



# EPOCH 600

## User's Manual

DMTA-10006-01EN [U8778382] — Revision A

March 2011

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

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

The information contained in this document is subject to change without notice.  
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## List of Abbreviations

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AC	alternating current	LCD	liquid crystal display
ACT	amplitude comparison technique	MEM	memory
ADDT	amplitude-distance differential technique	NDT	non-destructive testing
AVG	abstand verstärkung gröÙe	OS	overshoot
AWS	American Welding Society	PK	peak
BIP	beam index point	PRF	pulse repetition frequency
CSC	curved surface correction	R	receive
DAC	distance amplitude correction	RoHS	restriction of hazardous substances
DC	direct current	SDH	side-drilled hole
DGS	distance gain size	T/R	transmit/receive
EFUP	environmental friendly usage period	Trig	trigonometry
EMC	electromagnetic compatibility	TVG	time-varied gain
FSH	full-screen height	USB	universal serial bus
ID	identifier	VAC	volts alternating current
IF	interface gate	VGA	video graphics adapter
IIW	International Institute of Welding	WEEE	waste electrical and electronic equipment
IP	ingressprotection		

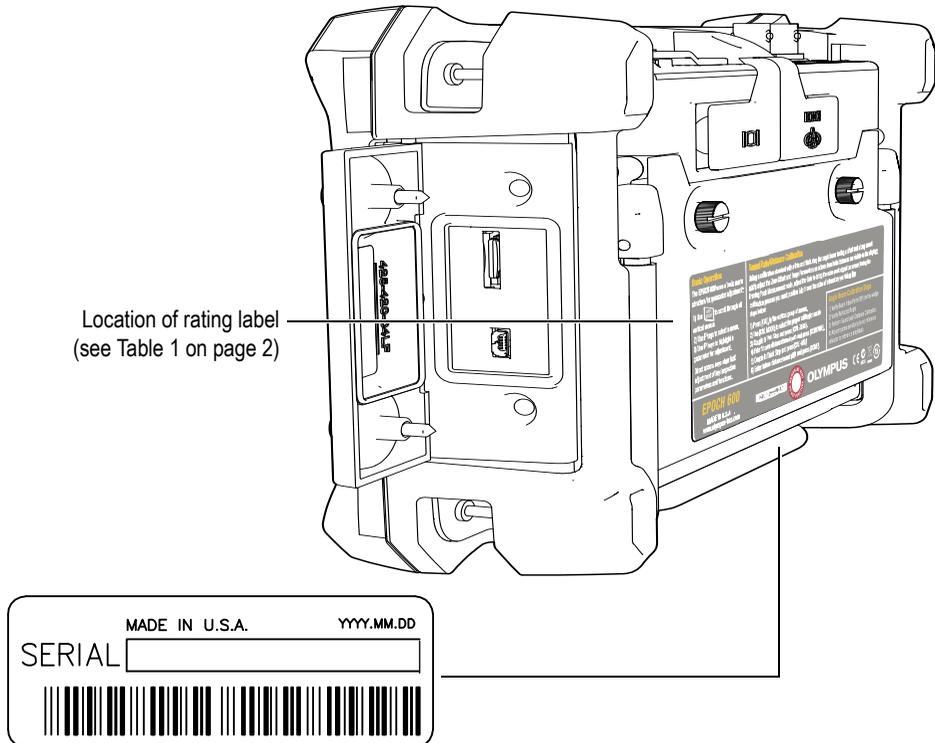


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## Labels and Symbols

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A rating label with safety-related symbols is attached to the instrument at the location shown in the following figure. The serial number label is located at the bottom of the instrument. If labels are missing or illegible, please contact Olympus.



**Table 1 Contents of the rating and the serial number labels**

<p>Rating plate label:</p>	
<p>Contains:</p>	
	<p>The CE marking is a declaration that this product conforms to all the applicable directives of the European Community. See the <i>Declaration of Conformity</i> for details.</p>
	<p>The WEEE symbol indicates that the product must not be disposed of as unsorted municipal waste, but should be collected separately.</p>
	<p>The C-Tick label indicates that the product complies with the applicable standard and establishes a traceable link between the equipment and the manufacturer, importer or their agent responsible for compliance and for placing it on the Australian market.</p>
	<p>The China RoHS mark indicates the product's Environmental Friendly Usage Period (EFUP). The EFUP is defined as the number of years for which listed controlled substances will not leak or chemically deteriorate while in the product. The EFUP for the EPOCH 600 has been determined to be 15 years. <b>Note:</b> The Environmental Friendly Usage Period (EFUP) is not meant to be interpreted as the period assuring functionality and product performance.</p>
	<p>The direct current symbol</p>

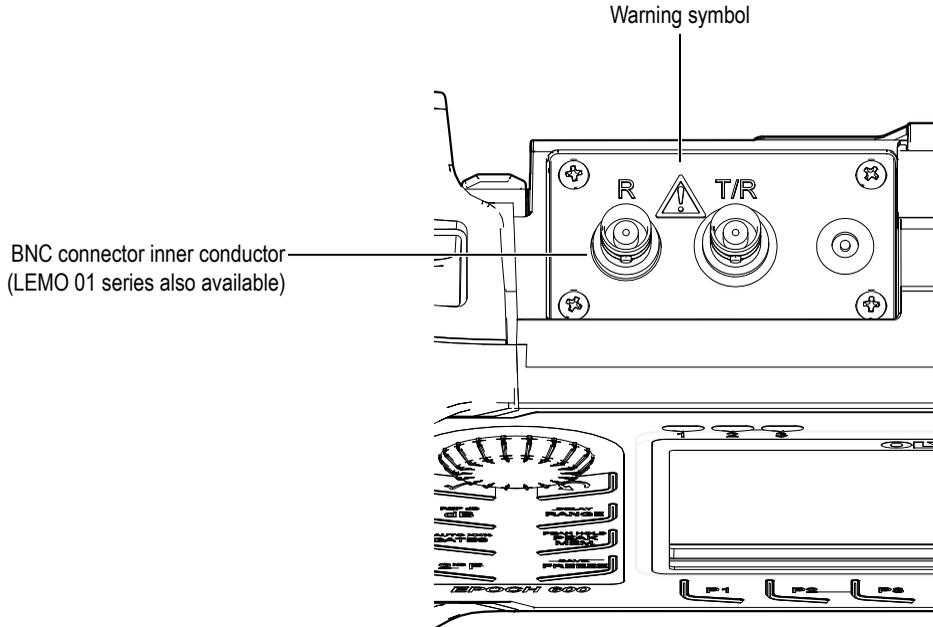
**Table 1 Contents of the rating and the serial number labels (continued)**

<b>SERIAL</b>	<p>The serial number is a 9-digit number in the following format:</p> <p style="text-align: center;"><b>yy nnnnn mm</b></p> <p>where:</p> <p><b>yy</b>          Production year</p> <p><b>nnnnn</b>      Unit number manufactured that month.</p> <p><b>mm</b>          Production month</p> <p>For example, the 10000504 serial number indicates that the fifth unit (00005) was produced in April 2010.</p>
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**DANGER**

Do not touch the inner conductor of the BNC (or LEMO) connectors to avoid risks of an electric shock. Up to 400 V can be present on the inner conductor. The warning symbol between the Transmit/Receive (T/R) and the Receive (R) BNC connectors shown in the figure below indicates this electric shock risk.



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## Important Information — Please Read Before Use

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### Intended Use

The EPOCH 600 instrument is designed to perform nondestructive inspections of industrial and commercial materials.



**DANGER**

Do not use the EPOCH 600 instrument for any purpose other than its intended use.

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### Instruction Manual

This instruction manual contains essential information on using this Olympus product safely and effectively. Before use, thoroughly review this instruction manual and use the product as instructed.

Keep this instruction manual in a safe, accessible location.

### Instrument Compatibility

Only use the EPOCH 600 instrument with the following ancillary equipment:

- Rechargeable lithium-ion (Li-ion) battery pack (P/N: 600-BAT-L [U8760056])

- Optional stand-alone external battery charger (P/N: EPXT-EC-X) [varies by configuration; must select power cord]
  - Charger/adaptor (P/N: EP-MCA-X) [varies by configuration; must select power cord]
- 



### **CAUTION**

Using incompatible equipment can result in a malfunction and/or in equipment damage.

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## **Repair and Modification**

The EPOCH 600 instrument does not contain any user-serviceable parts.

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### **CAUTION**

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

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## **Safety Symbols**

The following safety symbols may appear on the instrument and in the instruction manual:



General warning symbol:

This symbol is used to alert you to potential hazards. All safety messages that follow this symbol shall be obeyed to avoid possible harm.

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High voltage warning symbol:

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

## Safety Signal Words

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



**DANGER**

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



**WARNING**

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



**CAUTION**

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

## Notes Signal Words

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



**IMPORTANT**

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

**NOTE**

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

**TIP**

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

## Safety

Before applying power to the EPOCH 600, verify that the correct safety precautions have been taken (see the following warnings). In addition, note the external markings on the instrument that are described in the “Important Information — Please Read Before Use” section.

## Warnings



### General Warnings

- Carefully read the instructions contained in the user’s manual prior to powering on the instrument.
- Keep the user’s manual in a safe place for further reference.
- Follow the installation and operation procedures.

- It is imperative to respect the safety warnings on the instrument and in the user's manual.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment could be impaired.
- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Service instructions, when applicable, are for trained service personnel. To avoid a dangerous electric shock, do not perform any service unless qualified to do so. For any problem or question regarding this apparatus, contact Olympus or an authorized Olympus representative.



**WARNING**



- Before turning on the instrument, you must connect the protective earth terminal of the charger/adaptor to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Never negate the protective action by using an extension cord (power cable) without a protective conductor (grounding).
- Whenever it is likely that the ground protection is impaired, you must turn off the instrument and secure it against any unintended operation.
- The instrument must be connected only to a power source corresponding to the type indicated on the rating plate.

## WEEE Directive



In accordance with European Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE), this symbol indicates that the product must not be disposed of as unsorted municipal waste, but should be collected separately. Refer to your local Olympus distributor for return and/or collection systems available in your country.

## China RoHS

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



The China RoHS mark indicates the product's Environmental Friendly Usage Period (EFUP). The EFUP is defined as the number of years for which listed controlled substances will not leak or chemically deteriorate while in the product. The EFUP for the EPOCH 600 has been determined to be 15 years.

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

## EMC Directive Compliance

### FCC (USA) Compliance

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

### ICES-003 (Canada) Compliance

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

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

## Warranty Information

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

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

Inspect materials thoroughly on reception for evidence of external or internal damage that might have occurred during shipment. Notify the carrier making the delivery immediately of any damage, since the carrier is normally liable for damage in shipment. Preserve packing materials, waybills, and other shipping documentation in order to establish a damage claim. After notifying the carrier, contact Olympus for assistance with the damage claim and equipment replacement, if necessary.

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

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

## Technical Support

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



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## Introduction

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The preface contains the following topics:

- “Product Description ” on page 13
- “EPOCH 600” on page 14
- “About This Document” on page 14
- “Audience” on page 14
- “Typographical Conventions” on page 15

## Product Description

The EPOCH 600 is a portable ultrasonic non destructive test (NDT) instrument used to detect flaw conditions in welds, pipes, and many other structural and/or industrial materials. The instrument may be used in indoor and outdoor environments. This flaw detector offers advanced conventional ultrasonic performance. The instrument features a large dynamic range, superior measurement resolution, a full VGA resolution (640 x 480 pixels) color-liquid crystal display with transfective technology for superior visibility, and an intuitive user interface.

The EPOCH 600 features many performance, durability, and operational enhancements when compared to previous EPOCH flaw detector instruments. These enhancements include:

- Case sealed to the requirements of IP66 (adjustment knob configuration) or IP67 (navigation pad configuration) environmental rating
- Color liquid crystal display (LCD) with full VGA resolution and transfective technology
- Compliance with EN12668-1
- A 100 % digital high dynamic range receiver design

- 8 digital receiver filters
- Maximum 2000 Hz pulse repetition frequency (PRF)
- Dynamic DAC/TVG sizing software
- Onboard DGS/AVG sizing software
- Optional analog output
- Digital alarm outputs
- USB and RS-232 connectivity
- Adjustment knob or navigational arrow keys
- 2 GB MicroSD memory card
- VGA Output Capability

Read through this information completely at least once with your EPOCH 600 in hand so that you can combine reading the descriptions and examples with the actual use of the instrument.

## EPOCH 600

In order to accommodate different user needs and preferences, the EPOCH 600 is available in two hardware configurations: one with an adjustment knob and the other with a navigation pad. The adjustment knob and the arrow keys on the navigation pad are responsible for parameter adjustment and value slewing. You can choose either the adjustment knob or the navigation pad when ordering depending on which adjustment method you are more comfortable with.

## About This Document

This document is the user's manual for the EPOCH 600. This manual describes routine tasks for operating the EPOCH 600.

## Audience

This document is intended for operators of the EPOCH 600. Olympus recommends that all operators have a thorough understanding of the principles and limitations of ultrasonic non destructive testing. Olympus assumes no responsibility for incorrect operational procedure or interpretation of test results. We recommend that all operators seek adequate training prior to using this equipment.

While the EPOCH 600 is a continuously self-calibrating instrument, you must determine regulatory requirements. Olympus offers calibration and documentation services. Contact Olympus or your local representative with any special requests.

## Typographical Conventions

Table 2 on page 15 presents the typographical conventions employed in this document.

**Table 2 Typographic conventions**

<b>Convention</b>	<b>Description</b>
<b>Bold</b>	Used when referring to the label of a user interface element, including menu items, buttons, toolbar names, options, and tabs.
<b>[BOLD]</b>	Used when referring to an instrument front panel key.
<b>[2ND F], (BOLD)</b>	Used when referring to the secondary function of an instrument front panel key. <b>(BOLD)</b> is the secondary function of the key, appearing above the direct-access keypad key.
ALL UPPERCASE	Used to refer to computer keyboard keys
SMALL CAPS	Used to refer to marking on the instrument for connector names for example.
<i>Italics</i>	Used to refer to document titles.
< <i>n</i> >	Used to represent a variable.



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# 1. Instrument Overview

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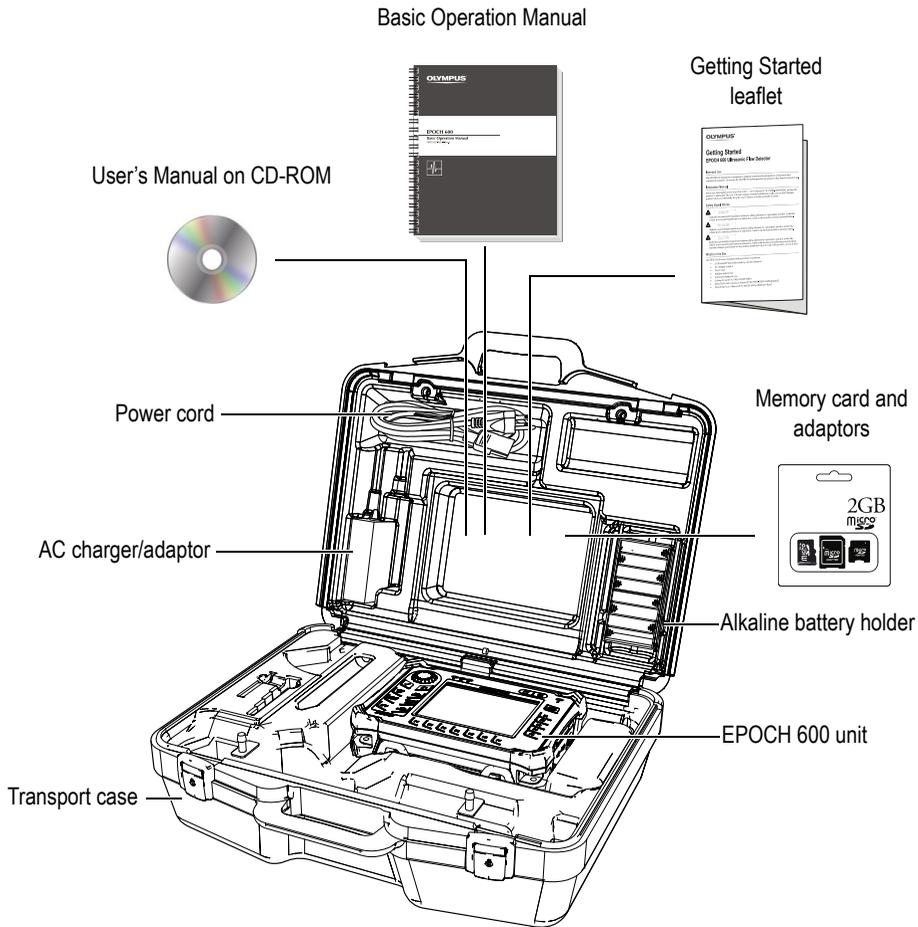
This chapter provides a brief overview of all common operational requirements of the EPOCH 600 instrument. This chapter is organized in the following manner:

- “What’s In the Box” on page 17
- “EPOCH 600 Instrument Configurations” on page 18
- “Connectors” on page 19
- “Power Requirements” on page 22
- “Installing the MicroSD Card” on page 28

## 1.1 What’s In the Box

The EPOCH 600 instrument comes standard with several key accessories (see Figure 1-1 on page 18):

- 2-GB MicroSD removable memory card and adaptors (P/N: MICROSD-ADP-2GB [U8779307])
- AC charger/adaptor (P/N: EP-MCA-X). Varies by configuration; must select power cord.
- Power cord
- Alkaline battery holder (P/N: 600-BAT-AA [U8780295])
- Instrument transport case (P/N: 600-TC [U8780294])
- *Getting Started* leaflet (P/N: DMTA-10008-01EN [U8778373])
- *EPOCH 600 Basic Operation Manual* (P/N: DMTA-10007-01EN [U8778365]) on hard copy
- *EPOCH 600 User’s Manual* (P/N: DMTA-10006-01EN) on CD-ROM (P/N: EP600-MANUAL-CD [U8778381])



**Figure 1-1** Transport case contents

For a list of optional accessories, please refer to parts list on page 283.

## 1.2 EPOCH 600 Instrument Configurations

The EPOCH 600 instrument is configured according to the customer's preferences in several ways. Available configurations include:

- Adjustment knob or navigation pad
- Keypad overlay (English, Japanese, Chinese, or Symbolic)
- BNC or LEMO 01 series transducer connectors
- Optional analog output port

Configuration selections must be made when ordering the instrument. The EPOCH 600 also comes standard with a rechargeable lithium-ion battery, an adjustable pipe stand, and a flexible display protector.

### 1.3 Connectors

Figure 1-2 on page 19 illustrates the connections of the EPOCH 600 with the AC charger/adaptor, the MicroSD card, and a PC.

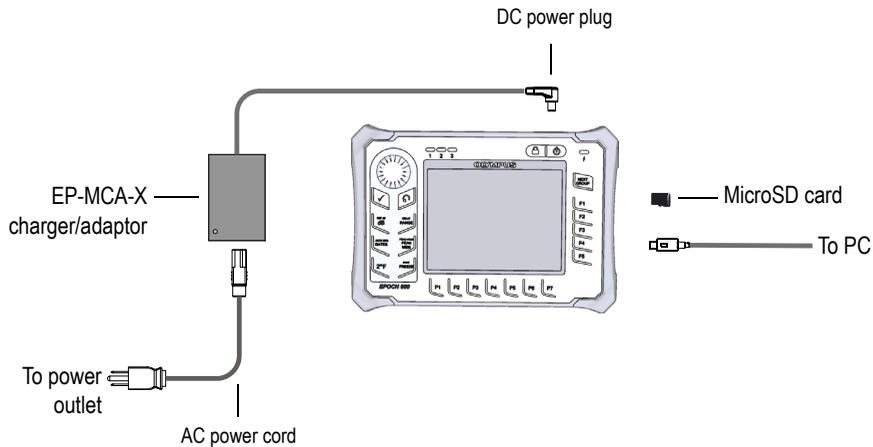


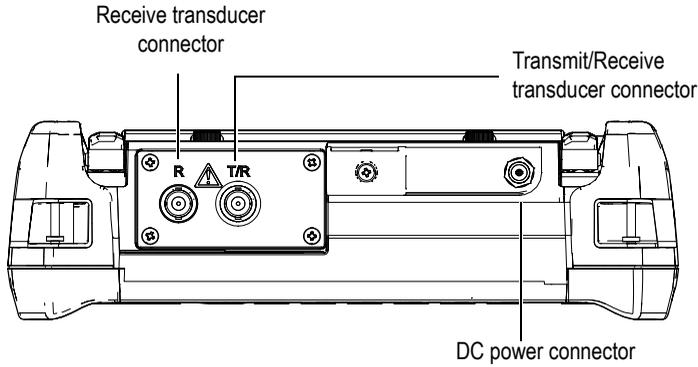
Figure 1-2 The EPOCH 600 connections



#### CAUTION

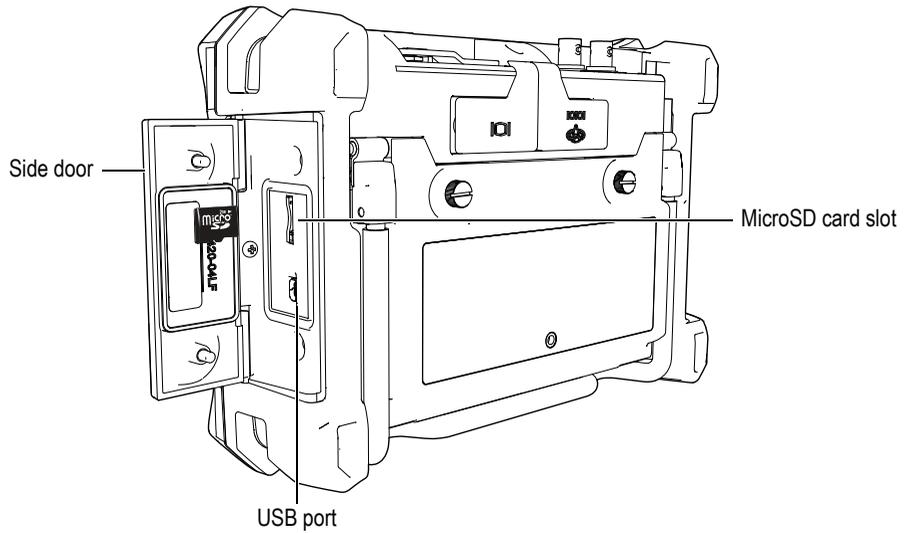
Use only the AC power cord supplied with the EPOCH 600. Do not use this AC power cord with other products.

The DC power, the Receive probe connector, and the Transmit/Receive probe connector are located on the top end of the EPOCH 600 (see Figure 1-3 on page 20).



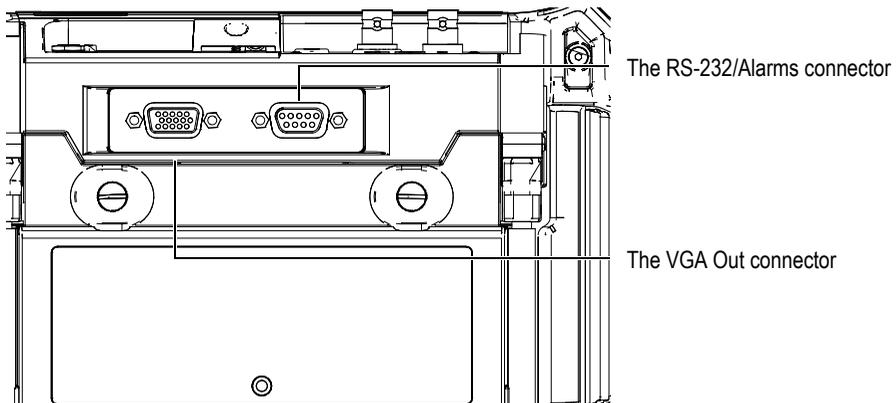
**Figure 1-3 The top end connectors**

The USB On-The-Go port and the external MicroSD memory card slot are located on the right side of the instrument, hidden behind the side door (see Figure 1-4 on page 21).



**Figure 1-4 The connectors behind the side door**

The RS-232/Alarms and the VGA Out connectors are located at the back of the instrument, in the upper section (see Figure 1-5 on page 21). A rubber cover protects each connector.



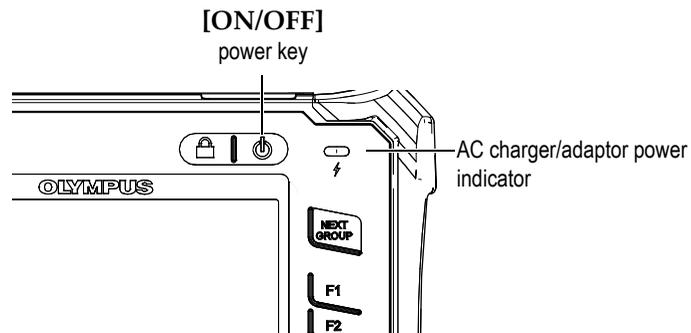
**Figure 1-5 The RS-232/Alarms and VGA Out connectors**

## 1.4 Power Requirements

Press the [ON/OFF] key to turn on the EPOCH 600 (see Figure 1-6 on page 22). Pressing this key once causes an initial beep, followed by the instrument startup screen and a second beep approximately 5 seconds later.

The EPOCH 600 is designed to operate using three power supply methods:

- Internal lithium-ion battery
- Directly from the EPOCH charger/adaptor
- Internal alkaline batteries



**Figure 1-6 Location of the EPOCH 600 power key and indicator**

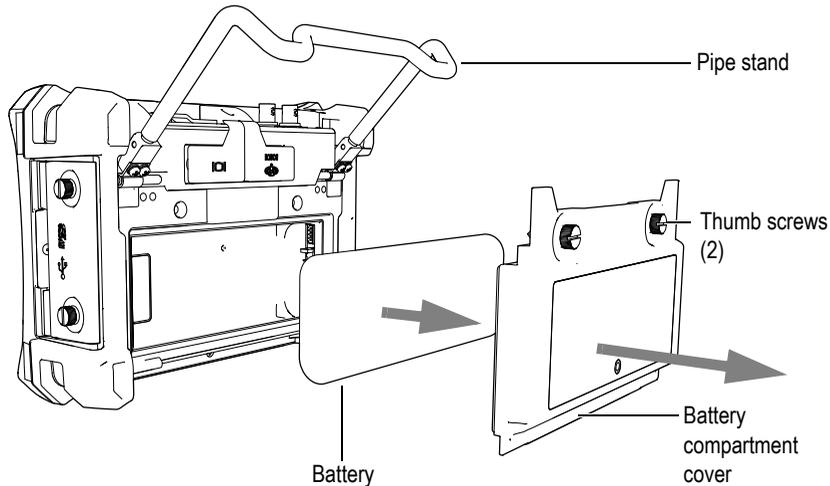
### 1.4.1 Lithium-Ion Battery

The lithium-ion (Li-ion) battery is the primary method for powering the EPOCH 600. This battery comes installed in every instrument. When properly maintained, and when the instrument is operated under typical inspection conditions, the lithium-ion battery should provide between 12 and 13 hours of continuous operation.

#### To install or replace the lithium-ion battery

1. Unfold the instrument pipe stand.
2. At the back of the instrument, loosen the two thumb screws securing the battery compartment cover (see Figure 1-7 on page 23).
3. Remove the battery compartment cover (see Figure 1-7 on page 23).
4. Remove the battery and/or install the battery in the battery compartment.

5. Ensure that the gasket of the battery compartment cover is clean and in good condition.
6. Install the battery compartment cover at the back of the instrument, and then tighten the two thumb screws to complete the installation (see Figure 1-7 on page 23).



**Figure 1-7 Removing the lithium-ion battery**

## 1.4.2 AC Charger/Adaptor

The EPOCH 600 AC charger/adaptor is provided with every instrument. This charger/adaptor allows you to power the EPOCH 600 with or without a battery installed, as well as to charge the lithium-ion rechargeable battery when installed in the instrument. A power indicator on the front panel of the unit displays the current status of the AC charger/adaptor.

### To connect the AC charger/adaptor

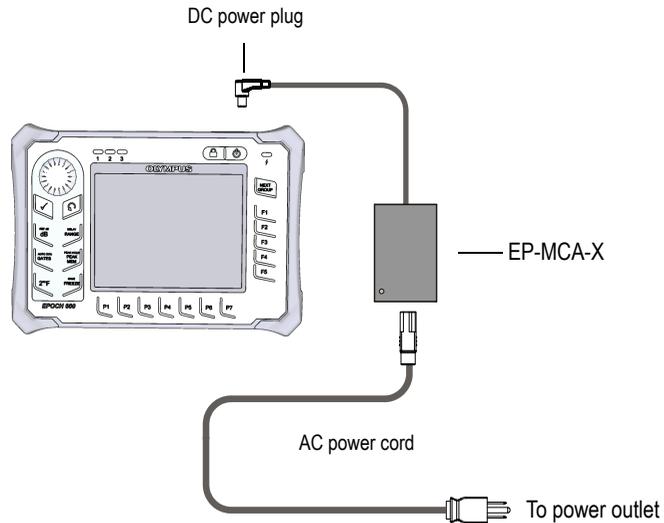
1. Connect the power cord to the charger/adaptor unit and to an appropriate power outlet.



**CAUTION**

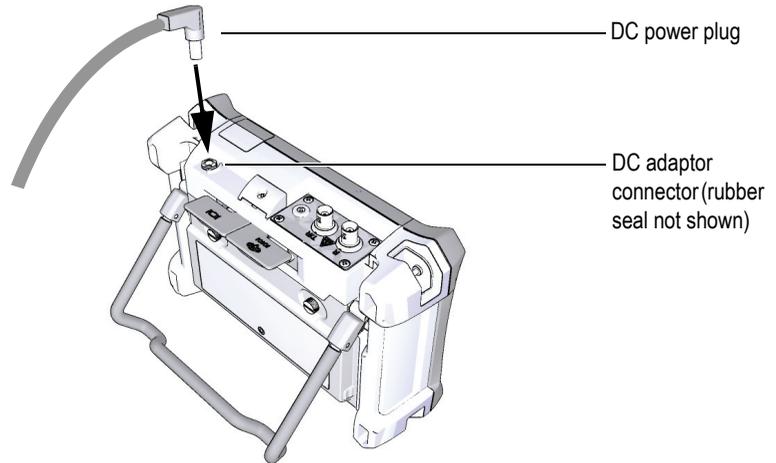
Use only the AC power cord supplied with the EPOCH 600. Do not use this AC power cord with other products.

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**Figure 1-8 Connecting the charger/adaptor**

2. Lift the rubber seal that covers the AC adaptor connector on top of the EPOCH 600 instrument.
3. Connect the DC output power cable from the AC charger/adaptor to the adaptor connector (see Figure 1-9 on page 25).



**Figure 1-9 Connecting the DC power plug**

The power status of the AC charger/adaptor and the battery charge condition are indicated both on the front panel of the EPOCH 600, as well as in the user interface (see Table 3 on page 25).

**Table 3 AC charger/adaptor power indicator status**

Power indicator status	AC line power connected	Indicator meaning	Battery indicator
Green	Yes	Internal battery fully charged	
Red	Yes	Internal battery is charging	
Off	No	AC charger/adaptor not connected	

**Table 3 AC charger/adaptor power indicator status (continued)**

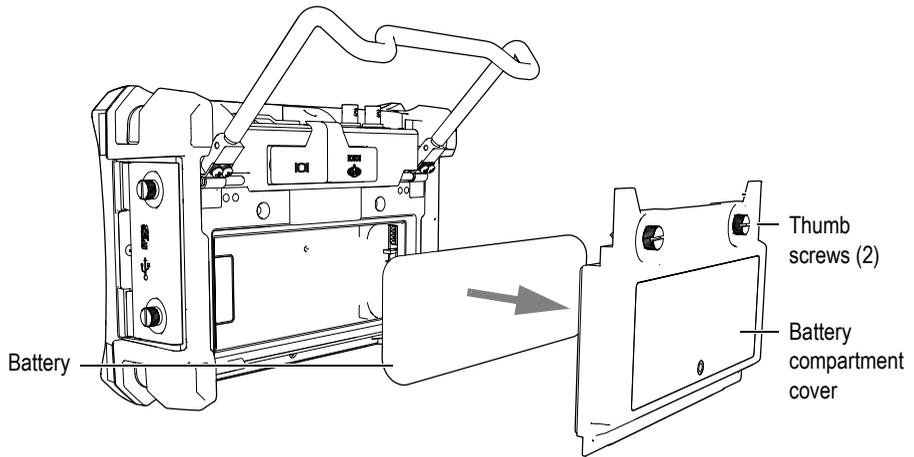
Power indicator status	AC line power connected	Indicator meaning	Battery indicator
Green	Yes	AC charger/adaptor connected No battery installed	

### 1.4.3 Alkaline Batteries

The EPOCH 600 comes standard with an alkaline battery holder (P/N: 600-BAT-AA [U8780295]). This holder accommodates 8 AA size alkaline batteries in situations where an AC power source is not available and the internal Li-ion battery is discharged. When operated under typical inspection conditions, the alkaline batteries will provide 3+ hours of continuous operation.

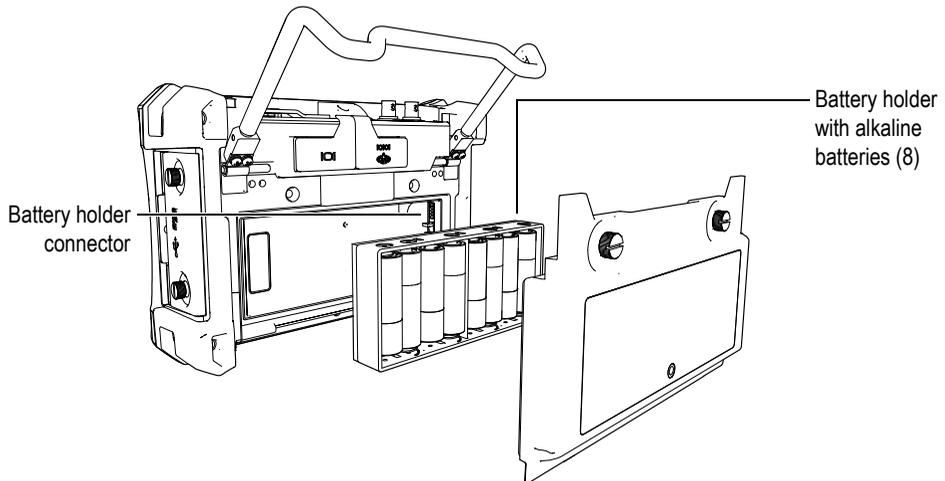
#### To install the alkaline battery holder

1. Unfold the instrument pipe stand.
2. Loosen the two thumb screws securing the battery compartment cover at the back of the instrument, and then remove the battery compartment cover (see Figure 1-10 on page 27).
3. Remove the lithium-ion battery (if installed) [see Figure 1-10 on page 27].



**Figure 1-10 Removing the battery compartment cover and the lithium-ion battery**

4. Install 8 AA size alkaline batteries into the alkaline battery holder.
5. Connect the alkaline battery holder connector into the instrument.
6. Position the alkaline battery holder in the battery compartment (see Figure 1-11 on page 27).



**Figure 1-11 The alkaline battery holder**

7. Install the battery compartment cover at the back of the instrument, and then tighten the two thumb screws.

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**NOTE**

When alkaline batteries are installed in the instrument, the battery indicator in the user interface displays **ALK**. The AC charger/adaptor does not recharge the batteries installed in the alkaline battery holder.

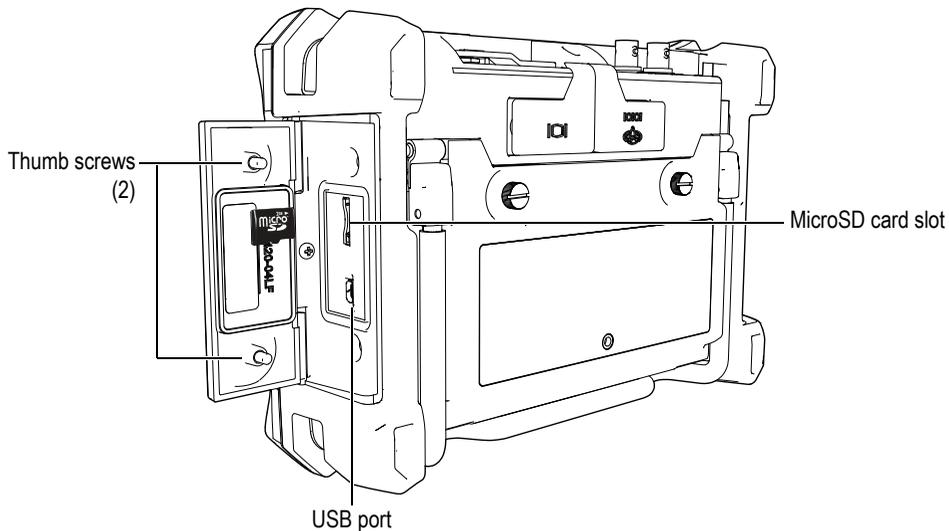
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## 1.5 Installing the MicroSD Card

The 2-GB MicroSD card is included with every EPOCH 600 shipment.

### To install the MicroSD removable memory card

1. Remove the card from its packaging.
2. Loosen the two thumb screws, and then open the EPOCH 600 side door (see Figure 1-12 on page 28).



**Figure 1-12 The side door**

3. Hold the card so that the MicroSD label faces toward the rear of the instrument.
4. Carefully slide the card into the MicroSD slot until it clicks (see Figure 1-12 on page 28).

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<b>NOTE</b>
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To remove the MicroSD card, carefully push the card into the instrument and release. A spring mechanism will partially eject the card, and then you can grasp and remove it from the instrument.

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## 2. Basic Operation

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This chapter is intended to quickly provide guidance for users who are familiar with ultrasonic flaw detection, but are new to the EPOCH 600. More detailed descriptions of these topics, along with a comprehensive guide to more advanced functions, are covered in the later chapters of this manual. This chapter is organized in the following manner:

- “User Interface” on page 31
- “Pulser and Receiver Settings” on page 37
- “Gates” on page 40
- “Calibration” on page 43
- “Data Logger” on page 47

### 2.1 User Interface

The EPOCH 600 uses a blend of direct-access keys and software menus to achieve full control over the instrument. The direct-access keypad provides instant control over functions that are commonly used during inspections. The software menus provide access to the majority of instrument functions, such as pulser/receiver settings, automated calibration, measurement setups, software features, data logging capabilities, and more.

Adjusting the value of a selected parameter is achieved using either the EPOCH 600 adjustment knob or the navigation keypad. The parameter adjustment method is determined by the configuration of the instrument selected at time of ordering. Both methods are outlined below.

## 2.1.1 Menus and Parameters

The majority of functions on the EPOCH 600 can be accessed and adjusted using the horizontal and vertical keys in the software user interface. The vertical keys, located on the right side of the display, are called menus, and the horizontal keys along the bottom of the display are called parameters, functions, or submenus (see Figure 2-1 on page 32). Each menu or parameter can be selected for adjustment by pressing its corresponding [F<n>] or [P<n>] key on the instrument keypad (see Figure 2-1 on page 32).

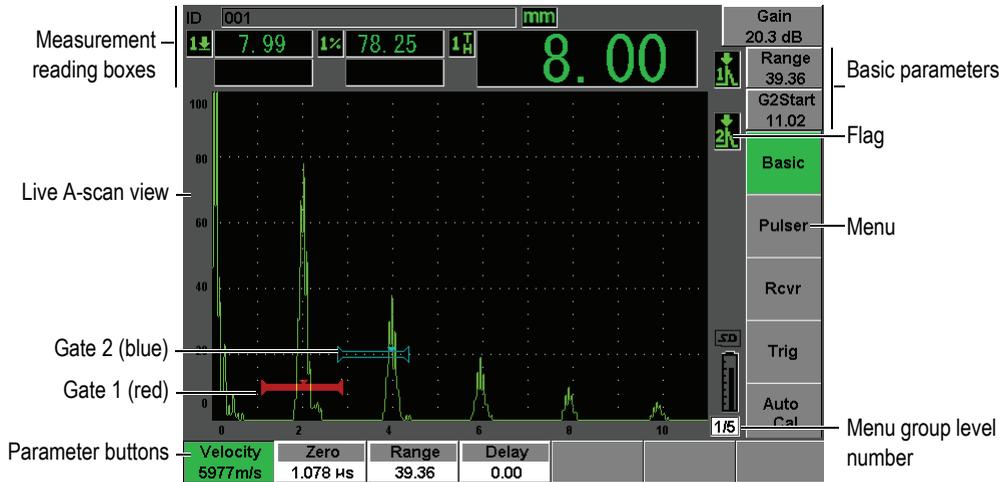


Figure 2-1 Software main display elements

There are five groups of menus on the EPOCH 600. Each menu group is identified with a number (1/5, 2/5, 3/5, 4/5, and 5/5). To scroll through all menu groups, use the [NEXT GROUP] key (see Figure 2-2 on page 33).

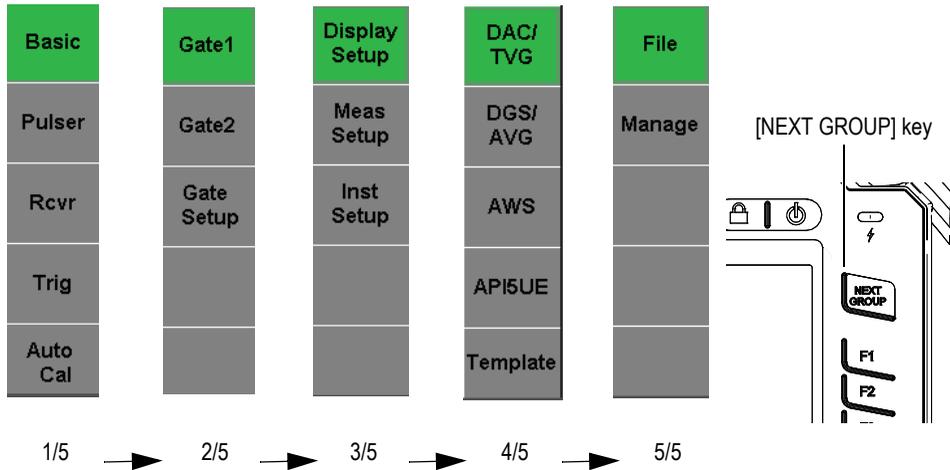


Figure 2-2 The menu groups and their level numbers

## 2.1.2 Parameter Adjustment – Knob Configuration

Once a parameter is selected, you can modify it using the adjustment knob. You can adjust most parameters in either coarse or fine increments. To toggle between coarse and fine adjustment, press the [CHECK] key.

Coarse adjustment selection is indicated by brackets around the parameter key (see Figure 2-3 on page 33). Fine adjustment is selected when no brackets are displayed.



Figure 2-3 Coarse and fine adjustment selection

### 2.1.3 Parameter Adjustment – Navigation Pad Configuration

Once a parameter is selected, you can modify it using the arrow keys on the navigation pad (see Figure 2-4 on page 34). You can adjust most parameters in either coarse or fine increments. The up and down arrows adjust in coarse increments, and the left and right arrows adjust in fine increments.

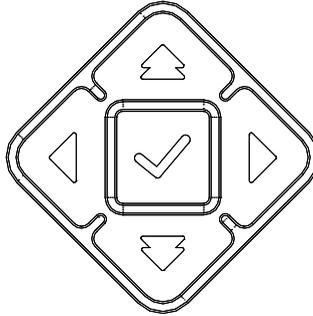
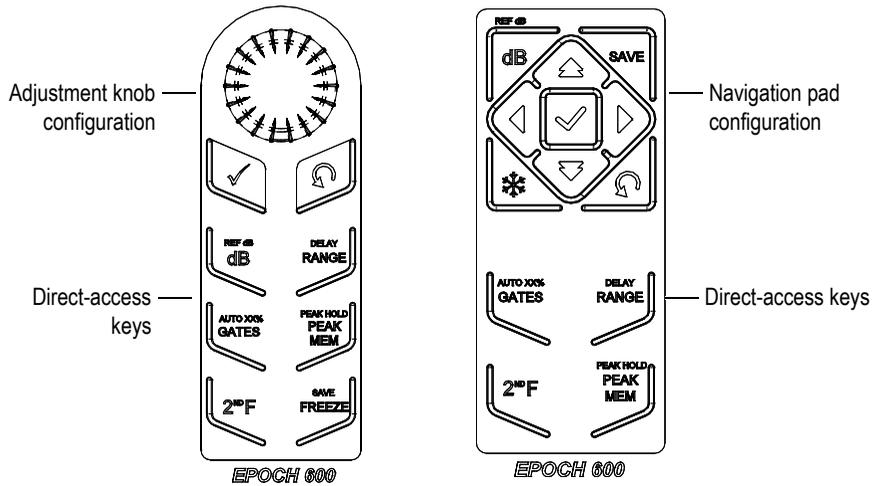


Figure 2-4 Arrow keys on the navigation pad

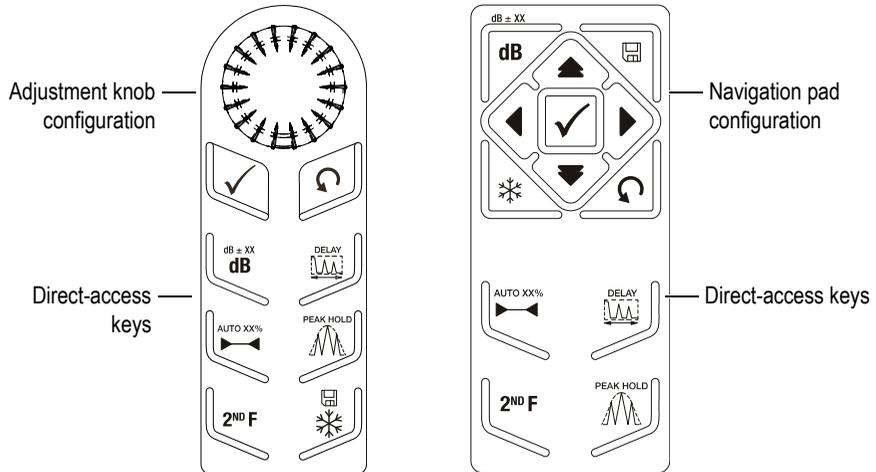
### 2.1.4 Direct-Access Keys

To facilitate fast adjustment of common parameters, the EPOCH 600 features a set of direct-access keys (see Figure 2-5 on page 35). When pressed, the software interface jumps directly to the associated parameter or activates the correct function.



**Figure 2-5 The direct-access keys – Both configurations (English)**

The EPOCH 600 is also offered in an international-symbol version (see Figure 2-6 on page 35).



**Figure 2-6 The direct-access keys – Both configurations (international symbols)**

When the **[RANGE]**, **(DELAY)**, **[dB]**, or **(REF dB)** direct-access keys are pressed, common preset values appear above the **[P<n>]** parameter keys. To select a preset value, press the corresponding **[P<n>]** parameter key.

## 2.1.5 Special Functions

There are several special functions to be aware of while using the EPOCH 600:

- After adjusting a parameter using direct-access keys, you can get back to the previous menu group using the **[ESCAPE]** key or the **[NEXT GROUP]** key.
- Pressing the **[ESCAPE]** key from any menu group will return the user to the **Basic** menu, which is the default menu at start-up.
- The **[LOCK]** key (knob configuration only) automatically locks adjustment of all parameters to prevent any unwanted parameter modifications due to an accidental movement of the knob (see Figure 2-7 on page 36).

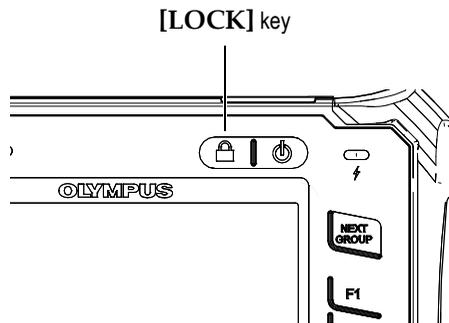


Figure 2-7 Adjustment knob configuration – **[LOCK]** key

- Pressing **[2ND F]**, **(AUTO XX%)** activates the AUTO XX% feature, which automatically adjusts the gain in order to set the gated echo amplitude to XX% of full screen height (the default XX value is 80 %). (See Figure 2-8 on page 37.)

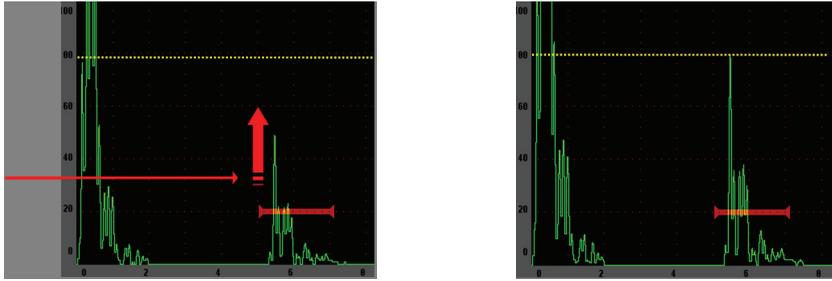


Figure 2-8 The AUTO XX% feature

## 2.1.6 Submenus

When selecting some items, such as **Display Setup**, the [NEXT GROUP] key scrolls through rows within the submenu, the adjustment knob or navigation pad arrows are used to adjust the selected value, and the [ESCAPE] key returns to the live A-scan view.

## 2.2 Pulser and Receiver Settings

The EPOCH 600 allows access to most of its pulser and receiver settings through the **Pulser** and the **Rcvr** menus. System sensitivity (gain) and reference gain are controlled exclusively using the direct-access keys.

### 2.2.1 Sensitivity

The system sensitivity (gain) is adjusted using the [dB] direct-access key.

#### To adjust the system sensitivity

1. Press [dB].
  2. Adjust the value:
    - ◆ Using the navigation pad arrow keys or by rotating the adjustment knob in either coarse or fine increments
- OR
- ◆ Pressing one of the [P<n>] parameter keys to select the corresponding preset value

Gain can also be automatically adjusted using the AUTO XX% feature. See “Special Functions” on page 36.

## 2.2.2 Reference Gain

You can define a reference gain by pressing [2ND F], (REF dB). This sets the current gain as the reference gain and activates a scanning gain for further adjustments (see Figure 2-9 on page 38).

When the reference gain is set, the [P<n>] parameter keys allow access to the following functions:

- **Add:** Combines current scanning gain with current reference gain and sets the resultant as the new reference gain.
- **Scan dB:** Toggles between current scanning gain and 0.0 dB scanning gain.
- **Off:** Turns off reference gain feature (scanning gain is lost).
- **+6 dB:** Increases the scanning gain by 6 dB.
- **-6 dB:** Decreases the scanning gain by 6 dB.



**Figure 2-9 The reference and scanning gains**

## 2.2.3 Pulser

The EPOCH 600 main pulser functions are accessible by selecting the **Pulser** menu. Each individual pulser parameter is displayed above the parameter keys, and can be adjusted by pressing the corresponding [P<n>] parameter key.

