



38DL PLUS

Ultrasonic Thickness Gage

Basic Operation Manual

DMTA-10009-01EN [U8778346] — Revision C

May 2011

Olympus NDT, 48 Woerd Avenue, Waltham, MA 02453, USA

© 2010, 2011 Olympus NDT, Inc. All rights reserved. No part of this publication may be reproduced, translated, or distributed without the express written permission of Olympus NDT, Inc.

This document was prepared with particular attention to usage to ensure the accuracy of the information contained therein. It 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]

Revision C

May 2011

Printed in the United States of America.

All brands are trademarks or registered trademarks of their respective owners and third party entities.

Table of Contents

List of Abbreviations	vii
Labels and Symbols	1
Important Information – Please Read Before Use	5
Intended Use	5
Instruction Manual	5
Repair and Modification	6
Safety Symbols	6
Safety Signal Words	7
Notes Signal Words	7
Warnings	8
WEEE Directive	9
China RoHS	9
EMC Directive Compliance	10
Warranty Information	10
Technical Support	11
1. Instrument Description	13
1.1 Product Description	13
1.2 Environmental Ratings	16
1.3 Instrument Hardware Components	17
1.4 Connectors	18
1.5 Keypad Functions	20
2. Powering the 38DL PLUS	25
2.1 About the Power Indicator	25
2.2 Using the AC Power	26
2.3 Using Battery Power	27

2.3.1	Battery Operating Time	28
2.3.2	Charging the Battery	28
2.3.3	Replacing the Battery	30
3.	Software User Interface Elements	33
3.1	About the Measurement Screen	33
3.2	About Menus and Submenus	35
3.3	About Parameter Screens	36
3.4	Selecting the Text Edit Mode	38
3.4.1	Editing Text Parameters Using the Virtual Keyboard	38
3.4.2	Editing Text Parameters Using the Traditional Method	40
4.	Initial Setup	43
4.1	Setting the User Interface Language and Other System Options	43
4.2	Selecting the Measurement Units	44
4.3	Setting the Clock	44
4.4	Changing Display Settings	45
4.4.1	About the Color Schemes	46
4.4.2	About Display Brightness	47
4.4.3	About Waveform Rectification	48
4.4.4	About the Waveform Trace	49
4.5	About the Range of the Waveform Display	50
4.5.1	Selecting the Range Value	51
4.5.2	Adjusting the Delay Value	51
4.5.3	Activating the Zoom Function	52
4.6	Adjusting the Measurement Update Rate	54
4.7	Changing the Thickness Resolution	54
5.	Basic Operation	57
5.1	Setting Up the Transducer	57
5.2	About the Calibration	60
5.2.1	Calibrating the Instrument	61
5.2.2	About Test Blocks	64
5.2.3	About the Transducer Zero Compensation	64
5.2.4	About the Material Sound Velocity and the Zero Calibrations	65
5.2.5	Entering a Known Material Sound Velocity	66
5.2.6	About Locked Calibrations	67
5.2.7	Factors Affecting the Performance and the Accuracy	67
5.3	Measuring Thicknesses	69
5.4	Saving Data	70
5.5	Measurements with THRU-COAT D7906 and D7908 Transducers	72

5.5.1	Enabling the THRU-COAT Function	72
5.5.2	Performing a THRU-COAT Calibration	73
5.6	About Echo Detection Modes with Dual Element Transducers	74
5.6.1	Blanking Adjustments in Manual Echo-to-Echo Detection Mode	77
5.6.2	Dual Element Transducer Selection in Echo-to-Echo Modes	78
5.6.3	Echo-to-Echo Mode Datalogger Flags	80
5.7	Using the VGA Output	80
Appendix: Technical Specifications		83
List of Figures		91
List of Tables		93
Index		95

List of Abbreviations

AC	alternative current	MEtoE	manual echo-to-echo
AEtoE	automatic echo-to-echo	MII	Ministry of Information Industry (People's Republic of China)
AVG	average	MIL	military
DB	database	NiMH	nickel metal hydride
DC	direct current	P/N	part number
EFUP	environmental friendly usage period	PDF	portable document format
EIP	electronic information products	PRF	pulse repetition frequency
EMAT	electromagnetic acoustic transducer	RoHS	restriction of hazardous substances
EMC	electromagnetic compatibility	SP	special
FCC	federal communications commission (USA)	STD	standard
HI	high	TFT	thin film transistor (liquid crystal display technology)
ID	identification	USB	universal serial bus
Li-ion	Lithium-ion	VAC	voltage alternative current
LOS	loss-of-signal	WEEE	waste electrical and electronics equipment
MB	main bang		

Labels and Symbols

Safety-related labels and symbols are attached to the instrument at the locations shown in Figure i-1 on page 1 and Figure i-2 on page 2. If labels or symbols are missing or illegible, please contact Olympus.



DANGER

Do not touch the inner conductor of the T/R 1 and T/R 2 connectors to avoid risks of an electric shock. Up to 200 V can be present on the inner conductor. The warning symbol between the Transmit/Receive (T/R) connector markings is shown in Figure i-1 on page 1.

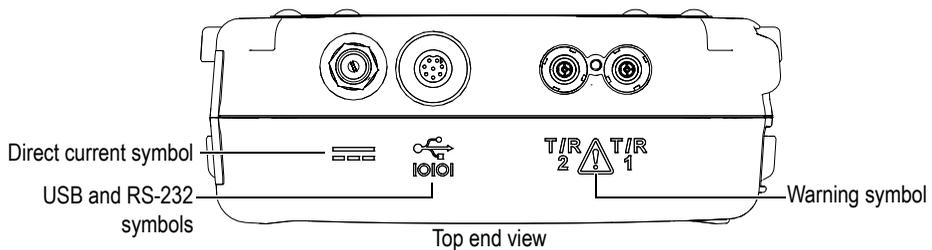


Figure i-1 The warning symbol between the T/R connectors

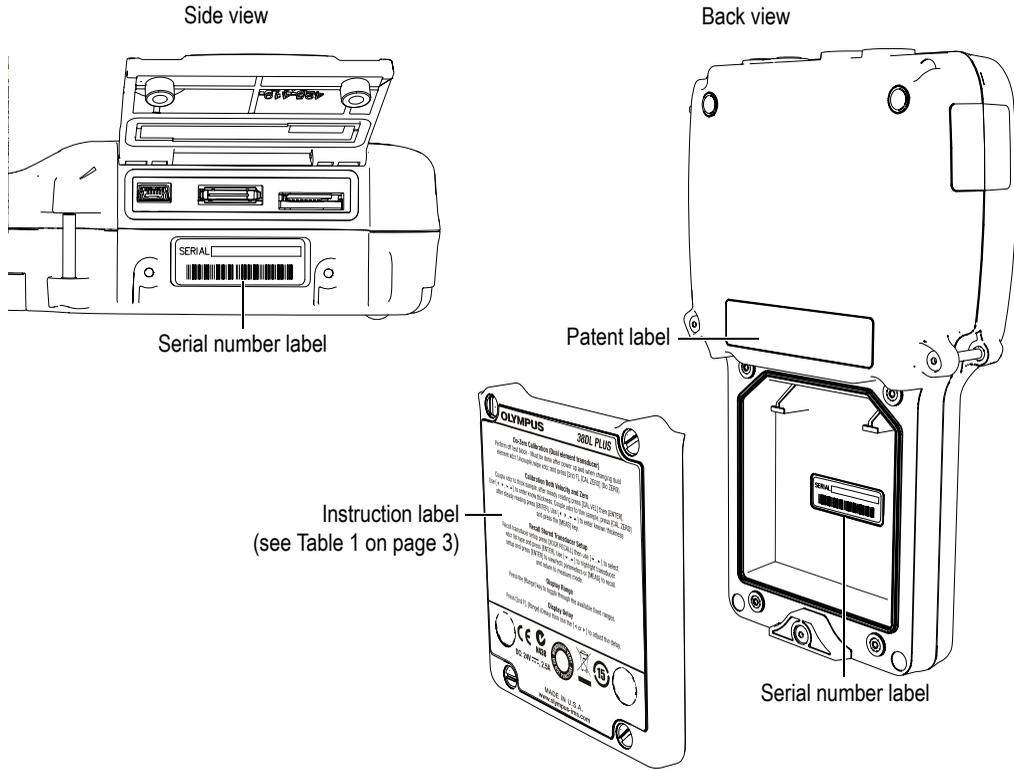


Figure i-2 Labels and symbols are attached to the instrument

Table 1 Label contents

Serial number label	<div data-bbox="642 204 1036 345" style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p>SERIAL yyynnnnmm</p>  </div> <p>Where:</p> <p>yy: last two digits of the production year</p> <p>nnnnn: 5-digit nonduplicated incrementing number representing the nth production unit of this product</p> <p>mm: production month</p>
Instruction label:	<div style="border: 1px solid black; padding: 10px; background-color: #f0f0f0;"> <div style="display: flex; justify-content: space-between; border-bottom: 2px solid black; padding-bottom: 5px;"> OLYMPUS 38DL PLUS </div> <p style="text-align: center;">Do-Zero Calibration (Dual element transducer) Perform off test block - Must be done after power up and when changing dual element xdcr. Uncouple, wipe xdcr, and press [2nd F], [CAL ZERO] (Do ZERO).</p> <p style="text-align: center;">Calibration Both Velocity and Zero Couple xdcr to thick sample, after steady reading press [CAL VEL] then [ENTER]. Use [◀ ▶, ▼ ▲] to enter known thickness. Couple xdcr to thin sample, press [CAL ZERO] after steady reading press [ENTER]. Use [◀ ▶, ▼ ▲] to enter known thickness and press the [MEAS] key.</p> <p style="text-align: center;">Recall Stored Transducer Setup Recall transducer setup press [XDCCR RECALL] then use [▼, ▲] to select xdcr list type and press [ENTER]. Use [▼, ▲] to highlight transducer setup and press [ENTER] to view/edit parameters or [MEAS] to recall and return to measure mode.</p> <p style="text-align: center;">Display Range Press the [Range] key to toggle through the available fixed ranges.</p> <p style="text-align: center;">Display Delay Press [2nd F], [Range] (Delay) then use the [◀ or ▶] to adjust the delay.</p> <div style="display: flex; justify-content: space-around; align-items: center; border-top: 2px solid black; padding-top: 10px;"> <div style="text-align: center;">  <p>DC: 24V , 2.5A</p> </div> <div style="text-align: center;">   <p>N438</p> </div> <div style="text-align: center;">  <p>MEMBRANE VENT DO NOT PUNCTURE</p> </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  <p>15</p> </div> </div> <p style="text-align: center; margin-top: 10px;">MADE IN U.S.A. www.olympus-ims.com</p> </div>

Table 1 Label contents (continued)

Symbol	Description
	The CE marking symbolizes conformity to all the essential requirements of the applicable European Union directives.
	The C-Tick label indicates that the product complies with the applicable standard and establishes a traceable link between the equipment and the manufacturer, importer or their agent responsible for compliance and for placing it on the Australian market.
	This symbol indicates the location of the membrane vent.
	The WEEE symbol indicates that the product must not be disposed of as unsorted municipal waste, but should be collected separately.
	The China RoHS mark indicates the product's Environmental Friendly Usage 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 Series has been determined to be 15 years. Note: The Environmental Friendly Usage Period (EFUP) is not meant to be interpreted as the period assuring functionality and product performance.
	The direct current symbol

Important Information — Please Read Before Use

Intended Use

The 38DL PLUS instrument has been designed to measure thicknesses of industrial and commercial materials.



