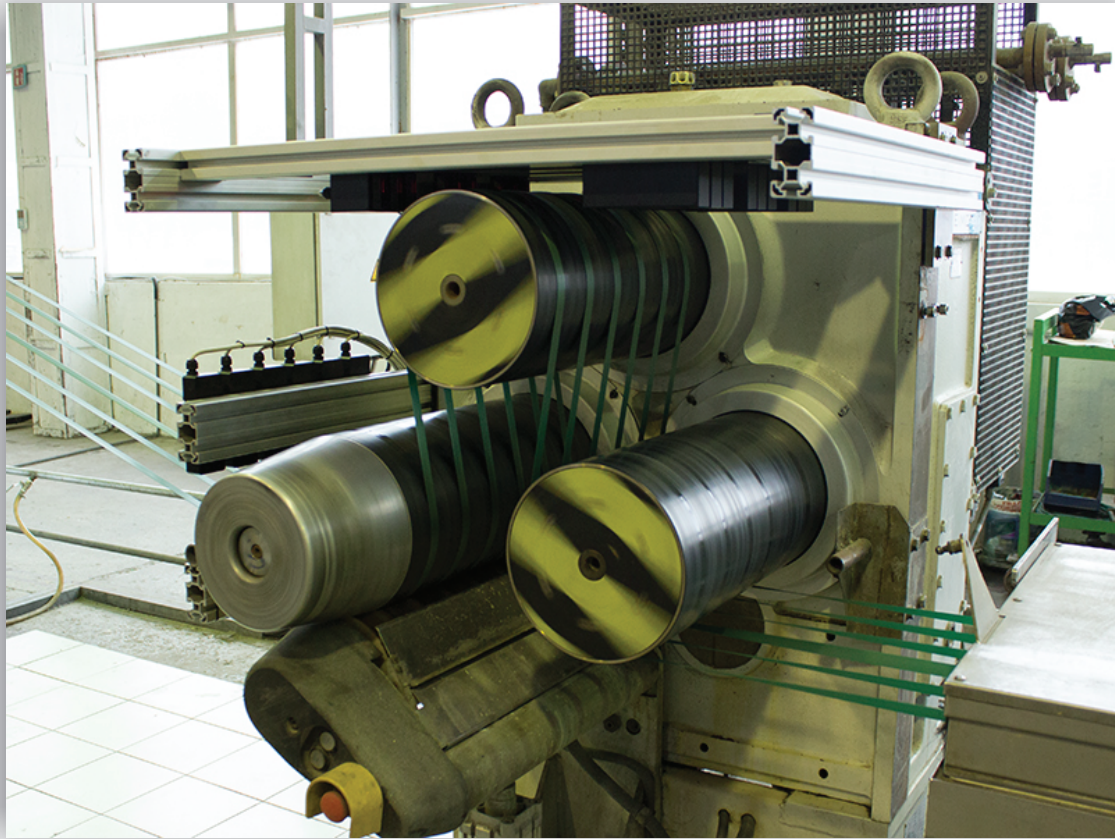




RIFTEK
Sensors & Instruments



AUTOMATED SYSTEM FOR TAPES GEOMETRY MEASUREMENT

RF089 Series

User's manual

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1. Safety precautions

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

2. Electromagnetic compatibility

The system have been developed for use in industry and meet the requirements of the following standards:

- EN 55022:2006 Information Technology Equipment. Radio disturbance characteristics. Limits and methods of measurement.
- EN 61000-6-2:2005 Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments.
- EN 61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use. EMC Requirements. General requirements.

3. Laser safety

The micrometers make use LED or c.w. 660 nm wavelength semiconductor laser. Maximum laser output power is $<0,2$ mW. The micrometers belong to the 1 laser safety class. The following warning label is placed on the laser body.



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

- Avoid staring into the laser beam during a prolonged time period;
- Do not disassemble the micrometer.

4. General information

The system is designed to control the geometrical parameters (width and thickness) and the temperature of the tapes, in particular, packing straps during the manufacturing process.

The system is applied in the mass production. Production line is the place of installation.

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

5. Structure and operating principle

Optical micrometers are used to control the geometrical parameters of the tapes. The principle of width measurement is shown in the Fig.1

Operation is based on the so-called 'shadow' principle. The micrometer consists of two blocks – transmitter and receiver. Radiation of a semiconductor laser or LED 1 is collimated by a lens 2. With a tape placed in the collimated beam region, shadow image formed is scanned with a CCD photo-detector array 3. A processor 4 calculates the position (size) of the tape from the position of shadow border (borders).

