

**Ultrasonic Flaw Detector**  
**Operating Manual**<sub>(2.0)</sub>

# Catalog

1. Introduction .....	1
1.1 Features of the Instrument.....	1
1.2 Specifications .....	3
1.3 Instrument Appearance and Interface .....	4
1.4 Keyboard Guide.....	4
1.5 Description of the Main Page .....	5
1.6 Overview of Pages (Total 11 Pages).....	6
1.7 Alarm Lights .....	7
2. Initial Start-up .....	8
2.1 Power Supply .....	8
2.2 Connecting a Probe .....	8
2.3 Starting the Instrument .....	9
3. Instrument Operation .....	10
3.1 Instrument operation flow chart .....	10
3.2 Select an exist channel: Expert Program .....	11
3.3 Channel Import and Export through USB Drive .....	11
3.4 Report Import and Export through USB Drive .....	12
3.5 Weld Illustration .....	13
4. Calibration and Measurement .....	14
4.1 Calibration with Straight- Beam and Angle-Beam Probes .....	14
4.2 Angle Beam Probes Calibration with Unknown Material Velocity .....	17
4.3 Calibration with Dual-Element (TR) Probes .....	18
4.4 Distance Amplitude Curve DAC.....	18
4.5 Recording the DAC Curve.....	19
4.6 Editing DAC Curve .....	22
4.7 Specifying the DAC Reference Curve .....	23
4.8 Measuring with DGS/AVG .....	24
5. Operation .....	27
5.1 Display mode selection .....	27
5.2 Parameter setting .....	28
5.3 Adjusting the Display Range .....	28
5.4 Setting the Material Velocity.....	29
5.5 Setting the Display Delay .....	29
5.6 Selecting the Probe Test Mode .....	29
5.7 Setting the A-Scan Reject Level.....	30
5.8 Setting the Gain .....	30
5.9 Changing the Gain-Adjustment Increment (DB STEP) .....	31
5.10 Configuring the Gates .....	31
5.11 Specifying the Probe Frequency .....	34
5.12 Specifying the Piezo Crystal Size .....	34
5.13 Setting the Probe X-Value .....	34
5.14 Probe Delay Calibration .....	35
5.15 Setting the Angle of Incidence .....	35
5.16 Freezing the A-Scan Display .....	35
5.17 Setting the Display Grid .....	35

5.18 Selecting Units.....	35
5.19 The unit of measurement will be set to the choice last displayed.Scale Setting .....	36
5.20 Setting the Display Brightness.....	37
5.21 Key Sound .....	37
5.22 Date and Time Setting.....	38
5.23 Resetting the Instrument.....	38
6. Maintenance and Care.....	39
6.1 Care of the Instrument.....	39
6.2 Care of the Batteries .....	39
6.3 Maintenance .....	39
6.4 Warranty .....	39
6.5 Tips on Safety.....	39
Appendix .....	40
Appendix A: Charging the Batteries.....	40

# 1. Introduction

This is an advanced digital ultrasonic flaw detector featuring a multi-color LCD and a host of new features to meet challenging inspection requirements. It combines powerful flaw detection and measurement capabilities, extensive data storage, and the ability to transfer detailed inspection data to the USB drive and PC via its high-speed USB port.

The instrument can be widely used in locating and sizing hidden cracks, voids, disbands, and similar discontinuities in welds, forgings, billets, axles, shafts, tanks and pressure vessels, turbines, and structural components.

## 1.1 Features of the Instrument

The instrument extends the performance and range of applications that are capable of being satisfied by a portable instrument. The quality, portability, durability, and dependability that you have come to expect from the popular leeb Series of instruments remain.

### Display

Hi-resolution multi-color LCD with continuously brightness control provides high contrast viewing of the waveform from bright, direct sunlight to complete darkness.

The hi-resolution multi-color TFT LCD display with fast 70 Hz update gives an “analog look” to the waveform providing detailed information that is critical in many applications including nuclear power plant inspections.

### Range

Up to 6000 mm in steel; range selectable in fixed steps or continuously variable. Suitable for use on large work pieces and in high-resolution measurements.

### Pulser

Test Modes: Pulse echo, dual element and thru-transmission

Probe Types: Single Straight, Single Angle, Daul Straight, Daul Anlge, Through.

### Receiver

Sampling: 10 digit AD Converter at the sampling speed of 200 MHz

Analog Bandwidth: automatically set by the instrument to match probe for optimum performance.

Gain: 0 dB to 110 dB (60 120dB) adjustable in selectable steps 0.1 dB, 1dB, 2 dB, 6 dB, and locked.

### Gates

Two fully independent gates offer a range of measurement options for signal height or distance using peak triggering.

Gate Start: Variable over entire displayed range

Gate Width: Variable from Gate Start to end of displayed range

Gate Height: Variable from 0 to 99%

Full Screen Height Alarms: Threshold positive/negative

## **Memory**

Memory of 200 set files(RFD60: 500) to store calibration set-ups.

Memory of 500 test report files(RFD60: 1000) to store. All the files can be stored, recalled and cleared. Connecting U-Disk, the unit can get unlimited memory.

## **Real Time Clock**

The instrument clock keeps running tracking the time.

## **Communication**

High speed USB2.0 port. Connecting U-Disk, the unit can get unlimited memory.

## **Battery**

Internal rechargeable Li-ion battery pack. 8 hours nominal operating time depending on display brightness 4 hours typical recharge time

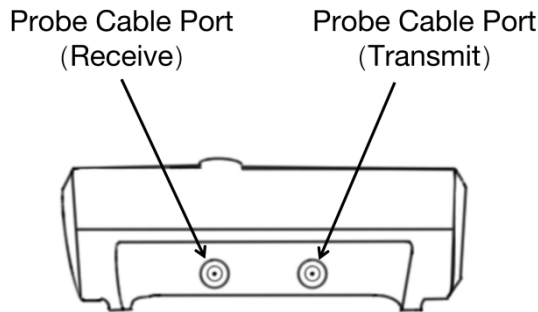
## **Functions**

- Semiautomatic two point calibration: Automated calibration of transducer zero offset ,angle, front end and/or material velocity
- Flaw Locating : Live display Sound-path, Projection (surface distance), Depth, Amplitude,
- Flaw sizing: Automatic flaw sizing using AVG DAC speeds reporting of defect acceptance or rejection.
- Digital Readout and Trig Function: Thickness/Depth can be displayed in digital readout when using a normal probe and beam path, Surface Distance and Depth are directly displayed when angle probe is in use.
- Curved Surface Correction feature
- Auto-gain function
- Envelope: Simultaneous display of live A-scan at 70 Hz update rate and envelope of A-scan display
- Peak Hold: Compare frozen peak waveforms to live A-Scans to easily interpret test results.
- A Scan Freeze: Display freeze holds waveform and sound path data
- Echo color within the Ga

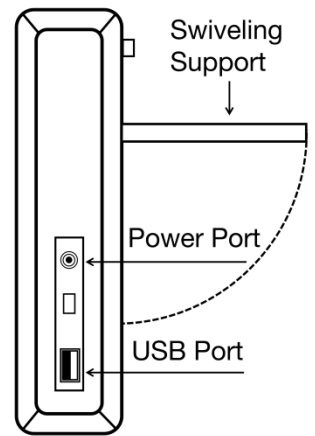
## 1.2 Specifications

Range: 0-6000 mm ,at steel velocity(RFD60 :10000mm)  
Material Velocity: 1000 ~ 10000 m/s  
Pulse Repetition Frequency: 10-2000Hz(RFD60 :3000Hz)  
Dynamic range:  $\geq 38$ dB  
Linearity: Horizontal: +/-0.2% FSW, Vertical: 0.25% FSH,  
Amplifier Accuracy +/-1 dB.  
Resolving Power: >40dB (5P14)  
Sensitivity Leavings: >65dB  
Reject (suppression): 0 to 80% full screen height  
200 independence setup, any criterion can be input freely, we  
can work in the scene without test block; (RFD60: 500)  
Big memory of 500 A graph (RFD60: 1000)  
Test Modes: Pulse echo, dual element and thru-transmission  
Probe Types: Single Straight, Single Angle,Daul Straight,  
Daul Anlge Through  
Gate Monitors: Two independent gates controllable over  
entire sweep range  
Units: Inch or millimeter  
Power Requirements: AC Mains 100-240 VAC, 50-60 Hz  
Display Delay: -20 to 3400  $\mu$ s  
Probe Delay/Zero Offset : 0 to 99.99 $\mu$ s  
Internal rechargeable Li-ion battery pack rated 7.2V at 5600  
mAh  
8 hours nominal operating time depending on display  
brightness  
4 hours typical recharge time  
HxWxD(mm): 238x160x45 (mm)  
Weight : 1.0kg  
Operating Temperature: -10°C to 50°C  
Storage Temperature: -30°C to 50°C  
Pulse Energy: 200V, 300V, 400V, 500V selectable  
Rectification: Positive half wave, negative half wave, full  
wave, RF System  
Gate Monitors: Two independent gates controllable over  
entire sweep range  
Sensitivity: 110 dB max in selectable resolution 0.1, 1.0, 2.0,  
6.0 dB.  
Transducer Connections: BNC or LEMO

