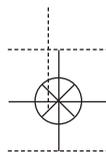


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HFD-1 Ultrasonic Flaw Detector



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The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

WARNING: These products are not designed for use in, and should not be used for, human applications.

Omega HFD-1

Ultrasonic Flaw Detector

OPERATING MANUAL

(Version 2.0.1)

To Our Valued Users,

Thank you for purchasing the Omega HFD-1. Omega looks forward to providing our services to you and our team has made every effort to satisfy your requirements. We assure you can use your instrument with confidence.

Prior to using the Omega HFD-1, please read the operating manual carefully in order to use it correctly and effectively. If you have any further questions about the instructions in the manual or operating the meter, please feel free to contact your sales representative at any time.

We thank again for purchasing the Omega HFD-1 and we look forward to providing you with the highest quality instruments on the market today and our world-class customer service.

Omega

Table of Contents

1. General Warnings	4
2. Brief Introduction	5
2.1 Main Features	5
2.2 Main Specifications	5
2.3 Description of the Main Parts	7
2.3.1 Instrument's Front Panel	7
2.3.2 The Instrument's Rear Panel	8
2.4 Key Functions	9
2.4.1 Main Menu Keys	9
2.4.2 Shortcut Keys	10
2.4.2.1: Using the Range Key	10
2.2.2.2 Using the Gain Key	10
2.2.2.3 Using the Pulse Shift Key	10
2.2.2.4 Using the Gate Key	10
2.2.2.5 Using the Gain Key	11
2.2.2.6 Using the Freeze Key	11
2.2.2.7 Using the Store Key	11
2.4.3 Selecting Menu Keys	12
2.4.4 Combined Key	12
2.5 Menu System and Its Description	13
2.5.1 Display Configuration	13
2.5.2 The Instrument's Menu Flow and its Description	13
2.5.2.1 Adjusting the Detection Parameters	13
2.5.2.2 Calibration Main Menu	16
2.5.2.3 Function Main Menu	16
3. The CTS-1002's Basic Adjustment and Application	17
3.1 Powering On or Off and Charging the Instrument	17
3.1.1 Powering On the Instrument	17
3.1.2 Powering Off the Instrument	17
3.1.3 Charging the Instrument	17
3.2 The Basic Adjustment of the Instrument	17
3.2.1 Adjusting the Basic Function for Flaw Detection	17

3.2.1.1	Setting and Adjusting the Parameters	17
3.2.1.2	Storing the Condition Parameters	18
3.2.1.3	Storing the Waveform Data of Flaw Detection	18
3.3	Calibrating the Instrument	19
3.3.1	Measuring the Sound Velocity	19
3.3.2	Calibrating the Probe's Delay Time (Correcting the Probe Zero Point)	20
3.3.3	Calibrating the Probe's K Value	22
4.	Application of the Flaw Detection	23
4.1	Searching for the Waveform Crest	24
4.2	Expanding the Display	24
4.3	Expanding the Gate 1	25
4.4	Using the Envelop Function	26
4.5	Using the DAC Curve	26
4.5.1	Creating the DAC Curve	26
4.5.2	Modifying the DAC Curve	29
4.5.3	Alarming and Storing the DAC Curve	30
4.6	Creating the Longitudinal Wave AVG Curve	30
4.7	Quitting the AVG	31
4.8	Data Function	32
4.8.1	Reviewing the Data	32
4.8.1.1	Deleting the Data	33
4.8.1.2	Calibrating the Data	33
4.8.1.3	Reviewing the Data	33
4.8.2	Transferring the Data	34
4.8.3	Storing and Recalling the Data of the Shortcut Channel	34
4.9	Continuous Recording Function	35
4.9.1	Continuously Recording the Waveform Data	36
4.9.2	Viewing the Continuous Recording and Storing Data	37
4.9.3	Storing and Obtaining the Continuous Storing and Recording Data	37
4.9.3.1	Storing the Recording Data	37
4.9.3.2	Replaying the Recording Data Stored in the Instrument	38
5.	Care and Maintenance of the Instrument and the Battery	38
5.1	Care of the Lithium Battery	38
5.2	Care and Maintenance of the Instrument	39

5.2.1 Care of the Instrument	39
5.2.2 Maintenance of the Instrument	39
5.2.3 The Instrument's Common Function Failures and Troubleshooting	39
6. Standard Package and Optional	40
6.1 Standard Package	40
6.2 Documentation	40
6.3 Optional Order	40
7. Technical Support and Service	40
Appendix A Application of the Square Wave	41
Appendix B Method of Upgrading the Software	43

1. General Warnings

Please follow these general warnings to ensure the safe operation and conditions of the instrument.

- 1.1 The power cable provided must be used with the instrument as well as the specified power source.
- 1.2 Before connecting the instrument, please read the operating manual about rating values and safety warnings. Also, check the instrument for the rating value and safety warnings to avoid fire or electrical shock.
- 1.3 When the instrument supplied by alternating current (charger), the earth terminal of the three line power cord used with the instrument should be connected to the ground well so that to avoid electric shock.
- 1.4 Use the enclosed lithium battery (CE approval).
- 1.5 Do not use the instrument in a place with explosive gas.
- 1.6 Keep the instrument clean and dry.
- 1.7 If any defect occurs, do not operate the instrument and do not open its front and rear covers. Omega is not responsible for any results caused by defective merchandise. All repair work must be made by Omega's Customer Service Department to determine cause of damage.
- 1.8 Please replace the battery periodically. The used battery should be placed in local recycle bin or sent back to Omega for  environmental protection.

2. Brief Introduction

The HFD-1 is a digital ultrasonic flaw detector with the most advanced technology. It is EN 12668:2000 and JB/T 10061 compliance featuring small size and light weight (only 1.0 kg) based on the leading technology of ultrasonic. The instrument has an industrial-leveled TFT display with full VGA (800×480) resolution providing superior visibility in all lighting conditions, including direct sunshine.

2.1 Main Features

- Advanced circuitry, 640MHz sampling frequency and 800×480 full WVGA resolution ensure quick and accurate display and analysis even when the signals are weak.
- Advanced tunable square wave technology. The HFD-1 provides excellent infiltration and high signal-to-noise ratio when detecting special composite materials, highly attenuated or thick work pieces.
- Zoom function for in-gate waveform enables users to conveniently observe the waveform detail. Zoom function for waveform display area and optimized height-to-width rate of the screen ensure echo with higher resolution.
- Waveform color change can be seen in gate for optional alarm, different colors prompts for the DAC warning.
- Standard dynamic DAC and AVG curve functions.
- Continuous store function complies with the new standard.
- Auto-calibration function includes fast calibrating material velocity, probe's delay time and angle.
- USB port for updating software, transferring, and printing data.
- The design meets the standard of IP54 NEMA3 certification and compatible with EN 12668:2000 standard
- 1.0kg, 2 lbs
- Over 8 hours of battery life.

2.2 Main Specifications

Transmitter Pulse	Square Wave Pulses: Transmitter Pulse Voltage: 25 ~ 250V, continuously adjustable with 25V increments Pulse Width: Continuously adjustable from 50 to 800ns with 5ns increments Under 400Ω/200V, double edge <10ns, automatic optimization for pulse excitation under high frequency
Test Mode	Pulse echo and dual transmission

Omega HFD-1 Operating Manual

Damping	400, 80 Ohm
Operating Frequency	Optional Broad or Narrow band selections Broadband: 0.5 ~ 20MHz. Narrowband: 1.5 ~ 3MHz
Gain	0.0~ 110.0dB. Steps as 0.1, 1.0, 2.0, 6.0 dB, 0.1 dB for intelligent adjustment function
Material Velocity	1000 ~ 15000m/s continuously adjustable. Set-in 30 common material velocities selectable
Test Range	0.0~10000mm longitudinal wave at steel velocity. Range continuously variable with minimum 0.1mm increments
Rectification	Positive half wave, negative half wave, full wave
Alarm	Real-time alarm signal, positive and negative thresholds, DAC alarm optional, alarm audible
Display	4.3" industrial-leveled TFT color LCD with 800×480 resolution
Pulse Shift	-7.5 ~ 3000μs
Probe Zero	0 ~ 999.9μs
Pulse Repetition Frequency (PRF)	25 ~ 800Hz, auto adjustment mode
Vertical Linearity Accuracy	≤3%
Horizontal Linearity Accuracy	≤0.2%
Surplus Sensitivity	≥60dB (200Φ2 flat bottom hole)
Resolution	≥36dB
Dynamic Range	≥32dB
Reject (suppression)	0 ~ 90%
Electric Noise Level	< 10%
Interface	Q9 transducer interface; USB HOST
Power Supply	Large-capacity lithium battery without memory effect; Battery Life: More than 8 hours; Built-in charger(optional external charger), AC Mains 220V
Standards	EN12668-1 compliance Conform to JB/T 10061-1999 standard
Protection Grade	IP54, NEMA3
Environmental Temperature	-30 ~ 50°C (-22 to 122°F)
Relative Humidity	20% ~ 95%RH
Weight	0.9Kg, 2 lbs (with battery and built-in charger)
Dimensions (L ×W×H)	Upper part: 215mm ×126mm×53mm (8.5 x 5.0 x 2.0") Lower part: 215mm ×104mm×42mm (8.5 x 4.0 x 1.65")

2.3 Description of the Main Parts

A. Front Panel shown below (Figure 1):

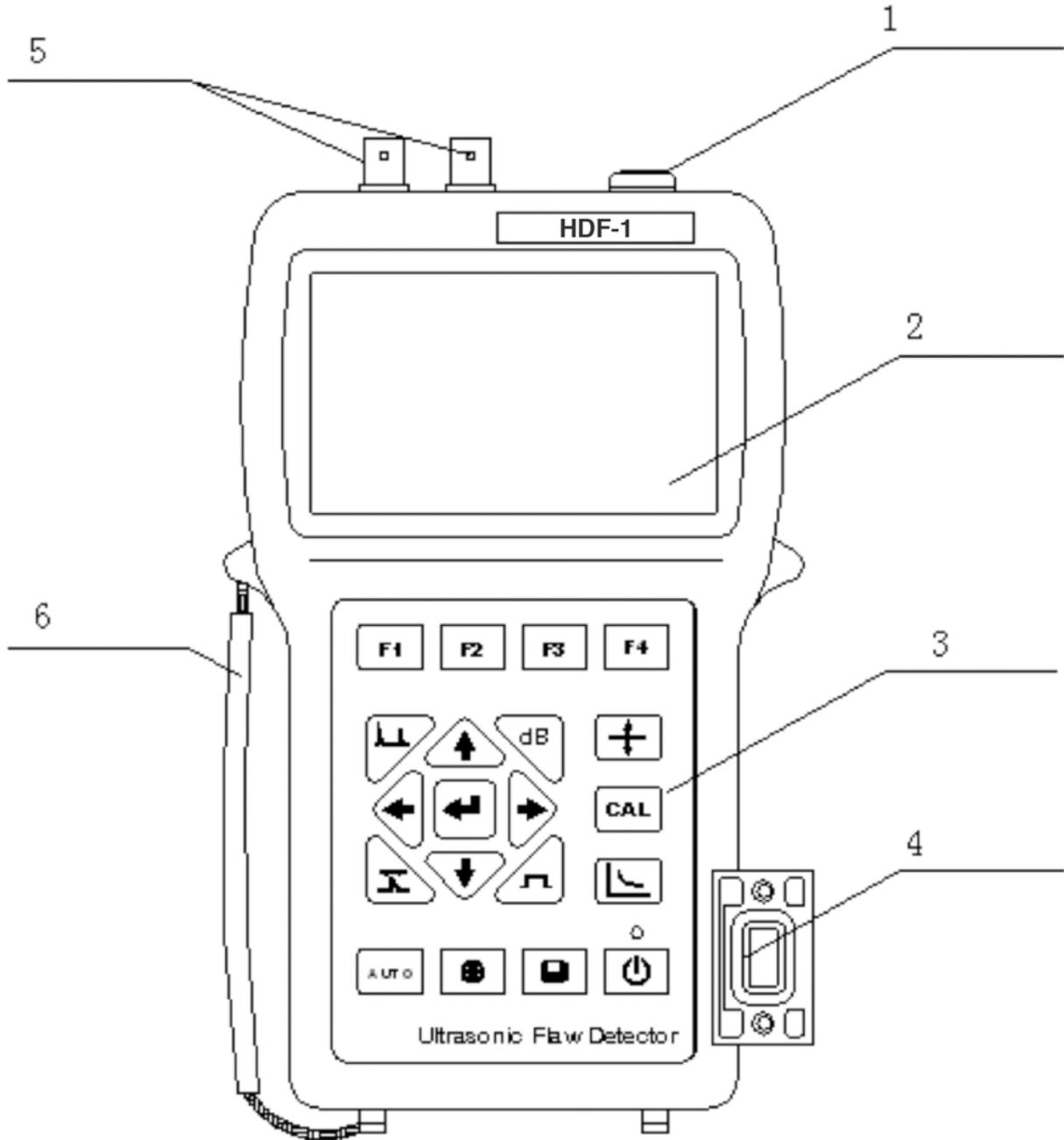


Figure 1.