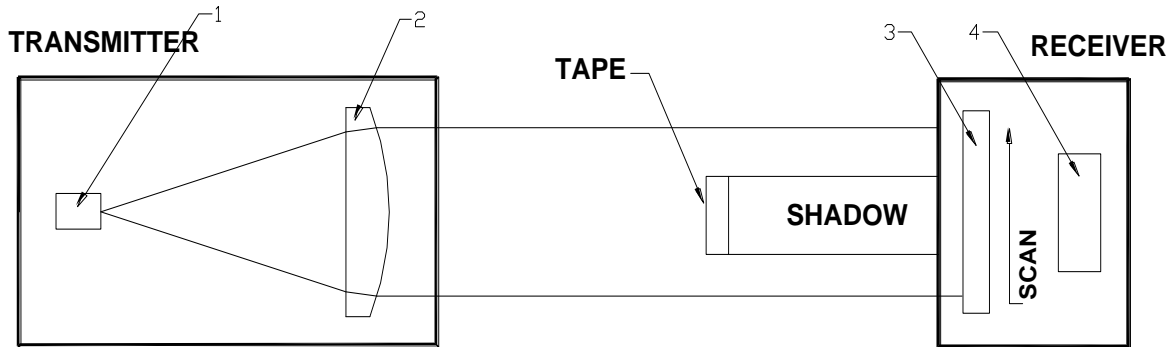


Figure 1

The principle of thickness measurement is shown in the Fig.2

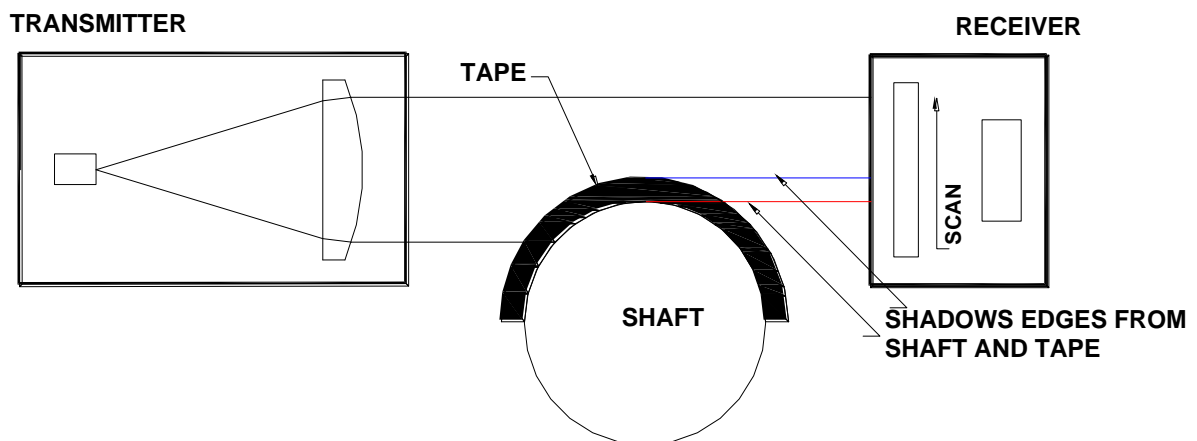


Figure 2

The tape thickness is calculated as the difference between the position of shadow borders of the tape and the shaft. The position of shadow border of the shaft is controlled by a stand-alone micrometer.

The structure of the control system is shown in the Fig.3.

The system contains a group of 6 optical micrometers 1 for simultaneous control of the tape width and the group of 9 micrometers, 6 of them are intended for simultaneous control of the tape thickness and 3 (subsidiary micrometers) – to control the shaft surface position. All micrometers are networked via RS485 interface in the switching center 3, which also includes the power supply of the entire system. The system contains the controller 4 (PDA) that is designed for data processing, indicating of the measurement results and data storage.

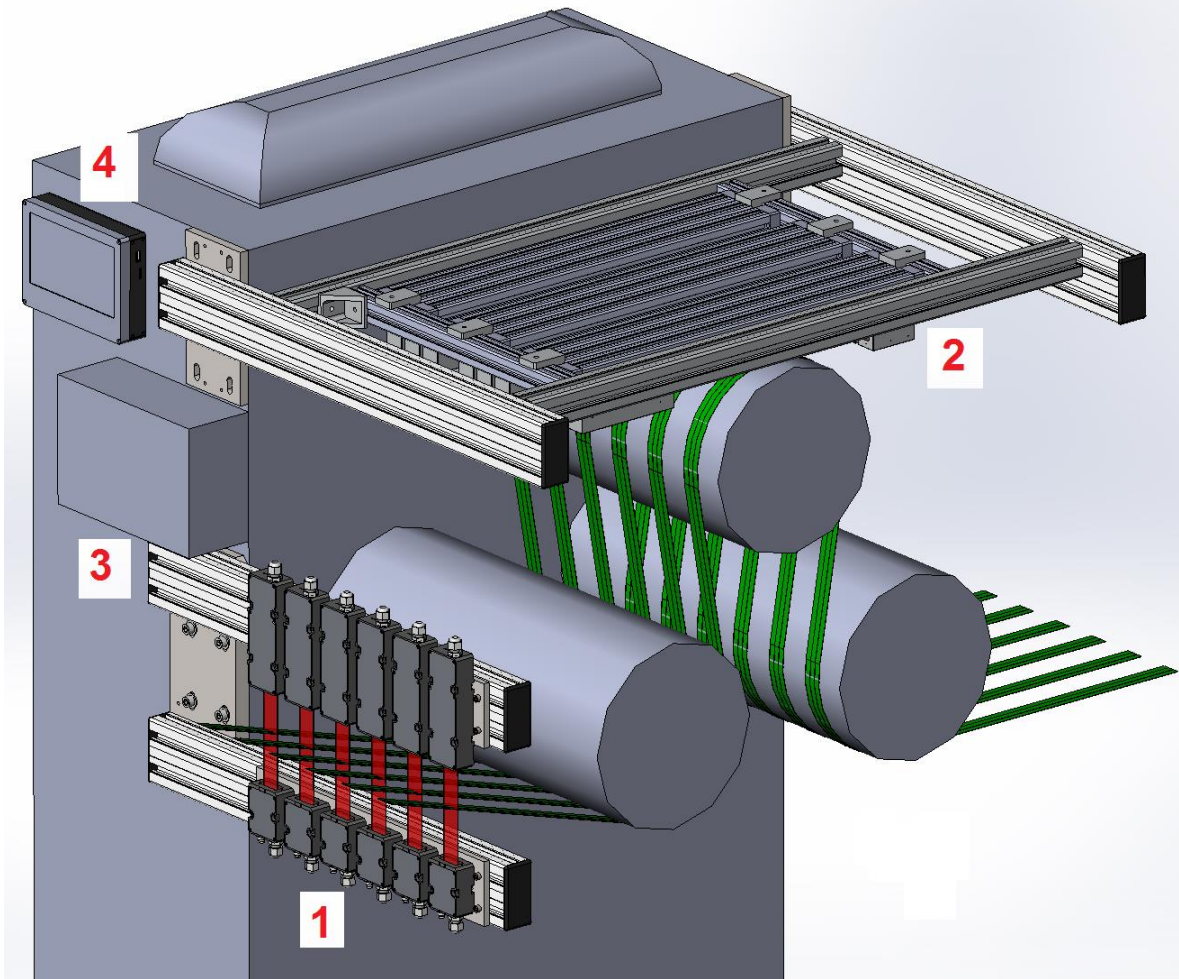


Figure 3

6. Basic technical data

Parameter	Value
Model of micrometer	RF651-25
Model of PDA	RF307
Model of temperature sensor	OMEGA OS-136-1-MA
Number of tapes controlled simultaneously	6
Number of temperature control points	3
Measurement range for the tape thickness, mm	0,02...20
Accuracy of the thickness measurement, μm	± 5
Measurement range for the tape width, mm	$\pm 0,2...20$
Accuracy of the width measurement, μm	± 10
Max measurement speed, measurement/s	2000
Power supply	three-phase AC network with frequency (50 ± 1) Hz, rated voltage 220/380V with a tolerance of $\pm 10\%$ voltage
Power consumption, W	4
Operation conditions	Temperature, $^{\circ}\text{C}$: $+1...+35^{\circ}\text{C}$ Rel. humidity at 25°C 65

7. Overall and mounting dimensions

7.1. Measurement modules

Fig. 5 and 6 show the dimensions of measurement modules as well as their installation on equipment.