## 1.3 Instrument Appearance and Interface

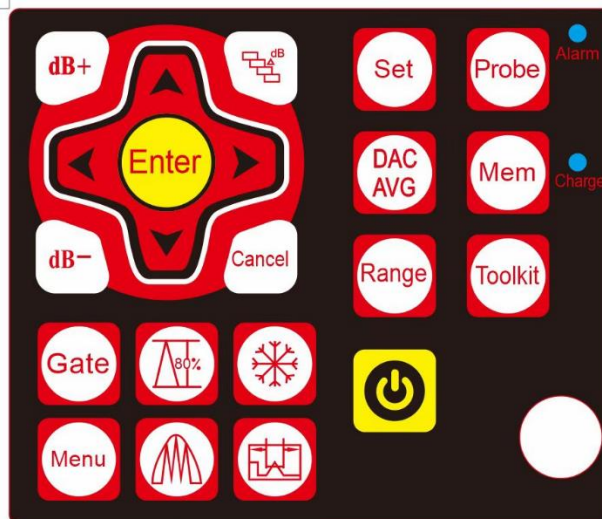


Top View



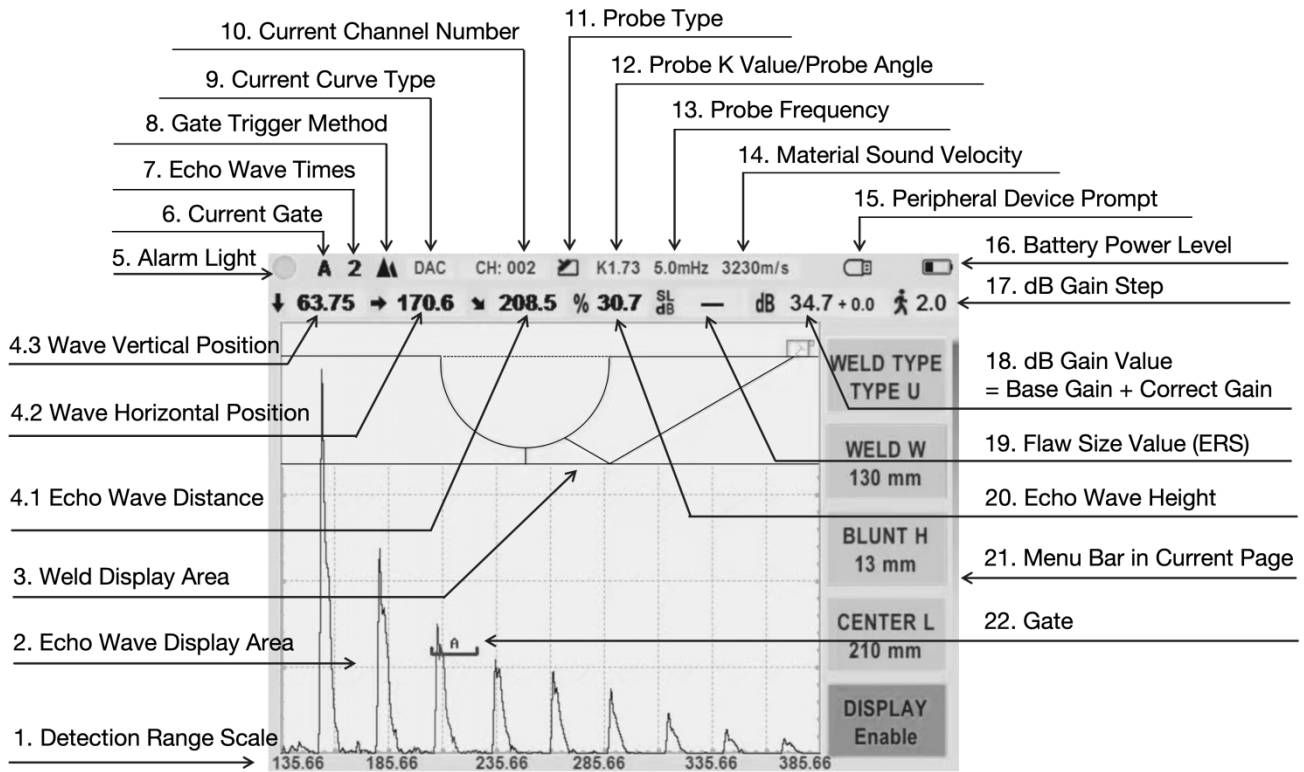
Side View

## 1.4 Keyboard Guide



- ◆ Keyboard Left/Right Key: used to switch Pages in the main interface, and used to select the adjustment digit in the dialog box;
- ◆ Freeze Key: under the frozen state of the screen, pressing the Menu Key will automatically store the corresponding flaw report of the current waveform;
- ◆ Cancel Key: the Cancel Key is used to switch between full-screen and non-full-screen display modes in the main interface or used to return to the previous step in the dialog box menu.
- ◆ Full Screen Mode: could adjust the gates with the up, down, left and right keys of the keyboard;
- ◆ Left / Right Keys: to adjust parameters or adjust the gate position (can be changed in the CFG Page)
- ◆ Speed Key: used to adjust the speed of parameter adjustment in the main interface, and used to determine the input in the small keyboard dialog box;
- ◆ On-off Key: click to adjust the dB gain step, long press to switch on/off;

## 1.5 Description of the Main Page



**1. Detection Range Scale:** Display the coordinate scale under the current detection range.

**4. Echo wave Position:** Vertical position, horizontal position and distance of the echo wave inside the gate. (Displayed as: ↓X.XX → X.XX ↗ X.XX)

**6. Current gate:** display the current controlled gate.





“A” means current selected gate is gate A;

“B” means current selected gate is gate B;

In full-screen mode, the Left/Right/up/down key is specifically used to control the gate movement.

**8. Gate trigger Method:** edge or peak.

**9. Current Curve Type:** DAC or AVG.

**11. Probe Type:** Straight beam single probe for , Angle beam single probe for , Dual element probe for , Through-transmit probe for .

**12. Probe K Value or Probe Angle :** click on this menu in the “PROBE” Page could be switched.

**19. Flaw Size Value:** means ERS (Equivalent Reflector Size) of the reflector signal inside the current selected gate. When the DAC curve is on, this value will be displayed as the dB offset of the peak echo inside the current selected gate to the reference DAC curve (DAC→OFFSET→SIZE REF). AVG can choose to display equivalent dB or equivalent hole mm.

**20. Echo Wave Height:** the current height of the echo inside the gate. Peak trigger mode to display the current peak echo in the gate, edge trigger mode to display the height of the gate, the display format is: XX.X%.

**Special Note:** Before using the probe, set the probe frequency and type according to the nominal value of the probe; otherwise it may affect the effect of flaw detection.

## 1.6 Overview of Pages (Total 11 Pages)



<b>SET</b>	Set No.	<b>PROBE</b>	TYPE	<b>DAC</b>	DAC/TCG
	SAVE		K Value / ANGLE		STANDARD
	RENAME		P-Delay		BUILD DAC
	DELETE		X_VALUE		EDIT DAC
	DEL ALL		X_FREQ		SIZE REF
	EXPORT		X_SIZE		DAC RL
	IMPORT				DAC SL
	EXPORT ALL		CAL PROBE		DAC EL
	IMPORT ALL		NAME		NO.4 /NO.5/NO.6
<b>AVG</b>	AVG DISP	<b>MEM</b>	ORDER RETRIEVE	<b>BASE</b>	RANGE
	BUILD AVG		NAME RETRIEV		VELOCITY
	EDIT AVG		DATE RETRIEVE		D-DELAY
	AVG_UL		SAVE REPORT		SCAE
	AVG_ML		SAVE PROBE RPT		THICKNESS
	AVG_DL		DEL ALL		DIAMETER
	SIZE TYPE		FORMAT MEMORY		
			EXPORT ALL		
			IMPORT ALL		
<b>GATE</b>	GATE SEL	<b>GAIN</b>	BASE GAIN	<b>CFG (CONFIG)</b>	LANGUAGE
	LOGIC		GAIN STEP		UNIT
	START		SCAN		GRID
	WIDTH		CORRECT		BRIGHT
	HEIGHT		AUTO GAIN		COLOR
	ALARM				KEY SOUND
	DETECTION				Warn Sound
	INDICATION				PRT COLOR
					PDF COLIOR
					L/R Key
		DATE & TIME			
<b>TOOLKI T</b>	CAPTURE: ENVELOPE/PEAK HOLD	<b>WELDS</b>	WELD TYPE		
	LEG BAND		WELD W		
	REJECT		BLUNT H/SLOPE AGL		
			CENTER L		
	G-COLOR		DISPLAY		
	THICKNESS				

## **1.7 Alarm Lights**

Two alarm lights appear at the top-right corner front of the instrument's keypad. One alarm light is marked as Alarm, which is assigned to the gate alarm. When a gate alarm is triggered, this light will illuminate. The other light is marked as Charge, indicating power and battery status.

## 2. Initial Start-up

### 2.1 Power Supply

The instrument can be operated with an external power adapter or with batteries. You can connect the instrument to the mains supply system even if it carries batteries. A discharged battery is charged in this case, viz. parallel to the instrument operation.

#### Operation Using Batteries

Use a lithium-ion battery pack provided with the instrument for the battery operation.

The battery compartment is situated at the instrument back. The cover is fastened with 2 screws To insert the battery pack

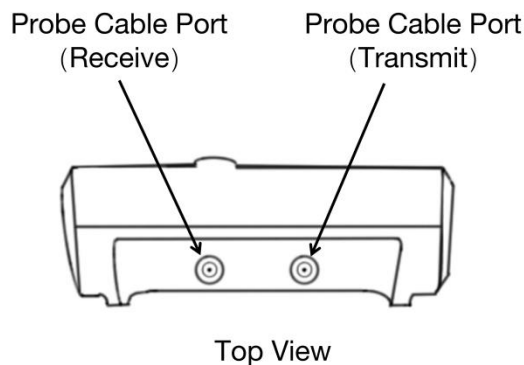
- Loosen the 2 screws of the battery cover.
- Lift the cover off upward.
- Insert the battery into the battery compartment.
- Close the battery compartment and fasten the screws.
- Turn on the instrument to make sure the battery is installed correctly and firmly.

### 2.2 Connecting a Probe

To prepare the instrument for operation, you have to connect a probe to it. The instrument is available with the probe connectors BNC (Lemo connectors are optional).

When connecting a probe to the instrument, it's not only important that the probe's physical connection be properly made. It's also important that the instrument is properly configured to work with the installed probe. The Instrument will operate with one or two single-element probes or with a dual-element probe.

To install a single-element probe, connect the probe cable to either of the two ports on the front of the instrument. When two probes, or a dual-element probe is connected to the instrument, the "Receive" probe connector should be installed in the right port and the 'Transmit' probe connector in the left port.



Connect one single element probe to either port. Connect leads from a Dual Element Probe to both ports.

For through-transmission, connect two single element probes to the transmit (left, labeled as T) and receive (right, labeled as T/R) ports.

## **2.3 Starting the Instrument**

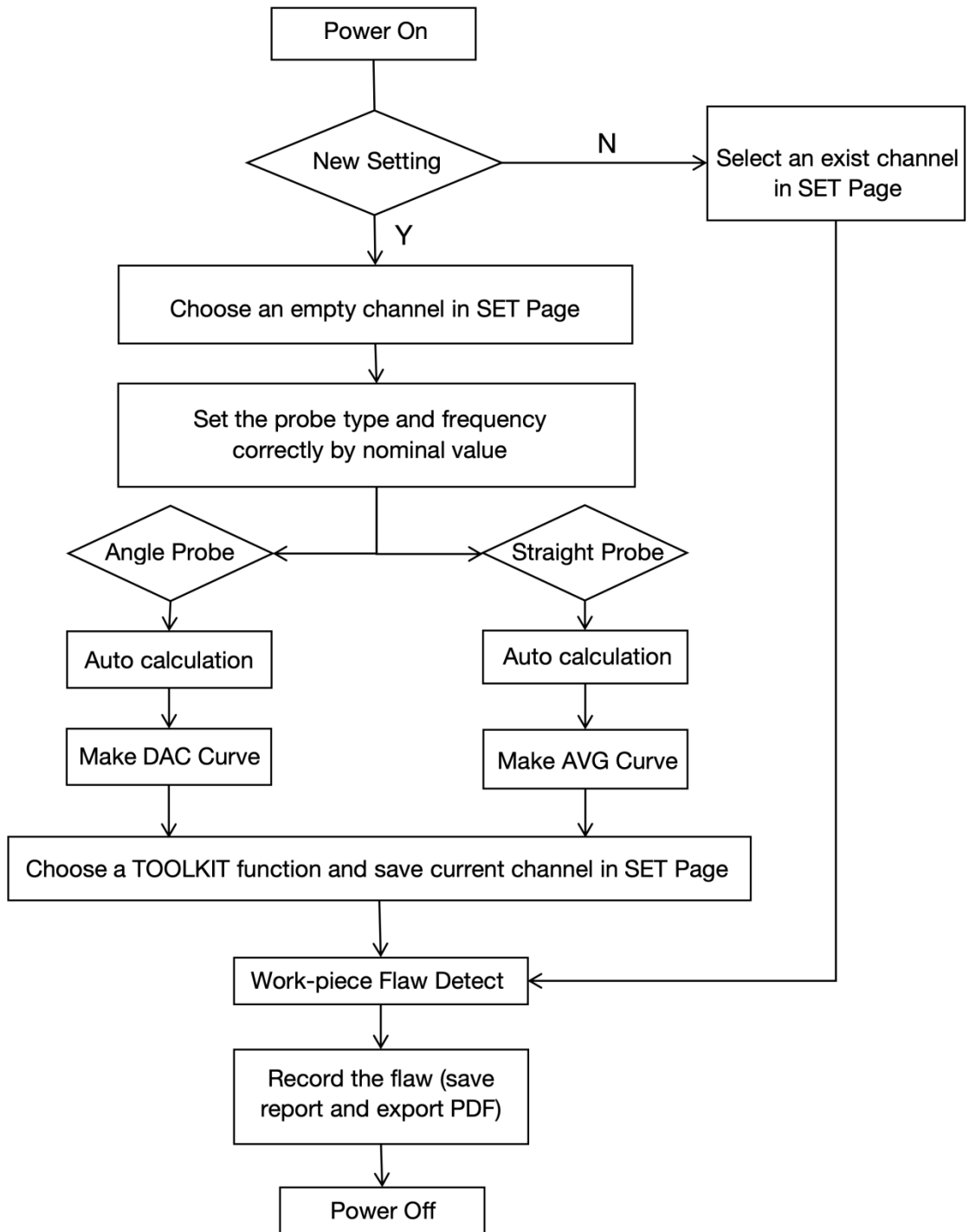
To start the instrument, simply press down the On/Off key. If it operates on the internal battery pack, make sure to install the battery pack correctly before starting.

