



38DL PLUS

Ultrasonic Thickness Gage

Basic Operation Manual

DMTA-10009-01EN [U8778346] — Rev. E
September 2022

This instruction manual contains essential information on how to use this Evident product safely and effectively. Before using this product, thoroughly review this instruction manual. Use the product as instructed. Keep this instruction manual in a safe, accessible location.

EVIDENT SCIENTIFIC INC., 48 Woerd Avenue, Waltham, MA 02453, USA

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This document was prepared with particular attention to usage to ensure the accuracy of the information contained therein, and corresponds to the version of the product manufactured prior to the date appearing on the title page. There could, however, be some differences between the manual and the product if the product was modified thereafter.

The information contained in this document is subject to change without notice.

Part number: DMTA-10009-01EN [U8778346]

Rev. E

September 2022

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List of Abbreviations

AC	alternative current
AEtoE	automatic echo-to-echo
AVG	average
DB	database
DC	direct current
EFUP	environment-friendly use period
EMAT	electromagnetic acoustic transducer
HI	high
ID	identification
Li-ion	lithium-ion
LOS	loss-of-signal
MB	main bang
MEtoE	manual echo-to-echo
MIL	military
NiMH	nickel metal hydride
P/N	part number
PDF	portable document format
PRF	pulse repetition frequency
SP	special
STD	standard
TFT	thin film transistor (liquid crystal display technology)
USB	universal serial bus
VAC	voltage alternative current

Important Information — Please Read Before Use

Intended Use

The 38DL PLUS is designed to perform nondestructive inspections on industrial and commercial materials.



WARNING

Do not use the 38DL PLUS for any purpose other than its intended use. It must never be used to inspect or examine human or animal body parts.

Instruction Manual

This instruction manual contains essential information on how to use this product safely and effectively. Before using this product, thoroughly review this instruction manual. Use the product as instructed. Keep this instruction manual in a safe, accessible location.

IMPORTANT

Some of the details of components illustrated in this manual may differ from the components installed on your device. However, the operating principles remain the same.

Device Compatibility

Only use this device with the approved ancillary equipment provided by Evident. Equipment provided by Evident and approved for use with this device is described later in this manual.



CAUTION

Always use equipment and accessories that meet Evident specifications. Using incompatible equipment could cause equipment malfunction and/or damage, or human injury.

Repair and Modification

This device does not contain any user-serviceable parts. Opening the device might void the warranty.



CAUTION

In order to prevent human injury and/or equipment damage, do not disassemble, modify, or attempt to repair the device.

Safety Symbols

The following safety symbols might appear on the device and in the instruction manual:



General warning symbol

This symbol is used to alert the user to potential hazards. All safety messages that follow this symbol shall be obeyed to avoid possible harm or material damage.



High voltage warning symbol

This symbol is used to alert the user to potential electric shock hazards greater than 1000 volts. All safety messages that follow this symbol shall be obeyed to avoid possible harm.

Safety Signal Words

The following safety symbols might appear in the documentation of the device:



DANGER

The DANGER signal word indicates an imminently hazardous situation. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, will result in death or serious personal injury. Do not proceed beyond a DANGER signal word until the indicated conditions are fully understood and met.



WARNING

The WARNING signal word indicates a potentially hazardous situation. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in death or serious personal injury. Do not proceed beyond a WARNING signal word until the indicated conditions are fully understood and met.



CAUTION

The CAUTION signal word indicates a potentially hazardous situation. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, may result in minor or moderate personal injury, material damage, particularly to the product, destruction of part or all of the product, or loss of data. Do not proceed beyond a CAUTION signal word until the indicated conditions are fully understood and met.

Note Signal Words

The following note signal words could appear in the documentation of the device:

IMPORTANT

The IMPORTANT signal word calls attention to a note that provides important information, or information essential to the completion of a task.

NOTE

The NOTE signal word calls attention to an operating procedure, practice, or the like, which requires special attention. A note also denotes related parenthetical information that is useful, but not imperative.

TIP

The TIP signal word calls attention to a type of note that helps you apply the techniques and procedures described in the manual to your specific needs, or provides hints on how to effectively use the capabilities of the product.

Safety

Before turning on the device, verify that the correct safety precautions have been taken (see the following warnings). In addition, note the external markings on the device, which are described under “Safety Symbols.”

Warnings



WARNING

General Warnings

- Carefully read the instructions contained in this instruction manual prior to turning on the device.
- Keep this instruction manual in a safe place for further reference.

- Follow the installation and operation procedures.
- It is imperative to respect the safety warnings on the device and in this instruction manual.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment could be impaired.
- Do not install substitute parts or perform any unauthorized modification to the device.
- Service instructions, when applicable, are for trained service personnel. To avoid the risk of electric shock, do not perform any work on the device unless qualified to do so. For any problem or question regarding this device, contact Evident or an authorized Evident representative.
- Do not touch the connectors directly by hand. Otherwise, a malfunction or electric shock may result.
- Do not allow metallic or foreign objects to enter the device through connectors or any other openings. Otherwise, a malfunction or electric shock may result.



WARNING

Electrical Warning

The device must only be connected to a power source corresponding to the type indicated on the rating label.



CAUTION

If a non-approved power supply cord not dedicated to Evident products is used, Evident will not be able to ensure the electrical safety of the equipment.

Battery Precautions



CAUTION

- Before disposing of a battery, check your local laws, rules, and regulations, and follow them accordingly.

- Transportation of lithium-ion batteries is regulated by the United Nations under the United Nations Recommendations on the Transport of Dangerous Goods. It is expected that governments, intergovernmental organizations, and other international organizations shall conform to the principles laid down in these regulations, thus contributing to worldwide harmonization in this field. These international organizations include the International Civil Aviation organization (ICAO), the International Air Transport Association (IATA), the International Maritime Organization (IMO), the US Department of Transportation (USDOT), Transport Canada (TC), and others. Please contact the transporter and confirm current regulations before transportation of lithium-ion batteries.
- For California (USA) only:
The device may contain a CR battery. The CR battery contains perchlorate material, and special handling may be required. Refer to <http://www.dtsc.ca.gov/hazardouswaste/perchlorate>.
- Do not open, crush, or perforate batteries; doing so could cause injury.
- Do not incinerate batteries. Keep batteries away from fire and other sources of extreme heat. Exposing batteries to extreme heat (over 80 °C) could result in an explosion or personal injury.
- Do not drop, hit, or otherwise abuse a battery, as doing so could expose the cell contents, which are corrosive and explosive.
- Do not short-circuit the battery terminals. A short circuit could cause injury and severe damage to a battery making it unusable.
- Do not expose a battery to moisture or rain; doing so could cause an electric shock.
- Only use an external charger approved by Evident to charge the batteries.
- Only use batteries supplied by Evident.
- Do not store batteries that have less than 40 % remaining charge. Recharge batteries to between 40 % and 80 % capacity before storing them.
- During storage, keep the battery charge between 40 % and 80 %.
- Do not leave batteries in the 38DL PLUS unit during device storage.

Regulations for Shipping Products with Lithium-Ion Batteries

IMPORTANT

When shipping a Li-ion battery or batteries, be sure to follow all local transportation regulations.



WARNING

Damaged batteries cannot be shipped through normal routes — DO NOT ship damaged batteries to Evident. Contact your local Evident representative or material disposal professionals.

Equipment Disposal

Before disposing of the 38DL PLUS, check your local laws, rules, and regulations, and follow them accordingly.

BC (Battery Charger - California, USA Community)



The BC marking indicates that this product has been tested and complies with the Appliance Efficiency Regulations as stated in the California Code of Regulations Title 20, Sections 1601 through 1608 for Battery Charger Systems. The internal battery charger within this device has been tested and certified pursuant to the California Energy Commission's (CEC) requirements; this device is listed on the online CEC's (T20) database.

CE (European Community)



This device complies with the requirements of directive 2014/30/EU concerning electromagnetic compatibility, directive 2014/35/EU concerning low voltage, and directive 2015/863 which amends 2011/65/EU concerning restriction of hazardous substances (RoHS). The CE marking is a declaration that this product conforms to all the applicable directives of the European Community.

UKCA (United Kingdom)



This device complies with the requirements of the Electromagnetic Compatibility Regulations 2016, the Electrical Equipment (Safety) Regulations 2016, and the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012. The UKCA marking indicates compliance with the above regulations.

RCM (Australia)



The regulatory compliance mark (RCM) label indicates that the product complies with all applicable standards, and has been registered with the Australian Communications and Media Authority (ACMA) for placement on the Australian market.

WEEE Directive



In accordance with European Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), this symbol indicates that the product must not be disposed of as unsorted municipal waste, but should be collected separately. Refer to your local Evident distributor for return and/or collection systems available in your country.



China RoHS

China RoHS is the term used by industry generally to describe legislation implemented by the Ministry of Information Industry (MII) in the People's Republic of China for the control of pollution by electronic information products (EIP).



The China RoHS mark indicates the product's Environment-Friendly Use Period (EFUP). The EFUP is defined as the number of years for which listed controlled substances will not leak or chemically deteriorate while in the product. The EFUP for the 38DL PLUS has been determined to be 15 years.

Note: The Environment-Friendly Use Period (EFUP) is not meant to be interpreted as the period assuring functionality and product performance.



电器电子产品有害
物质限制使用
标志

本标志是根据“电器电子产品有害物质限制使用管理办法”以及“电子电气产品有害物质限制使用标识要求”的规定，适用于在中国销售的电器电子产品上的电器电子产品有害物质使用限制标志。

（注意）电器电子产品有害物质限制使用标志内的数字为在正常的使用条件下有害物质等不泄漏的期限，不是保证产品功能性能的期间。

产品中有害物质的名称及含量

部件名称		有害物质					
		铅及其化合物 (Pb)	汞及其化合物 (Hg)	镉及其化合物 (Cd)	六价铬及其化合物 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
主体	机构部件	×	○	○	○	○	○
	光学部件	×	○	○	○	○	○
	电气部件	×	○	○	○	○	○

产品中有害物质的名称及含量

部件名称	有害物质					
	铅及其化合物 (Pb)	汞及其化合物 (Hg)	镉及其化合物 (Cd)	六价铬及其化合物 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
附件	×	○	○	○	○	○
本表格依据 SJ/T 11364 的规定编制。 ○：表示该有害物质在该部件所有均质材料中的含量均在 GB/T26572 规定的限量要求以下。 ×：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T26572 规定的限量要求。						

Korea Communications Commission (KCC)



Seller and user shall be noticed that this equipment is suitable for electromagnetic equipment for office work (class A) and it can be used outside the home. This device complies with the EMC requirements of Korea.

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다 .

EMC Directive Compliance

This equipment generates and uses radio-frequency energy and, if not installed and used properly (that is, in strict accordance with the manufacturer's instructions), may cause interference. The 38DL PLUS has been tested and found to comply with the limits for an industrial device in accordance with the specifications of the EMC directive.

FCC (USA) Compliance

NOTE

This product has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the product is operated in a commercial environment. This product generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this product in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

IMPORTANT

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the product.

FCC Supplier's Declaration of Conformity

Hereby declares that the product,

Product name: 38DL PLUS

Model: 38DL PLUS-MR/38DL PLUS-CW

Conforms to the following specifications:

FCC Part 15, Subpart B, Section 15.107 and Section 15.109.

Supplementary information:

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.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Responsible party name:

EVIDENT SCIENTIFIC INC.

Address:

48 Woerd Avenue, Waltham, MA 02453, USA

Phone number:

+1 781-419-3900

ICES-001 (Canada) Compliance

This Class A digital apparatus complies with Canadian ICES-001.

Cet appareil numérique de la classe A est conforme à la norme NMB-001 du Canada.

Warranty Information

Evident guarantees your Evident product to be free from defects in materials and workmanship for a specific period, and in accordance with conditions specified in the Terms and Conditions available at <https://www.olympus-ims.com/en/terms/>.

The Evident warranty only covers equipment that has been used in a proper manner, as described in this instruction manual, and that has not been subjected to excessive abuse, attempted unauthorized repair, or modification.

Inspect materials thoroughly on receipt for evidence of external or internal damage that might have occurred during shipment. Immediately notify the carrier making the delivery of any damage, because the carrier is normally liable for damage during shipment. Retain packing materials, waybills, and other shipping documentation needed in order to file a damage claim. After notifying the carrier, contact Evident for assistance with the damage claim and equipment replacement, if necessary.

This instruction manual explains the proper operation of your Evident product. The information contained herein is intended solely as a teaching aid, and shall not be used in any particular application without independent testing and/or verification by the operator or the supervisor. Such independent verification of procedures becomes increasingly important as the criticality of the application increases. For this reason, Evident makes no warranty, expressed or implied, that the techniques, examples, or procedures described herein are consistent with industry standards, nor that they meet the requirements of any particular application.

Evident reserves the right to modify any product without incurring the responsibility for modifying previously manufactured products.

Technical Support

Evident is firmly committed to providing the highest level of customer service and product support. If you experience any difficulties when using our product, or if it fails to operate as described in the documentation, first consult the user's manual, and then, if you are still in need of assistance, contact our After-Sales Service. To locate the nearest service center, visit the Service Centers page on the Evident Scientific Web site.

Introduction

This manual provides basic operating instructions for the 38DL PLUS ultrasonic thickness gage. The information in this manual is organized to explain the technology, safety details, hardware, and software. Practical measurement examples help the user become familiar with the instrument's capabilities.

IMPORTANT

For advanced instructions on instrument configuration, use, troubleshooting, and maintenance, refer to the *38DL PLUS User's Manual*. The list of other 38DL PLUS documents is provided in "Instruction Manual" on page 9.



Figure i-1 The 38DL PLUS instrument

1. Instrument Description

This chapter describes the main features and the hardware components of the 38DL PLUS instrument.

IMPORTANT

The *38DL PLUS Ultrasonic Thickness Gage — User’s Manual* (P/N: DMTA-10004-01EN) contains the information found in the present document as well as other sections describing the more advanced features of the instrument such as using special transducers, managing custom transducer setups, using software options, using the datalogger, and communicating with external devices.

You can find the PDF file of the *38DL PLUS Ultrasonic Thickness Gage — User’s Manual* (P/N: DMTA-10004-01EN) on the GageView CD (P/N: Gageview [U8147006]) that is included with the 38DL PLUS kit.

1.1 Product Description

The 38DL PLUS by Evident is a hand-held ultrasonic thickness gage designed for a wide variety of thickness measurement applications. With the 38DL PLUS, you only need access to one side of a part to measure, in a nondestructive manner, the thickness of corroded, pitted, scaled, granular, and other difficult materials (see Figure 1-1 on page 26).



Figure 1-1 Measuring thicknesses with the 38DL PLUS

The 38DL PLUS simultaneously displays a thickness readout and an A-scan view for waveform verification. The microprocessor of the 38DL PLUS continuously adjusts the receiver setup so that every measurement is optimized for reliability, range, sensitivity, and accuracy. An advanced internal datalogger can store up to 475000 thickness measurements and 20000 waveforms.

The 38DL PLUS operates with a full line of single element and dual element transducers to measure material thicknesses between 0.08 mm and 635 mm (0.003 in. and 25 in.). The temperature range of measured materials can be between $-20\text{ }^{\circ}\text{C}$ and $500\text{ }^{\circ}\text{C}$ ($-4\text{ }^{\circ}\text{F}$ and $932\text{ }^{\circ}\text{F}$) depending on the material characteristics, the transducer, and the measurement mode. You can also use single element or dual element transducers for echo-to-echo measurements.

You can connect the 38DL PLUS to a printer and to a computer using the bidirectional serial USB/RS-232 communication ports.

Advanced Measurement Features

- THRU-COAT measurement
- Temperature-compensated measurement
- Min/Average mode

- EMAT transducer capability
- Measurement-related status flags and alarms
- Full VGA color transfective LED back-lite display
- Automatic probe recognition for the standard D79X and MTD705 series transducers
- Dynamic default gain optimization
- V-path calibration to build custom V-path correction tables for any dual element transducer
- Warning against calibration doubling
- Calibration for unknown material sound velocity and/or transducer zero
- Echo-to-echo measurements
- Fast scan mode with 30 readings per second
- Manual gain adjustment in 1-dB steps
- Hold or blank thickness display during loss-of-signal (LOS) conditions
- Hold minimum, maximum, or both minimum and maximum functions
- Differential thickness display relative to the set point in absolute or percentage ratio
- Selection of password-protected lockout functions
- Selectable resolution: low of 0.1 mm (0.01 in.), standard of 0.01 mm (0.001 in.), or high (optional) of 0.001 mm (0.0001 in.) [option not available for all transducers]

A-Scan and B-Scan Display Options

- Real-time A-scan waveform display for verification of critical measurements
- Manual freeze mode with post processing
- Manual zoom and range control of waveform display
- Auto hold on LOS and auto zoom (measured echo centering)
- Extended blank
- Blank after first received echo in echo-to-echo mode
- Receiver gain readout
- Ability to capture and display waveform associated with minimum thickness during scanned measurements
- Display stored and downloaded waveforms

Internal Datalogger Functions

- Internal data storage and possibility to export data to a removable microSD memory card
- Capacity to store 475000 fully-documented thickness readings or 20000 waveforms with thickness readings
- Database enhancements include 32-character file naming and 20-character ID naming
- Automatic ID number increments following a preset sequence, or manual ID numbering using the keypad
- Save reading/waveform to an ID number
- Simultaneously show ID number, stored comments, and stored reference thickness while displaying active thickness and waveform
- Nine file formats available
- Erase selected data or all stored data
- Save or send an held or frozen reading to the thickness display
- Transmit selected data or all stored data
- Keypad-programmable communication parameters
- Standard USB and RS-232 directional communication

1.2 Environmental Ratings

The 38DL PLUS is a rugged and durable instrument that you may use in harsh environments. The 38DL PLUS was designed to meet the requirement of the IP67 standard (Ingress Protection).



