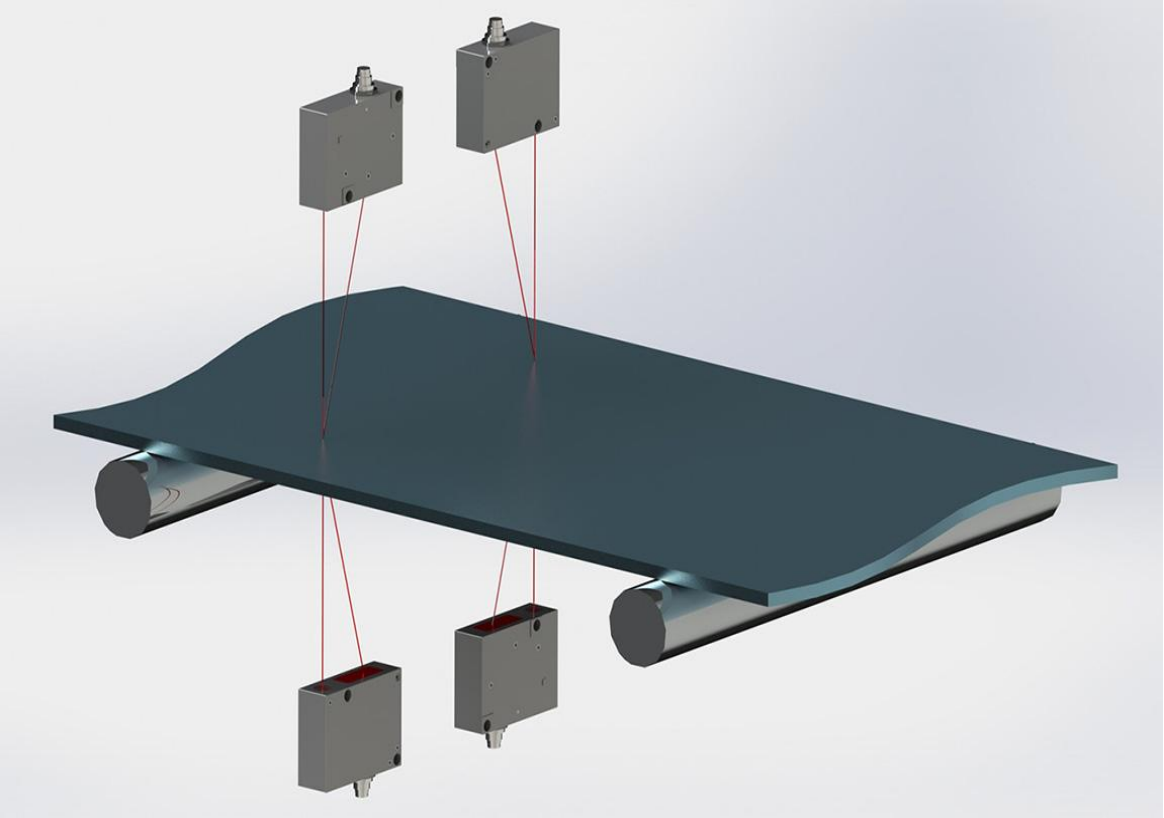
RIFTEK
Sensors & Instruments



THICKNESS MEASUREMENT SYSTEM

RF580 Series

User's manual

Contents

1. Safety precautions

- Use supply voltage and interfaces indicated in the system specifications.
- In connection/disconnection of cables, the system power must be switched off.
- Do not use the system in locations close to powerful light sources.
- To obtain stable results, wait about 20 minutes after sensor activation to achieve uniform sensor warm-up.
- The indication device must be grounded and connected to the grounding bus by a separate branch.

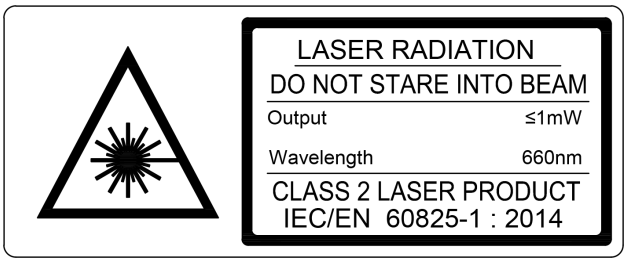
2. CE compliance

The system has been developed for use in industry and meets the requirements of the following Directives:

- EU directive 2014/30/EU. Electromagnetic compatibility (EMC).
- EU directive 2011/65/EU, “RoHS“ category 9.

3. Laser safety

The system makes use of laser sensors that belong to the 2 laser safety class according to IEC/EN 60825-1:2014. Maximum output power is 1 mW. The following warning label is placed on the sensor body:



The following safety measures should be taken while operating the sensor:

- Do not target the laser beam to humans.
- Do not disassemble the sensor.
- Avoid staring into the laser beam.

4. General information

The system is designed for non-contact measurement of the thickness of sheet materials such as tapes, boards, plates, and so on. It is an autonomous software and hardware complex that contains laser sensors (or contact encoders) and an indication device.

Technical characteristics of the system can be changed for a specific task.

5. Structure and operating principle

The system can support an unlimited number of thickness control points. Each control point is a sensor mounted according to Scheme #1 (Figure 1, left) or two sensors mounted according to Scheme #2 (Figure 1, right).

According to Scheme #1, the material thickness is defined as the difference between the distance from the base surface on which the material is placed, and the distance to the upper surface of the material measured by a sensor. The position of the sensor is calibrated relative to the base surface.

According to Scheme #2, the material thickness is defined as the difference in the distances to two surfaces of the material measured by each of the sensors. The position of the sensors is calibrated relative to each other.

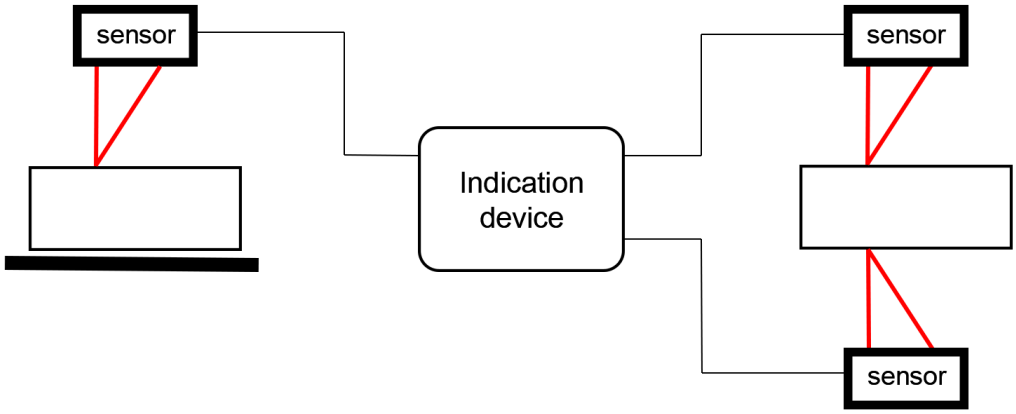


Figure 1. Scheme #1 with one sensor (left) and Scheme #2 with two sensors (right)

5.1. Laser sensors

The system can contain Laser triangulation sensors RF603 Series.
The User's manual for Laser triangulation sensors RF603 Series:
https://riftek.com/media/documents/rf60x/rf603/Laser_Triangulation_Sensors_RF603_Series_eng.pdf

5.2. Contact encoders

The system can contain Absolute linear encoders RF25x Series.
The User's manual for Absolute linear encoders RF25x Series:
https://riftek.com/media/documents/rf25/manual/Absolute_Linear_Encoders_RF25x_Series_eng.pdf

5.3. Indication device

The indication device is designed to receive information from sensors, analyze and display the measurement results.

