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EMU-S340
BLACK AND WHITE ELECTROMAGNETIC ULTRASONIC THICKNESS GAGE

OPERATION MANUAL

PLEASE SCAN QR CODE TO WATCH THE OPERATION VIDEO OF PRODUCTS.

VIDEO

Edition instructions

(V1.0 June, 2023, edition)

Dear Customer:

You are welcome to use our products and equipment. We hope that our products can provide more convenience for your work and become a good assistant in your work.

Please read this user manual carefully and follow the instructions in the manual.

If you have any questions during use, please feel free to call. Our service hotline will always provide you with the best service.

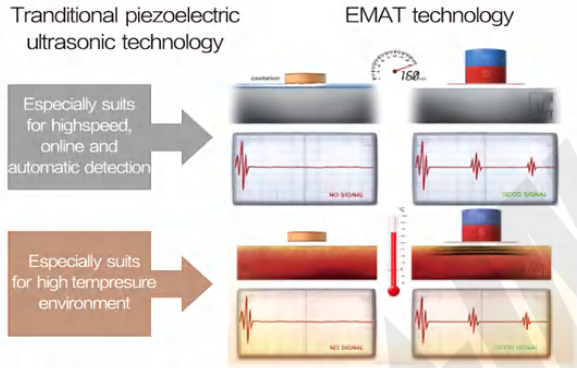
When you receive the product, please carefully check the product against the shipping list. Products and accessories are subject to the shipping list.

If the contents of the instruction manual are subject to change, please refer to the latest version without prior notice. We apologize for any inconvenience caused.

CONTENT

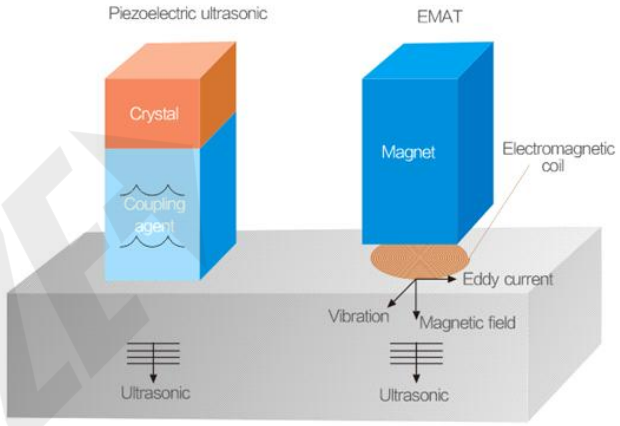
1.Brief introduction

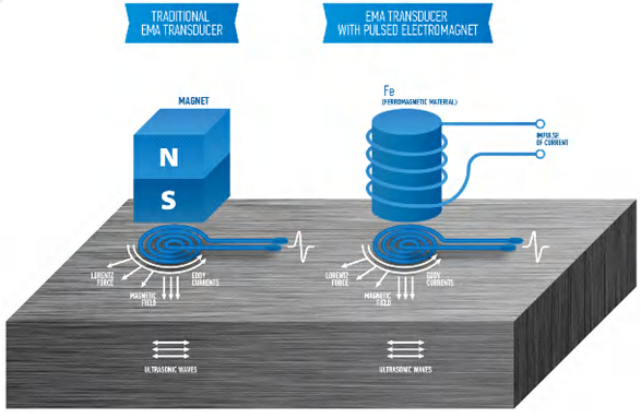
This non-contact thickness gauge is used to measure the tube/plate/bar of steel and steel alloy and the tube/plate/bar of aluminum alloy without surface polishing and without using coupling agent， sensor and the interval between the test object up to 4mm. The thickness can be measured directly through the paint, varnish, anticorrosive layer, enamel and plastic.



Technical comparison of tranditonal piezoeletric ultransonic technology and EMAT technology in high speed and high tempresure environment.

EMAT technology has been applied to manual, semi-automatic and fully automatic on-line non-destructive testing of various forgings, steel bars, steel plates, and steel pipes (including seamless steel pipes, oil casings, welded pipes, etc.) at room temperature and high temperature.





2.Functional features.

2.1 No need for surface polishing, penetration of anti-corrosion coating and rust, and no need for coupling agent.
2.2 Thickness measurement can penetrate surface corrosion, paint, corrosion protection and other coatings up to 4mm thick. The thickness value of metal objects displayed by the instrument does not need to consider the calculation of coating thickness.
2.3 Pulse probe at Normal temperature uses pulse electromagnet, basically no magnetic force; The weak permanent magnet is used for normal temperature and high temperature permanent magnet to replace the strong permanent magnet. It completely solves the problem that EMAT transducer suction is too large and difficult to remove, thus making manual spot inspection easier and safer.
2.4 Optional high temperature probe to detect high temperature components at 800℃.
2.5 With the function of temperature compensation, the actual temperature range of high-temperature components can be input to automatically compensate the change of speed, making the thickness measurement more accurate.
2.6 Measurement non-perpendicularity (transducer/probe to the normal line of the object to be tested) is up to ±25°, which requires less perpendicularity after the probe is placed.
2.7 It has the function of showing thickness measurement results in A-scan form and (time-based)B-scan image form and storing and querying, and allows users to set measuring parameters such as gate, thickness measurement mode and signal processing.
2.8 Using expert intelligent algorithm, there are three thickness measurement modes: automatic mode, single gate manual mode (single peak method), double gate manual mode (peak to peak method).It greatly reduces the influence of human factors and simplifies the operation steps.
2.9 Built-in database of basic material S-wave speed, and can customize S-wave speed value.
2.10 It can store 50000 thickness values and 4000 A-scan or B-scan data.
2.11 The back is integrated with bright LED light, which is convenient for on-site lighting.

2.12 A wrist band is integrated on the back for easy one-handed operation.
2.13 AC-DC hybrid power supply, built-in rechargeable lithium battery can work continuously≥9 hours.
2.14 Measurement data can be transmitted via USB to the upper PC for analysis and management.
2.15 Fully sealed IP66 dustproof and waterproof design, silicone sheath anti-drop and anti-vibration design, more suitable for bad working conditions.