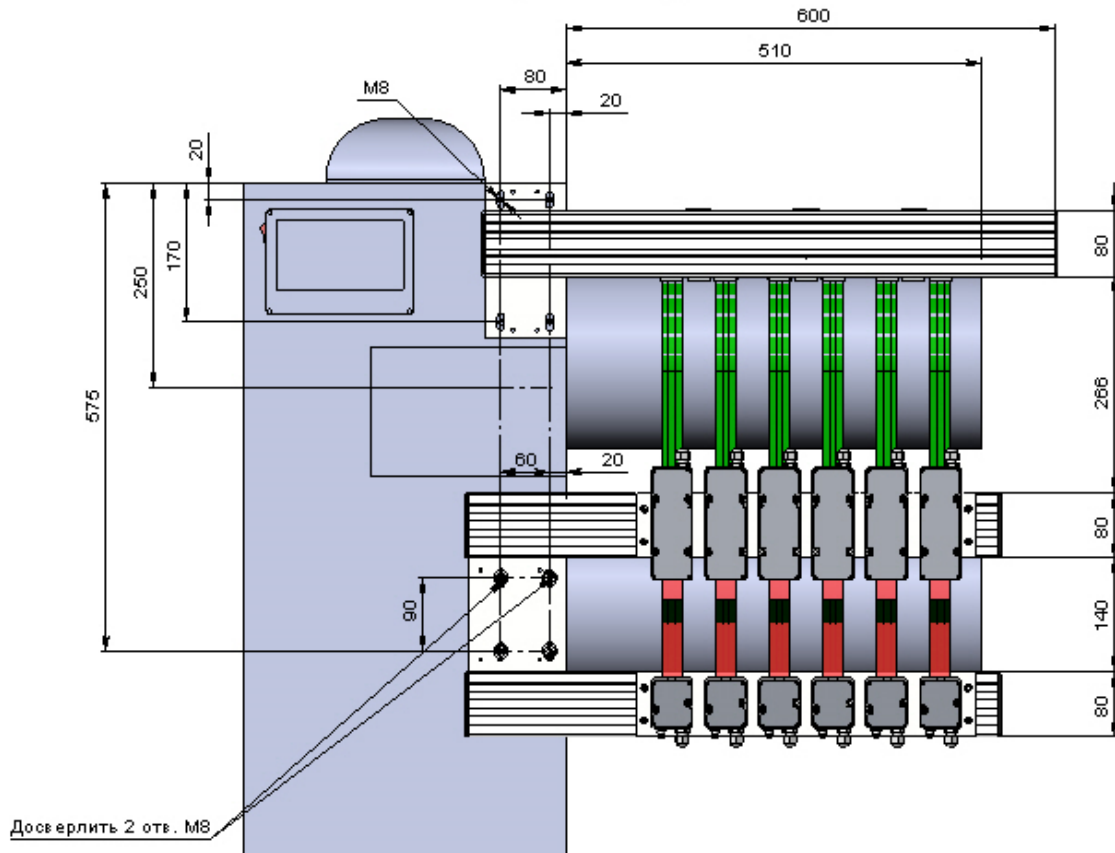


Figure 4

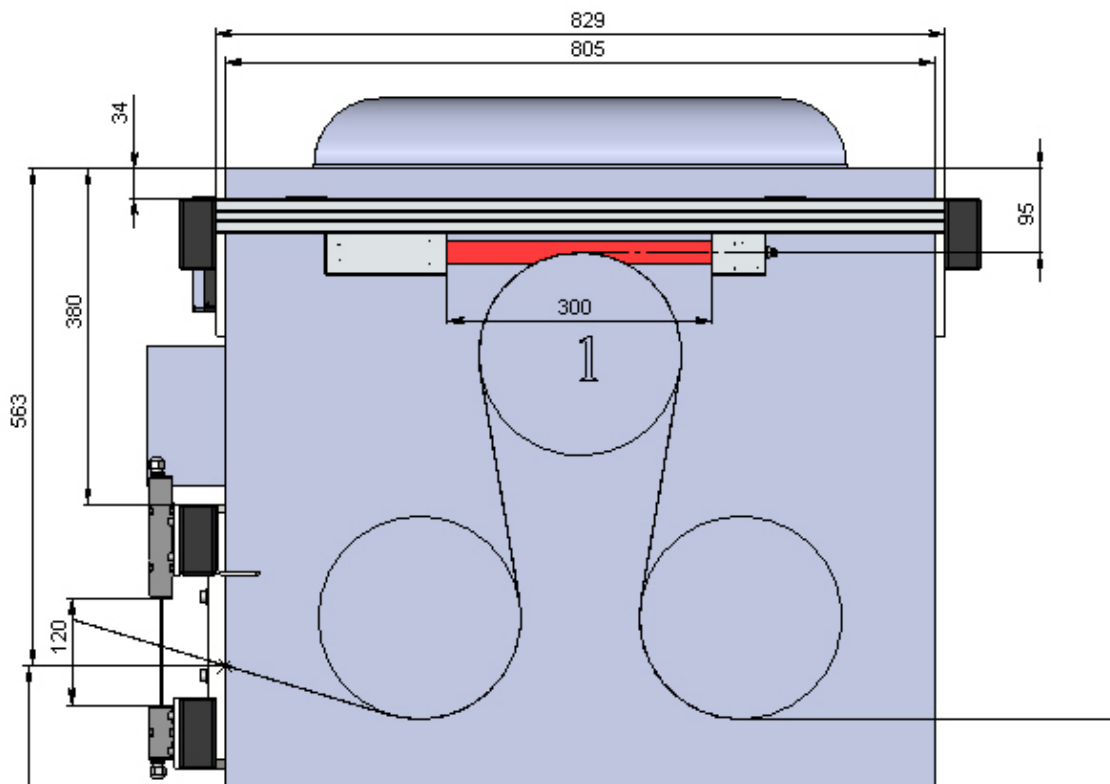


Figure 5

7.2. PDA

RF307 device is intended to process the data from the micrometers indicate results and store the data.