The following pulser functions are available for live adjustment in the **Pulser** menu:

- **PRF Mode:** Selects either Auto or Manual PRF adjustment mode. **Auto** changes the PRF setting based on the screen range, and **Manual** allows manual adjustment of PRF in 10-Hz increments.
- **PRF:** Pulse Repetition Frequency (PRF) values range: from 10 Hz to 2000 Hz in 10-Hz increments
- **Energy:** Pulse voltage values available: 0 V, 100 V, 200 V, 300 V, or 400 V
- **Damp:** Pulse damping values available: 50 Ω, 100 Ω, 200 Ω, or 400 Ω

- **Mode:** pulse modes available: **P/E** (pulse-echo), **Dual**, and **Thru** (through-transmission)
- **Pulser:** Pulser waveforms available: **Spike** or **Square** (tunable square wave)
- **Freq:** Pulse frequency (square wave pulse width) ranges from 0.1 MHz to 20.00 MHz

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<b>NOTE</b>
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The Spike pulse is equivalent to a 20-MHz square wave pulse.

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## 2.2.4 Receiver

The EPOCH 600 standard receiver functions are accessible by selecting the **Rcvr** menu. Each individual receiver parameter is displayed above the parameter keys, and can be adjusted by pressing the corresponding [P<*n*>] parameter key.

The following receiver parameters are available for live adjustments in the **Rcvr** menu:

- **Filter:** Receiver filter setting
- **Rect:** Waveform rectification (**Full** [fullwave], **Half+** [halfwave positive], **Half-** [halfwave negative], **RF** [no rectification])
- **Reject:** Percent reject (from 0 % to 80 %)

The eight filters available on the EPOCH 600 allow broadband or narrowband settings to match the requirements of a given application. Each is a fully digital filter set with the following low-pass and high-pass cutoffs:

- 0.2 MHz–10 MHz
- 2.0 MHz–21.5 MHz
- 8.0 MHz–26.5 MHz
- 0.5 MHz–4.0 MHz
- 0.2 MHz–1.2 MHz
- 1.5 MHz–8.5 MHz
- 5.0 MHz–15 MHz
- DC–10 MHz

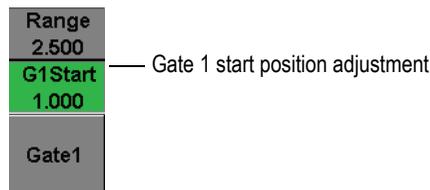
## 2.3 Gates

The EPOCH 600 features two standard, independent measurement gates: gate 1 and gate 2. Gate 1 is displayed as a red, solid horizontal line. Gate 2 is displayed as a blue, hollow horizontal line. These gates independently define digital measurements regions for amplitude, time-of-flight measurements, and other specialized readings. Each gate also features alarm and zoom functions.

### 2.3.1 Quickly Adjusting Basic Gate Parameters

The [GATES] direct-access key allows instant access to gate start, width, and level adjustments without requiring the user to enter any gate-related menus. This is the most common method for gate adjustments.

When the [GATES] key is pressed, the box above the first menu displays the gate 1 start position (see Figure 2-10 on page 40). Once selected, the knob or arrows can increase or decrease this value, in coarse or fine increments.



**Figure 2-10 The Gate 1 start position adjustment**

Pressing the [GATES] key repeatedly will scroll through the start, width, and level setting of every active gate. Pressing [ESCAPE] or [NEXT GROUP] returns the user to the menu group used prior to gate adjustment, allowing efficient adjustment of the gates with minimal interference for the operator.

For more comprehensive gate setup and adjustment, there are three menus that manage gate settings: **Gate1**, **Gate2**, and **Gate Setup**.

### 2.3.2 Gate 1 and Gate 2

Both **Gate 1** and **Gate 2** menus allow access to specific gate positioning and alarm functions. When either menu is selected, the following parameters become visible above the [P<n>] parameter keys.

- **Zoom:** Sets the display range to begin at the start position of the selected gate, and to stop at the end position of the selected gate (gate start + gate width).

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<b>NOTE</b>
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Pressing the **Zoom** [P<n>] parameter key repeatedly toggles the zoom on and off.

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- **Start:** Adjusts the start position of the selected gate.
- **Width:** Adjusts the width of the selected gate.
- **Level:** Adjusts the screen height of the selected gate (from 3 % to 95 %).
- **Alarm:** Sets the alarm condition of the selected gate (**Off, Positive, Negative, Min Depth**)
- **Min Depth:** Visible only when the **Alarm** parameter is set to **Min Depth**. Adjusts the threshold in time-of-flight units that triggers a Min Depth alarm condition.
- **Status:** Turns the gate on or off (effects measurements, alarms, and visibility of gate on screen).

### 2.3.3 Gate Setup

The **Gate Setup** menu allows more advanced settings for each gate to be adjusted prior to inspection. These settings are visible above the [P<n>] parameter keys. The following gate settings are available in the **Gate Setup** menu:

- **G1 Mode:** Sets the measurement trigger mode of gate 1 (**Peak, 1stPeak, Edge**)
- **G1 RF:** Sets the polarity of the gate 1 when the instrument is operating in RF rectification (**Dual, Positive, Negative**)
- **G1 %Amp:** Used only in **Edge** mode. Sets the measurement trigger for the % amplitude digital measurement of gate 1 when in **Edge** detection mode (**High Peak, 1stPeak**).
- **G2 Mode/G2 RF/G2 %Amp:** Same settings as above, but for gate 2 only.
- **G2 Tracks:** Toggles tracking mode of gate 2 with respect to gate 1 on or off. Tracking ON is considered true echo-to-echo measurement mode.

Gate measurement modes, selected by **G1 Mode** or **G2 Mode**, determine which gated echo or echo parameters triggers a digital measurement.

- **Peak:** Acquires measurement readings based on the highest peak within the gated region (does not have to cross the gate threshold) [see Figure 2-11 on page 42].

- **1stPeak:** Acquires measurement readings based on the first peak to cross the gate threshold (level) [see Figure 2-11 on page 42].
- **Edge:** Acquires measurement readings based on the position of the first crossing point of a gated signal (see Figure 2-11 on page 42).

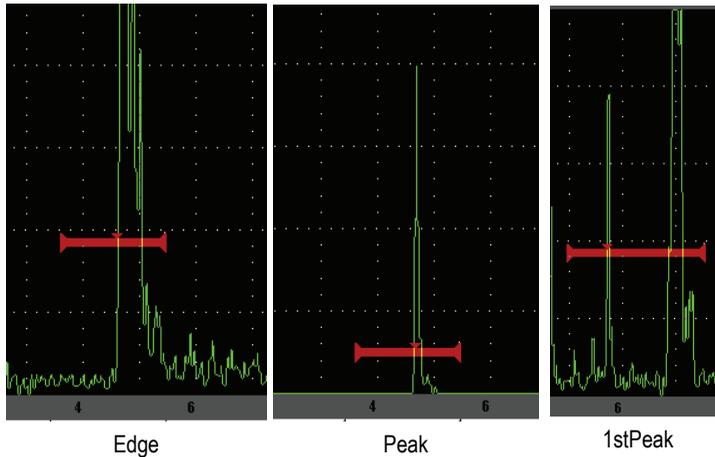


Figure 2-11 Measurement trigger in Edge, Peak, and 1stPeak modes

### 2.3.4 Alarm Indications

Whenever an alarm is triggered on either measurement gate, the operator is alerted in two different ways:

- An audible tone is emitted from the EPOCH 600
- One of two alarm indicators (LEDs) is illuminated on the front panel of the EPOCH 600 (see Figure 2-12 on page 42)

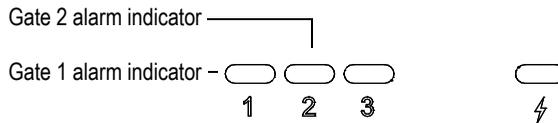


Figure 2-12 Gate 1 and gate 2 alarm indicator lights

<b>NOTE</b>
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The EPOCH 600 is also capable of outputting alarm signals through the 9-pin D-sub connector on the back panel of the instrument.

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## 2.4 Calibration

The EPOCH 600 can be easily calibrated for both zero offset and velocity in order to provide accurate thickness (soundpath) measurements from indications. The EPOCH 600 utilizes an auto-calibration system for a simple, two-step approach. The section below outlines the most standard and basic calibration example. More detailed information on calibration can be found in chapter 10 on page 149.

### 2.4.1 Measurement calibration

Calibration for accurate digital measurements is typically accomplished using two known thicknesses of a representative material. In this section, the terms THIN and THICK will be used to refer to either two thicknesses of a block or plate (straight beam calibrations) or two lengths of an angled soundpath (angle beam calibration).

#### To begin calibration

1. Couple the transducer to the thin step of the material.
2. Position gate 1 around the resulting indication on screen.
3. Bring the indication to 80 % full screen height using the (**AUTO XX%**) function.
4. Select the **Auto Cal** menu (see Figure 2-13 on page 44).

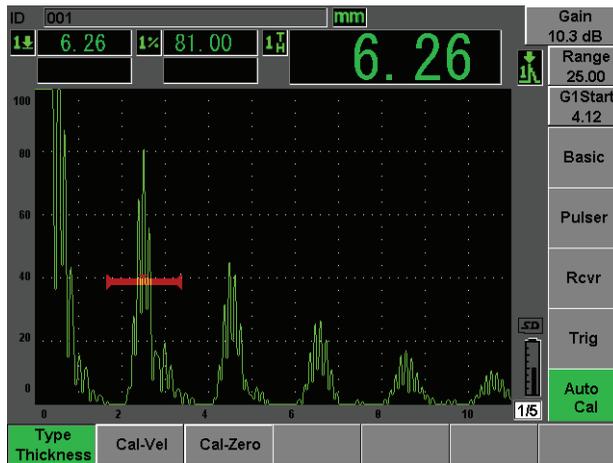


Figure 2-13 The Auto Cal menu

5. Use the Mode parameter to select the appropriate calibration mode (**Thickness** for straight beam or **Soundpath** for angle beam are the most common).
6. Press **Cal-Zero** (see Figure 2-14 on page 44).

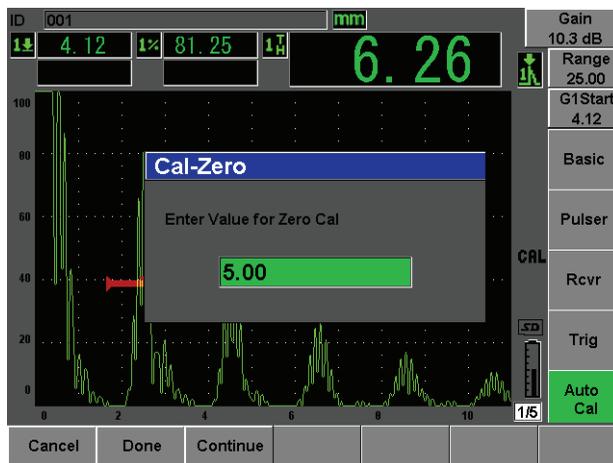


Figure 2-14 The Cal-Zero value

7. Use the knob or arrow keys to adjust the displayed value to the appropriate thickness. For this example, the transducer is coupled to a 5 mm step.
8. Press **Continue** to accept the adjusted value, and then move on to the second calibration step.
9. Couple the transducer to the thick step of material.
10. Position gate 1 around the resulting indication on screen.
11. Bring the indication to 80 % full screen height using the (**AUTO XX%**) function (see Figure 2-15 on page 45).
12. Press [**ESCAPE**] to return to the **Auto Cal** menu.

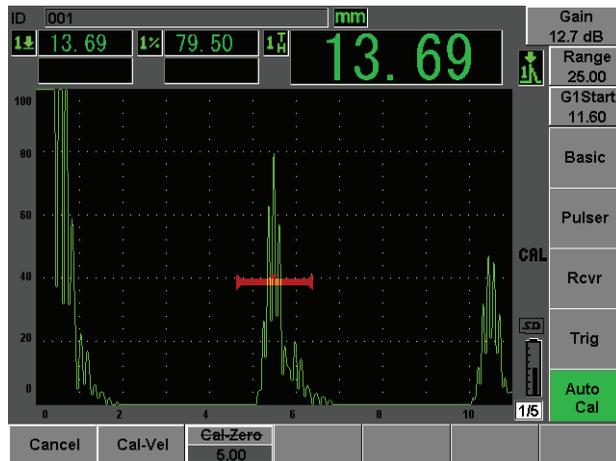


Figure 2-15 The gate 1 start

13. Press **Cal-Vel**.
14. Use the knob or arrow keys to adjust the displayed value to the appropriate thickness. For this example, the transducer is coupled to a 12.5 mm step (see Figure 2-16 on page 46).

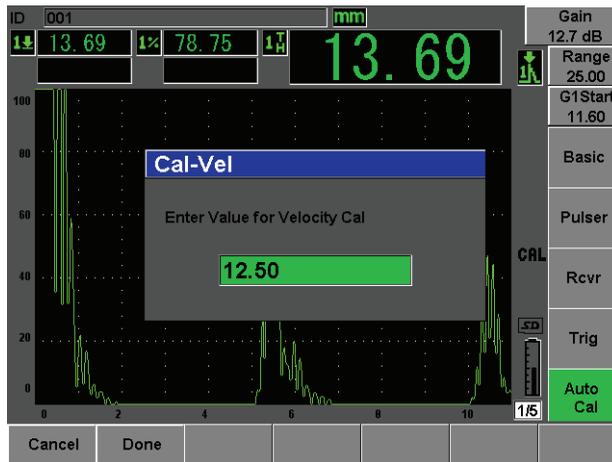


Figure 2-16 The Velocity Cal value

15. Press **Done** to accept the adjusted value and complete the calibration process.
16. Press **[RANGE]**, and then adjust the screen range to the desired setting (see Figure 2-17 on page 46).

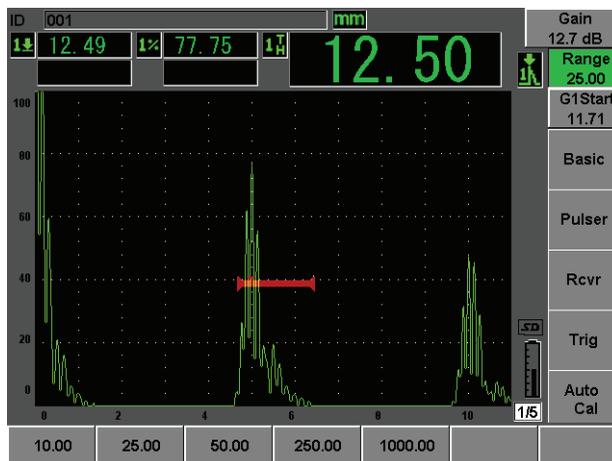


Figure 2-17 The Range value

## 2.4.2 Angle Beam Calibration

Angle beam calibrations typically require four steps. Each step is outlined below:

### To perform angle beam calibration

1. Verify the Beam Index Point (B.I.P.).
2. Verify the refracted angle of wedge.
3. Complete the distance calibration using steps of section 2.4.1 on page 43 (**Calibration** mode set to **SoundPath** or **Depth** depending on the reflector type).
4. Set the sensitivity by capturing sensitivity hole or notch in gate 1, bringing the indication to 80 % screen height using (**AUTO XX%**), and then setting the reference gain by pressing [**2ND F**], (**REF dB**) [see Figure 2-18 on page 47].

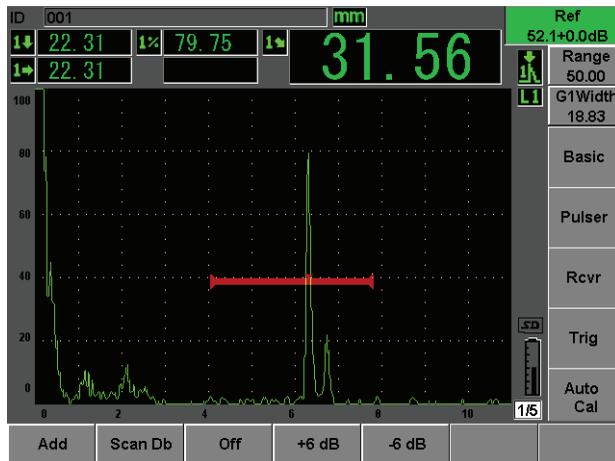


Figure 2-18 Reference gain setting

## 2.5 Data Logger

The EPOCH 600 features an onboard data logging system that allows standard storage of inspection files (Inc) and dedicated calibration files (Cal), as well as optional inspection files in corrosion style configurations (2D, 3D, Boiler, etc). Regardless of file type, each discrete data point saved on the EPOCH 600 stores all

active digital measurements, compressed A-scans, calibration data, alarm conditions, and active software features. The onboard memory is stored on a 2-GB MicroSD card, allowing storage of over 500,000 individual data points.

The section below outlines the procedure for setup and storage of the most basic and common file type, the calibration file. For full details and procedures on standard and optional file types, see chapter 11 on page 195.

## 2.5.1 Calibration Files

To setup and save a calibration file on the EPOCH 600, first complete all ultrasonic and software setups that will be saved within the calibration.

### To complete all ultrasonic and software setups

1. Select the **File** menu.
2. Press the **Create** key to enter the file creation screen.  
The **Create** screen appears (see Figure 2-19 on page 48).
3. In the **File Type** box, use the knob or arrow keys to select **Cal**.
4. Use the **[NEXT GROUP]** key to advance to the **Filename** box.
5. In the **Filename** box, create a file name (cannot exceed 32 characters) by pressing the **Edit** parameter key.

Figure 2-19 The Create screen

6. Use the knob or arrows to navigate through the virtual keypad (see Figure 2-20 on page 49).
7. Insert a character by pressing **INS** (see Figure 2-20 on page 49).

The screenshot shows a 'Create' dialog box with the following fields and controls:

- \*File Type:** Text box containing 'CAL'.
- \*Filename:** Text box containing 'ANGLE-45', with the text highlighted in green.
- Description:** Empty text box.
- Inspector Id:** Empty text box.
- Location Note:** Empty text box.
- \*Calibration ID:** Empty text box.
- Virtual Keypad:** A grid of characters:
 

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	*	#	
:	,	?	!	.	-	+	<	>	%	&		
- Navigation Buttons:** '<<', '>>', and '>>|' buttons on the right side.
- Function Buttons:** 'DEL' and 'INS' buttons on the right side.
- Bottom Bar:** An 'Edit' button and several empty buttons.

Figure 2-20 The virtual keypad

8. Use the **[NEXT GROUP]** key to complete the file naming process.

---

**NOTE**

For creation of an incremental (Inc) file, you must first create a Start Point.

---

9. Press the **[NEXT GROUP]** key until the **Create** button is highlighted.
10. Press **Save** (see Figure 2-21 on page 50).

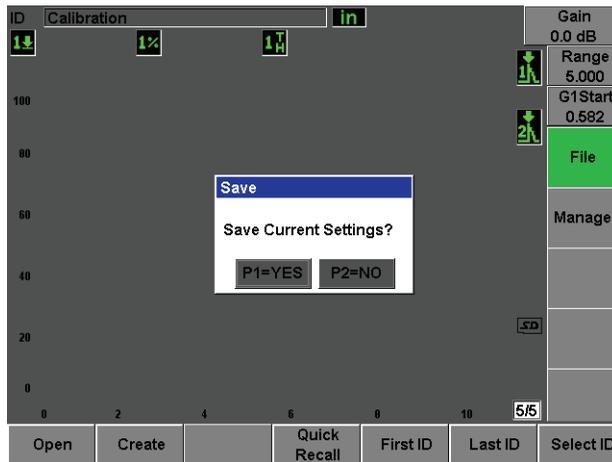


Figure 2-21 The Save dialog box

11. Press **[P1]** to accept the function.  
The user is then returned to the live screen.

## 2.5.2 Other Create Functions

Two other file creation functions exist, and are described below:

- **Create:** Creates the file in memory but does not open this file as the active storage location. Typically used when creating several files at once without saving data.
- **Open:** Creates the file in memory, and then opens it as the active storage locations, but does not save any file parameters to the file until you press **[2ND F]**, (**SAVE**). Typically used for inspection files, where the file is created prior to the start of the inspection.

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## 3. EPOCH 600 Hardware Features

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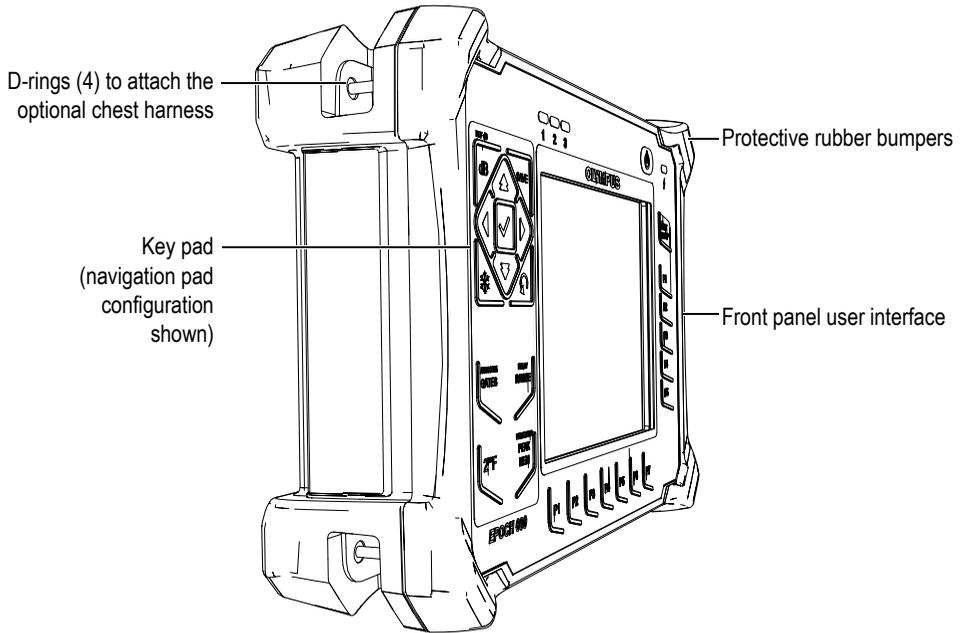
The EPOCH 600 has many physical features that are either completely new or improved compared to previous EPOCH flaw detector instruments. It is important for you to be familiar with the use and maintenance of these items.

This section covers the following topics:

- “Hardware Overview” on page 52
- “Front Panel User Interface” on page 53
- “Connectors” on page 62
- “Various Hardware Features” on page 66
- “Environmental Ratings” on page 68

### 3.1 Hardware Overview

Figure 3-1 on page 53 shows the EPOCH 600 instrument and identifies its main components.



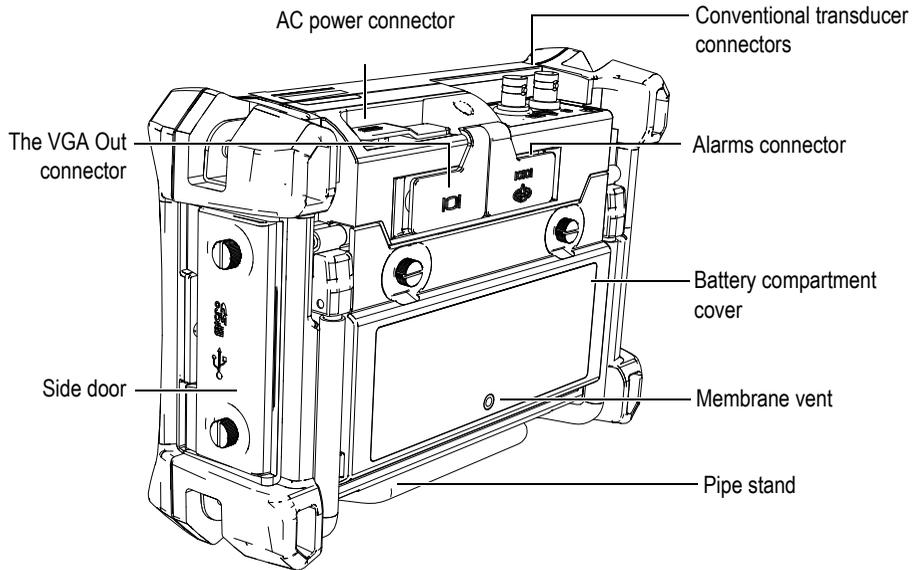


Figure 3-1 Overview of the EPOCH 600 hardware

## 3.2 Front Panel User Interface

In order to accommodate different user needs and preferences, the EPOCH 600 is available in two hardware configurations: one with an adjustment knob and the other with a navigation pad. The adjustment knob and the arrow keys on the navigation pad are responsible for parameter adjustment and value slewing. Users can choose either the adjustment knob or the navigation pad when ordering depending on which adjustment method they are more comfortable with.

### 3.2.1 Knob Configuration

The adjustment knob on the EPOCH 600 is used along with the **[CHECK]** and **[ESCAPE]** keys to adjust parameter values in either coarse or fine increments (see Figure 3-2 on page 54). The user has the ability to lock the knob to prevent accidental parameter value changes during an inspection. This configuration provides smooth value slewing for customers who prefer adjusting parameters using the knob.

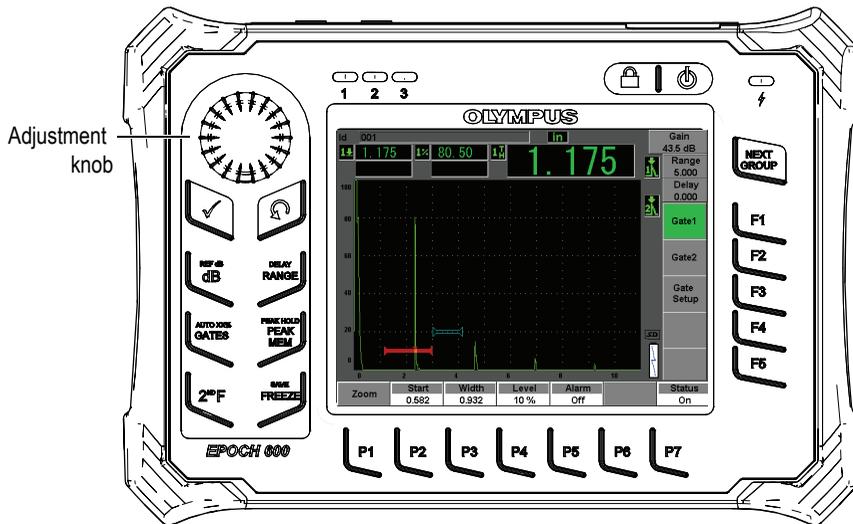


Figure 3-2 The EPOCH 600 – Adjustment knob configuration

### 3.2.2 Navigation Pad Configuration

The navigation pad is a hallmark feature of the EPOCH flaw detectors. The up and down arrows on the navigation pad are used for coarse parameter adjustment, and the left and right arrows for fine adjustment. The navigation pad also contains additional functions and frequently used parameters such as gain, save, and the [CHECK] and [ESCAPE] keys. This configuration is similar to previous EPOCH units (1000 Series, XT, LTC) to provide easy transitions within the EPOCH product line.

The EPOCH 600 front panel shown in Figure 3-3 on page 55 features a combination of direct-access keys, navigation arrows, and dynamic function and parameter access keys to optimize the usability of the instrument in any mode. The layout of the front panel provides direct access to common inspection parameters, and easy adjustment of values from either side of the instrument without obstructing the view of the display.

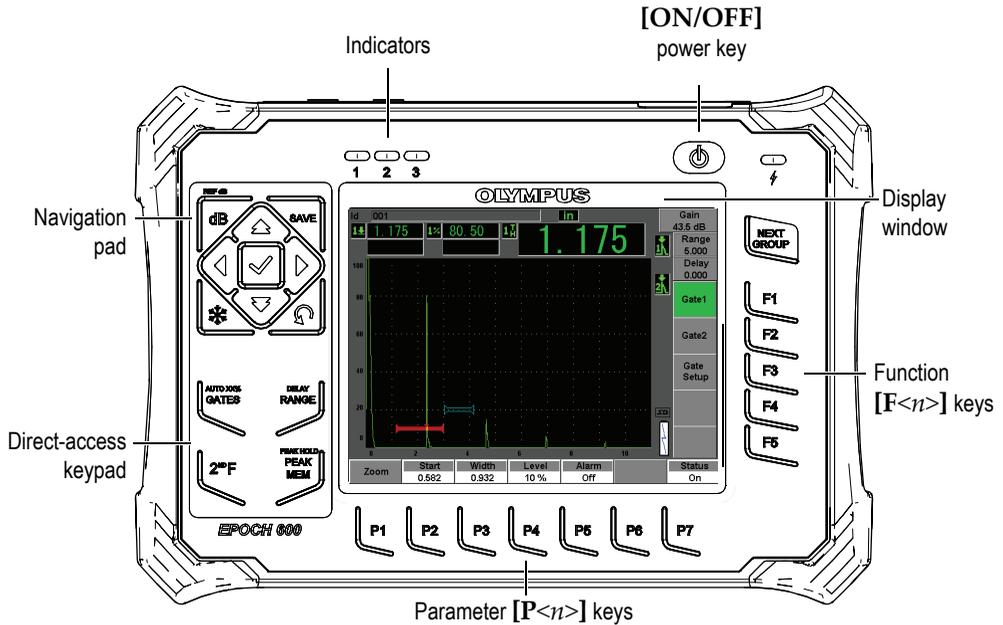


Figure 3-3 The EPOCH 600 – Navigation pad configuration

The direct-access keypad, on the left side of the front panel, provides keys for direct access to software parameters that are commonly used during inspection (see section 3.2.6 on page 58 for details).

### 3.2.3 General Purpose Keys

The EPOCH 600 provides navigation arrows or an adjustment knob (depending on the configuration), but also the [CHECK] and [ESCAPE] keys, which are general purpose keys, regardless of instrument mode or function (see Figure 3-4 on page 56 and Figure 3-5 on page 56).

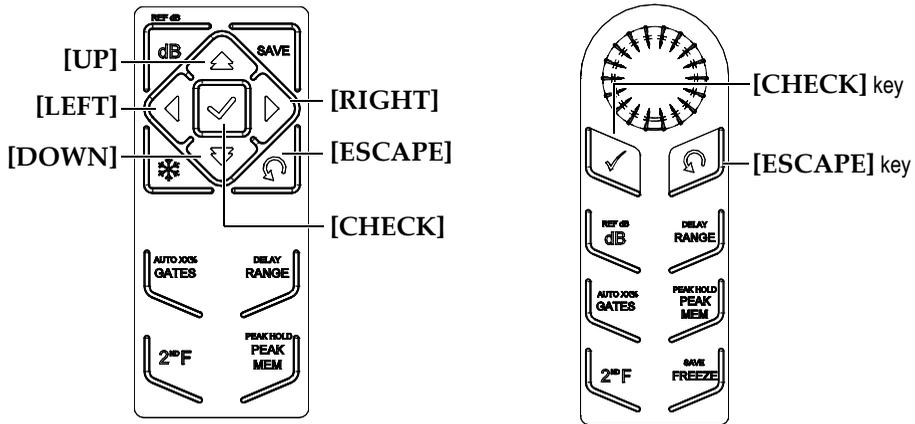


Figure 3-4 General purpose keys – English version

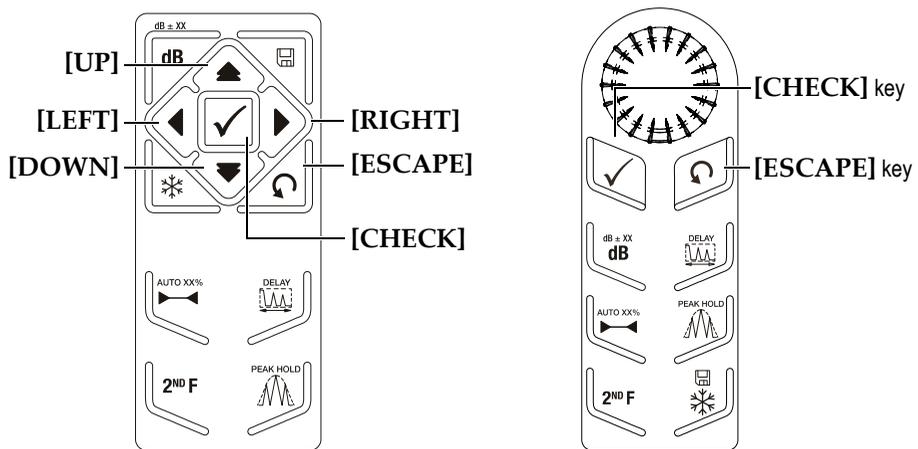


Figure 3-5 General purpose keys – International-symbol version

The [CHECK] key has two primary functions:

- When an adjustable parameter is highlighted, [CHECK] toggles the parameter adjustment between a coarse and a fine adjustment (knob configuration).

- Coarse adjustment is indicated by brackets around the parameter key.
- Fine adjustment does not have brackets.
- The [CHECK] key is used to scroll through the menus in numerical order (navigation pad configuration).

The [ESCAPE] key has three primary functions:

- When in a setup page, [ESCAPE] returns to the live inspection screen.
- Whichever the selected menu, the [ESCAPE] key returns to the **Basic** menu.
- When a direct access parameter (gain, range, gates, etc.) is selected, pressing the [ESCAPE] key will return to the previous menu.

### 3.2.4 Function and Parameter Keys

The EPOCH 600 handles adjustments and/or the activation of most software functions using an intuitive menu system. Menu system software buttons appear at all times, vertically on the right side and horizontally at the bottom of the display. Five function keys ([F1] through [F5]) and seven parameter keys ([P1] through [P7]) are located around the display, allowing you to individually activate a software button.

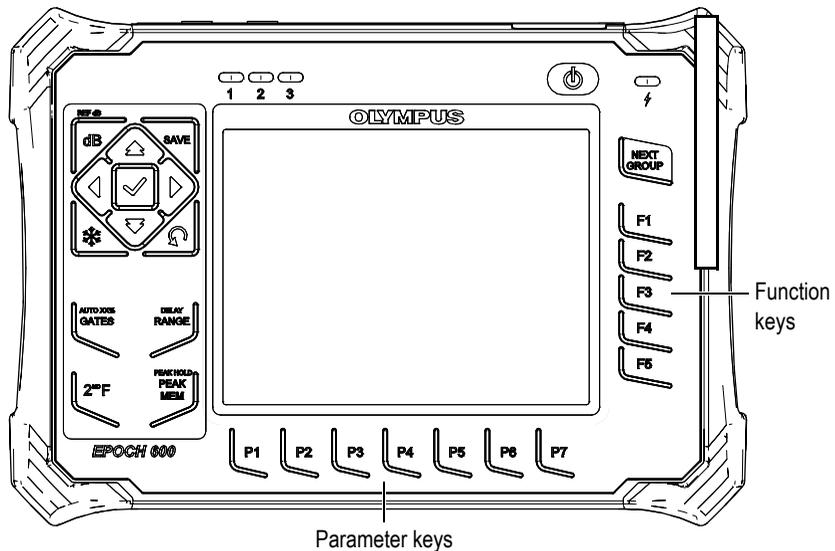


Figure 3-6 [F<n>] and [P<n>] keys pointing to software buttons

### 3.2.5 Parameter Adjustment

Software parameter value adjustments, such as gain or range, can be accomplished using two primary methods, depending on the instrument configuration:

- Use the [UP], [DOWN], [LEFT], and [RIGHT] arrow keys to increase and decrease a parameter value in either coarse or fine steps (navigation pad configuration).
- Turn the adjustment knob clockwise to increase parameter values, and counterclockwise to decrease a parameter value in either coarse or fine steps (knob configuration).

---

<b>TIP</b>
------------

The [CHECK] key sets the coarse/fine mode and the [ESCAPE] key returns the focus on the **Basic** menu.

---

### 3.2.6 About the Direct-Access Keypad

This section describes the direct-access keypad for both the navigation pad (see Figure 3-7 on page 59) and the knob configurations (see Figure 3-8 on page 60).

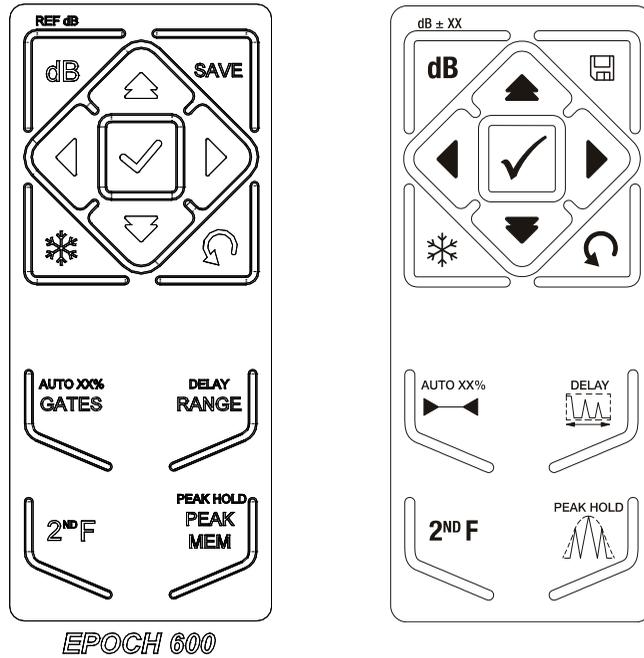


Figure 3-7 Navigation pad configuration (English and international-symbol versions)

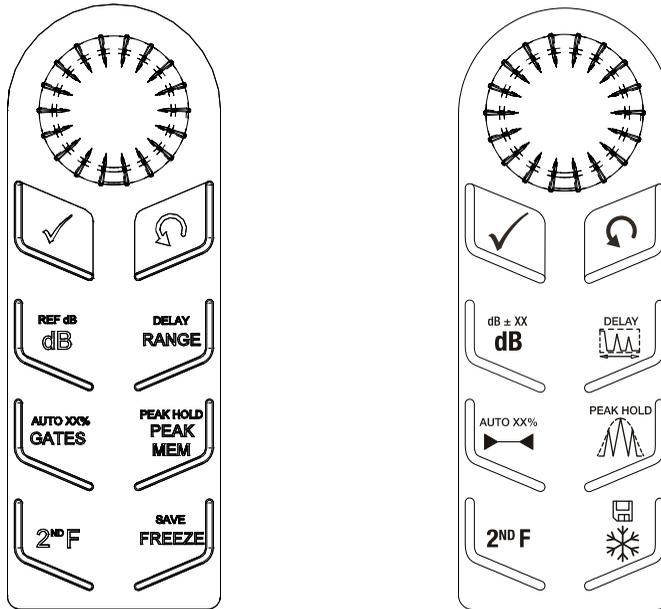


Figure 3-8 Knob configuration (English and international-symbol versions)

Table 4 on page 60 presents a description of each of the key for the English version of the keypad.

Table 4 English direct-access keypad key description

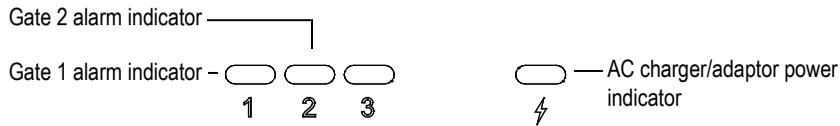
Nav. pad config.	Knob config.	Function
		[dB] Adjusts system sensitivity.
		[2ND F], (REF dB) Locks the reference gain level and allows the scanning gain to be used.

Table 4 English direct-access keypad key description (*continued*)

Nav. pad config.	Knob config.	Function
		<b>[SAVE]</b> Saves to the selected File and ID (navigation pad configuration only). <b>[2ND F], (SAVE)</b> Saves to the selected File and ID (knob configuration only).
		<b>[FREEZE]</b> Freeze holds the displayed waveform until <b>[FREEZE]</b> is pressed again.
		<b>[GATES]</b> Selects gates (1, 2, or IF) on the screen. <b>[2ND F], (AUTO XX%)</b> Automatically adjusts gated signal to XX% of full-screen height (see chapter 6.2 on page 112).
		<b>[RANGE]</b> Adjusts the instrument's range according to the sound level setting. <b>[2ND F], (DELAY)</b> Displays the delay that does not affect the calibrated zero offset.
		<b>[PEAK MEM]</b> Activates the peak memory function (see chapter 7.2 on page 122). <b>[2ND F], (PEAK HOLD)</b> Activates the peak hold function (see chapter 7.3 on page 124).
		<b>[2ND F]</b> Accesses the second function identified above the keypad keys when pressed and released.

## 3.2.7 About Indicators

The EPOCH 600 instrument provides one power and three alarm indicator lights (see Figure 3-9 on page 62). The indicators are located on the front panel above the display window (see Figure 3-3 on page 55).



**Figure 3-9 Front panel indicator lights**

The alarm indicators illuminate in red when the corresponding gate alarm is triggered. Refer to section 8.8 on page 139 for information on gate alarms.

Refer to Table 5 on page 71 for details on the meaning of the various states of the power indicator.

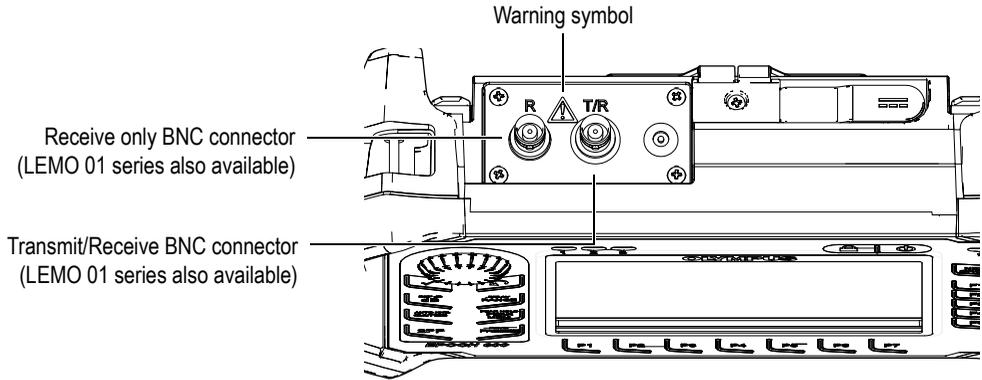
## 3.3 Connectors

The EPOCH 600 instrument provides numerous connections. The following sections describe these connections.

### 3.3.1 Transducer Connections

The EPOCH 600 instrument is supplied with either BNC or LEMO 01 series transducer connectors. The type of transducer connector is chosen at the time of order. If necessary, it is possible to change the type of transducer connection at an authorized Olympus service center for a small charge. Selection of these transducer connections is based on operator preference. Both the BNC and LEMO 01 series connectors available are rated to IP67 for use in most inspection environments. The EPOCH 600 is illustrated with BNC connectors in this document.

The transducer connectors are located at the top of the instrument on the left. The two connectors are easily accessible from the front of the instrument (see Figure 3-10 on page 63).



**Figure 3-10 Location of the transducer connectors**

For single-element transducers, either transducer connector may be used. For some dual transducer and for through-transmission inspections, the transducer connectors are labeled T/R and R. T/R should be used as the transmit channel, and R should be used as the receive channel in these situations.

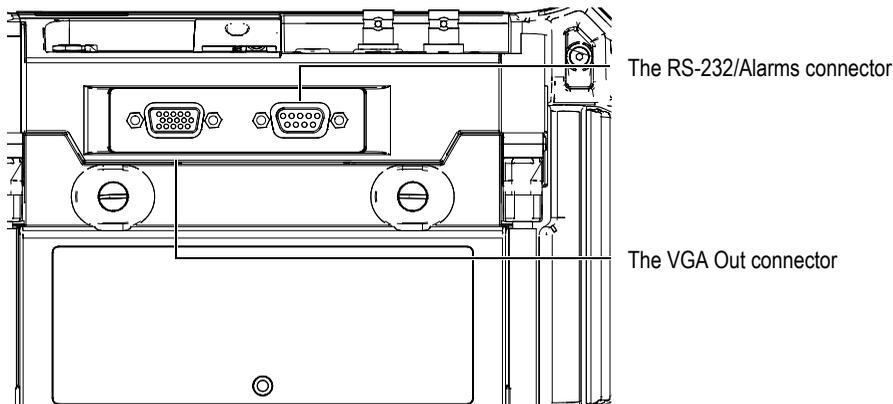


### **DANGER**

Do not touch the inner conductor of the BNC (or LEMO) connectors to avoid risks of an electric shock. Up to 400 V can be present on the inner conductor. The warning symbol between the Transmit/Receive (T/R) and the Receive (R) BNC connectors shown in Figure 3-10 on page 63 indicates this electric shock risk.

### **3.3.2 Input/Output Connectors**

The RS-232/Alarms and the VGA Out connectors are located at the back of the instrument, in the upper section (see Figure 3-11 on page 64). A rubber cover protects each connector. The connectors provide digital alarm outputs, a digital input, and encoder outputs. Analog output can be purchased for an additional charge at the time of instrument ordering. If purchased, this connector is located at the top of the instrument, to the right of the transducer connectors. Refer to section 14.3 on page 271 for the complete specifications of the supported I/O signals.



**Figure 3-11 The RS-232/Alarms and VGA Out connectors**



**CAUTION**

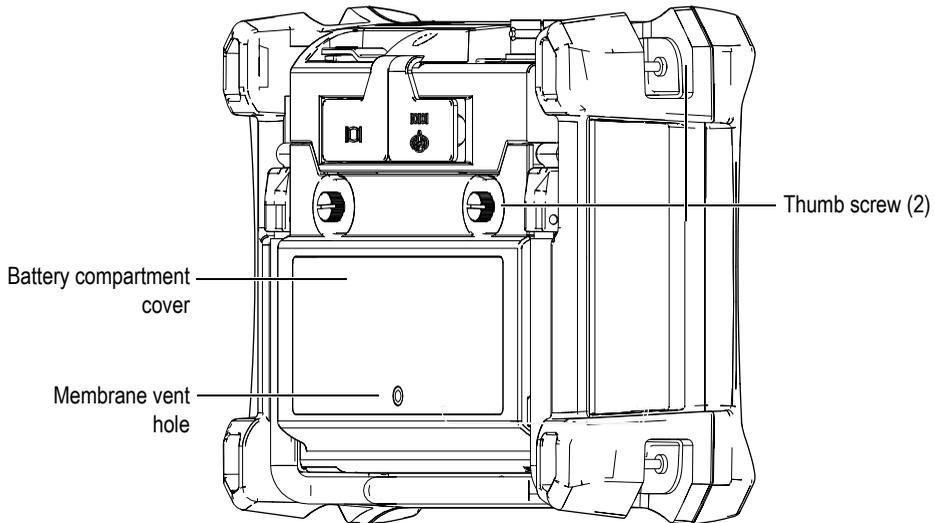
Do not expose the instrument to harsh and wet environments while the RS232/Alarms or the VGA Out connectors are not protected by their rubber covers. To prevent connector corrosion and damage to the instrument, keep the rubber protective covers on the connectors when no cable is connected.

---

### 3.3.3 Battery Compartment

The EPOCH 600 battery compartment cover allows you to quickly access the battery without the need for tools. Two thumb screws on the battery compartment cover secure it to the instrument case and ensure the compartment is sealed.

The battery compartment cover also has a small hole in the bottom center area that is covered on the inside by an environmentally sealed membrane vent. This vent is a safety feature that is required in the event that the instrument battery fails and emits gas. This vent must not be punctured.



**Figure 3-12 The battery compartment**

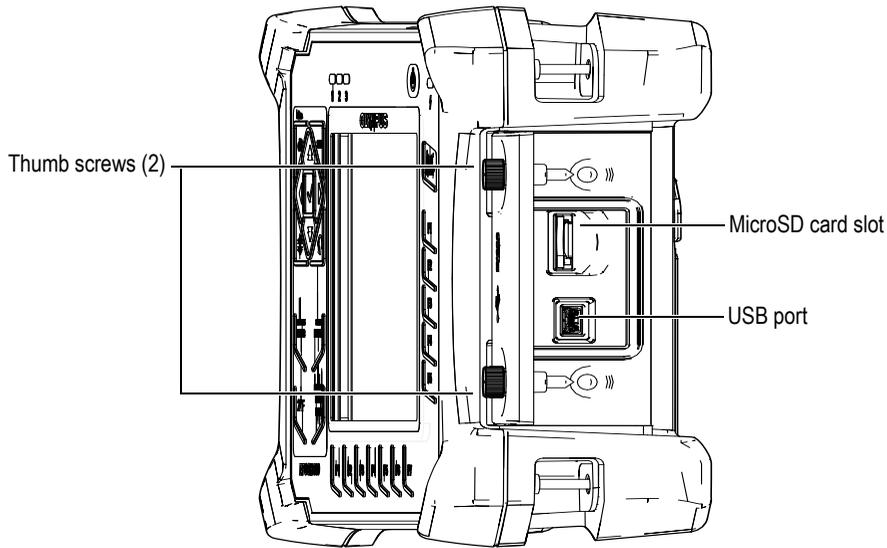
The EPOCH 600 accepts one rechargeable lithium-ion battery pack (P/N: 600-BAT-L [U8760056]) that can be recharged inside the instrument or on the optional external charging base (P/N: EPXT-EC-X). You can also use the EPOCH 600 with standard AA alkaline batteries for extended portable use.

### 3.3.4 MicroSD and PC Communication

On the right side of the EPOCH 600, a door covers the MicroSD and USB ports (see Figure 3-13 on page 66). The side door has an integral membrane seal to keep liquids away from the unsealed connections behind the door.

The EPOCH 600 utilizes 2 GB MicroSD memory cards for both onboard and removable memory. The onboard 2 GB MicroSD card is mounted to the PC board inside the instrument, and is responsible for all onboard data storage. In the event the instrument is damaged beyond repair, this MicroSD card can be removed at an authorized service center, allowing you to recover critical data from the damaged instrument.

Along with removable memory, the EPOCH 600 allows the user to connect to a PC via a single USB On The Go (OTG) port. PC communication requires Olympus GageView Pro PC interface program for file transfers, exports, and reporting.



**Figure 3-13 The connectors behind the side door**

The side door is kept closed by two thumb screws. You can also use a coin or a screwdriver to manipulate these thumb screws as needed.



**CAUTION**

Do not expose the instrument to harsh and wet environments while the computer connection compartment door is opened. To prevent connector corrosion and damage to the instrument, keep the computer connection compartment door closed and sealed when no cable is connected.

---

## 3.4 Various Hardware Features

The following sections describe various hardware features.

### 3.4.1 Instrument Stand

The EPOCH 600 features an articulating pipe stand for variable viewing angles (see Figure 3-14 on page 67). The stand is attached on the back of the instrument with two hard pivot blocks, and has been dipped into a high friction coating for resistance to sliding during use. The stand is bent in the center to easily accommodate being placed on a curved surface.

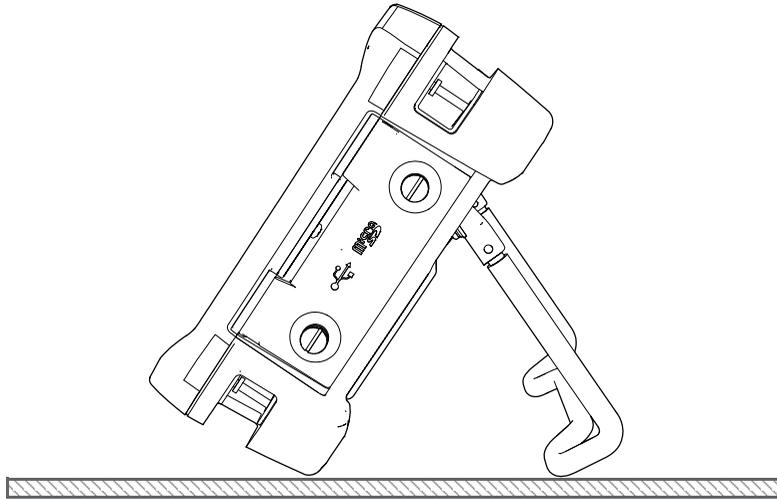


Figure 3-14 Tilted instrument

### 3.4.2 O-Ring Gasket and Membrane Seals

The EPOCH 600 contains seals that are used to protect the instrument internal hardware from the environment. These include:

- Battery compartment cover seal
- Side door seal
- Membrane vent

These seals must be properly maintained to assure environmental durability. Instrument seals are evaluated and replaced as needed during the instrument annual calibration. This should be performed at an authorized Olympus service center.

