UFD-P710

DIGITAL ULTRASONIC FLAW DETECTOR

(ADVANCED TYPE)

OPERATATION MANUAL

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To respected users，

Thank you for purchasing our product so that we have an opportunity to provide our services for you. We have made every effort to satisfy your requirements and assure you can enjoy our quality product with pleasure.

Please read the operating manual carefully prior to use of the board in order to operate correctly and effectively. Meanwhile, you can obtain our service at any time through the technical support and service within the manual. Through the appendix, you can also learn more about the use of the instrument, which is conducive to the appropriate use of this product.

We sincerely hope that the operating manual provides you with great help.

We thank again for use of the product and we hope to have more opportunities to provide our services for you.

Contents

1 Cautions

- Use the power cable provided with this instrument and use the specified type of power source.
- Please make sure all the rating values and cautions indicated on the instrument are referred to so as to prevent fire or electric accidents. Read the manual to know more about relevant rating values before making electric connections.
- When the instrument powered by alternating current (charger), the earth terminal of the tri-cord AC power cable used for the instrument should be well connected to the ground so as to prevent electric accidents.
- Make sure that the power is off before connecting the instrument to any external devices such as printer or the like.
- Use the lithium battery (CE approval) provided with the instrument.
- Do not use the instrument where explosive air exists.
- Keep the instrument clean and dry.
- Once any abnormality occurs, do not operate the instrument or open its front or rear covers. We are not responsible for any problem arising therefrom. All check and repair work should be left to professionals.
- The battery is a consumable commodity which needs to be replaced timely. The used-up battery should be delivered to local recycle bin or sent back to us for environmental protection.

2 Brief introduction

2.1 Functions and main features

The UFD-P710 is a digital ultrasonic flaw detector based on the advanced technologies of square wave drive with a high-resolution color LCD display. The instrument features stable performance, light weight and easy operation, so it is your cost-effective choice.

Our instrument is in accordance with the vessel standard TSG R0004-2009 and with European Standard EN12668-1:2010. Besides, the UFD-P710 is equipped with a high-resolution TFT display (640X480), suitable for outside work. As for the power supply, the high-performance lithium battery supports the uninterrupted service for 6-8 hours. It only weighs 1.5kg and is supplied with a multi-angle adjustable handle, which is perfect for field work.

The instrument applies the square wave drive technology. With multi-level damping and the tunable voltage pulse width, it can achieve the best match with probes, so as to strengthen the sensitivity and discernibility. It is applicable in the inspection in the petrochemical industry, pressure vessel, electricity power and railway transportation.

Main features

- Ergonomic design with a tunable handle and 5.7" display.
- Internal battery and charger.
- Weighing 1.5kg with battery; easy to operate and carry.
- Large storage for continuous dynamic data recording, which is at the request of the national TSG R0004-2009.
- Advanced circuitry and exceling sampling rate ensure the real-time and accurate display and interpretation of the flaw signals. And for any weak signal, it can instantly and accurately recognize and respond, which ensures a real-time and trustable inspection.
- Spectrum analysis.
- Friendly menu flow, keyboard used in concert with the rotary knob, a nimble and efficient way of operation with ease. Multiple inputting methods, a great help with forms and reports.
- Auto calibration for material velocity, as well as delay and angle of the transducer.
- DAC: could be set up, corrected, saved and recalled easily.
- Guarantee of safety: smart in-built li-ion charger; automatic indication to power supply; automatic shift between charging and power supply; temperature limits for both charge and supply;
- More than 6 hours of battery life.
- USB port for software update, data dump, and extensions like mouse, keyboard, USB disk; the storage of 32G for long time recording.

2.2 Main specifications

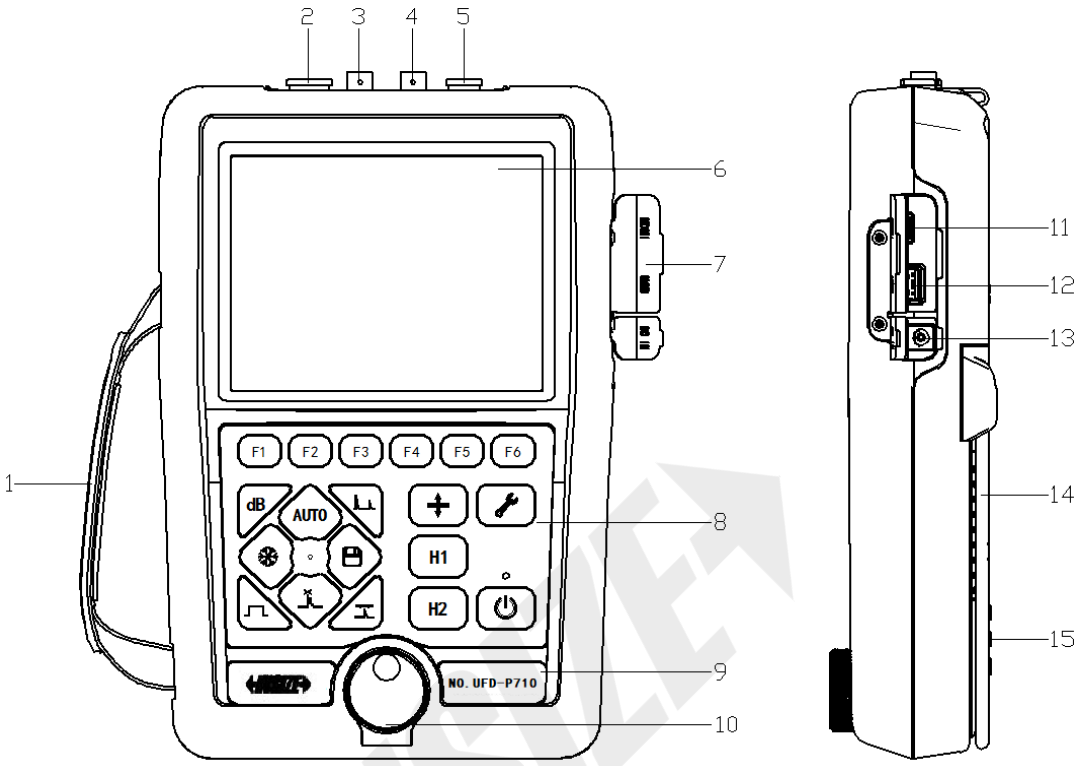
The main specification is shown in Table 2-1.

Table 2-1 the main specifications

Parameter	Illustration
Pulse Type	Negative square wave Tx: -50V~-250V , tunable with 50V per step Pulse Width: 50ns -800ns tunable with 10ns per step
Working Modes	P/E;P/C
Damping	400Ω/80Ω
Working Frequency	0.5MHz~20MHz, broadband and narrowband
Gain	0.0~110.0dB; 0.1dB /1.0dB /2.0dB /6.0dB per step; smart speed-up at 0.1dB
Material Velocity	1000m/s~15000m/s tunable; preset 30 frequently-used material velocity parameters
Range	2mm ~10000mm LW at steel velocity tunable with min 0.1mm per step
Rectification	Positive, Negative, Full, RF
Gate & Alarm	hardware driving real-time alarming; Alarming condition: excess/loss/DAC; Alarm mode: buzzer/LED
Display	TFT 5.7 inch TFT color display, pixels 640×480
Display Delay Range	-7.5μs ~3000μs
Probe Delay Available	0~200μs
PRF	25Hz ~1600Hz, auto /manual
Vertical Linearity	≤3.0%
Horizontal Linearity	≤0.4%
Sensitivity Surplus	≥62dB (200Φ2 FBH)
Signal Resolution	≥26dB (mated with 2.5P20 transducer)
Dynamic Range	≥32dB
Rejection	(0~99) %, without any dent to linearity or gain
Attenuator Error	±1dB/12dB
Ports	Q9 probe connector
	USB HOST; Mini HDMI
Power Supply	Large-capacity Li battery without memory effect; battery life: 6+hrs;
	In-built battery charger
Ambient Temperature	-30℃~50℃
Relative Humidity	20%~95% RH
Weight	Around 1.5kg (with battery & in-built charger)

2.3 Description of the main parts

The appearance of UFD-P710 is shown in Figure 2-1.



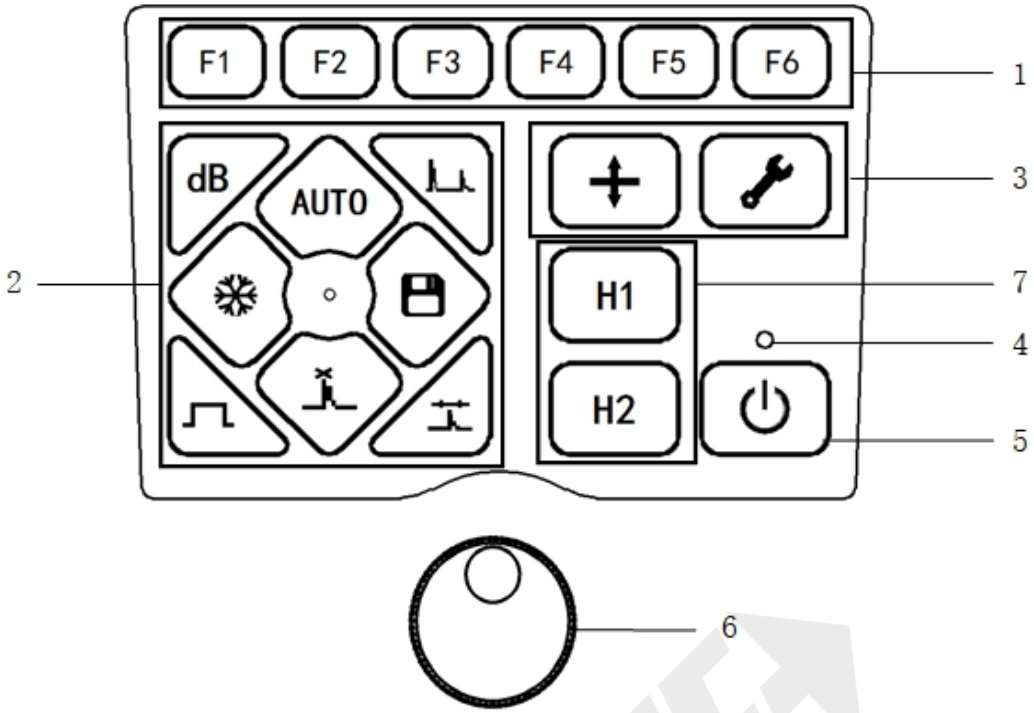
1. Handle	2. Encoder Port	3. BNC-R	4. BNC-T
5. Power Port	6. Display	7. External Port Cover	
8. Panel	9. Model Label	10. Functional Knob	11. mini HDMI port
12. USB Port	13. DC Port	14. Trestle	15. Battery Cover

Figure 2-1 the appearance of UFD-P710

2.4 Panel of the instrument

2.4.1 Classification of the keys

The panel of UFD-P710 is shown in Figure 2-2.