- 1. DC Power Supply Port
- 2. 4.3" Industrial-levelled TFT Color LCD with 800×480 Resolution
- 3. Pressing Keys
- 4. USB Port
- 5. Transmitter and Receiver Ports (Q9 connectors)
- 6. Portable Belt

2.3.2 The instrument's rear panel (figure 2):

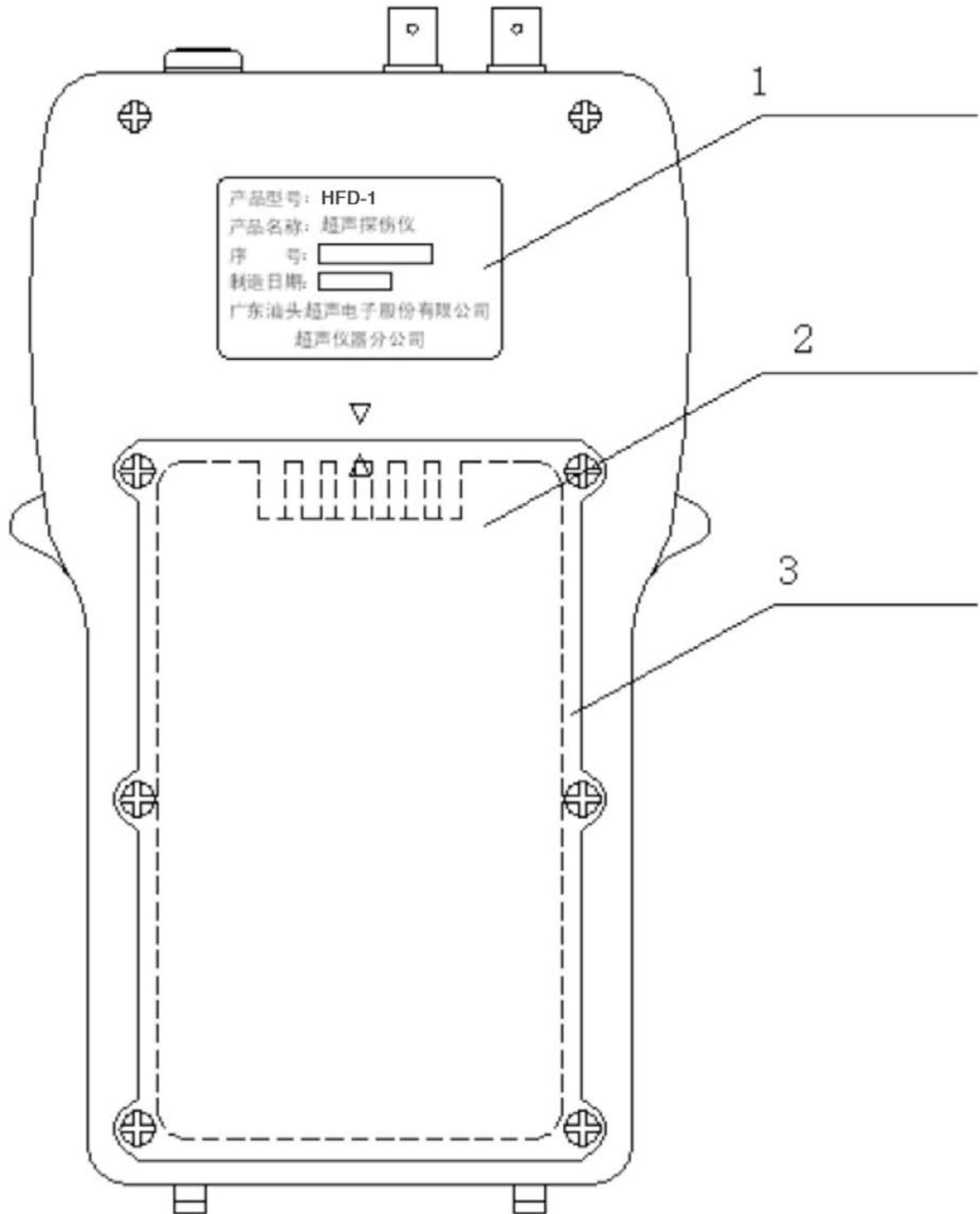


Figure 2.

1. Instrument Nameplate

2. Built-In Battery

3. Battery Cover

2.4 Keys Functions

The HFD-1’s keys consist of main menu keys, selecting menu keys, shortcut keys, adjusting keys and power switch (figure 3.):

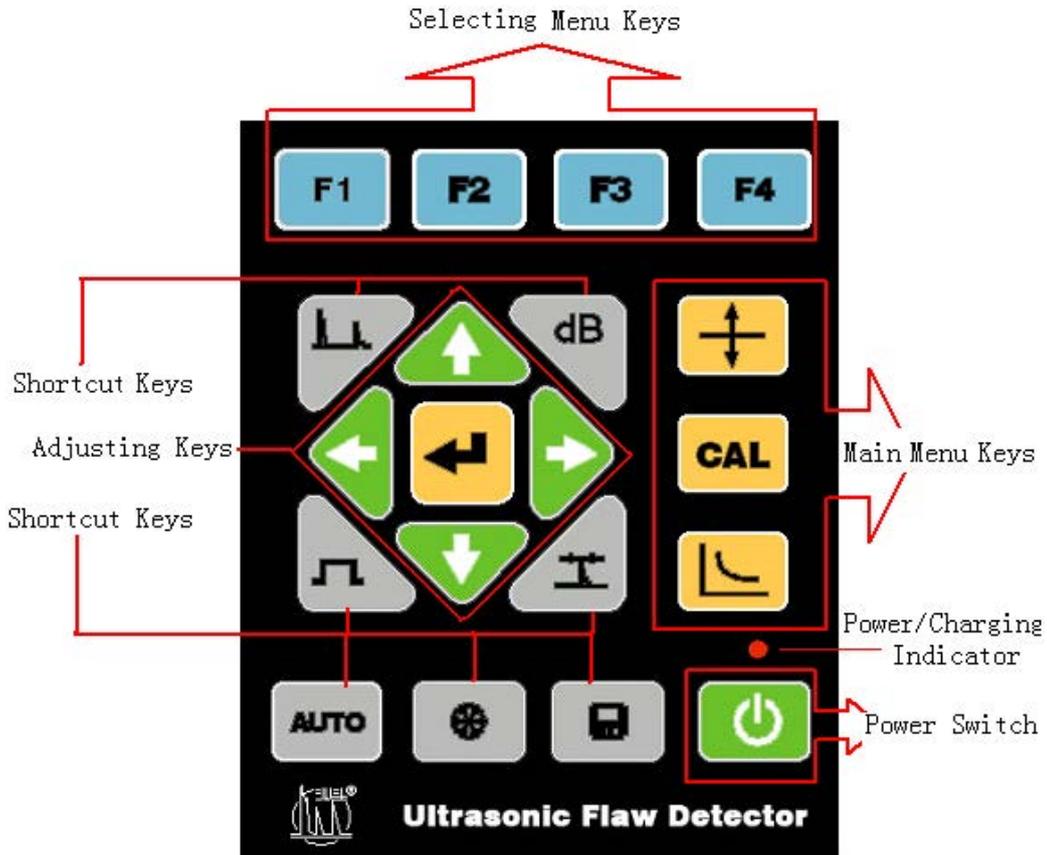


Figure 3

Distribution of the Pressing Keys

2.4.1 Main Menu Keys



Set/Test Key switches from the setting interface to the test interface. When it displays the parameters on the half screen under the setting state, use   to quickly move the cursor and press  to change a line. Press   to modify the parameters.



CAL Key calibrates the probe’s sound velocity and delay time as well as the angle probe K value. It also returns to the top-level calibration menu by pressing  after completing each calibration.



Function Key creates and modifies the DAC curve; expands the waveforms in gate 1 and in the display area; uses envelop, accesses data and continuously stores, recalls and prints data. The main functions of the instrument can be performed by pressing . The function menu consists of three pages, which can also be switched over by pressing .

2.4.2 Shortcut Keys



A. Range Key - adjusts the range.

Press  and the cursor will move to  the display interface (shown in figure 4).

In this case, press the *Left, Right, Up* or *Down* arrow to increase or decrease the range value.

Press  or press  again to adjust the increments. The range increments are divided into 0.1mm, 1mm, 10mm, and 100mm.

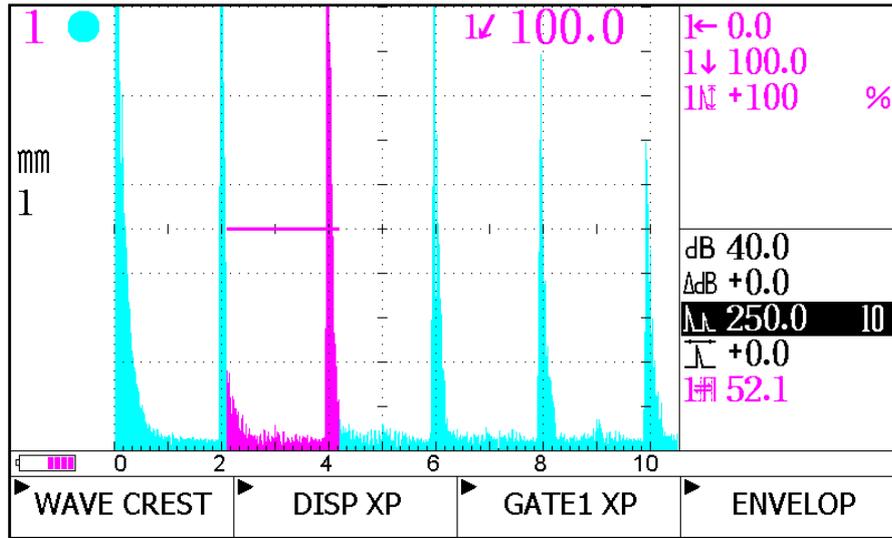


Figure 4. Display Interface of the BASIC Flaw Detection



B. Gain Key switches from the dB to ΔdB.

Press  and the cursor will move to the dB or ΔdB on the display interface (shown in figure 4).

In this case, press the *Left, Right, Up* or *Down* arrow to increase or decrease the gain value. Press  to adjust the dB or Δ dB increments.

The dB increments are divided into 0.1dB, 1dB, 2dB, and 6dB; the Δ dB increments are divided into 0.1dB, 2dB, 6dB, and A+. Press  to add the Δ dB to dB when using A+ increment.



C. Pulse Shift Key adjusts the pulse shift.

Press  the cursor will move to  on the display interface as shown in figure 4. In this case, press the *Left, Right, Up*, or *Down* arrow to increase or decrease the pulse shift value.

Press  or press  again to adjust the pulse shift increments. The pulse shift increments are divided into 0.1mm, mm, 10mm, and 100mm.



D. Gate Key adjusts the gates.

The HFD-1 provides two gates  Gate 1 and Gate 2. The *Gate Key* is only activated while

opening the gates. To open the gates, you can go to the 1-ALARM and the 2-ALARM on the *BASIC* under the setting state. Press the cursor will move to on the display (shown in figure 2).

Press the *Left, Right, Up* or *Down* to increase or decrease the adjusting value. Move the Gate 1 and press  to switch the parameters in the gate1, which include the gate position, gate width and gate threshold. If the gate 2 is opened, press  again, the cursor will move to , press *Left, Right, Up* or *Down* to increase or decrease the value. Move the Gate 2 and press  to switch the parameters in the gate

AUTO E. *Gain Key*

Press  and the waveform amplitude in the gate is automatically set to the adjusted automatic amplitude. The waveform amplitude of the automatic gain is set to the automatic amplitude of the system page on the half screen parameters.

 F. *Freeze Key*

Press  to freeze the waveform on the screen. To unfreeze, press it again and then modify other parameters

 G. *Store Key*

Press  to display the store interface and menu selection as shown in figure 5. Press it again to store the data.

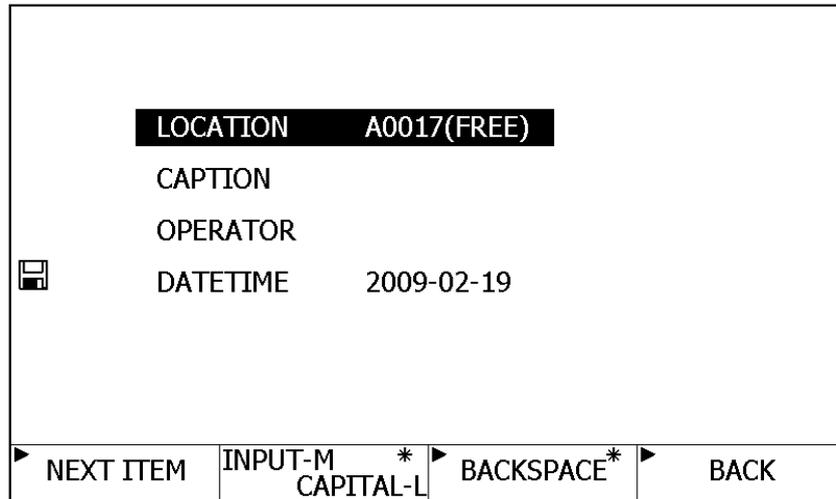


Figure 5 Data Store Interface

(NEXT ITEM): The cursor switches over *LOCATION, CAPTION* and *OPERATOR*.

(INPUT-M): The input method includes the Pinyin, Special Characters, Capital Letters, Small Letters and

Numbers, and press (*INPUT-M*), the corresponding menu key F2 will select one of them in cycle. When the input method is selected, a small keyboard will appear on lower side of the display screen. If you need to input the characters or numbers, press Left or Right arrow to move the cursor and press  to select the desired characters or numbers. If you select the Pinyin, there are 26 letters located on the first line of the small keyboard; press the *Left* or *Right* arrow to select the letter. Each cursor selects three letters, press  to confirm. In this case, the combined Pinyin appears on the second line of the small keyboard, press the *Down* arrow and the cursor will move to the second line on the small keyboard. Press the *Left* or *Right* arrow to select Pinyin, and then press  to confirm. After doing this, the selected Chinese character will appear on the second line of the small keyboard.