CAUTION

Evident cannot guarantee any level of ingress protection performance once the instrument seals have been manipulated. You must use sound judgment and take proper precautions before exposing the instrument to harsh environments.

To maintain the original level of ingress protection, you are responsible for the proper care of all routinely exposed membrane seals. Additionally, you are responsible for returning the instrument to an authorized Evident service center each year to ensure that the instrument seals are properly maintained.

1.3 Instrument Hardware Components

The 38DL PLUS front panel features a color display and a keypad. The instrument comes with a hand strap. A protective rubber boot includes a dust flap seal for the DC power and serial communication connectors, strap rings at the four corners, and a stand at the back (see Figure 1-2 on page 29).

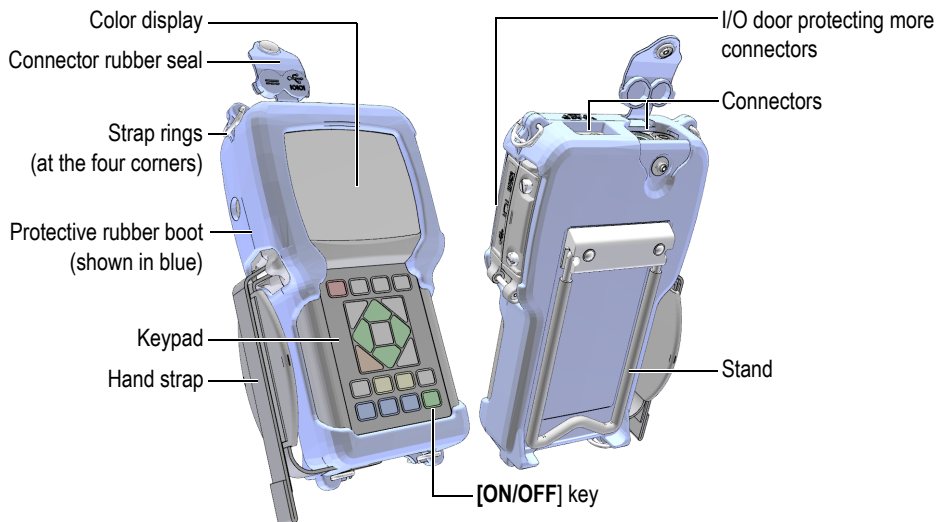


Figure 1-2 The 38DL PLUS hardware components

1.4 Connectors

Figure 1-3 on page 30 illustrates the possible connections of the 38DL PLUS with external devices.

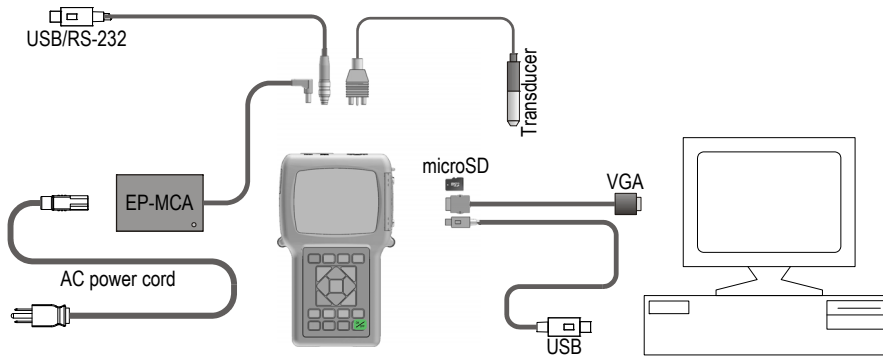


Figure 1-3 The 38DL PLUS connections



CAUTION

To avoid the risk of injuries or equipment damage, use only the AC power cord supplied with the 38DL PLUS. Do not use this AC power cord with other products.

The DC power, USB/RS-232 communication, and Transmit/Receive probe connectors are located on the top end of the 38DL PLUS (see Figure 1-4 on page 31).

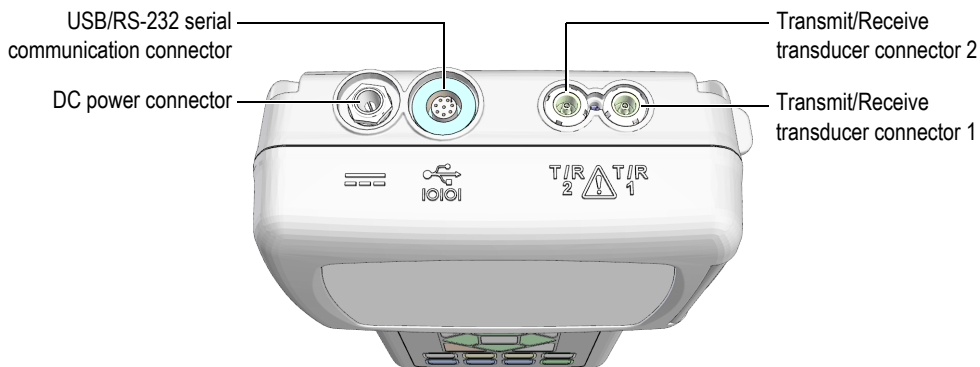


Figure 1-4 The top end connectors

The USB client connector, the VGA output connector, and the external microSD memory card slot are located on the right side of the instrument, hidden behind the I/O door (see Figure 1-5 on page 31).

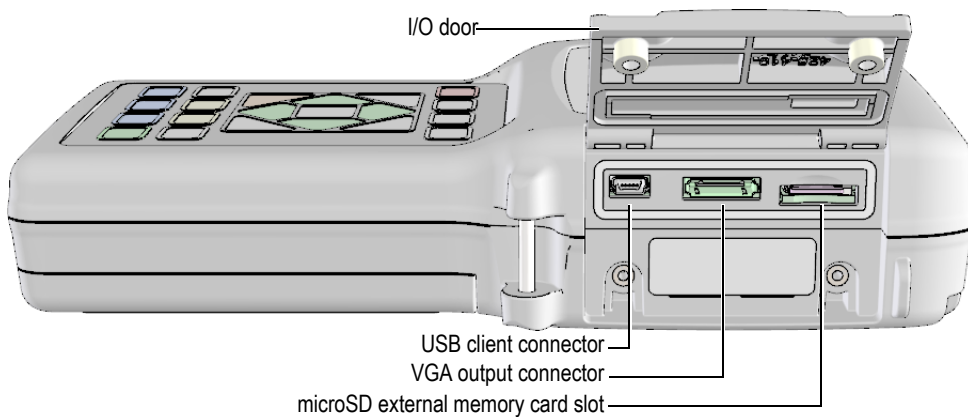


Figure 1-5 The connectors behind the I/O door

1.5 Keypad Functions

The 38DL PLUS comes either with the English, international, Chinese, or Japanese keypad (see Figure 1-6 on page 32). The functions are the same for all keypads. On the international keypad, the text labels on many keys are replaced by pictograms. In this document, keypad keys are referred to using the English label in bold and within brackets (ex.: [MEAS]).

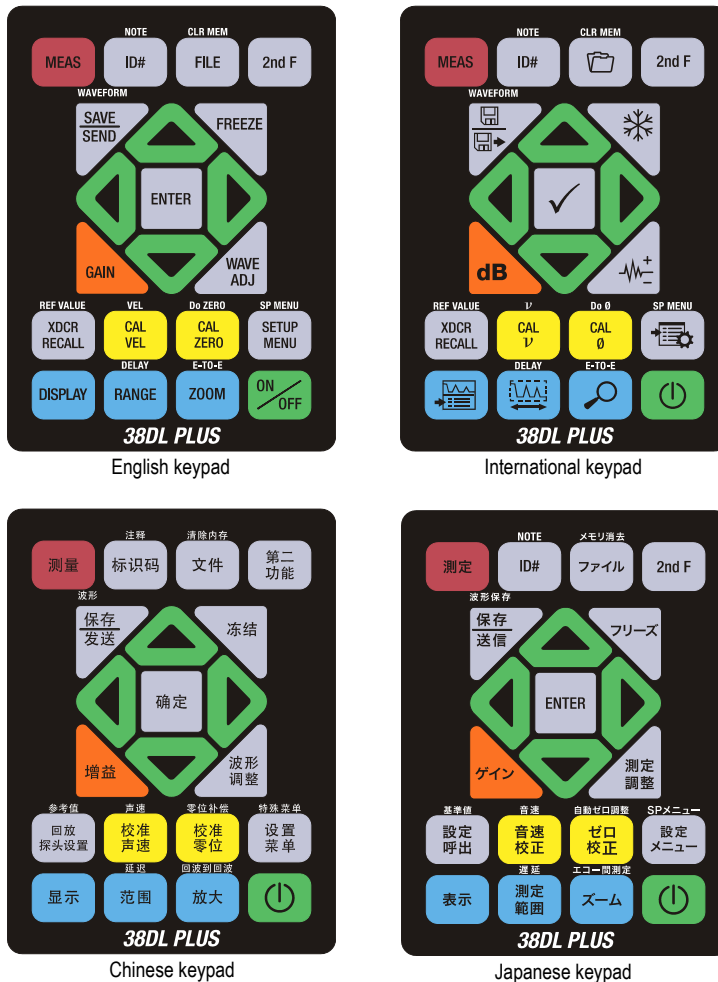


Figure 1-6 The 38DL PLUS keypads

Each key indicates its primary function. The area just above some of the keys indicates a secondary key function that you can activate by first pressing **[2nd F]**. Throughout this document, references to a secondary function are written as follows: **[2nd F], [Primary] (Secondary)**. For example, the instruction to activate the clear memory function is written as follows: “Press **[2nd F], [FILE] (CLR MEM)**”.

The **[▲]**, **[▼]**, **[◀]**, and **[▶]** keys, together with the **[ENTER]** key, are used to select menu items or screen parameters and to change parameter values. Use the **[MEAS]** key at any time to return to the measurement screen. The yellow keys are related to calibration. The blue keys are related to the display configuration.

Table 1 on page 33 lists the key functions available from the 38DL PLUS keypad.

Table 1 Keypad functions












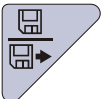
English	International	Functions
		Measurement — Completes the current operation and returns to the measurement screen.
		Identification number — Accesses several functions related to the ID numbers for the thickness measurement location.
 		Note — Allows you to create or select comments to store at an ID number location.
		File — Opens the file menu to access file commands (open, review, create, copy, edit, delete, send, import, export, note-copy, memory, and report).
 		Clear memory — Acts as an alternative method to erase an entire file. Also erases a range of data in a file or a single ID number location.
		Secondary function — Needs to be pressed prior to a key to activate the secondary function of the key.
		Save or send — Stores a measurement and optionally the corresponding waveform in the datalogger at the current ID number.

Table 1 Keypad functions (continued)



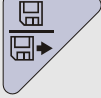





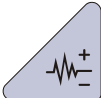





English	International	Functions
 		Save waveform — Stores a measurement and the corresponding waveform in the datalogger at the current ID number.
		Freeze — Causes the displayed waveform to immediately hold until the key is pressed again.
		Gain — Initiates the adjustment of the gain value when using dual element transducers.
		Wave adjustment — Toggles the display of a selectable waveform parameter with an editable value.
		Enter — Selects an highlighted item or accepts an entered value.
		Up arrow <ul style="list-style-type: none"> • In a screen or a list, moves to the previous element. • For some parameters (ex.: Gain), increases the value.
		Down arrow <ul style="list-style-type: none"> • In a screen or a list, moves to the next element. • For some parameters (ex.: Gain), decreases the value.
		Left arrow <ul style="list-style-type: none"> • Selects the previous available value for the selected parameter. • In text edit mode, moves the cursor one character position to the left.

Table 1 Keypad functions (continued)






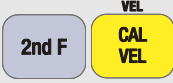





















English	International	Functions
		<p>Right arrow</p> <ul style="list-style-type: none"> Selects the next available value for the selected parameter. In text edit mode, moves the cursor one character position to the right.
		<p>Transducer recall — Recalls default or custom transducer (XDCR) setups.</p>
		<p>Reference value — For some functions (ex.: differential mode or temperature compensation) opens a screen allowing you to enter a reference value.</p>
		<p>Velocity calibration</p> <ul style="list-style-type: none"> Switches to the semi-automatic step block calibration mode. When using THRU-COAT mode, press [CAL VEL] twice to view and set the coating velocity. With the traditional text edit mode only, deletes the character at the cursor position.
		<p>Velocity</p> <ul style="list-style-type: none"> Opens a screen allowing you to view and manually change the sound velocity. In THRU-COAT mode or with the internal oxide option, pressing the keys a second time allows you to view/adjust the velocity for the coating or the oxide layer.
		<p>Zero calibration</p> <ul style="list-style-type: none"> Compensates for transducer zero or enables the step block zero calibration. With the traditional text edit mode only, inserts a character at the cursor position.
		<p>Do zero — Compensates for transducer delay for dual element transducers and for the M2008 transducer.</p>

Table 1 Keypad functions (continued)

English	International	Functions
		Setup menu — Provides access to instrument parameters (measurement, system, alarm, differential mode, communication, B-scan, DB grid, avg/min, temperature correction, multilayer [optional], oxide [optional], password set, instrument lock).
2nd F 		Special menu — Provides access to special gage parameters (clock, language, options, resets, tests, software diagnostics, instrument status).
		Display — Provides access to display parameters (color scheme, brightness, waveform rectification, waveform trace, and VGA output).
		Range — Changes the waveform display range to the next available value.
2nd F 		Delay — Allows editing the value for the beginning of the waveform display.
		Zoom — Dynamically changes the waveform display range so that the region immediately surrounding the measured echo is shown at maximum magnification.
2nd F 		Echo-to-Echo — With dual element transducers, opens a menu to select the measurement mode (standard, auto echo-to-echo, or manual echo-to-echo).
		On/Off — Turns the instrument power on or off.

2. Powering the 38DL PLUS

This chapter describes how to operate the 38DL PLUS using different power supply options.

2.1 Power Indicator

The power indicator is always present on the right side of the screen. It shows the level of the battery charge and on which type of power the instrument operates (see Figure 2-1 on page 37).

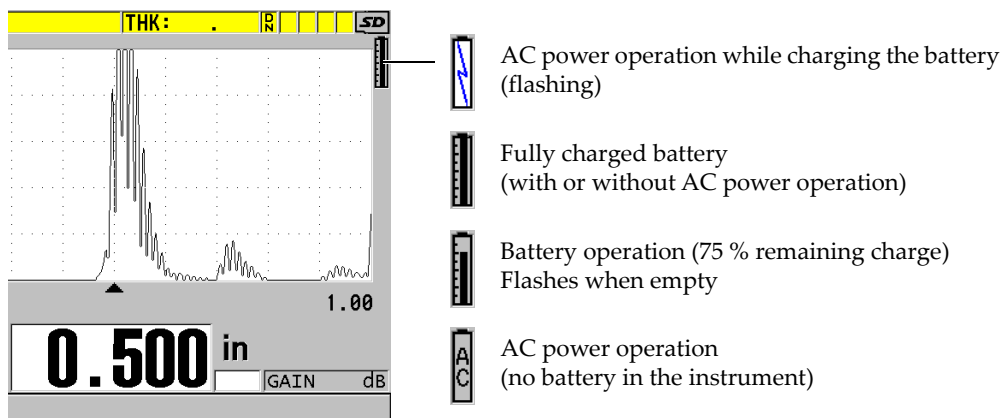


Figure 2-1 The power indicator for battery and AC operation

When the instrument operates on the battery, the vertical black bar in the power indicator indicates the remaining battery charge. Each graduation mark represents 12.5 % of the charge.

2.2 Using the AC Power

You can operate the 38DL PLUS with the AC power using the charger/adaptor (P/N: EP-MCA [U8767042]). The EP-MCA has a universal AC power input that operates with any line voltage from 100 VAC to 120 VAC or 200 VAC to 240 VAC and with 50 Hz to 60 Hz line frequency.