Fig. 6 shows overall dimensions of the device.

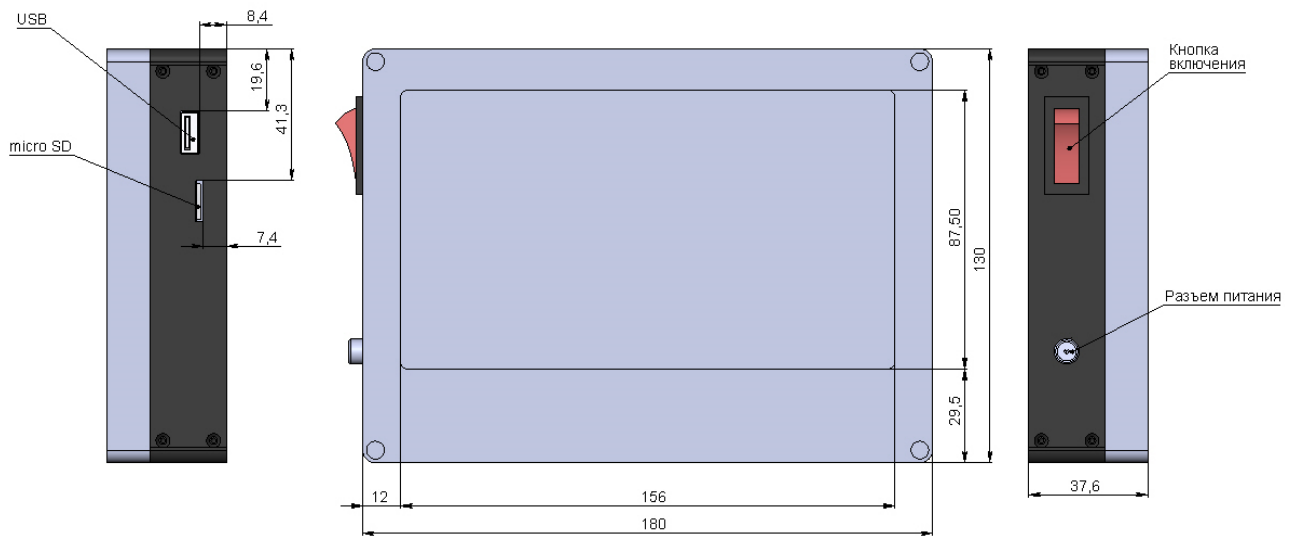


Figure 6

8. Block diagram

Fig. 7 shows the block diagram of the system.

Optical micrometers RF651 are linked via RS485 interface. Temperature sensors are included in the same network via ADC. The information from all micrometers and temperature sensors comes to the PDA RF307.

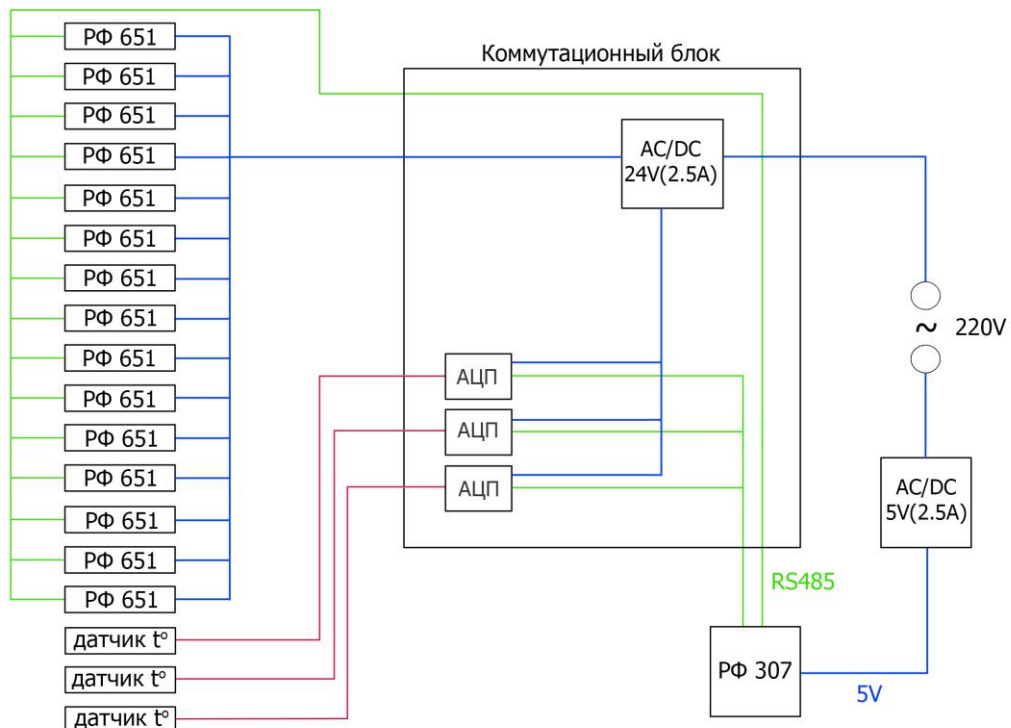


Figure 7

9. Cable connections scheme

Fig. 8 shows the cable connections.