(*BACKSPACE*) cancels the selected characters.

(*BACK*) returns to the test interface.

• *Note: If "Occupied" appears in the bracket of the "LOCATION" this indicates that the data already has been stored. To override, press .*

2.4.3 Selecting Menu Keys

    **Menu Keys** - correspond to the four menus located on lowest side of the display screen, and press one of the four menu keys to select the corresponding menu.

2.4.4 Combined Keys

In the *BASIC* test mode, press the *Combined Keys* to enter into the list interface below:

-   Recalls channels
-   Data Review
-   Transferring the A-Scan data

2.5 Menu System and Its Description

2.5.1 Display Configuration

The BASIC test interface of the instrument is shown in figure 6.

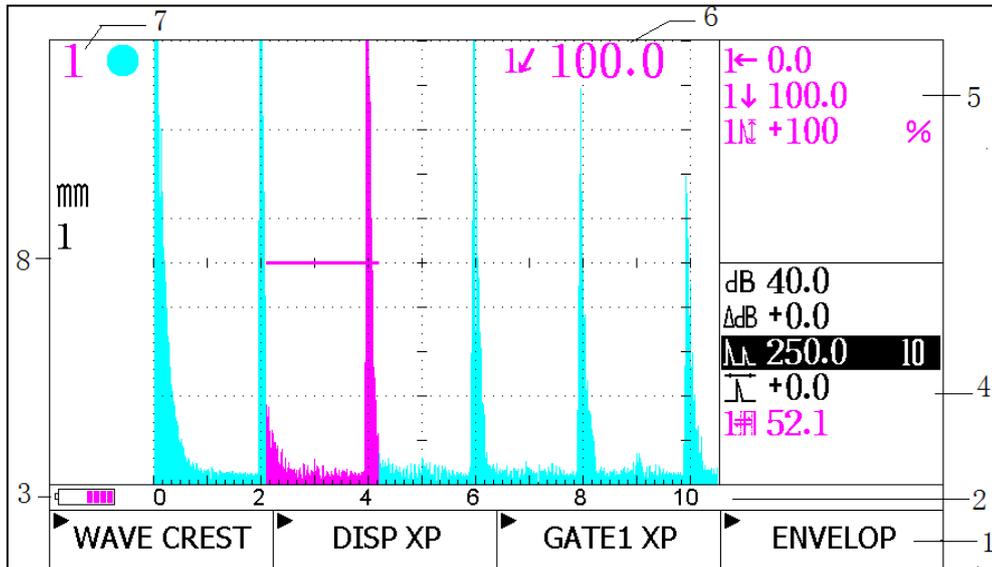


Figure 6 BASIC Test Interface of the Instrument

1. Menu Bar
2. Ruler
3. Battery Level Indicator
4. Commonly Used Parameters 5/ 6/ 7 (Test Results Display Areas):
 - "5" - horizontal, depth, and amplitude
 - "6" - the alarm indication light
 - "7" - the sound path for the Gate 1
8. Function Symbols Display Area

- When the gate alarm is triggered, the circle will be filled with the same color as the gate symbol. If the gate alarm is not triggered the circle will be displayed empty with a cross.

2.5.2 Menu & Description

The HFD-1 primarily uses the *Main Menu Keys* to adjust the parameters and perform the functions (see below). • Menu items noted with a * indicates that it cannot be adjusted or used.

A. Adjusting Detection Parameters

To set the different conditions required for flaw detection, press  to display the waveforms on the upper half and the parameters on the lower half of the screen (see figure 7). The A-scan wave form change can be seen during the adjustment.

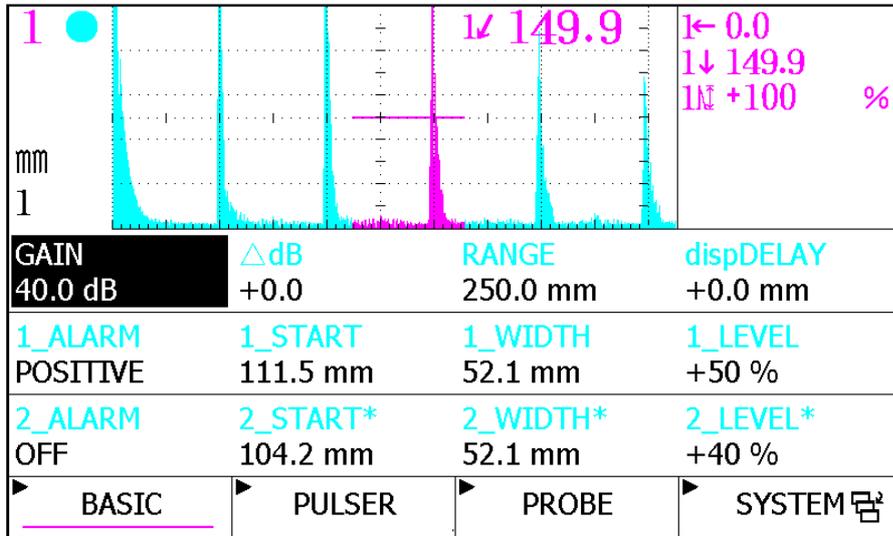


Figure 7 Setting the Parameters on the Half Screen



BASIC	PULSER	PROBE	SYSTEM
-------	--------	-------	--------

Each menu item contains the following parameters (see below/Table 1):

Table 1. Parameter Descriptions (parameters noted with * can not be adjusted)

Menu	Parameter	Description
BASIC	GAIN	
	Δ dB	
	RANGE	The Distance of testing or displaying
	DISP DELAY	Pulse shift
	1_START	The starting point of the Gate 1
	1_WIDTH	The width of the Gate 1
	1_LEVEL	The alarm limit of the Gate 1
	1_ALARM	Selects POSITIVE , NEGATIVE or OFF for the Gate 1
	2_START	The starting point of the Gate 2
	2_WIDTH	The width of the Gate 2
	2_LEVEL	The alarm limit of the Gate 2
PULSER	2_ALARM	Selects POSITIVE , NEGATIVE or OFF for the Gate 2
	DUAL	Selects the probe to SINGLE or DUAL
	DAMPING	Adjusts the damping level to 400 Ω or 80 Ω
	PRF VALUE*	Selects the PRF of 25 Hz, 50 Hz, 100 Hz, 200 Hz, 400V, 800Hz

Omega HFD-1 Operating Manual

PULSE	VOLTAGE	Transmitter voltage is from 25 V to 250V with increment of 25V
	TX WIDTH	The width of the transmitting square wave is 50-800ns,step as 5ns
	BAND-WIDTH	Bandwidth divides BAND: 0.5-20MHz; NARROW: 1.5-3.0MHz
	RECTIFY	Selects the FULL, POSITIVE or NEGATIVE rectification mode of
	REJECTION	0-99%
	UNITS	Test result display unit in mm or μ s
PROBE	PROBE	CONTACT/ ANGLE/ ANGLE S
	CRYSTAL	Crystal frequency and size
	K VALUE	K value or angle
	DELAY	The fixed sound wave delay for the probe and instrument
	X VALUE	The distance from the angle beam probe's BIP to front edge
	GATE-WAVE	The waveform in the gate whether changes its color with alarming
	SURFACE-C	Surface compensation value
	MATERIAL	Set-in commonly used materials contain 30 types
	VELOCITY	The velocity of sound through the material
	THICKNESS	The thickness of material being tested
	LEGS	The legs of the waveforms on the test result display area
SYSTEM (The first page)	HORN	The gate alarm sound is On or Off
	AUTO-A%	Sets the automatic gain range
	DP	The digital processing method of the displayed waveform divides into AVERAGE and PEAK. The AVERAGE for usual setting and the PEAK for fast scanning.
	DETECTION	PEAK mode
	RULER	The sound path projective value of the echo on different coordinate axis, divides into SURFACE, DEPTH, PATH, NORMAL ,which is conveniently for user who gets used to operating analog instrument.
	GRID	The grid behind the waveform divides into simple/fine/common (1/2/3) and can be used to determine the waveform amplitude coarsely.
	WAVEFORM	The waveform display mode contains FILLED and HOLLOW, the FILLED is suitable for scanning or outside use.
DATE	YEAR\MONTH\DAY	

Omega HFD-1 Operating Manual

	TIME	HOUR\MINUTE\SECOND
	LANGUAGE	CHINESE/ENGLISH
SYSTEM (The second page)	SCHEME	The color scheme of the display interface
	ITEM	The color scheme of the display interface
	COLOR	The color scheme of the display interface
	WAVE CREST	The setting amplitude to begin to find

B. Calibration Menu

CAL

1. VELOCITY	2. PROBE DELAY	3. K VALUE	
-------------	----------------	------------	--

C. Function Menu



: The function main menu contains three pages and press  to switch over them.

The first page	WAVE CREST	DISP XP	GATE 1 XP	ENVELOP
The second page	DAC	AVG	CURVE EXIT	DATA
The third page		R-SCAN		

(DAC) Functions:

(PREF.) adjusts the parameters for creating the DAC curve.

(EXEC) creates the DAC curve.

(MODIFY) adjusts or improves DAC curve.

(BACK) returns to the previous menu.

(AVG) Function:

(PREF.) adjusts the AVG curve parameters.

(RECORD) records the creating points.

(FINISH) creates the AVG curve.

(QUIT) exits the AVG curve, which means to clear the created AVG curve.

(DATA) Function: Reviews, recalls, communicates, prints, and stores data.

(REVIEW) reviews test data including the basic parameters and the stored A-Scan info.

(USB) transfers the test data to a USB flash disk.

(CHANNEL) stores and recalls the parameters of the shortcut channels.

(BACK) returns to the previous menu.

(R-SCAN) Function:

(RECORD) continuously records the waveform data during detection.

(STOP) stops the recording.

(VIEW) reviews the recorded waveform data.

(BACK) returns to the previous menu.

3. Basic Adjustment and Application

3.1 Powering On or Off and Charging

3.1.1 Powering On:

Press and hold 

When the red light is illuminated, press F1-F4 to access the instrument.

3.1.2 Powering Off

Press and hold  to turn off the instrument. The following text will appear on screen:

"PLEASE WAIT, SHUTTING DOWN THE SYSTEM. THANKS FOR THE USE" and the red indicator light will go off.

3.1.3 Charging

After turning off, plug in the DC adaptor. If the batteries are installed, the charging light will turn green and the charging time will be approximately 5 hours.

- *To obtain the best test result, it is recommended to use the DC power adapter. Usually when the instrument turns off, it is in charging status and automatically shuts off the charging function and supplies power with the DC adapter.*

3.2 Basic Adjustments

3.2.1 Adjusting the Basic Functions for Flaw Detection

A. Setting and Adjusting the Parameters

On the test interface (Figure 4), press  to set the parameters (Table 1). Press the "Left" or "Right" arrow to move the cursor and press the "Up" or "Down" arrow to adjust the parameter value. Press  to change the line. (Note: parameters with * cannot be adjusted)

After setting the parameters, Press  to return to the test interface.

Hint: If adjusting commonly used parameters such as dB, □dB, range, pulse shift and gate, use the shortcut keys to adjust (section 2.4.2).

- *If gate 1 is not displayed, press  to go to the 1-ALARM on the BASIC as shown in figure 7, and then select NEGATIVE or POSITIVE alarm. In this case, gate 1 is opened. On the other hand, if you select OFF on the 1- ALARM, gate 1 will be off and cannot be displayed on the screen. Gate 2 is the same as gate 1.*

B. Storing Parameters

Press  two times to display the second menu page, then press [DATA] to go to the next submenu.

Press (CHANNEL)-(SAVE AS) to display the stored interface of the channel (shown in figure 8).

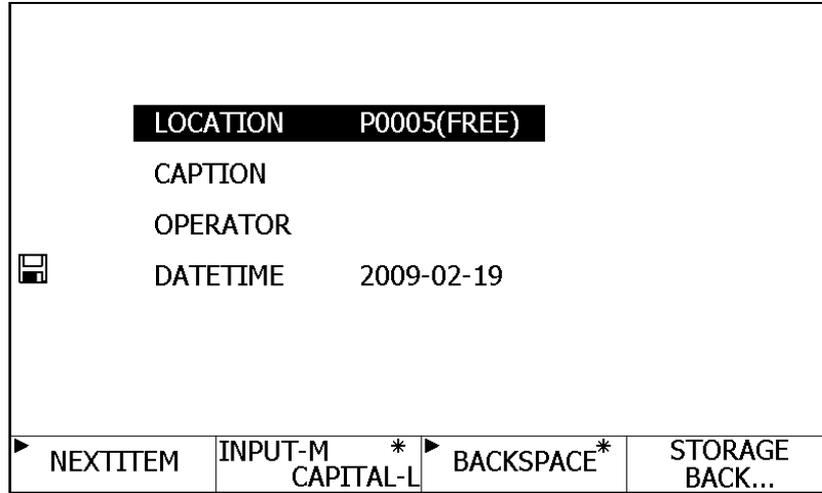


Figure 8 Channel Store Interface

Up to 10 groups of condition parameters can be stored in the (CHANNEL). Press the *Left, Right, Up* or *Down* arrow to select the store location. Press (NEXT ITEM) to select the next item. When the cursor moves to the "CAPTION" or "OPERATOR" location, press (INPUT-M) to select PINGYIN, Special Characters, Upper or Lower Case Letters or Numbers. In this case, a small keyboard appears on the bottom of the display screen, by pressing the *Left* or *Right* arrow you can select the input method and then by pressing the  to confirm. Finally, press  to store the parameters conditions.