### 3.4.3 Display Protection

The EPOCH 600 includes a clear-plastic sheet protecting the instrument display window. You are advised to leave this sheet in place. Replacements are available from Olympus in packages of 10 (P/N: 600-DP [U8780297]).



#### **CAUTION**

The display window is permanently bonded to the instrument case to fully seal the instrument. If the display window becomes damaged, the front part of the case must be replaced, along with the instrument's direct-access keypad.

---

## 3.5 Environmental Ratings

The EPOCH 600 is an extremely rugged and durable instrument that can be used in harsh environments. To classify the instrument's durability in wet or damp environments, Olympus has adopted the IP (ingress protection) system to rate how well the instrument is sealed.

The EPOCH 600 has been tested to the requirements of IP66 (knob configuration) or IP67 (navigation pad configuration). The instrument is designed and manufactured to meet this level of ingress protection when it leaves the factory. To maintain this level of protection, you are responsible for the proper care of all routinely exposed membrane seals. Additionally, you are responsible for returning the instrument to an authorized Olympus service center each year to ensure that the instrument seals are properly maintained. Olympus cannot guarantee any level of ingress protection performance once the instrument seals have been manipulated. You must use sound judgment and take proper precautions before exposing the instrument to harsh environments.

The EPOCH 600 adheres to the environmental standards listed in Table 16 on page 268.

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## 4. Powering the EPOCH 600

---

This chapter describes how to operate the EPOCH 600 using different power supply options. The topics are as follows:

- “Starting the EPOCH 600” on page 70
- “Using the AC Line Power” on page 71
- “Using Battery Power” on page 72
- “Charging the Battery” on page 74
- “Replacing the Battery” on page 76

## 4.1 Starting the EPOCH 600

Figure 4-1 on page 70 shows the location of the power key and of the AC charger/adaptor power indicator.

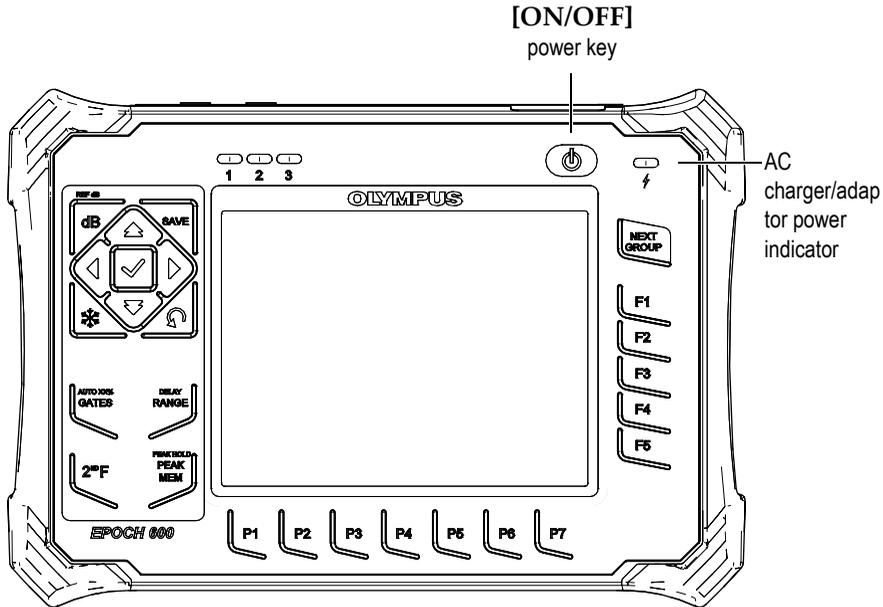


Figure 4-1 Location of the EPOCH 600 power key and indicator

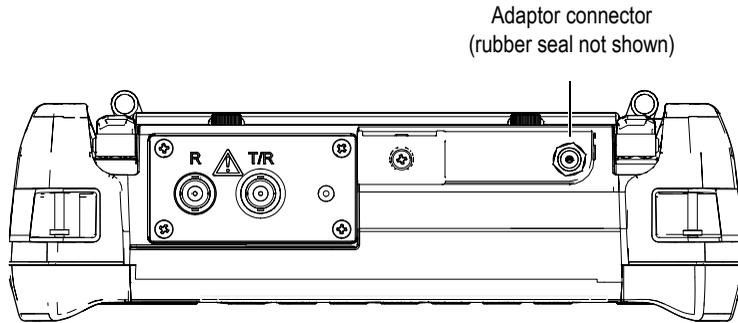
Pressing the [ON/OFF] power key causes an initial beep. The instrument's startup screen appears. The instrument then goes through a series of self-tests for 5 to 6 seconds and then starts up. The power indicator and the battery indicator provide basic feedback regarding the operating/charging status of the instrument (see Table 5 on page 71).

**Table 5 Power indicator status**

Indicator state	AC line power	Indicator meaning	Battery indicator
Green	Yes	Internal battery fully charged	
Red	Yes	Internal battery is charging	
Off	No	AC line power not connected	
Green	Yes	AC charger/adaptor connected No battery installed	

## 4.2 Using the AC Line Power

AC line power is supplied to the EPOCH 600 instrument using the charger/adaptor. The charger/adaptor has a universal AC power input, so it operates with any line voltage from 100–120 VAC or 200–240 VAC and with 50 Hz to 60 Hz line frequency. The charger/adaptor output connects to the AC adaptor plug of the EPOCH 600 (see Figure 4-2 on page 72).



**Figure 4-2 The Adaptor connector**

### To use AC line power

1. Connect the power cord to the AC charger/adaptor unit and to an appropriate line power source.
2. Remove the rubber seal over the adaptor connector on top of the EPOCH 600 instrument.
3. Connect the DC output power cable from the charger/adaptor to the adaptor connector (see Figure 4-2 on page 72).
4. Turn on the EPOCH 600 by pressing the front panel power key (see Figure 4-1 on page 70).

The front panel power indicator activates (see Figure 4-1 on page 70).

## 4.3 Using Battery Power

The EPOCH 600 operates with its standard rechargeable lithium-ion (Li-ion) battery (P/N: 600-BAT-L [U8760056]). You can also rely on standard alkaline batteries for extended portable use.

**WARNING**

Only use the Olympus rechargeable Li-ion battery pack (P/N: 600-BAT-L [U8760056]) with an EPOCH 600 instrument. Using any other battery can cause death or serious personal injury as the result of the explosion while charging the battery.

---

A battery charge indicator is always present near the bottom right of the active instrument display (see Figure 4-3 on page 73). The battery charge indicator contains a visual level representation of the remaining battery life. The battery charge indicator is accurate after 5 to 10 minutes of use.



**Figure 4-3 The battery charge indicator**

**Battery Operating Time**

Battery operating time depends on the age and manufacturer of the battery being used, and on the instrument settings. To provide realistic battery operating times, the EPOCH 600 instrument has been tested with mid-level parameters in each mode. The resulting battery operating time is between 12 and 13 hours.

---

**NOTE**

The battery might need several complete charge/discharge cycles to reach full capacity. This conditioning process is normal for these types of rechargeable batteries.

---

## 4.4 Charging the Battery

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### WARNING

The EPOCH 600 charger/adaptor is designed to charge EPOCH 600 batteries only (P/N: 600-BAT-L [U8760056]). Do not attempt to charge any other batteries, including alkaline batteries using the battery tray (P/N: 600-BAT-AA [U8780295]), or use any other chargers/adaptors. Doing so might cause an explosion or injury.

---

The EPOCH 600 battery can be charged internally using the charger/adaptor or externally using the optional standalone battery charger (P/N: EPXT-EC-X). Externally charging a battery is useful to charge one battery while using another in the instrument. For more information about this external charger, contact Olympus or your local sales representative.

---



### WARNING

Do not attempt to power or charge other electronic equipment with the EP-MCA-U charger/adaptor as this may cause death or serious personal injury as the result of the explosion while charging a battery.

Do not attempt to charge other batteries with the EPXT-EC-X standalone battery charger as this may cause death or serious personal injury as the result of the explosion while charging a battery.

---

When the EPOCH 600 is connected to AC power and turned on, the battery indicator displays a lightning bolt symbol instead of the standard level indicator with percentage showing remaining battery life.

### To charge the battery internally

1. Remove the adaptor connector seal on top of the instrument, and then plug in the AC charger/adaptor.
  2. Plug the power cord of the AC charger/adaptor to a power outlet.
-

The battery charges when the instrument is on or off, but the rate of charge is slower when the instrument is on. Refer to Table 5 on page 71 for power indicator meanings.

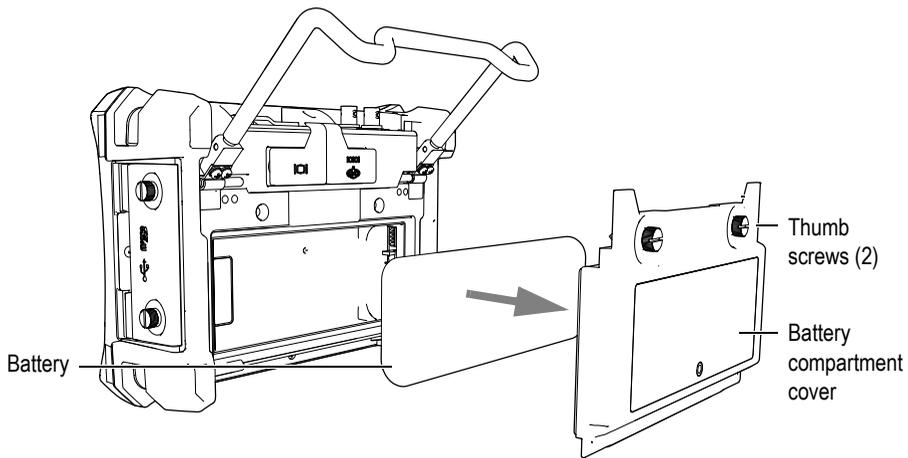
### **Battery Usage Instructions**

By nature, unused batteries slowly discharge. A fully discharged battery does not recharge. Follow the instructions below to maximize the battery performance:

- When the battery is used daily, connect it to the AC charger/adaptor when not in use.
- Whenever possible, the battery should remain connected to the AC charger/adaptor (overnight or over a weekend), so that it achieves 100 % full charge.
- The battery must reach full charge on a regular basis for proper capacity and cycle-life maintenance.
- Recharge discharged batteries as soon as possible after use.
- Store batteries in a cool, dry environment.
- Avoid long-term storage under sunlight or in other excessively hot places such as an automobile trunk.
- While in storage, fully recharge batteries at least once every two months.
- Never place partially discharged batteries in storage without a full recharge.

## 4.5 Replacing the Battery

The battery is located in a compartment that is accessible from the back of the EPOCH 600 (see Figure 4-4 on page 76).



**Figure 4-4 Opening the battery compartment**

### To replace the battery

1. Unfold the instrument pipe stand.
2. At the back of the instrument, loosen the two thumb screws securing the battery compartment cover (see Figure 4-4 on page 76).
3. Remove the battery compartment cover, and then remove the battery.



### **WARNING**

Only use the Olympus rechargeable Li-ion battery pack (P/N: 600-BAT-L [U8760056]) with an EPOCH 600 instrument. Using any other battery may cause death or serious personal injury as the result of the explosion while charging the battery.

4. Install another battery (P/N: 600-BAT-L [U8760056]) in the battery compartment.

5. Ensure that the gasket of the battery compartment cover is clean and in good condition.
6. Install the battery compartment cover at the back of the instrument, and then tighten the two thumb screws to complete the installation.



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## 5. EPOCH 600 Software Features

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This chapter describes the software components. Topics are as follows:

- “Software Main Display” on page 80
- “Menu Contents” on page 91
- “About Setup Pages” on page 95
- “Basic Procedures” on page 107
- “Resets Menu” on page 110
- “Software Diagnostic” on page 110

## 5.1 Software Main Display

The EPOCH 600 software main display elements are exploded in Figure 5-1 on page 80. The following sections describe each of the main display elements.

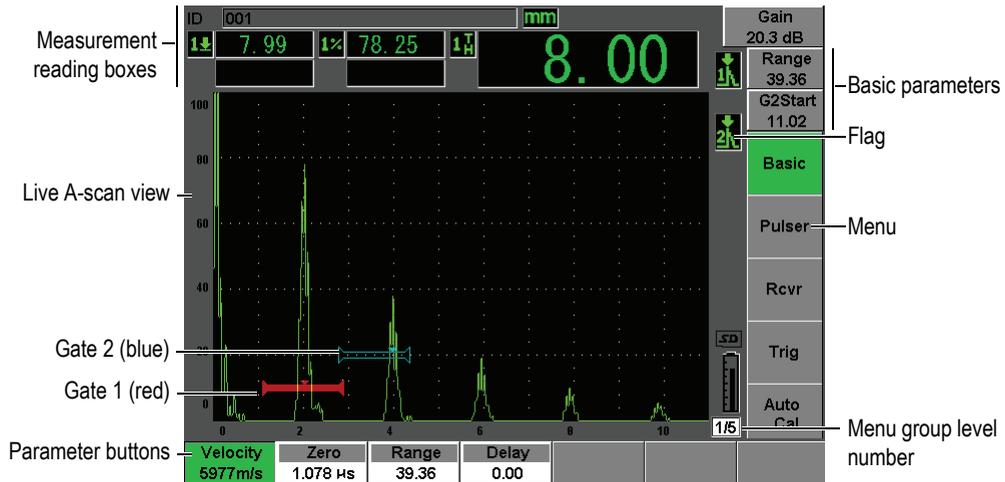


Figure 5-1 Exploded view of the software main display elements

### 5.1.1 About the Menu System

The intuitive menu system of the EPOCH 600 consists of menu groups, function buttons and parameter buttons (see Figure 5-3 on page 81).

There are five menu groups on the EPOCH 600. To scroll through all menu groups, use the [NEXT GROUP] key. The selected menu appears in green (see Figure 5-2 on page 81).

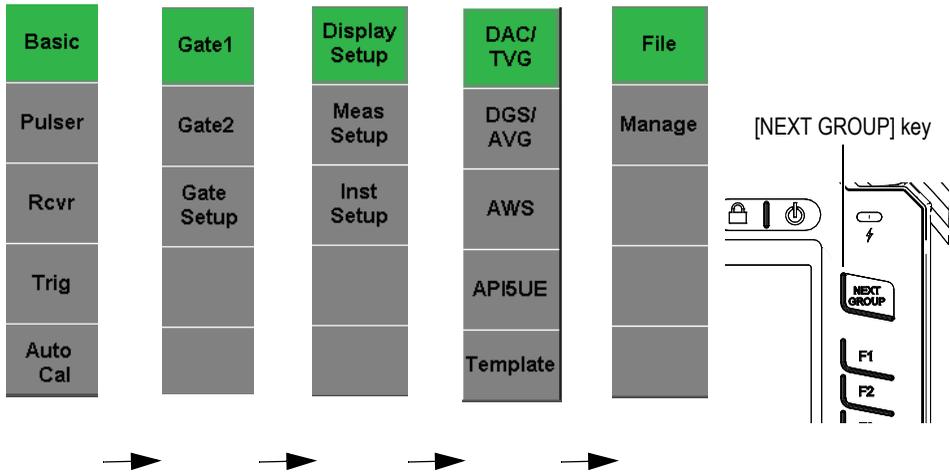


Figure 5-2 The menu groups



With the focus on one of the menu buttons, use the parameters key to select one of the available parameter, function, or submenu.

Other available menu groups

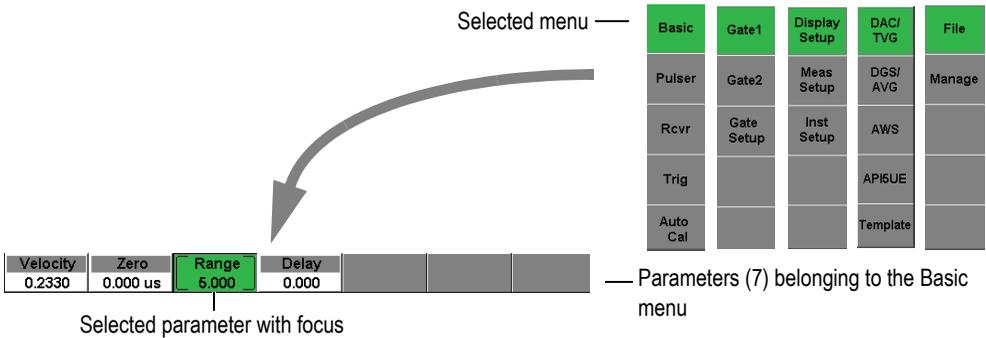


Figure 5-3 Overview of the menu system

Each menu group contains up to five menus appearing vertically on the right side of the software main display. Use the corresponding [**F**<*n*>] function key to select a menu.

Up to seven parameter buttons, associated with the selected menu, appear horizontally at the bottom of the software main display. Press the corresponding [**P**<*n*>] parameter key to select a parameter.

Section 5.2 on page 91 provides a complete and quick reference to all menu groups, menus, and parameters available.

## 5.1.2 About the Convention to Identify Menu Elements

In this document, the following convention is used to concisely refer to an element in the menu structure:

*Menu* > *Parameter* = *value*

where:

*Menu* is replaced by the label of the menu (ex.: **Meas Setup**)

*Parameter* is replaced by the label of the parameter (ex.: **Unit**)

*Value* is replaced by the desired editable or selectable value (ex.: **mm**)

For example, to instruct you to set the **Unit** parameter to **mm**, in the **Meas Setup** menu, the expression shown in Figure 5-4 on page 83 is used.

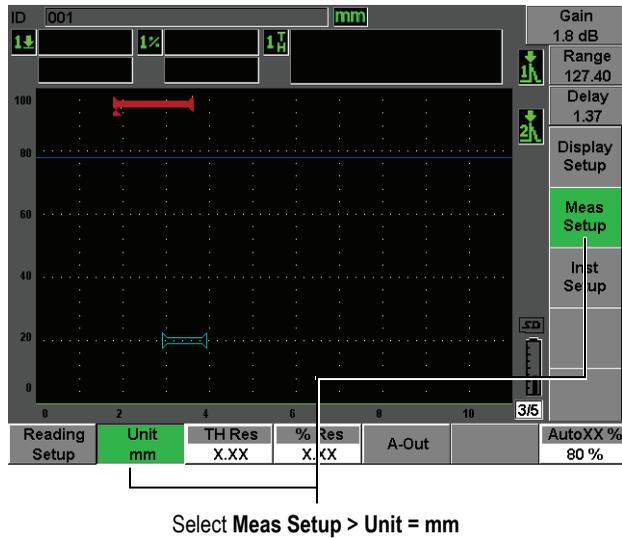


Figure 5-4 Concise convention to identify menu elements

Similarly, to instruct you to choose the **Width** parameter of the **Gate 1** menu, the following expression is used:

Choose **Gate 1 > Width**.

#### NOTE

Since you always must press [NEXT GROUP] to scroll through the different menus, the [NEXT GROUP] button and the number of times you must press it are not mentioned in the expression.

### 5.1.3 About the Focus

The function button that appears with a green (or white when in **Outdoor** scheme) background is the element that has the focus. There is always only one element that has the focus. When the focus is on a parameter button, the button background of the menu to which it belongs, also appears green, or grey when in Outdoor scheme. See the **Range** and the **Basic** buttons in Figure 5-5 on page 84 and Figure 5-6 on page 85.

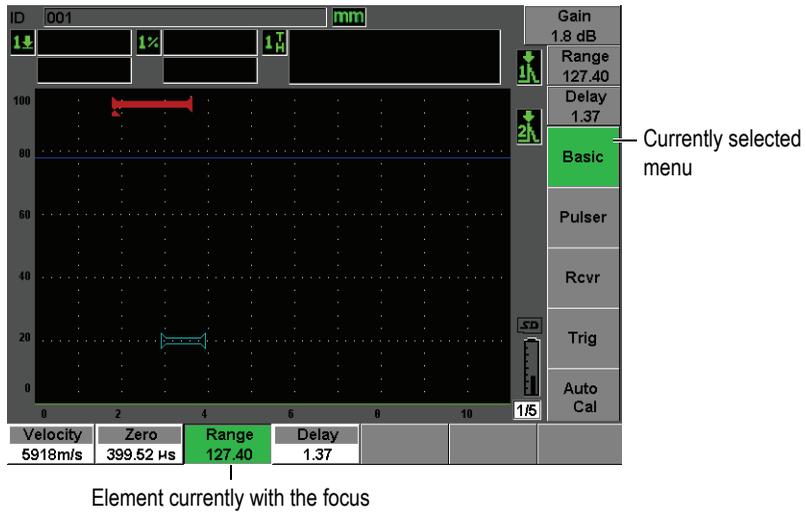


Figure 5-5 The focus is on the element appearing green

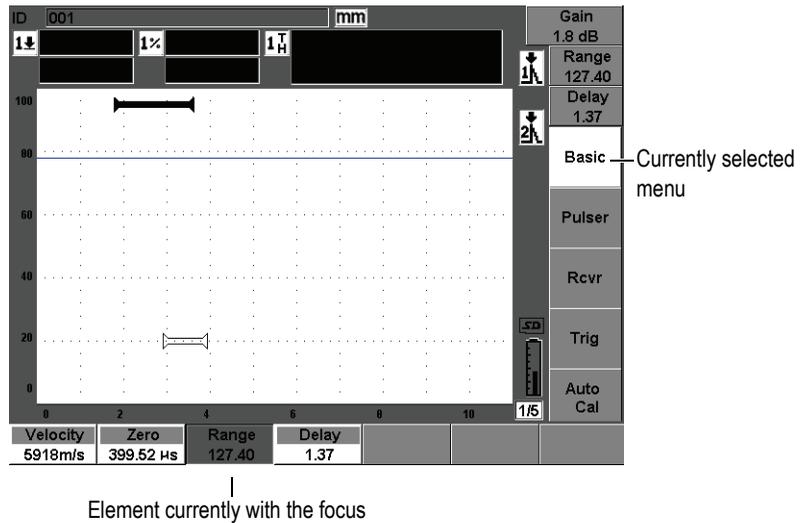


Figure 5-6 The focus is on the element appearing grey

## 5.1.4 About Button Types

Table 6 on page 85 presents the various types of buttons found in the EPOCH 600 interface.

Table 6 Button types

Type	Example	Description
Editable value	<b>Start</b> 0.582	Parameter with an editable value. Turn the adjustment knob or press the arrow keys to change the value.
Selectable value	<b>Alarm</b> Off	Parameter with a set of predetermined selectable values. Turn the adjustment knob or press the arrow keys to select the value.
Function	<b>Zoom</b>	Immediately executes a command when selected.

**Table 6 Button types (continued)**

Type	Example	Description
Submenu	<b>Display Setup</b>	Opens a dialog box or a screen with more parameters.

### 5.1.5 About the File Identifier and Message Bars

The file identifier bar appears at the top-left corner of the main display and shows the name of the currently opened identifier (ID) [see example in Figure 5-7 on page 86].



**Figure 5-7 File identifier bar with ID example**

The message bar appears at the bottom of the screen displaying messages and notifications as needed, following your actions (see example in Figure 5-8 on page 86).

**Figure 5-8 Message bar with a message example**

### 5.1.6 About Direct-Access Parameters

Direct-access parameters always appear at the top right corner of the display window. This allows you to always view these parameters from the main screen regardless of which menu or parameter you are currently accessing. These parameters include gain, range, delay, and gates.

Press the **[dB]** direct-access key to select the **Gain** parameter. The **Range** parameter is selected by pressing **[RANGE]**. Pressing **[GATES]** makes the **G1Start** parameter appear over the **Delay** button. Pressing **[2nd F], (DELAY)** brings back the **Delay** parameter.

Press the desired direct-access key to select the **Range**, **Delay**, or **G1Start** parameter. Once selected, the button turns green (see Figure 5-9 on page 87). Turn the adjustment knob or press the **[UP]** and **[DOWN]** arrow keys to edit the value. For additional information on gate adjustment, see section 8.2 on page 132.

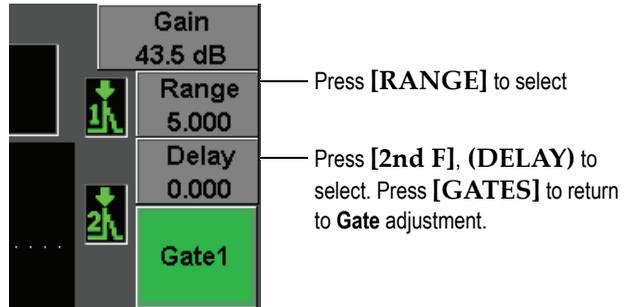


Figure 5-9 Example of the Range and Delay direct-access parameters

### 5.1.7 About Measurement Reading Boxes

The measurement reading boxes at the top-left corner of the software main display, below the message bar, present the icons and digital values for up to five selectable measurements (see Figure 5-10 on page 87). Refer to section 5.3.2 on page 98 for details on how to select measurements and for a description of available measurements.



Figure 5-10 Example of measurement reading boxes with their icons

### 5.1.8 About the Live-Scan Area

The large fixed-size live-scan area displays the ultrasonic data graphically (see Figure 5-11 on page 88).

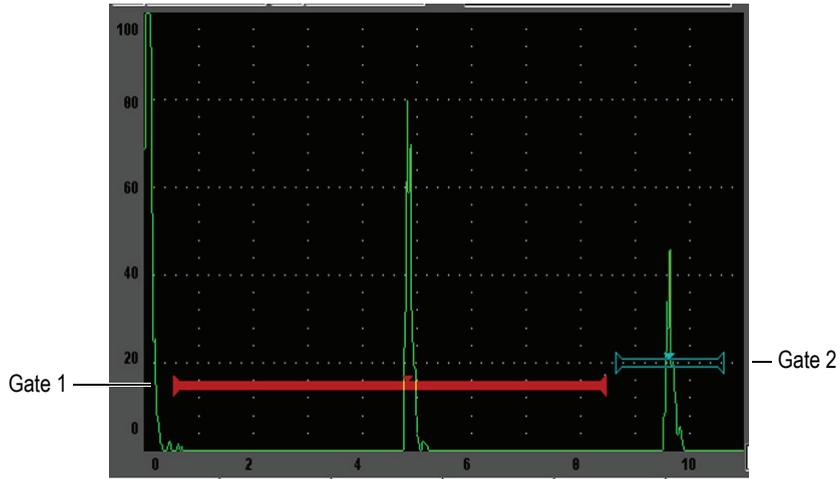


Figure 5-11 Example of an A-scan waveform with gates

## 5.1.9 About Flags

The EPOCH 600 indicates when particular functions are active by displaying a set of flags, in a thin vertical area on the right of the live-scan area (see Figure 5-12 on page 89). Table 7 on page 89 provides a description of the possible flags.

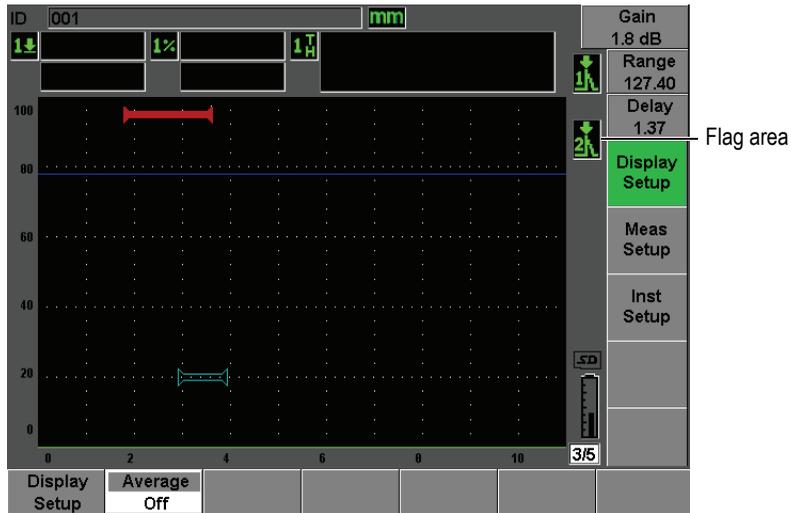


Figure 5-12 The area displaying flags

Table 7 Flag description

Flag	Description
<b>in</b>	Length units are inches
<b>mm</b>	Length units are millimeters
<b>μs</b>	Length units are microseconds
<b>2<sup>nd</sup></b>	Indicates that the [2 <sup>ND</sup> F] key has been pressed.

**Table 7 Flag description (continued)**

Flag	Description
	Gate 1 is in peak measurement mode.
	Gate 2 is in peak measurement mode.
	Gate 1 is in edge (or flank) measurement mode.
	Gate 2 is in edge (or flank) measurement mode.
	Gate 1 is in first-peak measurement mode.
	Gate 2 is in first-peak measurement mode.
<b>DAC</b>	DAC is active.
<b>DGS</b>	DGS is active.
<b>AWS</b>	AWS is active.
<b>API</b>	API 5UE is active.
<b>TS</b>	Template Storage is active.
<b>CAL</b>	Calibration is active.
<b>CSC</b>	Curved surface correction (CSC) is active.
<b>E-E</b>	Gate tracking (Echo-to-Echo) is active.
<b>Z</b>	Zoom is active.

**Table 7 Flag description (continued)**

Flag	Description
	[FREEZE] is active.
	[PEAK MEM] is active.
	[2 <sup>ND</sup> F], (PEAK HOLD) reference echo is active.
	Waveform averaging is active.
	Access to all instrument functions except [ON/OFF] is locked.
	Indicates that a MicroSD card is installed.
	Indicates that the MicroSD card is not installed.
	Current settings are restricting waveform update rate below 60 Hz.
	Indicates that the charger is connected and charging the battery.
	Indicates that the instrument is running off of battery power.

## 5.2 Menu Contents

The EPOCH 600 uses menus to categorize similar functions. It includes five menu groups shown in Table 8 on page 92.

**Table 8 Standard menu groups**

	Menu groups				
Menu buttons	<b>Basic</b>	<b>Gate1</b>	<b>Display Setup</b>	<b>DAC/ TVG</b>	<b>File</b>
	<b>Pulser</b>	<b>Gate2</b>	<b>Meas Setup</b>	<b>DGS/ AVG</b>	<b>Manage</b>
	<b>Rcvr</b>	<b>Gate Setup</b>	<b>Inst Setup</b>	<b>AWS</b>	
	<b>Trig</b>			<b>API5UE</b>	
	<b>Auto Cal</b>			<b>Template</b>	

Table 9 on page 92 to Table 13 on page 94 provide a quick reference of available menus and parameters for each menu group.

**Table 9 Content of the first menu group**

Menus	Parameters						
<b>Basic</b>	Velocity	Zero	Range	Delay			
<b>Pulser</b>	PRF Mode	PRF	Energy	Damp	Mode	Pulser	Freq
<b>Rcvr</b>	Filter	Rect					Reject
<b>Trig</b>	Angle	Thick	X Value	CSC	Diameter		
<b>Auto Cal</b>	Type	Cal-Vel	Cal-Zero				

**Table 10 Content of the second menu group**

Menus	Parameters						
<b>Gate 1</b>	Zoom	Start	Width	Level	Alarm	Min Depth (only when Alarm is set to Min Depth)	Status
<b>Gate 2</b>	Zoom	Start	Width	Level	Alarm	Min Depth (only when Alarm is set to Min Depth)	Status
<b>Gate Setup</b>	G1 Mode	G1 RF	G1 %Amp	G2 Mode	G2 RF	G2 %Amp	G2 Tracks

**Table 11 Content of the third menu group**

Menus	Parameters						
<b>Display Setup</b>	Display Setup						
<b>Meas Setup</b>	Reading Setup	Unit	TH Res	% Res	A-Out	Special	AutoXX %
<b>Inst Setup</b>	General	Status	Clock	Software Options	Misc	Tests	Software Diagnostic

**Table 12 Content of the fourth menu group**

Menus	Parameters						
<b>DAC/TVG</b>	Add (setup mode) DAC Gain (inspect mode)	Delete (setup mode) View (inspect mode)	Done (setup mode)	Gain Step (inspect mode)	G1Start		Setup
<b>DGS/AVG</b>	Ref (setup mode) Delta VT (inspect mode)	Reg Level (inspect mode)			G1Start		Setup

**Table 12 Content of the fourth menu group (continued)**

<b>Menus</b>	<b>Parameters</b>						
<b>AWS</b>	Ref B	Scan Db	Ref Level (inspect mode)		G1Start		Setup
<b>API5UE</b>	RefAMax (setup mode) Collect (setup mode, Peak Mem active, and inspect mode)	RefT1 (setup mode)	RefT2 (setup mode)	G1Start	Inspect (setup mode, data collected) Re-Cal (inspect mode)	Clear (setup mode, data collected)	Setup

**Table 13 Content of the fifth menu group**

<b>Menus</b>	<b>Parameters</b>						
<b>File</b>	Open	Create		Quick Recall	First ID	Last ID	Select ID
<b>Manage</b>	Reset	Memory	Send To	Edit	Copy	Delete	

## 5.3 About Setup Pages

The EPOCH 600 software features a number of setup pages allowing you to adjust instrument features and functions to your preferences. The setup pages are accessible by selecting the third group mode with the **[NEXT GROUP]** button. For example, choose **Display Setup** to access the **Display** setup page shown in Figure 5-13 on page 95.



**Figure 5-13 The Display setup page and its elements**

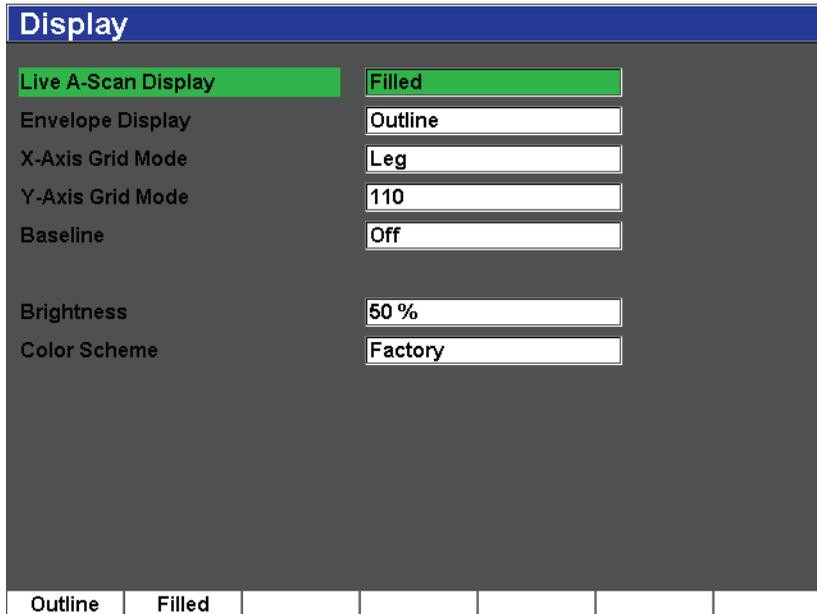
A title bar identifies the setup page. Parameters appear with the parameter label on the left and its current value and units (if applicable) on the right. A series of seven buttons appears at the bottom of setup pages and contain available values corresponding to the currently selected parameter. To scroll through the setups, press **[NEXT GROUP]**.

Press **[ESCAPE]** to leave a setup page and return to the live screen.

The following sections describe the available setup pages.

### 5.3.1 Display Setup Page

The **Display** setup page, shown in Figure 5-14 on page 96, is accessible by choosing **Display Setup**.



The screenshot shows a software interface titled "Display" with a dark blue header. Below the header, there are several settings, each with a label on the left and a value in a white box on the right. The "Live A-Scan Display" setting is highlighted with a green background and shows "Filled". Other settings include "Envelope Display" (Outline), "X-Axis Grid Mode" (Leg), "Y-Axis Grid Mode" (110), "Baseline" (Off), "Brightness" (50 %), and "Color Scheme" (Factory). At the bottom of the interface, there is a row of seven buttons: "Outline", "Filled", and five empty buttons.

Live A-Scan Display	Filled
Envelope Display	Outline
X-Axis Grid Mode	Leg
Y-Axis Grid Mode	110
Baseline	Off
Brightness	50 %
Color Scheme	Factory

Outline   Filled              

Figure 5-14 The Display setup page

The available parameters are:

**Live A-Scan Display:** sets the live A-scan drawing mode

- **Outline**
- **Filled**

**Envelope Display:** sets the peak memory and peak hold A-scan envelope drawing mode

- **Outline**
- **Filled**

**X-Axis Grid Mode:** sets the horizontal X-axis grid display mode

**Off:** no grid

**Standard:** 10 divisions spaced evenly and labeled 1 to 10

**Soundpath:** five divisions spaced evenly and labeled with corresponding sound path values

**Leg:** up to four divisions representing half-skip distances in angle beam inspection mode, based on test piece thickness value, and labeled L1 to L4

**Y-Axis Grid:** sets the vertical Y-axis grid display mode to 100 % or 110 % full screen height

**Baseline:** turns the Baseline Break feature on or off

This feature modifies the appearance of the A-scan in fullwave rectified mode. When active, the instrument locates all zero cross points in the RF waveform and pulls the fullwave rectified A-scan to the baseline. This feature helps to see small defects that are close to the back surface of the test piece, especially at large ranges.

**Brightness**

Used to adjust the screen brightness or by choosing one of the preset values (**0 %**, **25 %**, **50 %**, **75 %**, or **100 %**).

**Color Scheme:** sets the overall instrument color scheme

**Factory:** default multicolor display

**Outdoor:** white background, black text

## 5.3.2 Reading Setup Page

The **Reading** setup page, shown in Figure 5-15 on page 98, is accessible by choosing **Reading Setup**. This page allows you to select which measurement appears in the measurement reading boxes at the top of the software main display (see section 5.1.7 on page 87).

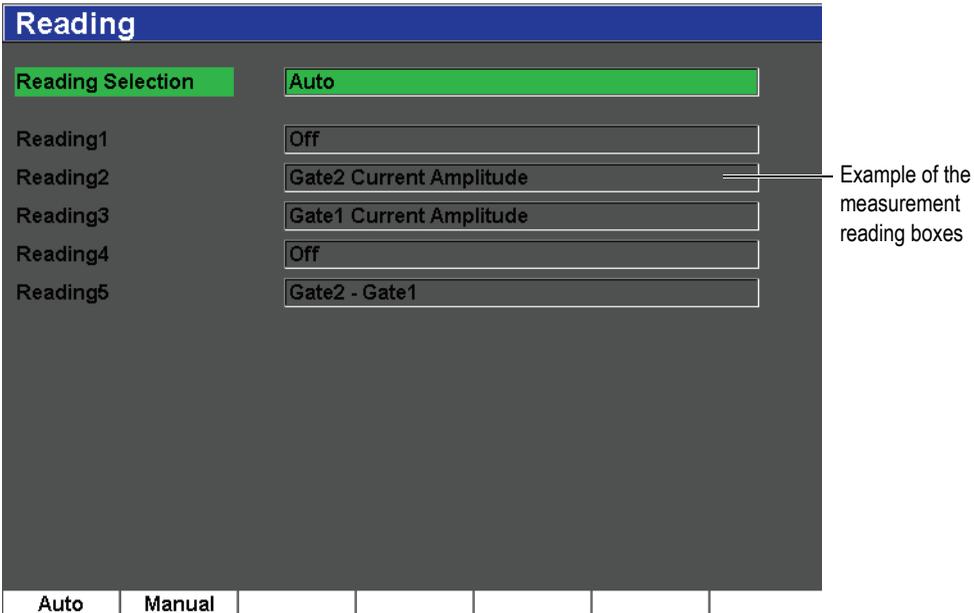


Figure 5-15 The Reading setup page

The available parameters are:

### Reading Selection

Used to set the measurement reading box definition mode to be automatically selected based on instrument function (**Auto**), or to be manually defined (**Manual**).

### Reading 1 to 5

Each measurement reading box is defined independently when in manual mode. Below the reading selection parameters, an example of the measurement reading boxes is displayed to illustrate the position of the measurement being adjusted

(see Figure 5-15 on page 98). Table 14 on page 99 presents the available measurement readings.



Figure 5-16 Example of measurement reading boxes with icons

Table 14 Available measurement readings

Icon	Measurement readings	Description
	Gate 1 Thickness	Thickness in gate 1. Not used with <b>Angle</b> .
	Gate 2 Thickness	Thickness in gate 2. Not used with <b>Angle</b> .
	Gate 1 Soundpath Distance	Soundpath (Angular) distance in gate 1.
	Gate 2 Soundpath Distance	Soundpath (Angular) distance in gate 2.
	Gate 1 Depth to Reflector	Depth to reflector in gate 1. Used with <b>Angle</b> .
	Gate 2 Depth to Reflector	Depth to reflector in gate 2. Used with <b>Angle</b> .
	Gate 1 Surface Distance	Horizontal distance to reflector in gate 1. Used with <b>Angle</b> .
	Gate 2 Surface Distance	Horizontal distance to reflector in gate 2. Used with <b>Angle</b> .
	Gate 1 Surface Dist – x Val	Horizontal distance minus X-Value (distance from beam index point to front of wedge) in gate 1. Used with <b>Angle</b> .
	Gate 2 Surface Dist – x Val	Horizontal distance minus X-value (distance from beam index point to front of wedge) in gate 2. Used with <b>Angle</b> .

**Table 14 Available measurement readings (continued)**

Icon	Measurement readings	Description
	<b>Gate 1 Minimum Depth</b>	Minimum depth in gate 1. Resets on gate adjustment and on most pulser/receiver adjustments.
	<b>Gate 2 Minimum Depth</b>	Minimum depth in gate 2. Resets on gate adjustment and on most pulser/receiver adjustments.
	<b>Gate 1 Maximum Depth</b>	Maximum depth in gate 1. Resets on gate adjustment and on most pulser/receiver adjustments.
	<b>Gate 2 Maximum Depth</b>	Maximum depth in gate 2. Resets on gate adjustment and on most pulser/receiver adjustments.
	<b>Gate 1 Current Amplitude</b>	Amplitude measurement in gate 1. Displays as % of full-screen height (FSH).
	<b>Gate 2 Current Amplitude</b>	Amplitude measurement in gate 2. Displays as % of full-screen height (FSH).
	<b>Gate 1 Maximum Amplitude</b>	Maximum amplitude in gate 1. Resets on gate adjustment and on most pulser/receiver adjustments.
	<b>Gate 2 Maximum Amplitude</b>	Maximum amplitude in gate 2. Resets on gate adjustment and on most pulser/receiver adjustments.
	<b>Gate 1 Minimum Amplitude</b>	Minimum amplitude in gate 1. Resets on gate adjustment and on most pulser/receiver adjustments.
	<b>Gate 2 Minimum Amplitude</b>	Minimum amplitude in gate 2. Resets on gate adjustment and on most pulser/receiver adjustments.
	<b>Gate 1 Amplitude to Curve</b>	Amplitude measurement in gate 1. Displays echo height as a percentage of DAC/TVG curve height.

**Table 14 Available measurement readings (continued)**

Icon	Measurement readings	Description
	<b>Gate 2 Amplitude to Curve</b>	Amplitude measurement in gate 2. Displays echo height as a percentage of DAC/TVG curve height.
	<b>Gate 1 db to Curve</b>	Amplitude measurement in gate 1. Displays echo dB value compared to curve height where the curve equals 0 dB.
	<b>Gate 2 db to Curve</b>	Amplitude measurement in gate 2. Displays echo dB value compared to curve height where the curve equals 0 dB.
	<b>Gate 2 – Gate 1 (Echo-to-Echo)</b>	Gate 2 thickness minus gate 1 thickness (echo-to-echo measurement).
	<b>AWS D1.1/D1.5 Weld Rating (D)</b>	D rating calculated for the gated echo.
	<b>Equivalent Reflector size</b>	Equivalent reflector size (flat-bottom hole) for DGS/AVG evaluation
	<b>Overshoot (OS)</b>	Overshoot value in dB comparing echo height to DGS/AVG curve.
	<b>API5UE Depth</b>	Imperfection size (crack height) calculated from API 5UE inspection procedure.

### 5.3.3 General Setup Page

The **General** setup page, shown in Figure 5-17 on page 102, is accessible by choosing **Inst Setup > General** and allows you to configure general parameters such as the user interface language and the instrument date mode.

The screenshot shows the 'General Setup' page with the following settings:

Language	English
Filter Group	Standard
Key Beep	Off
Alarm Beep	On
Cal Lock	Off
Radix Type	Period(.)
Date Mode	mm/dd/yyyy
Communications Protocol	Multi Char
Communications Device	RS232
Baud Rate	9600

At the bottom, there is a navigation bar with buttons for: English, German, French, Italian, Spanish, Portuguese, and >>.

Figure 5-17 The General Setup page

The available parameters are:

#### Language

Used to select the user interface language (English, Japanese, German, French, Spanish, Russian, and Chinese).

#### Filter Group

Used to select receiver filter group. Instrument includes **Standard** filter group only.

#### Key Beep

Used to activate an audible tone after every key press.

**Alarm Beep**

Used to activate an audible tone when a **Gate Alarm** is triggered.

**Cal Lock**

Used to lock access to all functions affecting calibration/waveform data. These include: **Basic, Pulser, Rcvr** (receiver), and **Trig** settings, as well as **Gain, Range,** and **Delay**. These parameters are crossed out when the **Cal Lock** function is turned **On**.

**Radix Type**

Used to select the format used by the instrument to display numeric values (radix) and the date.

**Date Mode**

Used to set the date format. You can choose between the **dd/mm/yyyy** and **mm/dd/yyyy** formats.

**Communications Protocol**

Used to select command type for remote/PC communication with the instrument (**Multi Char** or **Single Char**). When communication with the Olympus GageView Pro PC software, Multi Character mode must be selected.

**Communications Device**

Used to select the type of remote/PC communication (USB or RS-232). When communication with the Olympus GageView Pro PC software, USB mode must be selected.

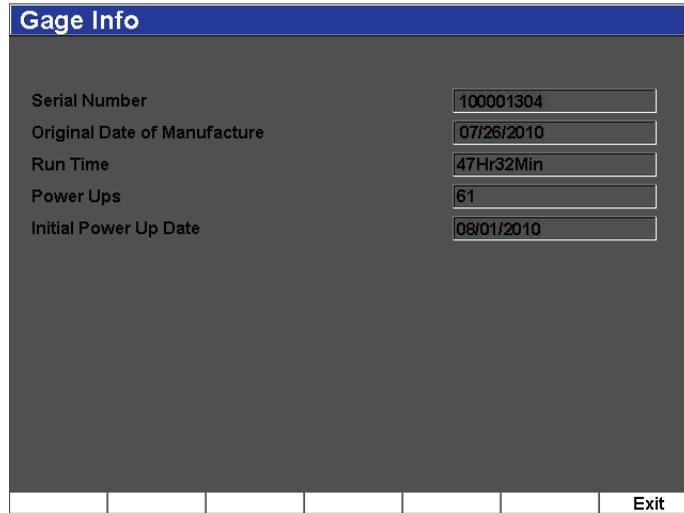
**Baud Rate**

Activated only when you select RS232 in the **Communications Device** box. Baud rate on instrument must match baud rate on PC.

### 5.3.4 Status Setup Page

The **Status** setup page, shown in Figure 5-18 on page 104, is accessible by choosing **Inst Setup > Status**. The page provides information about the current status of the instrument such as the internal temperature, battery state as well as instrument hardware/software identification data.





The screenshot shows a 'Gage Info' window with a dark background and a blue header. It contains five rows of data, each with a label on the left and a text input field on the right. The data is as follows:

Field Name	Value
Serial Number	100001304
Original Date of Manufacture	07/26/2010
Run Time	47Hr32Min
Power Ups	61
Initial Power Up Date	08/01/2010

At the bottom right of the window, there is an 'Exit' button.

Figure 5-19 The Gage Info page

### 5.3.5 Software Options Page

The **Software Options** page allows you to enter a activate code to allow access to a software option not included with the standard package of instrument features. This is provided by an Olympus representative after the purchase of a particular software option. Refer to section 12.1 on page 217 for details on software option activation.

### 5.3.6 Clock Setup Page

The **Clock** setup page, shown in Figure 5-20 on page 106, is accessible by choosing **Inst Setup > Clock** and allows you to configure the date and time settings for the instrument.

The screenshot shows a 'Clock' setup page with a dark grey background and a blue header. The page contains several input fields for setting the clock. The 'Year' field is highlighted in green and contains '2010'. The 'Month' field contains '5', the 'Day' field contains '6', the 'Mode' field contains '12 Hour', the 'Hour' field contains '10 AM', and the 'Minute' field contains '29'. At the bottom of the page, there is a navigation bar with 'Set' and 'Exit' buttons.

Year	2010	Mode	12 Hour			
Month	5	Hour	10 AM			
Day	6	Minute	29			
Set						Exit

Figure 5-20 The Clock setup page

**Year**

Used to set the year for the instrument internal clock.

**Month**

Used to set the month for the instrument internal clock.

**Day**

Used to set the day of the month for the instrument internal clock.

**Mode**

Used to set the hour display mode (**12 Hour** or **24 Hour**) for the instrument internal clock.

**Hour**

Used to set the hour for the instrument internal clock.

**Minute**

Used to set the minutes for the instrument internal clock.

## 5.4 Basic Procedures

The procedures contained in the following sections provide step-by-step information to perform basic tasks that you should quickly learn. The detail contained in these basic procedures is not repeated in the more complex procedures available in this document.

### 5.4.1 Navigating in the Menu Structure

The following procedure provides generic instructions to navigate in the menu structure.

#### To choose a menu group, a menu, and a parameter value

1. Select the desired menu group using the [NEXT GROUP] button. In the navigation pad configuration, the [CHECK] key is also used to scroll through the menu groups.
2. Select the desired menu using the [F<n>] function key corresponding to the desired function button. The menu indicator identifies the selected menu (see section 5.1.1 on page 80 for details on the menu structure).
3. Select the desired parameter using the [P<n>] parameter key corresponding to the desired parameter button.

### 5.4.2 Changing a Parameter Value

The following procedure describes how to change the value associated with a parameter button. The parameter value may be editable or selectable.

#### To change the value of a parameter

1. Access the desired setup page using the appropriate menu (Ex.: choose **Pulser**).
2. Select the desired value by pressing the corresponding [P<n>] parameter key (Ex.: choose **Damp**).

The button background of the selected parameter turns to green, showing that it now has the focus (see section 5.1.3 on page 84 for details on the focus concept).

3. Use the arrow keys or turn the adjustment knob to change the value.  
The edited value is immediately effective.

4. If needed, toggle the increase/decrease value mode from coarse to fine using one of the following methods:
    - ◆ Press **[CHECK]** (knob configuration).
- OR
- ◆ Press the **[UP]** and **[DOWN]** arrow keys for coarse adjustment and **[LEFT]** and **[RIGHT]** arrow keys for fine adjustments (navigation pad configuration).
- The increase/decrease value mode is coarse when the button label is in brackets and is fine when not in brackets.