Laser sensors must be connected via the special connectors mounted on the housing of the indication device. The LCD display with the touch screen shows information. When the thickness value exceeds the tolerances, the operator will be notified by an audible alarm. The thickness value output is based on the analysis of values received from sensors and calculated for a given averaging time, and is repeated with periodicity equal to the averaging time.

Overall and mounting dimensions of the indication device:

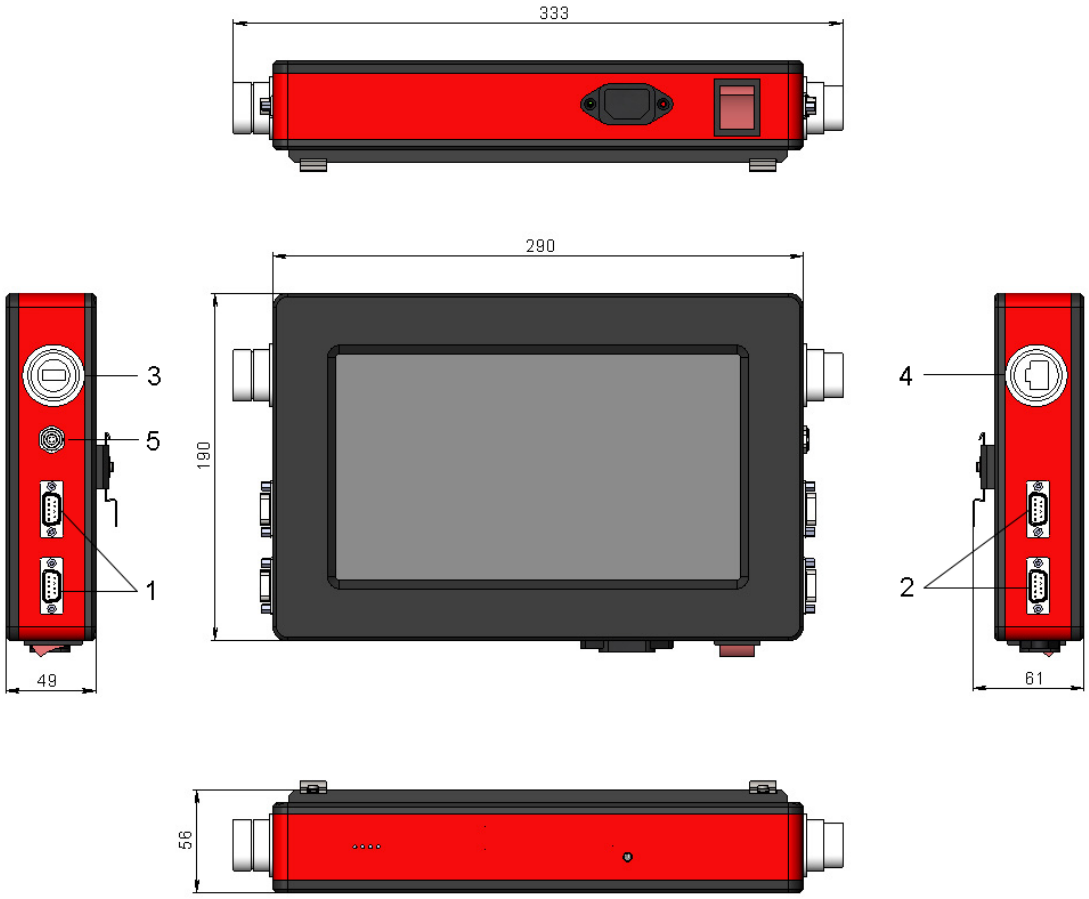


Figure 2. Overall and mounting dimensions of the indication device

Designations:
1 - DB9 connectors for connecting the sensors (Point 1);
2 - DB9 connectors for connecting the sensors (Point 2);
3 - USB;
4 - Ethernet;
5 - Encoder input and Logical output.

5.4. Analog output controller RF002.1-485-8I

The measurement system can be equipped with a controller designed to output analog signals (up to 8 outputs).

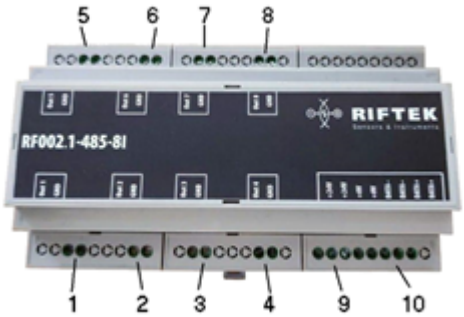


Figure 3. Analog output controller RF002.1-485-8I

Designations:
1-8 – analog output connectors for control points;
9 – power connectors +24V;
10 – connectors for connecting to the indication device via RS485.

6. Basic technical data

Parameter		Value
Thickness measurement range, mm		by request
Measurement error, mm		±0.1% of the laser sensors measurement range or according to the specification for encoders
Input interface, sensors connection		RS485
Output interface, result transfer		Ethernet
Logical output (OK/NOK)		Open collector
Analog outputs		4...20 mA, load <500 Ohm
Encoder input		TTL
Software update, data transfer		USB
Measurement speed, measurements/second		up to 100
Power supply, V		220 (±10 %) for AC network with frequency of 50 (±1) Hz
Power consumption, W		10
Operating conditions	Ambient temperature, °C	+1...+35
	Relative humidity, %	65 (at 25°C)

Note: System parameters can be changed for a specific task.

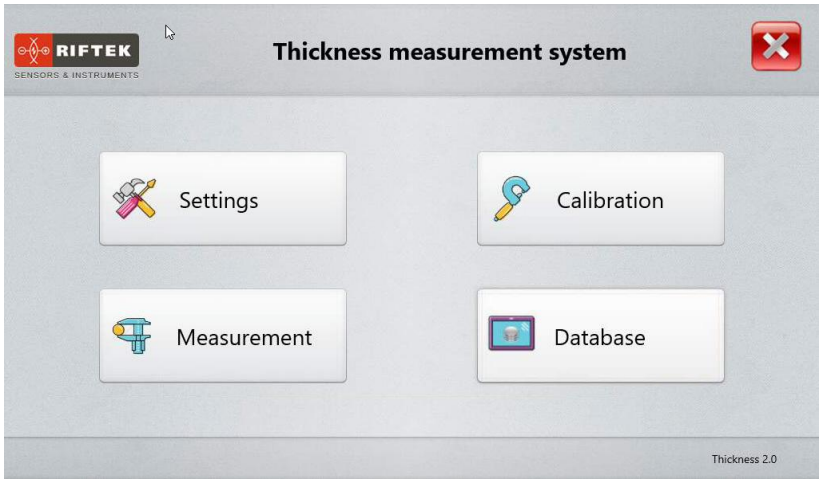
7. Example of item designation when ordering

RF580-SERIAL-Pn-Sn-Ln-An

Symbol	Description
SERIAL	Serial interface type: RS485 - 485 or Ethernet - ET.
Pn	Number of control points.
Sn	Number of sensors at each control point (1 or 2).
Ln	Number of logic outputs.
An	Number of analog outputs.