- *To store the parameters in the (CHANNEL), you can quickly the parameters from 1 to 4 channels by pressing and holding from F1 to F4 for 4 or 5 seconds (the channel 1 corresponds to F1, the rest channels are be done in the same manner).*

3.2.1.3 Storing the Waveform Data of Flaw Detection

To store the waveform data of detected flaw, press  to freeze the waveforms on the screen, and press  to go to the data store interface given in 2.4.2.7 and store the waveform data.

3.3 Calibrating the Instrument

To obtain the best test results, you should calibrate the instrument before detection.

Press **CAL** to go to the calibration screen (below/figure 9).

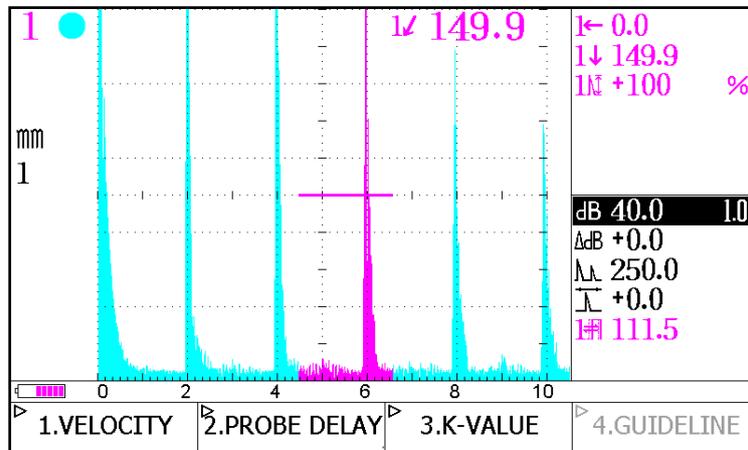


Figure 9. Calibration Display Screen

3.3.1 Measuring the Sound Velocity

The sound velocity of the material is a very important parameter for locating flaw accurately; you should therefore determine the sound velocity of unknown material before detection. Here, take a material with a thickness of 50mm and unknown sound velocity as an example to show how to measure the sound velocity.

Press (1.Velocity) to show Sound Velocity display screen (figure 10).

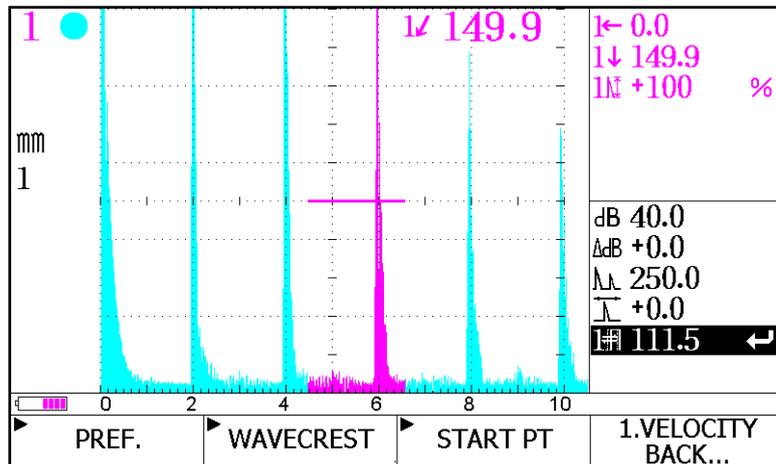
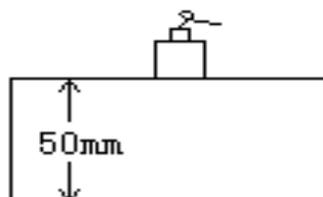


Figure 10. Sound Velocity Measurement Screen

Press (PREF.) to show the sound velocity parameter screen (figure 11).



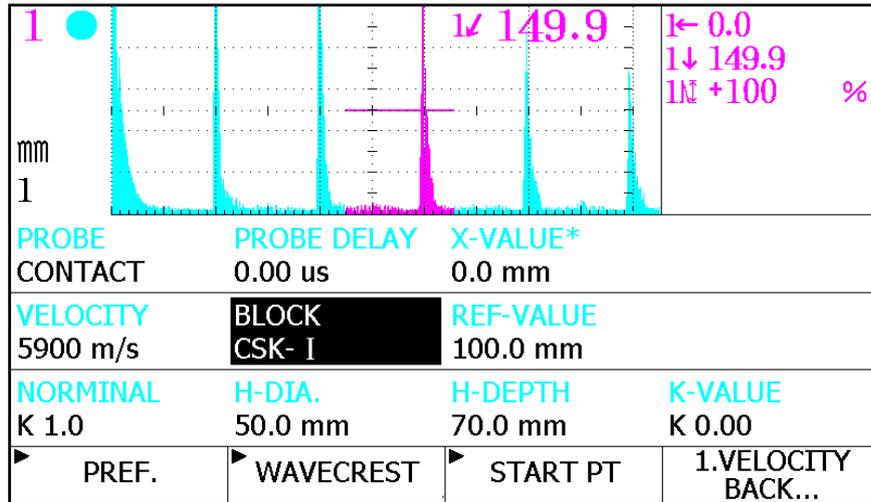


Figure 11 Parameters Adjustment Interface of Measuring the Sound Velocity

Press the *Left, Right* arrow to move the cursor to modify the parameters.

PROBE: CONTACT

REF-VALUE: 50mm

Press (PREF.) to return to the display interface (figure 9). Move gate 1 or press (WAVE CREST) to cover the first echo. While doing this, press (START PT). The waveform amplitude in the gate 1 will be automatically adjusted to 80% and read the sound path d1. Move gate 1 or press (WAVE CREST) to cover the second echo, press (END PT). The waveform amplitude in gate 1 will be automatically adjusted to 80% and read south path d2. Then compare the d2-d1 with the reference value. The sound velocity is automatically calculated and results displayed in the “VELOCITY” area (figure 11).

Press **CAL** to return to the display interface as shown (figure 9).

3.3.2 Calibrating the Probe's Delay Time (Correcting the Probe Zero Point)

Press (2.PROBE DELAY) on the display screen (figure 9). The Delayed Time Calibration screen appears (figure 12).

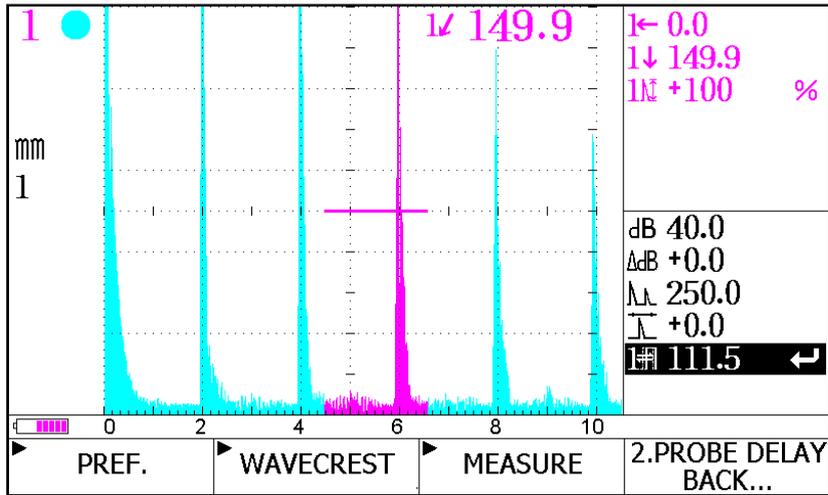


Figure 12. Delayed Time Calibration Screen

Press the menu key corresponding to (PREF.) to show the display screen for calibrating delayed time (figure 13).

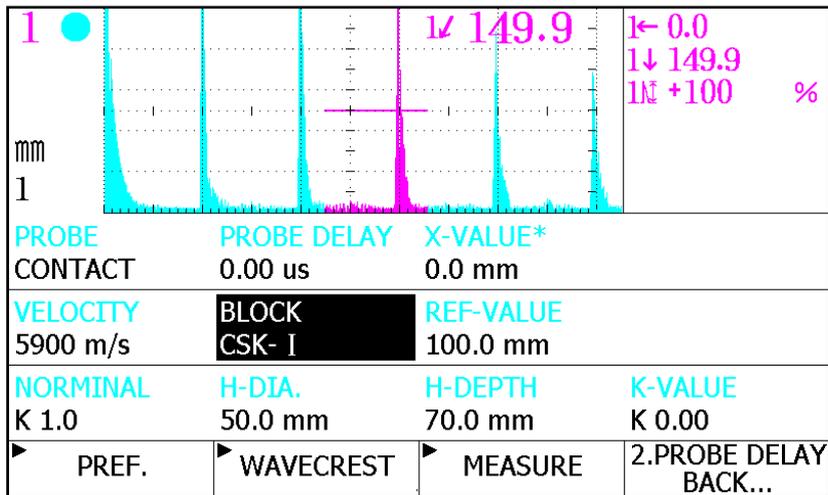


Figure 13. Adjusting Parameters for Calibrating Delayed Time

Take the test block and the contact probe given in 3.3.1 as an example, press the *Left* or *Right* arrow to move the cursor to the parameter selected and press *Up* or *Down* arrow to change the parameter.

PROBE: CONTACT

VELOCITY: If the sound velocity is calibrated in advance, the sound velocity displayed on the screen is the calibrated sound velocity. This can also be changed if you know the sound velocity .

REF-VALUE: 50mm

Press the menu key corresponding to (PREF) or (MEASURE) to return to the display screen (figure 12). Press (WAVE CREST) to make gate 1 cover the second echo and then press (MEASURE). The delayed time for the contact probe is automatically calculated and displayed in the “*PROBE*

DELAY” field (figure 13).

Press **CAL** to return to the display screen (figure 9) or press (BACK) to return to the previous menu.

3.3.3 Calibrating “K” Value

The function of measuring the K value is suitable for the angle and small angle probe. Since there is a difference between the probe’s nominal value (especially for the probe K value) and the actual value, the probe’s K value should be tested after calibrating the probe index so to exactly locate the flaw distance during detection.

Press (3. K VALUE) on the display screen (figure 9) and the go to the display screen (figure 14).

- *The K value calibration is only effective for angle and small angle probe. Set the probe type to angle or small angle before calibrating (see adjusting the parameters in 2.5.2.A).*

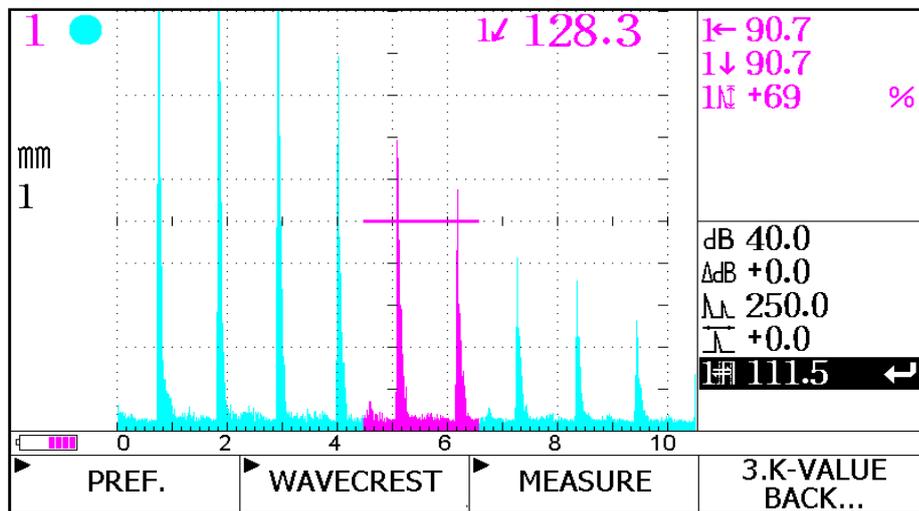


Figure 14. Calibration Interface of the Probe’s K Value

Press the menu key corresponding to (PREF.) to appear the display interface as shown in figure 15. Press the *Left* or *Right* arrow to move the cursor to the parameter needed. Press the *Up* or *Down* arrows to change the parameters. Input data for probe delay, sound velocity, hole diameter and the depth (Note: If the probe’s sound velocity and delay time are measured in advance, they will automatically change). Press the menu key corresponding to (PREF.) or (MEASURE) to return to the display screen (figure 14).

Example: Place the K2 angle probe on the test block and move it forward or backward until the highest echo is obtained and press (WAVE CREST) to make gate 1 cover the echo, then press (MEASURE). The value of probe K is automatically measured and displayed (figure 15).

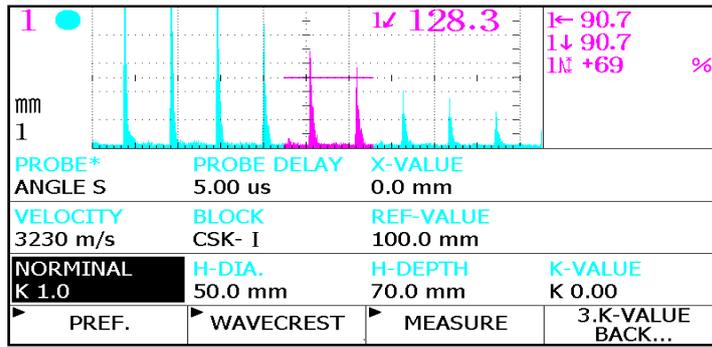
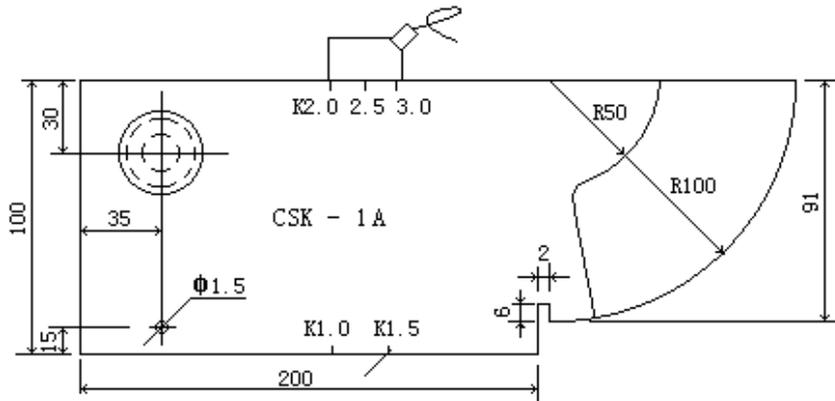


Figure 15. Parameter Adjustment Interface of the Probe's K Value Calibration



CSK-I Test Block of Measuring the Probe's K Value

4. Flaw Detection Functions

Omega's HFD-1 provides various auxiliary functions to detect flaws thereby eliminating manual calculations and simplifying the detection process.