To use AC power

1. Connect the AC power cord to the charger/adaptor (P/N: EP-MCA [U8767042]), and to an appropriate power outlet (see Figure 2-2 on page 38).



CAUTION

To avoid the risk of injuries or equipment damage, use only the AC power cord supplied with the 38DL PLUS. Do not use this AC power cord with other products.

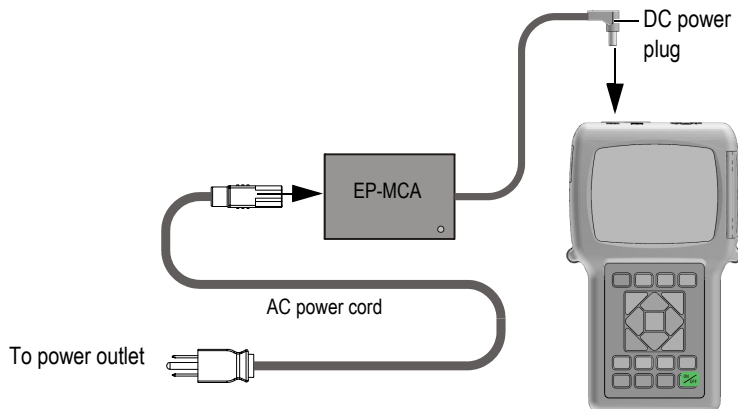


Figure 2-2 Connecting the charger/adaptor

2. On the 38DL PLUS, lift the rubber seal covering the DC adaptor connector on top of the 38DL PLUS (see Figure 2-3 on page 39).

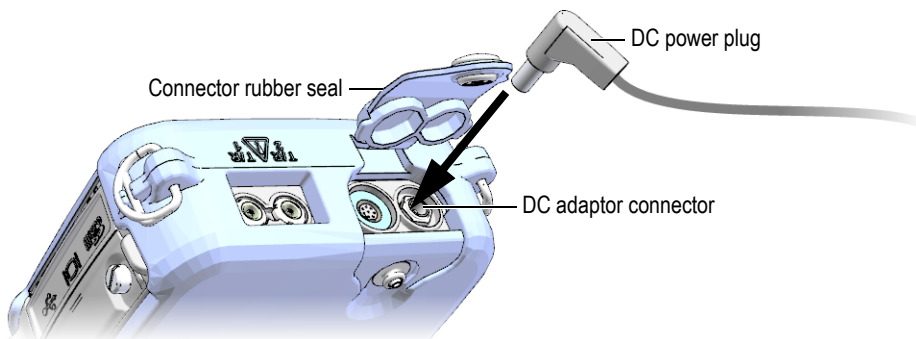


Figure 2-3 Connecting the DC power plug

3. Connect the DC power plug from the charger/adaptor to the DC adaptor connector (see Figure 2-3 on page 39).
4. Press [ON/OFF] to turn on the 38DL PLUS.

2.3 Using Battery Power

The 38DL PLUS comes with a rechargeable lithium-ion (Li-ion) battery (P/N: 38-BAT [U8760054]). The 38DL PLUS automatically recharges the 38-BAT battery when you connect the instrument to the AC power.

You can also operate the 38DL PLUS using four AA-size Alkaline or nickel metal hydride (NiMH) rechargeable batteries using the AA battery holder (P/N: 38DLP/AA [U8780290]). The 38DL PLUS does not recharge NiMH batteries. You must recharge AA batteries with an external battery charger (not included).

NOTE

The 38DL PLUS battery is not fully charged when shipped. You must fully charge the battery before operating the instrument from the battery power.

2.3.1 Battery Operating Time

The battery operating time depends on the type of battery being used, the age of the battery, and the instrument settings. To provide realistic battery operating times, the 38DL PLUS has been tested with mid-level operating parameters (update rate set to 4 Hz and display brightness set to 50 %).

The nominal battery operating times for new batteries are:

- Rechargeable Li-ion: 12 to 14 hours
- AA NiMH: 4 to 5 hours (externally recharged)
- AA Alkaline: 2 to 3 hours (nonrechargeable)

2.3.2 Charging the Battery



WARNING

The 38DL PLUS charger/adaptor (P/N: EP-MCA [U8767042]) is designed to charge 38DL PLUS batteries only (P/N: 38-BAT [U8760054]). Do not attempt to charge any other battery types (such as alkaline or NiMH) or use any other chargers/adaptors to charge the 38DL PLUS batteries (P/N: 38-BAT [U8760054]). Doing so may cause an explosion and injury.



WARNING

Do not attempt to power or charge other electronic equipment with the 38DL PLUS charger/adaptor (P/N: EP-MCA [U8767042]) as this may cause death or serious personal injury as the result of the explosion while charging a battery.

To charge the internal battery

- ◆ Connect the 38DL PLUS using the AC power (see “Using the AC Power” on page 38).
The battery charges when the instrument is ON or OFF, but the rate of charge is slower when the instrument is ON.

NOTE

When the battery is fully charged, the battery charging symbol (lighting bolt) is replaced with a “full battery” symbol (battery with all bars full). This is the indication that the battery is fully charged (see “Power Indicator” on page 37). It takes approximately 2 to 3 hours to fully charge a battery depending on its initial conditions.

NOTE

It may take several cycles of complete charging and discharging of the battery to bring the battery to full capacity. This conditioning process is normal for this type of rechargeable batteries.

Battery Usage Instructions

- If the battery is used daily (or frequently), connect the instrument to the charger/adaptor when not in use.
- Whenever possible, the instrument should remain connected to the EP-MCA charger/adaptor (overnight or over a weekend), so that the battery reaches a full charge.
- The battery must reach full charge on a regular basis for proper capacity and cycle-life maintenance.
- Fully recharge discharged batteries as soon as possible after use.

Battery Storage Instructions

- Never store discharged batteries without a full recharge.
- Store batteries in a cool, dry environment.
- Avoid long-term storage under sunlight or in other excessively hot places such as the trunk of an automobile.
- While in storage, fully recharge batteries at least once every two (2) months.

2.3.3 Replacing the Battery

The battery is located in a compartment that is accessible from the back of the 38DL PLUS (see Figure 2-4 on page 42).

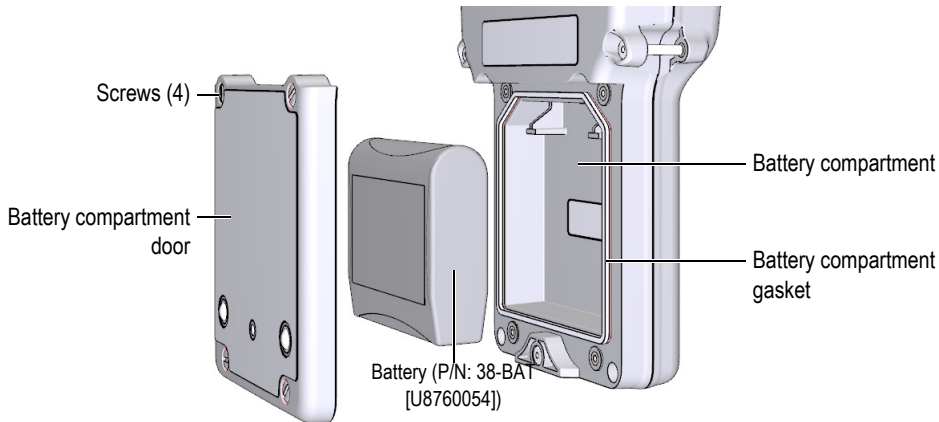


Figure 2-4 Opening the battery compartment



CAUTION

Do not attempt to replace the battery while the instrument is ON and/or connected to charger/adaptor. Dispose of used battery promptly. Keep away from children. The battery used in this device may present a risk of fire or chemical burn if mishandled. Do not disassemble, heat above 50 °C, or incinerate the battery. Replace the battery only with an Evident battery (P/N: 38-BAT [U8760054]).

To replace the battery

1. Disconnect the instrument from the charger/adaptor.
2. Ensure that the 38DL PLUS power is off.
3. Disconnect any other cable connected to the 38DL PLUS.
4. Remove the hand strap.
5. Remove the protective rubber boot.

6. At the back of the instrument, unscrew the four screws of the battery compartment cover (see Figure 2-4 on page 42).
7. Remove the battery compartment cover.
8. Remove the battery and carefully disconnect the battery connector.
9. Connect the new battery in the battery compartment.
10. Ensure that the gasket of the battery compartment cover is clean and in good condition.
11. Reinstall the battery compartment cover at the back of the instrument, and then tighten the four screws.
12. Reinstall the protective rubber boot and the hand strap.
13. Press **[ON/OFF]** to turn on the 38DL PLUS.
14. To answer the question appearing at the bottom of the screen (see Figure 2-5 on page 43):
 - ◆ Select **Li-ion** when using a 38-BAT battery.

OR

Select **NiMH** or **Alkaline** when using four NiMH AA batteries or four Alkaline AA batteries with the AA battery holder.



Figure 2-5 Selecting the new battery type

NOTE

When replacing the rechargeable 38-BAT battery, fully charge the battery to ensure the accuracy of the estimated remaining battery charge shown by the power indicator (see “Power Indicator” on page 37).

3. Software User Interface Elements

The following sections describe the main elements of the 38DL PLUS software screens and menus.

3.1 Measurement Screen

The 38DL PLUS starts with the measurement screen where you can see the ultrasonic echo on the waveform display and read the measured thickness value (see Figure 3-1 on page 45). The measurement screen is the main screen of the 38DL PLUS software. From anywhere in the 38DL PLUS software, simply press [MEAS] to return to the measurement screen. The power indicator is always present on the right side of the 38DL PLUS screen (see “Using Battery Power” on page 39 for details).

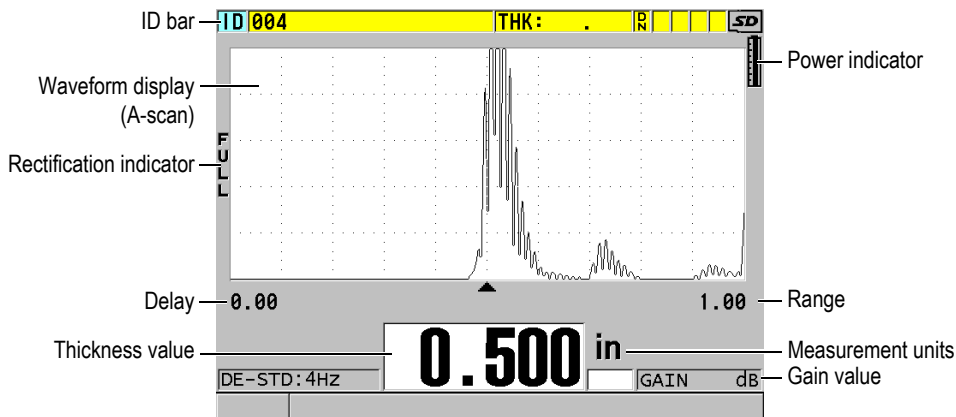


Figure 3-1 The main elements of the measurement screen

The waveform trace, called the A-scan, allows a skilled operator to verify that the signal used to make a thickness measurement is the correct back-wall echo and not noise, material anomaly, or the second multiple echo. The A-scan can also allow you to observe indications that may be too small to be measured by the instrument.

The ID bar, located at the top of the measurement screen, contains the ID for the actual thickness measurement location, the previously stored value, and comment notes indicators (see Figure 3-2 on page 46). The download indicator (R) appears when the previously stored thickness measurement comes from a file rather than from a newly acquired value.

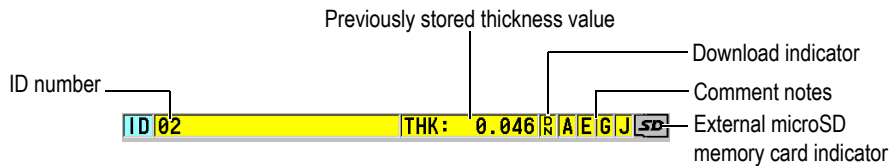


Figure 3-2 The ID bar

The external microSD memory card indicator appears in the top-right corner of the screen when a microSD memory card is inserted in its slot under the I/O door on the right side of the instrument (see Figure 1-5 on page 31). The 38DL PLUS recognizes an external microSD memory card when you start the instrument.

Depending on the context and on the available functions and options, various indicators and numeric values appear around the waveform display and around the main measurement value (see Figure 3-3 on page 47). A help text bar, at the bottom of the screen, indicates the keys that you can use to navigate and make a selection in the menu structure.

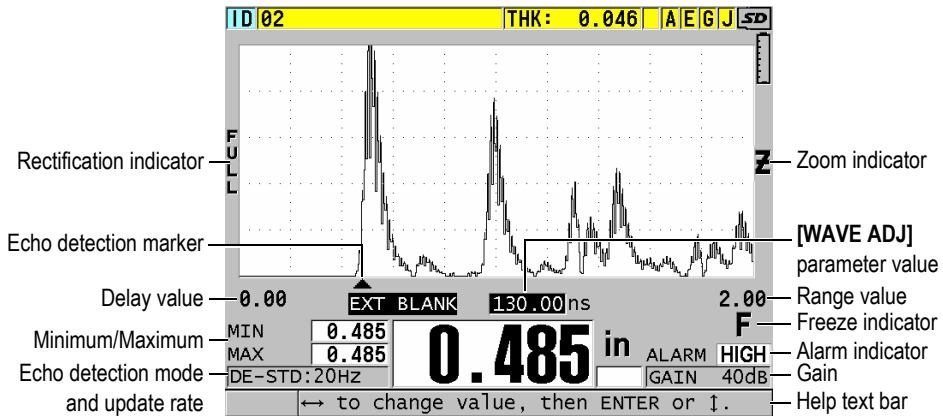


Figure 3-3 Example of other elements appearing on the measurement screen

The loss-of-signal (LOS) appears and the thickness value is cleared when the 38DL PLUS no longer detects ultrasonic echoes (see Figure 3-4 on page 47).

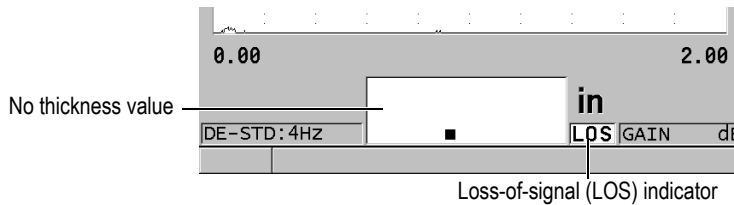


Figure 3-4 The loss-of-signal (LOS) indicator

3.2 Menus and Submenus

The 38DL PLUS displays menus and submenus when you press some of the front panel keys. The menu appears at the top-left corner of the screen (see Figure 3-5 on page 48). If applicable, a submenu also appears, conveniently showing the parameters available for the highlighted menu command.

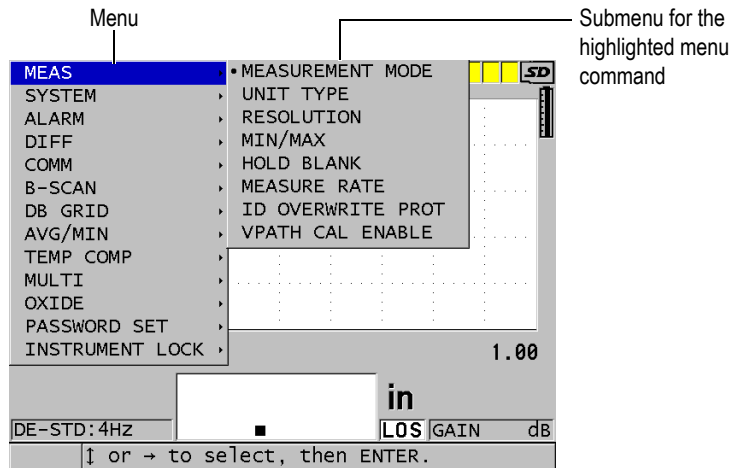


Figure 3-5 Menu and submenu example

To select a menu or a submenu command

1. Press one of the front panel keys to display a menu.
2. Use the [▲] and [▼] keys to highlight the desired menu command.
3. If applicable and needed, use the [▶] key to move the highlight to the submenu, and then use the [▲] and [▼] keys to highlight the desired submenu command.
4. Press [ENTER] to select the highlighted menu, or submenu command.

NOTE

In the remainder of this document, the above procedure is summarized by simply stating to select a specific menu or submenu command. For example: “In the menu, select MEAS.”

3.3 Parameter Screens

The 38DL PLUS parameters are logically grouped in parameter screens that you access using front panel keys or menu commands. Figure 3-6 on page 49 shows the MEAS parameter screen as an example.

