RIFTEK
Sensors & Instruments

SHAFTS GEOMETRY MEASUREMENT MACHINE

RF800 Series

User's manual

Contents

1. Safety precautions

- All specialists must study this User's Manual before operating the machine.
- Use supply voltage and interfaces indicated in the machine specifications.
- In connection/disconnection of cables, the power must be switched off.
- Do not use the machine in locations close to powerful light sources.
- To obtain stable results, wait about 20 minutes after powering the machine to achieve the uniform warm-up of the micrometer.
- During the measurement procedure, the protective doors of the machine must be closed.

2. CE compliance

The machine 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 machine contains an optical micrometer, which makes use of a LED. The micrometer belongs to the 1 laser safety class. The following warning label is placed on the housing:

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

- Avoid staring into the emitter during a prolonged time period.
- Do not disassemble the micrometer.

4. General information

The machine is designed to control the geometrical parameters of the 'shaft' type parts.

Field of application: large-scale production. Place of installation: production line, or laboratory.

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

5. Structure and operating principle

5.1. Optical micrometer

To measure the geometrical parameters of the 'shaft' type parts, a two-axis optical micrometer is used.

The operating principle of the micrometer (for one axis) is illustrated in Figure 1.

The micrometer consists of two blocks: transmitter and receiver. Radiation of LED 1 is collimated by a lens 2. With an object placed in the collimated beam region, a shadow image is formed by the telecentric system 3 on the CCD photodetector array 4. A processor 5 calculates the diameter of the object from the position of shadow borders.

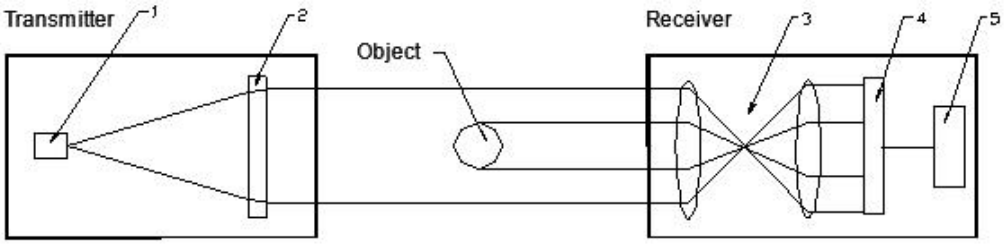


Figure 1

A two-axis optical micrometer contains two identical micrometers (in accordance with the scheme in Fig. 1) in one housing, placed at an angle of 90 degrees to each other, which makes it possible to control the diameter of the object in two mutually perpendicular directions, Fig. 2.

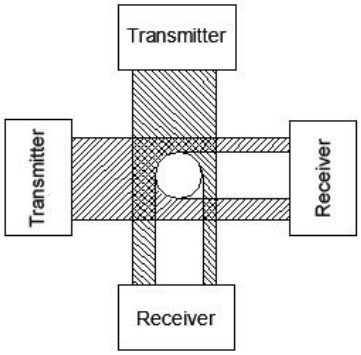
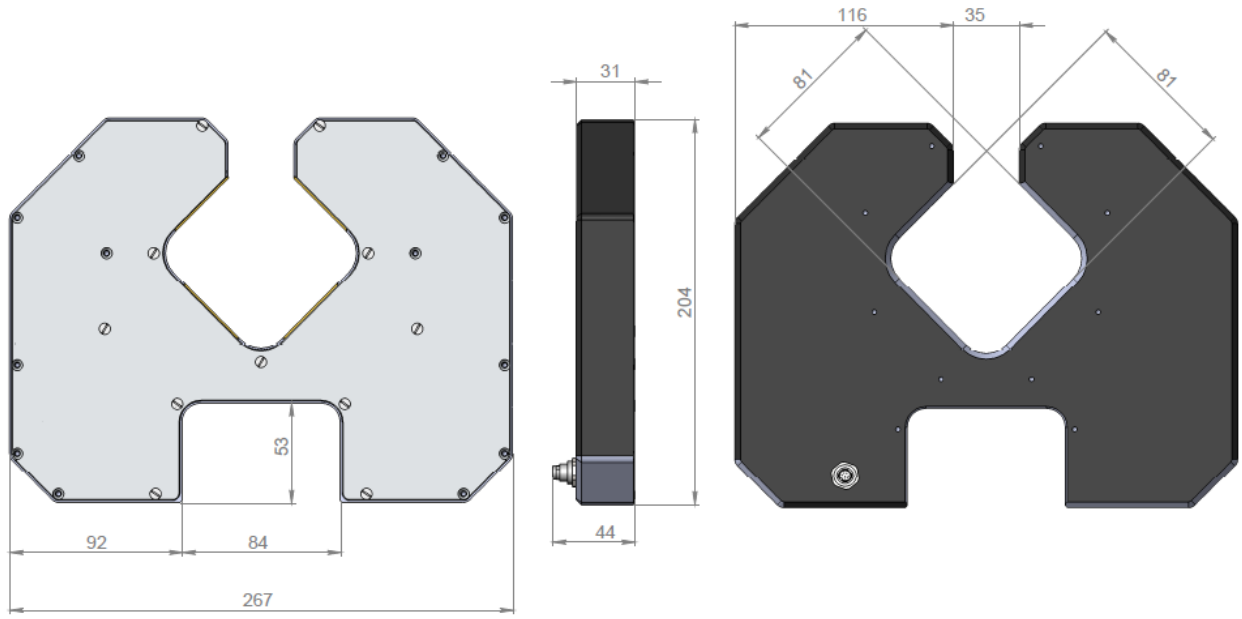


Figure 2

5.1.1. Micrometer specifications

Optical micrometer, RF656XY-35 model		
Measurement range, mm		±6x35
Minimum size of the object, mm		0.25
Maximum size of the object, mm		35
Accuracy, µm		±1
Repeatability, µm		0.5
Maximum scanning frequency, Hz		10000
Maximum update frequency, Hz		2000
Light source		LED
Lase safety class		1 (IEC60825-1)
Output interface		RS485
Synchronization input		2.4 – 5 V (CMOS, TTL)
Power supply, V		24 (9...36)
Power consumption, W		from 1.5 to 2
Environmental resistance	Enclosure rating	IP67
	Vibration	20 g / 10…1000 Hz, 6 hours for each of XYZ axes
	Shock	30 g / 6 ms
	Operating ambient temperature, °C	-10…+60
	Relative humidity	5-95%
Housing material		aluminum
Weight (without cable), gram		1600
Dimensions		see the figure



5.2. Structure

The structure of the machine (without protective doors) is illustrated in Figure 3.

The machine contains a frame (1) on which a linear guide (2) of the linear translation system is installed. The linear guide has a carriage (3) driven by a stepper motor (4).

An optical micrometer (5) is installed on the carriage (3). The end sensors (not shown) are used to monitor the end positions of the micrometer. A table with two Morse tapers (6 and 7) is used to install the controlled shaft. The Morse tapers are mounted on a bar (8) located along the the linear guide. One of the end sensors is mounted on the upper taper, the latter can be reinstalled along the bar (8) in order to control the shafts of different lengths.

In addition, the machine has a caliber, which is a part of the upper Morse taper. The caliber is designed for an automatic re-calibration of the micrometer to eliminate the measurement error caused by a change in the temperature of the machine.

The machine contains a mini-computer (9) with a graphic touch screen. The mini-computer has the special software designed to control the machine and to display results. The mini-computer can be built into the machine (as shown in Figure 3), or it can be installed on the special stand (see Figure 4).

The back side of the machine has a power supply 220/24V (10) with a circuit breaker (11), connector for the foot switch (12), USB connector (13) for the USB drive (for example, for data transfer), and the Ethernet connector (14), for example, to connect to the PC.