3.Technical parameters

3.1Thickness measurement: accuracy 0.04mm with range 1.5~100 mm(steel, 304 stainless steel), 0.1mm with range 100~200 mm(steel, 304 stainless steel), high temperature compensation thickness measurement accuracy 2%
3.2Minimum resolution: flat bottom blind hole Φ5mm
3.3 Working gap/lift: normal temperature permanent magnet probe ≤4mm(**Range** 3~200mm), high temperature permanent magnet probe ≤2mm
3.4Measurement unverticality (transducer/probe normal to the object under test) : ±25°
3.5 Excitation frequency：3.0~3.9MHz Measuring speed：16~1次/s
3.6 Minimum diameter of curvature: ≥6mm
3.7Sound speed range: 1000~9999 m/s, adjustment increment 1m/s
3.8Gate function: automatic gate, manual single gate, manual double gate
3.9Display: color LCD, 3.5 inch/320×480 pixel
3.10Communication interface：USB2.0
3.11 Size and Weight: height 195×width 90×thickness 40mm, ≤820g 3.12 Normal temperature pulse probe: pulse type electromagnet, the magnetic suction≈0N, circular Φ30×high 44mm, weight≤60g, line length 0.8m
3.13 Normal temperature magnetic probe: weak or less permanent magnets, the magnetic suction≈15N, circular Φ30×high 44mm, weight≤80g, line length 0.8m

3.14High temperature permanent magnetic probe: the magnetic suction≈20N, circular Φ45×length 300mm weight ≤370g，line length 0.8m
3.15Working Temperature: normal temperature probe -10~+60℃, high temperature probe -50~+800℃(-50~+310℃ can be continuously measured without special cooling; At +310~800℃, each measurement time ≤5s, cooling interval time ≥15s)

4.Working principle and structural characteristics

Figure 4-1 overall structure

The system is mainly composed of host, cable, probe / sensor [normal temperature permanent magnet probe, (optional) normal temperature pulse probe, (optional) high temperature permanent magnet probe], power adapter (charger) and so on.

The basic principle of electromagnetic ultrasonic thickness measurement is that the sensor generates ultrasonic signals in the workpiece through electromagnetic coupling phenomenon, and some ultrasonic signals are reflected back from the bottom surface of the component (referred to as echo). The sensor receives the reflected echo from the bottom surface of the measured workpiece by the inverse electromagnetic coupling phenomenon ***(usually using the highest peak point of the echo)*** to accurately calculate the round-trip time of the ultrasonic wave, and calculates the thickness value of the measured workpiece according to the following formula, and then displays the calculated result come out.

H = v · t/2 in the formula：H:measures thickness,
V:material speed (can be calibrated by standard test block calibration),
t:the propagation time of the ultrasonic wave back and forth in the component.

4.1**Probe /Sensor**
1)The operating temperature of the normal temperature permanent magnet probe is in the range of -10 to +60℃. For components with a slightly good surface quality and dense inner material, generally use a normal temperature pulse probe for measurement, or a normal temperature permanent magnet probe or a high temperature permanent magnet probe for measurement; for poor surface quality (more concave or corroded), internal material Slightly loose (such as duplex stainless steel, austenitic stainless steel, cast iron, etc.) Generally, it is measured using a normal temperature permanent magnet probe, or it can be measured using a high temperature permanent magnet probe.
2)High temperature permanent magnet probes are required for components from 50 to 800℃. The temperature of the high temperature permanent magnet probe is in the range of -50~ +800℃. Continuous measurement at -50~ +310°C does not require special cooling; at +310~800℃, each measurement time is≤5s, and the cooling interval is≥15s. When measuring high temperature components: (1) first select "high temperature permanent magnet EMA-HT probe" in the Main setting;(2) select the material to be

tested in "calibration→material" (the instrument can adjust the temperature compensation curve of this material) (3) In the Main setting;select the temperature of the standard test block to be the closest value; (4) calibrate by the speed method or the thickness method; (5) finally select the current surface temperature of the tested component in the Main setting
3)For high temperature components greater than 100℃, the A-scan echo quality difference/noise/signal-to-noise ratio difference may occur, which may cause the automatic thickness measurement value to be unstable. At this time, the automatic thickness measurement mode may be turned off, and 1 gate or 2 gate mode.
4)Probe cable: the normal temperature pulse probe uses two cables (one 2-core black sheathed cable and one 3-core gray or blue sheathed cable); the normal temperature permanent magnet probe and the high temperature permanent magnet probe share one 2-core black sheathed cable; the cable plug and socket have (red dot) alignment mark, first insert the good mark and then gently insert it. In the field and dust environment, pay special attention to prevent dust particles from entering the socket core.

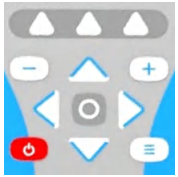
Attention: 1) Main setting → Sensor: Select the probe type (normal temperature permanent magnet EMA, normal temperature pulse EMA-IMP, high temperature permanent magnet EMA-HT). If the ambient temperature pulsed EMA-IMP probe is incorrectly selected as EMA or EMA-HT, it will result in inability to excite the pulse/no vibration, no measurement---, or the thickness measurement value is obviously wrong; if the Normal temperature permanent magnet EMA, high temperature permanent magnet EMA -HT probe, which is incorrectly selected as EMA-IMP, results in a longer single measurement time and a slightly higher temperature measurement error.
2) The Normal temperature permanent magnet probe and the high temperature permanent magnet probe have magnetic attraction. When testing ferromagnetic components, wear protective gloves and take special care: hold the probe or its handle tightly, place the edge of the probe on the workpiece to be tested at a certain

angle of inclination, and then gently put it in a vertical position. When removing the probe, first raise the probe to a certain angle of inclination and then pull it up. Do not directly hit the tested component and directly pull the probe.

4.1**Keyboard function**

Multi-function button
(the upper screen will prompt the current function)
▲: Move up, page up, zoom in

—: Reduce, right switch
◄: Left shift, left page turn



+: Increase, left switch
►: Right shift, right turn

⏻: Switch (press and hold for about 3s to boot, Press and hold for about 3s again to shut down)

☰:Main setting, return, press once to enter the Main setting interface, press again to return to the measurement interface

O: Enter, select, confirm, execute, save
▼: Move down, page down, zoom out

Among them —,+, ▲, ▼, ◄, ► will respond every time user press it,and will respond continuously when user press it long.

Figure 4-2

5.Method of operation

The "Precautions" on the front page must be strictly implemented. Before the official use, ensure that the battery is fully charged, and the components of each unit are fixed and reliable, and the wiring is correct (Figure 4-1). Note:【XX】represent button, < XX> represent reference, ···→represent next step.
Attention: Please pay attention to the full charge when using, low power (<1 grid 10%, flashing will indicate underpower), the energy stimulated will be low, the liftoff will be slightly lower, even the A-scan waveform but the thickness The value is only displayed - but no number; when the battery is under voltage, the error will be slightly larger when the current thickness value is calibrated, and the electromagnetic pulse probe will no longer be excited or the excitation amplitude is weak/vibration weak.