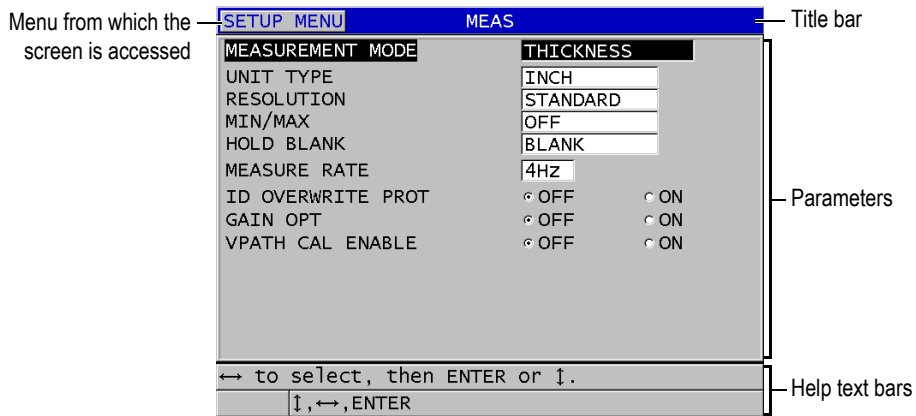


Figure 3-6 Parameter screen example

The title bar, located at the top of the parameter screen, indicates the parameter subject. When you access a parameter screen from a menu, a menu button appears on the left side of the title bar. You can select this menu button to easily return to the original menu. One or two help text bars, appearing at the bottom of the screen, indicate the keys to use to select a parameter and edit its value.

To select a parameter and edit its value

1. Use the [▲] and [▼] keys to highlight the desired parameter.
2. For parameters with predefined values, use the [▶] and [◀] keys to select the desired value.
3. In parameter screens containing lists or alphanumeric parameters:
 - In a list, use the [▲] and [▼] keys to highlight the desired list item.
 - For an alphanumeric parameter, use the [▲] and [▼] keys to enter the desired characters (see “Selecting the Text Edit Mode” on page 50 for details).
 - Press [2nd F], [▼] or [2nd F], [▲] to leave a list or an alphanumeric parameter, and respectively go to the next or previous screen element.
4. To exit the parameter screen:
 - ◆ Press [MEAS] to return to the measurement screen.

OR

When a menu button appears in the left corner of the title bar, use the [▲] key to highlight the menu button, and then press [ENTER] to reopen the menu.

NOTE

In the remainder of this document, the above procedure is summarized by simply stating to select a specific parameter or list, and its value. For example: “In the **MEAS** screen, set **MEASUREMENT MODE** to **THICKNESS**.”

3.4 Selecting the Text Edit Mode

The 38DL PLUS offers two methods to edit the value of alphanumeric parameters. You can either use the virtual keyboard or the traditional method. The virtual keyboard appears on the screen to show all the available characters that you can use (see “Editing Text Parameters Using the Virtual Keyboard” on page 50 for details). With the traditional method, you select each character from a hidden list of standard sorted letters, numbers, and special characters (see “Editing Text Parameters Using the Traditional Method” on page 52 for details).

To select the text edit mode

1. From the measurement screen, press [SETUP MENU].
2. In the menu, select **SYSTEM**.
3. In the **SYSTEM** parameter screen, highlight **TEXT EDIT MODE**, and then select the desired mode (**VIRTUAL** or **TRADITIONAL**).
4. Press [MEAS] to return to the measurement screen.

3.4.1 Editing Text Parameters Using the Virtual Keyboard

When the text edit mode is set to **VIRTUAL**, the virtual keyboard appears when you select an alphanumeric parameter (see Figure 3-7 on page 51).

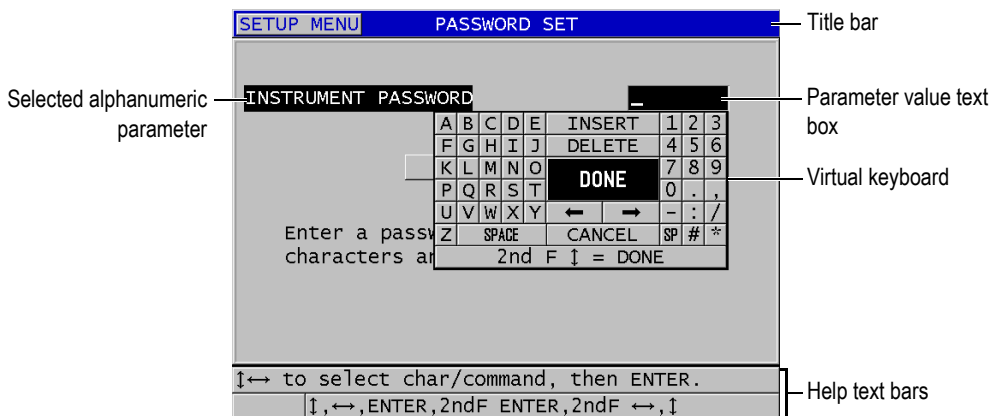


Figure 3-7 Example of the virtual keyboard

To edit an alphanumeric parameter value using the virtual keyboard

1. Select an alphanumeric parameter.
The virtual keyboard appears.
2. Use the [▲], [▼], [▶], and [◀] keys to highlight the character that you wish to enter, and then press [ENTER].
The selected character appears in the parameter value text box and the cursor moves to the next character position.
3. Repeat the previous step to enter other characters.
4. If you need to move the position of the cursor in the value text box, on the virtual keyboard, highlight either the left or right arrow button (below **DONE**), and then press [ENTER].
The cursor moves by one character position.
5. When you need to delete a character:
 - a) Move the cursor to the character you wish to delete.
 - b) On the virtual keyboard, highlight **DELETE**, and then press [ENTER].
6. When you need to insert a character:
 - a) Move the cursor to the character in front of which you wish to insert a character.
 - b) On the virtual keyboard, highlight **INSERT**, and then press [ENTER].
 - c) Enter the desired character in the inserted space.

7. If you want to cancel the editing operation and return to the original parameter value, on the virtual keyboard, highlight **CANCEL**, and then press **[ENTER]**.
8. To complete the editing of the parameter value, on the virtual keyboard, highlight **DONE**, and then press **[ENTER]**.

NOTE

When editing a multiple line parameter value, highlighting **DONE** and pressing **[ENTER]** moves the cursor to the next line. You can also press **[2nd F]**, **[▼]** to accept the text and move the cursor to the next line.

3.4.2 Editing Text Parameters Using the Traditional Method

When the text edit mode is set to **TRADITIONAL**, you select each character from a hidden circular list of standard sorted letters, numbers, and special characters (see Figure 3-8 on page 52). Only upper case letters are available.

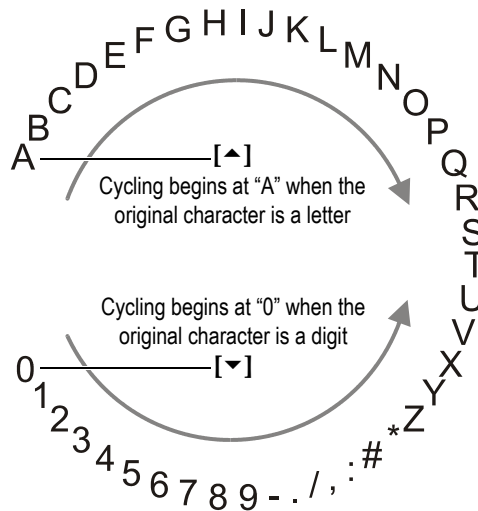


Figure 3-8 The character cycle of the traditional text edit method

To edit an alphanumeric parameter value using the traditional method

1. Select an alphanumeric parameter.
2. Use the [▲] and [▼] keys to select the character that you wish to enter. Hold down the key to quickly cycle through the letters, numbers, and special characters.
3. Use the [▶] keys to move to the next character.
4. Repeat the steps 2 and 3 to enter other characters.
5. If you need to move the position of the cursor in the value text box, use the [▶] or [◀] key.
6. To insert a character at the cursor position, press [CAL ZERO].
The character at the cursor and all those to the right moves one position to the right, making a space for a new character.
7. To delete the character at the cursor position, press [CAL VEL].
The character at the cursor is deleted and any characters to the right move to the left by one position.
8. Press [ENTER] to accept the character string and move to the next parameter.

4. Initial Setup

The following sections describe basic system configurations.

4.1 Setting the User Interface Language and Other System Options

You can configure the 38DL PLUS to present the user interface in the following languages: English, German, French, Spanish, Japanese, Chinese, Russian, Swedish, Italian, Norwegian, Portuguese, Czech, and a customized interface. You can also set the character delimiting the radix of a number.

The 38DL PLUS includes a beep tone generator to confirm when a key is pressed and to notify you of an alarm condition. You can set the beeper on or off.

To save battery while you do not use the instrument, you can enable the inactive time function so that the instrument automatically turns off when no key has been pressed and no measurement has been made within about six minutes.

To change the user interface language and other system options

1. Press **[SETUP MENU]**.
2. In the menu, select **SYSTEM**.
3. In the **SYSTEM** screen (see Figure 4-1 on page 56):
 - a) Set **BEEPER** to **ON** or **OFF**.
 - b) Set **INACTIVE TIME** to **ON** or **OFF**.
 - c) Set **LANGUAGE** to the desired language.
 - d) Set **RADIX TYPE** to the desired character (period or comma) to separate the integer and the decimal digits.

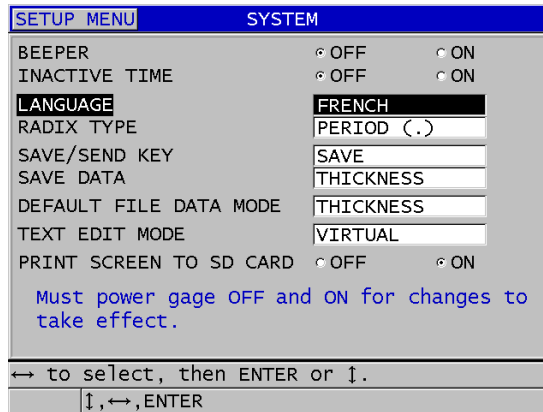


Figure 4-1 Selecting the user interface language

4. Press **[MEAS]** to return to the measurement screen.
5. Turn off the 38DL PLUS, and then turn it back on to activate the language change.

4.2 Selecting the Measurement Units

You can set the 38DL PLUS to show thickness measurements in inches or millimeters.

To set the measurement units

1. Press **[SETUP MENU]**.
2. In the menu, select **MEAS**.
3. In the **MEAS** screen, set **UNIT TYPE** to **INCH** or **MILLIMETER**.
4. Press **[MEAS]** to return to the measurement screen.

4.3 Setting the Clock

The 38DL PLUS has a built-in date and time clock. You can set the date and the time and select their format. The 38DL PLUS saves all measurements value with their acquisition date.

To set the clock

1. Press **[2nd F]**, **[SETUP MENU]** (SP MENU).
2. In the menu, select **CLOCK**.
3. In the **CLOCK** screen (see Figure 4-2 on page 57):
 - a) Set parameters to the current date and time and to the desired date and hour modes.
 - b) Select **SET**.

The screenshot shows a menu titled "CLOCK" with a blue header. The menu items are: MONTH (2), DAY (24), YEAR (2010), DATE MODE (MM/DD/YYYY), HOUR (2 PM), MINUTE (35), and HOUR MODE (12 HOUR). There are "SET" and "CANCEL" buttons at the bottom. Below the menu, there are two lines of instructions: "↔ to change value, then ENTER or ↓." and "↓, ↔, ENTER".

Figure 4-2 Selecting clock parameters

4.4 Changing Display Settings

You can change the appearance of some display elements such as colors, brightness, waveform rectification, and waveform trace.

To change the display setting

1. From the measurement screen, press **[DISPLAY]**.
2. In the **DISPLAY SETTINGS** screen (see Figure 4-3 on page 58), select the desired parameter and value for the following parameters:
 - **COLOR SCHEME** to either select the **INDOOR** or **OUTDOOR** optimized visibility (see "Color Schemes" on page 58 for details).

- **DISPLAY BRIGHTNESS** to select one of the predefined brightness levels (see “Display Brightness” on page 59 for details).
- **WAVEFORM RECTIFICATION** to select one of the rectification modes (see “Waveform Rectification” on page 60 for details).
- **WAVEFORM TRACE** to select one of the trace types (see “Waveform Trace” on page 61 for details).
- **VGA OUTPUT** to turn **ON** or **OFF**, the VGA signal for the VGA output (see “Using the VGA Output” on page 92 for details).

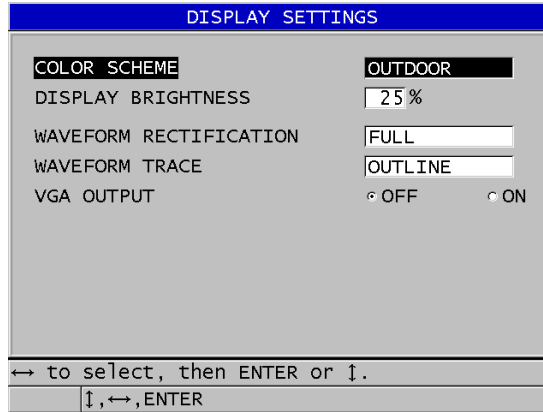


Figure 4-3 The **DISPLAY SETTINGS** screen

3. Press **[MEAS]** to return to the measurement screen.

4.4.1 Color Schemes

The 38DL PLUS offers two standard color schemes designed to provide best display visibility in indoor or outdoor lighting conditions (see Figure 4-4 on page 59). From the measurement screen, press **[DISPLAY]** to access the **COLOR SCHEME** parameter.

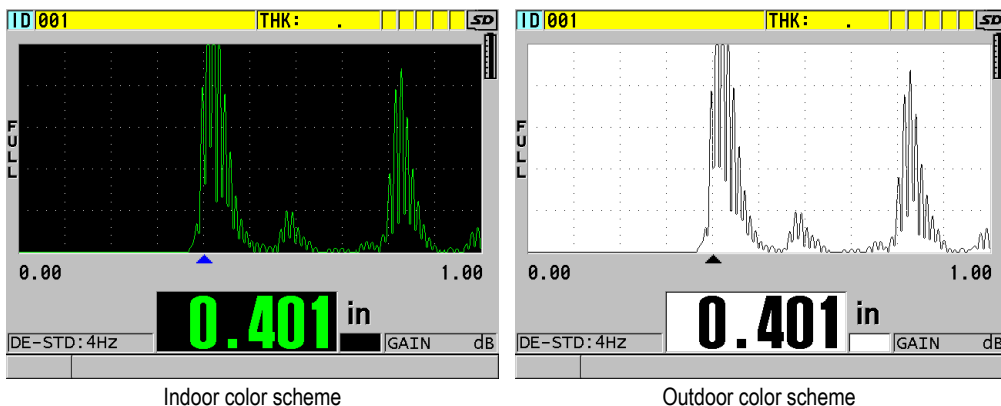


Figure 4-4 Example of the indoor and the outdoor color schemes

The indoor scheme gives the best visibility when you use the instrument indoors or in low lighting conditions. The indoor scheme presents green characters and waveform trace on a black background.

The outdoor scheme gives best visibility when you use the instrument in direct sunlight. The outdoor mode presents black characters and waveform trace on a white background. For best readability, in this document, most screen captures are shown with the outdoor color scheme.

NOTE

Colored measurement values corresponding to specific alarm conditions only appear when the indoor color scheme is selected.

4.4.2 Display Brightness

You can adjust the 38DL PLUS display brightness by selecting the backlight intensity. The display brightness can be set at 0 %, 25 %, 50 %, 75 %, and 100 %. Choosing a high percentage increases the brightness of the display. By default, the display brightness is set to 25 %. From the measurement screen, press **[DISPLAY]** to access the **DISPLAY BRIGHTNESS** parameter.

The 38DL PLUS uses a transfective color display that reflects ambient light and becomes brighter in direct light. With brighter ambient conditions, you can set the display brightness to a lower percentage.

NOTE

Reducing the display brightness percentage increases the battery life. Battery life specifications are based on backlight brightness set to 50 %.

4.4.3 Waveform Rectification

The rectification mode is the way in which the ultrasonic echoes are represented on the waveform display (see Figure 4-5 on page 60). The rectification mode does not affect the thickness measurement in any way. The rectification indicator (**FULL**, **POS**, **NEG**, or **RF**) appears on the left edge of the waveform display. From the measurement screen, press **[DISPLAY]** to access the **WAVEFORM RECTIFICATION** parameter.