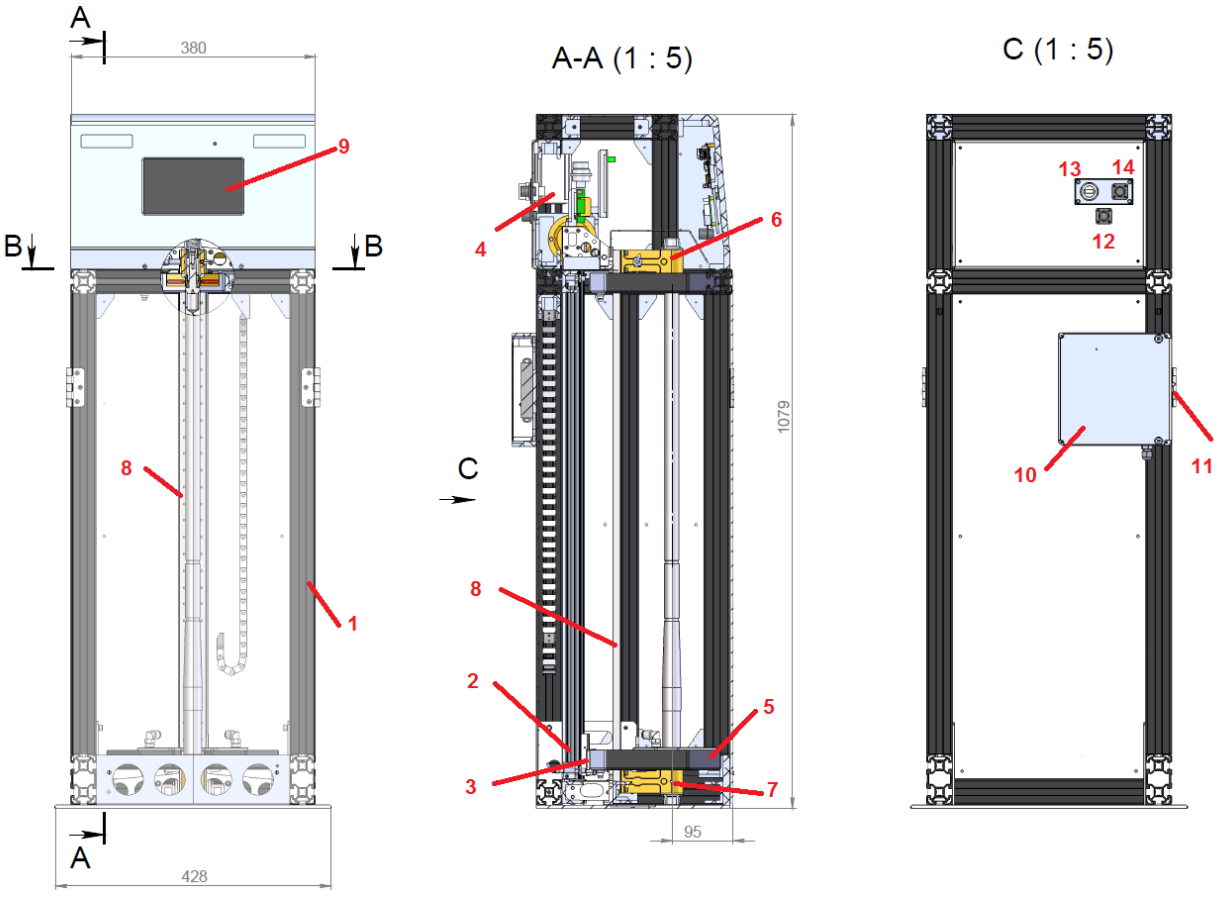


Figure 3

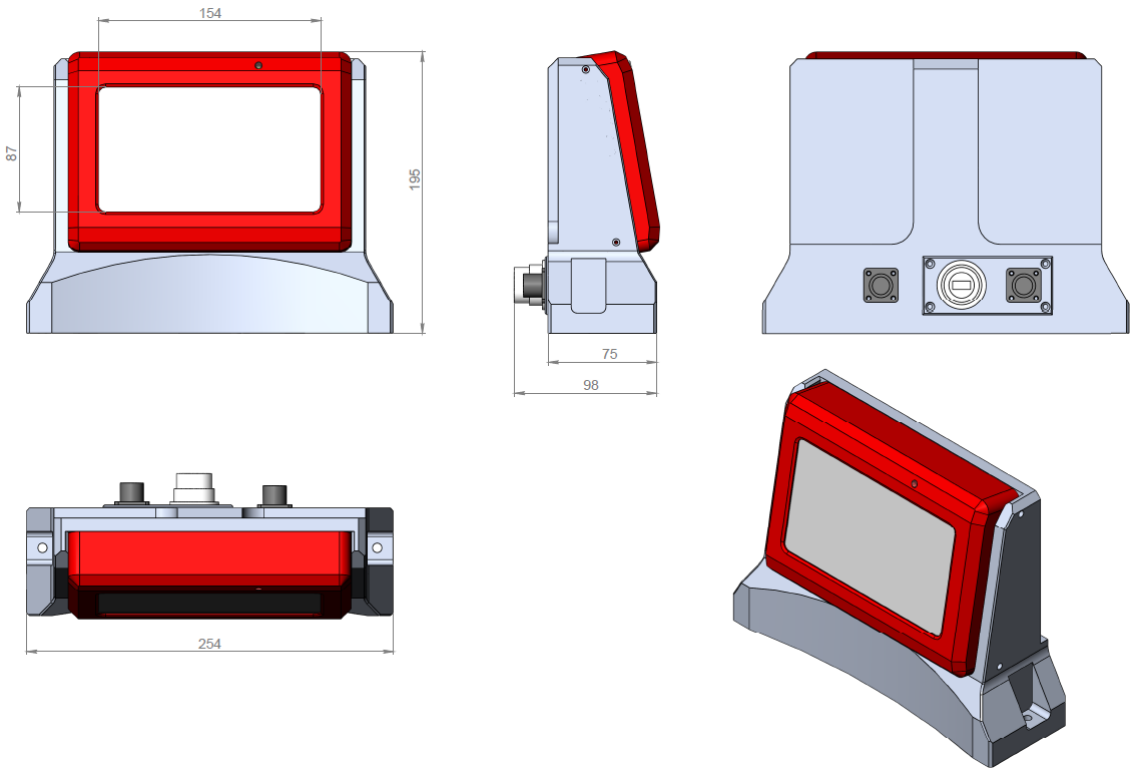


Figure 4

5.3. Operating principle

After the measurement algorithm has been programmed (position and number of controlled zones along the shaft, tolerances, etc. - see the software description), the operator installs a shaft into the machine. After a command from the operator (by the foot switch, or by the softkey on the touch screen), the linear translation system moves the micrometer along the shaft. The data from the micrometer (shaft diameters in two mutually perpendicular cross sections) synchronized with the linear position of the micrometer comes to the computer where the required parameters are calculated (shaft diameter and shaft shape error).

7

6. Basic technical data

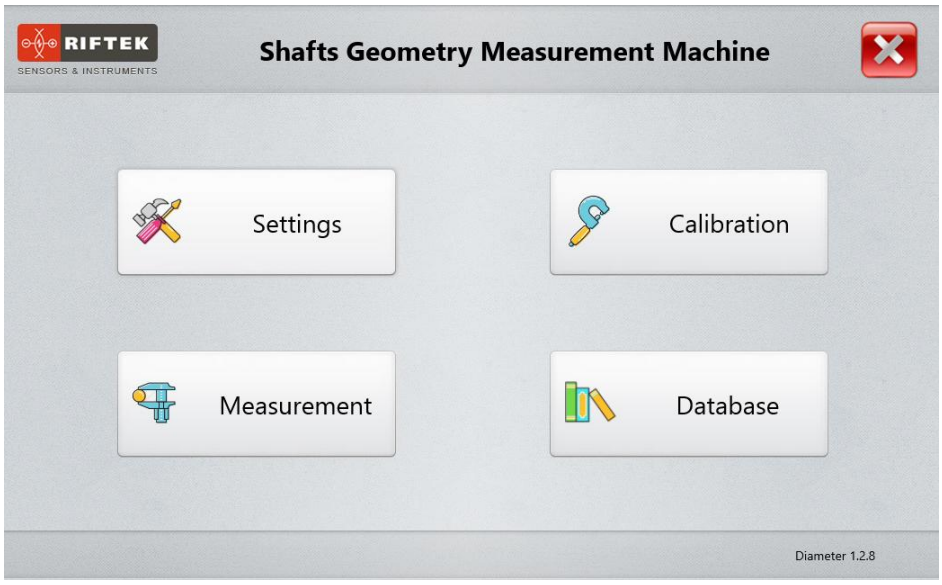
Parameter	Value
Shaft length, mm	160...750
Shaft diameter, mm	5...30
Accuracy, µm	±1
Time of measuring the shaft of the maximum length, s, no more than	20
Number of controlled shaft zones and their position	Programmable value
Maximum shaft weight, kg	2
Measured parameters	Diameter, ovality, taper
Sorting "OK"-"NOK"	Yes
Ability to sort by groups	Yes
Power supply	Three-phase alternating current network with frequency of (50 ± 1) Hz, nominal voltage 220 / 380V with a permissible voltage deviation of ±10%.
Power consumption, W	100
Environmental resistance	Operating ambient temperature: +1...+35°C Relative humidity for 25°C: 65%
Operation mode	3 shifts, 6 days a week
Dimensions, mm	380x428x1079

Note: Machine parameters can be changed for a specific task

7. Software

7.1. Main window

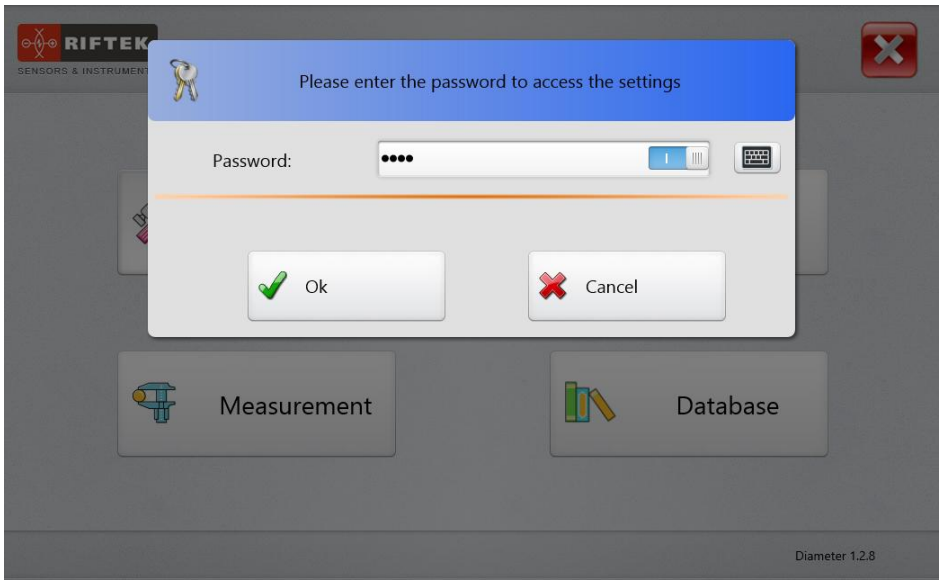
After the machine is powered on, the software is loaded and the main window appears.



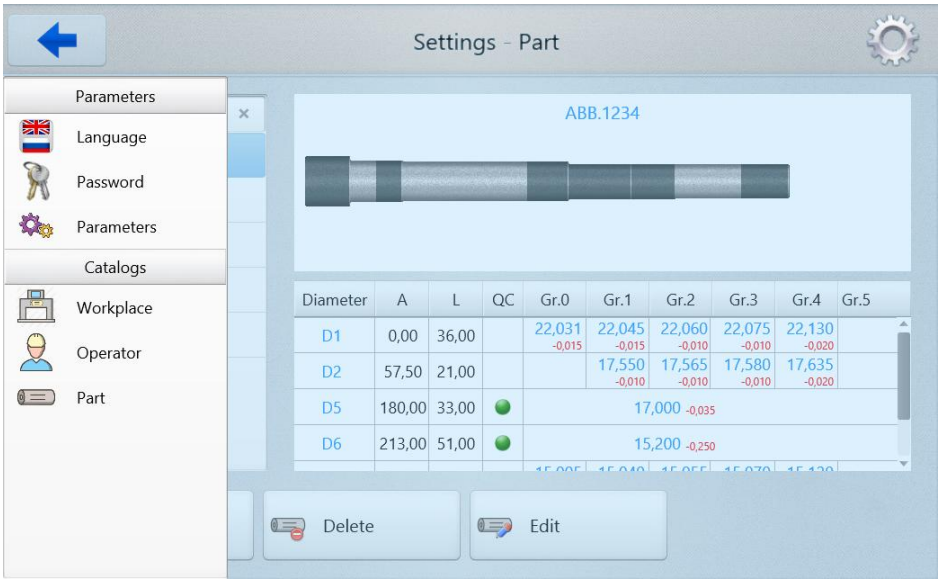
Button	Assignment
Settings	Set the measurement parameters.
Calibration	Perform the calibration procedure.
Measurement	Control the measurement process.
Database	View the database.

7.2. Settings

Only qualified users are allowed to change settings, so when you tap the **Settings** button, you will need to enter a password (by default: 1111).



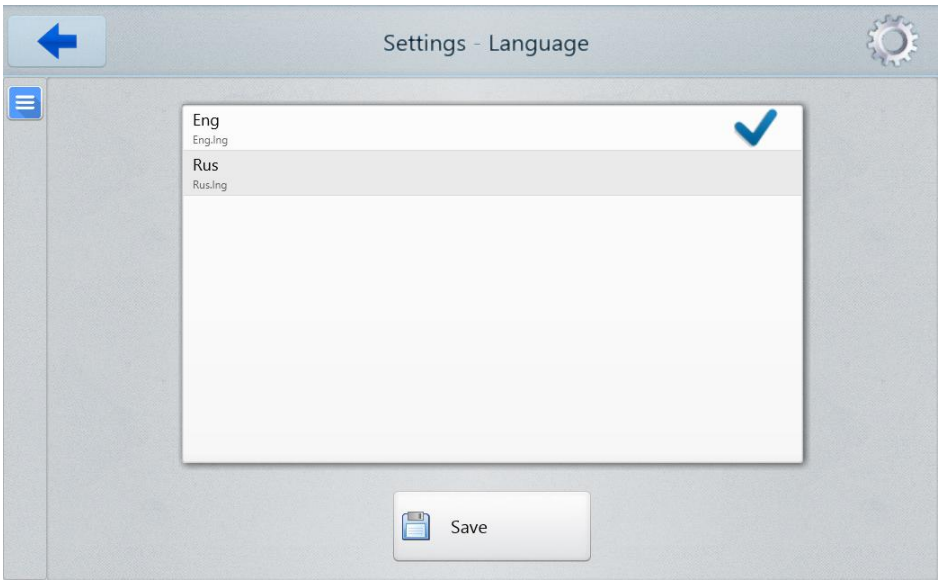
Enter the password and tap **Ok**. The **Settings** window appears:



The parameters menu is located in the left part of the window. The **arrow** in the upper left corner is used to go back to the previous window.