1: Menu Keys: Corresponding to the menu items on a certain interface of the software.

2: Direct-access Keys: A direct-access method to change the parameters or switch to other functions.

3: Setting/Inspection Keys: refer to the following instructions.

4: Power LED: turning red while the instrument's on; turning green while it's being charged.

5: Power Switch.

6: Functional Knob.

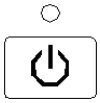
7: H1:tips window (contextual help); H2:target the next echo signal (by crest).

Figure 2-2 the panel

2.4.2 Description of keys

The description of keys is shown in Figure 2-2.

Table 2-2 the description of keys

Icon	Name	Illustration
F1 F2 F3 F4 F5 F6	*[MENU]*	Each key is corresponding to a certain function, and press to choose the corresponding function. (the function name will be displayed on the interface)
	*[SETTING]*	Press to enter the Setting Menu.
	*[INSPECTION]*	Press to enter the Inspection Menu.
dB	*[GAIN]*	Press to toggle between dB and △dB; rotate the functional knob to tune the value and press the functional knob to change the increments.
	*[GATE]*	Press to toggle between Gate 1 and Gate 2; rotate the functional knob to tune the value and press the functional knob to scroll through the Gate Start, Gate Width and Gate Threshold.
	*[FREEZE]*	Press to freeze/unfreeze the waveform.
	*[RANGE]*	Press this key and rotate the knob to set the inspection range.
	*[PULSE SHIFT]*	Press this key and rotate the knob to set the pulse shift.
	*[SAVE]*	Press to save the data.
AUTO	*[AUTO GAIN]*	Press to set the echo height as 80% automatically (with the range of 20%-100%) .
	*[HA MARK]*	Once it's pressed the highest amplitude within Gate 1 will be marked.
	*[POWER SWITCH]*	Press to turn on/off the instrument. When the instrument needs to charge, the red indicator light will illuminate; When the instrument is charging, the green indicator light will illuminate.
	*[FUNCTIONAL KNOB]*	Rotate to adjust the parameter value; press to perform other operations.
H1	*[H1]*	Press to display the Help information. Only available on the calibration menu.

H2	***[H2]***	Press to search the peak; will automatically adjust the gate start and gate width of Gate 1 and catch the next echo signal.

Note:

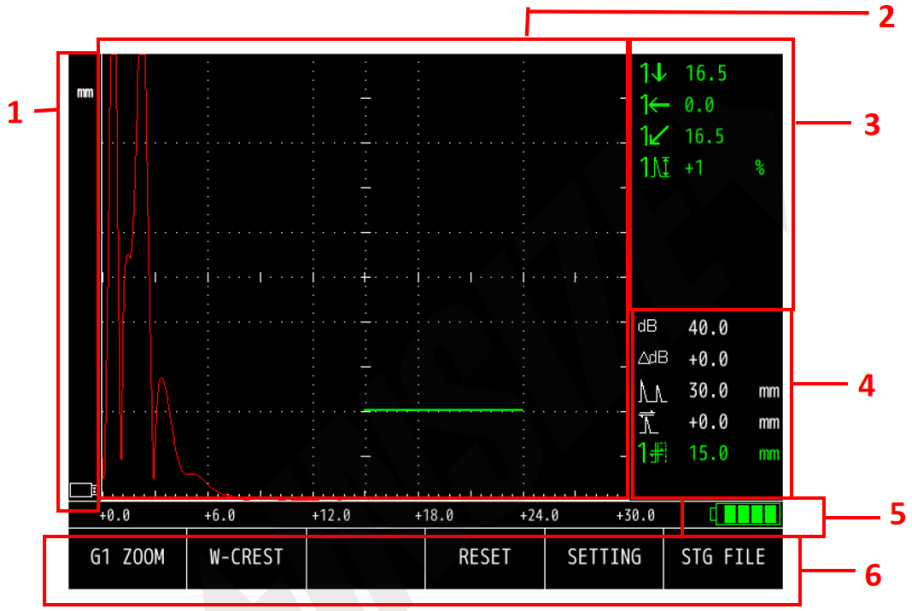
1) Rotate the knob to change the parameter values.

2) Press the knob to change the increments of different parameters.

2.5 Description of the menu flow

2.5.1 Main operation interface

The main operation interface is shown in Figure 2-3.



1: Tool/Effect Signs Zone.

2: Waveform Zone.

3: Readings Box (from top to the bottom: sound path, horizontal (X-value taken off), depth, and amplitude within Gate 1; sound path and amplitude within Gate 2).

4: Common Parameters Zone.

5: Power Status Zone.

6: Menu Bar.

Figure 2-3 the main operation interface

2.5.2 The illustration of the menu

The description of general parameters is shown in Table 2-3.

Table 2-3 the description of general parameters

Submenu	Sub-Sub	Description
TX	MODE	The mode of probes: P/E; P/C.
	DAMPING	The damping that matches the probe.
	PRF APT	The mode of PRF adjusting: MANUAL / AUTO.
	PRF	Pulse Repeat Frequency.
	SQW	Tunable pulse width and pulse voltage.
RX	BW	Choose the work frequency.
	RECT	Positive wave; negative wave; full wave; RF.
	REJECT	0～99%.
	UNIT	The result unit: mm/μs/in.
	FILTER	To adjust the filter.
PROBE	TYPE	Normal / angled / small angled.
	FREQ	Frequency and size.
	K-VALUE	K value or angle.
	DELAY	The fixed sound delay of the probe and the instrument, which is caused by the effect of wedges or membranes.
	X-VALUE	the distance from the incident point to the front edge of an angle probe.
DISPLAY	COLOR	options of color scheme for the interface.
	SCALE	options of sound path projection: incl/ horizontal/ depth/ sound path/ common.
	GRID	The back grounding behinds the waveform display and it can be used to size the waveform amplitude referentially. Optional: concise/dense/fine(1/2/3).
	WAVEFORM	The display of the wave. Optional: FILLED/ HOLLOW. (The FILLED mode provides vivid and clear representations, when working outdoors.)
	BRT	To adjust the brightness of the screen.
REGION	DATE	YY-MM-DD.
	TIME	H:M.
	LANGUAGE	ENGLISH.

The description of gate and system parameters is shown in Table 2-4.

Table 2-4 the description of gate and system parameters

Submenu	Sub-Sub	Description
SYSTEM	BUZZER	To turn on/off the alarm buzzer. Note: the indicator light cannot be turned off.
	AUTO-A%	To automatically set the amplitude.
	SPM	Signal processing method. Optional: AVERAGE(usually) /PEAK (fast scan).
	TOF	CREST/FLANK.
	SF-C	Surface compensation
GATE 1	G1 STRT	the start point of Gate 1.
	G1 WTH	the width of Gate 1.
	G1 THR	the alarm threshold of Gate 1.
	ALARM	Optional: EXCESS/ LOSS.
	ON/OFF	“on“ or “off” status of Gate 1.
GATE 2	G2 STRT	the starting spot of Gate 2.
	G2 WTH	the width of Gate 2.
	G2 THR	the alarm threshold of Gate 2.
	ALARM	Optional: EXCESS/ LOSS
	ON/OFF	“on” or “off” status of Gate 2
OBJECT	MATERIAL	30 common options.
	VELOCITY	The velocity of the materials shown in the MATERIAL.
	THK	The thickness of the object being tested. applied when it needs to calculate the LEGS in the angle beam inspection.
	LEGS	To show the quantity of legs, which will be displayed in the Readings Zone. (work with Gate 1)

The description of gate and system parameters is shown in Table 2-5.

Table 2-5 the description of calibration parameters

Submenu	Description
VELOCITY	To calibrate the material velocity.
DELAY	To calibrate the probe delay.
ANGLE	To calibrate the probe angle.
PF TEST	To test the performance of the instrument.
FREQ	To calibrate the probe frequency.

The description of main functions is shown in Table 2-6.

Table 2-6 the description of main functions

Submenu	Description
ENVELOPE	To record the trace graph of the crest point, which can be used to analyze the characterization of flaws.
DAC	Distance-Amplitude-Curve. Optional: NB47013/ GB11345 / ASME / ASME III / JIS / EN1712 / CUSTOM.
DGS	Distance-Gain-Size.
MORE….	More optional functions; please see the Chapter 4 for more details.

The description of extra functions is shown in Table 2-7.

Table 2-7 the description of extra functions

Submenu	Description
CSC	To correct location of the defect t by an “arc-depth” set from either inner or outer surface of a pipe or a ring.
REC	Making video of the scan process up to max 60 mins.
B-SCAN	Time-based triggering. Optional: THICKNESS mode/FULLWAVE mode.

The description of data-about functions is shown in Table 2-8.

Table 2-8 the description of the data-about functions

Submenu	Description
SAVE	To save the data.
REVIEW	To check the saved data, including the data of a single waveform, B-scan and continuous saving.
SETTING	One channel holds a set of instrument parameters.
DUMP	To transfer data.

2.5.3 Interface of setting.

The description of keys is shown in Table 2-9 and the full-screen parameters menu is shown in Figure 2-4.

Table 2-9 the description of the keys

Icon	Name	Illustration
	**SETTING**	Press to enter the full-screen parameters menu (see Figure 2-4).
	**Scrolling**	Press to scroll through the items.
	**Page Down/up**	Go to next/previous menu.
	**Functional Knob**	Rotate to adjust the value of the parameters.