The start display of the instrument appears; here you will also see the current software version and model of the instrument. The instrument carries out a self-check and then switches over to stand-by mode.

The instrument will automatically reload the last instrument setting. It has a special memory that retains all of its settings even when the power is off. The instrument will shut off automatically when the battery capacity level is too low.

### 3. Instrument Operation

#### 3.1 Instrument operation flow chart



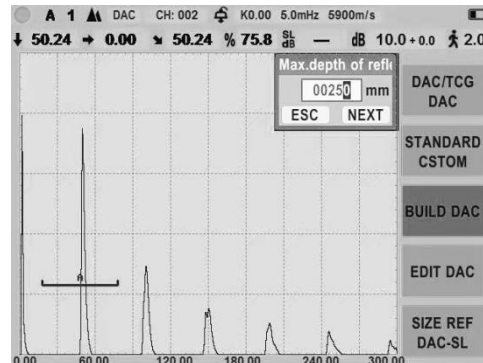
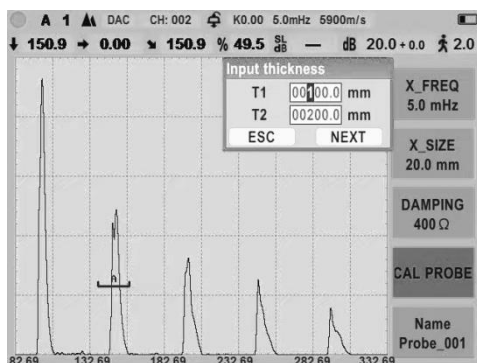
### 3.2 Select an exist channel: Expert Program

For those who are new to flaw detection, our company can provide corresponding "Expert Program" according to the work-piece of the user, without the need to calibrate the probe and make curves. Users only need to import the program into the flaw detector with USB flash drive and load the corresponding channel to start the flaw detection.

Operation Procedure: Plug in the USB drive with the expert program file--->"MEM" Page--->"IMPORT" menu--->Import the file to the corresponding channel--->switch to "Set No. " Menu ---> select the corresponding channel and you can start the flaw detection.

**The basic principle is that if you can turn on the detector, you can detect the flaws without setting the parameters of the detector.**

If it involves the operation of auto-calibration and curve building, there are dialog boxes to guide the whole process, press the OK Key to advance to the next step, press the Cancel Key to return to the previous step, no need to check the manual to follow the operation.

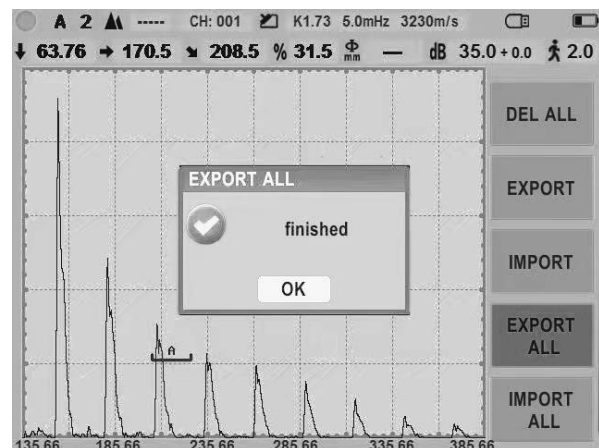
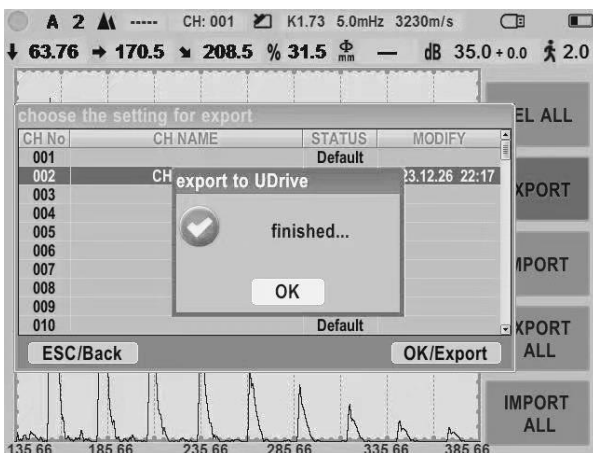


### 3.3 Channel Import and Export through USB Drive

Insert USB drive--->"SET" Page--->"EXPORT" Menu / "EXPORT ALL" Menu: Click OK and you can export any channel.

Insert USB drive--->"SET" Page--->"IMPORT" Menu / "IMPORT ALL" Menu: Click OK and you can import any channel. (Replace the file USB:\System\_US\ch.bin or ch00x.bin)

"SET" Page--->"Set No." Menu --->Select an empty channel to load, it will automatically load the default instrument configuration, which is equivalent to reset the factory settings, but will not delete the channels and reports and other stored content.



### 3.4 Report Import and Export through USB Drive

Name	RPT231226221154						
RPTDate	2023.12.26 22:11:54						
probeName	Probe_001						
Test Result							
Soundpath	208.5 mm						
Depth	63.76 mm						
Horizontal							
Height							
Ref dB							
Ref mm							
Param							
ProbeType	Angle						
Angle	1.73						
P-Delay	6.00 us	D-Delay	84.00 us	Scan Gain	0.0 dB	DAC-RL	
X-Freq	5.00 mHz	Thickness	84.0 mm	Correct	0.0 dB	DAC-SL	
X-Value	10.00 mm	Diameter	----	Energy	350 V	DAC-EL	
Damping	400 Ω	Scale	Sound Path	PulseWidth	250 nS		
Rectify	Full Wave	Reject	Off	PRF	150 Hz		
X-Size	9.0x9.0	Gate Sel	GATE A	CurveType	----		

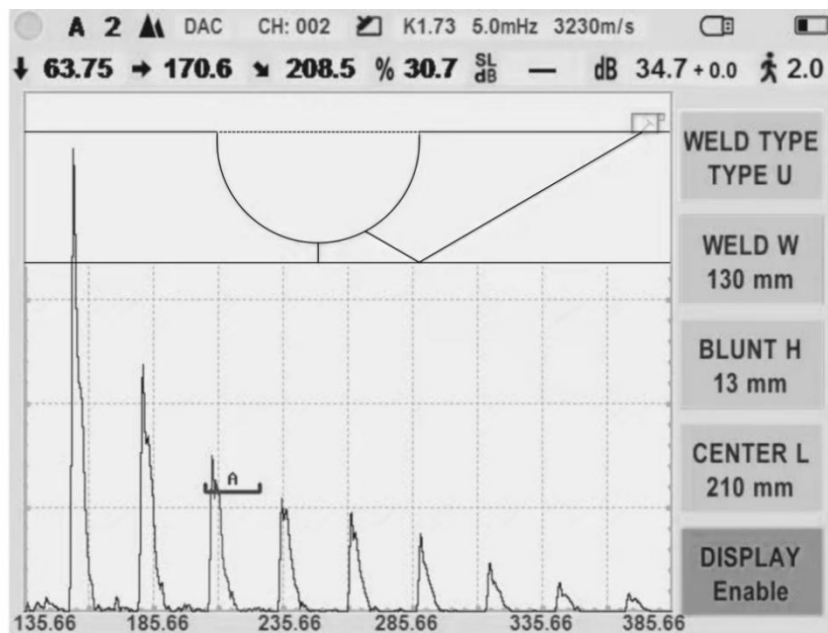
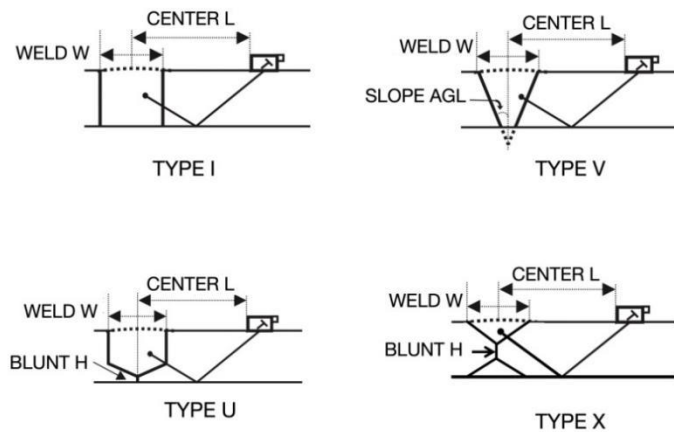
Insert the USB drive ---> "MEM" Page ---> "ORDER RETRIEVE" Menu ---> select the report and press OK: you will enter the report viewing page. You can export this report by pressing the OK Key in the report viewing page.

Insert USB drive--->"MEM" Page--->"EXPORT ALL" Menu / "IMPORT ALL" Menu: you can export/import all reports to USB drive with just one click. **(For Import: replace the file USB:\System\_US\report.bin)**

"CFG" Page--->"RPT COLOR" Menu: You can adjust the report color type in the report viewing page:"Black RGB" or "White RGB" is recommended.

"CFG" Page--->"PDF COLOR" Menu: You can adjust the color type in the exported PDF report: "White RGB" or "Black & White" is recommended.

### 3.5 Weld Illustration



Select the Angle Probe in the PROBE Page, and after finishing the calibration, you can switch to the weld page. Move the gate to cover the defective echo wave, click the "DISPLAY" Menu and adjust the corresponding parameters, the weld image will be dynamically refreshed in real time.

When the weld is displayed, click the Freeze Key+ Menu to save the report with the weld image.

## 4. Calibration and Measurement

Before working with the instrument, you have to calibrate the instrument: you have to adjust the material velocity and display range and allow for the probe delay depending on the material and dimensions of the test object.

To ensure a safe and proper operation of the instrument, it is necessary that the operator be adequately trained in the field of ultrasonic testing technology.

Below you will find some examples of common calibration methods for certain test tasks.

### 4.1 Calibration with Straight- Beam and Angle-Beam Probes

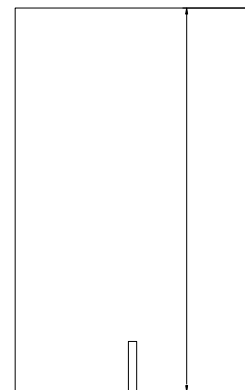
#### Case A: With Known Material Velocity Calibration process

- Set the known material velocity in **VEL** function.
- Couple the probe to the calibration block.
- Set the required display range in **RANGE**. The calibration echo must be displayed on the screen.
- Position the gate on one of the calibration echoes until the sound path of the echo is indicated in the measurement line.
- After this, change the adjustment of the function **P-DELAY** until the correct sound path for the selected calibration echo is indicated in the measurement line.

#### Example:

You are carrying out the calibration with a straight probe for the calibration range of 300 mm via the function group BASE using the calibration block DB-P (thickness 225 mm) which is laid flatwise.

- Select a new set.
- Set **PROBE** type to **STRAIGHT**.
- Set **RANGE** TO 300 mm.
- Set the known material velocity of 5920 m/s in **VEL**.
- Set the gate so that it is positioned on the first calibration echo (from 225 mm).
- Read the sound path on the status line. If this value is not equal to 225 mm, change the adjustment for the function **P-DELAY** until it is at 225 mm.
- Save the calibration result to current set file.



This completes the calibration of the instrument to the material velocity of 5920 m/s with a calibration range of 300 mm for the straight-beam probe used.