8. Service program

When you switch on the indication device, the main program window appears:

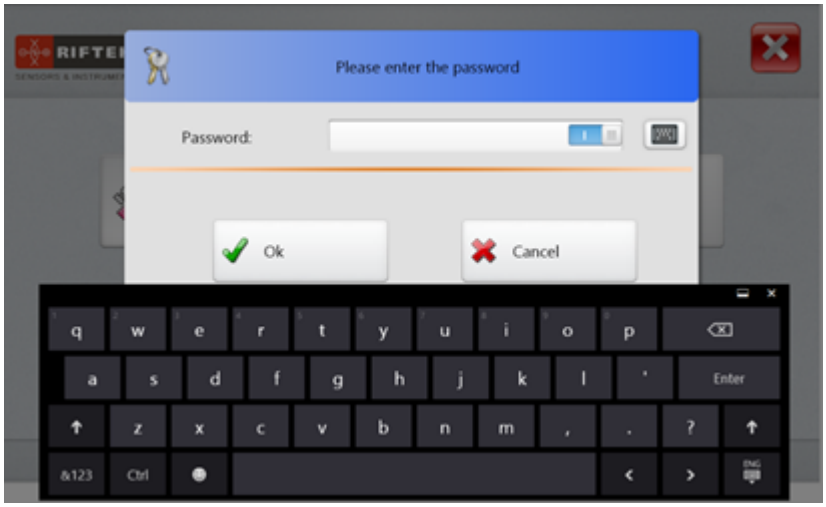


Buttons assignment:

Button	Assignment
Settings	Open the "Settings" window.
Measurement	Open the "Thickness measurement" window.
Calibration	Calibrate the system.
Database	Browse the database.

8.1. Settings

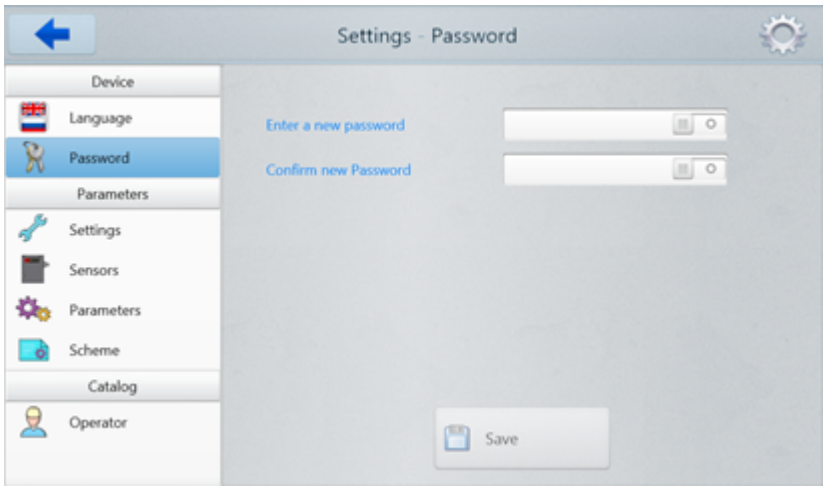
Before starting to work with the system, it is necessary to configure parameters. Tap the **Settings** button in the main window.The program will ask for a password. When initially installed, the program accepts the following password: 1111. Enter the password and tap **Ok**.



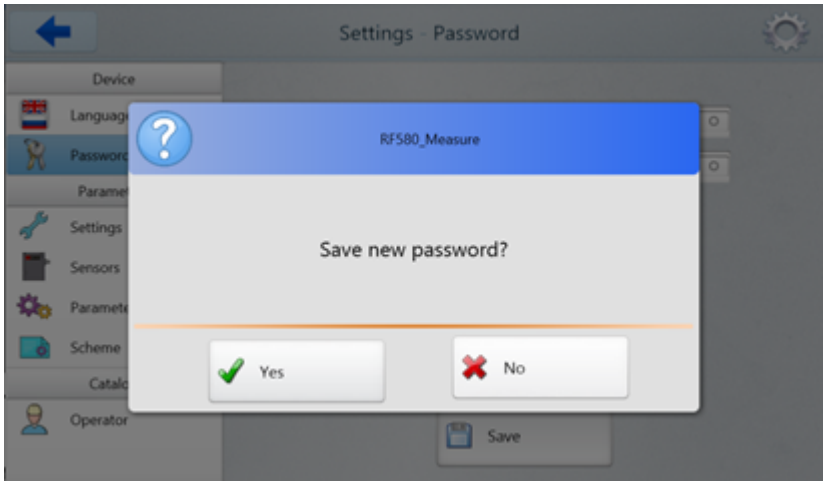
How to change the password, see par. 8.1.1.

8.1.1. Password

To change a password, tap **Password**. Then enter a new password, confirm it, and tap **Save**.



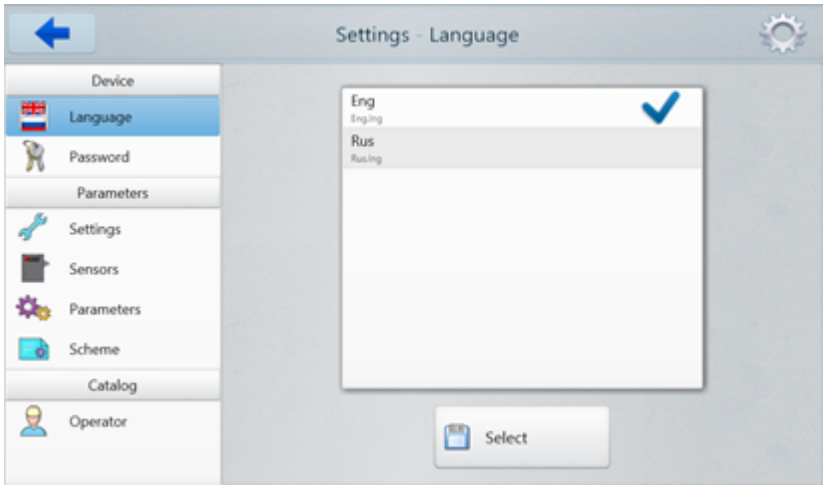
The program will prompt you to confirm the action:



Select "Yes" to save the new password, or select "No" to cancel the action.

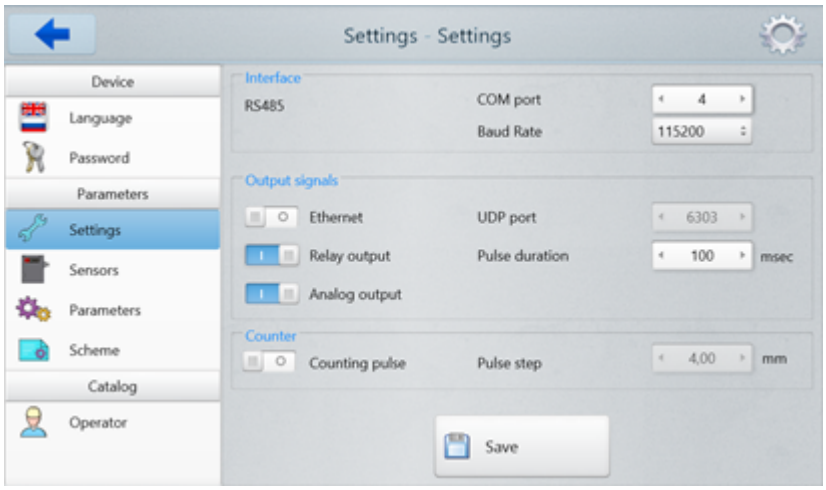
8.1.2. Language

In order to change the language of the program, tap **Language**, select the language support file, and tap **Select**.



8.1.3. Basic settings

The **Settings** tab:



In the **Interface** section, the user can specify the COM port number of the device and the baud rate.

In the **Output signals** section, the user can:

- enable the Ethernet interface and specify the UDP port;
- enable relay outputs and specify the pulse duration;
- enable the analog output.

