently in use, required for a future planned update.
- ***Warning Threshold:*** displays a warning if the value of a measurement is less than Threshold distance from the High or Low limits e.g. if the High is set to 10mm and the Threshold is set to 1mm, the gauge will display a warning on any measurements between 9mm and 10mm.

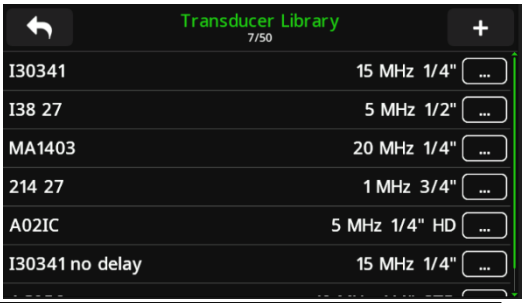
Note: Not all the values need to be set to create a valid limit file, but at least one High or Low value must be entered.

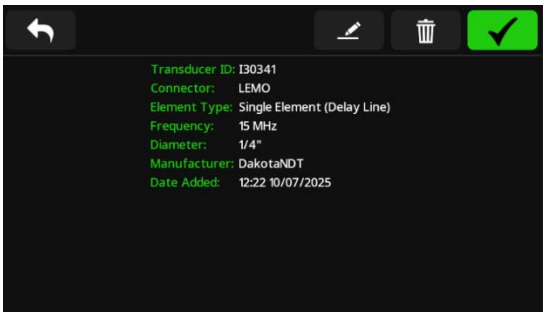
The summary panel collates the information entered on the Material panel. Once the values are set correctly tap the [✓] icon to save the limit file.

Note: Limit files can only be enabled when creating a new data log and have no effect outside of one.

4.3.3 Transducer Library & New Transducer Wizard

The Transducer Library stores all the previously setup lemo transducers in a convenient library to make it easier to switch between transducers while using the gauge.



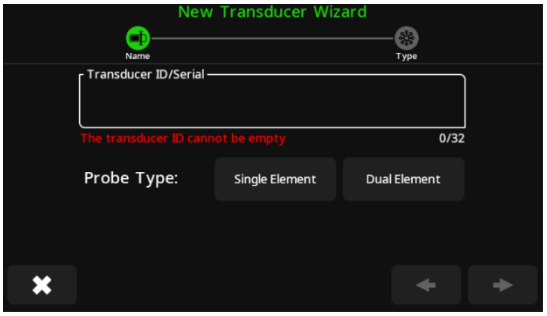


Every new lemo transducer used with the gauge will need to be setup via the New Transducer Wizard on the first use, whereas the gauge will automatically setup Dakota "intelligent" ODU transducers.

Clicking on the […] icon on any of the stored transducers will display the transducer information summary with all the information entered during the transducer setup.

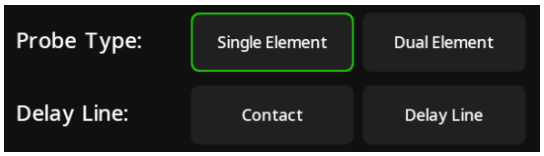
The toolbar icons (from left to right) allow you to rename, delete or apply a previously saved transducer file.

4.3.3.1 New Transducer Wizard



To add a new transducer to the library, tap the [+] icon on the top right of the Transducer Library toolbar.

Enter a unique ID or serial number for the transducer, and then select the specific type of transducer.



Single element transducers can be used in either direct contact or delay line mode, and the calibration routines will reflect this choice.

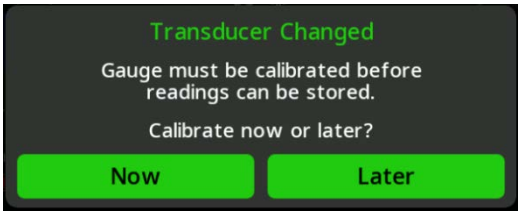
Once the type of transducer has been selected, enter the required transducer characteristics.

The gauge is compatible with many third party LEMO-00 transducers, select OEM if using one of these with the gauge.

- ***Frequency:*** the central frequency of the transducer (e.g., 5 MHz).
- ***Diameter:*** the stated diameter of the piezo-electric crystal.
- ***Type:*** Determined by the transducer's damping and wearface. If the specific type is unknown, select Standard.

Note: Correctly setting these variables is critical as they determine the gauge's pulse characteristics, filtering, and V-Path correction.

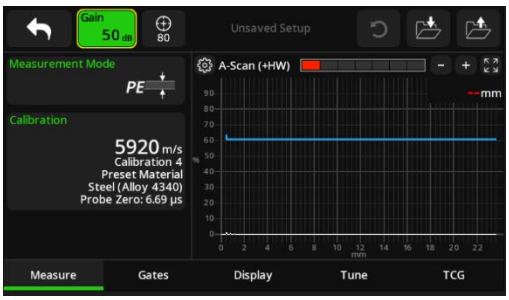
Once all the details have been entered correctly, the gauge will automatically switch to the new transducer, and this message will appear.



