



39DL PLUS

Ultrasonic Thickness Gauge

User's Manual

10-044018-01EN — Rev. 3
November 2024

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

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

Copyright © 2024 by Evident. All rights reserved. No part of this publication may be reproduced, translated, or distributed without the express written permission of Evident.

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

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

Part number: 10-044018-01EN

Rev. 3

November 2024

Printed in the United States of America

The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Evident Scientific Inc. is under license.



USB Type-C® and USB-C® are registered trademarks of USB Implementers Forum.



The microSD Logo is a trademark of SD-3C, LLC.



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

Table of Contents

List of Abbreviations	11
Important Information – Please Read Before Use	13
Intended Use	13
Instruction Manual	13
Device Compatibility	14
Repair and Modification	14
Safety Symbols	14
Safety Signal Words	15
Note Signal Words	16
Safety	16
Warnings	16
Battery Precautions	17
Regulations for Shipping Products with Lithium-Ion Batteries	19
Equipment Disposal	19
BC (Battery Charger - California, USA Community)	19
CE (European Conformity)	20
UKCA (United Kingdom)	20
RCM (Australia)	20
WEEE Directive	20
China RoHS	21
Korea Communications Commission (KCC)	22
EMC Directive Compliance	22
FCC (USA) Compliance	23
ICES-001 (Canada) Compliance	24
SAR/RF Exposure Notice	24
Radio Frequency Regulatory Compliance	25
Warranty Information	31

Technical Support	31
Introduction	33
1. Instrument Description	35
1.1 Product Description	35
1.2 Environmental Ratings	38
1.3 Instrument Hardware Components	38
1.4 Connectors	39
1.5 Keypad Functions	41
1.6 Accessing the Regulatory E-Label	46
2. Powering the 39DL PLUS	47
2.1 Power Indicator	47
2.2 Using the AC Power	48
2.3 Using Battery Power	49
2.3.1 Battery Operating Time	50
2.3.2 Charging the Battery	50
2.3.3 Replacing the Battery	52
3. Software User Interface Elements	55
3.1 Measurement Screen	55
3.2 Menus and Submenus	57
3.3 Parameter Screens	58
3.4 Selecting the Text Edit Mode	60
3.4.1 Editing Text Parameters Using the Virtual Keyboard	60
3.4.2 Editing Text Parameters Using the Traditional Method	62
4. Initial Setup	65
4.1 Setting the User Interface Language and Other System Options	65
4.2 Selecting the Measurement Units	66
4.3 Setting the Clock	66
4.4 Changing Display Settings	67
4.4.1 Color Schemes	68
4.4.2 Display Brightness	69
4.4.3 Waveform Rectification	70
4.4.4 Waveform Trace	71
4.5 Range of the Waveform Display	72
4.5.1 Selecting the Range Value	73
4.5.2 Adjusting the Delay Value	74
4.5.3 Activating the Zoom Function	74

4.6	Adjusting the Measurement Update Rate	76
4.7	Changing the Thickness Resolution	77
5.	Basic Operation	79
5.1	Setting Up the Transducer	79
5.2	Calibration	82
5.2.1	Calibrating the Instrument	83
5.2.2	Test Blocks	86
5.2.3	Transducer Zero Compensation	86
5.2.4	Material Sound Velocity and the Zero Calibrations	87
5.2.5	Entering a Known Material Sound Velocity	88
5.2.6	Locked Calibrations	89
5.2.7	Factors Affecting the Performance and the Accuracy	89
5.3	Measuring Thicknesses	91
5.4	Saving Data	92
5.5	Measurements with THRU-COAT D7906 and D7908 Transducers	94
5.5.1	Enabling the THRU-COAT Function	94
5.5.2	Performing a THRU-COAT Calibration	95
5.6	Echo Detection Modes with Dual Element Transducers	96
5.6.1	Blanking Adjustments in Manual Echo-to-Echo Detection Mode	99
5.6.2	Dual Element Transducer Selection in Echo-to-Echo Modes	100
5.6.3	Echo-to-Echo Mode Datalogger Flags	101
5.7	Using the VGA Output	102
6.	Using EMAT Transducers	103
6.1	Connecting the E110-SB EMAT Transducer	104
6.2	Calibrating with the E110-SB EMAT Transducer	105
7.	Software Options	107
7.1	Activating Software Options	108
7.2	High Resolution Software Option	109
7.3	Oxide Layer Software Option	110
7.3.1	Steam Boiler Tube Scale	110
7.3.2	Setting Up for Oxide Layer Measurement	111
7.3.3	Calibrating for Oxide Layer Measurement	112
7.3.4	Measuring Boiler Tube and Oxide Layer Thicknesses	113
7.4	Multi-Measurement Software Option	115
7.4.1	Active Measurement	116
7.4.2	Using the Multi-Measurement Normal Mode	117
7.4.3	Using the Multi-Measurement with the Soft Contact Mode	119
7.4.4	Using the Multi-Measurement % Total Thickness Mode	121

7.5	Encoded B-Scan Option	122
7.6	High Penetration Software Option	128
7.7	WiFi Software Option	129
7.8	Bluetooth Software Option	129
8.	Using Special Functions	131
8.1	Activating and Configuring a Differential Mode	131
8.2	Using the Minimum, Maximum, or Min/Max Thickness Mode	133
8.3	Preventing False Minimum/Maximum Thickness Readings	135
8.4	Using Alarms	135
8.5	Locking the Instrument	142
8.6	Freezing Waveforms	144
9.	Configuring the Instrument	147
9.1	Configuring Measurement Parameters	147
9.2	Configuring System Parameters	149
9.3	Configuring Communications	151
10.	Using Advanced Gaging Features	155
10.1	Adjusting the Gain with Dual Element and E110 EMAT Transducers	155
10.2	Adjusting the Extended Blank with Dual Element Transducers	157
10.3	B-Scan	159
10.3.1	Using the B-Scan	164
10.3.2	Using the B-Scan Alarm Mode	164
10.3.3	Saving B-Scans, A-Scans, or Thickness Readings	165
10.4	DB Grid	167
10.4.1	Activating and Configuring the DB Grid	167
10.4.2	Changing the Highlighted Cell in the DB Grid	170
10.4.3	Saving Thickness Readings in the DB Grid	172
10.4.4	Viewing an Inserted or an Appended Cell in the DB Grid	172
10.5	Configuring AVG/MIN Measurements	173
10.6	Making AVG/MIN Measurements	174
10.7	Using Temperature Compensation	176
11.	Using the Datalogger	179
11.1	Datalogger	179
11.2	Creating a Data File	183
11.2.1	Data File Types	185
11.2.1.1	Incremental Data File Type	185
11.2.1.2	Sequential Data File Type	187
11.2.1.3	Sequential with Custom Points Data File Type	188

11.2.1.4	2-D Grid Data File Type	190
11.2.1.5	2-D Grid with Custom Points Data File Type	194
11.2.1.6	3-D Grid Data File Type	196
11.2.1.7	Boiler Data File Type	198
11.2.1.8	3-D Custom File Type	200
11.2.2	File Data Modes	202
11.3	Performing File Operations	203
11.3.1	Opening a File	204
11.3.2	Copying a File	205
11.3.3	Editing a File	206
11.3.4	Deleting a File or its Contents	208
11.3.5	Deleting a Range of IDs	210
11.3.6	Deleting All Data Files	210
11.4	Notes	212
11.4.1	Creating or Editing Notes	212
11.4.2	Associating a Note to an ID or to a Range of IDs	213
11.4.3	Deleting a Note from a File	214
11.4.4	Copying a Note Table	215
11.5	Setting the ID Overwrite Protection	216
11.6	ID Review Screen	217
11.6.1	Reviewing Stored Data and Changing the Active ID	219
11.6.2	Editing the ID	219
11.6.3	Erasing Data in the Active File	221
11.7	Generating Reports	222
12.	Dual Element Transducer Setups	231
12.1	Standard D79X and Other Dual Element Transducers	231
12.2	Creating a Setup for Nonstandard Dual Element Transducers	232
12.3	Recalling Stored Dual Element Transducer Setups	235
12.4	V-Path	235
12.4.1	Activating the V-Path Function	236
12.4.2	Building a V-Path Correction Curve for a Nonstandard Dual Element Transducer	236
13.	Custom Setups for Single Element Transducers	241
13.1	Creating a Custom Setup for a Single Element Transducer	241
13.2	Quickly Adjusting Waveform Parameters For Single Element Transducers ..	244
13.3	Detection Modes	245
13.4	First Peak	247
13.5	Pulser Power	248
13.6	Time-Dependent Gain Curve	249

13.6.1	Maximum Gain	250
13.6.2	Initial Gain	251
13.6.3	TDG Slope	251
13.7	Main Bang Blank	252
13.8	Echo Window	253
13.8.1	Detection of Echo 1 and Echo 2	255
13.8.2	Interface Blank	256
13.8.3	Mode 3 Echo Blank	258
13.9	Saving Setup Parameters	259
13.10	Quickly Recalling a Custom Setup for Single Element Transducers	260
14.	Managing Communications and Data Transfer	263
14.1	GageView	263
14.2	Setting Up USB Communication	264
14.3	Setting Up RS-232 Serial Communication	266
14.4	Setting Up Bluetooth Communication	268
14.5	Setting Up WiFi Communication	269
14.6	Exchanging Data with a Remote Device	270
14.6.1	Sending Entire Files (RS-232)	271
14.6.2	Sending an ID Range from a File (RS-232)	272
14.6.3	Sending the Currently Displayed Measurement (RS-232)	273
14.6.4	Exporting a File to the External Memory Card	274
14.6.5	Importing Survey Files from the External Memory Card	275
14.6.6	Receiving Files from a Computer	277
14.7	Capturing 39DL PLUS Screen Images	278
14.7.1	Sending a Screen Capture to GageView	278
14.7.2	Sending a Screen Capture to the External microSD Card	280
14.8	RS-232 Serial Data Output Formats	281
14.9	Resetting the Communication Parameters	283
15.	Maintaining and Troubleshooting the 39DL PLUS	285
15.1	Providing Routine Gauge Maintenance	285
15.2	Cleaning the Instrument	286
15.3	Maintaining Transducers	286
15.4	Using Instrument Resets	286
15.5	Performing Hardware Diagnostic Tests	289
15.6	Performing the Software Diagnostic Test	291
15.7	Viewing the Instrument Status	292
15.8	Understanding Error Messages	293
15.9	Resolving Battery Pack and Charger Problems	293
15.10	Resolving Measurement Problems	294

Appendix A: Technical Specifications 297

List of Figures 305

List of Tables 311

List of Abbreviations

2-D	two-dimensional
3-D	three-dimensional
AC	alternative current
AEtoE	automatic echo-to-echo
AGC	automatic gain control
ASCII	American standard code for information interchange
AVG	average
CSV	comma separated variables
DB	database
DC	direct current
DIA	diameter
DIAG	diagnostic
DIFF	differential
EFUP	environment-friendly use period
EMAT	electromagnetic acoustic transducer
ESS	electronic stress screening
EXT	extended
FRP	fiber reinforced polymer
GB	giga bytes
GRN	green
HI	high
ID	identification
Li-ion	lithium-ion
LOS	loss-of-signal
MAX	maximum
MB	main bang
MEtoE	manual echo-to-echo
MIL	military
MIN	minimum
MTI	measured time interval
MULTI	multiple
NiMH	nickel metal hydride
P/N	part number

PDSTL	pedestal
PRF	pulse repetition frequency
SE	single element
SEC	second
SP	special
STD	standard
SW	software
SWC	shear wave couplant
TDG	time-dependent gain
TFT	thin film transistor (liquid crystal display technology)
TOF	time-of-flight
USB	universal serial bus
VAC	voltage alternative current
YEL	yellow

Important Information — Please Read Before Use

Intended Use

The 39DL PLUS is designed to perform nondestructive inspections on industrial and commercial materials.



WARNING

Do not use the 39DL PLUS for any purpose other than its intended use. It must never be used to inspect or examine human or animal body parts.

Instruction Manual

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

IMPORTANT

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

Device Compatibility

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



CAUTION

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

Repair and Modification

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



CAUTION

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

Safety Symbols

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



General warning symbol

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



High voltage warning symbol

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

Safety Signal Words

The following safety signal words might appear in the documentation of the device:



DANGER

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



WARNING

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



CAUTION

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

Note Signal Words

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

IMPORTANT

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

NOTE

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

TIP

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

Safety

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

Warnings



WARNING

General Warnings

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

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

**WARNING****Electrical Warning**

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

**CAUTION**

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

Battery Precautions**CAUTION**

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

- Transportation of lithium-ion batteries is regulated by the United Nations under the United Nations Recommendations on the Transport of Dangerous Goods. It is expected that governments, intergovernmental organizations, and other international organizations shall conform to the principles laid down in these regulations, thus contributing to worldwide harmonization in this field. These international organizations include the International Civil Aviation organization (ICAO), the International Air Transport Association (IATA), the International Maritime Organization (IMO), the US Department of Transportation (USDOT), Transport Canada (TC), and others. Please contact the transporter and confirm current regulations before transportation of lithium-ion batteries.
- For California (USA) only:
The device may contain a CR battery. The CR battery contains perchlorate material, and special handling may be required. Refer to <http://www.dtsc.ca.gov/hazardouswaste/perchlorate>.
- Do not open, crush, or perforate batteries; doing so could cause injury.
- Do not incinerate batteries. Keep batteries away from fire and other sources of extreme heat. Exposing batteries to extreme heat (over 80°C) could result in an explosion or personal injury.
- Do not drop, hit, or otherwise abuse a battery, as doing so could expose the cell contents, which are corrosive and explosive.
- Do not short-circuit the battery terminals. A short circuit could cause injury and severe damage to a battery making it unusable.
- Do not expose a battery to moisture or rain; doing so could cause an electric shock.
- Only use an external charger approved by Evident to charge the batteries.
- Only use batteries supplied by Evident.
- Do not store batteries that have less than 40% remaining charge. Recharge batteries to between 40% and 80% capacity before storing them.
- During storage, keep the battery charge between 40% and 80%.
- Do not leave batteries in the 39DL PLUS unit during device storage.

Regulations for Shipping Products with Lithium-Ion Batteries

IMPORTANT

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



WARNING

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

Equipment Disposal

Before disposing of the 39DL PLUS, check your local laws, rules, and regulations, and follow them accordingly.

BC (Battery Charger - California, USA Community)



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

CE (European Conformity)



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

UKCA (United Kingdom)



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

RCM (Australia)



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

WEEE Directive



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



China RoHS

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



The China RoHS mark indicates the product's Environment-Friendly Use Period (EFUP). The EFUP is defined as the number of years for which listed controlled substances will not leak or chemically deteriorate while in the product. The EFUP for the 39DL PLUS has been determined to be 15 years.

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



电器电子产品有害
物质限制使用
标志

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

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

产品中有害物质的名称及含量

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

产品中有害物质的名称及含量

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

Korea Communications Commission (KCC)



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

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

EMC Directive Compliance

This equipment generates and uses radio-frequency energy and, if not installed and used properly (that is, in strict accordance with the manufacturer's instructions), may cause interference. The 39DL PLUS has been tested and found to comply with the limits for an industrial device in accordance with the specifications of the EMC directive.

FCC (USA) Compliance

NOTE

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

IMPORTANT

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

FCC Supplier's Declaration of Conformity

Hereby declares that the product,

Product name: 39DL PLUS Ultrasonic Thickness Gauge

Model: 39DL PLUS

Conforms to the following specifications:

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

Supplementary information:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Responsible party name:

EVIDENT SCIENTIFIC, INC.

Address:

48 Woerd Avenue, Waltham, MA 02453, USA

Phone number:

+1 781-419-3900

ICES-001 (Canada) Compliance

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

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

SAR/RF Exposure Notice

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET-65 and RSS-102 of the IC (Industry Canada) radio frequency (RF) Exposure rules.

This product contains transmitter module:

FCC ID: 2AC7Z-ESPWROOM32UE

IC: 21098-ESPWROOMUE

KC: R-C-es5-ESP32WROOM-32E

CMIIT: 2020DP3047 (M)

Radio Frequency Regulatory Compliance

Table 1 on page 25 contains the regulatory compliance declarations for radio frequency information for every country and region. For Wireless specifications see Table 41 on page 304. For instructions on how to access the regulatory e-labels on your 39DL PLUS, refer to “Accessing the Regulatory E-Label” on page 46.

Table 1 Radio Frequency Regulatory Compliance



Country/Region	Mark	Declaration
USA	See e-label for FCC ID	This device contains radio transmitters and has been designed, manufactured and tested to meet the Federal Communications Commission (FCC) guidelines for RF exposure and Specific Absorption Rate. The FCC ID marking indicates compliance and certification with the above FCC guidelines.
Canada	See e-label for IC number	This device contains radio transmitters and has been designed, manufactured and tested to meet the Innovation, Science and Economic Development (ISED) Canada guidelines for RF exposure and Specific Absorption Rate. The IC number marking indicates compliance and certification with the above ISED guidelines.
UK		This device complies with the requirements of the Electromagnetic Compatibility Regulations 2016, the Electrical Equipment (Safety) Regulations 2016, the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012, and the Radio Equipment Regulations 2017. The UKCA marking indicates compliance with the above regulations.
EU		This device complies with the requirements of directive 2014/30/EU concerning electromagnetic compatibility, directive 2014/35/EU concerning low voltage, directive 2015/863 which amends 2011/65/EU concerning restriction of hazardous substances (RoHS), and directive 2014/53/EU concerning radio equipment (RED). The CE marking indicates compliance with the above directives.

Table 1 Radio Frequency Regulatory Compliance (continued)



Country/Region	Mark	Declaration
Australia and New Zealand		<p>The regulatory compliance mark (RCM) label indicates that the product complies with all applicable standards, and has been registered with the Australian Communications and Media Authority (ACMA) for placement on the Australian market. In addition, this device complies with the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) radiofrequency electromagnetic energy (RF EME) human exposure limits.</p>
Brazil		<p>The ANATEL marking indicates this device and the wireless technology within this device complies with the Agência Nacional de Telecomunicações (ANATEL) telecommunication regulations.</p> <p>This equipment is not entitled to protection against harmful interference and may not cause interference to duly authorized systems. For more information, see the ANATEL website - https://www.gov.br/anatel/pt-br</p> <p>A marcação ANATEL indica este dispositivo e a tecnologia sem fio contida neste dispositivo está em conformidade com os regulamentos de telecomunicações da Agência Nacional de Telecomunicações (ANATEL).</p> <p>Este equipamento não tem direito a proteção contra interferência prejudicial e não pode causar interferência a sistemas devidamente autorizados. Para mais informações, consulte o site da ANATEL - https://www.gov.br/anatel/pt-br</p>
Chile	N/A	<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Subsecretaría de Telecomunicaciones (SUBTEL).</p>

Table 1 Radio Frequency Regulatory Compliance (continued)


Country/Region	Mark	Declaration
China	See e-label for CMIIT ID	This device contains a radio transmitter and has been designed, manufactured and tested to meet the requirements of the State Radio Regulations of China (SRRC). The Chinese Ministry of Industry and Information Technology (CMIIT) ID number indicates compliance with the above requirements.
Hong Kong	N/A	This device contains radio transmitters and has been designed, manufactured and tested to meet the US Federal Communications Commission (FCC) and European Union (EU) guidelines for RF exposure and Specific Absorption Rate.
India	N/A	This device contains radio transmitters and has been designed, manufactured and tested to meet the US Federal Communications Commission (FCC) and European Union (EU) guidelines for RF exposure and Specific Absorption Rate. Thus, this device has received an Equipment Type Approval (ETA) certificate from the Wireless Planning & Coordination (WPC) Wing department.
Indonesia		This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Direktorat Jenderal Sumber Daya Dan Perangkat Pos Dan Informatika (SDPPI). The QR code, Certificate numbers, Certificate Holder's Registration number, and warning sign indicates compliance with the SDPPI.

Table 1 Radio Frequency Regulatory Compliance (continued)




Country/Region	Mark	Declaration
Israel	<p>Match approval number on behalf of the Israeli Ministry of Communications: XX-XXXXX (Or importer identification number: XXXXXXX) It is prohibited to perform operations on the device that could alter the wireless features of the device, including software changes, replacement of an original antenna or adding the option of connecting to an external antenna, without obtaining approval from the Ministry of Communications, due to fear of employee interference. The device is prohibited to operate outside the building, due to fear of wireless interference.</p>	<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Ministry of Communication (MOC).</p> <p>Is prohibited to perform operations on the device that could alter the wireless features of the device, including software changes, replacement of an original antenna or adding the option of connecting to an external antenna, without obtaining approval from the Ministry of Communications, due to fear of employee interference. The device is prohibited to operate outside the building, due to fear of wireless interference.</p>
Japan		<p>This device contains radio transmitters and has been designed, manufactured and tested to meet Radio Act requirements for RF exposure and Specific Absorption Rate. The GITECKI (Technical Conformity Mark) indicates compliance and certification with the above Radio Act requirements.</p>
Korea		<p>This device complies with the electromagnetic compatibility (EMC) and Radiofrequency (RF) requirements of Korea.</p>
Kuwait	N/A	<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Communication and Information Technology Regulatory Authority (CITRA).</p>
Malaysia		<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Malaysian Communications And Multimedia Commission (MCMC).</p>

Table 1 Radio Frequency Regulatory Compliance (continued)








Country/Region	Mark	Declaration
Mexico	See e-label for IFETEL/IFT number	This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Instituto Federal de Telecomunicaciones (IFETEL) and the The Normas Oficiales Mexicanas (NOM) The IFETEL/IFT number shows compliance with Mexico requirements.
Pakistan		This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Pakistan Telecommunication Authority (PTA). The PTA marking indicates compliance with the above requirements.
Peru	N/A	This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Ministerio de Transporte y Comunicaciones (MTC).
Saudi Arabia	N/A	This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Communications and Information Technology Commission (CITC).
Singapore	Complies with IMDA Standards	This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Infocomm Media Development Authority (IMDA). The IMDA marking indicates compliance with the above requirements.
South Africa		This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Independent Communications Authority of South Africa (ICASA). The ICASA marking indicates compliance with the above requirements.

Table 1 Radio Frequency Regulatory Compliance (continued)

Country/Region	Mark	Declaration
Taiwan		<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the National Communications Commission (NCC). The NCC certification indicates compliance with the above requirements.</p>
Thailand		<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the National Broadcasting and Telecommunications Commission (NBTC). The NBTC marking indicates compliance with the above requirements.</p> <p>This radiocommunication equipment is exempted to possess license, user license, or radiocommunication station license as per NBTC notification regarding radiocommunication equipment and radiocommunication station has been exempted for license according to radio communication act B.E.2498</p>
Ukraine		<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Technical Regulations of Radio Equipment” (UA RED TR).</p>
United Arab Emirates		<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Telecommunications and Digital Government Regulatory Authority (TDRA).</p>
Vietnam		<p>This device contains radio transmitters and has been designed, manufactured and tested to meet the requirements of the Vietnam Telecommunications Authority (VNTA).</p>

Warranty Information

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

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

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

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

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

Technical Support

Evident is firmly committed to providing the highest level of customer service and product support. If you experience any difficulties when using our product, or if it fails to operate as described in the documentation, first consult the user's manual, and then, if you are still in need of assistance, contact our After-Sales Service. To locate the nearest service center, visit <https://EvidentScientific.com/service-and-support/service-centers/>.

Introduction

This manual provides basic and advanced operating instructions for the 39DL PLUS ultrasonic thickness gauge. The information in this manual is organized to explain the technology, safety details, hardware, and software. Practical measurement examples help the user become familiar with the instrument's capabilities.



Figure i-1 The 39DL PLUS instrument

1. Instrument Description

This chapter describes the main features and the hardware components of the 39DL PLUS instrument.

1.1 Product Description

The 39DL PLUS by Evident is a hand-held ultrasonic thickness gauge designed for a wide variety of thickness measurement applications. With the 39DL 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 35).



Figure 1-1 Measuring thicknesses with the 39DL PLUS

The 39DL PLUS simultaneously displays a thickness readout and an A-scan view for waveform verification. The microprocessor of the 39DL 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 792000 thickness measurements and 20000 waveforms.

The 39DL PLUS operates with a full line of single element and dual element transducers to measure material thicknesses between 0.08 mm and 635 mm (0.003 in. and 25 in.). The temperature range of measured materials can be between -20°C and 500°C (-4°F and 932°F) depending on the material characteristics, the transducer, and the measurement mode. You can also use single element or dual element transducers for echo-to-echo measurements.

You can connect the 39DL PLUS to a computer using the bidirectional serial USB™/RS-232 communication ports.

Advanced Measurement Features

- THRU-COAT measurement
- Temperature-compensated measurement
- Min/Average mode
- EMAT transducer capability
- Measurement-related status flags and alarms
- Full VGA color transfective LED back-lite display
- Automatic probe recognition for the standard D79X and MTD705 series transducers
- Dynamic default gain optimization
- V-path calibration to build custom V-path correction tables for any dual element transducer
- Warning against calibration doubling
- Calibration for unknown material sound velocity and/or transducer zero
- Echo-to-echo measurements
- Fast scan mode with 30 readings per second
- Manual gain adjustment in 1-dB steps
- Hold or blank thickness display during loss-of-signal (LOS) conditions
- Hold minimum, maximum, or both minimum and maximum functions
- Differential thickness display relative to the set point in absolute or percentage ratio

- Selection of password-protected lockout functions
- Selectable resolution: low of 0.1 mm (0.01 in.), standard of 0.01 mm (0.001 in.), or high (optional) of 0.001 mm (0.0001 in.) [option not available for all transducers]

A-Scan and B-Scan Display Options

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

Internal Datalogger Functions

- Internal data storage and possibility to export data to a removable microSD memory card
- Capacity to store 792000 fully-documented thickness readings or 20000 waveforms with thickness readings
- Database enhancements include 32-character file naming and 20-character ID naming
- Automatic ID number increments following a preset sequence, or manual ID numbering using the keypad
- Save reading/waveform to an ID number
- Simultaneously show ID number, stored comments, and stored reference thickness while displaying active thickness and waveform
- Nine file formats available
- Erase selected data or all stored data
- Save or send an held or frozen reading to the thickness display
- Transmit selected data or all stored data
- Keypad-programmable communication parameters
- Standard USB and RS-232 directional communication

1.2 Environmental Ratings

The 39DL PLUS is a rugged and durable instrument that you may use in harsh environments. The 39DL PLUS was designed to meet the requirement of the IP67 standard (Ingress Protection).



CAUTION

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

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

1.3 Instrument Hardware Components

The 39DL 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 39).

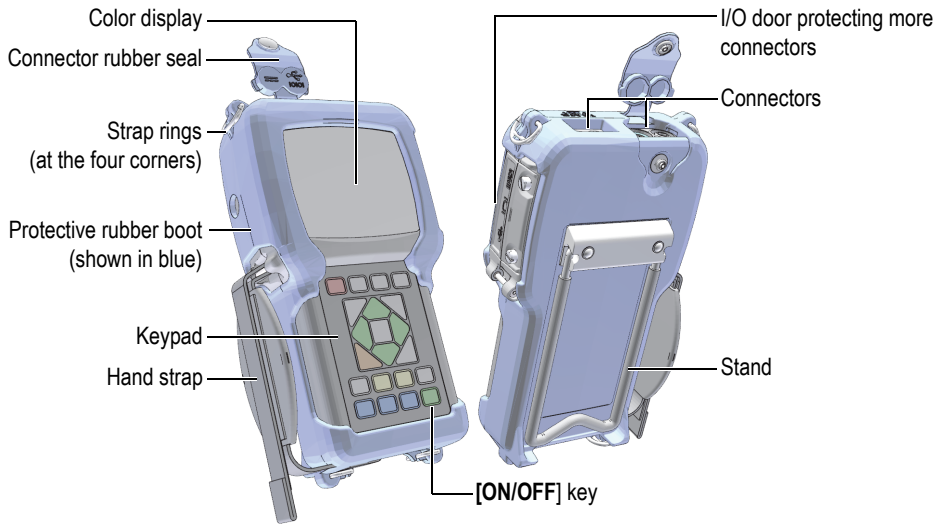


Figure 1-2 The 39DL PLUS hardware components

1.4 Connectors

Figure 1-3 on page 39 illustrates the possible connections of the 39DL PLUS with external devices.

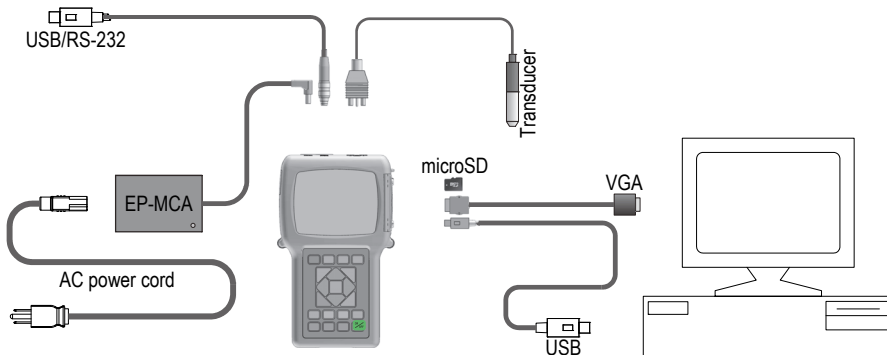


Figure 1-3 The 39DL PLUS connections



CAUTION

To avoid the risk of injuries or equipment damage, use only the AC power cord supplied with the 39DL 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 39DL PLUS (see Figure 1-4 on page 40).

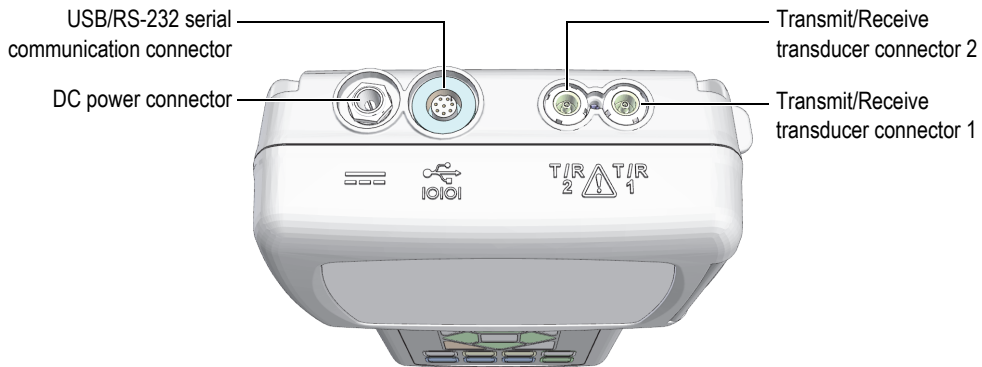


Figure 1-4 The top end connectors

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 41).

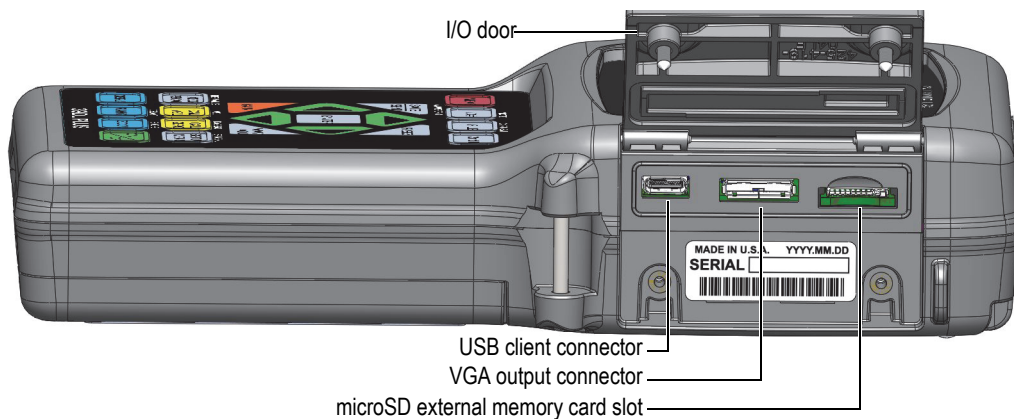


Figure 1-5 The connectors behind the I/O door

1.5 Keypad Functions

The 39DL PLUS comes either with the English, international, Chinese, or Japanese keypad (see Figure 1-6 on page 42). The functions are the same for all keypads. On the international keypad, the text labels on many keys are replaced by pictograms. In this document, keypad keys are referred to using the English label in bold and within brackets (ex.: **[MEAS]**).

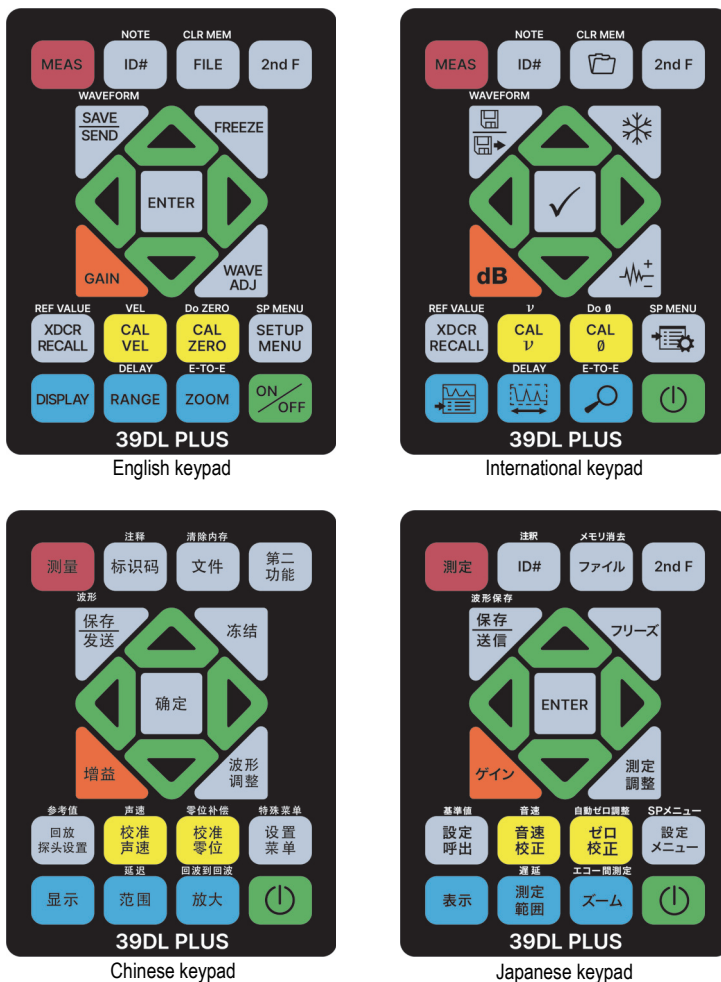


Figure 1-6 The 39DL PLUS keypads

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 43 lists the key functions available from the 39DL PLUS keypad.

Table 2 Keypad functions



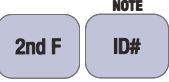


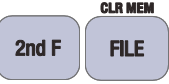



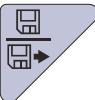
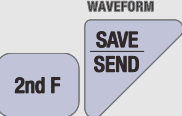
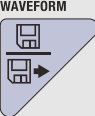
English	International	Functions
		Measurement — Completes the current operation and returns to the measurement screen.
		Identification number — Accesses several functions related to the ID numbers for the thickness measurement location.
		Note — Allows you to create or select comments to store at an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

Table 2 Keypad functions (continued)













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

Table 2 Keypad functions (continued)

































English	International	Functions
		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.
		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).

Table 2 Keypad functions (continued)

English	International	Functions
 		Special menu — Provides access to special gauge parameters (clock, language, options, resets, tests, software diagnostics, instrument status).
		Display — Provides access to display parameters (color scheme, brightness, waveform rectification, waveform trace, and VGA output).
		Range — Changes the waveform display range to the next available value.
 		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.

1.6 Accessing the Regulatory E-Label

All of the regulatory markings and notices are located in the 39DL PLUS e-label screen. To access the regulatory e-labels, complete the following steps.

1. Press **[SETUP MENU]**.
2. In the menu, select **REGULATORY**.
3. Press **[ENTER]**.
4. Scroll through the markings and notices using the up and down arrow keys.
5. Press **[MEAS]** to return to the measurement screen.

2. Powering the 39DL PLUS

This chapter describes how to operate the 39DL PLUS using different power supply options.

2.1 Power Indicator

The power indicator is always present on the right side of the screen. It shows the level of the battery charge and on which type of power the instrument operates (see Figure 2-1 on page 47).

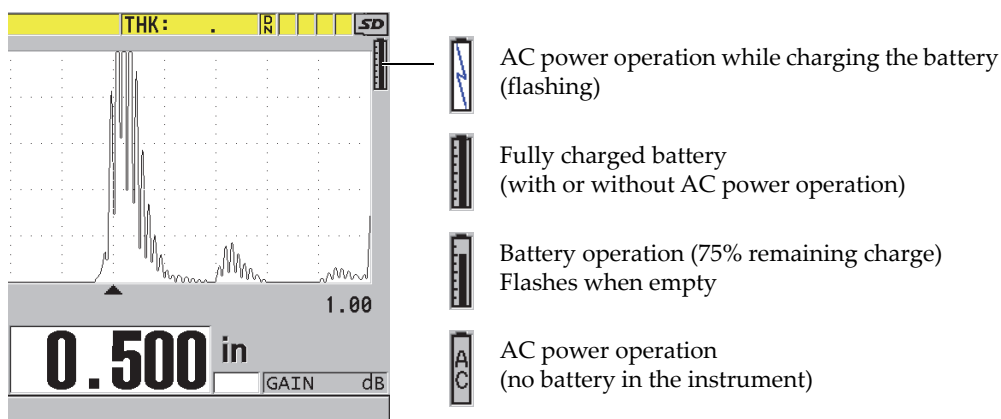


Figure 2-1 The power indicator for battery and AC operation

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 39DL 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 48).



CAUTION

To avoid the risk of injuries or equipment damage, use only the AC power cord supplied with the 39DL PLUS. Do not use this AC power cord with other products.

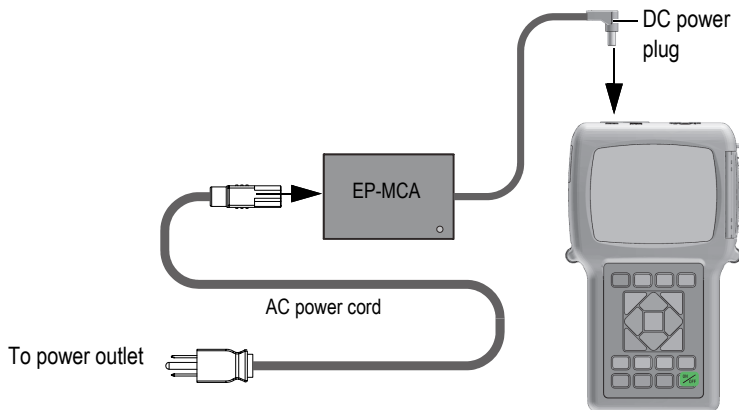


Figure 2-2 Connecting the charger/adaptor

2. On the 39DL PLUS, lift the rubber seal covering the DC adaptor connector on top of the 39DL PLUS (see Figure 2-3 on page 49).

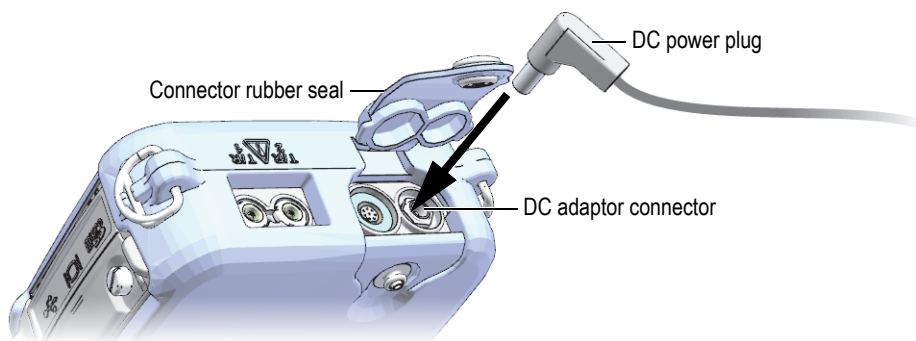


Figure 2-3 Connecting the DC power plug

3. Connect the DC power plug from the charger/adaptor to the DC adaptor connector (see Figure 2-3 on page 49).
4. Press [ON/OFF] to turn on the 39DL PLUS.

2.3 Using Battery Power

The 39DL PLUS comes with a rechargeable lithium-ion (Li-ion) battery (P/N: 38-BAT [U8760054]). The 39DL PLUS automatically recharges the 38-BAT battery when you connect the instrument to the AC power.

You can also operate the 39DL PLUS using four AA-size Alkaline or nickel metal hydride (NiMH) rechargeable batteries using the AA battery holder (P/N: 39DLP/AA [U8780290]). The 39DL PLUS does not recharge NiMH batteries. You must recharge AA batteries with an external battery charger (not included).

NOTE

The 39DL 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 39DL PLUS has been tested with mid-level operating parameters (update rate of 4 Hz and display brightness set to 50%).

The nominal operating time for a new rechargeable Li-ion battery is 8 hours.

2.3.2 Charging the Battery



WARNING

The 39DL PLUS charger/adaptor (P/N: EP-MCA [U8767042]) is designed to charge 39DL PLUS batteries only (P/N: 38-BAT [U8760054]). Do not attempt to charge any other battery types (such as alkaline or NiMH) or use any other chargers/adaptors to charge the 39DL PLUS batteries (P/N: 38-BAT [U8760054]). Doing so may cause an explosion and injury.



WARNING

Do not attempt to power or charge other electronic equipment with the 39DL 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 39DL PLUS using the AC power (see “Using the AC Power” on page 48).
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 “Power Indicator” on page 47). 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 39DL PLUS (see Figure 2-4 on page 52).

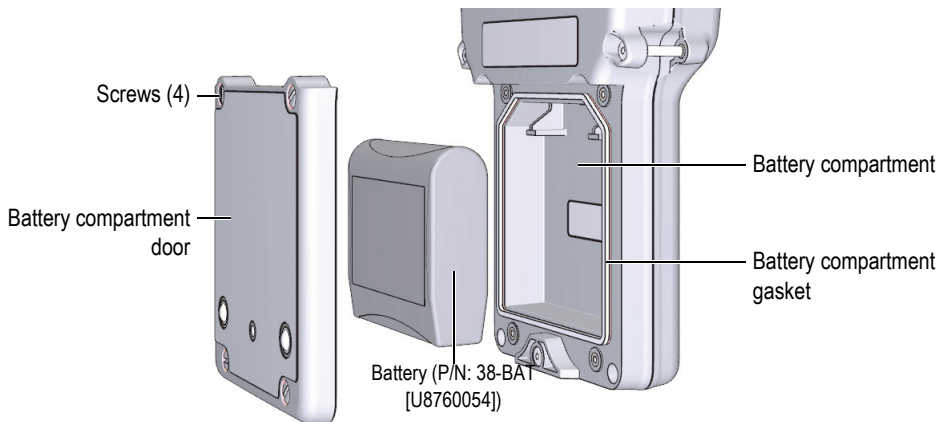


Figure 2-4 Opening the battery compartment



CAUTION

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

To replace the battery

1. Disconnect the instrument from the charger/adaptor.
2. Ensure that the 39DL PLUS power is off.
3. Disconnect any other cable connected to the 39DL 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 52).
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 39DL PLUS.

NOTE

After the battery is replaced, it may take some time for the battery level indicator to properly synchronize with the actual battery charge level.

3. Software User Interface Elements

The following sections describe the main elements of the 39DL PLUS software screens and menus.

3.1 Measurement Screen

The 39DL 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 55). The measurement screen is the main screen of the 39DL PLUS software. From anywhere in the 39DL PLUS software, simply press [MEAS] to return to the measurement screen. The power indicator is always present on the right side of the 39DL PLUS screen (see “Using Battery Power” on page 49 for details).

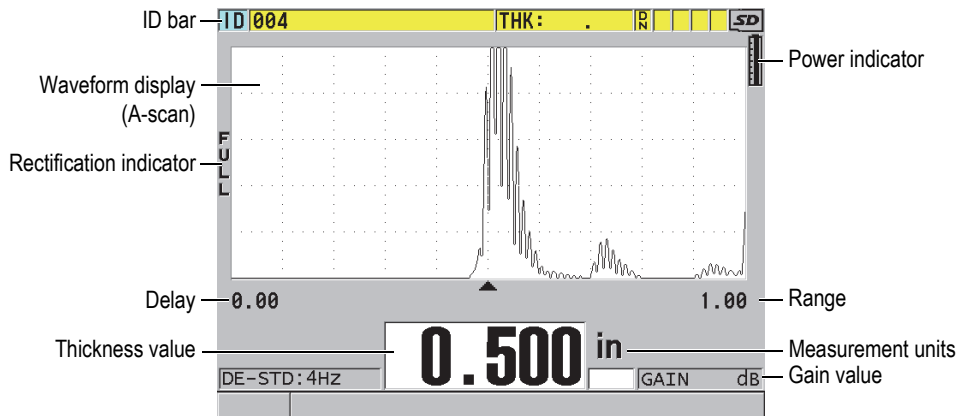


Figure 3-1 The main elements of the measurement screen

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

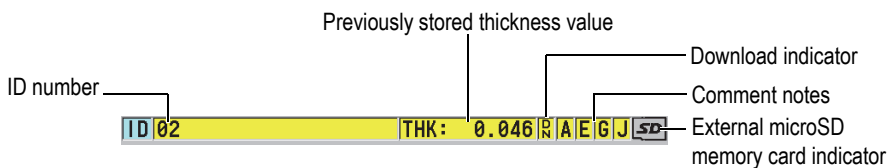


Figure 3-2 The ID bar

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 41). The 39DL 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 57). 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.

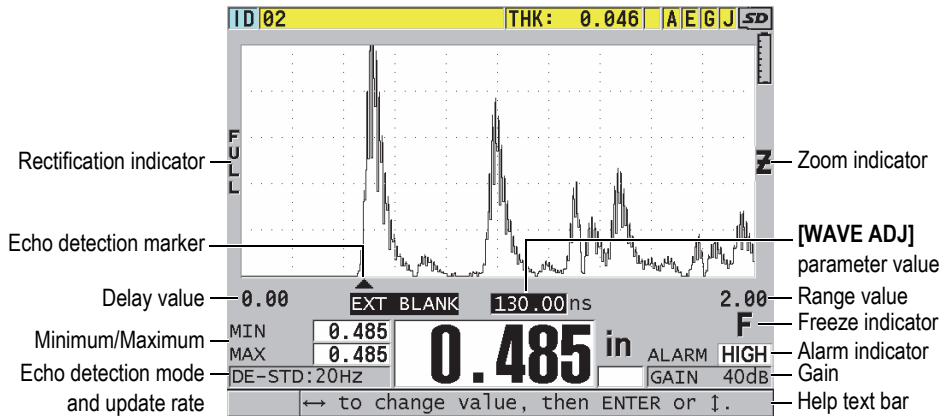


Figure 3-3 Example of other elements appearing on the measurement screen

The loss-of-signal (LOS) appears and the thickness value is cleared when the 39DL PLUS no longer detects ultrasonic echoes (see Figure 3-4 on page 57).

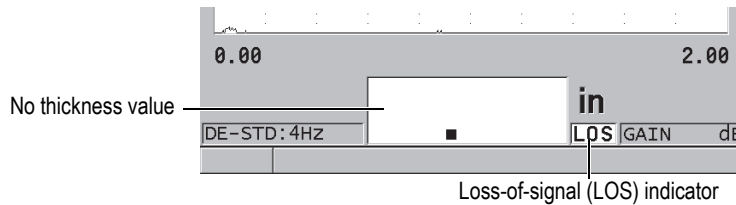


Figure 3-4 The loss-of-signal (LOS) indicator

3.2 Menus and Submenus

The 39DL 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 58). If applicable, a submenu also appears, conveniently showing the parameters available for the highlighted menu command.

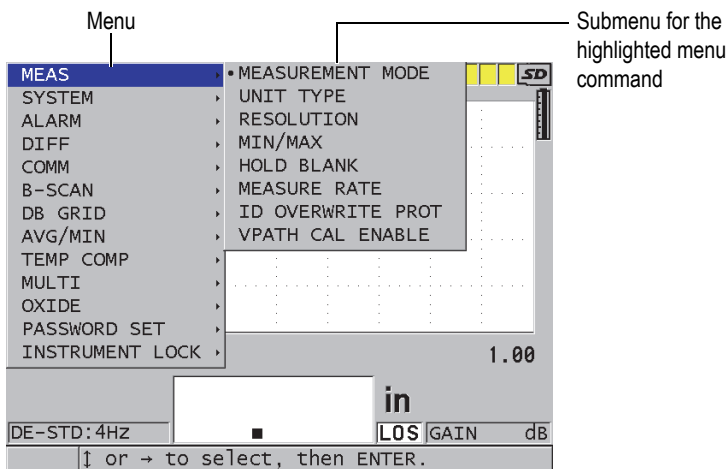


Figure 3-5 Menu and submenu example

To select a menu or a submenu command

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

NOTE

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

3.3 Parameter Screens

The 39DL PLUS parameters are logically grouped in parameter screens that you access using front panel keys or menu commands. Figure 3-6 on page 59 shows the **MEAS** parameter screen as an example.