7.2.1. Language

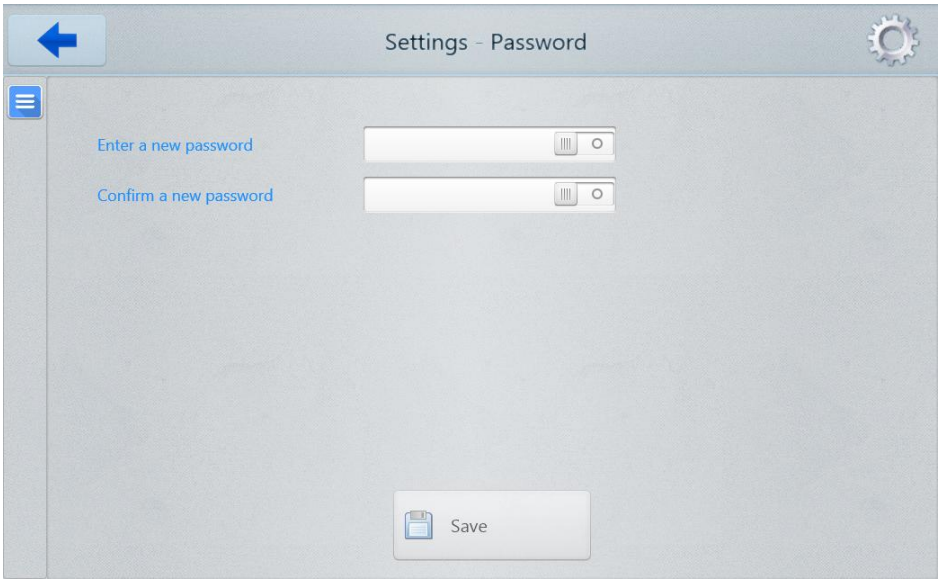
To select the language, tap **Language**. The following window appears:



Select the language and tap **Save**.

7.2.2. Password

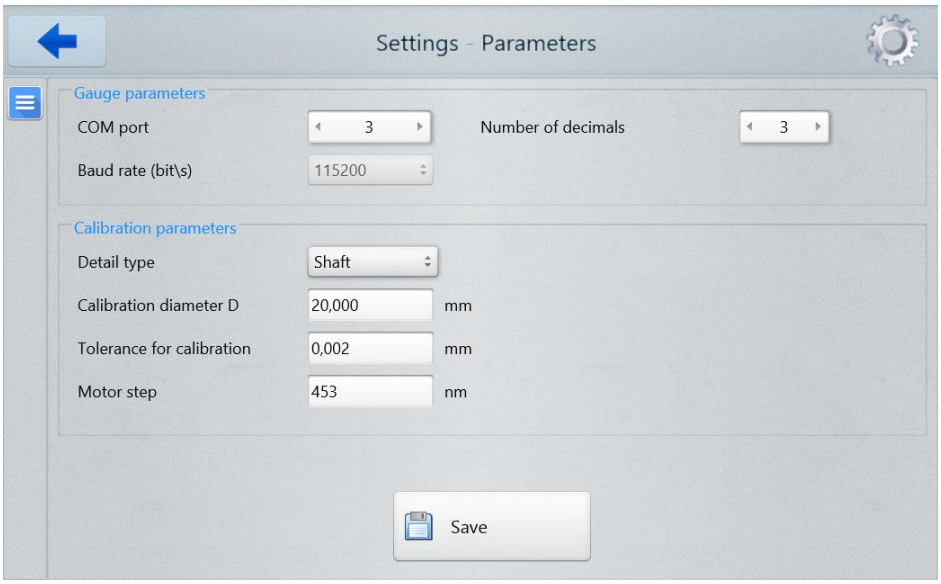
To change the password, tap **Password**. The following window appears:



Enter a new password and confirm it (the toggles in the fields are used to show/hide the entered characters). Tap **Save**.

7.2.3. Parameters

To change parameters, tap **Parameters**. The following window appears:



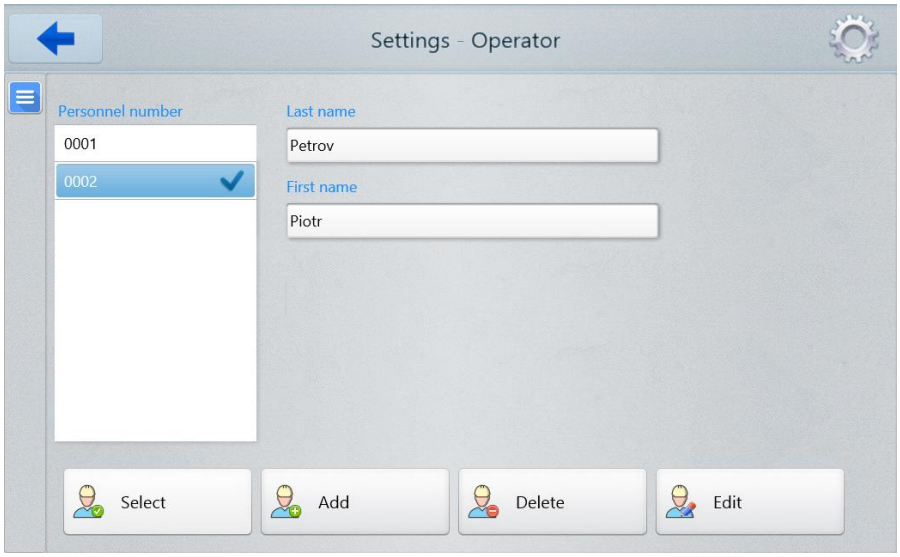
Parameter	Default value	Note
COM port	3	The COM port number of the internal RS485 network. This parameter can be changed only by the manufacturer.
Baud rate, bit/s	115200	The baud rate of the COM port. This parameter can be changed only by the manufacturer.
Number of decimals	3	The displayed number of decimals.
Part type	Shaft	This parameter is selected in accordance with the device type: Shafts control - 'Shaft', Holes control - 'Hole'.

Parameter	Default value	Note
Calibration diameter D	20 mm	The diameter of the caliber installed in the Morse taper (see p. 5.2.).
Tolerance for calibration	0.002 mm	This tolerance is used when testing the calibration accuracy (see p. 7.3.).
Motor step	453	Linear displacement of the micrometer, which corresponds to one step of the motor. This parameter can be changed only by the manufacturer.

To save changes, tap **Save**.

7.2.4. Operator

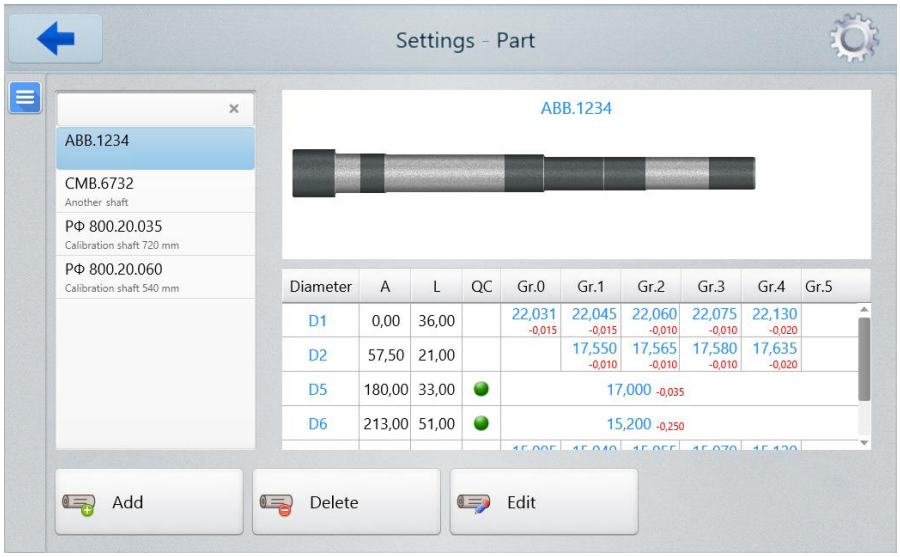
Tap **Operator**. The following window appears:



In this window, you can select, edit, delete, or add the new operator.

7.2.5. Part

In the program, the measured parts are shown as templates described by the following parameters: the position of the controlled zone on the shaft, its size and diameter, and the tolerances for sorting. The number of zones is up to 8. To set the template parameters, tap **Part**. The following window appears:



In this window, you can see a list of controlled shafts with their unique numbers and names. Parameters of the selected shaft are shown in the table (the selected shaft is highlighted in blue in the list to the left).

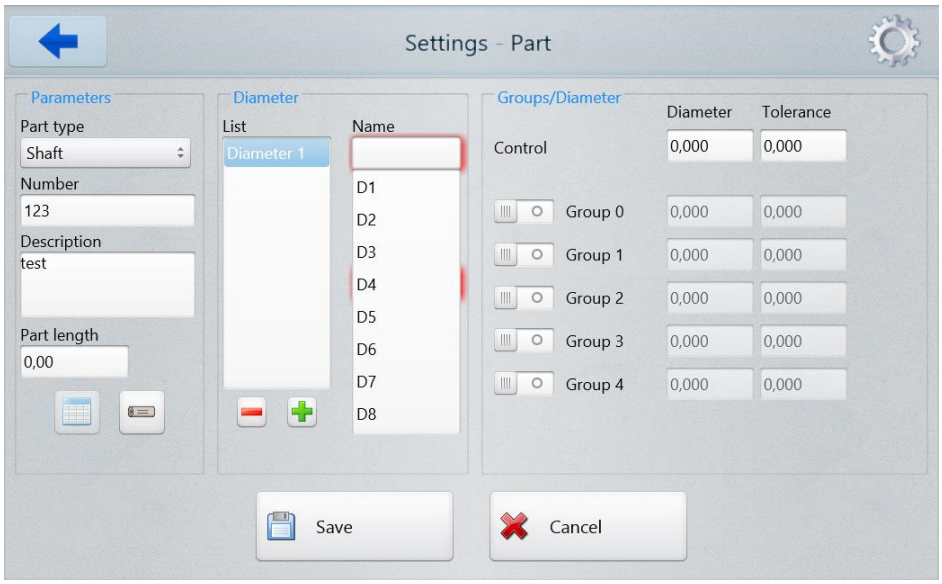
The description of parameters:

Name	Description
A	The position of the controlled zone on the shaft.
L	The length of the controlled zone.
Gr0...Gr4	Sorting groups (diameter value ± tolerance).
QC	Quality control sign.