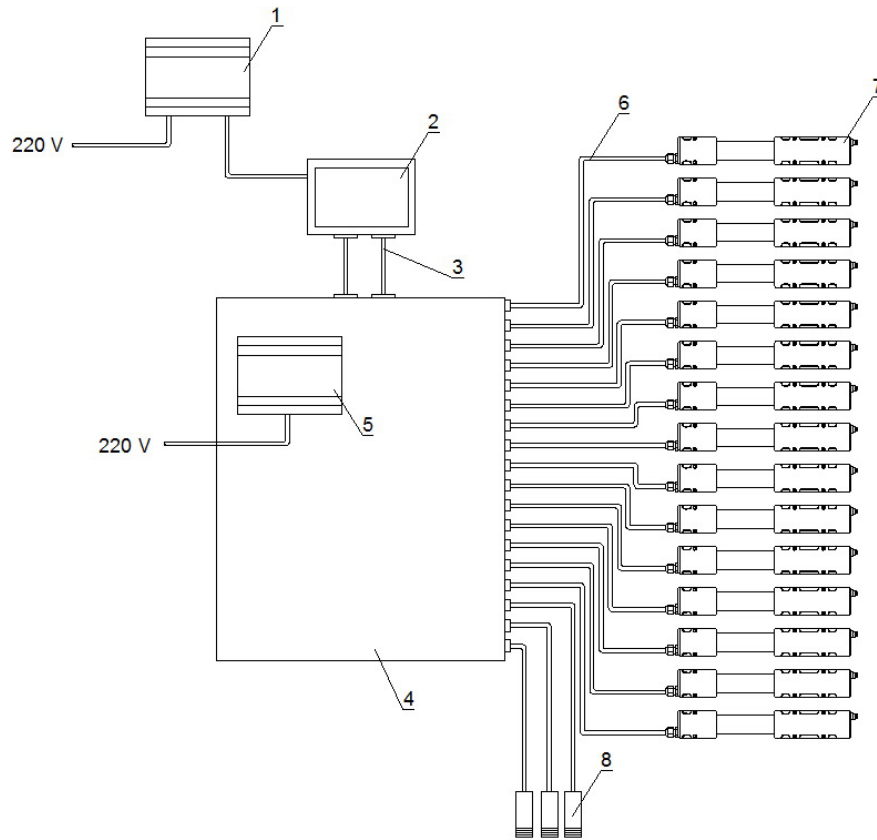


Figure 8

Fig. 8 indicates:

1 – power supply, 2 – PDA, 3,6 – RS485 cable, 4 – switching center, 5 – power supply, 7 – micrometers RF651 (15 items), 8 – temperature sensors (3 items).

(!) The power should be switched off while mounting cable connections.

10. Software

10.1. Main functions

The software provides:

- receipt and analysis of data from micrometers and temperature sensors with display and storage of measurement results;
- indication out of the valid values;
- calibration of thickness measurement subsystem;
- system setup;
- system self-diagnosis.

10.2. Measurements

After being switched on the RF307 device loads the program and shows the main working window (Fig. 9):

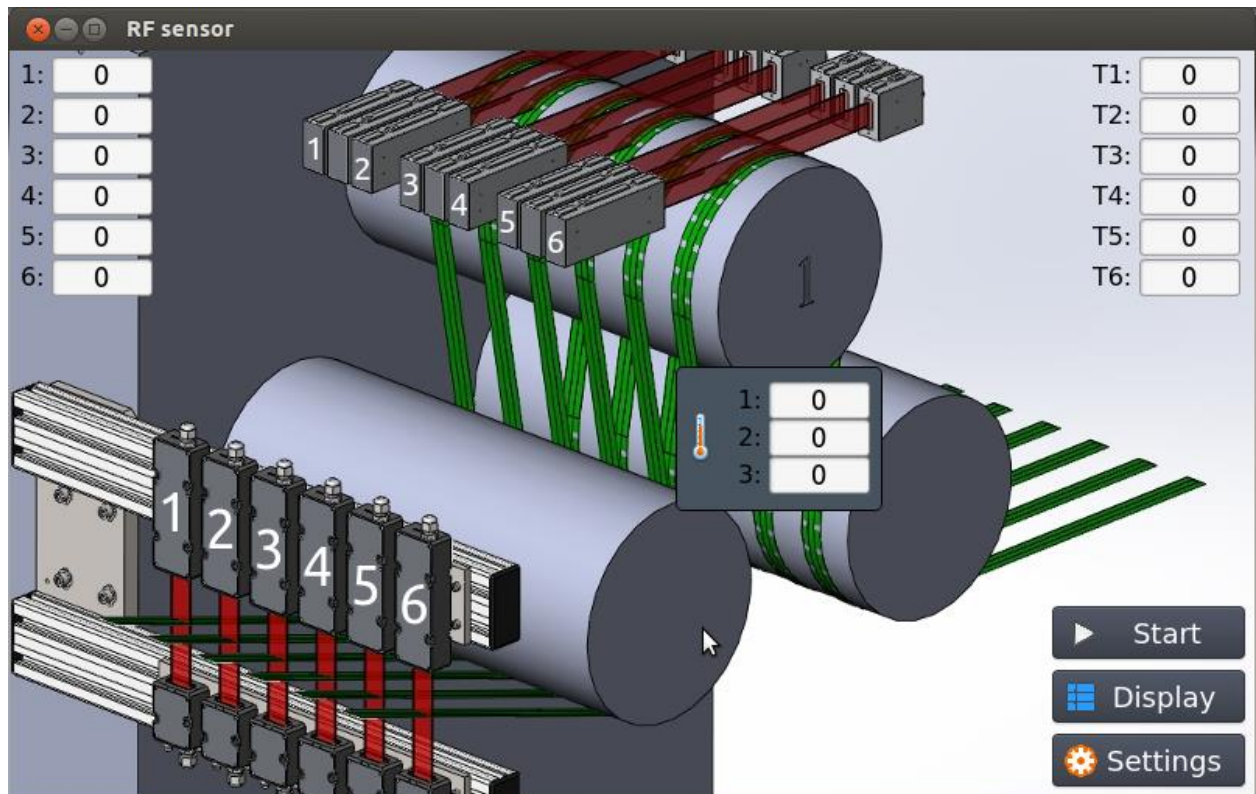


Figure 9

Press **Start** to initiate the measurement process. The results of measuring the width of strips are shown in the upper left part of the window, thickness – in the upper right and temperature – in the central part.

The width of the tape is the result of direct measurement of the micrometer.

The thickness of the tape - the result of indirect measurements, calculated as follows:

$$\text{Thickness} = (\text{Tape_sp} - \text{Shaft_cl}) - (\text{Shaft_sp} - \text{Shaft_cl}),$$

where Tape_sp – the current position of the upper surface of the tape (indicated by the main micrometers, see P. 5.),

Shaft_cl – position of the shaft surface (main micrometers) while system calibration (see P.10.3.),

Shaft_sp – the current position of the shaft surface (indicated by subsidiary micrometers, see P.5),

Shaft_cl – position of the shaft surface (subsidiary micrometers) while system calibration.

To control the current thickness indications from 9 micrometers press the **Display** button.