DANGER

Do not use the 38DL PLUS instrument for any purpose other than its intended use.

Instruction Manual

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

The other 38DL PLUS documents are:

38DL PLUS Ultrasonic Thickness Gage — Getting Started (P/N: DMTA-10010-01EN [U8778357])

A short leaflet containing essential information on how to quickly start operating the 38DL PLUS instrument.

38DL PLUS Ultrasonic Thickness Gage — User's Manual (P/N: DMTA-10004-01EN)

A document in PDF format containing the detailed description of the instrument as well as the setup and operation procedures for all instrument features. The PDF file can be found on the GageView CD (P/N: Gageview [U8147006]).

GageView Interface Program — User's Manual (P/N: 910-259-EN [U8778347])

The 38DL PLUS also works with the GageView interface program. Refer to this document for detailed information on GageView. The document is available in PDF format on the GageView CD and as online help in GageView.

Repair and Modification

Apart from the battery, the 38DL PLUS instrument does not contain any user-serviceable parts.



CAUTION

To prevent human injury and/or equipment damage, do not disassemble, modify, or attempt to repair the instrument.

Safety Symbols

The following safety symbols may appear on the instrument 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.



High voltage warning symbol:

This symbol is used to alert the user to potential electric shock hazards higher than 1,000 volts. All safety messages that follow this symbol shall be obeyed to avoid possible harm.

Safety Signal Words

The following safety symbols may appear in the documentation of the instrument:



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, could 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, could 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.

Notes Signal Words

The following safety symbols may appear in the documentation of the instrument:



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 that 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 that provides hints on how to use effectively the capabilities of the product.

Warnings



General Warnings

- Carefully read the instructions contained in this instruction manual prior to turning on the instrument.
- 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 instrument 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 instrument.
- Service instructions, when applicable, are for trained service personnel. To avoid a dangerous electric shock, do not perform any service unless qualified to do so. For any problem or question regarding this apparatus, contact Olympus or an authorized Olympus representative.



WARNING



- When using the 38DL PLUS charger/adaptor, you must connect the protective earth terminal of the charger/adaptor to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided

with a protective earth contact. Never negate the protective action by using an extension cord (power cable) without a protective conductor (grounding.)

- Whenever it is likely that the ground protection is impaired, you must turn off the instrument and secure it against any unintended operation.
- The instrument must be connected only to a power source corresponding to the type indicated on the rating plate.

WEEE Directive



In accordance with European Directive 2002/96/EC 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 Olympus 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 Environmental Friendly Usage 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 Series has been determined to be 15 years.

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

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

This equipment 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 equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment 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.

ICES-003 (Canada) Compliance

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Warranty Information

Olympus guarantees your Olympus product to be free from defects in materials and workmanship for a period and conditions specified in the Olympus terms and conditions, available at <http://www.olympus-ims.com/en/terms/>.

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

Inspect materials thoroughly on reception for evidence of external or internal damage that might have occurred during shipment. Notify the carrier making the delivery immediately of any damage, since the carrier is normally liable for damage in

shipment. Preserve packing materials, waybills, and other shipping documentation in order to establish a damage claim. After notifying the carrier, contact Olympus for assistance with the damage claim and equipment replacement, if necessary.

This instruction manual attempts to teach the proper operation of your Olympus 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 more important as the criticality of the application increases. For this reason, Olympus 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.

Olympus reserves the right to modify all products without incurring the responsibility for modifying previously manufactured products.

Technical Support

Olympus is firmly committed to providing the highest level of customer service and product support. If you experience any difficulties when using this Olympus product, or if it fails to operate as described in the documentation, first consult this instruction manual, and then, if you are still in need of assistance, contact the Olympus after-sales service. To locate the nearest service center, visit the Service Centers page at: www.olympus-ims.com.

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) located on the GageView CD (P/N: Gageview [U8147006]) that is included with the 38DL PLUS kit.

1.1 Product Description

The 38DL PLUS by Olympus 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 14).



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 475,000 thickness measurements and 20,000 waveforms.

The 38DL PLUS operates with a full line of single element and dual element transducers to measure material thicknesses between 0.003 in. and 25 in. (0.08 mm and 635 mm). The temperature range of measured materials can be between -4°F and 932°F (-20°C and 500°C) 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 0.01 in. (0.1 mm), standard of 0.001 in. (0.01 mm), or high (optional) of 0.0001 in. (0.001 mm) [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 475,000 fully-documented thickness readings or 20,000 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

Olympus 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 Olympus 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 17).

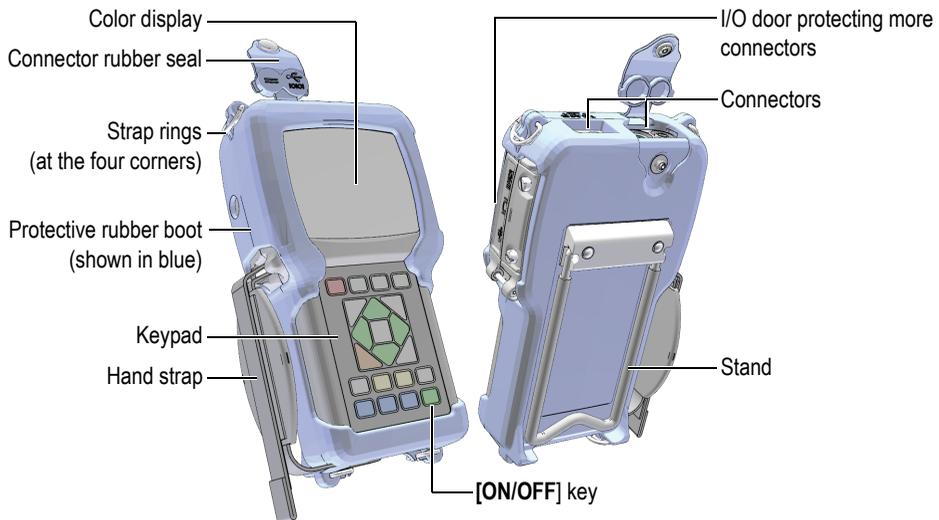


Figure 1-2 The 38DL PLUS hardware components

1.4 Connectors

Figure 1-3 on page 18 illustrates the possible connections of the 38DL PLUS with external devices.

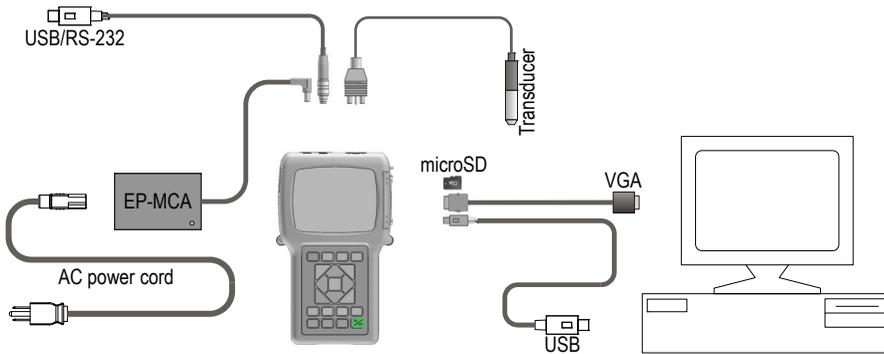


Figure 1-3 The 38DL PLUS connections



CAUTION

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 19).

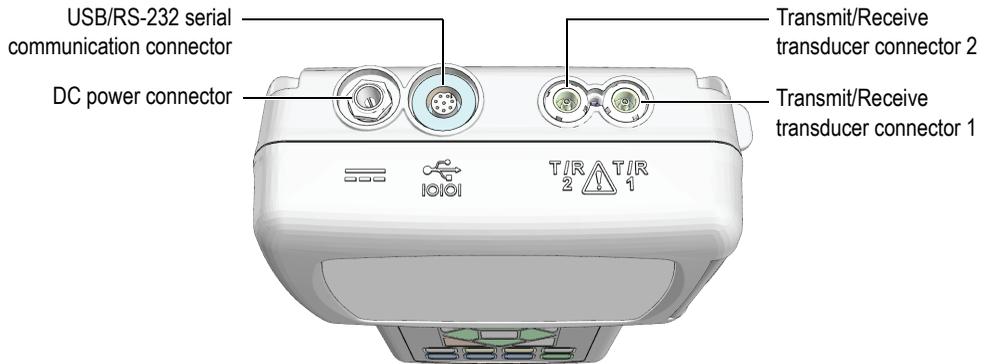


Figure 1-4 The top end connectors

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 19).