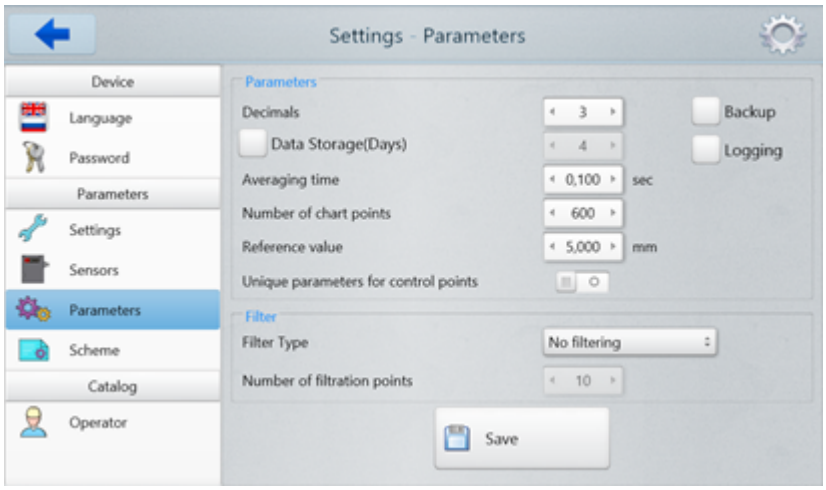
In the **Counter** section, the user can enable the counter and specify the pulse step.

Note: In this case, the pulse means, for example, the pulses from the encoder that characterize the movement of the object under control.

To save the changes, tap **Save**.

8.1.4. Parameters

The **Parameters** tab:



In the **Parameters** tab, the user can set general parameters and filtering. The general parameters are described in the table below.

Parameter	Description
Decimals	The number of decimals for the measurement results.
Data Storage	The number of days during which the data is stored. If this checkbox is selected, the saved data will be stored in the database for the selected number of days, outdated data will be deleted automatically.
Backup	If this checkbox is selected, a backup copy of the database will be automatically created when you exit the program.
Logging	If this checkbox is selected, the main processes of the system operation will be recorded (logged) to the file.
Averaging time	The time for which the measurement results will be output/saved (for example, every 0.1 s).
Number of chart points	The number of measured points displayed on the graph.
Reference value	The reference value used when calibrating the system.
Unique parameters for control points	By default, the nominal values, tolerances and analog output parameters are identical for all control points (if there are several). If this checkbox is selected, you can set unique parameters for each control point.

Filtering is used to reduce noise and achieve better resolution. Description of the parameters is given in the table below:

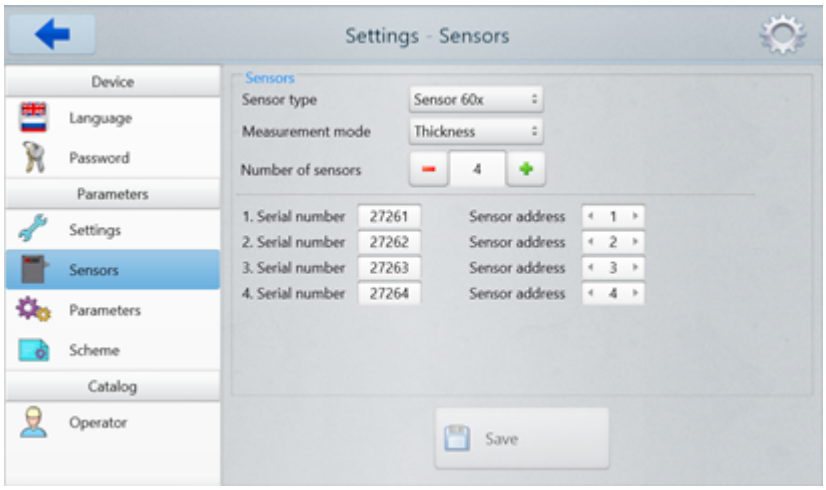
Parameter		Description
Filter type	No filtering	Without filtering.
	Moving Average	The number of filter points for the measured values. It is used to calculate the arithmetic mean. Each new measured value is added, the first measured value is removed from the averaging.

Parameter		Description
	Median Filter	The median is formed from a preselected number of filtration points for measurement values. The incoming measured values are sorted again after each measurement. Subsequently, the mean value will be output as the median. If the number of filter points is an even number, then the two average measurement values are added up and divided by two.
Number of filtration points		This parameter specifies the number of measurement values to which the filter applies.

To save the changes, tap **Save**.

8.1.5. Sensors

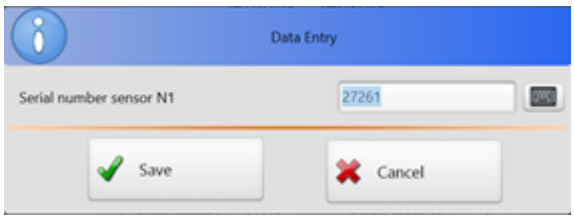
The **Sensors** tab:



In this tab, the user can select the measurement mode, specify the number of sensors in the system and their network addresses.

To select the measurement mode, use the **Measurement mode** drop-down list. There are two measurement modes: Thickness and Distance.

To specify the number of sensors in the system, use the **+/-** buttons. For each sensor, it is necessary to enter the serial number and address. A window for entering the serial number will appear when the cursor is placed in the **Serial number** field.

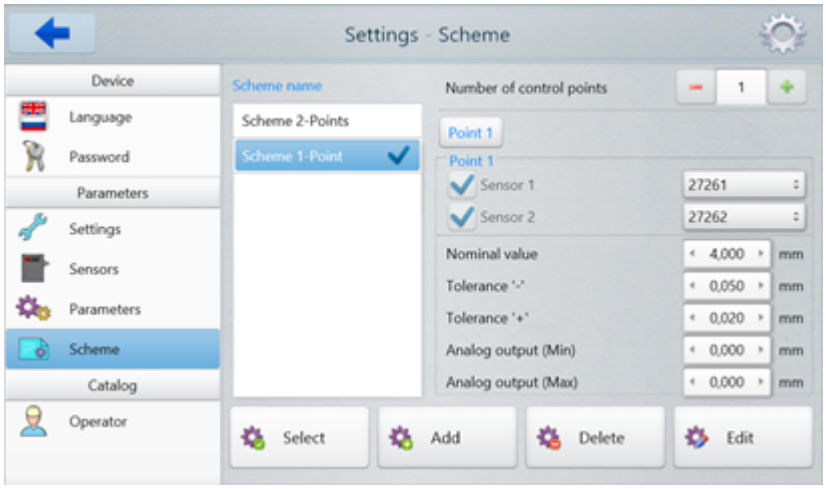


The sensor address is selected in the **Sensor address** field using the left / right arrows.

To save the changes, tap **Save**.

8.1.6. Measurement scheme

The **Scheme** tab:

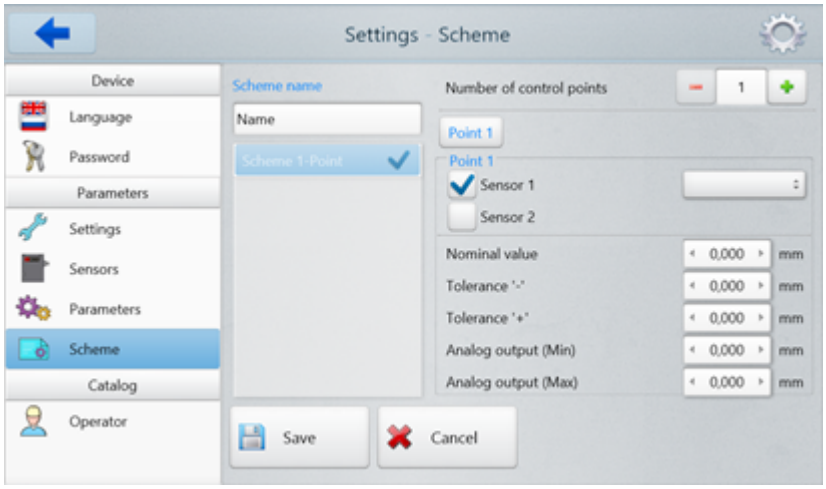


In this tab, the user can create a measurement scheme with the required number of control points (points for measuring thickness or distance). One or two sensors can be used for measuring at each point.