When the current indication goes beyond the tolerance, the corresponding measurement is highlighted in orange (Fig. 10).

The tolerance installation procedure is described in the p.10.4.

If the micrometer is not responding, it is highlighted in red.

The measurement results are stored in SQLite database file named «keep.db» at the root of the PDA flash drive, see point.10.5.

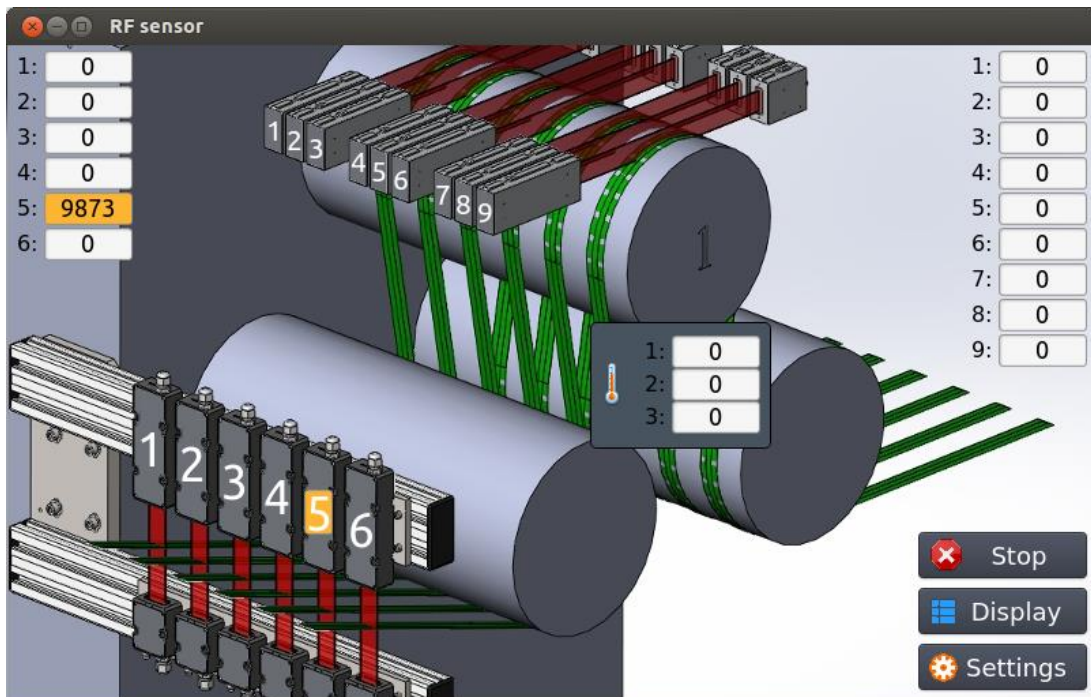


Figure 10

10.3. Calibration

10.3.1. Calibration of the thickness measurement micrometers

Calibration procedure:

- remove tapes from the shaft
- start measurement process by pressing «**Start**»
- open the calibration menu: **Settings** > **Set etalon/Sw. State** (Fig. 11)
- select the numbers of the micrometers to be calibrated (numbers 7-15 correspond to 9 micrometers of the tape thickness control subsystem)
- make sure that **Etalons** mode is selected and **Set** option in **Mode** field is on then press **Apply** button

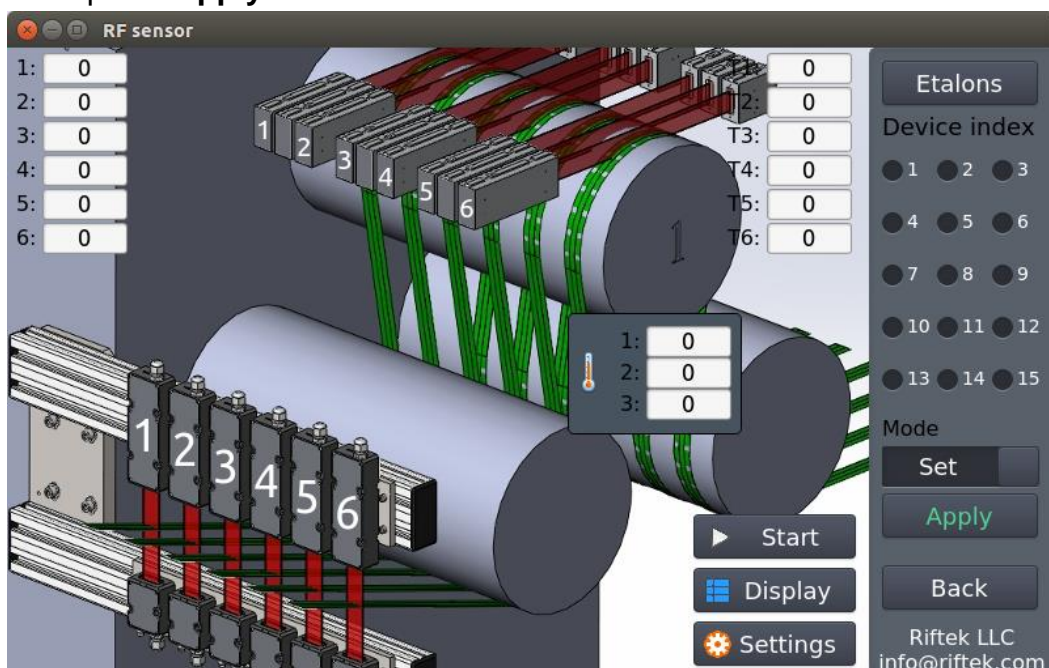


Figure 11

10.3.2. Thermometers calibration

- stop the calibration process by pressing **Stop** button
- open the calibration menu **Settings > Calibration** (Fig. 12)
- choose the number of temperature sensor (**Sensor index** field)
- direct the sensor to the surface with stated temperature, having entered the temperature value in **Temp. 1** or **Temp. 2** field and press **Set** button. When the operation is finished successfully the message **Calibration parameter has been successfully set** appears. Detailed information on temperature sensors can be found in OMEGA OS136-1-MA documentation
- perform the operation described in the previous paragraph for two different temperatures. By pressing the Set button the previous calibration value is overwritten

