EM1501

Electromagnetic Acoustic Thickness Gauge

User Manual

Saint Petersburg

Content

List of Abbreviations

Device, EM1501 – EM1501 Electromagnetic Acoustic Thickness Gauge

EMA – ElectroMagnetic Acoustic

PC – personal computer

PE – piezoelectric

Introduction

This user manual is a mandatory document for persons who operate and maintain the EM1501 Electromagnetic Acoustic Thickness Gauge.

Keep this user manual in a safe, accessible location.

This user manual contains complete and essential information on how to use the Device safely and effectively.

Before using the Device, thoroughly review this user manual. Use the Device as instructed.

Persons who use and maintain the Device must undergo periodic safety training.

IMPORTANT

Some of the details of components and/or software images in this user manual may differ from your Device's components or software display. However, the principles remain the same.

1 Device Description and Operation

1.1 Intended Use

The Device is intended to measure thickness of steel pipe walls, flat steel, rods, and other products made of steel as well as aluminum and other metals using:

- non-contact EMA transducers with a pulsed electromagnet;
- non-contact EMA transducers with a permanent magnet;
- traditional contact PE transducers.

1.2 Principle of Operation

The Device measures time during which the acoustic wave transits through the test object. The measured time is converted into thickness using the specified value of speed of ultrasonic wave propagation.

The Device can be connected to EMA transducers with a pulsed electromagnet, to EMA transducers with a permanent magnet, and to contact PE transducers.

A special data processing algorithm designed by Oktanta company allows to measure the test object thickness correctly even in the presence of disruptors such as metal anisotropy, several reflectors and external noise. The Device enables to eliminate influence of the human factor making the thickness measurements completely automatic.

1.3 Technical Specifications

Parameter	Value
Range of operating ambient temperature, °C	-20…+50
Duration of continuous work without battery recharge, hours	7
Range of sound velocity setting, m/s	1000…9999 with 1 m/s step
Highest number of measurements per second	16
Dimensions, mm	232 x 135 x 44
Weight, kg, no more	1.0

Parameter	Value
For EMA transducers	
Range of measured thickness for steel, mm	2…200
Thickness measurement error (for steel), mm – in the range from 0.5 to 25 mm inclusive – in the range from above 25 to 200 mm	 ± (0.08 + 0.001·H*) ± (0.1 + 0.005·H*)
Permissible clearance between the transducer and test object, mm –EMT15015P transducers – EMT14012 transducers – EMT14013 transducer	 up to 2 up to 4 up to 7
Permissible transducer skew, °	± 25
Lowest permissible radius of curvature of the test object surface, mm	≥10
Operating frequency of the Device, MHz	4
Range of operating temperature on the test object surface, °C	-20...+80 (-20 ...+750 with EMT14014T**)
For PE transducers	
Range of measured thickness for steel, mm	0.5...200
Thickness measurement error (for steel), mm – in the range from 0.5 to 25 mm inclusive – in the range from above 25 to 300 mm	 ± 0.08 ± (0.1 + 0.005·H*)
Lowest permissible radius of curvature of the test object surface, mm	25
Operating frequency of the Device, MHz	5, 10
Range of operating temperature on the test object surface, °C	-10…+60

* H – measured thickness value, mm.
** The EMT14014T transducer is not intended for long-term use at 750 ºC. The maximum temperature of long-term use of this transducer is 300 ºC. The objects with temperature of 300 ºC to 750 ºC shall be measured during short periods of time with 15 s intervals between measurements.

1.4 Device Description

The Device appearance is shown in Figure 1.1.

Figure 1.1 – The Device appearance

The Device front panel features a color liquid crystal display, a keyboard with 11 push-buttons and a calibration sample.

Table 1.1 lists the key functions available from the Device keyboard.

Table 1.1

Button	Brief description	Function
	On/Off	Switch on/off the Device
	Back	Return to the previous menu item and close the menu

Button	Brief description	Function
	Up	Navigate in the Device menu, change the A-scan scale and adjust the gates and thresholds
	Down	Navigate in the Device menu, change the A-scan scale and adjust the gates and thresholds
	Left	Switch between Device windows, navigate in the Device menu and adjust the gates
	Right	Switch between Device windows, navigate in the Device menu and adjust the gates
	Ok	Set the parameter selected in the Device menu, open the Device menu
	Menu	Open/close the Device settings
	Save	Save A-scans and C-scans to the Device memory
	Plus	Adjust selected parameters (gain level, gate length, C-scan parameters, Device interface settings), B-scan update
	Minus	Adjust selected parameters (gain level, gate length, C-scan parameters, Device interface settings)

At the top of the Device (see Figure 1.2), there are the following connectors:

- two connectors for EMA transducers: black – for EMA transducers with a permanent magnet, black and red – for EMA transducers with a pulsed electromagnet;

- two connectors for PE transducers.

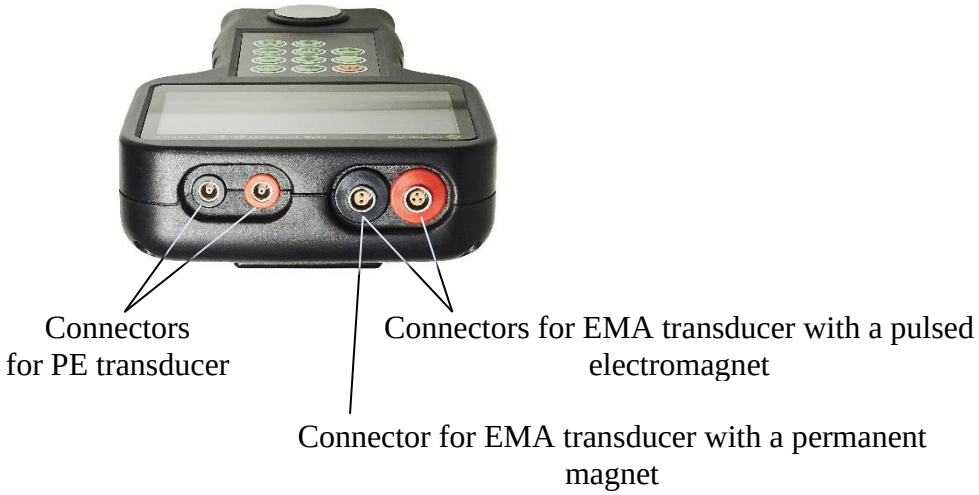


Figure 1.2 – The top end connectors

At the bottom of the Device (see Figure 1.3), there are connectors for connecting the recharger (DC power connector) and the PC (USB Type C serial communication connector).

Figure 1.3 – The bottom end connectors

On the back of the Device, there is information about the Device (Device name, serial number, manufacturer) and the stand.

1.5 User Interface

The Device has 4 modes:

- Auto thickness measurement – simple measurements for the test objects with quite good surface quality or in the presence of slight corrosion (see paragraph 3.1);

- A-scan – thickness measurement and A-scan display for the test objects that has complex shape, made by casting, as well as for the test objects prone to severe corrosion

(see paragraph 3.2). It can also be used in cases where the user wants to double-check the Device auto thickness measurements;

- B-scan – display of the A-scan and the cross-section profile of the test object. B-scan allows you to display the area of corrosion or other defects found on the test object (see paragraph 3.3);

- C-scan – display of the plane of the test object in the selected area indicating the measured thickness and A-scan at the current point. It allows you to perform sequential measurement of the thickness of the selected area of the test object with saving the data to the Device memory (see paragraph 3.4).

To switch between the modes, use the  and  buttons. The sequence of mode switching and window appearance are given in Figure 1.4.

Additionally, the Device allows the user to enter the required settings of the test object and the Device interface settings (see paragraphs 2.4, 2.6) and calibrate the transducer (see paragraph 2.5).

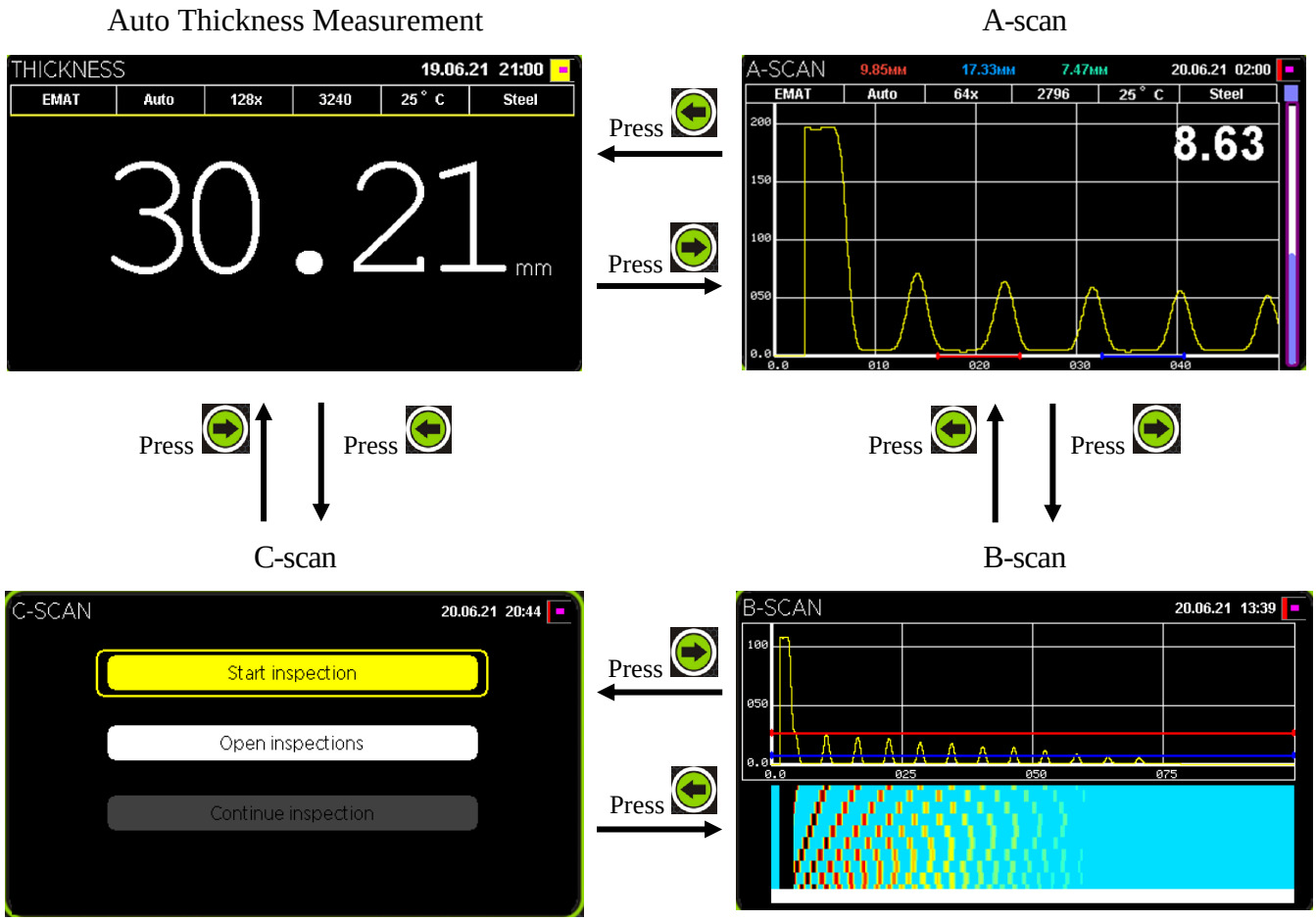


Figure 1.4 – Device mode switching

2 Preparation for use

2.1 Transducer Selection

2.1.1 The transducer is selected based on the test object temperature, base thickness, surface quality, etc. The characteristics of all applicable transducer are given in the comparative Table 2.1.