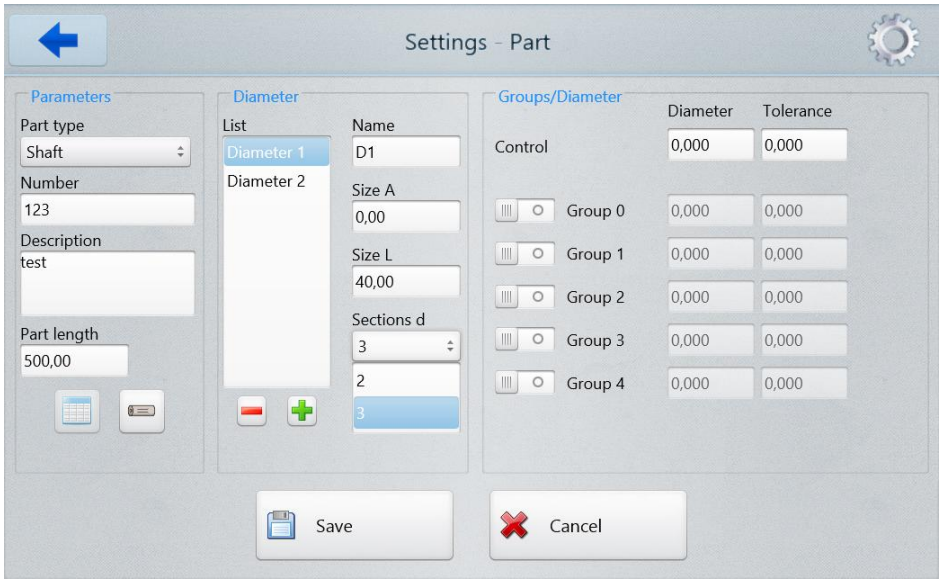
7.2.5.1. Adding / editing the part template

To add the part template to the list, tap **Add**. To edit the part template, tap **Edit**. The following window appears:

Enter a decimal number of the part, its description and length into the respective fields. To form the controlled zones, tap . "Diameter 1" appears in the **List**:

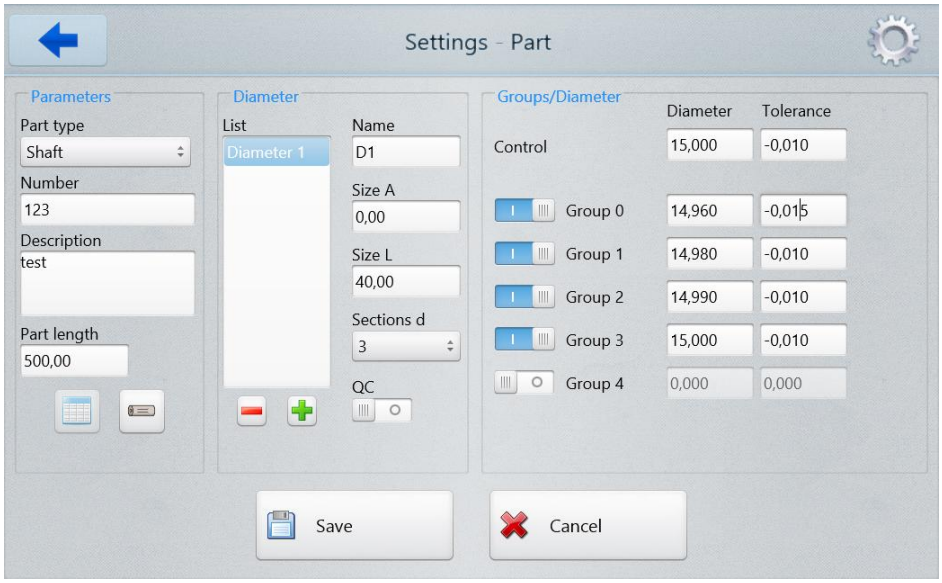


Select the diameter (D1...D8) from the **Name** drop-down list.



Enter the diameter value and the tolerance value into the **Diameter** field and the **Tolerance** field respectively. Enter the parameters of the controlled zone, namely, the position of the zone on the shaft (**Size A**) and the zone length (**Size L**). In addition, it is necessary to enter the number of controlled sections (**Sections d**): 2 or 3. When "2" is selected, the measurements are performed in two sections spaced from the edges of the zone for 3 mm. When "3" is selected, an additional measurement is made in the center of the zone. The diameter of the zone is calculated as the average diameter measured in the selected sections. The cylindricity value of the zone is calculated as the difference in diameters measured at the edges of the zone.

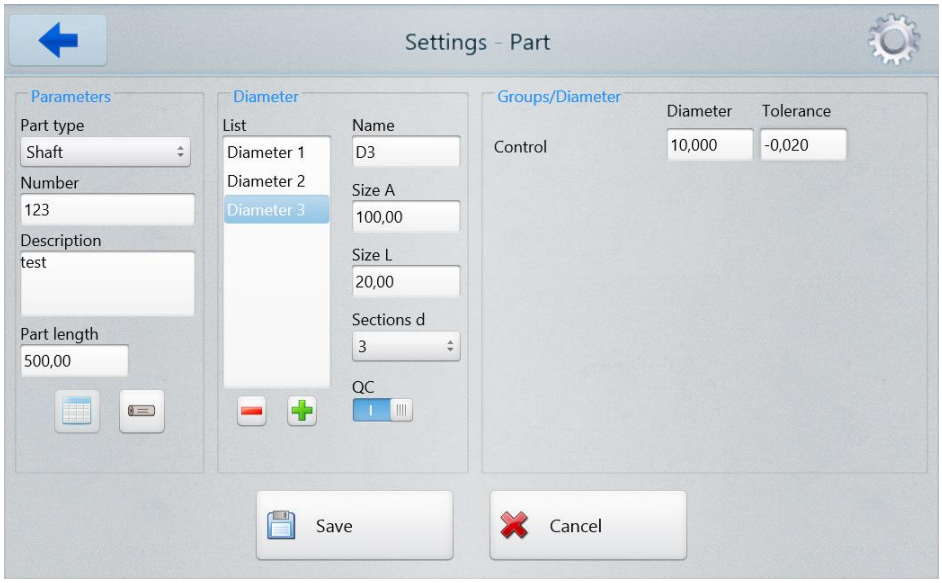
If it is necessary to divide the measured parts into groups, tap on the **Group** toggles and enter the diameter value and the tolerance value for each group.



These tolerances are also used to control the ovality and taper of the zone.

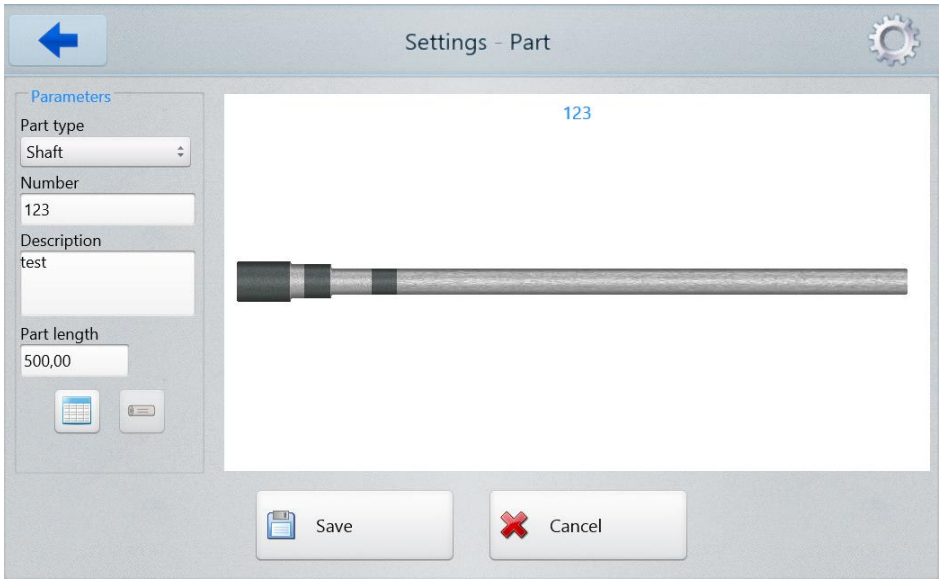
Enter the required number of zones and their parameters in accordance with the algorithm described above.

If the diameter is controlled only by the quality control department, tap on the **QC** toggle to enable it. The groups will be hidden.



7.2.5.2. Part template control

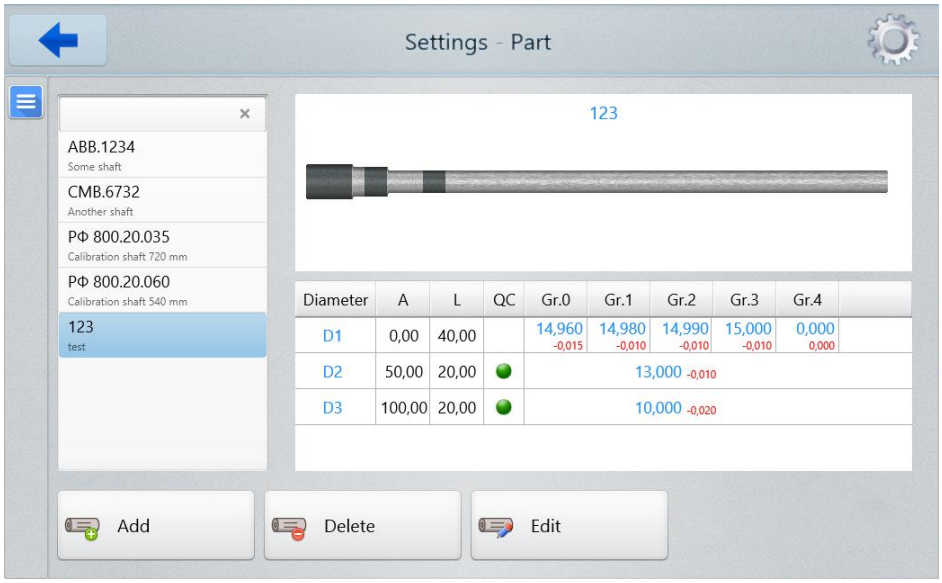
To control the part template, tap  .



This window displays the part template with the controlled zones. The proportions of the zones correspond to their size. To go back to the template creation window, tap  .