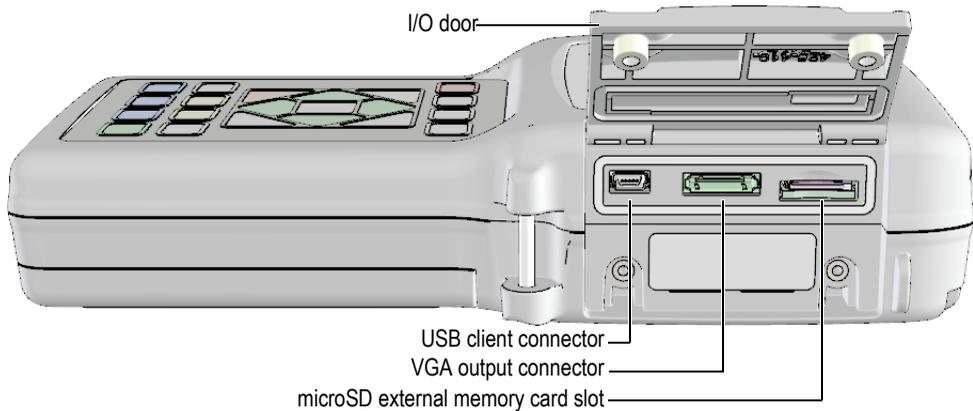


Figure 1-5 The connectors behind the I/O door

1.5 Keypad Functions

The 38DL PLUS comes either with the English or the international keypad (see Figure 1-6 on page 20). The functions are the same for both 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]**).

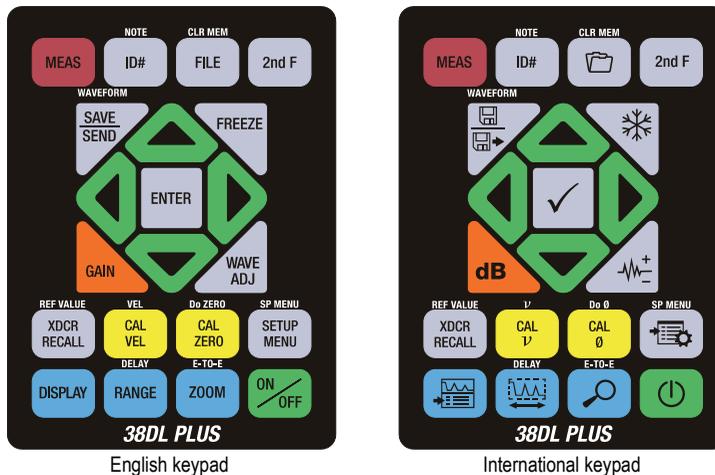


Figure 1-6 The 38DL PLUS keypads

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 2 on page 21 lists the key functions available from the 38DL PLUS keypad.

Table 2 Keypad functions

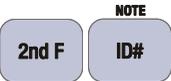
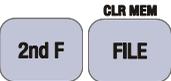
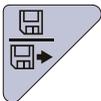
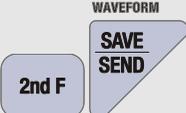
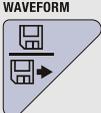
English	International	Functions
		Measurement — Completes the current operation and returns to the measurement screen.
		Identification number — Accesses several functions related to the ID numbers for the thickness measurement location.
		Note — Allows you to create or select comments to store at an 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.
		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.

Table 2 Keypad functions (continued)

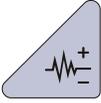
English	International	Functions
		Wave adjustment — Toggles the display of a selectable waveform parameter with an editable value.
		Enter — Selects an highlighted item or accepts an entered value.
		Up arrow <ul style="list-style-type: none"> • In a screen or a list, moves to the previous element. • 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.
		Right arrow <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.
		Transducer recall — Recalls default or custom transducer (XDCR) setups.
		Reference value — For some functions (ex.: differential mode or temperature compensation) opens a screen allowing you to enter a reference value.

Table 2 Keypad functions (continued)

English	International	Functions
		Velocity calibration <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.
 		Velocity <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.
		Zero calibration <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.
 		Do zero — Compensates for transducer delay for dual element transducers and for the M2008 transducer.
		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).
 		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).

Table 2 Keypad functions (continued)

English	International	Functions
		Range — Changes the waveform display range to the next available value.
 		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.
 		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 About the 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 25).

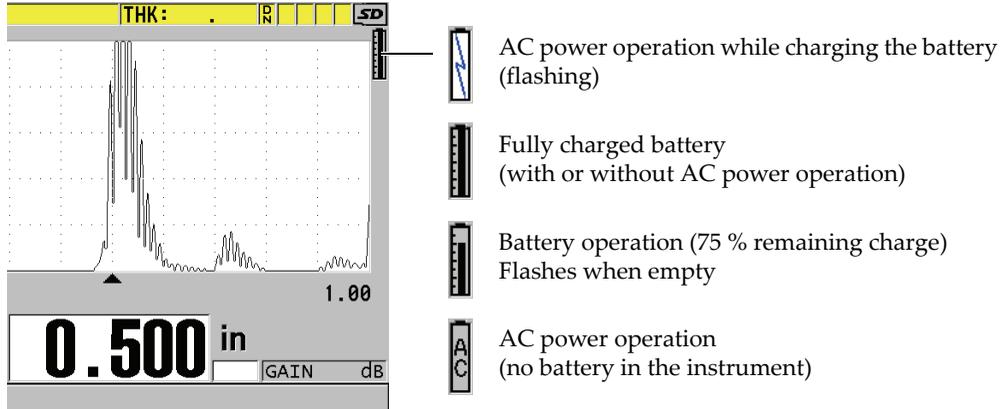


Figure 2-1 The power indicator for battery and AC operation

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 26).



CAUTION

Use only the AC power cord supplied with the 38DL PLUS. Do not use this AC power cord with other products.

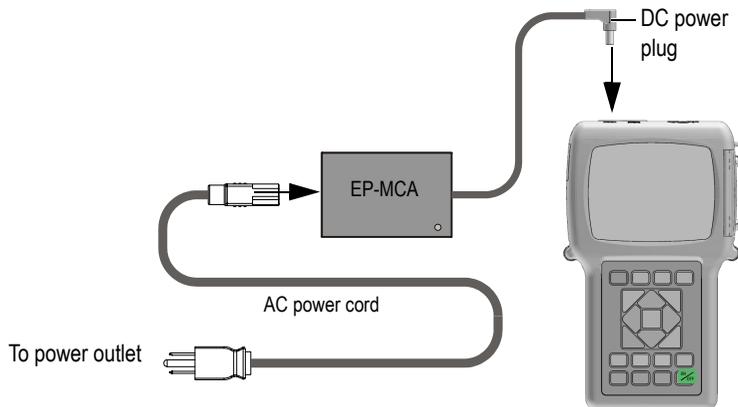


Figure 2-2 Connecting the charger/adaptor

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 27).

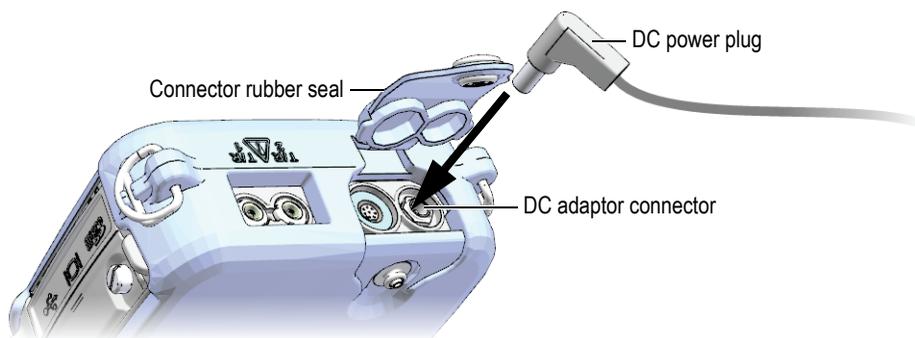


Figure 2-3 Connecting the DC power plug

3. Connect the DC power plug from the charger/adaptor to the DC adaptor connector (see Figure 2-3 on page 27).
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 or use any other chargers/adaptors. 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 section 2.2 on page 26). 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 (lightning bolt) is replaced with a “full battery” symbol (battery with all bars full). This is the indication that the battery is fully charged (see section 2.1 on page 25). 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 30).

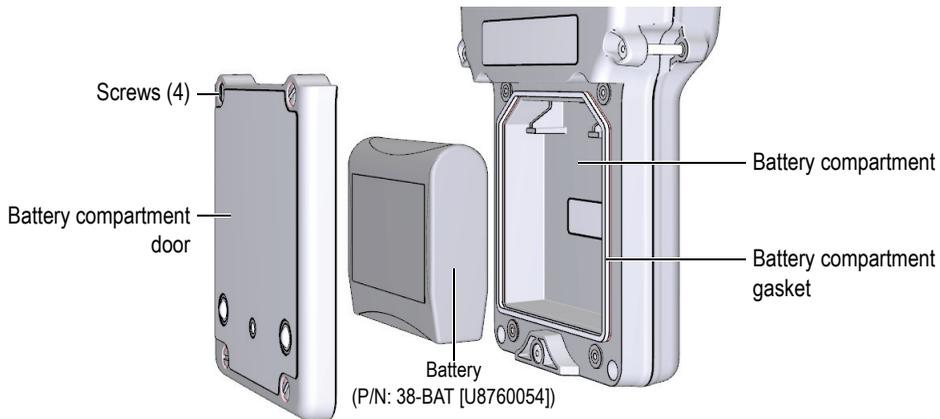


Figure 2-4 Opening the battery compartment



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 Olympus 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 30).
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 31):
 - ◆ 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 section 2.1 on page 25).

3. Software User Interface Elements

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

3.1 About the 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 33). 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 section 2.3 on page 27 for details).

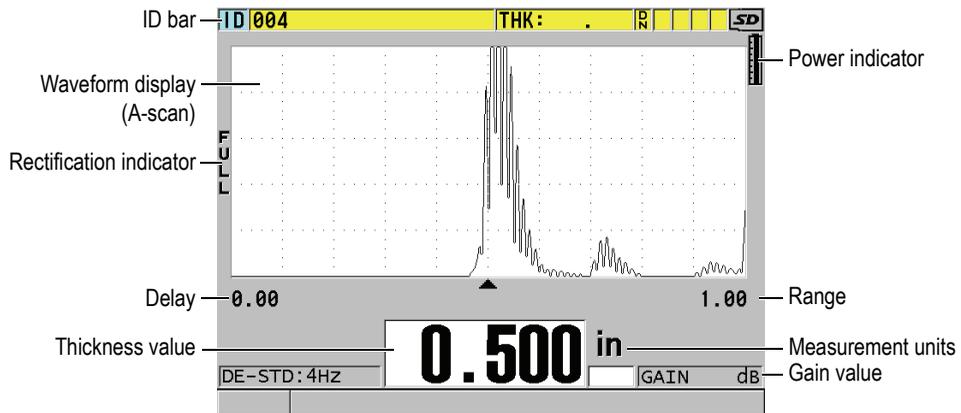


Figure 3-1 The main elements of the measurement screen

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 34). The download indicator (R) appears when the previously stored thickness measurement comes from a file rather than from a newly acquired value.