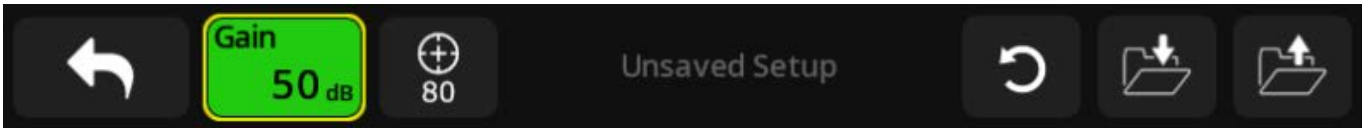
Selecting “Now” will open the New Calibration Wizard directly, but you can select “Later” to skip this until ready to calibrate. A calibration will need to be performed before a data log can be created with this transducer.

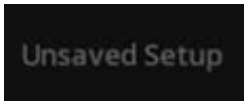
4.3.4 Reading Setup Screen

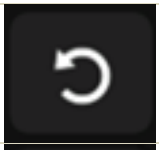
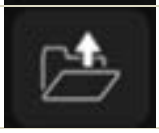
The Reading Setup screen provides the necessary controls to configure the gauge's measurement settings. On this screen, you can adjust parameters such as gain, range, delay and rectification mode; manage measurement setups (save, load, and create); and access Transducer and Calibration libraries.



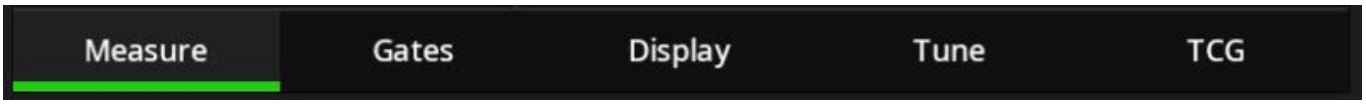
4.4 MAIN TOOLBAR



1		Back Button	Returns to the previous menu or screen.
2		Gain Adjust	Adjusts the amplification (gain) of the received ultrasonic signal. The value is given in decibels (dB).
3		Auto-80	Automatically adjusts the gain to set the current signal within the gate to 80% of the Full Screen Height (if possible).
4		Setup Name	If a saved setup is loaded, this area will display the name of that setup file. Displays ‘Unsaved Setup’ otherwise.

5		Restore Setup	When a named setup is loaded, this button discards any subsequent changes and restores the setup to its last saved state.
6		Save Setup	Saves the current settings as a new setup or allows you to overwrite the currently loaded one.
7		Load Setup	Opens the Setup Library to load a previously saved setup.

4.5 CONTROL TAB GROUPS



1	**Measure**	Allows you to change the measurement mode and selected calibration.
2	**Gates**	Controls responsible for the position, mode and polarity of measurement gates.
3	**Display**	Controls responsible for the A-Scan display parameters, such as the X-Axis quantity and rectification mode.
4	**Tune**	Allows you to adjust the pulser/receiver settings and choose your currently connected transducer.
5	**TCG**	Allows you to apply Ramp or Curve Time Corrected Gain to the A-Scan, as well as Backwall Suppression.

4.6 MEASURE TAB

4.6.1 Measurement Mode

The Measurement Mode button allows the user to select from the following:

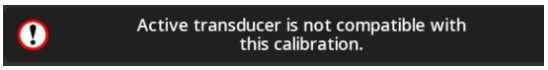
PE	**Material Thickness**	Uses 1 gate to measure the first echo received back from a material. Most common measurement mode, used for basic material thickness testing.
EE	**Material Thickness ThruPaint™**	Uses 2 gates to measure between the first and second echoes, or successive backwall echoes. Used for measuring the thickness of materials through a paint coating.
EEV	**Echo-Echo Verify**	Uses 3 gates to add an additional verification to ensure that Echo-Echo measurements are reasonable. Used to verify measurements on ThruPaint when signals are hard to interpret.

PE2	**2nd Layer**	Ability to measure total thickness, based on known material velocity in both layers, and one known layer thickness.
EE2	**2nd Layer Paint Thickness**	As PE2 for paint coated surfaces.

The measurement mode used will depend on the specific inspection being performed and is at the discretion of the operator or any specified work instructions.

4.6.2 Calibration Selection

Tapping the Calibration Library button allows the to select the currently applied calibration, either by choosing an older one or by creating a new one.