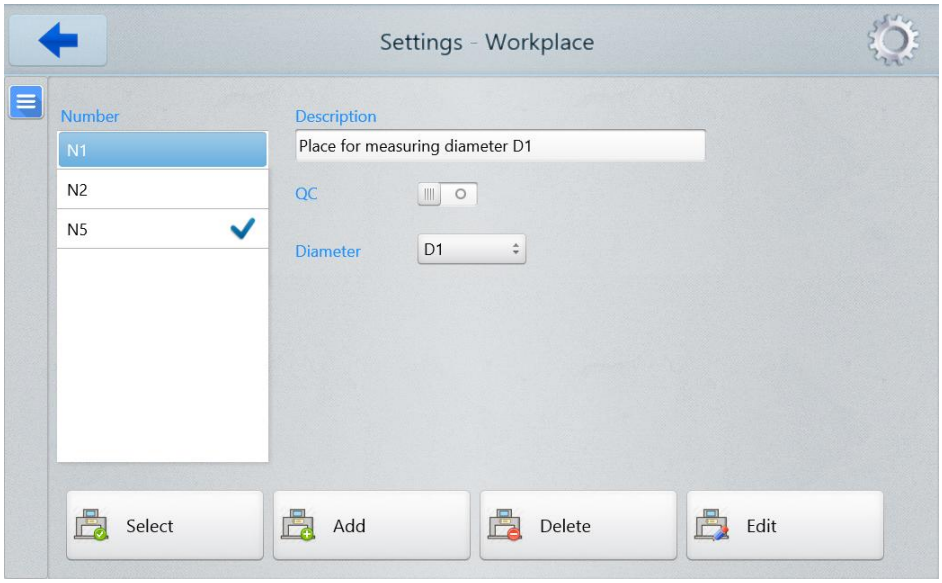
7.2.5.3. Saving the part template

To save the part template, tap **Save**. The program returns to the list of controlled parts and displays the parameters of the saved template.



7.2.6. Workplace

The machine can be installed on workplaces of various types (production line, quality control department). On production lines, only one selected zone is measured at each workplace. During the quality control, the whole shaft is measured without sorting into groups) To set the workplace type and its description, tap **Workplace**.



The list of workplace numbers is shown in the left side of the window.

The workplace number of the machine is marked with ✔.

Description of the workplace (in the right side of the window) is given for the workplace number highlighted in blue in the list to the left.

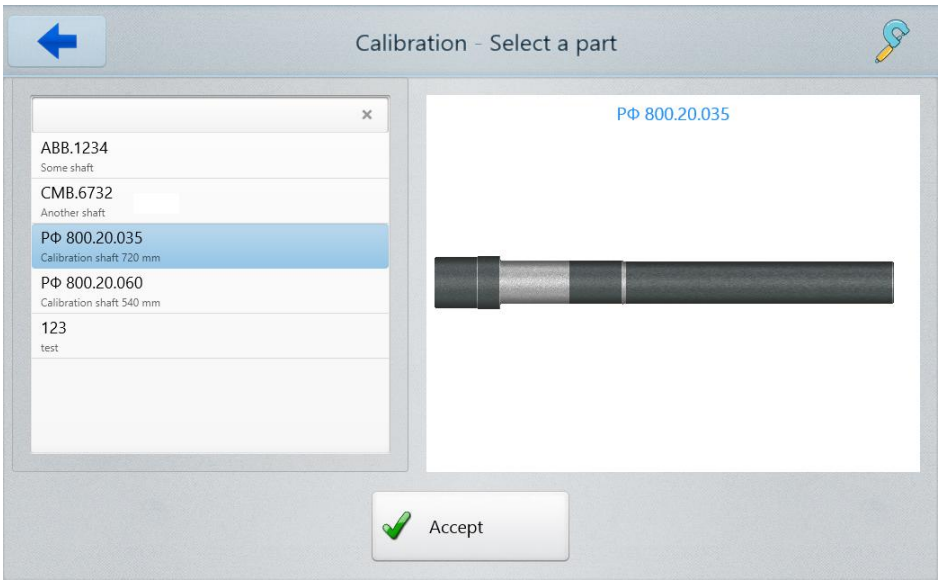
If the **QC** toggle is enabled, this workplace relates to the quality control department, and the measurements are performed in full (without sorting into groups).

To describe the workplace (not QC), disable the **QC** toggle and follow the steps below:

- Select (**Select** button), or add (**Add** button), and then select the workplace number.
- Select the controlled diameter from the **Diameter** drop-down list.
- Describe the workplace in the **Description** text box.

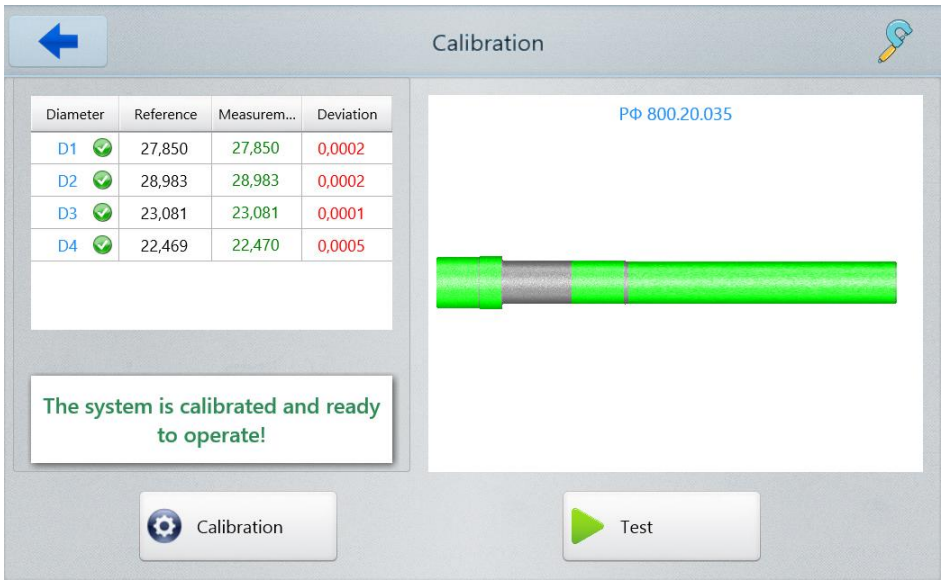
7.3. Calibration

To perform the calibration of the machine, go to the main menu and tap **Calibration**.



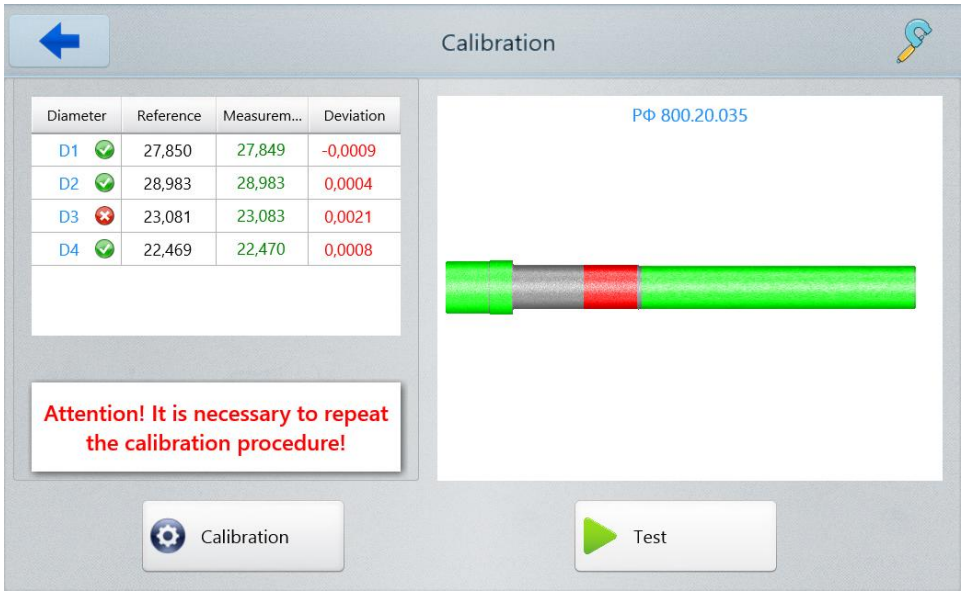
Select the shaft that will be used as the caliber. Tap **Accept**. The program displays the description of the selected shaft.

Install the shaft into the machine, and tap **Calibration**. The shaft will be scanned. If necessary, parameters of the optical micrometers will be corrected automatically, and then the shaft will be scanned again in order to test the machine. If successful, the following window appears:



The **Deviation** column shows the difference between the actual value and the measurement result. The calibration is successful if the deviation value doesn't exceed the tolerance (**Tolerance for calibration**, see par. 7.2.3.).

If the calibration is not successful, the following window appears:



Zones, in which the measurement result exceeds the tolerance, are shown in red.

Repeat the calibration procedure until you see the message informing about success.

8. Intended use

8.1. Preparation for use

Preparation of the machine includes:

- visual inspection,
- installation,
- switching on the machine,
- setting parameters and forming the database of templates,
- calibration of the machine,
- metrological verification of the machine.

8.1.1. Visual inspection

Before operating, it is needed to ensure of the serviceability of the machine:
- check the cables and ground wires,
- check the condition of output windows of the micrometer, and, if necessary, wipe them with a soft lint-free cloth.

8.1.2. Installation

Install the machine on the equipment. Connect the power cable (220V).

8.1.3. Switching on the machine

Feed power to the machine by switching on the circuit breaker, see Figure 3.

8.1.4. Setting parameters and forming the database of templates

Set parameters in accordance with p. 7.2. Form the database of templates in accordance with p. 7.2.5.

8.1.5. Calibration

Calibrate the machine in accordance with p. 7.3. The calibration procedure must be performed:
- daily before the work shifts,
- in case of changing the shaft type,
- if the position of the machine was changed.

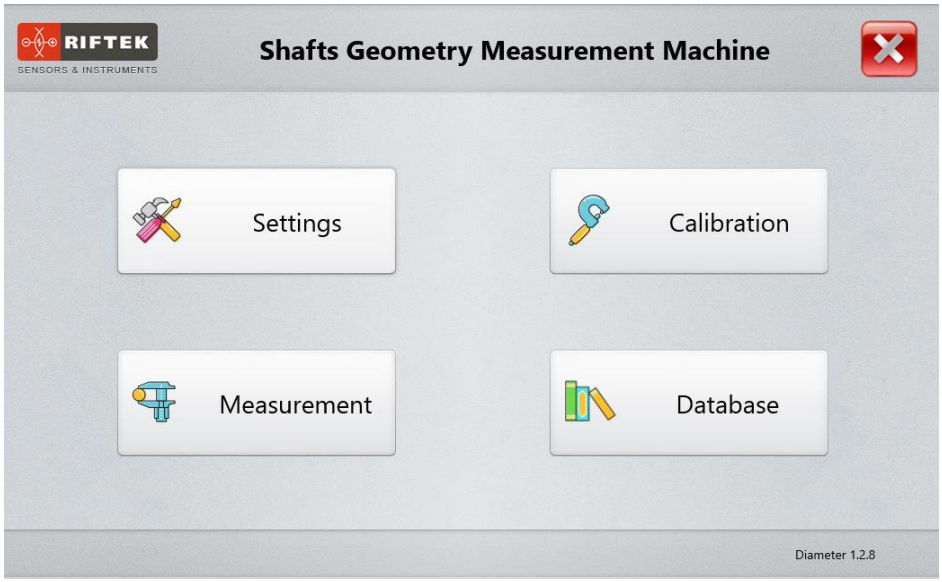
8.1.6. Metrological verification

Metrological verification of the machine must be performed:
- before commissioning,
- after repair,
- periodically during operation.