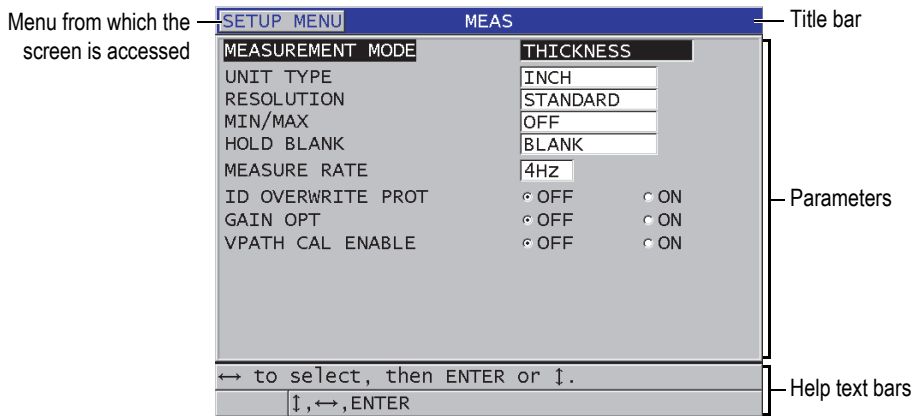


Figure 3-6 Parameter screen example

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

To select a parameter and edit its value

1. Use the [▲] and [▼] keys to highlight the desired parameter.
2. For parameters with predefined values, use the [▶] and [◀] keys to select the desired value.
3. In parameter screens containing lists or alphanumeric parameters:
 - In a list, use the [▲] and [▼] keys to highlight the desired list item.
 - For an alphanumeric parameter, use the [▲] and [▼] keys to enter the desired characters (see “Selecting the Text Edit Mode” on page 60 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 39DL PLUS offers two methods to edit the value of alphanumeric parameters. You can either use the virtual keyboard or the traditional method. The virtual keyboard appears on the screen to show all the available characters that you can use (see “Editing Text Parameters Using the Virtual Keyboard” on page 60 for details). With the traditional method, you select each character from a hidden list of standard sorted letters, numbers, and special characters (see “Editing Text Parameters Using the Traditional Method” on page 62 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 61).

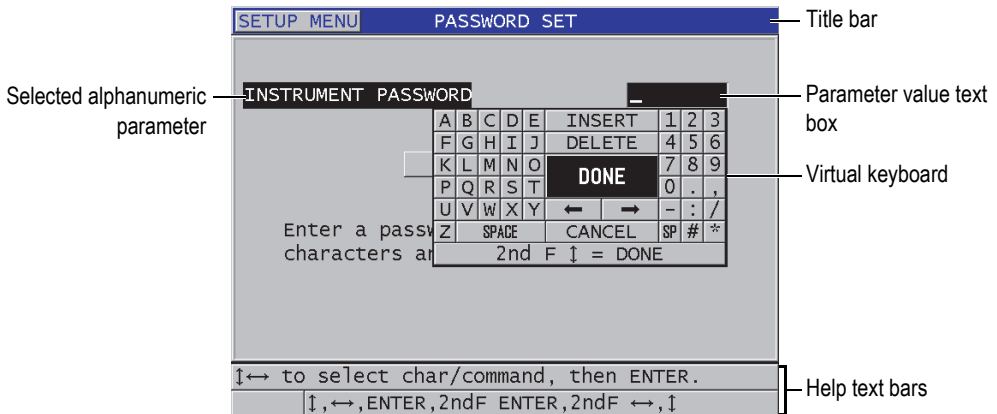


Figure 3-7 Example of the virtual keyboard

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 62). Only upper case letters are available.

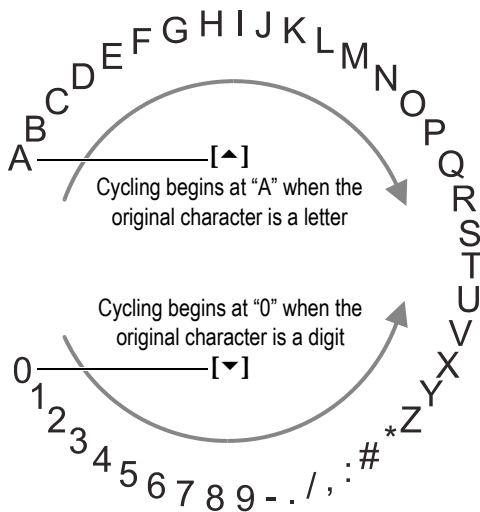


Figure 3-8 The character cycle of the traditional text edit method

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 39DL 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 39DL 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 66):
 - 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.

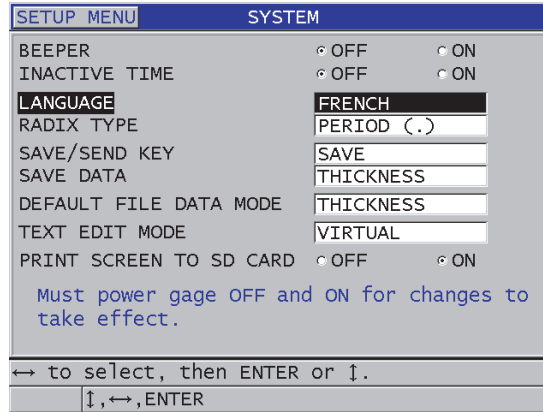


Figure 4-1 Selecting the user interface language

4. Press **[MEAS]** to return to the measurement screen.
5. Turn off the 39DL PLUS, and then turn it back on to activate the language change.

4.2 Selecting the Measurement Units

You can set the 39DL 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 39DL PLUS has a built-in date and time clock. You can set the date and the time and select their format. The 39DL 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 67):
 - 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 'MONTH' is set to 2, 'DAY' to 24, 'YEAR' to 2010, and 'DATE MODE' to MM/DD/YYYY. The 'HOUR' is set to 2 PM, 'MINUTE' to 35, and 'HOUR MODE' to 12 HOUR. There are 'SET' and 'CANCEL' buttons at the bottom. Below the screen, there are instructions: '↔ to change value, then ENTER or ↓.' and '↓, ↔, ENTER'.

Figure 4-2 Selecting clock parameters

4.4 Changing Display Settings

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

To change the display setting

1. From the measurement screen, press [DISPLAY].
2. In the **DISPLAY SETTINGS** screen (see Figure 4-3 on page 68), select the desired parameter and value for the following parameters:
 - **COLOR SCHEME** to either select the **INDOOR** or **OUTDOOR** optimized visibility (see “Color Schemes” on page 68 for details).

- **DISPLAY BRIGHTNESS** to select one of the predefined brightness levels (see “Display Brightness” on page 69 for details).
- **WAVEFORM RECTIFICATION** to select one of the rectification modes (see “Waveform Rectification” on page 70 for details).
- **WAVEFORM TRACE** to select one of the trace types (see “Waveform Trace” on page 71 for details).
- **VGA OUTPUT** to turn **ON** or **OFF**, the VGA signal for the VGA output (see “Using the VGA Output” on page 102 for details).

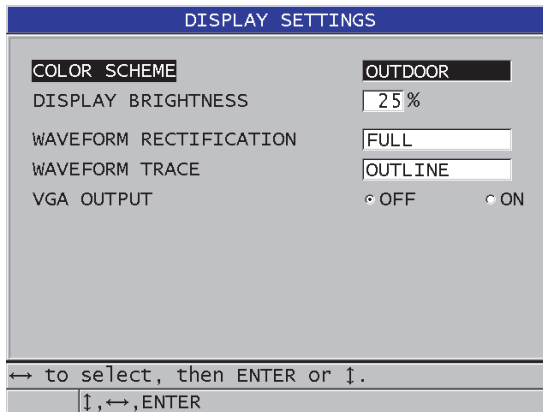


Figure 4-3 The **DISPLAY SETTINGS** screen

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

4.4.1 Color Schemes

The 39DL PLUS offers two standard color schemes designed to provide best display visibility in indoor or outdoor lighting conditions (see Figure 4-4 on page 69). From the measurement screen, press **[DISPLAY]** to access the **COLOR SCHEME** parameter.

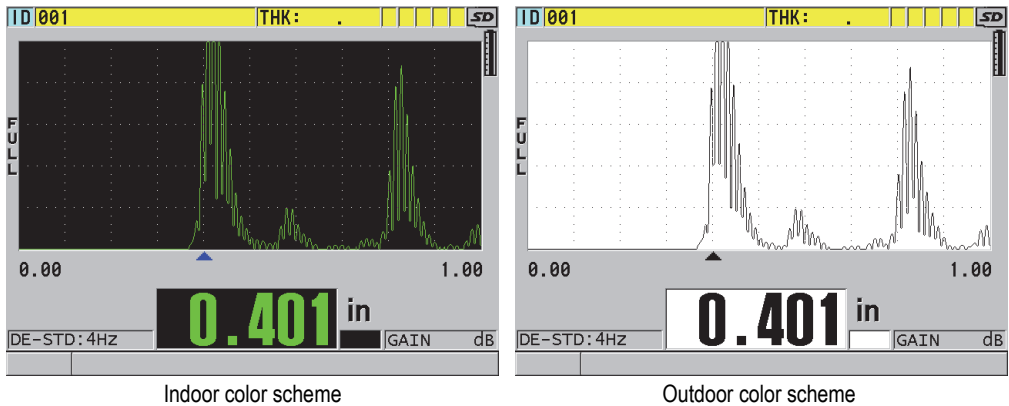


Figure 4-4 Example of the indoor and the outdoor color schemes

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

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

NOTE

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

4.4.2 Display Brightness

You can adjust the 39DL 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 39DL PLUS uses a transfective color display that reflects ambient light and becomes brighter in direct light. With brighter ambient conditions, you can set the display brightness to a lower percentage.

NOTE

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

4.4.3 Waveform Rectification

The rectification mode is the way in which the ultrasonic echoes are represented on the waveform display (see Figure 4-5 on page 70). The rectification mode does not affect the thickness measurement in any way. The rectification indicator (**FULL**, **POS**, **NEG**, or **RF**) appears on the left edge of the waveform display. From the measurement screen, press **[DISPLAY]** to access the **WAVEFORM RECTIFICATION** parameter.

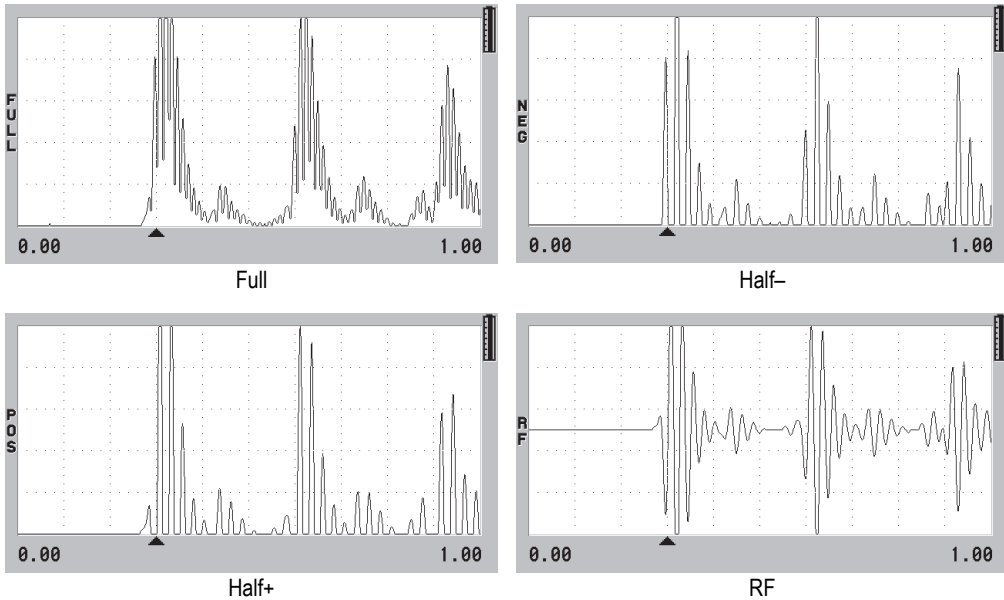


Figure 4-5 Examples of the rectification modes

The available rectification modes are:

FULL

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

HALF- (NEG indicator)

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

HALF+ (POS indicator)

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

RF

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

4.4.4 Waveform Trace

The 39DL PLUS can display the waveform trace as a line (**OUTLINE**) or as a **FILLED** area (see Figure 4-6 on page 72). From the measurement screen, press **[DISPLAY]** to access the **WAVEFORM TRACE** parameter.

NOTE

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

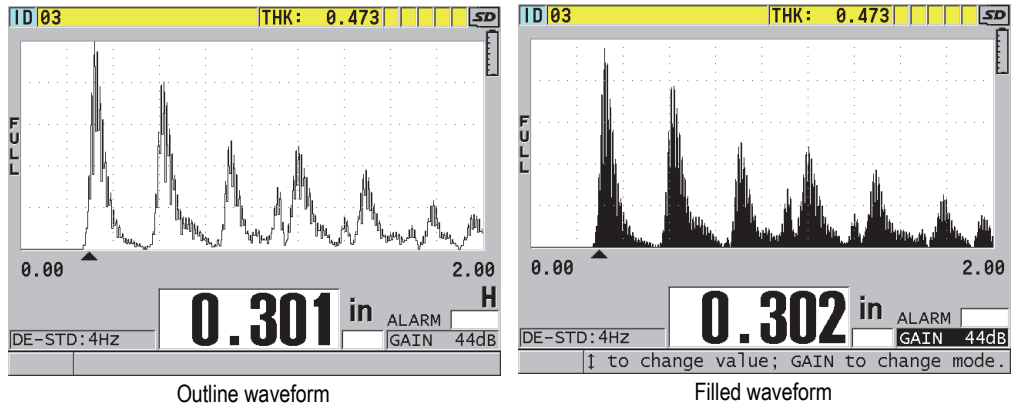


Figure 4-6 Examples of waveform trace modes

4.5 Range of the Waveform Display

The range of the waveform display is the distance spanned by the horizontal axis of the waveform display. The left end of the horizontal axis, the delay, is generally set to zero. You can manually adjust the delay value to change the starting point of the range (see “Adjusting the Delay Value” on page 74) and select the end point of the range (see “Selecting the Range Value” on page 73). You can also activate the zoom function to automatically set the delay and the range values to best see the echo (see “Activating the Zoom Function” on page 74).

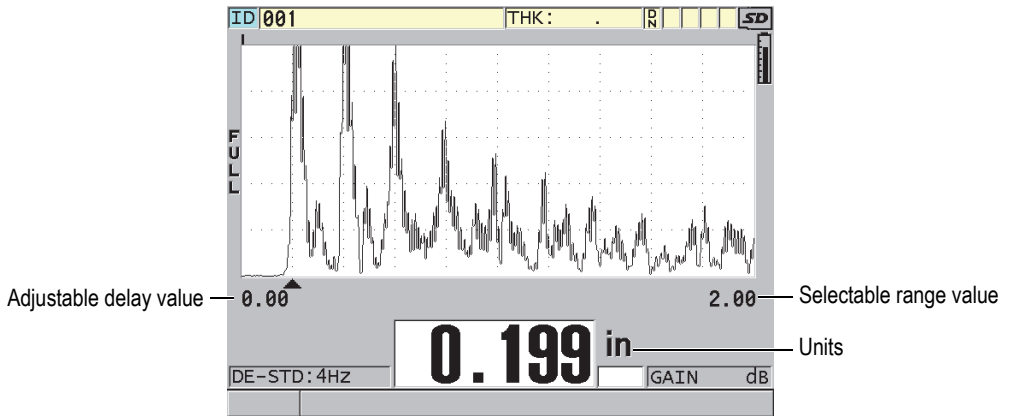


Figure 4-7 The range of the waveform display

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 75).

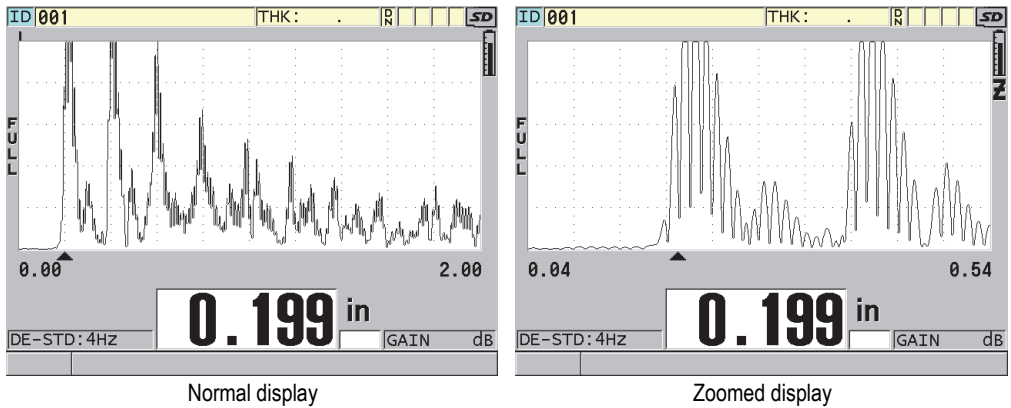


Figure 4-8 Comparing normal and zoomed display in mode 1

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 75).

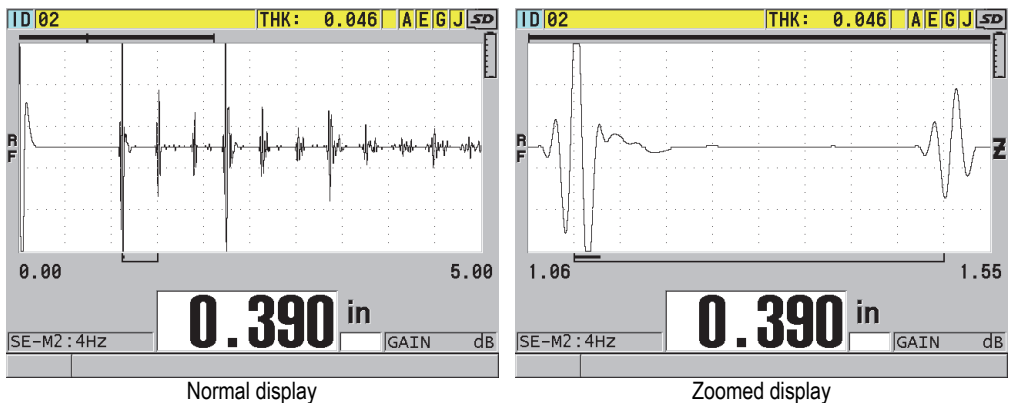


Figure 4-9 Comparing normal and zoomed display in mode 2

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 76).

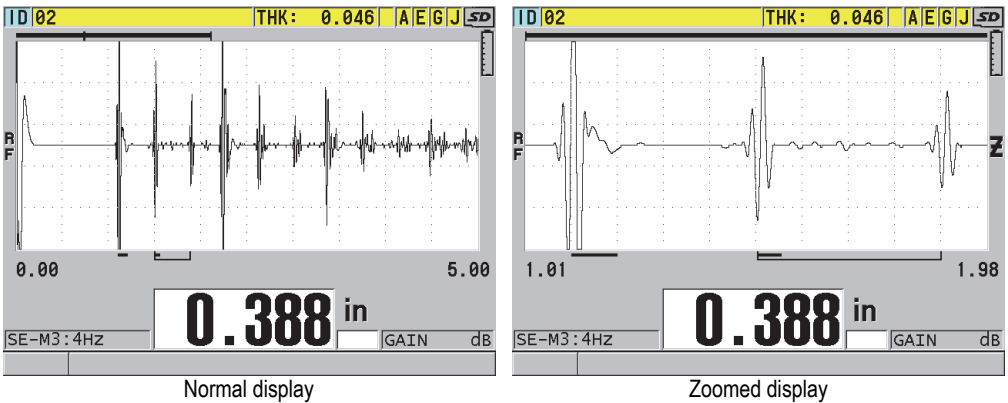


Figure 4-10 Comparing normal and zoomed display in mode 3

4.6 Adjusting the Measurement Update Rate

You can select a predefined measurement update rate (4 Hz, 8 Hz, 16 Hz, 20 Hz, 30 Hz, or MAX). The measurement update rate indicator is always present on the left of the thickness measurement (see Figure 4-11 on page 76).



Figure 4-11 The measurement update rate indicator

The **MAX** update rate is up to 60 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 39DL PLUS automatically uses the fastest update rate when entering the **Minimum** or **Maximum** mode. The maximum is equal to 60 Hz in most standard measurement modes.

To adjust the measurement update rate

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

4.7 Changing the Thickness Resolution

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

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

The high resolution software option (P/N: 39DLP-HR [U8147015]) allows to increase the resolution to 0.001 mm (0.0001 in.). The high resolution is available for measured thickness smaller than 102 mm (4 in.). The high resolution is not active with low-frequency transducers and when the high penetration software option is activated.

To change the thickness measurement resolution

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

- **LOW**: 0.1 mm or 0.01 in.
 - Optional **HIGH**: 0.001 mm or 0.0001 in.
4. Press [**MEAS**] to return to the measurement screen.

5. Basic Operation

The following sections describe the basic operation for the 39DL PLUS ultrasonic thickness gauge.

5.1 Setting Up the Transducer

The 39DL PLUS operates with a full line of single element and dual element transducers. The 39DL 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 39DL 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 39DL PLUS case (see Figure 5-1 on page 80). Use T/R 1 for a single element transducer.

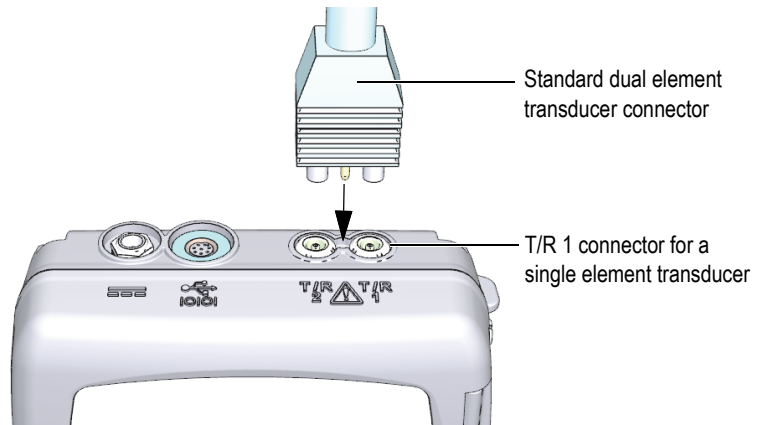


Figure 5-1 Plugging the transducer

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 80).

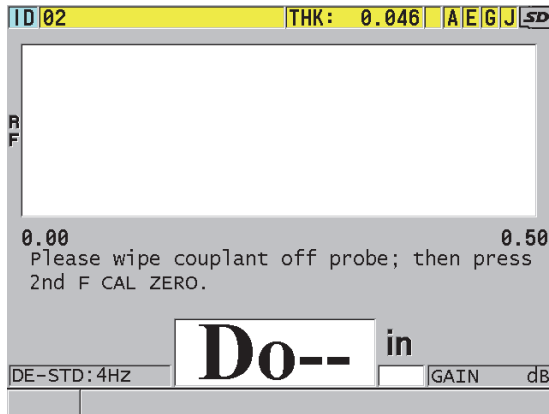
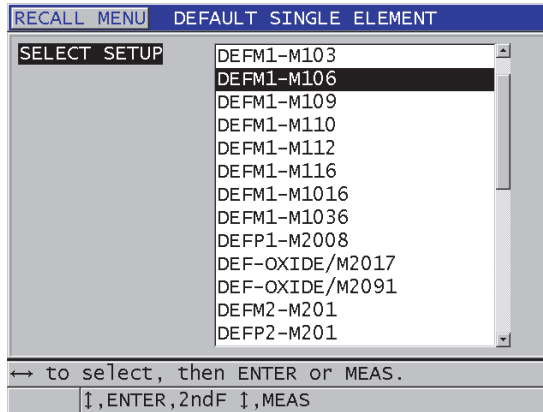


Figure 5-2 Initial screen with a standard D79X dual element transducer

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



Default setup naming convention:

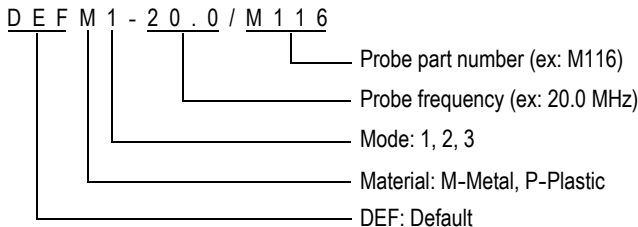


Figure 5-3 Selecting a default single element transducer setup

NOTE

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

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

5.2 Calibration

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

You need to perform the following three calibration types:

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

For dual element transducer only, calibrate for the sound transit time in each of the dual transducer delay lines. This compensation varies in each transducer unit and with temperature. You must perform the transducer zero compensation procedure when the unit is powered on, when the transducer is changed, and when the transducer temperature changes significantly (see “Setting Up the Transducer” on page 79 and “Transducer Zero Compensation” on page 86).

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

Perform a velocity calibration using a thick test block of the measured material with known thickness or by manually entering a previously determined material sound velocity. You must perform this procedure for each new measured material (see “Calibrating the Instrument” on page 83 and “Material Sound Velocity and the Zero Calibrations” on page 87).

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

Perform a zero calibration using a thin test block of the measured material with known thickness. Unlike the transducer zero compensation and the material sound velocity calibration, this procedure is not required unless you need the best absolute accuracy (better than ± 0.10 mm or ± 0.004 in.). You only need to do it once for each new transducer and material combination. You do not have to repeat the zero calibration when the transducer temperature changes; Transducer zero compensation is responsible for that task (see “Calibrating the Instrument” on page 83 and “Material Sound Velocity and the Zero Calibrations” on page 87).

5.2.1 Calibrating the Instrument

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

- Material sound velocity calibration
- Zero calibration

You must perform the calibrations using a thick and a thin sample of precisely known thicknesses. The sample must be made of the same material as the parts to be inspected (see “Test Blocks” on page 86 for details on test blocks).

The following procedure is illustrated using a dual element probe and a 5-step test block. Refer to “Calibration” on page 82 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 84):
 - 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.

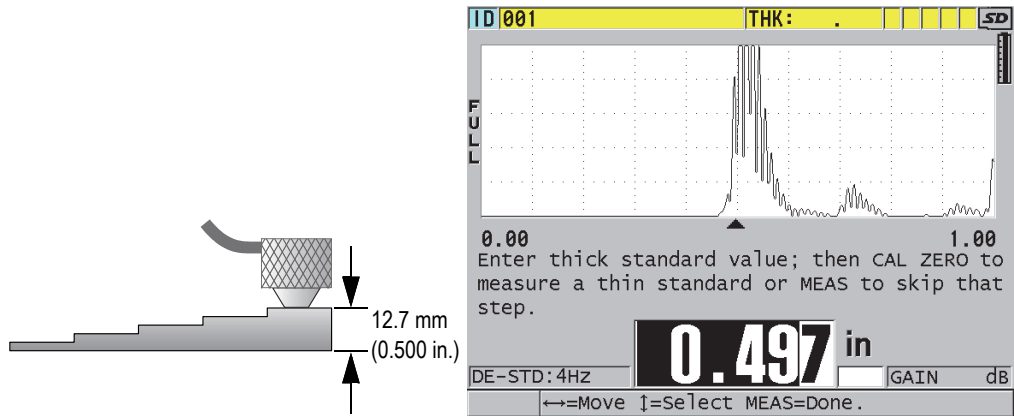


Figure 5-4 Performing the material sound velocity calibration on a 5-step test block

2. To perform the zero calibration (see Figure 5-5 on page 85):
 - a) Place a drop of couplant on the surface of the thin part of the test block.
 - b) Couple the transducer to the thin part of the test block, and then press **[CAL ZERO]**.
 - c) When the thickness reading is stable, press **[ENTER]**.
 - d) Using the arrow keys, edit the thickness value to match the known thin thickness of the test block.

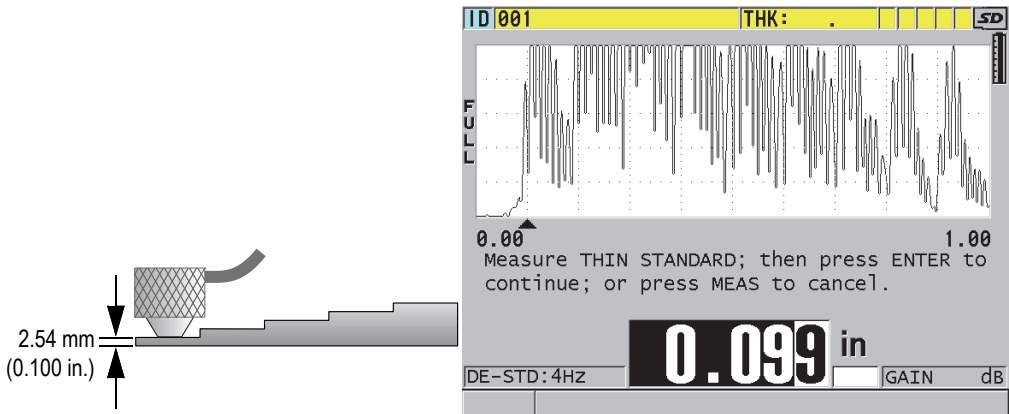


Figure 5-5 Performing the zero calibration on a 5-step test block

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

IMPORTANT

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

NOTE

When the 39DL PLUS detects an error in the calibration procedure, it successively displays the following messages in the help text bar before returning to the measurement screen:

“Potential wrong echo detected!”

“Invalid calibration results!”

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

5.2.2 Test Blocks

The 39DL 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 86).



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

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

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

5.2.3 Transducer Zero Compensation

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

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

NOTE

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

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

5.2.4 Material Sound Velocity and the Zero Calibrations

The 39DL 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 39DL 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 39DL PLUS compares the measured time of flight to the expected time of flight based on the current sound velocity. The 39DL 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 88), use the arrow keys to edit the velocity to the known value.

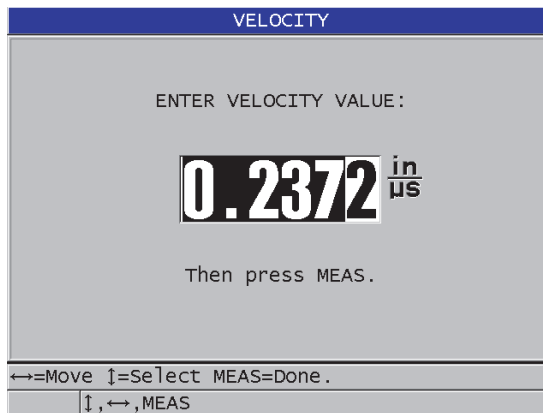


Figure 5-7 Entering a known material sound velocity

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

5.2.6 Locked Calibrations

The 39DL 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 89 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 39DL 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 gauge 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 39DL PLUS assumes the customary situation where the test piece is backed by air or a liquid, both of which have a lower acoustic impedance than metals, ceramics, or plastics. However, in some specialized cases, such as measurement of glass or plastic liners over metal, or copper cladding over steel, this impedance relationship is reversed and the echo appears phase reversed. In these cases, it is necessary to change the appropriate echo detection polarity in order to maintain accuracy. A more complex situation can occur in anisotropic or inhomogeneous materials such as coarse-grain metal castings or certain composites, where material conditions result in the existence of multiple sound paths within the beam area. In these cases, phase distortion can create an echo that is neither cleanly positive nor negative. Careful experimentation with reference standards is necessary in these cases to determine effects on measurement accuracy.

5.3 Measuring Thicknesses

You can start measuring thicknesses once a transducer is connected (see “Setting Up the Transducer” on page 79) and once the instrument is calibrated (see “Calibrating the Instrument” on page 83).

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 92).

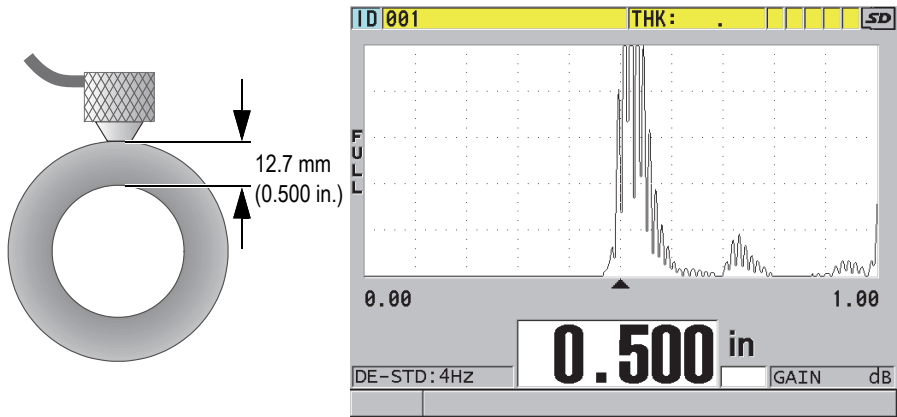


Figure 5-9 Coupling dual element transducer and reading the measured thickness

- Read the measured thickness value for the tested part.

5.4 Saving Data

The 39DL 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 93).

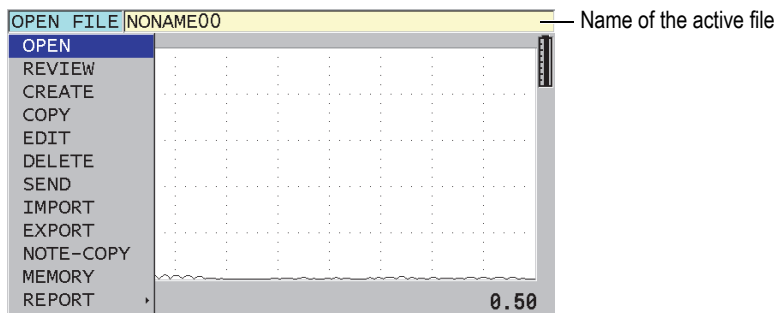


Figure 5-10 The active file name appearing in the ID bar

The NONAME00 increment type file, starting with the 001 ID, is the active file by default when you first use the 39DL 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 39DL PLUS.

To enable the THRU-COAT function

1. Connect a THRU-COAT transducer to the 39DL PLUS.
2. Start the instrument.
3. Wipe the couplant off the transducer tip.
4. Press [2nd F], [CAL ZERO] (Do ZERO).



Figure 5-11 Opening the THRU COAT SETUP dialog box

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

5.5.2 Performing a THRU-COAT Calibration

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

To perform a THRU-COAT calibration

1. Ensure that the THRU-COAT function is enabled (see “Enabling the THRU-COAT Function” on page 94).
2. Couple the transducer to the thick sample.
3. Press **[CAL VEL]**.
4. When the reading is stable, press **[ENTER]**.
5. Using the arrow keys, edit the thickness value to match the known thickness of the sample.
6. Couple the transducer to the thin sample.
7. Press **[CAL ZERO]**.
8. When the reading is stable, press **[ENTER]**.
9. Using the arrow keys, edit the thickness value to match the known thickness of the sample.
10. If the coating thickness measurement accuracy is important for your application, perform the following actions (omitting this step does not affect the accuracy of the metal thickness measurement):
 - a) Press **[CAL VEL]** again.
 - b) Couple the transducer to the coated sample.
 - c) When the reading is stable, press **[ENTER]**.
 - d) Using the arrow keys, edit the thickness value to match the known coating thickness of the coated sample.
11. Press **[MEAS]** to complete the calibration.

NOTE

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

5.6 Echo Detection Modes with Dual Element Transducers

With dual element transducers, the 39DL 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 96).

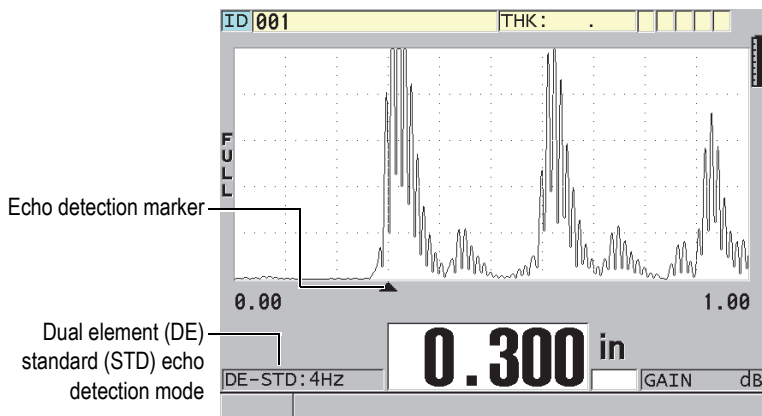


Figure 5-12 Measuring with the standard echo detection mode

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 layer 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 97). The echo height is automatically adjusted to a preset level.

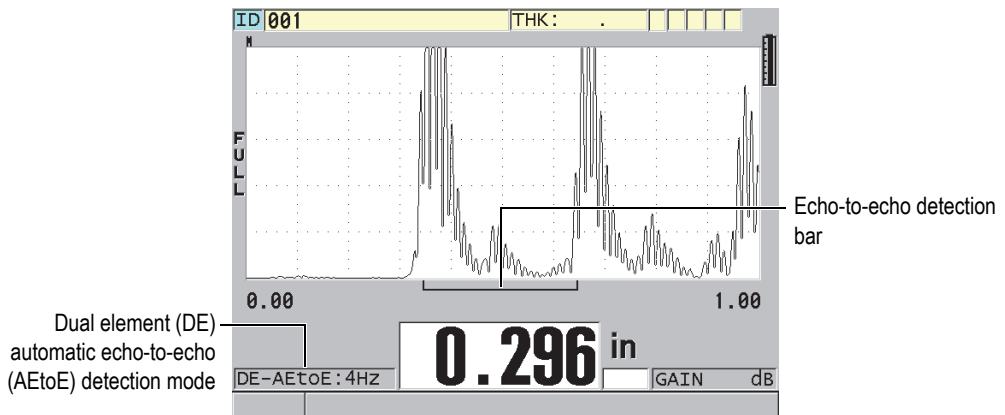


Figure 5-13 Measuring with the automatic echo-to-echo detection mode

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 98). 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.

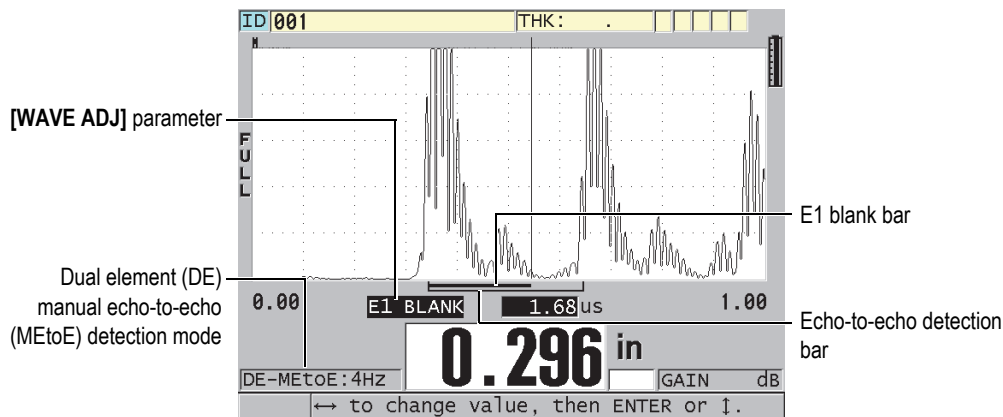


Figure 5-14 Measuring with the manual echo-to-echo detection mode

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 39DL 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 100).

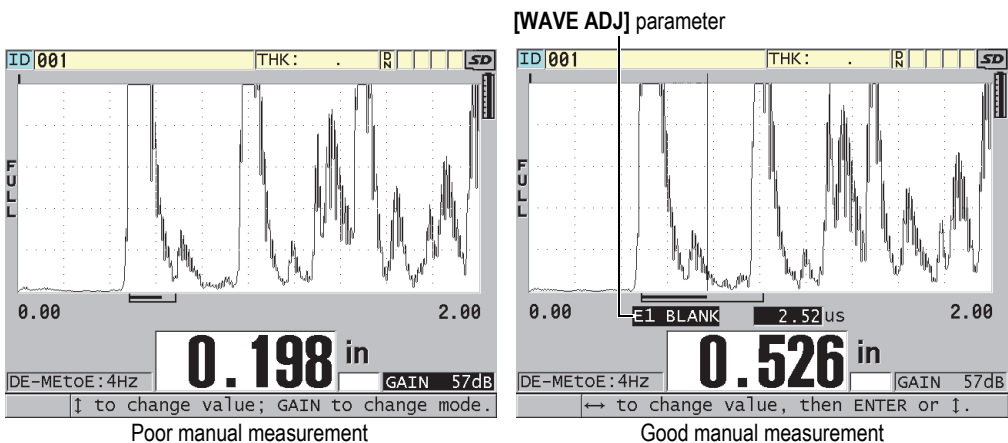


Figure 5-15 Comparing manual measurements

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

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

Although the echo-to-echo modes work with all of the 39DL PLUS dual element transducers, Evident recommends using particular transducers for specific thickness ranges in steel parts (see Table 3 on page 100).

Table 3 Recommended transducers for various steel thickness ranges

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

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

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

You can usually distinguish the unwanted shear-wave echo from the correct back-wall echo by examining the waveform display. The distance between the first and the second back-wall echoes is the same as the distance between the zero thickness point and the first back-wall echo. If there is an echo between the first two back-wall echoes, it is probably a mode-converted shear-wave echo. Use the manual echo-to-echo detection mode techniques and manually adjust the E1 blank to eliminate this error (see “Blanking Adjustments in Manual Echo-to-Echo Detection Mode” on page 99). Using the D797 transducer beyond 18 mm (0.7 in.) helps to eliminate the possibility of this error.

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

When the 39DL PLUS cannot make an echo-to-echo reading, the LOS flag appears on the screen. In this case, the waveform display shows that either no echoes are large enough to be detected or that only one echo is detectable. In this last case, the echo-to-echo detection bar begins at the detected echo but extends indefinitely to the right. Increase the gain value to make a good echo-to-echo reading. If this does not help, you can still obtain an approximate measurement by returning to the standard echo detection mode.

5.6.3 Echo-to-Echo Mode Datalogger Flags

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

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

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

5.7 Using the VGA Output

You can connect the 39DL PLUS to an external screen or projector to more easily show the content of the 39DL PLUS screen to other people. This feature is particularly useful when you need to train other 39DL PLUS users.

When you activate the VGA output, the 39DL 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 39DL PLUS.

To use the VGA output

1. Turn off the 39DL 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 39DL PLUS (see Figure 1-5 on page 41).
3. Connect the other end of the VGA output cable to the external screen or projector.
4. Turn on the 39DL PLUS.
5. Turn on the external screen or projector.
6. Press **[DISPLAY]**.
7. In the **DISPLAY SETTINGS** screen (see Figure 4-3 on page 68), set **VGA OUTPUT** to **ON**.
The 39DL PLUS screen becomes blank and the 39DL 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 39DL PLUS screen.

6. Using EMAT Transducers

This section provides background information regarding EMAT transducers and how to make basic thickness measurements using the 39DL PLUS and the E110-SB transducer.

An electromagnetic acoustic transducer (EMAT) uses the magnetostrictive principle to generate shear wave sound energy in ferrous metals that are externally coated with high temperature oxide scale. The E110-SB [U8471001] transducer does not work on nonferrous metal or in cases where the external surface is not coated with oxide scale. The EMAT transducer uses the external scale to generate shear wave sound energy and does not require the use of ultrasonic couplant. When the scale is not fully bonded to the surface of the steel, the shear wave sound energy is not transmitted to the steel.

The EMAT transducer is an effective way to estimate the remaining thickness of steel boiler tubes since you do not have to remove the external scale to perform the measurement. The EMAT transducer creates a nonfocused signal and is designed to give a good estimate of the remaining (± 0.25 mm or ± 0.010 in.) wall thickness. Because of the nonfocused nature of the transducer, it is relatively insensitive to small internal pits. The minimum thickness measurement capability of the 39DL PLUS and EMAT transducer is approximately 2.0 mm (0.080 in.) depending on material properties.

NOTE

Remove the external oxide and use a standard single or dual element transducer for a more accurate thickness measurement of remaining metal. Focused dual element transducers are also more sensitive to any internal pitting.

6.1 Connecting the E110-SB EMAT Transducer

You can use the E110-SB [U8471001] EMAT transducer with the 39DL PLUS. You need to use the EMAT 1/2XA/E110 [U8767104] filter adaptor and a standard LEMO-to-BNC cable (P/N: LCB-74-4 [U8800320]) as shown in Figure 6-1 on page 104.

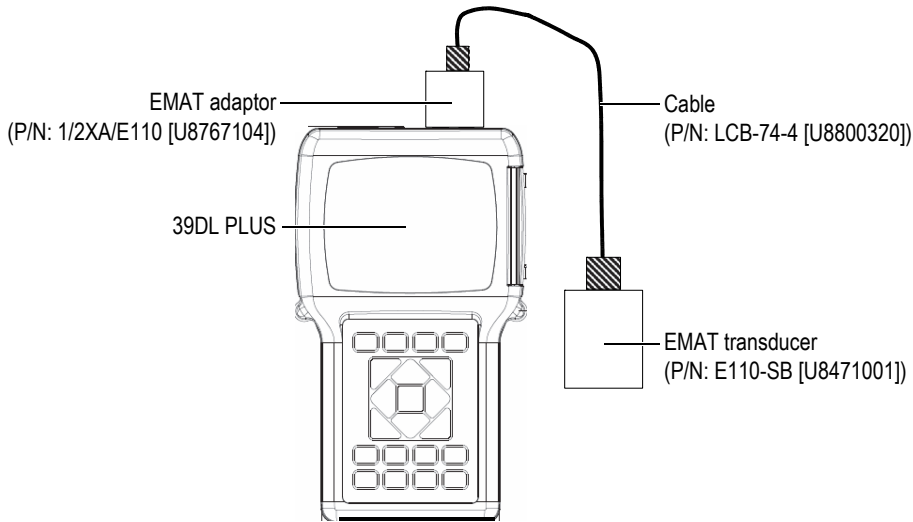


Figure 6-1 EMAT transducer and filter adaptor connection

The 39DL PLUS automatically detects the E110-SB and 1/2XA/E110 filter adaptor and automatically recalls the default **DEF-EMAT/E110** setup from the **DEFAULT SINGLE ELEMENT** transducer list. Like for standard transducers, you may need to adjust the gain and the extended blank to make proper thickness measurements. Experienced technicians familiar with the basic theory of ultrasonic gaging and the interpretation of ultrasonic waveforms can also press [**WAVE ADJ**] to adjust other transducer parameters.

6.2 Calibrating with the E110-SB EMAT Transducer

Calibration is the adjustment of the gauge so that it measures accurately on a particular material. The default velocity and zero offset for the E110-SB EMAT transducer are designed to provide a good estimate of the ferrous metal thickness underneath an external oxide scale coating.

To achieve the best accuracy, use calibration samples with external oxide scale made from the material to be tested. These samples should have a metal of known thickness (not including external oxide scale) and should represent the minimum and maximum thickness of your measurement range.

The calibration procedure is the same as for a standard transducer except that you do not need to use couplant to couple the transducer to the material. Refer to “Calibrating the Instrument” on page 83 for the calibration procedure.

NOTE

The EMAT transducer generates shear wave sound energy. Consequently, the velocity calculated by the gauge is the shear sound velocity of the material.

7. Software Options

You can increase the capability of the already versatile 39DL PLUS using the available software options (see Table 4 on page 107).

Table 4 39DL PLUS software options

Option	Description
HIGH RESOLUTION (see “High Resolution Software Option” on page 109)	Increases the thickness resolution to 0.001 mm or 0.0001 in. for single element transducers with a frequency ≥ 2.25 MHz.
OXIDE LAYER (see “Oxide Layer Software Option” on page 110)	Allows the 39DL PLUS to measure the thickness of both the boiler tube and its internal oxide.
MULTI-MEASUREMENT (see “Multi-Measurement Software Option” on page 115)	Allows the 39DL PLUS to measure and display up to four different layer thicknesses at the same time using single element transducers.
HIGH PENETRATION (see “High Penetration Software Option” on page 128)	Allows the 39DL PLUS to use low-frequency single element transducers (as low as 0.5 MHz) for thickness measurement in attenuating and sound scattering materials.

When you purchase a software option with the original 39DL PLUS order, the option is already activated. You can also purchase software options later. You can activate the software options without having to return the instrument to the factory, by entering an activation code in the instrument (see “Activating Software Options” on page 108).

Contact your local Evident representative for more information regarding ordering software options.

7.1 Activating Software Options

Each 39DL PLUS has a unique serial number code. An option key provided for a specific 39DL PLUS activates the purchased software options only on that specific 39DL PLUS unit. A single option key can activate one, several, or all software options.

To activate a software option

1. Press [2nd F], [SETUP MENU] (SP MENU).
2. In the menu, select **OPTIONS**.
3. In the **OPTIONS** screen (see Figure 7-1 on page 108), note the 16-digit alphanumeric serial number appearing in the **S/N** field. The **OPTION** list indicates the actual status of the software options where **Licensed** means that the option is activated.

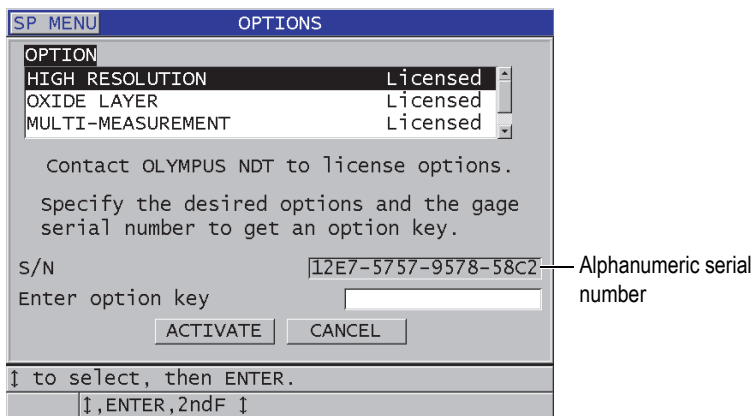


Figure 7-1 The OPTIONS screen to activate software options

4. Contact your local Evident representative to purchase one or more software options and provide the alphanumeric serial number. Your Evident representative will provide you the corresponding option key.
5. In the **OPTIONS** screen (see Figure 7-1 on page 108):

- a) In **Enter option key**, enter the option key that you received from the Evident representative.
 - b) Select **ACTIVATE**.
6. Restart the instrument to complete the activation.