### 5.4.3 Navigating in a Setup Page

Setup pages are accessible from parameter buttons. A setup page contains related fields/parameters.

#### To navigate in a setup page

1. Access the desired setup page using the appropriate menu (Ex.: choose **Display Setup**).
  2. Select the desired value by pressing the corresponding **[P<n>]** parameter key (Ex.: choose **Display Setup**).
  3. Press **[NEXT GROUP]** to select the field/parameter to be modified. In the navigation pad configuration, the **[CHECK]** key is also used to move from one menu field to the next.
  4. Use the arrow keys or turn the adjustment knob to change the value.
  5. Press **[ESCAPE]** to leave the menu and return to the live screen.
- The edited values are effective immediately. It is not possible to cancel the changes.

### 5.4.4 Entering an Alphanumeric Value Using the Virtual Keyboard

A setup page containing one or more parameters with alphanumeric values also contains a virtual keyboard. The virtual keyboard allows you to easily enter alphanumeric characters without having to use a USB keyboard.

#### To enter an alphanumeric value using the virtual keyboard

1. Access a setup page that contains parameters with alphanumeric values.

For example, choose **Manage > Edit** to access the **Edit** setup page shown in Figure 5-21 on page 109.

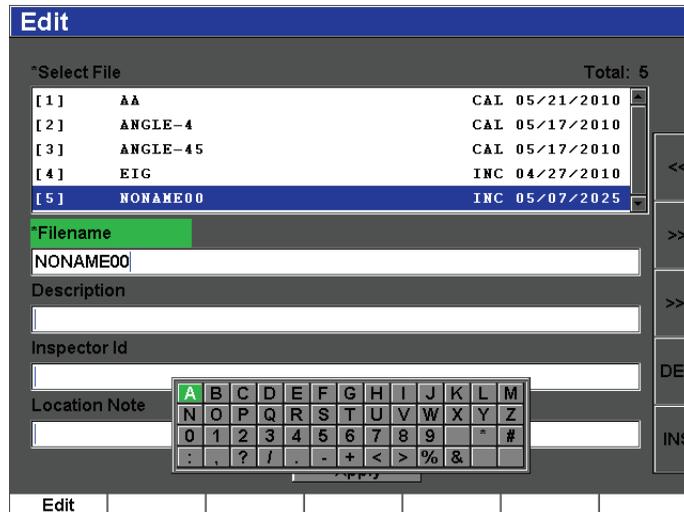


Figure 5-21 The Owner Info setup page with its virtual keyboard

2. Select the field that you want to edit using the [NEXT GROUP] button, and then choose **Edit**.
3. To enter a character from the virtual keyboard:
  - a) Move the cursor on the character to be added by pressing the [LEFT] or the [RIGHT] arrow key or by turning the adjustment knob.
  - b) Select **INS**.
4. Repeat step 3 to enter other characters.
5. To delete an already entered character:
  - a) Move the cursor on the character to be deleted by pressing the double arrow keys (<< or >>).
  - b) Select **DEL**.
6. To save the entered data and exit the setup page, press [NEXT GROUP] until the **Apply** button is selected, and then press [P1].

## 5.5 Resets Menu

The **Resets** menu allows the operator to reset various instrument functions to the factory standard values. To access the **Resets** menu, select **Manage > Reset**. This tab is shown in Figure 5-22 on page 110.

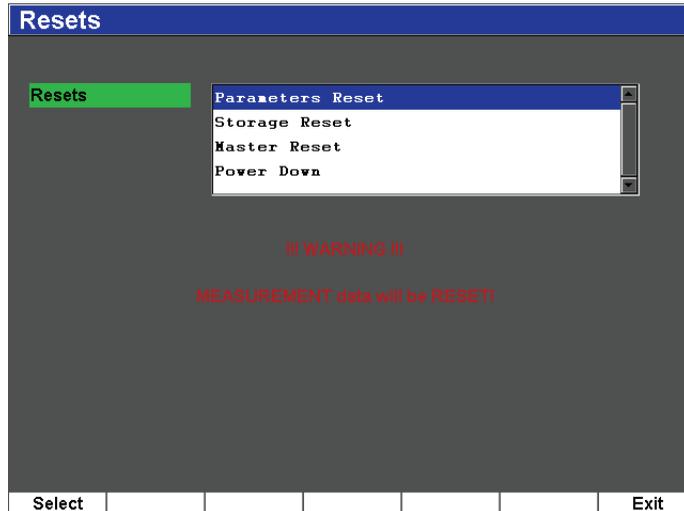


Figure 5-22 The Resets menu

## 5.6 Software Diagnostic

The **Software Diagnostic** menu logs software issues that may be affecting the EPOCH 600 performance. This menu may be used for troubleshooting by Olympus. To access the **Software Diagnostic** menu, choose **Inst Setup > Software Diagnostic**.

---

## 6. Adjusting the Pulser/Receiver

---

This chapter describes how to adjust the EPOCH 600 pulser/receiver. The topics are as follows:

- “Adjusting the System Sensitivity (Gain)” on page 111
- “Using the AUTO XX% Feature” on page 112
- “Setting Reference Gain and Scanning Gain” on page 113
- “Pulser Adjustments” on page 114
- “Receiver Adjustments” on page 118
- “Custom Filter Sets” on page 119

### 6.1 Adjusting the System Sensitivity (Gain)

#### To adjust the system sensitivity

1. Press [dB].
2. Adjust the system sensitivity (gain) in either coarse or fine increments.

---

<b>NOTE</b>
-------------

The total system sensitivity is 110 dB.

---

## 6.2 Using the AUTO XX% Feature

The AUTO XX% feature was formerly known as the AUTO-80 % in the EPOCH 4 Series. The default setting for **AUTO XX%** in the EPOCH 600 is 80 % full-screen height (FSH). You can adjust the FSH target value (XX) to meet the demands of the application.

The AUTO XX% feature is used to quickly adjust the instrument's gain (dB) setting to bring the gated peak echo to XX% FSH. AUTO XX% is especially useful for bringing the echo from a reference indication to XX% FSH to establish the instrument's reference gain level (see section 6.3 on page 113 for further information).

You can use the AUTO XX% feature to bring an echo to XX% FSH in any gate.

### To use AUTO XX% feature

1. Press **[GATES]** to select the gate that measures the echo to be adjusted.
2. Press **[2ND F], (AUTO XX%)** to activate the AUTO XX% feature.

---

<b>NOTE</b>
-------------

AUTO XX% can be activated at any time during operation. If you do not actively select a gate, AUTO XX% is applied to the most recently adjusted gate.

---

---

<b>NOTE</b>
-------------

AUTO XX% can be used when an echo exceeds the desired amplitude. The echo can be either above or below XX% FSH. If a signal is very high in amplitude (above 500 % FSH), it might be necessary to activate the AUTO XX% function more than once.

---

## 6.3 Setting Reference Gain and Scanning Gain

Establishing the current system gain as the reference (base) level is useful for inspections that require the establishment of a reference gain level, and then the addition or subtraction of scanning gain.

### To add scanning gain

1. Press **[2ND F], (REF dB)**.  
The gain display reads: **REF XX.X + 0.0 dB**. Scanning gain can now be added or subtracted.
2. Adjust the scanning gain in either coarse or fine increments.

---

<b>NOTE</b>
-------------

Coarse adjustment varies the gain value by  $\pm 6$  dB. Fine-adjustment varies the gain value by  $\pm 0.1$  dB.

---

While using the reference gain and scanning gain, the following parameters appear at the bottom of the screen.

#### **Add**

Used to add the scanning gain to the reference gain and deactivate the reference gain feature.

#### **Scan Db**

Used to toggle the scanning gain from the active level to 0.0 dB (reference level) allowing a direct amplitude comparison to the reference indication.

#### **Off**

Used to exit the reference gain function without adding the scanning gain to the base instrument gain.

#### **+6 dB**

Used to add 6 db to the reference gain. You add 6 dB each time you press this button.

#### **-6 dB**

Used to subtract 6 db from the reference gain. You subtract 6 dB each time you press this button.

## 6.4 Pulser Adjustments

The pulser settings in the EPOCH 600 are accessible from the **Pulser** menu. The pulser setup parameters are:

- Pulse Repetition Frequency (PRF)
- Pulse Energy (Voltage)
- Damping
- Test Mode
- Pulser Waveform
- Pulser Frequency Selection (Pulse Width)

### 6.4.1 Pulse Repetition Frequency (PRF)

Pulse repetition frequency (PRF) is a measure of how often the transducer is being pulsed by the electronic circuitry in the EPOCH 600.

PRF is typically adjusted based on the test method or test piece geometry. For parts with long sound paths, it is necessary to lower the PRF to avoid wrap-around interference that results in spurious signals on the display. For applications with rapid scanning, it is often necessary to use a high PRF rate to assure that small defects are detected as the probe moves along the part.

The EPOCH 600 allows you to manually adjust the PRF from 10 Hz to 2000 Hz in 50 Hz (coarse) or 10 Hz (fine) increments. The instrument also has two **Auto-PRF** settings to automatically adjust the PRF based on screen range.

#### To select a PRF adjustment method

- ◆ Choose **Pulser > PRF Mode**, and then vary the setting. The available choices are:

##### **Auto**

Used to automatically set the PRF value based on the chosen screen range.

##### **Manual**

Used to manually set the PRF value.

#### To adjust the PRF value in Manual PRF Mode

1. Choose **Pulser > PRF Mode = Manual**.
2. Choose **PRF**, and then adjust the PRF in either coarse or fine increments.

**NOTE**

The EPOCH 600 is a *single-shot* instrument. This means that the instrument acquires, measures, and draws the complete A-scan with each pulse rather than using multiple acquisitions to construct a full waveform. The measurement rate in the EPOCH 600 is always equal to the PRF rate unless you are using a multiplexer.

---

## 6.4.2 Pulse Energy (Voltage)

The EPOCH 600 can adjust the pulse energy from 0 V to 400 V in increments of 100 V. With this flexibility, you can set the pulse energy from to a minimum when you want to extend the battery life, or provide a very high power pulser for the most difficult materials.

### To adjust the pulser energy

- ◆ Choose **Pulser > Energy**, and then vary the value. In the **Energy** adjustment, coarse and fine steps are equal (100 V).

**NOTE**

To maximize instrument battery life and transducer life, it is recommended that you use lower energy settings when the application permits. For most applications, the energy setting does not need to exceed 200 V.

---

## 6.4.3 Damping

The damping control allows you to optimize the waveform shape for high resolution measurements using an internal resistive circuit. There are four damping settings on the EPOCH 600: **50  $\Omega$** , **100  $\Omega$** , **200  $\Omega$** , or **400  $\Omega$** .

### To adjust the Damping

- ◆ Choose **Pulser > Damp**, and then vary the setting.

---

**TIP**

Generally, the lowest resistance ( $\Omega$ ) setting increases the system damping and improves near-surface resolution, while the highest resistance setting decreases system damping and improves the instrument penetration power.

---

Selecting the correct damping setting fine-tunes the EPOCH 600 in order to operate with a particular transducer selection. Depending on the transducer being used, the various damping settings either improve near-surface resolution or improve the instrument's penetration power.

#### 6.4.4 Test Mode

The EPOCH 600 can operate in three test modes that you can select using the **Pulser > Mode** parameter:

##### **P/E**

Used to select pulse-echo mode, where a single element transducer sends and receives the ultrasonic signal. Use either transducer connector.

##### **Dual**

Used to select pitch-and-catch mode, where a dual-element transducer has one element that transmits the ultrasonic signal and another element that receives the signal. Use the T/R labeled transducer connection as the transmit connector.

##### **Thru**

Used to select the through transmission mode, where two separate transducers are typically located on opposite sides of the test specimen. One transducer transmits the ultrasonic signal, the other receives. Use the T/R labeled transducer connection as the transmit connector.

---

**NOTE**

To compensate for the one-way sound path in through transmission (**Thru**) mode, the EPOCH 600 does not divide transit time by two when calculating thickness measurements.

---

### To adjust the test mode

- ◆ Choose **Pulser > Mode**, and then vary the setting.

## 6.4.5 Pulser Waveform

The EPOCH 600 operates in two pulser waveform modes that you can select using the **Pulser > Pulser** parameter:

### Spike

Used to mimic a traditional spike pulse by using a narrow-width pulse to excite the transducer.

### Square

Used to tune the width of the pulse to optimize the response of the transducer.

---

<b>NOTE</b>
-------------

The EPOCH 600 uses the PerfectSquare technology to achieve optimum response from the tunable square wave pulser. This PerfectSquare technology maximizes the energy used to drive the connected transducer while providing excellent near-surface resolution.

---

### To adjust the pulser waveform

- ◆ Choose **Pulser > Pulser**, and then vary the setting.

## 6.4.6 Pulser Frequency Selection (Pulse Width)

The pulser frequency selection sets the pulse width when **Pulser > Pulser = Square**. This frequency selection allows you to tune the shape and duration of each pulse to obtain the best performance from the transducer being used. In general, the best performance is achieved by tuning the pulser frequency as close as possible to the center frequency of the transducer being used.

### To adjust the pulser frequency

- ◆ Choose **Pulser > Freq**, and then vary the setting.

**NOTE**

Actual results could vary due to the test material and/or variation in the transducer center frequency. Try various settings with a transducer and test piece to maximize ultrasonic performance.

---

## 6.5 Receiver Adjustments

The receiver settings are accessed from the **Rcvr** menu. The receiver parameters are:

- Digital Receiver Filters
- Waveform Rectification

### 6.5.1 Digital Receiver Filters

The has a total instrument bandwidth of 26.5 MHz at -3 dB. The instrument offers eight standard fixed digital filters. These are designed to improve the instrument's signal-to-noise ratio by filtering out unwanted high and/or low frequency noise outside of the test frequency spectrum. The **Standard** filter set also allows the instrument to provide the dynamic range (dB) required by EN12668-1.

In most cases, you should select either a broadband filter or a narrow-band filter that covers the frequency of the transducer being used. Due to the shifting of frequency spectrum in most materials, it might be necessary to adjust the filter settings to maximize instrument performance. Every material is different, and you must optimize the receiver settings based on the application.

The EPOCH 600 contains the following eight filters, compliant with EN12668-1:

- 2.0 MHz–21.5 MHz
- 0.2 MHz–10.0 MHz
- 0.2 MHz–1.2 MHz
- 0.5 MHz–4.0 MHz
- 1.5 MHz–8.5 MHz
- 5.0 MHz–15.0 MHz
- 8.0 MHz–26.5 MHz

- DC-10 MHz

### To adjust the Filter

- ◆ Choose **Rcvr > Filter**, and then vary the filter setting.

## 6.5.2 Waveform Rectification

The EPOCH 600 can operate in one of four different rectification modes that you can select using the **Rcvr > Rect** parameter: **Full-wave**, **Half-wave Positive**, **Half-wave Negative**, or **RF** (unrectified).

---

<b>NOTE</b>
-------------

The **RF** mode is not active while operating in special software feature modes, such as **DAC** mode or **Peak Memory**.

---

### To adjust the Rectification

- ◆ Choose **Rcvr > Rect**, and then vary the rectification setting.

## 6.6 Custom Filter Sets

The EPOCH 600 is capable of storing custom filter sets that are developed at a customer's request by Olympus. For more information, contact Olympus.



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## 7. Managing Special Waveform Functions

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This chapter describes how to manage special waveform functions. The topics are as follows:

- “Reject” on page 121
- “Peak Memory” on page 122
- “Peak Hold” on page 124
- “Freeze” on page 124
- “Grid Modes” on page 125

### 7.1 Reject

The **Rcvr > Reject** parameter allows you to eliminate unwanted, low-level signals from the display. The reject function is linear and adjustable from 0 % to 80 % FSH. Increasing the reject level does not affect the amplitude of the signals above the reject level.

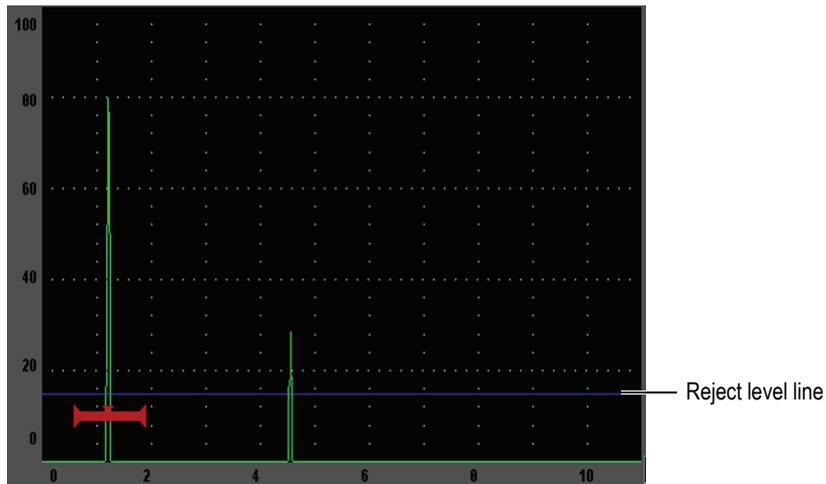
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<b>NOTE</b>
-------------

The reject function can also be used in the unrectified **Rcvr > Rect = RF** mode.

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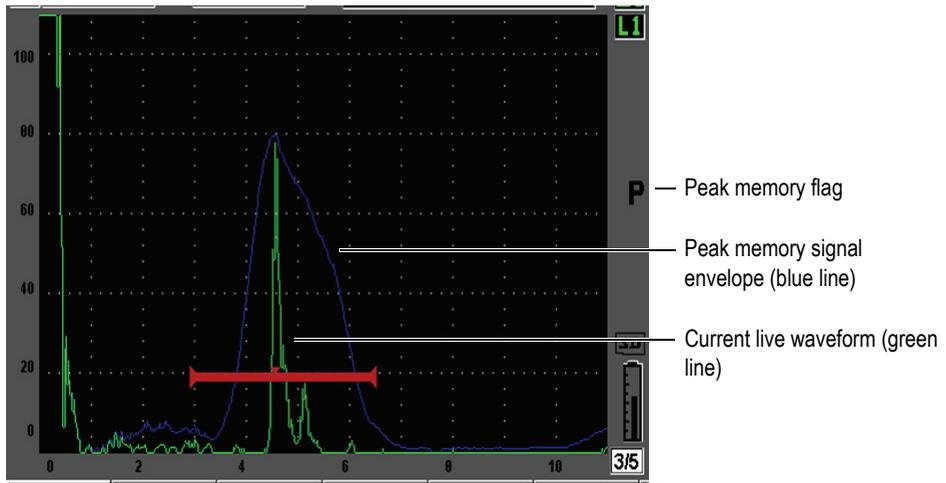
The reject level is displayed as an horizontal line on the instrument display (see Figure 7-1 on page 122) or two lines in the case of the unrectified **Rcvr > Rect = RF** mode.



**Figure 7-1 Horizontal line indicating the reject level**

## 7.2 Peak Memory

The peak memory function enables the display to capture and store on the screen the amplitude of each A-scan acquisition. The display updates each pixel if a signal of greater amplitude is acquired. When you scan the transducer over a reflector, the signal envelope (echo dynamic as a function of transducer position) is held on the screen as a green line (see Figure 7-2 on page 123). In addition, the current, live waveform is displayed at the appropriate place within the signal envelope.



**Figure 7-2 Peak memory signal envelope example**

This function is useful when it is necessary to find the peak from an indication during an angle beam inspection.

**NOTE**

The peak memory function cannot be activated in the unrectified **Rcvr > Rect = RF** mode.

**To activate peak memory function**

1. Press **[PEAK MEM]**.  
The **P** symbol appears in the flag area to indicate that the function is active.
2. Scan over a reflector to acquire the echo envelope.
3. Press **[PEAK MEM]** again to turn off the peak memory function.

## 7.3 Peak Hold

The peak hold function is similar to peak memory as it captures the current screen when the function is accessed. The difference is that with peak hold, the captured waveform is frozen on the screen and does not update even if the live waveform exceeds the frozen waveform's amplitude.

Peak hold is useful when you want to obtain a waveform from a known sample and compare it to a waveform from an unknown test piece. Similarities and/or differences in the waveforms can be noted to help determine the acceptance criteria for the unknown material.

### To activate peak hold

1. Obtain an echo on the screen.
2. Press **[2ND F]**, (**PEAK HOLD**).

This captures the screen and still allows viewing of the live waveform. The  symbol appears on the right side of the A-scan display indicating that the function is active.

3. Press **[2ND F]**, (**PEAK HOLD**) again to shut off the peak hold function.

## 7.4 Freeze

The freeze function holds, or freezes, the information on the screen at the moment you press **[FREEZE]**. Once the freeze function is activated, the pulser/receiver of the EPOCH 600 becomes inactive and does not acquire any further data. A  symbol appears on the right side of the screen indicating that the function is active. Press **[FREEZE]** again to restore the normal live display.

The freeze function is useful when storing waveforms as it holds the current A-scan allowing the transducer to be removed from the test piece. Once the display is frozen, you can use a variety of instrument functions. These include:

- Gate movement: to position the gate(s) over area(s) of interest to obtain measurement data.
- Gain: to amplify signals of interest or to reduce the amplitude of signals when high-scanning gain values are being used.

- Range and delay: manipulating the time base to focus on area of interest. The total instrument range can not be increased, but can be decreased to “zoom in” on a certain area of the frozen waveform.
- Rectification: to adjust the rectification view of the frozen waveform
- Data logger
- Printing

When freeze function is active, the following parameters cannot be changed/accessed:

- Zero offset
- Range (cannot be increased)
- Pulser/Receiver settings such as **PRF**, **Energy**, **Mode**, pulser waveform, and **Filter**

## 7.5 Grid Modes

The EPOCH 600 provides multiple grid modes for easy A-scan interpretation, depending on the application.

### To adjust the grid modes

1. Choose **Display Setup > Display Setup** to open the **Display** setup menu.
2. Move the focus to the **X-Axis Grid Mode** parameter using the **[NEXT GROUP]** button (see Figure 7-3 on page 126).

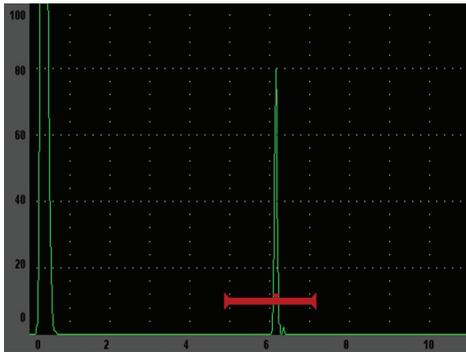
The image shows a software interface titled "Display" with a dark background. It contains several settings, each with a label on the left and a dropdown menu on the right. The "X-Axis Grid Mode" setting is highlighted with a green background, and its dropdown menu is also highlighted in green, showing the word "Standard". Other settings include "Live A-Scan Display" (Outline), "Envelope Display" (Filled), "Y-Axis Grid Mode" (100), "Baseline" (Off), "Brightness" (50%), and "Color Scheme" (Default). At the bottom of the window, there is a horizontal bar with several buttons: "Off", "Standard", "SoundPath", "Leg", and two empty buttons.

Live A-Scan Display	Outline
Envelope Display	Filled
<b>X-Axis Grid Mode</b>	<b>Standard</b>
Y-Axis Grid Mode	100
Baseline	Off
Brightness	50 %
Color Scheme	Default

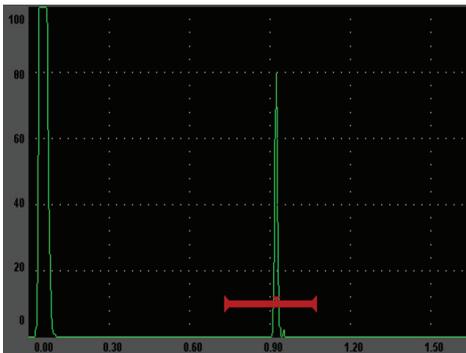
Off	Standard	SoundPath	Leg			
-----	----------	-----------	-----	--	--	--

**Figure 7-3** Selecting the x-axis grid mode

3. Choose the desired x-axis grid mode from the given options (see Figure 7-4 on page 127).



**Standard grid:** traditional flaw detector view with 10 divisions equally spaced across the screen range, and the numbers 1 - 10 appearing below each division.



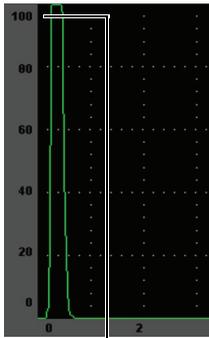
**Sound Path grid:** displaying actual sound path measurements at equally spaced increments along the horizontal axis. This mode displays 5 divisions, each labeled with its corresponding sound path value (depending on the **Basic > Range**, **Basic > Delay**, and **Meas Setup > Units** settings).



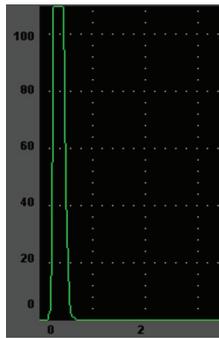
**Leg grid:** displaying vertical lines representing angle beam inspection legs. This mode displays up to 4 divisions, labeled **L1** to **L4**, which represent each half-skip distance of a test piece during an angle beam inspection. The spacing and number of divisions displayed depends on the **Basic > Range**, **Basic > Delay**, and **Trig > Thick** (material thickness) parameters.

Figure 7-4 The x-axis grid modes

4. Move the focus to the **Y-Axis grid Mode** parameter.
5. Choose the desired y-axis grid mode (see Figure 7-5 on page 128).



100 %



110 %

**100% or 110% grid:** maximum amplitude height displayed on the vertical y-axis.

**Figure 7-5** The y-axis grid modes

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## 8. Gates

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This chapter describes how to use the gates of the EPOCH 600. The topics covered are as follows:

- “Measurement Gates 1 and 2” on page 130
- “Quickly Adjusting Basic Gate Parameters” on page 132
- “Gate Measurement Modes” on page 133
- “Viewing Measurement Readings” on page 136
- “Gate Tracking and Echo-to-Echo Measurements” on page 136
- “Operating in Time-of-Flight Mode” on page 137
- “Using the Zoom” on page 138
- “Gate Alarms” on page 139

## 8.1 Measurement Gates 1 and 2

The EPOCH 600 has two independent flaw gates. In the A-scan, a gate is represented by an horizontal line with fixed start and end points. The length and horizontal position of the line identifies the sound path range, while the vertical position of the gate line represents a threshold amplitude level for echoes of interest. In the EPOCH 600, gate 1 appears as a solid red line while gate 2 appears as a hollow blue line.

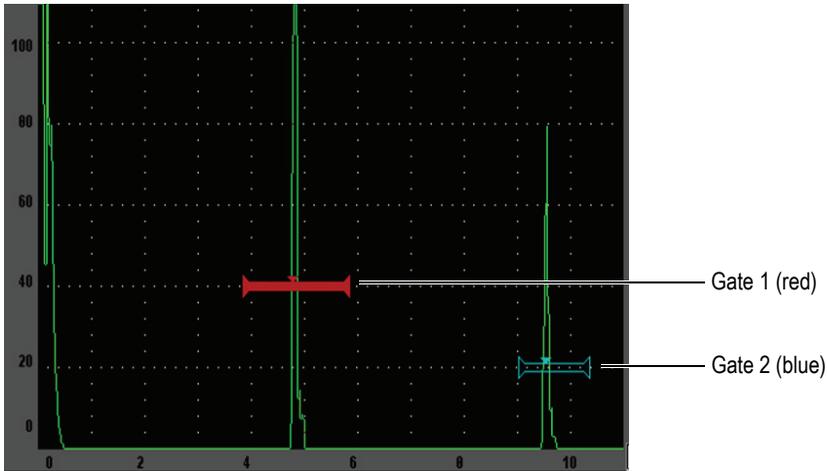


Figure 8-1 Gate 1 and gate 2 (with echo-to-echo turned on)

Both gates can be used to take thickness measurements with straight-beam transducers, sound path and depth measurements with angle beam transducers, measure signal amplitude, measure time-of-flight in microseconds, or to trigger threshold and minimum-depth alarms. The gates can also be used together to take echo-to-echo thickness measurements.

You can control the gates using the parameters in the **Gate 1** and **Gate 2** menus (see Figure 8-2 on page 131).



Figure 8-2 The Gate 1 menu

The available gate parameters are:

### Zoom

Used to zoom the display on the width of the gate (refer to section 8.7 on page 138 for details).

### Start

Used to adjust the gate start position.

### Width

Used to adjust the gate width.

### Level

Used to adjust the vertical position of the gate.

### Alarm

Used to select a gate alarm condition (refer to section 8.8 on page 139 for details).

### Min Depth

Used to adjust the minimum depth value which triggers a minimum depth alarm. This parameter will only be available if **Alarm = MinDepth**.

### Status

Used to toggle the state (**On** and **Off**) of the gate.

## 8.2 Quickly Adjusting Basic Gate Parameters

You can perform basic gate adjustments using the [GATES] direct-access key.

### To quickly adjust the position of a gate

1. Press the [GATES] direct-access key.

The focus moves to direct-access gate parameter box on the right side of the main display. The gate parameter box shows the first available gate parameter (see Figure 8-3 on page 132).

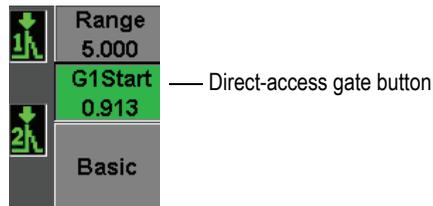


Figure 8-3 The direct-access gate parameter box

2. Edit the value using coarse or fine increments.
3. To select a different parameter for the selected gate, or a parameter in another active gate, press the [GATES] key until the desired parameter is selected. Successive presses of the [GATES] key will scroll through the following parameters: **G1Start**, **GIWidth**, **G1Level**, **G2Start**, **G2Width**, and **G2Level**.

---

<b>NOTE</b>
-------------

The [GATES] key only allows access to gates which are currently active. To activate a gate, select **Gate<n> > Status = On**.

---

4. Once the desired parameter has been selected, edit the value using coarse or fine increments. When needed, toggle between the coarse and fine adjustment mode.

**NOTE**

When adjusting a gate using the direct-access [GATES] key, the parameter key menu along the bottom of the screen disappears, and Gates becomes the active parameter. To return to the previously selected submenu, press either the [ESCAPE] or [NEXT GROUP] key. This allows you to make fast adjustments to the gate position and immediately return to the parameter of the previous operation.

### 8.3 Gate Measurement Modes

The EPOCH 600's two gates provide measurements of a gated indication based on one of three possible measurements modes. You can define the measurement mode of each gate in the **Gate Setup** menu (shown in Figure 8-4 on page 133).

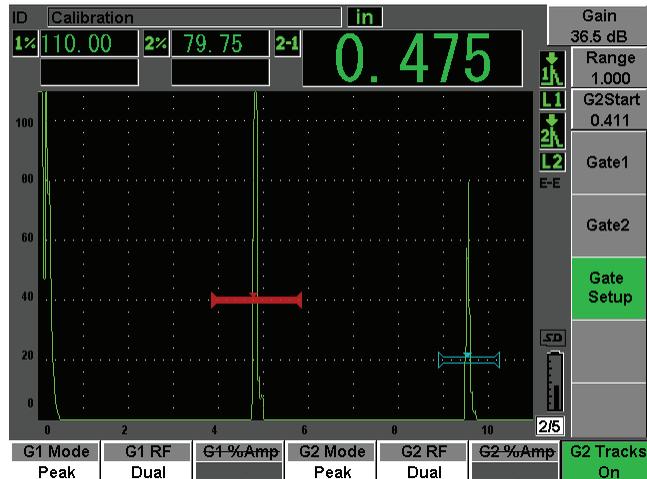


Figure 8-4 The Gate Setup menu

The available parameters are:

### G<n> Mode

Each gate can make measurements using the following modes:

#### Edge

Acquires measurement readings based on the position of the first crossing point of a gated signal. The indication must break the threshold of the gate for a measurement to be acquired. Also known as the *flank* mode.

#### Peak

Acquires measurement readings based on the position of the highest peak within the gated screen range. The indication does not have to break the gate threshold for a measurement to be acquired.

#### 1stPeak

Acquires measurement readings based on the position of the first peak to break the threshold of the gate within the gated region.

When a measurement is being made using one of the measurement gates, a small triangle appears on the gate to indicate from which echo/point the measurement is being acquired (see Figure 8-5 on page 134).

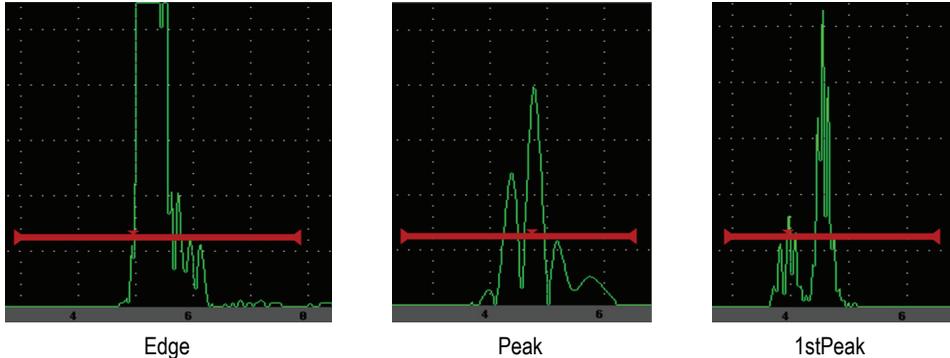


Figure 8-5 Arrow indicating measurement trigger in Edge, Peak, and 1stPeak modes

**G<n> RF**

In unrectified (RF) mode, used to choose the polarity of the gate. Options include:

**Dual**

The gate appears in the positive and negative side of the X-axis. Position and width are identical, and the gate level mirrors across the X-axis (example: 25 % and -25 %).

**Positive**

The gate appears only on the positive side of the x-axis.

**Negative**

The gate appears only on the negative side of the x-axis.

**G<n> %Amp**

In **Edge** mode only, this selection allows you to define the method for measuring amplitude of the gated indication:

**High Peak**

Acquires the amplitude measurement of the indication from the highest peak within the gate.

**1stPeak**

Acquires the amplitude measurement of the indication from the first peak within the gate. The peak must break the threshold of the gate to be measured. In this mode, you will now see two triangles appear on the gate. The solid triangle indicates the point from which thickness or soundpath/depth measurements are being acquired. The hollow triangle indicates the point from which the amplitude measurement is being made.

---

<b>NOTE</b>
-------------

The EPOCH 600 does not acquire measurement readings unless the indication of interest is within a gated region of the screen. You should be careful to adjust the **Start**, **Width**, and **Level** of a measurement gate so that only the indication of interest falls within the gated region, per the measurement mode definitions above.

---

## 8.4 Viewing Measurement Readings

The EPOCH 600 provides five customizable measurement reading boxes to display acquired measurements. These measurement readings must be properly defined to view the desired information from a given indication.

For more information on defining measurement reading boxes, and for a full list of possible measurement readings, see section 5.3.2 on page 98.

## 8.5 Gate Tracking and Echo-to-Echo Measurements

The gate tracking feature of the EPOCH 600 allows you to make echo-to-echo measurements whenever this feature is required by an application. Echo-to-echo measurements can be made between Gate 2 – Gate 1.

Gate tracking maintains a constant separation between the position of the indication in the first gate and the start position of the second gate. With this dynamic mobility, the tracking gate is always positioned where you want to measure other indications. When gate tracking is active, the start position value of the tracking gate (the second gate involved in the measurement) defines the separation between the gates, not a fixed start position.

### To make echo-to-echo measurements with gate 1 and gate 2

1. Activate both gates by selecting **Gate 1 > Status = On** and **Gate 2 > Status = On**.
2. As shown in the example of Figure 8-6 on page 137, position gate 1 over the first echo to detect, and then position gate 2 over the second echo to detect. The **Gate 2 > Start** position defines the separation between the position of the indication in gate 1 and the start of gate 2.

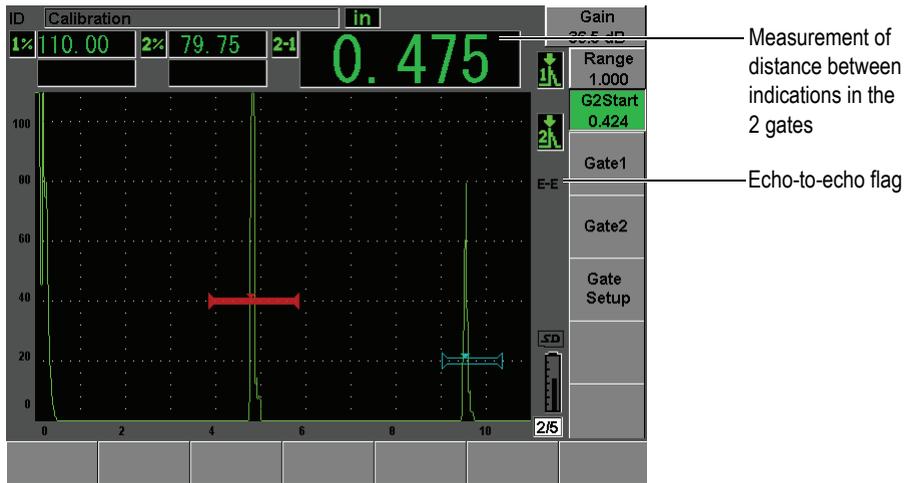


Figure 8-6 Echo-to-echo measurement example

3. Set gate 2 as the tracking gate by selecting **Gate Setup > G2 Tracks = On**.

The **E-E** echo-to-echo mode flag appears on the right side of the display, indicating that the instrument is measuring the distance between positions of the indications in gate 1 and gate 2.

4. To see the measurement value, configure one of the measurement reading boxes to display the **G2-1** parameter (see section 5.3.2 on page 98 for details).

## 8.6 Operating in Time-of-Flight Mode

The EPOCH 600 is capable of displaying time-of-flight (TOF) sound path data for a gated indication. Time-of-flight is the location of the reflector in terms of microseconds ( $\mu\text{s}$ ).

The time-of-flight mode does not divide the measurement reading value by two. The entire time-of-flight through the test piece in both directions is displayed.

As a reminder, when taking thickness measurements, the EPOCH 600 must divide the product of material velocity and time-of-flight by two in order to calculate the thickness of the part. If this were not done, the unit would display twice the actual thickness because the sound energy would pass through the part twice.

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<b>NOTE</b>
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When the instrument is set up to display distances in time-of-flight mode, the **Basic > Velocity** parameter becomes inactive. This is because the time-of-flight mode does not use the material velocity to calculate sound path measurements.

---

### To operate in time-of-flight mode

- ◆ Select **Meas Setup > Unit =  $\mu$ s**.

In time-of-flight mode, all distance measurements are displayed in microsecond values instead of inches or millimeters.

## 8.7 Using the Zoom

The EPOCH 600 allows you to quickly zoom the screen range to provide fine resolution of a particular inspection zone. Using zoom, the instrument automatically uses screen delay to bring the point that corresponds to the gate start to the left side of the screen and adjusts the displayed range to match the gate width. The new range equals the unzoomed gate width. The lowest achievable value of the expanded range is equivalent to the minimum range of the instrument at the current material-velocity setting. When the zoom is active, the  flag appears on the right side of the display.

### 8.7.1 Activating the Zoom

#### To activate the zoom for gate 1

1. Select **Gate 1 > Status = On** to activate gate 1.
2. Position gate 1 to the desired position.
3. Choose **Gate 1 > Zoom**.

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<b>NOTE</b>
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The same process can be applied to gate 2 as well, but the zoom feature can only be active for one gate at a time.

---

## 8.7.2 Zoom Applications

Zooming is especially useful in certain flaw detection applications. For example, when detecting branches of cracking such as intergranular stress-corrosion cracking (IGSCC), the inspector's job can be complicated by the geometry of the test specimen and also by the specific characteristics of the defect itself. In instances where the pipe counter bore is close to the weld root, it is possible to have three signals that all appear quite close to each other (the weld root, the counter bore, and the crack itself). In this situation, you can use the zoom to improve the visual resolution of the EPOCH 600 display so that each individual signal can be more easily identified.

When evaluating a crack signal, the inspector's attention is usually focused on the leading edge of an indication. By observing the number and location of small peaks along the leading edge of the signal, it is possible to make some assumptions regarding the presence and location of different branches of cracking. You can use the zoom to get a much more detailed view of an indication and to make better judgments regarding flaw location and depth.

Zooming is useful when inspecting particularly large or thick components when detail is lost due to using long-screen ranges. You can use the zoom to look at small sections of the test piece without disturbing the instrument's original calibration.

## 8.8 Gate Alarms

The EPOCH 600 features a variety of alarm configurations for each measurement gate. In unrectified (RF) mode, these alarms can be used in positive, negative, or dual gate modes.

By default, when an alarm condition is triggered, the EPOCH 600 emits an audible beep. The instrument also illuminates the red indicator, above the display window, corresponding to the gate with which the alarm has been triggered. To toggle the audible alarm on and off, see section 5.3.3 on page 102.

The three primary types of gate alarms are positive threshold, negative threshold, and minimum depth.

## 8.8.1 Threshold Alarms

Threshold alarms can be set on gate 1 or gate 2.

A positive logic alarm is triggered when a signal breaks the gate threshold. A negative logic alarm is triggered when a signal drops out of the gate threshold.

When you set a threshold alarm, the appearance of the tick marks at the end of the gate changes. For positive logic alarms, the tick marks point upward and for negative logic alarms they point downward (see Figure 8-7 on page 140). All alarm conditions are stored in the EPOCH 600 data logger when the gate alarm is active and triggered at the time of file storage. All saved IDs with an active alarm display A1 for Gate 1 alarm, A2 for Gate 2 alarm, or AIF for interface gate alarm.

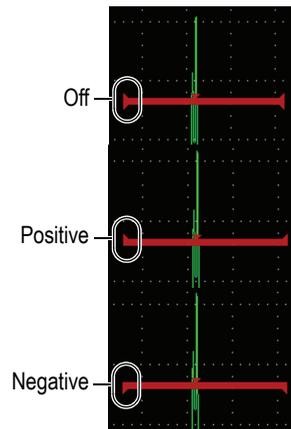


Figure 8-7 Gate tick marks indicating alarm threshold type

### To set a threshold alarm

1. Activate the gate by selecting **Gate<n> > Status = On**.
2. Position the gate to cover the desired area.
3. Choose **Gate<n> > Alarm**, and then select either the **Positive** or **Negative** threshold alarm condition.

## 8.8.2 Minimum Depth Alarm

The EPOCH 600 is equipped with a minimum depth alarm that is triggered whenever the current thickness measurement reading falls below an operator-defined level. The minimum depth alarm can be used either with a single gate or in echo-to-echo measurement mode.

## 8.8.3 Minimum Depth Alarm with a Single Gate

When the minimum depth alarm is activated, a marker appears on the gate to visually indicate the current setting (see Figure 8-8 on page 141). Any indication that exceeds the gate threshold to the left of the marker triggers the alarm.

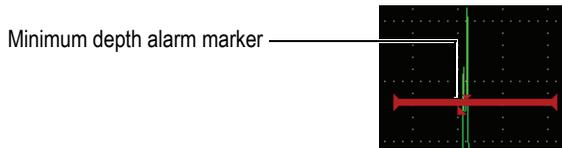


Figure 8-8 Minimum depth alarm marker

### To set a minimum depth alarm

1. Activate the gate by selecting **Gate<n> > Status = On**.
2. Position the gate to cover the desired area.
3. Select **Gate<n> > Alarm = Min Depth**
4. Choose **Gate<n> > Min Depth**, and then adjust the desired minimum value. The minimum depth alarm value must be greater than the gate start value and less than the gate width value.

## 8.8.4 Minimum Depth Alarm with Gate Tracking

The EPOCH 600 can use the minimum-depth alarm when making echo-to-echo thickness measurements with gate tracking. When gate tracking is active, the tracking gate moves side-to-side, tracking the position of the echo in the non tracking (first) gate. With gate tracking active, the **Min Depth** alarm threshold is relative to the position of the echo in the non tracking gate (first gate).

To set up a minimum depth alarm with gate tracking, follow the steps described in section 8.8.3 on page 141.



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## 9. Input and Output Features

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This chapter describes the input and output features of the EPOCH 600. The topics covered are as follows:

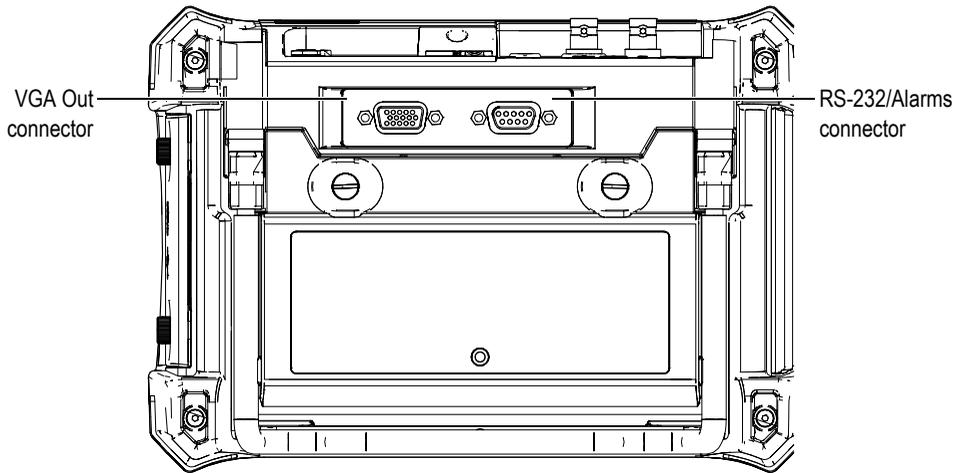
- “VGA Output” on page 143
- “Analog Output” on page 144
- “Serial Communication (RS-232)” on page 146
- “USB Communication” on page 146
- “Serial/USB Command Protocol” on page 147

### 9.1 VGA Output

The EPOCH 600 comes standard with VGA output capability. This function uses pins on the output port located at the back of the instrument. Using the VGA output, you are able to display the full contents of the EPOCH 600 screen on any device that accepts VGA input.

#### To use the VGA output

1. Turn off the EPOCH 600 and the VGA device.
2. Connect the 600-C-VGA-5 (U8780298) cable (optional item) to the VGA output connector of the EPOCH 600 (see Figure 9-1 on page 144), and then to the VGA device.



**Figure 9-1 The RS-232/Alarms and VGA Out connectors**

3. Turn on the EPOCH 600 and the VGA device.

## 9.2 Analog Output

The EPOCH 600 offers a programmable analog output (optional). This analog output allow the EPOCH 600 to continuously output thickness or amplitude information to an external device, such as a strip chart recorder or a computer outfitted with an analog/digital converter card.

The information is output as a scaled voltage, on either a 0–1 V or 0–10 V scale. The EPOCH 600 is connected to the external device by means of the analog output LEMO 00 connector on the top of the instrument, to the right of the transducer connectors. Each scaled voltage can be output at full PRF rate (up to 6 kHz), or can be compressed to a 60 Hz output, depending on the acquisition rate required by the connected data acquisition device.

The analog output setup parameters are located in the **A-Out** setup page accessible by choosing **Meas Setup > A-Out** (see Figure 9-2 on page 145).

A-Out	
Reading	Gate2 Current Amplitude
Output	0-1V
Mapping	Range
Load	1000.0 K $\Omega$

Figure 9-2 The A-Out setup page

There are four main parameters that control each analog output signal:

### Reading

Used to select the measurement (thickness or amplitude) to output to the ANALOG OUT connector.

### Output

Used to select the range of voltage output from the unit (0-1 V or 0-10 V).

### Mapping

Used to select the scale of the output voltage based either on the full-screen range (**Range**) or on the gate width (**GateWidth**).

### Load

Used to select the value for the impedance of the peripheral device measuring the analog output of the EPOCH 600 instrument.

Matching the impedance of the output from the EPOCH 600 with the impedance of the input to the peripheral device allows the EPOCH 600 to properly offset the analog output to produce predictable output voltages based on screen

measurements. For example, a measurement on the EPOCH 600 of 10 mm on a 100 mm screen range, with an analog output range of 0-10 V, should produce an analog output of 1 V. Without impedance matching, the value can be skewed above or below the expected 1 V output value (0.95 V or 1.02 V, etc).

## **9.3 Serial Communication (RS-232)**

The EPOCH 600 comes standard with a serial communications (RS-232) port, which is combined with the Alarm signals on the same connector (see Figure 9-1 on page 144). Serial communication uses pins on the combined RS-232/Alarms output connector located at the back of the instrument. Through serial communication, you are able to connect the EPOCH 600 to a computer for communication with the EPOCH 600 computer interface program, GageView Pro.

Serial communication also allows remote command of the EPOCH 600. For more information, please see section 9.5 on page 147.

## **9.4 USB Communication**

The EPOCH 600 comes standard with one On-the-Go dual-purpose USB port used currently for PC communication.

### **9.4.1 USB Client**

The USB Client port is used for computer communication. USB client allows a peripheral device to pass commands to the EPOCH 600, but does not allow the EPOCH 600 to command a peripheral device. The USB Client port is the standard port for communication with the EPOCH 600 computer interface program, GageView Pro.

## **9.4.2 USB Host**

The USB Host port is available for future use.

## **9.5 Serial/USB Command Protocol**

The EPOCH 600 can be remotely controlled via either the serial (RS-232) communications port or the USB client port. A comprehensive series of remote commands is available to allow access to all functions of the instrument. Contact Olympus for further information.



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## 10. Calibrating the EPOCH 600

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This chapter describes how to calibrate the EPOCH 600. Calibration is the process of adjusting the unit so that it measures accurately on a particular material, using a particular transducer at a particular temperature.

You must adjust the zero offset and velocity parameters of the EPOCH 600 during calibration. Zero offset (sometimes referred to as probe delay) compensates for the dead time between the firing of the main bang and the entry of the sound into the test piece. The unit must be programmed with the correct velocity setting so that it matches the material velocity of the test piece.

The EPOCH 600 features an advanced auto-calibration (parameters in the **Auto Cal** menu), which provides for a fast and easy calibration process. The following section details the procedure to calibrate the EPOCH 600 when using the four basic transducer configurations: straight beam, delay line, dual element, and angle beam.

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<b>NOTE</b>
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Do not use the auto-calibration when the EPOCH 600 is in the following modes: Microsecond (time-of-flight), DAC, or TVG.

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Calibration is explained in detail in the following sections:

- “Getting Started” on page 150
- “Calibration Modes” on page 151
- “Calibrating with a Straight Beam Transducer” on page 152
- “Calibrating with a Delay Line Transducer” on page 157
- “Calibrating with a Dual Element Transducer” on page 163
- “Calibrating in Echo-to-Echo Mode” on page 168

- “Calibrating to Known Sound Path Values with an Angle Beam Transducer” on page 172
- “Calibrating to Known Depth Values with an Angle Beam Transducer” on page 183
- “Curved Surface Correction” on page 188
- “Common Angle Beam Calibration Block Diagrams” on page 189

## 10.1 Getting Started

Until you are completely comfortable operating the EPOCH 600, we recommend that a basic review and setup procedure be used prior to starting the actual calibration.

### To setup the EPOCH 600 before calibrating

1. Press [**dB**] to select an initial gain value that is appropriate for the calibration. If the appropriate gain level is unknown, set the initial gain at 20 dB and adjust it as necessary during calibration.
2. Choose **Basic** > **Velocity**, and then enter an approximate velocity for the test material. Refer to Appendix A on page 273 for a table with sound velocities for various materials.