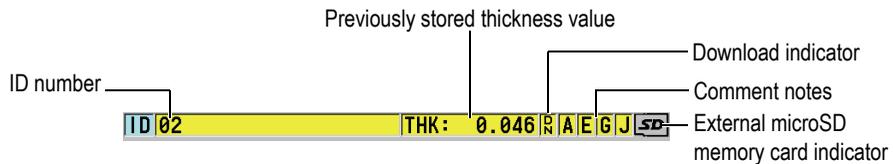


Figure 3-2 The ID bar

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 19). 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 35). 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.

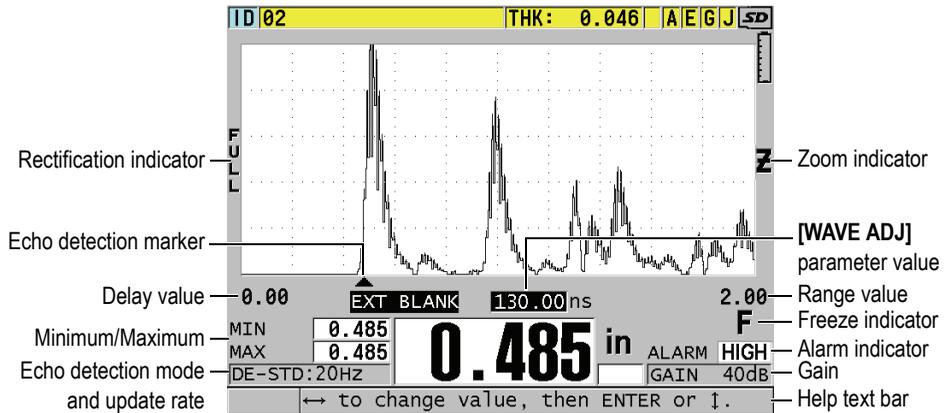


Figure 3-3 Example of other elements appearing on the measurement screen

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 35).

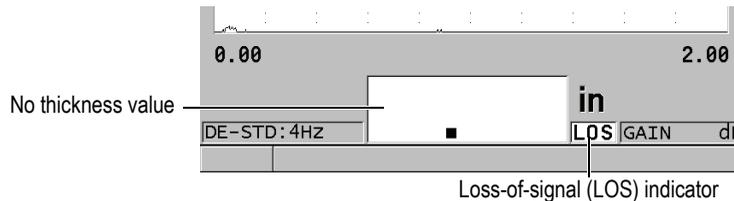


Figure 3-4 The loss-of-signal (LOS) indicator

3.2 About 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 36). If applicable, a submenu also appears, conveniently showing the parameters available for the highlighted menu command.

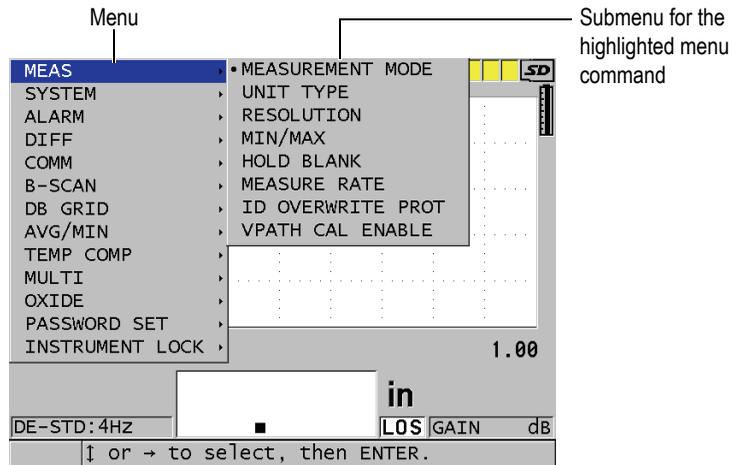


Figure 3-5 Menu and submenu example

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 About 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 37 shows the MEAS parameter screen as an example.

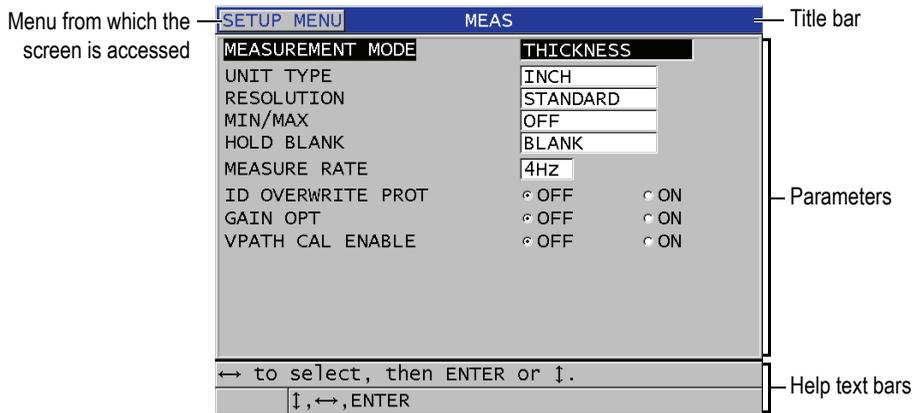


Figure 3-6 Parameter screen example

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 section 3.4 on page 38 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 section 3.4.1 on page 38 for details). With the traditional method, you select each character from a hidden list of standard sorted letters, numbers, and special characters (see section 3.4.2 on page 40 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 39).

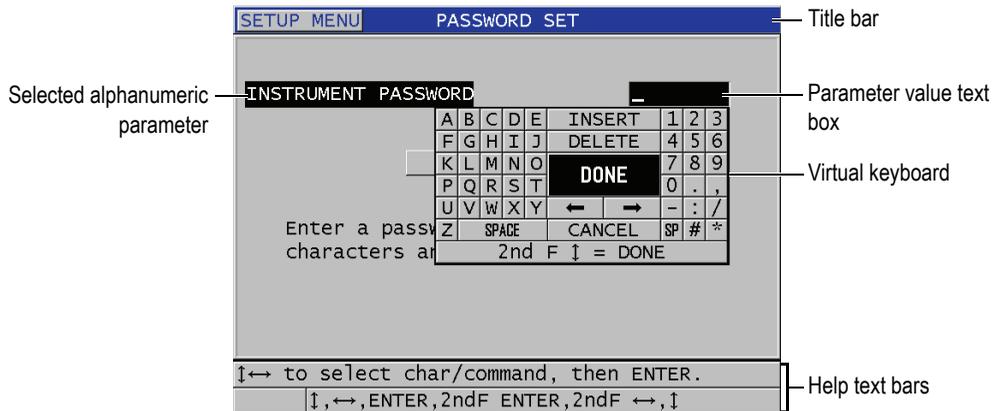


Figure 3-7 Example of the virtual keyboard

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 40). Only upper case letters are available.

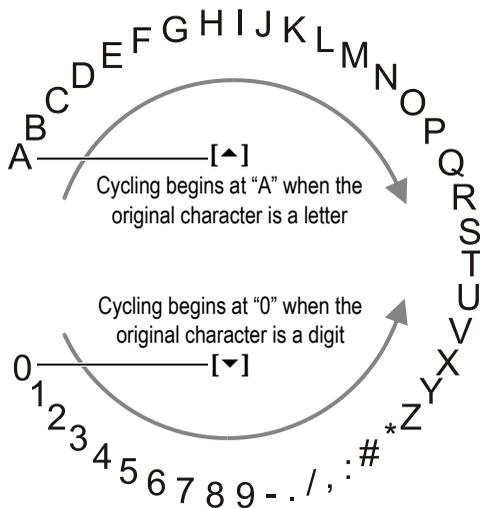


Figure 3-8 The character cycle of the traditional text edit method

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 44):
 - 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.

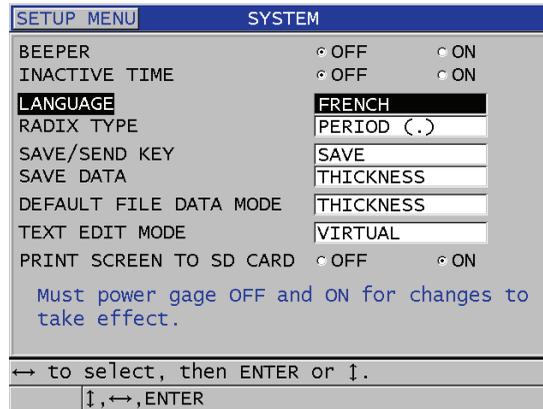


Figure 4-1 Selecting the user interface language

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 45):
 - a) Set parameters to the current date and time and to the desired date and hour modes.
 - b) Select **SET**.

The screenshot shows the 'SP MENU' and 'CLOCK' screens. The 'CLOCK' screen displays the following settings:

MONTH	2
DAY	24
YEAR	2010
DATE MODE	MM/DD/YYYY
HOUR	2 PM
MINUTE	35
HOUR MODE	12 HOUR

At the bottom of the screen, there are two buttons: 'SET' and 'CANCEL'. Below the main screen, there is a navigation bar with the text: '↔ 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 46), select the desired parameter and value for the following parameters:
 - **COLOR SCHEME** to either select the **INDOOR** or **OUTDOOR** optimized visibility (see section 4.4.1 on page 46 for details).

- **DISPLAY BRIGHTNESS** to select one of the predefined brightness levels (see section 4.4.2 on page 47 for details).
- **WAVEFORM RECTIFICATION** to select one of the rectification modes (see section 4.4.3 on page 48 for details).
- **WAVEFORM TRACE** to select one of the trace types (see section 4.4.4 on page 49 for details).
- **VGA OUTPUT** to turn **ON** or **OFF**, the VGA signal for the VGA output (see section 5.7 on page 80 for details).