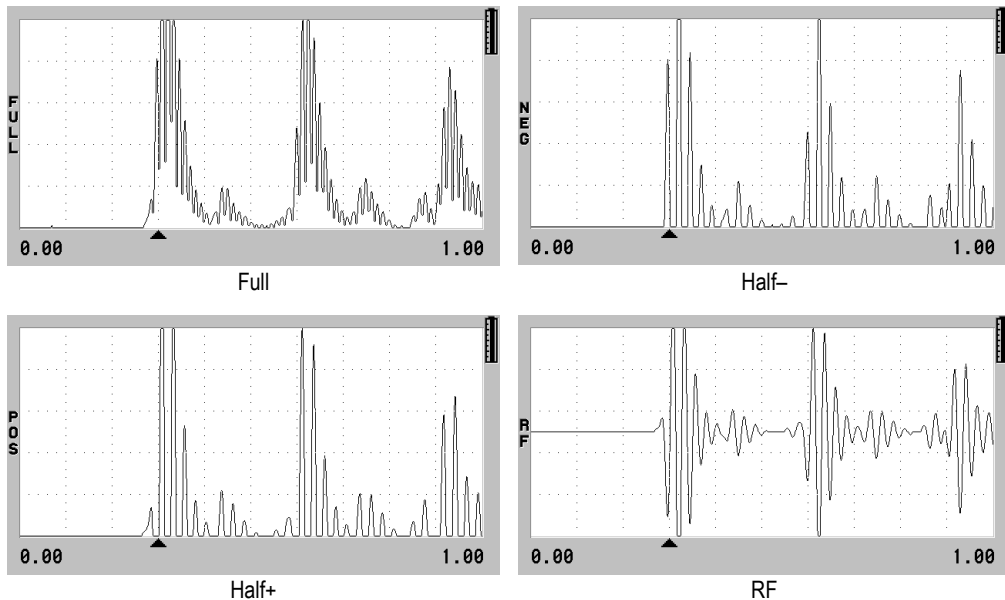


Figure 4-5 Examples of the rectification modes

The available rectification modes are:

FULL

Shows the negative portion of the echo folded around the baseline so that both positive and negative waveform lobes are displayed. Gives the best overall representation of position and magnitude for most thickness measurement applications. **FULL** is the default mode for dual element transducers.

HALF- (NEG indicator)

Shows negative waveform lobes as positive and does not show the positive lobes.

HALF+ (POS indicator)

Shows positive waveform lobes and does not show the negative waveform lobes.

RF

Shows negative and positive lobes on either side of the baseline. **RF** is the default mode for single element transducers.

4.4.4 Waveform Trace

The 38DL PLUS can display the waveform trace as a line (**OUTLINE**) or as a **FILLED** area (see Figure 4-6 on page 62). From the measurement screen, press **[DISPLAY]** to access the **WAVEFORM TRACE** parameter.

NOTE

A filled waveform trace is only possible when the waveform rectification is set to **FULL**, **HALF+**, or **HALF-**.

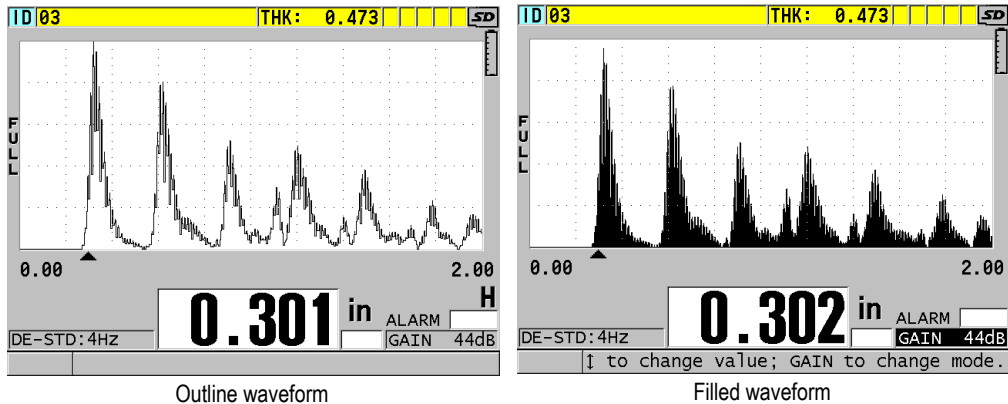


Figure 4-6 Examples of waveform trace modes

4.5 Range of the Waveform Display

The range of the waveform display is the distance spanned by the horizontal axis of the waveform display. The left end of the horizontal axis, the delay, is generally set to zero. You can manually adjust the delay value to change the starting point of the range (see "Adjusting the Delay Value" on page 64) and select the end point of the range (see "Selecting the Range Value" on page 63). You can also activate the zoom function to automatically set the delay and the range values to best see the echo (see "Activating the Zoom Function" on page 64).

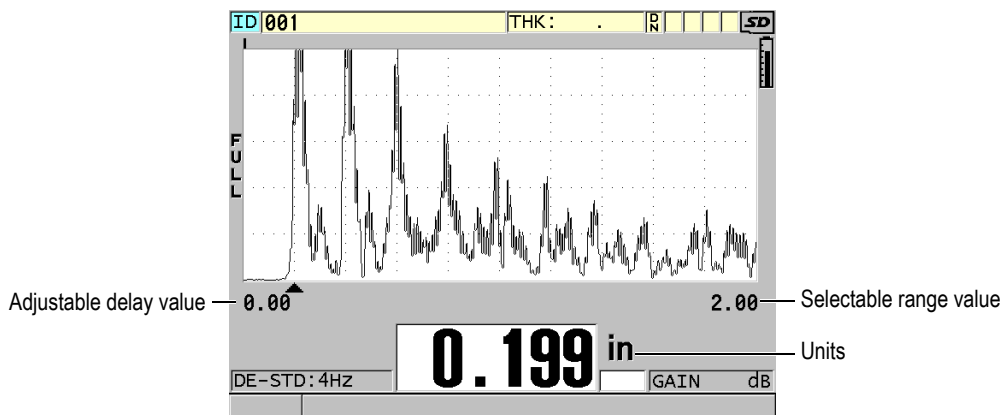


Figure 4-7 The range of the waveform display

4.5.1 Selecting the Range Value

There are fixed ranges available for each transducer frequency. The available ranges are also dependent on material sound velocity. These selectable ranges let you adjust the thickness span of the waveform display to only show the thickness range being measured and thus, obtain maximum waveform resolution for each application. The range setting affects the waveform display only. You can still make measurements even when the display range does not show the detected echo from which the thickness is measured. You cannot manually set the range while the zoom is active.

To select the range value

1. From the measurement screen, press **[RANGE]**.
The waveform range changes to the next higher available range.
2. Continue to press **[RANGE]** until you obtain the desired range.
The range value recycles to the minimum range value following the maximum value.

4.5.2 Adjusting the Delay Value

The delay of the waveform display adjusts the beginning of the horizontal span. You can adjust the delay to display the waveform of interest in the center of the waveform display. This function is very useful when using delay line or immersion transducers, or when measuring thick material so that the measured echoes can be seen in greater detail.

To adjust the delay value

1. Press **[2nd F]**, **[RANGE]** (**DELAY**).
2. Use the arrow keys to adjust the delay value.
3. Press **[2nd F]**, **[RANGE]** (**DELAY**) again to stop editing the delay value.

TIP

Press and hold the **[RANGE]** key to reset the delay to zero.

4.5.3 Activating the Zoom Function

The zoom function automatically and dynamically sets the delay and the range values to optimally track and show the detected echo in the waveform display.

To activate the zoom function

1. From the measurement screen, press **[ZOOM]**.
The zoom flag (**Z**) appears on the right side of the waveform display, below the power indicator.
2. Press **[ZOOM]** again to turn off the zoom function.

The resulting zoomed waveform depends on the current measurement mode. The zoom for D79X dual element transducers and mode 1 single element transducers centers the first back-wall echo on the screen (see Figure 4-8 on page 65).

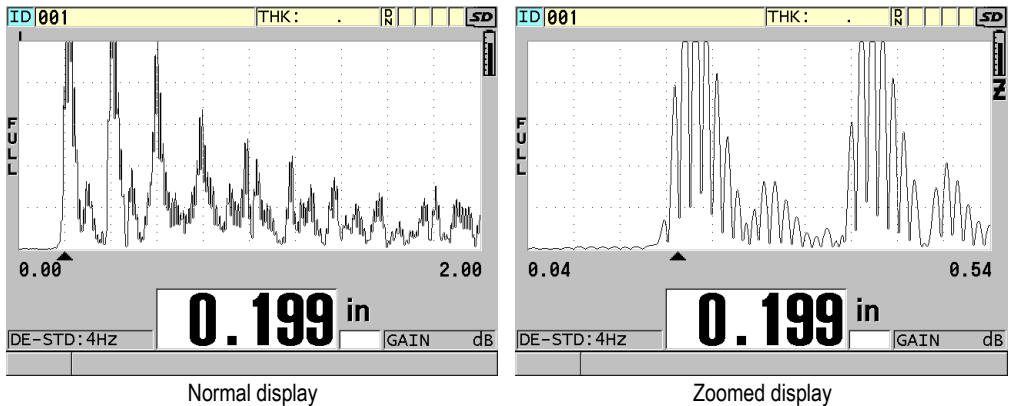


Figure 4-8 Comparing normal and zoomed display in mode 1

The zoom with single element transducers in mode 2 adjusts the waveform range and delay so that the interface echo and the first back-wall echo appear on the waveform display (see Figure 4-9 on page 65).

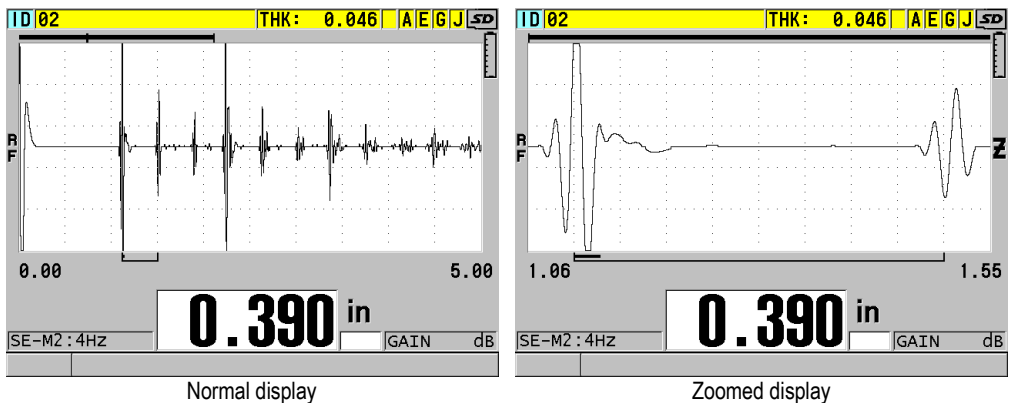


Figure 4-9 Comparing normal and zoomed display in mode 2

The zoom with single element transducers in mode 3 adjusts the waveform range and delay so that the interface echo and the second measured back-wall echo appear on the waveform display (see Figure 4-10 on page 66).

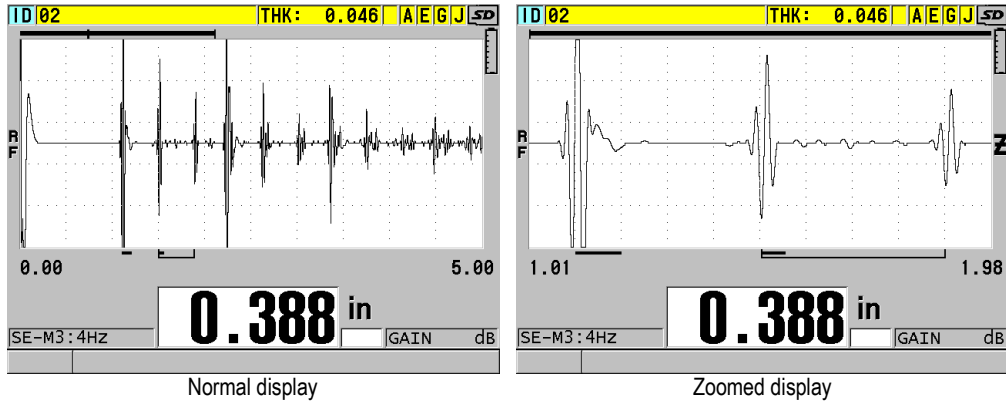


Figure 4-10 Comparing normal and zoomed display in mode 3

4.6 Adjusting the Measurement Update Rate

You can select a predefined measurement update rate (4 Hz, 8 Hz, 16 Hz, 20 Hz, or **MAX**). The measurement update rate indicator is always present on the left of the thickness measurement (see Figure 4-11 on page 66).



Figure 4-11 The measurement update rate indicator

The **MAX** update rate is up to 30 Hz and is dependent on measurement type. This option is useful when making high temperature thickness measurements to help limit the transducer contact time or for applications where you scan the transducer over an area to find the minimum thickness.

NOTE

The 38DL PLUS automatically uses the fastest update rate when entering the **Minimum** or **Maximum** mode.

To adjust the measurement update rate

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **MEAS**.
3. In the **MEAS** screen, set the **MEASURE RATE** to the desired value.
4. Press **[MEAS]** to return to the measurement screen.

4.7 Changing the Thickness Resolution

You can change the thickness measurement resolution, meaning the number of digits shown to the right of the decimal point. The resolution selection affects all displays and data output of values with thickness units. This includes measured thickness, differential reference value, and alarm set points. The highest thickness resolution with dual element transducer is 0.01 mm (0.001 in.). The velocity is always reported with full four-digit resolution.

You can reduce the resolution in some applications where the extra precision of the last digit is not required, or where extremely rough outside or inside surfaces make the last thickness display digit unreliable.

The high resolution software option (P/N: 38DLP-HR [U8147015]) allows to increase the resolution to 0.001 mm (0.0001 in.). The high resolution is available for measured thickness smaller than 102 mm (4 in.). The high resolution is not active with low-frequency transducers and when the high penetration software option is activated.

To change the thickness measurement resolution

1. Press **[SETUP MENU]**.
2. In the menu, select **MEAS**.
3. In the **MEAS** screen, set **RESOLUTION** to the desired option:
 - **STANDARD**: 0.01 mm or 0.001 in. (default)
 - **LOW**: 0.1 mm or 0.01 in.

- Optional **HIGH**: 0.001 mm or 0.0001 in.
4. Press [**MEAS**] to return to the measurement screen.

5. Basic Operation

The following sections describe the basic operation for the 38DL PLUS ultrasonic thickness gage.

5.1 Setting Up the Transducer

The 38DL PLUS operates with a full line of single element and dual element transducers. The 38DL PLUS automatically recognizes standard D79X dual element transducers and automatically loads the appropriate predefined setup. The predefined setup contains ultrasonic velocity for the stainless steel step block supplied with the instrument. With dual element transducers, you need to perform a transducer zero compensation.

For a single element transducer, or other dual element transducers, you need to manually load an appropriate setup. The 38DL PLUS ships from the factory set up with default conditions for the purchased transducers using an approximate sound velocity for the stainless steel test block provided with the instrument. The default conditions are selected to facilitate instrument usage for your applications.

To set up the transducer

1. Plug the transducer into the transducer connector(s) at the top of the 38DL PLUS case (see Figure 5-1 on page 70). Use T/R 1 for a single element transducer.

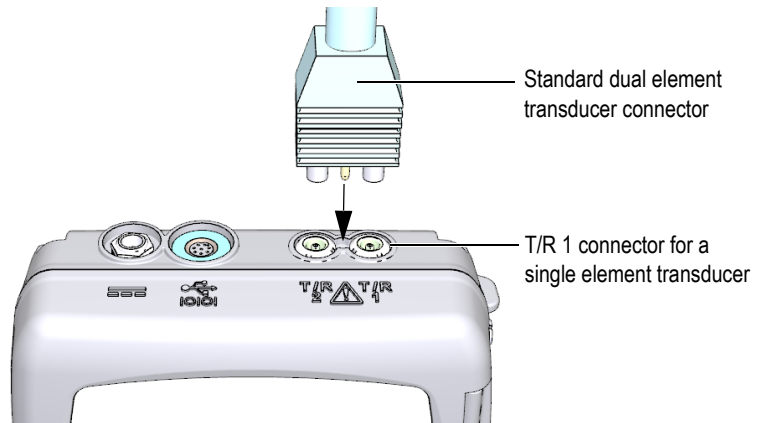


Figure 5-1 Plugging the transducer

2. Press [ON/OFF] to start the instrument. The measurement screen appears. With a standard D79X dual element transducer, the “Do--” message appears in the measurement screen (see Figure 5-2 on page 70).