5.1 Main setting

Press ☰ once to enter the Main setting interface, and press again to return to the measurement interface. When the current window bar is displayed in purple, user can press ▲, ▼ to move to the window bar to be modified···→press O once to display green, then press ▬、＋to modify···→press O to confirm the modified value And remember, the current window bar will be displayed in purple again. The default is as follows:

Main setting	
Light	OFF
Accumulation	128
A-scan	Filtered
Algorithm	Auto
Gates	Edit
Auto gain	ON
Imp. count	2
Frequency	3.0 MHz
Sensor	EMA
Object temp.	25° C

Figure5-1 main setting
(default recommended value)

Light: OFF, ON, control the backlight LED light. When it is on, it will appear on the upper right side of the screen. After rebooting, it will default to “OFF”.

●Accumulation: The number of slips of the coherent integration algorithm in the calculation of the thickness value, referred to as the number Accumulation, the coherent integration algorithm can significantly improve the signal-to-noise ratio, thereby improving the thickness measurement accuracy. This parameter is important and will have a significant impact on: data stability, single measurement time, and especially on lift height. The larger the value, the larger the degree of lift, and the longer the single measurement time (single measurement reaction time is approximately equal to the accumulated value of ms milliseconds); it is recommended to set it to 64~256, try to measure at 128 (single measurement time is about 128ms). For large lift height, poor surface quality (more serious than convex or concave or rust), loose internal material (such as cast iron), when the thickness data jumps, it should be set to 128 or 256 or even 512. The excitation frequency of the electromagnetic pulse probe is controlled by the number Accumulation, and the larger the Accumulation number, the lower the excitation frequency.
●A-scan: A-scan waveform display mode during A-scan: Original (original RF wave), Detected (full detection is forward unipolar), Filtered (full detection is positive unipolar and Digital envelope filtering is performed to automatically filter out baseline noise clutter and slightly increase the lift clearance).
●Algorithm: The method of calculating thickness based on waveform: ①Auto: Automatically calculate the thickness value without the gate, which greatly simplifies the operation steps. ②1 gate (single peak method): manually move the single gate, the distance between the start wave and the echo peak point spanned by gate 1 is the current thickness value, and gate 2 is invalid /not involved in the calculation. ③2 gates (peak-to-peak method): the manual moving gate 1 spans to the first echo, and the manual moving gate 2 spans to the second echo. The distance between the peak points of the two echoes is the current value. Thickness value. It will default to "Auto" after rebooting. Attention: The waveform of the instrument shows that the blind zone is about 5mm, and the thickness of the workpiece is less than 5mm.

The first echo of the workpiece will be hidden in the blind zone. The single gate is actually stuck on the second echo, so it will be mistakenly measured as 2 times the thickness value. Need to use automatic or double gate algorithm, cannot use single gate algorithm.

●Gates: It is only included in the thickness calculation when the algorithm is selected as single gate (single peak method) and double gate (peak-to-peak method). When the algorithm is automatic, although the gate can also be edited and moved, it is not included in the calculation. Gate 1 is red, gate 2 is green, and the editable state is sky blue. ▬、＋change the width of the gate (every press will increase it, it will decrease continuously when long press), ▲、▼、◄、►move the gate position (every press will move once, long press will move continuously). When the gate moves to the vertical top or bottom of the screen, the automatic limit will no longer move. When the gate moves to the leftmost or rightmost level of the screen, it will automatically change to a point no longer moving, indicating that it is outside the display area of the screen, and it needs to be reversed multiple times or consecutively to move back to the screen display field.

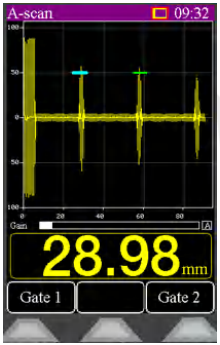


Figure 5-2

Attention: 1) When the material of the component is poor, the temperature is higher than 100℃, and the shape is narrow, the sidewall reflection interference wave, the A-scan echo quality difference/noise/signal-to-noise ratio difference may cause the automatic thickness measurement value not to be Stable jump, user can turn off the automatic thickness measurement mode, and use single gate or double gate mode.
2) Single gate (single peak method, using gate 1 in thickness calculation, gate 2 invalid / not involved in calculation) and double gate (peak-to-peak method, gates 1, 2 are included in thickness calculation), gate level The left and right positions affect the thickness measurement value, and the vertical position of the gate does not affect the measurement result.
3) When the gate is not visible, please carefully check the peripheral side of the screen. There should be a red point (gate 1), a green point (gate 2), and a sky blue point (selectable for editing). Indicates that the gate is outside the display area of the screen. User need to press ◄、►、▲、▼multiple times in the opposite direction to move back to the screen display field.

● Imp. count: The number of single electrical signal pulses that excite electromagnetic ultrasound. This parameter is very important and will affect the stability and certainty of the peak of the echo. If the number of pulses is not appropriate, it may result in: large echo noise/signal-to-noise ratio difference, high peak level sway or wave top alternately high and low Multiple seams can cause incorrect and unstable thickness measurements. Usually: the number of pulses in the thin material (thickness < about 2mm) workpiece is 1, the number of pulses in the medium thickness (about 2mm≤thickness about 80 mm) is 2, and the number of pulses in the thick material (about 80 mm < thickness) is 3. After rebooting, it will default to 2. If the number of pulses is changed during the measurement, it needs to be recalibrated (see 5.3) re-measurement, otherwise the error will be slightly larger or even worse.

● Auto Gain: √ ON: Automatically adjusts the gain (the amplification factor of the echo signal), but the single measurement time will be slightly slower. The middle of the A-scan measurement interface will display **A** on the right side. The single measurement

time will be slightly longer. OFF: by manually pressing━、＋to adjust the gain, the single measurement time will be significantly faster. The middle right side of the A-scan measurement interface will be displayed. (When the gain indicator bar is reduced to the leftmost side, user need to press it a few more times to reduce to the minimum value.). It will be " √ ON" by default after restarting, some components (poor surface quality, etc.) may cause the gain to not stabilize automatically, or block at the fullest grid without waveform and no thickness, at this time, the automatic gain can be turned off, manually adjust the gain **M** The gain should not be too large, otherwise it will cause the (any echo) peak to be over-cut and not measured---.