CAUTION!!!
Replace the transducer when the Device is OFF.

2.1.2 The EMT14014T transducer does not allow heating to temperatures exceeding 300 ºC while operation. Therefore, while operating with the objects heated to the temperatures exceeding 300 ºC, it is necessary to observe time intervals in accordance with Table 2.2.

Table 2.1 – Comparative table for transducer selection

Transducer	Test object temperature range, °C	Thickness range, mm	Operating gap, mm	Description
EMT15015P	-20 to +80	2 to 100	0 to 2	The transducer is equipped with a pulsed electromagnet that operates only during the measurement. After the measurement, the electromagnet is switched off, dirt is not attracted to the transducer, so this transducer does not require cleaning. At the same time, the power of the sound wave for such a transducer is less than that of the EMA transducer with a permanent magnet. The transducer is used for the test objects with quite good surface quality or in the presence of slight corrosion
EMT14012	-20 to +80	2 to 200	0 to 4	Compact transducer, suitable for most of applications
EMT14013*	-20 to +80	2 to 200	0 to 6	The transducer has the enhanced magnetic system and is used in such cases when operation with the maximum operating gap or on the objects with poor surface quality due to heavy corrosion is required
EMT14014T*	-20 to +750	2 to 200	0 to 3	The transducer has a steel housing and special heat-resistant protector and is designed for operation with the objects heated up to 750 °C
EDC10P5F3	-5 to +50	0.5 to 20	-	The transducer operates at 10 MHz and is designed for thickness measurements of the thin objects and small defects detection
EDC5P7.2FS10	-5 to +50	1 to 200	-	The transducer operates at 5 MHz and is designed for thickness measurements of the medium thick objects and suitable for most of applications
EDC5P10FS15	-5 to +50	2 to 200	-	The transducer operates at 5 MHz and is designed for thickness measurements of the thick objects

* The transducer is not included in the basic configuration of the Device, and can be ordered additionally.

Table 2.2 – EMT14014T transducer measurement modes

Temperature range, ºC	Measurement duration, seconds
0 – 300	continuously
300 – 750	0 – 5 (time interval between measurements:15 seconds)

2.2 Device Switching On

2.2.1 To switch the Device on, press and hold the button for 3 seconds. A window with information about the Device including the software version appears on the screen (Figure 2.1).

Figure 2.1 – Window with information about the Device

2.2.2 When the Device is loaded, a window with measured thickness appears (Figure 2.2). The date (in the day:month:year format) and time set in the Device (see paragraph 2.6) are always displayed in the upper right corner of the screen.

2.2.3 The Device automatically starts calibration of the PE transducer using the calibration sample (Figure 2.5) if the PE transducer is selected (see paragraph 2.5.3.1).

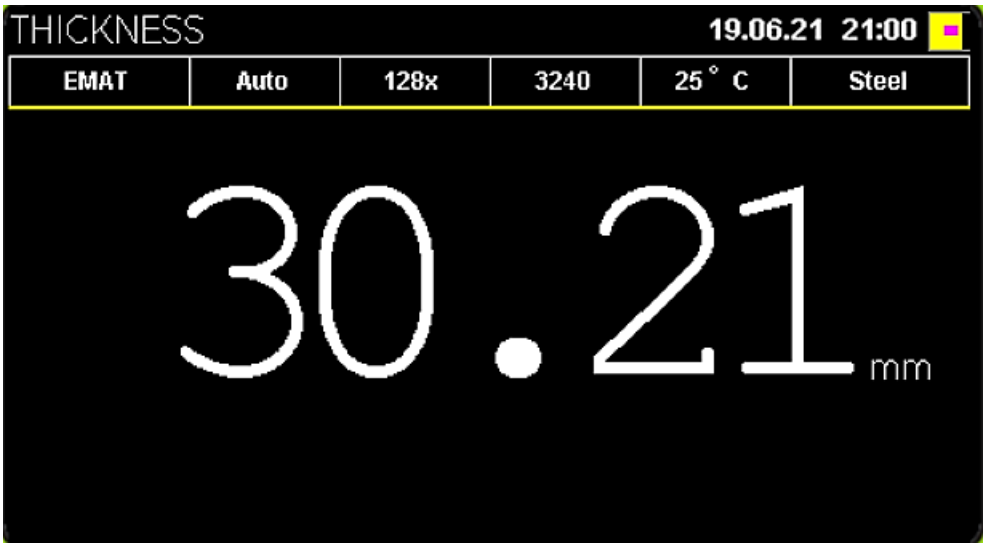


Figure 2.2 – Window with measured thickness

2.2.4 Check the battery charge level in the upper right corner of the screen:

-  (green color) – the battery is fully charged;
-  (yellow color) – the battery is low, charge the battery;
-  (red color) – the battery is discharged, charge the battery urgently.

If necessary, charge the battery (see paragraph 3.7).

2.3 Device Switching Off

2.3.1 If the "Auto off" mode is enabled, the Device switches off automatically after a specified period of time if no buttons are pressed and no measurements are in progress (see Table 2.4).

2.3.2 To manually switch off the Device, press and hold the  button for 3 seconds.

2.4 Setting up for Test Object

2.4.1 The following current Device settings are displayed in the upper part of the "Thickness" (Figure 2.2) and "A-scan" (Figure 3.1) windows:

- selected type of the connected transducer (see paragraph 2.1);
- thickness measurement mode (for gates setting see paragraph 3.2);

- averaging number used in the Device;
- acoustic speed depending on the material and temperature of the test object;
- selected temperature of the test object;
- selected material of the test object.

2.4.2 To change the settings, open the Context menu of the "Thickness" or "A-scan" windows (Figure 2.3) by pressing the OK button.

2.4.3 Select a Context menu item using the ◄ and ► buttons, then press the OK button.

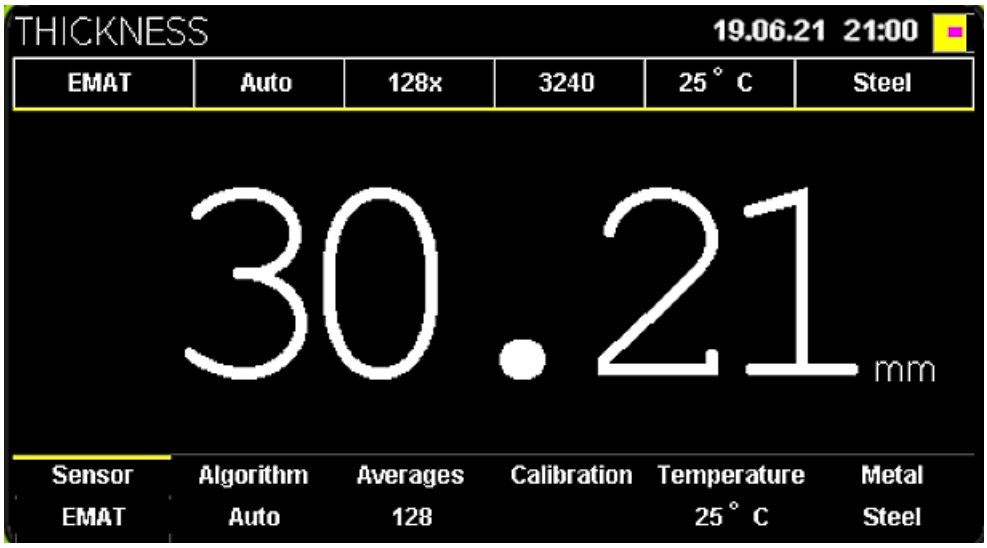
2.4.4 In the opened item/window, select/enter the required parameter using the ▲ and ▼ buttons, then press the OK button:

- Sensor – select the type of connected transducer (see paragraph 2.1);
- Averages – select the number of averages used by the Device. By default, the Device uses 128 accumulations of the useful signal. When the Device measures thickness of a test object with poor surface quality and across a wide gap, it is recommended to increase the number of averages, which increases the reliability and accuracy of measurements, but increases the measurement time;
- Temperature – select the temperature of the test object. The Device automatically adjusts the acoustic speed depending on the specified temperature of the test object;
- Metal – select the material of the test object. The Device automatically sets the acoustic speed value and the function of the dependence of acoustic speed on temperature. Depending on the characteristics of the metal of the test object, acoustic speed may differ slightly from the one set in the Device, so it is recommended to calibrate the transducer (see paragraph 2.5).

A detailed description of the Context menu settings is given in Table 2.3.