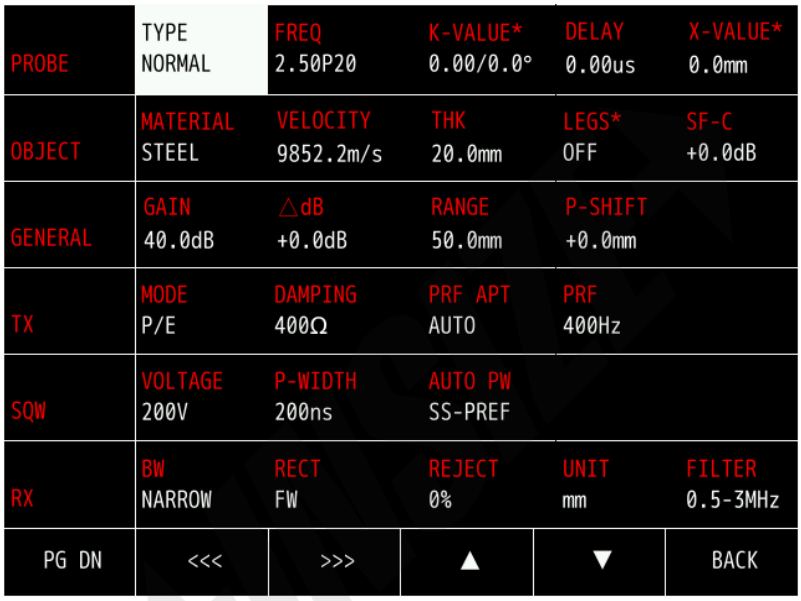


Figure 2-4 the full-screen parameters menu

3 Operation and application

3.1 Powering on / off

3.1.1 Powering on

You can press and hold the ⏻ until the indicator light flashes red. After the start page is present, you can press the [F1]-[F6] keys (any of them) to enter the system.

3.1.2 Powering off

You can press and hold the ⏻ until the information reading “Shutting Down…” is present. Then you can release the key, waiting for the instrument shutting down and the indicator light extinguishing.

3.1.3 Charging

Make sure that the instrument is off and you can connect the DC SPQ-1020 adaptor to the DC IN port on the instrument. After the charging is done, you should unplug the SPQ-1020 adaptor. If there is a battery inside the machine, the indicator light flashes green. The battery takes about 5 hours to fully charge.

***Note**: In order to make sure the best inspection performance, once the adaptor is connected to the instrument, the battery will be automatically charged when the instrument is off. When the instrument is on for inspection, the battery will be uncharged and the adaptor directly powers the instrument.*

3.2 Setting

Before starting to work, you need to set the parameters according to the test object or the probe selected. There are two ways to set the parameters.

a) See Chapter 2.5.2 for the detailed operations

b) Press [+] to enter the inspection menu (see Figure 3-1) and choose the [SETTING]. You can set parameters on the full-screen parameters menu. (see Figure 2-4)

***Note**:*

1) When the parameters are set, you can save it as a Channel (see Chapter 3.6 for more details) for recall.

2) The current parameter setting will be automatically saved when the instrument shuts down and automatically restored for the next booting up.

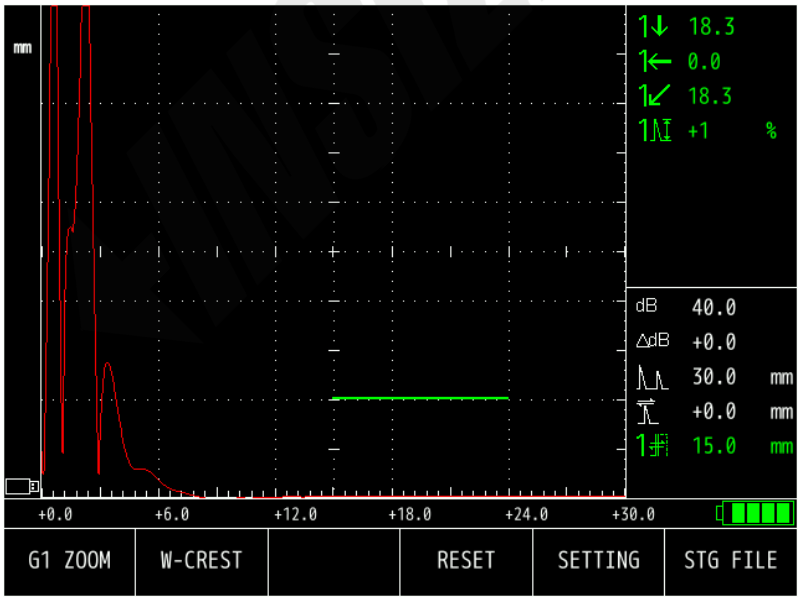


Figure 3-1 the inspection menu

3.3 Calibration

Before conducting the inspection, you need to calibrate the instrument and probe first.

You can press the [wrench] > [CAL] to enter the calibration menu (see Figure 3-2). The system has summarized all the parameters that need to be calibrated. You can just calibrate them in sequence.

***Note**: In the process of setting the parameters, you can press the [H1] key for the detailed illustration.*

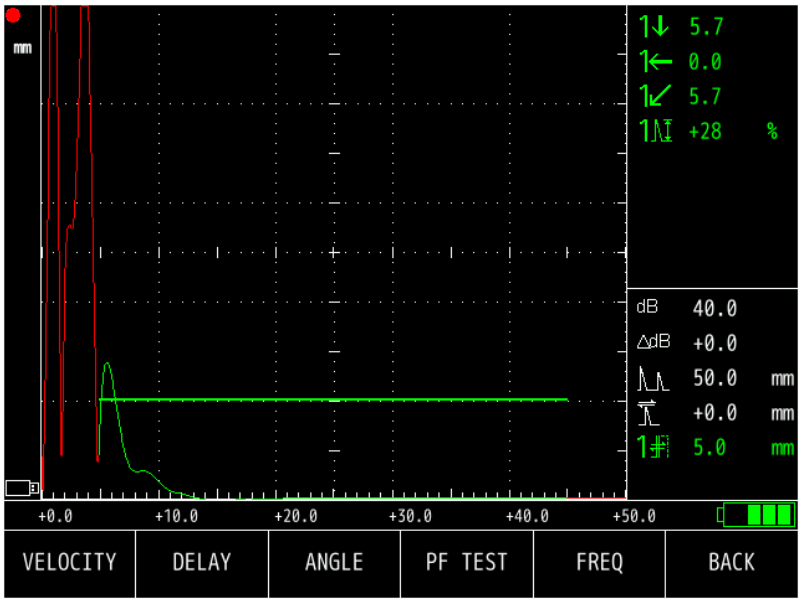


Figure 3-2 the calibration menu

The following operation is the illustration of the calibration of K1 angle-probe.

3.3.1 Material velocity calibration

The operation of material velocity calibration is as followed:

a) Press the > [CAL]> [VELOCITY] to enter the Material Velocity Calibration menu.

b) The instrument will automatically adjust the start point and width of Gate1 and Gate2.

c) Put in the reference value and place the angle-probe on the R100 rim of V1 test block. Then move the probe to find the first and second echo.

d) Make the Gate1 and Gate2 gate the first and the second echo.

e) Press the [AUTO CAL] and the result will be shown on the velocity reading box.

3.3.2 Probe delay calibration

The operation of probe delay calibration is as followed:

a) Press the > [CAL]> [DELAY] to enter the Delay Calibration menu.(see Figure 3-3)

b) Place the angle-probe on the R100 rim of V1 test block to find the wave peak. (press the [W-CREST] to position the gate surround the echo)

c) Press the [CAL] and the result will be shown on the probe delay reading box.

At the same time, if there's a mark on the "arc center" of the R100 rim, you can get the X-value directly measuring by the bottom ruler of the probe. If there's no such mark, measure the distance between the edges of the block and the probe front as S manually by an extra ruler. Take that value off 100mm and put the result on [X-VALUE] which is one of the parameters for angle calibration stated next (see Figure 3-4).

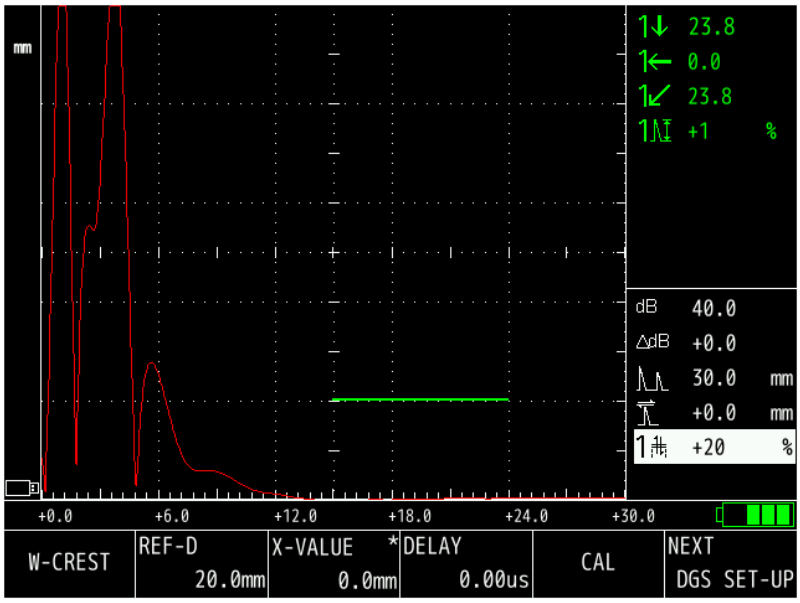


Figure 3-3 the delay menu

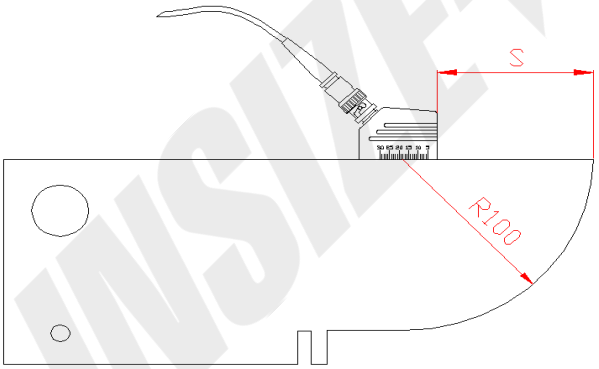


Figure 3-4 the X-Value Measurement

3.3.3 Incident angle calibration

The operation of Incident angle calibration is as followed:

a) Press the  > [CAL]> [ANGLE] to enter the incident angle calibration menu (see Figure 3-5).

b) Set the [RFL DIA] and [RFL DTH].

c) Place the probe on the test block and move to spot the strongest echo signal.

d) Press the  to position the gate around the echo)

e) Press the [CAL] and the result will be shown on the [ANGLE] reading box.