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<b>NOTE</b>
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The **Velocity** parameter is disabled when the instrument is in time-of-flight mode. Select **Meas Setup** > **Unit = mm** or **in** to enable the **Velocity** parameter.

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3. Choose **Basic** > **Zero**, and then adjust the zero offset of the instrument to 0.000  $\mu$ s.
4. Choose **Basic** > **Range** or press the [**RANGE**] key, and then set the range based on the sound path range within the selected calibration block.

---

<b>TIP</b>
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Use more range than necessary to ensure all calibration echoes appear on the screen.

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5. Choose **Basic** > **Delay**, and then set the screen delay to 0.000 in. or 0.00 mm.

6. Choose **Trig > Angle**, and then enter the correct refracted angle for the probe (0 for a straight beam or 90° probe, 45 for a 45° probe, etc.).
7. Choose **Trig > Thick**, and then set the material thickness to 0.00 in. or 0.00 mm.
8. Choose **Rcvr > Reject**, and then set the reject level to 0 %.
9. Select **Gate 1 > Status = On** to activate gate 1.
10. Couple the transducer to the block, and then adjust the pulser and filter settings to create a clean A-scan.  
For more information on pulser and receiver adjustments, see section 6.4 on page 114 and section 6.5 on page 118.

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<b>TIP</b>
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Use the auto measurement reading selection feature so that the EPOCH 600 automatically displays relevant thickness/sound path measurements during calibration based on the instrument settings. For more information, see section 5.3.2 on page 98.

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## 10.2 Calibration Modes

The EPOCH 600 features multiple calibration modes to accurately meet the requirements of the selected transducer, calibration test block, and application. These calibration modes can be adjusted in the **Auto Cal** menu. There are two modes for straight beam transducers and two modes for angle beam transducers.

### 10.2.1 Straight Beam Modes

Straight beam calibrations can be performed by two methods. For the purposes of this calibration discussion, *straight beam* refers to all zero-degree probes, including contact, dual, delay line, immersion, etc. The two methods of straight beam calibration are:

#### Thickness

This standard straight beam calibration mode requires you to provide two different, known material thicknesses to properly calibrate the instrument. The thin material thickness allows for zero offset calibration, and the thick material thickness allows for velocity calibration.

## Echo-to-echo

This calibration mode allows you to use any echo-to-echo measurement to calibrate for material velocity only. In echo-to-echo calibration, the effects that cause zero offset are eliminated by gating a particular indication that represents the start point of the measurement. A second gate is set to track that gated indication to acquire a measurement. This means that you must only calibrate for the material velocity of the inspection to acquire accurate echo-to-echo measurements. You can perform echo-to-echo measurements between **G2–G1**, and this calibration mode will only be available if Gate 2 tracking is turned on (see section 8.5 on page 136).

## 10.2.2 Angle Beam Modes

Angle beam calibrations can be performed by two methods:

### Sound path

This standard angle beam calibration mode uses the sound path measurement of two different, known material thicknesses to properly calibrate the instrument. Typically, these sound path measurements are made from the radius of a calibration test block. The smaller (thin) soundpath measurement allows for zero offset calibration, and the larger (thick) soundpath measurement allows for velocity calibration.

### Depth

This angle beam calibration mode uses the known depth of two different reflectors to properly calibrate the instrument. Typically, these depth measurements are made from side-drilled holes of equal size. For accurate measurements, you must first verify the refracted angle of the transducer, as the EPOCH 600 calculates depth values based on sound path and known refracted angle. The shallow reflector depth allows for zero offset calibration, and the deep reflector depth allows for velocity calibration.

## 10.3 Calibrating with a Straight Beam Transducer

The sample straight beam calibration described below is performed using an Olympus transducer part number A109S-RM, with a frequency of 5.0 MHz and an element diameter of 0.50 in. (13 mm).

The calibration requires a test block with two known thicknesses made from the material to be measured. Ideally, the two thicknesses should represent thicknesses that are both below and above the expected thickness of the material being inspected.

For this example, Olympus standard 5-step steel test block (P/N: 2214E) is used. The steps measure 0.100 in., 0.200 in., 0.300 in., 0.400 in., and 0.500 in.

---

<b>NOTE</b>
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If the EPOCH 600 is set to work in metric units, the calibration process is exactly the same, except that the entries are in millimeters rather than inches.

---

### To calibrate using a straight-beam transducer

1. Follow the initial setup procedure outlined in section 10.1 on page 150.
2. Connect the transducer to an appropriate cable and then connect the cable to either of the transducer connectors at the top of the instrument.
3. Select **Auto Cal > Type = Thickness**.
4. Couple the transducer to the thin calibration block step. For this example, the transducer is coupled to the 0.200 in. step.

---

<b>NOTE</b>
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Depending on the frequency of the contact transducer being used, it might be impossible to obtain a proper reading on very thin material.

---

5. Use the **[GATES]** key to position gate 1 so that the first back-wall echo from the known thickness step exceeds the gate threshold.
6. Press **[dB]**, and then adjust the gain value so that the echo amplitude is at approximately 80 %.

---

<b>TIP</b>
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The AUTO XX% feature can be used to automatically adjust the gain to set the gated echo amplitude to XX% of full screen height (the default XX value is 80 %). To activate this feature, press **[2ND F], (AUTO XX%)**.

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A thickness measurement reading appears in large text above the A-scan (see Figure 10-1 on page 154).

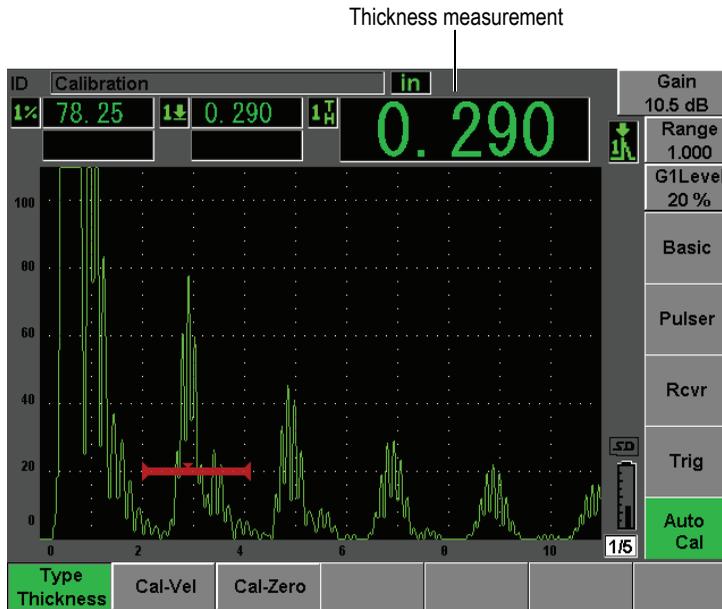


Figure 10-1 Example of a gated signal for zero calibration

7. Once a steady reading is achieved, choose **Auto Cal > Cal-Zero**.  
The screen freezes and the **Cal-Zero** box appears (see Figure 10-2 on page 155).



Figure 10-2 Entering the Zero Cal thickness value

8. Adjust the value to match the known thickness of the gated indication (0.200 in. in this example), and then choose **Continue** to continue to the second calibration step (see Figure 10-3 on page 156). The thickness value used in this part of the calibration will be stored for reference in the **Cal-Zero** parameter box.

#### NOTE

If for any reason you need to exit without acquiring calibration data, press **Cancel**.

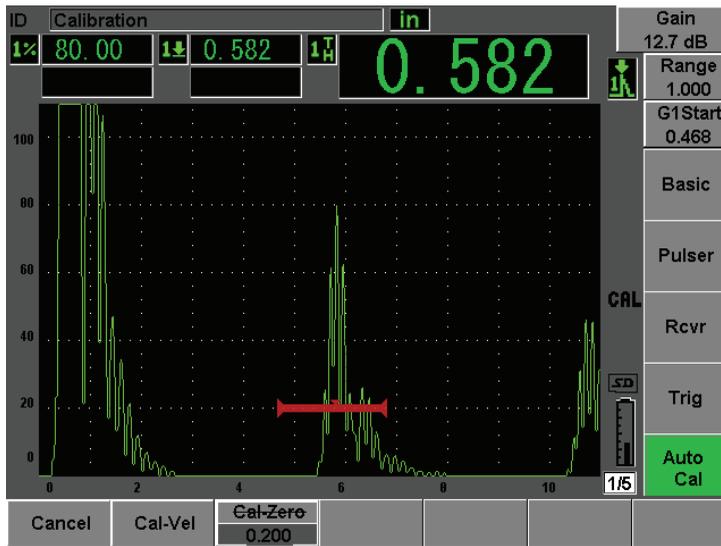


Figure 10-3 Example of a gated signal for velocity calibration

9. Couple the transducer to the thick calibration block step.  
In this example, the transducer is coupled to the 0.500 in. step.
10. Use the [**GATES**] key to position gate 1 so that the first back-wall echo from the known thickness step exceeds the gate threshold.
11. Press [**dB**] to adjust the gain setting so that the echo amplitude is at approximately 80 %.  
A thickness measurement reading appears in large text above the A-scan.
12. Once a steady reading is achieved, choose **Auto Cal > Cal-Vel**.  
The screen freezes and the **Enter Value for Velocity Cal** box appears (see Figure 10-4 on page 157).

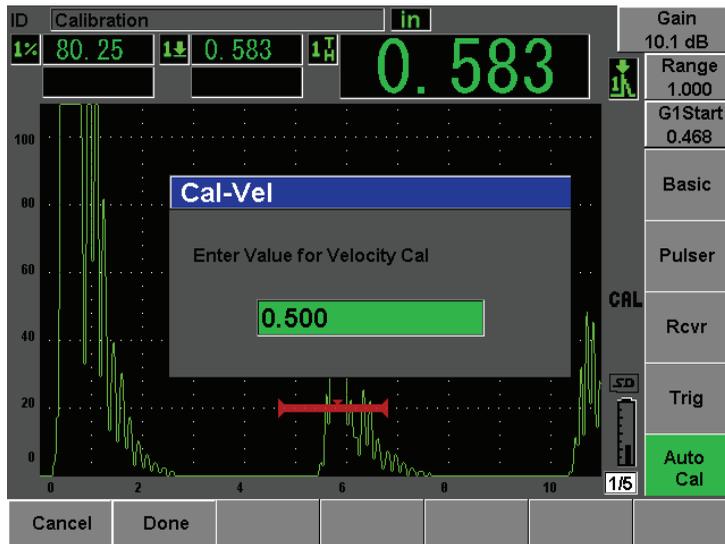


Figure 10-4 Entering the Velocity Cal thickness value

13. Adjust the value to match the known thickness of the gated indication (0.500 in. in this example), and then choose **Done** to complete the calibration process.

#### TIP

It is possible to use the auto-calibration on a test block with only one known thickness. In this scenario, leave the transducer coupled on the unique thickness, move the gate over to one of the multiple back-wall echoes, and then enter the correct sound path thickness (the appropriate multiple of the first back-wall echo) during the velocity portion of the calibration.

## 10.4 Calibrating with a Delay Line Transducer

The sample delay line calibration described below is performed using Olympus transducer part number V202-RM, with a frequency of 10.0 MHz and an element diameter of 0.25 in. (6 mm).

The calibration requires a test block with two known thicknesses, made from the material to be measured. Ideally, the two thickness measurements are both below and above the expected thickness of the material to be inspected. For this example, we are using Olympus standard 5-step steel-test block, part number 2214E. The steps measure 0.100 in., 0.200 in., 0.300 in., 0.400 in., and 0.500 in.

---

<b>NOTE</b>
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If the EPOCH 600 is set to work in metric units, the calibration process is exactly the same, except that the entries are in millimeters rather than inches.

---

### To calibrate using a delay line transducer

1. Follow the initial setup procedure outlined in section 10.1 on page 150.
2. Connect the transducer to an appropriate cable and then connect the cable to either of the transducer connectors at the top of the instrument.  
With a zero offset of 0.000  $\mu\text{s}$ , the excitation pulse (or main bang) should appear on the left side of the screen.
3. Choose **Basic > Zero**, and then increase the value until the excitation pulse moves off the left side of the screen and the interface echo from the end of the delay line tip appears on the screen.
4. Verify that the echo represents the end of the delay by tapping your finger on the end of the couplant-coated delay line. This dampens the signal and the echo should jump up and down on the screen.
5. Choose **Basic > Zero**, and then increase the value to move this echo to the left side of the screen so that it is barely visible.

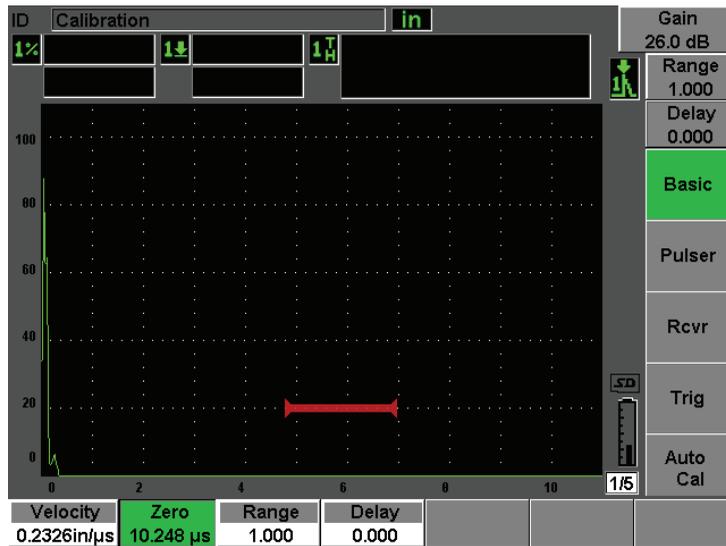


Figure 10-5 Adjusting zero offset for the first delay line echo

6. Select **Auto Cal > Type = Thickness**.
7. Couple the transducer to the thin calibration block step. For this example, the transducer is coupled to the 0.100 in. step.
8. Use the **[GATES]** key to position gate 1 so that the first back-wall echo from the known thickness step exceeds the gate threshold.
9. Press **[dB]**, and then adjust the gain value so that the echo amplitude is at approximately 80 %.

#### TIP

The AUTO XX% feature can be used to automatically adjust the gain to set the gated echo amplitude to XX% of full screen height (the default XX value is 80 %). To activate this feature, press **[2ND F]**, (**AUTO XX%**).

A thickness measurement reading appears in large text above the A-scan (see Figure 10-6 on page 160).

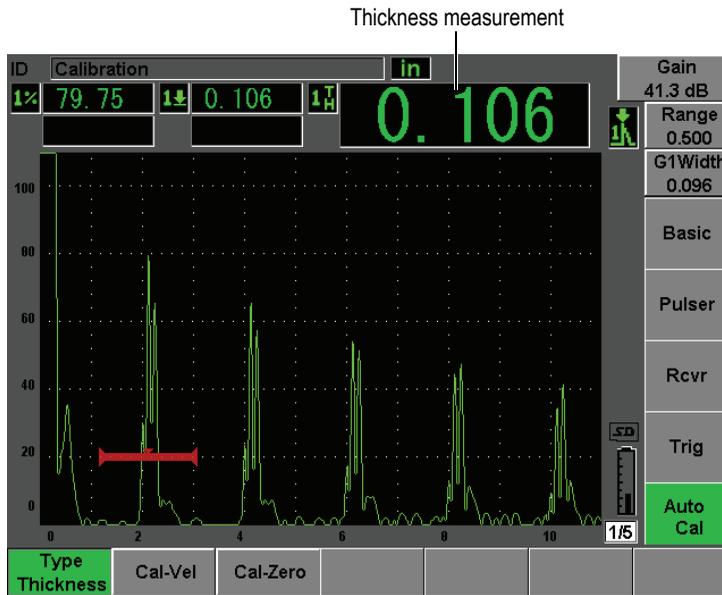


Figure 10-6 Example of a gated signal for zero calibration

#### NOTE

Ensure that it is the first back-wall echo being gated, not a multiple echo from the end of the delay line tip.

10. Once a steady reading is achieved, choose **Auto cal** > **Cal-Zero**.  
The screen freezes and the **Cal-Zero** box appears (see Figure 10-2 on page 155).

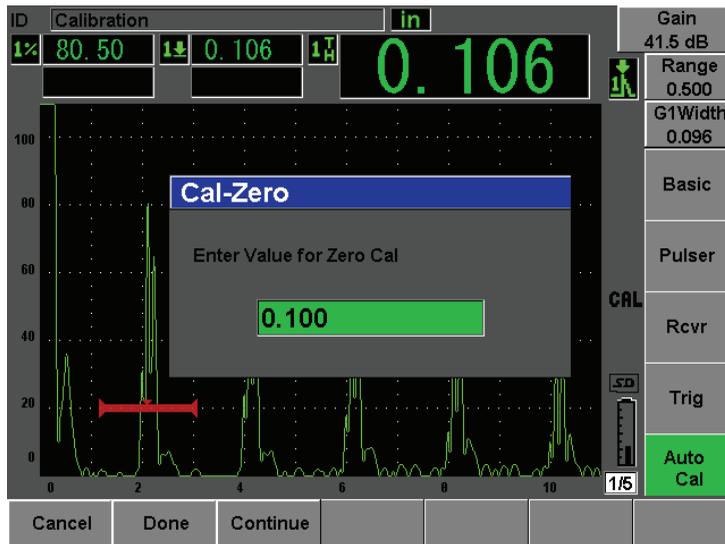


Figure 10-7 Entering the Zero Cal thickness value

11. Adjust the value to match the known thickness of the gated indication (0.100 in. in this example), and then choose **Continue** to continue to the second calibration step (see Figure 10-8 on page 162). The thickness value used in this part of the calibration will be stored for reference in the **Cal-Zero** parameter box.

#### NOTE

If for any reason you need to exit without acquiring calibration data, press **Cancel**.



Figure 10-8 Example of a gated signal for velocity calibration

12. Couple the transducer to the thick calibration block step.  
In this example, the transducer is coupled to the 0.500 in. step.
13. Use the [GATES] key to position gate 1 so that the first back-wall echo from the known thickness step exceeds the gate threshold.
14. Press [dB], and then adjust the gain value so that the echo amplitude is at approximately 80 %.  
A thickness measurement reading appears in large text above the A-scan.
15. Once a steady reading is achieved, choose **Auto Cal** > **Cal-Vel**.  
The screen freezes and the **Cal-Vel** box appears.
16. In the **Cal-Vel** box, adjust the value to match the known thickness of the gated indication (0.500 in. in this example), and then choose **Done** to complete the calibration process (see Figure 10-9 on page 163).

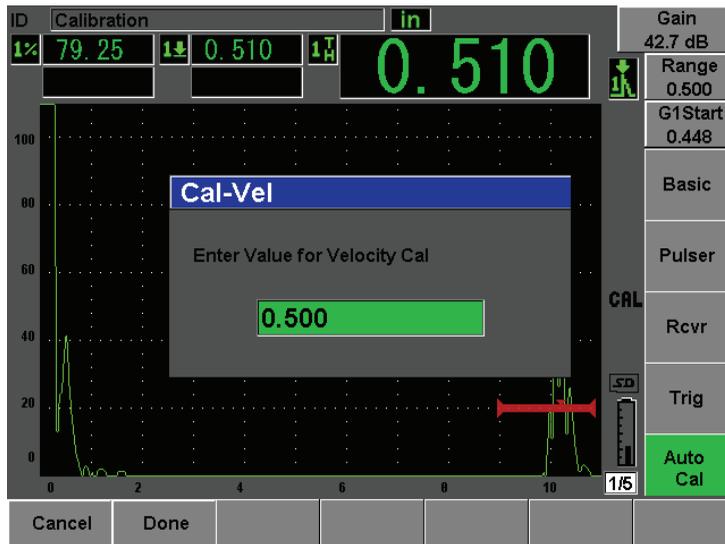


Figure 10-9 Entering the Velocity Cal thickness value

#### NOTE

It is possible to use the auto-calibration on a single test block of known thickness. You can use multiple back-wall echoes instead of coupling on both a thin step and a thick step. In this scenario, leave the transducer coupled on the thin step, move the gate over to one of the multiple back-wall echoes, and then enter the correct sound path thickness (2, 3, 4, etc. multiple of the first back-wall echo) during the velocity portion of the calibration.

## 10.5 Calibrating with a Dual Element Transducer

The sample dual element calibration described below is performed using an Olympus transducer part number DHC711-RM with a frequency of 5.0 MHz and an element diameter of 0.25 in. (6 mm).

The calibration requires a test block with two known thicknesses made from the material being measured. Ideally, the two thicknesses should represent thicknesses that are both below and above the expected thickness of the material to be inspected. For this example, Olympus standard 5-step steel test block (part number 2214E) is used. It has steps measuring 0.100 in., 0.200 in., 0.300 in., 0.400 in., and 0.500 in.

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<b>NOTE</b>
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If the EPOCH 600 is set to work in metric units, the calibration process is exactly the same, except that the entries are in millimeters rather than inches.

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<b>NOTE</b>
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Due to the acoustic characteristics of dual transducers, nonlinearity in the distance calibration occurs as the thickness of the material decreases. The point of maximum sensitivity is determined by the roof angle of the particular dual transducer. It is recommended that the distance calibration is carried out using a step block that covers the range of interest. Be careful when interpreting thickness measurement readings made outside the calibrated range. The EPOCH 600 does not have v-path correction; therefore, there might be some nonlinearity within the calibrated range depending on the minimum thickness used in the calibration process.

---

The zero offset value of dual element transducers can vary significantly at extreme temperatures. If the temperature changes more than a few degrees from the temperature at which the zero offset value was established, recheck its value. If thickness measurements are to be made over a wide temperature range, it is strongly recommended to use Olympus dual transducers that are designed for high-temperature applications and that have built-in delay lines with a stable sound velocity that does not change significantly with temperature. Specific recommendations are Olympus D790-SM and D791 dual element transducers.

### To calibrate using a dual element transducer

1. Follow the initial setup procedure outlined in section 10.1 on page 150.
2. Connect the transducer to an appropriate cable, and then connect the cable to the transducer connectors at the top of the instrument.
3. Select **Pulser > Mode = Dual**.

4. Press **[dB]**, and then increase the gain significantly so that the leading edges of the back-wall echoes appear as nearly vertical lines on the screen.
5. To use the leading edge when making thickness measurements, set the measurement gate to the edge detection mode by selecting **Gate Setup > G1 Mode = Edge**.
6. Select **Auto Cal > Type = Thickness**.
7. Couple the transducer to the thin calibration block step.  
For this example, the transducer is coupled to the 0.100 in. step. As noted above, a higher gain setting is required to produce a clean leading edge of the signal. Do not be concerned with the jagged peaks of the echo. Concentrate on the leading edge only.
8. Use the **[GATES]** key to position gate 1 so that the leading edge of the first back-wall echo from the known thickness step exceeds the gate threshold.
9. Press **[dB]** and adjust the gain setting so that the leading edge from the echo is as close to vertical as possible.

A thickness measurement reading appears in large text above the A-scan.

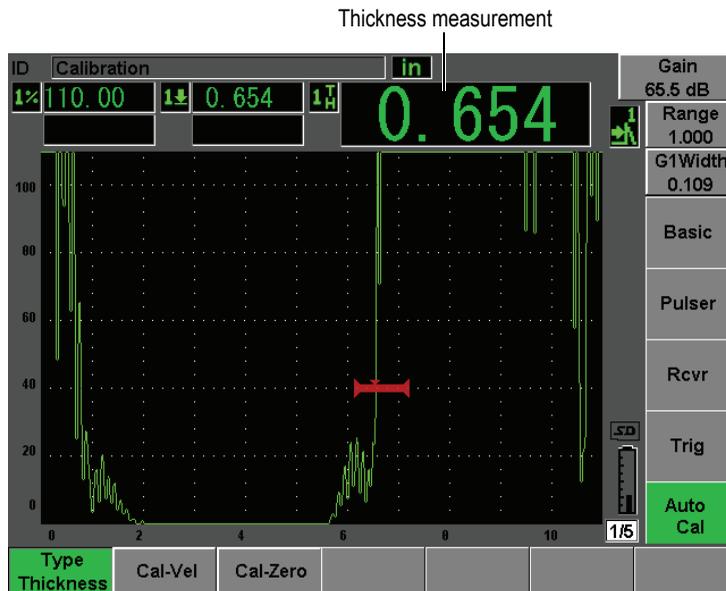


Figure 10-10 Example of a gated signal for zero calibration

- Once a steady reading is achieved, Choose **Auto Cal > CAL Zero**.

The screen freezes and the **Cal-Zero** box appears (see Figure 10-11 on page 166).

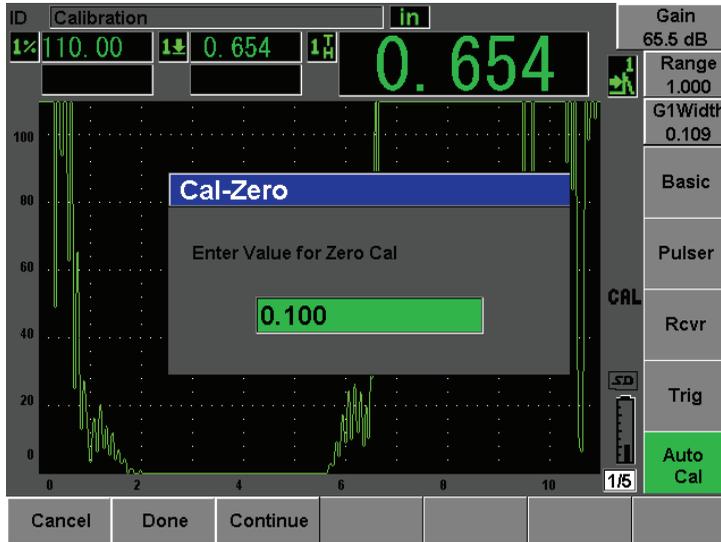


Figure 10-11 Entering the Zero Cal thickness value

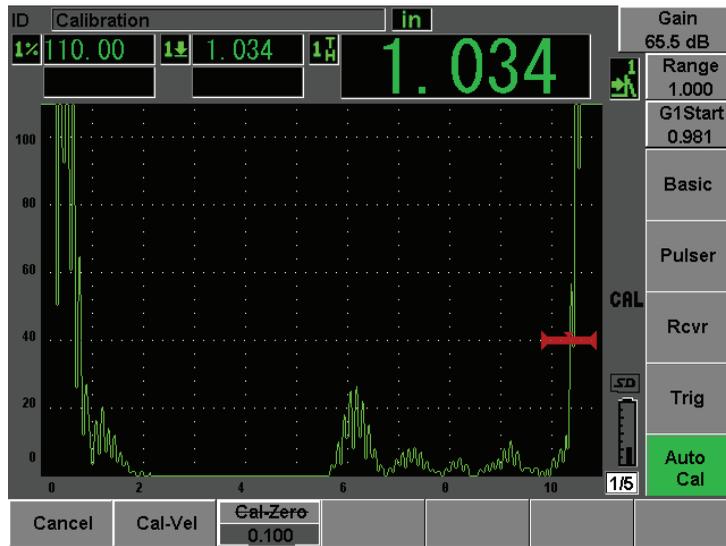
- Adjust the value to match the known thickness of the gated indication (0.100 in. in this example), and then choose **Continue** to continue to the second calibration step. The thickness value used in this part of the calibration will be stored for reference in the **Cal-Zero** parameter box.

---

**NOTE**

If for any reason you need to exit without acquiring calibration data, press **Cancel**.

---



**Figure 10-12 Example of a gated signal for velocity calibration**

12. Couple the transducer to the thick calibration block step.  
In this example, the transducer is coupled to the 0.500 in. step.
13. Use the **[GATES]** key to position gate 1 so that the first back-wall echo from the known thickness step exceeds the gate threshold. Adjust the gain so that the echo amplitude is at approximately 80 %.
14. Once a steady reading is achieved, choose **Auto Cal > CAL Velocity**.  
The screen freezes and the **Enter Value for Velocity Cal** box appears.
15. Adjust the value to match the known thickness of the gated indication (0.500 in. in this example), and then choose **Done** to complete the calibration process (see Figure 10-13 on page 168).

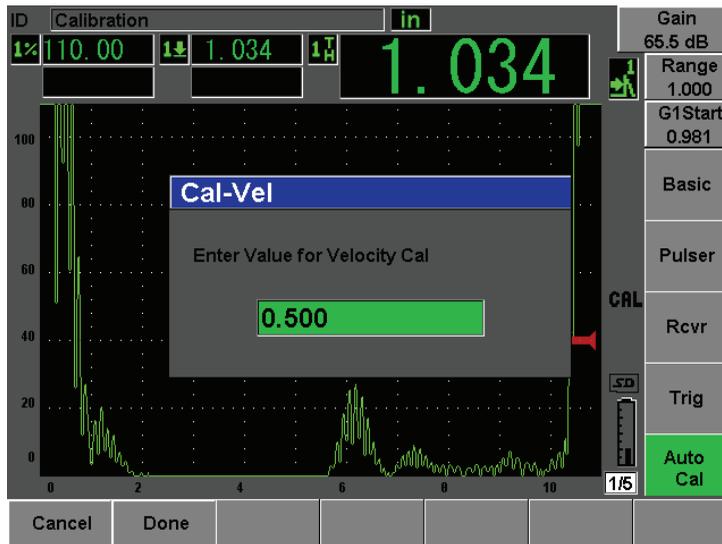


Figure 10-13 Entering the Velocity Cal thickness value

## 10.6 Calibrating in Echo-to-Echo Mode

The sample echo-to-echo calibration described below is performed using Olympus delay line transducer part number V202-RM, with a frequency of 10.0 MHz and an element diameter of 0.25 in. (6 mm).

In Echo-to-echo mode, the calibration requires a test block with only one known thickness, made from the material to be measured. Ideally, the thickness measurement is very close to the expected thickness of the material to be inspected. Echo-to-echo mode measures the distance between two actual indications, one representing the measurement start point and one representing the measurement end point. This eliminates the need for zero offset calibration, since the effects that cause a zero offset are accounted for by gating the start-point indication. Therefore, in an Echo-to-echo mode calibration, the instrument must only calibrate for material velocity to provide accurate readings.

For this example, we are using Olympus standard 5-step steel-test block, part number 2214E. The steps measure 0.100 in., 0.200 in., 0.300 in., 0.400 in., and 0.500 in.

**NOTE**

If the EPOCH 600 is set to work in metric units, the calibration process is exactly the same, except that the entries are in millimeters rather than inches.

---

**To calibrate in echo-to-echo mode using a delay line transducer**

1. Follow the initial setup procedure outlined in section 10.1 on page 150.
2. Connect the transducer to an appropriate cable, and then connect the cable to either of the conventional transducer connectors at the top of the instrument.  
With a zero offset of 0.000  $\mu\text{s}$ , the excitation pulse (or main bang) should appear on the left side of the screen.
3. Choose **Basic > Zero**, and then increase the value until the excitation pulse moves off the left side of the screen and the interface echo from the end of the delay line tip appears on the screen.
4. Verify that the echo represents the end of the delay by tapping your finger on the end of the couplant-coated delay line.  
This dampens the signal and the echo should jump up and down on the screen.
5. Choose **Basic > Zero**, and then increase the value to move this echo to the left side of the screen so that it is barely visible.  
At least two gates must be active to acquire an echo-to-echo measurement. Gate Tracking must also be active.
6. Activate gate 1 and gate 2, by selecting **Gate 1 > Status = On** and **Gate 2 > Status = On**.
7. Select **Gate Setup > G2 Tracks = On** so that gate 2 tracks gate 1.  
For more information on gate tracking activation, see section 8.5 on page 136.
8. Select **Auto Cal > Type = G2-1**.
9. Couple the transducer to the calibration block.  
For this example, the transducer is coupled to the 0.300 in. step.
10. Use the **[GATES]** key to position gate 1 so that the first back-wall echo from the known thickness step exceeds the gate threshold.
11. Use the **[GATES]** key to position the separation of gate 1 and gate 2 so that the second back-wall echo from the known thickness step exceeds the gate 2 threshold.
12. Adjust the gain so that neither signal is saturated, and so that the echo amplitude in gate 2 is above 50 %.

A thickness measurement reading appears in large text above the A-scan, labeled 2-1.

### TIP

In attenuating materials, it might be impossible to bring the second indication above 50 % while avoiding saturation of the first signal. If this is true, try using the **Edge** detection mode instead of the peak detection to ensure accurate measurements (see section 8.3 on page 133 for details).

### NOTE

Ensure that gate 1 and gate 2 are capturing successive back-wall echoes, not multiple echoes from the end of the delay line tip.

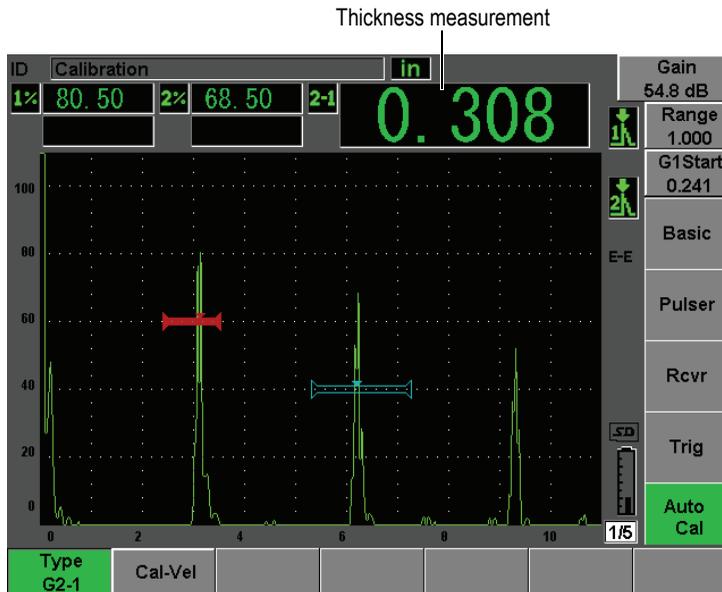


Figure 10-14 Example of gated signals for velocity calibration

13. Once a steady reading is achieved, choose **Auto Cal > Cal-Vel**.  
The screen freezes and the **Cal-Vel** box appears (see Figure 10-15 on page 171).

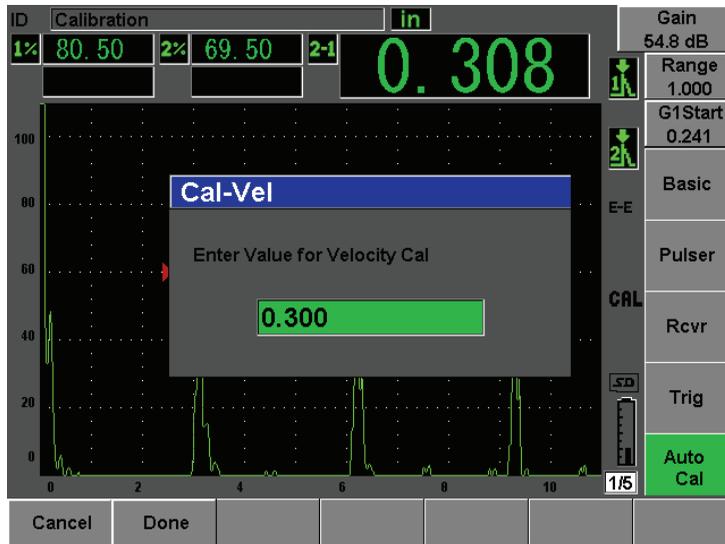


Figure 10-15 Entering the Velocity Cal thickness value

14. Adjust the value to match the known thickness of the gated indication (0.300 in. in this example), and then choose **Done** to complete the calibration process.

#### NOTE

If for any reason you need to exit without acquiring calibration data, press **Cancel**.

## 10.7 Calibrating to Known Sound Path Values with an Angle Beam Transducer

The following sample angle beam calibration procedure is performed using an Olympus transducer part number A430S-SB with a frequency of 2.25 MHz and an element size of 0.625 in. x 0.625 in. The transducer is mounted on a 45° wedge, part number ABWS-6-45. An Olympus IIW Type I carbon-steel calibration block, part number TB7541-1, is used.

### To calibrate using an angle beam transducer

1. Follow the initial setup procedure outlined in section 10.1 on page 150.
2. Connect the transducer to an appropriate cable, and then connect the cable to either of the conventional transducer connectors at the top of the instrument.
3. Choose **Trig > Angle**, and then enter the correct refracted angle for the transducer/wedge combination (45° for this example).
4. Choose **Basic > Velocity**, and then enter the approximate shear-wave velocity of the material being inspected (0.1280 in./ $\mu$ s or 3.251 mm/ $\mu$ s if working in metric units for this example using carbon steel).
5. Choose **Basic > Range**, and then enter an appropriate range for the test block being used (12.000 in. or 304.80 mm if working in metric units for this example).

Review the following procedures:

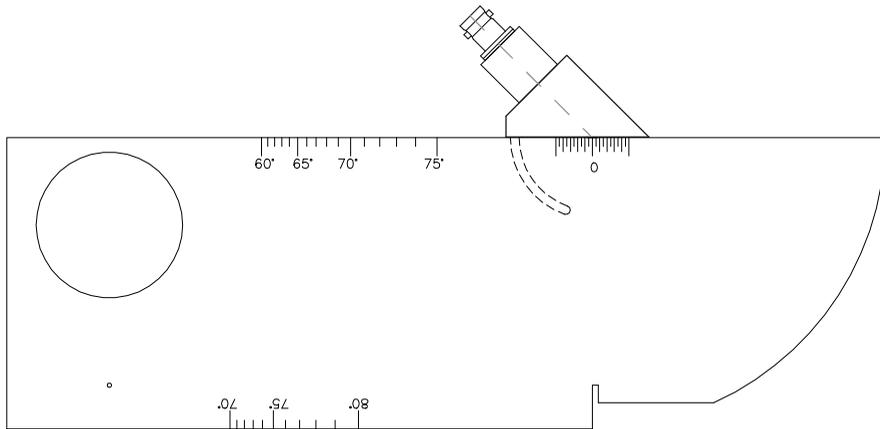
- “Locating the Beam Index Point” on page 172
- “Verifying the Refracted Angle” on page 174
- “Calibrating for Distance” on page 176
- “Calibrating for Sensitivity” on page 181

### 10.7.1 Locating the Beam Index Point

The beam index point (BIP) is the point at which the sound leaves the wedge and enters the material with maximum energy. The following procedure provides a method to identify the BIP for your probe/wedge.

#### To locate the BIP

1. Couple the probe to the test block at the 0 mark.



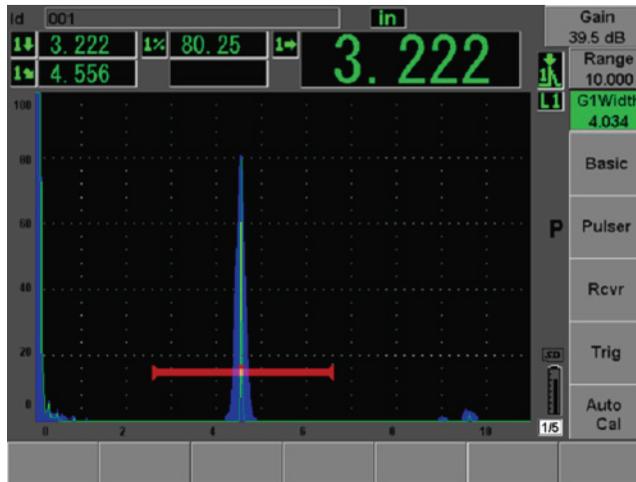
**Figure 10-16 IIW block with probe at 0 mark**

2. Manipulate the probe until a high-amplitude signal appears on the screen after the excitation pulse.  
This is the reflection from the large arc of the block that is located on the Type I block at 4.00 in. (100 mm).
3. Move the probe forward and backward to bring the echo to its maximum amplitude (peak).
4. Ensure the echoes do not exceed 100 %. If necessary, reduce the gain.

---

**TIP**

The peak memory is an excellent tool for finding the BIP. Press **[PEAK MEM]** to turn peak memory on. This feature draws and collects the echo envelope of the signal while also drawing the live waveform (see Figure 10-17 on page 174). Match the live waveform with the maximum point corresponding to the previously accumulated echo dynamic curve. Press **[PEAK MEM]** again to turn peak memory off.



**Figure 10-17 Using the Peak Memory feature to find the BIP**

- 
5. Hold the probe stationary once the signal is peaked up and mark the side of the transducer wedge directly over the 0 mark on the block.  
This is the BIP, the point at which the sound leaves the wedge and enters the material with maximum energy.

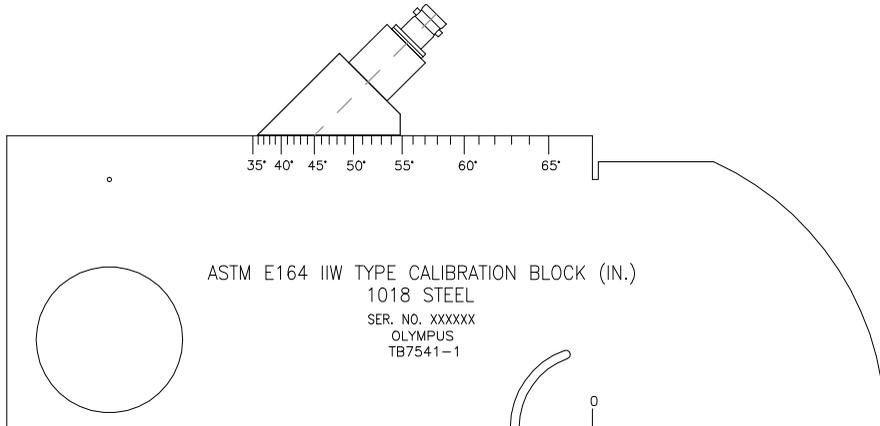
### 10.7.2 Verifying the Refracted Angle

The expected refracted angle of the probe should already have been entered in the EPOCH 600 in the initial steps of the calibration procedure. Although the wedge may be marked 45°, for example, the actual refracted angle could be slightly different due

to the properties of the test material or the amount of wear on the wedge. It is necessary to verify the actual angle. This ensures that the EPOCH 600 sound path calculations are accurate.

### To verify the refracted angle

1. Position the probe over the appropriate angle mark on the block (45° in this example).



**Figure 10-18 The IIW block with probe at the 45° mark**

2. Move the probe backward and forward to maximize the amplitude of the echo coming from the large circular hole in the side of the block. The circular hole may be filled with Plexiglas, but the procedure is the same.

#### **TIP**

Press **[PEAK MEM]** to use the Peak Memory feature to help find the peak of the signal.

3. Hold the probe stationary once the signal amplitude reaches a maximum and then note the degree mark on the block that is aligned with the BIP, which was marked on the side of the wedge in the procedure of section 10.7.1 on page 172. This is the actual refracted angle (Beta) for this particular transducer and wedge in steel.

4. If this refracted angle value (Beta) differs from the value entered previously, select **Trig > Angle**, and then enter the corrected angle.



Figure 10-19 Verifying the refracted angle

### 10.7.3 Calibrating for Distance

The ASTM E-164 IIW Type I block, which has a crescent cut in the side, produces echoes at 4 in. (100 mm) and 9 in. (225 mm) on the screen, which are used for sound path distance calibration. The following procedure uses the Olympus IIW Type I carbon steel calibration block, part number TB7541-1. For information on distance calibration with other standard calibration blocks, see section 10.10 on page 189.

#### NOTE

If the EPOCH 600 is set to work in metric units, the calibration process is exactly the same, except that the entries are in millimeters rather than inches.

**To calibrate for sound path distance**

1. Choose **Basic > Range**, and then set the value to 12.00 in. (300 mm).  
This should ensure that the echoes from the block are visible on screen.
2. Select **Auto Cal > Type = Soundpath**.
3. Couple the transducer to the calibration block so that the BIP is directly over the 0 mark on the ASTM test block. Do not move the transducer from this point during the distance calibration step.
4. Use the **[GATES]** key to position gate 1 so that the first reflection from the arc of the block is exceeding the gate threshold.  
This reflection should be close to 4 in. (100 mm).
5. Press **[dB]**, and then adjust the gain setting so that the echo amplitude is at approximately 80 %.

---

<b>TIP</b>
------------

The AUTO XX% can be used to automatically adjust the gain to set the gated echo amplitude to XX% of full screen height (the default XX value is 80 %). To activate this feature, press **[2ND F], (AUTO XX%)**.

---

A thickness measurement reading appears in large text above the A-scan (see Figure 10-20 on page 178).

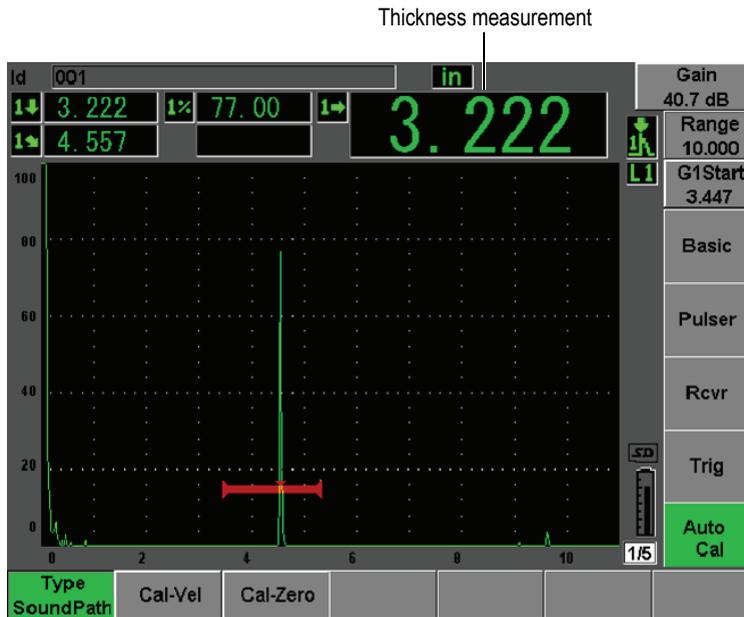


Figure 10-20 Example of a gated signal for zero calibration

6. Once a steady reading is achieved, choose **Auto Cal** > **Cal-Zero**.  
The screen freezes and the **Cal-Zero** box appears.



**Figure 10-21 Entering the Zero Cal thickness value**

7. Adjust the value to match the known thickness of the gated indication (4.000 in. in this example), and then choose **Continue** to continue to the second calibration step.

#### NOTE

If for any reason you need to exit without acquiring calibration data, press **Cancel**.

8. Use the **[GATES]** key to position gate 1 so that the second echo reflection from the arc of the block is within the gated region. This reflection should be close to 9 in. (225 mm) [see Figure 10-22 on page 180].

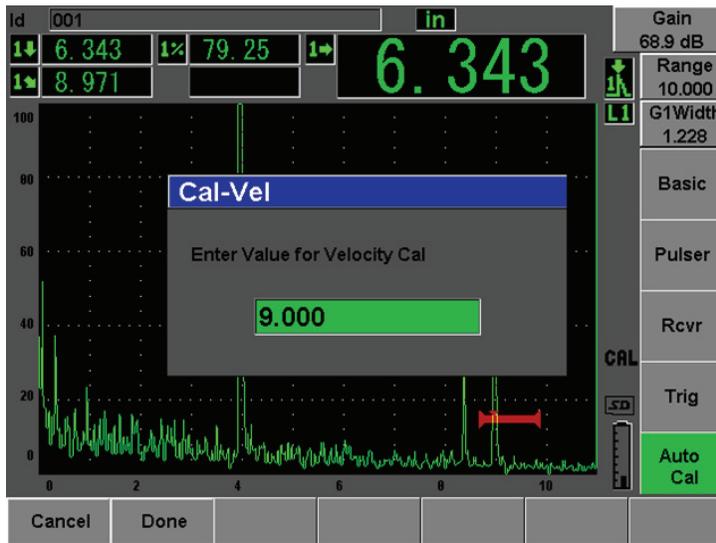


Figure 10-22 Example of a gated signal for velocity calibration

#### NOTE

Another echo might be present on the screen at approximately the 8 in. (200 mm) point. Disregard this echo as it is usually the result of beam spreading and sound bouncing off the side of the block. Ensure that gate 1 is not over this echo.

9. Press **[dB]**, and then adjust the gain so that the echo amplitude is at approximately 80 %.  
A thickness measurement reading appears in large text above the A-scan.
10. Once a steady reading is achieved, choose **Auto Cal > Cal-Vel**.  
The screen freezes and the **Enter Value for Velocity Cal** box appears (see Figure 10-23 on page 181).

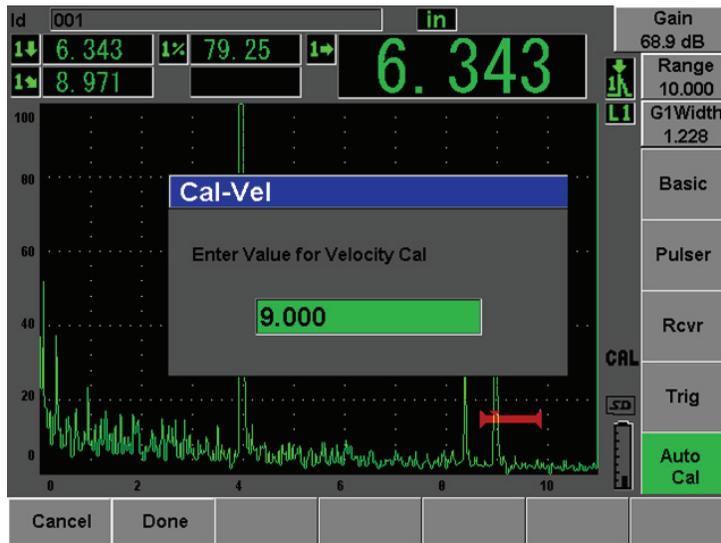


Figure 10-23 Entering the Velocity Cal thickness value

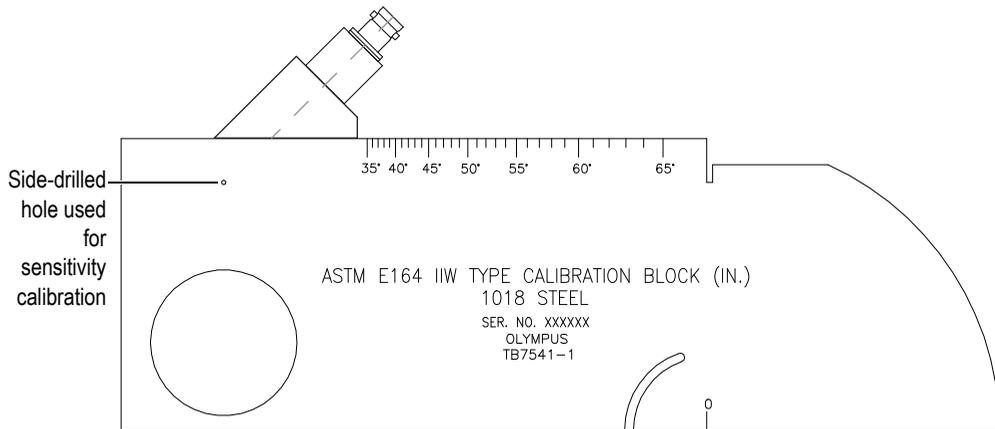
- Adjust the value to match the known thickness of the gated indication (9.000 in. in this example), and then press **Done** to complete the calibration process.