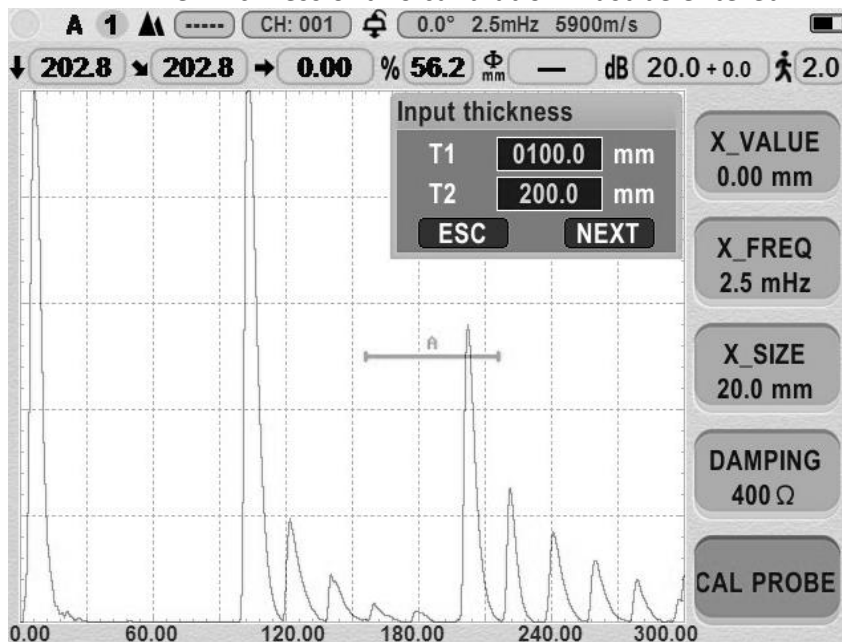
## Case B: With Unknown Material Velocity(Straight- Beam Probes)

Use the semiautomatic calibration function of the instrument via the function CAL PROBE for this calibration case.

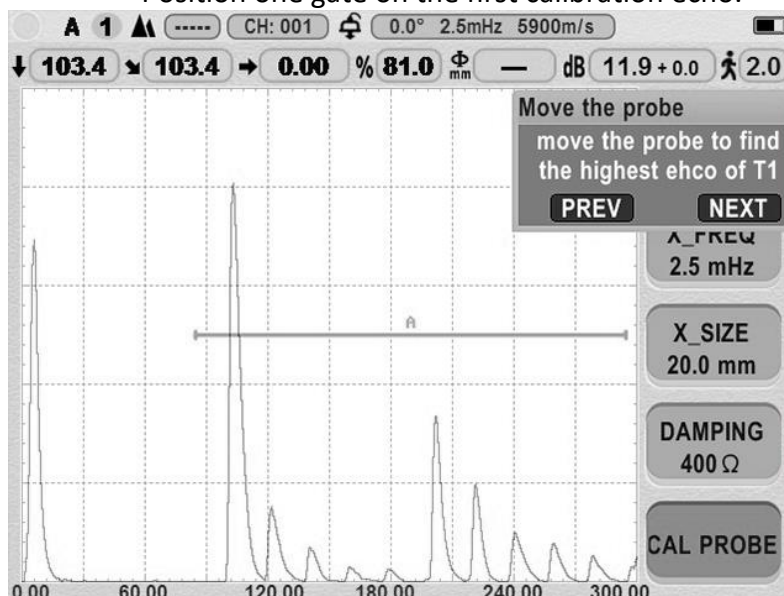
The Thickness of two calibration must be entered.. The instrument will then carry out a plausibility check, calculate the material velocity and the probe delay, and automatically set the parameters using the calculation result.

### Calibration Process

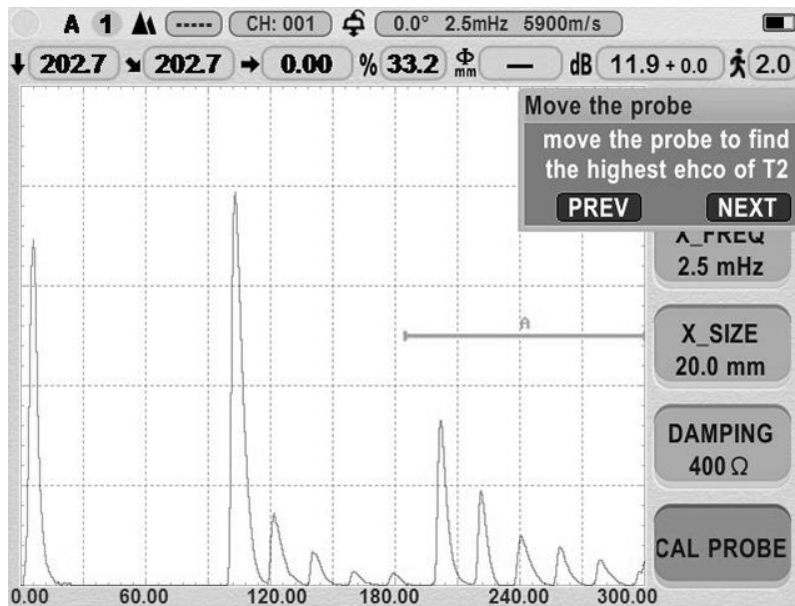
- Set PROBE type to STRAIGHT.
- The Thickness of two calibration must be entered.



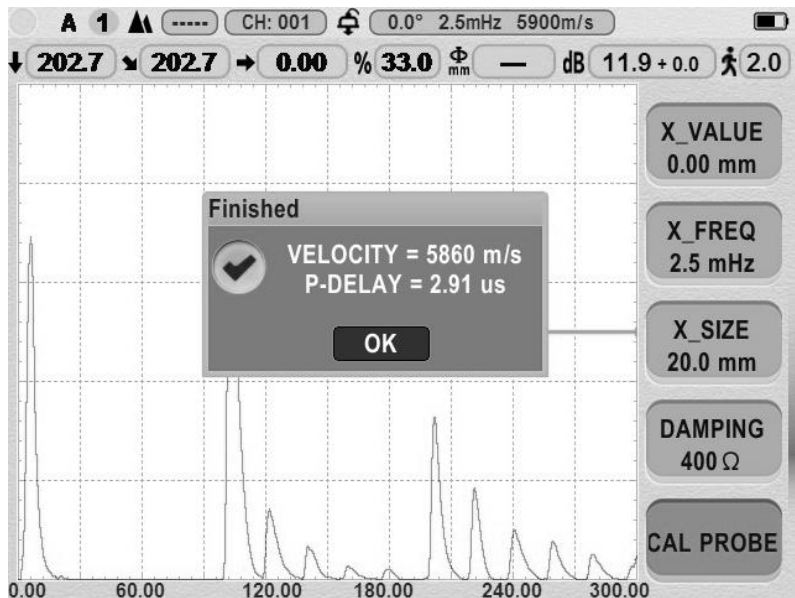
- Position one gate on the first calibration echo.



- Position the other gate on the second calibration echo.



- Show calibration result.

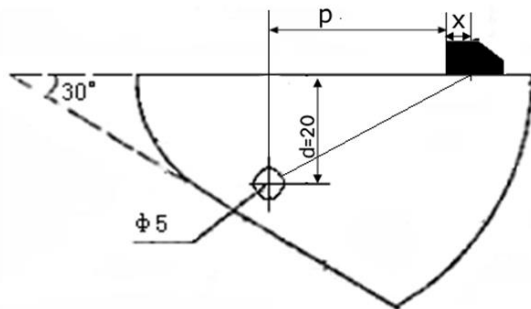
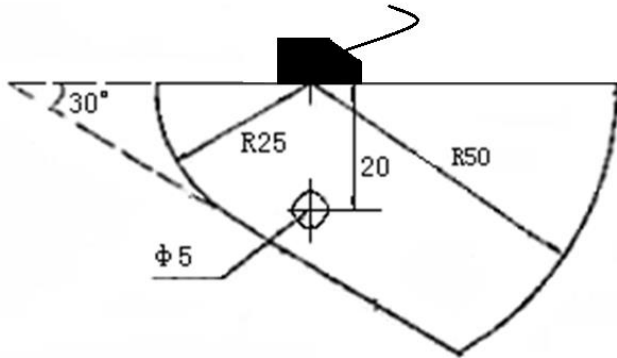


The calibration is confirmed by the result message. The instrument will now automatically determine the sound velocity and the probe delay and set the corresponding functions accordingly. The value of the function **P-DELAY** will be set to the correct value.

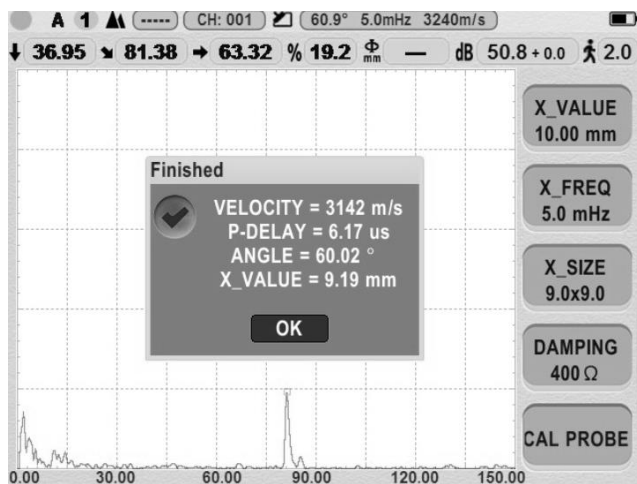
If the instrument is not able to carry out any valid calibration on the basis of the input values and the echoes recorded, a corresponding error message is displayed. In that case, please check the values of your calibration lines and repeat the process of recording the calibration echoes.

## 4.2 Angle Beam Probes Calibration with Unknown Material Velocity

1. Use 25/100 echo to calibrate p\_delay and velocity.
2. Use echo of hole to calibrate angle.



(图 2)



### 4.3 Calibration with Dual-Element (TR) Probes

Dual-element (TR) probes are especially used for wall thickness measurement. The following peculiarities must be taken into account when using these probes: Echo Flank. Most dual-element (TR) probes have a roof angle (transducer elements with inclined orientation toward the test surface). This causes mode conversions both at beam index (sound entry into the material) and at the reflection from the backwall, which can result in very jagged echoes.

V-Path Error. Dual-element (TR) probes produce a v-shaped sound path from the pulser via the reflection from the backwall to the receiver element. This so-called “V-path error” affects the measuring accuracy. You should therefore choose two wall thicknesses that cover the expected thickness measurement range for the calibration. In this way, the V-path error can be corrected to the greatest possible extent.

Higher Material Velocity. Due to the V-path error, a higher material velocity than that of the test material is given during calibration, especially with small thicknesses. This is typical of dual-element (TR) probes and serves for compensation of V-path error.

With small wall thicknesses, the above-described effect leads to an echo amplitude drop which has to be especially taken into account with thicknesses less than 2 mm. A stepped reference block having different wall thicknesses is required for calibration. The wall thicknesses must be selected so that they cover the expected readings.

### Calibration Process

We recommend to use the semiautomatic calibration function for the calibration with T/R probes.

- Set PROBE type to DAUL.
- The Thickness of two calibration must be entered.
- Position one gate on the first calibration echo.
- Position one gate on thesecond calibration echo.
- Show calibration result.

If necessary, check the calibration on one or several known calibration lines, e.g. using the stepped reference block.