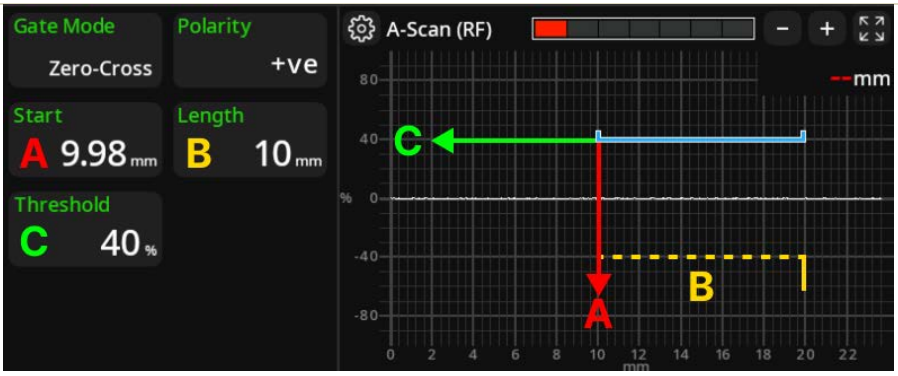


If a calibration is selected that does not match the transducer connected, a message will appear to alert the user that the calibration cannot be used.

4.6.3 Gates Tab

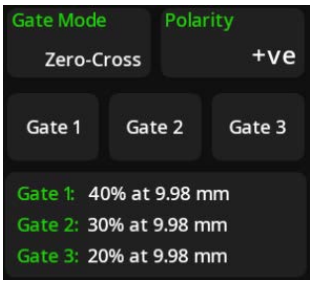
The contents of the Gates tab changes depending on the measurement mode selected in the Measurement tab, as this setting determines the total number of active gates.

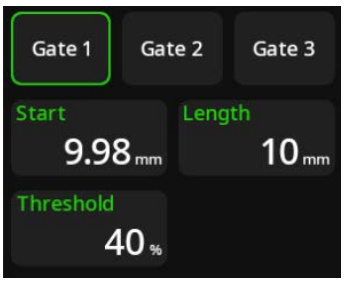
When **Pulse Echo Mode** (1 gate) is selected, the following controls are available:



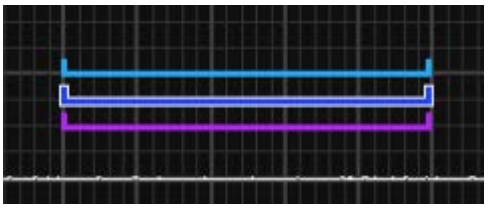
Gate Mode	Determines the detection style of the gate.
Polarity	Determines whether the gate is on the positive or negative side of the amplitude graph; disabled when rectification is enabled in the Display tab.
Start	The start position of the gate is the earliest point a detection can be made
Length	The overall length of the gate along the X axis
Threshold	The height a signal must exceed to trigger the gate

If **Echo-Echo** or **Echo-Echo-Verify** measurement mode is selected, the gates tab is modified to allow for each of the active gates to be selected and adjusted individually; selecting one of the gates displays the adjustment controls.





The A-Scan panel will also highlight the selected gate with a white border to make it easier to see which one is currently being adjusted (Gate 2 is selected in the image).



While the Gates tab is selected, the user can drag their finger across the A-Scan to reposition the gates without having to enter specific values in the control fields.

4.6.4 Gate Modes

Gate Mode determines where the gate places the measurement point after being triggered by a signal. Each gate mode will change the measured value on the same waveform, so it's important to be consistent and to select the right one for the task.

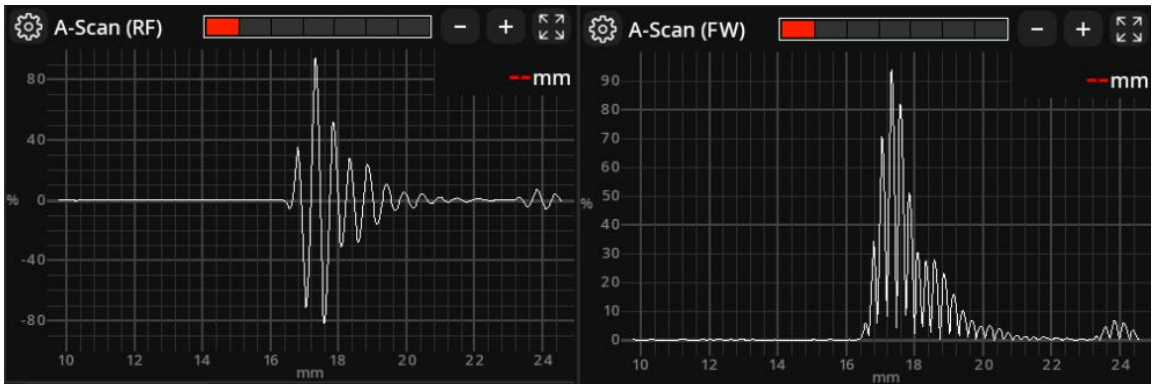
Flank	Triggers at the exact point a signal crosses the gate. Used widely, considered the classic or standard gate mode.
Peak	Triggers on the highest signal that crosses the gate. Used for very noisy signals to increase consistency of measurement.
Zero Cross	Triggers at the position after the Flank detection point where the signal crosses the X axis at 0. Used to compensate for measurement error caused by large amplitude variance.