8.2. Working with the machine

The measurement of geometrical parameters is fully automated and the work with the machine is reduced to the mechanical adjustment, and then to the work with the software. Follow the steps below:
- Configure the machine to operate with the shaft of the appropriate diameter, see par. 8.2.1.
- Configure the machine to operate with the shaft of the required length, see par. 8.2.2.
- Start the software, see par. 7.
- Install the controlled shaft into the machine.

ATTENTION: It is necessary to clean the shaft from cutting fluid and oil before installing into the machine!
- Tap the **Measurement** button.



8.2.1. Shafts of different diameters

The machine is equipped with the Morse tapers of two types: a small taper and a big taper (see Figure 5 and Table 5 in Catalog RF800.00.000, items 7 and 8). To replace the tapers, it is necessary to: unscrew the calibers, get the tapers, tighten the calibers, install the new tapers.

8.2.2. Shafts of different lengths

To measure the shafts of different lengths, the machine is adjusted by moving the upper rack of the Morse taper with the end sensor fixed to it along the table (see Figure 5 in Catalog RF800.00.000).

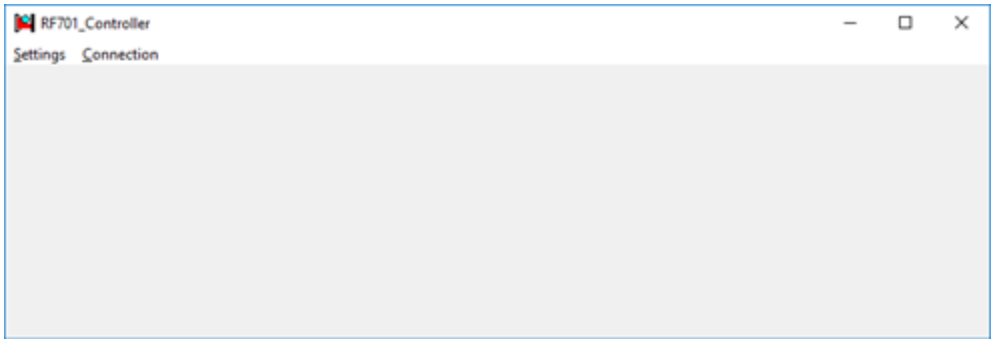
8.2.3. Setting the origin of the linear coordinate

After you replace the support taper, it is necessary to set the origin of the linear coordinate.

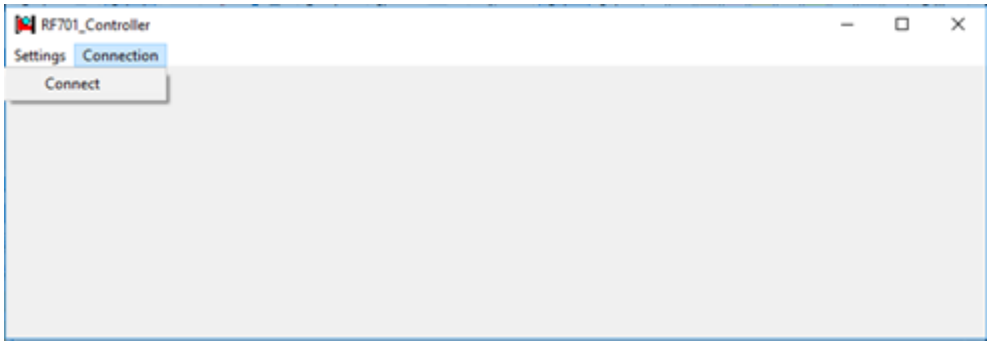
The upper end sensor, installed on the movable Morse taper, specifies the origin of the linear coordinate of the linear translation system (the coordinate of the starting position of the micrometer). In the starting position, the micrometer must be positioned so that the caliber (the part of the Morse taper) is placed within the measurement zone of the micrometer.

Follow the steps below:

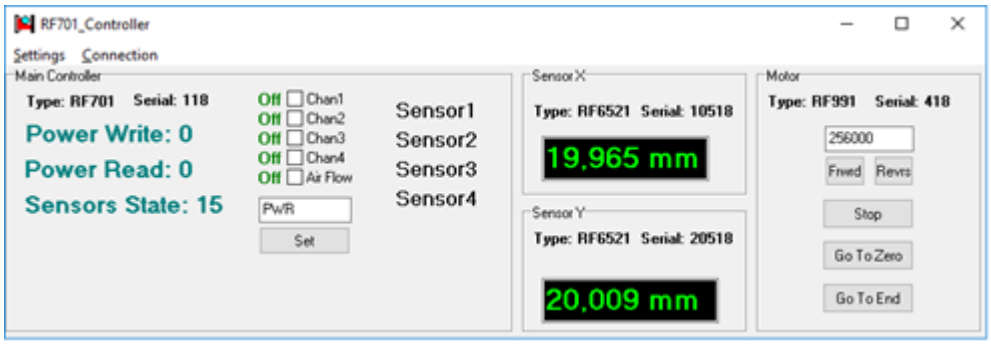
1. Start **RF701_Controller.exe**, which is in the **Riftek install \RF701_Controller** directory on the desktop of the mini-PC.



2. In the **Settings** menu, select a port: **COM4**.
3. Select **Connection > Connect** in order to connect to the system.

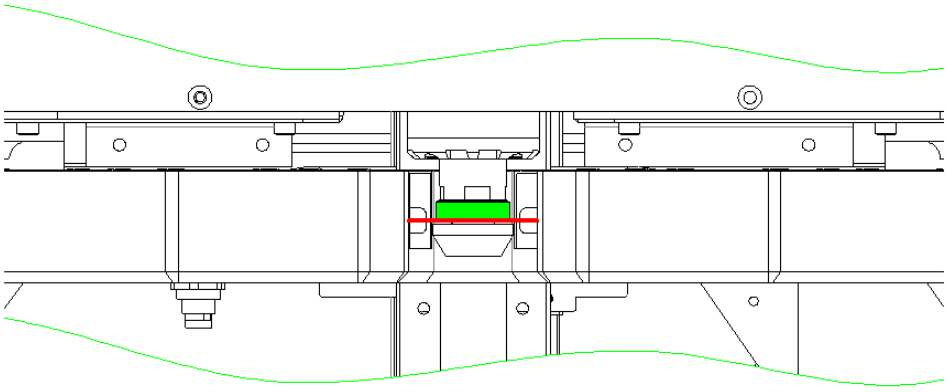


4. Tap the **GoToEnd** button in order to move the micrometer to the lowest position.

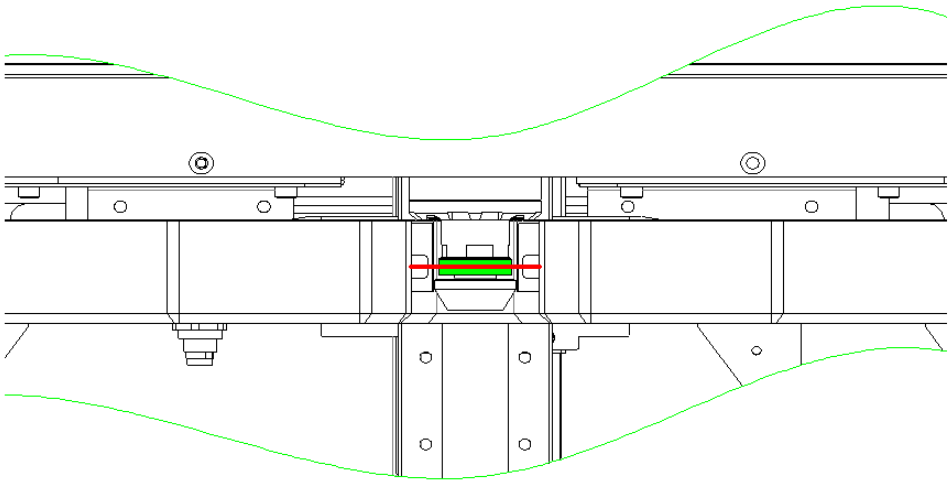


5. Install the rack 3 (see Figure 4 in Catalog RF800.00.000) at the highest position.
6. Install the shaft into the machine. **ATTENTION:** the shaft must be installed!
7. Tap the **GoToZero** button in order to move the micrometer to a zero position.

The caliber must be on the beam axis of the micrometer.
The figure below illustrates the incorrect position of the micrometer:



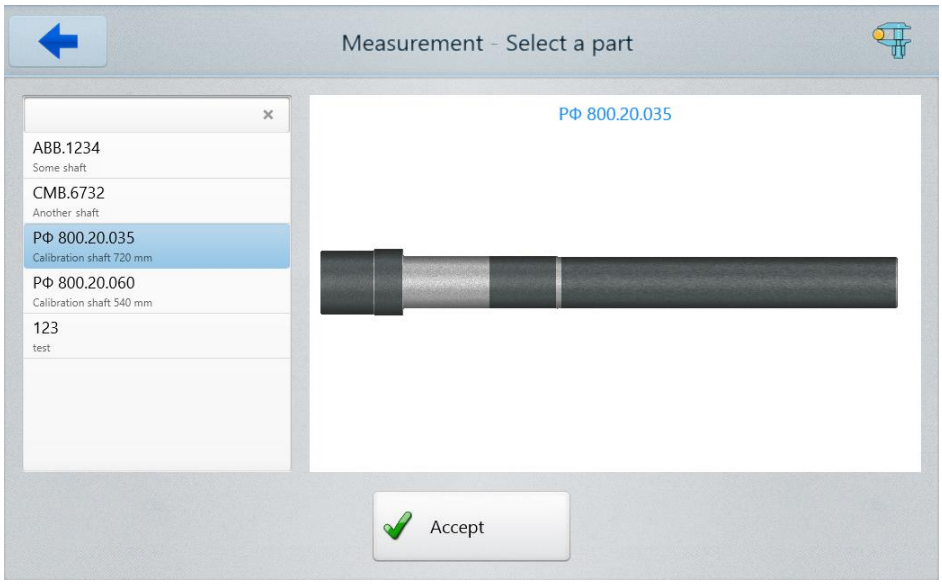
The figure below illustrates the correct position of the micrometer:



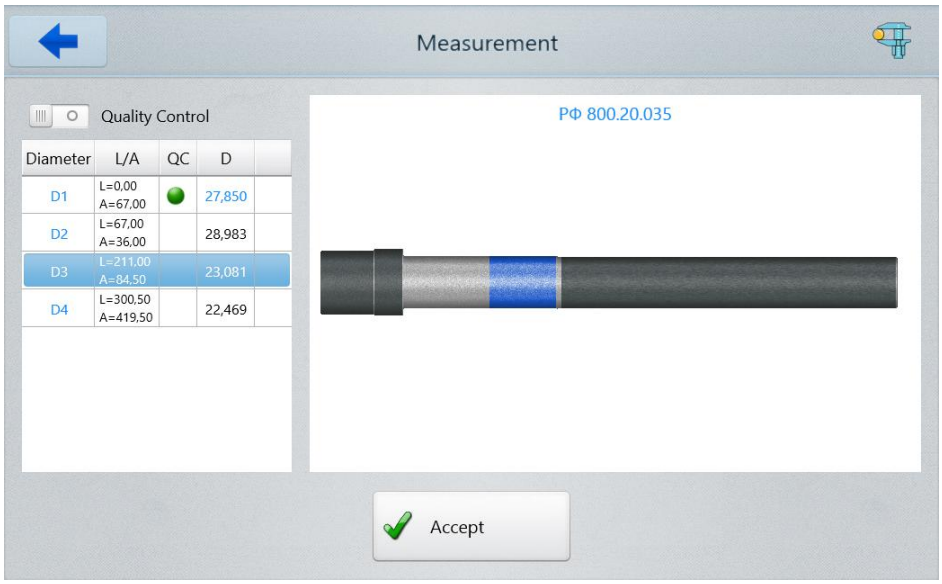
8. If the setting is incorrect, tap the **GoToEnd** button in order to move the micrometer to the lowest position.
9. Screw the rack 1-2 turns.
10. Repeat steps 6-9 until the beam axis of the micrometer is on the axis of the caliber.
11. Secure the rack by using the counter bush.