***Note**: You should set the nominated value on [ANGLE] before calibration, and the values on [RFL DIA] and [RFL DTH] will be automatically set to corresponding values.*

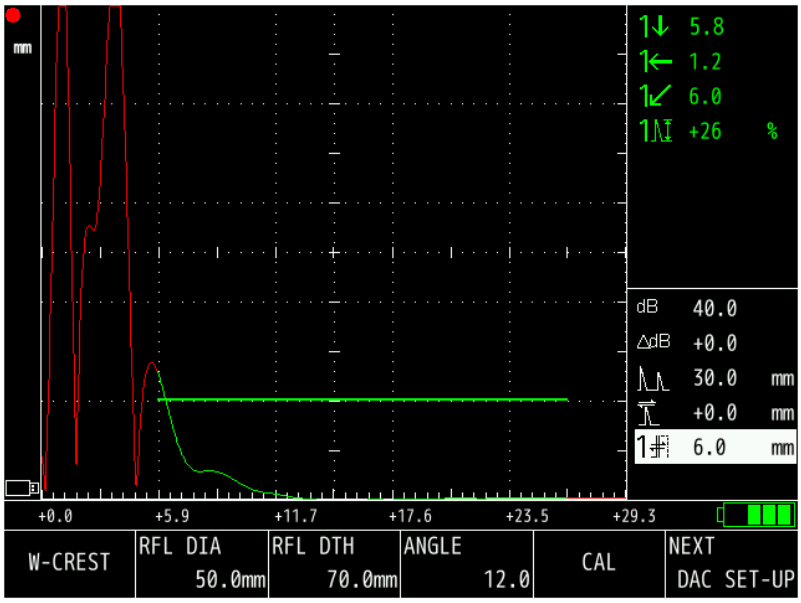


Figure 3-5 the angle calibration menu

3.4 How to conduct an inspection

a) Set the parameters. (see Chapter 3.2 for details).

b) Calibrate the probe and instrument (see Chapter 3.3 for details).

c) Make the DAC or DGS curve on request (see Chapter 4 for details).

d) Turn on CSC or ENVELOPE if needed.

e) The c) d) steps can be omitted.

f) Press the  to enter the inspection menu (see Figure 3-6) and begin the inspection.

g) Scan the object and spot the defect, and then save the data to finish the inspection.

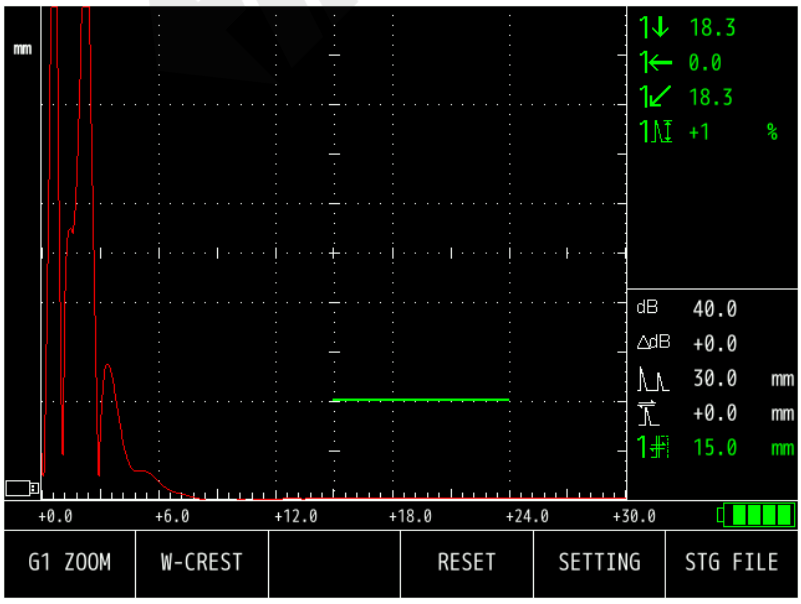


Figure 3-6 the inspection menu

3.5 Auxiliary tools

3.5.1 Auto gain

You can press the AUTO for once and it will automatically adjusts gated signal to the set amplitude (%).

To set the value of amplitude, you can select the >[SYSTEM]>[AUTO-A%] or select the >[SETTING]>[AUTO-A%].

3.5.2 Gate zoom

You can press the >[G1 ZOOM] to extend the waveform in the gate to the full screen for checking details and press again to call off this effect.

3.5.3 Target a signal

You can press the H2 to automatically adjust the start point and width of Gate1 and make Gate 1 gate the next signal.

Note: *When the echo reaches a certain amplitude, it can be found and trapped by the gate. So you can press the [SETTING]>[TGT-THR] to set the amplitude threshold of echoes to be trapped.*

3.5.4 Alarming color

You can press the > [SETTING]> [PG DN]> [ALM CLR] to enable this function. After this function is on, the color of the waveform in Gate 1 will be different from other.

3.5.5 DAC curve

You can press the > [TOOLS]> [DAC] to make a DAC curve. (see Chapter 4 for more details).

To disable this function, you should press the > [TOOLS]> [DAC]> [DONE] or press the > [OFF].

3.5.6 DGS curve

You can press the > [TOOLS]> [DGS] to make a DGS curve. (see Chapter 4 for more details)

To disable this function, you should press the > [TOOLS]> [DGS]> [DONE] or press the > [OFF].

3.5.7 CSC

To enable the function: press the > [EXTRAL]> [CSC]> [ON].

To disable the function: press the > [EXTRAL]> [CSC]> [OFF]. (see Chapter 4 for more details)

3.5.8 Envelope

When the ENVELOPE is activated, move the probe forward and backward on the test block and it draws a peak envelope of the echo dynamics and be shown on the screen with the different colors from the waveform. Therefore, you can easily find out the strongest echo signals according to the shape of the envelope and analyze the characteristics of the flaws.

a) To enable the envelope: press the > [TOOLS]> [ENVELOPE]> [ON].

b) To disable the envelope: press the > [TOOLS]> [ENVELOPE]> [OFF].

3.6 Data storage and recall

3.6.1 To save the waveform

On the A-scan inspection mode, you can press the or > [FILE]> [SAVE] to enter the data storage menu (see Figure 3-7). After inputting file information, you can select [SAVE] to save the data.

Figure 3-7 the data storage menu

3.6.2 Channels

As for the in-site inspection, we normally need to tackle more parts and apply more probes because of the complicated situation. Therefore, we make it accessible for saving and recalling multiple groups of parameters for calibration according to different demands. The UFD-P710 can hold one group of data in one channel.

To save to a channel:

Press the >[FILE]> [SETTINGS] to enter the channel storage and recall menu (see Figure3-8). The [SVAE] button is for saving data to the channel and the [LOAD] is for recalling data.

***Note**: The current parameter setting will be automatically saved when the instrument shuts down and automatically restored for the next booting up.*

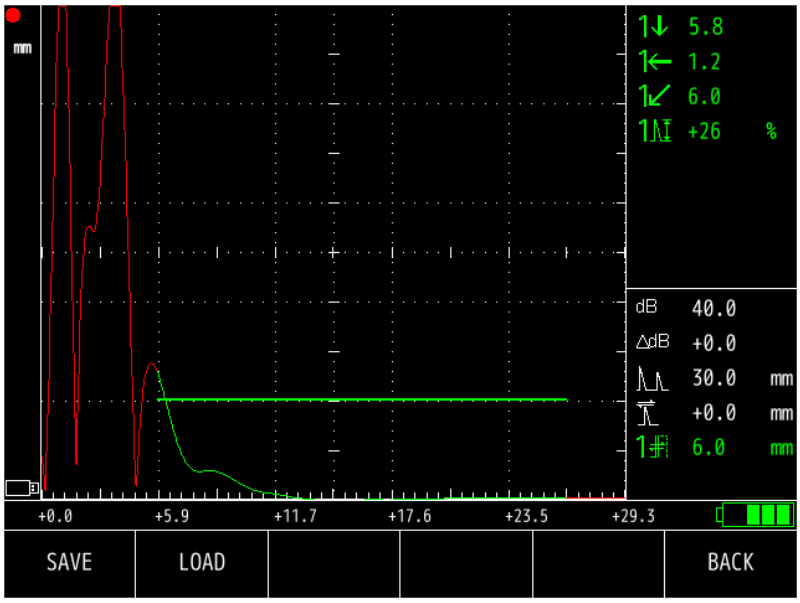


Figure 3-8 the saving and recalling menu

4 Advanced tools

4.1 CSC

It's the abbreviated term for Curved Surface Correction which means to automatically correct the flaw indication when using shear wave circumferential inspection with an angle probe to detect curved parts.

To use the CSC:

a) Press the  > [EXTRA]> [CSC]; (see Figure 4-1).

b) Select [OUTER] for the circumferential inspection of the outer curved-surface or [INNER] for the circumferential inspection of the inner curved-surface by rotating the knob.

c) Set [RADIUS] and [THK] (thickness).

d) Press [ON] and the  (outer) or  (inner) will be displayed on the tool/effect zone.

e) The corrected arc length and depth will be displayed on the reading box.

f) Press [OFF] to turn it off and the sign on the tool/effect zone will disappear.