Figure 5-3

Attention: 1) The instrument usually uses the sound path at the highest peak point of the echo to calculate the thickness value. The vertical up and down sway of the highest peak generally does not affect the thickness measurement; the highest peak level sways and the wave top alternates. Multiple seams can cause incorrect or unstable thickness measurements.
2) The surface quality of the components is poor (the upper and lower surfaces are uneven, pits, cracks or slopes, etc.), and there are large discontinuities in the interior (slag inclusion, pores, delamination, buried cracks, buried convex and concave slopes), probe bottom distance The surface of the component to be inspected is far away (the gap, the coating, etc. are too thick), which may result in poor echo quality, large noise / signal-to-noise ratio difference, and even no echo, which may result in incorrect thickness measurement or even no thickness measurement. Turn off the automatic mode in the algorithm and use single gate or double gate mode.
3) If the thickness measurement is abnormal (unstable or wrong), it is advisable to observe the waveform quality of the A-scan first:

①ensure that there is at least one (preferably more than two) bottom waves; ②the signal-to-noise ratio is better (the noise is small) , echo and clutter can be more clearly separated, if the echo and noise are mixed, it is difficult to distinguish, especially the thin workpiece of 0.X-1.Xmm, it will be difficult or impossible to measure the stability); ③20%≤echo amplitude The value is relative to the full screen≤90%; ④the highest peak level is stable around and the wave top is not alternately high and low. If the waveform quality is not good, the main setting [Algorithm (Auto or 1 and 2 gate), Probe /Sensor , Imp. count, Frequency, Voltage, Auto gain, Accumulation, Detection mode, etc.] are not suitable or cannot be Test the components of this material.

●Frequency: When the frequency is high, the measurement accuracy is slightly higher, but the ultrasonic penetration capability is slightly lower; when the frequency is low, the measurement accuracy is slightly lower, but the ultrasonic penetration capability is slightly stronger. For thin or internally dense components, a slightly higher frequency is generally used to achieve a slightly higher measurement accuracy; for thick or internal loose (such as cast iron) components, a slightly lower frequency is generally used to achieve a slightly higher penetration. If the frequency is changed during the measurement process, it needs to be recalibrated and then measured again (see 5.3), otherwise the error will be slightly larger or even worse.
●Sensor: Normal temperature permanent magnet EMA, normal temperature pulse EMA-IMP, high temperature permanent magnet EMA-HT, see <4.1 Probe /Sensor>.
●Temperature to be measured: Select the closest value of the current surface temperature of the tested component (for example, 320℃ set as 300℃ and 330℃ set as 350℃), the instrument will automatically calculate the speed to calculate the new speed value. To make the thickness measurement more accurate. See <4.1 Probe / Sensor 3 > .

5.2 System setting
Press ☰ once to enter the Main setting interface···→press"⏶ System"to enter the setting interface. When the current window bar is displayed in green, press ▲、▼ to move to the window bar to be

modified···→press **O** once to display purple, press **—**、＋to modify···→press **O** to confirm the modified value. And remember, the current window bar will be displayed in green again. The default is as follows:

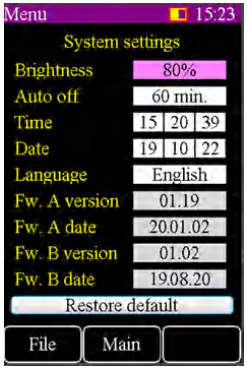


Figure 5-4 system settings
(default recommended value)

●Brightness: 5 levels of screen brightness adjustment, 20 40 60 80 100%.
●Language: 3 system languages, Russian, English, Chinese
●Auto off: After a certain period of no button operation, the instrument can automatically shut down to save power. NO (no shutdown), 5, 15, 30, 60 minutes.
●Time: The internal clock of the instrument is modified, hour, minute, and second (top right of the screen **17:42**
●Date: The internal calendar of the instrument is modified, year, month and day.
Firmware A version, firmware A date, firmware B version, firmware B date: The program firmware ID inside the instrument, the user does not need to modify.
●Restore default: Restore most (not all) parameters to factory defaults. When the parameter modification is confusing, the

instrument works abnormally (with waveform but not measured, display is not complete, etc.). The default value can be reset as follow.

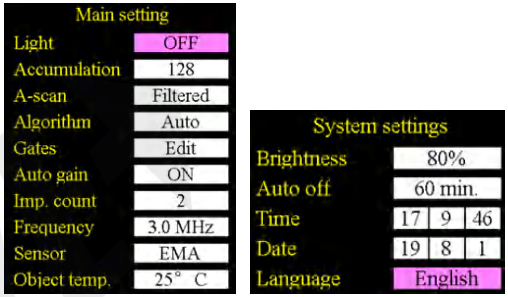


Figure 5-5 restore default (recommended value)

5.3 Calibration

Before the formal thickness measurement, it is necessary to calibrate at one temperature (usually 25±10℃, relative humidity ≤85% R.H) using one of the three methods of"sound speed, thickness, material". If the frequency or number of pulses is changed during the measurement, it needs to be recalibrated and then measured again, otherwise the error will be slightly larger or even worse.
Press" Calib."in the measurement interface to enter the calibration interface.

Figure 5-6

●Speed calibration: directly modified to the known speed of sound of target workpiece. Press “ ”
●Speed”···→press◄、►to move to the position to be modified ···→press▲、▼or ▬、＋ to modify the number···→press **O** to confirm the modified value and remember. Recommendation: firstly, the thickness method is used to automatically calculate the speed value, and then the speed method is used for calibration. Manually adjusting the speed value makes the calibration result more accurate.
●Thickness calibration: use the same material as the material to be inspected (note: not a standard test block that is randomly equipped) and the test piece with the known thickness value is calibrated. The thickness of the test piece is as close as possible to the theoretical thickness of target workpiece. The probe should be placed on the test block first (if it is not placed on the test block, the thickness value will be displayed as 0 and the thickness value cannot be input. If the thickness value is forcibly calibrated, the sound speed value of the instrument will be exceeded and the measurement will not be performed. Only display --- even the screen flashes. At this time, user need to manually modify the sound speed value to 1000~9999 or turn it off again (default is 1000) to work normally), press “ thickness”···→press◄、► to move To the position to be modified···→press ▲、▼or ▬、＋ to modify the number···→press O once to confirm the modified value and remember. The instrument calculates the speed value in reverse according to the input standard thickness value, and then calculates the actual thickness value by using the speed value in the forward direction. Therefore, the thickness method calibration deviation is slightly larger than the speed method. If the calibration result is not very accurate. , can repeat 3 to 4 calibrations, or use speed calibration.
●Material method calibration: Select the corresponding material speed from the material's shear wave speed list (the speed at 25℃ in the list). Press “ Material”···→press ◄、►to move to the material user want to select → press O to confirm. The material list is the standard sound speed at 25℃, and the instrument will calculate the new speed value by combining " Main setting ≡ → measured temperature".Attention: When