8.2.4. Template selection

Select the template from the list. The template that was used for calibration is highlighted in blue.



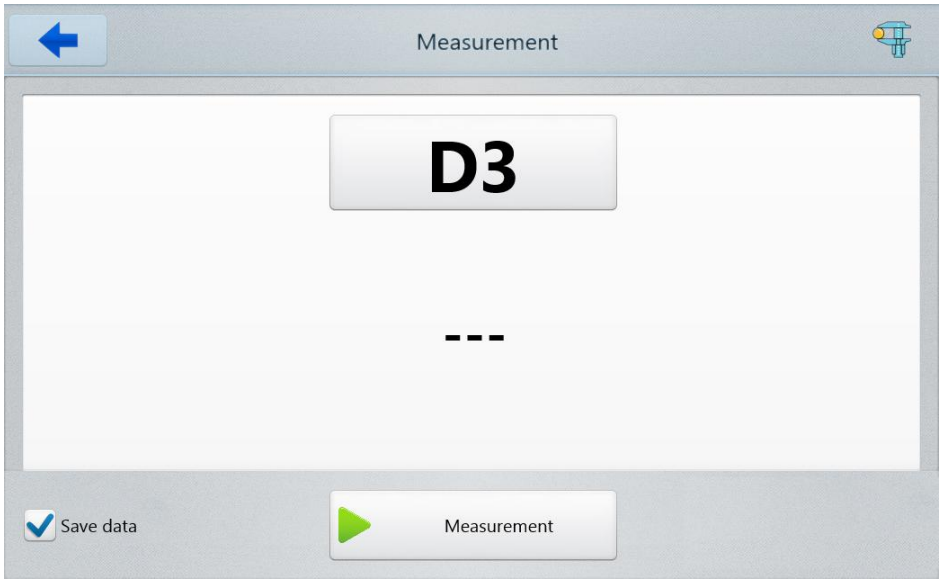
After you select the template, tap the **Accept** button. The program will display the parameters of the selected template:



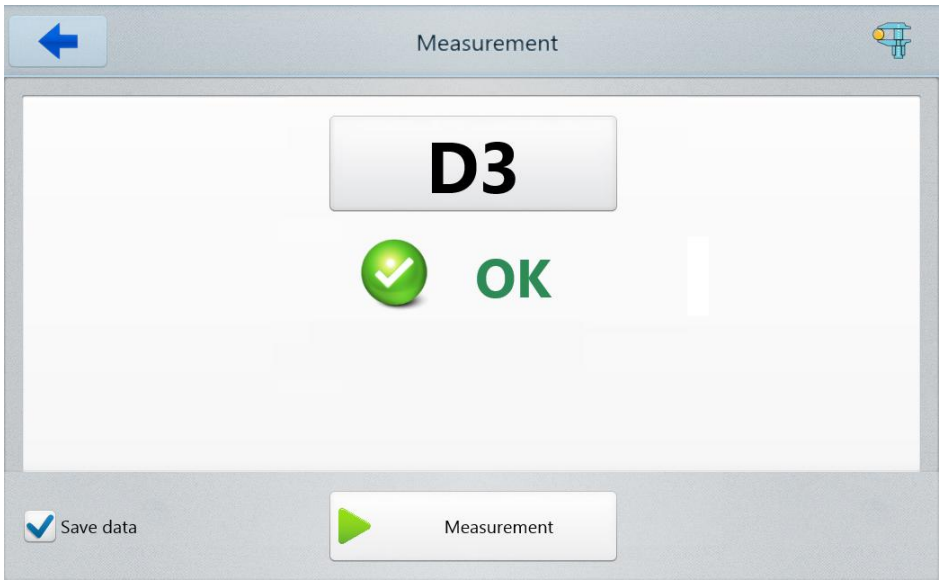
In this window, you can see the following: the number of the shaft is РФ800.20.035, the workplace is the D3 diameter control (highlighted in blue in the table and in the figure), not QC (QC toggle is disabled). If the selected template is what you need, tap **Accept**, otherwise go back to the previous window (tap on the blue arrow), and select another template.

8.2.5. Measurement

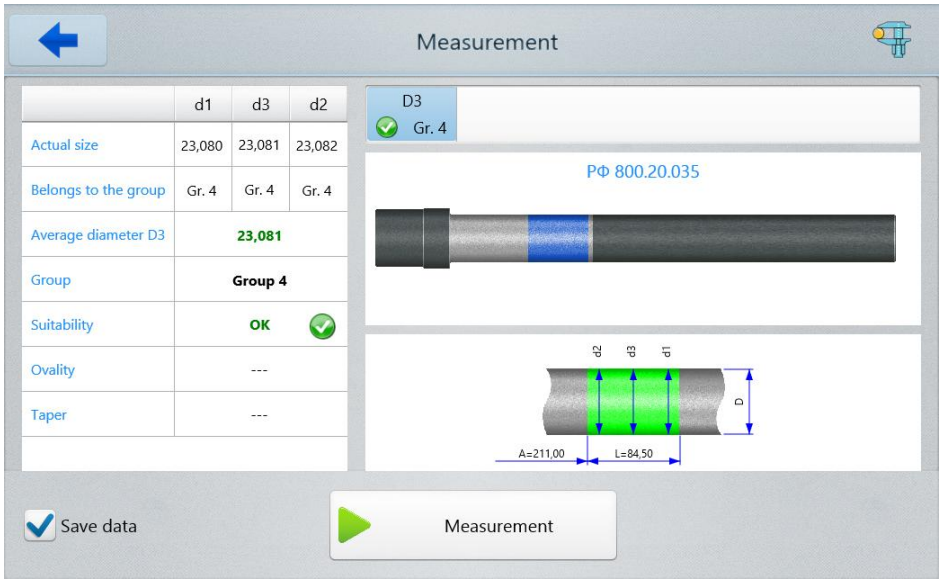
After you select the template, the program prompts to start the measurement process:



If you need to save the result to the database, select the **Save data** option.
Tap the **Measurement** button, or press the foot switch.
If the result is acceptable, the program will display the following:



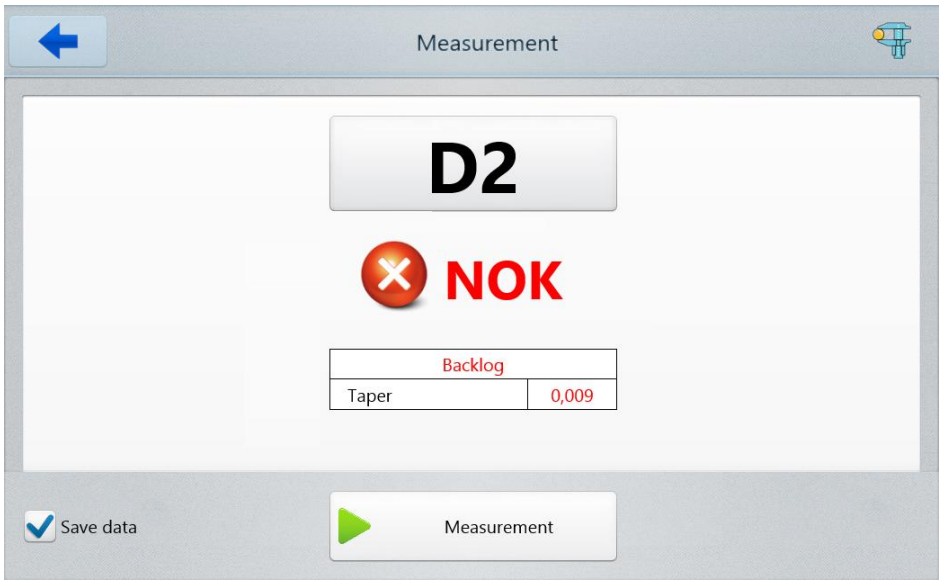
For more information, tap **D3**:



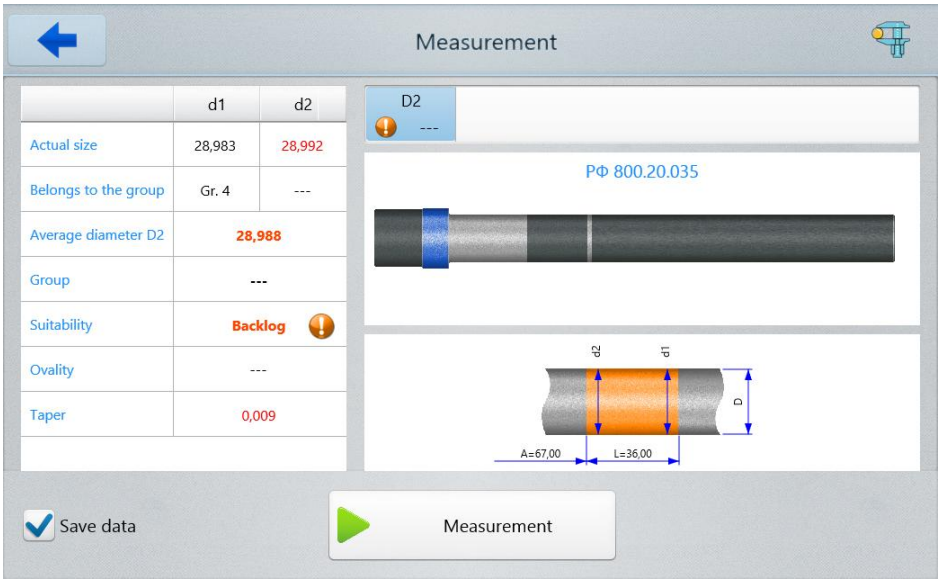
The shaft is considered suitable if the diameters in all three controlled sections of the zone are in the same sorting group, and if the ovality and taper do not exceed the tolerance set for this sorting group.

To measure the shaft again or to measure the new shaft, install the shaft into the machine and repeat the measurement procedure described in this paragraph.