#### 10.7.4 Calibrating for Sensitivity

The final step in the angle beam calibration is to calibrate for sensitivity. This allows you to set up a reference gain level for your inspection.

##### To calibrate for sensitivity

- Couple the probe to the IIW calibration block so that the transducer is aiming at the 0.060 in. (1.5 mm) diameter side-drilled hole, used as a reference-reflector.



**Figure 10-24 The IIW block with probe facing sensitivity hole**

2. Move the probe backward and forward to maximize the amplitude of the echo from the hole. Do not confuse the reference-reflector echo from the side of the block.

---

<b>TIP</b>
------------

Press **[PEAK MEM]** to use the Peak Memory feature to help find the peak of the signal.

---

3. Once the echo amplitude is maximized, adjust the system sensitivity (gain) to bring the reference-reflector signal to a predetermined reference line on the screen. In this example, the echo is brought to 80 % of full-screen height.
4. Press **[2ND F], (REF dB)** to lock in the reference-gain level and add/subtract scanning gain separately.
5. Use the **Add, Scan Db, +6 dB, -6 dB, and Off** parameters to make scanning gain adjustments once the reference gain (**Ref**) is active (see Figure 10-25 on page 183). For more information on these functions, please see section 6.3 on page 113.

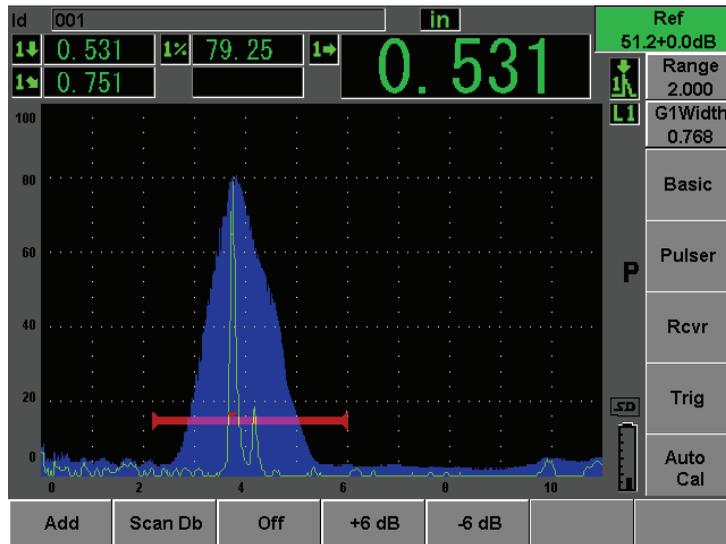


Figure 10-25 Setting the reference gain

## 10.8 Calibrating to Known Depth Values with an Angle Beam Transducer

The EPOCH 600 allows you to perform distance calibration with an angle beam transducer based on the known depth of equal sized reflectors (usually side-drilled holes) instead of known sound paths. The following sample angle beam calibration details the procedure for the depth calibration.

As with any angle beam calibration, you must also verify the beam index point (BIP), refracted angle, and perform a sensitivity calibration. It is of particular importance to verify the refracted angle before performing a distance calibration. The acquired depth measurement(s) used in this mode of calibration are based on calculations from the sound path of the reflector (direct measurement) and the value of the manually entered angle parameter. If the angle value is not correct, the distance calibration in depth mode will not be accurate.

The following procedure describes only the depth distance calibration process for the EPOCH 600. To verify the BIP and the refracted angle, and to calibrate for sensitivity, refer to section 10.7 on page 172. The following sample angle beam calibration is performed using an Olympus transducer part number A430S-SB with a frequency of

2.25 MHz and an element size of 0.625 in. x 0.625 in. The transducer is mounted on a 45° wedge, part number ABWS-6-45. An Olympus NAVSHIPS carbon-steel calibration block, part number TB7567-1, is used.

### Calibrating for Distance

The NAVSHIPS Block, which has six No. 3 side-drilled holes at various depths (see Figure 10-35 on page 193), produces echoes at various depths on the screen in 0.25 in. (6.35 mm) increments, which are used for depth distance calibration. This allows you to calibrate for various inspections ranges up to 2.75 in. (69.85 mm). For this sample calibration, the side-drilled holes at depth 0.5 in. and 1.5 in. (12.5 mm and 38 mm) are used.

For information on distance calibration with other standard calibration blocks, see section 10.10 on page 189.

---

<b>NOTE</b>
-------------

If the EPOCH 600 is set to work in metric units, the calibration process is exactly the same, except that the entries are in millimeters rather than inches.

---

### To calibrate for depth distance

1. Choose **Basic > Range**, and then set the value to 4 in. (100 mm). This ensures that the echoes from the block are visible on screen.
2. Select **Auto Cal > Type = Depth**.
3. Couple the transducer to the calibration block and move the probe backward and forward to maximize the reflection from the side-drilled hole at depth 0.5 in. (12.7 mm).

---

<b>TIP</b>
------------

Press [**PEAK MEM**] to use the Peak Memory feature to help find the peak of the signal.

---

4. Use the [**GATES**] key to position gate 1 so that the reflection from the first side-drilled hole is exceeding the gate threshold. This reflection should be close to 0.5 in. (12.5 mm) [see Figure 10-26 on page 185].

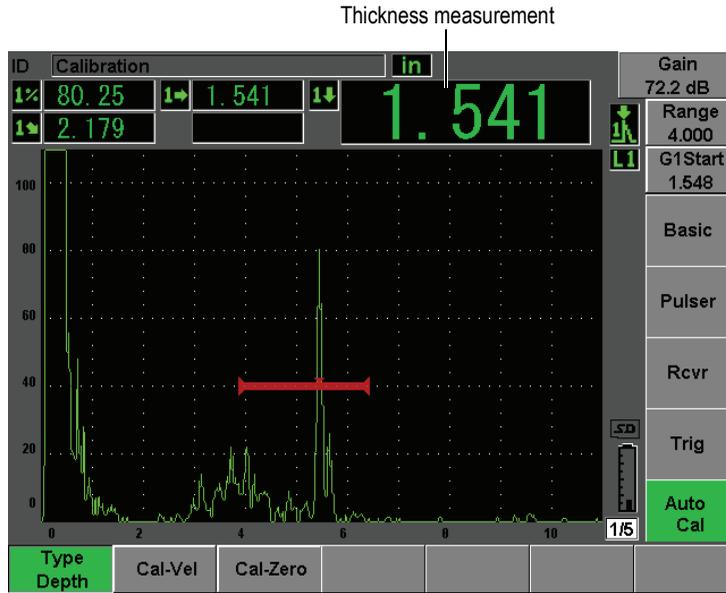


Figure 10-26 Example of a gated signal for zero calibration

5. Press **[dB]**, and then adjust the gain so that the echo amplitude is at approximately 80 %.

#### TIP

The AUTO XX% feature can be used to automatically adjust the gain to set the gated echo amplitude to XX% of full screen height (the default XX value is 80 %). To activate this feature, press **[2ND F]**, **(AUTO XX%)**.

- A thickness measurement reading appears in large text above the A-scan.
6. Once a steady reading is achieved, choose **Auto Cal > Cal-Zero**.  
The screen freezes and the **Cal-Zero** box appears (see Figure 10-27 on page 186).



Figure 10-27 Entering the Zero Cal thickness value

7. Adjust the value to match the known thickness of the gated indication (0.500 in. in this example), and then choose **Continue** to continue to the second calibration step (see Figure 10-28 on page 187).

---

**NOTE**

If for any reason you need to exit without acquiring calibration data, press **Cancel**.

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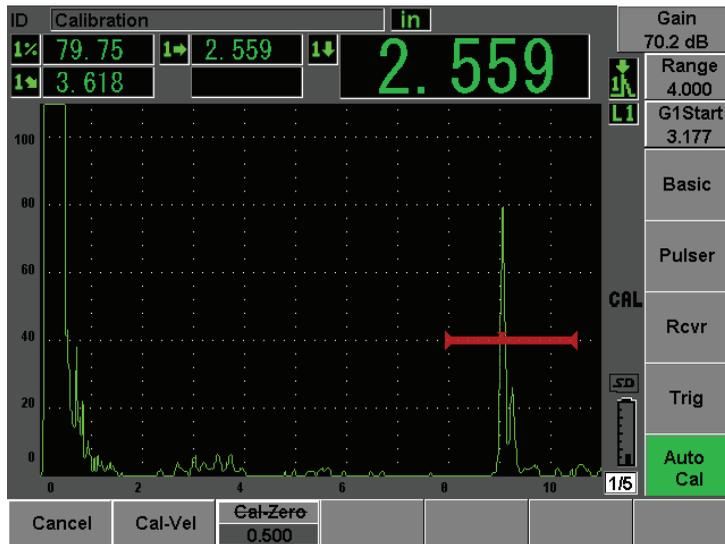


Figure 10-28 Example of a gated signal for velocity calibration

8. Use the [GATES] key to position gate 1 so that the reflection from the second side-drilled hole is within the gated region.  
This reflection should be close to 1.5 in. (38.1 mm).
9. Press [dB] and adjust the gain so that the echo amplitude is at approximately 80 %.  
A thickness measurement reading appears in large text above the A-scan.
10. Once a steady reading is achieved, choose **Auto Cal** > **Cal-Vel**.  
The screen freezes and the **Cal-Vel** box appears (see Figure 10-29 on page 188).

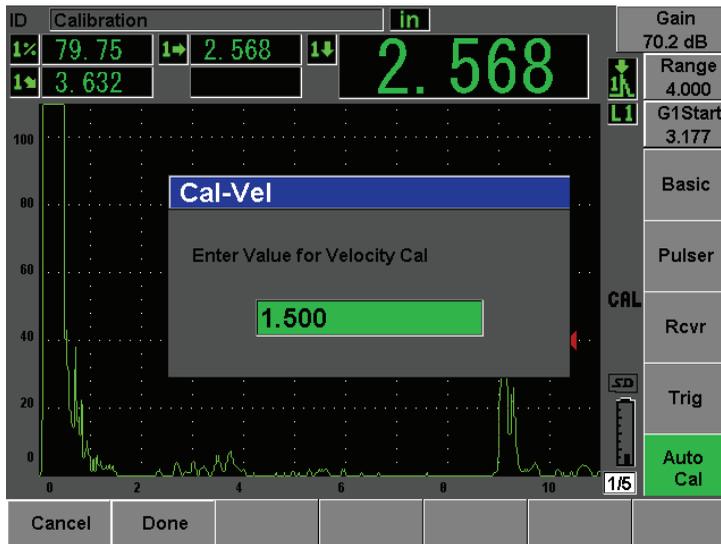


Figure 10-29 Entering the Velocity Cal thickness value

- Adjust the value to match the known thickness of the gated indication (1.500 in. in this example), and then choose **Done** to complete the calibration process.

## 10.9 Curved Surface Correction

The EPOCH 600 provides for surface distance correction when inspecting pipes, cylinders, and other curved surfaces using an angle beam transducer. This applies only to inspections where the surface of the test piece is curved in the direction of the sound path of the transducer. This feature corrects the horizontal distance and depth to reflector measurements based on part thickness and part diameter. The correction is applicable for curved surface inspections where the transducer is placed on the outer diameter of the part. Curved surface correction can also be applied to solid cylinders (bars).

### To activate curved surface correction

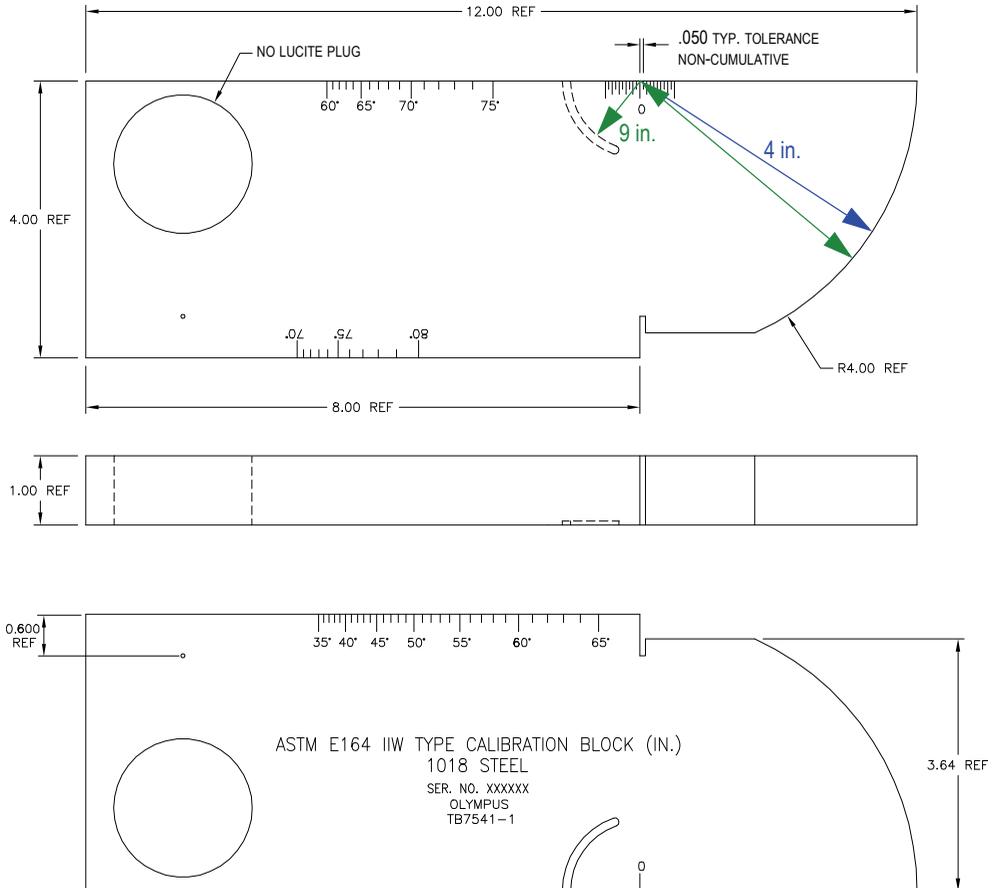
- Select **Trig > CSC = Outer Dia** or **Bar** to activate curved surface correction for either tubular or solid cylinders.

The **CSC** symbol appears in the flag area.

2. Choose **Trig > Diameter**, and then enter the outer diameter of the inspection piece.

## 10.10 Common Angle Beam Calibration Block Diagrams

Figure 10-30 on page 189 to Figure 10-36 on page 194 illustrate calibration blocks commonly used with angle beam probes.



**Figure 10-30** The ASTM E164 IIW type calibration block (P/N: TB7541-1)

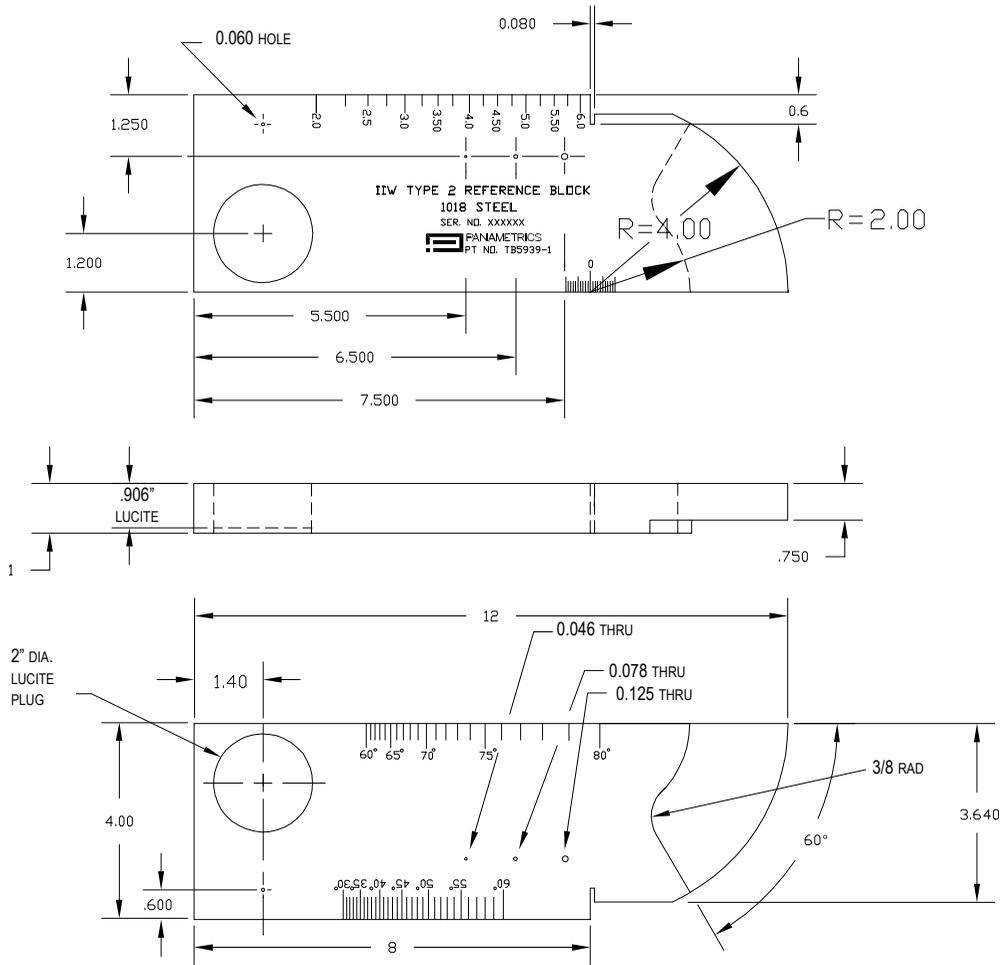
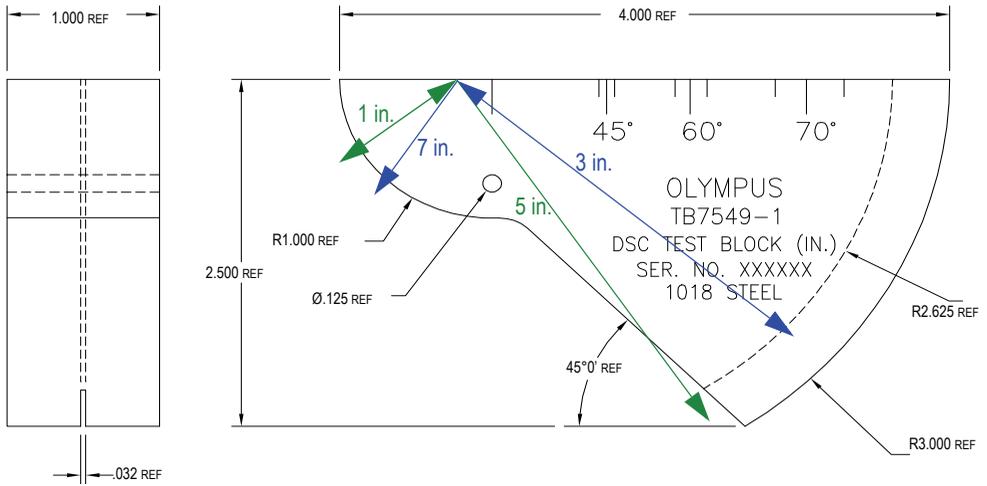
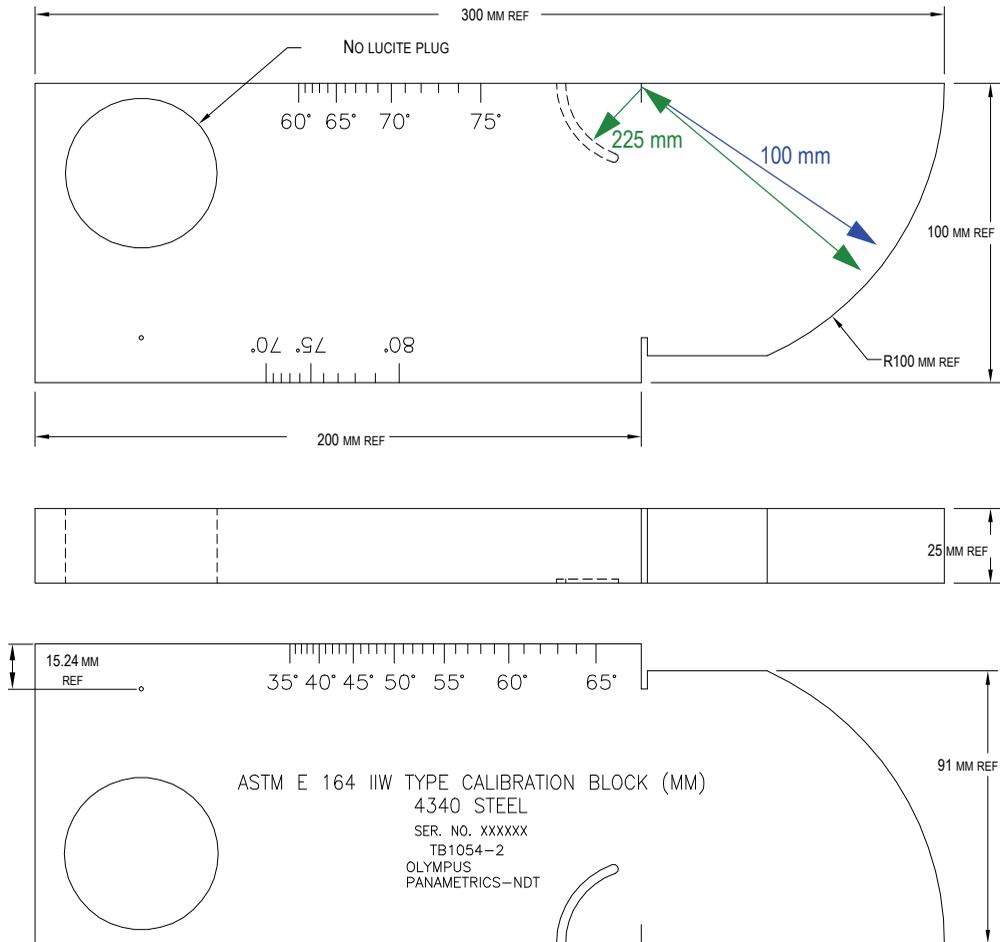


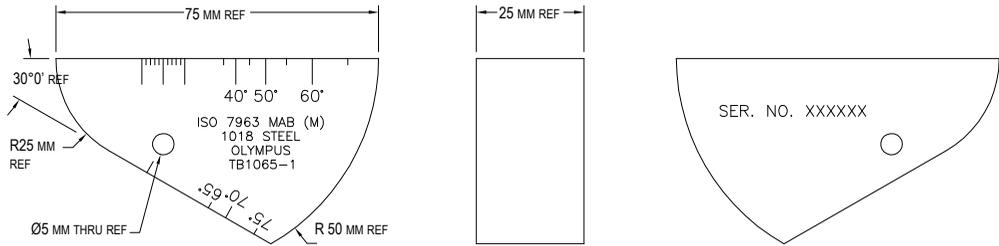
Figure 10-31 The IIV type 2 reference block (P/N: TB5939-1)



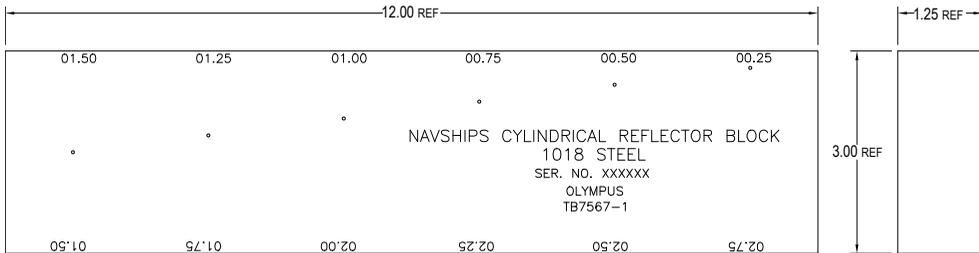
**Figure 10-32 The distance and sensitivity calibration (DSC) test block (P/N: TB7549-1)**



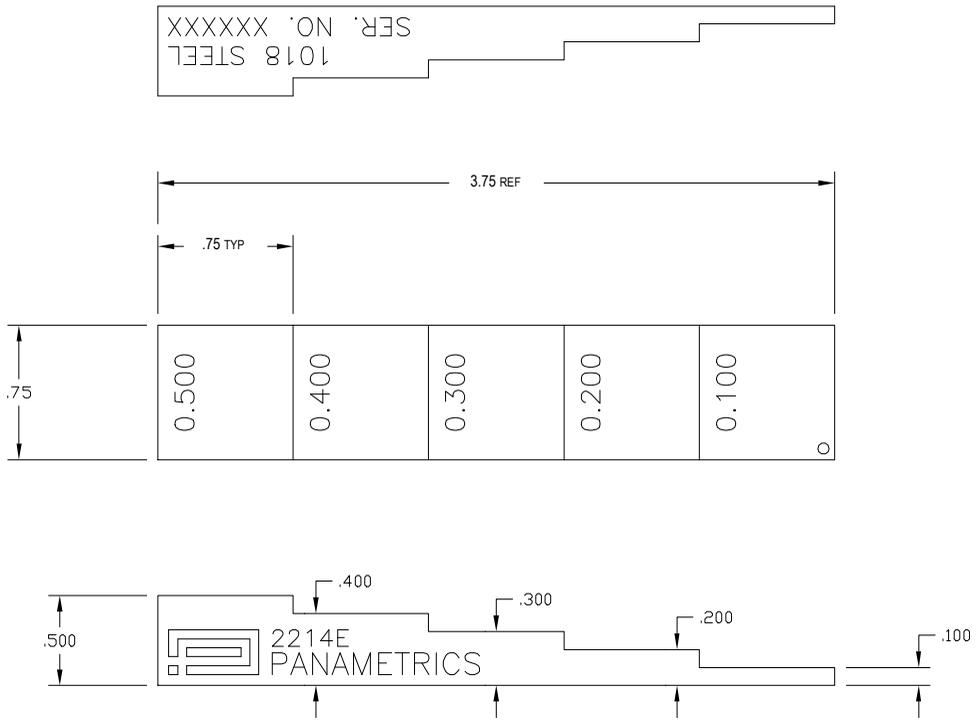
**Figure 10-33 The ASTM E164 IIW type metric calibration block (P/N: TB1054-2)**



**Figure 10-34 The ISO 7963 MAB calibration block (P/N: TB1065-1)**



**Figure 10-35 The Navships cylindrical reflector block (P/N: TB7567-1)**



**Figure 10-36 The 5-step precision thickness calibration block (P/N: 2214E)**

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## 11. Managing the Data Logger

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This chapter describes how to manage the EPOCH 600 internal data logger. Topics covered include the following:

- “Data Logger Overview” on page 195
- “Data Logger Storage Capacity” on page 196
- “Data Logger Menu Functions” on page 196
- “Data Logger Parameter Functions” on page 199
- “Saving Screen Captures” on page 215

### 11.1 Data Logger Overview

Olympus has designed the data logger for ease of use and a wide range of file types and features for flaw detection and corrosion thickness gaging requirements. The data logger includes the following capabilities:

- Data organized by file and identifier (ID) codes
- Alphanumeric filenames and identifier (ID) codes
- File description, inspector ID, and location note field for every file
- File types:
  - Calibration files
  - Incremental files
- Ability to edit files and add and delete IDs, rename files, clear file contents, and delete files.
- On-screen review of all file contents
- File summary screen for measurement review without images and setup
- Ability to transfer data between the EPOCH 600 and a computer or printer.

- Ability to store files, images, and exported data on removable memory.

## 11.2 Data Logger Storage Capacity

The EPOCH 600 stores the following information every time you press [2ND F], (SAVE) or [SAVE] (depending on the configuration):

- File name
- Identifier (ID) code
- Alarm conditions
- Gate measurement modes
- Sound path leg for each gate
- Up to five measurement reading box values (all active user-selected measurements on the instrument screen).
- A-scan waveform
- Peak memory envelope or peak hold waveform, if active
- Complete setup parameters
- Flag status ([FREEZE], zoom, [PEAK MEM], etc.)
- Active software feature(s) [DAC/TVG, DGS/AVG, AWS D1.1/D1.5]

The EPOCH 600 data logger can store over 300,000 IDs with the information listed above. All data is stored for every ID that you choose to save on the instrument's internal 2 GB MicroSD card.

## 11.3 Data Logger Menu Functions

The EPOCH 600 Data Logger is split into two main function sets: **File** and **Manage**. The available parameters in the **File** and **Manage** menus are listed below along with their function. Many of the parameters in the data logger open a menu and are not simply adjustable values. Please note that some of the parameters perform more than one function.

### 11.3.1 File Menu

This section presents the **File** menu (see Figure 11-1 on page 197).

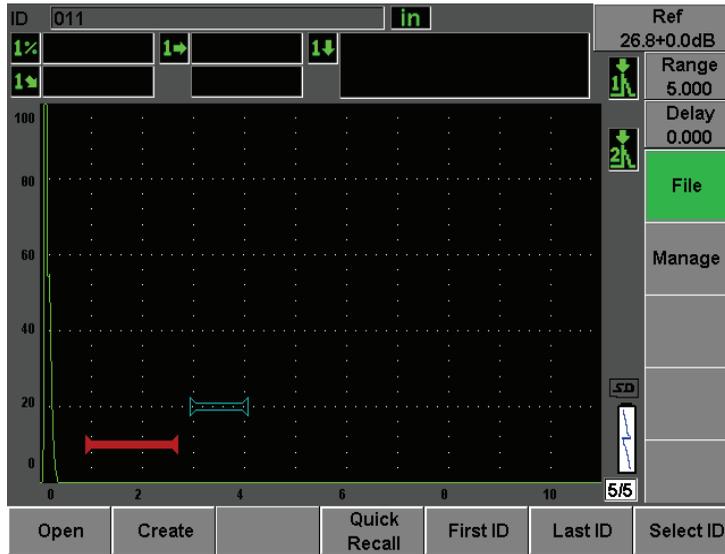


Figure 11-1 The File menu

### Open

Used to:

- Select a file as the active storage location
- View details about a specific file
- View setup and waveform data for saved IDs in a file
- Recall a file ID to bring saved data to the live screen
- View a summary of all saved data in a file
- Export file data to MicroSD card

### Create

Used to create a new file

### Quick Recall

Used to recall a saved setup from a calibration file from calibration file list

### First ID

Used to jump to the first identifier (ID) in the currently open file

**Last ID**

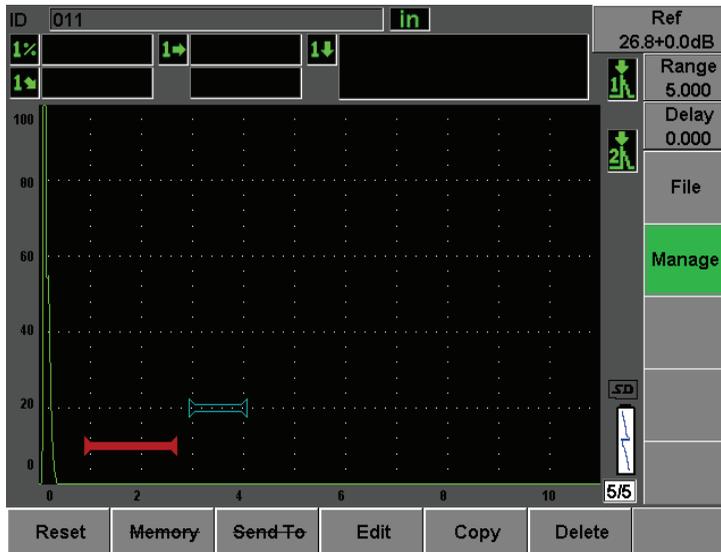
Used to jump to the last identifier (ID) in the currently open file

**Select ID**

Used to select ID from list of all IDs in the currently open file

**11.3.2 Manage Menu**

This section presents the **Manage** menu (see Figure 11-2 on page 198).



**Figure 11-2 The Manage menu**

**Reset**

Used to access **Resets** setup menu for parameter and database reset functions

**Edit**

Allows editing of file names and description parameters

**Copy**

Used to make a duplicate copy of a saved file on the instrument

**Delete**

Used to delete a saved file from the instrument

---

<b>NOTE</b>
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The **Memory** and **Send To** functions are currently not available.

---

## 11.4 Data Logger Parameter Functions

As stated above, each of the data logger parameters in the **File** and **Manage** menus performs specific functions. The following sections will describe the functions of each of the parameters in the data logger menus.

### 11.4.1 Open Function

The **Open** parameter performs multiple functions for saved files in the data logger. Each of these functions is described in detail in the sections that follow.

#### 11.4.1.1 Selecting a File as the Active Storage Location.

The EPOCH 600 maintains a list of all files that have been created or downloaded to the instrument. To save information to a file, you must first open a specific file to select it as the active storage location.

The open function allows you to use calibration files and inspection storage files at the same time within a procedure while minimizing required button presses. For example, a particular inspection may require the use of three separate transducers and therefore three calibrations, but you may wish to store all inspection data in one inspection file. In this situation, open the desired inspection file first.

#### To open a file and set it to the active storage location

1. Choose **File > Open**.

The Open menu appears (see Figure 11-3 on page 200).

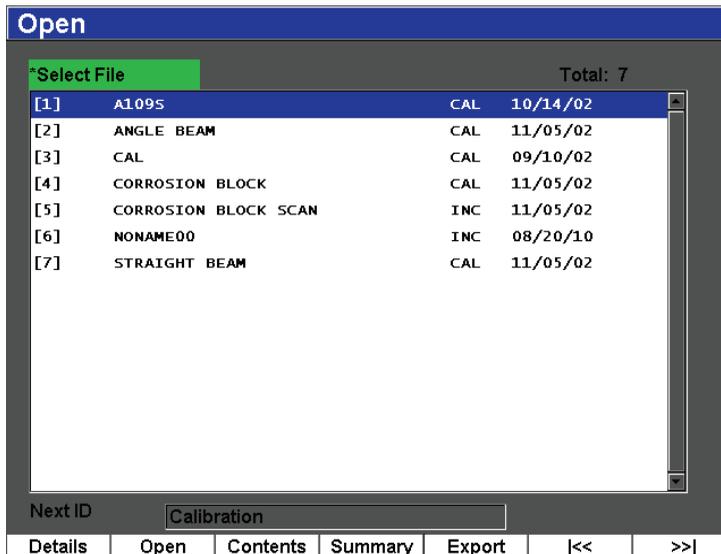


Figure 11-3 The Open function

2. Select the specific file that you want to open.
3. Choose **Open** to open the selected file and return to the live screen.  
The first empty ID of the opened file is now displayed on the top left corner of the display.
4. When you press the [SAVE] key, current on-screen data and settings are saved to the currently open ID.

#### 11.4.1.2 Viewing details about a specific file

After you have created a file, you are able to view the file setup information.

##### To view the setup information

1. Choose **File > Open**, and then select the specific file that you want to view.
2. Press [P1] to enter the **Details** menu.  
File setup and creation information are displayed here (see Figure 11-4 on page 201).

Details						
Filename	<input type="text" value="A109S"/>					
Description	<input type="text"/>					
Inspector ID	<input type="text"/>					
Location Note	<input type="text"/>					
File Type	<input type="text" value="CAL"/>					
Date Created	<input type="text" value="10/14/02"/>	<input type="text" value="03:41 AM"/>				
Date Modified	<input type="text" value="11/08/10"/>	<input type="text" value="06:53 PM"/>				
Total ID Count	<input type="text" value="1"/>					
Done	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Figure 11-4 The Details menu

3. Press **Done** to return to the **Open** menu or press the [ESCAPE] key to return to the main screen.

### 11.4.1.3 Viewing Setup and Waveform Data for Saved IDs in a File

Once data has been saved into a file, you are able to view contents of the saved data. The waveform and basic setup parameters are stored on one screen, and the complete setup information on another screen.

1. Choose **File > Open**, and then select the specific file that you want to view.
2. Press **Contents** to view the saved waveform and the basic setup data.

The ID being viewed shows up at the top left corner of the screen (see Figure 11-5 on page 202).

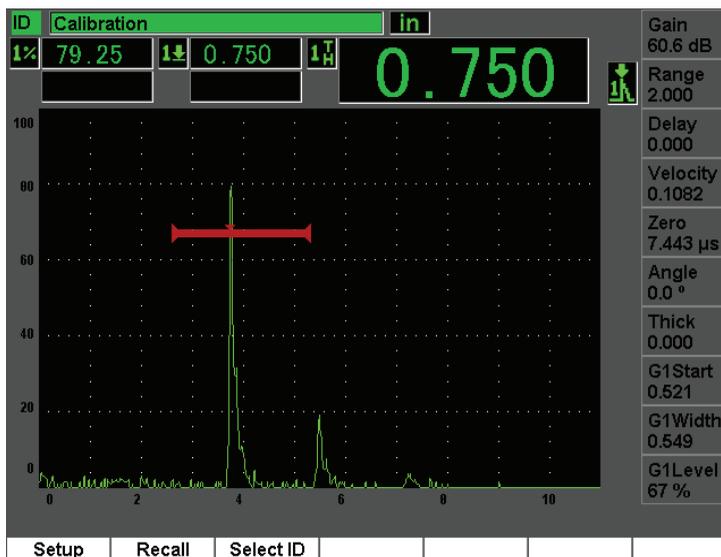


Figure 11-5 Viewing file content (waveform)

3. Press **Setup** to view the complete setup parameters for the current ID (see Figure 11-6 on page 203).

ID	Calibration		
Velocity	0.1082 in/ $\mu$ s	Zero	7.443 $\mu$ s
Range	2.000	Delay	0.000
Angle	0.0°	Thick	0.000
CSC	Off	CSC Diameter	25.000
G1Start	0.521	G2Start	Off
Width	0.549	Width	Off
Level	67 %	Level	Off
Alarm	Off	Alarm	Off
PRF	290 Hz	Damp	50 $\Omega$
Mode	Dual	Energy	100 v
Freq	5.00 MHz	Reject	0 %
Filter	0.2-10 MHz	Rect	Full
Pulser	Square		
Waveform	Recall	Select ID	

Figure 11-6 Viewing file content (setup)

- To switch to a different ID, use the knob (or arrows) to scroll through the saved IDs in the file or press [P3] to enter the **Select ID** menu.
- When you have selected the ID you want to view, press [P1] (**Select**).
- To return to the **Open** menu, press the [ESCAPE] key.

#### 11.4.1.4 Recalling a File ID to Bring Saved Data to the Live Screen

To bring saved data to the live screen, you must recall that particular file ID. For incremental (INC) files, you must select the specific ID to be recalled. For calibration (CAL) files, recalling the file automatically recalls the parameters in the single ID saved in that file.

##### To bring saved data to the live screen

- Choose **File > Open**, and then select the specific file that you want to view.
- Press **Contents** to view the saved waveform and basic setup data.  
The ID being viewed shows up at the top left corner of the screen.
- Select the ID you want to recall using the knob/arrows or choose **Select ID**.
- When you have selected the ID you want to view, press **Select**.

5. Choose **Recall** to recall the selected ID and bring the parameters to the live screen.
6. The unit then returns to the live screen with a notification “New setup recalled. Press any key to continue.”

### 11.4.1.5 Viewing a Summary of all Saved Data in a File

After you have completed saving data to a file, you may want to simply view a summary of the different measurements saved in the different IDs within the file. (These measurements are selected from **Meas Setup > Reading Setup**.)

#### To view a summary of all saved data in a file

1. Choose **File > Open**, and then select the specific file that you want to view.
2. Press **Summary** to view a measurement summary for all the saved IDs in the selected file (see Figure 11-7 on page 204).

Summary						
Filename		CORROSION BLOCK SCAN			Total: 18	
#1	A0	in				
1%	8.75	1↓	1.499		1↑	1.500
#2	A1	in				
1%	80.00	1↓	0.498		1↑	0.498
#3	A2	in				
1%	63.00	1↓	0.750		1↑	0.750
#4	A3	in				
1%	41.25	1↓	1.000		1↑	1.001
#5	A4	in				
1%	75.25	1↓	0.750		1↑	0.750
#6	A5	in				
1%	1.75	1↓	1.323		1↑	1.324
#7	A6	in				
1%	13.00	1↓	1.230		1↑	1.230
#8	A7	in				
1%	16.50	1↓	1.088		1↑	1.088
#9	A8	in				
1%	7.00	1↓	1.078		1↑	1.078
#10	A9	in				
1%	6.75	1↓	1.126		1↑	1.126
Done	Report		<<	<<	>>	>>

Figure 11-7 File measurement summary

3. To view a statistical report of all the file data, press **Report** (see Figure 11-8 on page 205).

Report	
Start ID	A0
End ID	B7
Total ID Count	18
Min ID Count	1
Min Thickness	0.498
Max ID Count	1
Max Thickness	1.500
Alarm ID Count	0
Alarm	0.000%
Mean	1.093
Median	1.122
Standard Deviation	0.236
Done	Summary

Figure 11-8 File report with statistical data

4. Press **Summary** to return to the measurement summary.
5. Press **Done** to return to the **Open** menu or the **[ESCAPE]** key to return to the main screen.

#### 11.4.1.6 Exporting File Data to the Micro SD Card

Many customers use the data saved from their instruments in flaw detection reports of their findings. Rather than require manual copying of the measurements to the reports, the EPOCH 600 has the capability to export saved file data to the Micro SD card that is included with the instrument. The file data will export in a “.csv” format, which can be opened in programs such as Microsoft Excel.

##### To export file data to the Micro SD card

1. Choose **File > Open**, and then select the specific file that you want to export.
2. Press **[P5]** to export the file data to the Micro SD card.

A “.csv” file with the same name as the exported file is then saved to the Micro SD card. All the measurements and corresponding values for each ID is listed in columns in the file when it is opened in a program such as Excel.

## 11.4.2 Create Function

In order to save file data on the EPOCH 600, you must first create a file. There are two standard file types: Calibration (CAL) and Incremental (INC). These files allow storage of calibration data or standard inspection data. Not all items are mandatory to properly set up a file for data storage.

Each time you press the **[SAVE]** key, file data is saved in a file identifier (ID). The number of IDs in a file depends on the file type selected and the number of data sets the you have saved. On the main screen of the EPOCH 600, the currently open file ID is displayed at the top left corner.

### 11.4.2.1 File Types

The EPOCH 600 contains two standard file types: Incremental and Calibration. A Calibration (CAL) file is designed for storage of instrument setups (calibrations). These files can only contain one saved ID at a time. This allows you to rapidly recall an instrument setup, either from the data logger submenu, or by entering the Quick Recall function. Each CAL file contains a single ID for storing a single setup and waveform.

Unlike Calibration files, Incremental (INC) can contain more than one ID for storing file data. Each time the **[SAVE]** key is pressed, the ID increments using the following incrementing rules:

- Only that portion of an ID number consisting of digits and letters (no punctuation marks) beginning with the right-most character and extending leftward to the first punctuation mark or to the left-most character (whichever comes first) can increment.
- Digits are cycled 0, 1, 2,..., 9, 0, etc. The 9 to 0 transition is done only after incrementing the character to the left. Letters are cycled A, B, C,..., Z, A, etc. The Z to A transition is done only after incrementing the character to the left. In either case, if there is no character to the left or if the character to the left is a punctuation mark, then the ID number cannot increment.
- If an ID number cannot increment, then after a measurement reading is saved, an error beep sounds and the momentary message "Cannot Increment ID" is shown on the display above the function keys. Subsequent saves overwrite measurement readings if you do not manually change the ID number first.

### 11.4.2.2 File Creation

This section explains how to create files onboard the instrument.

## To create files onboard the instrument

1. Choose **File > Create** to open the **Create** setup menu (see Figure 11-9 on page 207). Please note that required files in the **Create** setup menu are marked with an “\* ”.

Create						
*File Type	CAL					
*Filename	A541					
Description	ANGLE BEAM					
Inspector ID	SMITH					
Location Note	MA					
*Calibration ID	Calibration					
<b>Create</b>						
Create	&Open	&Save				

**Figure 11-9 The Create setup menu**

2. In the **Create** setup page, select the file type (**INC** or **CAL**).
3. In the **Filename** field, select **Edit On**, and then enter a file name (up to 32 characters long) using the virtual keyboard.

### NOTE

Special characters such as spaces, decimals, slashes, and punctuation are not permitted in the **Filename** field.

4. If desired, enter a file description in the **Description** field.
5. If desired, enter identification information for the inspector in the **Inspector ID** field.

6. If desired, enter information regarding the inspection location in the **Location Note** field.
7. If desired, enter an **ID Prefix**. This prefix will save as part of the ID but will not increment.
8. Enter a **Start ID** for the file. If a CAL file type has been selected, this field will automatically be set to **Calibration**. (Since the ID in a CAL file does not increment, significant digits are not of concern for the ID.)
9. Once you have completed the file setup, choose **Create** to exit the setup page and create the desired file.

---

<b>NOTE</b>
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Once a file is created, you must open the file before trying to save information. This is a separate function from Create. See section 11.4.1.1 on page 199 for instructions on how to open a file.

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10. You can also choose **&Open** to create and open the file in a single step, or **&Save** to create, open, and save the current settings to the current file in a single step.

### 11.4.2.3 Saving Data to Files

The EPOCH 600 allows you to save data whenever there is an active file (survey) and an ID has been entered. Files are created by choosing **File > Create**, as described in section 11.3.1 on page 196, or in GageView Pro and transferred to the instrument. Pressing **[2ND F]**, **(SAVE)** or **[SAVE]** (depending on the configuration), saves the data within the active file.

---

<b>NOTE</b>
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If there is no active ID, the instrument displays the error message “No active ID” at the top of the display. You must have an active file (survey) and an ID entered before saving data. For more information, see section 11.3.2 on page 198.

---

When you press **[2ND F]**, **(SAVE)** or **[SAVE]** (depending on the configuration), the EPOCH 600 saves the following information:

- Filename
- ID

- Up to 5 measurement readings (operator selected)
- A-scan waveform
- All instrument setup parameters
- Alarm information
- Any display flags
- Gate measurement mode icons
- Leg indicators for both gates
- Any displayed peak memory envelopes or peak hold A-scans
- Software feature/option setups

### 11.4.3 Quick Recall Function

The EPOCH 600 allows you to quickly recall a calibration file without the need to go into the **File Review** submenu. The quick calibration recall feature is accessed by selecting **File > Quick Recall**. The **Recall** menu shows a list of all CAL files stored on the EPOCH 600 instrument.

---

<b>NOTE</b>
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Only files created using the CAL file type are displayed in the quick recall setup window.

---

#### To quickly recall a file using the recall setup

1. Select **File > Quick Recall**.

The Recall setup menu appears (see Figure 10-11 on page 166).

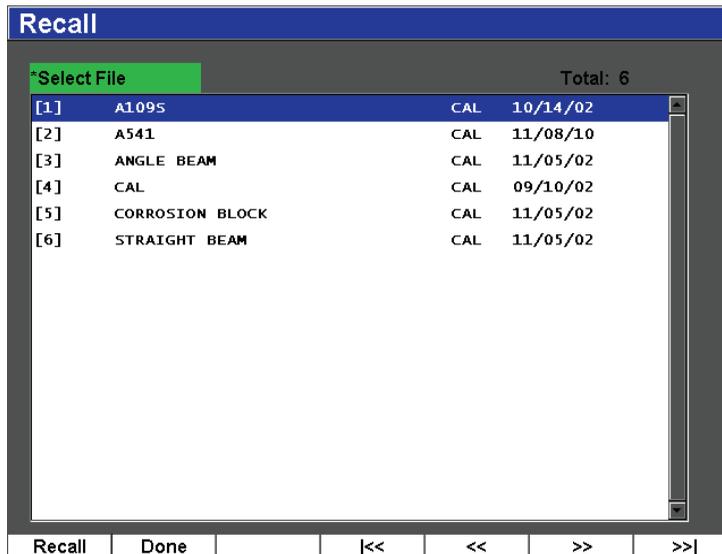


Figure 11-10 The Recall setup menu

2. Use the [UP] and [DOWN] arrow keys or the adjustment knob to select the desired calibration file.
3. Press **Recall** to select the desired file and recall its settings as the live instrument parameters.
4. Press [ESCAPE] to cancel the operation and return to the live screen.

#### 11.4.4 First ID, Last ID, and Select ID Functions

When a file is opened, it defaults to the first open ID. The currently selected ID is displayed at the top left corner of the main screen.

- To select the first ID in the file, choose **File > First ID**.
- To then jump to the last ID in the currently open file, choose **File > Last ID**.
- To select from a list of all the available IDs in the currently open file, choose **File > Select ID** (see Figure 11-11 on page 211).

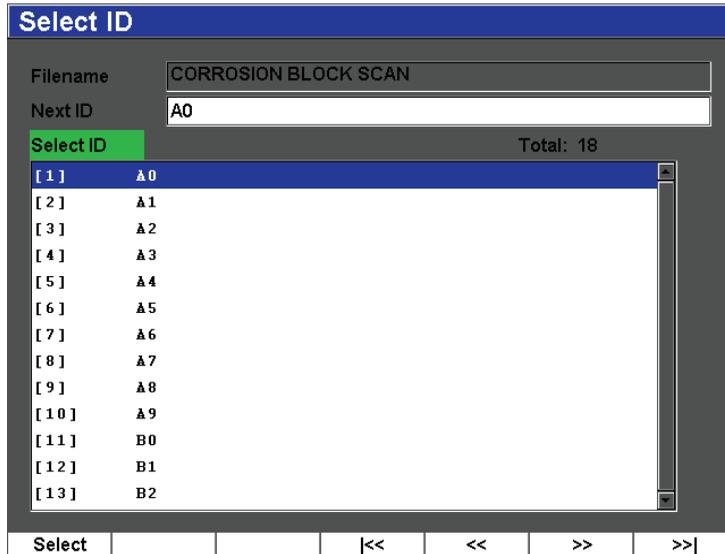


Figure 11-11 The Select ID menu

## 11.4.5 Reset Function

The EPOCH 600 allows you to reset its current settings to default values, when necessary. The instrument reset parameters are available in the **Resets** setup menu accessible by choosing **Manage > Reset** (see Figure 11-12 on page 212). Use the arrow keys or the adjustment knob to highlight the desired reset type and press **Select**. The four reset types are as follows:

### Parameters reset

Resets only the current on-screen parameters to system default values.

### Storage Reset

Erases all saved files in the Datalogger. (Only the default NONAME00 file will remain.)

### Master Reset

Resets the current on-screen parameters to system default values and erases all saved files in the instrument Datalogger.

### Power Down

Used to turn off the gage.

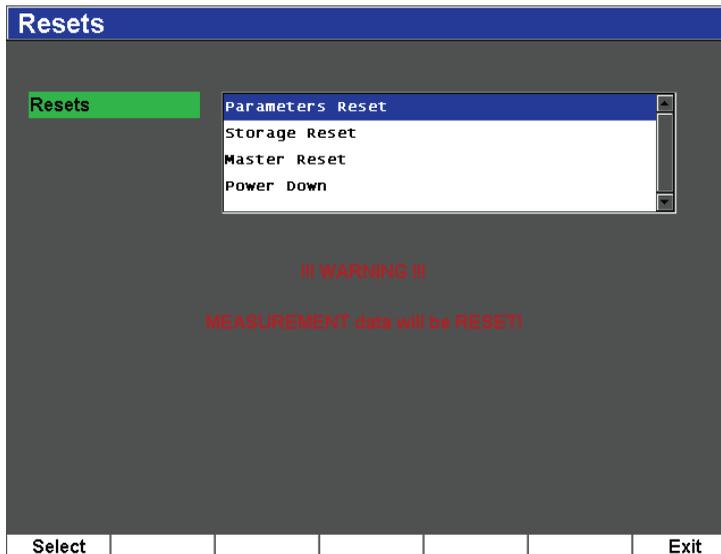


Figure 11-12 The Resets setup menu

## 11.4.6 Edit, Copy, and Delete Functions

The **Edit** function is used to edit file name and description parameters once a file has been saved.