measuring high temperature components: (1) First select“High temperature permanent magnet EMA-HT probe”in the ≡ Main setting; (2) Select the material to be tested in “Calib.→ Material” (the instrument can transfer the material); (3) Then select the temperature of the standard test block to be the closest value in the ≡Main setting; (4) calibrate by the speed method or thickness method; (5) Finally select the measured component in the ≡ Main setting. The current surface temperature is the closest value (for example, 320℃ set as 300℃ , 330℃ set as 350℃). After the above operation, the instrument will automatically compensate the sound speed to make the thickness measurement more accurate. Otherwise the measured value may be incorrectly temperature compensated and not accurate.

5.4 Measurement
It has simple, A-scan, (time-based) B-scan display measurement results, and can store, query, and delete measurement data/waveform. The top of the screen is the status bar: the left side is the current interface indication, and the right side 17:42 is the illumination LED light, battery power, and instrument clock.

▬、＋、▲、▼、◄、► in <4.2 Keyboard Function> will respond once every time user press it, and will respond continuously when user press it long. All parameters (including algorithm, gate, gain) in <5.1 Main setting> are valid for all three types of measurement interfaces.

5.4.1Simple Mode
Press“ Simple”to enter the measurement interface. The upper left side of the screen is the sensor/probe type (normal temperature permanent magnet EMA, normal temperature pulse EMA-IMP, high temperature permanent magnet EMA-HT), the upper right side is the current sound speed m/s, the middle is the current The thickness value mm and the lower part are grouped lists of data saves or queries.

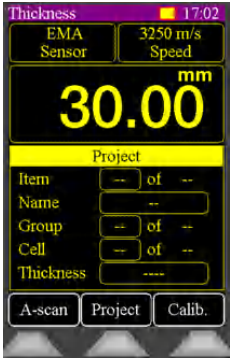


Figure 5-7

●Data grouping ,new creation ,saving

Press “ Project”···→press “ New”···→Edit project name: Press ▲、▼、◄、►、**O** to edit the project name on the virtual keyboard, press ▲、▼、◄、► to move to virtual Enter the keyboard, press **O** to confirm and exit the virtual keyboard···→ edit the number of groups: the current project will be divided into several groups of space, press ◄、► to move the edit position, press ▲、▼ or ▬、＋ to modify the number, press O to confirm and Exit ···→Edit Grid: Each group will be divided into several cells. Press ◄、► to move the edit position, press ▲、▼ or ▬、＋to modify the number, press **O** to confirm and exit.

Figure 5-8

The function keys of the virtual keyboard are: letters, numbers, symbols, switch numbers or letters 123/ABC, switch letter caps, Space, move edit position ← →, delete Bck forward, confirm and exit Enter.

As shown in the figure above: There are 4 projects, currently the first project, the project name is A1; there are 5 groups of data under the current project, now the second group; there are 6 cell data in the current group, now the 3rd Group cell, the stored thickness value is 32.00mm. Each time user press **O**(from the last item), a thickness value is saved, and the number of cells and the number of groups are automatically increased until the number of groups and the number of cells are full.

●Data group query, delete /clear

Figure 5-9

Press ▲, ▼ to move to (Items, Groups, Cell) to edit the position ···→press ▬、＋ to modify the number, display the saved thickness value in the thickness column···→press "Delete / Clear”the confirmation dialog box will pop up ···→Press ◄、► move to “NO”or “YES”, press **O** to cancel or confirm, only the current item, or the current group, or the current cell thickness value will be deleted separately· ···→Press “ Delete all /Clear all”to pop up the confirmation dialog box ···→Press ◄、►move to “NO”or“YES”, press **O** to cancel or confirm, delete all items, or under current project The thickness value of all groups, or all cells under the current group.

5.4.2 A-scan

●A-scan: See <5.1 Main setting A-scan> for corresponding setting.

Press “ A-scan” to enter the measurement interface. The A-scan waveform has the Original (original RF wave), the detection Detected (the full detection is forward unipolar), and the Filtered (the full detection is forward unipolar and digitally packaged. The network filtering can automatically filter out the baseline noise clutter and slightly increase the lift clearance. Press ▲、▼ to zoom in and out, press ◄, ► to move left and right to view the waveform details. The A-scan range will be automatically locked to 200mm steel. (For example, stainless steel, aluminum, copper, etc., the thickness of the transverse wave is 200mm thick, the A-scan echo will be displayed at the edge of the screen at 200mm and cannot be seen.) When user want to see >200mm waveform, press ▲≥5 times→ press ►≥5 times→ press▼≥5 times.

Figure 5-10

●Algorithm setting: see <5.1 Main setting Algorithm> for corresponding setting.

In A-scan measurement interface, the similarities and differences of the three automatic thickness measurement algorithms of “ automatic, single gate (single peak method) and double gate (peak-to-peak method) can be visually seen, and the gate can be easily edited and moved. Adjust the manual gain.

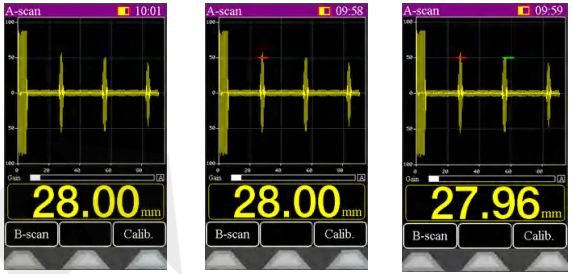


Figure 5-11

●Gate edit movement: See <5.1 Main setting Gate> for corresponding setting.
●Manual gain adjustment: Refer to <5.1 Main setting Auto Gain> for corresponding setting.
●Data saving
In A-scan measurement interface, each time user press **O**, a data record is saved (file name is ASCAN_year YY. month MM. day DD -hh: minute mm: second ss), the newly saved file will be at the most in the list. Upper end.
●Data query，deletion
Press once to enter the Main setting interface···→press “ File” to enter the file record management interface···→press ▲, ▼ to move to the edit position···→press **O** once to view, once again O return to file record management Interface ···→Press “ Delete” to pop up the confirmation dialog box ···→Press ◄, ►Move to “NO” or “YES”, press **O** to cancel or confirm, only delete the current record file ···→Press “ Delete All” to pop up the confirmation dialog box ···→press ◄, ► to “NO” or “YES”, press O to cancel or confirm, delete all log files all the time (wait a few seconds for all deletions, The prompt will disappear automatically after the record is cleared.