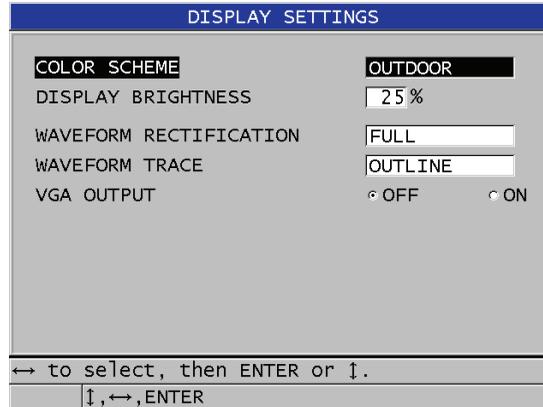


Figure 4-3 The DISPLAY SETTINGS screen

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

4.4.1 About the 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 47). From the measurement screen, press **[DISPLAY]** to access the **COLOR SCHEME** parameter.

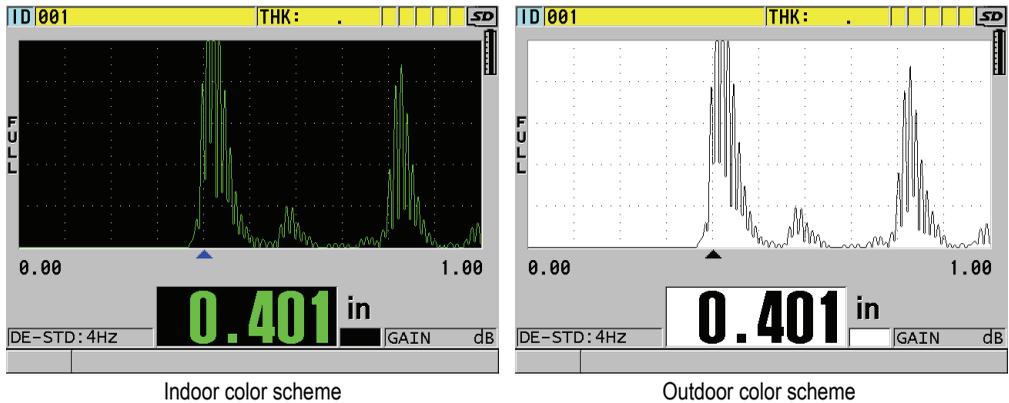


Figure 4-4 Example of the indoor and the outdoor color schemes

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 About 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 About 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 48). 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.

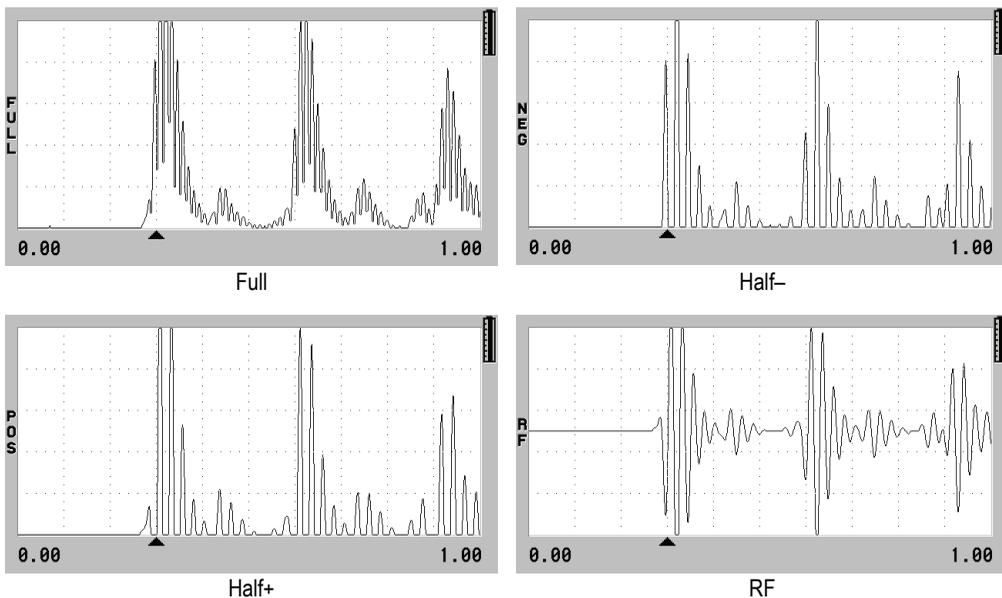


Figure 4-5 Examples of the rectification modes

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 About the 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 50). 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-**.

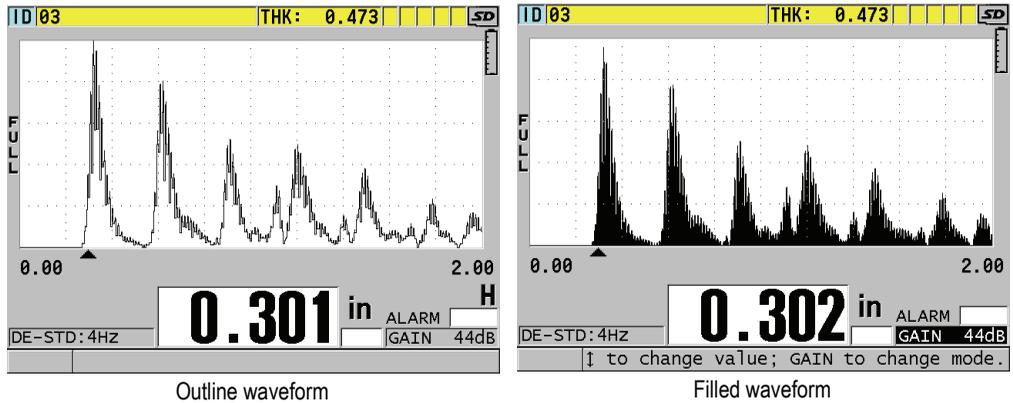


Figure 4-6 Examples of waveform trace modes

4.5 About the 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 section 4.5.2 on page 51) and select the end point of the range (see section 4.5.1 on page 51). You can also activate the zoom function to automatically set the delay and the range values to best see the echo (see section 4.5.3 on page 52).

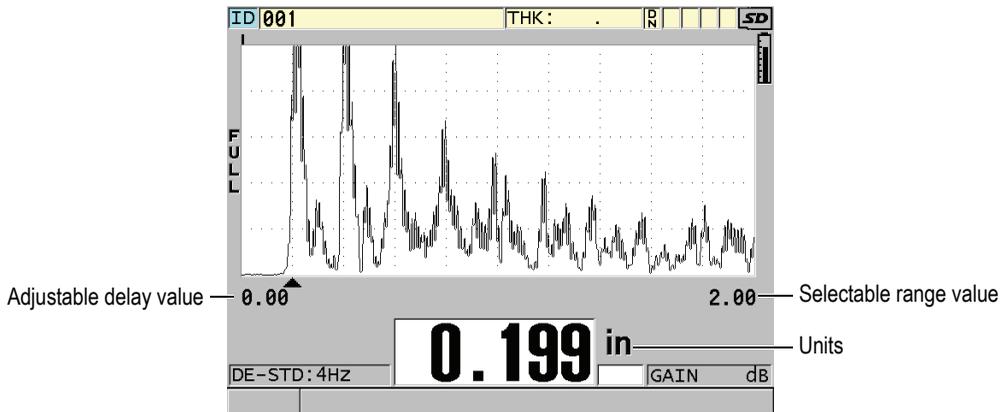


Figure 4-7 The range of the waveform display

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 52).

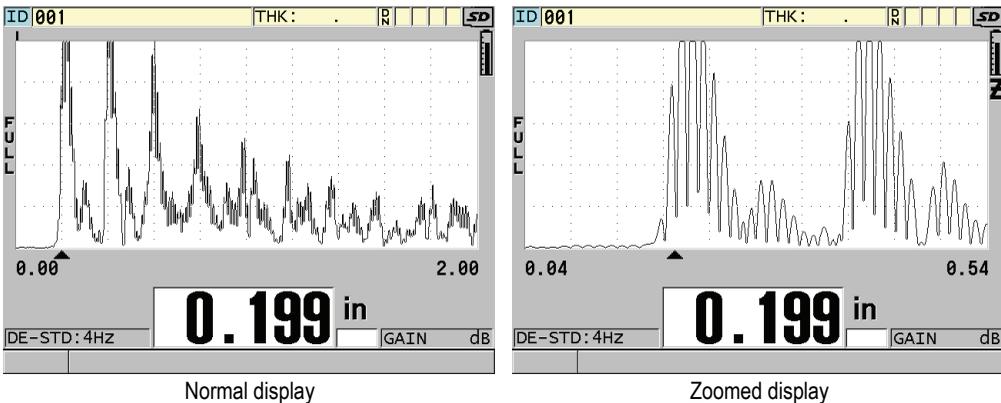


Figure 4-8 Comparing normal and zoomed display in mode 1

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 53).



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 53).

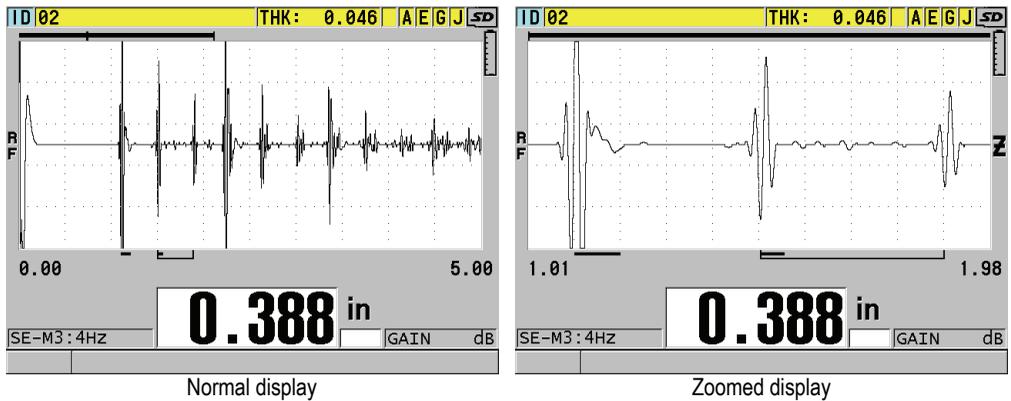


Figure 4-10 Comparing normal and zoomed display in mode 3

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 54).