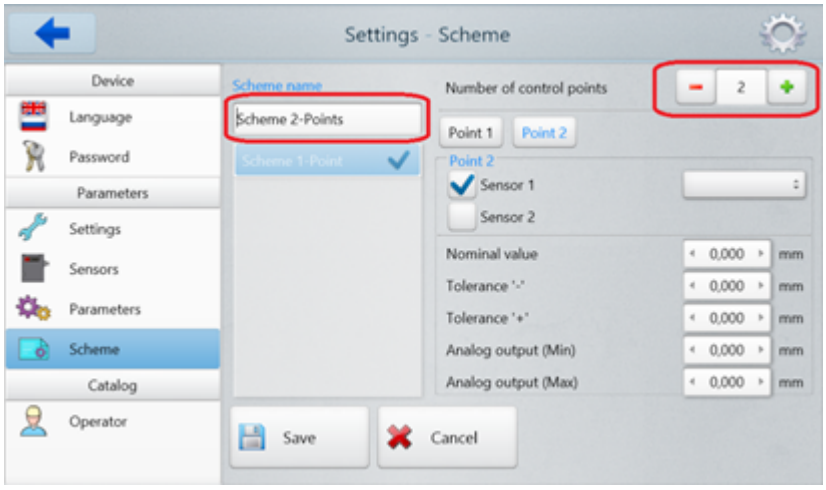
Buttons assignment:

Button	Assignment
Select	Selecting a set of parameters. To select a set of parameters, you need to tap on it in the **Scheme name** list and then tap the **Select** button.
Add	Adding a new set of parameters. To add a new set of parameters, you need to tap the **Add** button, specify the nominal thickness of the measured object (**Nominal value**), tolerances (**Tolerance '-'** and **Tolerance '+'**) and set the minimum / maximum thickness for the analog output (if selected).
Delete	Deleting a set of parameters. To delete a set of parameters, you need to tap on it in the **Scheme name** list and then tap the **Delete** button.
Edit	Editing a set of parameters. To edit a set of parameters, you need to tap on it in the **Scheme name** list and then tap the **Edit** button.

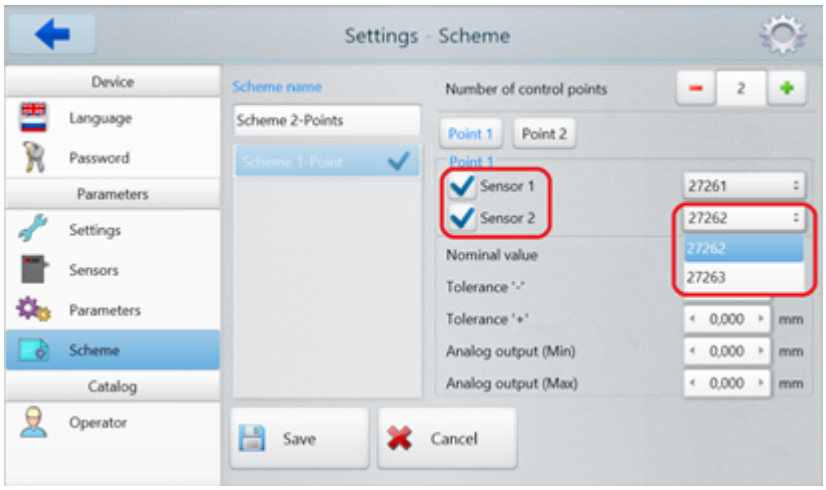
An example of adding the measurement scheme with two control points. After clicking the **Add** button, the data entry window for the new scheme appears on the screen:



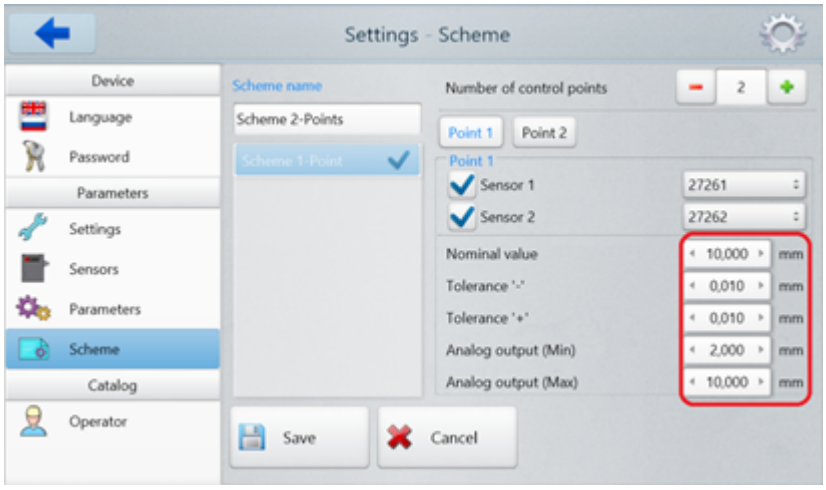
1. Type the name of the scheme in the **Scheme name** field.
2. Specify the number of control points in the **Number of control points** field.



3. For each point, select the sensors from the drop-down list.



4. Specify the nominal thickness value (**Nominal value**), tolerances (**Tolerance '-'** and **Tolerance '+'**) and the value of the boundaries of the analog outputs.

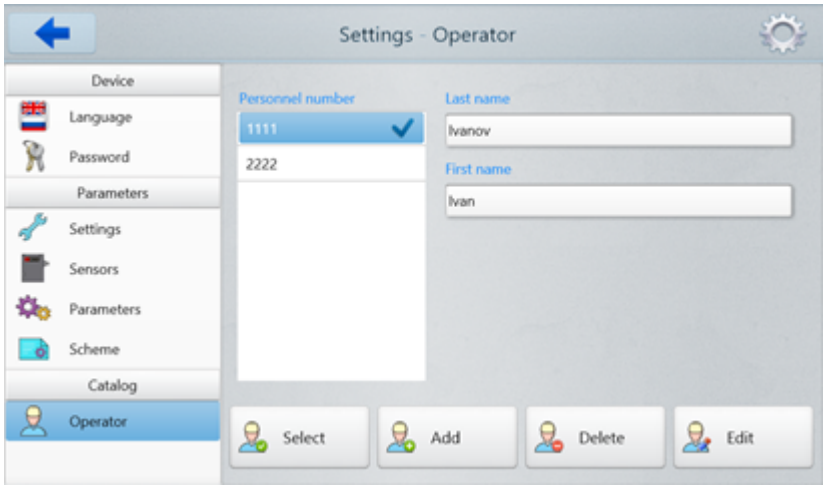


5. Perform the same actions for each measurement point. To change the current edited point, tap on the button with the corresponding name (**Point 1**, **Point 2**...).

6. Save the changes by tapping the **Save** button.

8.1.7. Operator

The **Operator** tab:



In this tab, the user can enter the operator's data. Subsequently, when saving the measurement results to the database, the data of the selected operator is entered to the database.