2.4.5 Exit the Context menu by pressing the ↩ button.

"Thickness" window



"A-scan" window

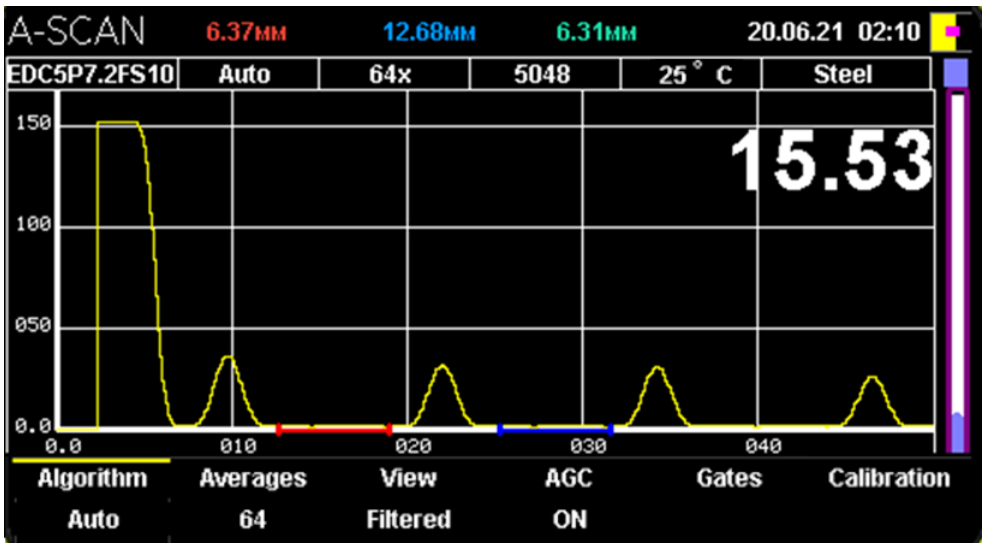
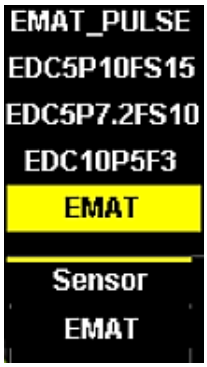
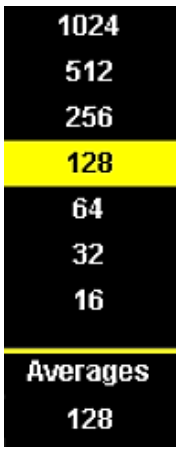
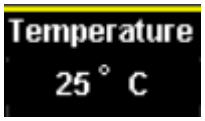


Figure 2.3 – Context ("OK") menu

Table 2.3

Menu item	Brief description	Detailed description
	Type of the connected transducer	Select the type of the connected transducer: - EMAT_PULSE – EMA transducer with a pulsed electromagnet; - EMAT – EMA transducer with a permanent magnet; - EDC10P5F3, EDC5P7.2FS10, EDC5P10FS15 – PE transducer (see Table 2.1)
	Number of averages	By default, the Device uses 128 accumulations of the useful signal. Thus, the final thickness measurement is performed using 128 measured values by averaging them. When the Device measures thickness of a test object with poor surface quality and across a wide gap, it is recommended to increase the number of averages. **Increasing of the number of averages increases the reliability and accuracy of measurements, but also increases the measurement time**
	Temperature of the test object	After selecting this item, the window "Temperature C" is displayed on the Device screen to specify the test object temperature (in °C). The acoustic speed depends on the material temperature. Therefore, different acoustic speed shall be used for different temperatures. The Device can automatically correct the acoustic speed depending on the test object temperature

Menu item	Brief description	Detailed description
	Material of the test object	Select the material of the test object. The selected material affects both the acoustic speed and the function of the dependence of acoustic speed on temperature

2.5 Calibration

2.5.1 General Information

2.5.1.1 Calibration of the PE transducer using the calibration sample is performed each time before starting work. Calibration of PE or EMA transducer using a known thickness or acoustic speed is performed as necessary to adjust the Device to work with a specific test object.

2.5.1.2 To calibrate the transducer, open the "Calibration" Context menu of the "Thickness" or "A-scan" window (Figure 2.4) by pressing the  button.

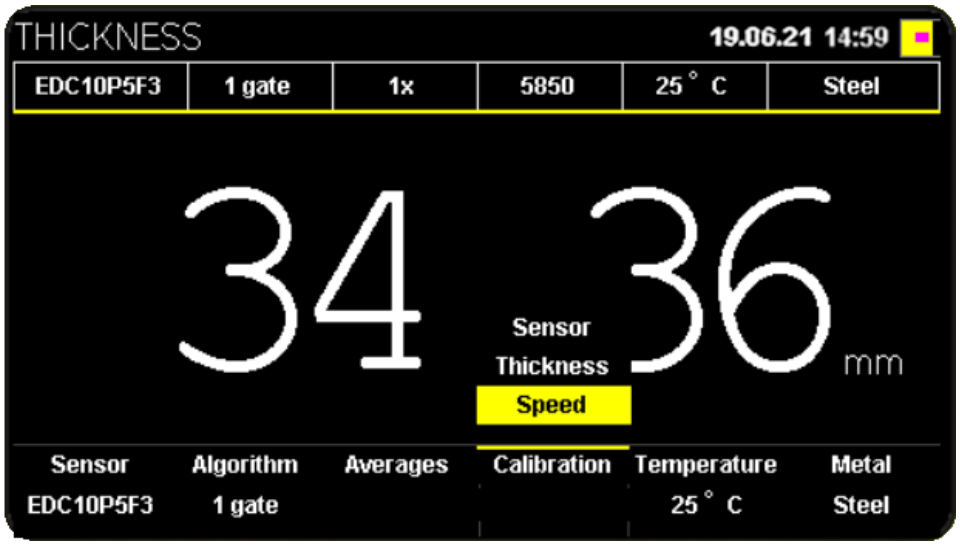


Figure 2.4 – Context ("OK") menu. The "Calibration" item

2.5.1.3 Calibration of the transducers is performed in the following ways (Figure 2.5):

- according to the calibration sample on the front panel of the Device ("Sensor" item) (only for PE transducers). After selecting this item, information about the calibration of the transducer is displayed on the Device screen;

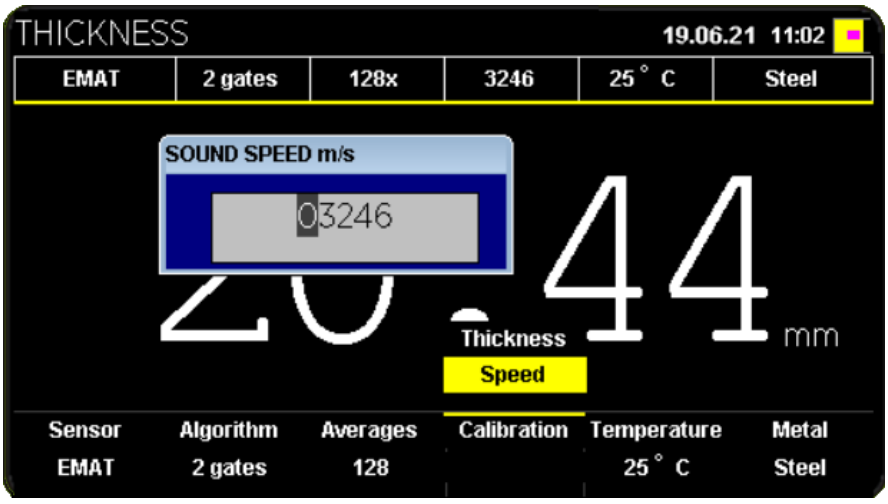
- according to the known acoustic speed for the test object ("Speed" item). After selecting this item, the "Sound speed m/s" window is displayed on the Device screen;

- according to the known thickness of the test object ("Thickness" item). After selecting this item, the "Current thickness mm" window is displayed on the Device screen.

2.5.1.4 The value of the acoustic speed and thickness is set using the  ,  ,  ,  buttons and is saved using the  button.

PE transducer calibration

Acoustic speed setting



Calibration according to known thickness

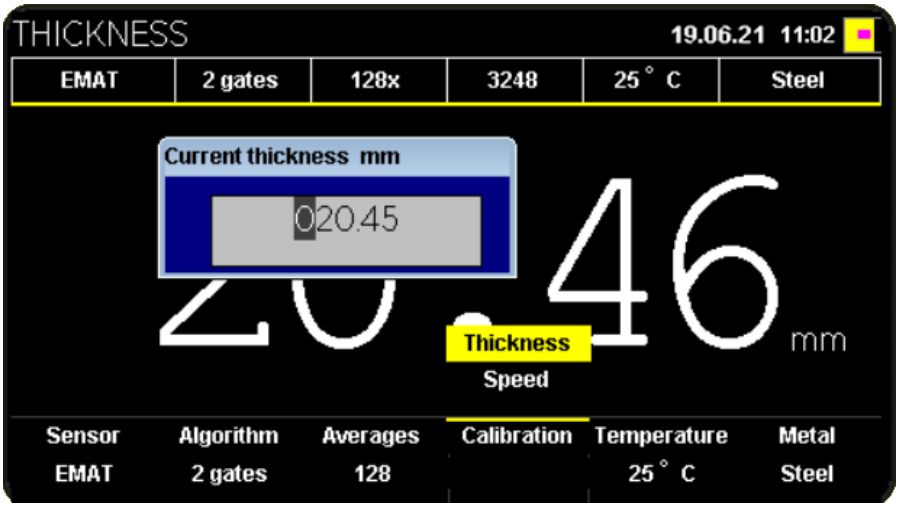


Figure 2.5 – Device calibration methods

2.5.2 EMA Transducer Calibration

2.5.2.1 Place the transducer on the test object surface.

2.5.2.2 Open the Context "OK" menu in the "Thickness" or "A-scan" window.

2.5.2.3 Depending on the calibration method, select the "Thickness"/"Speed" item in the Calibration menu.

2.5.2.4 In the window that opens (Figure 2.5), set the value of the known thickness or acoustic speed in the test object using the  ,  ,  and  buttons, then press the  button.

2.5.2.5 The Device performs the calibration and closes the window.

WARNING!

All EMA transducers intended for this Device use transverse ultrasonic wave. The typical speed of the transverse wave for the steel is 3250 m/s.

2.5.3 PE Transducer Calibration

WARNING!

The PE transducers shall be calibrated before starting work by calculating delay in prism which sizes constantly decrease as the transducer wears out.

2.5.3.1 Step 1. The Device automatically starts calibration of the PE transducer using the calibration sample after the Device is switched on and the PE transducer is selected, and also after selecting the PE transducer during operation of the Device.

Note – If necessary, you can start this calibration manually by selecting the "Sensor" item in the "Calibration" menu of the Context "OK" menu (in the "Thickness" or "A-scan" window).

2.5.3.2 Apply couplant to the calibration sample and place the transducer on the sample. The Device performs the calibration and closes the "Calibration" window.

2.5.3.3 Step 2. To calibrate the transducer using a known thickness or acoustic speed of the test object, open the Context "OK" menu in the "Thickness" or "A-scan" window.