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 0.001 in. (0.01 mm). 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 0.0001 in. or 0.001 mm. The high resolution is available for measured thickness smaller than 4 in. (102 mm). 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**: 0.001 in. or 0.01 mm (default)
 - **LOW**: 0.01 in. or 0.1 mm
 - Optional **HIGH**: 0.0001 in. or 0.001 mm
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 58). Use T/R 1 for a single element transducer.

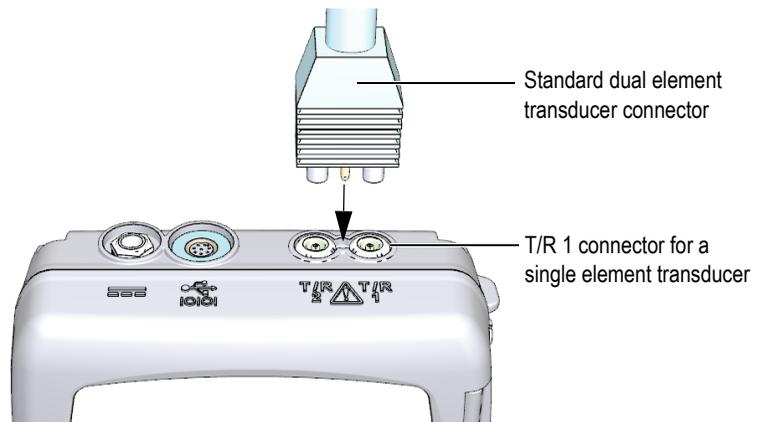


Figure 5-1 Plugging the transducer

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 58).

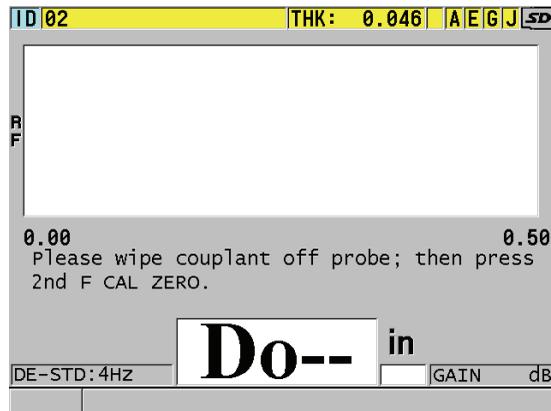
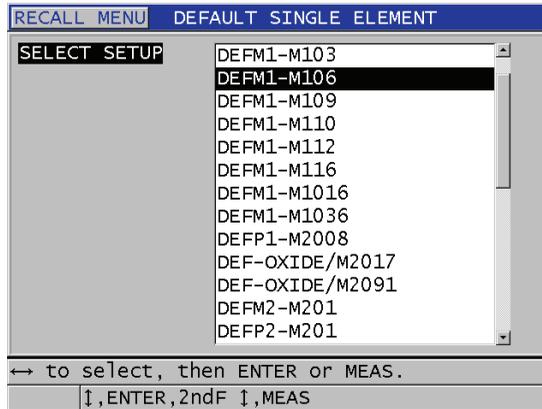


Figure 5-2 Initial screen with a standard D79X dual element transducer

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 59), in the list of available default setups, highlight the setup for the transducer that you are using.



Default setup naming convention:

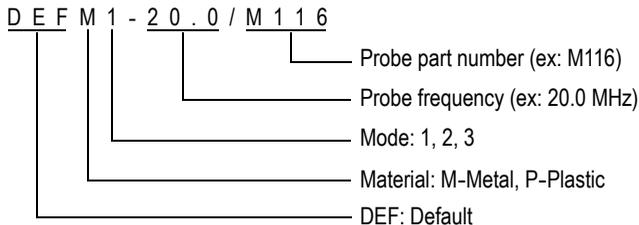


Figure 5-3 Selecting a default single element transducer setup

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 About the 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 section 5.1 on page 57 and section 5.2.3 on page 64).

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 section 5.2.1 on page 61 and section 5.2.4 on page 65).

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 ± 0.004 in. or ± 0.10 mm). 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 section 5.2.1 on page 61 and section 5.2.4 on page 65).

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 section 5.2.2 on page 64 for details on test blocks).

The following procedure is illustrated using a dual element probe and a 5-step test block. Refer to section 5.2 on page 60 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 62):
 - 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.

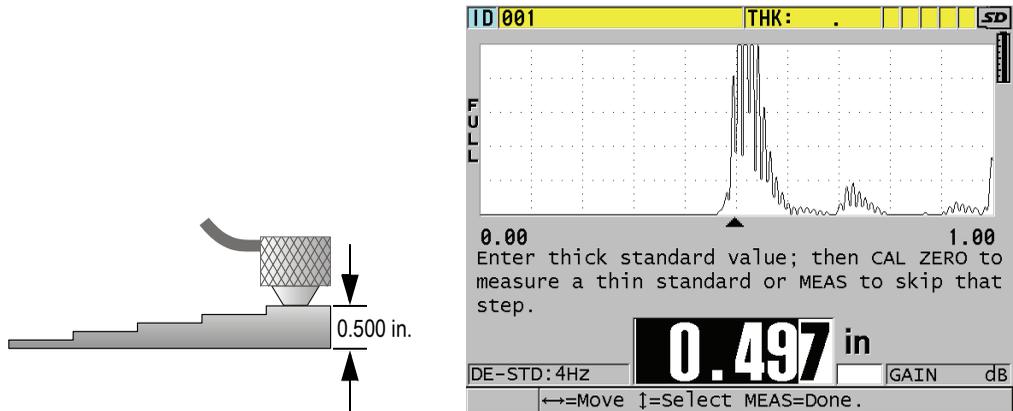


Figure 5-4 Performing the material sound velocity calibration on a 5-step test block

2. To perform the zero calibration (see Figure 5-5 on page 63):
 - 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.

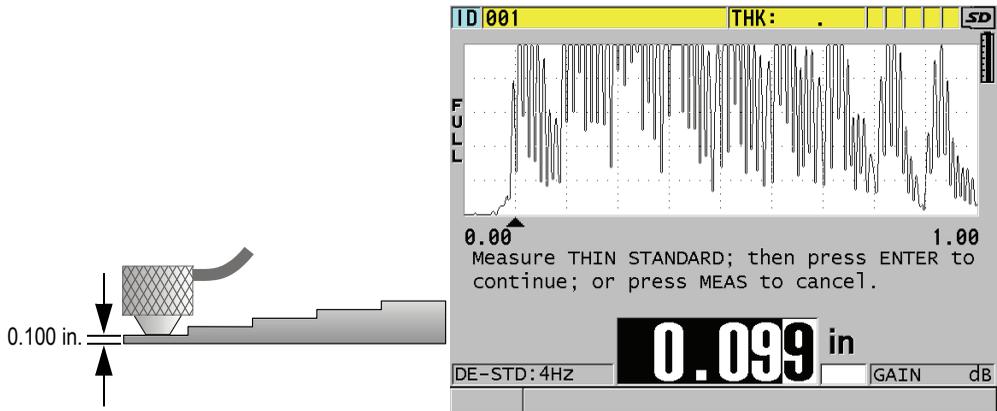


Figure 5-5 Performing the zero calibration on a 5-step test block

- 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 About 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 64).



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 About the 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, Olympus 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 About the 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 66), use the arrow keys to edit the velocity to the known value.

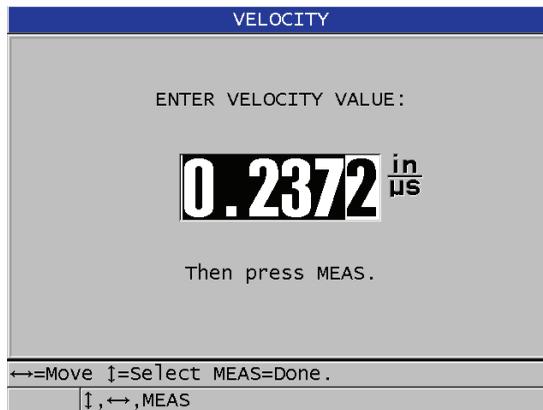


Figure 5-7 Entering a known material sound velocity

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

5.2.6 About 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 67 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 \times 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 in homogeneous 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 section 5.1 on page 57) and once the instrument is calibrated (see section 5.2.1 on page 61).

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 70).

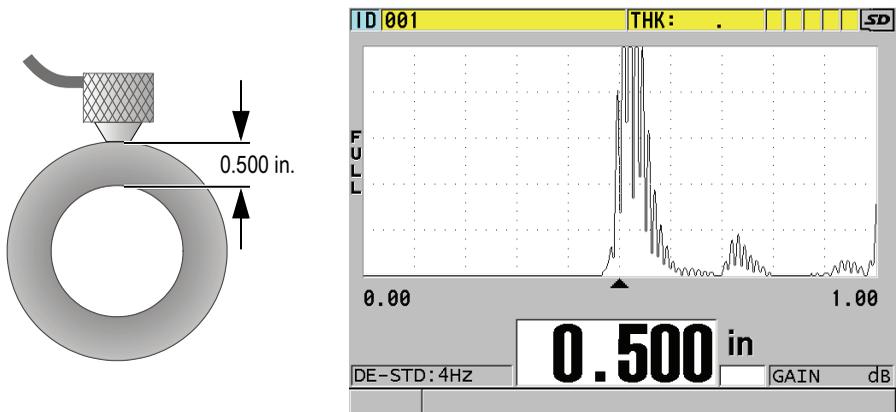


Figure 5-9 Coupling dual element transducer and reading the measured thickness

- 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 71).