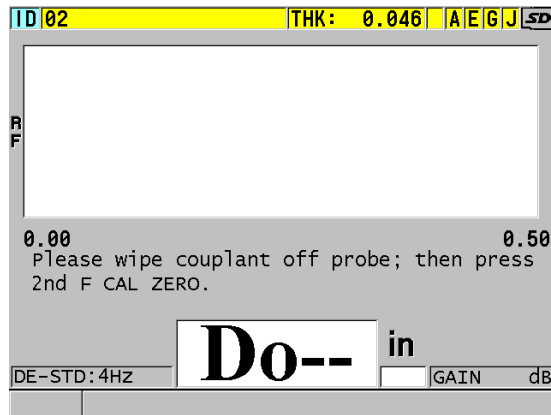
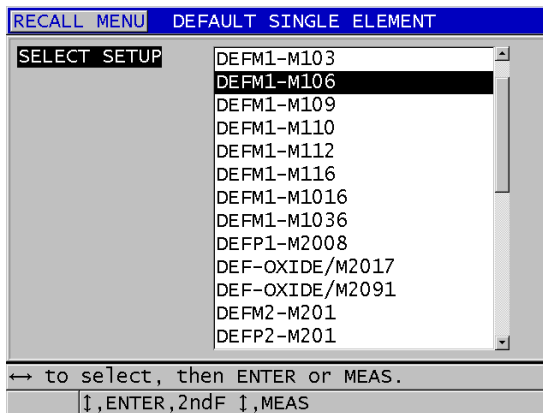


Figure 5-2 Initial screen with a standard D79X dual element transducer

3. For dual element transducers, perform the transducer zero compensation:
 - a) Wipe couplant off the tip of the transducer.

- b) Press [**2nd F**], [**CAL ZERO**] (**Do ZERO**).
 4. For a single element transducer, or other dual element transducers, load an appropriate setup:
 - a) Press [**XDCR RECALL**].
 - b) In the menu, select the default choice for the probe type that you use (ex.: **DEFAULT SINGLE ELEMENT**).
 - c) In the **DEFAULT** screen for the type of probe that you are using (see the example shown in Figure 5-3 on page 71), in the list of available default setups, highlight the setup for the transducer that you are using.



Default setup naming convention:

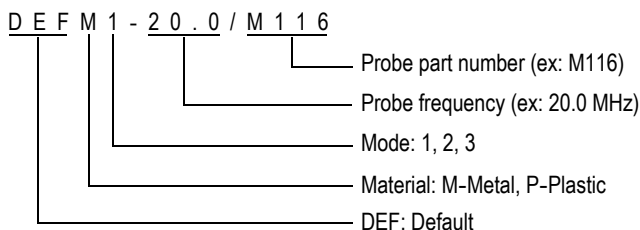


Figure 5-3 Selecting a default single element transducer setup

NOTE

You can rename the setups listed as USER-1 through USER-35 for special applications.

- d) Press **[MEAS]** to automatically recall the setup parameters for the chosen setup and return to the measurement screen.

5.2 Calibration

The calibration is the process of adjusting the instrument to accurately measure on a particular material, using a known transducer at a given temperature. Calibrating the instrument is always necessary before inspecting a specific material. The measurement accuracy is only as good as the calibration that you perform.

You need to perform the following three calibration types:

Transducer zero compensation (**[Do ZERO]**)

For dual element transducer only, calibrate for the sound transit time in each of the dual transducer delay lines. This compensation varies in each transducer unit and with temperature. You must perform the transducer zero compensation procedure when the unit is powered on, when the transducer is changed, and when the transducer temperature changes significantly (see “Setting Up the Transducer” on page 69 and “Transducer Zero Compensation” on page 76).

Material sound velocity calibration (**[CAL VEL]**)

Perform a velocity calibration using a thick test block of the measured material with known thickness or by manually entering a previously determined material sound velocity. You must perform this procedure for each new measured material (see “Calibrating the Instrument” on page 73 and “Material Sound Velocity and the Zero Calibrations” on page 77).

Zero Calibration (**[CAL ZERO]**)

Perform a zero calibration using a thin test block of the measured material with known thickness. Unlike the transducer zero compensation and the material sound velocity calibration, this procedure is not required unless you need the best absolute accuracy (better than ± 0.10 mm or ± 0.004 in.). You only need to do it once for each new transducer and material combination. You do not have to repeat the zero calibration when the transducer temperature changes; Transducer zero compensation is responsible for that task (see “Calibrating the Instrument” on page 73 and “Material Sound Velocity and the Zero Calibrations” on page 77).

5.2.1 Calibrating the Instrument

When you want to make accurate measurements, you need to perform the following calibrations:

- Material sound velocity calibration
- Zero calibration

You must perform the calibrations using a thick and a thin sample of precisely known thicknesses. The sample must be made of the same material as the parts to be inspected (see “Test Blocks” on page 76 for details on test blocks).

The following procedure is illustrated using a dual element probe and a 5-step test block. Refer to “Calibration” on page 72 for more details on the calibration process.

To calibrate the instrument

1. To perform the material sound velocity calibration (see Figure 5-4 on page 74):
 - a) Place a drop of couplant on the surface of the thick part of the test block.
 - b) Couple the transducer to the thick part of the test block using moderate to firm pressure.
The waveform and the thickness reading appear on the screen.
 - c) Press **[CAL VEL]**.
 - d) When the thickness reading is stable, press **[ENTER]**.
 - e) Using the arrow keys, edit the thickness value to match the known thick thickness of the test block.

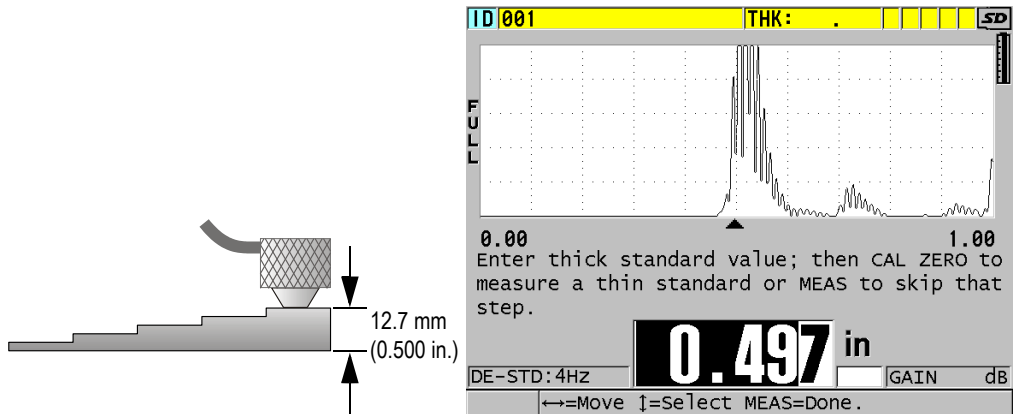


Figure 5-4 Performing the material sound velocity calibration on a 5-step test block

2. To perform the zero calibration (see Figure 5-5 on page 75):
 - a) Place a drop of couplant on the surface of the thin part of the test block.
 - b) Couple the transducer to the thin part of the test block, and then press **[CAL ZERO]**.
 - c) When the thickness reading is stable, press **[ENTER]**.
 - d) Using the arrow keys, edit the thickness value to match the known thin thickness of the test block.

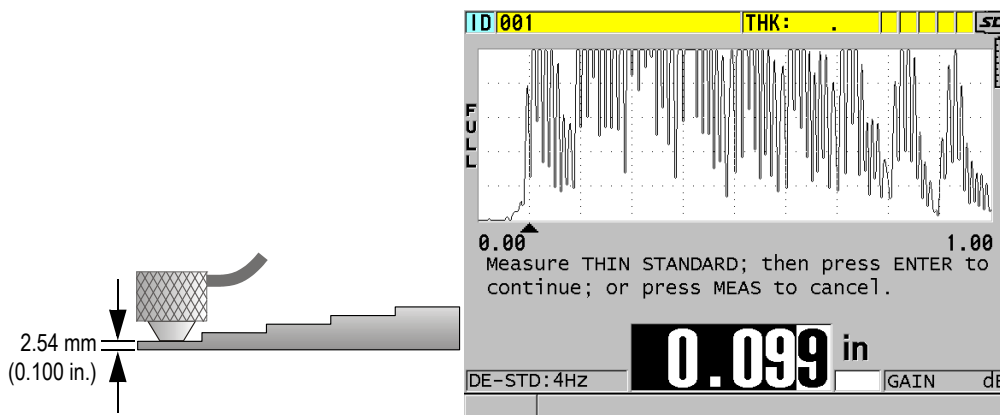


Figure 5-5 Performing the zero calibration on a 5-step test block

3. Press **[MEAS]** to complete the calibration and return to the measurement screen.

IMPORTANT

If you turn off the instrument before pressing **[MEAS]**, the velocity is not updated to the new value; instead the instrument retains the previous value.

NOTE

When the 38DL PLUS detects an error in the calibration procedure, it successively displays the following messages in the help text bar before returning to the measurement screen:

“Potential wrong echo detected!”

“Invalid calibration results!”

In this case, the velocity is not changed. The probable case is that an incorrect thickness value was entered.

5.2.2 Test Blocks

The 38DL PLUS comes with a cylindrical stainless steel test block with two thicknesses. You can use the two precisely known test block thicknesses to perform the material sound velocity and the zero calibrations.

Precision step test blocks are also often used when more than two known thicknesses are needed (see Figure 5-6 on page 76).



Figure 5-6 Example of a 5-step test block

When performing the material sound velocity and zero calibration, you must use a test block with the following characteristics:

- Made from the same material as the parts to be tested.
- Have two or more precisely known thicknesses
- Have one part as thin as the thinnest section of the parts to be tested to perform the zero calibration. The surface condition should be similar to that of the tested parts. Rough surfaces generally reduce the accuracy of measurements, but simulating actual surface conditions on the calibration block can help to improve results.
- Have one part as thick as the thickest section of the parts to be tested, to perform the material sound velocity calibration. The front and back surfaces should be smooth and parallel.
- Be at the same temperature as the samples to be measured.

5.2.3 Transducer Zero Compensation

Perform a transducer zero compensation by pressing **[2nd F]**, **[CAL ZERO]** (**Do ZERO**) whenever the message “**Do—**” or the zero indicator appear. You should also perform this procedure when the dual element transducer temperature has changed.

The frequency at which you perform a transducer zero compensation procedure depends on the rate of change of the internal temperature of the dual element transducer. This is related to the material surface temperature, frequency of transducer application, length of time the transducer is held in contact with the material, and the accuracy that you want to obtain.

NOTE

When measurements are made on surfaces that are significantly above room temperature, the zero should be recalibrated on a regular basis. This is less important for transducers part numbers D790-SM, D791-RM, D797-SM, and D798 than for other transducers that have various types of resin delay lines.

For high temperature measurements, Evident recommends that you develop a transducer zero compensation schedule that takes these factors into account. For example, use the D790-SM, D791-RM, or D797-SM for high temperature applications, minimizing the frequency of the zero compensation. You can also use the D790-SM and D791-RM for general purpose applications.

5.2.4 Material Sound Velocity and the Zero Calibrations

The 38DL PLUS performs a material gain optimization during the velocity calibration procedure when this feature is activated.

For dual element transducers, the material gain optimization (**GAIN OPT** in the **MEAS** screen) evaluates the signal from the test block and automatically sets a starting default gain based on the transducer sensitivity and material noise levels. When the default gain required is outside of the allowable range, a message appears, specifying that the transducer may not be functioning correctly.

The 38DL PLUS performs a calibration doubling verification to help prevent mis-calibrating on thin samples. Doubling occurs when the instrument measures the time to the second back-wall echo rather than detecting the first back-wall echo. The 38DL PLUS compares the measured time of flight to the expected time of flight based on the current sound velocity. The 38DL PLUS displays a warning message if doubling is suspected. Doubling can occur when measuring a thickness that is below the minimum range of the transducer, or when a transducer is worn or low in sensitivity.

NOTE

You can also achieve a material sound velocity and zero calibration procedure by performing the operations in the reverse order, starting with the zero calibration, followed by the material sound velocity calibration.

5.2.5 Entering a Known Material Sound Velocity

When preparing to measure thicknesses on parts made of a different material, if you know the sound velocity for the material, you can directly enter the velocity without performing a material sound velocity calibration procedure.

To enter a known material sound velocity

1. From the measurement screen, press **[2nd F]**, **[CAL VEL]** (**VEL**).
2. In the **VELOCITY** screen (see Figure 5-7 on page 78), use the arrow keys to edit the velocity to the known value.

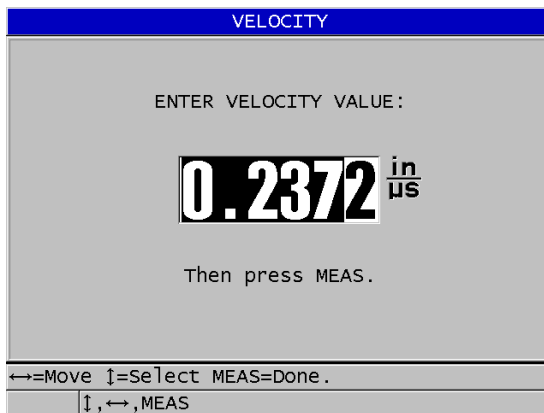


Figure 5-7 Entering a known material sound velocity

3. Press **[MEAS]** to return to the measurement screen.

5.2.6 Locked Calibrations

The 38DL PLUS includes a password-protected locking function to prevent changes to setups and prevent access to some functions. A change to the calibration is one action that you can lock. When this is the case, the message shown in Figure 5-8 on page 79 appears momentarily on the help text bar.



Figure 5-8 The calibration lock message

5.2.7 Factors Affecting the Performance and the Accuracy

The following factors affect the performance of the instrument and the accuracy of the thickness measurements.

Calibration

The accuracy of any ultrasonic measurement is only as good as the accuracy and care with which you calibrate the instrument. The 38DL PLUS ships from the factory with standard setups for a number of transducers and applications. In some cases, it may be desirable to optimize these setups for specific measurement situations. In all cases, it is essential that you perform the velocity and zero calibrations whenever the test material or transducer is changed. Periodic checks with samples of known thickness are recommended to verify that the gage is operating properly.

Surface roughness of the test piece

The best measurement accuracy is obtained when both the front and back surfaces of the test piece are smooth. When the contact surface is rough, the minimum thickness that can be measured will be increased because of sound reverberating in the increased thickness of the couplant layer. Additionally, when the two test piece surfaces are rough, the slightly different multiple sound paths seen by the transducer may cause distortion in the returning echo, resulting in measurement inaccuracies.

Coupling technique

In mode 1 (contact transducer) measurements, the couplant layer thickness is part of the measurement and is compensated by a portion of the zero offset. If maximum accuracy is to be achieved, then the coupling technique must be

consistent. In order to accomplish consistent measurements, use a couplant of reasonably low viscosity; employ only enough couplant to achieve a reasonable reading; and apply the transducer with uniform pressure. Practice will show the degree of moderate to firm pressure that produces repeatable readings. In general, smaller diameter transducers require less coupling force to squeeze out the excess couplant than larger diameter transducers. In all modes, tilting the transducer distorts echoes and causes inaccurate readings, as noted below.

Curvature of the test piece

A related issue to this section involves the alignment of the transducer with respect to the test piece. When measuring on curved surfaces, it is important that the transducer be placed approximately on the centerline of the part and held as steadily to the surface as possible. In some cases, a spring-loaded V-block holder may be helpful for maintaining this alignment. In general, as the radius of curvature decreases, the size of the transducer should be reduced, and the more critical transducer alignment will become. For very small radii, an immersion approach is necessary. In some cases it may be useful to observe the waveform display as an aid in maintaining optimum alignment. Practice the best way to hold a transducer with the aid of a waveform display. On curved surfaces, it is important to use only enough couplant to obtain a reading. Excess couplant forms a fillet between the transducer and the test surface where sound reverberates and possibly creates spurious signals that may trigger false readings.

Taper or eccentricity

If the contact surface or back surface of the test piece is tapered or eccentric with respect to the other, the return echo is distorted due to the variation in sound path across the width of the beam. The accuracy of the measurement is reduced. In severe cases, no measurement is possible.

Acoustic properties of the test material

There are several conditions found in certain engineering materials that can potentially limit the accuracy and range of ultrasonic thickness measurements:

- Sound scattering:
In materials such as cast stainless steel, cast iron, fiberglass, and composites, sound energy scatters from individual crystallites in the casting or boundaries of dissimilar materials within the fiberglass or composite. Porosity in any material can have the same effect. Adjust the instrument sensitivity to prevent detection of these spurious scatter echoes. This compensation can in turn limit the ability to discriminate a valid return echo from the back wall of the material, thereby restricting measurement range.
- Sound attenuation or absorption:
In many organic materials such as low density plastics and rubbers, sound

energy is attenuated very rapidly at the frequencies used for ultrasonic gaging. This attenuation typically increases with temperature. The maximum thickness that can be measured in these materials will often be limited by attenuation.