2.5.3.4 Depending on the calibration method, select the "Thickness"/"Speed" item in the Calibration menu.

2.5.3.5 In the window that opens (Figure 2.5), set the value of the known thickness or acoustic speed in the test object using the  ,  ,  and  buttons, then press the  button.

2.5.3.6 The Device performs the calibration and closes the window.

2.5.3.7 Apply couplant to the calibration sample and place the transducer on the sample.

2.5.3.8 The Device performs the calibration and closes the window.

WARNING!

All PE transducers intended for this Device use longitudinal ultrasonic wave. The typical speed of the longitudinal wave for the steel is 5950 m/s.

2.6 Setting up Device Interface

2.6.1 To edit the Device settings (Figure 2.6), press the  button. The description of the Device interface settings is given in Table 2.4.

2.6.2 Press the  button to exit the Device settings.

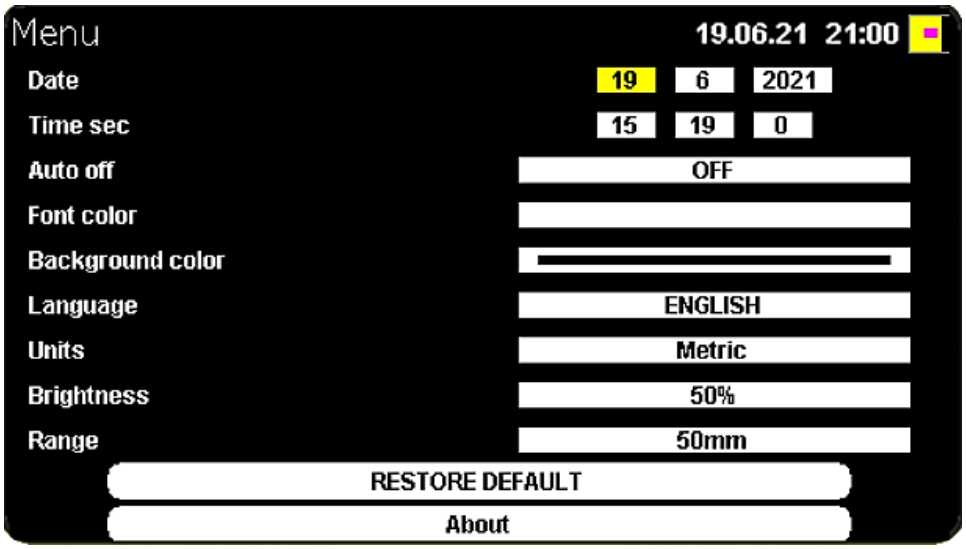


Figure 2.6 – Device settings

Table 2.4

Menu item	Description	Buttons for setting up
Date	Set the current date	and
Time sec	Set the current time	and
Auto off	Set the time after which the Device switches off automatically if no buttons are pressed and no measurements are in progress	and
Font color	Select display color for thickness and additional information on the Device screen	and
Background color	Select the background color	and
Language	Select the Device interface language. Available options are Chinese, English, Korean and Russian	and
Units	Select the measurement units. Available options are millimeters and inches	and
Brightness	Set the screen brightness (in percent)	and

Menu item	Description	Buttons for setting up
Range	Set the maximum length of the A-scan displayed on the screen	 and 
RESTORE DEFAULT	Restore all defaults of the Device	
About	Show the software version	

3 Basic Operation

3.1 **Thickness Measurement**

3.1.1 Prepare the Device for use in accordance with paragraph 2.

3.1.2 If necessary, clean the surface of the test object and apply couplant (when using PE transducers).

3.1.3 Switch on the Device. When no test object is near the transducer, the thickness values on the Device screen can change randomly.

3.1.4 Place the transducer on the test object surface. Depending on the selected number of averages, the Device will display the measured thickness in the time period from 100 ms to 3 s.

Note – If the 1 or 2 gate thickness measurement mode is selected, the thickness measurement is not performed automatically, but is made taking into account the gates configured in the A-scan mode (see paragraph 3.2).

3.1.5 If the quality of the surface of the test object does not allow thickness measurement, it is recommended to move the transducer 5 - 10 mm to the side and repeat the measurement.

3.1.6 For the test objects prone to severe corrosion, it is recommended to increase the number of averages (see paragraph 2.4).

3.2 Thickness Measurement with A-scan Display

3.2.1 A-scan (Figure 3.1, Figure 3.4) is used to inspect the test objects that has complex shape, made by casting, as well as for the test objects prone to severe corrosion.

The "A-scan" window displays the following information:

- measured thickness and A-scan with two gates;

- position of the maximums in the red and blue gates, the difference between the position of the maximum in the red gate and the maximum in the blue gate (at the top of the screen).

Note – Each gate is a selected time interval in which the maximum value is calculated.

- gain level indicator (on the right side of the screen).

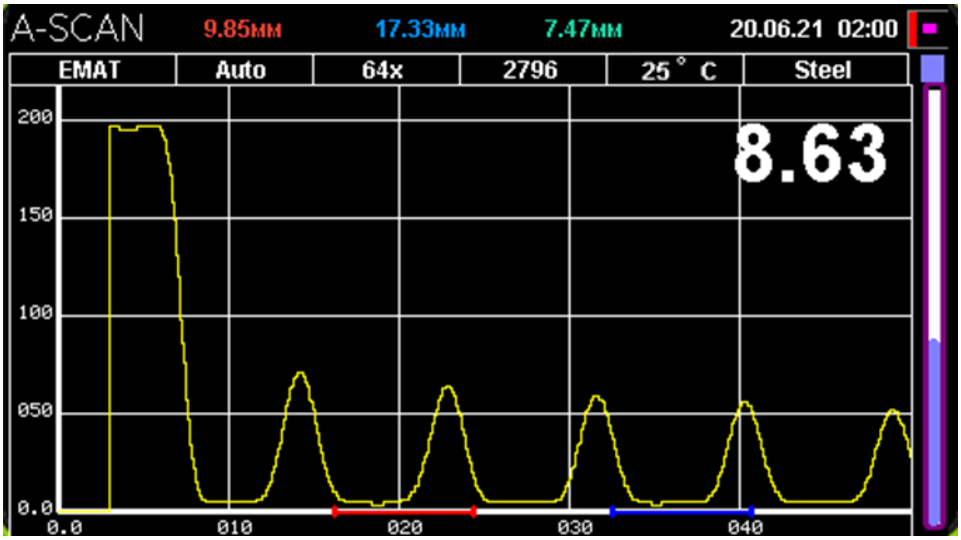


Figure 3.1 – A-scan appearance

3.2.2 To change the A-scan scale:

3.2.2.1 Press the  or  button. In this case, SCALE appears on the screen (Figure 3.2).

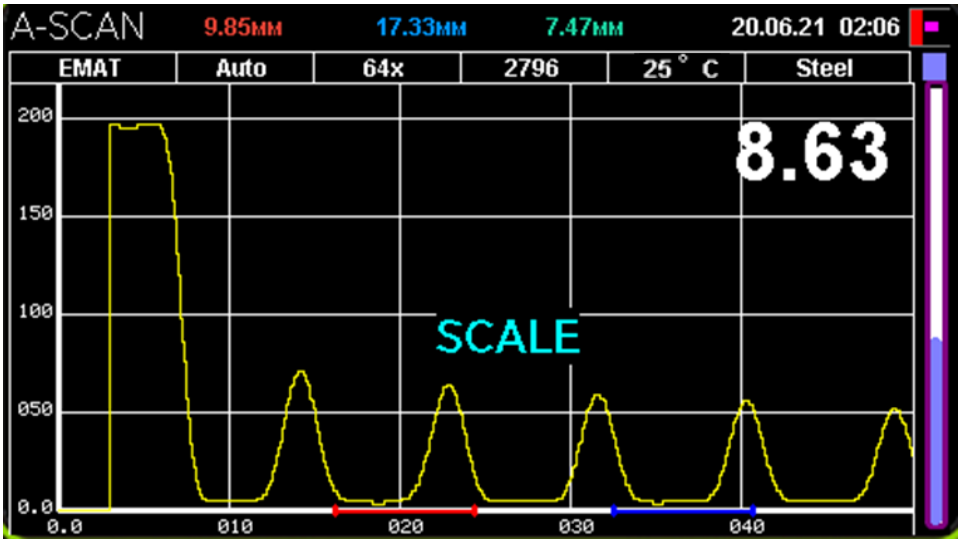


Figure 3.2 – A-scan scale change mode

3.2.2.2 In this mode, you can change the A-scan scale using the  and  buttons. You can also move the display area using the  and  buttons.

3.2.2.3 Upon selection of the position and size of the scaled area, press the 

button or the  button.

3.2.3 Configure the A-scan and gates using the Context menu (Figure 2.3, operations with the Context menu are described in paragraphs 2.4.2 - 2.4.5):

- Algorithm – select thickness measurement algorithm: Auto (suitable for most measurements, without operator intervention, see paragraph 3.1), 1 gate (for inspection of test objects with a thickness greater than 6 mm), 2 gates (for inspection of test objects of any thickness);

- Gates – adjust the position and length of the gates depending on the selected thickness measurement algorithm;

- View – select the A-scan view: the original bipolar signal, the detected signal or the filtered signal;

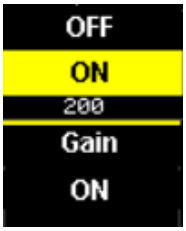
- AGC – select the gain control mode: manual (item "OFF") or automatic (item "ON"). After selecting the automatic mode, adjust the gain level using the  and  buttons.

A detailed description of the Context menu settings is given in Table 3.1.

3.2.4 To save the A-scan to the Device memory, press the 

button.

Table 3.1

Menu item	Brief description	Detailed description
	Thickness Measurement Algorithm Selection	The automatic algorithm is suitable for most applications and allows to obtain the thickness without user intervention. The thickness measurement algorithm using one gate calculates the position of the maximum in the red gate and converts the obtained value into thickness. The position of the red gate and its length are specified by the user. The thickness measurement algorithm using two gates calculates the positions of the maximums in the red and blue gates. The Device calculates the thickness using the difference between the positions of the maximums in the red and blue gates. The position of the gates and their lengths are specified by the user
	A-scan View Change	- the original bipolar signal; - the detected signal; - the filtered signal
	Select manual or automatic gain control mode	By default, the Device uses automatic gain control ("ON" item), the upper part of the gain control indicator is displayed in blue. After selecting the "OFF" item, the Device switches to manual gain control mode: the upper part of the gain level indicator changes its color from blue to white (Figure 3.3). In manual mode, the gain level is adjusted using the  and  buttons.