### To edit file creation parameters

1. Choose **Manage > Edit**.

The Edit setup menu appears (see Figure 11-13 on page 213).

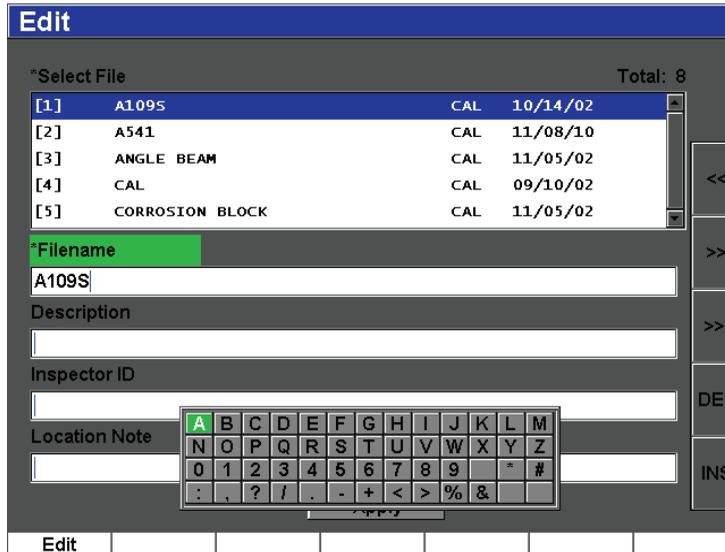


Figure 11-13 The Edit setup menu

2. Select the desired file to be edited from the available list.  
Both CAL and INC files will be listed.
3. Edit the desired fields by pressing **Edit** in the specific field.
4. Select **Apply** and press **Ok** to confirm the changes. Press the **[ESCAPE]** key to return to the main screen.

The **Copy** function is used to make a duplicate copy of a saved file on the instrument.

### To copy a file

1. Choose **Manage > Copy**.  
The Copy setup menu appears (see Figure 11-14 on page 214).

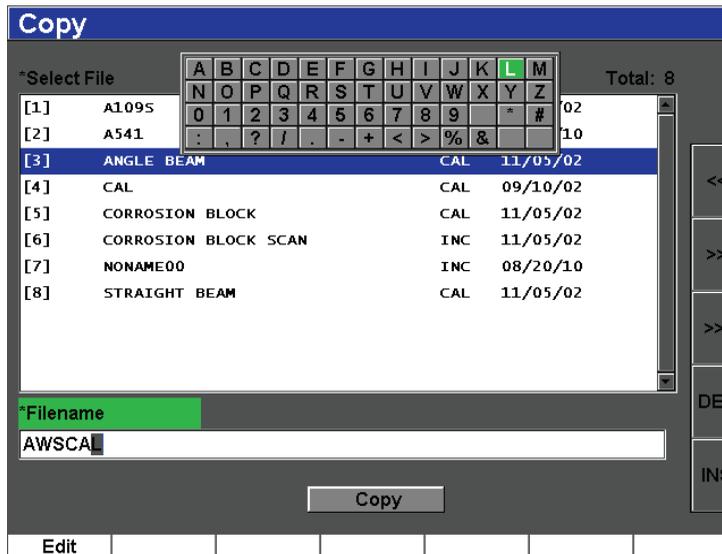


Figure 11-14 The Copy setup menu

2. Select the desired file to be copied from the available list. Both CAL and INC files will be listed.
3. In the **Filename** field, enter the desired name for the copied file. (The same rules mentioned previously for file names apply to this field.)
4. Select **Copy** and press **Ok** to confirm the changes. Press the **[ESCAPE]** key to return to the main screen.

The **Delete** function is used to delete a saved file from the instrument. This function deletes the file name as well as all the saved data and IDs contained within it.

### To delete a file

1. Choose **Manage > Delete**.  
The Delete setup menu appears (see Figure 11-15 on page 215).

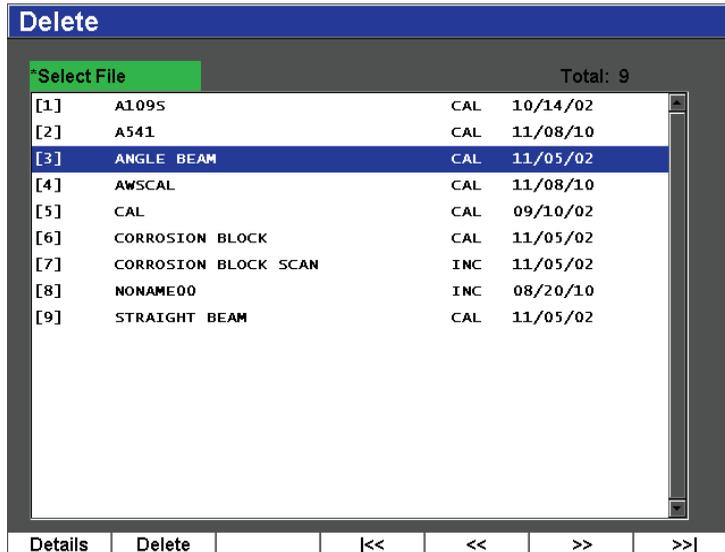


Figure 11-15 The Delete setup menu

2. Select the desired file to be deleted from the available list. Both CAL and INC files will be listed.
3. To view the details of a file before deletion, press **Details**.
4. Press **Delete** to erase the selected file from the instrument.

## 11.5 Saving Screen Captures

You can save screen captures of the EPOCH 600 to the Micro SD card included with the instrument. This function, similar to the **Print Screen** function on a PC, allows you to quickly capture live inspection data information for use in reports. The saved screen captures will be saved as bitmap (.bmp) file types on the Micro SD card.

### To save a screen capture

1. Set up the EPOCH 600 to the correct parameters, menu, or screen that you want to capture.
2. Press **[2nd F]**, **[F1]** to capture the image.

The screen freezes for a few seconds, and then the unit beeps to alert you that the save is complete.

3. Insert the Micro SD card into a PC or PC card reader (adaptors for this purpose are included with the instrument). The saved screen shots are titled starting with "BMP0.bmp" and increases in number as each screen shot is saved.

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## 12. Software Features and Options

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This chapter discusses the activation and operation of software features and options for the EPOCH 600. The topics are as follows:

- “Defining Licensed and Unlicensed Software Features” on page 217
- “Dynamic DAC/TVG” on page 219
- “DGS/AVG” on page 233
- “AWS D1.1/D1.5 Weld Rating Software” on page 243
- “API 5UE” on page 249
- “Waveform Averaging” on page 259

### 12.1 Defining Licensed and Unlicensed Software Features

The EPOCH 600 comes standard with many software features that expand the instrument’s capabilities beyond standard flaw detection.

The following software features are standard components of the EPOCH 600 conventional flaw detector:

- Dynamic DAC/TVG
- DGS/AVG

The EPOCH 600 also has five software options available. These options are not standard inclusions of the base instrument, and must be purchased and added to the unit. These options (AWS D1.1/D1.5, API 5UE, and Waveform Averaging), can be activated at the time of purchase of the instrument, or can be activated remotely after purchase of the instrument.

If a software option is not activated, you do not have access to the submenu that controls this function. Olympus can provide an activation code that is entered in the instrument and allows access to the option. This allows the software to be activated without having to return the instrument to a service center.

## To activate a software option

1. Choose **Inst Setup > Software Options** to open the **Software Options** setup page shown in Figure 12-1 on page 218.

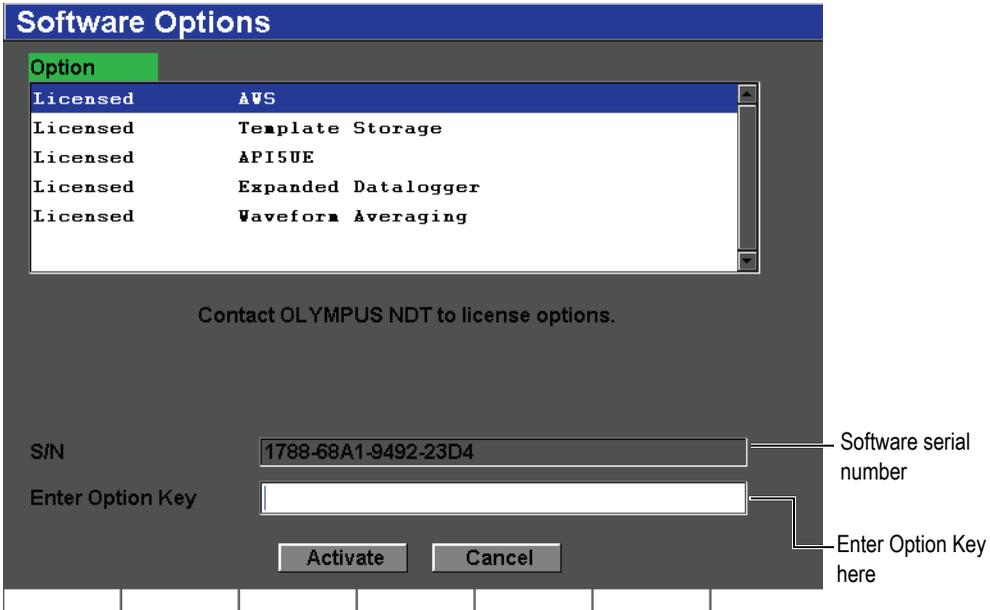


Figure 12-1 The Option key entry dialog box

2. Note the 16-character software serial number for your instrument that appears in the S/N parameter.
3. Contact Olympus to purchase the software option, providing the software serial number.  
Olympus provides an activation code.
4. Once this remote activation code is provided, open the **Software Options** setup page.

5. Press **Edit On** to activate the virtual keypad.
6. Using the virtual keyboard, enter the activation code in the **Enter Option Key** field (see Figure 12-1 on page 218).
7. When finished entering the activation code, press the **[NEXT GROUP]** key to select **Activate**.
8. Press the **[P1]** key to activate the option and return to the live screen.

## 12.2 Dynamic DAC/TVG

A distance amplitude correction (DAC) curve is used to plot amplitude variations of signals from reflectors of the same size, but at different distances from the transducer. Normally, these reflectors produce echoes of varying amplitude due to material attenuation and beam spread as the sound beam travels through the part. The purpose of the DAC curve is to graphically compensate for material attenuation, nearfield effects, beam spread, and surface roughness.

After plotting a DAC curve, reflectors of the same size as those used for creation of the curve produce echoes that peak along the curve despite different locations within the test piece. Similarly, reflectors that are smaller than those used to create the curve fall below the level, while larger reflectors exceed the curve level.

When a DAC curve is created in the EPOCH 600, the instrument also creates a time-varied gain (TVG) setup. TVG is used to compensate for the same factors as DAC, but the presentation is different. Instead of drawing a curve across the display that follows the reference-reflector peaks downward as sound is attenuated, the TVG setup amplifies the gain as a function of time (distance) to bring the reference-reflectors to the same screen height (80 % FSH).

The EPOCH 600 DAC/TVG feature allows you to quickly and easily toggle between DAC and TVG views, giving freedom to use both techniques during a single inspection. When you switch from DAC to TVG view, the DAC curves are displayed as TVG lines across the screen. The time-varied gain effectively amplifies the signals across the time base to make the DAC curves appear as straight lines across the screen.

You can customize DAC/TVG setups to your unique application requirements using the flexible DAC/TVG software feature for the EPOCH 600. The DAC/TVG feature incorporates several DAC/TVG modes that adhere to ASME, ASME III, and JIS sizing codes. The software offers direct control of gain, range, zero offset, and delay, as well as scanning gain and transfer correction. In addition, the DAC/TVG option provides customizable DAC warning curves.

## 12.2.1 Feature Activation and Reference Correct

Prior to the activation of any options associated with DAC/TVG, the instrument must be properly calibrated to the material being inspected. DAC/TVG can be activated in the **DAC/TVG** setup page accessible by choosing **DAC/TVG >Setup** (see Figure 12-2 on page 220).

DAC/TVG						
DAC/TVG Mode	ASME-3					
Ref Correct	Off					
Off	ASME	ASME-3	JIS	Custom		

Figure 12-2 The DAC/TVG setup page

You may also choose to apply a feature known as **Ref Correct** (reference correction) to the digital analysis of the live A-scan and DAC/TVG option. The reference correction feature, when activated, allows full gain manipulation of either the live echo peaks or the DAC curve while providing the % amplitude or dB comparison of the actual peak-to-curve ratio. In this way, you can use scanning gain while maintaining an accurate measurement reading of the ratio of the gated peak to the DAC curve for sizing purposes. The gated echo amplitude is corrected back to the reference gain level for amplitude evaluation compared to the DAC curve.

Once the proper selection of DAC/TVG has been made (including activation of **Ref Correct** where applicable), use the **[ESCAPE]** key to return to the live A-scan screen and begin DAC/TVG setup.

Once in the live A-scan mode, the **DAC/TVG** menu will contain the various setup and adjustment parameters for this feature. These parameters access to several important functions that control DAC/TVG setup and operation.

To deactivate a DAC/TVG feature, return to the **DAC/TVG** setup page and, and then set **DAC/TVG Mode = Off**.

In the following sections, all DAC/TVG modes are covered. The DAC/TVG setup procedure is the same for all modes. The setup is covered in detail in the ASME/ASME-III section to follow. Any differences in the procedure to set up other DAC/TVG modes are discussed in the pertinent section for that particular mode.

### **12.2.2 ASME/ASME III DAC/TVG**

The ASME DAC mode is a single DAC curve drawn from peak-to-peak on reference-reflectors. The ASME III (or ASME-3) mode draws three DAC curves: one main curve from peak-to-peak on the reference-reflectors and two warning curves at  $-6$  dB and  $-14$  dB compared to the main curve.

### **12.2.3 ASME III DAC Setup Example**

Once you have selected the desired DAC mode and returned to the live screen, set your range so that your first reflector for your DAC curve is toward the left side of your screen (see Figure 12-3 on page 222).

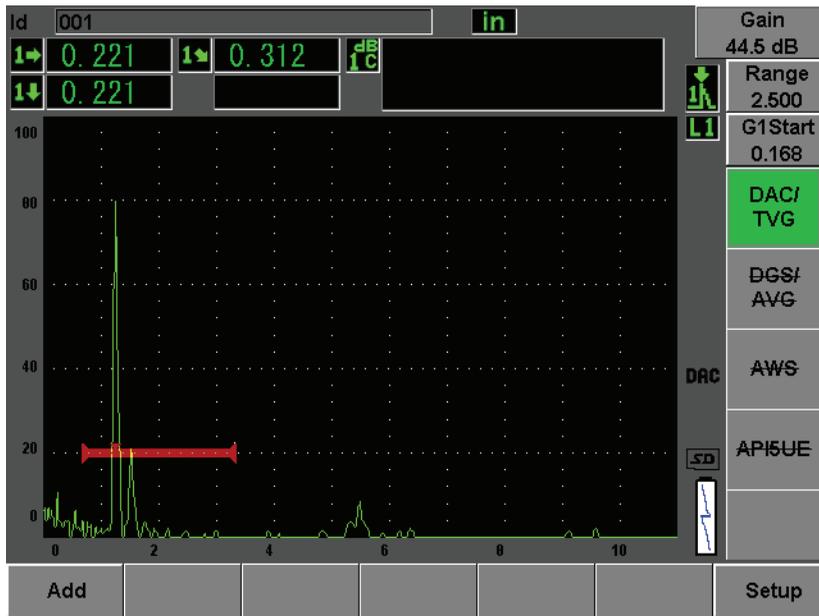


Figure 12-3 First DAC setup step

To capture DAC points, you must move gate 1 to the echo, and then choose **DAC/TVG > Add**. The **Gate 1** start parameter can be accessed by pressing the **[GATES]** key or by selecting **[P5]** from the **DAC/TVG** menu.

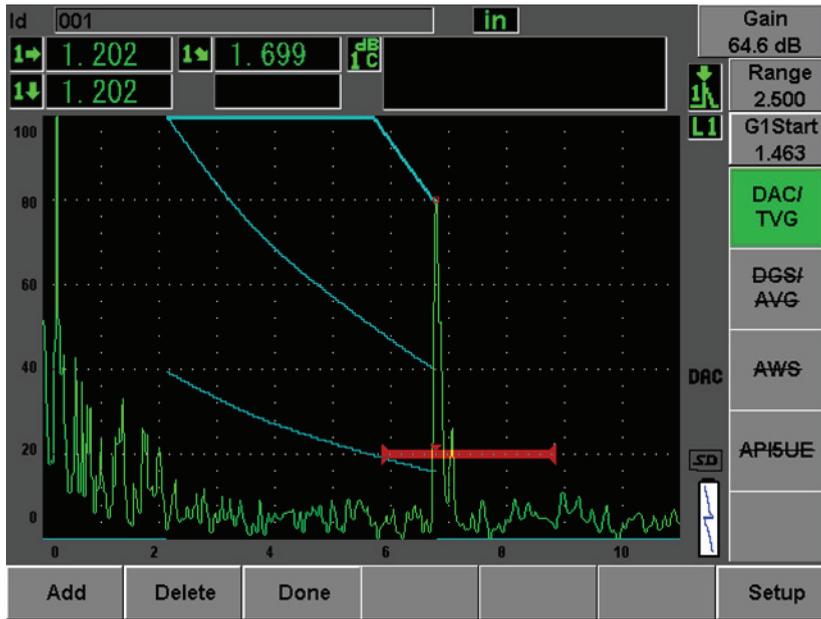
The EPOCH 600 allows you to bring each echo used to create a DAC curve to 80 % FSH before acquiring the point. This feature can help create a more precise DAC curve, especially in the far-field. Press **[2ND F]**, **(AUTO XX%)** to activate AUTO 80 % for each indication before capturing the point.

Once a point is captured, the peak amplitude of that point is marked using a “x” symbol. Figure 12-4 on page 223 shows a partially completed DAC curve.



Figure 12-4 DAC Setup one point

The EPOCH 600 allows you to bring each echo used to create a DAC curve to 80 % FSH before acquiring the point. This feature can help create a more precise DAC curve, especially for longer soundpaths or in attenuating materials. Press **[2ND F]**, **(AUTO XX%)** to activate AUTO 80 % for each indication before capturing the point. (See Figure 12-5 on page 224.)



**Figure 12-5 Partial DAC curve with each echo set to 80 % FSH**

The instrument has drawn a DAC curve with three levels from the first point to the second. You have used the AUTO 80 % function to bring the second point to 80 % full-screen height. This assures that the point is captured accurately because amplitude resolution is better at greater echo heights. This also pushes the first captured echo over 110 % FSH so the main DAC curve and the  $-6$  dB warning curve extend downward to the second point from off-screen.

While acquiring DAC points, you have two other choices besides **Add** and **1-Auto**:

#### **Delete**

Deletes the most recently captured DAC point.

#### **Done**

Completes curve acquisition and switches to inspection mode.

TIP

If you need to continue capturing points, you may increase the instrument range or increase the display delay to view echoes further out in time.

Once the correct number of points have been captured, choose **DAC/TVG > Done** to complete the DAC curve and switch to the DAC inspection mode.

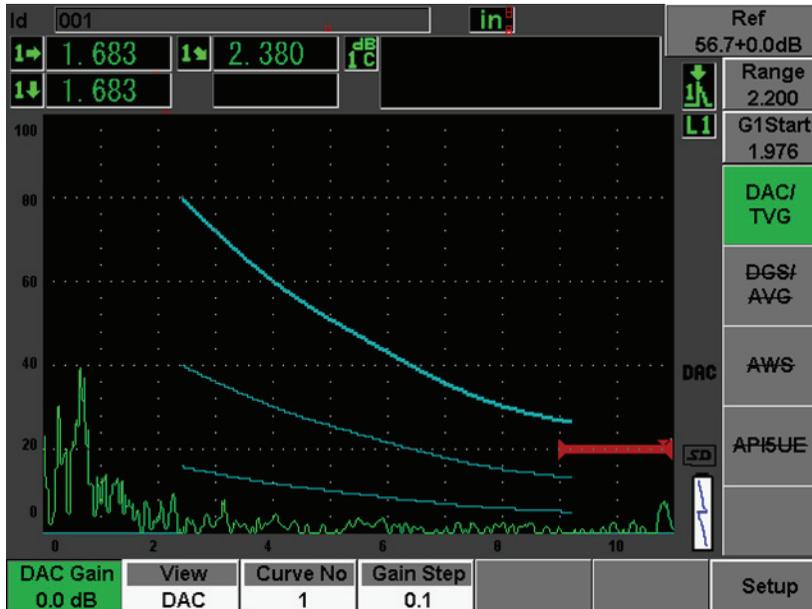


Figure 12-6 The completed DAC curve

Once the DAC curve is complete and the instrument is in inspection mode, the instrument provides a new set of parameters:

### DAC Gain

This adjustment allows you to manipulate the screen height/gain of both the DAC/TVG curve as well as the echoes on screen. This allows for amplitude-to-curve comparison at code compliant screen levels across the time base.

## View

This function allows you to toggle between the DAC curve acquired and the corresponding TVG setup based on the DAC curve information.

## Next DAC

This function cycles through the available DAC curves (if more than one is available) for amplitude comparison with on-screen echoes.

## Gain Step

This setting controls the steps by which **Curve Gain** is adjusted. Possible steps are 0.1, 1.0, 2.0, 3.0, 6.0, 12.0 dB.

## G1Start

The start position of Gate 1 is also adjustable through the DAC menu as well as by pressing the [GATES] key.



Figure 12-7 Completed DAC curves in DAC view mode

While DAC/TVG is active, you have full control of the **Range**, **Delay**, and **Zoom** settings. With this you can focus on areas of interest within the DAC setup. Figure 12-8 on page 227 shows a reduced range with delay.



Figure 12-8 A small range DAC

## 12.2.4 Gain Adjustment Options

The EPOCH 600 DAC/TVG software features three separate types of gain adjustment for each DAC/TVG setup. These gain adjustments allow for better inspection precision, easy manipulation of curves and live peak information, and transfer correction.

### 12.2.4.1 Scanning Gain

In order to quickly find and identify potential defects, it is commonly required by code to increase the gain (scanning gain) on the EPOCH 600 from the reference (calibration) gain for scanning purposes. However, once a potential defect is identified, this gain is usually removed to view the reflector at **Ref** gain level, set at calibration. The DAC/TVG software for the EPOCH 600 is fully capable of adding temporary scanning gain for inspection purposes. This scanning gain only affects the live A-scan and does not adjust the level of the DAC curve(s) set up on screen.

## To add temporary scanning gain

1. Press **[dB]**.
2. Adjust the gain in either coarse or fine increments, or use the **[dB] > +6 dB** and **-6 dB** keys to increase or decrease scanning gain.
3. Press **[dB]** to access the **Gain** menu.
4. Choose **dB > Scan dB** to toggle between the base (reference) gain and the adjusted scanning gain.
5. Choose **dB > Off** to turn scanning gain off completely.

Figure 12-9 on page 228 shows an ASME DAC setup with 3 dB of scanning gain added.

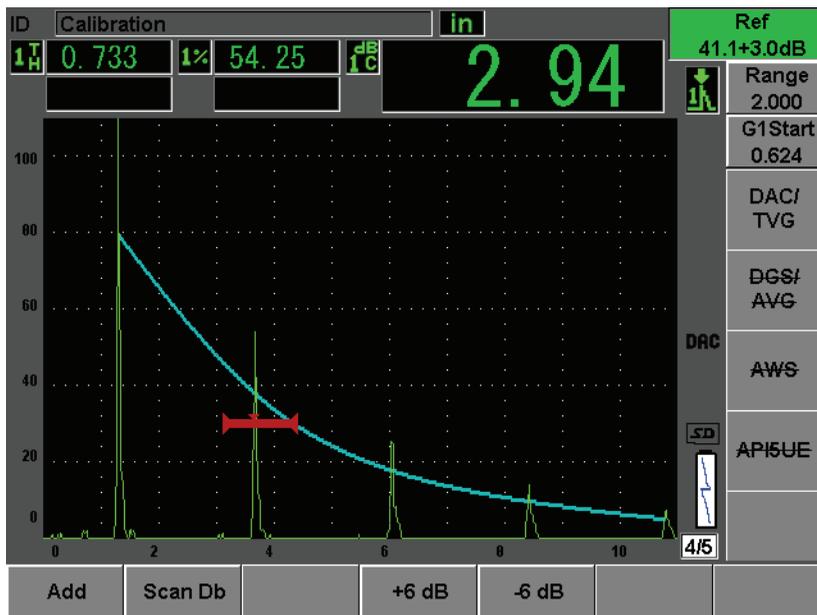


Figure 12-9 ASME DAC with 3 dB scanning gain

### NOTE

When reference correction is active, the digital comparison between a captured reflector and the DAC curve is accurate even with the scanning gain applied to the inspection provided that the gated echo is not saturated. Figure 12-10 on page 229 shows the same setup as above but with **Reference Correction** active. Notice that the scanning gain has been removed from the dB-to-curve measurement in location 5. The instrument compares the echo height to the DAC curve, compensates for the added scanning gain, and reports the true-amplitude comparison.

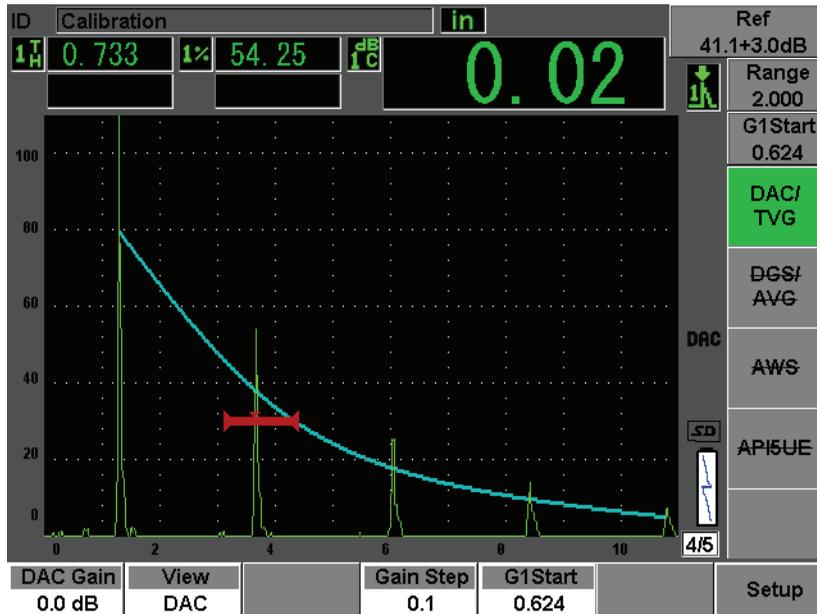


Figure 12-10 ASME DAC with 3 dB scanning gain and reference correction active

#### 12.2.4.2 Curve Adjustment Gain (DAC Gain or TVG Gain)

The overall gain level of the entire DAC curve and TVG line setup can be adjusted higher or lower from the Reference Gain. Most inspection codes do not permit reflectors to be sized below 20 % FSH. Therefore, to inspect beyond a certain

depth/sound path time within a part, it is necessary to raise the gain of both the live A-scan and the DAC curve to continue the inspection. This is accomplished on the EPOCH 600 using the curve gain (DAC curve adjustment gain).

### To adjust the Curve Gain

1. Choose **DAC/TVG > Gain Step**, and then choose the desired increment of the gain adjustment.
2. Choose **DAC/TVG > DAC Gain**, and then adjust the curve gain by the selected increment either positive or negative.

Figure 12-11 on page 230 shows a DAC setup with DAC gain in use to provide accurate echo amplitude measurement by placing the echo close to 80 % FSH.

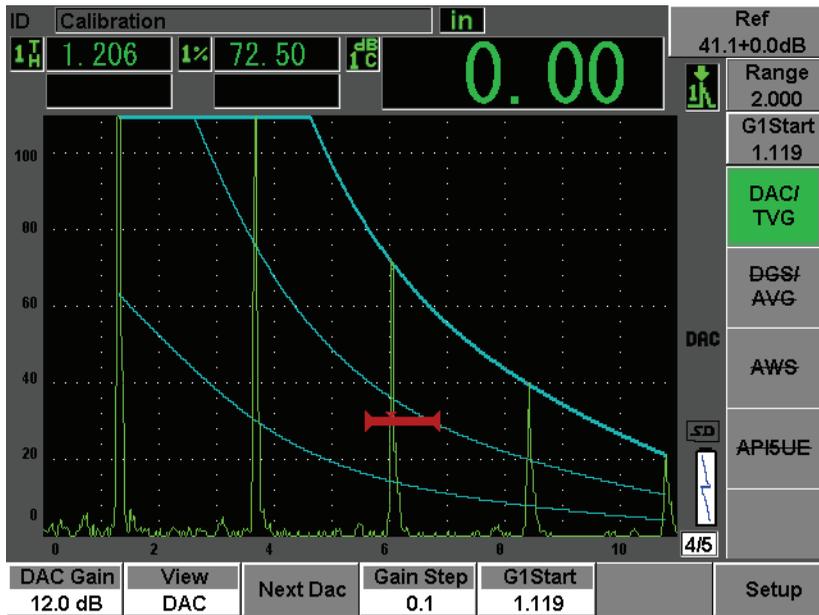


Figure 12-11 DAC curves with adjusted gain

#### 12.2.4.3 Transfer Correction

Transfer Correction is an adjustment in the reference gain setting during calibration of the instrument, and is typically added when the surface conditions between a calibration block and test piece are different. The coupling conditions on the test

surface can often cause signal loss after calibrating a DAC curve, which results in inaccurate comparisons of the test reflectors with the calibrated DAC curve. The EPOCH 600 can be easily adjusted for this potential difference by adding transfer correction to the calibrated base gain after completing the DAC curve setup.

### To add transfer correction to a completed DAC curve

1. Choose **Basic**.
2. Press [**dB**].
3. Use the [**UP**] and [**DOWN**] arrow keys or the adjustment knob to bring the scanning gain to the desired level for transfer correction.
4. Once the desired scanning gain is displayed, choose [**dB**] > **Add** to add the scanning gain to the base gain and to apply the transfer correction.

## 12.2.5 JIS DAC

The Japanese Industrial Standard (JIS) DAC mode meets the requirements of JIS Z3060. The JIS DAC curve setup is identical to the standard DAC/TVG setup. However, there are some minor functionality differences when compared to other DAC/TVG modes:

- Only the main DAC curve is viewable in TVG mode
- Any of the six curves can be used to trip the alarm when in the JIS DAC mode. Additionally, you can set the alarm to positive or negative. To select the curve to be used as the alarm reference level, first activate JIS DAC and then choose **DAC/TVG > Next DAC**. The selected curve appears as a double thickness line. Once a curve has been selected, an alarm can be activated and set to be either a positive or a negative threshold detection.

## 12.2.6 Custom DAC Curves

The DAC/TVG software option for the EPOCH 600 features a customizable DAC curve setup that allows you to define up to six additional reference curves from the primary curve at varying levels from -24 dB to +24 dB. The Custom DAC Curves option is ideal for unique sizing inspections and procedure development. The Custom DAC Curve function also allows the option of either a straight-line connection or a curved, polynomial connection of each point of the DAC curve to meet various international or customer-specific requirements.

## To activate and set up the customized curves

1. Open the **DAC/TVG** setup page by choosing **DAC/TVG > Setup**.
2. Select **Custom** from the **DAC/TVG Mode** field.
3. Select **Curve Type** (polynomial [curved] or straight-line segments).
4. Select the **No Of Curves** to be used in addition to the main curve (for example, if six (6) curves are activated, you see seven curves in total) [see Figure 12-12 on page 232].
5. For each warning curve, choose **Curve<n> dB**, and set the value compared to the main curve.
6. Press **[ESCAPE]** to return to the live screen to begin capturing DAC points.

DAC/TVG	
DAC/TVG Mode	Custom
Ref Correct	Off
Curve Type	Polynomial
<b>No of Curves</b>	<b>6</b>
Curve 1 dB	-24 dB
Curve 2 dB	-12 dB
Curve 3 dB	-6 dB
Curve 4 dB	+ 0 dB
Curve 5 dB	+ 6 dB
Curve 6 dB	+12 dB

Figure 12-12 Custom DAC setup

The custom DAC setup and functionality are the same as the ASME and ASME III discussed earlier in this section. Figure 12-13 on page 233 shows a completed custom DAC setup.

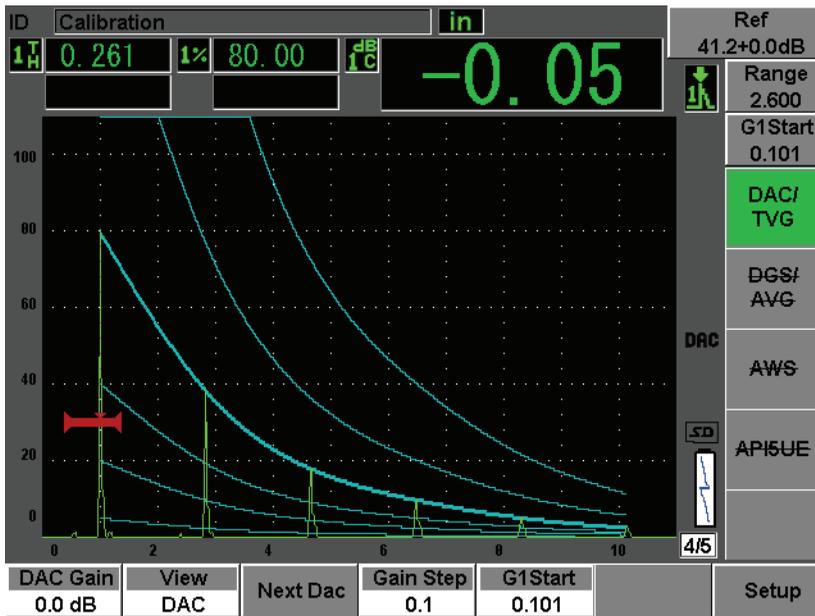


Figure 12-13 Completed custom DAC

Once the custom DAC curve points have been captured and completed, you have full capability to toggle between DAC and TVG views, to manipulate **Range**, **Delay**, **CAL Zero**, and **Angle**, and also to add necessary scanning gain, curve gain adjustment or transfer correction. The TVG view of any custom DAC curve includes the user-defined reference curves as well as the primary DAC curve. Custom DAC curve also incorporates the reference correction functionality, if desired.

## 12.3 DGS/AVG

The Onboard DGS/AVG option in the EPOCH 600 permits complete DGS/AVG setups to be performed on the instrument. With the DGS/AVG method, you can size defects based upon a calculated DGS/AVG curve for a given transducer, material, and reflector size. This method requires that you only have one reference-reflector in order to create a DGS curve for flaw sizing. This is much different than the DAC or TVG method which requires that you have representative defects at various depths within a part in order to create a curve for flaw sizing.

To setup DGS/AVG curves on the instrument very quickly, Olympus has developed a transducer library that is stored in the instrument's memory. This library contains the entire Atlas Series European specification conventional transducers as well as several other transducers that are commonly used by inspectors. The library includes five categories:

1. **Straight Beam** contact (includes protected face)
2. **Angle Beam** transducers
3. **Dual** transducers
4. **Custom Straight** contact
5. **Custom Angle** beam

All required data for building DGS/AVG curves is stored in the instrument's memory for each transducer in the library. If you want to use a probe that is not in the default library, you can enter the required transducer characteristics in the GageView Pro computer interface program and download them to the EPOCH 600. Probes that are downloaded to the instrument appear in the custom transducers section of the transducer library.

The onboard DGS/AVG option provides you with rapid setup times and easy flaw-size evaluation. This software option has been designed to meet the EN 583-2:2001 requirements. It is extremely important that you be familiar with this specification and others, and be qualified according to local standards to properly use this instrument function. Since the curves used for defect sizing are calculated based upon many variables, a proper instrument setup is required for accurate results.

### 12.3.1 Option Activation and Setup

Prior to activation of the DGS/AVG option, the instrument must be properly calibrated to the material being inspected. You then activate the DGS/AVG option in the **DGS/AVG** setup page (shown in Figure 12-14 on page 235) by choosing **DGS/AVG > Setup**.

DGS/AVG	
DGS/AVG	On
Probe Type	Straight Beam
Probe Name	CN4R-10
Reflector Type	Backwall
Delta VT	+0.0 dB
Reg Level	0.050 IN
Warning Level	-6.0 dB
ACV Specimen	0.0 dB/IN
ACV Cal Block	0.0 dB/IN
Off	On

Figure 12-14 DGS/AVG setup page

This screen allows you to define the exact probe being used for the inspection, and to set up the DGS/AVG curve to be drawn. There are several adjustments that can be made from this setup page:

### DGS/AVG

Activate/Deactivate the DGS/AVG function

### Probe Type

Selects the type of probe to be used (Straight Beam, Angle Beam, Dual, or Custom).

### Probe Name

Selects the actual probe to be used.

### Reflector Type

Defines the type of reflector to be used to acquire a reference indication to build the DGS/AVG curve.

- For straight beam and dual probes, the available reflectors are:

- Back wall
- Side-drilled hole (SDH)
- For angle beam probes, the available reflectors are:
  - K1-IIW block arc
  - K2-DSC block
  - Side-drilled hole (SDH)
  - Flat-bottom hole (FBH)

### **Reflector Dia.**

Used for angle beam inspections only. This allows you to define the diameter of the flat-bottom hole (FBH) or side-drilled hole (SDH) used as a reference-reflector. This size is required to properly position the DGS/AVG curve.

### **DeltaVK**

Used for angle beam inspections with reference-reflector K1-IIW or K2-DSC blocks only. This correction value for the angle beam transducer can be found listed on the DGS/AVG diagram for the selected transducer.

### **DeltaVT**

Transfer correction value, used to compensate in amplitude differences as a result of coupling variation (surface condition) from the calibration block to the test piece. EN 583-2:2001 provides methods for calculating transfer correction.

### **Reg. Level**

The height of the main DGS/AVG curve. The curve represents the amplitude from a flat-bottom hole with a diameter of the registration level at different depths. This is usually equal to the critical flaw size for the application.

### **Warning Level**

This is the position of the secondary DGS/AVG “warning” curve compared to the position of the main DGS/AVG curve. If this value is set to zero, the warning curve is turned off.

### **ACV Specimen**

This is the attenuation value in dB/m for the test piece (specimen). In some cases, it is necessary to calculate the relative attenuation within the test piece and enter the value here.

### **ACV Cal Block**

This is the attenuation value in dB/m for the calibration block. In some cases, it is necessary to calculate the relative attenuation within the calibration block and enter the value here.

## X Value

Used for angle beam inspections only. This is the length of the transducer wedge from the BIP to the front of the wedge, and is used to remove the wedge length from the surface distance measurements.

---

<b>NOTE</b>
-------------

You, as a trained operator, must be aware of when it is necessary to apply values to **ACV Specimen** and **ACV Cal Block**. These values affect the shape of the DGS/AVG curve and, therefore, affect the accuracy of defect sizing. A suggested method for the measurement of relative attenuation can be found later in this manual.

---

Once you have correctly completed the selections in the DGS/AVG setup page, press **[ESCAPE]** to return the live A-scan display.

### To complete the DGS/AVG curve setup

1. Couple the transducer to the calibration block and obtain a reflection from the selected reference-reflector.
2. Press **[GATES]** to gate the reference indication.
3. Press **[2ND F]**, (**AUTO XX%**) to bring the reference-reflector to 80 % FSH.
4. Press **DGS/AVG > Ref** to capture the reference-reflector and build the DGS/AVG curve.

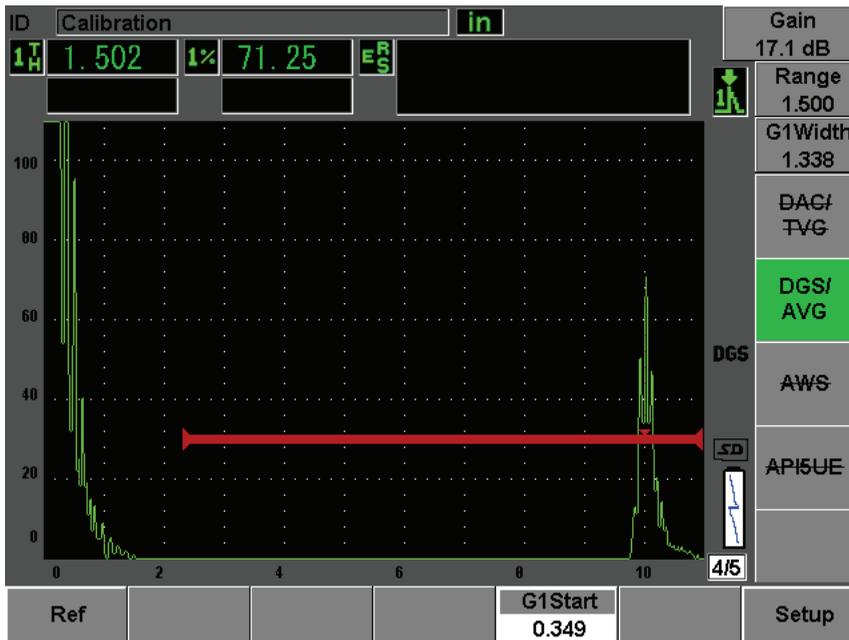


Figure 12-15 Reference-reflector before capture

After capturing the reference-reflector, the EPOCH 600 automatically calculates the DGS/AVG curve(s) and displays them at the correct registration level amplitude on the screen.



Figure 12-16 DGS/AVG curves on the screen

### 12.3.2 Curve Adjustment Options

Once a DGS/AVG curve has been calculated on the EPOCH 600, it is possible to make adjustments to that curve during an inspection. These adjustments include gain adjustments allowing proper defect scanning and code-compliant defect sizing, as well as reference-reflector adjustments.

### 12.3.3 Transfer Correction

Transfer correction is an adjustment in the reference gain setting during calibration of the instrument. It is typically added when the surface conditions between a calibration block and test piece are different. The coupling conditions on the test surface can often cause signal loss after calibrating a DGS/AVG curve, which results in inaccurate comparisons of the test reflectors with the calibrated DGS/AVG curve. The EPOCH 600 allows you to adjust for this difference by adding transfer correction to the calibrated base gain after completing the DGS/AVG curve setup.

The transfer correction can be added during initial setup of the DGS/AVG curve (**DeltaVt** value), but typically this factor is unknown until after the setup is completed.

### To add transfer correction to a completed DGS/AVG curve

- ◆ Choose **DGS/AVG > Delta VT** to adjust the value of the transfer correction.

---

<b>NOTE</b>
-------------

When adjusting transfer correction, the curve height should remain constant, but the echo height changes.

---

## 12.3.4 DGS/AVG Curve Gain

The overall gain level of the entire DGS/AVG curve can be adjusted higher or lower from the reference gain. Most inspection codes do not permit reflectors to be sized below 20 % FSH. Therefore, to inspect beyond a certain depth/sound path time within a part, it is necessary to raise the gain of both the live A-scan and the DGS/AVG curve to continue the inspection. This is accomplished on the EPOCH 600 using DGS/AVG curve-adjustment gain.

### To adjust the DGS/AVG curve gain

1. Press [**dB**].
2. Adjust the curve gain in either coarse or fine increments. The curve-gain difference is added/subtracted from the instrument base (reference) gain.

---

<b>NOTE</b>
-------------

DGS/AVG curve gain adjustment are applied to both the echo height and curve height to maintain the amplitude ratio and therefore, the sizing comparisons.

---

Figure 12-17 on page 241 shows a DGS/AVG setup with curve-gain in use to provide accurate echo-amplitude measurement by placing the echo close to 80 % FSH.



Figure 12-17 Gain curve adjusted DGS

### 12.3.5 Registration Level Adjustment

The registration level of the DGS/AVG curve defines the height of the main curve. The curve height represents the amplitude from a flat-bottom hole with a diameter of the registration level at different depths. This is usually equal to the critical flaw size for the application. The EPOCH 600 allows you to adjust this registration level during a live inspection.

#### NOTE

This curve-height adjustment is possible because the DGS/AVG curves are calculated based on a captured reference-reflector and mathematical probe data. This allows the EPOCH 600 to plot the attenuation curve (in steel) for a particular

size reflector without having to acquire individual data points, as is required in a DAC/TVG setup. This is one of the key advantages of the DGS/AVG sizing technique over the DAC/TVG sizing technique.

---

### To adjust the registration level

- ◆ Choose **DGS/AVG > Reg Level** to adjust the current registration-level value.

## 12.3.6 Relative Attenuation Measurement

There are several methods for measuring the ultrasonic attenuation within a material. Often the procedure measures absolute attenuation in a material. This usually requires an immersion test setup and a time-consuming set of measurements. For the purpose of flaw sizing with the DGS/AVG method, it might be suitable in many conditions to measure relative attenuation in the test piece or calibration block as needed. This section outlines one method of relative attenuation measurement that is simple and has been found to be generally effective. There might be more suitable methods available. You must decide the most appropriate method to arrive at the values for **ACV Specimen** and **ACV Cal Block** based on the application and local requirements.

### Measurements:

$\Delta V_g$  = Gain difference between two successive back-wall echoes (d and 2d)

$\Delta V_e$  = From DGS/AVG diagram. Gain difference on back wall curve from d to 2d

### Calculations:

$\Delta V_s = \Delta V_g - \Delta V_e$  [mm]

Sound attenuation coefficient:  $\alpha = \Delta V_s / 2d * 1000$  [dB/m]

## 12.4 AWS D1.1/D1.5 Weld Rating Software

The AWS D1.1 software option for the EPOCH 600 has been created to assist you in performing inspections covered under the American Welding Society D1.1 (or D1.5) Structural Welding code for steel. This code provides inspectors with a method to classify discontinuities found in welds using ultrasonic inspection. This code uses the following formula to develop an indication rating for a reflector found during an inspection:

$$A - B - C = D$$

where:

A = Discontinuity indication level (dB)

B = Reference indication level (dB)

C = Attenuation factor:  $2 * (\text{sound path in inches} - 1 \text{ in.})$  (dB)

D = Indication rating (dB)

The AWS D1.1 inspector must take the Indication Rating (D) that is calculated based on A, B, and C to an "Ultrasonic Acceptance – Rejection Criteria" table produced by the AWS in order to classify the severity of the discontinuity that has been located. As an inspection is performed, you are required to develop an AWS report that lists the values for all variables listed above as well as transducer information, discontinuity length and location, and the your overall evaluation of the discontinuity.

For further details regarding the test equipment, methods, interpretation, and classification requirements for these inspections, please refer to the AWS D1.1 Code Book.

### 12.4.1 Description

Olympus has developed the AWS D1.1 software option for the EPOCH 600 with the goal of simplifying inspector tasks and lowering the overall inspection time. This is accomplished by having the EPOCH 600 perform some required calculations automatically and also by permitting the inspector to document discontinuities in the EPOCH 600 data logger for reporting purposes.

The EPOCH 600 can also transfer inspection data to the GageView Pro computer interface program to aid in report generation. This program allows the inspector to view the instrument's setup parameters, the waveform generated by a discontinuity, the discontinuity's sound path and location information, and all values for the AWS D1.1 formula variables.

## 12.4.2 Option Activation

The first step in operating the EPOCH 600 for AWS D1.1 inspections is to calibrate the instrument for the transducer and test conditions. For information on the angle beam calibration of the EPOCH 600, see the calibration section of this manual or the appropriate guidelines from the American Welding Society.

### To activate the AWS software feature

1. Select **AWS > Setup**.  
The **AWS** setup page appears (see Figure 12-18 on page 245).
2. In the **AWS** menu, select **AWS = On**.
3. Press **[ESCAPE]** to return to the live screen and begin AWS inspection.

After activation, you must set a **Ref B** value in order to begin an inspection. This number represents the gain level necessary to bring the echo from a reference-reflector to a user defined full-screen height (FSH). The EPOCH 600 allows the user to define the reference level to adhere to best practices and procedures. The reference-reflector is often a side-drilled hole in the calibration block used for the angle beam calibration. Other reference-reflectors can be used provided that they meet AWS requirements for these inspections.

### To adjust the reference level for echo evaluation

- ◆ In the live AWS screen, press P3, and then adjust the value to the proper reference height.



Figure 12-18 AWS setup page

### To store a Ref B value

1. Use the **[GATES]** key to gate the echo from the reference-reflector. Move the probe forward and backward to bring the echo to its maximum amplitude (peak), using Peak Memory if necessary.
2. Press **[2ND F]**, (**AUTO XX%**) to bring the maximum peak of the gated echo to reference height.
3. Choose **AWS > Ref B** to store the gated reflector as the **Ref B** value and choose **YES** to confirm (see Figure 12-19 on page 246).

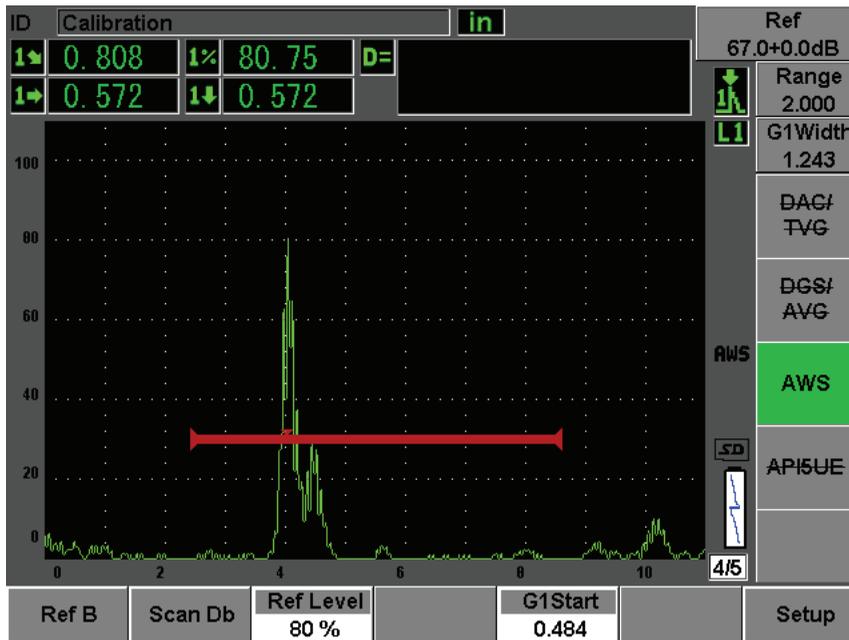


Figure 12-19 Reference B value before storage

Once the **Ref B** value is stored, the instrument displays a live D rating of any gated indication (see Figure 12-20 on page 247). This live D value, which represents the defect indication rating used with the published “AWS Acceptance - Rejection Criteria” tables to classify a potential flaw, can be viewed as a separate measurement reading in one of the five boxes. To activate and view this measurement, see section 5.3 on page 95.