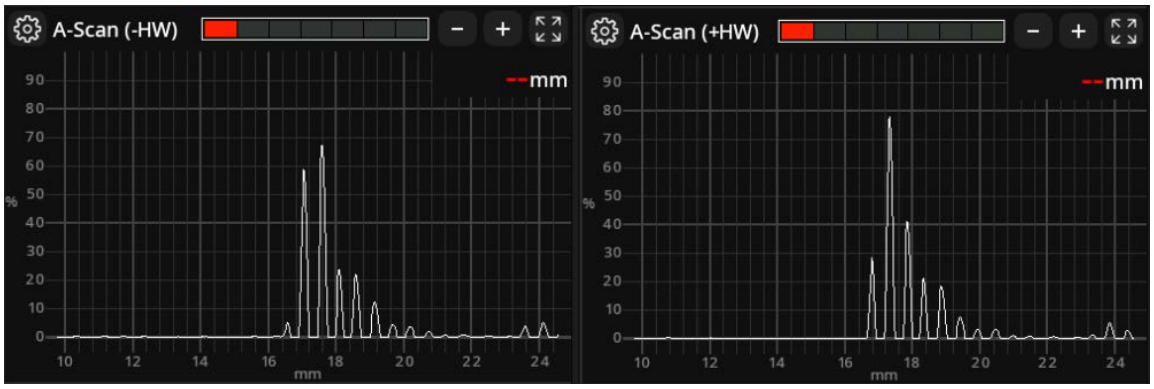
4.6.5 Display Tab

Rectify	Determines the rectification mode of the A-Scan display
X-Axis	Determines whether the X-axis is displayed in terms of Time or Distance
Delay	Determines the start position of the X-axis on the A-Scan display
Range	Determines the total width of the A-Scan display

4.6.6 Rectification

Rectification is the process of converting the raw radio frequency (RF) signal into a more easily interpretable waveform by displaying either the full (FW) or half (HW) positive or negative portion of the signal amplitude against time. The selected mode is displayed on the top left.

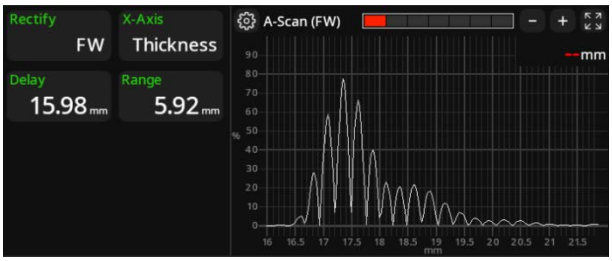


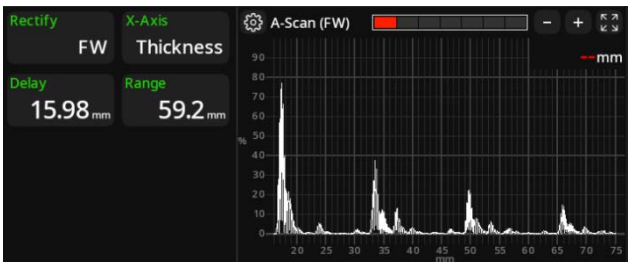


Clockwise from top left: Radio Frequency (RF), Full Wave (FW), Half Wave -ve (-HW), Half Wave +ve (+HW)

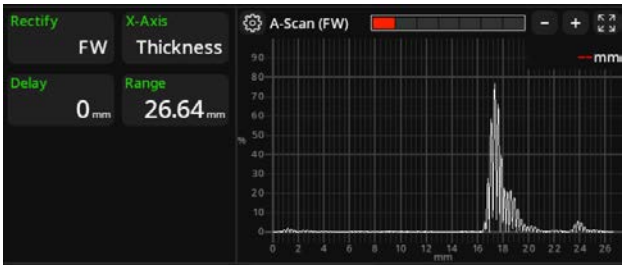
4.6.7 Delay & Range

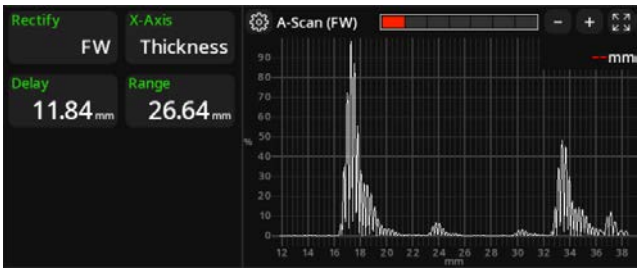
***Range**:* defines the total width of the displayed signal, corresponding to a specific time or distance within the material.





Delay: sets the starting point of the range, allowing the user to shift the viewing window and focus on signals that appear later in time, effectively zooming in on a specific area of interest.