### 4.4 Distance Amplitude Curve DAC

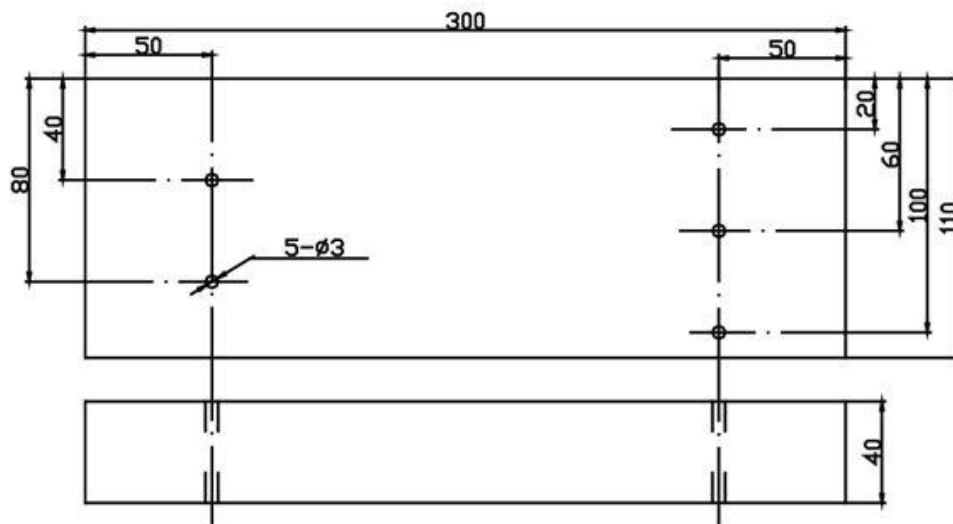
The instrument is available with Multi-Curve Distance Amplitude Curve (DAC) function. Functions for the distance-amplitude curve are accessed through the DAC Menu

When displayed, the DAC curve visually represents a line of constant reflector peaks over a range of material depths. A new feature of the instrument is a multiple-curve option that displays three dB offset DAC curves simultaneously. Each curve represents constant reflector size at varying material depth. Remember that in DAC mode, the only deviation from traditional display and operation is the appearance of the DAC curve. All A-Scan echoes are displayed at their non-compensated height.

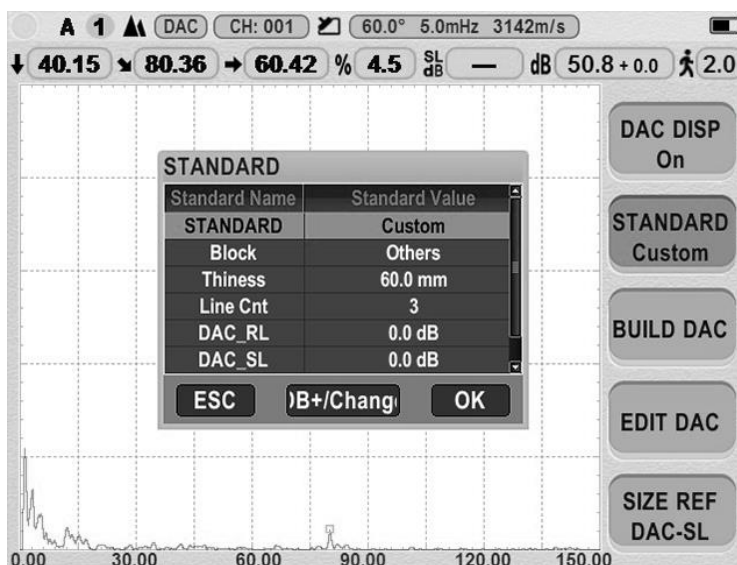
A DAC curve is programmed using a series of same-reflector echoes at various depths covering the range of depths to be inspected in the test material. Because near field and beam spread vary according to transducer size and frequency, and materials vary in attenuation and velocity, DAC must be programmed differently for different applications. A DAC curve can be based on up to 16 data points (material depths). These points are recorded from the DAC menu as described below.

### 4.5 Recording the DAC Curve

DAC Curve points are typically taken from a standard with equally sized reflectors (holes) located at various material depths. The primary echo from each of these points (for up to a total of 16 echoes) are recorded. When DAC is active, the instrument displays a curve that represents echo peaks for constant reflectors at varying material depth.



- Before starting to record a reference curve, the instrument must be correctly calibrated. To program the DAC Curve:
- Select a standard for DAC.



When operating with DAC turned on, three DAC curves including RL, SL and EL are typically displayed. The three curves can be offset from the original DAC curve (ML) by a user-inputted amount. The unit support one to six DAC curves, when we

Select a standard, The offset of

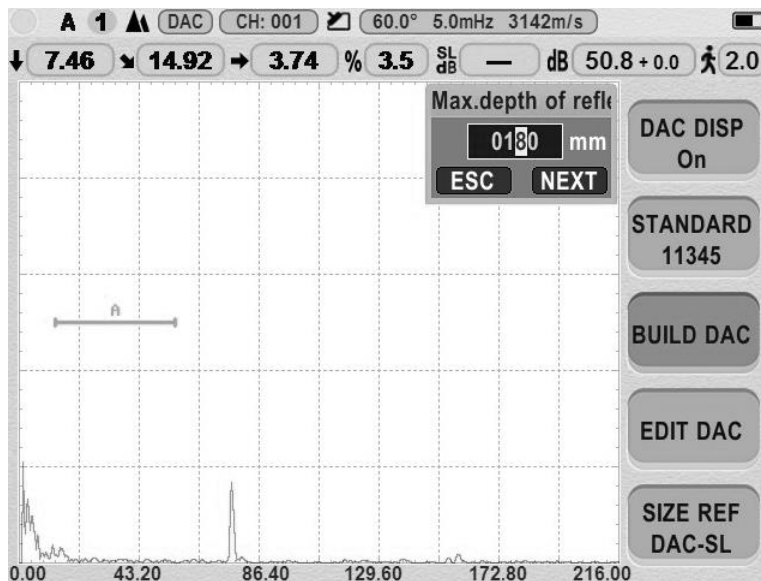
DAC curves is fixed. In custom

Mode, we can adjust offset freely.

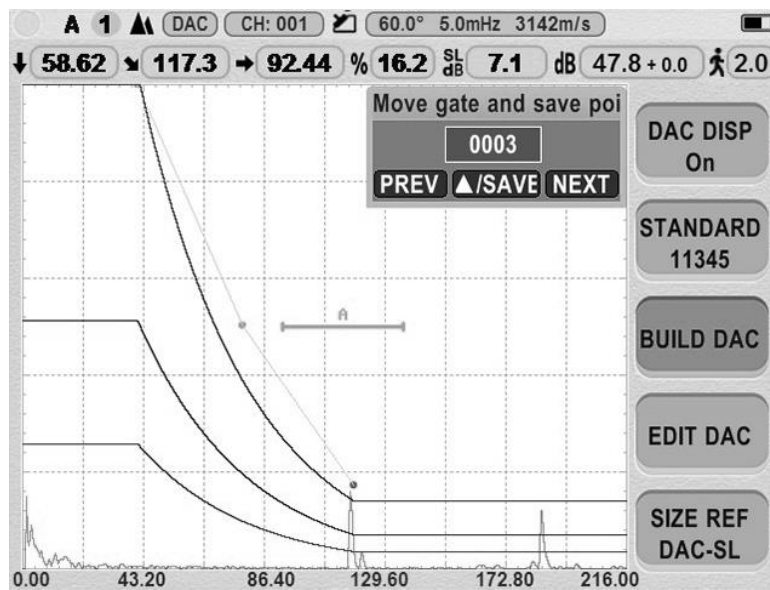
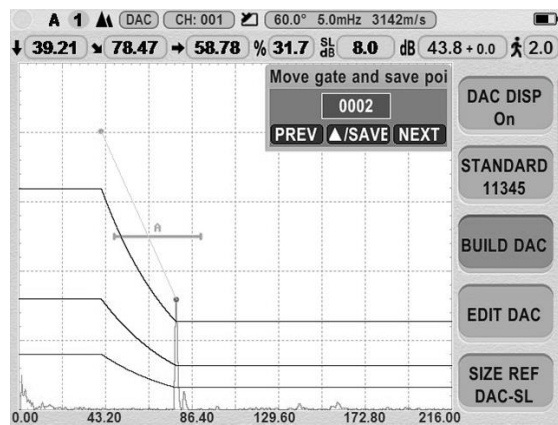
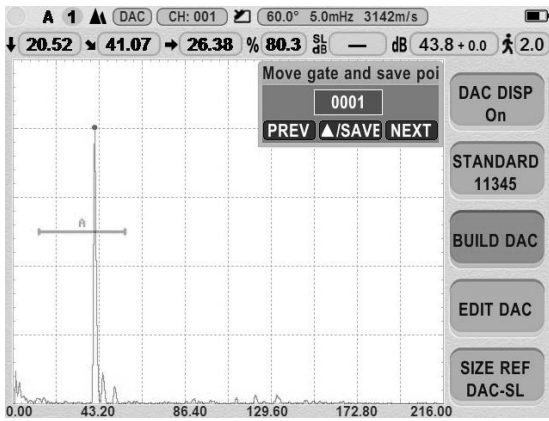
The offset range from -50dB to 50dB.



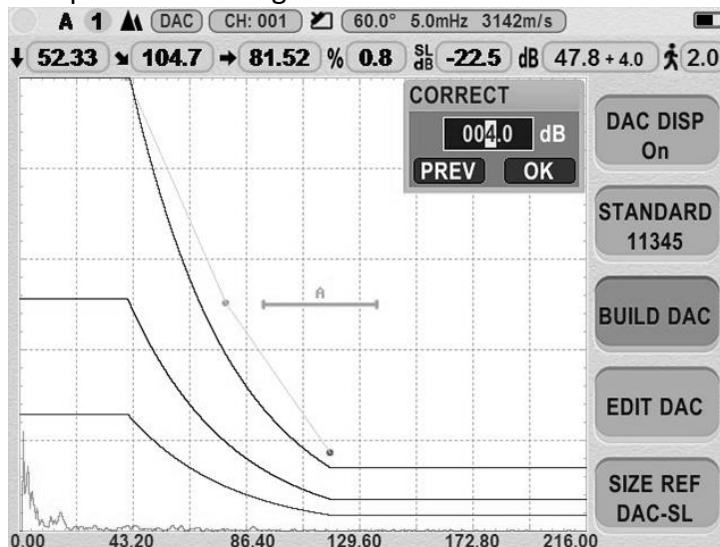
- Start building DAC curve. Input max depth of reflector.



- Move gate and save points.



- Input the correct gain.



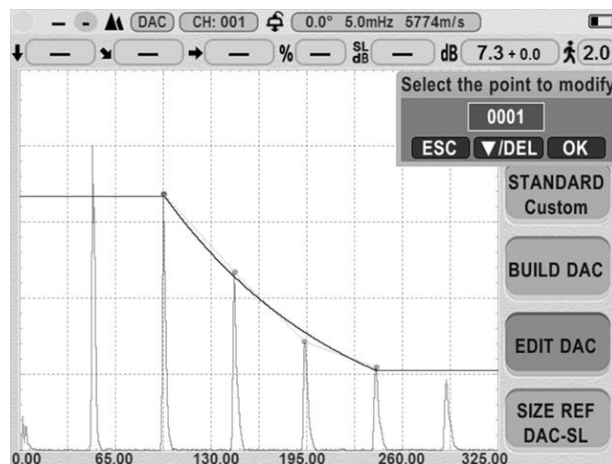
- Finished.






#### 4.6 Editing DAC Curve

After reference points are recorded, their values may be manually adjusted, or some points may be manually deleted. To edit or delete points:

- With the **DAC** menu accessed, select **EDIT** submenu.
- Select **EDIT** function. Continue to press enter key to start the EDIT process. When DAC EDIT process is triggered, "DAC" and a digit number appear indicating the point index on the top right corner of the display.



- Press  or  to select the point to edit.
- Turn the knob clockwise or anticlockwise to adjust the point's echo height.
- Press **down** key to delete a point .