Buttons assignment:

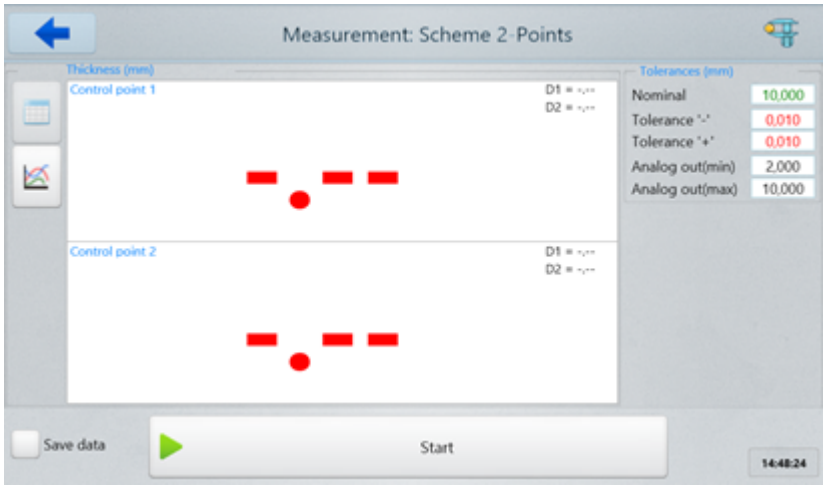
Button	Assignment
Select	Selecting the current operator. To select the current operator, you need to tap on the personnel number and then tap the **Select** button.
Add	Adding a new operator. To add a new operator, you need to tap the **Add** button, specify the personnel number, last name and first name of the operator.
Delete	Deleting the operator. To delete the operator, you need to tap on the personnel number and then tap the **Delete** button.
Edit	Editing the operator's data. To edit the operator's data, you need to tap on the personnel number and then tap the **Edit** button.

To save the changes, tap **Save**.

8.2. Measurement

In the main window, tap the **Measurement** button. The **Measurement Scheme** window appears.

The **Measurement Scheme** window for the two-point measurement system:



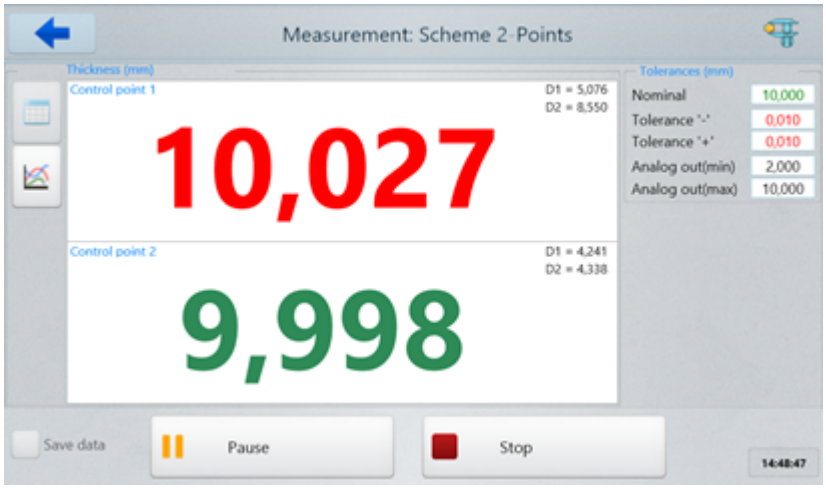
This window displays:

- name of the selected set of parameters (to the right of the window name);
- current measured thickness (green or red);
- sensor readings (**D1** and **D2**);
- nominal thickness (**Nominal**);
- tolerances (**Tolerance '-'** and **Tolerance '+'**);
- analog output boundaries (**Analog out(min)** and **Analog out(max)**);
- buttons for selecting the mode of displaying the measurement results: numerical  or graphical  .

To save the measurement results to the database, tick the **Save data** checkbox.

To start the measurement process, tap the **Start** button.

The **Measurement Scheme** window during the measurement process (shown for a two-point scheme):

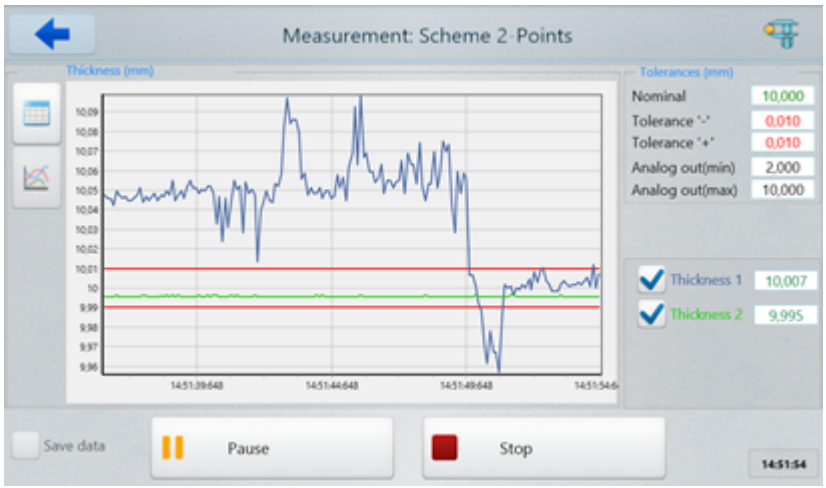


To stop the measurement process, tap the **Stop** button.

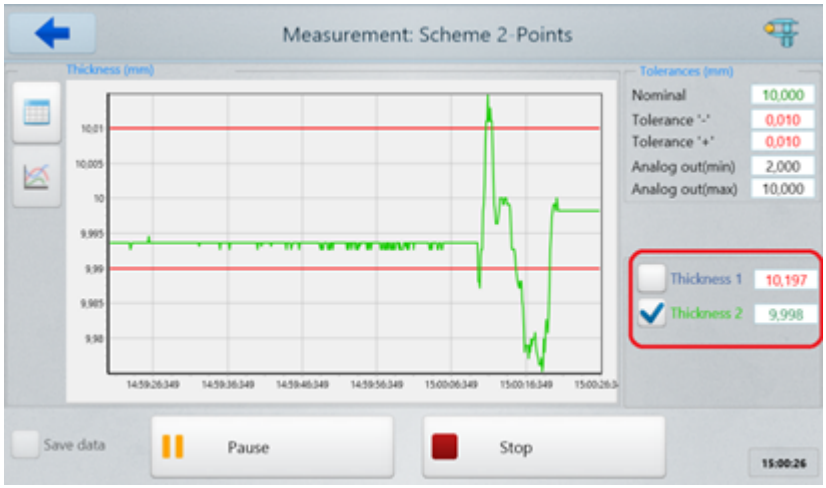
To pause the measurement process, tap **Pause**.

When the thickness value does not exceed the tolerances, it will be displayed in green, otherwise - in red.

To switch to the graphical display of results, tap the button  .

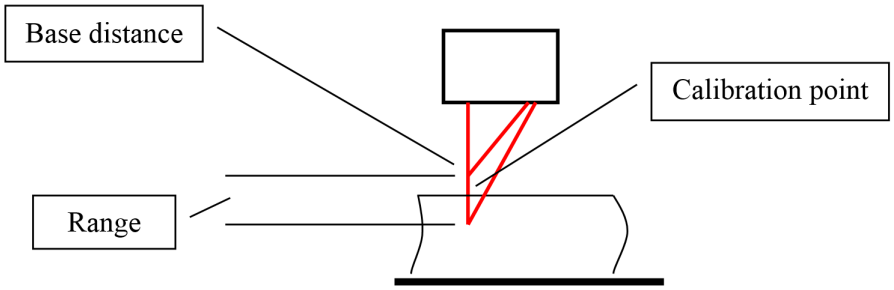


To cancel the data output at the control point, uncheck the corresponding field:



8.3. Calibration

The thickness of materials is controlled within the working range of a sensor (sensors).