Using these two controls together, the user can focus in or zoom out on areas of interest to make it easier to see wave echodynamics or gain variance over time.

In simplest terms, the Range is the width of the graph, the Delay is the start or origin of the graph.

4.6.8 Tune Tab

Use the Tune tab to fine-tune the instrument's signal path for the selected transducer and application.

Adjusting the pulser Voltage and receiver Filter Mode is critical for maximizing sensitivity and achieving a clean signal response.

These settings must be considered together, as the ideal configuration depends directly on the transducer being used.

Transducer	Determines the currently selected transducer; if using a smart transducer this field is locked while the transducer is connected. See **7.3.3 – Transducer Library & New Transducer Wizard** for more details.
Voltage	Determines the voltage of the pulse used to energise the transducer; higher frequency transducers have their max voltage limited to certain values to prevent damage.
Averaging	Determines how many samples are averaged together before being displayed on the A-Scan. Increasing this value reduces grass and noise but can also decrease how responsive the gauge feels.
Filter Mode	Determines the high and low pass filters to optimise signal to noise ratio. This is set automatically after a transducer is selected but can be adjusted later. See **7.4.6.1 – Filter Mode** for more details.

4.6.9 Filter Mode

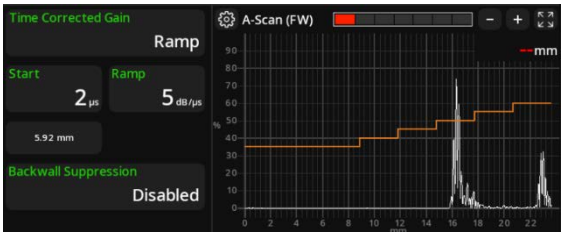
Filtering can be an important tool for increasing signal to noise ratio when performing an ultrasonic inspection. By default, the gauge automatically applies a high and low pass filter with a window around the transducer's central frequency. This filtering can be disabled, or the individual bands can be configured using Advanced mode.

4.6.10 Time Corrected Gain (TCG) Tab

Time Corrected Gain is a technique in ultrasonic testing that allows you to alter the gain along the time axis of the trace; typically 'correcting' for the natural attenuation of the ultrasonic signal in the test material. The gauge also allows the user to configure more complex zonal TCGs, which can raise or lower the gain in selected positions.

The TCG tab allows the user to enable and configure this behaviour, which can be useful when working with attenuative or complex materials. By default, TCG is disabled.

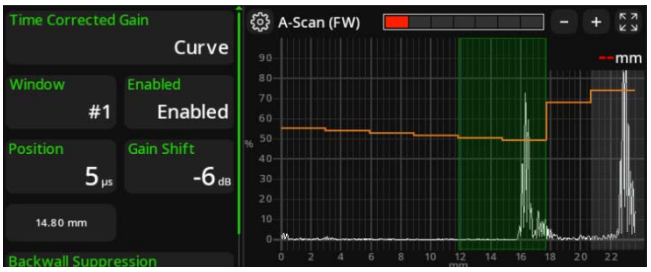
- ***Ramp TCG***
  Ramp is the simpler of the two modes and simply increases the gain linearly at the Ramp rate starting from the Start point.



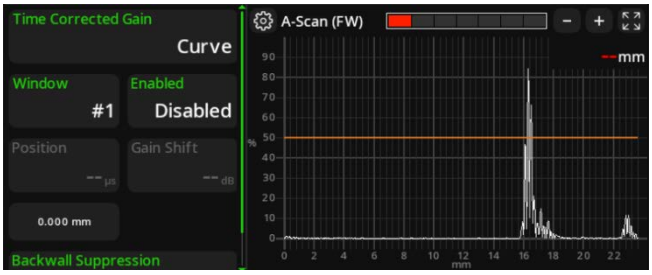
- These settings are visually represented by the TCG overlay (orange line on A-Scan), which is automatically enabled while in the TCG tab. To see it outside of this tab, it can be enabled in the A-Scan settings by clicking the cog icon.

- **Curve TCG**
  Curve extends the capability of TCG to allow Windows to be configured that adjust the gain either up or down.

  This can be useful when performing inspections on composite parts, or other complex materials that have specific zones of interest where higher sensitivity is needed.

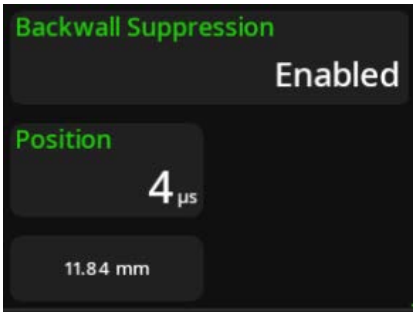


  In this example, Window #1 has been used to reduce the gain around the first back wall echo and Window #2, to increase the gain for the echo afterwards. This is reflected in the height of the peaks and represented in the orange TCG overlay.