To access the first page of the main menu for the most commonly used functions, press

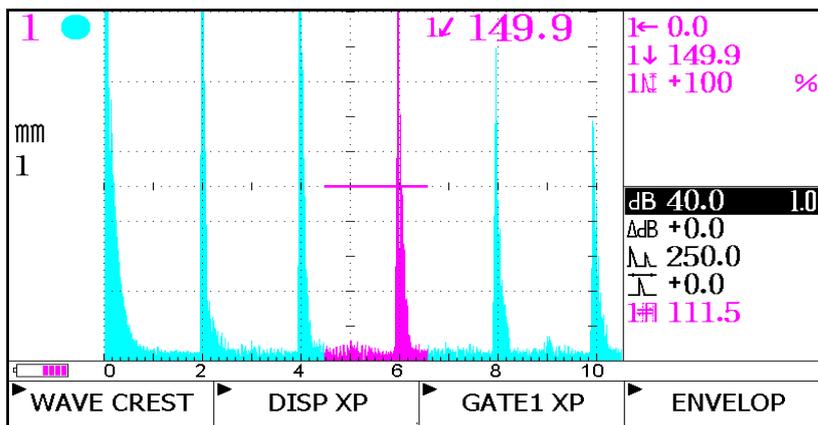


Figure 16. Function Menu Display Screen /First Page

Press again and the screen toggles over to the second page of the function menu (figure 17).

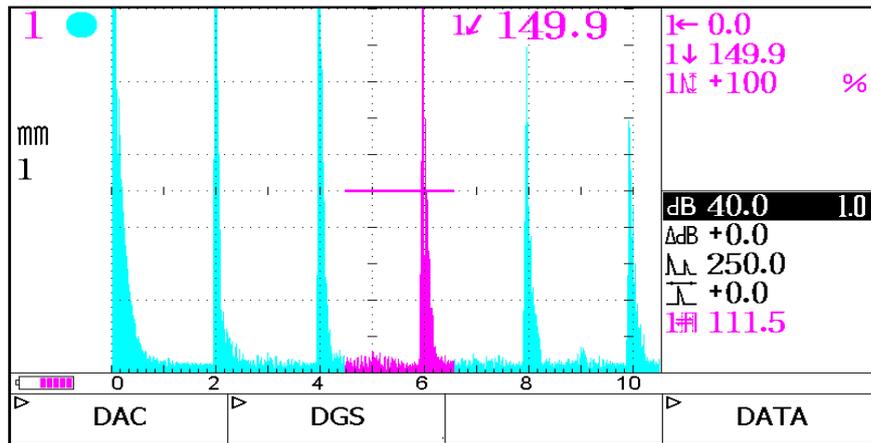


Figure 17. Function Menu Display Screen/Second Page

Press  for the third time and the screen toggles over to the last page of the function menu (figure 18).

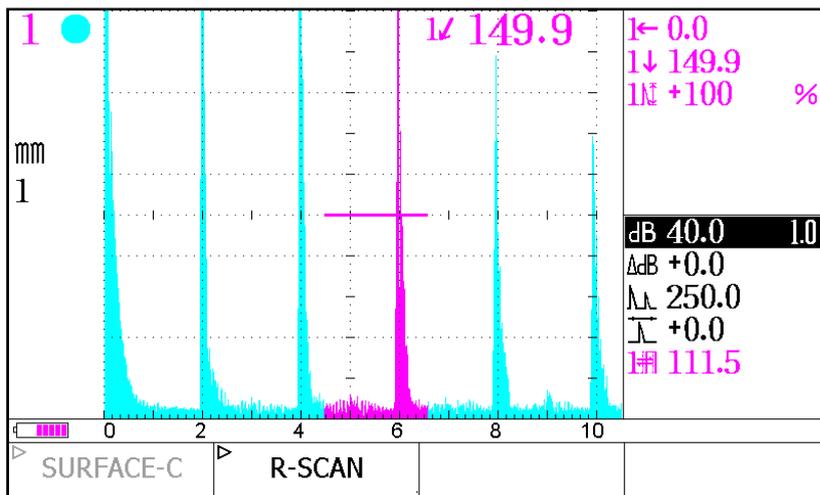


Figure 18. Function Menu Display Screen/Third Page

Function Menu Display Screen, First Page Operations (4):

4.1 Searching for the Waveform Crest

Press function (WAVE CREST). Gate 1 will automatically cover the echo with the amplitude over the waveform crest. Set the waveform crest on the second page of the (SYSTEM) of setting parameters.

4.2 Expanding the Display

The display expansion enlarges the waveform on screen for better viewing. Press (DISP XP), and the waveform covers almost the full screen (bottom function areas are covered over). The following functions are not covered over and are displayed on the lower left area of the screen: commonly used functions, the gain, Δ dB and test range (the default display) (figure 19).

- The DAC, AVG and MODIFY functions can not be used during the display expansion mode.

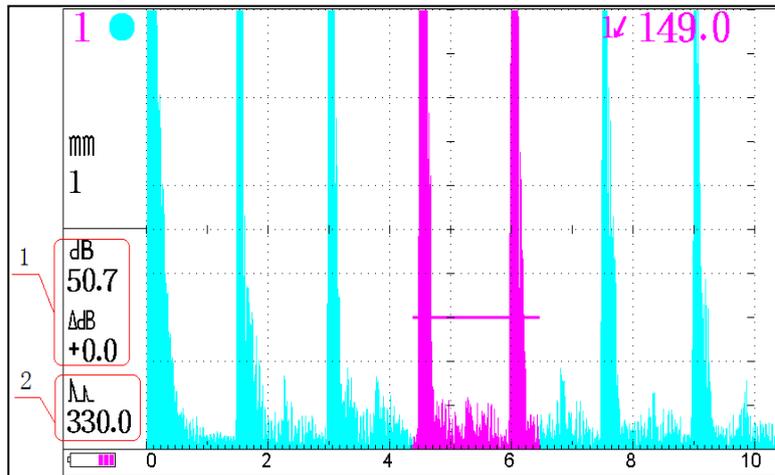


Figure 19. Display Expansion Screen

Adjusting the Gain (1): Press \leftarrow dB and the cursor moves to number "1". Adjust the gain increments (done like the BASIC test mode).

Display the Range (2): Displays the range, shift and gate alternately. Press the shortcut keys corresponding to the range, shift and gate and the parameters displayed in the 2 area will be changed. To adjust these value and increments, follow the BASIC test mode.

Press from F1 to F4 or the main menu key to exit the display expansion screen.

4.3 Expanding Gate 1

Press (GATE 1 XP) to expand the waveform in gate 1. The prompt symbol for gate 1 expansion will appear in the display area (figure 20). To cancel expansion, press (GATE 1 XP) again.

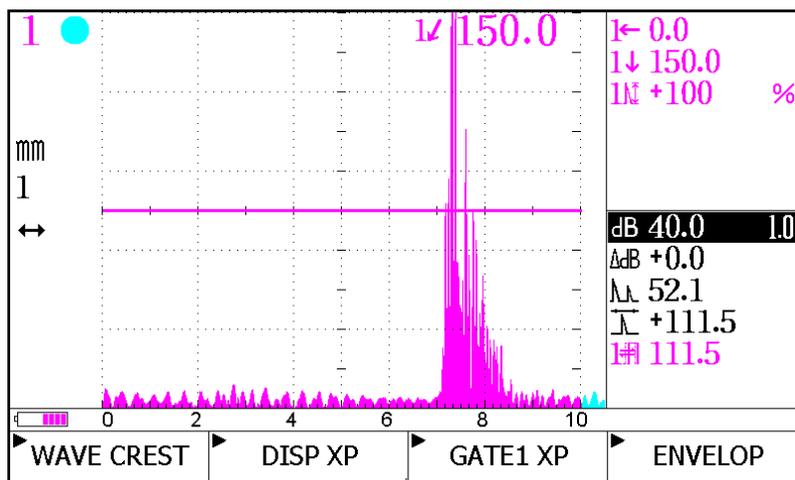


Figure 20. Gate 1 Expansion Screen

•The DAC and AVG functions do not function when the expansion mode is in operation.

4.4 Using the Envelop Function

The purpose of the envelop function is to assist determining the property of the defect. As the probe moves over the test piece, the peak points of continuous echoes form an envelop line on-screen. By using contrasting colored lines for the waveform and the envelop line, the highest echo of the defect can easily be discovered.

Press the (ENVELOP) key to display the envelop function’s main screen (figure 21). Here, the envelop prompt symbol is displayed in the function symbol display area. To cancel, press (ENVELOP) again.

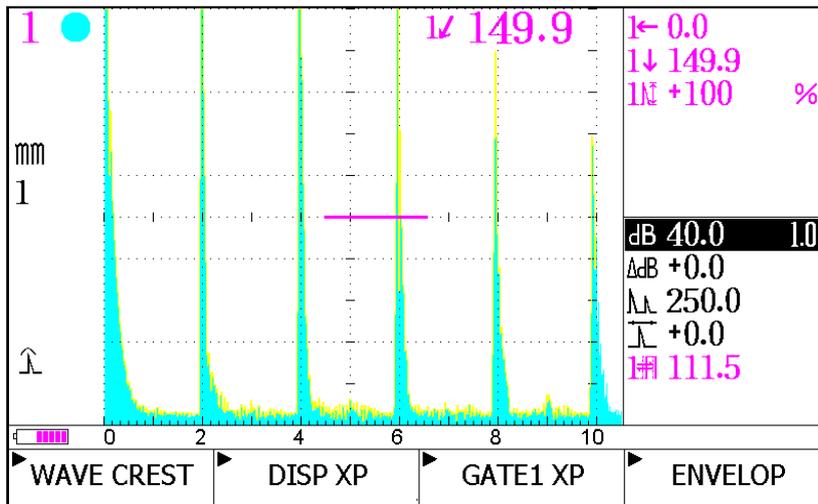


Figure 21. Envelop Function – Main Screen

4.5 Using the DAC Curve

The DAC Curve (Distance Amplitude Correction Curve) represents the way the echo amplitude from a specified reflector varies with distance; this is represented by curve. Since it is very difficult to calculate the transverse wave sound field when detecting flaws with angle probe, the DAC Curve function is used to evaluate and quantify these flaws.

The DAC Curve is measured by a test block that automatically produces results but also can be calculated by arithmetic formulas but is only suitable for more than 3 near the field.

Once the DAC Curve creation process begins and the first point has been recorded, the “range, “dB” and “shift” fields can not be adjusted; however, the remaining fields are adjustable (i.e. “□dB” , “gates”, etc...). Most important to remember is the type of probe used in calculating the DAC Curve; calibrate the “delay time” and “K value” of the probe before creating to ensure accurate results.

4.5.a: Creating the DAC Curve

To access the DAC Curve Main Menu (Figure 22, below), first go to the second page of the

“Function” menu (Figure 17, page 24) and press (DAC).

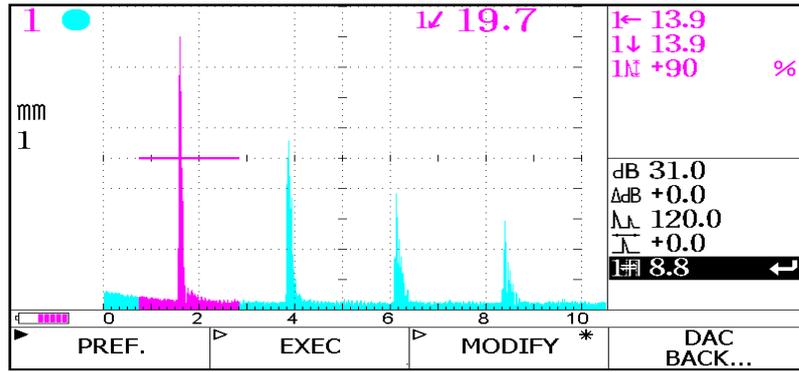


Figure 22. The DAC Curve Main Menu - Creating and Modifying

Adjusting Parameters: press (PREF.) and the adjustable parameters (Smooth, Eval Line, Size Line and Reject Line) appear on the upper half of the screen (Figure 23). Press the “Left” or “Right” arrows to move the cursor and the “Up” or “Down” arrows to adjust the parameters.