7.2 High Resolution Software Option

The 39DL PLUS has the ability to display thickness values with its standard resolution of 0.01 mm (0.001 in.) and low resolution of 0.1 mm (0.01 in.). These resolutions are adequate for most ultrasonic thickness measurement applications.

For single element transducers, the high resolution software option adds the ability to display thickness readings with a high resolution of 0.001 mm (0.0001 in.). High resolution is not available for all transducers or measurement screens and is also limited by maximum thickness. Even though the 39DL PLUS has the ability to display thickness readings in high resolution, the measurement accuracy is highly dependent on material, geometry, surface condition, temperature, and needs to be determined on a case-by-case sample evaluation.

High resolution is available for the following transducers and measurement conditions:

- Single element transducer in the frequency range of 2.25 MHz to 30.0 MHz
- Thickness measurement below 100 mm (4.00 in.)

High resolution is not available for the following transducer or measurement conditions:

- Dual element transducers
- Low-frequency transducers with frequency below 2.25 MHz
- Thickness ranges over 100 mm (4.00 in.)

Once activated the high resolution selection appears in the resolution selection list (see “Changing the Thickness Resolution” on page 77).

7.3 Oxide Layer Software Option

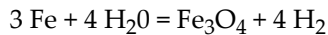
The oxide layer software option allows the 39DL PLUS to measure the thickness of both the boiler tube and its internal oxide at the same time. When the oxide layer option is activated, the **OXIDE** item appears in the menu when you press [SETUP MENU]. Table 5 on page 110 indicates the transducer to use when using the oxide layer software option.

Table 5 Oxide layer transducers

Transducer	Minimum internal scale thickness
M2017 [U8415002]	0.254 mm (0.010 in.)
M2091 [U8415018] normal incident shear	0.152 mm (0.006 in.)

7.3.1 Steam Boiler Tube Scale

The very high temperatures found inside steam boilers (over 500°C or 1000°F) can cause the formation of magnetite (a specific type of hard and brittle iron oxide), on the inside and outside surfaces of steel boiler tubes. At very high temperatures, water vapor reacts with the iron in the steel to form magnetite and hydrogen, according to the following formula:



The speed of this reaction increases with temperature. Oxygen atoms diffuse inward through the magnetite layer, and iron atoms diffuse outward, so that scale continues to grow even after the tube surface is completely covered.

Magnetite scale acts as a thermal insulation on the pipe, since the thermal conductivity of the scale is approximately 3% of that of steel. When heat no longer radiates efficiently from the flame through the tube and into the steam within, the tube wall heats to temperatures beyond intended operating range. Long term exposure to overly high temperatures, combined with the very high pressure inside the tube, leads to intergranular micro-cracking in the metal and to creep deformation (slow swelling or bulging of the metal). This eventually leads to tube failure.

The growth of magnetite scale and associated metal damage are primary limiting factors for boiler tube service life. The process begins slowly and then accelerates. As the scale grows thicker, the tube wall becomes hotter, which in turn increases the rate of both scale growth and metal damage. Studies in the power generation industry indicate that the effect of scale is relatively insignificant up to thicknesses of approximately 0.3 mm (0.012 in.). Beyond that thickness, the negative effects of scale increase rapidly. Measurement of scale thickness allows a plant operator to estimate remaining tube service life and to identify and replace tubes that are approaching the failure point. Ultrasonic testing with the 39DL PLUS provides a quick and nondestructive method for measuring scale.

7.3.2 Setting Up for Oxide Layer Measurement

You need to connect an appropriate transducer, select the corresponding default setup, and configure the oxide and material measurement parameters.

To set up for oxide layer measurement

1. Connect the M2017 or M2091 transducer to an LCM-74-4 cable.
2. Connect the cable to the T/R 1 single-element transducer connector at the top of the 39DL PLUS.
3. Press **[ON/OFF]** to start the instrument.
4. While in the measurement screen, press **[XD CR RECALL]**.
5. In the **DEFAULT SINGLE ELEMENT** screen, highlight **DEF-OXIDE/M2017** or **DEF-OXIDE/M2091** depending on which transducer you are using.
6. Press **[MEAS]**.
7. Press **[SETUP MENU]**.
8. In the menu, select **OXIDE**.
9. In the **OXIDE** screen (see Figure 7-2 on page 112):
 - a) In **OXIDE MEAS TYPE**, select the type of measurement for the oxide layer (**THICKNESS** or **TIME OF FLIGHT**).
 - b) In **MATERIAL MEAS TYPE**, select the type of measurement for the material layer.

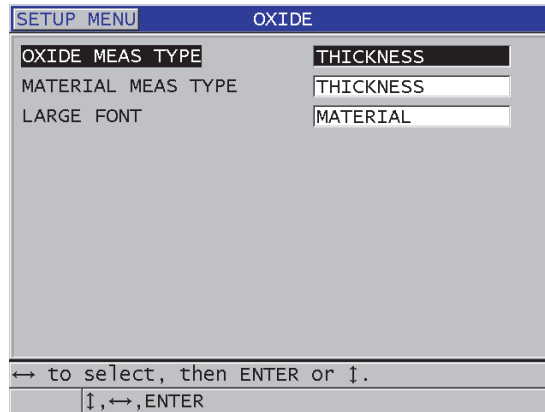


Figure 7-2 The OXIDE screen

- c) In **LARGE FONT**, select which measurement appears in the larger font in the measurement screen (see Figure 7-3 on page 112).

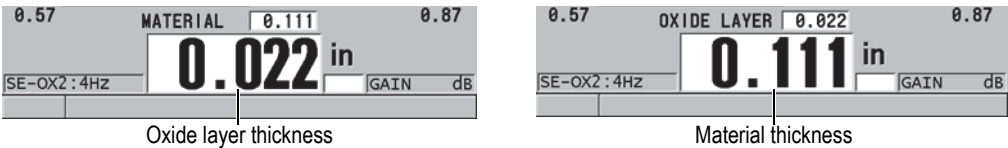


Figure 7-3 Selecting which measurement appears with the larger font

- Press **[MEAS]** to return to the measurement screen that is now showing both the **MATERIAL** and the **OXIDE LAYER** measurements.

7.3.3 Calibrating for Oxide Layer Measurement

For the best accuracy, perform the material sound velocity and zero calibrations on oxide-free samples with known boiler tube thickness and on a sample with known internal oxide scale thickness.

To calibrate for oxide layer measurements

- Couple the transducer to the thick oxide-free boiler tube sample.

NOTE

When using the M2091 normal incident shear transducer, you must use shear wave couplant (SWC) between the delay line and the surface of the material

2. Press **[CAL VEL]**.
3. When the reading is stable, press **[ENTER]**.
4. Using the arrow keys, edit the thickness value to match the known thickness of the thick sample.
5. Couple the transducer to the thin oxide-free boiler tube sample.
6. Press **[CAL ZERO]**.
7. When the reading is stable, press **[ENTER]**.
8. Using the arrow keys, edit the thickness value to match the known thickness of the thin sample.
9. Press **[CAL VEL]** again.
10. Couple the transducer to the sample with known internal oxide thickness.
11. When the reading is stable, press **[ENTER]**.
12. Using the arrow keys, edit the thickness value to match the known internal oxide thickness.
13. Press **[MEAS]** to complete the calibration.

7.3.4 Measuring Boiler Tube and Oxide Layer Thicknesses

With the oxide layer software option, the 39DL PLUS simultaneously measures the thickness of the boiler tube metal and the thickness of oxide scale that has built up inside the tube.

Figure 7-4 on page 114 shows the correct ultrasonic signals using the single element transducer default setup DEF-OXIDE/M2017. The 39DL PLUS makes a standard mode 2 measurement from the delay line echo (surface of the boiler tube) to the echo from the inside of the oxide layer (total back-wall echo). The instrument centers the data window on the detected total back-wall echo and then searches for the steel/oxide interface echo in the data window. An oxide echo marker indicates the detected steel/oxide interface echo.

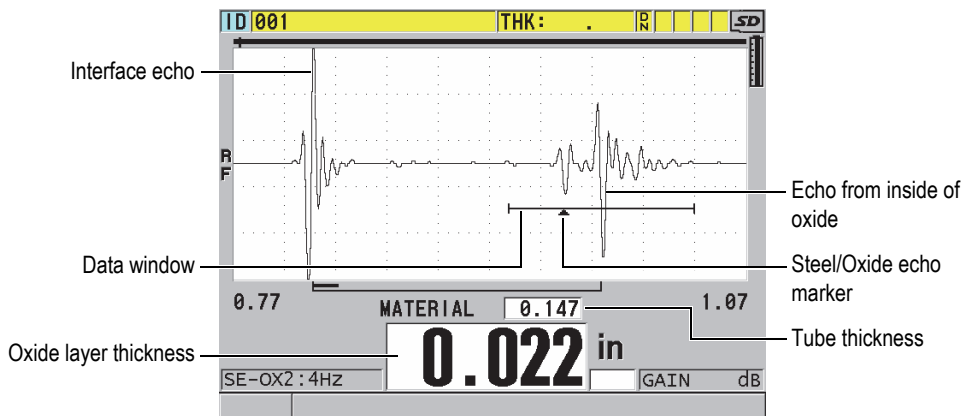


Figure 7-4 Measurement screen with the oxide layer software option

NOTE

To achieve accurate boiler tube and internal oxide scale thickness readings, remove any oxide scale or coating from the external surface of the boiler tube.

The minimum internal oxide thickness that the 39DL PLUS can measure depends on the material sound velocity but is approximately 0.254 mm (0.010 in.) with the M2017 transducer or 0.152 mm (0.006 in.) with the M2091 transducer. The 39DL PLUS only displays the thickness of the steel boiler tube when the internal oxide scale thickness is below the minimum measurement capability or when it is exfoliated (disbonded) from the inside of the boiler tube.

Figure 7-5 on page 115 shows a waveform from a sample in which the internal oxide layer is disbonded from the boiler tube. Because the oxide is disbonded, sound energy does not travel into the internal oxide layer, and only a single reflected echo from the inside of the boiler tube appears. When the internal oxide is thinner than 0.25 mm (0.010 in.), the waveform looks almost identical. The steel/oxide interface is so close in time to the echo from the inside of the oxide that it cannot be separated from the total back-wall echo and will produce a single echo.

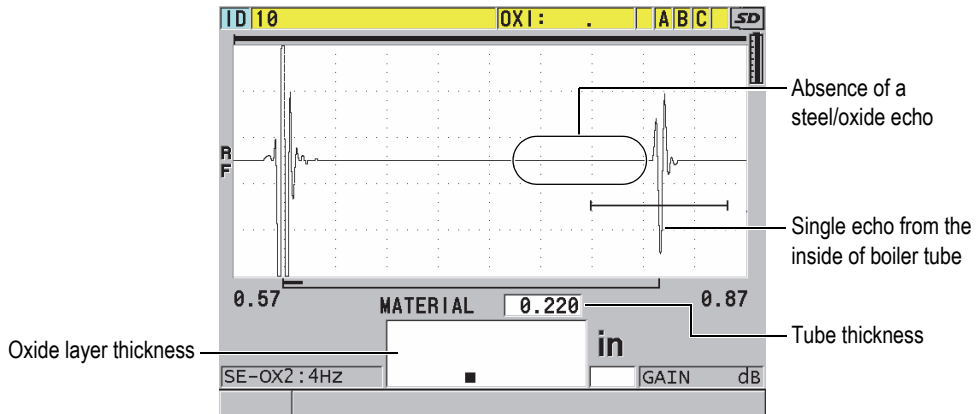


Figure 7-5 Measurement screen for a disbonded oxide layer

7.4 Multi-Measurement Software Option

The multi-measurement software option allows the 39DL PLUS to measure and display the individual thickness of up to four layers of multilayer materials. You can combine this function with the barrier layer thickness mode to measure the thickness of barrier layers in multilayer plastic containers. You can save the measured values to the internal datalogger or send them to a computer.

Multi-measurement common applications are:

- Multilayer plastic fuel tanks
- Multilayer plastic bottle preforms
- Multilayer aircraft windows
- Contact lenses: radius of curvature and thickness calculation
- Co-extruded plastic
- Two-layer hot tubs and spas

The 39DL PLUS has three different multi-measurement modes:

NORMAL

Measures and displays up to four different thickness layers or three layers and the sum of any selected layers.

SOFT CONTACT

Displays sagittal height and lens thickness, and calculates the radius of curvature of soft contact lenses. This mode is designed specifically for the measurement of soft contact lenses.

% TOTAL THK

Displays the thickness of any layer as a percentage of the total thickness. Use this mode for barrier layer measurement applications.

IMPORTANT

Before you can use the multi-measurement function with the **NORMAL** and the **% TOTAL THK** modes, you must create and save a custom setup for each thickness layer that you want to include in the multi-measurement. Refer to “Dual Element Transducer Setups” on page 231 for information about creating custom setups. All custom setups included in the multi-measurement configuration must use the same **PROBE TYPE**.

7.4.1 Active Measurement

With the multi-measurement, one of the displayed measurement is the active measurement. The value of the active measurement is highlighted and is repeated at the bottom of the screen. The corresponding waveform appears in the waveform display (see Figure 7-6 on page 117).

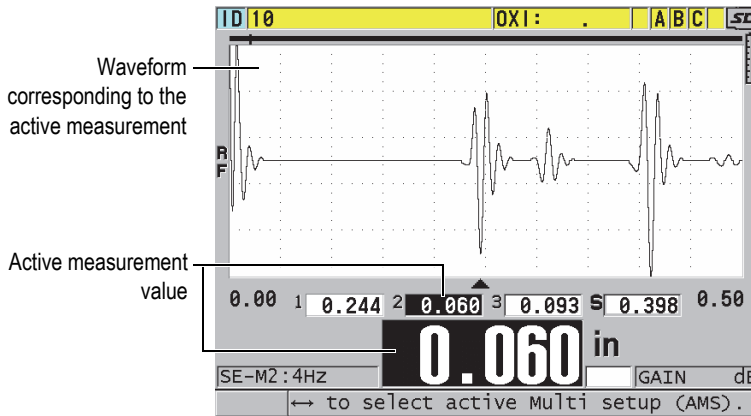


Figure 7-6 Waveform display screen

To change the active measurement

1. Enable the multi-measurement mode (see “Using the Multi-Measurement with the Soft Contact Mode” on page 119).
2. Use the arrows keys to change the active measurement.

7.4.2 Using the Multi-Measurement Normal Mode

Use the multi-measurement normal mode unless you want to show thickness values as a percentage of the total thickness or when you want to inspect soft contact lenses.

To use the multi-measurement normal mode

1. Create and store a custom setup to measure the thickness of each individual layer (see “Dual Element Transducer Setups” on page 231).
2. Ensure that the multi-measurement software option is activated (see “Activating Software Options” on page 108).
3. Press [SETUP MENU].
4. In the menu, select **MULTI**.
5. In the **MULTI** screen (see Figure 7-7 on page 118):
 - a) Set **MULTI ENABLE** to **ON**.

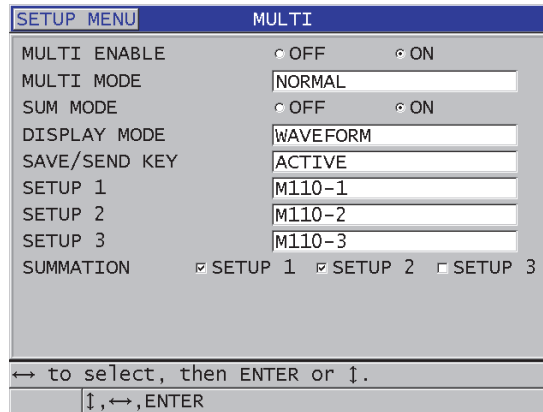


Figure 7-7 Setting multi-measurement parameters in the normal mode

- b) Set **MULTI MODE** to **NORMAL**.
- c) Set **SUM MODE** to one of the following options:
 - **ON**: Measures and displays up to three individual layer thicknesses and calculates and displays the sum of thicknesses for selected layers.
 - **OFF**: Measures and displays up to four individual layer thicknesses.
- d) Set **DISPLAY MODE** to (see Figure 7-8 on page 119):
 - **WAVEFORM** to display the multiple measurements horizontally below the waveform display.
 - **LARGE FONT** to display the multiple measurements vertically using large fonts.

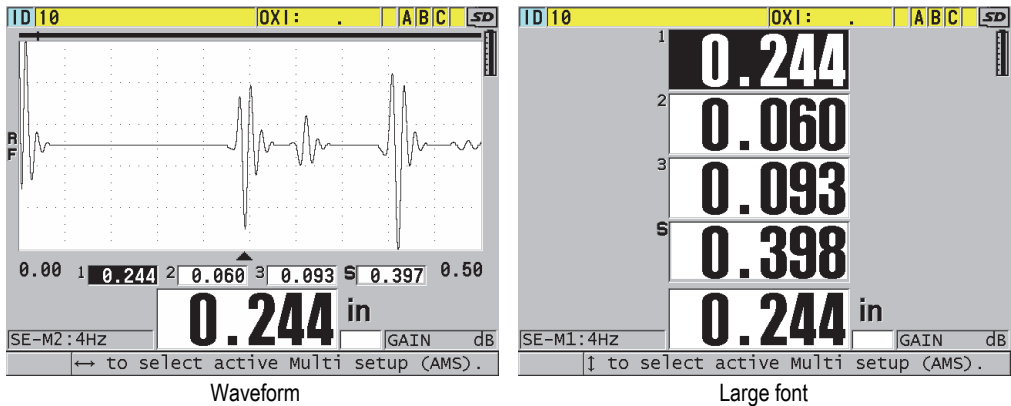


Figure 7-8 Multi-measurement display modes with three layers and the sum

- e) Set **SAVE/SEND KEY** to one of the following options to determine the operation when you press **[SAVE/SEND]**:
- **ACTIVE**: Saves only the active measurement (the highlighted thickness) to the datalogger.
 - **AUTO-INCR ACTIVE**: Saves the active measurement to the datalogger, and then changes the active setup to the next setup in the multi-measurement list. This option allows you to easily save all multilayer measurement by repeatedly pressing **[SAVE/SEND]**.
- f) For **SETUP 1**, **SETUP 2**, **SETUP 3**, and **SETUP 4**, select the custom setups that you created in step 1 for each of the layers. Selecting **NONE** shows no thickness at the location.
- g) When **SUM MODE** is set to **ON**, in **SUMMATION**, select the setups for which you want to sum the thickness measurements.
- h) Press **[MEAS]** to return to the measurement screen with the multi-measurement function active in the normal mode.

7.4.3 Using the Multi-Measurement with the Soft Contact Mode

Before you can use the multi-measurement function, you must create and save custom setups for the sagittal height and the lens thickness measurement. The 39DL PLUS calculates the radius of curvature using the sagittal height value and the diameter of the pedestal that you enter.

To use the multi-measurement with the soft contact mode

1. Create and store custom setups for the sagittal height and lens thickness measurements (see “Creating a Setup for Nonstandard Dual Element Transducers” on page 232).
2. Ensure that the multi-measurement software option is activated (see “Activating Software Options” on page 108).
3. Press **[SETUP MENU]**.
4. In the menu, select **MULTI**.
5. In the **MULTI** screen (see Figure 7-9 on page 121):
 - a) Set **MULTI ENABLE** to **ON**.
 - b) Set **MULTI MODE** to **SOFT CONTACT**.
 - c) Set **DISPLAY MODE** to **WAVEFORM** or **LARGE FONT** (see Figure 7-8 on page 119).
 - d) Set **SAVE/SEND KEY** to one of the following options to determine the operation when you press **[SAVE/SEND]**:
 - **ACTIVE**: Saves only the active measurement (the highlighted thickness) to the datalogger.
 - **AUTO-INCR ACTIVE**: Saves the active measurement to the datalogger, and then changes the active setup to the next setup in the multi-measurement list. This option allows you to easily save all multilayer measurement by repeatedly pressing **[SAVE/SEND]**.
 - e) In **SGTTL HT**, select the custom setup for the sagittal height measurement.
 - f) In **LENS THK**, select the custom setup for the lens thickness measurement.
 - g) In **PDSTL DIA**, enter the diameter of the pedestal being used.
 - h) Press **[MEAS]** to return to the measurement screen with the multi-measurement function active in the soft contact mode.

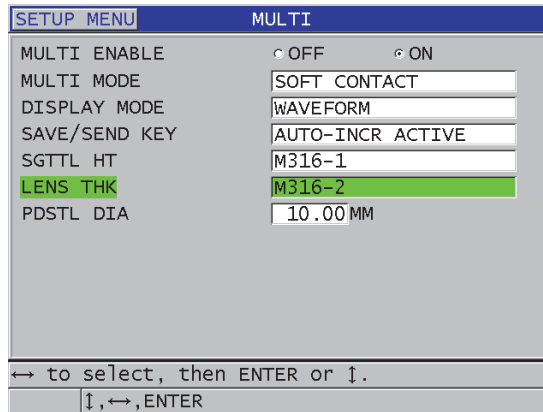


Figure 7-9 Setting multi-measurement parameters in the soft contact mode

7.4.4 Using the Multi-Measurement % Total Thickness Mode

The multi-measurement % total thickness mode is very similar to the normal mode. The difference is that it can measure the thickness of up to three layers and show the thickness of one layer as a percentage of the sum of selected layers.

To use the multi-measurement % total thickness mode

1. Follow the procedure to use the multi-measurement normal mode (see “Using the Multi-Measurement Normal Mode” on page 117) except that you set **MULTI MODE** to **% TOTAL THICKNESS**.
2. In the **MULTI** screen (Figure 7-10 on page 122):
 - a) In **TOTAL**, select the setups for which you want to sum the thickness measurements.
 - b) In **SHOW TOTAL**, select **YES** to show the calculated total thickness on the display while the multi-measurement is active.
 - c) In **SHOW AS %**, select the setups for which you want to show the thickness measurement as a percentage of the total thickness.
 - d) Press **[MEAS]** to return to the measurement screen with the multi-measurement function active in the % total thickness mode.

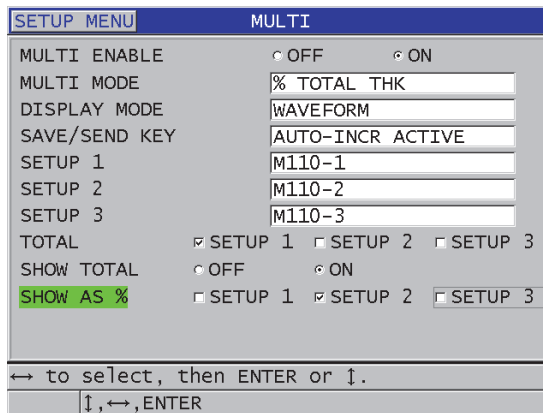


Figure 7-10 Setting multi-measurement parameters in the % total thickness mode

7.5 Encoded B-Scan Option

The 39DL PLUS standard software has the capability to save non-encoded B-scans. Non-encoded B-scans run at a fixed rate, and do not capture the distance traveled information with the scan. The Encoded B-Scan software option allows the 39DL PLUS to be connected to a linear encoder so that an encoded B-scan can be generated that captures the thickness and distance traveled in a linear B-scan. B-scans can be saved to the internal data logger, and uploaded to the GageView interface program.

The Encoded B-Scan option is designed to work with the Evident B-Scan Encoder Buggy (part number EP4/ENC [U8780018]), but it can be connected to other linear encoders. Please contact Evident for more information about connecting the 39DL PLUS encoded B-Scan to other encoders.

A maximum of 10000 thickness readings with distance traveled (DT) can be saved in a single B-scan. The B-scan also captures the minimum thickness location, in addition to the associated waveform for the minimum thickness. Saved B-scans can be reviewed on the 39DL PLUS, or transferred to the GageView interface program for review. The thickness and distance traveled data can be exported to Excel. The maximum number of B-scans that can be stored in the 39DL PLUS's internal memory is approximately 47 (10000 readings per scan).

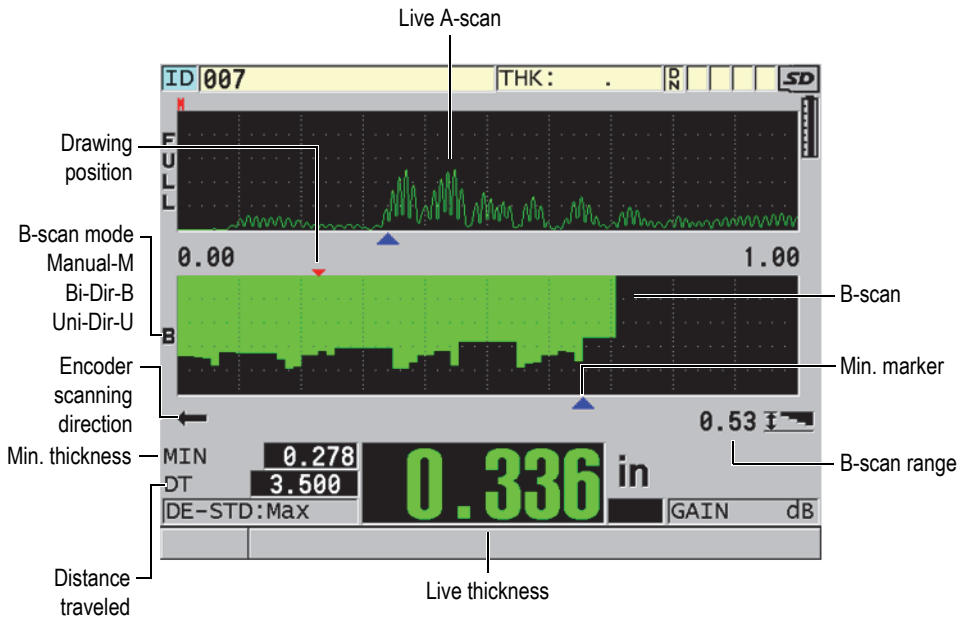


Figure 7-11 Encoded B-scan main screen

The optional B-scan feature can be activated using a software key. Please contact Evident to purchase the encoded B-scan feature.

In order to use the encoded B-scan feature you will need the following:

1. Encoded B-Scan software code (P/N: 39DLP-EBSCAN [U8147018])
2. B-Scan Encoder Buggy (P/N: EP4/ENC [U8780018])

NOTE

The EP4/ENC is designed to work with the D790 and D790-SM dual element transducers when the bell housing is not in place.

The D790 and D790-SM are not included with the EP4/ENC.

3. D790 or D790-SM transducer. Please contact Evident for pricing on longer cables for the D790-SM transducer.

4. Encoder cable; this cable connects the EP4/ENC B-Scan Encoder Buggy to the combination 11 pin USB/RS-232/B-scan connector located on the top of the 39DL PLUS.

Select one of the following:

- 3.05 m (10 foot) encoder cable (P/N: 39DLP-ENC-CBL-10 [U8840168])
- 7.62 m (25 foot) encoder cable (P/N: 39DLP-ENC-CBL-25 [U8840169])
- 15.24 m (50 foot) encoder cable (P/N: 39DLP-ENC-CBL-50 [U8840170])
- 30.48 m (100 foot) encoder cable (P/N: 39DLP-ENC-CBL-100 [U8840171])

The Encoded B-scan can be activated and configured from the **B-SCAN** screen (see Figure 7-12 on page 124) by pressing [SETUP MENU], and then selecting **B-SCAN** in the menu. Most of the controls for the encoded B-scan are the same as those for the standard non-encoded B-scan. Please refer to “B-Scan” on page 159 for more information concerning B-scan configuration.

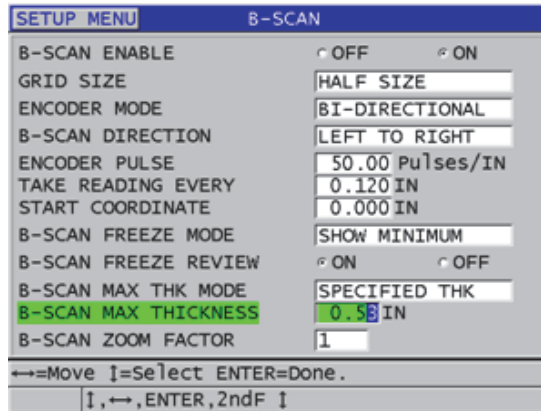


Figure 7-12 Changing B-scan parameters

Additional configuration parameters for the Encoded B-Scan option are listed below.

ENCODER MODE

MANUAL: Time based no encoder.

B-DIRECTIONAL: The B-scan moves forward or backward with the encoder.

UNI-DIRECTIONAL: The B-scan moves forward only, regardless of whether the encoder moves forward or backward.

ENCODER PULSE

The encoder pulse must be set in accordance with the encoder being used and its specifications. The Evident EP4/ENC Encoder Buggy is always set to 1.97 pulses/mm or 50 pulses/in..

TAKE READING EVERY

This indicates the spacing between measurements. There is fixed spacing based on the number of pulses per inch or per millimeter of the encoder.

NOTE

The smaller the spacing, the slower the maximum scan speed. Maximum scanning speed can be calculated as follows:

$$\text{Maximum scan speed} = 20 \times \text{Reading spacing}$$

Table 6 on page 125 provides sample scan-speed calculations.

Table 6 Sample scan-speed calculations^a

Spacing (in.)	Max. scan speed (in./sec)	Spacing (mm)	Max. scan rate (mm/sec)
0.040 (min. spacing)	0.80	1.016 (min. spacing)	20
0.100	2.00	1.524	30
0.200	4.00	2.032	40
0.500	10.00	12.70	254

a. Maximum reading spacing is 595.38 mm (25 in.)

Maximum B-scan distance is also dependent on the reading spacing setting. The maximum B-scan length can be calculated as follows:

$$\text{Maximum scan distance} = \text{Reading spacing} \times 10000$$

Table 7 on page 126 provides sample maximum-distance calculations.

Table 7 Sample maximum-distance calculations

Spacing (in.)	Max. scan distance (ft)	Spacing (mm)	Max. scan distance (m)
0.040 (min. spacing)	33.3	1.016 (min. spacing)	10.1
0.060	50	1.524	15.2
0.100	83	2.032	20.3
0.200	166.6	2.540	25.4
0.500	416.6	12.70	127.0

START COORDINATES

Used to set the starting point for the distance traveled by the scan. This is generally set to 0.00, but can be used to define the start point for multiple B-scans.

ZOOM FACTOR

Used to set the number of vertical lines on the B-scan representing a single thickness reading.

A zoom factor of 1 indicated that every vertical line in the B-scan represents a single thickness reading. Setting the zoom factor to 1 yields a very compressed B-scan image (see Figure 7-13 on page 127).

A zoom factor of 10 indicates that 10 vertical lines in the B-scan represent a thickness reading. Setting the zoom factor to 10 yields an expanded B-scan (see Figure 7-14 on page 127 and Figure 7-15 on page 128).

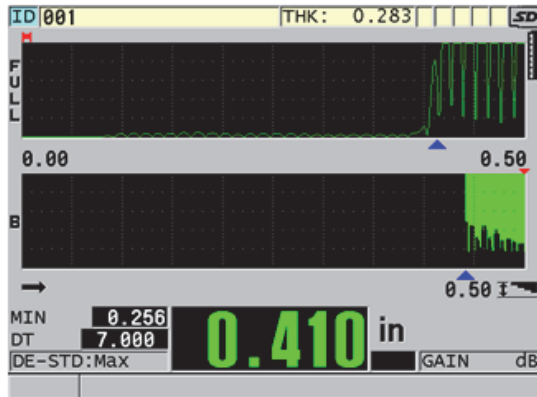


Figure 7-13 7 inch scan zoom set to 1

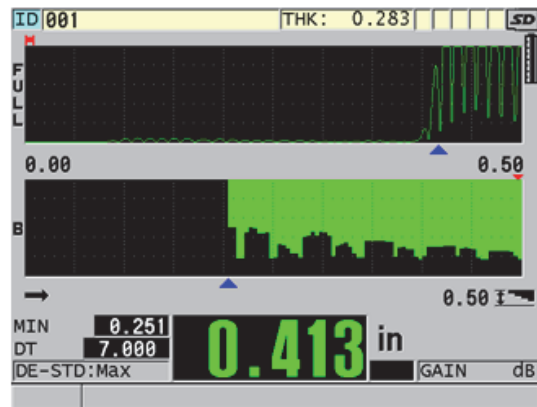


Figure 7-14 7 inch scan zoom set to 5

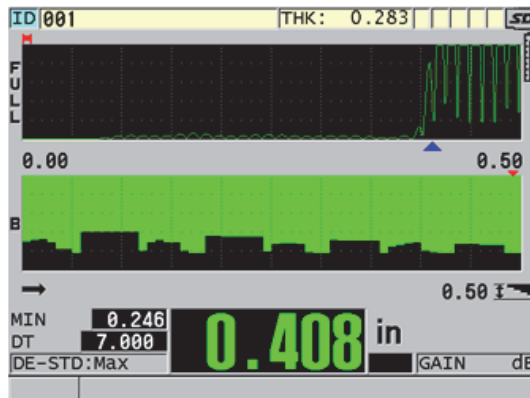


Figure 7-15 7 inch scan zoom set to 10

7.6 High Penetration Software Option

The 39DL PLUS high penetration software option coupled with low-frequency single element transducers (down to 0.5 MHz) allows you to make thickness, material sound velocity, and time of flight measurements, on materials such as composites, fiberglass, plastic, rubber, and cast metals that are difficult or impossible to measure using standard ultrasonic instruments. The M2008 [U8415001] transducer is a special low-frequency transducer used to measure the thickness of thick fiber reinforced polymer (FRP) and composite materials.

NOTE

With a M2008 transducer only, press [2nd F], [CAL ZERO] (Do ZERO) at any time to auto-adjust the zero offset and compensate for temperature changes in the delay line.

To use the high penetration software option with the M2008 transducer

1. Ensure that the high penetration software option is activated (see “Activating Software Options” on page 108 for details).
2. Connect the M2008 transducer to the T/R 1 and T/R 2 connectors at the top of the 39DL PLUS.

3. Press [**XDCR RECALL**].
4. In the menu, select **DEFAULT HP SINGLE ELEMENT**.
5. In the **DEFAULT HP SINGLE ELEMENT** screen, highlight the default transducer setup for the M2008 (**DEFP1-0.5-M2008**) or any custom setup that uses the M2008 transducer.
6. Press [**MEAS**] to return to the measurement screen with the recalled transducer setup.
7. Wipe couplant off the transducer tip.
8. Press [**2nd F**], [**CAL ZERO**] (**Do ZERO**).
9. Perform the material sound velocity and zero calibration (see “Calibrating the Instrument” on page 83).

7.7 WiFi Software Option

The 39DL PLUS has built-in WiFi. Enabling the WiFi option allows the 39DL PLUS to transmit stored data and stream readings via WiFi to computers, tablets, or phones.

7.8 Bluetooth Software Option

The 39DL PLUS has built-in Bluetooth. Enabling the Bluetooth option allows the 39DL PLUS to transmit stored data and displayed readings via Bluetooth to supported devices.

8. Using Special Functions

This chapter describes how to use special 39DL PLUS functions and modes. The 39DL PLUS has many thickness measurement features. Although the features outlined in this section are not required for basic thickness operation, they can make the gauge a more versatile instrument.

8.1 Activating and Configuring a Differential Mode

The 39DL PLUS includes differential modes to easily compare the actual measurement with a reference value that you enter. The actual thickness measurement appears on the thickness display and the differential value appears in the differential display area (see Figure 8-1 on page 131).

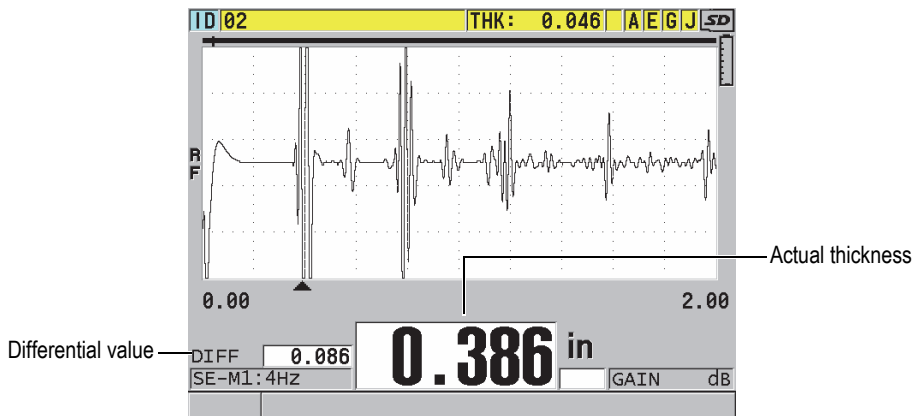


Figure 8-1 Normal differential mode

The units and resolution of the differential thickness are the same as those selected for the thickness measurement.

When you press [SAVE/SEND] while in **NORMAL** or **% RATIO** differential modes, the 39DL PLUS saves the actual thickness value along with the “D” flag, indicating that the **Differential** mode is active.

To activate and configure a differential mode

1. While in the measurement screen, press [SETUP MENU].
2. In the menu, select **DIFF**.
3. In the **DIFF** screen (see Figure 8-2 on page 133):
 - a) Set **DIFF ENABLE** to **ON** to activate the differential function.
 - b) In **DIFF MODE**, select one of the three differential modes:
 - **NORMAL**: Shows the actual thickness along with the difference between the actual thickness measurement and the **REF VALUE** that you entered.

$$\text{Differential}_{Normal} = \text{Current thickness} - \text{Reference value}$$

- **% RATIO**: Shows the actual thickness along with the percent difference from the **REF VALUE** that you entered.

$$\text{Differential}_{\% \text{ Ratio}} = \frac{\text{Current thickness} - \text{Reference value}}{\text{Reference value}} \times 100$$

- **REDUCTION RT**: Shows the actual thickness as well as the percent difference between the actual thickness and the former value. The former value is the thickness of the metal prior to the bending process. Use this mode for metal bending or other application in which you need to track the percentage of wall thinning.
- c) When **DIFF MODE** is set to **NORMAL** or **% RATIO**, in **REF VALUE**, enter the reference value.

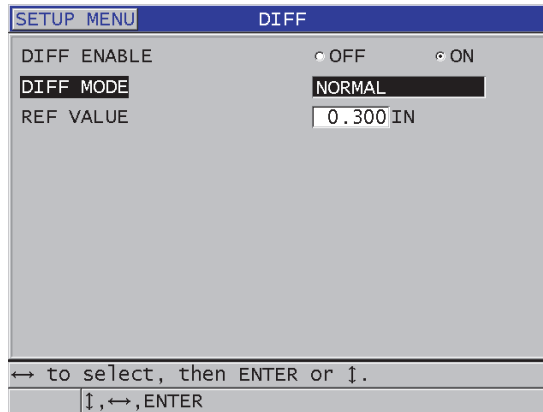


Figure 8-2 The DIFF screen

When **DIFF MODE** is set to **REDUCTION RT** only:

- d) In **FORMER THICKNESS**, enter the original thickness value, as measured before bending the metal.
 - e) In **LARGE FONT**, select which measurement appears at the bottom of the measurement screen with the large font (**THICKNESS** or **REDUCTION RT**).
4. Press **[MEAS]** to return to the measurement screen with the displayed differential value.

8.2 Using the Minimum, Maximum, or Min/Max Thickness Mode

You can activate the minimum, maximum, or min/max thickness mode to also display retained minimum and/or maximum thickness values. The **MIN** and/or **MAX** values appear on the left side of the main thickness reading (see Figure 8-3 on page 134). The minimum or maximum thickness value replaces the main thickness display when the transducer is uncoupled or when a loss-of-signal (LOS) occurs. The replacing value appears with outlined digits.

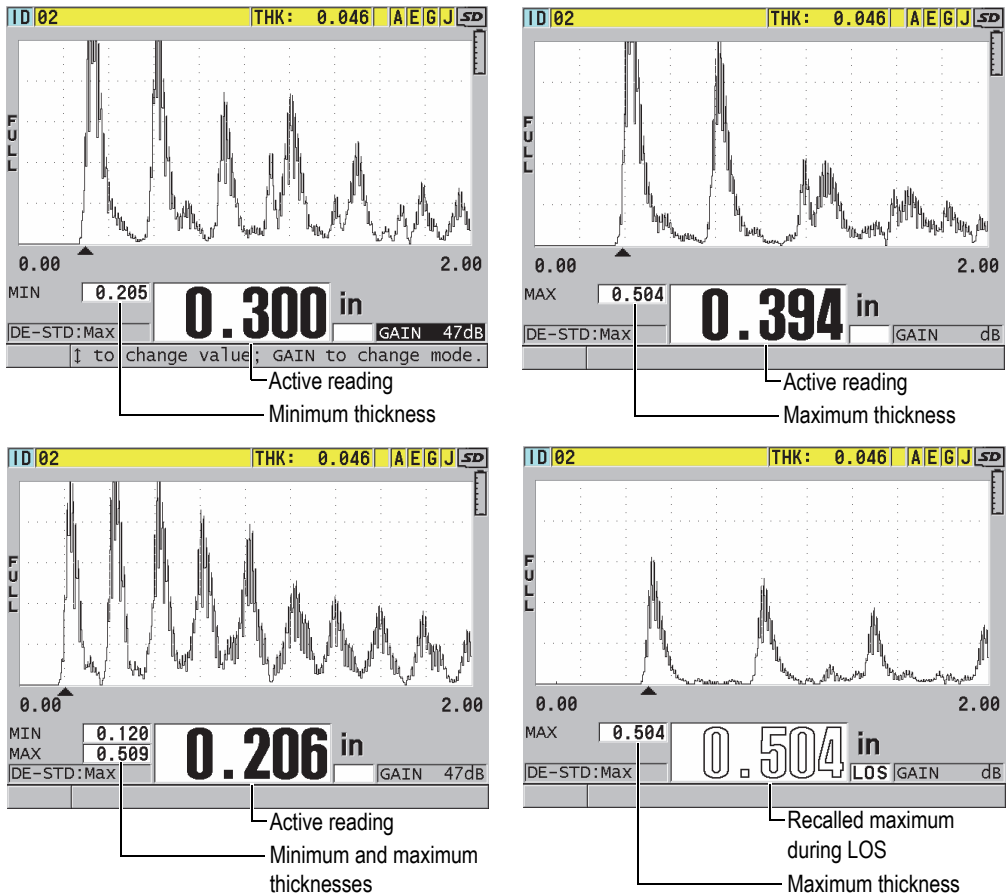


Figure 8-3 Displaying the minimum and/or maximum thickness

NOTE

The fastest display update rate is automatically activated when entering the minimum or maximum thickness mode. When leaving the mode, the display update rate is restored to its previous state.

The minimum and maximum thickness modes respectively display the smallest and largest thickness measured value from the time you activate the minimum mode or from the time you reset it. The modes are useful when it is important to determine the thinnest/thickest reading obtained while making a series of readings on a test piece.

To activate the minimum, maximum, or min/max mode

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **MEAS**.
3. In the **MEAS** screen, set **MIN/MAX** to the desired mode (**OFF**, **MIN**, **MAX**, or **BOTH**).
4. Press **[MEAS]** to return to the measurement screen.
5. In the measurement screen, press **[MEAS]** again to reset the held minimum, maximum, or min/max values.
The thickness display will blank indicating that the old **MIN/MAX** value is reset. Saving or sending a **MIN/MAX** reading also resets the value.

8.3 Preventing False Minimum/Maximum Thickness Readings

A false minimum or maximum reading can occur when you lift the transducer from the test piece. This is due to excess couplant, particularly on smooth surfaces, which causes the instrument to read the thickness of a couplant drop when you lift the transducer.

To prevent false minimum/maximum thickness readings

1. Activate the minimum or maximum thickness mode (see “Using the Minimum, Maximum, or Min/Max Thickness Mode” on page 133).
2. Before uncoupling the transducer, press **[FREEZE]** to freeze the waveform.
3. Once the transducer is uncoupled, press **[FREEZE]** again to unfreeze the display and recall the minimum thickness and waveform.

8.4 Using Alarms

You can activate one of the 39DL PLUS alarm modes to help you identify when the actual thickness measurement is above or below editable reference values.

When an alarm condition occurs, the 39DL PLUS warns you as follows:

- The **HIGH** or **LOW** alarm indicator flashes with a red background at the bottom right corner of the measurement screen (see Figure 8-4 on page 136).
- The thickness value appears in red.
- When the beeper is active (see “Setting the User Interface Language and Other System Options” on page 65), the 39DL PLUS emits a long beep.

NOTE

The thickness value and alarm indicator appear in color only when the indoor color scheme is active (see “Color Schemes” on page 68 to change the color scheme).

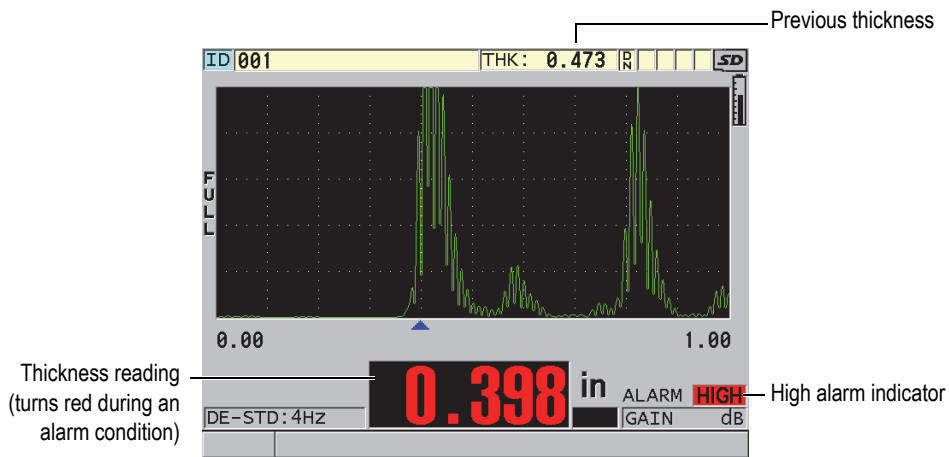


Figure 8-4 Example of a HIGH alarm indicator

The datalogger records an alarm condition in the second status box for all stored measurements. An **A** indicates the alarm mode, an **L** indicates a low alarm condition, and an **H** indicates a high alarm condition.

There are four different alarm modes (**STANDARD**, **PREVIOUS THK**, **B-SCAN**, and **REDUCTION RT**):

STANDARD

The standard alarm warns you when the actual measured thickness is below a low reference value or above a high reference value. The reference values are thickness set points using the current instrument units and resolution.

PREVIOUS THK

To use this function, you must first open a previously stored inspection file. The alarm uses the previous thickness value as its reference when determining if the actual thickness is in a high or low alarm condition. The previous thickness alarm warns you when the actual measured thickness is outside the alarm reference values when compared to the previous thickness value at each ID location within the file.

You can choose the **ABSOLUTE DIFF** (differential) mode to set the following parameters:

- When the thickness differential is smaller than or equal to the **ABSOLUTE LOSS** value, a low alarm is indicated.
- When the thickness differential is greater than the **ABSOLUTE GROWTH** value, a high alarm is indicated.

Table 8 on page 137 shows the result for an example where both **ABSOLUTE LOSS** and **ABSOLUTE GROWTH** are set to **1.27 mm (0.05 in.)**.

Table 8 Alarm calculation example with the ABSOLUTE DIFF mode

Previous values	Actual thickness	Low alarm	High alarm	Calculations
7.62 mm (0.300 in.)	6.07 mm (0.239 in.)	Yes	No	$7.62 - 6.07 > 1.27$ mm ($0.300 - 0.239 > 0.050$ in.)
7.62 mm (0.300 in.)	8.03 mm (0.316 in.)	No	Yes	$8.03 - 7.62 > 0.127$ mm ($0.316 - 0.300 > 0.005$ in.)
7.62 mm (0.300 in.)	7.24 mm (0.285 in.)	No	No	$7.62 - 7.24 < 0.127$ mm ($0.300 - 0.285 < 0.050$ in.)
7.62 mm (0.300 in.)	7.67 mm (0.302 in.)	No	No	$7.67 - 7.62 < 0.127$ mm ($0.302 - 0.300 < 0.005$ in.)

You can also choose the **% DIFF** (differential) mode to set the following parameters:

- When the thickness differential is smaller than or equal to the **% LOSS** value, a low alarm is indicated.

- When the thickness differential is greater than the % **GROWTH** value, a high alarm is indicated.

Table 9 on page 138 shows the result for an example where both % **LOSS** is set to 20% and % **GROWTH** is set to 5%.

Table 9 Alarm calculation example with the % DIFF mode

Previous values	Actual thickness	Low alarm	High alarm	Calculations
7.62 mm (0.300 in.)	6.07 mm (0.239 in.)	Yes	No	$\frac{7.62 - 6.07}{7.62} \times 100 > 20\%$ <p>or in inches:</p> $\frac{0.300 - 0.239}{0.300} \times 100 > 20\%$
7.62 mm (0.300 in.)	8.03 mm (0.316 in.)	No	Yes	$\frac{8.03 - 7.62}{7.62} \times 100 > 5\%$ <p>or in inches:</p> $\frac{0.316 - 0.300}{0.300} \times 100 > 5\%$
7.62 mm (0.300 in.)	7.24 mm (0.285 in.)	No	No	$\frac{7.62 - 7.24}{7.62} \times 100 < 20\%$ <p>or in inches:</p> $\frac{0.300 - 0.285}{0.300} \times 100 < 20\%$
7.62 mm (0.300 in.)	7.67 mm (0.302 in.)	No	No	$\frac{7.67 - 7.62}{7.62} \times 100 < 5\%$ <p>or in inches:</p> $\frac{0.302 - 0.300}{0.300} \times 100 < 5\%$

B-SCAN

The B-scan alarm mode is similar to the standard alarm mode except that in the B-scan alarm mode, lines are shown in the B-scan grid when the reference values fall within the B-scan thickness range (see Figure 8-5 on page 139). In addition, the alarms are operational as you review B-scan thicknesses in B-scan freeze review mode.