Figure 5-12

5.4.3(Time-based) B-scan

The instrument uses the internal clock for "time-axis based B-scan" measurements, with the Y-axis representing the thickness value (mm) and the X-axis representing the time (seconds).

●Measurement, save

Press “ B-scan” to enter the measurement interface···→

Press “ 30~300s” to start recording data continuously. The

hand-held probe is close to the detection surface of the tested component, and the probe is slowly moved at an average speed. 30~300s means the X-axis duration time (s). Each time user press **O**, a data record is saved (file name is BSCAN_year YY. month MM. day DD-hh: minute mm: second ss), and the newly saved file will be at the top of the list.

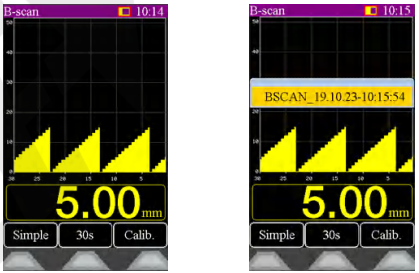


Figure 5-13 B-scan

Y axis: thickness value mm、X axis: time

●Data query, delete: see < 5.4.2 A-scan Data query, delete >

5.5 Basic Operation Process Steps

1)Preparation: On-site environmental inspection···→Select the appropriate probe /sensor (transducer) according to the object to be inspected···→Connect the probe cable.

2)press and hold for about 3s and wait for about 5s to start the instrument to the measurement interface, and observe whether the power (the power indicator on the right side of the screen) is sufficient. If the battery is less than 1 grid (10%), it will flash to indicate that the battery is lack of power. Please connect the power adapter to charge to 4 grids (40%) or work directly with the charger.

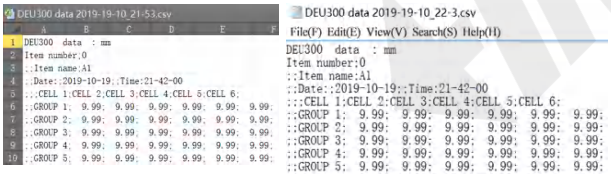
3)Press once to enter the Main setting interface, set the appropriate detection parameters, screen brightness, turn the light on or off, and press again to return to the measurement interface.

4)Press the corresponding (multi-function button) for speed or thickness calibration, which can be calibrated on a standard test

piece of known thickness of the same material.
5)Press or adsorb the probe (transducer) at the detection point of the component. After the thickness data is stable, user can save it by press **O.** Move the probe to the next detection point. After the thickness data is stable, press **O** once. Save it···→…… until all the test points have been measured.
6)In the"Simple" mode, use the 、▲、▼、━、＋、**O** buttons to query or delete the thickness value; in ☰ Main setting ···→File, then press 、▲、▼、◄、►、**O** buttons to performs A-scan, (time-based) B-scan data query or deletion.
7)After the work is finished, press ⏻ and hold for about 3s, and wait until the instrument is turned off to the black screen.
8)After work: clean the probe, cable and its connector···→remove the cable, place the components in the corresponding slot of the special anti-vibration box ···→count all parts without missing ··· → box lid And fasten.

Attention: If the instrument crashes during operation (some accidental factors may be caused) (the button does not respond, cannot be turned off, etc.), user can press ⏻ and ◄ at the same time, and then press ⏻ and hold for about 3s to restart.

5.6 Data export and management
<5.4.1 simple mode > saved thickness value grouping data (Excel format.csv),< 5.4.2 A-scan > and < 5.4.3 B-scan > saved image data.jpg，can be automatically imported into the PC



View in Microsoft Excel　　View in Notepad

Figure 5-14 Thickness value grouping data (.csv)

Install the <DEU100 data management > on PC···→DEU100 device is in shutdown mode first ···→Connect the USB2.0 data cable between the PC and the DEU100 EMA thickness gauge···→run DEU100.exe···→Press ⏻ for about 3s to boot, the PC software will read the instrument data and save it in the data folder in the same directory.

Device communication online status： DEVICE DISCONNECTED、CONNECTED。

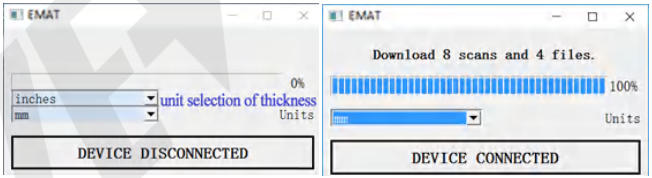


Figure 5-15

Attention: User should first open the DEU100.exe software and then turn on the instrument. If user turn on the instrument first and then open the DEU100.exe software, the following error message may appear.

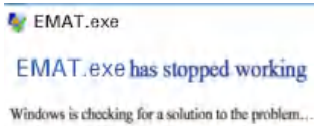


Figure 5-16

6.Maintenance

6.1The use and replacement of the probe protection wear belt
The front end of the probe will inevitably be worn by the workpiece in the process of use, it is appropriate to paste protective wear tape. Normal temperature permanent magnetic probe and use (normal temperature) ordinary wear tape, high temperature probe need to use high temperature wear tape. Please check the wear band at the

front of the probe before use, and replace it in time if it is seriously damaged. Wear-resistant tape replacement steps: clean the front surface of the probe stains···→paste wear-resistant tape, wear-resistant tape for single-sided adhesive mode, tear and paste in the front surface of the probe (Note: the temperature type of wear-resistant tape must match the temperature type of the probe) ···→ excess overhanging edge must be cut off.

6.2There are (red dot) alignment marks on the plugs and sockets of the cable. Aim the mark first and then gently insert it. In the field and dust environment, pay special attention to prevent dust particles from entering the socket core.