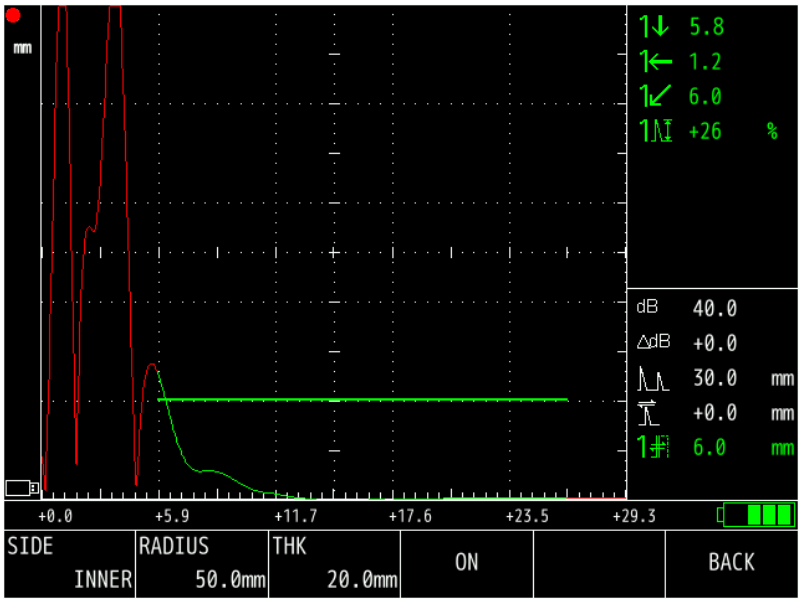


Figure 4-1 the CSC menu

4.2 REC (record)

To use the REC:

a) a) Press the  > [EXTRA]> [REC] (see Figure 4-2).

b) Select [ON] and it begins recording; during the recording, you can select [STOP] to pause.

c) After the recording, select [SAVE].

d) Select [REVIEW] to recall the saved file.

Note: *Only the gate and gain (dB) are tunable during the REC process.*

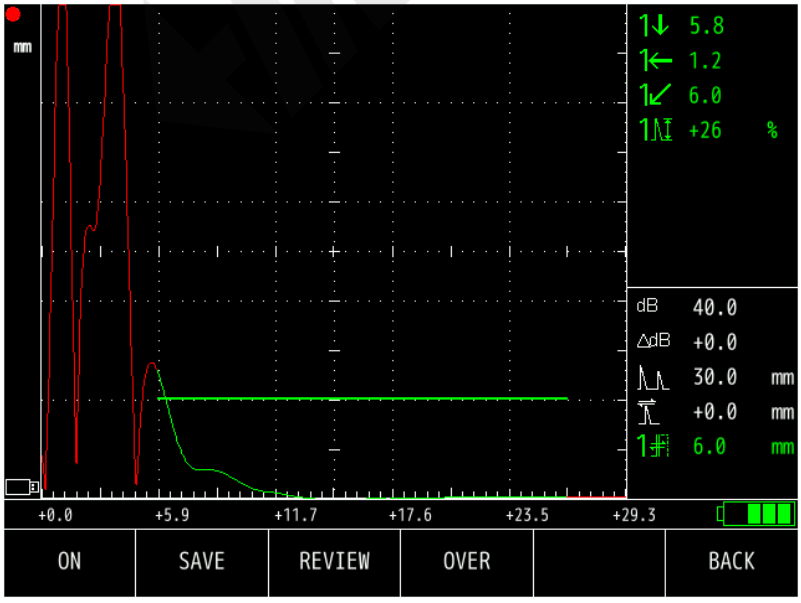


Figure 4-2 the REC menu

4.3 DAC

Distance-Amplitude-Curve (DAC) is used to plot amplitude variations of signals from reflectors of the same size, but at different distances from the transducer. It is exclusively intended for shear wave application with angle probe since this involves a series of complicated calculations.

The DAC curve can be plotted by having test on a test block or by the formula (while the one gotten by the formula only applies on the near field). So you should go empirical over more than 3 SDHs on the test block, and the instrument will automatically create a DAC curve.

4.3.1 Create a DAC curve

During the process of plotting the DAC curve, the [RANGE], [dB] and [SHIFT] are unadjustable. DAC is related to the application of probes; therefore, you should calibrate the probe delay and incident angle before creating a DAC curve. Otherwise, the curve may be unusable.

Options of standard are available such as NB47013, GB11345, ASME, ASME Ⅲ, JIS, EN1712 and “custom” for maximum 7 lines.

To create a DAC curve:

a) Press the > [TOOLS]> [DAC] to enter the DAC creating menu (see Figure 4-3).

b) Select [STANDARD] and rotate the knob to choose the standard in accordance with the DAC curve you want to create.

c) Select [PRESET] to set the DAC curve parameters.

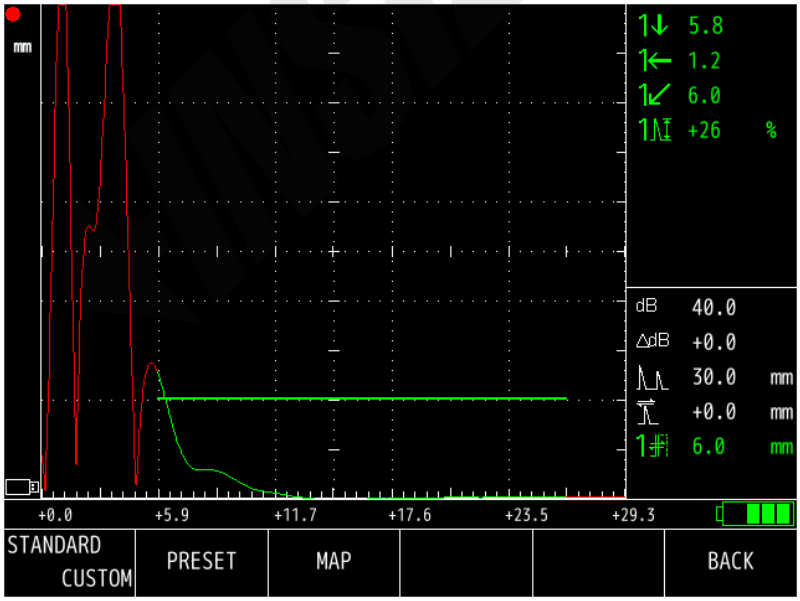


Figure 4-3 the DAC menu

d) Select [MAP] to create the DAC curve (see Figure 4-4).

e) Adjust the Gate to gate the echo and select [MARK]; during the process, when you are looking for the first recorded echo, just press the [H2] key to automatically trap the echo and then pre AUTO , so that you don’t need to adjust the gate and gain manually.

f) Select [DONE] to finish the DAC curve.

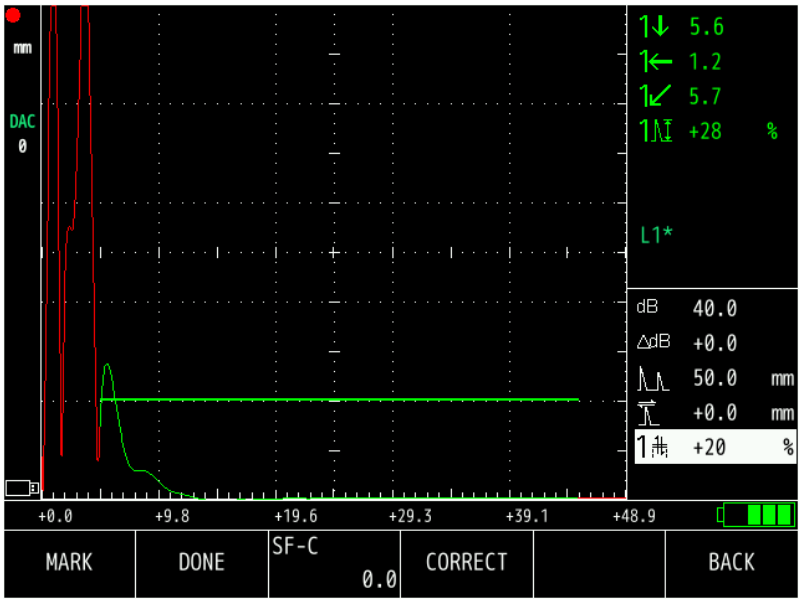


Figure 4-4 the DAC creating menu

4.3.2 DAC correction

To correct the DAC curve:

a) Press the > [TOOLS]> [DAC]> [MAP]> [CORRECT] to enter the DAC correction menu (see Figure 4-5).

b) Select [POINT] to tune and then set [HEIGHT] by rotating the knob.

c) Select [DELETE] to delete the points on the curve.

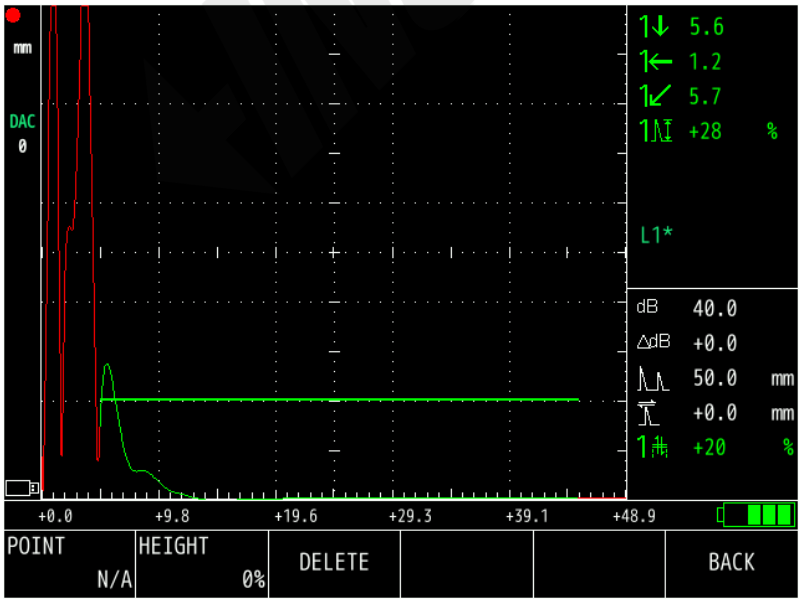


Figure 4-5 the DAC correction menu

4.3.3 DAC alarm and storage

Target an echo signal within the completed DAC with the gate. If the signal exceeds certain line of the curve, "(Line) + XX dB" will be indicated on the readout zone to show which line is exceeded by how much dB. Usually, color of the lowest line will change to remind the user of that.