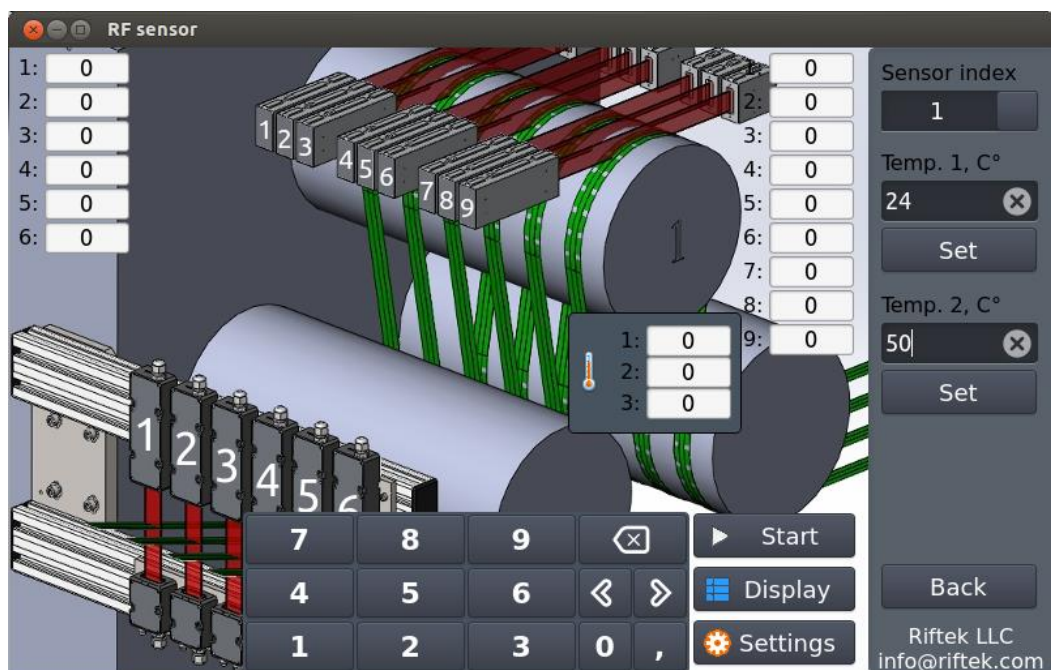


Figure 12

10.4. Settings

All sensors in the system are numbered (Index) from 1 to 18, where the 1-6 match the sensors 1-6 from width measurement group of sensors, numbers 7-15 in the Settings match the sensors 1-9 from width measurement group of sensors and numbers 16-18 match the three temperature sensors. Indexes T1-T6 indicates the results of indirect thickness measurement.

To perform the system settings enter the General menu.

- in the **Timeout** field the delay in milliseconds between successive cycles of the sensors polling is set
- to set the tolerances choose the number of the sensor in the **Index** field and set the upper and lower limits in the fields **Upper limit** and **Lower limit** correspondingly
- to set the production task number use the field **Task Number**

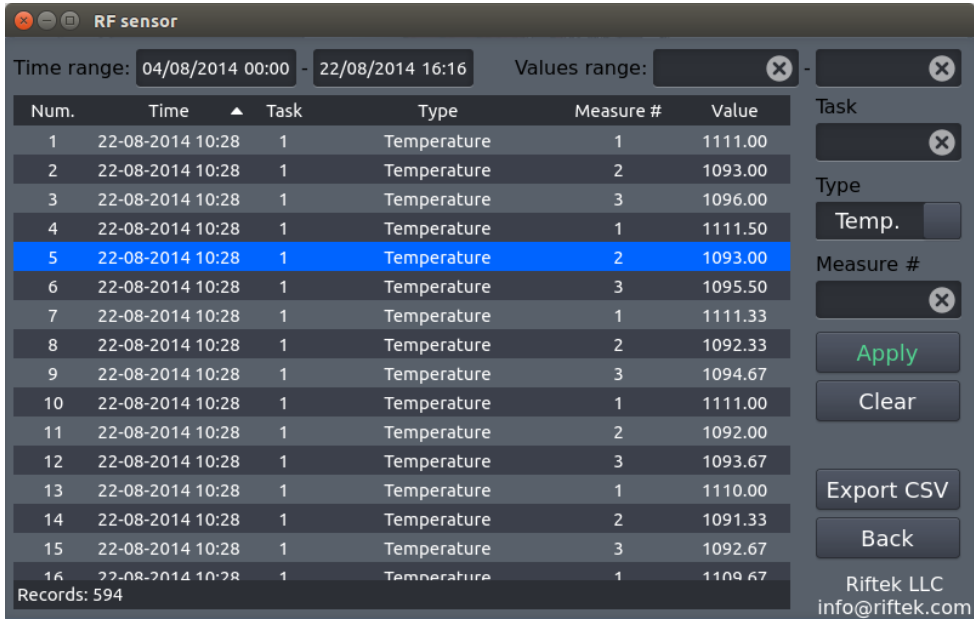
- to enable or disable the recording of measurements in the database, use the field **Save log**
- with the use of **Time** and **Date** fields the system date and time can be set
- in the **Free space** field the empty space on a removable device is shown (micro SD card)
- to apply polling period and tolerances settings press **Apply**
- to undo all the changes press **Discard**
- to add/remove the devices participating in the poll and to calibrate micrometers enter the menu **Set etalon/Sw. State**. The top button also serves as an indicator and switch modes, namely, **States** – the mode of active devices selection is active; **Etalons** – the mode of setup/reset of micrometers calibration is active. Use the **States** function to disable the devices that are not used in the polling during the system operation. It is necessary when the device is faulty or is not in use, neglecting the recommendation above may cause long delays while polling and therefore the entire system delay. The use of the **Etalons** mode is described in the paragraph 10.3.1
- to set the number of measurements used to calculate an average value use the **Averaging** field.

10.5. Measurement journal

During operation the system generates measurement journal. To view the measurement log enter the **Journal** menu (Fig. 13). This menu is intended for viewing the measurements stored on a flash drive in the SQLite database file named keep.db. Each entry has the following structure:

- Time – measurement time.
- Task – production task number.
- Type – measurement type (temperature, width, thickness).
- Measure # – number of measurement of a particular type (Corresponds to the Index notion, described in the paragraph 10.4).
- Value – measured/calculated value.
To display the item you need use the filters:
- Time range – time range selection.
- Values range – selection of the displayed measured values range.
- Task – production task number.
- Type – measurement type (Device – value received from the device; Thickn. – calculated thickness; Temp. - temperature).
- Measure # – number of the measurement device of a particular type.