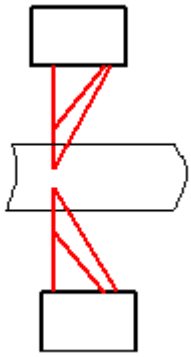


Figure 4.1. Scheme #1

Figure 4.2. Scheme #2

To get the optimum results of the thickness control, a sensor should be mounted so that the controlled surface (surfaces) of the sample of nominal thickness was located in the middle of the working range of a sensor. Since a laser sensor is calibrated in its own coordinate system, and the thickness measurement is carried out relative to a base surface on which the controlled sample is located or relative to two sensors, it is necessary to calibrate a sensor relative to a base surface (Scheme #1) or to calibrate the sensors relative to each other (Scheme #2). The calibration must be done by using the sample of the known thickness.

Follow the steps below to perform the calibration procedure properly:

- Install the sample of the known thickness in the control area.
- Go to the **Settings** window, tap **Parameters** and type the sample thickness in the **Reference value** field.
- Go back to the main menu and tap the **Calibration** button. The **Calibration** window appears. The name of the selected set of parameters is displayed to the right of the window name.

The **Calibration** window:

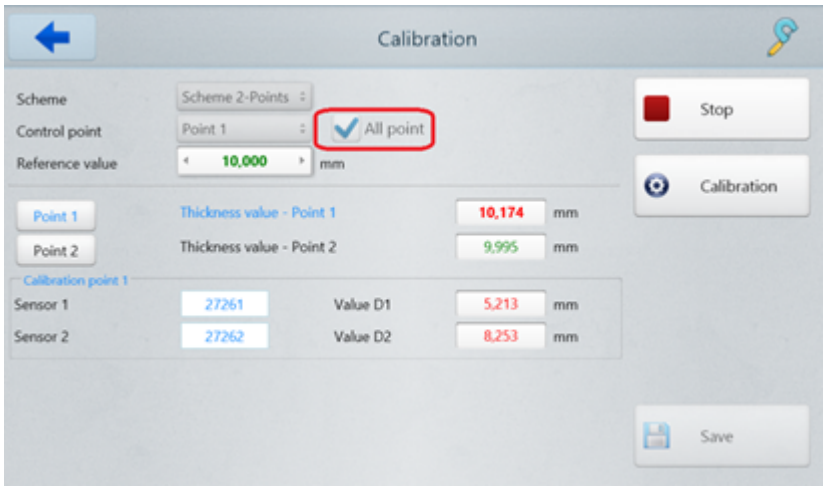
- Tap the **Connect** button to connect to the sensors.

By default, the current measurement scheme is selected for calibration. In the **Scheme** drop-down list, you can select any other scheme.

Calibration can be performed separately for each control point (in case there are more than one control point) or for all points simultaneously.

- To perform the calibration for a separate point, or if there is only one control point in the scheme, select a control point in the **Control Point** drop-down list.

- To perform the calibration for all control points, select the **All point** checkbox.



- Tap the **Start** button to start the measurement process. Parameters **Value D1**, **Value D2**, **Thickness** and **Calibration point** take values equal to the readings of the sensors in the sensor coordinate system.
- Tap the **Stop** button.
- Tap the **Calibration** button to start the calibration process. Parameters **Value D1**, **Value D2** and **Calibration point** are the sensor readings in the sensor coordinate system. The **Thickness** parameter (sample thickness) takes values equal to the sensor readings in the coordinate system of the surface on which the sample is installed.

- If the value of the **Thickness** parameter is equal to the value of the **Reference value** parameter, the calibration is successful. Tap the **Save** button.

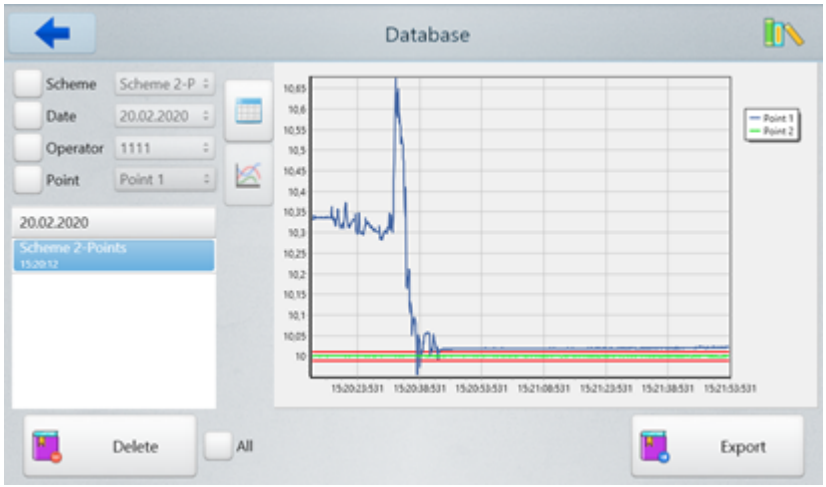
8.4. Database

During the system operation, the thickness values are written to the database (provided that the **Save data** option is selected, see Par. 8.2.).

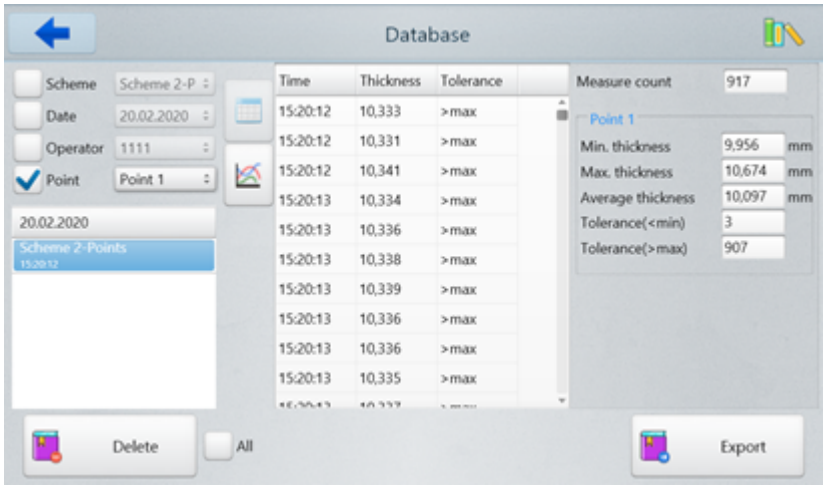
To browse the database, tap the **Database** button in the main menu. The **Database** window appears. Then you need to select a set of measurements from a list located on the left side of the window.

Data can be presented both in tabular and graphical form.

To view the data in graphical form, tap  :



To view the data in tabular form, tap  :



To work with the table, use a vertical scrollbar.

To delete a single measurement, tap on it in the table and then tap the **Delete** button.

To delete all measurements, select the **All** checkbox and then tap the **Delete** button.

Data can be exported to CSV, XLS and XML formats - tap the **Export** button and select the required format.

9. Operating the system

It is imperative to follow the steps below:

- Connect the sensors and controller (if used) to the indication device.
- Mount the sensor above the surface on which the controlled material will move (Scheme #1), or mount two sensors on opposite sides of the material (Scheme #2). Sensors should be mounted taking into account their working range and the nominal thickness of the material (see par. 8.3).
- Set parameters (see par. 8.1).
- Perform the calibration procedure (see par. 8.3).
- Start the measurement process (see par. 8.2).