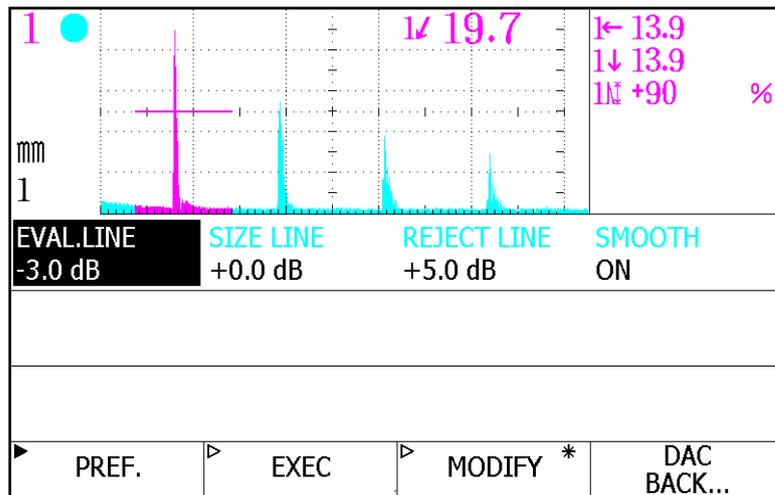


Figure 23. Main Menu – Adjustable Parameters, DAC Curve

The “Smooth” parameter divides into “Curve” and “Straight” sub-parameters. Input the dB values for “Eval. Line”, “Size Line” and “Reject Line” parameters and press (PREF.) or (BACK) to return DAC Curve main menu screen (Figure 22). Press (EXEC) to return to the DAC Curve main menu and create the DAC curve.

Place the probe on the CSK-□A test block (Figure 23a, below) to locate the reflection echoes from the $\Phi 1 \times 6$ transverse holes found on either of seven different depths (10mm, 30mm, 50mm, 70mm, 90mm, 10mm, and 130mm) of the test block.

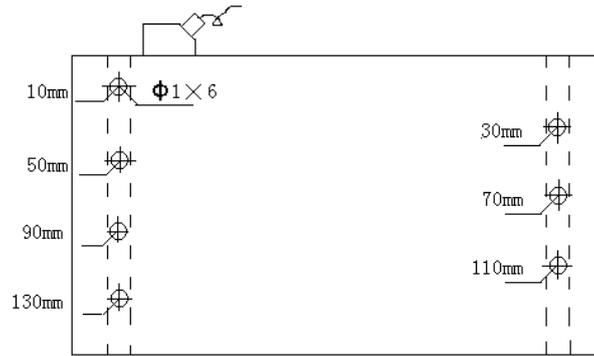


Figure 23a. CSK-III Test Block

Example:

First, find a 10mm deep hole and align the probe with that hole. Move the probe on the test block to find the echo coming from that hole and move gate 1 to cover the waveform required for recording. If the waveform amplitude is insignificant, press **AUTO** to improve it to 80% (the automatic gain is set to 80%) and press (RECORD) to obtain the first point of the curve. On screen, a line is drawn and “DAC” appears in the function symbol display area on the left side of the CTS-1002 (Figure 24).

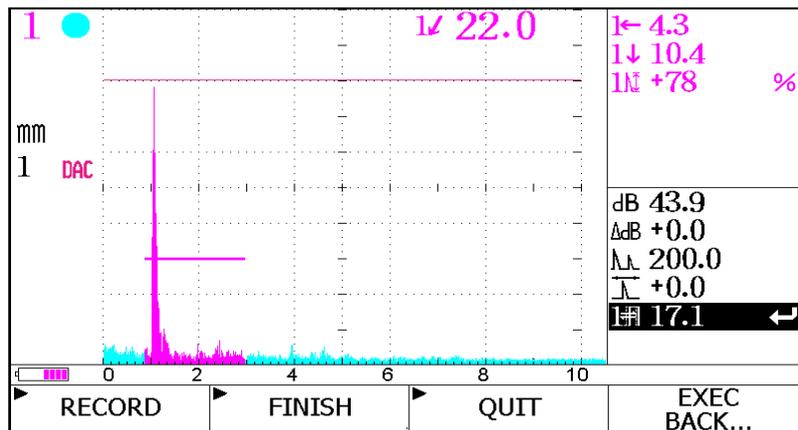


Figure 24. Creating and Recording the First Point of the DAC Curve

Next, place the probe to align a 30mm deep hole and move gate 1 to cover the waveform required for recording and press (RECORD) to obtain the second curve point. Then press (FINISH) after recording the last point. By doing this, three curves will be drawn on the screen according to the parameter settings of the EVAL.LINE, SIZE LINE and REJECT LINE (shown in figure 25).

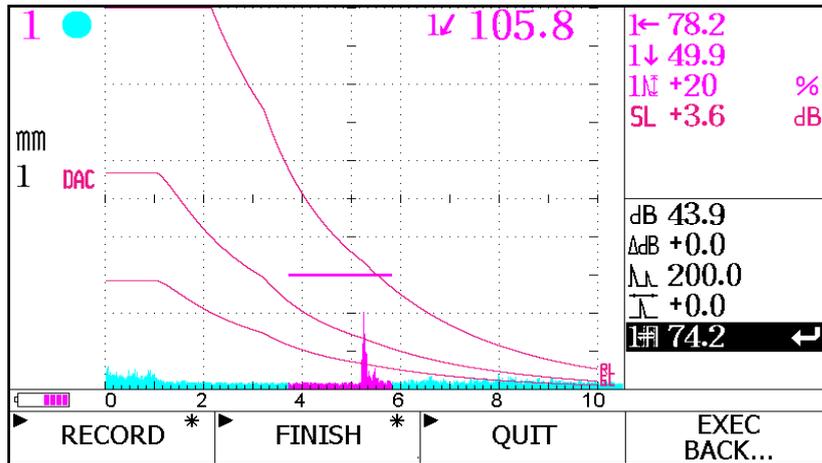


Figure 25. The DAC Curve Finished Results

Once the data lines appear on screen (figure 25), press (QUIT) to exit the DAC Curve mode. Upon exiting, a “?” pops open and confirmation is required to either clear or save this data. Press (BACK) to return to the DAC Curve main menu, “creating” and “modifying” (Figure 22).

4.5.b Modifying the DAC Curve

To modify the data stored in the newly created DAC Curve, press (MODIFY) to access the DAC Curve Modification Main Menu (Figure 26). Note: (MODIFY) can only be used when there are visible DAC Curve lines on screen (Figure 26).

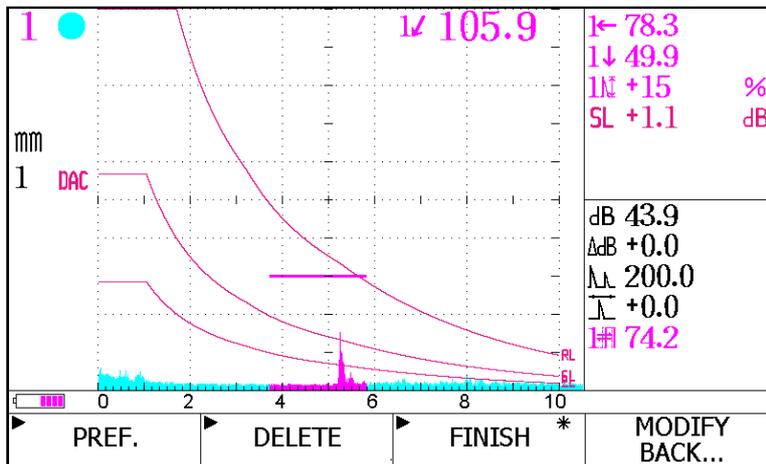


Figure 26. Modifying the DAC Curve

To access the DAC Curve modification menu, press (PREF) (Figure 27, below). Select the curve point needing modification and adjust the amplitude; the curve will change. Press (FINISH) to refresh the screen for full results. To remove the data completely for a specific point, select the curve and press (DELETE). To return to the DAC Curve Modification Menu (Figure 26, page 28), press either the (PREF) or (BACK) buttons.

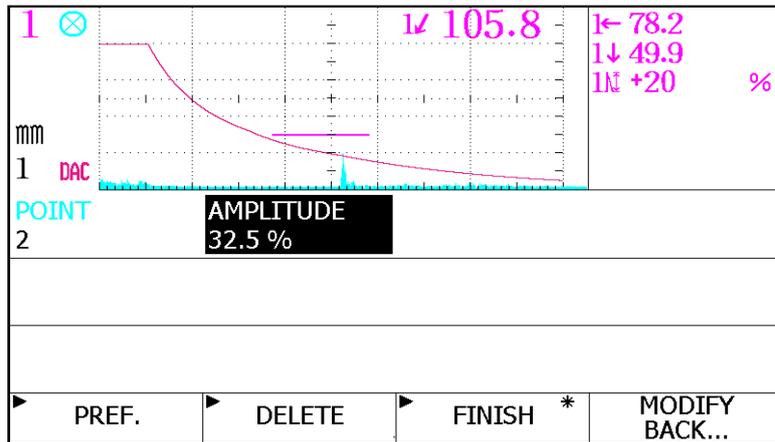


Figure 27. Modifying the Parameters of the DAV Curve

4.5.c Alarming and Storing the DAC Curve

- * The “Alarm” function: Omega’s HFD-1 meter detects inaccurate data results and alerts the user producing either a warning beep or flashing light.

Example (For reference, see Figure 26, page 29):

Use gate 1 to select an echo on the DAC curve. If the echo is over one of the curves, the corresponding amplitude produces an equivalent result on screen. “SL +3.6dB” indicates the location of the highest flawed echo is on the curved area and “3.6dB” is greater than the size line.

Since the amplitude of the echo in gate 1 is greater than the size line, the meter will alert the user of the inaccuracy.

- * The “Store” function: Used to warehouse the parameters of the DAC Curve and flawed echos that were detected. Press  to save the parameters when the DAC Curve is visible on screen.

4.6 Creating the Longitudinal Wave AVG Curve

The AVG Curve, also referred to as “DGS”, explicates the distance, gain and flaw size relationships. AVG Curve to calculate the defected counterpart, this function using the AVG Curve iSince it can conveniently calculate the flaw equivalent, the AVG curve therefore becomes the main method of flaw equivalent and especially suitable for detecting the forges.

To create the AVG Curve:

1. Press  to retrieve the “Function Menu” screen (Figure 17, pg. 24).
2. Press (AVG) to access the main menu for creating the AVG Curve (Figure 28, below).
3. Press (PREF) to set the “Reference Size” and “Curve Size” parameters.
 - a. “Reference Size”: the sizes of the flat bottom hole on the test block being calibrated.

Omega HFD-1 Operating Manual

Select any size from the $\Phi 1$ to $\Phi 10$ range.

- b. "Curve Size": the size of the AVG curve. Select any hole from the $\Phi 1$ to $\Phi 20$ size range. Example: if the defected counterpart is greater than $\Phi 2$, the hole should be rejected as a false detection and $\Phi 2$ from the Curve Size should be selected.
4. To return to the AVG Curve menu screen (Figure 28, below), press (PREF).

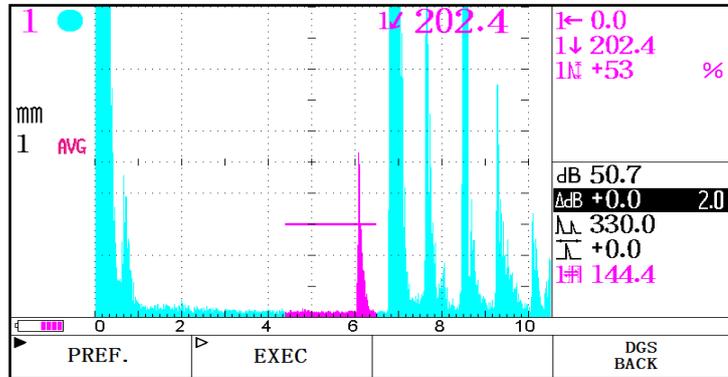


Figure 28. The AVG Curve Menu Screen

Example 2: The test block being used for calibration has a flat bottom hole of 200 $\Phi 2$. To calculate the reference size needed to create a $\Phi 2$ curve, move the probe over the test block to locate the highest echo and cover the echo with gate 1. Press (RECORD) to record this position, and then press (FINISH) to create the corresponding AVG curve. After doing this, the AVG will appear in the "Function Symbol Display Area" (Figure 29, below). The increased equivalent value, $\Phi 2$, and the dB difference of the echo amplitude relative to the AVG curve, are displayed on the echo results found within gate 1. Press (QUIT) to exit the AVG curve or cancel the current AVG curve.

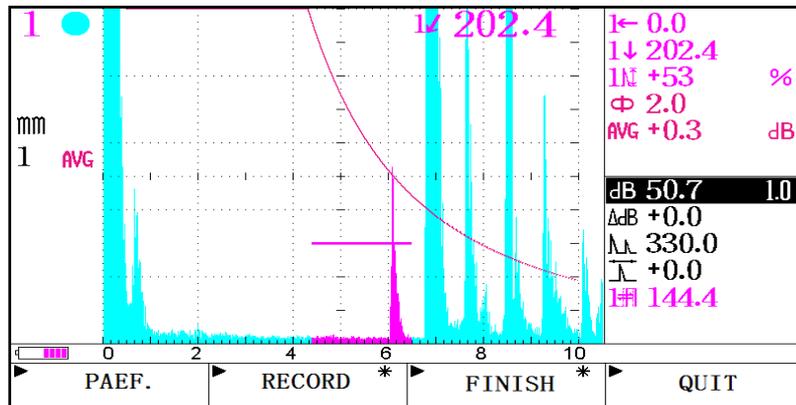


Figure 29. The AVG Curve

4.7 Exiting the DAC or AVG Curve, Shortcut:

To exit the DAC or AVG Curve screen quickly, press "CURVE QUIT??" as a shortcut (Figure 30, below).

Note: access to the exit shortcut is available only when the DAC or AVG Curve menus are in use.