Menu item	Brief description	Detailed description
Gates	Setting up two gates (red and blue)	Each gate is a selected time interval in which the maximum value is calculated (Figure 3.4). The position and length of each gate can be changed as follows: - open the Gates menu by pressing the OK button. Then, the red gate is highlighted on the screen (Figure 3.5); - use the ← and → buttons to change the gate position and the + and − buttons to change the gate length; - upon selection of the position and length of the red gate, press the OK button. Then, the blue gate is highlighted on the display (Figure 3.6); - you can set the position and length of the blue gate in the same way as those of the red gate; - upon selection of the position and length of the blue gate, press the OK button

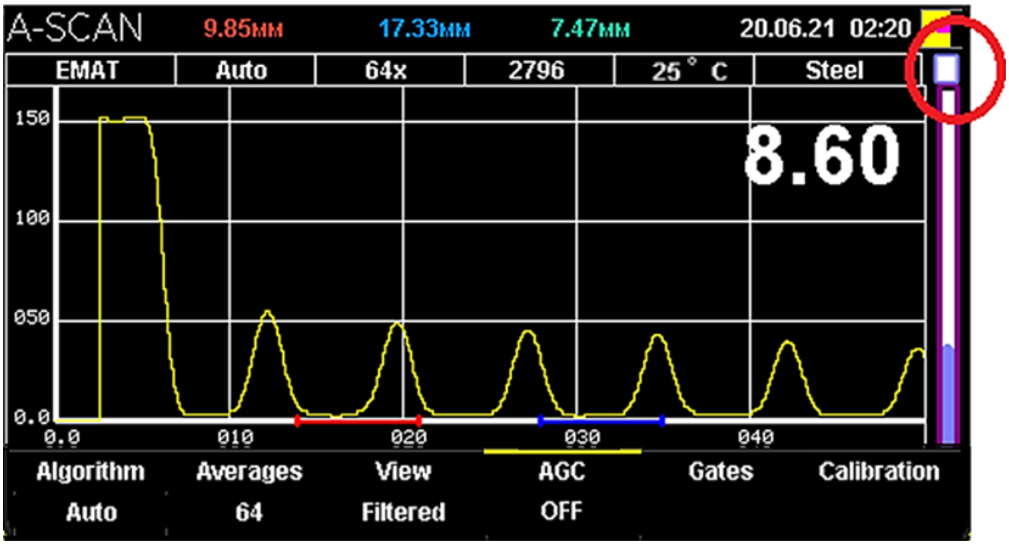


Figure 3.3 – Gain level indicator position

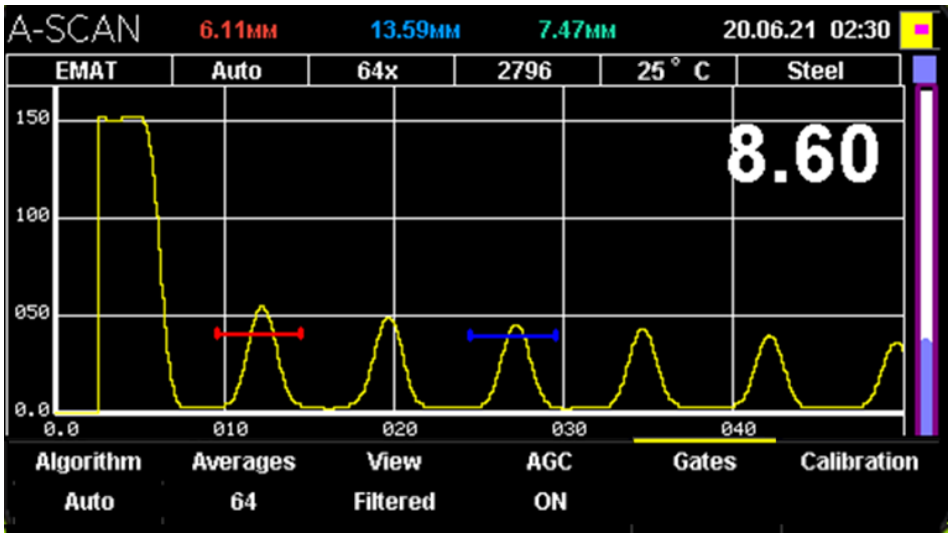


Figure 3.4 – Gate information display

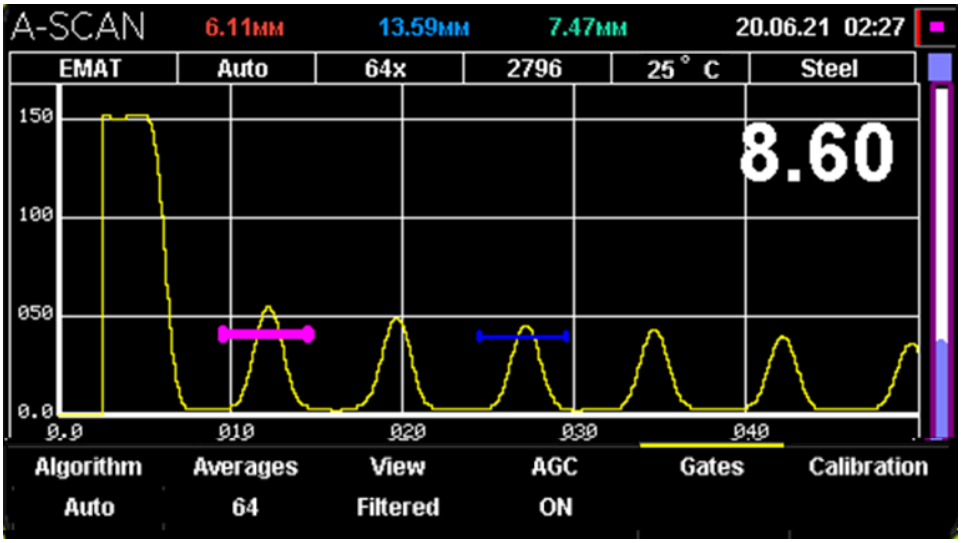


Figure 3.5 – Red gate selection

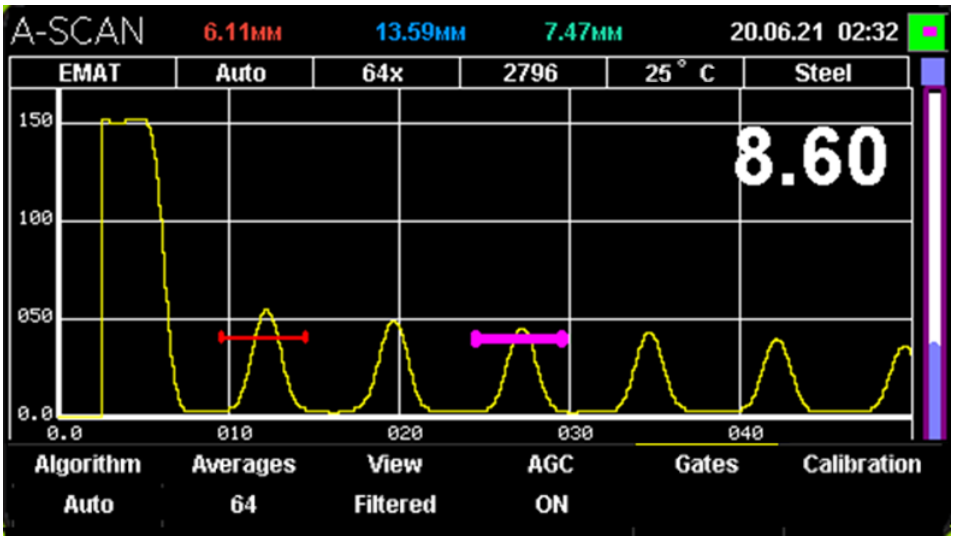


Figure 3.6 – Blue gate selection

3.3 B-scan Display

3.3.1 B-scan (Figure 3.7) is used for simultaneous display of A-scan (with two thresholds: blue and red) and B-scan (sectional profile of the test object under inspection).

All A-scan points which values are lower than the blue threshold position are displayed on the B-scan in light-blue. All A-scan points which values are higher than the red threshold position are displayed on the B-scan in black. All A-scan points which values are between two thresholds are displayed with gradient.

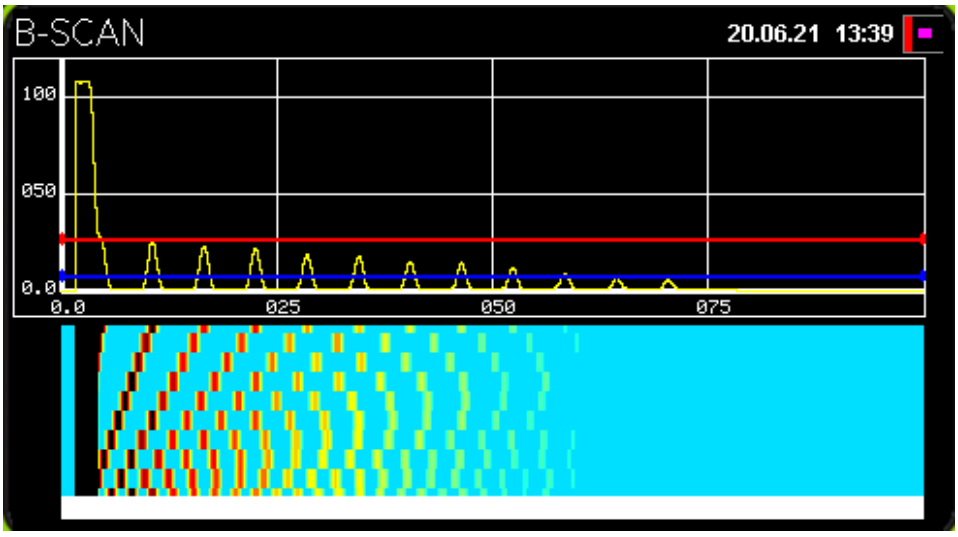


Figure 3.7 – B-scan window appearance

3.3.2 Change the B-scan display scale similarly to paragraph 3.2.2.

3.3.3 Configure the B-scan and thresholds using the Context menu (Figure 3.8, operations with the Context menu are described in paragraphs 2.4.2 - 2.4.5). Description of the Context menu is given in Table 3.2.