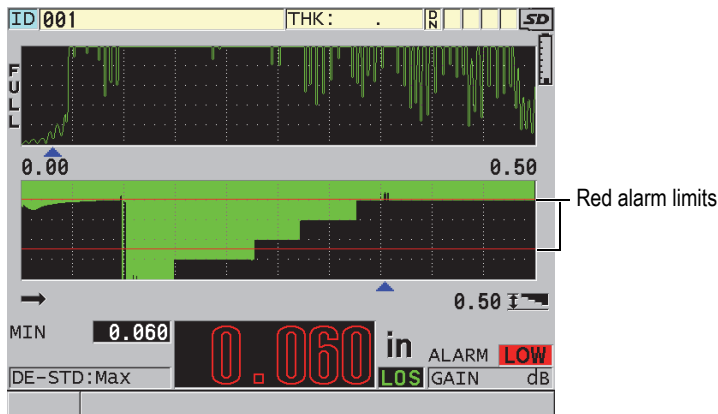


Figure 8-5 Example of a B-scan alarm mode

NOTE

The thickness value and the alarm indicator appear in color only when the indoor color scheme is active (see “Color Schemes” on page 68 to change the color scheme).

REDUCTION RT

The **REDUCTION RT** option appears only when the active file is configured with **FILE DATA MODE** set to **REDUCTION RT**. You set the reduction percentage for a low (**YELLOW ALARM**) and high (**RED ALARM**) limits, and the instrument displays (see Figure 8-6 on page 140):

- The **RED** indicator for reduction rates that are greater than or equal to the **RED ALARM** value.
- The **YEL** indicator for reduction rates that are between the **YELLOW ALARM** and the **RED ALARM** values.
- The **GRN** indicator for reduction rates that are below the **YELLOW ALARM** value.

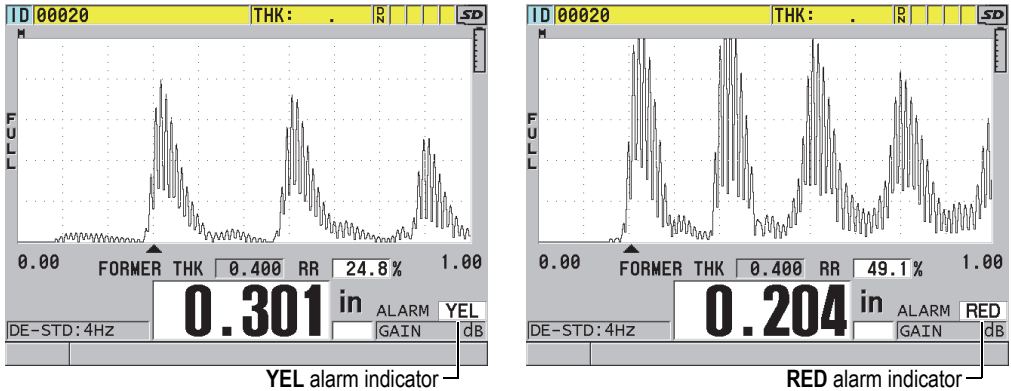


Figure 8-6 YEL (yellow) and RED alarm indicators

To set the alarm

1. From the measurement screen, press [SETUP MENU].
2. In the menu, select **ALARM**.
3. In the **ALARM** screen (see Figure 8-7 on page 141):
 - a) Set **ALARM ENABLE** to **ON** to activate the alarm function.
 - b) In **ALARM MODE**, select the desired alarm mode (**STANDARD**, **PREVIOUS THK** [previous thickness], **B-SCAN**, or **REDUCTION RT** [reduction rate]).
The other parameters vary depending on the alarm mode selection.

NOTE

The **B-SCAN** option appears only when the B-scan mode is active (see “Using the B-Scan” on page 164).

The **REDUCTION RT** option appears only when the active file is configured with the **FILE DATA MODE** parameter set to **REDUCTION RT** (see “File Data Modes” on page 202).

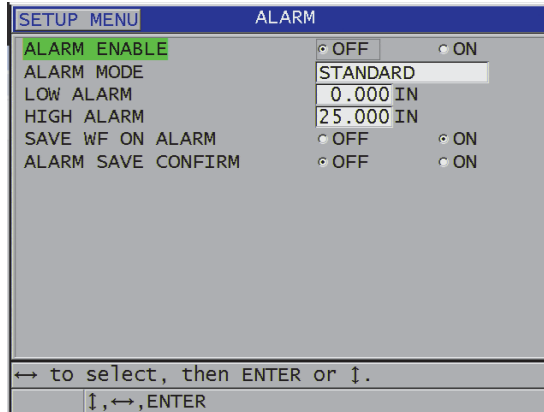


Figure 8-7 Setting up the STANDARD alarm

4. When **ALARM MODE** is set to **STANDARD** or **B-SCAN**, set the **LOW ALARM** and the **HIGH ALARM** values.

OR

When **ALARM MODE** is set to **PREVIOUS THK**:

- a) With **PREVIOUS THK MODE** set to **ABSOLUTE DIFF** [absolute differential], set the **ABSOLUTE LOSS** and the **ABSOLUTE GROWTH** values.
- b) With **PREVIOUS THK MODE** set to **% DIFF** [percent differential], set the **% LOSS** and the **% GROWTH** values.

OR

When **ALARM MODE** is set to **REDUCTION RT**, set the **YELLOW ALARM** and the **RED ALARM** values.

5. Select **ON** for **SAVE WF ON ALARM** to configure the device to save the waveform image and thickness value when an alarm condition is reached and the **Save** key is pressed.
6. Select **ON** for **ALARM SAVE CONFIRM** to require a confirmation before saving the reading that triggered the alarm condition.
7. Press **[MEAS]** to return to the measurement screen.

NOTE

Alarm reference values that were entered in one unit system are displayed as the equivalent value when the alternate units are selected.

8.5 Locking the Instrument

The 39DL PLUS offers an instrument lock allowing a supervisor to restrict access to selected functions. The supervisor can also enter a password to prevent other users from unlocking the functions. Once a password has been set, you must reenter the password before you can lock or unlock any function.

You can lock the following functions (ON=Locked):

- Calibration with [CAL VEL] and [CAL ZERO] ([2nd F], [CAL ZERO] (Do ZERO) still available)
- Setup menus accessed with [SETUP MENU] and [SP MENU]
- Transducer setup recall with [XDCR RECALL]
- Datalogger operations (except [SAVE/SEND])
- Gain adjustment with [GAIN]
- Waveform adjustment with [WAVE ADJ]
- WiFi
- Bluetooth

Locking the calibration prevents changes to calibration values so that no parameters can affect the value of the measurement; these include material velocity and test block zero calibration. However, you can still view these values, use the measurement screen, and use the datalogger functions.

Anytime a user attempts to use a locked function, a message appears in the help bar to indicate that the function is locked (see Figure 8-8 on page 142).



Figure 8-8 Example of a locked function message in the help bar

To set the password

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **PASSWORD SET**.
3. In the **PASSWORD SET** screen, in **INSTRUMENT PASSWORD**, enter your password using up to eight alphanumeric characters.

IMPORTANT

If you forget the password, you can unlock the instrument and deactivate the password by entering the master password "OLY39DLP".

When you want to change the password, you must first use the master password to deactivate the password, and then set a new password.

4. Select **SET** to set the password and return to the measurement screen.

To lock and unlock instrument functions

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **INSTRUMENT LOCK**.
3. In the **INSTRUMENT LOCK** screen (see Figure 8-9 on page 144):
 - a) If a password was set, enter the password in **PASSWORD**.
 - b) Set the functions you want to lock to **ON** and the ones you want to unlock to **OFF**.
 - c) Select **SET** to activate the instrument lock and return to the measurement screen.

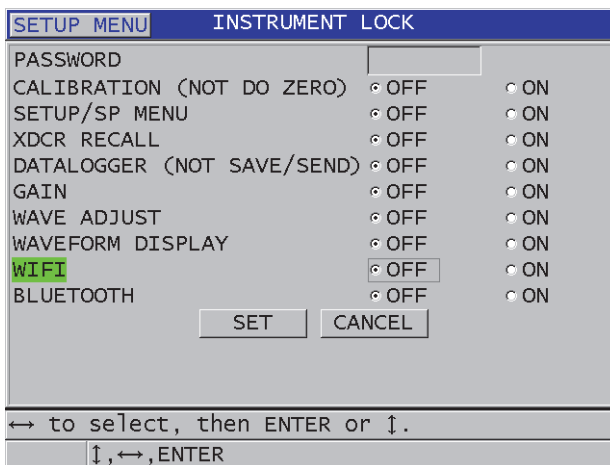


Figure 8-9 The INSTRUMENT LOCK screen

8.6 Freezing Waveforms

Pressing **[FREEZE]** stops updating the displayed waveform and keeps the waveform and thickness on the display even if you move or uncouple the transducer. The freeze indicator (**F**) appears on the right side of the waveform display when the freeze function is active.

The freeze function is convenient to easily set the gain parameters, review a B-scan, or perform a high temperature measurement, without having to maintain the transducer coupled to the test piece.

You may also want to use the freeze function to pause measurements before uncoupling the transducer from the test piece, to prevent recording wrong minimum or maximum values.

To freeze the waveform and thickness display

1. Press **[FREEZE]** while making a measurement.
2. Press **[FREEZE]** again to unfreeze the waveform and thickness display.

NOTE

Pressing [MEAS] or [SAVE/SEND] also unfreezes the display.

9. Configuring the Instrument

This chapter describes how to configure various instrument parameters.

9.1 Configuring Measurement Parameters

The **MEAS** setup is the most commonly used setup menu screen where you access global parameters concerning the instrument measurement features.

To configure measurement parameters

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **MEAS**.
The **MEAS** screen appears. The last parameters differ depending if a single or dual element transducer is connected (see Figure 9-1 on page 147).

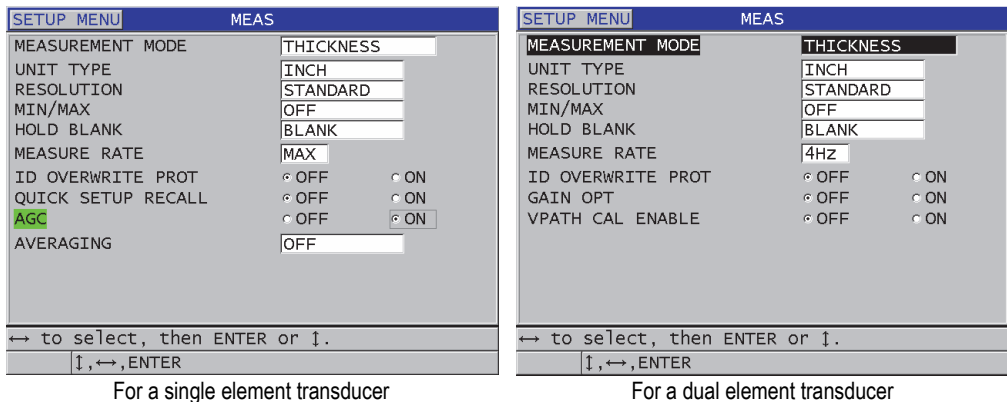


Figure 9-1 The MEAS screen

3. In **MEASUREMENT MODE**, select what the instrument measures and displays among the following options:
 - **THICKNESS**: the thickness of the inspected part
 - **VELOCIMETER**: the sound velocity in the material of the inspected part
 - **TIME OF FLIGHT**: the round trip time-of-flight (TOF) of the sound in the inspected part
 4. In **UNIT TYPE**, select between the **INCH** (English) or **MILLIMETER** (metric) units.
Time-of-flight measurements are always expressed in microseconds.
 5. In **RESOLUTION**, select between **STANDARD**, **LOW**, or **HIGH** (see “Changing the Thickness Resolution” on page 77 for details).
 6. In **MIN/MAX**, select to activate either the **MIN** (minimum), **MAX** (maximum), or **BOTH** modes (see “Using the Minimum, Maximum, or Min/Max Thickness Mode” on page 133 for details).
 7. In **HOLD BLANK**, configure the instrument to either continue to show (**HOLD**) or not hold (**BLANK**) the last measured thickness and waveform while a loss-of-signal (LOS) occurs.
-

NOTE

The **MIN/MAX** and **HOLD BLANK** functions are mutually exclusive. You must set **MIN/MAX** to **OFF** to be able to change the **HOLD BLANK** function. Similarly, you must set **HOLD BLANK** to **BLANK** to be able to change the **MIN/MAX** function.

8. In **MEASURE RATE**, adjust the measurement update rate (see “Adjusting the Measurement Update Rate” on page 76 for details).
 9. Set **ID OVERWRITE PROT** to **ON** if you want to see a confirmation message in the help bar when attempting to save a measurement reading in an ID that already contains a value (see “Setting the ID Overwrite Protection” on page 216 for details).
 10. For single element transducers only, set **QUICK SETUP RECALL** to **ON** to activate the quick recall of the first four custom setups using the combination of **[2nd F]** and the arrow keys (see “Quickly Recalling a Custom Setup for Single Element Transducers” on page 260 for details).
 11. For single element transducers only, set **AGC** to **ON** to set the automatic gain control (AGC) function to automatically bring all measured back-wall echoes to the same amplitude.
-

TIP

The **AGC** function works well for most standard thickness gauge applications and is by default turned on. In some thickness applications, the receiver gain is set at or near its maximum value. In such cases, turn off the AGC function to prevent reading instability.

12. For single element transducers only, set **AVERAGING** to **OFF** to turn thickness averaging off, set **AVERAGING** to **ON** to perform a running average of the last 5 thickness readings, or set **AVERAGING** to **On-QBar** to display a quality measurement Q-bar below the measurement screen indicating the stability of the averaged reading.
13. For dual element transducers only, set **GAIN OPT** to **ON** to activate the gain optimization during the zero and material velocity calibrations (see “Material Sound Velocity and the Zero Calibrations” on page 87 for details).
14. For dual element transducers only, set **VPATH CAL ENABLE** to **ON** to activate the V-Path calibration option when you press **[CAL VEL]** (see “Building a V-Path Correction Curve for a Nonstandard Dual Element Transducer” on page 236 for details).
15. Press **[MEAS]** to return to the measurement screen.

9.2 Configuring System Parameters

The **SYSTEM** screen, allows you to configure many 39DL PLUS system parameters.

To configure system parameters

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **SYSTEM**.
The **SYSTEM** screen appears (see Figure 9-2 on page 150).

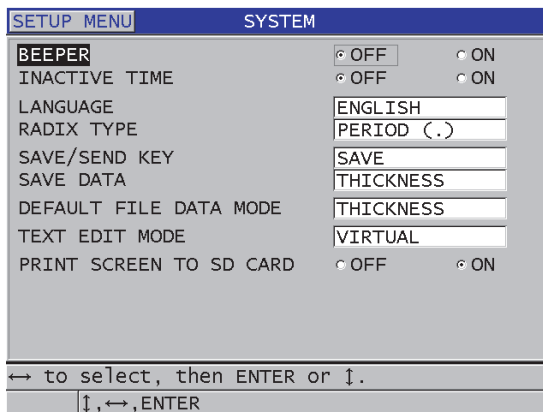


Figure 9-2 The SYSTEM screen

3. Set **BEEPER** to **ON** or **OFF** (see “Setting the User Interface Language and Other System Options” on page 65 for details).
4. Set **INACTIVE TIME** to **ON** or **OFF** (see “Setting the User Interface Language and Other System Options” on page 65 for details).
5. In **LANGUAGE**, select the desired user interface language (see “Setting the User Interface Language and Other System Options” on page 65 for details).
6. Set **RADIX TYPE** to the desired character (period or comma) to separate the integer and the decimal numbers.
7. Set **SAVE/SEND KEY** to configure what happens to the actual data (as set in **SAVE DATA**) when you press [**SAVE/SEND**]. The options are:
 - **SAVE**: saves the actual data to the internal datalogger.
 - **SEND**: sends the actual data to the RS-232 port (see “Setting Up RS-232 Serial Communication” on page 266 for details on RS-232 data communication).
 - **SAVE + SEND**: saved the data to the internal datalogger and sends the data to the RS-232 port.

NOTE

The **SAVE/SEND KEY** parameter also affects the save/send operation triggered using the optional foot switch. The 39DL PLUS cannot send a single thickness value through the USB communication port.

8. Set **SAVE DATA** to save only the thickness measurement (**THICKNESS**) or both the thickness and the waveform (**THK+WF**).

NOTE

The calibration and setup parameters are also always saved/sent along with the thickness measurement.

9. Set **DEFAULT FILE DATA MODE** to the desired default file data mode when you create a file (see “File Data Modes” on page 202 for details).
10. Set **TEXT EDIT MODE** to choose how to enter alphanumeric values using either the virtual keyboard (**VIRTUAL**) or the legacy character wheel selection (**TRADITIONAL**) [see “Selecting the Text Edit Mode” on page 60 for details].
11. Set **PRINT SCREEN TO SD CARD** to **ON** to enable the 39DL PLUS to create a BMP image file on the external microSD card for the actual screen shot, when you press **[2nd F]**, **[DISPLAY]** (see “Sending a Screen Capture to the External microSD Card” on page 280 for details).
12. Press **[MEAS]** to return to the measurement screen.

9.3 Configuring Communications

The 39DL PLUS features an RS-232 and a USB port allowing you to connect the instrument to a computer, or optional accessories such as a caliper. The 39DL PLUS also contains built-in Bluetooth and WiFi for wireless connection. When connected to a computer, tablet, or phone, the 39DL PLUS can send and receive data, or can be remotely controlled.

The instrument is set to use USB communication by default. You can select which type of communication you wish to use along with other communication parameters.

To configure the communication parameters

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **COMM**.
3. In the **COMM** screen (see Figure 9-3 on page 152):

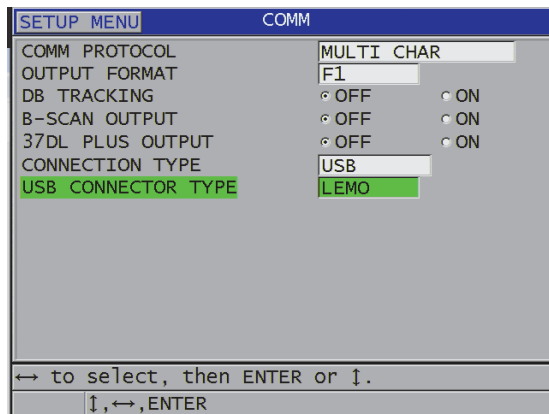


Figure 9-3 Changing the communication parameters

- a) In **COMM PROTOCOL**, select which remote command set the instrument uses for communication:
 - **MULTI CHAR**: Multi character commands used for communication with a computer running the GageView interface program.
 - **SINGLE CHAR**: Single character command normally used when an external program is controlling the instrument by remotely sending commands to mimic keystroke.
- b) In **OUTPUT FORMAT**, select the format of the data being output (**F1, F2, F3,...F11**). Refer to Table 24 on page 281 and Table 25 on page 282 for the description of available output formats.

NOTE

Contact Evident for more information on the following communication parameters:

- Multi and single character remote commands.
- Send formats (F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, and F11).

- c) Set **DATABASE TRACKING** to **ON** to allow the instrument to track the measurement parameters (calibration settings, transducer type, gain etc.) that were used in a previous inspection. In order for this feature to be implemented, you must load the previous inspected file to the 39DL PLUS

and overwrite the old readings with the new inspection data.

When database tracking is selected, the following measurement related parameters are automatically adjusted to match those stored at the current ID number:

- Alarm mode (on/off)
- Alarm set points
- Differential mode (on/off)
- Differential reference value
- Min/max mode (min/max/off)
- Extended blank value
- Resolution
- Units
- Gain
- Velocity
- Transducer type (user prompt only)

When database tracking is selected and a waveform is stored at the current ID number, the following additional waveform related parameters are automatically adjusted to match those stored with that waveform:

- Range
- Zoom (on/off)
- Extended blank position
- Rectification mode (full wave, half wave negative, half wave positive, RF)

If the database does not have any data stored at the current ID number, then the setup remains unchanged.

NOTE

Even if database tracking is activated, you can override the settings for the current ID number by manually changing any setup parameter.

-
- d)* Set **B-SCAN OUTPUT** to **ON** to output the B-scan data when communicating with the GageView interface program. Set it to **OFF** when communicating with other interface programs that do not support the B-scan data. This parameter only applies to files that have stored B-scan images.

- e) Set **37DL PLUS OUTPUT** to **ON** to have the 39DL PLUS send data in the same format as the 37DL PLUS to communicate with external software programs that were written for the 37DL PLUS.
- f) In **CONNECTION TYPE**, choose which communication format the instrument uses:
 - o **USB** (default): Universal serial bus used to communicate with a computer running the GageView interface program (see “Setting Up USB Communication” on page 264).
 - o **RS-232**: Used for communication with digital calipers, and other RS-232 communication devices (see “Setting Up RS-232 Serial Communication” on page 266).
 - o **Bluetooth**: Connect the device to another device using Bluetooth (see “Setting Up Bluetooth Communication” on page 268).
 - o **WiFi**: Connect the device to another computer, tablet, or phone using WiFi (see “Setting Up WiFi Communication” on page 269).
- g) In **BAUD RATE**, set the RS-232 data transfer rate to match that of the device with which the 39DL PLUS communicates.
- h) In **CONTINUOUS OUTPUT**, select the rate at which the 39DL PLUS sends measurement data through the RS-232 communication port:
 - o **OFF**: No continuous output.
 - o **ON**: The output rate is controlled by the **MEASURE RATE** setting in the **MEAS** setup menu (see “Adjusting the Measurement Update Rate” on page 76).
 - o **5 SEC AVERAGE**: Outputs one averaged thickness reading every 5 seconds.
 - o **10 SEC AVERAGE**: Outputs one averaged thickness reading every 10 seconds.

NOTE

The other RS-232 parameters are fixed (Word length = 8, Stop bits = 1, Parity = None).

- 4. Press **[MEAS]** to return to the measurement screen.

10. Using Advanced Gaging Features

The 39DL PLUS has many advanced thickness measurement features that assist in making the gauge a more versatile instrument. This chapter describes how to use these advanced features.

10.1 Adjusting the Gain with Dual Element and E110 EMAT Transducers

By default, the 39DL PLUS automatically sets the gain to an optimum value to obtain the most accurate measurement. This works well for most corrosion measurement applications.

In special circumstances, you may need to manually adjust the gain to get a correct thickness measurement. For example, in high temperature measurements, increasing the gain is generally recommended.

NOTE

Evident recommends to manually adjust the gain only when you are an experienced operator who can analyze and understand the waveform display.

With D79X series dual element and E110 EMAT transducers, you can manually adjust the gain by pressing **[GAIN]**. The gain value, expressed in decibels (dB), appears near the lower-right corner of the display (see Figure 10-1 on page 156).

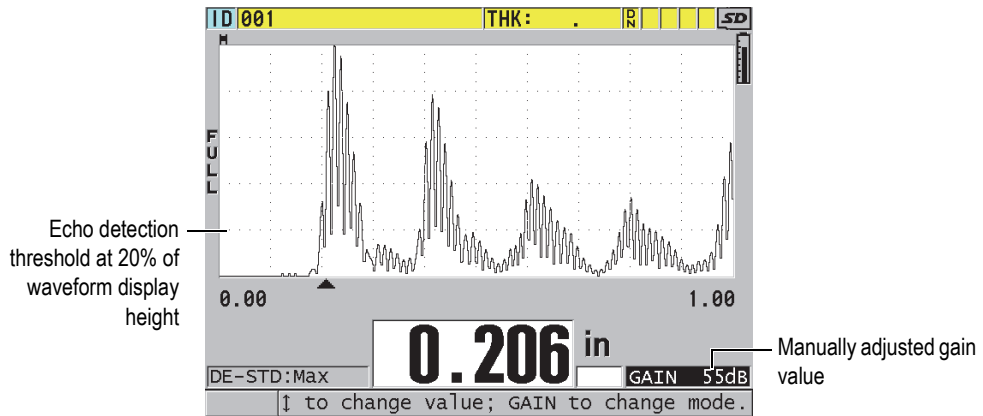


Figure 10-1 Manually adjusting the gain

When activated, the manual gain adjustment also modifies the way in which echoes are shown on the waveform display. With the default automatic gain, the measured echo peak is visible on the display so that you can readily observe the measured echo position, independently of its strength or of the gain. When you manually adjust the gain, the displayed echo height changes to be proportional to the actual echo amplitude at the receiver output, allowing you to readily observe gain changes.

The peak detection threshold for thickness calculation is at 20% of the waveform display height, the first graticule line above the baseline in Figure 10-1 on page 156. The peak amplitude of measured echoes must be at or above the threshold to be processed for thickness calculation.

To view, restore, or change the gain value

1. Press **[GAIN]** to view the current automatic gain value.
The gain value appears near the lower-right corner of the display. The waveform display changes to the amplitude proportional to gain mode.
2. Press **[▲]** or **[▼]** to adjust the gain in steps of ± 1 dB.
The gain value and the height of the echoes change accordingly.
 - Increase the gain value when the peak amplitude of the echo that should be detected is below 20 % of the waveform display height.
This prevents the gauge from reading a too high value when skipping one back-wall echo, measuring twice the correct thickness (doubling).

- Reduce the gain value when noise peaks are above 20 % of the waveform display height.
This prevents the gauge from detecting a noise peak rather than the correct back-wall echo.
- 3. Press **[GAIN]** again to restore the last previously set gain.
- 4. Press **[GAIN]** again to return to the automatically adjusted echo height mode.
The default automatic gain mode is indicated by a blank **Gain** field.

10.2 Adjusting the Extended Blank with Dual Element Transducers



CAUTION

Evident recommends using the extended blank parameter only when you are an experienced operator who thoroughly understands the acoustic properties of the material being measured. Incorrect use of the extended blank can cause the gauge to misread areas of thin material.

Normally, the 39DL PLUS searches for echoes down to nearly zero thickness. However, some special circumstances such as a high degree of near surface corrosion, aluminum material, enclosed flaws, or laminations can generate echoes that the instrument may falsely detect as the low thickness. When these echoes are larger than the sought after back-wall echo, the manual gain adjustment (see “Adjusting the Gain with Dual Element and E110 EMAT Transducers” on page 155) cannot prevent this false detection. However, the extended blank parameter allows you to define an early period in which the 39DL PLUS will not perform echo detection, and therefore, prevent erroneous measurements.

To use the extended blank

1. Press **[WAVE ADJ]**.
The waveform adjustment parameter and its value appear on the measurement screen (see Figure 10-2 on page 158).
2. If needed, use the **[▲]** and **[▼]** keys to select **EXT BLANK**.
The extended blank becomes active, but initially, its value is zero. The gauge remains in the measurement screen.

- Use the [▶] or [◀] keys to respectively increase or decrease the blank value until you exclude early unwanted echoes from detection.
The extended blank horizontal bar just above the waveform display indicates the extended blank length (see Figure 10-2 on page 158).

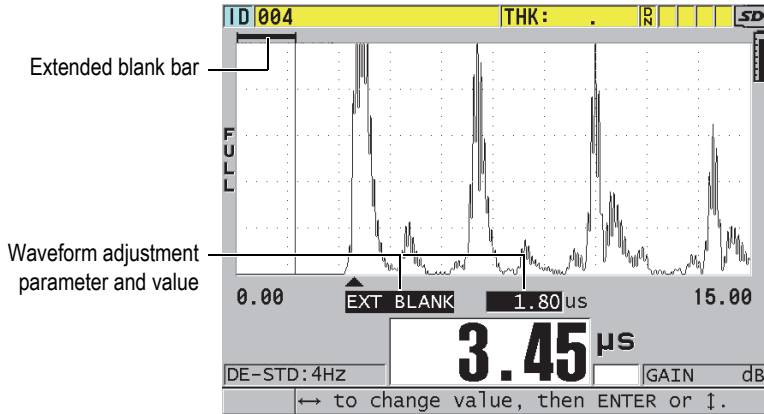


Figure 10-2 Adjusting the extended blank length

- To turn off the extended blank, use the [◀] key to decrease the extended blank value back to zero.

NOTE

If the measurement point changes when the extended blank is moved, echoes can change in height. This is because in the normal waveform display mode, the 39DL PLUS attempts to adjust the height.

The instrument also attempts to make the most accurate measurement by identifying the beginning of an echo. When the extended blank is positioned within an echo instead of to its left, the gauge is unable to make an accurate detection.

10.3 B-Scan

A B-scan is a cross-sectional image of thickness readings. The 39DL PLUS can acquire and display B-scan data (see Figure 10-3 on page 159). When you activate the B-scan, the thickness reading profile builds up and scrolls on the screen. Once a B-scan is acquired, you can freeze the screen and review the recorded thickness values.

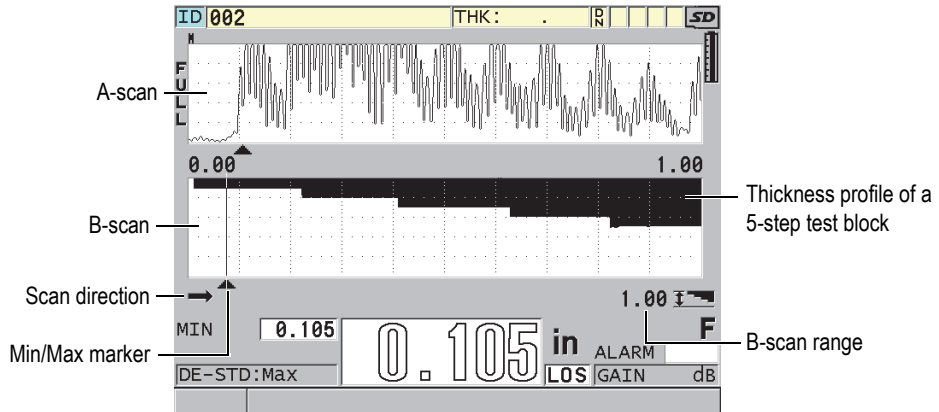


Figure 10-3 B-scan example for a 5-step test block

While the B-scan is running, you can save individual thickness readings, save the current B-scan screen (with all thickness values), or the entire scan (up to 10000 readings) [see “Saving B-Scans, A-Scans, or Thickness Readings” on page 165].

You can activate and configure the B-scan from the **B-SCAN** screen (see Figure 10-4 on page 160), accessible by pressing **[SETUP MENU]**, and then selecting **B-SCAN** in the menu.

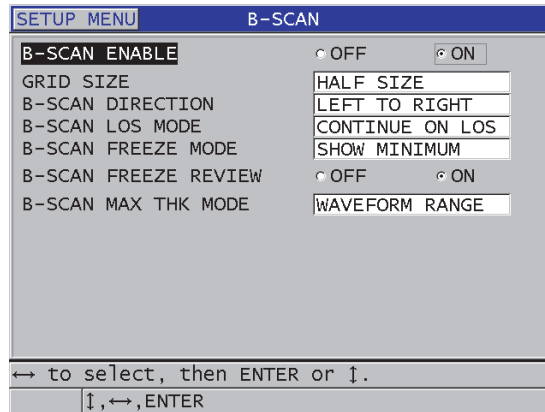


Figure 10-4 Changing B-scan parameters

The **B-SCAN** screen contains the following parameters:

GRID SIZE

Determines the size of the B-scan with the following two options (see Figure 10-5 on page 161):

HALF SIZE

Displays a half-height A-scan waveform and a half-height B-scan.

FULL SIZE

Displays the B-scan over the entire waveform display area.

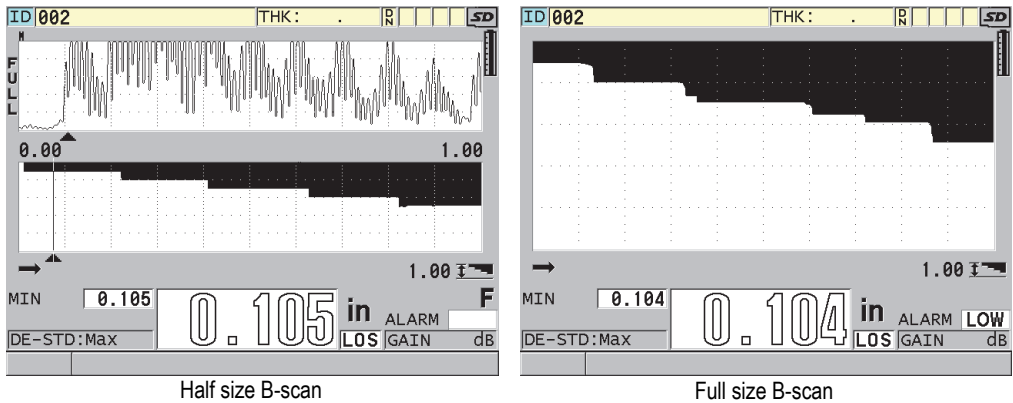


Figure 10-5 The half-size and full-size B-scans

B-SCAN DIRECTION:

Choose the B-scan direction to match the direction of transducer movement. A scan direction arrow appears below the left corner of the B-scan display to indicate the transducer scan direction (see Figure 10-6 on page 161). The data starts appearing on the screen in the opposite direction.

LEFT TO RIGHT

The transducer scans the part from left to right and the data starts appearing at the right of the screen and scrolls to the left.

RIGHT TO LEFT

The transducer scans the part from right to left and the data starts appearing at the left of the screen and scrolls to the right.

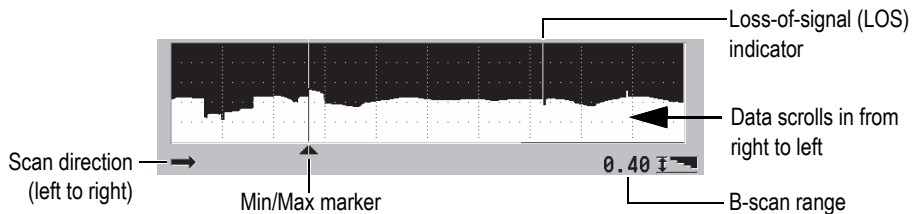


Figure 10-6 B-scan elements

B-SCAN LOS MODE

Determines how the B-scan behaves when a loss-of-signal (LOS) occurs.

STOP ON LOS

The B-scan stops scrolling when a LOS occurs. When the instrument regains measurements, a thin blank vertical line is inserted into the B-scan as a marker showing that a LOS has occurred (see Figure 10-6 on page 161).

CONTINUE ON LOS

The B-scan continues scrolling when a LOS occurs.

B-SCAN FREEZE MODE

Determines which A-scan waveform and thickness reading are displayed when you press **[FREEZE]** while a B-scan is active.

SHOW MINIMUM

Displays the waveform and thickness reading for the minimum reading collected during the scan.

SHOW MAXIMUM

Displays the waveform and thickness reading for the maximum reading collected during the scan.

SHOW CURRENT

Displays the last thickness reading made before pressing **[FREEZE]**.

B-SCAN FREEZE REVIEW

When this feature is enabled and a B-scan is active, pressing **[FREEZE]** freezes the B-scan image in review mode. In this mode, a vertical line, the review marker, appears to indicate the location of the displayed thickness (see Figure 10-7 on page 163). The displayed thickness is either the minimum, maximum, or current thickness depending on which **B-SCAN FREEZE MODE** option is selected. The 39DL PLUS displays both the thickness value and the corresponding waveform. Use the **[◀]** and **[▶]** keys to move the review marker and read the thickness at the review marker location.

TIP

If the minimum or maximum value moves off the B-scan screen, press **[FREEZE]** to center the B-scan and the review marker on the minimum or maximum thickness.

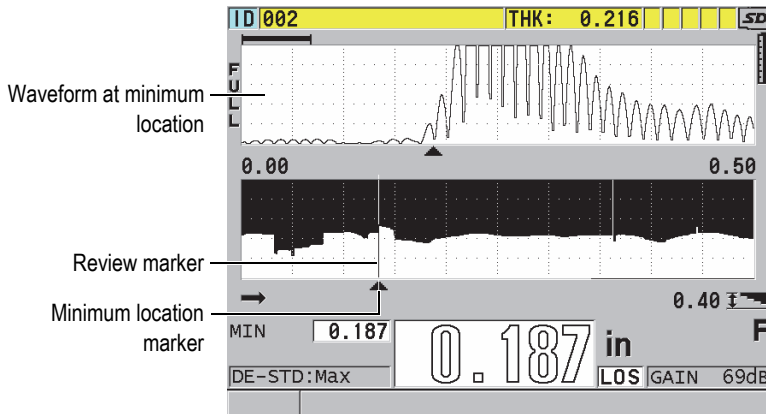


Figure 10-7 B-scan freeze review elements

B-SCAN MAX THK MODE:

Determines the vertical scale of the B-scan with the following two options:

A-SCAN RANGE

The top and bottom of the vertical scale correspond to the start and end of the A-scan display range.

SPECIFIED THK

The top of the vertical scale represents the zero value and the bottom of the scale is the value that you enter in the **B-SCAN MAX THICKNESS** parameter that appears. The allowed range is 0.00 mm to 635.00 mm (0.000 in. to 25.000 in.).

NOTE

Evident does not recommend using the A-scan zoom feature when **B-SCAN MAX THICKNESS** is set to **A-SCAN RANGE**. The zoom constantly adjusts the start and the end points of the A-scan range, resulting in a B-scan image where the scale changes as the thickness changes.

10.3.1 Using the B-Scan

The following procedure describes how to activate and use the B-scan.

To use the B-scan

1. While in the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **B-SCAN**.
3. In the **B-SCAN** screen, set **B-SCAN ENABLE** to **ON**, and configure the other B-scan parameter as desired (see “B-Scan” on page 159).
4. Press **[MEAS]** to return to measurement screen with the B-scan active.
The B-scan begins drawing the cross section of the material as soon as the first non-LOS reading is collected.
5. To stop the collection of B-scan data:
Press **[FREEZE]**.
OR
With **B-SCAN LOS MODE** set to **STOP ON LOS**, simply uncouple the transducer from the test material.
6. While the B-scan is frozen, if **B-SCAN FREEZE REVIEW** is set to **ON**, use the **[◀]** and **[▶]** keys to move the review marker and read the thickness value corresponding to the marker position.
7. Press **[MEAS]** again to reset the B-scan and begin a new B-scan.
8. Refer to “Saving B-Scans, A-Scans, or Thickness Readings” on page 165 for details on how to save B-scan data.

10.3.2 Using the B-Scan Alarm Mode

You can specify B-scan low and high alarm reference values and turn the visual and audible alarm functions **ON** and **OFF**. The B-scan alarm mode is similar to the standard alarm mode (see “Using Alarms” on page 135) except that the alarm lines are shown in the B-scan grid, as long as the alarm reference values fall within the B-scan thickness range. The alarms are also operational as you review B-scan thicknesses in review mode, in a frozen B-scan.

To use the B-scan alarm mode

1. Activate and configure the B-scan (see “Using the B-Scan” on page 164).
2. While in the measurement screen, press **[SETUP MENU]**.

3. In the menu, select **ALARM**.
4. In the **ALARM** screen:
 - a) Set **ALARM ENABLE** to **ON**.
 - b) Set **ALARM MODE** to **B-SCAN**.
 - c) Enter the desired **LOW ALARM** and **HIGH ALARM** values.
5. Press **[MEAS]** to return to the measurement screen.
6. The horizontal red alarm lines appear on the B-scan (see Figure 8-5 on page 139).

10.3.3 Saving B-Scans, A-Scans, or Thickness Readings

The 39DL PLUS can do the following tasks while using the B-scan:

- Save a live thickness reading while the B-scan is running.
- Save any reviewed thickness reading on a frozen B-scan.
- Save all thickness readings for one B-scan screen (600 readings) along with the minimum or maximum thickness readings for a held B-scan.
- Save all thickness readings for one B-scan screen (600 readings), the minimum or maximum thickness reading and waveform for a held B-scan.
- Save an entire B-scan history up to 10000 thickness readings, the minimum or maximum thickness readings and waveform, and the held B-scan.

To save a live thickness reading while the B-scan is running

- ◆ Press **[SAVE/SEND]**.

To save any reviewed thickness reading on a frozen B-scan

1. While the B-scan is running, press **[FREEZE]** to enter the review mode.
2. Use the **[◀]** and **[▶]** keys to review any thickness on the frozen B-scan.
3. Press **[SAVE/SEND]** to save to the datalogger, the thickness value for the review marker position.

To save the minimum or maximum thickness reading for a frozen B-scan

1. Set **B-SCAN FREEZE MODE** to **SHOW MINIMUM** or **SHOW MAXIMUM**.
The gauge displays the minimum or maximum thickness reading with the corresponding waveform.
2. While the B-scan is running, press **[FREEZE]** to enter the review mode.

3. Press **[SAVE/SEND]** while the minimum or maximum thickness reading is displayed.

To save the minimum or maximum A-scan along with the frozen B-scan

1. Set **B-SCAN FREEZE MODE** to **SHOW MINIMUM** or **SHOW MAXIMUM**. The gauge displays the minimum or maximum thickness reading with the corresponding waveform.
2. While the B-scan is running, press **[FREEZE]** to enter the review mode.
3. Press **[2nd F]**, **[SAVE/SEND]** (**WAVEFORM**) while the minimum or maximum thickness reading is displayed.

To save the entire B-scan (B-scan history)

1. While the B-scan is running or when it is frozen, press **[2nd F]**, **[SAVE/SEND]** (**WAVEFORM**).

The **Save B-Scan history?** message appears on the help text bar.

2. Select **Yes** or **No**:

Yes

Saves the entire B-scan history including the Minimum or Maximum thickness with corresponding waveforms.

No

Saves the current B-scan screen and the waveform.

NOTE

When a B-scan screen is saved to the datalogger, the gauge saves the thickness values for the 600 data points appearing on the display. All thickness values on a saved B-scan can be reviewed during ID Review. Recall the saved B-scan and use the **[◀]** and **[▶]** keys to review each thickness reading.

NOTE

You can save a maximum of 10000 thickness readings to a B-scan. When the maximum number of thickness points reaches 10000, the gauge prompts you to save the B-scan history or to reset the B-scan without saving.

10.4 DB Grid

The database grid (DB grid) is a table representation of 2-D data. This representation gives you the ability to move freely in any direction on a grid rather than follow a preset list of IDs. Instead of automatically incrementing to the next ID location, you can use the arrow keys to move to a location that is more convenient. You can simultaneously display the A-scan, the DB grid, and the thickness reading (see Figure 10-8 on page 167). You can configure the grid cells to show a data cell flag and a background color corresponding to the range in which their thickness reading falls.

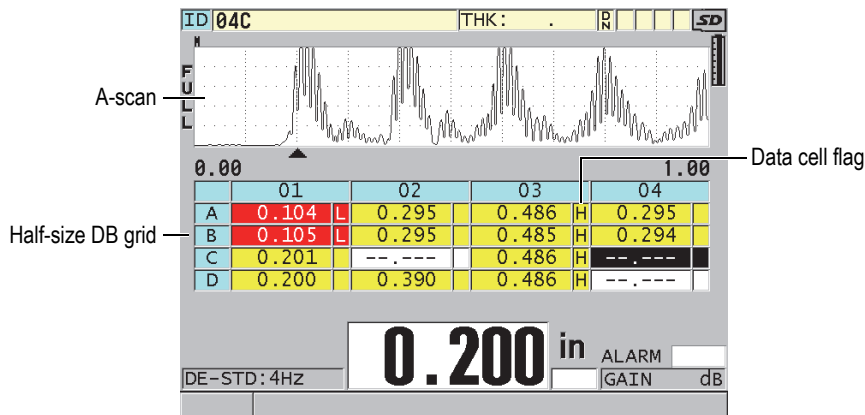


Figure 10-8 Example of the half-size DB grid

10.4.1 Activating and Configuring the DB Grid

You activate and configure the DB grid options from the **DB GRID** screen.

To activate and configure the DB grid

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **DB GRID**.
3. In the **DB GRID** screen (see Figure 10-9 on page 168), perform the following steps.

SETUP MENU		DB GRID	
DB GRID ENABLE	<input type="radio"/> OFF	<input checked="" type="radio"/> ON	
GRID SIZE	<input type="text" value="HALF SIZE"/>		
TRANSPOSE GRID	<input type="radio"/> OFF	<input type="radio"/> ON	
LINEARIZE GRID	<input type="radio"/> OFF	<input type="radio"/> ON	
DATA CELL FLAG	<input type="text" value="NONE"/>		
GRID COLOR OPTION	<input type="radio"/> OFF	<input checked="" type="radio"/> ON	
LO RANGE COLOR	<input type="text" value="RED"/>		
LO RANGE VALUE	<input type="text" value="0.000"/>		
MID RANGE COLOR	<input type="text" value="YELLOW"/>		
HI RANGE COLOR	<input type="text" value="GREEN"/>		
HI RANGE VALUE	<input type="text" value="0.000"/>		
↔ to select, then ENTER or ↓.			
↑, ↔, ENTER			

Figure 10-9 Changing DB grid parameters

4. Set **DB GRID ENABLE** to **ON** to activate the DB grid.
5. Set **GRID SIZE** to one of the desired database grid size options (see Figure 10-10 on page 169):

HALF SIZE

Displays a half-screen A-scan waveform and a half-screen database grid. Up to five grid rows are shown.

FULL SIZE

Displays the database grid on the entire screen. Up to 11 grid rows are shown.

NOTE

With both options, the number of grid columns shown varies, depending on the length of column labels and whether or not a database flag is displayed with each data cell.

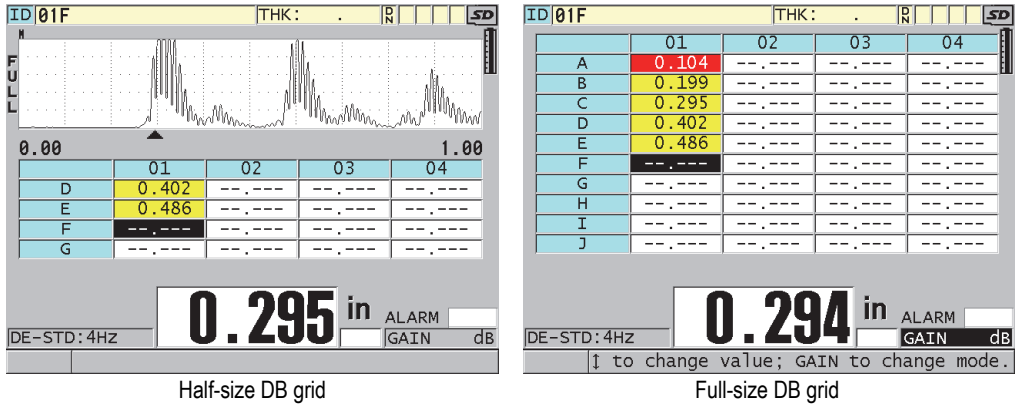


Figure 10-10 Example of half-size and full-size DB grids

- Set **TRANSPOSE GRID** to **ON** to interchange the rows and columns in a grid (see Figure 10-11 on page 169).

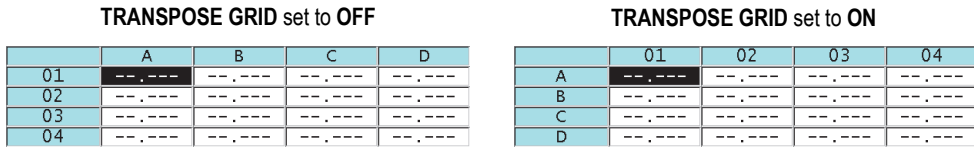


Figure 10-11 Grid transposition example

NOTE

The ID number increments in the order assigned when the file was originally set up independently of the **TRANSPOSE GRID** value.

- Set **LINEARIZE GRID** to **ON** to display the grid IDs in the linear form (see Figure 10-12 on page 170).

ID	THICKNESS
A01	-- .---
A02	-- .---
A03	-- .---
A04	-- .---

Figure 10-12 Example of a linearized DB grid

8. Set **DATA CELL FLAG** to one of the available options to display a single data flag with each data cell in the DB grid. The data cell flag is a letter that appears in a small box to the right of the thickness value in the data cell (see Figure 10-8 on page 167). The available options are:

NONE

No data cell flag appears.

MIN/MAX

“m” indicates a minimum thickness.

“M” indicates a maximum thickness.

ALARM

“L” indicates any kind of low alarm condition including a standard low alarm condition or a previous thickness alarm.

“H” indicates any high alarm condition.

A-SCAN

“W” indicates that a waveform is stored with the thickness.

9. Set **GRID COLOR OPTION** to **ON** to activate usage of low, mid, and high range colors for the grid cell background.
10. Set **LO RANGE COLOR** to the desired cell background color (**RED**, **YELLOW**, or **GREEN**) when the cell thickness value is smaller than the **LO RANGE VALUE**.
11. Set **MID RANGE COLOR** to the desired cell background color (**RED**, **YELLOW**, or **GREEN**) when the cell thickness value is between the **LO RANGE VALUE** and the **HI RANGE VALUE**.
12. Set **HI RANGE VALUE** to the desired cell background color (**RED**, **YELLOW**, or **GREEN**) when the cell thickness value is higher than the **HI RANGE VALUE**.

10.4.2 Changing the Highlighted Cell in the DB Grid

You can easily move the selected cell in the DB grid using the arrow keys.