6.3When cleaning all parts, it should be wiped with a soft damp cloth. Do not soak or flush directly.

6.4The inside of the instrument is embedded with a DC7.4V /5000mAh lithium battery. It is recommended to replace the battery every 3 years. When the battery is fully charged, the battery indicator on the upper right side of the instrument screen is close to full (95%) display. After a period of use, the battery will automatically decrease; if the power is below 1 grid (10%), it will flash to indicate under power, then user need to connect the power adapter to charge to 4 grids (40%) or more. Working directly with the charger while charging, the battery indicator has a red frame indicating that it is charging.

6.5Try to charge when it is turned off, and the instrument will automatically flash the battery status. It takes 3~4h to complete a charge under normal conditions.

The instrument can work while charging with the power adapter, but it will introduce a small amount of grid noise, which generally does not affect the measurement results. If the ultrasonic noise is found to be large (especially when using a pulse probe), when the measured value is unstable, try to unplug the power adapter and use only the battery for testing.

6.6After use, remember to turn off the power of the main unit to avoid damage caused by over-discharge of the battery. Do not store it for a long time. If it is not used for a long time, please charge and maintain it regularly (about once every 1.5 months, every charge for 3~4h)

6.7When transporting, remove the probe and other components

and place it in the special shockproof box slot, and place the cable in suitable position.

6.8When not in use, please place it in the indoor/car interior, store the ambient temperature -20℃~ +60℃, relative humidity ≤85%, ventilation, non-corrosive gas.

7.Common fault analysis and elimination

Fault phenomenon	Possible cause analysis	Solution
The Device does not start when booting, or automatically shuts down after booting.	The built-in lithium battery is low on power/low voltage	External single-phase AC100~240V power supply, can work while charging
	Ambient temperature is too low ≤-20℃ or too high ≥60℃	Control the temperature of the test environment within the requirements of the equipment parameters.
The battery is not fully charged, or it can be charged quickly but can be used up quickly.	Lithium battery is damaged, or cycle life is over	Replace the battery with a new one，it is recommended to replace the battery every 3 years.
After booting, it will automatically shut down after a period of time.	Check the automatic shutdown time in the system settings. After a certain period of no button operation, the instrument will automatically shut down to save power: NO (no shutdown), 5, 15, 30, 60 minutes	
The screen is too dark or too bright	Check the screen brightness in the system settings: 5 levels of adjustment, 20 40 60 80 100%	
No thickness measurement---, echo signal with	Whether the plug connector between the Probe /Sensor and the host is loose	Check and tighten each connector
	The Probe /Sensor is not on the metal	The Probe /Sensor is not on

ultrasonic wave signal but no strong amplitude	component being inspected	the metal component being inspected
	The sensor/probe type in the Main setting does not match the actual: If the ambient temperature pulse EMA-IMP probe is incorrectly selected as EMA or EMA-HT, it will result in no excitation pulse/no vibration, no measurement—, or significant thickness measurement error.	
	When the thickness method is calibrated, the probe should be placed on the test block first. If it is not placed on the test block, the thickness value will be displayed as 0 and the thickness value cannot be input. If the thickness value is forcibly calibrated, the sound speed value of the instrument will be exceeded. No more measurement but only display – even the screen flickers. In this case, user need to manually modify the sound speed value to 1000~9999 or turn it off again (default is 1000) to work normally. The thickness method calibration deviation will be slightly larger than the speed method. If the results of the 2 calibrations are not very accurate, the calibration can be repeated 3 to 4 times. Recommendation: Firstly, the thickness method is used to automatically calculate the speed value, and then the speed method is used for calibration. Manually adjusting the speed value makes the calibration result more accurate.	
	The electromagnetic pulse probe will normally heat up, and the excitation energy is slightly smaller. For metal materials with a little attenuation of ultrasonic waves, there may be no echo/unexpected thickness---- : for example, duplex stainless steel (the attenuation of one direction to the ultrasonic wave is larger than the other direction) There may be one direction to measure thickness, the other direction is no echo/not measured thickness----; austenitic stainless steel, cast iron, etc. may have no echo/unexpected thickness—-. At this time, it is better to use (highest energy) permanent magnet high temperature or (higher energy) permanent magnet normal temperature probe, it should be able to measure thickness normally.	
	The components of some working conditions (poor surface quality, etc.) may cause the gain to not be stabilized automatically, or A blocked at the fullest grid without waveform and no thickness. In this case, the automatic gain can be turned off and the gain can be manually adjusted. The M gain should not be exceeded, otherwise it will cause (any echo) peak too high to be cut without measuring ---	
	Worst case: Electromagnetic ultrasound technology (including most other brands) does not necessarily measure all metal materials, Even stainless steel has many components.	
Gate position is not visible in gate mode	Please carefully check the peripheral side of the screen, there should be a red point (gate 1), a green point (gate 2), and a sky blue point (selectable for editing). Indicates that the gate is outside the display area of the screen. User need to press ◄、►、▲、▼multiple times in the opposite direction to move back to the screen display field.	

Single measurement time is slightly slower	The sensor/probe type in the Main setting does not match the actual: If the EMA and the EMA-HT probe are incorrectly selected as EMA-IMP, the single measurement time will be lengthened and the high temperature thickness measurement error will be slightly larger. Auto gain: When it is turned on, it will automatically adjust the A gain (the amplification factor of the echo signal), but the single measurement time will be slower; the single measurement time will be obviously faster after the shutdown, but user need to manually press –,+ in the A-scan interface. to adjust the M gain value.
Abnormal (unstable or wrong) measurement of thickness; poor or unstable ultrasonic signal quality	Please pay attention to the full charge when using, the power is low (<1 grid 10%, flashing will indicate underpower), the energy stimulated will be low, the liftoff will be slightly lower, even the A-scan waveform but the thickness value only display - no number; when the battery is under voltage, the error will be slightly larger when the current thickness value is calibrated and other thicknesses will be measured, the electromagnetic pulse probe will no longer be excited or the excitation amplitude will be weak/vibration weak.
	The instrument can work while charging with the power adapter, but it will introduce a small amount of grid noise, which generally does not affect the measurement results. If the ultrasonic noise is found to be large (especially when using a pulse probe), when the measured value is unstable, try to unplug the power adapter and use only the battery for testing.
	Probe type selection error: Main setting →sensor: select probe type (normal temperature permanent magnet EMA, normal temperature pulse EMA-IMP, high temperature permanent magnet EMA-HT). If the ambient temperature pulsed EMA-IMP probe is incorrectly selected as EMA or EMA-HT, it will result in inability to excite the pulse/no vibration, no measurement---, or the thickness measurement value is obviously wrong; if the EMA, the EMA -HT probe, which is incorrectly selected as EMA-IMP, it will results in a longer single measurement time and a slightly higher temperature measurement error.
	The number of Accumulation in the Main setting is important and will obviously affect data stability, single measurement time, especially affecting liftoff. The larger the value, the larger the degree of lift, and the longer the single measurement time (single measurement reaction time is approximately equal to the accumulated value of ms milliseconds); it is recommended to set it to 64~256, try to measure at 128 (single measurement time is about 128ms) . For large lift height, poor surface quality (more serious than convex or concave or rust), loose internal material (such as cast iron), when the thickness data jumps, it should be set to 128 or 256 or even 512.
	More iron filings adsorbed on the probe/sensor，can be removed by adhesive