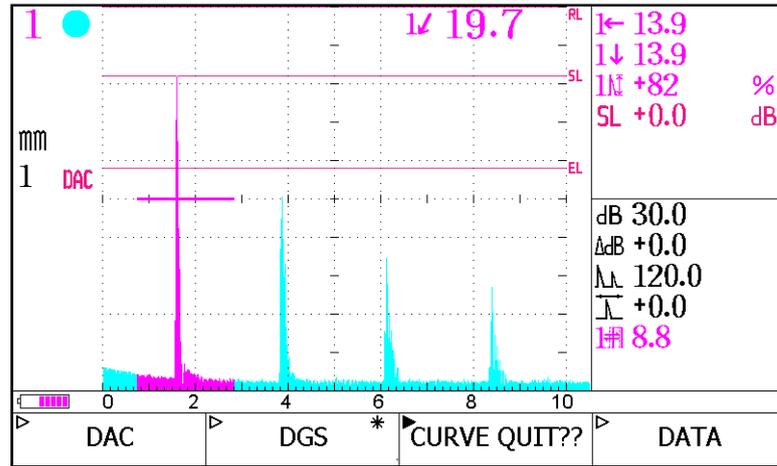


Figure 30. The DAC or AVG Curve Menu Screen - “Curve Quit ??” Exit Shortcut Location

4.8 Data Function

The primary use for the “Data” function is to review, print, and transfer data to a USB flash disk and for storing shortcut channels (Figure 30, above). Press (DATA) to retrieve the “Data Function” display screen (Figure 31, below).

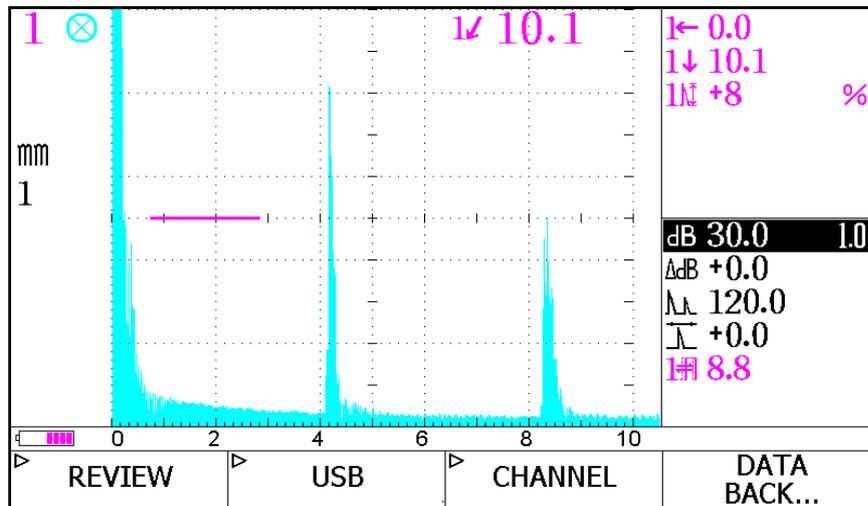


Figure 31 Data Function Display Screen

4.8.1 Reviewing Data

The user must be on the “Data Function” display screen (Figure 31, above) to review data. Press (REVIEW) and then (A-SCAN). The “Data Review List” screen will open (Figure 32, below). At this point, the user has (3) options to select from: (a) Delete Data, (b) Calibrate Data, and (c) Review Data in Detail.

LOCATION	CAPTION	OPERATOR	DATE	TIME
A0001			2009-01-15	
A0002			2009-01-15	
A0003			2009-01-15	
A0004			2009-01-15	
A0005			2009-01-15	
A0006			2009-12-11	
A0007			2009-12-12	
A0008			2009-12-12	
A0009			2009-12-12	
A0010			2009-12-12	

▶ DELETE	CALIBRATE OFF	▶ DOVIEW	A-SCAN BACK...
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Figure 32. Screen Shot: Data List for Review

4.8.1. a. Deleting Data

Selecting from the data list, move the “Up” or “Down” arrow to select the data line to be deleted.

Press (DELETE). A confirmation message opens on the delete menu, “DELETE? DELETE??”.

Press delete again to expunge the data permanently.

4.8.1. b. Calibrating Data

Selecting from the data list, move the “Up” or “Down” arrow to select the data line to be adjusted.

Press (CALIBRATE OFF) to open the calibration function. The stored A-Scan waveform will compare with the live waveform.

4.8.1. c. Reviewing Data in Detail

Selecting from the data list, move the “Up” or “Down” arrow to highlight the data line to be verified.

Press  to view the details of the data parameters (Figure 33).

DUAL*	DAMPING*	PRF VALUE*	PRF MODE*
OFF	400 Ω	400 Hz	AUTO
VOLTAGE*	TX WIDTH*		
200 V	200 ns		
BAND-WIDTH*	RECTIFY*	REJECTION*	UNITS*
NARROW	FULL	0 %	mm
PROBE*	CRYSTAL*	K/ANGLE*	PROBE DELAY*
CONTACT	2.50P13	0.00/0.0 °	0.00 us
X-VALUE*	GATE-WAVE*	SURFACE-C*	DEPTH-C*
0.0 mm	ON	+0.0 dB	OFF
MATERIAL*	VELOCITY*	THICKNESS*	
STEEL	5900 m/s	20.0 mm	

▶ DELETE *	CALIBRATE * OFF	▶ DOVIEW	A-SCAN BACK...
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Figure 33. Detailed Data Parameters

The user can return to the “Data List for Review” screen by pressing  and  simultaneously or view the A-Scan Waveform graphically.

***Viewing A-Scan Waveform Graphics:**

To view the A-scan Waveform of the data line selected, the user can open the screen in two ways:

- The user is already checking the parameters of the data line in detail (Figure 33, above). Press  again to display the stored A-scan Waveform (Figure 34, below).

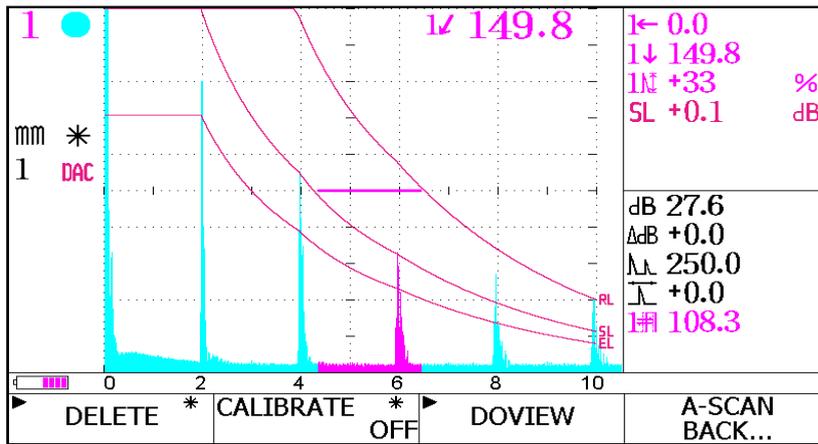


Figure 34. Screen Shot: A-Scan Waveform

- The user is on the “Data List for Review” screen (Figure 32, page 32); press (DOREVIEW).

4.8.2 Transferring Data and A-Scan Waveform Video

The stored memory of Omega’s HFD-1 meter contains both data results and A-Scan Waveform graphics and are transferable to a USB flash disk. To copy over, return to the “Data Function” display screen (Figure 31, page 31) and press (USB).

Transferring Data: Press (RECORD)

Transferring A-Scan Waveform Graphics: Press (A-SCAN).

4.8.3 Storing and Recalling Data of the Shortcut Channel

Store the data of the shortcut channel according to 3.2.1.2 section in this manual.

To display the “Shortcut Channel Data Recall”, first return to the “Data Function” display screen (Figure 31, pg 31). Press (CHANNEL) and then press (DOCALL); the “Shortcut Channel Data Recall” screen is displayed. The user now can either delete the parameters or compare them to new test results.

LOCATIONCAPTION	OPERATOR	DATETIME
P0001		2009-01-01
P0002		2009-01-10
P0003		2009-01-01
P0004		2009-01-04

At the bottom of the screen, there are control buttons: 'DELETE', 'DOCALL', and 'RECALL BACK...'.

Figure 35. “Shortcut Channel Data Recall” Screen

- a. **Deleting Stored Parameters:** Highlight the intended data line for removal and press (DELETE)
- b. **Recalling Store Parameters:** Highlight the data line for retraction and press (DOCALL).
The archived parameters and the current test parameters appear graphed together for comparison in the display area of the “Channel Parameters Recall” display screen (Figure 36).

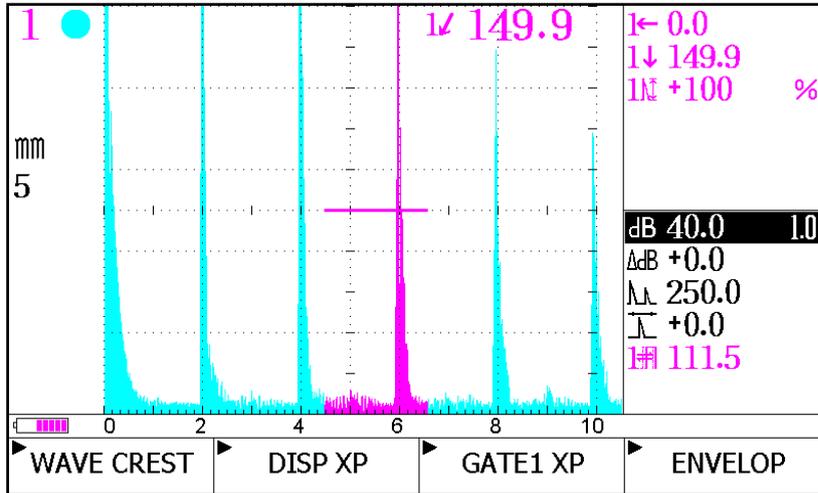


Figure 36. “Channel Parameters Recall” Screen Shot

- c. **Adjusting Stored Parameters:** Press one button from F1 to F4 in the (CHANNEL) Channel 1 corresponds to F1, channel 2 correspond to F2, etc...

To return to the “Shortcut Channel Data Recall” screen (Figure 35, above), press  and  simultaneously.

4.9 Recording Function

The Recording function tapes a waveform and its surrounding waveforms for further analysis and discussion. The available recording time is 9 minutes (25 frames per second).

To access the “Record” function, return to the “Channel Store” display screen (Figure 18, pg 23), press (R-SCAN) and the main screen for “Recording Waveform” data is displayed (Figure 37).

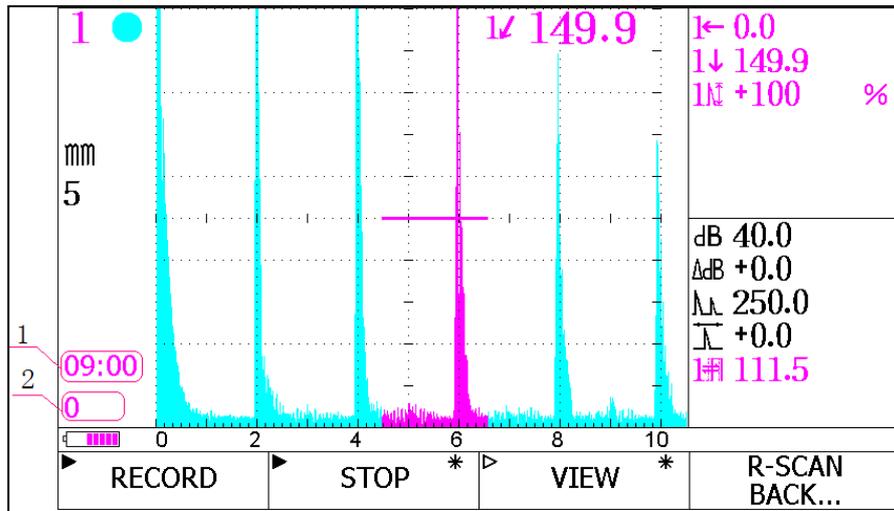


Figure 37. "Recording Waveform Data" Screen Shot

- 1. Available Recording time
- 2. Number of Recorded Frames

4.9.1 Recording the Waveform Data

To BEGIN recording: Press (RECORD). There is a visible five second countdown to the actual start recording mode. Note: Once (RECORD) is activated, the menu name changes to (PAUSE), the "Available Recording Time" (1) gradually decreases and the "Number of Recorded Frames" (2) increases (Figure 38).

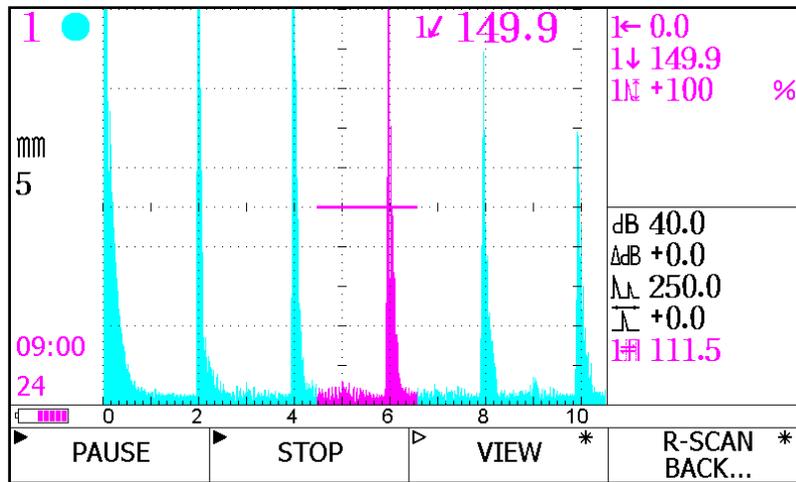


Figure 38. Recording Interface

Pausing or Stopping Recording

The "Pause" or "Stop" recording functions are not interchangeable; each one has a distinct effect on the how the data is or is not stored.