To change the highlighted cell in the DB grid

1. Activate and configure the DB grid (see “Activating and Configuring the DB Grid” on page 167).
2. From the measurement screen, press **[ID#]**.
3. In the ID review screen (see Figure 10-13 on page 171):
 - a) Use the **[▲]**, **[▼]**, **[◀]**, and **[▶]** keys to highlight the desired grid cell.
 - b) Press **[2nd F]**, **[▲]** to jump to the last ID location in the file.
 - c) Press **[2nd F]**, **[▼]** to jump to the first ID location in the file.
 - d) Press **[ID#]** at any time to edit the displayed ID location.

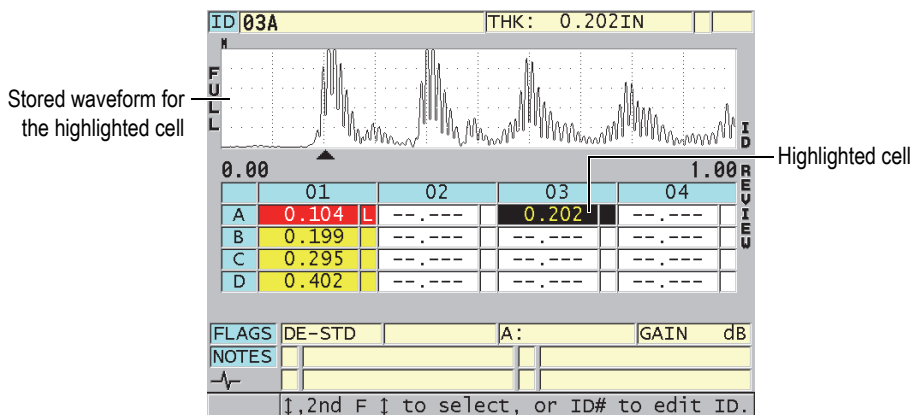


Figure 10-13 The highlighted DB grid cell in the ID review screen

4. Press **[MEAS]** to return to the measurement screen with the current ID number changed to the ID location selected in the ID review screen.
OR
Press **[2nd F]**, **[MEAS]** to return to measurement screen with the current ID number unchanged. The current ID location is the last active ID location in the measurement screen.

10.4.3 Saving Thickness Readings in the DB Grid

To save thickness readings in the DB grid

1. Activate and configure the DB grid (see “Activating and Configuring the DB Grid” on page 167).
2. Move to the desired DB grid cell (see “Changing the Highlighted Cell in the DB Grid” on page 170).
3. In the measurement screen, while the thickness value is displayed, press **[SAVE/SEND]** to save the thickness.

OR

Press **[2nd F]**, **[SAVE/SEND]** (**WAVEFORM**) to save the thickness and the waveform.

The displayed thickness value and setup information are stored at the current ID location identified by the highlighted cell in the grid. If the thickness display is blank when you press **[SAVE/SEND]**, then “--.--” is saved in place of a value.

The ID number is automatically updated to the next ID number in the sequence. The new ID number is indicated on the ID bar and its cell is highlighted in the grid. If the ID number cannot be updated, a long beep sound is emitted and the instrument displays a message pertaining to the reason the ID was unable to update. In this case, the ID number on the display remains unchanged.

10.4.4 Viewing an Inserted or an Appended Cell in the DB Grid

You can insert or append a cell in the DB grid. To maintain the format of the grid, the inserted or appended cell does not appear in the grid. However, the cell after which it is inserted or to which it is appended appears shaded with a grey background (see Figure 10-14 on page 172).

Cell with an inserted or appended cell

	01	02	03	04
A	0.104	--.--	0.202	--.--
B	0.199	--.--	--.--	--.--
C	0.295	--.--	--.--	--.--
D	0.402	--.--	--.--	--.--

Figure 10-14 Example of an inserted cell

To view an inserted or an appended cell in the DB grid

1. Activate and configure the DB grid (see “Activating and Configuring the DB Grid” on page 167).
2. Press [ID#], and then use the arrow keys to move to the desired shaded grid cell.
3. Press [ZOOM].
The grid changes to a linear view and the inserted or appended ID number is displayed (see Figure 10-15 on page 173).

ID	THICKNESS	
01A	0.104	L
01B	0.199	
01BB	0.200	
01C	0.295	

Inserted cell —

Figure 10-15 Example of a zoomed inserted cell

4. Press [ZOOM] again to return to the normal DB grid view.

10.5 Configuring AVG/MIN Measurements

You can use the AVG/MIN measurement function to store the average or the minimum measurement of several successive thickness readings to the datalogger.

To configure the AVG/MIN measurement option

1. From the measurement screen, press [SETUP MENU].
2. In the menu, select **AVG/MIN**.
3. In **AVG/MIN** screen (see Figure 10-16 on page 174):
 - a) Set **AVG/MIN ENABLE** to **ON** to activate the average/minimum measurement function.
 - b) Set **MODE** to **AVERAGE** to calculate the average of the sequential thickness readings or **MINIMUM** to calculate the minimum of the sequential thickness readings.
 - c) Set **# OF READINGS** to set the number of thickness values in the sequence (**2**, **3**, or **4**).

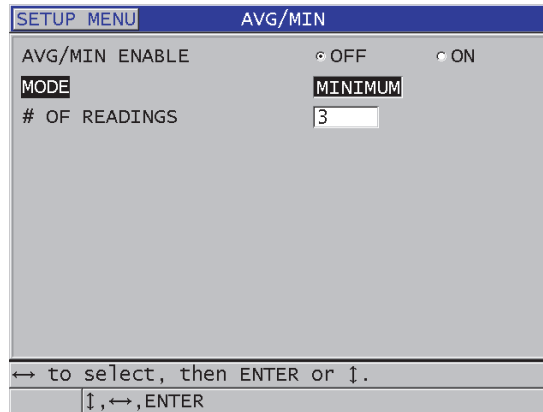


Figure 10-16 Opening the Avg/Min measure dialog box

4. Press [MEAS] to return to measurement screen.

10.6 Making AVG/MIN Measurements

When you are in the measurement screen and the AVG/MIN measurement is active, the last measured thickness values (up to four) appear above the current thickness value together with the average or minimum value (see Figure 10-17 on page 175).

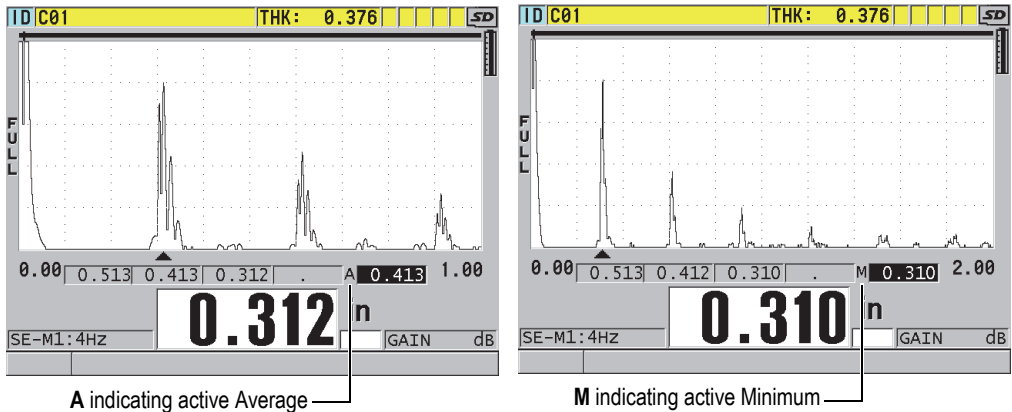


Figure 10-17 Examples of the measurement screen with the AVG/MIN measurement active

To make thickness readings using the AVG/MIN measurement

1. Activate and configure the **AVG/MIN** function (see “Configuring AVG/MIN Measurements” on page 173).
2. Couple your transducer to the material.
The thickness appears on the display.
3. Press **[SAVE/SEND]** to display the thickness in the left most thickness box. Each time you press **[SAVE/SEND]** the actual thickness reading appears in the next shaded box moving to the right while the minimum or average of the thickness readings is automatically calculated and placed in the right most box.
4. If you want to replace a reading, use the **[◀]** and **[▶]** keys to switch from one highlighted box to another, and press **[SAVE/SEND]** to save the new reading.
5. When the minimum or average box is highlighted, press **[SAVE/SEND]** a last time to store that value in the datalogger at the current ID# location, and clear all the boxes.

OR

Press **[MEAS]** to clear all the boxes without saving to the datalogger.

10.7 Using Temperature Compensation

The 39DL PLUS can compensate for changes in sound velocity due to temperature variations. This function is useful for example when the test block may be at room temperature while the actual material can be at an elevated temperature.

Using the temperature compensation function, you can input the temperature of the calibration standard in °F or °C units. You can manually enter a fixed elevated temperature, manually enter a temperature for the current ID location, or automatically read the temperature from an optional temperature probe.

The sound velocity of most steel changes about 1% for every 55°C (100°F) change in temperature. The following equation is used to compensate for the change in sound velocity due to temperature.

$$\text{Temperature corrected thickness} = MTI \times V_0 \times (1 + (k \times (T_1 - T_0)))$$

Where:

MTI = Measured time interval

V_0 = Calibrated test block velocity

T_1 = Actual material temperature

T_0 = Temperature at calibration

k = Temperature coefficient (normally -0.00018 for °C or -0.0001 for °F)

A temperature coefficient of -0.00018 for °C (or -0.0001 for °F) assumes a 1% change in velocity per 55°C (100°F) change in temperature.

To use the temperature compensation

1. Press **[SETUP MENU]**.
2. In the menu, select the **TEMP COMP**.
3. In the **TEMP COMP** screen (see Figure 10-18 on page 177):
 - a) Set **TEMP COMP ENABLE** to **ON** to activate the temperature compensation function.
 - b) Set **DEGREE UNITS** to the desired temperature units (**FAHRENHEIT** or **CELSIUS**).
 - c) Set **CALIBRATION TEMP** to the temperature of the test block used to perform the calibration. The allowable range is -10°C to 500°C or 14°F to 932°F.

- d) Set **TEMP COEFFICIENT** to the desired value (typically -0.00018 for $^{\circ}\text{C}$ or -0.00010 for $^{\circ}\text{F}$) for steel.
- e) Set **CURRENT TEMP** to the temperature of the actual test piece.

NOTE

You can specify a negative sign using the [▶] or [◀] keys to move the cursor over the "+" or "-", and then using the [▲] and [▼] keys to change the sign.

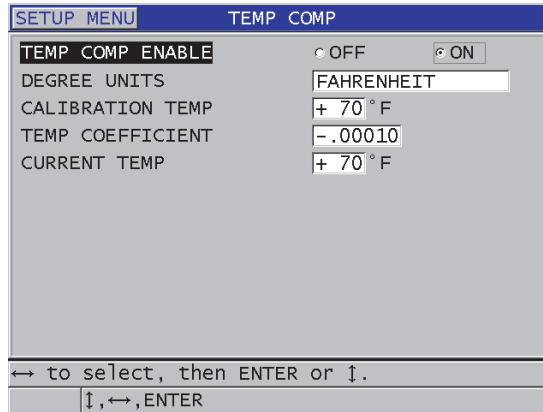


Figure 10-18 The TEMP COMP screen

4. Press [MEAS] to return to the measurement screen with the activated temperature compensation (see Figure 10-19 on page 178). The measured thickness is temperature-compensated based on the **CALIBRATION TEMP**, the **CURRENT TEMP**, and the **TEMP COEFFICIENT** parameter values.

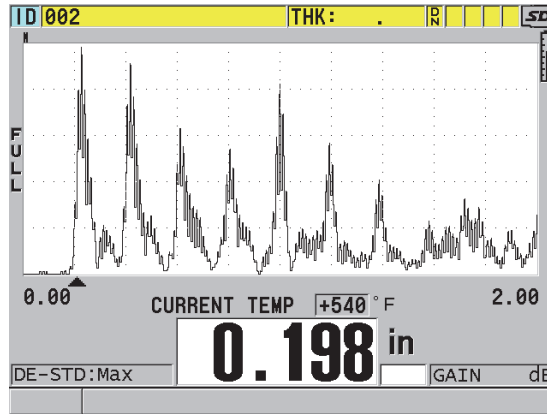


Figure 10-19 Displaying temperature compensation data

5. While the temperature compensation function is active, if the temperature of the test piece changes, you can quickly change the **CURRENT TEMP** as follows:
 - a) Press [2nd F], [XDCR RECALL] (REF VALUE).
 - b) In the **CURRENT TEMPERATURE** screen, enter the new current temperature value.

NOTE

Both the thickness and current temperature values are saved to the internal datalogger.

11. Using the Datalogger

This chapter describes how to use the 39DL PLUS internal datalogger to organize your data.

11.1 Datalogger

The 39DL 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 11-1 on page 179).

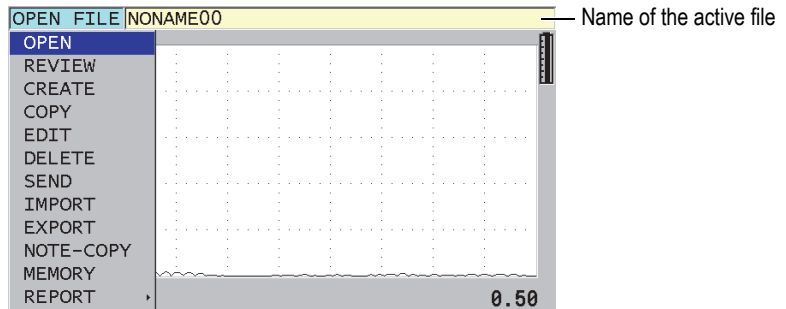


Figure 11-1 The active file name appearing in the ID bar

A file also contains header parameters that you can define to better describe the content of the file. You can define notes in the file, and associate up to four notes to an ID or to a range of IDs. In the file, you can organize the ID range, select the data format, and select the saved data. Table 10 on page 180 summarizes the contents of a file and indicates where you can find more information.

Table 10 File contents summary

Contents	Description	See section
Header	Extra parameters to describe the contents and the context of the data	“Creating a Data File” on page 183
Measurement data	Organized by predefined IDs arranged by file types	“Data File Types” on page 185
	Data format defined by the file data mode	“File Data Modes” on page 202
	Saved data (thickness measurement with or without the waveform) configured using the setup menu	“Saving Data” on page 92
Notes	Centralized in a note table	“Notes” on page 212
	Associated to an ID or to a range of IDs	“Associating a Note to an ID or to a Range of IDs” on page 213

You can identify the datalogger parameters in the ID bar at the top of the measurement screen (see Figure 11-2 on page 181).

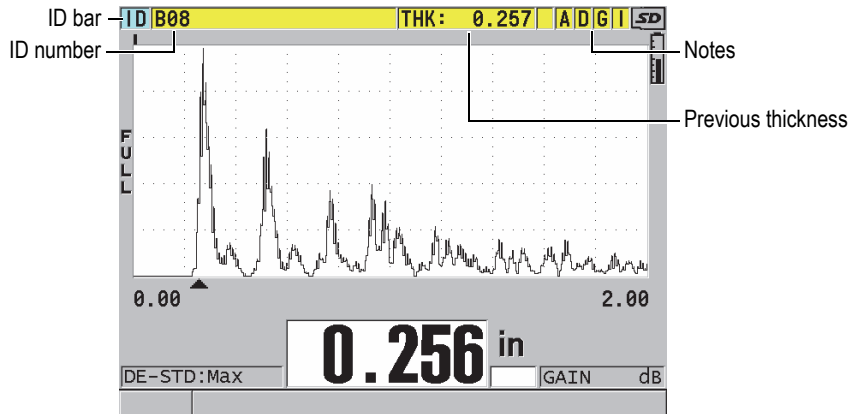


Figure 11-2 Identifying datalogger parameters

With each measurement, the 39DL PLUS also stores a complete description of the measurement conditions. Table 11 on page 182 describes the additional data stored with each thickness measurement and with each waveform.

Table 11 Additional information stored with the data

For a measurement	For a waveform
File name File header data Identifier Units (in. or mm) LOS (loss-of-signal) Differential mode Differential reference value Alarm mode Alarm status Alarm set points Minimum or maximum mode Minimum or Maximum Reading Velocity Resolution Transducer setup number and information Coating thickness (when THRU-COAT is active) Temperature (when temperature compensation is active) Oxide thickness (when Oxide Measurement is active)	Zoom status Horizontal axis limits Detection marker position Delay Range Rectification mode

You can store approximately 792000 thickness values without waveforms in the internal memory or approximately 20000 thickness values with waveforms. You can increase the storage capacity by using an optional external microSD memory card. The maximum size of the external microSD card that can be used on the 39DL PLUS is 32 GB.

With the datalogger, you can easily create a data file (see “Creating a Data File” on page 183), perform a number of file operations (see “Performing File Operations” on page 203), add notes (see “Notes” on page 212), and perform data operations (see “Setting the ID Overwrite Protection” on page 216).

11.2 Creating a Data File

The following procedure describes how to create a data file in the 39DL PLUS.

NOTE

You can also create a 39DL PLUS data file from a computer using the GageView interface program. Refer to the *GageView Interface Program — User's Manual* (P/N: 910-259-EN [U8778347]) for details.

To create a data file

1. From the measurement screen, press **[FILE]**.
2. In the menu, select **CREATE**.
3. In the **CREATE** screen (see Figure 11-3 on page 184):
 - a) In the **FILE NAME** parameter, enter the desired file name using up to 32 characters.
 - b) In the **DESCRIPTION** parameter, optionally enter a description of the contents of the file.
 - c) In the **INSPECTOR ID**, optionally enter an identification of the inspector.
 - d) In the **LOCATION NOTE** parameter, optionally enter an identification of where the measurement are performed.
 - e) Select the appropriate **DATA FILE TYPE** for your application (see “Data File Types” on page 185 for details).
 - f) Select the appropriate **FILE DATA MODE** for your application (see “File Data Modes” on page 202 for details).
 - g) Set the **DELETE PROTECTION** mode **ON** or **OFF**.
Delete protection locks the file so it cannot be deleted. You can unlock the file for deletion using the file edit function.
 - h) Depending on the selected **FILE TYPE**, refer to the following sections for the remaining steps of this procedure:
 - **INCREMENTAL** see “Incremental Data File Type” on page 185
 - **SEQUENTIAL** see “Sequential Data File Type” on page 187

- **SEQ+CUSTOM PT** see “Sequential with Custom Points Data File Type” on page 188
- **2D GRID** see “2-D Grid Data File Type” on page 190
- **2D+CUSTOM PT** see “2-D Grid with Custom Points Data File Type” on page 194
- **3D GRID** see “3-D Grid Data File Type” on page 196
- **BOILER** see “Boiler Data File Type” on page 198
- **3D CUSTOM** see “3-D Custom File Type” on page 200

FILE MENU		CREATE	
FILE NAME			
DESCRIPT	A B C D E	INSERT	1 2 3
	F G H I J	DELETE	4 5 6
INSPECTO	K L M N O	DONE	7 8 9
	P Q R S T		0 . /
LOCATION	U V W X Y	← →	- : /
	Z SPACE	CANCEL	SP # *
FILE TYPE	INCREMENTAL		
FILE DATA MODE	THICKNESS		
DELETE PROTECTION	OFF ON		
START ID			
CREATE CANCEL			
↑↔ to select char/command, then ENTER.			
↑, ↔, ENTER, 2ndF ENTER, 2ndF ↔, ↓			

Figure 11-3 Example of the CREATE screen

TIP

At any time, you can press [2nd F], [▲] or [2nd F], [▼] to scroll between parameters on the screen.

11.2.1 Data File Types

You can create a data file using one of the following eight data file types:

- Incremental
- Sequential
- Sequential with Custom Point
- 2-D Matrix Grid
- 2-D Matrix Grid with Custom Point
- 3-D Matrix Grid
- Boiler
- 3-D Custom

11.2.1.1 Incremental Data File Type

The incremental data file type uses the alphanumeric start ID value (up to 20 characters) and automatically increments to the subsequent ID value using the following incrementing rules:

- Increments only digits and letters, not punctuation or other special characters.
- Begins incrementing with the right-most character.
- Extends leftward until reaching the first punctuation or special character, or the left-most character, whichever comes first.
- Increments digits from 0, 1, 2,..., 9. Makes the 9 to 0 transition only after incrementing the character to the left.
- Increments letters from A, B, C,..., Z. Makes the Z to A transition only after incrementing the character to the left.
- When an ID cannot be incremented after saving a reading, the **Cannot increment ID!** message momentarily appears in the help text bar. Subsequent saves overwrite the reading of the last possible ID until you change the ID value range.

NOTE

To make the gauge increment through a range of numbers several digits wide while beginning with a single digit ID number, the maximum number of digit positions must be entered initially using leading zeroes (see examples in Table 12 on page 186).

Table 12 Resulting ID examples for the INCREMENTAL file type

START ID	Resulting IDs	
1	1, 2, 3,..., 9	
0001	0001 0002 0003 ... 0009	0010 ... 9999
ABC	ABC ABD ABE ... ABZ	ACA ACB ACC ... ZZZ
1A	1A 1B 1C ... 1Z	2A 2B ... 9Z
ABC*12*34	ABC*12*34 ABC*12*35 ABC*12*36 ... ABC*12*99	

To create an incremental data file

1. From the measurement screen, press **[FILE]**, and then select **CREATE** in the menu (see "Creating a Data File" on page 183 for details on the first parameters).
2. In the **CREATE** screen (see Figure 11-4 on page 187):
 - a) Enter the **START ID** value.
 - b) Select **CREATE**.

The screenshot shows a 'CREATE' dialog box with a blue title bar. Below the title bar is a 'FILE NAME' input field. A grid of characters (A-Z, INSERT, DELETE, DONE, SPACE, CANCEL) is displayed. Below the grid are fields for 'FILE TYPE' (set to INCREMENTAL), 'FILE DATA MODE' (set to THICKNESS), and 'DELETE PROTECTION' (radio buttons for OFF and ON). At the bottom are 'CREATE' and 'CANCEL' buttons. A help line at the very bottom reads: '↕↔ to select char/command, then ENTER. ↕,↔,ENTER,2ndF ENTER,2ndF ↔,↕'.

Figure 11-4 The CREATE screen for the incremental data file type

11.2.1.2 Sequential Data File Type

The sequential data file type is similar to the incremental type but you can define both a starting and ending ID numbers. The resulting file is inclusive of the starting and ending points and all incremental points in between (see examples in Table 13 on page 187).

Table 13 Resulting ID examples for the SEQUENTIAL file type

START ID	END ID	Resulting IDs
ABC123	ABC135	ABC123 ABC124 ABC125 ... ABC135
XY-GY	XY-IB	XY-GY XY-GZ XY-HA ... XY-IB

To create a sequential data file

1. From the measurement screen, press **[FILE]**, and then select **CREATE** in the menu (see “Creating a Data File” on page 183 for details on the first parameters).
2. At the bottom of the **CREATE** screen, select **CONTINUE**.
3. In the second page of the **CREATE** screen (see Figure 11-5 on page 188):
 - a) Enter the **START ID** and **END ID** values.
 - b) Select **CREATE**.

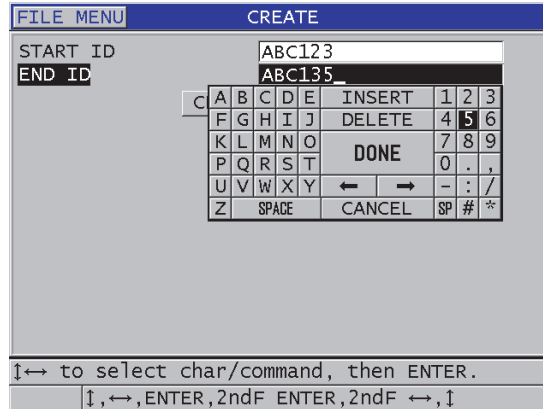


Figure 11-5 Selecting the ID range for the sequential file type

11.2.1.3 Sequential with Custom Points Data File Type

The sequential with custom point (**SEQ+CUSTOM PT**) data file type is defined by a starting and an ending ID number plus a series of custom points. The resulting file is inclusive of the start and end points and all points in between. In addition, multiple thickness readings per ID number location are assigned using the assigned custom points.

Use the sequential with custom point data file type for example when you want to measure along a pipe or tube, where at each ID number location, you can take measurements at the top, bottom, left, and right of the pipe (see an example in Table 14 on page 189).

Table 14 Resulting ID example for the SEQ+CUSTOM PT file type

START ID	END ID	Custom points	Resulting IDs
XYZ1267	XYZ1393	TOP BOTTOM LEFT RIGHT	XYZ1267TOP XYZ1267BOTTOM XYZ1267LEFT XYZ1267RIGHT XYZ1268TOP XYZ1268BOTTOM XYZ1268LEFT ... XYZ1393RIGHT

The allowable number of characters for each custom point depends on the ID number of characters defined in the start and end ID values. The total number of characters of the ID value plus the custom points cannot exceed 20 characters. For example, when the start and end ID values are seven characters long, as in the example in Table 14 on page 189, the maximum allowable length for each custom point is thirteen ($20 - 7 = 13$).

To create a sequential data file with custom points

1. From the measurement screen, press **[FILE]**, and then select **CREATE** in the menu (see “Creating a Data File” on page 183 for details on the first parameters).
2. At the bottom of the **CREATE** screen, select **CONTINUE**.
3. In the second page of the **CREATE** screen (see Figure 11-6 on page 190):
 - a) Enter the **START ID** and **END ID** values.
 - b) Enter two or more **CUSTOM POINTS** values.
 - c) Press **[2nd F]**, **[▼]** to finish entering **CUSTOM POINTS** values.
 - d) Select **CREATE**.

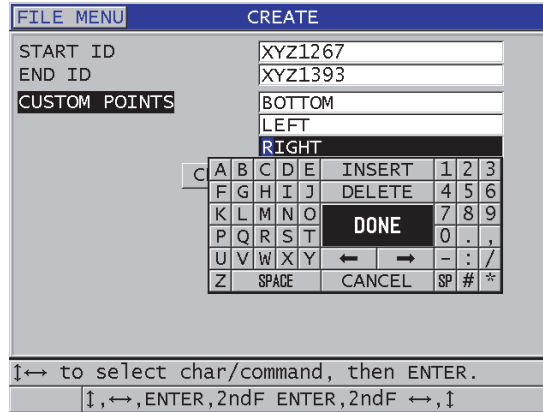


Figure 11-6 Configuring the ID range for a sequential with custom points data file type

11.2.1.4 2-D Grid Data File Type

A grid is a sequence of ID numbers arranged to describe a path through a two-dimensional. Each part of the ID number corresponds to a particular matrix dimension.

A 2-D (two-dimensional) sequence begins with the ID number that refers to the first column and the first row (see Figure 11-7 on page 191). Then the column (or row) increments one value at a time until the sequence reaches the last column (or row) value while the other dimension value stays constant. At this point, the other dimension increments from its first to its last value. This continues until the ID number that refers to the last column and the last row is reached. You can select to first increment either the columns or the rows.

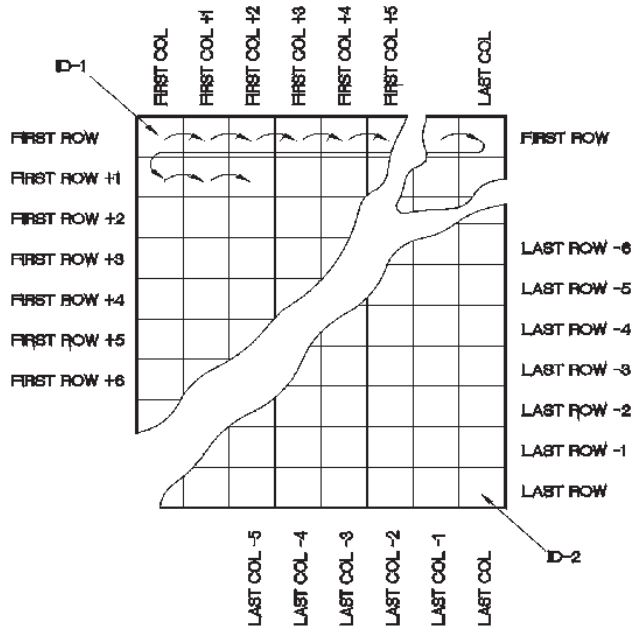


Figure 11-7 General 2-D grid example

A grid structure may associate one dimension of the grid with the physical parts whose wall thickness is to be measured. The particular measurement points on each part are then associated with the other dimension of the grid (see the example in Figure 11-8 on page 192).

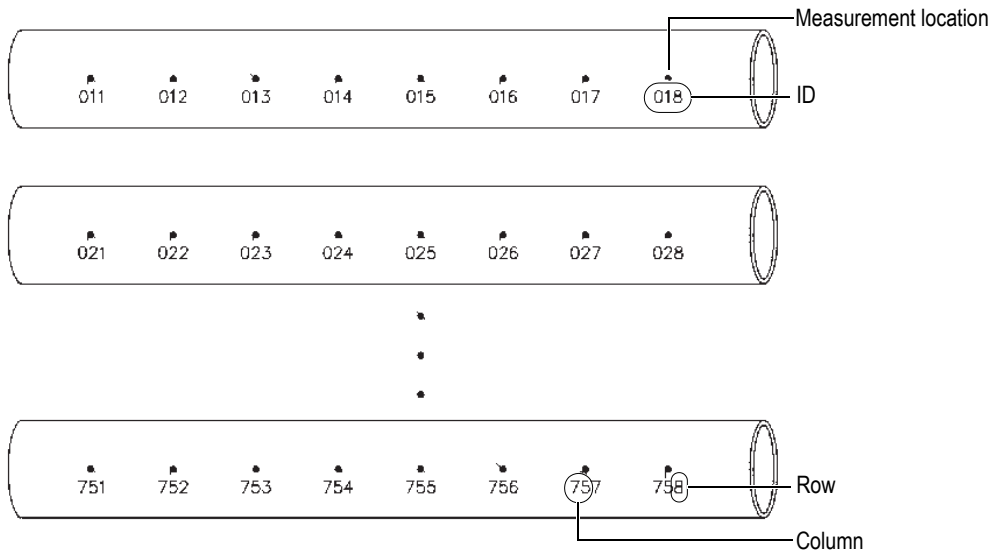


Figure 11-8 One grid for 75 identical parts

Alternatively, the rows and columns of a grid may refer to a two-dimensional map of measurement points on the surface of one part. In this case, a different grid is made for each part (see the examples in Figure 11-9 on page 193).

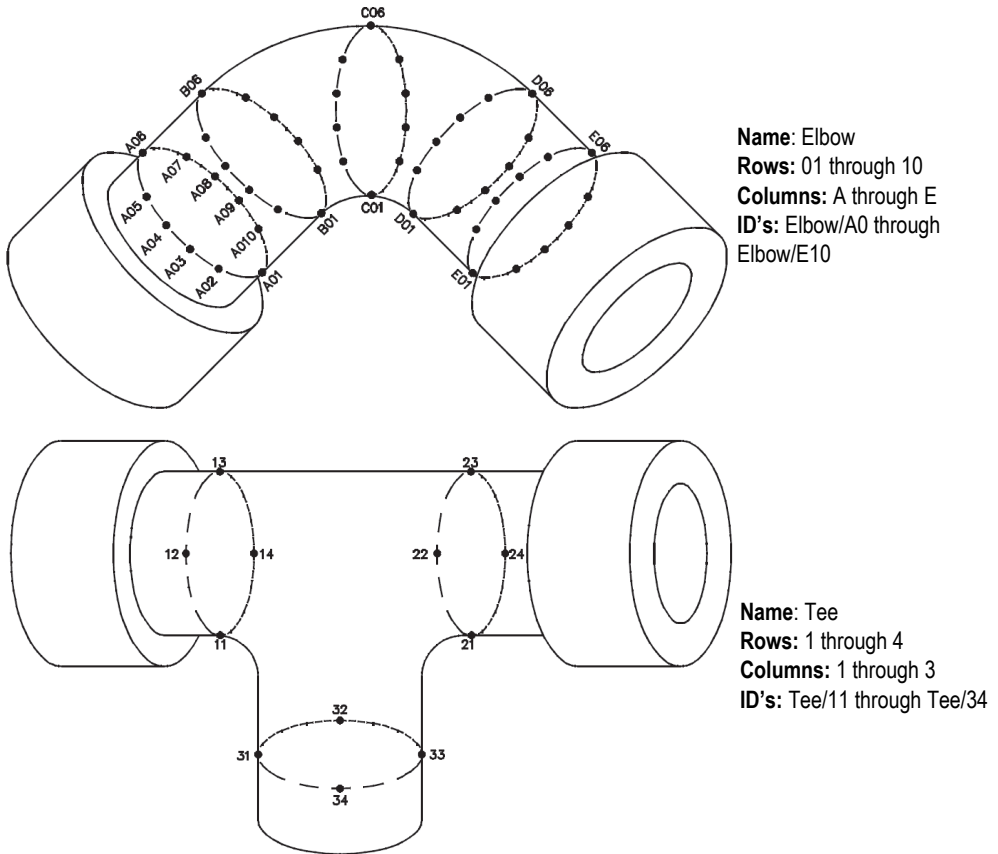


Figure 11-9 Different named grid for each part

To create a 2-D grid data file

1. From the measurement screen, press **[FILE]**, and then select **CREATE** in the menu (see "Creating a Data File" on page 183 for details on the first parameters).
2. At the bottom of the **CREATE** screen, select **CONTINUE**.
3. In the second page of the **CREATE** screen (see Figure 11-10 on page 194):
 - a) Enter the **START COLUMN**, **END COLUMN**, **START ROW**, and **END ROW** values.

- b) Select the **ID FORMAT** to determine how letters are incremented after Z:
STANDARD: A, B, C... Z, AA, AB, AC... ZZ.
EPRI: A, B, C... Z, AA, BB, CC... ZZ.
- c) In **INC 1ST BY**, select which parameter increments the first (**ROW** or **COLUMN**).
- d) Select **CREATE**.

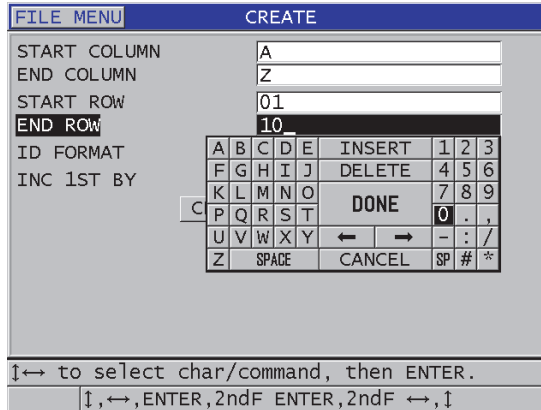


Figure 11-10 Configuring the ID range for a 2-D grid data file type

NOTE

The 39DL PLUS has the ability to add a row, add a column, and change the incrementing direction after a grid file is created (see “Editing a File” on page 206 for details).

11.2.1.5 2-D Grid with Custom Points Data File Type

The 2-D grid with custom points data file type is similar to the 2-D grid data file type (see “2-D Grid Data File Type” on page 190), except that you can add custom points. Custom points to record multiple readings with each grid ID number (see an example in Table 15 on page 195).

Table 15 Resulting ID example for the 2D+CUSTOM PT file type

Parameters	Values	CUSTOM POINTS	Resulting IDs
START COLUMN	A	LEFT	A01LEFT
END COLUMN	J	CENTER	A01CENTER
START ROW	01	RIGHT	A01RIGHT
END ROW	17		A02LEFT
			...
			J17RIGHT

To create a 2-D grid with custom points data file

1. From the measurement screen, press **[FILE]**, and then select **CREATE** in the menu (see “Creating a Data File” on page 183 for details on the first parameters).
2. At the bottom of the **CREATE** screen, select **CONTINUE**.
3. In the second page of the **CREATE** screen (see Figure 11-11 on page 196):
 - a) Enter the **START COLUMN**, **END COLUMN**, **START ROW**, and **END ROW** values.
 - b) Enter two or more **CUSTOM POINTS** values.
 - c) Press **[2nd F]**, **[▼]** to finish entering **CUSTOM POINTS** values.
 - d) In **INC 1ST BY**, select which parameter increments first (**POINT**, **ROW**, or **COLUMN**).
 - e) In **INC 2ND BY**, select which parameter increments second (**POINT**, **ROW**, or **COLUMN**).
 - f) Select **CREATE**.

FILE MENU		CREATE	
START COLUMN	A		
END COLUMN	J		
START ROW	01		
END ROW	17		
CUSTOM POINTS	LEFT		
	CENTER		
	RIGHT		
INC 1ST BY	A B C D E	INSERT	1 2 3
INC 2ND BY	F G H I J	DELETE	4 5 6
	K L M N O	DONE	7 8 9
	P Q R S T		0 . ,
	U V W X Y	← →	- : /
	Z SPACE	CANCEL	SP # *
↑↔ to select char/command, then ENTER.			
↑, ↔, ENTER, 2ndF ENTER, 2ndF ↔, ↓			

Figure 11-11 Configuring the ID range for a 2-D grid with custom points data file type

NOTE

The columns of the 39DL PLUS can increment past Z. For example: Start Column: A; End Column: AC; Column Result: A, B, C,...Z, AA, AB, AC.

11.2.1.6 3-D Grid Data File Type

A 3-D grid is a sequence of multipart ID numbers arranged to describe a path through a three-dimensional matrix. Each part of the ID number corresponds to a particular matrix dimension.

A 3-D (three-dimensional) sequence begins with the ID number that refers to the first column, the first row, and the first point. Each time you press **[SAVE/SEND]**, the value for the first dimension increments by one while the values for the other two dimensions remain unchanged. When the sequence reaches the last value of the first dimension, the value for the second dimension increments by one. This continues until the ID number that refers to the last column, last row and last point is reached. You can select either the columns, rows, or points to increment first.

A three-dimensional grid structure may associate two dimensions of the grid (for example, the columns and rows) with the physical coordinates on the part whose wall thickness is to be measured. The particular measurement points on each part are then

associated with the third dimension of the grid (for example, the points). This scenario allows multiple readings to be stored at each grid coordinate. The example shown in Table 15 on page 195 assumes that you chose to increment the point first, the row second and the column third.

Table 16 Resulting ID example for the 3-D GRID file type

Parameters	Values	Resulting IDs
Start column	A	A1X
End column	F	A1Y
Start row	1	A1Z
End row	4	A2X
Start point	X	...
End point	Z	A4Z
		B1X
		B1Y
		...
		AF4Z

To create a 3-D grid data file

1. From the measurement screen, press **[FILE]**, and then select **CREATE** in the menu (see “Creating a Data File” on page 183 for details on the first parameters).
2. At the bottom of the **CREATE** screen, select **CONTINUE**.
3. In the second page of the **CREATE** screen (see Figure 11-12 on page 198):
 - a) Enter the **START COLUMN**, **END COLUMN**, **START ROW**, **END ROW**, **START POINT**, and **END POINT** values.
 - b) In **INC 1ST BY**, select which parameter increments first (**POINT**, **ROW**, or **COLUMN**).
 - c) In **INC 2ND BY**, select which parameter increments second (**POINT**, **ROW**, or **COLUMN**).
 - d) Select **CREATE**.

FILE MENU		CREATE
START COLUMN	A	
END COLUMN	F	
START ROW	1	
END ROW	4	
START POINT	X	
END POINT	Y	
INC 1ST BY	POINT	
INC 2ND BY	ROW	
		CREATE CANCEL
↔ to select, then ENTER or ↓.		
↓, ↔, ENTER		

Figure 11-12 Configuring the ID range for a 3-D grid data file type

11.2.1.7 Boiler Data File Type

A boiler file is a special file type designed specifically for boiler applications. A common method for identifying a thickness measurement location is using the following three dimensional approach:

Elevation

The first dimension refers to the physical distance from the bottom of the boiler toward the top.

Tube number

The second dimension refers to the number of the specific boiler tube to be inspected.

Custom points

The third dimension refers to the actual thickness reading location at the specified elevation on the specified tube.

The three dimensions are combined in a single ID number to precisely identify the exact location of each thickness reading. Table 17 on page 199 shows an example where you chose to increment the custom points first, the tube number second, and the elevation third.

Table 17 Resulting ID example for the BOILER file type

ELEVATIONS	START TUBE	END TUBE	CUSTOM POINTS	Resulting IDs
10FT 20FT 45FT 100FT	01	73	L (left) C (center) R (right)	10FT-01L 10FT-01C 10FT-01R 10FT-02L ... 10FT-73R 20FT-01L ... 100FT-73R

To create a boiler data file

1. From the measurement screen, press **[FILE]**, and then select **CREATE** in the menu (see “Creating a Data File” on page 183 for details on the first parameters).
2. At the bottom of the **CREATE** screen, select **CONTINUE**.
3. In the second page of the **CREATE** screen (see Figure 11-13 on page 200):
 - a) Enter the **START TUBE** and **END TUBE** values.
 - b) Enter two or more **CUSTOM POINTS** values.
 - c) Press **[2nd F]**, **[▼]** to finish entering **CUSTOM POINTS** values.
 - d) Enter two or more **ELEVATIONS** values.
 - e) Press **[2nd F]**, **[▼]** to finish entering **ELEVATIONS** values.
 - f) In **INC 1ST BY**, select which parameter increments first (**POINT**, **TUBE**, or **ELEVATIONS**).
 - g) In **INC 2ND BY**, select which parameter increments second (**POINT**, **TUBE**, or **ELEVATIONS**).
 - h) Select **CREATE**.

Figure 11-13 Configuring the ID range for a boiler data file type

11.2.1.8 3-D Custom File Type

The 3-D custom file type is very similar to a standard 3-D Grid except that the point parameter can be a custom list of points.

Table 18 on page 200 shows an example where the custom point increments first, the custom row second, and the column third.

Table 18 Resulting ID example for the 3-D CUSTOM file type

Parameters	Value	CUSTOM ROWS	CUSTOM POINTS	Resulting IDs
START COLUMN END COLUMN	A F	-TOP- -MIDDLE- -BOTTOM-	LEFT RIGHT	A-TOP-LEFT A-TOP-RIGHT A-MIDDLE-LEFT A-MIDDLE-RIGHT ... F-BOTTOM-LEFT F-BOTTOM-RIGHT

To create a 3-D custom data file

1. From the measurement screen, press **[FILE]**, and then select **CREATE** in the menu (see “Creating a Data File” on page 183 for details on the first parameters).

2. At the bottom of the **CREATE** screen, select **CONTINUE**.
3. In the second page of the **CREATE** screen (see Figure 11-14 on page 201):
 - a) Enter the **START COLUMN**, and **END COLUMN** values.
 - b) Enter two or more **CUSTOM ROWS** values.
 - c) Press [**2nd F**], [**▼**] to finish entering **CUSTOM ROWS** values.
 - d) Enter two or more **CUSTOM POINTS** values.
 - e) Press [**2nd F**], [**▼**] to finish entering **CUSTOM POINTS** values.
 - f) In **INC 1ST BY**, select which parameter increments first (**POINT**, **ROW**, or **COLUMN**).
 - g) In **INC 2ND BY**, select which parameter increments second (**POINT**, **ROW**, or **COLUMN**).
 - h) Select **CREATE**.

FILE MENU	CREATE
START COLUMN	A
END COLUMN	F
CUSTOM ROWS	MIDDLE
	BOTTOM
CUSTOM POINTS	LEFT
	RIGHT
INC 1ST BY	POINT
INC 2ND BY	ROW
	CREATE CANCEL
↔ to select, then ENTER.	
↓, ↔, ENTER	

Figure 11-14 Configuring the ID range for a 3-D custom data file type

NOTE

The columns of the 39DL PLUS can increment past Z. For example:
 Start Column: A;
 End Column: AC;
 Column Result: A, B, C,...Z, AA, AB, AC.

11.2.2 File Data Modes

When you create a data file on the 39DL PLUS, you must select the file data mode to determine which measured values to store in the file (see step 3.f in “Creating a Data File” on page 183). Table 19 on page 202 describes the available file data mode options. You can only store one type of data in a file.

Table 19 File data mode stored measurements

File data mode	Stored measurements	When to use
THICKNESS	Standard thickness Echo-to-echo thicknesses	When basic thickness measurement functions
THRU COAT	Coating thickness Material thicknesses	When using THRU-COAT (see “Measurements with THRU-COAT D7906 and D7908 Transducers” on page 94)
TEMP COMP	Material temperature Material thickness	When using temperature compensation (see “Using Temperature Compensation” on page 176)
OXIDE LAYER	Oxide thickness Material thickness	When using the optional oxide software (see “Oxide Layer Software Option” on page 110)
VELOCITY	Velocity	When performing velocity measurements
MIN/MAX	Minimum thickness Maximum thickness	When using the MIN/MAX mode (see “Using the Minimum, Maximum, or Min/Max Thickness Mode” on page 133)
TIME OF FLT	Time of flight	When measuring time of flight
REDUCTION RT	Material thickness Reduction rate	When the reduction rate differential mode is activated (see REDUCTION RT in “Using Alarms” on page 135)

Table 19 File data mode stored measurements (continued)

File data mode	Stored measurements	When to use
SOFT CONTACT	Sagittal height Radius of curvature Lenses thickness	When using the multilayer software option (see “Using the Multi-Measurement with the Soft Contact Mode” on page 119)
% TOTAL THK	Thickness Percent total thickness	When using the multilayer software option (see “Using the Multi-Measurement % Total Thickness Mode” on page 121)

You can set the default file data mode to the option you use most frequently.

To change the default file data mode

1. From the measurement screen, press [SETUP MENU].
2. In the menu, select **SYSTEM**.
3. In the **SYSTEM** screen, set **DEFAULT FILE DATA MODE** to the desired option (see Table 19 on page 202 for details).
4. Press [MEAS] to return to the measurement screen.

11.3 Performing File Operations

Pressing [FILE] opens a menu from which you can perform numerous file operations (see Figure 11-15 on page 204). The following sections describe how to perform the operations. Datalogger files are stored in the internal microSD memory card. You can import/export files from/to an external microSD memory card.

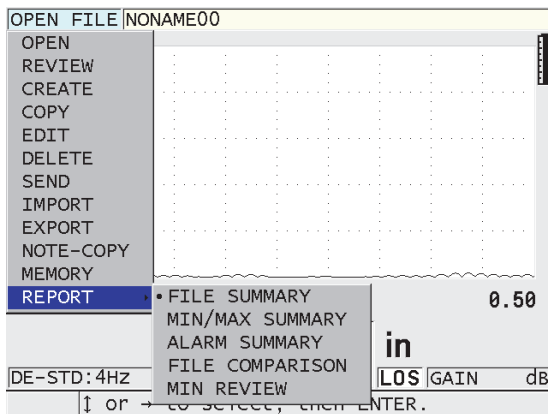


Figure 11-15 The file menu and report submenu

11.3.1 Opening a File

You can open an existing file to make it the active file to which new measurements will be saved.

To open a file

1. Press **[FILE]**.
2. In the menu, select **OPEN**.
3. In the **OPEN** screen (see Figure 11-16 on page 205):
 - a) In **SORT BY**, select how files appearing on the screen are sorted (by **NAME** or by **DATE CREATED**).
 - b) In the list of files, select the file that you wish to open.
The descriptive header for the highlighted file name appears on the lower section of the display.
 - c) Select **OPEN** to return to the measurement screen with the selected file as the active file and the ID number set to the first ID number in the file.

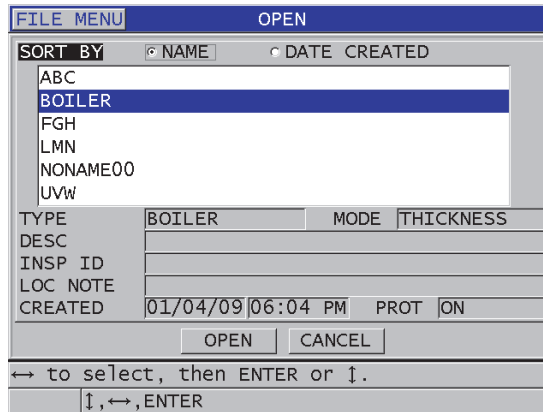


Figure 11-16 Opening a file

11.3.2 Copying a File

You can duplicate a file that already exists in the datalogger. The file copy function is useful when you need to create a new file with the exact same ID number structure as a previously created file. You can also choose to copy the thickness data.

The file copy only allows you to copy an existing file in the internal memory to the internal memory. Use the file import and export functions to copy data between the internal memory and the external microSD card.

To copy a file

1. From the measurement screen, press **[FILE]**.
2. In the menu, select **COPY**.
3. In the **COPY** screen (see Figure 11-17 on page 206):
 - a) In the list, select the source file.
 - b) In **COPY NAME**, enter the file name for the destination file.
 - c) Set **COPY THICKNESS DATA** to **YES** when you want to also copy the thickness readings from the original file into the new file.
 - d) Select **COPY**.

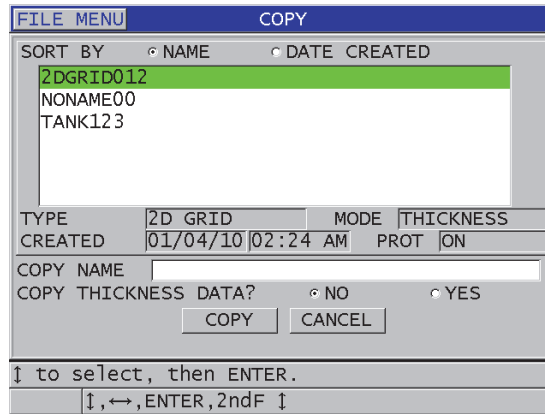


Figure 11-17 Copying a file

4. Open the newly created file when you want to make it the active file (see “Opening a File” on page 204.)

11.3.3 Editing a File

Once a file is created, you can use the edit function to change the following file parameters:

- File name
- File description
- Inspector ID
- Location note
- Delete protection (on/off)
- End row, column, or point of a grid file
- Incrementing order of a grid file
- Incrementing direction (forwards or reverse) for rows, columns, points, tube numbers, and elevations

The edit function does not let you edit the file type and cannot be used to edit individual measurement identifiers (ID) or actual thickness readings.