	tape.
	①The surface quality of the components is poor (the upper and lower surfaces are uneven, pits, cracks or slopes, etc.)；②There are large discontinuities (slag inclusion, pores, delamination, buried cracks, buried convex and concave slopes)；③Probe bottom farther away from the surface of the component to be inspected (void, coating, etc.), the echo quality is poor, the noise is large, the signal-to-noise ratio is poor, and there is no echo, which leads to incorrect thickness measurement or even no thickness measurement. Try to turn off the automatic mode in the algorithm and use 1 or 2 gate mode.
	If the thickness measurement value is abnormal (unstable or wrong), it is advisable to observe the waveform quality of the A-scan first: ①ensure that there is at least one (preferably more than two) bottom waves; ②the signal-to-noise ratio is better (the clutter noise is small, the back wave and the clutter can be clearly separated. If the echo is mixed with the noise, it is difficult to distinguish it, especially the thin workpiece of 0.X-1.Xmm. It will be difficult or impossible to measure the thickness); ③20% ≤ the amplitude of the echo is relative in the full screen ≤90%; ④the highest peak level is stable around and the wave top is not alternately high and low. If the waveform quality is not good, the Main setting (algorithm (automatic or single and 2 gate), Probe /Sensor type, pulse number, frequency, voltage, gain, Accumulation number, detection mode, etc.) is not suitable or cannot be tested the components of this material.
	When the parameters are modified, the instrument works abnormally (there are waveforms but not measured, the display is incomplete, etc.). The default value can be reset once, and most (not all) parameters are restored to the factory default values. See < 5.2 System Settings • Restore defaults >.
	When two or more electromagnetic ultrasonic instruments are close to each other (the distance between the hosts and the probes are less than 3meters), mutual interference may occur (waveform instability, random waves appear), and the thickness measurement value is unstable and occasionally large and even value jumping. It is necessary to turn on only one electromagnetic system, or try the distance between the main gauges and the probes of each thickness gauge ≥5-10m
	See Attention to eliminate possible causes one by one
The thickness value is stable, but the error is slightly larger or even worse.	If the frequency or number of pulses is changed during the measurement, it needs to be recalibrated and then measured again (see 5.3), otherwise the error will be slightly larger or even worse. The waveform of the instrument shows that the dead zone is about 5mm, and the first echo of the workpiece with thickness ≤5mm will be hidden in the blind zone. The single gate is actually stuck on the second echo and therefore will be mistakenly measured as 2 times thickness. In this case, it needs to be used Automatic or 2 gate algorithm, cannot use single gate algorithm.

Large error when measuring high temperature components	When measuring high temperature components: **(1)** first select EMA-HT probe" in the Main setting ☰ ; **(2)** select the material to be tested in "calibration →material" (the instrument can adjust the temperature compensation curve of this material) ; **(3)** In the Main setting ☰ , select the temperature of the standard test block to be the closest value; **(4)** calibrate by the speed method or the thickness method; **(5)** finally select the current surface temperature of the tested component in the Main setting ☰ . The closest value (for example, 320°C set as 300°C , 330°C set as 350°C). After the above operation, the instrument will automatically compensate the sound speed to make the thickness measurement more accurate. Otherwise the measured value may be incorrectly temperature compensated and not accurate. The temperature compensation curve is only an approximate fitting curve with inevitable fitting error, so the measurement accuracy of ***high temperature workpieces should be relaxed to 2%***. Since the temperature of the calibration test block is closer to the temperature of the measured workpiece, the thickness measurement error will be smaller, so ***try to calibrate at a similar temperature***. For high temperature components greater than 100°C, the A-scan echo quality difference/noise/signal-to-noise ratio difference may occur, which may cause the automatic thickness measurement value to be unstable. At this time, the automatic thickness measurement mode may be turned off, and then use 1 gate or 2 gate mode.	
Stainless steel, aluminum, copper and other 200mm thick parts, cannot see the echo of 200mm A scan	The A-scan range will be automatically locked to 200mm steel. (For example, stainless steel, aluminum, copper, etc., the thickness of the transverse wave is 200mm thick, the A-scan echo will be displayed at the edge of the screen at 200mm and cannot be seen.) When user want to see >200mm waveform, press ▲≥5 times → press ►≥5 times → press ▼≥5 times.	
The instrument crashes (the button does not respond, the data is garbled, it cannot be turned off, etc.)	If the work process (some accidental factors may lead to) the instrument crashes, the button does not respond, the data is turbulent, unable to shut down, etc.	User can press ⏻ and ◄ at the same time to forced shutdown, and then press ⏻ and hold for about 3s to restart.
		Use with caution! Press ⏻ and ▼ at the same time, after a few seconds: reset all Main setting, delete all data records (thickness value, A-scan, B-scan), forced shutdown.
When connected with the upper computer, data export often fails,	Poor quality of USB cable (lines long, wire diameter is small, internal broken). The quality of the lead from the USB	Redo the operation in the order of <5.6>,and try to: change computer's USB port ,replace the computer replace the quality USB cable

the DEVICE communication online status is always displayed as DEVICE DISCONNECTED , the DEU100.exe interface on the computer flashes back.	socket in the computer case to the main board is poor (unshielded, lines long, wire diameter is small). The computer's USB port socket is loose, the contact is bad, the computer's USB port current drive ability is weak.	(length is shorter , wire diameter is smaller). **Use with caution!** Press  and ▼ at the same time, after a few seconds: reset all Main setting, delete all data records (thickness value, A-scan, B-scan), forced shutdown.