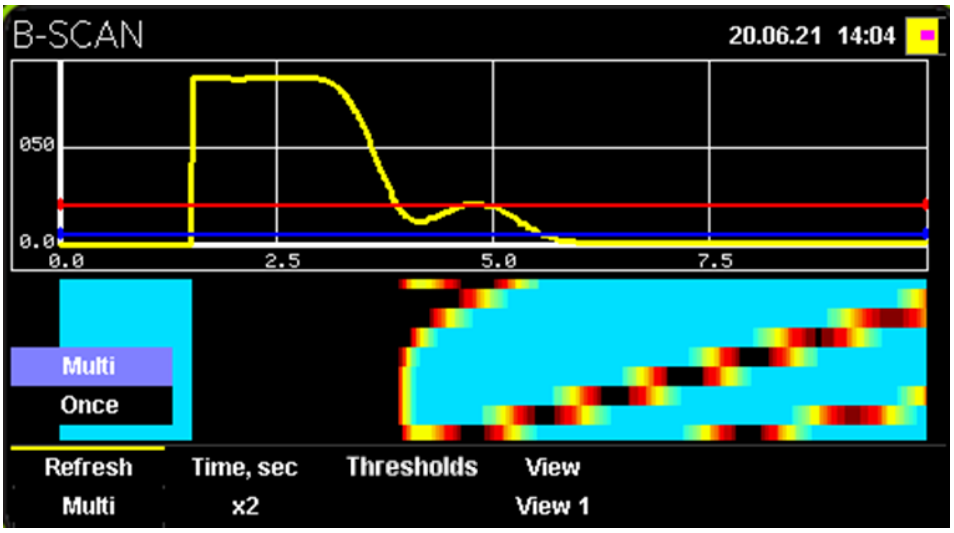


Figure 3.8 – Context ("OK") menu. B-scan window

Table 3.2

Menu item	Brief description	Detailed description
Multi Once Refresh Multi	B-scan refresh mode	When the once mode is selected, the B-scan is not updated until the user presses the button. In this case, "Press + to start up" will be displayed at the top of the Device screen. When the multi mode is selected, the B-scan is filled and updated continuously
x5 x4 x3 x2 x1 Time sec x2	Screen Filling Time	Increase or decrease time during which the B-scan in fully filled: select in what number of times the time of B-scan updating is greater than the standard value

Menu item	Brief description	Detailed description
Thresholds	Thresholds	The threshold position influences the B-scan appearance. The Device has two adjustable thresholds. The thresholds can be adjusted as follows: - select the "Thresholds" item in the Context menu and press the OK button. Then, the red threshold is highlighted on the screen (Figure 3.9); - use the ↑ and ↓ buttons to move the highlighted threshold and press the OK button. Then, the blue threshold is highlighted instead of the red one; - you can adjust the position of the blue threshold in the same way as those of the red threshold; - press the OK button
View 3 View 2 View 1 View View 1	B-scan Appearance	Select the B-scan window appearance (view). Possible options for displaying the B-scan are shown in Figure 3.10

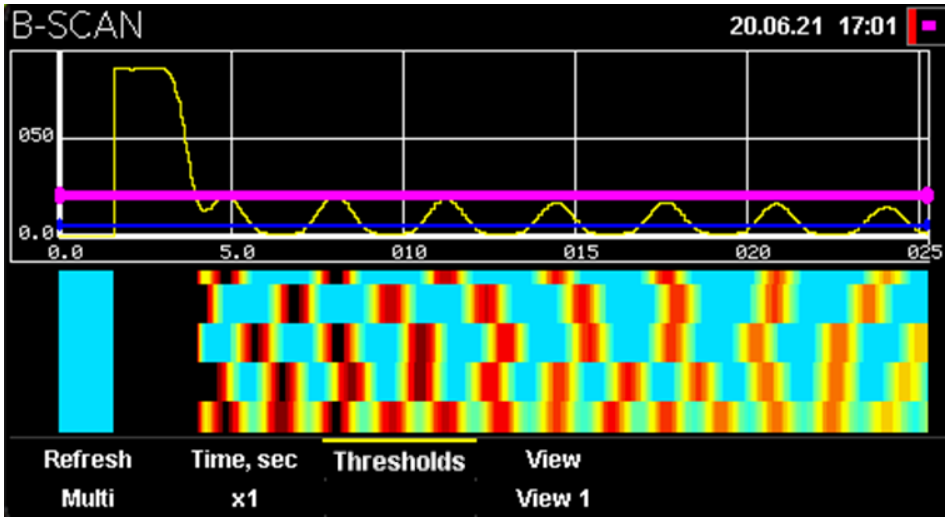


Figure 3.9 – Red threshold highlighting

View 1

View 2

View 3

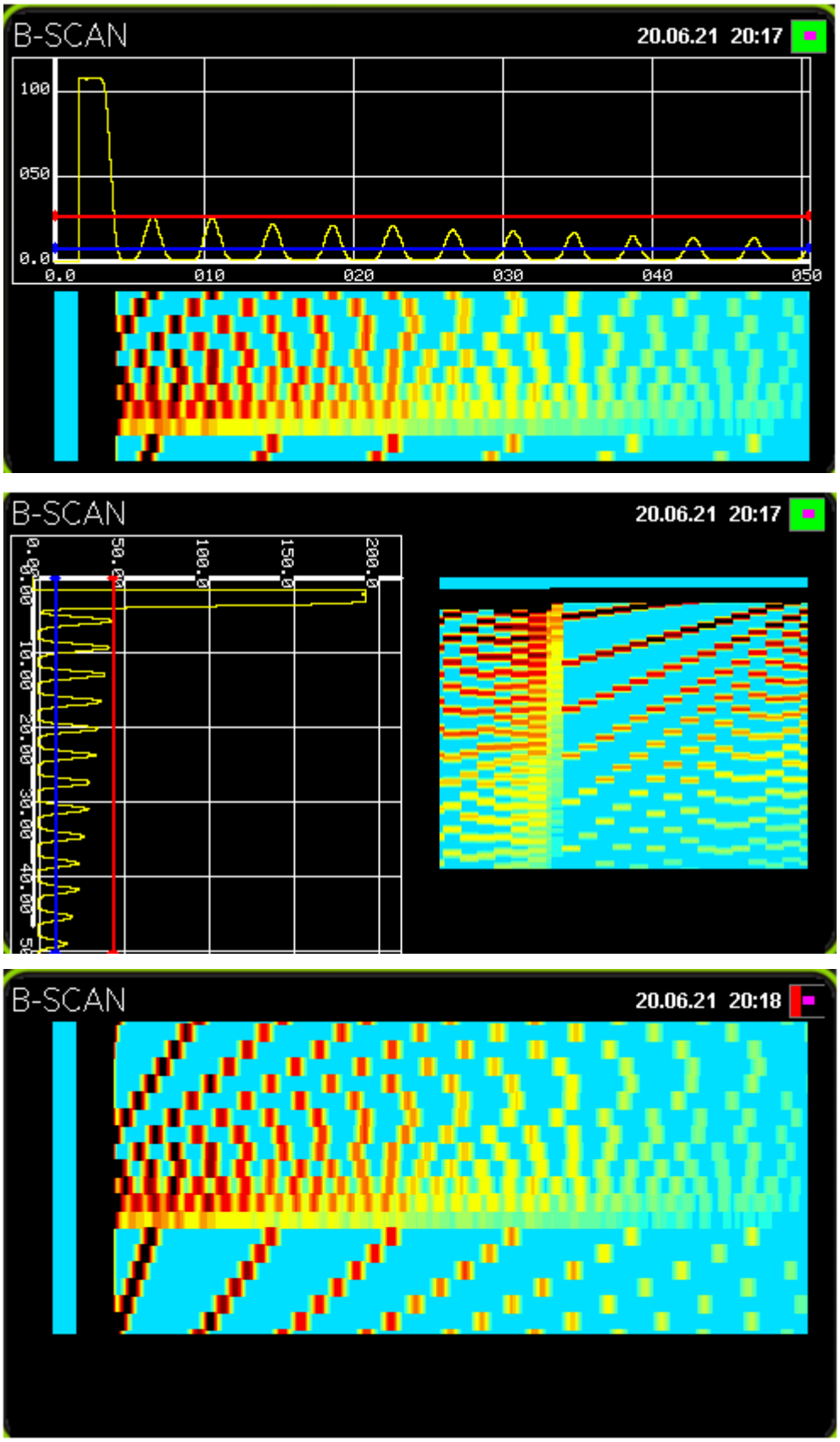


Figure 3.10 – B-scan appearance options

3.4 Measuring Thickness of Selected Area (C-scan)

3.4.1 C-scan (Figure 3.11) is used for sequential measurement of the thickness of the selected area of the test object with saving the data to the Device memory.

Figure 3.11 – C-scan window appearance

3.4.2 "C-scan" window consists of three items:

- Start inspection (see paragraph 3.4.4);
- Open inspection (see paragraph 3.4.5);
- Continue inspection (see paragraph 3.4.7).

3.4.3 To navigate through these items, use the  ,  buttons. To select an item, use the  button. To return from any selected item, press the  button.