- When complete select **FINISH** and press  key and follow the on-screen prompts to finish the editing.

## 4.7 Specifying the DAC Reference Curve

Once the DAC curve is recorded and displayed, echoes are automatically compared to the size reference curve, which can be specified in the SIZE REF selection. The options include RL, SL, EL, and GL.

The dB equivalent height of the signal above or below the corresponding DAC Reference Curve amplitude is displayed as a comparison result.

The comparison result is shown as right figure.

Note that the result is like: SL 6.3dB. It means that the peak echo height inside selected gate is 6.3 dB offset to the DAC-SL line.



## Echo Evaluation with DAC

In order to be able to evaluate a flaw indication by means of the DAC, certain conditions must be met.

- The DAC curve must already be recorded.
- It only applies to the same probe that was used when recording the curve. Not even another probe of the same type must be used.
- The DAC only apply to the material corresponding to the material of the reference block.
- All functions affecting the echo amplitude must be set the same way as they were when the curve was recorded.

## 4.8 Measuring with DGS/AVG

Using the **AVG** (the same as DGS) function, you can compare the reflecting power of a natural flaw in the test object with that of a theoretical flaw (circular disk-shaped equivalent reflector) at the same depth.

**Note:** You are comparing the reflecting power of a natural flaw with that of a theoretical flaw. No definite conclusions may be drawn on the natural flaw (roughness, inclined position, etc.).

The so-called AVG diagram forms the basis for this comparison of the reflecting power. This diagram consists of a set of curves showing the correlation of three influencing variables:

- Distance between the probe and circular disk-shaped equivalent reflector
- Difference in gain between various large circular disk-shaped equivalent reflectors and an infinitely large backwall
- Size of the circular disk-shaped equivalent reflector. The influencing variable always remains constant for one curve of the set of curves.

The advantage of the AVG method lies in the fact that you can carry out reproducible evaluations of small discontinuities. The reproducibility is most of all important, for example, whenever you aim to carry out an acceptance test.

Apart from the influencing variables already mentioned, there are other factors determining the curve shape: sound attenuation, transfer losses, amplitude correction value, probe and etc.

The following probe parameters affect the curve shape:

- Element or crystal diameter
- Frequency
- Delay length
- Delay velocity

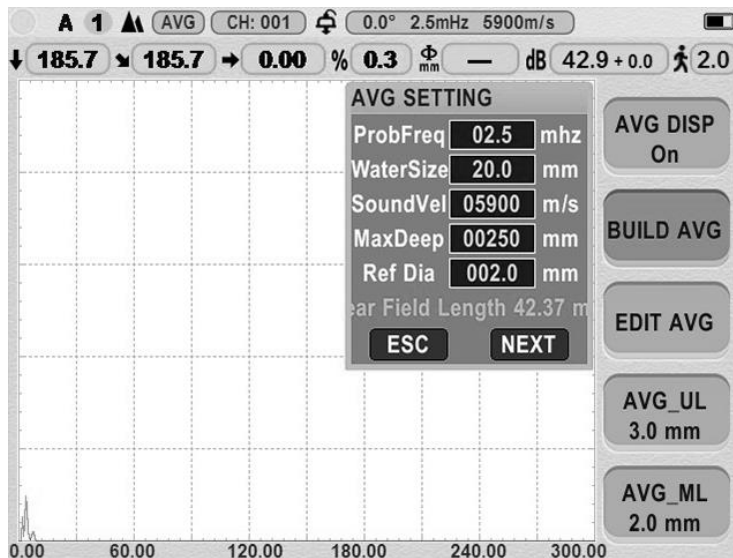
You can adjust these parameters on the instrument in such a way that you can use the AVG method with many different probes and on different materials.

**Note:** Before setting the AVG function, the instrument must first be calibrated because all functions affecting the AVG evaluation mode (**VEL**, **P-DELAY**, **DAMPING**, **ENERGY**, **P-WIDTH**, **FREQ**, **DIAMETER**, **RECTIFY**) can no longer

be changed after the reference echo has been recorded.

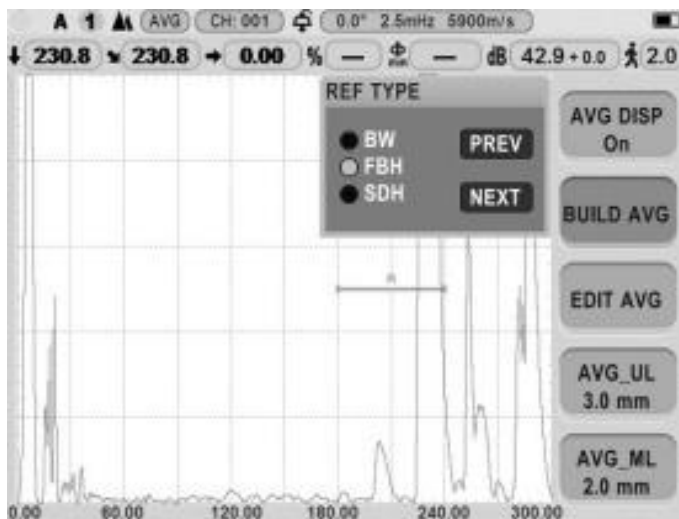
### **Settings for the AVG measurement**

Before using the AVG feature to evaluate reflectors in test pieces, the characteristics of the attached probe must be specified, certain characteristics of the reference standard must be input, and a reference echo must be stored.



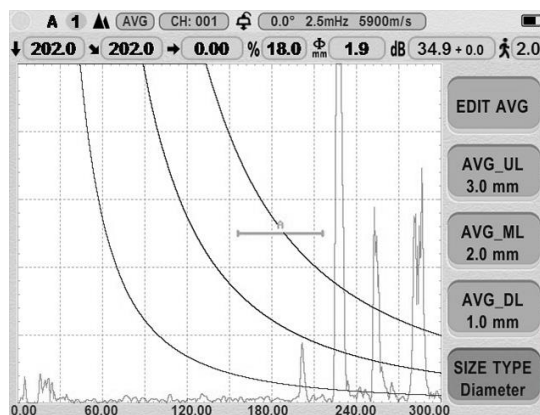
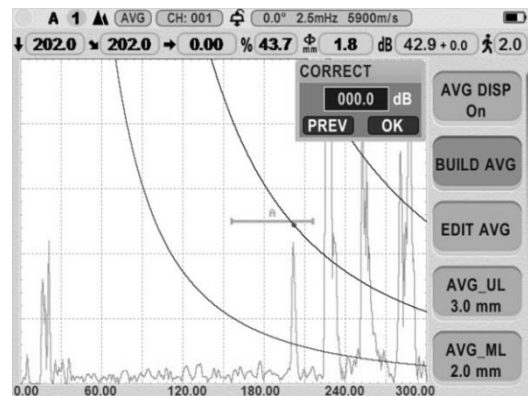
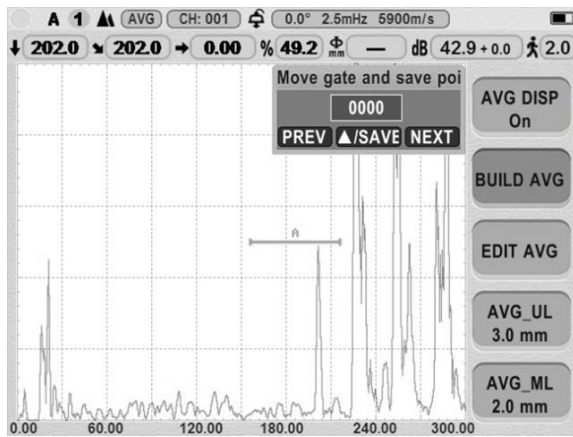
### Record the Reference Echo that Defines the AVG Curve

Prior to generating the AVG curve, a test standard with a known reflector must be used to define a reference point.



Acceptable test standards include these reference types:

- BW – Backwall echo with reference defect size defined as infinity
- SDH – Side Drilled Hole with a reference defect size defined as the hole's diameter.
- FBH – Flat Bottom Hole with a reference defect size equal to the hole's facial diame



Follow these steps to record a reference echo, Once a reference echo has been recorded, the AVG curves (the AVG-UL, the AVG-ML and the AVG-DL) are automatically displayed using default settings.

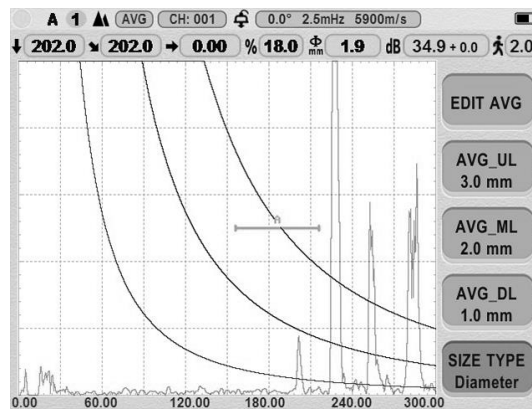
### Creating AVG Offset Curves

When operating with AVG turned on, three AVG curves including the AVG-UL, the AVG-ML and the AVG-DL are typically displayed. The three curves can be offset by user-inputted equivalent flaw size values in the AVG-UL, AVG-ML and AVG-DL selection. The offset values will usually depend on the largest acceptable flaw size.

### Evaluating Test Samples in AVG Mode

Once the AVG curve is recorded and displayed, echoes are automatically compared to the AVG curve and evaluated based on the recorded reference. The result is shown as ERS (Equivalent Reflector Size), which evaluates the reflected echo and calculates the equivalent reflector size.

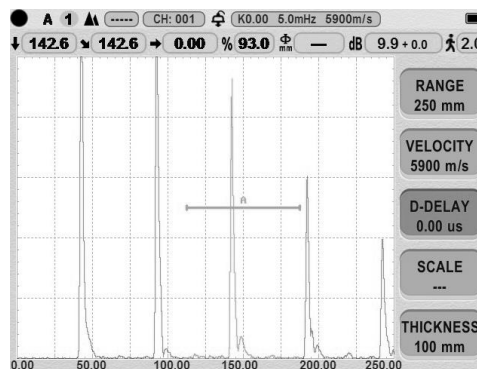
This is shown in right figure. Note that the ERS is  $\Phi 1.9$  mm.



## 5. Operation

### 5.1 Display mode selection

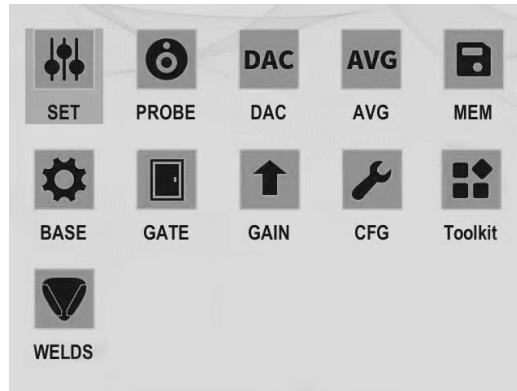
**Mode A:** Full screen mode, the left/right/up/down Key will be used to move the gate only.



**Mode B:** Common display with Menu bar on the right.



**Mode C:** Main menu mode.



**Mode A:** Cancel key is pressed and display mode will change to B.

Menu key is pressed and display mode will change to C.

**Mode B:** Cancel key is pressed and will change to A. Menu key is pressed, Display mode will change to C.

**Mode C:** Cancel key is pressed and display mode will change to B.

Enter key is pressed and display mode will change to B.