In order to fulfill the request to display the records matching the selected filters, click **Apply**. To reset the filter values to their default values, click **Clear**. Table with records supports vertical scrolling, sorting by columns by clicking on the table top and row highlighting. By default, sorting is done on time: first the records that were saved before. Table records can be saved in the root of the flash drive as * .csv file. In .csv files the columns are separated with a semicolon. Click **Export CSV** to save the file. The name of the file includes the date and time when it was saved. After the file was saved the message (Fig. 14) appears.



Num.	Time	Task	Type	Measure #	Value
1	22-08-2014 10:28	1	Temperature	1	1111.00
2	22-08-2014 10:28	1	Temperature	2	1093.00
3	22-08-2014 10:28	1	Temperature	3	1096.00
4	22-08-2014 10:28	1	Temperature	1	1111.50
5	22-08-2014 10:28	1	Temperature	2	1093.00
6	22-08-2014 10:28	1	Temperature	3	1095.50
7	22-08-2014 10:28	1	Temperature	1	1111.33
8	22-08-2014 10:28	1	Temperature	2	1092.33
9	22-08-2014 10:28	1	Temperature	3	1094.67
10	22-08-2014 10:28	1	Temperature	1	1111.00
11	22-08-2014 10:28	1	Temperature	2	1092.00
12	22-08-2014 10:28	1	Temperature	3	1093.67
13	22-08-2014 10:28	1	Temperature	1	1110.00
14	22-08-2014 10:28	1	Temperature	2	1091.33
15	22-08-2014 10:28	1	Temperature	3	1092.67
16	22-08-2014 10:28	1	Temperature	1	1109.67

Records: 594

Figure 13

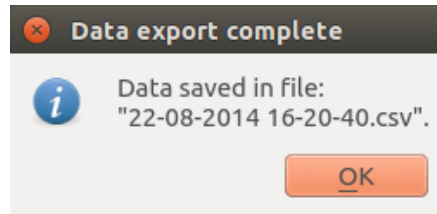


Figure 14

NOTE. To enter the date and time values are special graphics components shown in Figures 15 and 16, respectively. To enter numeric values use keypad, Figure 17.

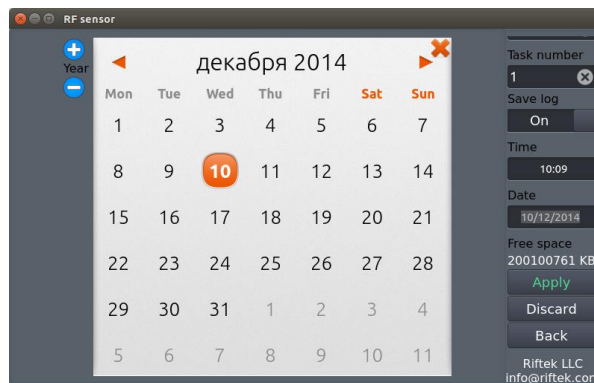


Figure 15



Figure 16

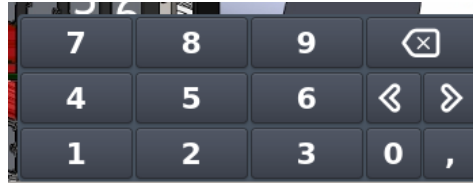


Figure 17

When typing the corresponding values the keyboard appears automatically.

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11. Intended use

11.1. Prepatation for use

Preparation of the system includes:

- external inspection;
- set up on a conveyor;
- switching the system;
- calibrating the system;
- system setup.

11.1.1. External inspection

Before operating it is needed to ensure of the serviceability of the equipment, check the cables, ground wires. Check the condition of output windows of the scanner and, if necessary, wipe them with a soft cloth.

11.1.2. Set up on a conveyor

Install the system on a conveyor according to the Fig. 2-5 of this manual. Make the electrical connections in accordance with the Fig. 8.

11.1.3. Switching the system

11.1.4. Calibrating the system

Выполнить калибровку системы в соответствии с п. 10.3.2 настоящего руководства. Калибровка установки производится: Calibrate the machine according to the Paragraph 10.3.2. Calibration should be held:

- on a weekly basis before the work shifts,
- if the position of the system was changed,
 - when the ambient temperature has changed (several degrees in average per day in relation to the previous day).

11.1.5. Configuring system settings

Configure the settings according to the Paragraph 10.4 and 10.5.

11.1.6. Checking the system

To check the functionality of the system conduct a full cycle control of the geometrical parameters of the control sample tape. It is recommended to conduct at list one functional test of the system in a month.

11.2. Operating the system

The geometric parameters measurement cycle is fully automated and operation of the system is reduced to the work with the program.

- prepare the system according to the Paragraph 11.1.
- to start the measurement process press the **Start** button.

12. Maintenance

12.1. General instructions

Maintenance of the system is carried out to ensure constant-ready status and continued availability of its work and to prevent premature failure. Maintenance includes preventive measures aimed at identification and elimination of defects and to ensure the normal operation while installation and working. It is recommended to conduct the daily, weekly and annual maintenance work.

12.2. Safety precautions

During the installation maintenance security measures outlined in the Paragraph 1 should be observed.

12.3. Maintenance procedure

12.3.1. Daily maintenance work

Daily maintenance includes:

- visual inspection of the system
- checking of completeness,
- checking for any damage of the structural elements, power and instrument cables, indicators and connectors,
- weakening of screw connections and insulation failures,
- before starting work, it is necessary to clean the output micrometer windows with a soft dry cloth.

12.3.2. Regular maintenance work

Regular maintenance work includes:

- cleaning of micrometer windows with a dry soft lint-free cloth from contamination of dirt.

12.3.3. Yearly maintenance work

Authenticated calibration of the micrometers should be made once a year.

12.4. Operability test

It is recommended to conduct the functional test at least once at the beginning or during the shift, for what it is necessary to complete full cycle control of the geometrical parameters of the control sample (not supplied).

13. Warranty policy

Warranty assurance for the Tape measurement system - 12 months from the date of putting in operation; warranty shelf-life - 12 months.