— Velocity variations:

An ultrasonic thickness measurement is accurate only to the degree that material sound velocity is consistent with the instrument calibration. Some materials exhibit significant variations in sound velocity from point to point. This happens in certain cast metals due to the changes in grain structure that result from varied cooling rates, and the anisotropy of sound velocity with respect to grain structure. Fiberglass can show localized velocity variations due to changes in the resin/fiber ratio. Many plastics and rubbers show a rapid change in sound velocity with temperature, requiring that velocity calibration be performed at the temperature where measurements are made.

Phase reversal or phase distortion

The phase or polarity of a returning echo is determined by the relative acoustic impedances (density × velocity) of the boundary materials. The 38DL PLUS assumes the customary situation where the test piece is backed by air or a liquid, both of which have a lower acoustic impedance than metals, ceramics, or plastics. However, in some specialized cases, such as measurement of glass or plastic liners over metal, or copper cladding over steel, this impedance relationship is reversed and the echo appears phase reversed. In these cases, it is necessary to change the appropriate echo detection polarity in order to maintain accuracy. A more complex situation can occur in anisotropic or inhomogeneous materials such as coarse-grain metal castings or certain composites, where material conditions result in the existence of multiple sound paths within the beam area. In these cases, phase distortion can create an echo that is neither cleanly positive nor negative. Careful experimentation with reference standards is necessary in these cases to determine effects on measurement accuracy.

5.3 Measuring Thicknesses

You can start measuring thicknesses once a transducer is connected (see “Setting Up the Transducer” on page 69) and once the instrument is calibrated (see “Calibrating the Instrument” on page 73).

To measure thicknesses

1. Apply couplant to the test block or tested part at the measuring spot.

NOTE

In general, use a thinner couplant such as propylene glycol, glycerin, or water for smooth material surfaces. Rough surfaces require a more viscous couplant such as gel or grease. Special couplants are required for high temperature applications.

- Using moderate to firm pressure, couple the tip of the transducer to the surface of the test material, and keep the transducer as flat as possible on the material surface (see Figure 5-9 on page 82).

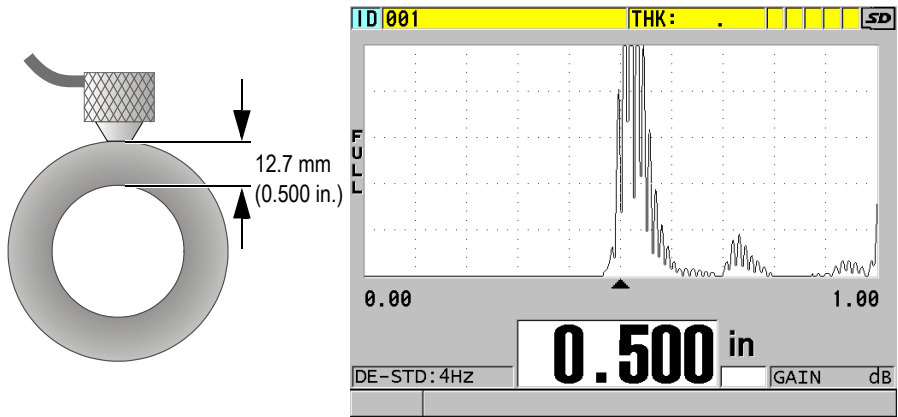


Figure 5-9 Coupling dual element transducer and reading the measured thickness

- Read the measured thickness value for the tested part.

5.4 Saving Data

The 38DL PLUS datalogger is a file based system where one file is opened at a time. The active file stores a measurement at a thickness measurement location ID. Each time you press **[SAVE/SEND]**, the displayed value is saved to the active file at the current ID. The ID is automatically incremented for the next measurement. When you press **[FILE]**, the name of the active file appears in the ID bar above the menu (see Figure 5-10 on page 83).

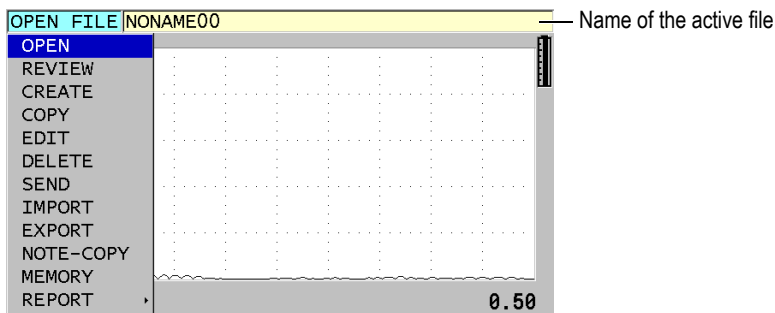


Figure 5-10 The active file name appearing in the ID bar

The NONAME00 increment type file, starting with the 001 ID, is the active file by default when you first use the 38DL PLUS or after resetting the instrument memory. You can create various types of files and define IDs to represent various 1-D, 2-D, or 3-D thickness measurement locations. When restarting, the instrument automatically opens the last file that was used.

The following special cases may occur:

- When the thickness value is blank, “— —” is saved rather than a value.
- When a measurement is already stored at the current ID, the new value overwrites the old thickness reading unless the overwrite protection is enabled.
- When the ID increment reaches the end of a sequence and cannot be updated, **Last ID** appears on the help text bar, a long beep sound is emitted (when the beeper is active), and the ID on the display remains unchanged.

To save data at the current ID in the active file

- ◆ While the desired thickness value and waveform are displayed, press [SAVE/SEND] to save the measured thickness value.
OR
Press [2nd F], [SAVE/SEND] (WAVEFORM) to save the measured thickness value and the waveform.

TIP

If you want to always save both the thickness and the waveform when you press [SAVE/SEND], in the SYSTEM screen, set SAVE DATA to THK+WF.

5.5 Measurements with THRU-COAT D7906 and D7908 Transducers

THRU-COAT is a function that measures the true metal thickness of coated or painted parts. This function only requires a single back-wall echo and is recommended for heavy corrosion applications where the outside of the material is coated or painted. If needed, you can also calibrate the measurement of the coating/paint layer to precisely measure the thickness of the coating/paint.

5.5.1 Enabling the THRU-COAT Function

The THRU-COAT function is only available when you connect a THRU-COAT transducer (P/N: D7906 [U8450005] or D7908 [U8450008]) to the 38DL PLUS.

To enable the THRU-COAT function

1. Connect a THRU-COAT transducer to the 38DL PLUS.
2. Start the instrument.
3. Wipe the couplant off the transducer tip.
4. Press [2nd F], [CAL ZERO] (**Do ZERO**).

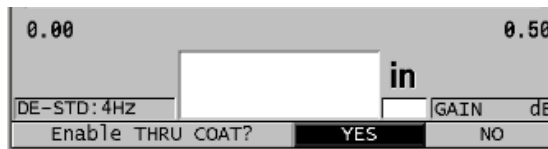


Figure 5-11 Opening the THRU COAT SETUP dialog box

5. Select **YES** to answer the **Enable THRU COAT?** prompt.

5.5.2 Performing a THRU-COAT Calibration

The calibration procedure for a THRU-COAT probe is similar to the procedure for other probes. As for a normal calibration, you need two uncoated samples with accurately known thin and thick thicknesses to perform the following calibration procedure. The difference is that towards the end of the procedure, you can press **[CAL VEL]** a second time to calibrate the coating thickness measurement on a sample with an accurately known coating thickness.

To perform a THRU-COAT calibration

1. Ensure that the THRU-COAT function is enabled (see “Enabling the THRU-COAT Function” on page 84).
2. Couple the transducer to the thick sample.
3. Press **[CAL VEL]**.
4. When the reading is stable, press **[ENTER]**.
5. Using the arrow keys, edit the thickness value to match the known thickness of the sample.
6. Couple the transducer to the thin sample.
7. Press **[CAL ZERO]**.
8. When the reading is stable, press **[ENTER]**.
9. Using the arrow keys, edit the thickness value to match the known thickness of the sample.
10. If the coating thickness measurement accuracy is important for your application, perform the following actions (omitting this step does not affect the accuracy of the metal thickness measurement):
 - a) Press **[CAL VEL]** again.
 - b) Couple the transducer to the coated sample.
 - c) When the reading is stable, press **[ENTER]**.
 - d) Using the arrow keys, edit the thickness value to match the known coating thickness of the coated sample.
11. Press **[MEAS]** to complete the calibration.

NOTE

Pressing [2nd F], [CAL VEL] (VEL) opens the VELOCITY screen where you can see and edit the calibrated metal sound velocity. Pressing [2nd F], [CAL VEL] (VEL) again opens the VELOCITY screen for the calibrated sound velocity through the coating.

5.6 Echo Detection Modes with Dual Element Transducers

With dual element transducers, the 38DL PLUS offers three echo detection modes allowing you to measure thicknesses in various material conditions. A description of each of the three echo detection modes (STANDARD, AUTO E-TO-E, and MANUAL E-TO-E) follows:

STANDARD

The standard echo detection mode measures the thickness based on the time of flight between the main bang to the first back-wall echo. Use this mode for uncoated materials with good echo waveforms.

The DE-STD indicator appears to the left of the thickness reading and a triangular echo detection marker appears at the back-wall echo below the waveform display (see Figure 5-12 on page 86).

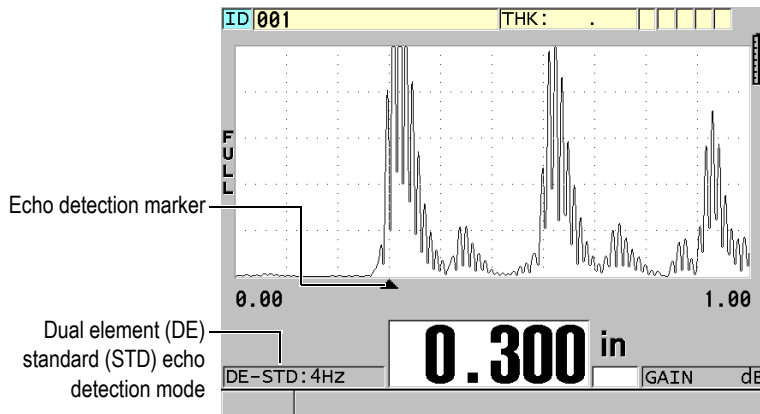


Figure 5-12 Measuring with the standard echo detection mode

AUTO E-TO-E

The automatic echo-to-echo detection mode measures the thickness using the time of flight between two consecutive back-wall echoes. Use this mode for painted or coated materials since the time interval between consecutive back-wall echoes excludes the time of flight through a paint, resin, or coating layer. The **DE-AEtoE** indicator appears to the left of the thickness reading. The triangular marker is replaced by an echo-to-echo detection bar to indicate the exact pair of back-wall echoes used to determine the thickness (see Figure 5-13 on page 87). The echo height is automatically adjusted to a preset level.

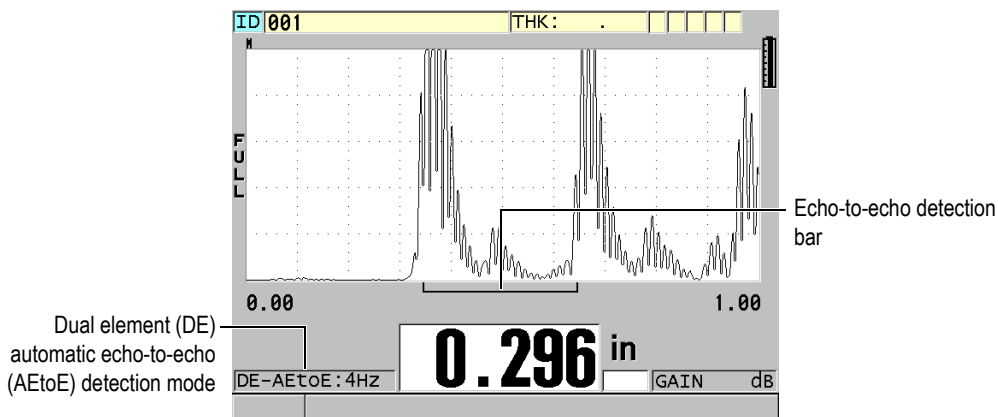


Figure 5-13 Measuring with the automatic echo-to-echo detection mode

MANUAL E-TO-E

The manual echo-to-echo detection mode also measures the thickness using the time of flight between two consecutive back-wall echoes. In this mode, you can however also manually adjust the gain and the blanking parameters. Use this mode when material conditions produce noisy signals where the automatic mode may be less effective.

The **DE-MEtoE** indicator appears to the left of the thickness reading. The echo-to-echo detection bar is similar to the automatic echo-to-echo mode but includes the adjustable E1 blank bar that indicates the area to exclude for echo detection (see Figure 5-14 on page 88). Following the E1 blank, the instrument detects the next echo with an amplitude of at least 20 % of the waveform display height. In this mode, press **[WAVE ADJ]**, and then use the arrow keys to adjust the **EXT BLANK**, the **E1 BLANK**, and the **GAIN** parameters.

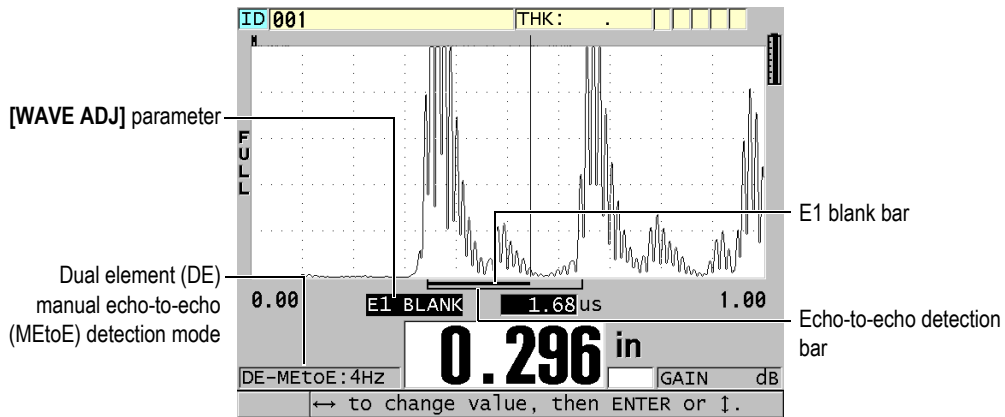


Figure 5-14 Measuring with the manual echo-to-echo detection mode

NOTE

In severe corrosion situations where valid multiple echoes are not present, you must use the standard mode to be able to measure thicknesses.

You can use dual element transducers in all three modes. You can use all measurement, display, and datalogger functions with the echo-to-echo modes. The internal datalogger recognizes and saves all necessary echo-to-echo information to upload and download thickness, waveform, and setup data.

TIP

You do not have to switch between echo detection modes when measuring both coated and uncoated areas because you can measure uncoated wall thicknesses using an echo-to-echo mode.

To change the echo detection mode

1. Press **[2nd F]**, **[ZOOM]** (E-TO-E).

2. In the menu, select the desired echo detection mode (**STANDARD**, **AUTO E-TO-E**, or **MANUAL E-TO-E**).
3. To perform the zero calibration again:
 - a) Place a drop of couplant on the surface of the thin part of the test block.
 - b) Couple the transducer to the thin part of the test block, and then press **[CAL ZERO]**.
 - c) When the thickness reading is stable, press **[ENTER]**.
 - d) Using the arrow keys, edit the thickness value to match the known thin thickness of the test block.

5.6.1 Blanking Adjustments in Manual Echo-to-Echo Detection Mode

The 38DL PLUS offers two blanking functions to help detect valid echoes in situations where material conditions generate unwanted signals:

EXT BLANK

The extended blank creates a blanked zone that begins at the left edge of the waveform display and in which no signals are detected. In situations where the second or third pair of back-wall echoes are stronger or cleaner than the first pair, use the extended blank to control which pair of echoes to use for measurement.

E1 BLANK

The echo 1 (E1) blank runs for a selected interval following the first detected echo. Use the E1 blank to exclude any unwanted peaks occurring between the first and the second back-wall echoes. Unwanted peaks may be trailing edges of a large first echo, or shear wave reflections on thick test pieces. The E1 blank parameter is only available in the manual echo-to-echo detection mode.

To adjust the extended and the E1 blank parameters

1. Select the manual echo-to-echo mode:
 - a) Press **[2nd F]**, **[ZOOM]** (**E-TO-E**).
 - b) In the menu, select **MANUAL E-TO-E**.
2. Press **[WAVE ADJ]**.

The wave adjustment parameter appears (see Figure 5-15 on page 90).