## 5.2 Parameter setting

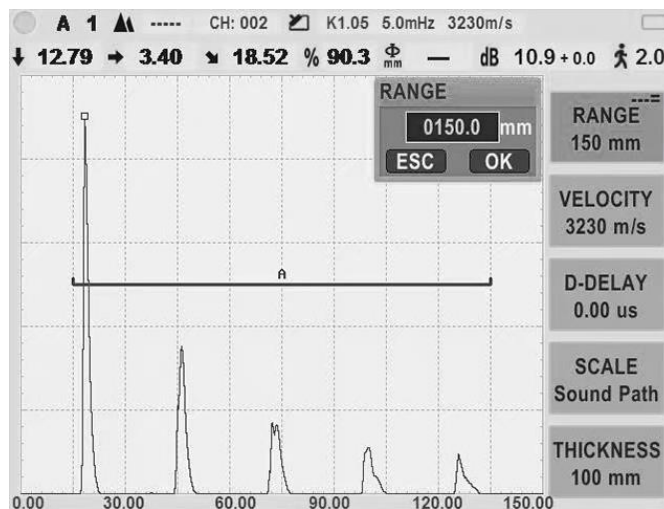
Parameter values can be changed by press left/right Key after the parameter item is selected. The values will take effect immediately. Parameters of the device are interrelated, if there is incorrect parameter, device will correct it immediately, or pop up error message.

## 5.3 Adjusting the Display Range

The **BASE** Page enables you to make the basic adjustment of the display range. The display on the screen must be adjusted for the material to be tested and for the probe used.

Calibration requires the use of calibrated standard made of the same material as the test piece. Prior to calibrating the instrument/probe combination, the A-Scan display-screen range (the material thickness value represented by the full horizontal width of the screen) will normally be set to a value equal to or slightly larger than the calibrated standard.

- Activate the **range** menu by pressing the range key.
- Press knob to bring up dialog box of range.
- To change the range, turn the knob.
- The display's horizontal range will remain as set.



## 5.4 Setting the Material Velocity

Use **VELOCITY** to set the sound velocity within the test object. Always ensure that the function **VEL** is correctly set. The instrument calculates all range and distance indications on the basis of the value adjusted here.

## 5.5 Setting the Display Delay

Here you can choose whether to display the adjusted range (for example 300 mm) starting from the surface of the test object, or in a section of the test object starting at a later point. This allows you to shift the complete screen display and consequently also the display zero. If the display should for example start from the surface of the test object, the value in **D-DELAY** must be set to 0. To set the display delay

- Activate the **BASE** submenu (located in the **BASIC** menu) by pressing the menu key below it. Three functions will appear down the right side of the display screen.
- Select the function item titled **D-DELAY**.

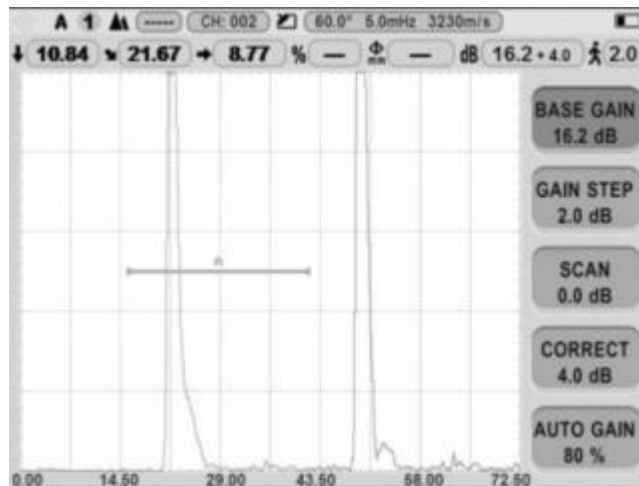
To change the display delay, turn the knob. You'll note that the displayed echoes shift to the left or right. **D-DELAY** range: -20~3400  $\mu$ s

## 5.6 Selecting the Probe Test Mode

You can use the function **PROBE** to activate the pulser-receiver separation. The following modes are available:

- **SINGLE**- For single straight beam transducer operation (





The gain includes the basic gain, the offset gain and the correction gain. The basic gain and the correction gain are also displayed on the top-right corner of the screen.

The maximum of the total gain (the basic gain plus the offset gain plus the correction gain) is 120 dB.

The offset gain is for the purpose of flaw evaluation. The DAC/AVG curves remain unchanged when adjusting the offset gain.

Sensitivity correction gain: Compensate for the transfer losses in the material under test. This correction gain is necessary if test object and reference block have different surface qualities. You have to find out the adjustment value for the compensation of transfer losses by experiments. The gain is varied accordingly in this correction, while the curve line remains unchanged. To set the sensitivity correction gain, select the function **T-CORR** and then adjust its value according to the experiment.

When DAC is active, adjusting the basic gain setting will result in an equal adjustment of the DAC curve position. To increase the instrument gain without changing the DAC curve position, use the **T-CORR** function to compensate for varying coupling/surface conditions.

## 5.9 Changing the Gain-Adjustment Increment (DB STEP)

When adjusting the A-Scan Gain, each click of the dB+-key increases or decreases the gain level by a dB increment equal to the **DB STEP**. Several values can be specified for **DB STEP**. Available increments include: 0.1dB, 1dB, 2dB, 6dB.

Note that DB STEP value can be quickly changed by repeatedly pressing the On-off Key.

## 5.10 Configuring the Gates

The gates monitor the range of the test object where you expect to detect a flaw. If an echo exceeds or falls below the gate, an alarm signal is shown via the ALRM LED. The gate chooses the echo for the digital time-of-flight or amplitude measurement.

The instrument has two gates: gate A and B. Gate A and B are independent of one another. Setting the position and characteristics of the A- and B-Gates is the first step to configuring the instrument for flaw detecting or material-thickness measurement. The GATE functions controls not only the location of the A and B-Gates, but also the alarms and other features activated when an A-Scan signal crosses a specific gate.

A-Scan signals crossing the A or B-Gate are evaluated for the purposes of flaw detection and material-thickness evaluation. When the signal crosses the A or B-Gate, the maximum point (peak) of the signal (in the specific gate) is used for evaluation purposes. The measured value is indicated on the status line.

### Positioning Gates

Use the following procedures to set the vertical and horizontal position of the A and B-Gates. Remember that gate position has the following effects on instrument performance:



- A-Scan echoes on the right side of the display screen represent features that occur at a greater depth from the test-material surface than those on the left of the display screen. Therefore, moving a gate to the right means that the gate is evaluating a deeper portion of the test material.
- A wider gate will simply span the equivalent of more test-material depth. Increasing the vertical height (called threshold) of a gate means that only reflected signals of sufficiently large amplitude will cross the gate.

### Setting a Gate's Starting Point

You can fix the starting point of the gates A or B within the display range.

- Activate the GATE submenu (located in the main menu).
- Select the gate START function and adjust the starting point by turning the knob. Increasing and decreasing the value of the starting point moves the gate to the right and left, respectively.
- The gate starting point will remain as set, even when width adjustment is made.

**You can also set the selected gate's starting point using the knob in full screen mode.**

You can also adjust gate's width by simply pressing the  and . Note that the instrument will only search the echo whose peak crosses the selected gate in this function.

### **Setting a Gate's Threshold (Vertical Position)**

You can determine the threshold value of the gates within the range of 0 to 99% FSH (Full Screen Height) for triggering the LED alarm if this value is exceeded or not reached, depending on the setting of the ALARM function.

- Activate the GATE submenu (located in the MAIN menu).
- Select the gate to be positioned using the GATE function.
- Select the THRESH function and adjust the vertical height by turning the Key Increasing and decreasing the value of the threshold moves the gate up and down, respectively.

### **Defining Gate Alarm Logic**

This function allows you to choose the method for triggering the Gate alarm. Gate alarms can be set to trigger when an A-Scan echo crosses the gate (POSITIVE logic) or when no echo crosses the gate (NEGATIVE logic) within the displayed range.

A-Gate is locked to POSITIVE logic. And Gate can be set to either POSITIVE or NEGATIVE. The appearance is different between the POSITIVE gate and the NEGATIVE gate when displayed, as is shown in right figures.

When a gate alarm is activated, one or more of the following will occur:

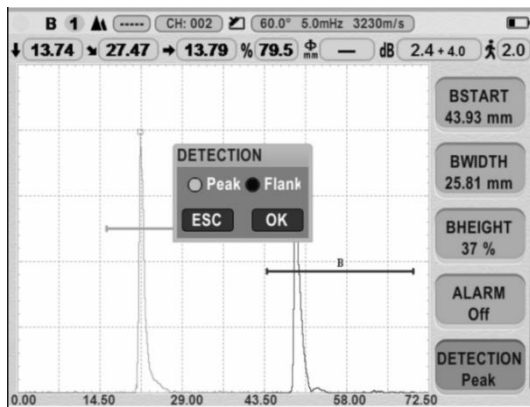
- An alarm indication light on the front of the instrument will illuminate
- An audible alarm (HORN) will sound

### **Specifying the Gate Detection Mode**

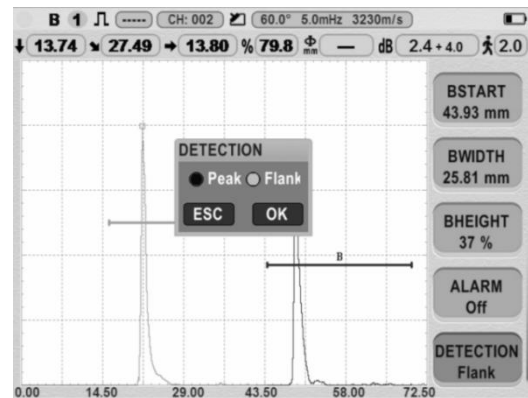
A-Scan signals crossing the A or B-Gate are evaluated for the purposes of flaw detection and material-thickness evaluation. When the signal crosses the A or B-Gate, either the gate-crossing point (flank) or the signal, or the maximum point (peak) of the signal (in the specific gate) is used for evaluation purposes. The DETECT function allows the user to specify which A-Scan feature (FLANK or PEAK) is used to evaluate the signal in each gate.

DETECT set to PEAK means that the highest peak in the gate represents the triggering of the gate;

DETECT set to FLANK means that the gate-crossing point represents the triggering of the gate.



DETECT Mode: PEAK



DETECT Mode: FLANK

Note that the detection method chosen will be reflected by a small icon. This icon is displayed on the status bar containing the measured reading.

## 5.11 Specifying the Probe Frequency

In this function, **you can specify the probe frequency according to the frequency of your probe**. The instrument will automatically utilize a built-in filter to match the probe frequency.

- Activate the **PROBE** submenu by pressing the probe key .
- Select the function item titled **FREQ**.
- To change the specified frequency, turn the knob.
- The probe frequency will be set to the last one displayed.

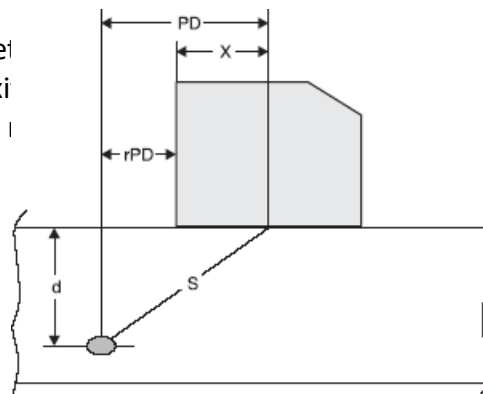
## 5.12 Specifying the Piezo Crystal Size

Use **P\_SIZE** function to set the Piezo Crystal Size of your probe. This value is required when programming the AVG.

## 5.13 Setting the Probe X-Value

The function **X-VALUE** enables you to set probe's leading face and probe index/sound exit is required for the automatic calculation of the beam transducer operation.

Adjustment range: 0~50 mm



## 5.14 Probe Delay Calibration




Each probe has a delay line between the transducer element and the coupling face. This means that the initial pulse must first pass through this delay line before the sound wave can enter the test object. You can compensate for this influence of the delay line in the function P-DELAY.

If the value for P-DELAY is not known, read Chapter 5 in order to determine this value.