To edit an existing file

1. From the measurement screen, press **[FILE]**.
2. In the menu, select **EDIT**.
3. In the **EDIT** screen (see Figure 11-18 on page 207):
 - a) In the list, select the file to edit.

NOTE

When scrolling through the file names, a descriptive header for the highlighted file name appears on the lower section of the display. This information can assist in selecting the proper file if you are uncertain of the exact file name.

- b) To rename the file, edit the **NAME** value.
- c) Edit the file description (**DESC**), the inspector identification (**INSP ID**), and the location note (**LOC NOTE**) values as needed.
- d) To change the file lock state, set **DELETE PROTECTION** to **ON** or **OFF**.
- e) For a nongrid file, select **UPDATE**.

The screenshot shows the 'EDIT' screen with the following details:

- FILE MENU** and **EDIT** tabs at the top.
- SORT BY**: NAME, DATE CREATED
- File list: ABC, **BOILER** (highlighted), FGH
- TYPE**: BOILER, **MODE**: THICKNESS
- CREATED**: 01/04/09 06:04 PM, **PROT**: ON
- NAME**: BOILER01
- DESC**: A B C D E INSERT 1 2 3
- INSP ID**: F G H I J DELETE 4 5 6
- LOC NOTE**: K L M N O DONE 7 8 9
- DELETE PROT**: P Q R S T 0 . ,
- U V W X Y ← → - : / N
- Z SPACE CANCEL SP # *

Instructions at the bottom: ↑↔ to select char/command, then ENTER.
 ↑, ↔, ENTER, 2ndF ENTER, 2ndF ↔, ↓

Figure 11-18 Entering new file information

4. For a grid file, select **CONTINUE**, and then in the second page of the **EDIT** screen (see Figure 11-19 on page 208):

- a) Increase the **END COLUMN** and **END ROW** values as needed. You cannot decrease the values.
- b) If needed, change the **INC 1ST BY** value.
- c) Change the incrementing direction of rows, columns, points, tubes, and elevations.

FORWARD increments in the direction specified when the file was created, and **REVERSE** increments in the opposite direction of that which was specified during file creation.

- d) Select **UPDATE**.

The screenshot shows a software interface titled "EDIT" with a menu bar containing "FILE MENU". The main area contains several input fields and buttons:

- END COLUMN:** A text box containing the value "Z".
- END ROW:** A text box containing the value "15".
- INC 1ST BY:** A text box containing the value "ROW".
- COL INC DIRECTION:** A dropdown menu with "FORWARD" selected and highlighted in green.
- ROW INC DIRECTION:** A dropdown menu with "FORWARD" selected.
- Buttons:** "UPDATE" and "CANCEL" buttons are located below the direction dropdowns.

At the bottom of the screen, there are two lines of text:

↔ to select, then ENTER or ↓.

↓, ↔, ENTER

Figure 11-19 Displaying the grid edit screen

11.3.4 Deleting a File or its Contents

You can use the file delete function to completely erase the file from the datalogger memory or to erase the contents of a file. Files that are delete-protected cannot be deleted until the delete protection is disabled (see “Editing a File” on page 206.)



CAUTION

Once you delete a file, you cannot recover any information that was once contained in that file.

To delete a file stored in the 39DL PLUS

1. From the measurement screen, press **[FILE]**.
2. In the menu, select **DELETE**.
3. In the **DELETE** screen (see Figure 11-20 on page 209):
 - a) In the list, select one or more files to delete.
A check mark appears on the right on the line of files that you selected.
 - b) Press **[2nd F]**, **[▼]** to leave the list.
 - c) Select the desired **Delete Stored Data** or **Entire File** option.
 - d) Set **DELETE MODE** to **DATA** to only delete the contents of the file.
OR
Set **DELETE MODE** to **FILE** to completely erase the file from the memory.
 - e) Select **DELETE** to perform the operation.

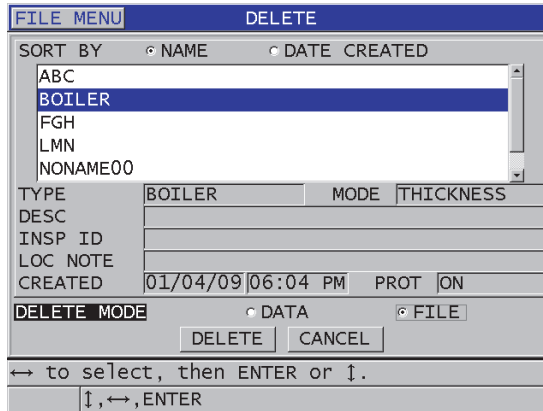


Figure 11-20 Deleting a file

NOTE

When you select to delete multiple files, and some files are delete-protected, the 39DL PLUS will only delete the files that are not delete-protected.

11.3.5 Deleting a Range of IDs

You can delete a range of IDs in the active file using the clear memory function. This function deletes both the data and the ID number locations for incremental and manual (built in GageView) data files. For other data file types only the data is deleted, not the ID number locations.

To delete a range of IDs in a file

1. Open the file from which you wish to delete the data of a range of IDs (see “Opening a File” on page 204).
2. Press [2nd F], [FILE] (CLR MEM).
3. In the **CLEAR ID RANGE**, screen (see Figure 11-21 on page 210):
 - a) Edit the **STARTING ID** and the **ENDING ID** values to define the range of IDs that you wish to delete from the file.
 - b) Select **CLEAR**.

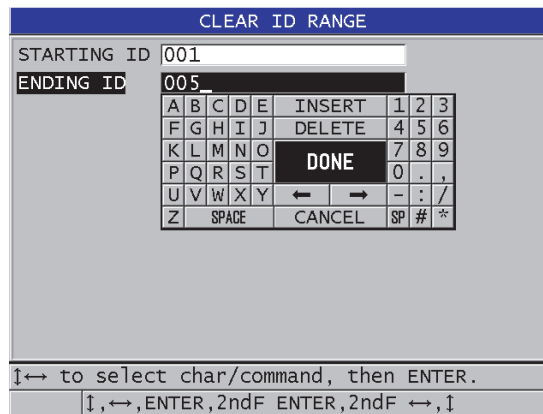


Figure 11-21 Deleting the data of an ID range in the active file

11.3.6 Deleting All Data Files

You can use the reset function to quickly erase all the files stored in the 39DL PLUS.



CAUTION

Using the measurement reset erases all files and data contained in those files. The deleted files and the data they contain cannot be recovered. The datalogger will be completely empty after this procedure.

To delete all files

1. Press [2nd F], [SETUP MENU] (SP MENU).
2. In the menu, select **RESETS**.
3. In the **RESETS** screen (see Figure 11-22 on page 211):
 - a) In the **RESETS** list, select **INTERNAL MEMORY RESET** to delete all files on the internal microSD memory card.
 - b) Select **RESET** to delete all the files.

OR

Select **CANCEL** or press [MEAS] to abort the operation.

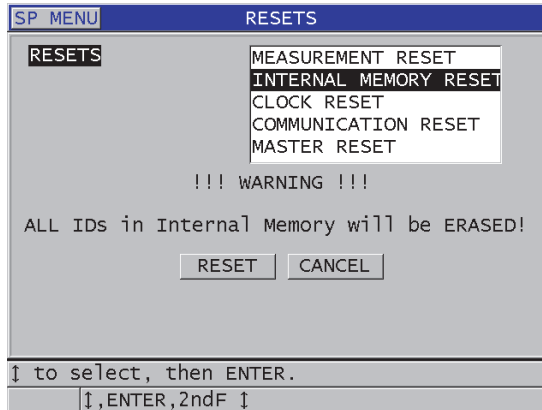


Figure 11-22 Warning message when resetting measurements

11.4 Notes

A note is an annotation that you can record with a particular measurement, for example to identify an unusual measurement condition. With the 39DL PLUS, you can define a list of text notes saved with the data file (see Figure 11-23 on page 212).

The screenshot shows the 'FILE NOTES' screen with a table of notes and a selection bar. The table has two columns for letter codes (A-Z) and note descriptions. The 'D' note is selected. The selection bar shows 'ID 001' and 'TO 001'. There are 'SAVE' and 'CANCEL' buttons, and a status bar at the bottom with navigation instructions.

Letter Code	Note Description	Selection
<input type="checkbox"/>	A OBSTRUCTION	<input type="checkbox"/>
<input type="checkbox"/>	B THIN AREA	<input type="checkbox"/>
<input type="checkbox"/>	C OUT OF TOLERANCE	<input type="checkbox"/>
<input checked="" type="checkbox"/>	D MIN THICKNESS	<input checked="" type="checkbox"/>
<input type="checkbox"/>	E	<input type="checkbox"/>
<input type="checkbox"/>	F	<input type="checkbox"/>
<input type="checkbox"/>	G	<input type="checkbox"/>
<input type="checkbox"/>	H	<input type="checkbox"/>
<input type="checkbox"/>	I	<input type="checkbox"/>
<input type="checkbox"/>	J	<input type="checkbox"/>
<input type="checkbox"/>	K	<input type="checkbox"/>
<input type="checkbox"/>	L	<input type="checkbox"/>
<input type="checkbox"/>	M	<input type="checkbox"/>
<input type="checkbox"/>	N	<input type="checkbox"/>
<input type="checkbox"/>	O	<input type="checkbox"/>
<input type="checkbox"/>	P	<input type="checkbox"/>
<input type="checkbox"/>	Q	<input type="checkbox"/>
<input type="checkbox"/>	R	<input type="checkbox"/>
<input type="checkbox"/>	S	<input type="checkbox"/>
<input type="checkbox"/>	T	<input type="checkbox"/>
<input type="checkbox"/>	U	<input type="checkbox"/>
<input type="checkbox"/>	V	<input type="checkbox"/>
<input type="checkbox"/>	W	<input type="checkbox"/>
<input type="checkbox"/>	X	<input type="checkbox"/>
<input type="checkbox"/>	Y	<input type="checkbox"/>
<input type="checkbox"/>	Z	<input type="checkbox"/>

ID 001 TO 001

SAVE CANCEL

←=edit ENTER=[un]select ↓,2nd F ↵=move

Figure 11-23 The FILE NOTES screen

A note is made of up to 16 characters. In the **FILE NOTES** screen, you can enter up to 26 notes per file. Each note is uniquely identified by a letter code. You can select up to four notes in the list, and then associate them to an ID or to a range of IDs.

When a note is associated to the current ID, the letter code of the note appears in the ID bar at the top of the measurement screen (see Figure 11-2 on page 181).

11.4.1 Creating or Editing Notes

You create or edit the text notes in the note table that is saved with a file.

NOTE

You can also quickly and easily create a note table on a computer using the GageView interface program. Refer to the *GageView Interface Program — User's Manual* (P/N: 910-259-EN [U8778347]) for details.

To create or edit notes

1. Open the file in which you want to create or edit the notes (see “Opening a File” on page 204).
 2. Press **[2nd F], [ID#] (NOTE)**.
 3. In the **FILE NOTES** screen:
 - a) Select the letter code for the note that you wish to create or edit.
 - b) Press the **[▶]** key to enter the edit mode.
 - c) Create or edit the note text.
 - d) Repeat steps 3.a to 3.c to create or edit other notes.
 - e) Select **SAVE** to save the note list to the file.
-

NOTE

If there are any previous notes, the **FILE NOTES** screen may show these notes.

11.4.2 Associating a Note to an ID or to a Range of IDs

You can associate up to four notes to each measurement ID within a file. You can also select to use up to four notes and save them to a range of IDs in a file. Notes can be saved to an ID with or without a thickness reading. Notes can be added to an ID or a range of IDs without overwriting the stored thickness readings.

To associate a note to an ID or to a range of IDs

1. From the measurement screen, press **[2nd F], [ID#] (NOTE)**.
 2. In the **FILE NOTES** screen (see Figure 11-24 on page 214):
 - a) Select the letter code for the note that you wish to associate.
-

- b) Press **[ENTER]**.
A checkmark appears in the check box to the left of the letter code.
- c) Repeat steps 2.a to 2.b when you want to associate other notes (up to four).
- d) In **ID**, enter the ID or the start ID of the range to which you want to associate the note(s).
- e) In **TO**, enter the ID or the end ID of the range to which you want to associate the note(s).
- f) Select **SAVE** to save the note list to the file.
The letter codes for the checked notes are assigned to the selected ID range.

FILE NOTES			
<input type="checkbox"/>	A	OBSTRUCTION	<input type="checkbox"/>
<input checked="" type="checkbox"/>	B	HIGH TEMP	<input type="checkbox"/>
<input checked="" type="checkbox"/>	C	ROUGH SURFACE	<input type="checkbox"/>
<input type="checkbox"/>	D		<input type="checkbox"/>
<input type="checkbox"/>	E		<input type="checkbox"/>
<input type="checkbox"/>	F		<input type="checkbox"/>
<input type="checkbox"/>	G		<input type="checkbox"/>
<input type="checkbox"/>	H		<input type="checkbox"/>
<input type="checkbox"/>	I		<input type="checkbox"/>
<input type="checkbox"/>	J		<input type="checkbox"/>
<input type="checkbox"/>	K		<input type="checkbox"/>
<input type="checkbox"/>	L		<input type="checkbox"/>
<input type="checkbox"/>	M		<input type="checkbox"/>
<input type="checkbox"/>	N		<input type="checkbox"/>
<input type="checkbox"/>	O		<input type="checkbox"/>
<input type="checkbox"/>	P		<input type="checkbox"/>
<input type="checkbox"/>	Q		<input type="checkbox"/>
<input type="checkbox"/>	R		<input type="checkbox"/>
<input type="checkbox"/>	S		<input type="checkbox"/>
<input type="checkbox"/>	T		<input type="checkbox"/>
<input type="checkbox"/>	U		<input type="checkbox"/>
<input type="checkbox"/>	V		<input type="checkbox"/>
<input type="checkbox"/>	W		<input type="checkbox"/>
<input type="checkbox"/>	X		<input type="checkbox"/>
<input type="checkbox"/>	Y		<input type="checkbox"/>
<input type="checkbox"/>	Z		<input type="checkbox"/>
ID		10FT-01L	TO 10FT-01L
		SAVE	CANCEL
↔=edit ENTER=[un]select ↓,2nd F ↑=move			

Figure 11-24 Selecting a note from the notes table

NOTE

The letter codes are automatically untagged every time you press **[SAVE/SEND]**. Therefore, you must select the desired comment code before using the **[SAVE/SEND]** key.

11.4.3 Deleting a Note from a File

You can delete a note from a file.

**CAUTION**

To prevent loss of data, do not delete notes of letter codes that have already been associated with an ID or with a range of IDs. This would destroy the meaning of the letter codes stored with IDs.

To delete a note from a file

1. Open the file in which you want to delete a note (see “Opening a File” on page 204).
2. Press **[2nd F], [ID#] (NOTE)**.
3. In the **FILE NOTES** screen:
 - a) Select the letter code for the note that you wish to delete.
 - b) Press the **[▶]** key to enter the edit mode.
 - c) Delete all the characters of the note text.
 - d) Select **SAVE** to save the edited note list to the file.

11.4.4 Copying a Note Table

You can easily copy notes from one file to another file in the 39DL PLUS. This is very useful when you are creating files from the 39DL PLUS and want to use a common note table.

**CAUTION**

To prevent loss of data, do not copy a note table to a file that has existing stored letter codes. Copying would redefine the meaning of existing stored notes.

For example, if A = HOT SURFACES in the original note table, and you copy a note table where A = PAINTED SURFACES, this changes the definition of A, and thus changes the meaning of any previously stored A notes.

To copy a note table

1. Press **[FILE]**.
2. In the menu, select **NOTE-COPY**.
3. In the **NOTE-COPY** screen (see Figure 11-25 on page 216):
 - a) Select the **SOURCE FILE**, the file from which you want to copy the note table.
 - b) Select the **DESTINATION FILE**, the file to which you want to copy the note table.
 - c) Select **COPY**.

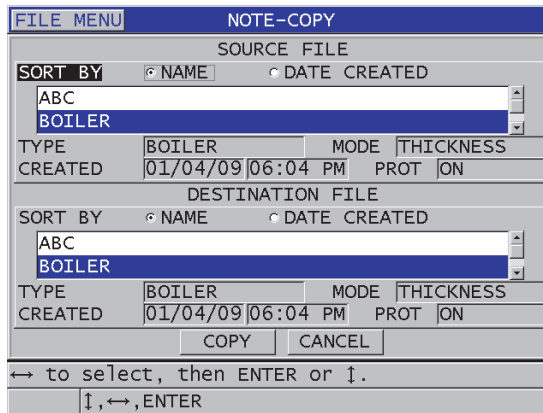


Figure 11-25 Copying a note table from one file to another

11.5 Setting the ID Overwrite Protection

You can activate the ID overwrite protection to warn you every time that you attempt to overwrite an existing measurement in a file. You can enable this function at any time.

When the ID overwrite protection is enabled, a message appears on the help text bar when you attempt to save data over existing thickness readings/waveforms. Select **YES** to replace the previous reading with the new one, or **NO** to leave the original value.



Figure 11-26 The ID overwrite protection message

To set the ID overwrite protection

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **MEAS**.
3. In the **MEAS** screen, set **ID OVERWRITE PROTECTION** to **ON** or **OFF**.
4. Press **[MEAS]** to return to the measurement screen.

11.6 ID Review Screen

You can review the data stored in the active file using the ID review screen. You toggle the state of the ID review screen by pressing **[ID#]**. The ID review screen shows the waveform and the data for the active ID.

Figure 11-27 on page 218 shows an example of ID review screen and describes its contents. The area under the waveform is reserved for status flags describing the displayed stored thickness values. The flags are the same single letter abbreviations for status words that are transmitted by the gauge using the send commands (see “Managing Communications and Data Transfer” on page 263).

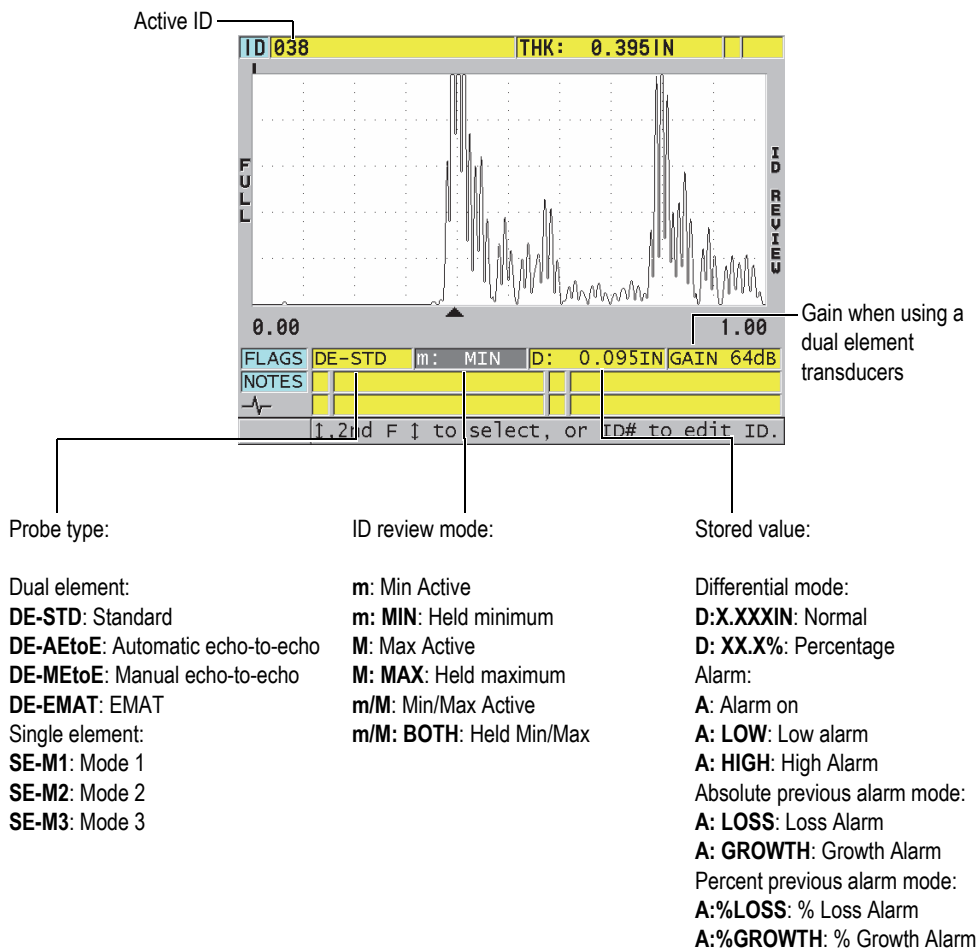


Figure 11-27 Identifying the ID review screen

The ID review screen has three purposes:

- Review datalogger contents by scanning through stored ID locations in the active file.
- Move within the data file and change the current ID location to any location that already exists in the data file.

- Change the current ID location to any location that already exists in the data file for the purposes of editing that ID location.

11.6.1 Reviewing Stored Data and Changing the Active ID

You use the ID review screen to review the data in the active file.

To review stored data and change the active ID

1. Open the file that you wish to review (see “Opening a File” on page 204).
2. From the measurement screen, press **[ID#]**.
3. While in the ID review screen (see Figure 11-27 on page 218):
 - a) Review the waveform, status flags, notes, and measured values for the active ID.
 - b) Press **[▲]** to display the data for the next ID in the file.
 - c) Press **[▼]** to display the data for the previous ID in the file.
 - d) Press **[2nd F]**, **[▲]** and **[2nd F]**, **[▼]** to respectively jump to the last ID and to the first ID in the file.
 - e) Press **[ID#]** to edit the ID (see “Editing the ID” on page 219).
4. Press **[MEAS]** to return to the measurement screen with the new active ID.

11.6.2 Editing the ID

You can edit the ID for one of two following purposes:

- Change the active ID to quickly jump to an existing ID. This is useful when you are using a large database and it would take too long to locate the desired ID using the arrow keys.
- Change the active ID to a new ID, which does not yet exist in the file. This mode is useful when you want to include additional measurement points to the active file. Additional IDs can be added anywhere in the database (beginning, middle, end).

NOTE

No stored data is shown while editing the ID.

To use the ID edit mode

1. Open the file in which you wish to edit an ID (see “Opening a File” on page 204).
2. From the measurement screen, press **[ID#]**.
3. Select the ID you wish to edit (see “Reviewing Stored Data and Changing the Active ID” on page 219).
4. Press **[ID#]** again, and edit the ID value (see Figure 11-28 on page 220).

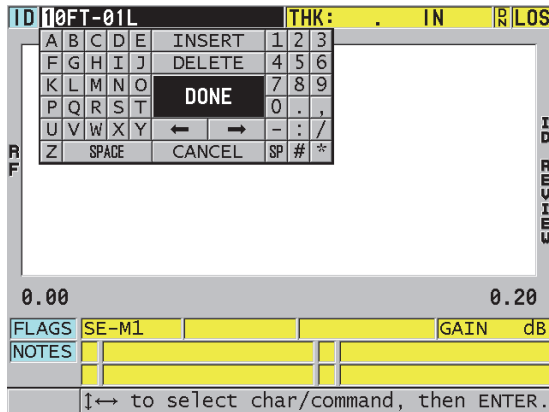


Figure 11-28 Editing the ID # edit mode

5. Press **[MEAS]** to return to the measurement screen with the new active ID.
6. When the edited ID is not in the database, the help text bar message shown in Figure 11-29 on page 221 appears, select **INSERT** to insert the new ID before the active ID.

OR

Select **APPEND** to add the new ID at the end of the file.

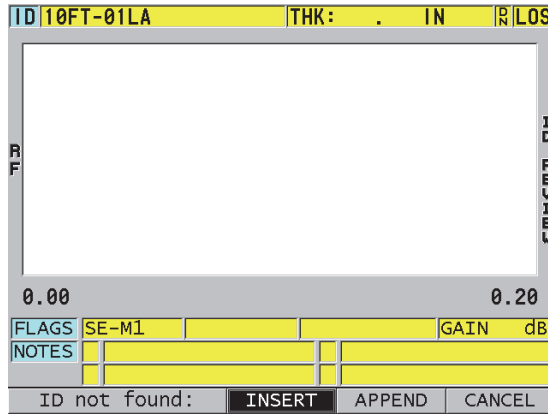


Figure 11-29 The message when the edited ID is not in the database

7. Press **[SAVE/SEND]** with or without an active measurement in order for the edited ID to become a permanent part of the database.
The sequence resumes at the previous active ID.

11.6.3 Erasing Data in the Active File



CAUTION

Data erased by the following techniques **CANNOT** be recovered.

To erase a single measurement

1. From the measurement screen, press **[ID#]**.
The ID review screen appears and shows the active ID with its stored data.
2. Select the ID to be erased (see “Reviewing Stored Data and Changing the Active ID” on page 219).
3. Press **[2nd F], [FILE] (CLR MEM)** to erase the data at the displayed ID.
The displayed ID changes to the next ID in the sequence.

TIP

To replace a thickness reading, it is easier to save a new measurement at the desired ID from the measurement screen. If you do not want to save a measurement at a specific ID, press **[SAVE/SEND]** from the measurement screen when you are not taking a measurement. This stores an LOS condition and --.-- at the specific ID number.

4. Press **[MEAS]** to return to the measurement screen.
-

NOTE

When deleting the measurement stored in an ID, the ID is also deleted. In all other file types, only the thickness and waveform data is deleted.

11.7 Generating Reports

The 39DL PLUS can generate inspection data reports without having to connect to a computer. The following reports are available:

File summary

Shows basic statistics for the file (minimum thickness and location, maximum thickness and location, high and low alarm conditions along with the mean, median, and standard deviation).

Minimum/Maximum summary

Shows a list of ID number location that have the minimum and maximum thickness in a file.

Alarm summary

Shows a list of all the ID number locations where a low alarm and high alarm occurred.

File comparison

Allows you to select two files and compare them. The first file contains the previous inspection data and the second file contains the current inspection data. The report indicates the maximum wall loss and any area of greater wall thickness (growth) and their ID number locations.

Minimum Review

Allows you to select a file and then review all minimum thickness locations in the file. You can verify the thickness at all minimum location and replace them if needed.

To generate a report

1. From the measurement screen, press **[FILE]**.
2. In the menu, select **REPORT**.
3. In the submenu, select the desired type of report. When you select:
 - **FILE SUMMARY**, go to step 4
 - **MIN/MAX SUMMARY**, go to step 5
 - **FILE COMPARISON**, go to step 6
 - **ALARM SUMMARY**, go to step 7
 - **MIN REVIEW**, go to step 8
4. In the **FILE SUMMARY** screen (see Figure 11-30 on page 223):
 - a) Select the file for which you want to create the report.
 - b) Select **REPORT**.

The **FILE SUMMARY** report result screen opens (see Figure 11-31 on page 224).

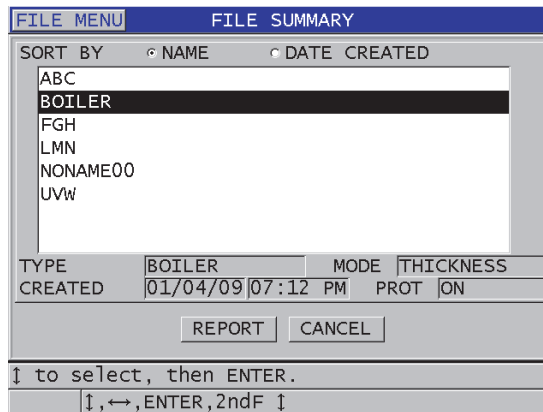


Figure 11-30 The **FILE SUMMARY** report screen

FILE SUMMARY			
START ID	10FT-01L		
END ID	100FT-73R		
TOTAL ID COUNT	876		
#MINS:	34	MIN VAL:	0.398
#MAXS:	34	MAX VAL:	0.494
#HI ALARMS:	0	%HI:	0.000%
#LO ALARMS:	0	%LOW:	0.000%
MEAN:	0.446		
MEDIAN:	0.446		
STD DEV:	0.048		
CANCEL		NEW REPORT	

Figure 11-31 The FILE SUMMARY report result screen

- c) Select **CANCEL** to return to the measurement screen or **NEW REPORT** to generate another report.
5. In the **MIN/MAX SUMMARY** screen:
- a) Select the file for which you want to create the report.
 - b) Select **REPORT**.
- The **MIN/MAX SUMMARY** report result screen opens with the first min ID # highlighted (see Figure 11-32 on page 224).

MIN/MAX SUMMARY	
MIN VAL :	0.398
MAX VAL :	0.494
#MINS:	34
	10FT-12C
	10FT-12R
	10FT-13L
	10FT-13C
#MAXS:	34
	10FT-01L
	10FT-01C
	10FT-01R
	10FT-02L
CANCEL NEW REPORT	

Figure 11-32 The MIN/MAX SUMMARY report screen

- c) Press **[2nd F], [▲]** or **[2nd F], [▼]** to move between the **#MINS** and **#MAXS** lists.
 - d) Select **CANCEL** to return to the measurement screen or **NEW REPORT** to generate another report.
6. In the **FILE COMPARISON** screen (see Figure 11-33 on page 225):
- a) In the upper list, select the reference file that you want to use in the comparison.
 - b) In the lower list, select the comparison file (containing newer data for the same measurement points).
 - c) Select **REPORT**.
The **FILE COMPARISON** report result screen opens with the first maximum wall loss ID highlighted (see Figure 11-34 on page 226).

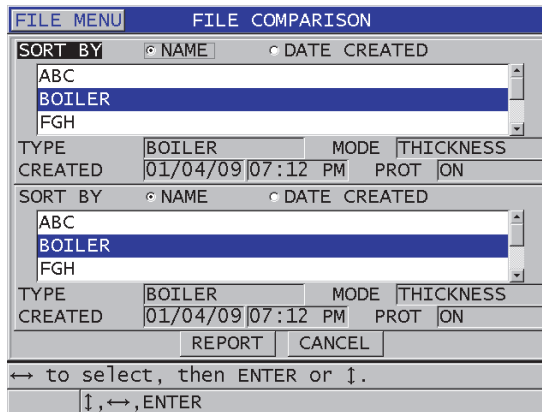


Figure 11-33 The FILE COMPARISON report screen

FILE COMPARISON	
MAX WALL LOSS:	0.200
AVG WALL LOSS:	0.150
# OF MAX WALL LOSS IDs:	4
007	
008	
009	
010	
# OF GROWTH IDs:	2
005	
006	

CANCEL NEW REPORT

Figure 11-34 The FILE COMPARISON report result screen

- d) Review the maximum wall loss location list and the maximum wall growth location list.
 - e) Select **CANCEL** to return to the measurement screen or **NEW REPORT** to generate another report.
7. In the **ALARM SUMMARY** screen:
- a) Select the file for which you want to generate the report.
 - b) Select **REPORT**.
The report page of the **ALARM SUMMARY** screen opens with the first low alarm location ID highlighted (see Figure 11-35 on page 227).

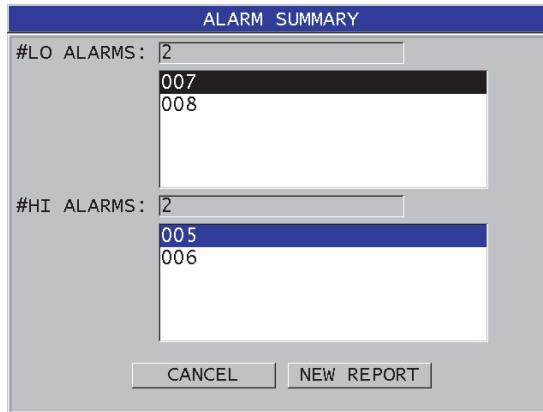


Figure 11-35 The ALARM SUMMARY report result screen

- c) Review the low and the high alarm location lists.
 - d) Select **CANCEL** to return to the measurement screen or **NEW REPORT** to generate another report.
 8. In the **MIN REVIEW** screen:
 - a) Select the file for which you want to generate the report.
 - b) Select **REPORT**.
The **MIN/MAX SUMMARY** report result screen opens with the minimum thickness ID highlighted (see Figure 11-36 on page 228).

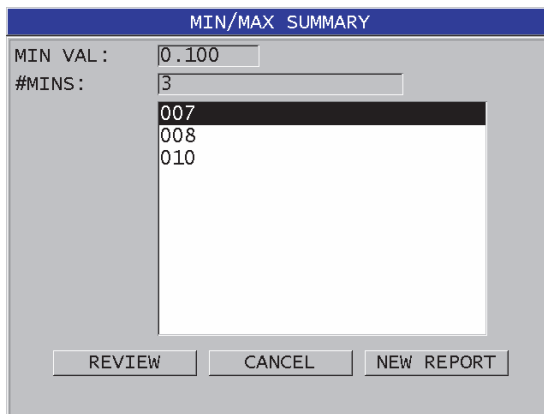


Figure 11-36 The MIN/MAX SUMMARY report result screen

- c) In the list, select an ID.
 The 39DL PLUS returns to the live measurement screen at the selected minimum ID in the file (see Figure 11-37 on page 228).

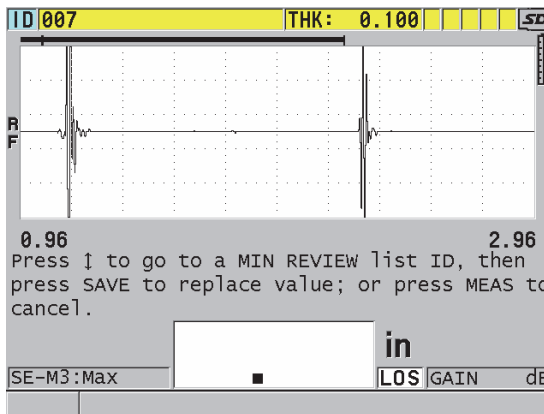


Figure 11-37 Returning to the measurement screen

- d) You can couple the probe back to the minimum ID location to verify the thickness, and then press [SAVE/SEND] to store the new measurement.
 e) Use the [▲] and [▼] keys to move to other minimum review list IDs.

f) Press **[MEAS]** to exit the minimum review.

12. Dual Element Transducer Setups

You can use a wide variety of transducers with the 39DL PLUS. You can create, store, and quickly recall setups in the instrument for the transducers that you use and for specific applications.

The 39DL PLUS comes with predefined setups that always remain in the instrument as defaults and cannot be removed (see Table 20 on page 231). The default conditions are selected to easily get you started with your applications. You can however easily change existing setups and create up to 35 user-defined application setups, providing flexibility for a wide range of applications.

Table 20 Predefined setups

Quantity	Setup type	Application
22	Predefined	Standard single and dual element probes
7	Predefined	High penetration option
2	Predefined	Internal oxide software option
35	User-defined	Custom applications

12.1 Standard D79X and Other Dual Element Transducers

The 39DL PLUS is compatible with a full line of Evident dual element thickness gauge transducers (see Table 21 on page 233). The 39DL PLUS automatically recognizes a D79X transducer when you plug one and automatically requests you to perform a transducer zero compensation ([Do ZERO]).

The 39DL PLUS recognizes the transducer through the identification pin located in the molded plug of the cable. Transducer recognition allows the 39DL PLUS to automatically recall setup parameters for the transducer along with a corresponding V-path correction. This generally provides the highest degree of accuracy and repeatability. For best performance, Evident recommends using an Evident dual element transducer. Evident cannot guarantee proper performance with other dual element transducers or transducers that are not designed for use with the 39DL PLUS.

If a dual element transducer without a recognition pin is plugged into a 39DL PLUS, the instrument prompts you to select a generic transducer setup or one of the previously created custom stored transducer setup. The 39DL PLUS has the ability to build and store a custom transducer setup for nonrecognized dual element transducers in the frequency range of 1 MHz to 10 MHz.

12.2 Creating a Setup for Nonstandard Dual Element Transducers

The 39DL PLUS automatically detects standard D79X series dual element transducers and automatically loads the appropriate setup. When you use a nonstandard dual element transducer, you need to create a custom setup.

To create a setup for a nonstandard dual element transducer

1. Connect the nonstandard dual element transducer to the 39DL PLUS.
2. In the **GENERIC SETUP SELECTION** screen that appears (see Figure 12-1 on page 233):
 - a) In the **SETUP TYPE** list, select **DEFAULT**.
 - b) In the **SELECT SETUP** list, select the setup that best matches the frequency of the connected transducer.

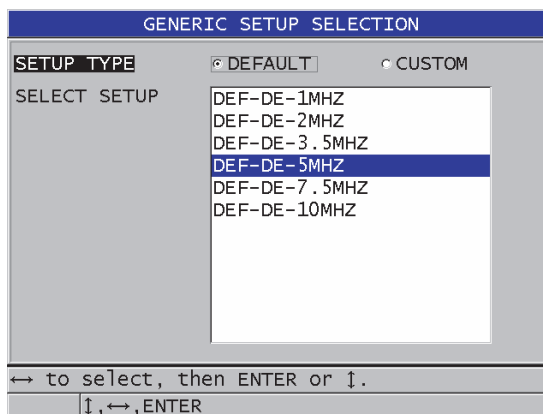


Figure 12-1 The GENERIC SETUP SELECTION screen

3. Press **[MEAS]** to return to the measurement screen.
4. Press **[XDCR RECALL]**.
5. In the menu, select **DEFAULT DUAL ELEMENT**.
6. In the **DEFAULT DUAL ELEMENT** screen, among the default transducer list, select the transducer that best matches the frequency and the diameter of the dual element transducer that you are using (see Table 21 on page 233).

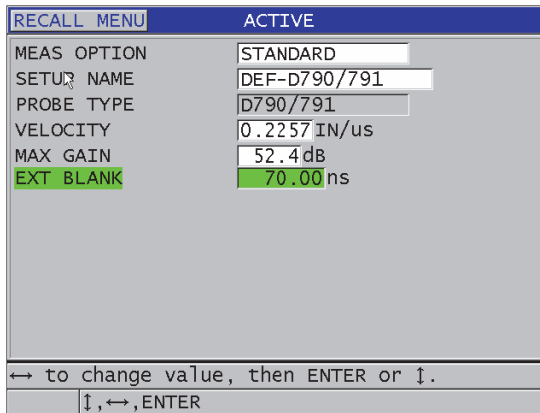
Table 21 Default transducers

Default transducer	Frequency	Tip diameter
D790/791/D799	5 MHz	11.0 mm (0.434 in.)
D792/D793	5 MHz	7.2 mm (0.283 in.)
D794	10 MHz	7.2 mm (0.283 in.)
D797	2 MHz	22.9 mm (0.900 in.)
D798/D7226	7.5 MHz	7.2 mm (0.283 in.)
D7912/D7913	10 MHz	7.5 mm (0.295 in.)
MTD705	5 MHz	5.1 mm (0.200 in.)
D7906 (THRU-COAT)	5 MHz	11.0 mm (0.434 in.)
D7908	7.5 MHz	7.2 mm (0.283 in.)
Generic setups for dual element transducers:		
DEF-DE-2MHZ	2 MHz	

Table 21 Default transducers (continued)

Default transducer	Frequency	Tip diameter
DEF-DE-3.5MHZ	3.5 MHz	
DEF-DE-5MHZ	5 MHz	
DEF-DE-7.5MHZ	7.5 MHz	
DEF-DE-10MHZ	10 MHz	

7. In the **ACTIVE** screen (see Figure 12-2 on page 234):
 - a) Set **MEAS OPTION** to the desired echo detection mode to use with this transducer (see “Echo Detection Modes with Dual Element Transducers” on page 96 for details).
 - b) In **SETUP NAME**, enter a setup name that describes the transducer and the application for which the setup will be used.
 - c) Set **VELOCITY** to the sound velocity in the material to be tested.
 - d) If needed, adjust the **MAX GAIN** value (see “Maximum Gain” on page 250).
 - e) If needed, adjust the **EXT BLANK** value (see “Adjusting the Extended Blank with Dual Element Transducers” on page 157).
 - f) Press **[SAVE/SEND]** to save the changes to the setup.

**Figure 12-2 Example of the ACTIVE screen**

8. In the **SAVE SETUP** screen:
 - a) If needed, highlight **SAVE AS**, and then modify the setup name.

- b) In the **SAVE TO** list, select the custom setup location where to save the setup.
 - c) Select **SAVE**.
9. Back in the **ACTIVE** screen, press **[MEAS]** to return to the measurement screen.

12.3 Recalling Stored Dual Element Transducer Setups

The 39DL PLUS allows you to store and recall setups for dual element transducers. Stored dual element transducer setups can also include calibration information like the velocity, the zero offset, the V-path, and the default gain. This feature makes it easy to change between different transducer setups designed for different applications.



CAUTION

Unsaved data will be lost when a different application setup is recalled. Save all changes made to the active setup before recalling another setup.

To recall a custom dual element transducer setup

1. Press **[XDCR RECALL]**.
2. In the menu, select **CUSTOM DUAL ELEMENT**.
3. In the **CUSTOM DUAL ELEMENT** screen, select the desired custom setup.
4. In the **ACTIVE** screen, review the setup parameters.
5. Press **[MEAS]** to return to the measurement screen with the recalled setup active.

12.4 V-Path

The V-path is the path along which the ultrasonic wave travels from one element to the other when using a dual element transducer. Since the V-path is slightly longer than twice the thickness, the instrument must calculate a compensation to measure the true thickness. Using a V-path correction allows the 39DL PLUS to measure thicknesses with the highest degree of accuracy and repeatability.

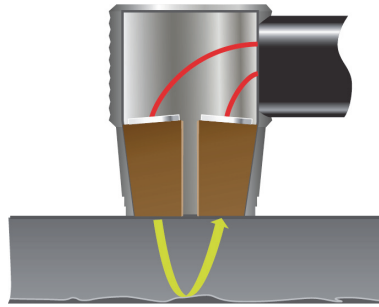


Figure 12-3 Illustration of the V-path

When you connect an Evident standard D79X series dual element transducer, the 39DL PLUS automatically recognizes it and recalls the appropriate default setup and V-path correction. The 39DL PLUS also includes a function to build a custom V-path compensation for almost any other dual element transducer. This compensation curve is saved and recalled along with a custom setup.

12.4.1 Activating the V-Path Function

You need to activate the V-path function to be able to build a V-path correction curve.

To activate the V-path function

1. Press [SETUP MENU].
2. In the menu select **MEAS**.
3. In the **MEAS** screen, set **VPATH CAL ENABLE** to **ON**.
4. Press [MEAS] to return to the measurement screen.

12.4.2 Building a V-Path Correction Curve for a Nonstandard Dual Element Transducer

Creating a custom V-path requires a multi-step test block representing the thickness range and material to be tested (minimum and maximum thicknesses). You need to measure on at least three test block steps. You can use up to ten known thicknesses to generate a V-path correction curve. Using more V-path calibration points improves the accuracy of the measurements.

IMPORTANT

When using generic dual element transducers, you need to determine the exact thickness range over which you will measure. The minimum and maximum thicknesses are highly dependent on:

- Frequency of the transducer
 - Material being tested
 - Roof angle of the transducer
 - Delay material in the transducer
 - Signal noise in the transducer
-

**CAUTION**

Evident cannot guarantee the accuracy or performance with non-D79X transducers. The user assumes all responsibility for assuring that the generic dual element transducer is performing properly and is suitable for the application.

To build a V-path correction for a nonstandard dual element transducer

1. Ensure that the transducer is not coupled to the test material and that there is no couplant on the tip to the transducer.
2. Press [**2nd F**], [**CAL ZERO**] (**Do ZERO**) to perform the transducer zero calibration.
3. To ensure that the instrument properly detects echoes:
 - a) Press [**RANGE**] until the range value is higher than the maximum thickness of the test block.
 - b) Couple the transducer to the thickest test block step, and then press [**GAIN**] to adjust the gain so that the instrument properly detects the back-wall echo, and then ensure that there are no noise signals above 20% of the screen height.

NOTE

The thickness readings at this point may not be accurate because a proper zero offset for the transducer has not yet been set.

- c) Couple the transducer to the thinnest test block step.
 - d) If necessary, press **[GAIN]** to adjust the gain so that the instrument properly detects the back-wall echo.
 - e) If necessary, adjust the extend blank so that the gauge is making proper detection on the back-wall signal (see “Blanking Adjustments in Manual Echo-to-Echo Detection Mode” on page 99).
 - f) Ensure that the instrument properly detects echoes on all test block steps.
4. Activate the V-path function (see “Activating the V-Path Function” on page 236 for details).
 5. Couple the transducer to a thick sample representing the thickest material that you will measure.
 6. Press **[CAL VEL]**.
 7. In the help text bar, select **YES** to the **VPath Calibration?** prompt (see Figure 12-4 on page 238).



Figure 12-4 Answering YES at the V-path calibration prompt

8. While the transducer is coupled to the thick sample and getting a steady thickness reading, press **[ENTER]**.
9. In the **V-PATH CALIBRATION** screen, edit the point **1** value to match the known thickness (see Figure 12-5 on page 239).

V-PATH CALIBRATION				
ENTER VALUE FOR TEST BLOCK POINT 1				
1	2	3	4	5
0.500	--.---	--.---	--.---	--.---
6	7	8	9	10
--.---	--.---	--.---	--.---	--.---
NEXT TEST BLOCK POINT 2				
Then CAL VEL to measure next selected test block point or MEAS if done.				
←=Move ↓=Select MEAS or ENTER=Done.				
↑, ←, ENTER, MEAS, CAL VEL				

Figure 12-5 Editing point 1 of the V-path calibration

10. Press [CAL VEL].
11. Couple the transducer to the next thickest sample to get a steady thickness reading, and then press [ENTER].
12. In the **V-PATH CALIBRATION** screen, edit the value for the next point to match the known thickness.
13. Repeat steps 10 to 12 for the other thicknesses. You need a minimum of three points and a maximum of ten V-path calibration points.
14. When all known thickness values from all calibration points have been entered, press [MEAS].
15. At this point you can either press [CAL VEL] to view the V-path Calibration table.
OR
Save the V-path calibration as a custom dual element transducer setup:
 - a) Press [SAVE/SEND].
 - b) In the **SAVE SETUP** screen, enter the desired custom setup file name (see Figure 12-6 on page 240).

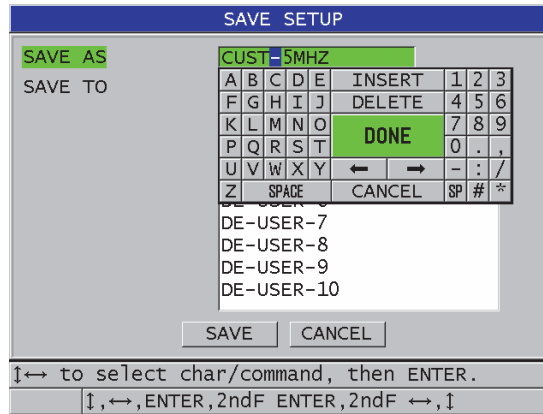


Figure 12-6 Saving the setup

- c) In the **SAVE TO** list, select a storage location.



CAUTION

DE-USER-X (where X = 1 to 10) represents an empty location. Selecting a custom setup location that already has a stored custom setup deletes and replaces the contents with the new custom dual element transducer setup.

- d) Select **SAVE** to save the custom setup.
- e) In the **ACTIVE** screen, review the parameters.
- f) Press **[MEAS]** to return to the measurement screen.
The new custom transducer is now the active setup and can be recalled from the list of custom dual element transducer setups.

13. Custom Setups for Single Element Transducers

The 39DL PLUS includes predefined setups for standard single element transducers. In some cases, a 39DL PLUS ships from the factory preprogrammed with one or more custom setups to meet special customer requirements. You can create your own custom setups to meet the need of a particular single element transducer or for a particular application. With predefined and custom setups you can quickly change between transducer and application setups by selecting a previously saved setup.

13.1 Creating a Custom Setup for a Single Element Transducer

You should create a custom setup when the measurement requirements of a particular application are not optimally met by one of the standard setups. Once adjustments are made, you can name and store this setup in one of the 35 user-defined setup locations.



CAUTION

The adjustments described in the following procedure and subsections should be made only by a qualified technician who is familiar with the basic theory of ultrasonic gaging and the interpretation of ultrasonic waveforms.

Many of the adjustments that you can make in a setup are interactive. All of them have an effect on the measurement range and/or measurement accuracy of the 39DL PLUS. In most cases, do not attempt adjustments without monitoring the waveform. Additionally, when establishing a custom setup for a specific application, it is essential to verify the performance on reference standards representing the materials and thickness range to measure.

To create a custom setup for a single element transducer

1. Connect the single element transducer to the 39DL PLUS (see “Setting Up the Transducer” on page 79).
2. Press [**XDCR RECALL**].
3. In the menu, select the **CUSTOM SINGLE ELEMENT**.
4. In the **CUSTOM SINGLE ELEMENT** screen, select the desired custom setup location (**SE-USER-n**) in which you wish to save the custom setup.

TIP

To reduce the number of changes to make to parameter values, you can also select an existing single element setup with parameter values that are close to the desired setup.

5. In the **ACTIVE** screen (see Figure 13-1 on page 242):
 - a) Set **DET MODE** to the desired detection mode (see “Detection Modes” on page 245 for details).