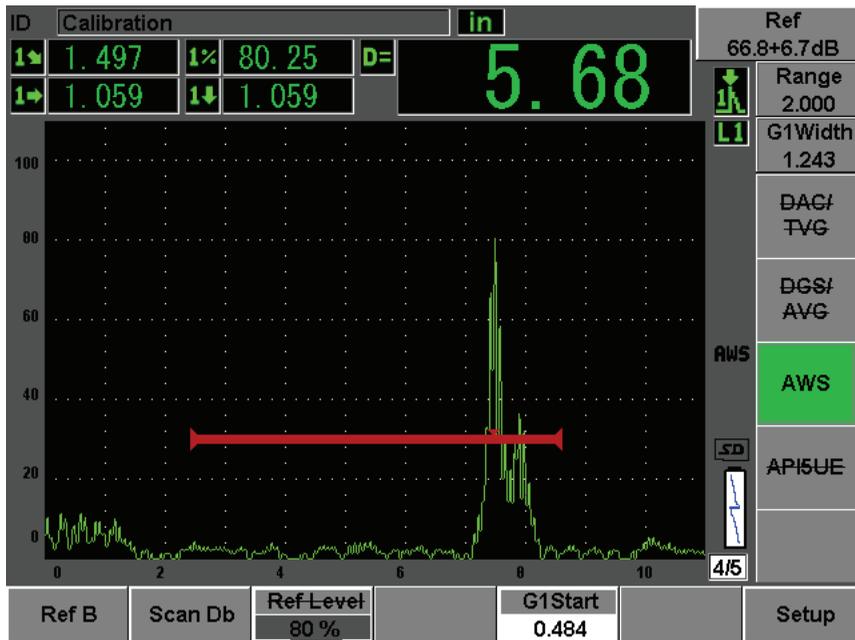


Figure 12-20 Active AWS with D rating

### 12.4.3 Scanning Gain

AWS codes require that you enter a certain amount of scanning gain to the **Ref B** gain value. This allows you to locate flaws that might be smaller or deeper in the test piece than the reference flaw.

#### To add scanning gain

1. Use the **[dB]** key to adjust the scanning-gain value necessary to perform the inspection as outlined by the AWS Code.
2. Choose **[dB] > Scan dB** to toggle the scanning gain on and off as necessary.

---

**NOTE**

To display a D indication rating value, the gated echo must peak at an amplitude less than 110 % FSH. Often, you simply have to turn off the scanning gain to bring the echo peak onto the screen. In some cases, further gain adjustments may be necessary.

---

## 12.4.4 Calculating A and C Values

When a gated echo whose peak is below 100 % FSH is present, the EPOCH 600 automatically calculates the A and C values necessary to provide a D indication rating value. For A, the EPOCH 600 automatically calculates the required dB value to bring the gated echo to reference height. To calculate C, the EPOCH 600 uses the data in the sound path calculator to generate an attenuation factor.

---

**NOTE**

In order for this calculation to be accurate, you must enter the correct thickness for the test piece.

---

By pressing **[SAVE]**, you can now save the data for this discontinuity in the EPOCH 600 data logger. For general data logger information, see chapter 11 on page 195.

At the bottom of an ID saved with AWS D1.1 active, you can see the values for A, B, C, and D. This data is viewable in the file review window.

---

**NOTE**

While using the EPOCH 600 and the AWS D1.1 software feature, it is your responsibility to take into account any inspection conditions that could cause variations in the displayed indication rating (D value), as well as interpret the meaning of echo indications and reported D values corresponding to these indications properly.

---

## 12.5 API 5UE

The API 5UE software option for the EPOCH 600 is intended to assist with performing inspections in accordance with the American Petroleum Institute's Recommended Practice 5UE. This practice was developed specifically for OCTG manufacturers to inspect and characterize inner-diameter (ID) cracking in newly fabricated pipe. The API 5UE code uses two crack sizing methods to characterize ID cracking: the Amplitude Comparison Technique (ACT) and the Amplitude-Distance Differential Technique (ADDT). The software developed for the EPOCH 4PLUS aids in performing the ADDT method, which uses the following formula to determine ID crack size:

$$di = A_{\max} \times (T_2 - T_1) \times k$$

where:

di = imperfection size

$A_{\max}$  = Maximum amplitude returned from defect area (usually 80 %)

$T_1$  = 6dB drop point from leading peak of  $A_{\max}$  (distance or time)

$T_2$  = 6dB drop point from trailing peak of  $A_{\max}$  (distance or time)

k = A constant calculated from calibration to a reference notch

During an inspection using the ADDT method from the API 5UE practice, a potentially rejectable crack is found and inspected to find its peak amplitude. This amplitude is then set to 80 % of full screen height (FSH) and designated as  $A_{\max}$ . The transducer is then moved towards the crack until the signal has dropped 6 dB, or to ½ the screen height of  $A_{\max}$ . This position is noted as  $T_1$ . The transducer is then moved away from the crack until the signal has dropped 6 dB on the other side of  $A_{\max}$ . This position is noted as  $T_2$ . Using these measurements, along with a k factor constant calculated during calibration, the crack size di is calculated and recorded.

For further details regarding this calculation, along with the calculation of the “k factor” constant, please refer to API's Recommended Practice 5UE specification.

### Description

The API 5UE software option for the EPOCH 600 was designed to greatly simplify the number of operations needed to perform the ADDT test, and to greatly reduce your overall inspection time. This is accomplished using the Peak Memory function to draw a peak envelope of the crack signal and quickly capture the  $A_{\max}$ ,  $T_1$ , and  $T_2$

points using a single key press. Using this collected data from the peak envelope, the EPOCH 600 performs the necessary calculation using the formula above and displays the crack height in the upper right corner of the screen. You can then save all relevant values of the inspected crack to the data logger for reporting purposes and/or transfer to a PC using the GageView Pro interface program (see Figure 12-21 on page 250).



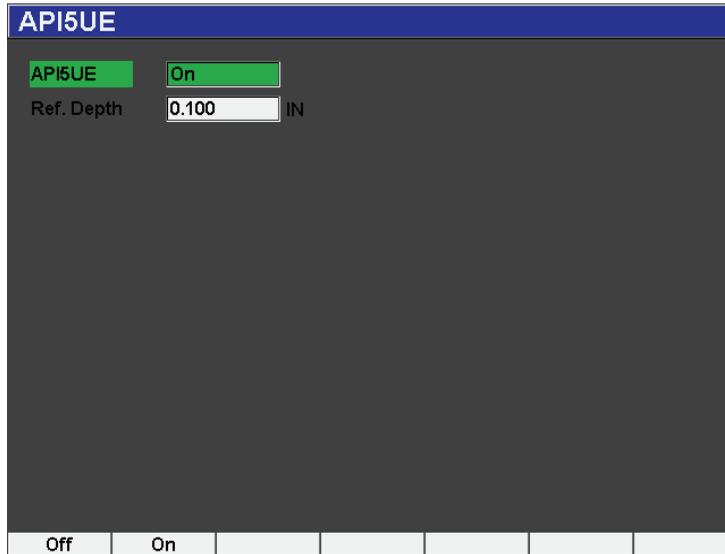
Figure 12-21 Completed API 5UE sizing

## 12.5.1 Option Activation and Setup

If the API 5UE software option has been licensed on the instrument, it can be activated at any time during standard operation.

### To activate the API 5UE software option

1. Select **API5UE > Setup**.
2. In the **API5UE** menu, select **API5UE = On** (see Figure 12-22 on page 251).
3. Press **[NEXT GROUP]**, and then enter the known height of the calibration reference notch in the **Ref. Depth** box.
4. Press **[ESCAPE]** to return to the live screen.



**Figure 12-22 Waveform averaging option setup**

When API 5UE is activated, the function keys on the EPOCH 600 aid the inspector in collecting data for calibration and collecting inspection data. Also, the AUTO XX% feature allows you to automatically bring any captured echo to 80 % of FSH, which is particularly helpful in obtaining a precise  $A_{\max}$  reading from a reference notch.

The API 5UE code specifies that prior to inspection, the instrument must be calibrated using a reference notch of known depth (in certain circumstances, a through-drilled hole is desirable for calibration – see the full text of API’s Recommended Practice 5UE for details concerning reference standard selection). The depth of this reference notch must be entered correctly in the activation menu for the API 5UE software option.

Prior to calibrating with a reference notch, the instrument should be calibrated to verify beam index point, refracted angle and distance in the inspection material. Please see section 10.7 on page 172 and 10.8 on page 183 for details regarding angle beam calibration.

## 12.5.2 Envelope Mode

The simplest method for inspection of crack depth is using API 5UE in Envelope Mode. This method allows the operator to collect all pertinent data with the press of a single key and size potential defects in the most efficient manner.

### 12.5.2.1 Calibration

Calibrating for API 5UE inspection in Envelope mode requires the activation of the Peak Memory function. Envelope mode automatically becomes active when the Peak Memory feature is turned on. To activate the Peak Memory function, press **[PEAK MEM]**. The letter "P" should appear to the right of the live A-Scan display.

Once the Peak Memory function is activated, calibrate the instrument using the following steps.

#### To calibrate the instrument

1. Find the reflection from the calibration notch and use AUTO XX% to bring this indication to 80 % FSH.
2. Adjust gate 1 so that it surrounds the indication.
3. Move the transducer forward and backward over the notch to draw a peak envelope of the echo dynamics of the notch.
4. Press **[P1]** to collect the  $A_{max}$ ,  $T_1$ , and  $T_2$  data from the envelope (see Figure 12-23 on page 253).
5. Press **[P5]** to move from calibration mode to Inspect mode.

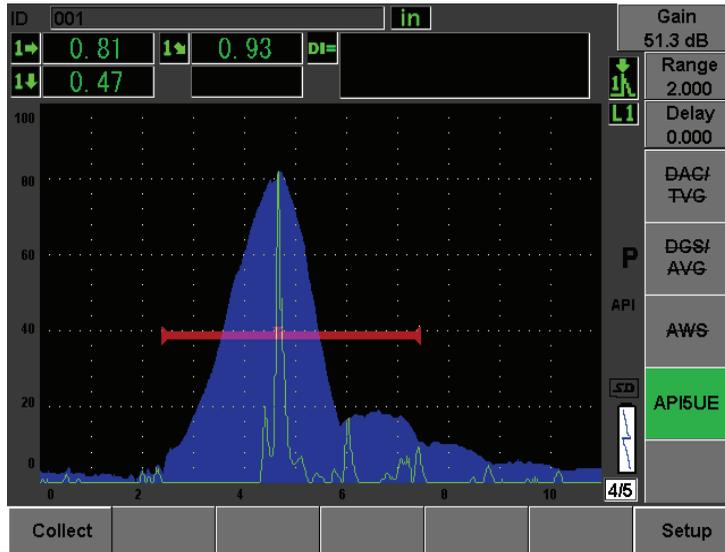


Figure 12-23 Calibration data in collect mode

### 12.5.2.2 Crack Sizing

The EPOCH 600 automatically collects  $A_{max}$ ,  $T_1$ , and  $T_2$  and calculates a “k factor” from the known reference height  $d_r$ . These three collected values ( $A_{max}$ ,  $T_1$ , and  $T_2$ ) are displayed on the screen in their respective positions using “□” marks.

Once you are satisfied with the collected calibration data, press [P5] to move from Calibration mode to Inspect mode (see Figure 12-24 on page 254).

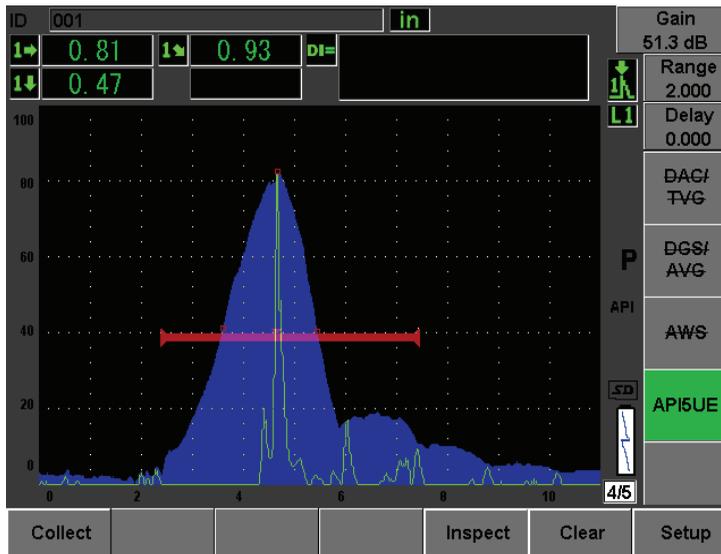


Figure 12-24 The Inspect mode

Crack sizes are displayed under the “Di” measurement (see section 5.3.2 on page 98).

With the Peak Memory function active, the unit is default to Envelope mode for crack sizing. Use the following steps to size a crack using the Envelope mode.

### To size a crack using the Envelope mode

1. Activate the Peak Memory function by pressing [PEAK MEM].
2. Find the signal from the potential defect bring to maximum amplitude (see API’s Recommended Practice 5UE for crack scanning and inspection requirements).
3. If necessary, use the AUTO XX% feature to bring the peak amplitude to 80 % of FSH.
4. Scan forward and backward from the peak amplitude of the crack to draw a “peak envelope” of the crack signal.
5. Adjust your screen range to adequately encompass the entire peak envelope, and then set the gate level to less than half the peak amplitude height (in % FSH).
6. Press [P1] to collect  $A_{max}$ ,  $T_1$ , and  $T_2$  from the peak envelope.

The crack size indication (di) appears at the top right corner of the live A-Scan display.

7. Find the reflection from the calibration notch and use AUTO XX% to bring this indication to 80 % FSH
8. Adjust gate 1 so that it surrounds the indication.
9. Move the transducer forward and backward over the notch to draw a peak envelope of the echo dynamics of the notch.
10. Press **[P1]** to collect the  $A_{\max}$ ,  $T_1$ , and  $T_2$  data from the envelope
11. Press **[P5]** to move from calibration mode to Inspect mode.

To inspect a separate crack, or to collect new data for the same crack, press **[P6]** to clear the current data and follow the steps above to inspect again.

### 12.5.3 Manual Mode

You can also use the Manual mode approach with the API 5UE option. This mode allows you to manually select the  $A_{\max}$ ,  $T_1$ , and  $T_2$  points from a live A-Scan to obtain a crack depth indication.

#### 12.5.3.1 Calibration

When not using the Peak Memory function, it is possible to manually collect each calibration data point to calibrate the instrument for inspection. This manual collection only works when the Peak Memory function is OFF.

After activating the API 5UE software and inputting a reference notch depth, use the following steps to calibrate in Manual mode.

#### To calibrate in Manual mode

1. Find the signal from the reference notch.
2. Adjust your screen range to adequately display the full range of motion of the reference notch signal.
3. Adjust the gate 1 to encompass the full range of motion of the reference notch signal, and then bring the gate to below 40 % FSH.
4. Find the reflection from the calibration notch and use AUTO 80% to bring this indication to 80 % FSH.
5. Press **[P1] RefAMax** to store the  $A_{\max}$  point, and then press **[P1]** to confirm (see Figure 12-25 on page 256).

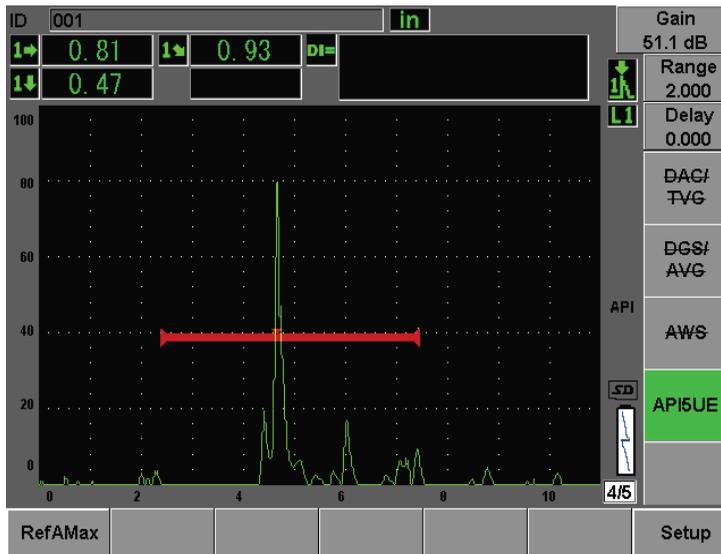


Figure 12-25 Storing the  $A_{\max}$  point

6. Move the transducer forward over the notch until the peak drops to 40 % FSH on the leading edge of the signal.
7. Press **[P2] RefT1** to collect the 6 dB drop position of the leading peak and assign this value as  $T_1$  (see Figure 12-26 on page 257).

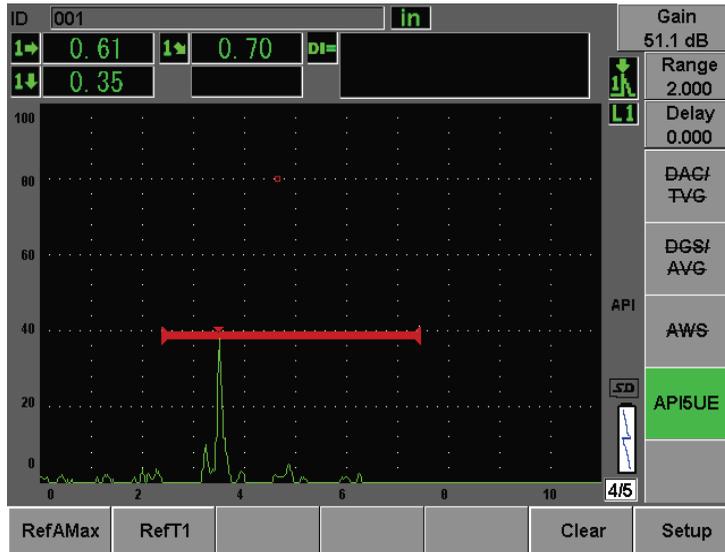


Figure 12-26 Storing the  $T_1$  point

8. Move the transducer backward over the notch until the peak drops rises to 80 % and then falls back to 40 % FSH on the trailing edge of the signal.
9. Press **[P3] RefT2** to collect the 6 dB drop position of the trailing peak and assign this value as  $T_2$  (see Figure 12-27 on page 258).

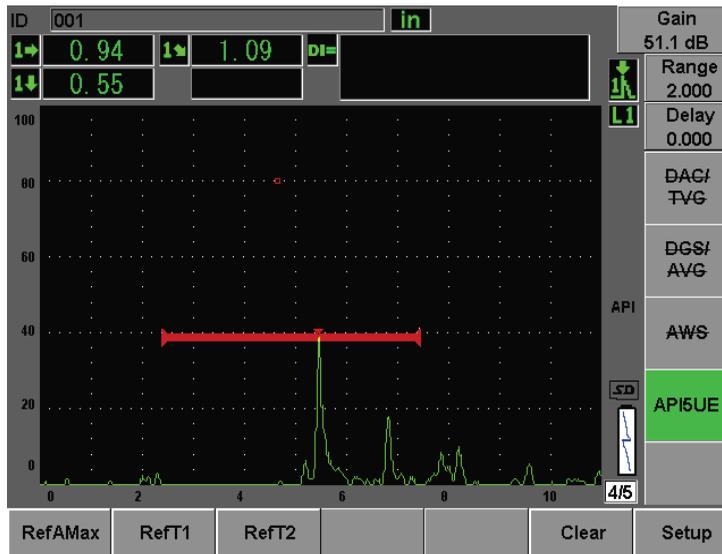


Figure 12-27 Storing the  $T_2$  point

10. Press the **[P5]** key to complete the calibration and move to the Inspect mode.
11. If you are not satisfied with the collected points, you can overwrite a particular point using the previous Parameter keys (**[P1]**, **[P2]**, or **[P3]**), or press **Clear** (**[P5]**) to clear the entire calibration and begin again.

### 12.5.3.2 Crack Sizing

Once the API 5UE software has been properly calibrated to a reference notch, use the following steps to size a crack using the Manual mode.

#### To size a crack using the Manual mode

1. Find the signal from the potential defect bring to maximum amplitude (see API's Recommended Practice 5UE for crack scanning and inspection requirements).
2. If necessary, use the AUTO XX% feature to bring the peak amplitude to 80 % of FSH.
3. Once the peak amplitude is displayed on the screen, use the AMax function key (**[P2]**) to assign this peak amplitude value as  $A_{max}$ . Note the value of the peak amplitude in %FSH.

4. Move the transducer towards the potential defect until the peak has dropped to  $\frac{1}{2}$  the value of  $A_{\max}$  (in % FSH) on the leading edge of the signal. Press the  $T_1$  function key ([P2]) to collect the 6dB drop position of the leading peak and assign this value as  $T_1$ .
5. Move the transducer away from the potential defect until the peak has dropped to  $\frac{1}{2}$  the value of  $A_{\max}$  (in % FSH) on the trailing edge of the signal. Press the  $T_2$  Function Key ([P3]) to collect the 6 dB drop position of the trailing peak and assign this value as  $T_2$ . The crack size indication will appear at the top right corner of the live A-Scan display.
6. To inspect a separate crack, or to collect new data for the same crack, press [P6] to Clear the current data and follow the steps above to inspect again.

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<b>NOTE</b>
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At any time during an inspection in either Envelope mode or Manual mode, it is possible to re-calibrate the instrument. Press the **RE-CAL** function key ([P5]) to enter the calibration mode and follow the steps defined in section 12.5.2.1 on page 252 and 12.5.3.1 on page 255 to re-calibrate.

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## 12.6 Waveform Averaging

The Waveform Averaging software option allows the live A-scan view to represent an average of successively acquired A-scans. Waveform averaging improves signal-to-noise ratio when static flaws are detected.

It is not advisable to use waveform averaging when dynamically scanning a test material for flaws. This will actually average out the high peak flaw echoes with the lower amplitude clean signals that surround it, making it harder to identify specific flaw signals.

You can select the precision of the averaging, choosing between **2X**, **4X**, **8X**, **16X**, or **32X** averaging to remove spurious noise signals from the A-scan while maintaining relevant signals.

## 12.6.1 Option Setup

If the Waveform Averaging software option has been licensed on the instrument, it can be activated at any time during standard operation.

### To activate the Waveform Averaging software feature

1. Select **Meas Setup > Special**.  
The **Special** screen appears (see Figure 12-28 on page 260).
2. In the **Special** menu, select **Average**.
3. Select the level of averaging.
4. Press **[ESCAPE]** to return to the live screen.

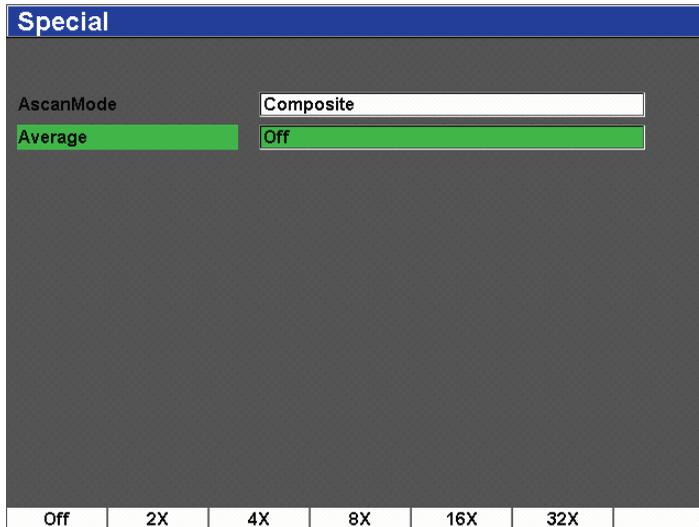
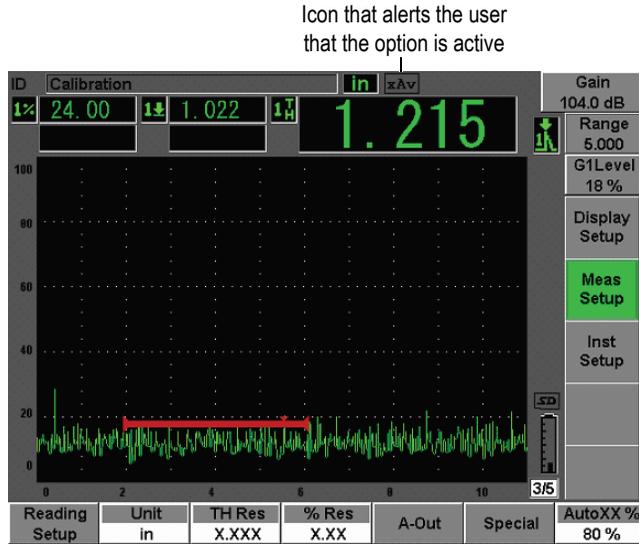


Figure 12-28 Waveform Averaging option setup

## 12.6.2 Using the Averaging Option

Once the Waveform Averaging option has been turned on, an icon is displayed on the top of the screen to alert you that the option is active (see Figure 12-29 on page 261).



**Figure 12-29 The Waveform Averaging icon**

It is important to note that the effective measurement rate when using the averaging software is not equal to the PRF as it is in standard mode. The effective measurement rate when using the averaging option is equal to the total PRF divided by the averaging factor.

At higher averaging rates, the screen update rate may be less than 60 Hz (depending on the PRF value). Since 60 Hz is usually the industry standard for screen update rate, you will be notified by an icon on the right side of the waveform display if the update rate is less than 60 Hz (see Figure 12-30 on page 262).

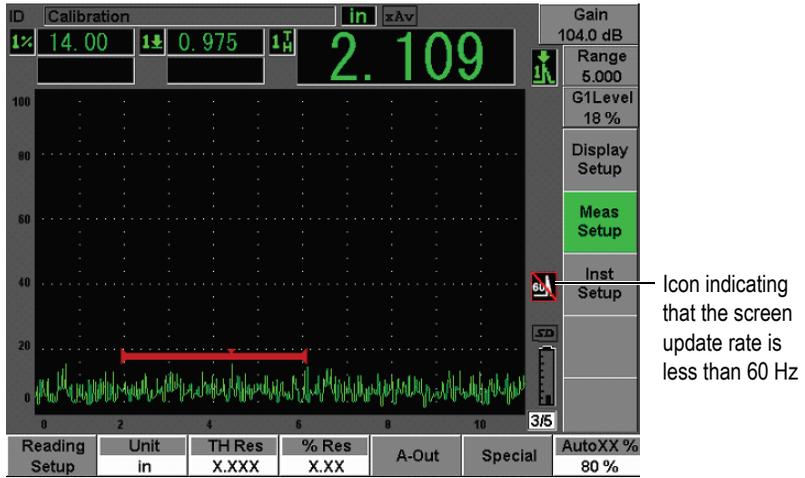


Figure 12-30 Update rate less than 60 Hz

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## 13. Maintenance & Troubleshooting

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This chapter details the maintenance tasks to be performed on the EPOCH 600 and provides a troubleshooting guide. The topics are as follows:

- “Instrument Cleaning” on page 263
- “Verifying O-Ring Gaskets and Seals” on page 263
- “Protecting the Display” on page 264
- “Annual Calibration” on page 264
- “Troubleshooting” on page 264

### 13.1 Instrument Cleaning

When needed, wash the instrument only with mild soap and water on a damp cloth.

### 13.2 Verifying O-Ring Gaskets and Seals

The EPOCH 600 contains seals that are used to protect the instrument’s internal hardware from the environment. These include:

- Battery compartment cover seal
- Side door seal
- Membrane vent
- Main o-ring seals between the top and bottom half of the instrument and the aluminum heat-sink band
- Conventional transducer gasket

Regularly clean and verify the state of the above seals and gaskets to ensure the integrity of the hardware protection.

## 13.3 Protecting the Display

EPOCH 600 instrument includes a clear-plastic sheet protecting the display window. Leave the clear-plastic sheet in place when using the instrument to continuously protect the display. Clear-plastic sheet replacements are available from Olympus in packages of 10 (P/N: 600-DP [U8780297]).



### CAUTION

The display window is permanently bonded to the upper-half of the instrument case to fully seal the instrument. If the display window becomes damaged, the entire upper-half of the case must be replaced, along with the instrument direct-access keypad.

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## 13.4 Annual Calibration

Olympus recommends that you send your EPOCH 600 instrument once a year to an Olympus service center for annual calibration. Contact Olympus for details.

## 13.5 Troubleshooting

### Symptom

The **[On/Off]** power key is the only operational front panel key. Nothing happens when pressing other keys.

### Possible cause

The **All Lock** function is active, locking all front panel keys.

### Solution

Turn the instrument power Off and On to unlock the keys.

Symptom

Several software functions are unavailable.

Possible cause

The **Cal Lock** function is active, locking all front panel keys.

Solution

Turn the instrument power Off and On to unlock the keys.

Symptom

The instrument does not start when pressing the [ON/OFF] power key (following a software update).

Possible cause

Interrupted, incomplete, or corrupted software update.

Solution

1. Remove the battery from the EPOCH 600 as well as the AC line power.
2. Replace the battery in the EPOCH 600.
3. Start the unit.



## 14. Specifications

This chapter describes the EPOCH 600 specifications. The topics are as follows:

- “General and Environmental Specifications” on page 267
- “Channel Specifications” on page 269
- “Input/Output Specifications” on page 271

### 14.1 General and Environmental Specifications

**Table 15 General specifications**

Parameter	Value
Overall dimensions (W x H x D)	236 mm x 167 mm x 70 mm 9.3 in. x 6.57 in. x 2.76 in. (see on page 267)
Weight	1.68 kg (3.72 lb), including lithium-ion battery
Keypad	English, International, Japanese, Chinese
Languages	English, Spanish, French, German, Italian, Japanese, Chinese, Russian, Portuguese, Polish, Dutch, Korean, Czech, Hungarian, and Finnish
Transducer connections	BNC or LEMO 01
Data storage	Onboard up to 10,000 IDs with waveform, standard 2 GB MicroSD card (removable)
Battery type	Single lithium-ion rechargeable standard or standard AA alkaline batteries
Battery life	12 hours
Power requirements	AC Mains: 100 VAC to 120 VAC, 200 VAC to 240 VAC, 50 Hz to 60 Hz

**Table 15 General specifications (continued)**

<b>Parameter</b>	<b>Value</b>
Display type	Full VGA (640 × 480 pixels) transfective color LCD, 60 Hz update rate
Display dimensions (W × H, Diagonal)	132.5 mm × 99.4 mm, 165.1 mm (5.2 in. × 3.9 in., 6.5 in.)
Warranty	1 year limited

**Table 16 Environmental ratings specifications**

<b>Parameter</b>	<b>Value</b>
IP rating	Designed to meet requirements of IP66 (knob configuration) or IP67 (navigation pad configuration)
Explosive atmosphere	MIL-STD-810F Procedure 1, NFPA 70E, Section 500, Class 1, Div. 2, Group D
Shock tested	IEC 60068-2-27, 60 g, 6 μs H.S., multiple axes, 18 total
Vibration tested	Sine vibration, IEC 60068-2-6, 50 Hz to 150 Hz at 0.03 in. DA or 2 g, 20 sweep cycles
Operating temperature	-10 °C to 50 °C (-14 °F to 122 °F)
Battery storage temperature	0 °C to 50 °C (32 °F to 122 °F)

## 14.2 Channel Specifications

**Table 17 Pulser specifications**

Parameter	Value
Pulser	Tunable Square Wave
PRF	10 Hz to 2000 Hz in 10 Hz increments
Energy settings	100 V, 200 V, 300 V, or 400 V
Pulse width	Adjustable from 30 to 10,000 ns (0.1 MHz) with PerfectSquare Technology
Damping	50, 100, 200, 400 $\Omega$

**Table 18 Receiver specifications**

Parameter	Value
Gain	0 dB to 110 dB
Maximum input signal	20 V p-p
Receiver input impedance	400 $\Omega$ $\pm$ 5 %
Receiver bandwidth	0.2 to 26.5 MHz @ -3 dB
Digital filter settings	Eight digital filter sets standard (0.2–10 MHz, 2.0–21.5 MHz, 8.0–26.5 MHz, 0.5–4 MHz, 0.2–1.2 MHz, 1.5–8.5 MHz, 5–15 MHz, DC–10 MHz)
Rectification	Fullwave, positive halfwave, negative halfwave, RF
System linearity	Horizontal: $\pm$ 0.2 % FSW
Vertical Linearity	0.25 % FSH, amplifier accuracy $\pm$ 1 dB
Reject	0 to 80 % FSH with visual warning
Amplitude Measurement	0 to 110 % full screen height with 0.25 % resolution
Measurement Rate	Equivalent to PRF in all modes

**Table 19 Calibration specifications**

Parameter	Value
Automated calibration	Velocity, zero offset Straight beam (first backwall or echo-to-echo) Angle beam (soundpath or depth)
Test Modes	Pulse echo, dual, or through transmission
Units	Millimeters, inches, or microseconds
Range	1 to 10,160 mm (0.039 to 400 in.)

**Table 19 Calibration specifications (continued)**

Parameter	Value
Velocity	635 to 15240 m/s (0.0250 to 0.6000 in/ $\mu$ sec)
Zero Offset	0 to 750 $\mu$ sec
Display Delay	-59 to 25,400 mm (-2.323 to 1000 in.)
Refracted Angle	0° to 85° in 0.1° increments

**Table 20 Gate specifications**

Parameter	Value
Measurement gates	2 fully independent gates for amplitude and TOF measurements
Gate start	Variable over entire displayed range
Gate width	Variable from gate start to end of displayed range
Gate height	Variable from 2 to 95 % full screen height
Alarms	Positive and negative threshold, minimum depth (gate 1 and gate 2)

**Table 21 Measurement specifications**

Parameter	Value
Measurement display locations	5 locations available (manual or auto selection)
Gate 1	Thickness, soundpath, projection, depth, amplitude, time-of-flight, min/max depth, min/max amplitude
Gate 2	Same as Gate 1
Echo-to-Echo	Standard Gate2 – Gate1
Other Measurements	Overshoot (dB) value for DGS/AVG, ERS (equivalent reflector size) for DGS/AVG, AWS D1.1/D1.5 rating (D), reject value
DAC/TVG	Standard
DAC Points	Up to 50 points, 110 dB dynamic range
Special DAC Modes	20–80 % DAC, custom DAC (up to 6 curves)
Curved Surface Correction	Standard OD or bar correction for angle beam measurements

## 14.3 Input/Output Specifications

Table 22 on page 271 provides the specifications for the input output signals.

**Table 22 Input/output specifications**

Parameter	Value
USB ports	1 USB
Video output	VGA output standard
RS-232	Yes
Analog outputs	1 analog output, selectable 1 V/10 V full scale, 4 mA max. (optional)
Alarm outputs	2 alarm outputs, 5 V TTL, 10 mA

Table 23 on page 271 describes all the connections available on the Alarms 26-pin D-sub connector. Table 24 on page 271 describes all the connections available on the VGA Out 15-pin connector.

**Table 23 EPOCH 600 9-pin port output**

Pin	Signal	Description
1	+5 V	+5 V voltage
2	TXD	Transmit data (serial)
3	RXD	Receive data (serial)
4	DSR	Data set ready (serial)
5	GND	Ground
6	DTR	Data terminal ready (serial)
7	NC	Not connected
8	ALARM GATE 1	Gate 1 alarm
9	ALARM GATE 2	Gate 2 alarm

**Table 24 EPOCH 600 15-pin port output<sup>a</sup>**

Pin	Signal	Description
1	VGA_RED	VGA red output

**Table 24 EPOCH 600 15-pin port output\* (continued)**

Pin	Signal	Description
2	VGA_GREEN	VGA green output
3	VGA_BLUE	VGA blue output
4	NC	Not connected
5	GND	Ground
6	GND	Ground
7	GND	Ground
8	GND	Ground
9	NC	Not connected
10	GND	Ground
11	NC	Not connected
12	NC	Not connected
13	LCD_HSYNC	Horizontal sync.
14	LCD_VSYNC	Vertical sync.
15	NC	Not connected

a. Standard VGA output configuration

## Appendix A: Sound Velocities

Table 25 on page 273 lists the ultrasonic velocity in a variety of common materials. This is only a guide. The actual velocity in these materials might vary significantly due to a variety of causes, such as, composition, preferred crystallographic orientation, porosity, and temperature. For maximum accuracy, establish the sound velocity in a given material by first testing a sample of the material.

**Table 25 Ultrasonic velocities in a variety of common materials**

Material	V (in./ $\mu$ s)	V (m/s)
Acrylic resin (Perspex)	0.107	2730
Aluminum	0.249	6320
Beryllium	0.508	12900
Brass, naval	0.174	4430
Copper	0.183	4660
Diamond	0.709	18000
Glycerin	0.076	1920
Inconel <sup>®</sup>	0.229	5820
Iron, Cast (slow)	0.138	3500
Iron, Cast (fast)	0.220	5600
Iron oxide (magnetite)	0.232	5890
Lead	0.085	2160
Lucite <sup>®</sup>	0.106	2680
Molybdenum	0.246	6250
Motor oil (SAE 20/30)	0.069	1740

**Table 25 Ultrasonic velocities in a variety of common materials (continued)**

Material	V (in./ $\mu$ s)	V (m/s)
Nickel, pure	0.222	5630
Polyamide (slow)	0.087	2200
Nylon, fast	0.102	2600
Polyethylene, high density (HDPE)	0.097	2460
Polyethylene, low density (LDPE)	0.082	2080
Polystyrene	0.092	2340
Polyvinylchloride, (PVC, hard)	0.094	2395
Rubber (polybutadiene)	0.063	1610
Silicon	0.379	9620
Silicone	0.058	1485
Steel, 1020	0.232	5890
Steel, 4340	0.230	5850
Steel, 302 austenitic stainless	0.223	5660
Steel, 347 austenitic stainless	0.226	5740
Tin	0.131	3320
Titanium, Ti 150A	0.240	6100
Tungsten	0.204	5180
Water (20°C)	0.0580	1480
Zinc	0.164	4170
Zirconium	0.183	4650

## References

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2. Fredericks, J. R. *Ultrasonic Engineering*. New York: John Wiley & Sons, Inc., 1965.
3. *Handbook of Chemistry and Physics*. Cleveland, Ohio: Chemical Rubber Co., 1963.
4. Mason, W. P. *Physical Acoustics and the Properties of Solids*. New York: D. Van Nostrand Co., 1958.
5. Papadakis, E. P. Panametrics - unpublished notes, 1972.

## Appendix B: Glossary

**Table 26 Glossary**

<b>Term</b>	<b>Definition</b>
Acoustic impedance	A material property defined as the product of sound velocity (C) and the material's density (d).
Acoustic interface	The boundary between two media of different acoustic impedance.
Acoustic zero	The point on the data display that represents the entry surface of the specimen.
Amplifier	An electronic device that increases the strength of a signal fed into it by obtaining power from a source other than the input signal.
Amplitude	Referring to an indication on the data display, the vertical height of an indication measured from the lowest to the highest point on the indication.
Angle beam transducer	A transducer that transmits or receives the acoustic energy at an angle to the surface to set up shear waves or surface waves in the part being inspected.
A-scan	Pulse-echo format wherein the data display shows the pulse travel time in the horizontal direction (left to right) representing the corresponding sound paths. The vertical direction (bottom to top) displays the maximum value of the acoustic pressure echo amplitude received by the probe.

**Table 26 Glossary (continued)**

Term	Definition
Attenuation	The loss in acoustic energy that occurs between any two points of travel. This loss may be due to absorption, reflection, scattering, and other phenomena.
Back or back-wall echo	The echo received from the side of the specimen opposite the side to which the transducer is coupled. This echo represents the thickness of the specimen at that point.
Background noise	Extraneous signals caused by sources within the ultrasonic testing system and the material being tested.
Beam-index point (BIP)	For an angle beam probe, the point where the sound leaves the wedge and enters the specimen.
Cal. block velocity	Material sound velocity for the calibration block.
Couplant	A material (usually a liquid or gel) used between the transducer and the test specimen to eliminate air from this space and thus facilitate the passage of sound waves into and out of the specimen.
Critical defect	Either the largest tolerable defect or the smallest intolerable defect. The critical defect size is usually given by a specification or code.
Cross talk	An unwanted condition affecting dual element transducers in which acoustic energy travels from the transmitting crystal to the receiving crystal by routes other than the intended path through the material.
Damping (control)	A variable resistance across the pulser circuit output which shapes the excitation pulse. Typically it is used to change pulse characteristics to optimize either penetration (low damping) or near-surface resolution (high damping).
Damping material	Any gel, rubber-like substance, or other material which, when used in the transducer, results in a shorter ringing time of the piezoelectric crystal.

**Table 26 Glossary (continued)**

Term	Definition
Decibel (dB)	<p>A unit which compares levels of power. Two power levels P1 and P2, are said to differ by n decibels when: <math>n = 10 \log_{10} \left( \frac{P_2}{P_1} \right)</math></p> <p>This unit is often used to express sound intensities. In this case, P2 is the intensity of the sound under consideration and P1 is the intensity the reference level.</p>
Delay control	Subcircuit of the sweep generator that allows a variably adjustable time period from the sending of the trigger pulse to the start of the sweep across the data display.
Detectability	The ability of a test system (instrument and transducer) to detect or “see” a given size reflector. This is also known as “sensitivity.”
Distance amplitude correction (DAC)	A method of flaw evaluation that uses a test block with a known size reflector at varying known distances from the transducer. This allows you to plot a curve on the data display that represents the amplitude of that size reflector throughout a given distance range. This curve compensates for the loss of energy due to beam spreading and attenuation.
Dual element probe	A probe containing two piezoelectric elements, one which transmits and one which receives.
Dynamic range	The ratio of maximum to minimum reflective areas that can be distinguished on the cathode ray tube (usually based on decibel ratios).
Electronic zero	The point in time when the pulser fires the initial pulse to the transducer and the point on the cathode ray tube screen where the electron beam leaves the baseline due to the initial pulse signal coming from the transmitter.
First critical angle	The minimum incident angle in the first medium at which the refracted longitudinal wave is eliminated from the test specimen.

**Table 26 Glossary (continued)**

Term	Definition
Flaw	A discontinuity that may be undesirable but does not necessarily call for rejection.
Frequency	The number of complete cycles undergone or produced by an oscillating body.
Gain	Used in electronics with reference to an increase in signal power; usually expressed as the ratio of the output power to the input power in decibels.
Gate	An electronic baseline display used to electronically monitor portions of the displayed range with reference to distance or amplitude.
Hertz (Hz)	The derived unit of frequency defined as the frequency of a periodic phenomenon of which the period is one second; equal to one cycle per second. Symbol Hz. 1 kilohertz (kHz) = $10^3$ cycles per second 1 Megahertz (MHz) = $10^6$ cycles per second.
Immersion testing	A test method, useful for testing irregularly shaped parts, in which the part to be tested is immersed in water (or other liquid) so that the liquid acts as a couplant. The transducer is also immersed in the liquid, but not in contact with the part being tested.
Incidence, angle of	The angle between a sound beam striking an acoustic interface and the normal (that is, perpendicular) to the surface at that point. Usually designated by the Greek symbol $\alpha$ (alpha).
Indication	The signal displayed on the data display signifying the presence of a sound wave reflector in the part being tested.
Indication (defect) level	The number of decibels of calibrated gain which must be set on the instrument to bring the indication (defect) echo signal to peak at the reference line on the screen.
Initial pulse (IP)	The pulse of electrical energy sent by the pulser to the transducer.

**Table 26 Glossary (continued)**

<b>Term</b>	<b>Definition</b>
Leg	In angle beam testing, the path the shear wave travels in a straight line before being reflected by the opposite surface of the material being tested.
Linearity, vertical or amplitude	The characteristics of an ultrasonic test system indicating its ability to respond in a proportional manner to a range of echo amplitudes produced by specified reflectors.
Linearity, horizontal or distance	The characteristics of an ultrasonic test system indicating its ability to respond in a proportional manner to a range of echo signals, produced by specified reflectors, variable in time, usually a series of multiple back reflections.
LOS	Acronym for loss of signal.
Longitudinal wave	Mode of wave propagation characterized by particle movement parallel to the direction of wave travel.
Main bang	Term used to describe the initial pulse voltage.
Mode conversion	Changing a portion of sound beam energy into a wave of a different mode due to refraction at incident angles other than zero degrees. In NDT, this usually involves conversion of longitudinal waves into shear waves or surface waves.
Peaking up	Maximizing the height of any indication displayed on the data display by positioning the main axis of the sound beam directly over the reflector.
Penetration	The ability of the test system to overcome material loss attenuation; that is, the ability of the sound beam to bypass small reflectors such as grain boundaries and porosity in the specimen.

**Table 26 Glossary (continued)**

Term	Definition
Piezoelectric elements	A family of materials (such as lead metaniobate, quartz, lithium sulfate) that possess the characteristic ability to produce: a) A voltage differential across their faces when deformed by an externally applied mechanical force, and b) A change in their own physical configuration (dimensions) when an external voltage is applied to them.
Probe	Another name for transducer.
Pulse repetition rate or pulse repetition frequency (PRF)	The frequency with which the clock circuit sends its trigger pulses to the sweep generator and the transmitter, usually quoted in terms of pulses per second (PPS).
Range	The distance represented by the entire horizontal data display.
Receiver	That circuit of a flaw detector that receives both the initial pulse voltage from the transmitter and the returning echoes (as voltages) from the transducer. By passing these incoming signals through certain subcircuits, the signals are rectified, filtered, and amplified with the results send to the screen for display.
Reference echo	The echo from a reference-reflector.
Reference level	The number of decibels of calibrated gain which must be set on the instrument to bring the reference-reflector signal to peak at the reference line on the data display.
Reference line	A predetermined horizontal line (usually dictated by specifications) on the data display representing some percentage of total data display height, at which reference echoes and indication echoes are compared.
reference-reflector	A reflector of known size (geometry) at a known distance, such as a flat-bottom hole.

**Table 26 Glossary (continued)**

<b>Term</b>	<b>Definition</b>
Refraction, angle of	The angle of sound reflection in the wedge which is equal to the angle of incidence (also in the wedge.) The angle of reflectance is measured from the normal to the reflected sound beam.
Registration	The minimum detectable flaw size.
Reject (control)	Also known as suppression, limits the input sensitivity of the amplifier in the receiver. "Grass" or scattering noise can be reduced or eliminated from the data display by its use. On most analog instruments it also destroys the vertical linearity relationship between echo heights.
Resolution	The ability of the test system (instrument and transducer) to distinguish reflectors at slightly different depths.
Scanning level	The number of decibels of calibrated gain above the reference level added to insure seeing potentially significant reflectors at the end of the V-path in a weld inspection.
Second critical angle	The minimum incident angle in the first medium at which the refracted shear wave leaves the body of the test specimen.
Sensitivity	The ability of the test system (instrument and transducer) to detect a given size reflector at a given distance.
Signal-to-noise ratio	The ratio of amplitudes and indications from the smallest defect considered significant and those caused by random factors, such as grain scattering or instrument noise.
Single element probe	A probe containing only one piezoelectric element, which is used to both transmit and receive sound.
Skip-distance	In angle beam testing, the surface distance which represents one V-path of sound in the material.
Sound beam	The characteristic shape of the ultrasonic wave sent into the material.

**Table 26 Glossary (continued)**

Term	Definition
Sound path distance	The distance from the transducer beam index point to the reflector located in the specimen, measured along the actual path that the sound travels. Sometimes referred to as angular distance in angle beam testing.
Straight beam probe (Normal beam probe)	A probe which transmits the sound into the material perpendicular to the entry surface.
Surface wave	Mode of wave propagation characterized by an elliptical movement of the particles (molecules) on the surface of the specimen as the wave front moves forward, this movement penetrating the specimen to a depth of one wavelength.
Through transmission	A test method in which the vibrations emitted by one transducer are directed toward, and received by, another transducer. The ratio between quantity of vibration sent and received is a measure of the integrity, or quality of the material being tested.
Time-varied gain (TVG)	Circuit that automatically adjusts the gain so that the echo amplitude of a given size reflector is displayed at a constant data display height regardless of the distance to that given size reflector.
Transducer	A device that transforms one form of energy into another.
Transmitter	Circuit of the flaw detector that sends the initial pulse voltage to both the transducer and receiver.
Ultrasonic	Of or relating to frequencies above the human audible range; for example, above 20,000 cycles/s (20 kHz).
V-path	The angular distance sound travels, measured from the top surface of the material to the bottom, and reflecting back up to the top surface.
Wavelength	The distance between like points on successive wave fronts; such as the distance between any two successive particles of the oscillating medium that are in the same phase. It is denoted by the Greek letter $\lambda$ (lambda).

## Appendix C: Parts List

**Table 27 EPOCH 600 basic kit [spares can be purchased]**

Part Number	U8 Number	Description
EP600-BA-UEE-K	U8051216	EPOCH 600 instrument NOTE: The part number vary according to the instrument configuration. The instrument can be adapted to have different keypads, manual languages, power cords, etc. Contact your Olympus representative for further information.
EP-MCA-X	See note	AC charger/adaptor NOTE: The part number vary according to the instrument configuration. You must specify the power cord type.
600-BAT-L	U8760056	EPOCH 600 lithium-ion rechargeable battery
600-TC	U8780294	EPOCH 600 instrument transport case
EP600-MANUAL-CD	U8778381	<i>EPOCH 600 User's Manual (CD-Rom)</i>
DMTA-10007-01EN	U8778365	<i>EPOCH 600 Basic Operation Manual</i>
DMTA-10008-01EN	U8778373	<i>EPOCH 600 Getting Started</i>
600-BAT-AA	U8780295	8-cell battery holder with connector plug
MICROSD-ADP-2GB	U8779307	2-GB MicroSD memory card with adaptors

**Table 28 EPOCH 600 software options**

<b>Part Number</b>	<b>U8 Number</b>	<b>Description</b>
EP600-DGS-AVG	U8140146	EPOCH 600 onboard DGS/AVG software option
EP600-AWS	U8140147	EPOCH 600 AWS D1.1/D1.5 software option
EP600-TEMPLATE	U8140148	EPOCH 600 template storage software option
EP600-API5UE	U8140149	EPOCH 600 API 5UE software option
EP600-XDATA	U8140150	EPOCH 600 expanded data logger software option
EP600-AVERAGE	U8140151	EPOCH 600 waveform averaging software option
GAGEVIEWPRO	U8140075	GageView Pro PC interface software
GAGEVIEWPRO-KIT-USB-A-AB	U8140076	GageView Pro PC interface software with USB A-AB cable, 6 feet

**Table 29 EPOCH 600 optional accessories**

<b>Part Number</b>	<b>U8 Number</b>	<b>Description</b>
EPXT-EC-X	See note	EPOCH external charger NOTE: The part number vary according to the instrument configuration. You must specify the power cord type.
600-STAND	U8780296	EPOCH 600 pipe stand assembly
EP4/CH	U8140055	EPOCH Series chest harness
600-DP	U8780297	EPOCH 600 display protectors (pack of 10)

**Table 29 EPOCH 600 optional accessories (continued)**

<b>Part Number</b>	<b>U8 Number</b>	<b>Description</b>
EPLTC-C-USB-A-6	U8840031	EPOCH LTC USB communication cable (mini-AB to TYPE-A/HOST)
EPLTC-C-USB-B-6	U8840033	EPOCH LTC USB communication cable (mini-AB to TYPE-B/CLIENT)
600-C-VGA-5	U8780298	5-feet EPOCH 600 VGA cable (1.5 meter)
EP1000-C-9OUT-6	U8779017	6-feet standard 9-pin communication cable (1.8 meter)
600-C-RS232-5	U8780299	5-feet EPOCH 600 RS-232 cable (1.5 meter)
EP600-WARRANTY	U8780300	EPOCH 600 extended warranty (1 additional year)



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