Window	There are 16 available windows to select from, if required.
Enabled	Determines whether the specific window is active.
Position	The position of the Window in microseconds. For reasons related to the gain switching circuitry, this is only adjustable in set microsecond intervals. The position is also reported in terms of calibrated length underneath.
Gain Shift	The amount of gain to add or subtract from the set's overall gain level.

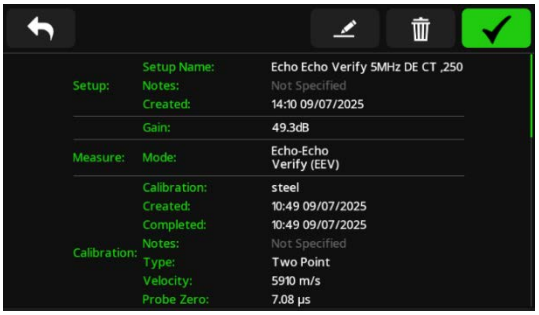
4.6.11 Backwall Suppression



The Backwall Suppression feature makes it easier to perform a Backwall Echo Attenuation style inspection for castings and composites.

Backwall Suppression allows the user to dramatically ramp down the gain at the specified position; this allows a high scanning gain in the volumetric region prior to the backwall echo, while maintaining the ability to see the change in amplitude of that signal.

4.7 READING SETUP LIBRARY



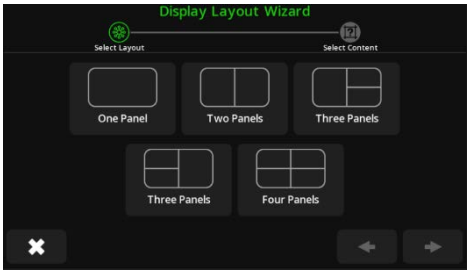
The Setup Library is where all the setup files created in the Reading Setup screen as stored. Saved setups can be selected from here or by using the toolbar on the Reading Setup screen. Clicking the [+] icon opens the Reading Setup screen.

Tap a setup to display the file's details, which contains all saved variables along with calibration dates and transducer information.

1		Back Button	Returns to the previous menu or screen.
2		Rename Setup	Allows you to change the name of the setup file.

3		Delete Setup	Deletes the setup file permanently.
4		Apply Setup	Applies all saved settings from the setup file to the gauge and returns you to the main screen.

4.7.1 Display Settings



The Display Settings menu allows the user to customise the home screen to show specific information.

There are 5 different layouts to choose from, and 4 separate panels that can be selected to populate each:

1		**A-Scan**	The A-Scan Waveform panel displays received echo signals on an amplitude/distance graph.
2		**Statistics**	When using a data log, the Statistics panel will collate statistical information about the saved readings such as mean, median and type.
3		**Live Reading**	The Live Reading panel displays the currently measured value, along with the reading stability indicator.
4		**Reading Grid**	When using a data log, the Grid panel will display the saved readings in an interactive manner that can be panned and zoomed.
5		**Image Collect**	When in an Image Collect Data Log, this panel will display the image with the specified measurement points.

Note: When setting up the display, all panels must be populated and cannot be left empty.

Note: The Default Setting button will autofill the panels with a standard layout.

4.8 GAUGE SETTINGS

- ***Bluetooth:*** enable and disable the Bluetooth on the gauge, displays the Bluetooth ID and gives access to a QR code link to DakMaster™ Software download page.
- ***Volume:*** adjust or mute the gauge speaker's volume.

- ***Screen:*** adjust the screen brightness or enable Auto Adjust. Adjust or disable the Auto Sleep and Auto Dim features.

  Note: *Auto sleep and dim will only take effect while the gauge is in a menu, while on a reading screen the gauge will remain at full power.*

- ***Regional:*** set the gauge language, measurement units, style of decimal separator and keyboard layout.

  Note: *Any changes to the Regional settings will require a full gauge restart to take effect.*

- ***Time & Date:*** set the gauge's date and time, adjust the display format and enable or disable the time display on the taskbar.

- ***Input Functions***: enable utility features that can make using the gauge feel more intuitive including:

  - ***Tap To Focus:*** changes how the user interacts with settings across the rest of the gauge. If enabled, tapping on a control will highlight it in yellow, which then allows the user to adjust the control using the gauge's arrow keys. If disabled, tapping a control widget will instead open the numerical entry panel.

  - ***Home Screen Gain Adjustment:*** allows the user to adjust the set's gain on the home screen by using the up and down arrow keys. The Auto-80 routine can also be activated by pressing the right arrow. The Gain Step control determines how much the gain will increase or decrease by when modified using the arrow keys.

  - ***Control Screen:*** enables or disables the swipe down command screen. If enabled, this menu can be displayed by swiping downwards from the top edge of the screen. The command screen allows quick adjustment of several gauge settings without having to navigate the menu.