3.4.4 Start Inspection

3.4.4.1 The appearance of this window (Figure 3.12) depends on the test object selected.

Pipe test object

Matrix test object

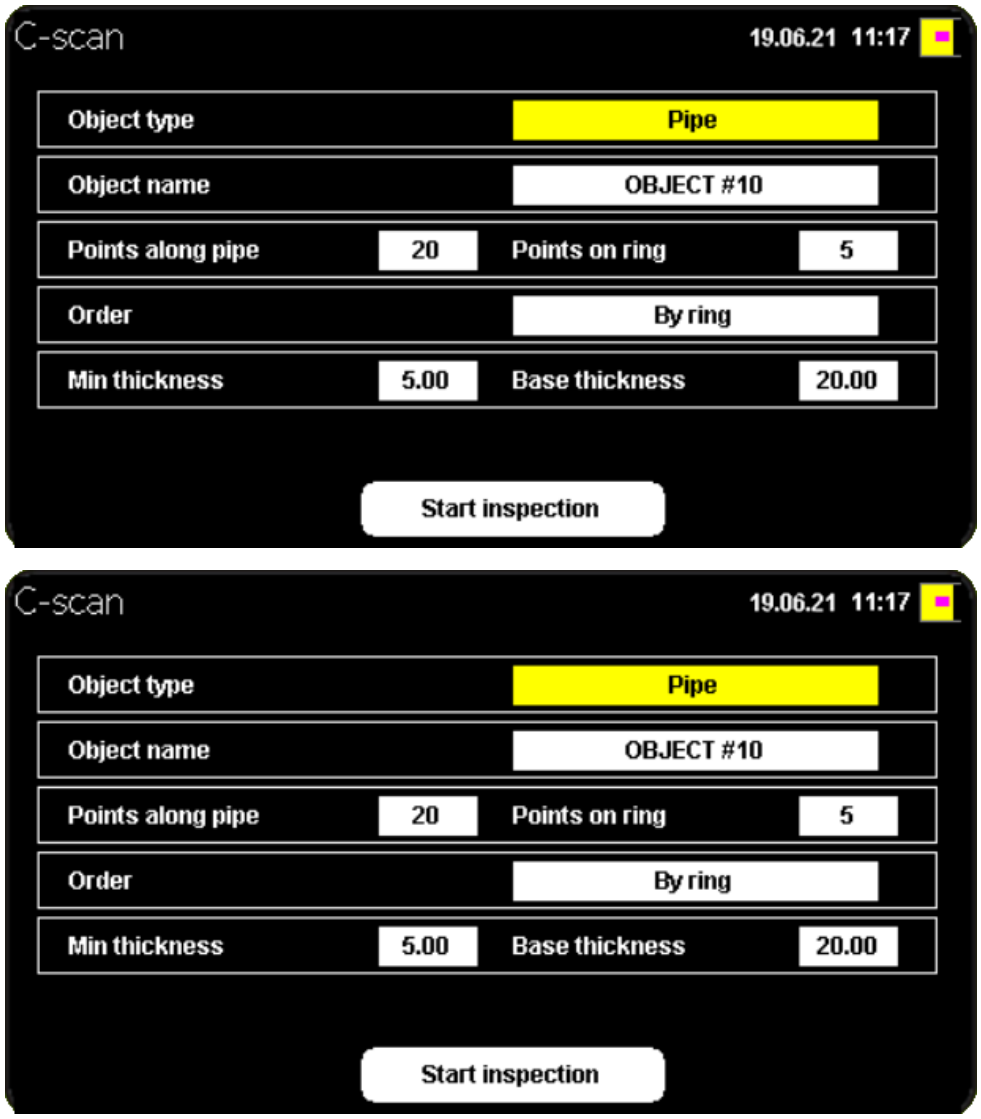


Figure 3.12 – Start Inspection window appearance

3.4.4.2 To navigate through this window, use the , buttons. To change the settings, use the and buttons:

- select the type of the test object;

- for the "Pipe" test object, set the necessary number of the measured points in one ring as well as number of rings along the pipe;

- for the "Matrix" test object, set the number of the measured points in horizontal plane and the same in the vertical plane;

- select the order of filling of the C-scan: the data can be filled both from top to bottom (vertical lines) and from left to right (horizontal lines).

3.4.4.3 To enter the base thickness and minimum permissible thickness of the test object:

- select the "Min thickness" or "Base thickness" field and press the OK button;

- in the window that opens, set the thickness value using the , , and buttons;

- press the OK button.

3.4.4.4 To enter the name of the test object:

- select "Object name" item using the , buttons and press the OK button. The window shown in Figure 3.13 opens;

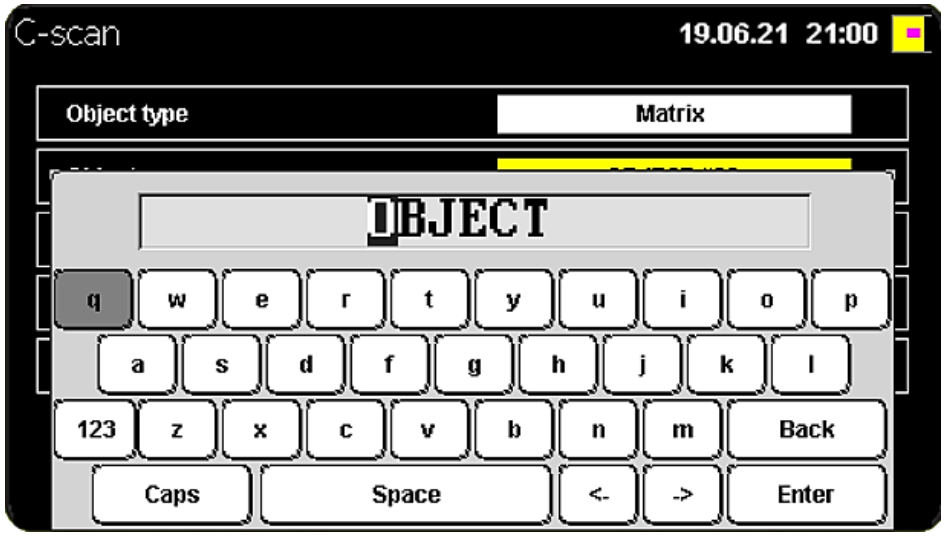


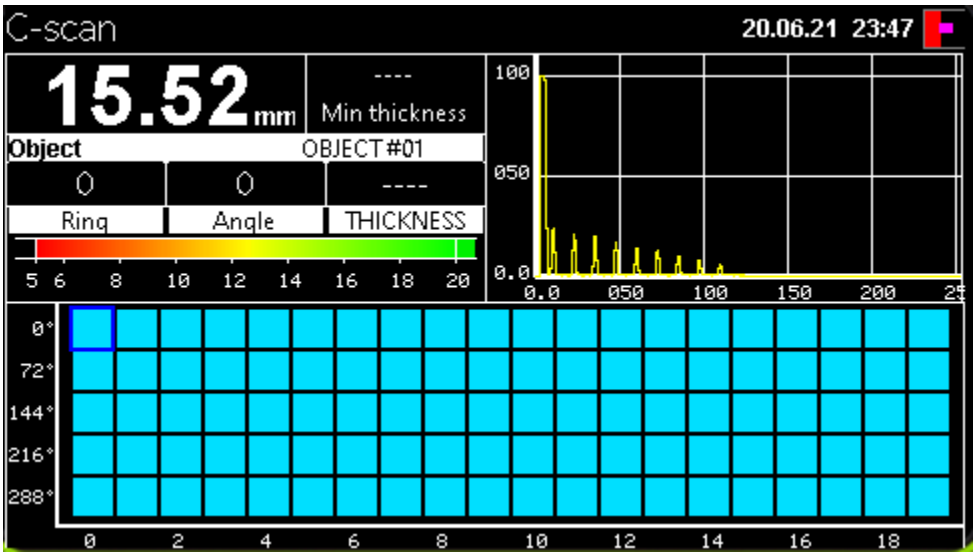
Figure 3.13 – Test object name entering

- select symbols, letters, and numbers using the , , and buttons, enter the selected symbol – using the OK button;

- upon completion, select the "Enter" button on the screen and press the OK button.

3.4.4.5 To start filling the C-scan, select the "Start inspection" item and press the OK button. Then, the window looks as shown in Figure 3.14.

Pipe test object



Matrix test object

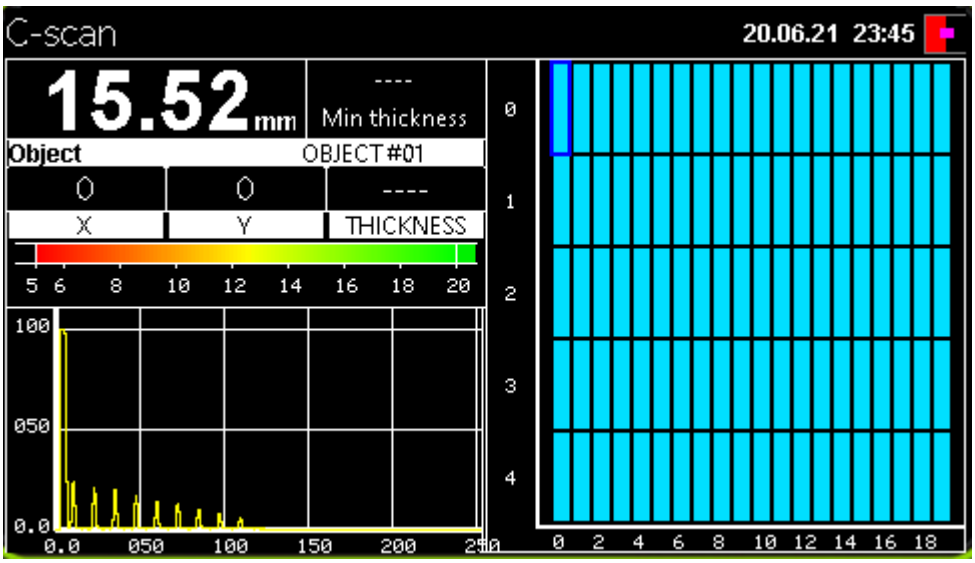


Figure 3.14 – C-scan filling mode

3.4.4.6 This window shows the A-scan, C-scan, current value of the measured thickness, current coordinate, as well as the minimum thickness which was found during the whole time of C-scan filling.

3.4.4.7 The current position is highlighted with blue square cursor on the C-scan. Prior to the inspection start, this square cursor is at the point with coordinate (0.0).

3.4.4.8 To fill the C-scan, the user places the transducer on the required point of the test object surface and presses the SAVE button; the cursor coordinate increases by one increment and the procedure repeats.

3.4.4.9 In the course of the C-scan filling, all points with thicknesses less than the minimum permissible thickness are displayed in black. Such points are visible very well on the background. The points with thicknesses higher that the base thickness are displayed in green. The points with thicknesses between the minimum and base values are displayed on the C-scan with gradient.

3.4.5 Open Inspections

3.4.5.1 This item enables to open the previously saved inspection results. If necessary, the user can repeat measurements for any point in the previously saved archive. The window for selecting a previously saved archive is shown in Figure 3.15.

3.4.5.2 To navigate through the menu items, press the , , and buttons. To select the menu item, press the OK button. The Context menu is described in Table 3.3.