9.1. Connecting sensors to the indication device

If the system contains up to 4 sensors, then connection to the indication device can be made via DB9 connectors on the side panel (see Figure 2, par. 5.3). If the number of sensors exceeds the number of connectors on the housing of the indication device, the connection is made through special switching units (supplied with the system).

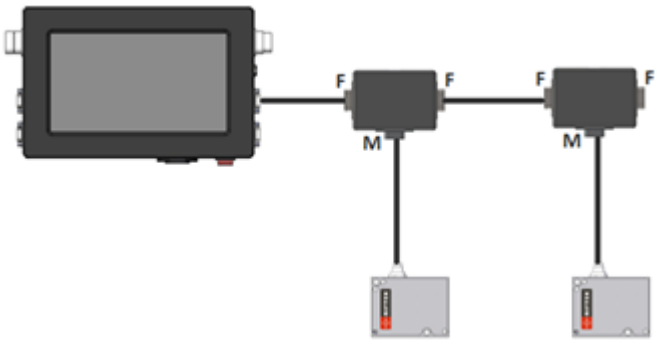


Figure 5. Connecting sensors to the indication device

9.2. Connecting the analog output controller

A separate power supply unit must be used for the analog output controller RF002.1-485-8I. Switching and power supply of sensors is also carried out through the controller.

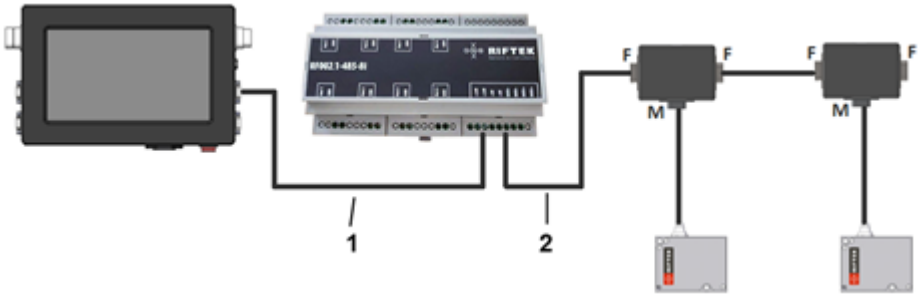


Figure 6. Connecting the analog output controller

1 – Cable 1 (from the indication device).
2 – Cable 2 (to the sensors).

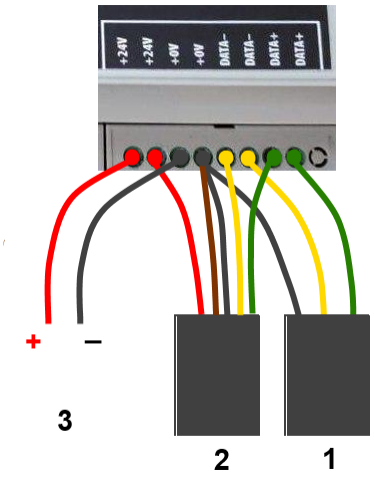


Figure 7. Connecting the analog output controller

1 – Cable 1 (from the indication device).
2 – Cable 2 (to the sensors).
3 – External power supply +24V.

9.3. Ethernet interface

The Ethernet interface is used only to transmit the thickness value.

9.3.1. Data packet format

By default, the sensor transmits the UDP packet to destination port **6303**. The destination port can be changed in the settings (see par. 8.1.3).

The packet consists of a header field (8 bytes) and a data field (16 bytes).

Data field:

- byte 0, byte 1: start of packet - [0x55,0xAA]
- byte 2, byte 3: device number - [580 - 0x44, 0x02]
- byte 4, byte 5: packet number
- byte 6, byte 7: data size - [16 bytes - 0x10]
- byte 8, byte 9, byte 10, byte 11: measurement result for control point #1
- byte 12, byte 13, byte 14, byte 15: measurement result for control point #2
- byte 16, byte 17, byte 18, byte 19: measurement result for control point #3
- byte 20, byte 21, byte 22, byte 23: measurement result for control point #4

An example of data packet for two control points:

55h,AAh,6Dh,5Dh,79h,02h,10h,00h,8Ah,C0h,08h,00h,ACh,C5h,08h,00h,00h,00h,00h,00h,00h,00h,00h,00h

55h, AAh	- start of packet
02h, 44h	- device number [580]
79h, 02h	- packet number [cnt = 633]
10h, 00h	- data size [16 bytes]
8Ah, C0h, 08h, 00h	- data [D1 = 0008C08Ah = 573578]
ACh, C5h, 08h, 00h	- data [D2 = 0008C5ACh =574892]
00h, 00h, 00h, 00h	- data [D3 = 00h = 0]
00h, 00h, 00h, 00h	- data [D4 = 00h = 0]

The result (in mm) is calculated by the following formula:
X1=D/10000 = 573578/10000 = 57.3578 mm
X2=D/10000 = 574892/10000 = 57.4892 mm

9.4. Encoder input and Logical output

The open collector is triggered when the thickness value exceeds the tolerance.
View from the side of connector contacts used in the device is shown below.

Binder on cable

pins 1,2 - Pulse input
pins 3,4 - Relay output

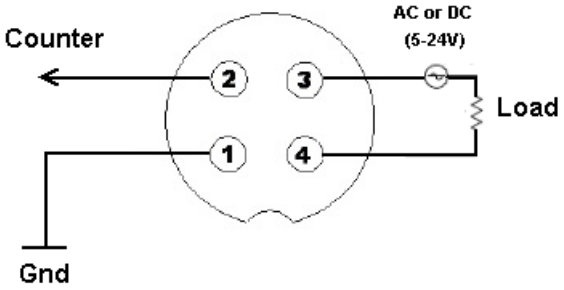


Figure 8. View from the side of connector contacts

9.5. Analog outputs

The change in the signal at the analog output occurs synchronously with the change in the result at the corresponding control point transmitted via the serial interface.

The range of the current output is 4...20 mA.

The wiring diagram is shown in Figure 9. The value of the load resistor must not exceed 500 Ohms.

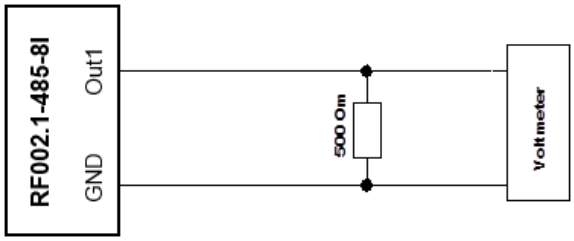


Figure 9. Wiring diagram

In the settings, it is necessary to specify the minimum / maximum value of the measured thickness, within which the entire range of the analog output signal will be scaled.

10. Technical support

Technical assistance related to incorrect work of the system and to problems with a service program is free.

Requests for technical assistance should be addressed at support@riftek.com, or by phone +375-17-3573657.

11. Warranty policy

Warranty assurance for the Thickness Measurement System RF580 Series - 24 months from the date of putting in operation; warranty shelf-life - 12 months.

12. Revisions

Date	Revision	Description
28.06.2017	1.0.0	Starting document.
07.06.2018	1.1.0	Updated: • description of the indication device (p. 5.3.); • description of the service program (p. 8.); • description of the open collector (p. 9.2.).
20.02.2020	2.0.0	Updated: • description of the service program (p. 8.); Added: • description of analog outputs (п. 5.4, п. 9.2, п. 9.5).