"PAUSE": Temporarily interrupts recording but with the ability to start again without overwriting the original data. However, once recording has ended, the data can not be stored.

* Press (PAUSE) to engage the function. The menu name will change back to (RECORD).

“STOP”: Stops the recording for the current time but with the option to start recording again and to save data. Once the recording restarts, the original data is overwritten but can be saved.

* Press (STOP) to stop recording.

* Press  to save the data after the wavelength has been recorded in full.

Press (RETURN) to return to the previous menu.

4.9.2 Viewing the Data

Press (VIEW) to view the display screen (Figure 39).

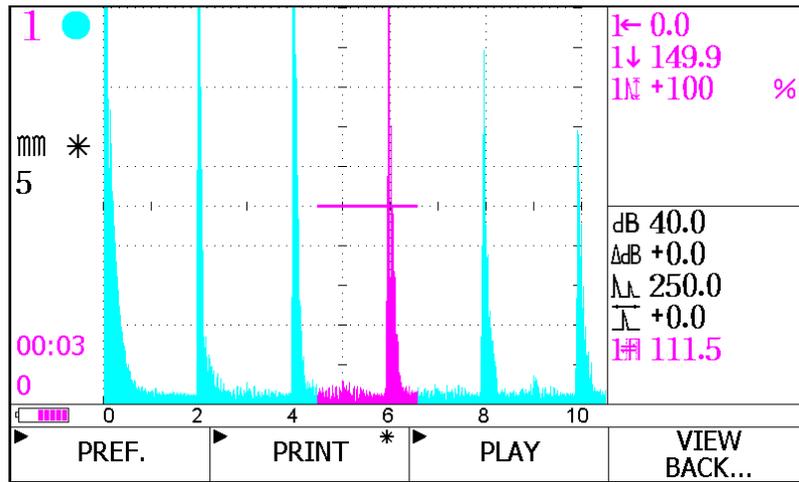


Figure 39 “Recorded Data” Display Screen

Press (PLAY) to begin video in full or to view selected frames, press (PREF) (Figure 40).

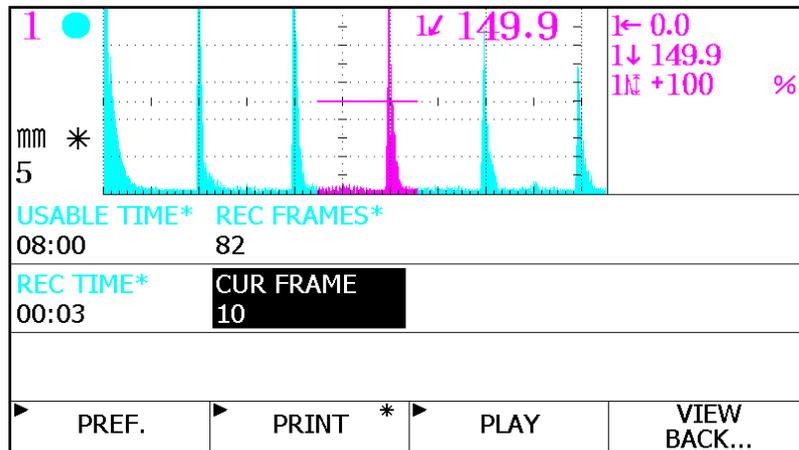


Figure 40. Video Replay Screen

Press (BACK) to return to the previous menu.

4.9.3 Storage Location & Video Replay

4.9.3.1 Storage Location

Once recording finishes, press  to view the “Storage Location” screen (Figure 41).

Move cursor to “Location” and enter information. Continue to enter information for “Caption” and “Operator” and press  to save.

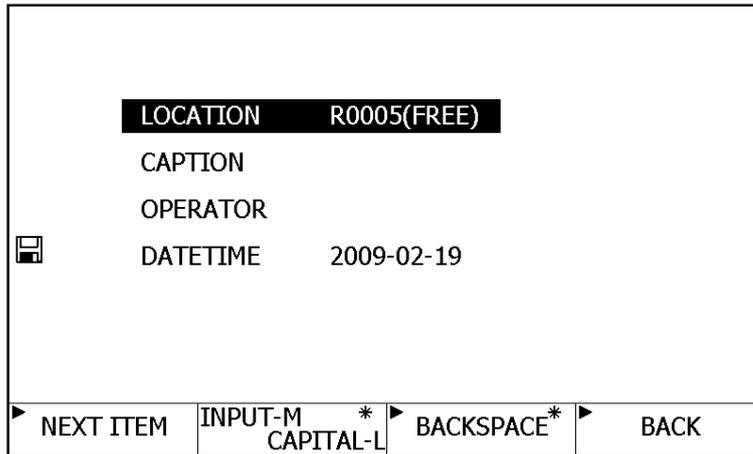


Figure 41. "Storage Location" Display Screen

4.9.3.2 Video Replay

Press the main menu function key to return to the Data Function Display Screen (Figure 31) and scroll to the second page.

Press (DATA) and then (REVIEW). The "Video Replay" screen opens up (Figure 42).

Press (R-SCAN) to open the "Data File" screen listing file names.

Press (VIEW) to recall the "Recorded Data" display screen shown in Figure 39.

Press (PLAY) to view full length recording or press (PREF.) to view selected frames (Figure 40).

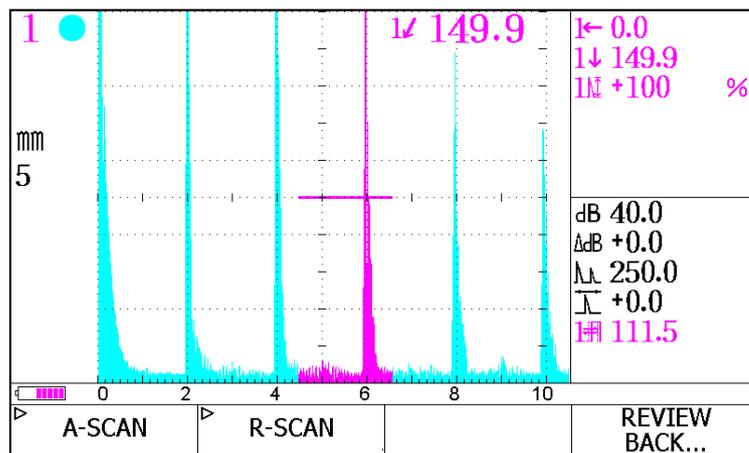


Figure 42. Selection Interface of Replaying the Data

5. Care and Maintenance of HFD-1 Meter & Lithium Batteries

5.1 Lithium Batteries

5.1.1 General Care

Fully charge the batteries every month to extend battery life.

Use the battery charger that came with meter.

Remove batteries if the meter is not in use for an extended length of time.

If any deflection occurs during use, check battery volt charge. Optimal charge should be above 12.0v with no-load.

5.1.2 Safety Tips

Omega HFD-1 Operating Manual

Do not put batteries in or leave near fire, heat, water, or coupling agent.

Do not insert metal objects into the battery output port; it will short circuit.

Do not try to dismantle batteries.

5.2 Omega HFD-1 Meter

The Omega HFD-1 meter is a sophisticated electronic apparatus and care should be exercised during use to ensure optimal results. Prior to leaving the manufacturing warehouse, each meter is tested for quality assurance. If any defects occur under normal operating conditions, please contact Omega's Technical Support and Service Department. All review and repair work should be made by Omega's professional team.

5.2.1 General Care

When operating meter with the batteries, turn the power switch off to reduce power consumption.

Turn the meter on for 1 to 2 hours each month to keep the components moisture free.

If the meter is inactive for a length of time, turn off power switch.

Turn off power switch before connecting communication or printer cables.

Hold the plug by the metal cover while inserting the cable probe; do not forcibly insert or drag the cable.

Clean the meter and accessories after each use.

Keep the meter in a dry area and avoid contact with water or machine oil.

Avoid contact with other electrical equipment to prevent shock.

5.2.2. Troubleshooting

Symptom	Caused by	Processing method
The display interface disappears quickly after installing the battery and turning on the instrument.	Low power	Charge the battery.
Abnormal display and parameters during operation.	Memory error caused by some reasons.	Turn off the instrument and then turn it again, press  to display "Initializing the System" on the screen, in this case, the instrument will return to initialization state.

6. Standard Package and Optional

6.1 Standard Package

Description	Quantity	Unit
HFD-1 ultrasonic flaw detector (Basic model)	1	set
SPQ-1002 power adaptor	1	set
DC-19 lithium battery	1	set
Q9-2 probe cable	2	piece
JLX-1008 AC power cable	1	piece
2.5P20 contact probe	1	piece
BH-50 standard echo probe	1	piece
2.5P 13×13K1 angle probe	1	piece

6.2 Documentation

Description	Quantity	Unit
Operating manual	1	copy
Certificate	1	copy
Packing list	1	copy
Warranty card	1	copy

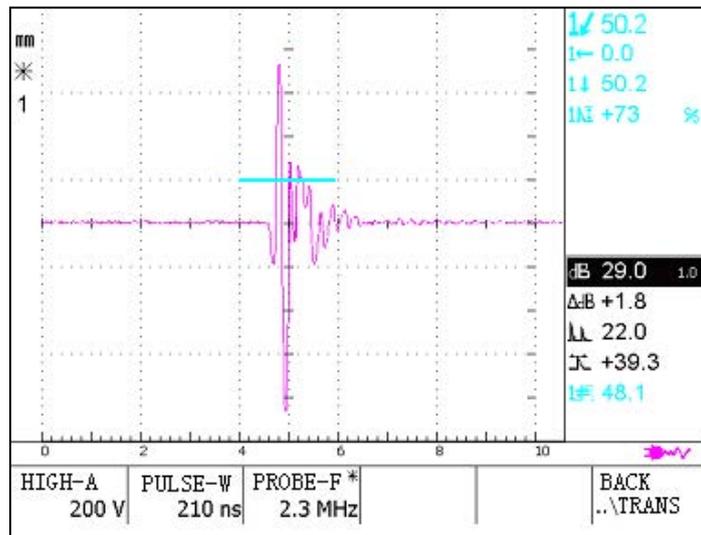
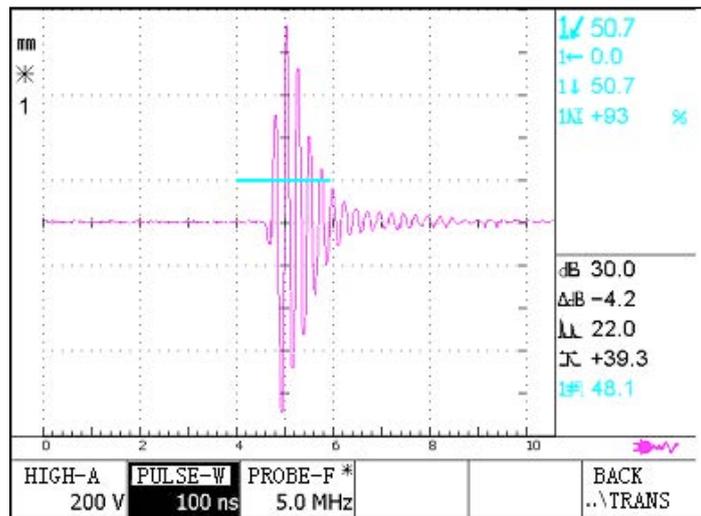
6.3 Optional Order

CD-18 lithium-ion battery	1	piece
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Appendix A Application of the Square Wave

A.1 Square wave excites the non-inductive coil with frequency of 5MHz, adjust the different width to obtain the best sensitivity and resolution.

A.2 The sensitivity is the best when the width of the square-wave is the half cycle of the probe frequency (for example, 5MHz corresponds to approximately 100ns). Two images are shown below when using the same echo probe BH-50.



A.3 The sensitivity is the best when the width of the square-wave is a cycle of probe frequency (for example, 5MHz corresponds to approximately 210ns).

A.4 Under the same voltage condition, the sensitivity excited by the square wave is more than 12dB compared with that of excited by the negative pulse voltage.

A.5 The square wave can match well with the probes imported from abroad.

A.6 The use of the square wave can extend the probe's operation time since the crystal withstand voltage of the composite material is generally lower.

Appendix B Method of Upgrading the Software

B.1 The 1002's software can be upgraded by using a USB flash disk and its upgrade procedures are as follows:

B.1.1 Insert the USB flash disk to the USB port before turning on the instrument.

B.1.2 Turn on the instrument to go to its display interface.

B.1.3 Wait for 30 seconds, you can see the LED lights if the USB flash disk offers with LED indicator, and then it goes off, and lights again in a few seconds.

B.1.4 Press  on the lower right corner of the front panel for approximately 3 seconds.

B.1.5 "UPDATING THE SYSTEM, PLEASE WAIT!!" will appear on the screen for prompt. If you can not read out the USB flash disk, "NOT FOUND USB DISK, PLEASE TRY!!" will appear on the screen for prompt. In this case, you can perform the previous step again.

B.1.6 After updating the software, the instrument will turn off automatically.

B.2 Supplemental Instruction

B.2.1 Make sure there is only an upgrade software version before performing the previous operation.

B.2.2 If display "NOT FOUND USB DISK, PLEASE TRY!!" in step B1.1.5, which indicates the USB flash disk can not be contacted well, or, can not be identified. It is better to use the USB flash disk manufactured by Kingston, Dynamic Express, SanDisk, Netac.

B.2.3 If any abnormal occurs during upgrading the software, you can also contact us by phone.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

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RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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