## 5.15 Setting the Angle of Incidence

The ANGLE function enables you to adjust the angle of incidence of your probe for the material used. This value is required for the automatic calculation of the flaw position. The angle of incidence for the straight-beam probe is fixed to 0°. Adjustment range: 0°~89°.

## 5.16 Freezing the A-Scan Display

Whenever an A-Scan is active, pressing  freezes the A-Scan display. The active A-Scan will remain as it appeared when  was pressed and the display will remain frozen until  is pressed again.

## 5.17 Setting the Display Grid

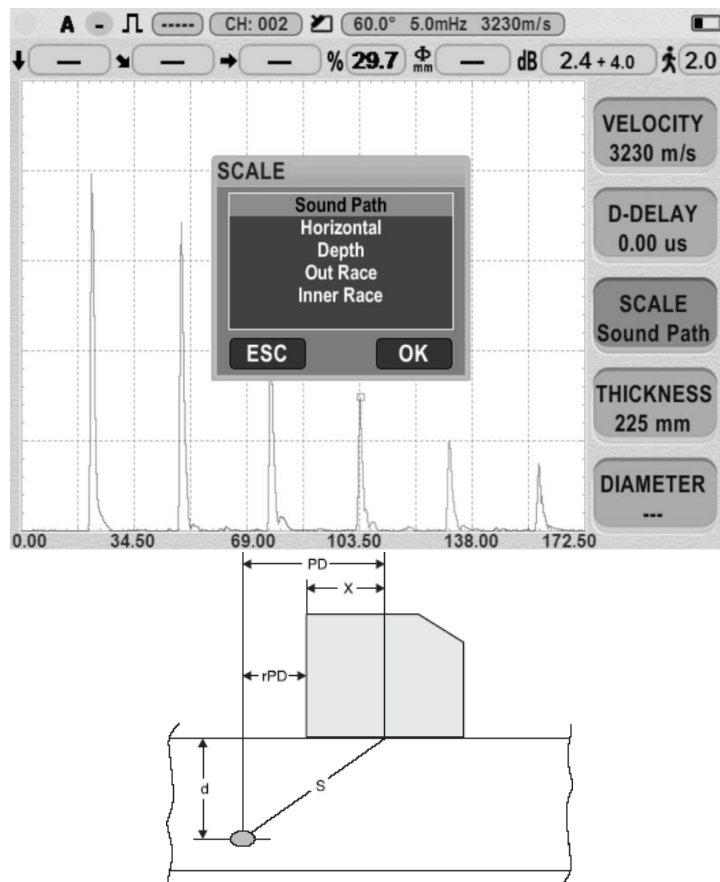
- Activate the CFG submenu. Eight functions will appear down the right side of the display screen.
- Use knob to select the function item titled GRID and bring up dialog box.
- To change the grid type, Press key  or turn the knob. Each grid style is shown in the display screen's A-Scan window as it is selected. You'll note that the following styles are available:
  - G0-Ten major horizontal and five vertical divisions, with two major horizontal and vertical divisions.
  - G1-Two major horizontal and vertical divisions.
  - G2-No on-screen grid. Only display-edge marks are visible.
  - G3- Ten major horizontal and five vertical divisions.
- The grid style will be set to the last one displayed.

## 5.18 Selecting Units

In the function UNITS you can choose your favorite unit system between METRIC and IMPERIAL unit systems.

- Activate the SYS submenu (located in the CFG menu) by pressing the menu key below it.
- Select the function item titled UNITS. You'll note that the following options are available:
  - METRIC-metric unit system.
  - IMPERIAL-Imperial unit system

## 5.19 The unit of measurement will be set to the choice last displayed. Scale Setting

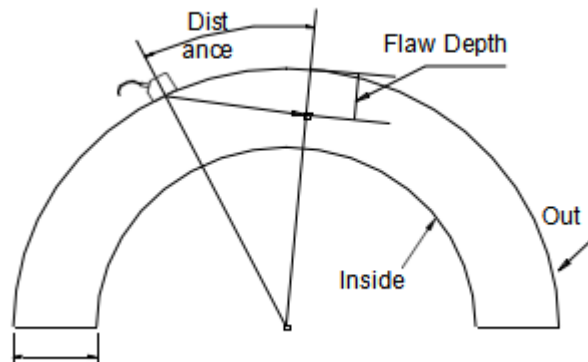


As an alternative to the measured values, the instrument enables to display a scale on the first status line. The scale gives you an overview of the position of echoes.

The following settings are possible:

- Sound Path: Display of sound path scale
- Horizontal: Display of projection distance scale
- DEPTH: Display of depth distance scale
- Out Race: Probe locate outside of Curved'
- Inner Race: Probe locate inside of Curved surface

Curved Surface Correction: When using angle beam transducers on a curved surface the instrument will calculate the surface distance and depth of defect, taking into account the internal or external radius.



**THICK:** Use the **THICK** function to set the material's wall thickness. This value is required for the automatic calculation of the real depth.

Adjustment range: 0~5000 mm

**Diameter** (Outside diameter of the test object): You will need the **CSC** function for tests on circular curved surfaces, for example when testing longitudinally welded tubes. In order to make the instrument carry out the corresponding correction of (reduced) projection distance and depth, you should enter the outside diameter of your test object in this function.

Adjustment range: 0~5000 mm

Select the function **SCALE**. Then use the knob to set the required display mode..

## 5.20 Setting the Display Brightness

Use the function **BRIL** to set the display brightness.

- Activate the **CFG** submenu. 8 functions will appear down the right side of the display screen.
- Select the function item titled **BRIL**.
- To change the brightness level, turn the knob.
- The display brightness will remain at the level last displayed.

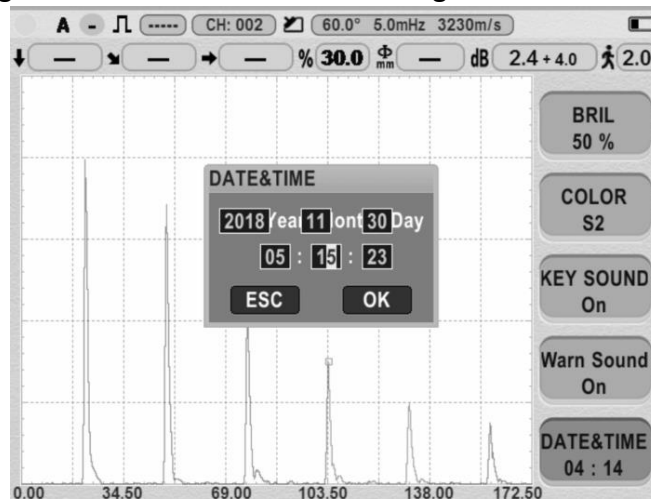
Note: For the 20% option, the instrument consumes less current and consequently increases the operating time in battery operation.

## 5.21 Key Sound

The key sound can be turned on or off using the **KEY SOUND** function located in the **CFG** submenu (**CFG**→**KEY SOUND**).

## 5.22 Date and Time Setting

For a correct documentation you should always make sure that you are using the correct date and time setting.



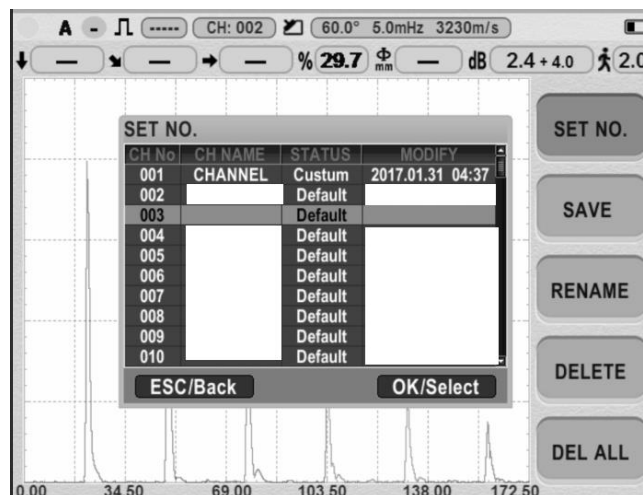
Time is displayed in Hour-Minute format. And the time setting procedure is similar to that of the date.

Once set, the internal clock of the instrument will maintain the current date and time.

## 5.23 Resetting the Instrument

In case the instrument can no longer be operated, or you need to make a basic initialization (factory setting), you can reset the instrument to original.

The instrument can be reset by the SET RECALL function. Load a setting with default set.



Any empty set is a setting with default set.

During system reset, the instrument settings will be reset to default, but the saved settings and the reports will be reserved.

### NOTE:

1. The effects of resetting the instrument may not be reversed.
2. No key action should be performed during resetting process

## 6. Maintenance and Care

### 6.1 Care of the Instrument

Clean the instrument and its accessories using a moist cloth. Only use the following recommended instrument cleaners: water, a mild household cleaner or alcohol (no methyl alcohol).

**Attention:**

Do not use any methyl alcohol, solvents, or dye penetrant cleaners! The plastic parts can be damaged or embrittled by this.

### 6.2 Care of the Batteries

Capacity and life of batteries mainly depend on the correct handling. Please therefore observe the tips below.

You should charge the batteries in the following cases:

- Before the initial startup
- After a storage time of 3 months or longer
- After frequent partial discharge

### 6.3 Maintenance

The instrument requires basically no maintenance.

**Attention:**

Repair work may only be carried out by authorized Service staff of us.

### 6.4 Warranty

When used in accordance with the manufacturer's written instructions and under normal operating conditions, the instrument is conditionally guaranteed to be free from defects in material and workmanship for a period of two years from date of shipment.

This warranty shall not apply to equipment subjected to misuse or abuse, improper installation, alteration, neglect, or accident. Excluded from this warranty are expendable items such as transducers, interconnecting cables, and batteries.

This warranty is limited to the original purchaser and is not transferable. No other warranty, expressed or implied, is made.

### 6.5 Tips on Safety

The design of the instrument meets safety standard. During the operation, it shall meet the specified external ambient condition, and the operator shall be furnished with concerned technology background, so as to guarantee safe operation.


**Note:**


1. **This instrument is a non-destructive inspection instrument for inspecting material, it is not allowed to use as a medical instrument.**
2. **The instrument is limited to be used in lab and industrial environment.**

# Appendix

## Appendix A: Charging the Batteries

The approximate level of remaining battery life is visually displayed by the battery indicator. When fresh batteries with full capacity are installed, the icon

will appear as . As the battery life is consumed, the icon will begin to “empty”. When the battery indicator is almost empty as indicated by the

symbol , charge the batteries as soon as possible. You may take a second battery pack or replacement battery pack with you if you cannot connect the instrument to mains.

The instrument automatically shuts off when batteries are too weak for reliable operation. Settings are saved and restored when the instrument is turned on again.

You can charge the lithium-ion battery pack either directly in the instrument or by means of an external battery charger provided with the instrument.

### **Attention:**

*You should only use the batteries provided by us and the corresponding battery charger. An improper handling of the batteries and of the battery charger may cause explosion hazard.*

If a battery pack is located in the instrument, the charging process is started automatically when you connect the plug-in power supply unit. You can carry out ultrasonic inspections and charge a battery at the same time.

The charging time is about 10 hours with a simultaneous ultrasonic inspection. If the instrument is not being used for ultrasonic inspections, the charging time is about 4 hours. This charging time applies to ambient temperatures from 25 to 30

°C. Please take into consideration that the batteries are not charged to their full capacity at higher temperatures.

The POWER LED display at the top-right corner of the keypad indicates the status of the charging process. It will flash red/green during the charging process. And the flash will stop when the charging process stops.

### **Note:**

- The battery pack should be charged over a period of time, even not used.
- The instrument can only work with the specially designed battery pack and power adapter (charger) supplied by us. Working with others may result in damage of the instrument, battery leakage, fire or even explosion.