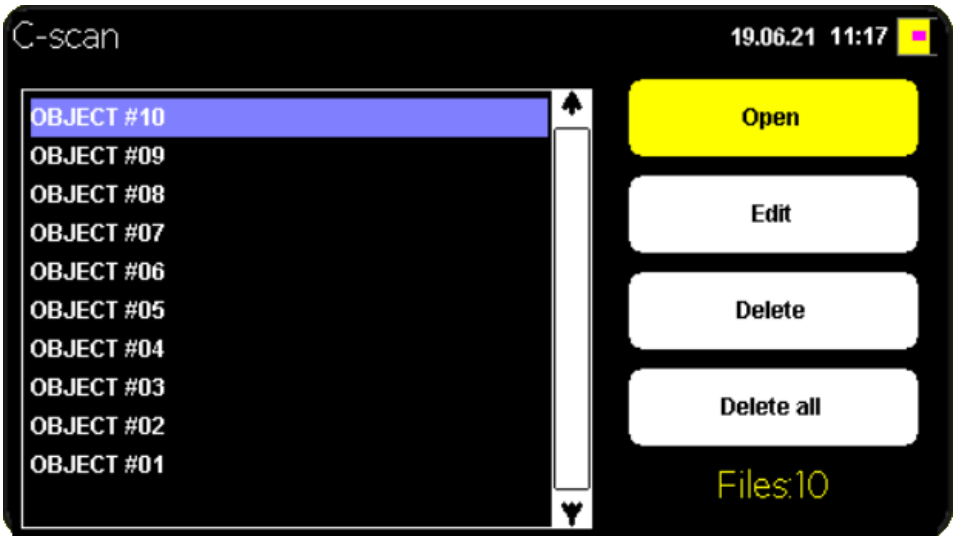


Figure 3.15 – Open inspections window

Table 3.3

Menu item	Description
Open	Select and open the previously saved archive
Edit	Select, open and edit the previously saved archive
Delete	Select and delete the previously saved archive
Delete all	Delete all archives saved to the Device memory

3.4.6 Operations with the C-scan are performed in accordance with paragraphs 3.4.4.6 - 3.4.4.9. To move the square displaying the current position on the C-scan, use the  , , , buttons.

3.4.7 Continue Inspection

3.4.7.1 This item becomes active when the user has started the inspection earlier and has terminated it by switching to the other windows of the Device. When this item is selected, the Device returns to the previously started inspection.

3.4.7.2 After opening the C-scan, continue filling it in accordance with paragraphs 3.4.4.6 - 3.4.4.9. To move the square displaying the current position on the C-scan, use the  , , , buttons.

3.5 Operation with PC

3.5.1 To exchange data, connect the Device to the USB port of the computer on which the EMViewer software is installed using the USB-C cable supplied with the Device.

Note – The EMViewer software is not included in the basic configuration of the Device and is available upon request.

3.5.2 The EMViewer software implements the following functions:

- download saved files with measurements (A-scans and C-scans) in ".csv" format from the Device memory. You can then view these files and create a control report in the EMViewer software or view these files in Microsoft Excel or similar program;

- operate in real time with the Device, display and adjust A-scans and C-scans.

3.5.3 A description of how to work with the EMViewer software is provided in the User Manual for this program.

3.6 Device Operation Features

3.6.1 The Device has the electromagnetic-acoustic transducer with a permanent magnet or a pulsed electromagnet that introduces a number of requirements for operation with the Device:

- Be careful when moving the transducer near knives, forks, needles, and other sharp metal objects. These objects can be magnetized to the transducer casing and injure the user;

- When placing the transducer on an unattached relatively light test object, hold the test object by hand;

- The transducer can disable magnetic cards if it is placed near them;

- In case of sharp inaccurate placement of the transducer on the test object, a stroke may occur due to additional acceleration caused by the magnetic field. It is recommended to place the transducer on the test object smoothly, without throwing and holding it by hand to increase the service life of the transducer;

- It is recommended to place the transducer on the test object at an angle of 60°. After touching the test object surface by the transducer, the transducer should be straightened to a 90° angle.

3.6.2 It is necessary to monitor the integrity of the transducer protector during the whole service life of the Device. If the protector is damaged and the coil wires are out of the coating, it is necessary to replace the transducer.

CAUTION!

Long-term operation of the product with a damaged transducer can lead to complete failure of the Device. The contact of the damaged transducer (when the coil wires are out of the coating) with the metal can lead to sparking.

3.7 Battery Charge

3.7.1 The battery must reach full charge on a regular basis for proper capacity and cycle-life maintenance.

3.7.2 To charge the battery, connect the Recharger supplied with the Device to the DC power connector of the Device and to an appropriate power outlet.

3.7.3 It takes at least four hours to charge a fully discharged battery to 100%. Charge the Device when it is off. When the Device is charging in the off state, the battery charge level is displayed on the screen.

CAUTION!

Long-term storage of the Device battery in the fully discharged state can decrease battery capacity and reduce its service life. When the battery is completely discharged, charge it as soon as possible. Consider this requirement during long-term storage of the Device.

4 Maintenance

4.1 Transducer Replacement

When the plastic coating of the transducer is worn out, replace the transducer.

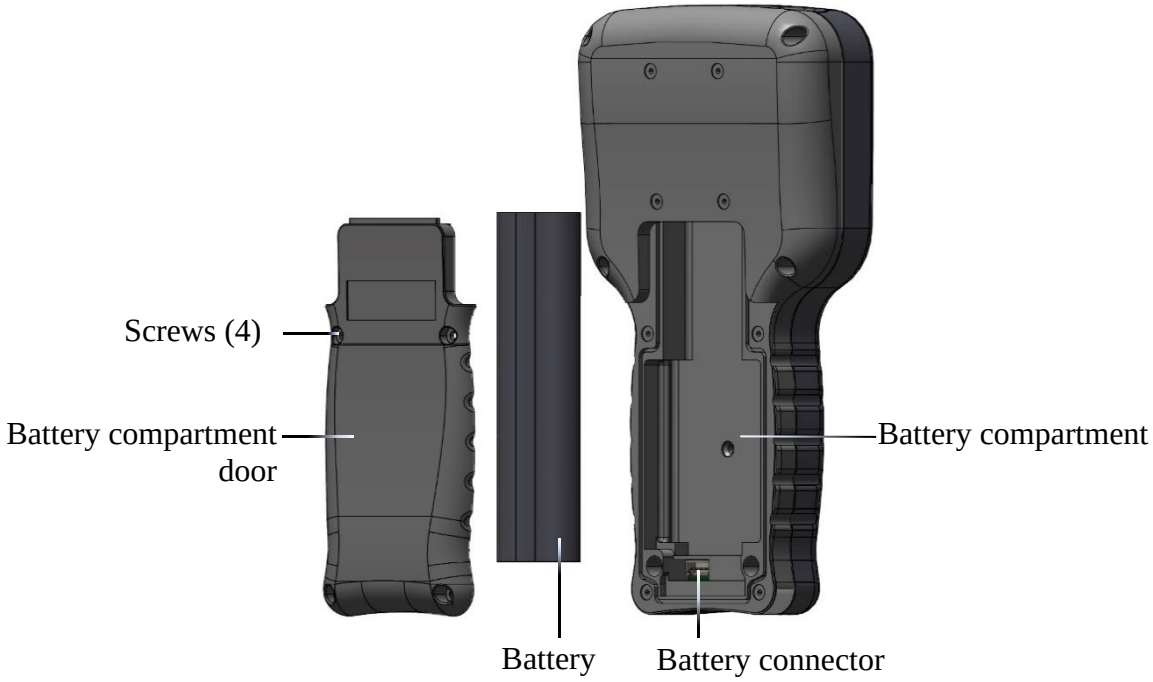
CAUTION!!!

Replace the transducer when the Device is OFF.

4.2 Battery Replacement

The Device is equipped with a removable battery; the user can replace the battery for a new one, if necessary. Replace the battery once per three years.

The battery is located in a compartment that is accessible from the back of the Device (Figure 4.1).



The stand is not shown

Figure 4.1

CAUTION!!!

Do not attempt to replace the battery while the Device is ON and/or connected to recharger.

5 Transportation and Storage

During storage and transportation of the Device, maintain the following climatic conditions:

- air temperature: from +5 to +30 °C;

- humidity: 80% at +25 °C.

Store and transport the Device only in the case from the scope of supply. Avoid any mechanical damages of the case and Device.

Battery storage instruction:

- never store discharged batteries without a full recharge;

- during long-term storage, the Device battery will discharge that can affect the Device further operation. So, we recommend to perform regular check (at least once per year) of the battery charge level and, if necessary, to recharge the battery (see paragraph 3.7).

6 Equipment Disposal

Before disposing of the Device, check your local laws, rules, and regulations, and follow them accordingly.

Before disposing of a battery, check your local laws, rules, and regulations, and follow them accordingly.

7 Scope of Supply

Basic configuration:

Name	Quantity
Thickness gauge	1 pc.
Protective cover	1 pc.
Storage case	1 pc.
Recharger (adapter and cable)	1 pc.
User manual	1 pc.
EMT15015P EMA transducer (with a pulsed electromagnet)	1 pc.
EMT14012 EMA transducer (with a permanent magnet)	1 pc.
Connecting cable for EMA transducers	1 pc.
EDC10P5F3 Piezoelectric transducer	1 pc.
EDC5P7.2FS10 Piezoelectric transducer	1 pc.
EDC5P10FS15 Piezoelectric transducer	1 pc.
Connecting cable for piezoelectric transducers	1 pc.
USB-C cable	1 pc.

Not included in the basic configuration, but can be ordered additionally:

- EMA transducer EMT14013 to work with a gap up to 6 mm;

- High-temperature EMA transducer EMT14014T to work with objects with a surface heated up to 750 °C.

8 Manufacturer Warranty

8.1 The warranty period is 24 months from the purchase date. Within the warranty period, the Manufacturer shall rectify faults of the Device provided that the housing is not damaged and the warranty seals are available.

8.2 The Manufacturer may withdraw its warranty obligations when:

- the Device is used for purposes other than those specified in this user manual;
- the Device operation, storage, and transportation conditions and requirements specified in this user manual are not met;
- there are mechanical damages of the Device as a result of careless handling.

9 Warranty Certificate

Device	EM1501 Electromagnetic Acoustic Thickness Gauge
Serial Number	
Date of manufacture	
Warranty Period	
Manufacturer	Oktanta LTD 34 Olga Berggholz Street, Saint Petersburg 192148, Russia +7(812)385-54-28 info@oktanta-ntd.ru _____ signature, stamp

10 Information about Repair

Date of Application	Fault Type	Repair	Completed/Not Completed (Date, Signature, Stamp)

11 Information about Calibration Test

Date of calibration test	Valid till	Calibrator