RECALL MENU	ACTIVE
DET MODE	MODE 1
SETUP NAME	SE-USER-1
MEAS TYPE	STANDARD
PROBE TYPE	M112
VELOCITY	0.2260 IN/us
ZERO VALUE	643.0
PULSER POWER	200 VOLTS
MAX GAIN	53.9 dB
INIT GAIN	35.9 dB
TDG SLOPE	1.07 dB/us
MB BLANK	0.25 us
ECHO WINDOW	199.65 us
ECHO 1 DETECT	-SLOPE
↔ to select, then ENTER or ↓.	
↑, ↔, ENTER	

Figure 13-1 The **ACTIVE** screen for the setup of a single element transducer

- b) Enter a **SETUP NAME** that describes the transducer and/or the application for which you create the setup.
- c) Set **MEAS TYPE** to the desired measurement type. The available choices are:

- **STANDARD:** For normal mode 1, 2, or 3 positive or negative peak measurement.
 - **OXIDE LAYER** (optional): For simultaneous measurement of the thickness of a boiler tube and of its internal oxide layer with the oxide layer software option (see “Oxide Layer Software Option” on page 110 for details).
 - **BARRIER LAYER** (optional): For thickness measurement of thin barrier layer materials in multilayer plastic with the multi-measurement software option (see “Multi-Measurement Software Option” on page 115 for details).
 - **FIRST PEAK:** For the detection of the first of several peaks of similar amplitudes (see “First Peak” on page 247 for details).
- d) Set **PROBE TYPE** to indicate the transducer type to be used with this setup. The selected probe type must match the frequency of the transducer being used for proper pulser/receiver performance.
 - e) Set **VELOCITY** to the value of the sound velocity in the material to be tested with this setup (see “Material Sound Velocity and the Zero Calibrations” on page 87).
 - f) Set **ZERO VALUE** to the calibrated zero offset value (time of flight of the echo that is not traveling through the material) for this transducer (see “Calibrating the Instrument” on page 83).
 - g) If needed, increase the **PULSER POWER** to increase the ultrasound wave penetration in the material. Reduce the value for better near surface resolution (see “Pulser Power” on page 248 for details).
 - h) Set **MAX GAIN** to the desired maximum gain value (see “Maximum Gain” on page 250 for details).
 - i) Set **INIT GAIN** to the desired initial gain value (see “Initial Gain” on page 251 for details).
 - j) Set **TDG SLOPE** to the desired time-dependent gain slope value (see “TDG Slope” on page 251 for details).
 - k) Set **MB BLANK** to the desired main bang blank time interval (see “Main Bang Blank” on page 252 for details).
 - l) Set **ECHO WINDOW** to the desired time interval (see “Echo Window” on page 253 for details).
 - m) Set **ECHO 1 DETECT** to **-SLOPE** to detect the negative peak of the first echo, or **+SLOPE** to detect the positive peak of the first echo (see “Detection of Echo 1 and Echo 2” on page 255 for details).
6. Press [SAVE/SEND].

7. In the **SAVE SETUP** screen:
 - a) If needed, in **SAVE AS**, edit the setup name.
 - b) In the **SAVE TO** list, select the desired custom setup location where you want to save the setup.
 - c) Select **SAVE**.
8. Press **[MEAS]** to return to the measurement screen.
The saved setup becomes the active setup.

13.2 Quickly Adjusting Waveform Parameters For Single Element Transducers

With single element transducers, you can quickly adjust individual waveform parameters using the **[WAVE ADJ]** key.

To quickly adjust individual waveform parameters

1. Ensure that a single element transducer is connected to the 39DL PLUS.
2. From the measurement screen, press **[WAVE ADJ]**.
The waveform adjustment parameter appears on the measurement screen above the thickness value (see Figure 13-2 on page 244).

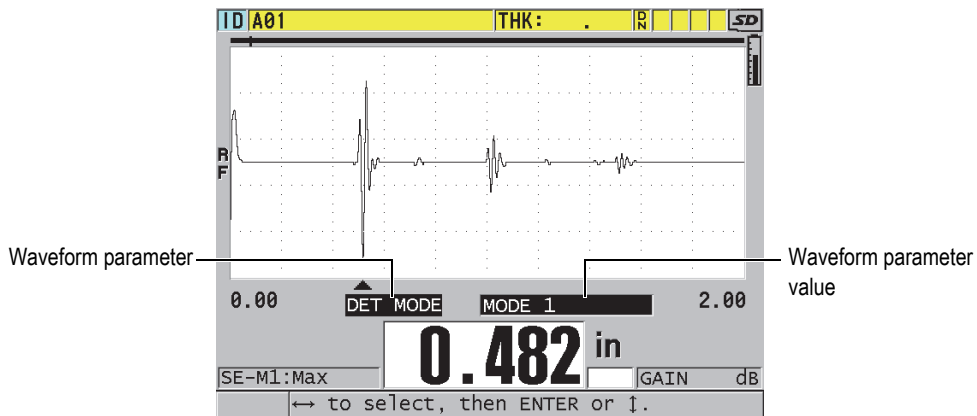


Figure 13-2 Adjusting the waveform parameters

3. Use the [▲] or [▼] key to select the parameter that you wish to adjust among the following:
 - **DET MODE** (see “Detection Modes” on page 245 for details)
 - **M3 BLANK** in mode 3 only (see “Mode 3 Echo Blank” on page 258 for details)
 - **IF BLANK** in mode 2 and 3 only (see “Interface Blank” on page 256 for details)
 - **ECHO 2 DETECT** in mode 2 and 3 only (see “Detection of Echo 1 and Echo 2” on page 255 for details)
 - **ECHO 1 DETECT** (see “Detection of Echo 1 and Echo 2” on page 255 for details)
 - **ECHO WINDOW** (see “Detection of Echo 1 and Echo 2” on page 255 for details)
 - **MB BLANK** (see “Main Bang Blank” on page 252 for details)
 - **TDG SLOPE** (see “TDG Slope” on page 251 for details)
 - **INIT GAIN** (see “Initial Gain” on page 251 for details)
 - **MAX GAIN** (see “Maximum Gain” on page 250 for details)
 - **PULSER POWER** (see “Pulser Power” on page 248 for details)
 - **PROBE TYPE**
 - **MEAS TYPE** (see step 5.c in “Creating a Custom Setup for a Single Element Transducer” on page 241 for details)
4. Use the [◀] or [▶] keys to select the value for the selected parameter.
5. Repeat steps 3 and 4 to adjust other parameters.
6. Press [WAVE ADJ] again to hide the waveform adjustment parameter.

13.3 Detection Modes

There are three detection modes (**Mode 1**, **Mode 2**, and **Mode 3**):

Mode 1

Measures the time of flight between the main bang and the first back-wall echo using a direct contact transducer (see Figure 13-3 on page 246).

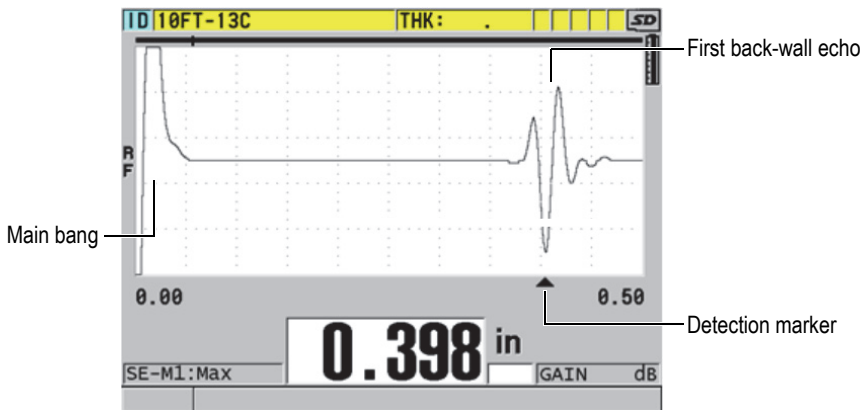


Figure 13-3 Mode 1 detection example

Mode 2

Measures the time of flight between the interface (or delay line) echo and the first back-wall echo using a delay line or an immersion transducer (see Figure 13-4 on page 246).

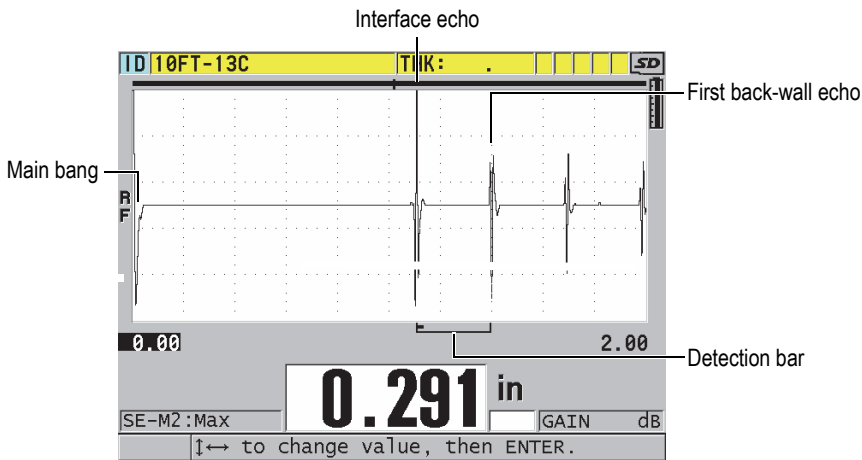


Figure 13-4 Mode 2 detection example

Mode 3

Measures the time of flight between one back-wall echo to the next back-wall echo using a delay line or an immersion transducer (see Figure 13-5 on page 247).

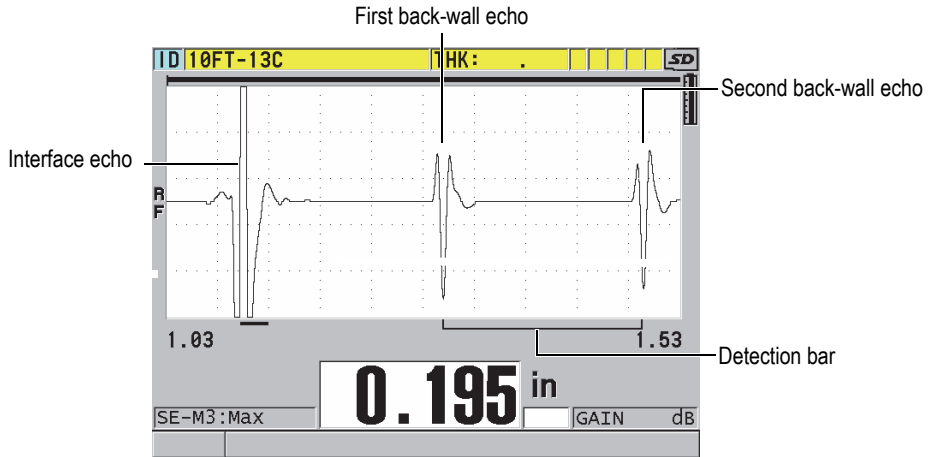


Figure 13-5 Mode 3 detection example

NOTE

Refer to “Echo Window” on page 253 for information on the modes in relation with the echo window.

13.4 First Peak

With single element transducers, the 39DL PLUS normally detects peaks on either the highest positive or highest negative peak of the RF waveform. This feature works well for most precision thickness applications.

This normal peak detection can be unstable for applications in which the back-wall echo is irregular and contains several negative or positive peaks that are close in amplitude. In these cases, the thickness reading can fluctuate as the gauge switches detection from one peak to another. This can happen for example in applications

measuring the length of bolts or the thickness of gel coat over fiberglass (see Figure 13-6 on page 248). In these cases, to help stabilize the echo detection and thickness measurements, select the first peak algorithm to detect the first of several peaks of similar amplitudes (see step 5.c in “Creating a Custom Setup for a Single Element Transducer” on page 241).

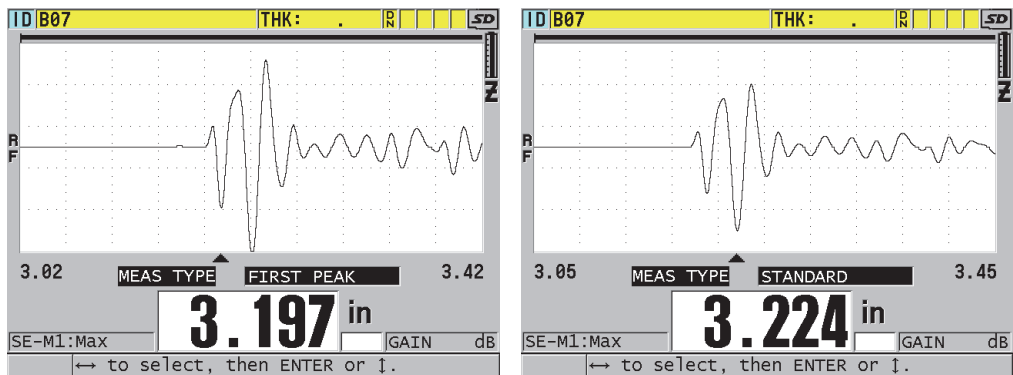


Figure 13-6 Detection of the first or the second negative peak

13.5 Pulsar Power

You can set the excitation pulse (main bang) voltage to one of the following values: 60 V, 110 V, 150 V, 200 V, and 325 V.

Higher voltages may provide greater penetration at the expense of a lower near-surface resolution, especially in mode 1. Inversely, lower voltages may provide better near-surface resolution at the expense of a lower penetration.

For most applications, the 110 V value provides the best signal-to-noise ratio for returning echoes. The pulser power indicates the voltage used to excite the transducer and therefore, affects the size of the initial pulse (see Figure 13-7 on page 249) and the amount of energy going into the material.

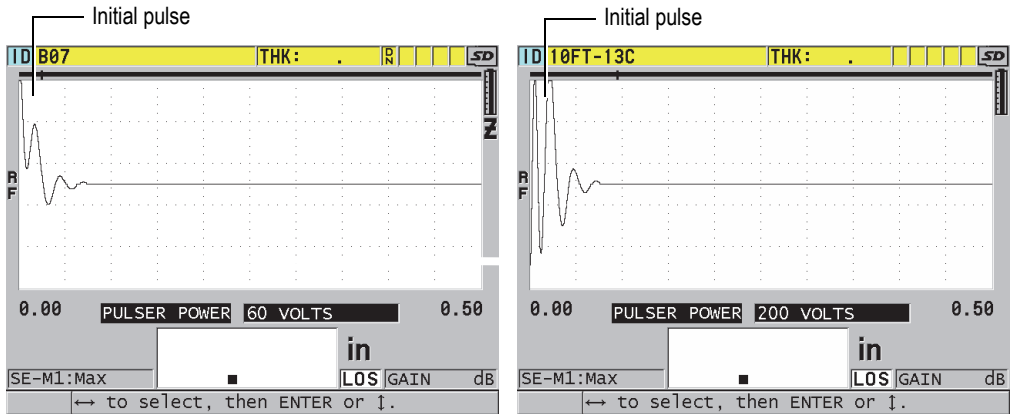


Figure 13-7 Comparing pulser power set to 60 V and 200 V

13.6 Time-Dependent Gain Curve

With single element transducers, the 39DL PLUS either uses the automatic gain control (AGC) [see “Configuring Measurement Parameters” on page 147 for details on how to activate the AGC] or the time-dependent gain (TDG) functions to automatically adjust receiver gain to an optimum level when an echo is detected.

The 39DL PLUS offers three parameters to draw a time-dependent gain curve: **INIT GAIN**, **TDG SLOPE**, and **MAX GAIN** (see Figure 13-8 on page 250). From the initial gain level, receiver gain slopes up to the maximum gain level at the rate determined by the **TDG SLOPE** setting. When you adjust any of the received gain parameters, a black time-dependent gain curve is displayed so that you can clearly see the zones of initial gain, slope, and maximum gain.

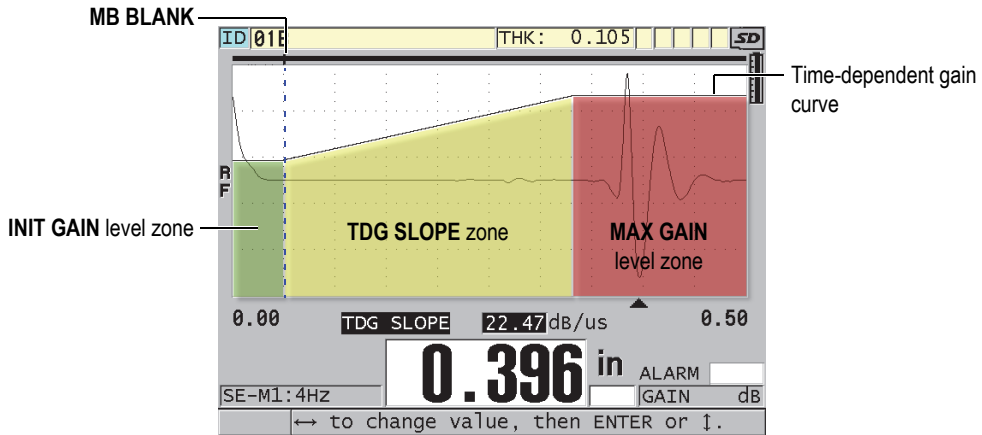


Figure 13-8 The TDG zones and parameters

You can use the TDG curve to optimize near-surface resolution while providing a higher maximum gain for thicker samples. You can also use the TDG curve in measurements of highly scattering materials, such as cast metals and fiberglass, to minimize detection of scattered echoes occurring ahead of the back-wall echo.

13.6.1 Maximum Gain

The maximum gain indicates the maximum (time-dependent) receiver gain possible. The maximum gain is used to amplify echoes that are further out in time. In general for a given application, you should set the maximum gain high enough so that all echoes of interest are detected.

You can adjust the maximum available receiver gain from 0.0 dB to 99.0 dB. When no echo is detected (LOS prompt), the gain rises to the maximum level set by the initial gain, slope, and maximum gain. When the maximum gain is set too high, the gauge may hang up on transducer noise or other spurious signals; when it is set too low, returning echoes may not be high enough for detection.

NOTE

The max gain can never be lower than the initial gain and has a maximum value of 99.0 dB.

13.6.2 Initial Gain

The initial gain sets an upper limit on receiver gain in the vicinity of the excitation pulse (mode 1) or of the interface echo (modes 2 and 3). By effectively making the excitation pulse or interface echo smaller, the TDG curve allows detection of echoes occurring close to the pulse. You can adjust the initial gain from 0 dB to the maximum defined by the **MAX GAIN** setting.

The **INIT GAIN** setting is most critical in applications where minimum thickness measurements must be optimized. It should always be set with the aid of a reference standard representing that minimum. In cases where the minimum thickness capability is less important than penetration and scatter echoes are not a problem, you can set the initial gain equal to the maximum gain.

The initial gain does the following:

- Indicates the initial (time-dependent) receiver gain currently selected
- Amplifies echoes that are close to the Main Bang or interface echoes
- Starts at time zero and extends to:
 - the main bang blank in mode 1
 - the end of the interface blank in modes 2 and 3

13.6.3 TDG Slope

The TDG slope controls the rate at which the receiver gain slopes up from the initial gain level to the maximum gain level. The TDG slope starts at the position of the **MB BLANK** parameter in mode 1 and at the end of the **IF BLANK** parameter in mode 2 and mode 3. The TDG slope helps suppress reflections from grain structure or fibers. Generally, you should set the TDG slope as high as possible to reach the maximum gain as quickly as possible without having the gauge hang up on spurious signals. You can set the slope from 0.0 dB/ μ s to 39.95 dB/ μ s.

13.7 Main Bang Blank

The main bang blank is effectively a blank zone that protects the receiver from false readings generated by the main bang. This blank or dead zone (up to 18 microseconds) prevents the detection of the trailing edge echoes of the excitation pulse as if they were back-wall or interface echoes. The end of the main bang blank indicates the point in time where the gauge begins to search for echoes.

In general, set the main bang blank just beyond the point where the gauge hangs up, and then test with the transducer both coupled to and uncoupled from the test material to ensure accurate measurements.

In mode 1, however, the length of the main bang blank determines the minimum thickness that can be measured, and it must be positioned with care after selecting the initial gain level (see Figure 13-9 on page 252). When the main bang blank is too short, the instrument hangs up on the excitation pulse and readings are not possible. When the main bang blank is too long, the minimum measurable thickness is unnecessarily restricted. When using immersion transducers, ensure that the main bang blank is always set before the interface echo from the shortest water path.

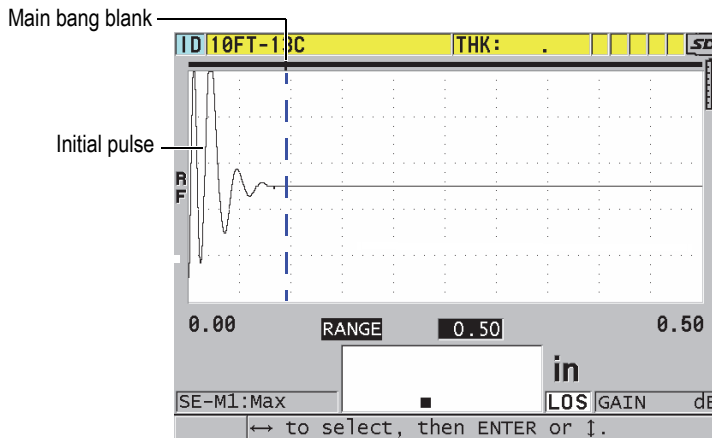


Figure 13-9 Main bang blank position for mode 1

In mode 2 and mode 3, the setting of the main bang blank is not critical when set at some point between the end of the excitation pulse and the interface echo (see Figure 13-10 on page 253).

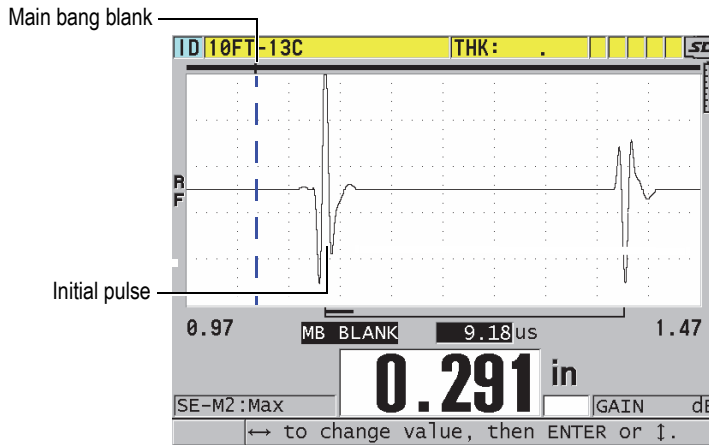


Figure 13-10 Main bang blank position for mode 2 and mode 3

13.8 Echo Window

The echo window is the time interval after each main bang during which the instrument is enabled to detect echoes. The echo window interval begins at the end of the main bang blank. The echo window ends $x \mu\text{s}$ following the main bang in mode 1, or $x \mu\text{s}$ following the interface blank in mode 2 and mode 3.

In mode 1, you can usually set the echo window to any value greater than the round-trip pulse transit time in the thickest or slowest piece of material to be measured (see Figure 13-11 on page 254). The exact setting is not critical as long as it is long enough to include the farthest echo of interest.

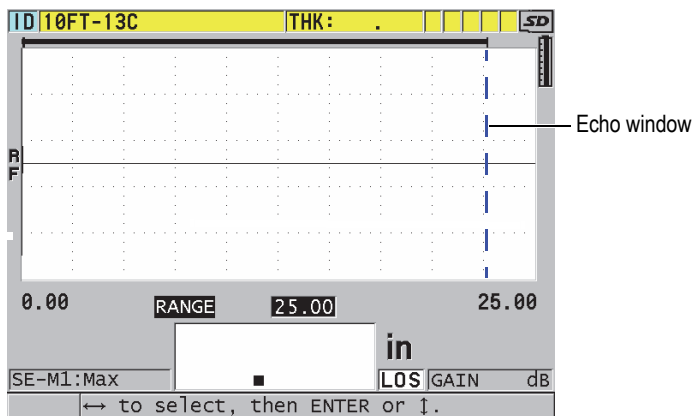


Figure 13-11 Echo window setting for mode 1

In mode 2 and mode 3, the echo window is limited to the time interval between successive interface echoes (see Figure 13-12 on page 254). The end of the echo window must be set ahead of the second interface echo to prevent an incorrect detection, which in turn determines a maximum measurable thickness. In applications involving mode 2 and mode 3 immersion measurements, the echo window placement must apply throughout the range of the water paths to be used.

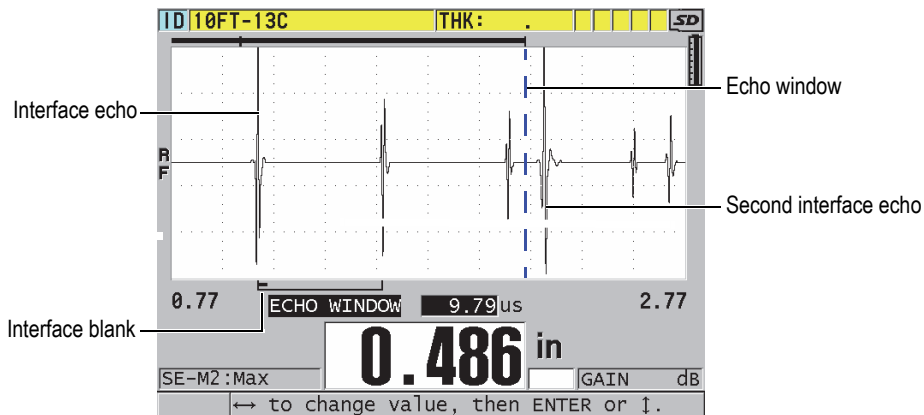


Figure 13-12 Echo window setting for mode 2 and mode 3

13.8.1 Detection of Echo 1 and Echo 2

You can select the detection polarity (positive or negative) for the first and second echoes. Depending on the measurement mode and on the type of test material, the maximum amplitude in an echo can either be a positive or negative peak. Positive and negative polarity refer to processed echoes displayed on the waveform display (see Figure 13-13 on page 255). To measure thicknesses with the highest accuracy, it is important that the 39DL PLUS detects the maximum amplitude peak in an echo.

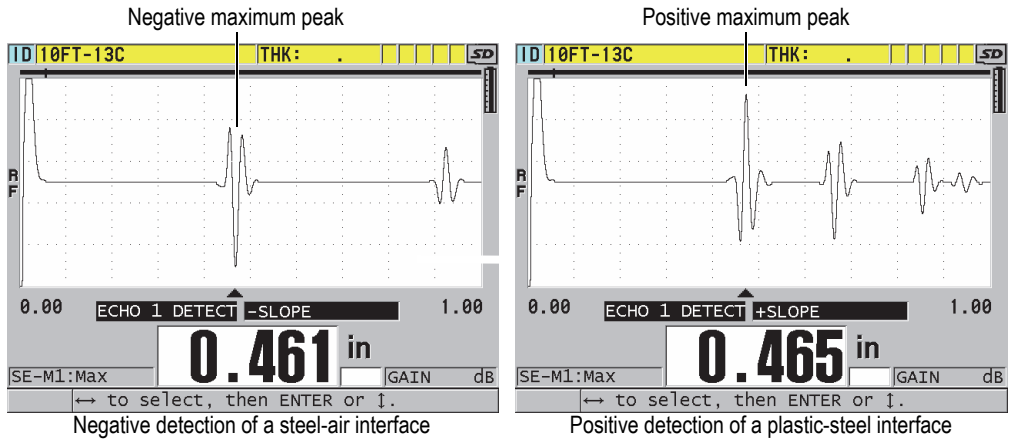


Figure 13-13 Negative and positive echo detection examples

Refer to Table 22 on page 256 to help you decide which detection polarity to select for a given application.

Table 22 Polarity of echoes

Measurement mode	Echo 1	Echo 2
Mode 1 using contact transducer	Back-wall echo normally negative except when measuring material of low acoustic impedance bonded to a material of high impedance (such as plastic or rubber over metal), where the echo is phase-reversed.	Not applicable
Mode 2 using delay line or immersion transducers	Interface echo normally positive for high-impedance materials such as metals and ceramics, and negative for low-impedance materials such as most plastics.	Back-wall echo normally negative unless the back-wall echo represents the sort of low-to-high impedance boundary.
Mode 3 using delay line or immersion transducers	Interface echo normally positive for high-impedance materials.	Back-wall echo normally negative except in some special cases involving difficult geometries where phase distortion may cause the positive side of the back-wall echo to be better defined than the negative side.

13.8.2 Interface Blank

The interface blank represents a blank or dead zone up to 20 μs long that follows the leading edge of the interface echo. The interface blank is only available in mode 2 and mode 3.

In mode 2, the interface blank prevents the detection of trailing lobes or cycles of the interface echo, which might otherwise be detected as back-wall echoes, resulting in a hang-up condition (see Figure 13-14 on page 257). The interface blank should be set as short as possible to avoid unnecessarily restricting minimum measurable thicknesses.

The initial gain parameter often helps reduce the interface echo amplitude and permits the use of a shorter interface blank. Check the interface blank settings with the transducer both coupled to and uncoupled from the test material.

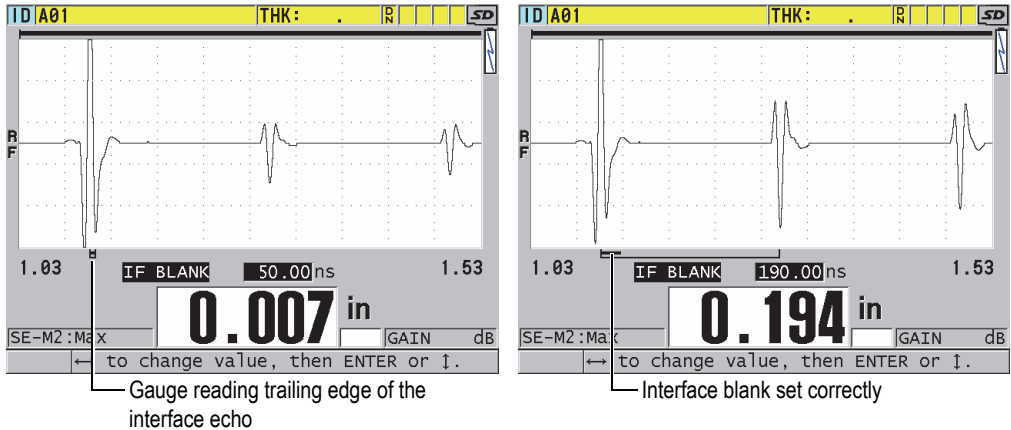


Figure 13-14 Examples of the interface blank in mode 2

In mode 3, the interface blank selects which pair of back-wall echoes are measured (see Figure 13-15 on page 258). In most conditions, the interface blank would be set just short of the first back-wall echo. However, as a practical matter, the first back-wall echo from thin materials is often distorted or lost in the interface echo. With some challenging geometries (such as tight radii), later pairs of back-wall echoes may be cleaner than early ones. In these cases, set the interface blank to a length that ensures detection of a clean and well-defined pair of back-wall echoes, even if echoes are not the first two.

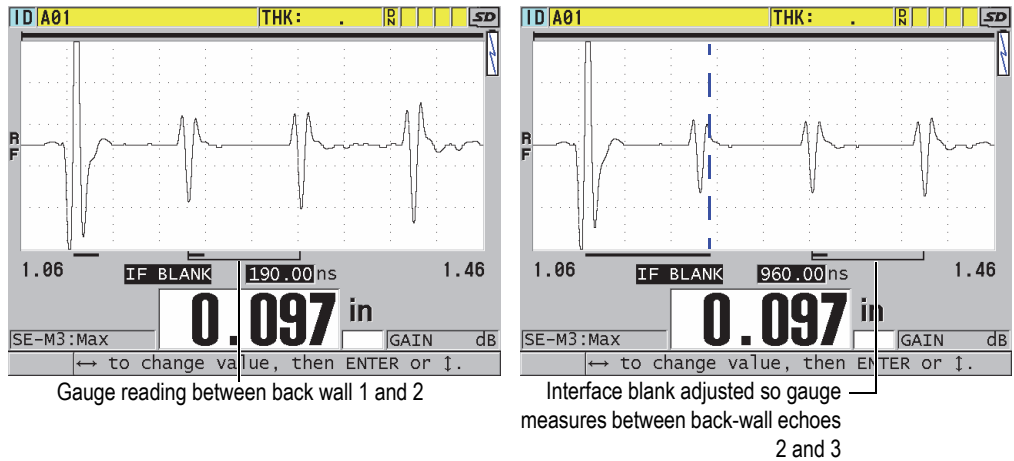


Figure 13-15 Examples of the interface blank in mode 3

13.8.3 Mode 3 Echo Blank

The echo blank in mode 3 (**M3 BLANK**) is similar to the interface blank in mode 2 or to the main bang blank in mode 1. This function creates a blank or dead zone up to 20 μ s long following the leading edge of the first detected back-wall echo, to prevent detection of trailing lobes or cycles of that echo and the resulting gauge hang-up (see Figure 13-16 on page 259).

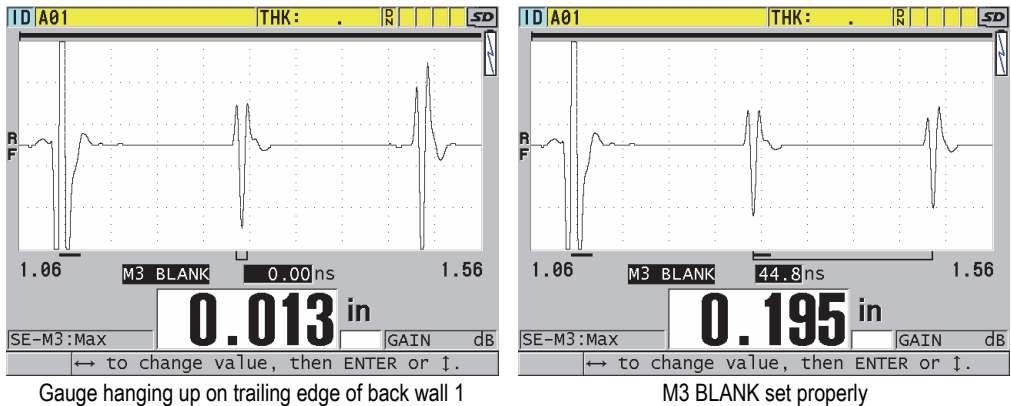


Figure 13-16 Examples of M3 Blank adjustment

Because the mode 3 echo blank limits minimum measurable thicknesses, set the controls as short as possible; typically no longer than a few hundred nanoseconds. Special cases may be an exception where mode conversion effects on curved samples cause significant spurious signals between legitimate echo peaks; in such cases set the mode 3 echo blank as long as necessary to prevent detection of the spurious signals.

13.9 Saving Setup Parameters

After adjusting selected waveform parameters, you can store the settings for a quick and easy recall. The 39DL PLUS can store up to 35 custom setups in its internal memory.

To save setup parameters

1. Make the appropriate changes to the waveform parameters.
2. Press [XDCR RECALL].

In the menu, ensure that **ACTIVE** is highlighted. The changes that you made are located in the active setup.

3. Press [SAVE/SEND].
4. In the **SAVE SETUP** screen (see Figure 13-17 on page 260):
 - a) In **SAVE AS**, enter a name for the custom setup.

- b) In the **SAVE TO** list, select one of the 35 available custom setup location.



CAUTION

Setups named **SE-USER-1** through **SE-USER-35** are empty locations. Use caution when selecting a location that already contains a custom setup because the new setup will replace the old information.

- c) Select **SAVE** to save the custom setup.

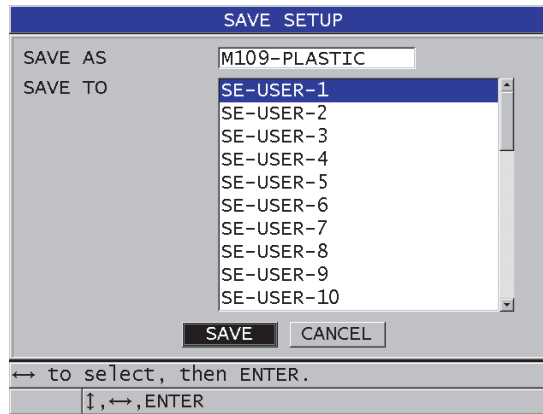


Figure 13-17 Saving custom setups

5. In the **ACTIVE** screen, review the setup parameters.
6. Press **[MEAS]** to return to the measurement screen.

13.10 Quickly Recalling a Custom Setup for Single Element Transducers

Normally, you can change the setup for a custom application by pressing **[RECALL XDCR]** to select the appropriate setup in the list of available setups, and then press **[MEAS]**. This process is adequate for typical setups that are changed infrequently. However, when it is necessary to frequently change between two or more custom setups, rather use the quick setup recall function.

When the quick setup recall function is activated, you can use a simple keypad shortcut to quickly switch to any of the first four custom setups for single element transducers.

To activate the quick setup recall function

1. From the measurement screen, press **[SETUP MENU]**.
2. In the menu, select **MEAS**.
3. In the **MEAS** screen, set **QUICK SETUP RECALL** to **ON**.
4. Press **[MEAS]** to return to the measurement screen.

To quickly recall one of the four first custom setups

- ◆ While in measurement screen with the quick setup recall function activated, press **[2nd F], [▲]** to recall the first custom single element transducer setup.
OR
Press **[2nd F], [▶]** to recall the second custom single element transducer setup.
OR
Press **[2nd F], [▼]** to recall the third custom single element transducer setup.
OR
Press **[2nd F], [◀]** to recall the fourth custom single element transducer setup.

NOTE

This feature only works when a single element transducer is plugged into the 39DL PLUS.

14. Managing Communications and Data Transfer

This section describes how the 39DL PLUS can communicate with a computer to send, receive, import, and export files. The 39DL PLUS has two communication ports: USB and RS-232, and wireless communication via Bluetooth and WiFi.

The 39DL PLUS comes standard with a USB cable for communicating using the USB 2.0 protocol. You must purchase an optional RS-232 cable (see Table 23 on page 266) to use RS-232 communication. The 39DL PLUS can send data to any device capable of receiving ASCII-formatted data using the RS-232C/D protocol. This includes personal computers, minicomputers, and dataloggers. The data cable must be compatible with the 39DL PLUS output connector and the serial input connector of the receiving device. Evident supplies cables for computers and provides assistance with connecting to any other equipment.

14.1 GageView

GageView is the Evident interface program designed to communicate with instruments such as the 39DL PLUS. GageView provides the capability to create inspection database files, upload and download data files, and generate reports. Evident recommends to use GageView to communicate with the 39DL PLUS and to manage 39DL PLUS data.

GageView is compatible with Windows 7, Windows 10, and Windows 11. For more details, refer to the *GageView Interface Program — User's Manual* (P/N: 910-259-EN [U8778347]).

14.2 Setting Up USB Communication

The default communication protocol for the 39DL PLUS is USB 3.0. Other communication types (RS-232, Bluetooth, and WiFi) are available.

To set up the USB communication

1. Ensure that the 39DL PLUS driver is installed on the computer.
This driver is installed when you install the GageView interface program.

NOTE

For more information on installing GageView, refer to the *GageView Interface Program – User’s Manual* (P/N: 910-259-EN [U8778347]).

2. If you use a communication program other than GageView, refer to the program documentation to properly configure the program for USB communication.
3. Turn the 39DL PLUS on.
4. From the measurement screen, press [SETUP MENU].
5. In the menu, select **COMM**.
6. In the **COMM** screen, set **CONNECTION TYPE** to **USB** (see Figure 14-1 on page 264).

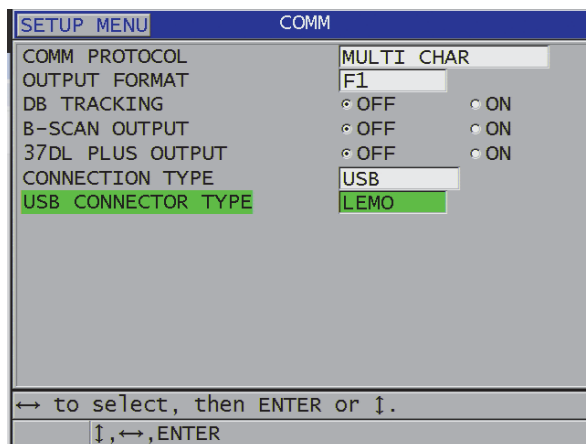


Figure 14-1 Selecting USB and connector type

7. Set the **USB CONNECTOR TYPE** to **STANDARD** (default USB-C side port) or **LEMO** (top I/O connector).
8. Press **[MEAS]** to return to the measurement screen.
9. Connect one end of a USB cable to the USB client connector under the I/O door of the 39DL PLUS, and the other end to a USB port of the computer (see Figure 14-2 on page 265).

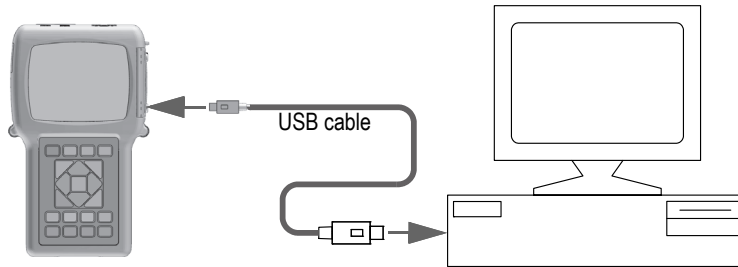


Figure 14-2 Connecting the 39DL PLUS to a computer

The first time that you connect the 39DL PLUS to this computer, the computer prompts you that a new hardware device has been detected and asks if you would like to install the driver. Refer to the *GageView Interface Program – User’s Manual* (P/N: 910-259-EN [U8778347]) for more information.

The driver loads, and then you can start to use a program such as GageView to communicate with the 39DL PLUS.

TIP

If you experience problem to establish the communication between the 39DL PLUS and a remote device, consider using the 39DL PLUS communication reset function to return all communication parameters to the default values (see “Resetting the Communication Parameters” on page 283), and then reconfigure only needed communication parameters.

14.3 Setting Up RS-232 Serial Communication

The 39DL PLUS can transmit stored data and displayed readings over its input/output (I/O) RS-232 cable to any device with a RS-232 serial interface. The 39DL PLUS can also receive and execute commands sent from any device with a serial interface.

To enable the 39DL PLUS to communicate with another RS-232 serial device, you must use the correct cable. Since all computers do not have the same serial port connector, the correct cable must be ordered from Evident. The RS-232 cable is an option for the 39DL PLUS, which you can specify at the time of order (see Table 23 on page 266).

Table 23 Optional RS-232 cables

I/O cable part number	Computer serial port connector	Cable length	Typical device
38DLP-9FS	"D" Type, 9-pin male	2 m (6 ft)	Windows computer

The serial communication parameter configuration must be the same in both the 39DL PLUS and the other device. In the 39DL PLUS, the baud rate is selectable (1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200) while the other RS-232 parameter are fixed:

- Word length = 8 characters
- Stop Bits = 1
- Parity = None

To set up the RS-232 serial communication

1. Refer to the receiving device hardware and software documentation, and set the receiving device serial communication parameters to values supported by the 39DL PLUS:
 - a) Set the baud rate to 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200.
 - b) Set the stop bits to 1.
 - c) Set the parity to none.
2. On the 39DL PLUS, from the measurement screen, press **[SETUP MENU]**.
3. In the menu, select **SYSTEM**.
4. In **SYSTEM** screen, set **SAVE/SEND KEY** to **SEND**.

5. Press **[SETUP MENU]**.
6. In the menu, select **COMM**.
7. In the **COMM** screen (see Figure 14-3 on page 267):
 - a) Set **CONNECTION TYPE** to **RS-232**.
The RS-232 parameters appear.
 - b) Set **RS-232 DEVICE** to match the type of device to which you connect the 39DL PLUS:
 - **TERMINAL**: when connecting to computers.
 - **CALIPER**: when connecting to the Evident caliper (P/N: HPV/C [U8780124]).
 - **FISCHER**: when connecting to the Fischer coating gauge.
 - c) Set **BAUD RATE** to the same value selected in step 1.a.
 - d) Set **CONTINUOUS OUTPUT MODE** to one of the following options:
 - **OFF**: Continuous output is off (default value).
 - **ON**: Continuously sends data at the selected measurement rate (see “Adjusting the Measurement Update Rate” on page 76).
 - **5 SEC AVERAGE**: Sends one averaged thickness reading every 5 seconds.
 - **10 SEC AVERAGE**: Sends one averaged thickness reading every 10 seconds.

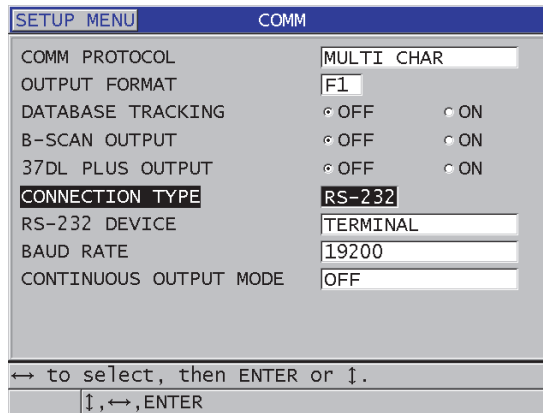


Figure 14-3 Viewing communication parameters

8. Using the appropriate RS-232 cable (see Table 23 on page 266), connect the 39DL PLUS to the remote serial communication device.
9. If needed, on the remote serial communication device, start the serial communication program.
10. Press **[MEAS]** to return to the measurement screen.

TIP

If you experience a problem to establish the communication between the 39DL PLUS and a remote device, consider using the 39DL PLUS communication reset function to return all communication parameters to the default values (see “Resetting the Communication Parameters” on page 283) and reconfigure only needed communication parameters.

14.4 Setting Up Bluetooth Communication

The 39DL PLUS can transmit stored data and displayed readings via Bluetooth to supported devices.

To set up the Bluetooth communication

1. Turn the 39DL PLUS on.
2. From the measurement screen, press **[SETUP MENU]**.
3. In the menu, select **COMM**.
4. In the **COMM** screen, set **CONNECTION TYPE** to **BLUETOOTH** (see Figure 14-4 on page 269).

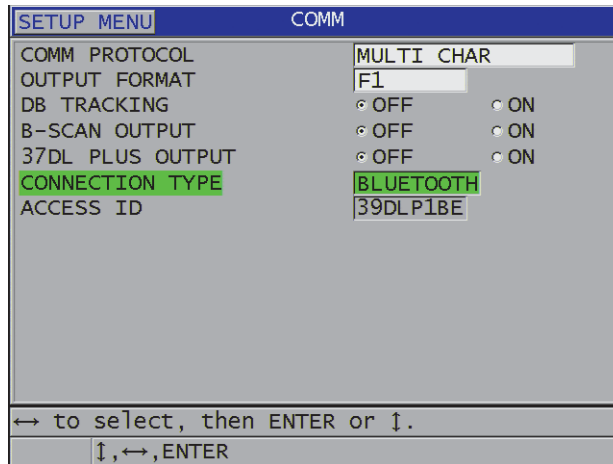


Figure 14-4 Configuring Bluetooth

5. Set a unique **ACCESS ID** for the 39DL PLUS.
6. Press **[MEAS]** to return to the measurement screen.

14.5 Setting Up WiFi Communication

The 39DL PLUS can transmit stored data and stream readings via WiFi to computers, tablets, or phones. While streaming readings via WiFi, the 39DL PLUS duplicates the waveform, measurements, and measurement markers to the screen of the connected device. The information transmitted from the 39DL PLUS can also be integrated into a third-party or custom software application.

NOTE

For details on integrating the 39DL PLUS via WiFi to third-party or custom applications, contact Evident.

To set up the WiFi communication

1. Turn the 39DL PLUS on.
2. From the measurement screen, press [SETUP MENU].
3. In the menu, select **COMM**.
4. In the **COMM** screen, set **CONNECTION TYPE** to **WIFI** (see Figure 14-5 on page 270).

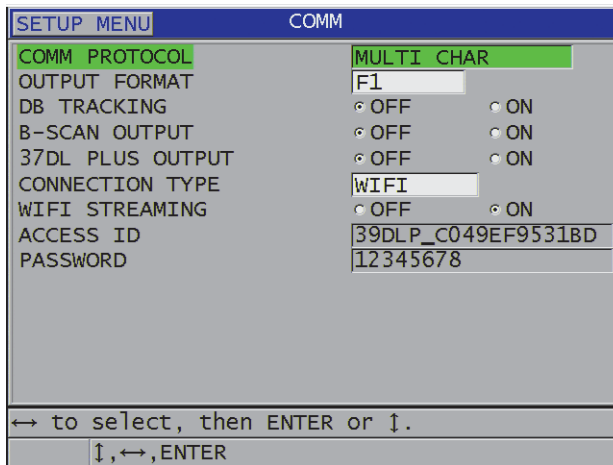


Figure 14-5 Configuring WiFi

5. Enable **WIFI STREAMING**.
6. Set a unique **ACCESS ID** for the 39DL PLUS.
7. Accept the default **PASSWORD** or create a new one.
8. Press [MEAS] to return to the measurement screen.

14.6 Exchanging Data with a Remote Device

You can exchange 39DL PLUS data with a remote device such as a computer.

NOTE

Data transmitted from the 39DL PLUS remains in the 39DL PLUS internal memory.

14.6.1 Sending Entire Files (RS-232)

You can send a single or multiple files from the 39DL PLUS to a computer. The data that is transmitted includes the file name, the file header, ID numbers, thickness data, flags, calibration setups, and notes.

To send entire files from the 39DL PLUS to a computer

1. Ensure that the RS-232 communication parameters are configured correctly (see “Setting Up RS-232 Serial Communication” on page 266).
2. From the measurement screen, press **[FILE]**.
3. In the menu, select **SEND**.
4. In the **SEND** screen (see Figure 14-6 on page 272):
 - a) Use the **[◀]** and **[▶]** keys to select to send **ALL** files or only **SELECTED** files. When you select **ALL**, in the file list, a check mark appears on the right of all files.
 - b) When you select **SELECTED**, you can individually select the files to send:
 - (1) Set **SORT BY** to the desired sort option (**NAME** or **DATE CREATED**).
 - (2) In the file list, highlight each file, and then press **[ENTER]** to toggle the file transfer check mark so that only files you wish to send have a check mark on the right.
 - (3) Press **[2nd F]**, **[▼]** to leave the file list.
 - c) Select the **SEND** button at the bottom of the screen.