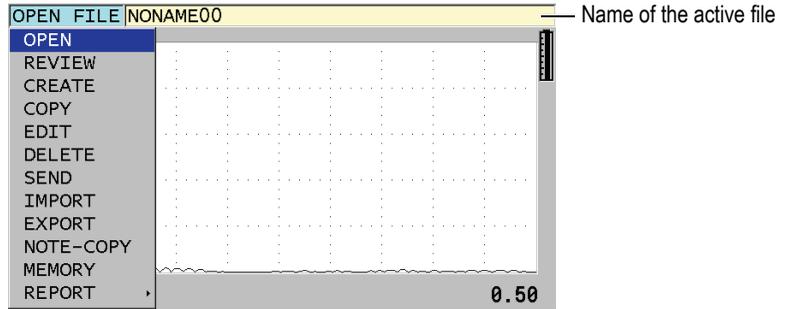


Figure 5-10 The active file name appearing in the ID bar

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 section 5.5.1 on page 72).
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 About 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 74).

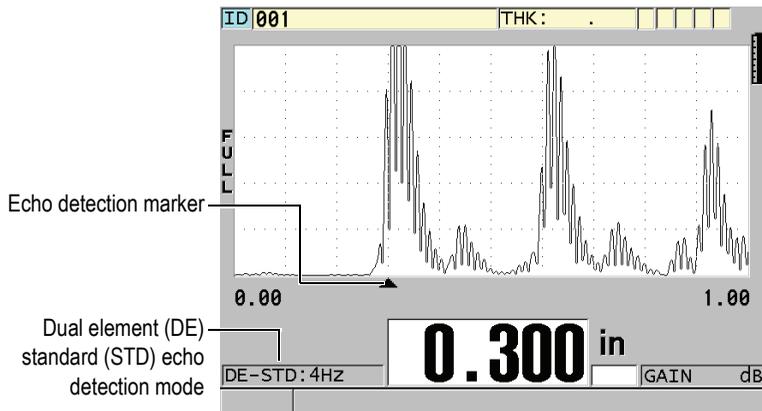


Figure 5-12 Measuring with the standard echo detection mode

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 75). The echo height is automatically adjusted to a preset level.

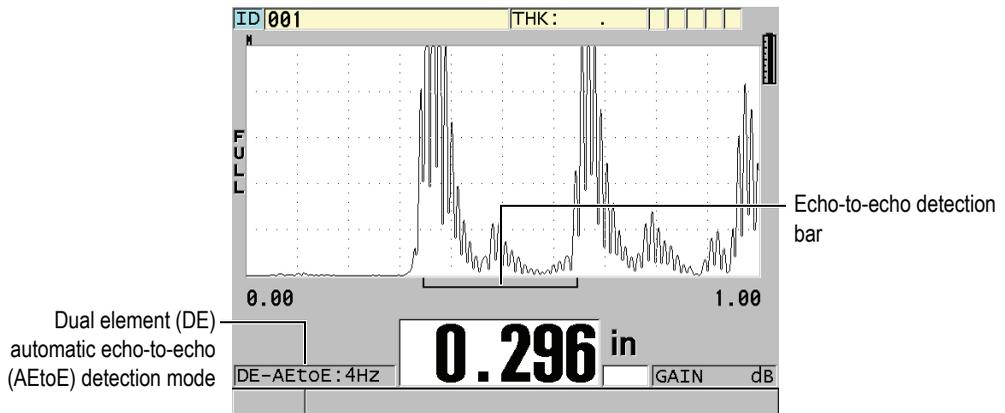


Figure 5-13 Measuring with the automatic echo-to-echo detection mode

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 76). 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.

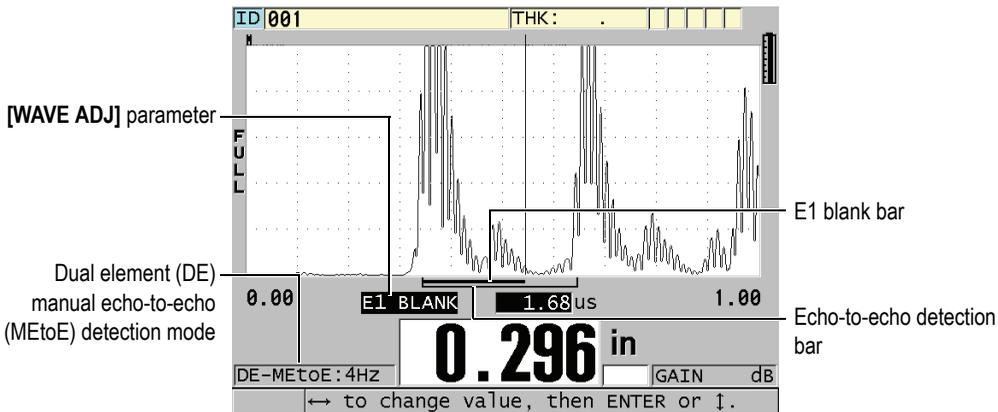


Figure 5-14 Measuring with the manual echo-to-echo detection mode

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 78).

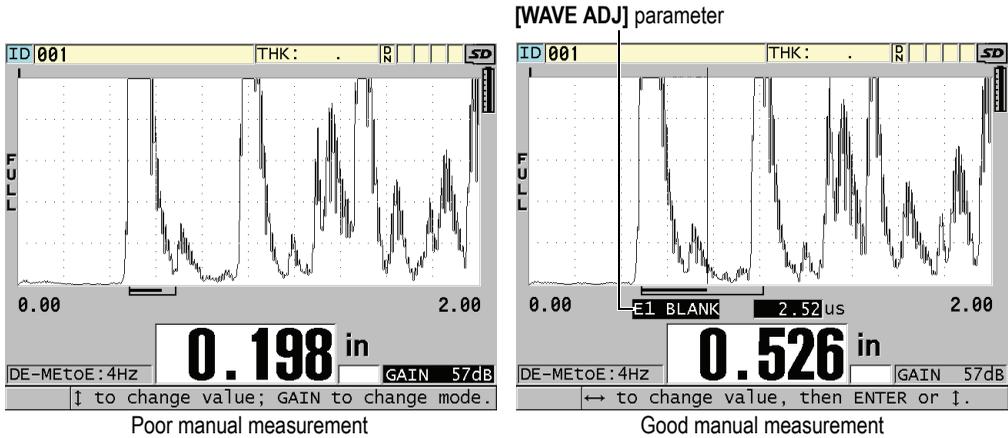


Figure 5-15 Comparing manual measurements

3. Use the [**▲**] and [**▼**] keys to select either the EXT BLANK or the E1 BLANK parameter.
4. Use the [**▶**] and [**◀**] 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, Olympus recommends using particular transducers for specific thickness ranges in steel parts (see Table 3 on page 79).

Table 3 Recommended transducers for various steel thickness ranges

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

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 0.7 in. (18 mm). 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 section 5.6.1 on page 77). Using the D797 transducer beyond 0.7 in. (18 mm) 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 0.2 in. (5 mm) 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
- **l**: 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 19).
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 46), 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 4 General EN15317 Specifications

Parameter	Value
Size	Height x Width x Depth Without protective boot: <ul style="list-style-type: none"> • 8.33 in. x 5.04 in. x 1.82 in. • 211.6 mm x 128.1 mm x 46.2 mm With the rubber protective boot: <ul style="list-style-type: none"> • 9.30 in. x 5.14 in. x 2.62 in. • 236.2 mm x 130.6 mm x 66.5 mm
Weight	1.80 lb (816.5 g)
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: 14 °F to 122 °F (–10 °C to 50 °C)
Battery storage temperature	–4 °F to 104 °F (–20 °C to 40 °C)
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

Table 4 General EN15317 Specifications (continued)

Parameter	Value
Thru coating	Echo-to-echo measurement and THRU-COAT
Minimum and maximum thickness	Single element: 0.004 in. to 25 in. (0.1 mm to 635.0 mm) Dual element: 0.020 in. to 25 in. (0.5 mm to 635.0 mm)

Table 5 Display EN15317 Specifications

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

Table 6 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 7 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 8 Other EN15317 Specifications

Parameter	Value
Data storage	Internal and external 2 GB microSD memory cards. Each card: 475,000 thickness readings or 20,000 waveforms with thickness readings
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 x 480 pixels
Printer output	RS-232 serial

Table 9 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 10 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	Selectable from the keypad: LOW: 0.01 in. (0.1 mm) STD: 0.001 in. (0.01 mm) HI: 0.0001 in. (0.001 mm) with high resolution option. Not all resolutions are available for all measurement modes
Material sound velocity range	0.0300 in./ μ s to 0.5511 in./ μ s (0.762 mm/ μ s to 13.999 mm/ μ s)
Material sound velocity resolution	0.0001 in./ μ s (0.001 mm/ μ s)
Alarm set points range	0.00 in. to 25.00 in. (0.00 mm to 635.00 mm)

Table 11 Datalogger Specifications

Parameter	Value
Storage capacity	475,000 thickness readings or 20,000 waveforms with thickness readings
ID number length	1 to 20 characters
File name length	1 to 32 characters

Table 11 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 12 Typical measurement ranges and default setups for single element transducer^a

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

Table 12 Typical measurement ranges and default setups for single element transducer^a (continued)

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

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

Table 13 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 13 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	0.0200 in./ μ s to 0.7362 in./ μ s (0.508 mm/ μ s to 18.699 mm/ μ s)
ZERO	Zero calibration factor	0.00 to 999.99

Table 14 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 gage for that transducer. Non-Olympus 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, 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

List of Figures

Figure 1-1	Measuring thicknesses with the 38DL PLUS	14
Figure 1-2	The 38DL PLUS hardware components	17
Figure 1-3	The 38DL PLUS connections	18
Figure 1-4	The top end connectors	19
Figure 1-5	The connectors behind the I/O door	19
Figure 1-6	The 38DL PLUS keypads	20
Figure 2-1	The power indicator for battery and AC operation	25
Figure 2-2	Connecting the charger/adaptor	26
Figure 2-3	Connecting the DC power plug	27
Figure 2-4	Opening the battery compartment	30
Figure 2-5	Selecting the new battery type	31
Figure 3-1	The main elements of the measurement screen	33
Figure 3-2	The ID bar	34
Figure 3-3	Example of other elements appearing on the measurement screen	35
Figure 3-4	The loss-of-signal (LOS) indicator	35
Figure 3-5	Menu and submenu example	36
Figure 3-6	Parameter screen example	37
Figure 3-7	Example of the virtual keyboard	39
Figure 3-8	The character cycle of the traditional text edit method	40
Figure 4-1	Selecting the user interface language	44
Figure 4-2	Selecting clock parameters	45
Figure 4-3	The DISPLAY SETTINGS screen	46
Figure 4-4	Example of the indoor and the outdoor color schemes	47
Figure 4-5	Examples of the rectification modes	48
Figure 4-6	Examples of waveform trace modes	50
Figure 4-7	The range of the waveform display	50
Figure 4-8	Comparing normal and zoomed display in mode 1	52
Figure 4-9	Comparing normal and zoomed display in mode 2	53
Figure 4-10	Comparing normal and zoomed display in mode 3	53
Figure 4-11	The measurement update rate indicator	54