The storage of DAC curve includes the inspection data and DAC parameters.

To save the DAC curve:

Press the [ ] or the [ ] > [FILE]> [SAVE] under the DAC status (a DAC icon is shown on the left side of the screen).

4.4 DGS

In ultrasonic flaw inspection, the shape, characteristics and orientation of flaws are various. Flaws share the same waveform may end up with great differences. Therefore, the concept of "equivalent" is introduced to describe the size of flaws. Under the same inspection condition, when the echo height of the natural flaw is the same as the manual reflector, it indicates that the size of the natural flaw is equivalent to the manual reflector.

DGS is an abbreviated term of Distance-Gain-Size, also called AVG in German, describing the relations among these three factors.

The DGS curve provided by the UFD-P710 is only suitable for specific normal probes, which can be used to adjust the sensitivity and size the defects. It also can be applied on the inspection on forged components, fine crystal casting components, profiles and so on.

Notes for creating a DGS curve:

a) Choose a probe with proper frequency and element size and set the correct parameters. Theoretically, the results are not available for distance less than 3 times of the near-field and the representation of which is replaced by a straight line alone. If the depth of the test block is not deep enough, you should consider calibrating the signal of the reference reflector at the echo multiple times later to make sure that it's within the available range.

b) The difference between the attenuation coefficient of the test block and that of the object to be tested is not considered.

c) The difference between coupling conditions (the surface of the test block and object to be tested) is not considered.

d) Reference reflector: flat bottom or flat-bottomed hole (the size of the flat-bottomed hole ranges 1mm to10mm).

e) DGS curve size: 1mm to 10mm.

To create a DGS curve:

a) Press the [ ] > [TOOLS]> [DGS].

b) Select [PRESET]> [REF RFL] to choose [FBH].

c) Select [RFL SIZE] to adjust the value to 2.0 (Φ2).

d) Select [REG LV] to adjust the value to 2.0 (Φ2).

e) Keep the probe well coupled on the test block and spot the strongest echo signal of Φ2 200 FBH. Press H2 to target it with the gate.

f) Select [MAP]> [MARK] to finish the DGS curve.

g) When you need to remake the curve, select [REMAP] to create another curve.

h) Select [DGS OFF] to disable and delete the curve.

After the DGS is plotted, the result will be shown on the last line of the reading box(see Figure 4-6). The result on the first line indicates the flaw is equal to a Φ 2.0mm FBH. And the second parameter is the gain difference of the echo amplitude relative to the DGS curve (DGS+0.1dB means that the echo amplitude is 2dB higher than the DGS curve).

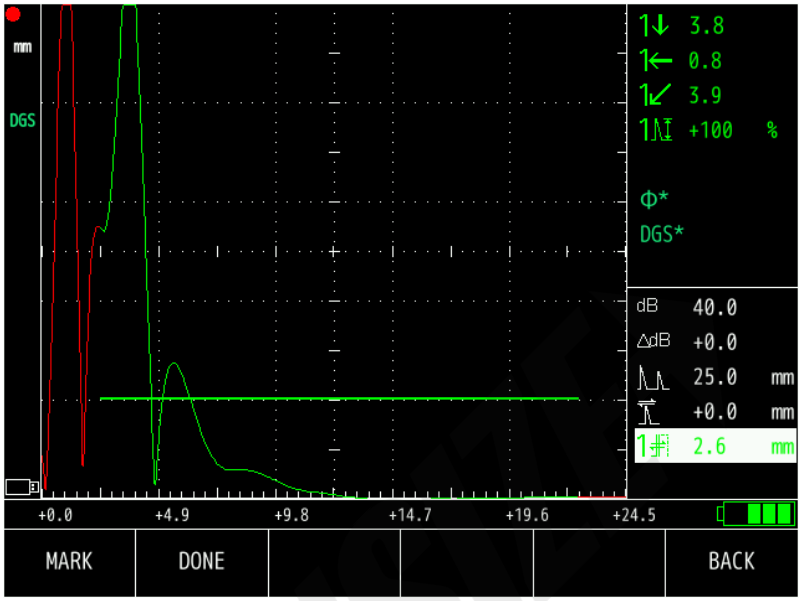


Figure 4-6 the DGS curve menu

4.5 API 5UE (American Petroleum Institute's Recommended Practice 5UE)

To use the API 5UE:

a) Press the > [TOOLS]> [MORE...]> [API 5UE].

b) Select [Dr] to input the calibrated reference reflector (with the known depth of grooves and through-holes).

c) Press the to adjust to a proper inspection range.

d) Select [EVL ON].

e) Make sure that the probe is well coupled on the test block.

f) Move the probe to make the dynamic echo enveloping required by API 5UE.

g) Adjust Gate1 to gate the echo.

h) Select [K–CAL] , then place and move the probe on the object to be tested to make the dynamic echo enveloping.

i) Select [Di] to get the result.

4.6 AWS D1.1/D1.5 (American Welding Society D1.1/D1.5)

To use the AWS:

a) Press the > [TOOLS]> [MORE...]> [AWS].

b) Choose the proper probes and test block according to AWS D1.1/D1.5.

c) Place the probe properly and make sure it's well coupled.

d) Move the probe forward and backward to spot the strongest echo signal and adjust the gain to bring the echo amplitude to 20%-100%. Let Gate1 surround the echo.

e) Select [B REF] to save the current gain as B Reference Level (the result will be shown on the B Ref reading box).

f) Couple the probe on the object to be tested and make sure it's well coupled.

g) Move the probe forward and backward to obtain the strongest echo signal and adjust the gain to bring the echo amplitude to the value of B Reference Level. Let Gate1 surround the echo.

h) Select [A IND] to store the gated reflector as A Indication Level (the result will be shown on the A IND reading box).

i) The C Attenuation Factor and D Indication Rating will be automatically calculated and the result will appear on the [C Att] / [D Rating] reading box.

j) C Attenuation Factor Formula: C=(SA-1)x2;

k) D Indication Rating Formula: D=A-B-C.

Note:

1) Under the same conditions specified in step a), repeat steps f) ~ i) to calculate the C Attenuation Factor and D Indication Rating of different workpieces.

2) When recording B REF in step e), the values on A, C, and D are all cleared.

3) All the calculations are based on AWS D1.1-2006 and AWS D1.5-2002.

4.7 Crack altimetering

To use the crack altimetering:

a) Press the  > [TOOLS]> [MORE...]> [ALTI-MTR].

b) Select [ANGLE].

c) After Gate 1 surrounds the echo on the first tip, select [GET1].

d) After Gate 2 surrounds the echo on the second tip, select [GET2]; And the result will be shown on the [ALTITUDE].

4.8 Input method

There are five input methods optional, including pinyin, uppercase letters, lowercase letters, numbers and symbols.

In the process of data processing (storage, recall, etc.), when you need to input information (such as file title, operator name), you can open the input method (see Figure 4-7).

Figure 4-7 the input method

The illustration of the operation of the input method is shown in Table 4-1:

Table 4-1 the operation of the input method

F2	**[F2]**	To switch the input method.
F3	**[F3]**	To put the cursor on the letter zone and rotate the knob to scroll through the letter zone.
F5	**[F5]**	To backspace
F6	**[F6]**	To confirm and go back

4.9 Data processing

4.9.1 Data storage

To save the data:

Press the or > [FILE]> [SAVE] to enter the data storage menu (see Figure 4-8).

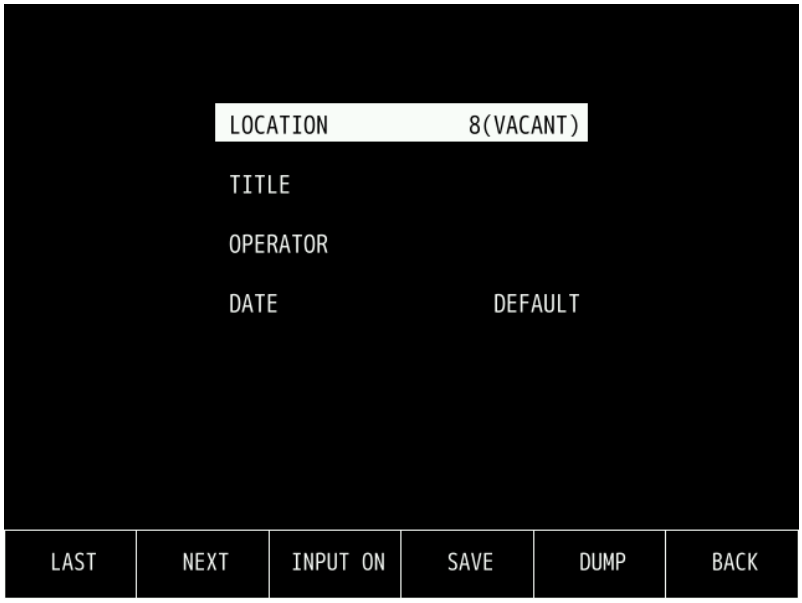


Figure 4-8 the data storage menu

Notes:

1) *Select [LAST] and [NEXT] to scroll through the menu items.*
2) *Rotate the knob to change the content of each item.*
3) *The [TITLE] and the [OPERATOR] are non-mandatory items.*
4) *The [DATE] does not need to be entered. It is automatically generated when you save it.*

4.9.2 Recall

To recall the data:

a) Press the > [FILE]> [REVIEW] to enter the file selecting menu (see Figure 4-9).

b) Choose from [A-SCAN], [REC] and [B-SCAN]; When you choose [A-SCAN], the file selecting menu will bump up (see Figure 4-10). And you can rotate the knob to choose the desire file and press [LOAD] to recall the file.

c) The waveform representation of the desire file will be shown on the screen (see Figure 4-11).

d) If the file contains DAC or AVG curves, select [APPLY CV] to bring it up.

e) If you want to use this waveform for comparison, select [APPLY CM]. The Waveform comparison function is enabled.