4.9 RECORDING

The Recording settings allow the user to change the maximum length of any A-Scan recordings and to configure a timed countdown for recordings, giving the user time to press the button and then position the transducer correctly before the recording begins.

4.10 RESET

The Reset menu allows a factory reset of the gauge without deleting user data such as Transducers, Data Logs, Calibrations, Limits or Setups.

5.0 A-SCAN RECORDINGS & B-SCANS

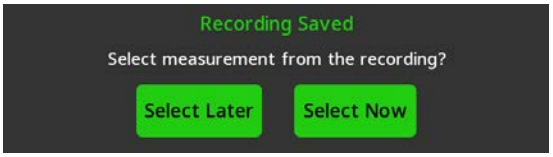
A 10-second recording of the A-Scan waveform alongside a measurement can be saved in any data log file. In some circumstances, it may be preferable to record the A-Scan display to highlight specific echodynamic features that may be present during an inspection.

5.1 RECORDING MODE

To create a recording, press the recording icon on the top toolbar on the main screen. This icon will appear next to the [Measure] icon when a data log file is open and active.

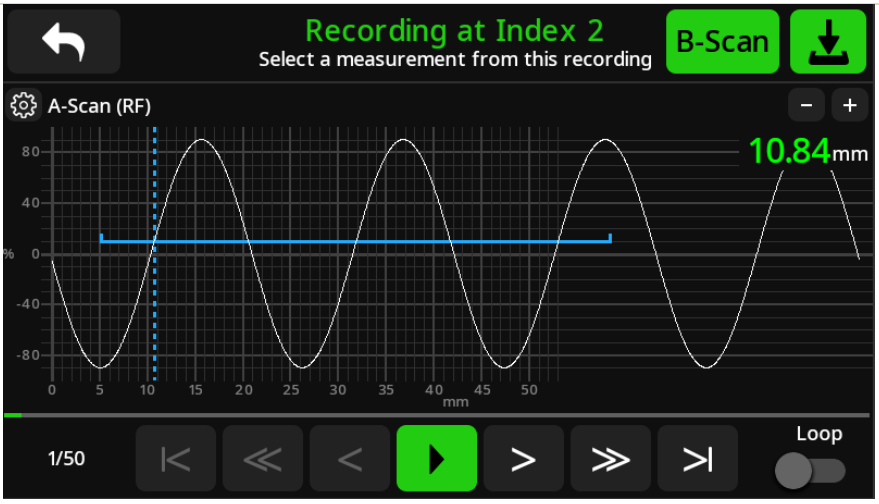
After the configured countdown delay, the recording will begin, and a timer will appear inside the record button to show how long is left before it completes. A recording can be stopped earlier by pressing the button again.

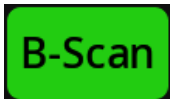
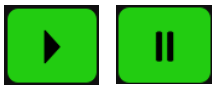
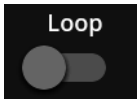
Once the recording has been stopped, the user will be asked if they wish to select an individual frame from the recording as the measurement.



This selected measurement will determine the thickness reading and A-Scan displayed in the data log for reporting purposes, while the full recording will be saved separately.

The Recording screen will appear if Select Now is chosen.



	**Select Frame**	Selects the currently displayed frame as the chosen frame to display when this measurement is reviewed.
	**Generate B-Scan**	Creates a B-Scan image from the currently displayed recording and navigates to the B-Scan inspection view.
	**Play/Pause**	Starts or stops the playback of the A-Scan recording.
	**Skip/Skip 10/End**	Allows the user to move forward through the recording by different frame amounts.
	**Back/Back 10/Start**	Allows the user to move backwards through the recording by different frame amounts.
	**Loop Toggle**	When enabled, playback will restart from the beginning once the end of the recording is reached.

Once satisfied with the frame selection, pressing the Select Frame button will save that frame as the measurement and then prompt the user to choose if they wish to keep or delete the recording.

5.2 GENERATE B-SCAN FROM RECORDING

Amplitude B-Scans can be created from saved A-Scan recordings to better examine the echodynamic profile of parts under test. While reviewing a recording, the B-Scan can be generated by pressing the [B-Scan] icon.

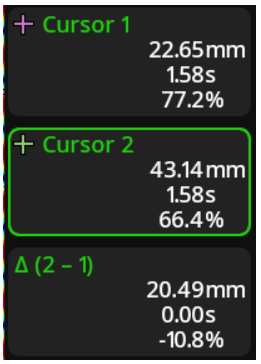
The colours are chosen based on the amplitude of the A-Scan's waveform at each position; an Amplitude B-Scan is a collection of A-Scan waveforms stacked side by side and coloured according to signal height.

Tapping the gear icon on the top left of the B-Scan enables a menu which allows the user to display the measurement cursors and adjust the display output.

5.2.1 Cursor Measurement Mode

Cursors allow the user to measure the depth and time of indications on the B-Scan by displaying these variables in a toolbar on the right-hand side of the display.