Figure 5-1	Plugging the transducer	58
Figure 5-2	Initial screen with a standard D79X dual element transducer	58
Figure 5-3	Selecting a default single element transducer setup	59
Figure 5-4	Performing the material sound velocity calibration on a 5-step test block	62
Figure 5-5	Performing the zero calibration on a 5-step test block	63
Figure 5-6	Example of a 5-step test block	64
Figure 5-7	Entering a known material sound velocity	66
Figure 5-8	The calibration lock message	67
Figure 5-9	Coupling dual element transducer and reading the measured thickness	70
Figure 5-10	The active file name appearing in the ID bar	71
Figure 5-11	Opening the THRU COAT SETUP dialog box	72
Figure 5-12	Measuring with the standard echo detection mode	74
Figure 5-13	Measuring with the automatic echo-to-echo detection mode	75
Figure 5-14	Measuring with the manual echo-to-echo detection mode	76
Figure 5-15	Comparing manual measurements	78

List of Tables

Table 1	Label contents	3
Table 2	Keypad functions	21
Table 3	Recommended transducers for various steel thickness ranges	79
Table 4	General EN15317 Specifications	83
Table 5	Display EN15317 Specifications	84
Table 6	Transmitter EN15317 Specifications	84
Table 7	Receiver EN15317 Specifications	84
Table 8	Other EN15317 Specifications	85
Table 9	Environmental rating specifications	85
Table 10	Measurement specifications	86
Table 11	Datalogger Specifications	86
Table 12	Typical measurement ranges and default setups for single element transducer	87
Table 13	Setup parameter description	88
Table 14	General specifications	89

Index

A

AA battery holder 27
AC power 26
 cord 18
 using 26
acoustic properties of test material 68
activating
 zoom 52
active file name 71
adjusting
 delay value 51
 extended and E1 blanks 77
 update rate 54
alarm indicator 35
Alkaline batteries
 operating time 28
 using 27
arrow keys 20
A-scan 34
Australia EMC compliance 4
AUTO E-TO-E 75

B

basic operation 57
battery
 charge 25
 charging 28
 compartment door 30
 full capacity 29
 operating time 28
 power 27
 rechargeable 27
 replacement 30

 storage instructions 29
 usage instructions 29

beeper 43
blank
 adjusting 77
 thickness value 71
brightness, display 46

C

calibration 60, 67
 instrument 61
 locked 67
 material sound velocity 65
 test block 64
 THRU-COAT 73
 transducer zero compensation 64
Canada, ICES-003 compliance 10
caution notes
 AC power cord 18, 26
 battery replacement 30
 definition 7
 ingress protection guarantee 17
 instrument disassembly, modification, or
 repair 6
CE mark 4
changing
 display settings 45
 echo detection mode 76
 language 43
 thickness measurement resolution 55
character
 cycle in traditional method 40
 deleting 41

- inserting 41
- charging batteries 28
- China RoHS 4, 9
- clock
 - setting 45
- coated material 72
- color scheme 46
 - changing 45
- comment notes 34, 80
- compliance
 - CE (Europe) 4
 - C-Tick (Australia) 4
 - EMC directive 10
 - FCC (USA) 10
 - ICES-003 (Canada) 10
- configuring
 - beeper 43
 - inactive time 43
 - radix type 43
- connections 18
- copyright ii
- corrosion applications 72
- couplant types 70
- coupling technique 67
- C-Tick mark 4
- curvature of test piece 68

D

- danger notes
 - definition 7
 - electric shock 1
 - instrument intended use 5
- data
 - saving 71
- datalogger
 - echo-to-echo flags 80
 - file based system 70
 - functions 16
- date, setting 45
- DC power connector 19
- DE-AEtoE indicator 75
- default file 71
- delay 50
 - adjusting value 51
- deleting

- a character 41
- DE-MEtoE indicator 75
- DE-STD indicator 74
- direct current symbol 4
- display
 - brightness 46, 47
 - changing settings 45
 - options 15
- document
 - copyright ii
 - part number ii
 - publishing date ii
 - revision ii
- documentation CD 13
- doubling 79
- download indicator 34
- dual element transducer
 - connector 18
 - selection for echo-to-echo modes 78
 - zero compensation 60, 64

E

- E1 blank
 - adjusting 77
 - description 77
- eccentricity or taper 68
- echo detection mode 74
 - changing 76
- echo-to-echo mode
 - blanking adjustments 77
 - flags 80
- editing
 - value with traditional method 41
 - value with virtual keyboard 39
- electric shock, danger note 1
- EMC directive compliance 10
- EN15317 specifications 83
- enabling THRU-COAT 72
- English keypad 20
- entering known material sound velocity 66
- environmental rating 16
- error messages
 - calibration 63
- extended blank
 - adjusting 77

F

fast mode 54
 FCC (USA) compliance 10
 file name 71
 filled waveform 50
 flags, echo-to-echo 80
 freeze indicator 35
 full rectification 48

G

GageView
 manual 6
 getting started manual 5

H

half- rectification 48
 half+ rectification 48
 hand strap 17
 help text bar 35
 high resolution software option 55
 high temperature measurements 65

I

I/O door 19
 ICES-003 (Canada) compliance 10
 ID bar 33, 34
 ID number 34
 important notes
 definition 7
 turning off before procedure completion 63
 user's manual 13
 inactive time 43
 indicators
 alarm 35
 DE-AEtoE 75
 DE-MEtoE 75
 DE-STD 74
 download 34
 freeze 35
 LOS 35
 microSD card 34
 power 25, 33
 rectification 33
 zoom 35
 indoor color scheme 47
 initial screen 58

inserting a character 41
 instruction label
 content 3
 location 2
 instruction manual 5
 instrument
 calibrating 61
 intended use 5
 international keypad 20
 IP67 ingress protection 16

K

keypad 20
 functions 20, 21
 secondary function 20
 known material sound velocity 66

L

labels
 instructions 2, 3
 safety 1
 language, changing 43
 last ID 71
 loading, setup 59
 locked calibration 67
 loss-of-signal indicator 35

M

MANUAL E-TO-E 75
 material
 coated or painted 72
 entering sound velocity 66
 sound velocity calibration 60, 62, 65
 measurement
 features 14
 update rate 54
 measurement screen 33
 measuring thickness 69
 membrane vent 4
 memory card
 indicators 34
 microSD 18
 slot 19
 menus 35
 selecting a ~ command 36
 mode 1 52

mode 2 53

mode 3 53

N

NiMH rechargeable batteries 27

operating time 28

NONAME00 default file 71

notes

alarm colors only with indoor color scheme
47

battery charge cycles 29

battery not initially fully charged 27

calibration error 63

couplant types 70

definition 8

display brightness and battery life 48

entering known material sound velocity 74

filled waveform trace condition 49

fully charge battery after replacement 31

fully charged battery 29

high temperature measurement 65

menu selection writing convention 36

move to the next line in text edit 40

parameter selection writing convention 38

user defined setups 60

O

Olympus

office address ii

technical support 11

outdoor color scheme 47

outline waveform 50

P

painted material 72

parameter

screens 36

selecting 37

patent label 2

performing

THRU-COAT calibration 73

phase

distortion 69

reversal 69

power

AC 26

battery 27

indicator 25, 33

product description 13

protective rubber boot 17

R

radix type 43

range 50

selecting value 51

rectification

changing setting 46

indicator 33

mode 48

repair and modification 6

replacing the battery 30

resolution, changing 55

RF rectification 48

RoHS symbol 4, 9

S

safety

labels and symbols 1

signal words 7

symbols 6

saving

data 71

secondary key function 20

selecting

menu command 36

parameter and value 37

range value 51

text edit mode 38

serial communication connector 19

serial number

label content 3

label location 2

setting

clock 45

transducer 57

units 44

setups

loading 59

shear-wave, unwanted 79

software options

high resolution 55

sound

- attenuation or absorption 68
- scattering 68
- velocity calibration 60, 65
- stand 17
- standard echo detection mode 74
- step test block 64
- strap rings 17
- submenus 35
- support information 11
- surface roughness of test piece 67
- symbols
 - CE (Europe) 4
 - C-Tick (Australia) 4
 - direct current 4
 - RoHS 4, 9
 - safety 1
 - WEEE 4
- T**
- T/R transducer connector 19
- taper or eccentricity 68
- technical specifications 83
- technical support 11
- test block 64
- test piece, curvature of 68
- text edit
 - mode selection 38
 - traditional method 40
 - virtual keyboard 38
- thickness
 - measuring 69
 - resolution 54
- THRU-COAT
 - enabling 72
 - measurement 72
 - performing calibration 73
- time, setting 45
- tip notes
 - definition 8
 - save both thickness value and waveform 72
 - switching between echo detection modes 76
- title bar 37
- trademark disclaimer ii
- traditional text edit method 40, 41
- transducer
 - setting 57

- U**
- units, setting 44
- unwanted shear-wave echo 79
- update rate 54
 - adjusting 54
- USA FCC compliance 10
- USB
 - client connector 19
 - connector 18
- USB/RS-232 connector 18, 19
- user interface language 43
- user's manual 6
- using
 - AC power 26
 - VGA output 80

- V**
- velocity
 - calibration 60, 65
 - variations 69
- VGA output
 - activating 46
 - connector 18, 19
 - using 80
- virtual keyboard 38
 - editing value 39

- W**
- warning notes
 - charger/adaptor usage 28
 - definition 7
 - electrical 8
 - general 8
- warranty information 10
- waveform
 - delay 50
 - display 33
 - range 50
 - rectification 48
 - rectification, changing 46
 - trace 34, 49
 - trace, changing 46
- WEEE directive 4, 9

- Z**
- zero calibration 60, 63

zero compensation 60

zoom

activating 52

indicator 35

zoomed display 52