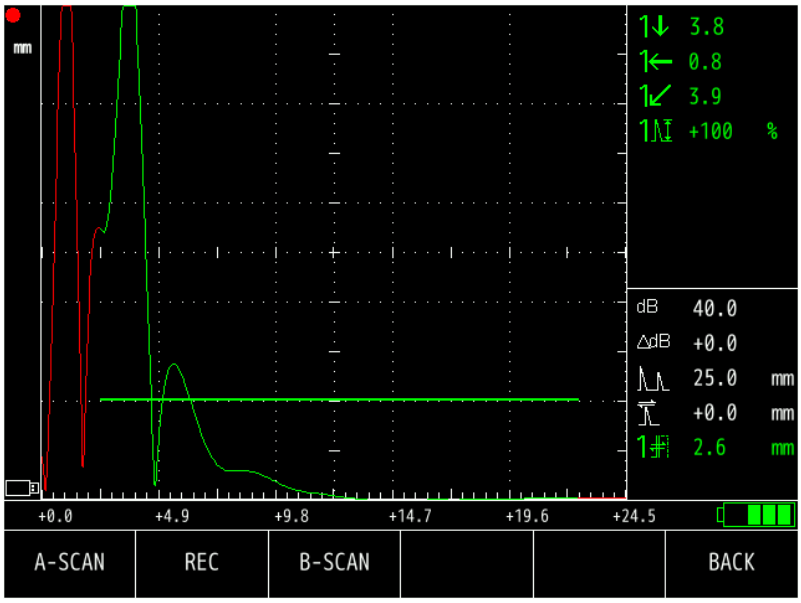


Figure 4-9 the file selecting menu

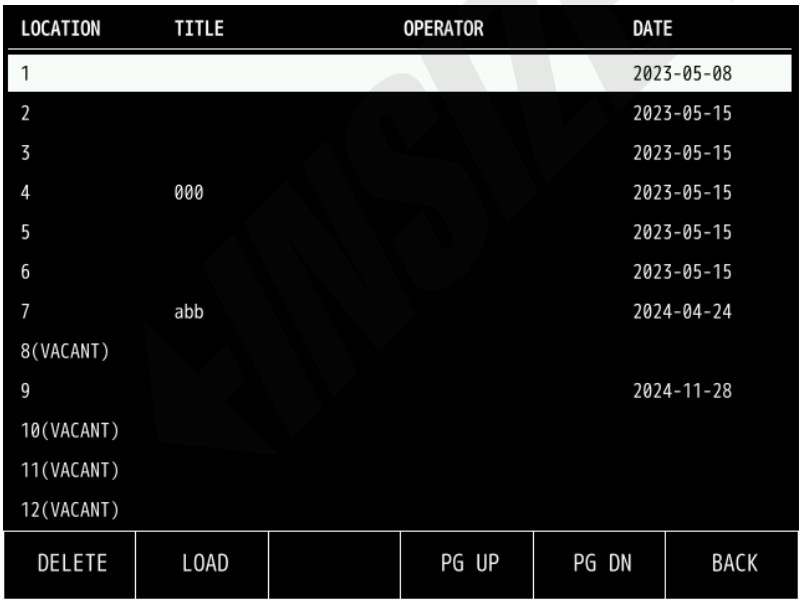


Figure 4-10 the file selecting menu

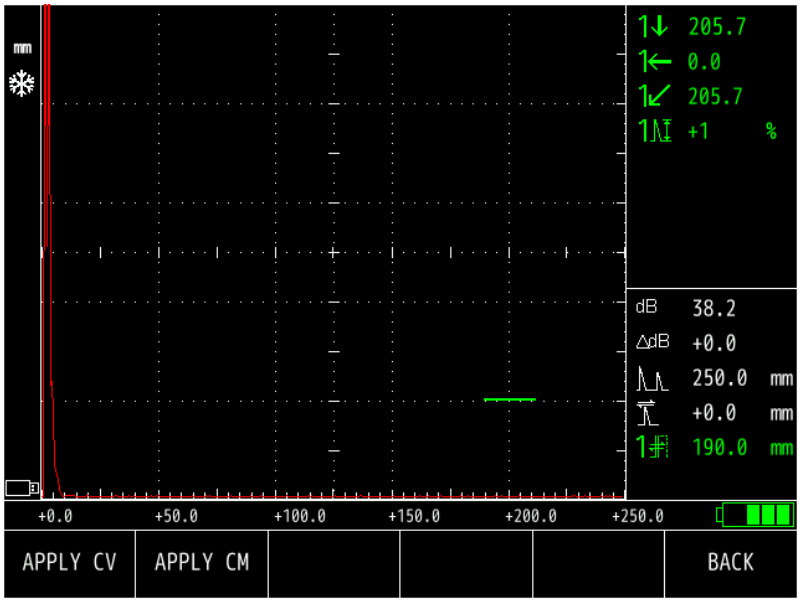


Figure 4-11 the waveform reviewing menu

4.10 Performance test

This function can automatically test horizontal linearity, vertical linearity, sensitivity surplus, dynamic range, resolution, electrical noise level and other indicators (see Figure 4-12).

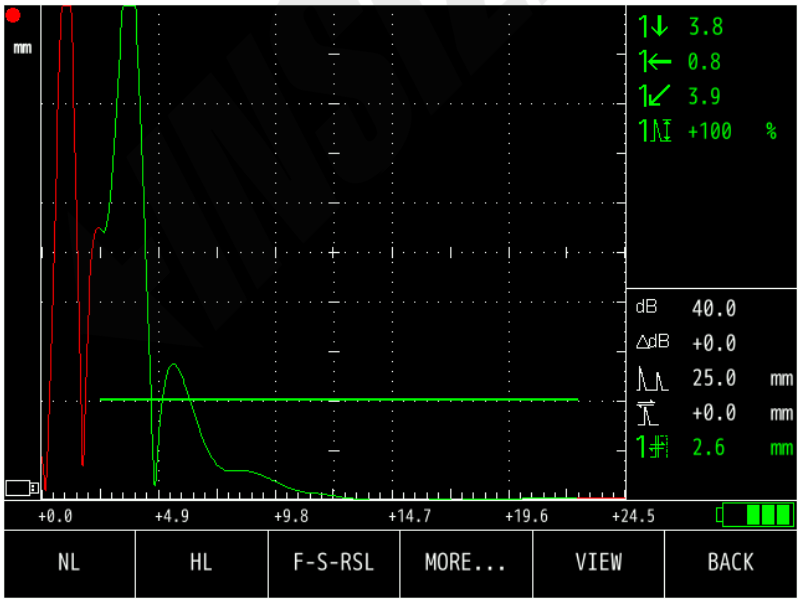


Figure 4-12 the performance test

To have a performance test:

a) Press the  > [CAL]> [PE TEST].

b) Choose the desire item for testing.

c) Select [TEST].

Notes:

1) *Before testing, please set the velocity and probe zeroing.*
2) *Select the [VIEW] to see the test results.*

4.11 Spectrum analysis

To use the spectrum analysis:

a) Press the  >[CAL]> [FREQ].
b) Press the  to make the desired echo indication show on the screen.
c) Adjust Gate1 so that it surrounds the echo and choose [CAL]. Then the test result will be shown on the Frequency Reading box.

4.12 B-Scan

This function is to visually show the longitudinal section image of the object to be tested so as to interpret the location and depth of flaws. There are two options of mode available: THICKNESS and FULLWAVE.

4.12.1 Thickness mode

This is intended for the residual corrosion thickness measurement, i.e. corrosion severity of an object by monitoring the backwall echo signal with the gate showing the length vertically -Y and the thickness horizontally –X (aligned with the beampath scale).

The illustration of parameters:

MODE: THK (THICKNESS)

LENGTH: the length of the test object (or the distant required for the probe to move on the test object for inspection), with the unit of mm.

TIME: The time required for the probe to move on the test object for inspection, with the unit of s.

4.12.2 Fullwave mode

This function is to visually show the cross section image of the object to be tested so as to interpret the location and depth of flaws(specially for normal beam inspection). The indicating manner (X/Y) is the same as that of Thickness Mode. The amplitude is shown in different colors.

Color-Amplitude scale:

0% 50% 100%

The illustration of parameters:

MODE: FW (FULLWAVE)

LENGTH: the length of the test object (or the distant required for the probe to move on the test object for inspection), with the unit of mm.

TIME: The time required for the probe to move on the test object for inspection, with the unit of s.

4.12.3 The operation of B-Scan

To use the B-scan:

a) Press the >[EXTRA]> [B-scan].

b) Choose [ENABLE].

c) Choose [PRESET]> [MODE]> [THK].

d) Set the [LENGTH] and [TIME].

e) Choose [ON] to begin the scan.

f) The result will be shown on the screen.(see Figure 4-13).

Notes:

1) If you need to save the image, choose [SAVE].

2) Before enabling the B-scan, you need to set the start point, width, threshold, gain and range in A-scan mode.

3) In normal situation, the echo amplitude ranges 50%-80% of full screen height.

4) When adjusting Gate1, make sure that the start point and width cover the testing range. For example, the thickness of the test object is 50mm, and the inspection range is 30mm to 50mm. The gate needs to cover this inspection range, and the gate height does not need to be adjusted.

5) After enabling the scan, no parameters can be adjusted.

6) Once you need to pause, please choose [OVER].

7) During the scan, the probe moving speed should be consistent with the scanning speed of instrument B as far as possible.