The **Accessing storage. Please wait** message appears on the help text bar while the data is transferred.

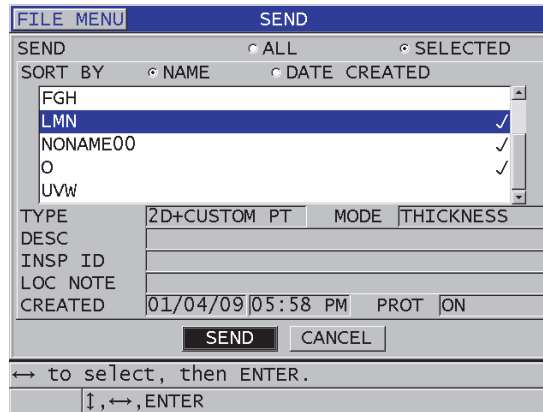


Figure 14-6 Selecting a file to send

14.6.2 Sending an ID Range from a File (RS-232)

The 39DL PLUS allows you to only transmit a portion of a given file to a computer.

To send a specific range of ID numbers from a specific file

1. Ensure that the RS-232 communication is configured correctly (see “Setting Up RS-232 Serial Communication” on page 266).
2. Open the file that contains the data to be transmitted, if the desired file is not already the active file (see “Opening a File” on page 204).
3. From the measurement screen, press and hold **[SAVE/SEND]**, until the **ID - RANGE SEND** screen opens.

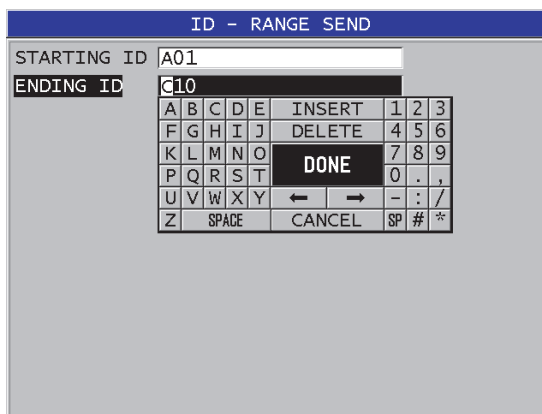


Figure 14-7 Identifying a range of ID numbers to send

4. Enter the **STARTING ID** and the **ENDING ID** of the desired range of ID numbers that you want to transmit.
5. Select **SEND**.
The gauge transmits the data for the specified range.

14.6.3 Sending the Currently Displayed Measurement (RS-232)

You can transmit the current displayed measurement data only. This function is useful when the 39DL PLUS is continuously connected to an external device (data collector or computer) and you need to collect only data on command.

To perform a single send

1. Ensure that the RS-232 communication is configured correctly (see “Setting Up RS-232 Serial Communication” on page 266).
2. Setup the desired measurement screen on the 39DL PLUS.
3. Make a thickness reading.
4. Press **[SAVE/SEND]** briefly (release in less than one second).

The displayed measurement data with its appropriate setup flags is transmitted and the instrument returns to the original measurement screen.

NOTE

The specific data transmitted depends on the datalogger output format. Pressing **[SAVE/SEND]** while the thickness display is blank sends “-.--” and the displayed flags.

NOTE

Sending a displayed reading blanks a held reading, resets the minimum or maximum function, and releases a frozen waveform.

14.6.4 Exporting a File to the External Memory Card

The 39DL PLUS has the ability to export files from the internal memory to the external microSD memory card. You can export the files in CSV (comma separated variables), text (space delimited), or in survey (used by the GageView interface program) format. Using a microSD card reader, you can then open these files directly on your computer in Microsoft Excel, or any other program. You can import survey files in GageView from the microSD card reader.

You can send your user-defined transducer setups to the GageView interface program to save a copy of these setups on a computer. You can also send these transducer setups back to the 39DL PLUS (see “Importing Survey Files from the External Memory Card” on page 275). This procedure allows you to easily set up multiple 39DL PLUS instruments with the same custom transducer setup.

To export files to the external memory card

1. Ensure that a microSD memory card is inserted in its slot under the I/O door on the right side of the 39DL PLUS (see Figure 1-5 on page 41).
2. If you inserted the microSD memory card while the 39DL PLUS was turned on, turn the 39DL PLUS off, and then back on so that it recognizes the presence of the memory card.
3. From the measurement screen, press **[FILE]**.
4. In the menu, select **EXPORT**.

5. In the **EXPORT** screen (see Figure 14-8 on page 275):
 - a) If needed, change the **SORT BY** parameter to change how files are sorted in the file list.
 - b) In the file list, highlight the file that you want to export.
 - c) Set **FILE** to the desired file format:
 - **SURVEY FILE**: to be imported in GageView
 - **EXCEL CSV**: to be opened in Microsoft Excel
 - **TEXT FILE**: to be opened in many Windows-based programs
6. Select **EXPORT**.
 The selected file is created in the following folder on the external microSD memory card: \EvidentNDT\39DLP\Transfer.
 The instrument automatically returns to the measurement screen.

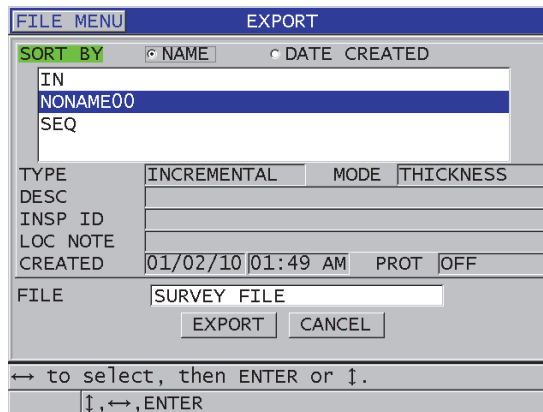


Figure 14-8 The EXPORT screen

14.6.5 Importing Survey Files from the External Memory Card

You can import a survey file from the external microSD memory card to the 39DL PLUS internal memory. You can use this function in conjunction with the GageView interface program to import survey files that have been exported from GageView to a microSD card. This feature allows you to import files in the 39DL PLUS while the instrument is in the field and cannot be connected to a computer.

To import survey files from the external memory card

1. Ensure that the \EvidentNDT\39DLP\Transfer folder on your external microSD memory card contains the file that you wish to import in the 39DL PLUS internal memory.
2. Insert the microSD memory card in its slot under the I/O door on the right side of the 39DL PLUS (see Figure 1-5 on page 41).
3. If you inserted the microSD memory card while the 39DL PLUS was turned on, turn the 39DL PLUS off, and then back on so that it recognizes the presence of the memory card.
4. From the measurement screen, press **[FILE]**.
5. In the menu, select **IMPORT**.
6. In the **IMPORT** screen (see Figure 14-9 on page 276):
 - a) Select the file to import in the list of available files.
The listed files are those found in the \EvidentNDT\39DLP\Transfer folder on the external microSD memory card.
 - b) Select **IMPORT**.
 - c) When a file with the same name already exists in the 39DL PLUS, the **Overwrite existing file?** message appears. When you still want to import the file, select **YES**.
A beep confirms the end of the file transfer and the instrument returns to the measurement screen.

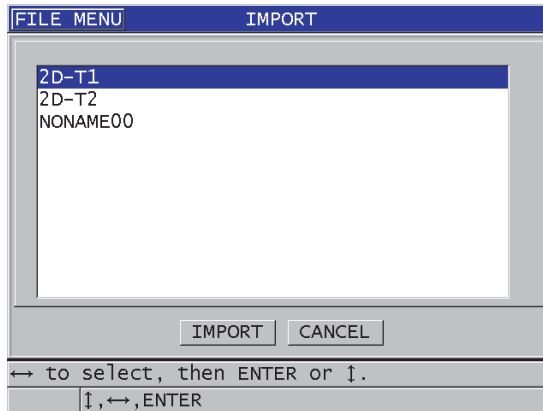


Figure 14-9 Example of the IMPORT screen

14.6.6 Receiving Files from a Computer

The same type of datalogger information, which you can send to a computer, can also be received or downloaded from a computer into the instrument. There are two benefits:

- At the next survey date, months, or years later, retrieve to the gauge previously saved thickness survey data stored in a computer file with ID numbers. You can use this retrieved data for the following purposes:
 - To guide you through the measurement sequence using the ID numbers.
 - To compare current values, at the measurement site, with previously measured thickness values.
 - To manually or automatically verify that the current measurement setup is identical to the previously used setup.
- Create ID number sequences in a computer, and then download them to the instrument. This externally created sequence can guide you through the prescribed measurement location path. The ID sequence created in the computer must have setup information. The setup can be the gauge default setups or any other desired sequence of setups.

The data downloaded to the 39DL PLUS must be in the same precise format in which data is transmitted. Evident recommends using the GageView interface program to handle all functions of interfacing, storing, and creating 39DL PLUS data. Please contact Evident for information on additional software data management programs.

To receive a data file from a computer

1. When using GageView or another program to send the file from the computer using the USB port, set the USB communication parameters and connect the 39DL PLUS to the computer (see “Setting Up USB Communication” on page 264).
2. When using a program to send the file from the computer using the RS-232 port, set the RS-232 communication parameters and connect the 39DL PLUS to the computer (see “Setting Up RS-232 Serial Communication” on page 266).
3. Turn on the 39DL PLUS and ensure that the measurement screen is active.
4. On the computer, begin sending formatted data.
The 39DL PLUS displays a **RECEIVING DATA** screen while the data is sent, and then returns to the measurement screen.

14.7 Capturing 39DL PLUS Screen Images

You can save a snapshot of the full 39DL PLUS screen contents to an image file. This function is useful when you need an exact replica of the display for reporting or documentation purposes. You can do this using one of the following two methods:

- Sending a Screen Capture to GageView (see section 14.7.1 on page 278)
- Sending a Screen Capture to the External microSD Card (see section 14.7.2 on page 280)

14.7.1 Sending a Screen Capture to GageView

You can send the full 39DL PLUS screen contents to the GageView interface program.

Refer to the *GageView Interface Program — User's Manual* (P/N: 910-259-EN [U8778347]) for information on how to install and use GageView.

To send a screen capture to GageView

1. Set the USB communication parameters, and then connect the 39DL PLUS to the computer (see “Setting Up USB Communication” on page 264).
2. On the 39DL PLUS, select the screen that you wish to capture.
3. On the computer, start GageView.
4. In GageView, perform the following tasks only the first time that you connect the 39DL PLUS to GageView on this computer:
 - a) On the GageView menu, select **Device > Config**.
 - b) In the **Device Configuration** dialog box (see Figure 14-10 on page 279):
 - (1) In the **Device List**, select 39DL PLUS, and then click **Add**. 39DL PLUS (USB) appears in the **Current Configured Devices** list.
 - (2) Select the **Connect at Startup** check box so that GageView automatically attempts to connect to the 39DL PLUS when it starts.
 - (3) Click **OK**.

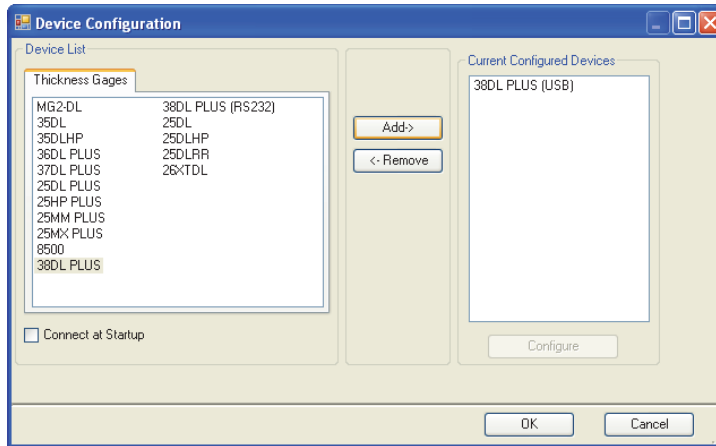


Figure 14-10 The Device Configuration dialog box

5. In GageView, perform the following tasks:
 - a) On the menu, select **Device > Tools**.
 - b) In the **Device Tools** dialog box (see Figure 14-11 on page 280), select **Screen Capture**, and then click **Receive**.
The screen image appears when the data transfer completes.
 - c) Click **Copy** to copy the screen capture to the Windows clipboard.
OR
Click **Save** to save the image as a BMP file to a folder and file name of your choice.

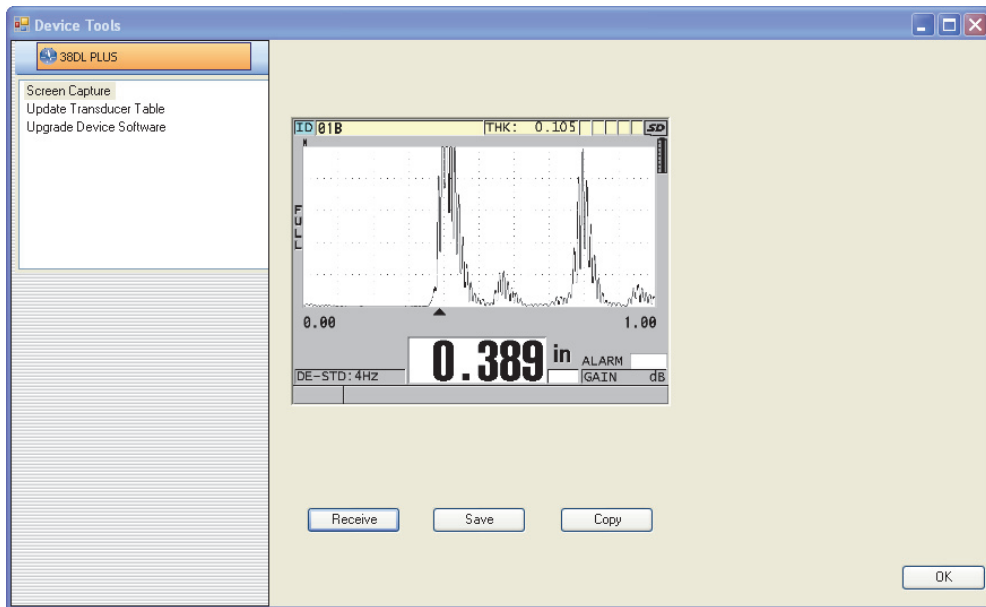


Figure 14-11 The Device Tools dialog box with a screen capture

14.7.2 Sending a Screen Capture to the External microSD Card

The 39DL PLUS has the ability to copy the contents of the current screen to the external microSD card. The screen shot is saved as a bitmap (.bmp) file. You can then connect the microSD card to a computer and open the file in any program that can view bitmap (.bmp) files.

To send a screen capture to the external microSD card

1. Ensure that a microSD memory card is inserted in its slot under the I/O door on the right side of the 39DL PLUS (see Figure 1-5 on page 41).
2. If you inserted the microSD memory card while the 39DL PLUS was turned on, turn the 39DL PLUS off, and then back on so that it recognizes the presence of the memory card.
3. Ensure that the function to save a screen capture to the microSD card is enabled:
 - a) From the measurement screen, press [SETUP MENU].
 - b) In the menu, select **SYSTEM**.

- c) Set **PRINT SCREEN TO SD CARD** to **ON**.
4. Select the screen that you wish to capture.
5. Press **[2nd F]**, **[DISPLAY]**.
The screen freezes for about 20 seconds as the file is being sent to the following folder on the external memory card: \EvidentNDT\39DLP\Snapshot.
The screen shots are automatically named BMP*n*.bmp where *n* starts at 0 and is incremented by one each time a new screen shot is added.
6. To transfer the image file:
 - a) Remove the microSD memory card from its slot in the 39DL PLUS.
 - b) Using a microSD card reader, connect the memory card to a computer.
 - c) Copy the file from the \EvidentNDT\39DLP\Snapshot folder on the card to the desired folder on the computer.

14.8 RS-232 Serial Data Output Formats

The 39DL PLUS supports 10 output formats for RS-232 transmitted data. Output formats vary depending whether you are using a dual element transducer or a single element transducer. Table 24 on page 281 and Table 25 on page 282 describe the contents of each format for dual element transducers or a single element transducers respectively.

NOTE

For USB communications, the output format is normally set to F1.

Table 24 Serial data output format for dual element transducers

Format	File header	ID header	Thickness table	Waveforms	Setup table	Note table
F1	✓	✓	✓	✓	✓	✓
F2	✓	✓	✓		✓	✓
F4			✓	✓		
F5		✓	✓	✓	✓	✓
F6		✓	✓		✓	✓
F7		✓	✓	✓	✓	

Table 24 Serial data output format for dual element transducers (continued)

Format	File header	ID header	Thickness table	Wave-forms	Setup table	Note table
F8		✓	✓		✓	
F9		✓	✓	✓	✓	✓
F10		✓	✓		✓	✓
F11			✓			

Table 25 Serial data output format for single element transducers

Format	File header	ID header	Thickness table	Wave-forms	Setup table	Note table
F1	✓	✓	✓	✓	✓	✓
F2	✓	✓	✓		✓	
F4			✓	✓		
F5		✓	✓	✓	✓	
F6		✓	✓		✓	
F7		✓	✓	✓	✓	
F8		✓	✓		✓	
F9		✓	✓	✓	✓	✓
F10		✓	✓		✓	
F11			✓			

To view or change the current output file format

1. From the measurement screen, press [SETUP MENU].
2. In the menu, select **COMM**.
3. In **COMM** screen, view or change the **OUTPUT FORMAT** value (see Table 24 on page 281 and Table 25 on page 282 for a description of the formats).

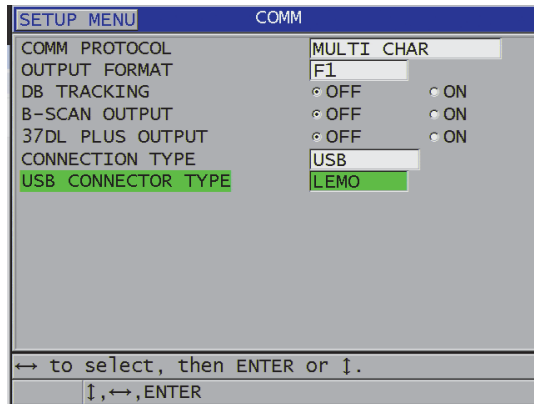


Figure 14-12 Viewing or changing the file output format

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

14.9 Resetting the Communication Parameters

The communication reset function quickly returns communication parameters to the factory default values. This function may be useful when you experience difficulties to establish the communication with a remote device. Table 26 on page 283 gives the default values for the communication parameters.

Table 26 Default communication parameter values

Parameter	Value
COMM PROTOCOL	MULTI CHAR
OUTPUT FORMAT	F1
DATABASE TRACKING	OFF
B-SCAN OUTPUT	OFF
37DL OUTPUT	OFF
CONNECTION TYPE	USB
USB CONNECTOR TYPE	STANDARD

To reset the communication parameters

1. Press [2nd F], [SETUP MENU] (SP MENU).
2. In the menu, select **RESETS**.
3. In the **RESETS** screen (see Figure 14-13 on page 284):
 - a) In the **RESETS** list, select **COMMUNICATION RESET**.
 - b) Select **RESET**.

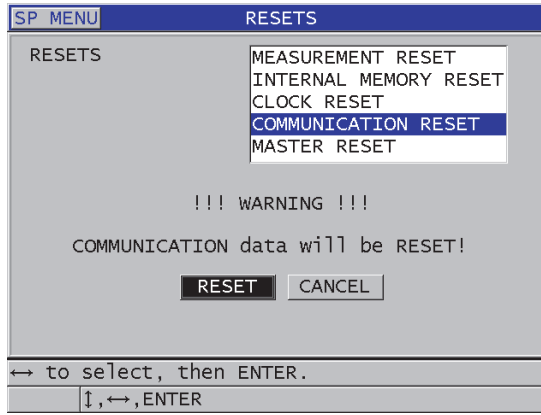


Figure 14-13 Selecting the **COMMUNICATION RESET**

15. Maintaining and Troubleshooting the 39DL PLUS

This section describes how to maintain your 39DL PLUS by applying routine care and maintenance.

15.1 Providing Routine Gauge Maintenance

The 39DL PLUS case is sealed to prevent intrusion of environmental liquids and dust when the I/O door is closed. However, the instrument should never be immersed in any fluid.

The 39DL PLUS case is designed to withstand normal field use. However, as with any electronic instrument, damage is possible if not handled with some care. Observe the following instructions in particular:

- Never press a key with a hard or sharp object.
- When connecting cables to the instrument, first align the connector with the mating receptacle on the instrument (dual element D79X series transducer center pin is down, and the RS-232 I/O cable key tab facing down), then carefully insert the connector straight into the receptacle.
- When disconnecting cables from the instrument, first grasp the connector (not the cable), and then gently pull it out.
- Do not throw or drop the instrument.
- Do not use strong solvents or abrasives to clean the rubber boot, case, keypad, and display screen.

15.2 Cleaning the Instrument

First, clean the instrument with a dry damp cloth. If necessary, after closing the I/O door and the connector dust flap, use a wet damp cloth with a mild detergent to wash the instrument. Dry the instrument before using it.

15.3 Maintaining Transducers

The ultrasonic transducers used with the 39DL PLUS are rugged devices that need little care. However, they are not indestructible, and some attention to the following items result in the longer life span.

- Make high-temperature measurements only with suitable high temperature transducers. Standard transducers can be damaged or destroyed if put in contact with surfaces hotter than approximately 52°C (125°F).
- Cutting, pinching, or pulling the cables causes damage to the cables. Be careful to prevent mechanical abuse to the cables. Never leave a transducer where a heavy object can be placed on the cable. Never remove a transducer from the gauge by pulling on the cable; pull on the molded connector only. Never tie a knot in the transducer cable. Do not twist or pull the cable at the point where it connects to the transducer.
- Excessive wear at the tip of the Transducer degrades its performance. To minimize wear, do not scrape or drag the transducer across rough surfaces. Operating the transducer may become erratic or impossible when a transducer tip becomes rough or cracked. Although some wear is normal, severe wear limits transducer life. Take particular care with plastic delay line transducers; replace worn delay lines.

15.4 Using Instrument Resets

The 39DL PLUS includes reset functions to quickly restore the gauge to its default parameters. Resets are useful shortcuts to known configurations. The reset functions are:

MEASUREMENT RESET

Changes the measurement parameters to the default factory values listed in Table 27 on page 287.

Table 27 Measurement default settings

Parameter	Default value
Measurement mode with differential	Fast, min, max, and alarms turned off
Material sound velocity	5.969 mm/s or 0.2350 in./s (approximate velocity of the included test blocks)
Differential reference value	0.0 mm or 0.0 in.
Low alarm reference value	0.0 mm or 0.0 in.
High alarm reference value	635.0 mm or 25.0 in.
Display update rate	4 per second
Zoom	Off
Range	Minimum range
LOS condition	Blank thickness display
Resolution	0.01 mm or 0.001 in.

INTERNAL MEMORY RESET

Deletes all stored data on the internal microSD memory card and reformats the card.

**CAUTION**

The internal memory reset permanently deletes all stored thickness readings/waveforms that are stored in the memory card. However, this reset does not delete any stored transducer setups.

CLOCK RESET

Resets the date to 01/01/2010 in the MM/DD/YYYY format and the time to 12:00AM in the 12-hour format.

COMMUNICATION RESET

Changes the communication settings to the default factory values listed in Table 28 on page 288.

Table 28 Default communication settings

Parameter	Default value
COMM PROTOCOL	Multi Character
OUTPUT FORMAT:	F1
DATABASE TRACKING	Off
B-SCAN OUTPUT	Off
37DL PLUS OUTPUT	Off
CONNECTION TYPE	USB

MASTER RESET

Performs the measurement reset and the internal memory reset in one step.

**CAUTION**

The master reset permanently deletes all stored thickness readings/waveforms that are stored in the internal memory card of the 39DL PLUS.

To activate a reset function

1. Press **[2nd F]**, **[SETUP MENU]** (SP MENU).
2. In the menu, select **RESETS**.
3. In the **RESETS** screen (see Figure 15-1 on page 289):
 - a) In the **RESETS** list, highlight the desired reset function.
A warning message appears, indicating the type of data that will be reset.
 - b) Select **RESET**.

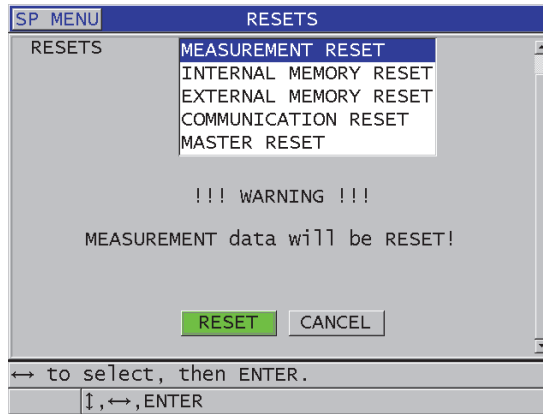


Figure 15-1 Activating a reset function

15.5 Performing Hardware Diagnostic Tests

The 39DL PLUS includes a function to perform several diagnostic self tests. The tests can help in localizing a suspected hardware problem or to verify correct hardware operation. Some tests are designed for Evident internal testing procedures during the manufacturing process.

The available tests are:

- Keypad test
- Video test
- Internal microSD card test (Pass or Fail)
- External microSD card test (Pass or Fail)
- Dual element transducer test
- ESS Test (Electronic Stress Screening) [for Evident internal use only]
- B-scan Test (for Evident internal use only)
- Battery Test (for Evident internal use only)
- One-wire test (for Evident internal use only)

To perform a diagnostic test

1. Press [2nd F], [SETUP MENU] (SP MENU).

2. In the menu, select **TESTS**.
3. In the **TESTS** screen, select the desired test, and then press **[ENTER]**.
4. When **KEYPAD TEST** is selected, in the **KEYPAD TEST** screen (see Figure 15-2 on page 290):
 - a) Test any key by pressing it on the keypad.
When that specific key is working correctly, the instrument displays the name of the key in the last key pressed box.
 - b) Press **[ENTER]** to terminate the keypad test.

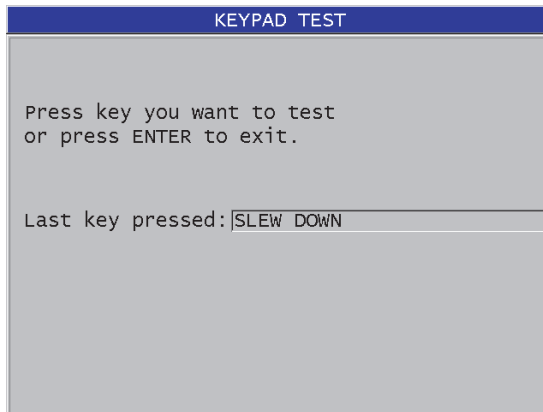


Figure 15-2 The KEYPAD TEST screen

5. When **VIDEO TEST** is selected:
 - a) In the **VIDEO TEST** screen, press **[DISPLAY]** to start the video test.
The display shows three vertical color strips that darken to black. Any problems with the display show up as a disruption of the pattern.
 - b) Press **[ENTER]** to terminate the video test.
6. When **INTERNAL SD CARD TEST** or **EXTERNAL SD CARD TEST** is selected, in the **INTERNAL SD CARD TEST** or **EXTERNAL SD CARD TEST** screen:
 - a) Press **[DISPLAY]** to start the test.
The test result appears in **SD Card Test Status**. The possible results are:
 - **PASS**: indicates that the card is functioning properly.
 - **FAIL**: indicates that there is a problem with the memory card. When the external card fails, re-install or replace the card, and then restart the instrument. When the internal card fails, contact Evident for service.

- b) Press **[ENTER]** to terminate the **SD CARD** test.
- 7. When **DUAL XDCR TEST** is selected, in the **DUAL XDCR TEST** screen (see Figure 15-3 on page 291):
 - a) Press **[DISPLAY]** to start the test which measures the time of flight through each side of a dual element transducer.
The measured parameter values appear.
 - b) Interpret the **Tx** and the **Rx** values as follows:
 - Similar values indicate a normal dual element transducer.
 - A difference between the values indicates that the delay line wear is not the same for each element.
 - A missing value indicates that a cable is broken or that the element is not functioning.
 - c) You can note the calculated **ZERO VALUE**.
 - d) Press **[ENTER]** to terminate the dual element transducer test.

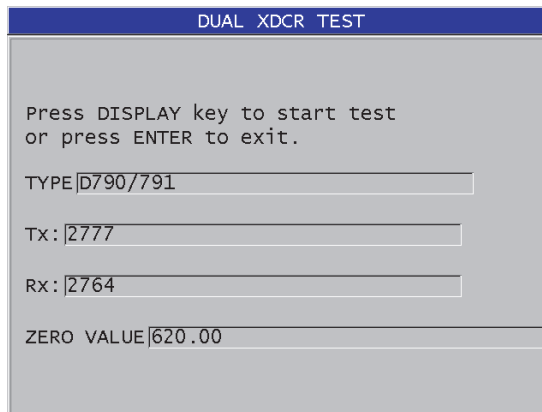


Figure 15-3 The DUAL XDCR TEST screen

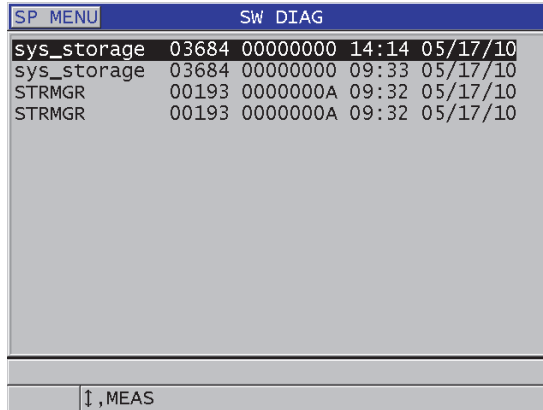
15.6 Performing the Software Diagnostic Test

The software diagnostic (**SW DIAG**) function presents a log of errors that occurred during instrument operation. Evident uses this information to troubleshoot the operating software.

To assess the software diagnostic

1. Press [2nd F], [SETUP MENU] (SP MENU).
2. In the menu, select **SW DIAG**.

The **SW DIAG** screen appears, showing the log of errors (see Figure 15-4 on page 292).



SP MENU		SW DIAG		
sys_storage	03684	00000000	14:14	05/17/10
sys_storage	03684	00000000	09:33	05/17/10
STRMGR	00193	0000000A	09:32	05/17/10
STRMGR	00193	0000000A	09:32	05/17/10

↓,MEAS

Figure 15-4 Example of the SW DIAG screen

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

15.7 Viewing the Instrument Status

The **STATUS** screen lists important information about the instrument. The status screen shows the following information:

- Current instrument internal temperature
- Current battery charge level
- Instrument model
- Software release date (build date)
- Software version
- Hardware version
- Options code (S/N) to be communicated to Evident for software option activation

To view the instrument status

1. Press [2nd F], [SETUP MENU] (SP MENU).
2. In the menu, select **STATUS** (see Figure 15-5 on page 293).

SP MENU		STATUS	
INTERNAL TEMPERATURE		49.0 °C	
BATTERY LEVEL		55 %	
MODEL NAME		39DLP	
BUILD DATE		03/20/2024	
S/W VERSION		1.00J/ESP:1.00D/MON:1.00B	
H/W VERSION		PCB:0/FPGA:9	
E-S/N		604B-9282-0E20-2415	
I-S/N			
INITIAL POWER UP DATE		0-/0-/1	
SHIPMENT DATE		0-/0-/1	
TOTAL OPERATION TIME		20Hr34Min	
POWER UP COUNT		129	
LANGUAGE VERSION		1	
ENTER to show menu, MEAS to exit.			
ENTER, MEAS			

Figure 15-5 Example of the STATUS screen

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

15.8 Understanding Error Messages

When operating the gauge, certain error messages may appear. Usually these messages indicate a problem with the operating procedure, but some might indicate a physical problem with the gauge itself. If you do not understand an error message, contact Evident for assistance.

15.9 Resolving Battery Pack and Charger Problems

The power indicator (in the upper-right corner of the display) shows bars that indicate the percentage of remaining battery charge level. When the charge level becomes low, the gauge automatically turns off. If the gauge turns off immediately after you turn it on or if you cannot turn it on, the battery pack is probably depleted.

After recharging the battery pack (see “Charging the Battery” on page 50), you may need to replace the battery if the instrument only operates when the charger is connected.

NOTE

The battery is designed to withstand several hundred discharge-recharge cycles before failing.

The power indicator only shows the remaining charge level when the charger is not connected to the instrument.

If you are still unable to turn on the instrument after the charger is connected for several minutes, the instrument or the charger may be at fault.

15.10 Resolving Measurement Problems

Table 29 Measurement troubleshooting

Symptom	Possible explanation
No or weak echoes, no measurement (LOS)	<ul style="list-style-type: none"> • Insufficient couplant, especially on rough or curved surfaces • Gain set too low • Material is too attenuating or surfaces are not parallel or are too rough. • Gauge requires service, try the master reset. • The echo is too low in amplitude to be detected. Try increasing the gain.
Strong echoes, no measurements	<ul style="list-style-type: none"> • The echo may be in a blank area of the waveform and cannot be detected. • The echo is outside of the echo window.

Table 29 Measurement troubleshooting (continued)

Symptom	Possible explanation
Strong echoes, incorrect measurements	<ul style="list-style-type: none">• Out of calibration; perform calibration.• Differential mode — check DIFF flag.• Min or Max mode — see “Using the Minimum, Maximum, or Min/Max Thickness Mode” on page 133.• Material is too grainy, has flaws, inclusions or laminations, or very high surface noise; try manual gain adjustment or extended blank.

Appendix A: Technical Specifications

Table 30 General EN15317 specifications

Parameter	Value
Size	Height × Width × Depth Without protective boot: 211.6 mm × 128.1 mm × 46.2 mm (8.33 in. × 5.04 in. × 1.82 in.) With the rubber protective boot: 236.2 mm × 130.6 mm × 66.5 mm (9.30 in. × 5.14 in. × 2.62 in.)
Weight	816.5 g (1.80 lb)
Power supply types	AC-DC adaptor 24 V Lithium-ion battery Five AA auxiliary batteries
Probe sockets types	Dual LEMO with center pin IP67
Battery operating time Lithium-ion	8 hours typical
Operating temperature	Charging: 0°C to 45°C (32°F to 113°F) Operating (not charging): -10°C to 50°C (14°F to 122°F)
Storage temperature	With battery in unit: -20°C to 50°C (-4°F to 122°F) Battery only: -20°C to 50°C (-4°F to 122°F) Without battery in unit: -20°C to 70°C (-4°F to 158°F)
Relative humidity (RH)	Noncondensing operation: 70% RH @ 45°C (113°F) Noncondensing stored in case w/ battery: 90% RH @ 50°C (122°F)
Battery indicator	8-step battery charge level indication Flashing low-battery warning

Table 30 General EN15317 specifications (continued)

Parameter	Value
Pulse repetition frequency (PRF)	1 kHz burst Measurement rates: 4 Hz, 8 Hz, 16 Hz, 20 Hz, 30 Hz, and Max
Alarm indicators	Visual high-alarm and low- alarm indicators with audio tone
Thru coating	Echo-to-echo measurement and THRU-COAT
Minimum and maximum thickness	Single element: 0.1 mm to 635.0 mm (0.004 in. to 25 in.) Dual element: 0.5 mm to 635.0 mm (0.020 in. to 25 in.)

Table 31 Display EN15317 specifications

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

Table 32 Transmitter EN15317 specifications

Parameter	Value
Transmitter pulse	Adjustable square wave pulser
Pulser voltage	Pulse voltages: 60 V, 110 V, 150 V, 200 V, and 325 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 33 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 34 Other EN15317 specifications

Parameter	Value
Data storage	Internal 2 GB and external 32 GB microSD memory cards. Internal card: 792000 thickness readings or 20000 waveforms with thickness readings
Data output types	3.0 USB client RS-232 Removable microSD memory card
Wi-Fi®	Supports 802.11 b/g/n (2.4GHz)
Bluetooth	Supports Bluetooth
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, 30 Hz, and Max
Number of pixels to display a waveform	640 × 480 pixels

Table 35 Environmental rating specifications

Parameter	Value
IP rating	Designed for IP67
Explosive atmosphere	MIL-STD-810H, Section 511.7, Procedure I
Mechanical shock test	MIL-STD-810H, Section 514.8, Procedure I
Vibration test	MIL-STD-810H, Section 516.8, Procedure I
Drop test	MIL-STD-810H, Section 516.8, Procedure IV (packaged and unpackaged) - Transit Drop

Table 36 Measurement specifications

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

Table 37 Datalogger specifications

Parameter	Value
Storage capacity	792000 thickness readings or 20000 waveforms with thickness readings
ID number length	1 to 20 characters
File name length	1 to 32 characters

Table 37 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 32 GB maximum capacity

Table 38 Typical measurement ranges and default setups for a single element transducer^a

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

Table 38 Typical measurement ranges and default setups for a single element transducer^a (continued)

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

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

Table 39 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, 200 V, and 325 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 39 Setup parameter description (continued)

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

Table 40 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 gauge for that transducer. Non-Evident transducers might work, but performance is not guaranteed. Following transducers are supported: D790, D790-SM, D791, D791-RM, D792, D793, D794, D797, D798, D7906-SM, D7908, D799, D7912, D7913, and MTD705
Single element transducers	Can be used with contact, delay line, and immersion transducers from 2 MHz to 30 MHz. High precision software option expands the frequency range to 0.5 MHz to 30.0 MHz

Table 41 Wireless specifications

Wireless Characteristic	Specification
Network standard	IEEE 802b/g/n
Transmission frequency range	2,412 – 2,462 MHz
Frequency bands & maximum RF power	2,450 MHz (b) – 20 dB 2,450 MHz (g) – 18 dB 2,450 MHz (n20) – 14 dB 2,450 MHz (BLE) – 0.0 dBm Conducted
Typical maximum SAR	540 mW/Kg at 0 cm (FCC & IC) 250 mW/Kg at 0 cm (EU)
Modulation types	DSSS, OFDM, GFSK

List of Figures

Figure i-1	The 39DL PLUS instrument	33
Figure 1-1	Measuring thicknesses with the 39DL PLUS	35
Figure 1-2	The 39DL PLUS hardware components	39
Figure 1-3	The 39DL PLUS connections	39
Figure 1-4	The top end connectors	40
Figure 1-5	The connectors behind the I/O door	41
Figure 1-6	The 39DL PLUS keypads	42
Figure 2-1	The power indicator for battery and AC operation	47
Figure 2-2	Connecting the charger/adaptor	48
Figure 2-3	Connecting the DC power plug	49
Figure 2-4	Opening the battery compartment	52
Figure 3-1	The main elements of the measurement screen	55
Figure 3-2	The ID bar	56
Figure 3-3	Example of other elements appearing on the measurement screen	57
Figure 3-4	The loss-of-signal (LOS) indicator	57
Figure 3-5	Menu and submenu example	58
Figure 3-6	Parameter screen example	59
Figure 3-7	Example of the virtual keyboard	61
Figure 3-8	The character cycle of the traditional text edit method	62
Figure 4-1	Selecting the user interface language	66
Figure 4-2	Selecting clock parameters	67
Figure 4-3	The DISPLAY SETTINGS screen	68
Figure 4-4	Example of the indoor and the outdoor color schemes	69
Figure 4-5	Examples of the rectification modes	70
Figure 4-6	Examples of waveform trace modes	72
Figure 4-7	The range of the waveform display	73
Figure 4-8	Comparing normal and zoomed display in mode 1	75
Figure 4-9	Comparing normal and zoomed display in mode 2	75
Figure 4-10	Comparing normal and zoomed display in mode 3	76
Figure 4-11	The measurement update rate indicator	76

Figure 5-1	Plugging the transducer	80
Figure 5-2	Initial screen with a standard D79X dual element transducer	80
Figure 5-3	Selecting a default single element transducer setup	81
Figure 5-4	Performing the material sound velocity calibration on a 5-step test block	84
Figure 5-5	Performing the zero calibration on a 5-step test block	85
Figure 5-6	Example of a 5-step test block	86
Figure 5-7	Entering a known material sound velocity	88
Figure 5-8	The calibration lock message	89
Figure 5-9	Coupling dual element transducer and reading the measured thickness	92
Figure 5-10	The active file name appearing in the ID bar	93
Figure 5-11	Opening the THRU COAT SETUP dialog box	94
Figure 5-12	Measuring with the standard echo detection mode	96
Figure 5-13	Measuring with the automatic echo-to-echo detection mode	97
Figure 5-14	Measuring with the manual echo-to-echo detection mode	98
Figure 5-15	Comparing manual measurements	100
Figure 6-1	EMAT transducer and filter adaptor connection	104
Figure 7-1	The OPTIONS screen to activate software options	108
Figure 7-2	The OXIDE screen	112
Figure 7-3	Selecting which measurement appears with the larger font	112
Figure 7-4	Measurement screen with the oxide layer software option	114
Figure 7-5	Measurement screen for a disbanded oxide layer	115
Figure 7-6	Waveform display screen	117
Figure 7-7	Setting multi-measurement parameters in the normal mode	118
Figure 7-8	Multi-measurement display modes with three layers and the sum	119
Figure 7-9	Setting multi-measurement parameters in the soft contact mode	121
Figure 7-10	Setting multi-measurement parameters in the % total thickness mode ..	122
Figure 7-11	Encoded B-scan main screen	123
Figure 7-12	Changing B-scan parameters	124
Figure 7-13	7 inch scan zoom set to 1	127
Figure 7-14	7 inch scan zoom set to 5	127
Figure 7-15	7 inch scan zoom set to 10	128
Figure 8-1	Normal differential mode	131
Figure 8-2	The DIFF screen	133
Figure 8-3	Displaying the minimum and/or maximum thickness	134
Figure 8-4	Example of a HIGH alarm indicator	136
Figure 8-5	Example of a B-scan alarm mode	139
Figure 8-6	YEL (yellow) and RED alarm indicators	140
Figure 8-7	Setting up the STANDARD alarm	141
Figure 8-8	Example of a locked function message in the help bar	142
Figure 8-9	The INSTRUMENT LOCK screen	144
Figure 9-1	The MEAS screen	147
Figure 9-2	The SYSTEM screen	150

Figure 9-3	Changing the communication parameters	152
Figure 10-1	Manually adjusting the gain	156
Figure 10-2	Adjusting the extended blank length	158
Figure 10-3	B-scan example for a 5-step test block	159
Figure 10-4	Changing B-scan parameters	160
Figure 10-5	The half-size and full-size B-scans	161
Figure 10-6	B-scan elements	161
Figure 10-7	B-scan freeze review elements	163
Figure 10-8	Example of the half-size DB grid	167
Figure 10-9	Changing DB grid parameters	168
Figure 10-10	Example of half-size and full-size DB grids	169
Figure 10-11	Grid transposition example	169
Figure 10-12	Example of a linearized DB grid	170
Figure 10-13	The highlighted DB grid cell in the ID review screen	171
Figure 10-14	Example of an inserted cell	172
Figure 10-15	Example of a zoomed inserted cell	173
Figure 10-16	Opening the Avg/Min measure dialog box	174
Figure 10-17	Examples of the measurement screen with the AVG/MIN measurement active	175
Figure 10-18	The TEMP COMP screen	177
Figure 10-19	Displaying temperature compensation data	178
Figure 11-1	The active file name appearing in the ID bar	179
Figure 11-2	Identifying datalogger parameters	181
Figure 11-3	Example of the CREATE screen	184
Figure 11-4	The CREATE screen for the incremental data file type	187
Figure 11-5	Selecting the ID range for the sequential file type	188
Figure 11-6	Configuring the ID range for a sequential with custom points data file type	190
Figure 11-7	General 2-D grid example	191
Figure 11-8	One grid for 75 identical parts	192
Figure 11-9	Different named grid for each part	193
Figure 11-10	Configuring the ID range for a 2-D grid data file type	194
Figure 11-11	Configuring the ID range for a 2-D grid with custom points data file type	196
Figure 11-12	Configuring the ID range for a 3-D grid data file type	198
Figure 11-13	Configuring the ID range for a boiler data file type	200
Figure 11-14	Configuring the ID range for a 3-D custom data file type	201
Figure 11-15	The file menu and report submenu	204
Figure 11-16	Opening a file	205
Figure 11-17	Copying a file	206
Figure 11-18	Entering new file information	207
Figure 11-19	Displaying the grid edit screen	208

Figure 11-20	Deleting a file	209
Figure 11-21	Deleting the data of an ID range in the active file	210
Figure 11-22	Warning message when resetting measurements	211
Figure 11-23	The FILE NOTES screen	212
Figure 11-24	Selecting a note from the notes table	214
Figure 11-25	Copying a note table from one file to another	216
Figure 11-26	The ID overwrite protection message	217
Figure 11-27	Identifying the ID review screen	218
Figure 11-28	Editing the ID # edit mode	220
Figure 11-29	The message when the edited ID is not in the database	221
Figure 11-30	The FILE SUMMARY report screen	223
Figure 11-31	The FILE SUMMARY report result screen	224
Figure 11-32	The MIN/MAX SUMMARY report screen	224
Figure 11-33	The FILE COMPARISON report screen	225
Figure 11-34	The FILE COMPARISON report result screen	226
Figure 11-35	The ALARM SUMMARY report result screen	227
Figure 11-36	The MIN/MAX SUMMARY report result screen	228
Figure 11-37	Returning to the measurement screen	228
Figure 12-1	The GENERIC SETUP SELECTION screen	233
Figure 12-2	Example of the ACTIVE screen	234
Figure 12-3	Illustration of the V-path	236
Figure 12-4	Answering YES at the V-path calibration prompt	238
Figure 12-5	Editing point 1 of the V-path calibration	239
Figure 12-6	Saving the setup	240
Figure 13-1	The ACTIVE screen for the setup of a single element transducer	242
Figure 13-2	Adjusting the waveform parameters	244
Figure 13-3	Mode 1 detection example	246
Figure 13-4	Mode 2 detection example	246
Figure 13-5	Mode 3 detection example	247
Figure 13-6	Detection of the first or the second negative peak	248
Figure 13-7	Comparing pulser power set to 60 V and 200 V	249
Figure 13-8	The TDG zones and parameters	250
Figure 13-9	Main bang blank position for mode 1	252
Figure 13-10	Main bang blank position for mode 2 and mode 3	253
Figure 13-11	Echo window setting for mode 1	254
Figure 13-12	Echo window setting for mode 2 and mode 3	254
Figure 13-13	Negative and positive echo detection examples	255
Figure 13-14	Examples of the interface blank in mode 2	257
Figure 13-15	Examples of the interface blank in mode 3	258
Figure 13-16	Examples of M3 Blank adjustment	259
Figure 13-17	Saving custom setups	260
Figure 14-1	Selecting USB and connector type	264

Figure 14-2	Connecting the 39DL PLUS to a computer	265
Figure 14-3	Viewing communication parameters	267
Figure 14-4	Configuring Bluetooth	269
Figure 14-5	Configuring WiFi	270
Figure 14-6	Selecting a file to send	272
Figure 14-7	Identifying a range of ID numbers to send	273
Figure 14-8	The EXPORT screen	275
Figure 14-9	Example of the IMPORT screen	276
Figure 14-10	The Device Configuration dialog box	279
Figure 14-11	The Device Tools dialog box with a screen capture	280
Figure 14-12	Viewing or changing the file output format	283
Figure 14-13	Selecting the COMMUNICATION RESET	284
Figure 15-1	Activating a reset function	289
Figure 15-2	The KEYPAD TEST screen	290
Figure 15-3	The DUAL XDCR TEST screen	291
Figure 15-4	Example of the SW DIAG screen	292
Figure 15-5	Example of the STATUS screen	293

List of Tables

Table 1	Radio Frequency Regulatory Compliance	25
Table 2	Keypad functions	43
Table 3	Recommended transducers for various steel thickness ranges	100
Table 4	39DL PLUS software options	107
Table 5	Oxide layer transducers	110
Table 6	Sample scan-speed calculations	125
Table 7	Sample maximum-distance calculations	126
Table 8	Alarm calculation example with the ABSOLUTE DIFF mode	137
Table 9	Alarm calculation example with the % DIFF mode	138
Table 10	File contents summary	180
Table 11	Additional information stored with the data	182
Table 12	Resulting ID examples for the INCREMENTAL file type	186
Table 13	Resulting ID examples for the SEQUENTIAL file type	187
Table 14	Resulting ID example for the SEQ+CUSTOM PT file type	189
Table 15	Resulting ID example for the 2D+CUSTOM PT file type	195
Table 16	Resulting ID example for the 3-D GRID file type	197
Table 17	Resulting ID example for the BOILER file type	199
Table 18	Resulting ID example for the 3-D CUSTOM file type	200
Table 19	File data mode stored measurements	202
Table 20	Predefined setups	231
Table 21	Default transducers	233
Table 22	Polarity of echoes	256
Table 23	Optional RS-232 cables	266
Table 24	Serial data output format for dual element transducers	281
Table 25	Serial data output format for single element transducers	282
Table 26	Default communication parameter values	283
Table 27	Measurement default settings	287
Table 28	Default communication settings	288
Table 29	Measurement troubleshooting	294
Table 30	General EN15317 specifications	297

Table 31	Display EN15317 specifications	298
Table 32	Transmitter EN15317 specifications	298
Table 33	Receiver EN15317 specifications	298
Table 34	Other EN15317 specifications	299
Table 35	Environmental rating specifications	299
Table 36	Measurement specifications	300
Table 37	Datalogger specifications	300
Table 38	Typical measurement ranges and default setups for a single element transducer	301
Table 39	Setup parameter description	302
Table 40	General specifications	303
Table 41	Wireless specifications	304