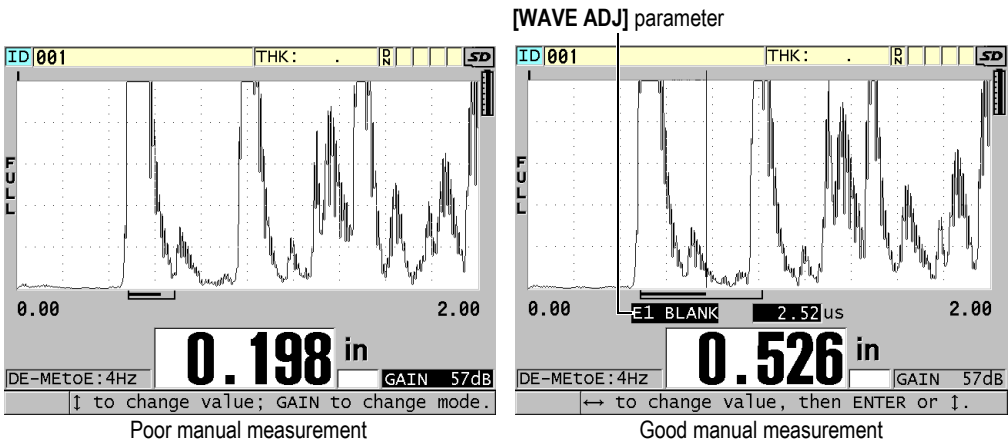


Figure 5-15 Comparing manual measurements

3. Use the [\blacktriangle] and [\blacktriangledown] keys to select either the EXT BLANK or the E1 BLANK parameter.
4. Use the [\blacktriangleright] and [\blacktriangleleft] keys to adjust the value to exclude unwanted peaks and detect the desired echoes.

5.6.2 Dual Element Transducer Selection in Echo-to-Echo Modes

Although the echo-to-echo modes work with all of the 38DL PLUS dual element transducers, Evident recommends using particular transducers for specific thickness ranges in steel parts (see Table 2 on page 90).

Table 2 Recommended transducers for various steel thickness ranges

Transducer type	Thickness range ^a
D798	1.5 mm to 7.6 mm (0.060 in. to 0.300 in.)
D790/791	2.5 mm to 51 mm (0.100 in. to 2.00 in.)
D797	12.7 mm to 127 mm (0.500 in. to 5.00 in.)
D7906	2.5 mm to 51 mm (0.100 in. to 2.00 in.)

a. Thickness ranges are dependent on transducer type, material conditions, and temperature.

In some cases, an error can occur if you are using a D790 transducer to measure thicknesses above 18 mm (0.7 in.). Typically, this error is due to a mode-converted shear-wave echo that may appear before the second back-wall echo. If this unwanted echo is larger than the second back-wall echo, the gage measures to it, which produces a thinner reading.

You can usually distinguish the unwanted shear-wave echo from the correct back-wall echo by examining the waveform display. The distance between the first and the second back-wall echoes is the same as the distance between the zero thickness point and the first back-wall echo. If there is an echo between the first two back-wall echoes, it is probably a mode-converted shear-wave echo. Use the manual echo-to-echo detection mode techniques and manually adjust the E1 blank to eliminate this error (see “Blanking Adjustments in Manual Echo-to-Echo Detection Mode” on page 89). Using the D797 transducer beyond 18 mm (0.7 in.) helps to eliminate the possibility of this error.

In some cases, the second or third back-wall echo is smaller in amplitude than subsequent echoes. This causes the instrument to give a double or triple reading. If you are using a D790 transducer, this effect may occur around 5 mm (0.2 in.) on flat smooth steel samples. If this occurs, it is clearly visible on the waveform display and you can work around it using the manual echo-to-echo detection mode, or moving the extended blank beyond the previously detected first echo.

When the 38DL PLUS cannot make an echo-to-echo reading, the **LOS** flag appears on the screen. In this case, the waveform display shows that either no echoes are large enough to be detected or that only one echo is detectable. In this last case, the echo-to-echo detection bar begins at the detected echo but extends indefinitely to the right. Increase the gain value to make a good echo-to-echo reading. If this does not help, you can still obtain an approximate measurement by returning to the standard echo detection mode.

5.6.3 Echo-to-Echo Mode Datalogger Flags

The following flags are used in the echo-to-echo modes in the first flag field of the uploaded thickness table and in the comment note box at the top right corner of the measurement screen:

- **E**: Automatic echo-to-echo detection mode
- **e**: Manual echo-to-echo detection mode
- **M**: Standard detection mode
- **I**: LOS in automatic echo-to-echo detection mode

- **n**: LOS in manual echo-to-echo detection mode
- **L**: LOS in standard echo detection mode

5.7 Using the VGA Output

You can connect the 38DL PLUS to an external screen or projector to more easily show the content of the 38DL PLUS screen to other people. This feature is particularly useful when you need to train other 38DL PLUS users.

When you activate the VGA output, the 38DL PLUS screen becomes blank and its contents appears only on the connected external screen. The VGA output is always turned off when you restart the 38DL PLUS.

To use the VGA output

1. Turn off the 38DL PLUS.
2. Connect the optional VGA output cable (P/N: EPLTC-C-VGA-6 [U8840035]) to the VGA output connector, located under the I/O door on the right side of the 38DL PLUS (see Figure 1-5 on page 31).
3. Connect the other end of the VGA output cable to the external screen or projector.
4. Turn on the 38DL PLUS.
5. Turn on the external screen or projector.
6. Press **[DISPLAY]**.
7. In the **DISPLAY SETTINGS** screen (see Figure 4-3 on page 58), set **VGA OUTPUT** to **ON**.
The 38DL PLUS screen becomes blank and the 38DL PLUS screen contents appears on the external screen.
8. Turn the instrument off and then back on if you need to restore the contents on the 38DL PLUS screen.

Appendix: Technical Specifications

Table 3 General EN15317 specifications

Parameter	Value
Size	Height × Width × Depth Without protective boot: <ul style="list-style-type: none"> 211.6 mm × 128.1 mm × 46.2 mm (8.33 in. × 5.04 in. × 1.82 in.) With the rubber protective boot: <ul style="list-style-type: none"> 236.2 mm × 130.6 mm × 66.5 mm (9.30 in. × 5.14 in. × 2.62 in.)
Weight	816.5 g (1.80 lb)
Power supply types	AC-DC adaptor 24 V Lithium-ion battery 24.42 Wh Five AA auxiliary batteries
Probe sockets types	Dual LEMO with center pin IP67
Battery operating time Lithium-ion	12.6 hours minimum 14 hours typical 14.7 hours maximum
Operating temperature	With lithium-ion battery: -10 °C to 50 °C (14 °F to 122 °F)
Battery storage temperature	-20 °C to 40 °C (-4 °F to 104 °F)
Battery indicator	8-step battery charge level indication Flashing low-battery warning
Pulse repetition frequency (PRF)	1 kHz burst Measurement rates: 4 Hz, 8 Hz, 16 Hz, 20 Hz, and 30 Hz
Alarm indicators	Visual high-alarm and low- alarm indicators with audio tone
Thru coating	Echo-to-echo measurement and THRU-COAT

Table 3 General EN15317 specifications (continued)

Parameter	Value
Minimum and maximum thickness	Single element: 0.1 mm to 635.0 mm (0.004 in. to 25 in.) Dual element: 0.5 mm to 635.0 mm (0.020 in. to 25 in.)

Table 4 Display EN15317 specifications

Parameter	Value
Type	Color graphical TFT, LCD, 640 × 480 pixels
Size	[Height] × [Width], [Diagonal] 56.16 mm × 74.88 mm, 93.6 mm (2.21 in. × 2.94 in., 3.68 in)

Table 5 Transmitter EN15317 specifications

Parameter	Value
Transmitter pulse	Adjustable square wave pulser
Pulser voltage	Pulse voltages: 60 V, 110 V, 150 V, and 200 V
Pulse rise time	Damping in: 5 ns typical Damping out: 3.5 ns typical (pulse width dependent)
Pulse duration	Adjustable to probe frequency

Table 6 Receiver EN15317 specifications

Parameter	Value
Gain control	Automatic or manual: 0 dB to 99 dB
Frequency range	0.5 MHz to 24 MHz typical (filter dependent)

Table 7 Other EN15317 specifications

Parameter	Value
Data storage	Internal and external 2 GB microSD memory cards. Each card: 475000 thickness readings or 20000 waveforms with thickness readings

Table 7 Other EN15317 specifications (continued)

Parameter	Value
Data output types	2.0 USB client RS-232 Removable microSD memory card
Calibration setting storage	Default single and dual element transducer setups 35 custom single element and 10 custom dual element storage locations
Calibration	Single or two-point calibration test block Velocity can be entered manually. Multi-points for custom V-path calibration with dual element transducers
Display response time	Adjustable 4 Hz, 8 Hz, 16 Hz, 20 Hz, and 30 Hz
Number of pixels to display a waveform	640 × 480 pixels
Printer output	RS-232 serial

Table 8 Environmental rating specifications

Parameter	Value
IP rating	Designed for IP67
Explosive atmosphere	MIL-STD-810F, Section 511.4, Procedure I
Shock test	MIL-STD-810F, Section 516.5, Procedure I
Vibration test	MIL-STD-810F, Section 514.5, Procedure I
Drop test	MIL-STD-810F, Section 516.5, Procedure IV- Transit Drop

Table 9 Measurement specifications

Parameter	Value
Measurement modes	<p>Standard dual element: Time between excitation pulse and first back-wall echo using dual element transducer.</p> <p>Dual echo-to-echo: Time between successive back-wall echoes using dual element transducers.</p> <p>Thru-coat: Time between excitation pulse and first back-wall echo while ignoring or displaying a coating thickness.</p> <p>Mode 1: Time between excitation pulse and first echo following blank period using contact transducers.</p> <p>Mode 2: Time between the interface echo and the first back-wall echo. Normally used with delay line or immersion transducers.</p> <p>Mode 3: Time between a pair of back-wall echoes following the interface echo. Normally used with delay line or immersion transducers.</p>
V-path correction	Automatic or manually created, dependent on transducer type
Measurement resolution	<p>Selectable from the keypad:</p> <p>LOW: 0.1 mm (0.01 in.)</p> <p>STD: 0.01 mm (0.001 in.)</p> <p>HI: 0.001 mm (0.0001 in.) with high resolution option.</p> <p>Not all resolutions are available for all measurement modes</p>
Material sound velocity range	0.762 mm/ μ s to 13.999 mm/ μ s (0.0300 in./ μ s to 0.5511 in./ μ s)
Material sound velocity resolution	0.001 mm/ μ s (0.0001 in./ μ s)
Alarm set points range	0.00 mm to 635.00 mm (0.00 in. to 25.00 in.)

Table 10 Datalogger specifications

Parameter	Value
Storage capacity	475000 thickness readings or 20000 waveforms with thickness readings
ID number length	1 to 20 characters
File name length	1 to 32 characters

Table 10 Datalogger specifications (continued)

Parameter	Value
File formats	Incremental Sequential (defined by starting and ending ID number) Sequential with custom points 2-D grid 2-D grid with custom points 3-D grid 3-D custom Boiler
External memory card	microSD memory card 2 GB maximum capacity

Table 11 Typical measurement ranges and default setups for a single element transducer^a

Setup name	Transducer	Typical measurement range
DEFM1-20.0-M116	M116	Steel: 0.250 mm to 8.000 mm (0.020 in. to 1.500 in.)
DEFM1-10.0-M112	M112	Steel: 0.760 mm to 250.000 mm (0.030 in. to 10.000 in.)
DEFM1-10.0-M1016	M1016	Steel: 0.760 mm to 250.00 mm (0.030 in. to 10.000 in.)
DEFM1-5.0-M110	M110	Steel: 1.00 mm to 380.00 mm (0.040 in. to 15.000 in.)
DEFM1-5.0-M109	M109	Steel: 1.00 mm to 500.00 mm (0.050 in. to 20.000 in.)
DEFM1-2.25-M106	M106	Steel: 2.00 mm to 635.00 mm (0.080 in. to 25.000 in.)
DEFM1-2.25-M1036	M1036	Steel: 2.00 mm to 635.00 mm (0.080 in. to 25.000 in.)
DEFM3-20.0-M208	M208	Steel: 0.25 mm to 5.00 mm (0.008 in. to 0.200 in.)
DEFP2-20.0-M208	M208	Plastic: 0.12 mm to 5 mm (0.005 in. to 0.200 in.)
DEFM3-10.0-M202	M202	Steel: 0.25 mm to 12.00 mm (0.010 in. to 0.500 in.)
DEFM2-10.0-M202	M202	Steel: 0.75 mm to 12.00 mm (0.030 in. to 0.500 in.)
DEFP2-10.0-M202	M202	Plastic: 0.6 mm to 6 mm (0.025 in. to 0.25 in.)
DEFM3-15.0-V260	V260	Steel: 0.25 mm to 5.00 mm (0.010 in. to 0.200 in.)
DEFM2-15.0-V260	V260	Steel: 0.75 mm to 12.50 mm (0.030 in. to 0.500 in.)
DEFP2-15.0-V260	V260	Plastic: 0.25 mm to 3 mm (0.010 in. to 0.120 in.)
DEFM2-5.0-M201	M201	Steel: 1.50 mm to 25.40 mm (0.050 in. to 1.000 in.)
DEFP2-5.0-M201	M201	Plastic: 0.62 mm to 12.5 mm (0.025 in. to 0.500 in.)
DEFM2-5.0-M206	M206	Steel: 1.25 mm to 19.00 mm (0.050 in. to 0.750 in.)
DEFP2-5.0-M206	M206	Plastic: 1 mm to 12.5 mm (0.040 in. to 0.500 in.)

Table 11 Typical measurement ranges and default setups for a single element transducer^a (continued)

Setup name	Transducer	Typical measurement range
DEFM2-2.25-M207	M207	Steel: 2.00 mm to 19.00 mm (0.080 in. to 0.750 in.)
DEFP2-2.25-M207	M207	Plastic: 2 mm to 12.5 mm (0.080 in. to 0.500 in.)
DEFM2-20.0-M208	M208	Steel: 0.50 mm to 10.00 mm (0.020 in. to 0.200 in.)
DEFM1-0.5-M101	M101	Steel: 12.5 mm to 635 mm (0.500 in. to 25.00 in.)
DEFM1-1.0-M102	M102	Steel: 5.0 mm to 635 mm (0.200 in. to 25.00 in.)
DEFM1-1.0-M103	M103	Steel: 2.5 mm to 635 mm (0.100 in. to 25.00 in.)
DEFP1-0.5-M2008	M2008	Fiberglass: 5.0 mm to 75 mm (0.200 in. to 3.00 in.)

- a. The maximum thickness measuring capability depends on transducer type, material conditions, and temperature.

Table 12 Setup parameter description

Name	Description	Units/Resolutions/Range
MEAS OPTION	Echo detect mode	Standard dual Dual echo-to-echo Thru-Coat Mode 1 Mode 2 Mode 3
MEAS TYPE	Special measurement modes	Standard or Oxide (optional) Barrier Layer (optional) First Peak
PROBE TYPE	Transducer types	Dual element Direct contact Delay line Immersion EMAT
PULSER POWER	Pulser power	60 V, 110 V, 150 V, or 200 V
MAX GAIN	Maximum receiver gain	0.0 dB to 99.8 dB, 0.3 dB steps
INIT GAIN	Initial TDG gain	0 to MaxGain, 1 dB steps.
TDG SLOPE	Time Gain slope (default)	0.0 dB/s to 39.9 dB/s
MB BLANK	Main Bang Blank	0 ns to 225 μ s

Table 12 Setup parameter description (continued)

Name	Description	Units/Resolutions/Range
ECHO WINDOW	Echo detect gate which begins at end of MB (main bang) blank in mode 1 or interface echo in modes 2 and 3. The value reported for the end of echo window is relative to the main bang.	0 ns to 224.71 μ s. 55 ns or MB blank time interval, whichever is less.
ECHO 1 DETECT	Detection polarity of first echo	+ or -
ECHO 2 DETECT	Detection polarity of second echo	+ or -
IF BLANK	Blank after interface echo	0 μ s to 20 μ s
M3 BLANK	Blank after first measured back-wall echo in mode 3	0 μ s to 20 μ s
VELOCITY	Ultrasonic sound velocity of material to be measured	0.508 mm/ μ s to 18.699 mm/ μ s (0.0200 in./ μ s to 0.7362 in./ μ s)
ZERO	Zero calibration factor	0.00 to 999.99

Table 13 General specifications

Element	Description
Keypad	Sealed and embossed membrane surface Tactile and audible feedback, color-coded graphics, 21 keys
Dual element transducers	Automatically identifies the transducer type and optimizes the gate for that transducer. Non-Evident transducers might work, but performance is not guaranteed. Following transducers are supported: D790, D790-SM, D791, D791-RM, D792, D793, D794, D795, D797, D798, D7906-SM, D7908, D799, D7912, D7913, and MTD705
Single element transducers	Can be used with contact, delay line, and immersion transducers from 2 MHz to 30 MHz. High precision software option expands the frequency range to 0.5 MHz to 30.0 MHz

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