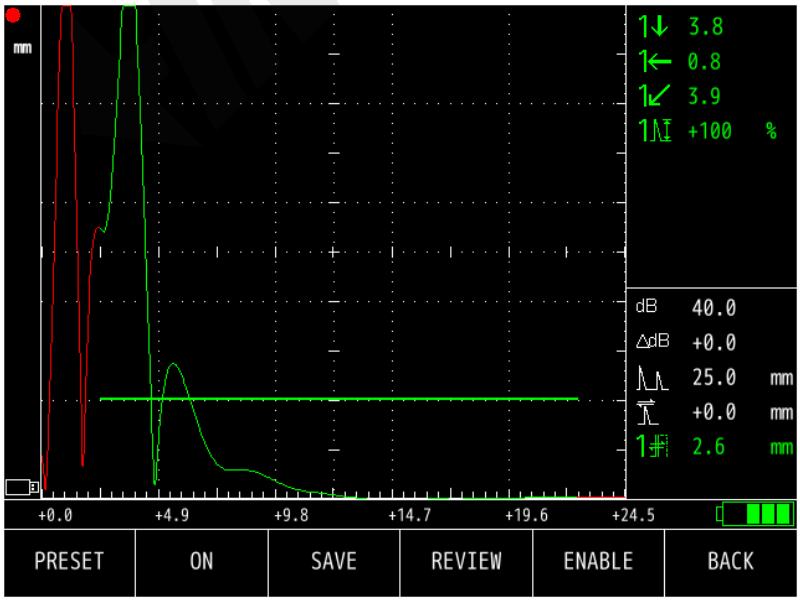


Figure 4-13 the B-scan menu

4.13 Language

The optional language in this instrument is English. To choose the wanted language, you can press the  >[GENERAL]>[REGION]>[LANGUAGE].

5 Instructions and precautions of charging or using the battery

5.1 Instructions of charging the battery

5.1.1 Through adapter

5.1.1.1 Take the instrument out from the protective sheath and keep it dry;

5.1.1.2 Plug the adapter to the instrument (DC IN) and connect the adapter to the AC 220V power source carefully in case of electric sparks;

5.1.1.3 When the indicator light turns green, it indicates that the instrument is charging**;** and when the indicator light extinguishes, it indicates that the charging is done.

5.1.1.4 It takes 4-6 hours to fill the battery up. After the charging, please remove the adapter to avoid the risk of overcharge and fire;

5.1.1.5 Do not surround the instrument on charge with flammable or explosive materials. If the long-time charge is needed, please take out the battery to charge it on an external charger;

5.1.2 Through external charger

5.1.2.1 Align the pins on the top of the battery with those at the bottom of the charger.

5.1.2.2 Insert the battery right into the charger.

5.1.2.3 Connect the charger to a AC 220V power source.

Note*: When inserting the lithium-ion battery into the socket of the charger, do not push too hard. Make sure the battery contacts are properly aligned with the contacts in the socket.*

5.1.2.4 Leave the battery on the charger until the LED stops twinkling for being constant green to indicate “charged-up”.

5.2 Precautions of charging or using the battery

5.2.1 Precautions of charging

5.2.1.1 The charging area should be set up in a cool and ventilated room as far as possible, and there should be no flammable and explosive materials around, and obvious warning signs are required.

5.2.1.2 Make sure that the instrument and battery are both clean and dry before charging.

5.2.1.3 Please use the charging devices provided with this instrument and refer to the instructions. Otherwise, the lithium battery may be damaged or anything dangerous may be caused.

5.2.1.4 When charging for a long time, the charging area needs to be manned.

5.2.1.5 Please take out the battery when the charge is done. Do not leave the battery in the charging status for a long time.

5.2.1.6 Please follow the solutions stated below if abnormal heat, combustion or burst occurs due to incorrect handling:

a) Abnormal Heat: Cool it off with sand. Don't touch the battery by hand in case of scald. Dispose of the battery after the temperature returns to normal;

b) Combustion or Burst: People must be evacuated. Combustion over battery alone is usually flameless while likely to ignite the flammable or packing materials around. On the premise of precautions, if combustion or burst takes place on one or several batteries, just apply sand to them; if it involves with a large area, use the dry power extinguisher. Do not apply water in case of a second short-circuit leading to further danger.

5.2.2 Precautions of using lithium battery

5.2.2.1 Do not open, squeeze or punch the battery in case of accidental injuries.

5.2.2.2 Do not burn the battery. Keep it away from fire or any other thermal sources. Exposure to thermal source above 80℃ will make it blast and cause injuries.

5.2.2.3 Be cautious not to damage the battery by dropping, hitting or any other way; which might expose corrosive and explosive materials from within. Take good care of it during carriage by any tool. Fasten cabin cover tightly with the button on it in case the battery slips out.

5.2.2.4 Be careful not to have the battery short-circuit at both ends in case it causes injuries and gets ruined.

5.2.2.5 Keep the battery away from moisture or rain in case of electric shock.

5.2.2.6 Only use the external charger provided with our company.

5.2.2.7 Do not leave the battery on the storerooms or places with flammable and explosive materials in case of fire.

5.2.2.8 When anything abnormal happens on the battery, like odor emission, heat, deformation and discoloration, it should be disposed immediately.

5.2.2.9 Do not leave the battery on the battery compartment.

5.2.2.10 For short-term storage (within 6 months), battery should be stored in a dry place without corrosive gas.

5.2.2.11 For long-term storage (more than 6 months), battery should be fillet up to 50%-70% and stored in a cool and dry place. Charge the battery every 3 months, so as to avoid the low power caused by self-discharge and the damage of the battery.

5.2.2.12 It is not recommended that the battery is stored for over two years. Because the longer the storage time, the more serious the loss of lithium battery capacity.

5.2.2.13 Carry the battery with caution in case of dropping, damaging and crushing.

5.2.2.14 Dispose of the battery in accordance with national laws and regulations instead of discard or crush it if it wears out.

6 Instrument use, care and maintenance

6.1 Instrument use and care

6.1.1 In order to ensure a safe and correct operation, operators should be trained in formal ultrasonic flaw inspection methods and read this manual in detail before using the instrument.

6.1.2 The operator should be formally trained about UT and well acquainted with the features of this instrument through close study on the manual, so as to understand the purposes of various keys and the knob, as well as how to use them correctly. The panel should be gently handled.

6.1.3 The instrument should be carried softly. Prevent it from being dropped, shocked or splashed over. Do not pack it with hard objects such as probes and blocks in case of damage.

6.1.4 Avoid using it in intensively magnetic , dusty, rocking sites or where the temperature is too high or too low. Any liquid should be prevented from seeping into the instrument. And don't place the probe with oil or water couplant on the screen to avoid internal circuit damage caused by liquid seeping. If the external ceramic antenna is applied for GPS, make sure it's fixed up in case it shears off while swinging.

6.1.5 Don't forcedly press the key or rotate the knob. Don't operate the instrument with an oily and muddy hand so as to damage the keyboard.

6.1.6 Don't use it under low power.

6.1.7 The battery should be charged in time after discharging; otherwise the battery even cannot be recharged.

6.1.8 Fasten the battery compartment with screws in case of battery dropping and damages or even accidents.

6.1.9 Please use the provided cables for probe and power supply. Incompatible cables might cause circuit malfunction inside or damage to the ports. Unplug the cables for probe and power supply by the connector instead of the cord. Take a close look at the connector of the cable for stains or dusts. Clear them up before you do plugging or unpluging.

6.1.10 Once there's weird sound or smell of scorching during operation, please shut down the instrument, cut the power and inform the maintainer immediately in case the condition gets worse.

6.1.11 Wipe oil stains, dusts off the instrument with brush, dry cloth or the rag that's soaked with insulating oil. The cleaning should cover the instrument all over including the housing and the display glass to the surface, the edge of the keys and even the knob especially back from sandy environment. The cleaned instrument should then be put in where is ventilated and dry.

6.1.12 After the in-site application, clean the dust inside the knob with a brush.

6.1.13 Make sure that the bracket is not loose after use. Fasten it if it is.

6.1.14 Turn on the instrument every month for at least once if it's expected to stay out of service for long time. Keep it on for at least half an hour every time.

6.1.15 Once any malfunction happens to the instrument, please shut down the instrument and conduct troubleshooting. Once the instrument needs to be repaired or recalibrated, please contact us. If the user handles it by himself, we are not responsible for any consequences arise therefrom.

6.1.16 The use and caution of the lithium battery refers to Chapter 5.

6.2 Instrument maintenance

6.2.1 The instrument will go through strict quality control before being packed and delivered. So if something goes wrong while it is working, just contact the manufacturer for troubleshooting or send it back for repair at designated place.

6.2.2 Check the voltage of the battery if the instrument goes abnormal. The load-free voltage should be 12V. If it's lower than that, charge the battery up before use.

6.2.3 If the power indication goes wrong over long-time use, change the internal lithium battery. Don't forget to lock the back cover.

Appendix A Common problems and solutions

Symptom	Reason	Solution
The screen fades after the battery is putting on and the instrument is on.	low power	Charge the battery
Image and data error during inspection.	RAM error for some sort of reason	a) Restart the instrument. b) Press and hold the  key, until an indication "initializing..." appears on the screen. c) Wait until this process is over and start the work from origin.
The indication of "No USB found" appears while the USB is plugged.	loose contact or failure to identify such kind of USB.	a) Plug the USB again; b) Or change another USB.
Failure to make DAC	a) under RF mode; b) DGS is enabled.	a) change the rectification mode; b) disable the DGS.
Failure to do DGS	a) under RF mode; b) DAC is enabled or on; c) Probe type is angle-probe.	a) shift RF mode to another one; b) turn off or disable DAC
Failure to do REC	wrong setting or procedure	Restart the instrument
Inaccurate depth readout when using angle probe.	a) No calibration for sound velocity and zero; b) Wrong setting or calibration of angle value; c) Gate A didn't surround the echo.	a) calibrate velocity and delay; b) set or calibrate the correct angle value; c) target the strongest echo signal with the gate.
inaccurate horizontal readout when using angle probe.	a) without correct calibration on velocity and delay; b) wrong setting or calibration of angle value; c) wrong setting of X-value; d) without targeting the strongest echo signal with the gate.	a) calibrate velocity and delay; b) set or calibrate the correct angle value; c) set the right X-value; d) target the strongest echo signal with the gate.

Appendix B software update

Procedure:

a) Copy the update file to the root directory of USB disk;

b) Turn on the instrument;

c) Wait until “Press F1-F6 to Login” appears;

d) Plug the USB drive and wait until “new device found, USD drive connected” appears;

e) Press the  for 3 seconds and the update will be triggered.

***Note**: If it indicates “USB Disk Not Connected”, please try another one.*

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