Cursor Mode	Description
Off	No cursors will be displayed.
One Cursor	A single cursor will be displayed.
Two Cursors	Two cursors will be displayed, a third information box will be displayed showing the difference between them.



The first line is the measured depth of the signal, the second row is the time that A-Scan was taken, and the third row is the measured amplitude of that signal.

5.2.2 Show Grid, Threshold and Amplitude Smoothing

There are three display features that allow for changes to the B-Scan output.

- ***Show Grid:*** toggles the visibility of the time/distance measurement grid.
- ***Threshold:*** hides all signals below a certain threshold value, ensuring that only sections of waveform above a certain height are displayed on the scan. This can be useful with very noisy materials to artificially raise the noise floor and only show indications above a certain size. For example, if Threshold is set to 10%, all indications below 10% will be reduced to 0.
- ***Amplitude Smoothing:*** applies a visual smoothing effect to make the output scan look less jagged. Smoothing is applied after scan generation so it will not alter the values displayed by the cursors.

6.0 BUTTON NAVIGATION

The CMX10-DL is intended to be used with both touchscreen and button controls, but it can be operated entirely using the buttons if required by the user.

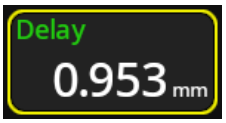
When the tab softkey is pressed, a yellow highlight will appear around the top left element on the screen.

with Tab softkey pressed

This highlight indicates the currently selected element, which can be accessed by pressing the central softkey.

When the highlighted element is a numerical entry button, the value can be adjusted by using the arrow softkeys.

> [Up arrow] >



> [Down arrow] >

Note: Holding down the key will gradually increase the rate of adjustment.

7.0 TECHNICAL SPECIFICATION

Battery Type:	RRC2040 Rechargeable Smart Battery Pack Li-Ion, Nominal Voltage 10.8V, 3350mAh/36.20Wh
Battery Life:	Approximately 14 hours
USB Rating:	USB C, 5V Power Rating 0.6A / 3W
LCD Display:	800RGB * 480 All View
Operating Temperature:	-10 to 50°C (14 to 112°F)
Relative Humidity:	0 to 95%
IP Rating: (equivalent to)	Gauge Only IP65
Dimensions:	180 x 105 x 50mm (7.1 x 4.1 x 2”)
Weight:	Gauge Only 870g (With supplied Battery)
Pollution Degree:	Level 3
Operating Altitude:	Maximum 4000m
External PSU:	External PSU Input Voltage: 100-240V~/50-60Hz/600-300mA Unit Input Voltage from external PSU: 15V, 2A, 30W Power consumption from external PSU: 15V @ 1.25A (18.75W), as this is also charging the
Power Consumption from Battery:	4.5W

8.0 LEGAL NOTICES & REGULATORY INFORMATION

Declaration of Conformity - CE: 2014/53/EU
Radio Equipment - Directive 2014/30/EU
EMC - Directive
2011/65/EU Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) - Directive

The CE Declaration of Conformity is available to download via:
https://downloads.elcometer.com/Declaration_of_Conformity/English/DoC_CMX10-DL.pdf

Declaration of Conformity - UKCA:
S.I. 2017 No. 1206 Radio Equipment Regulations 2017
S.I. 2016 No. 1091 Electromagnetic Compatibility Regulations 2016
S.I. 2012 No. 3032 Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Regulations 2012

The UKCA Declaration of Conformity is available to download via:
https://downloads.elcometer.com/Declaration_of_Conformity/English/DoC_CMX10-DL.pdf

This product is designed for indoor and outdoor use
Operational Frequency Band: 2,402 - 2,480 MHz
Maximum Transmitted Power: <4 dBm
This product is Class B, Group 1 ISM equipment according to CISPR 11.
Class B product: Suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.
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.
USB C: 5V Power Rating 300mW. The USB is for data transfer only. It is not a charging cable and is not to be connected to the mains via a USB mains adapter.
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
The ACMA compliance mark can be accessed via Menu /About/Legal Information/Regulatory
The Giteki mark, its product identification code, the FCC ID and Bluetooth SIG QDID can be accessed via Menu./About/Legal Information/Regulatory
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
-- Reorient or relocate the receiving antenna.
-- Increase the separation between the equipment and receiver.
-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
-- Consult the dealer or an experienced radio/TV technician for help.
To satisfy FCC RF Exposure requirements for mobile and base station transmission devices, a separation distance of 20cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
Modifications not expressly approved by Elcometer Limited could void the user's authority to operate the equipment under FCC rules.
This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
This Class B digital apparatus complies with CAN ICES-3 (B)/NMB-3(B).

The Dakota CMX10-DL is packed in a cardboard package. Please ensure that all packaging is disposed of in an environmentally sensitive manner. Consult your local Environmental Authority for further guidance.

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