If the result is not acceptable, the program will display the following (Diameter D2 Control):

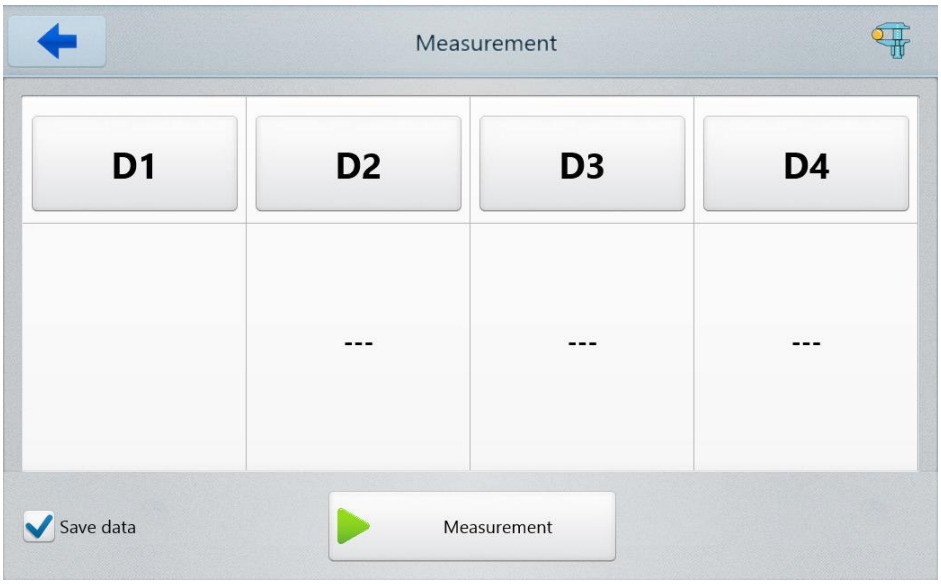


For more information, tap **D2**:

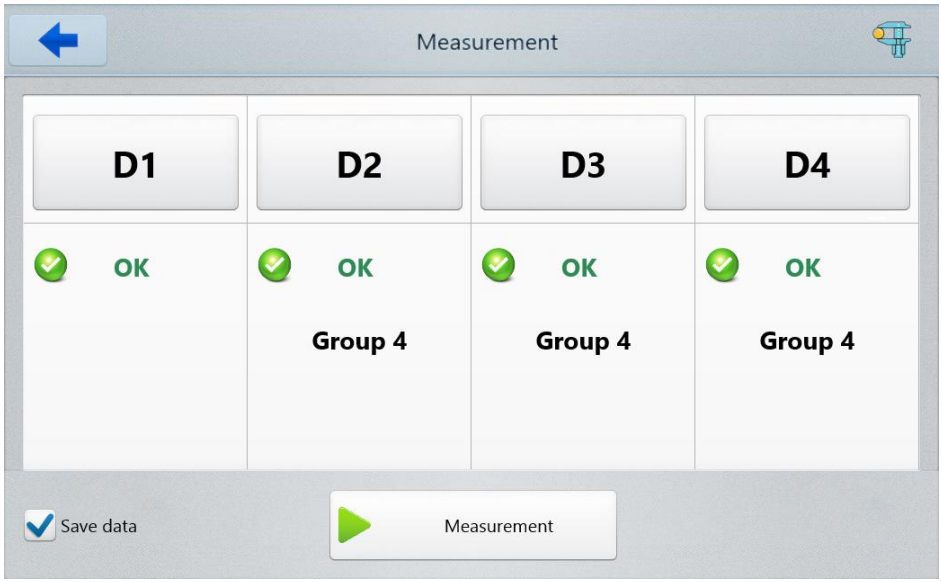


An example of measuring the shaft during the Quality Control (diameter D1):
The selected template:

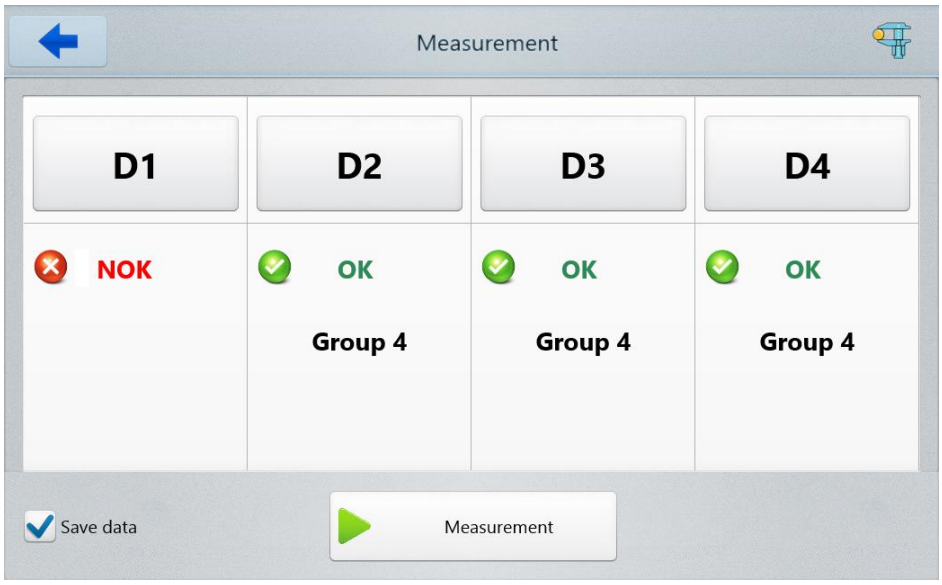
During the measurement process, the program displays the following.



The measurement result (acceptable):



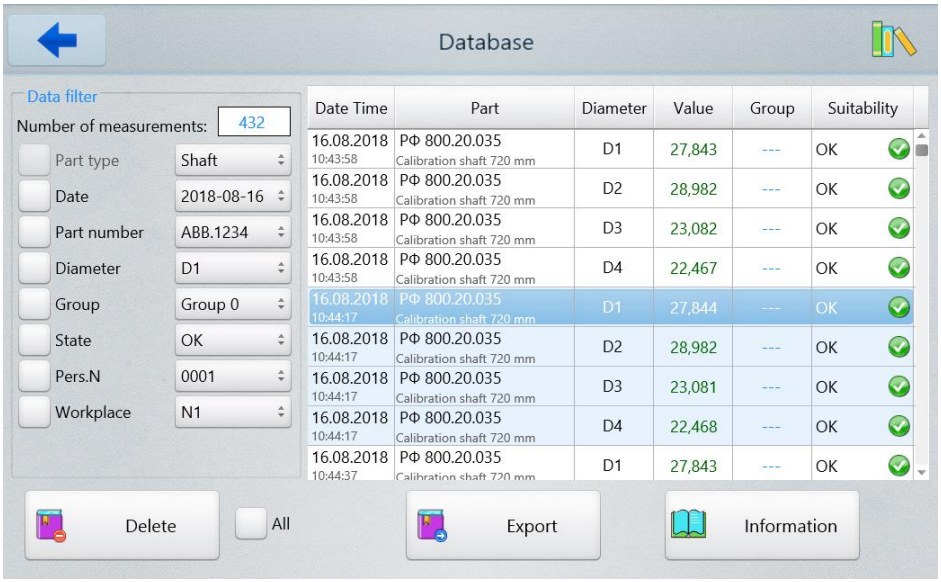
The measurement result (defective):



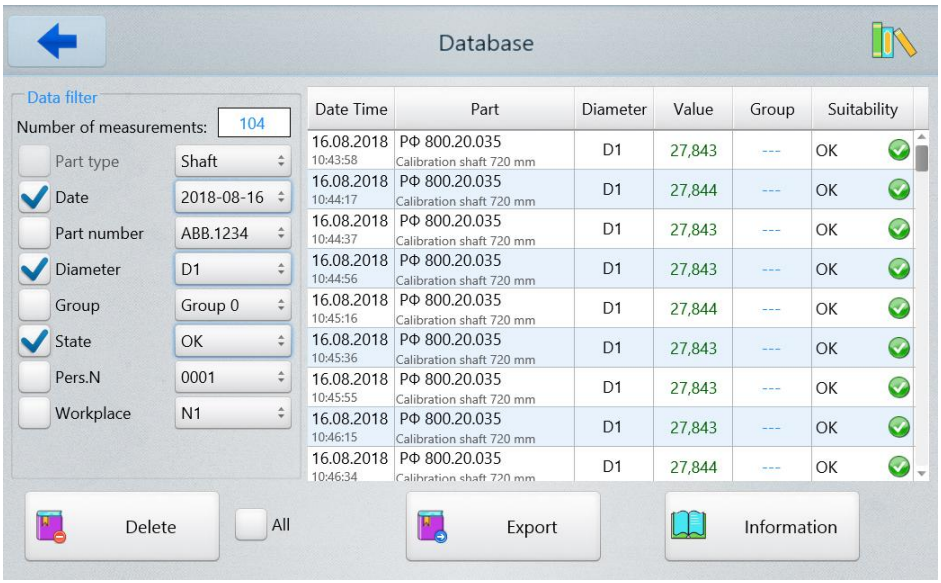
For more information, tap the **D1...D4** buttons.

8.3. Working with the database

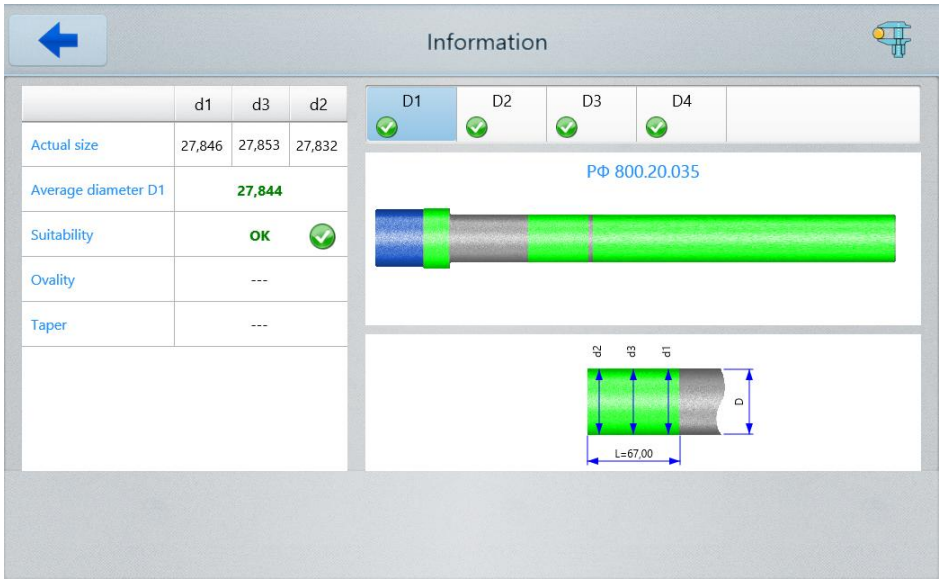
The results will be saved to the database, if the **Save data** option is enabled (see par. 8.2.5.). To go to the database, tap the **Database** button in the main window. The program will display the database:



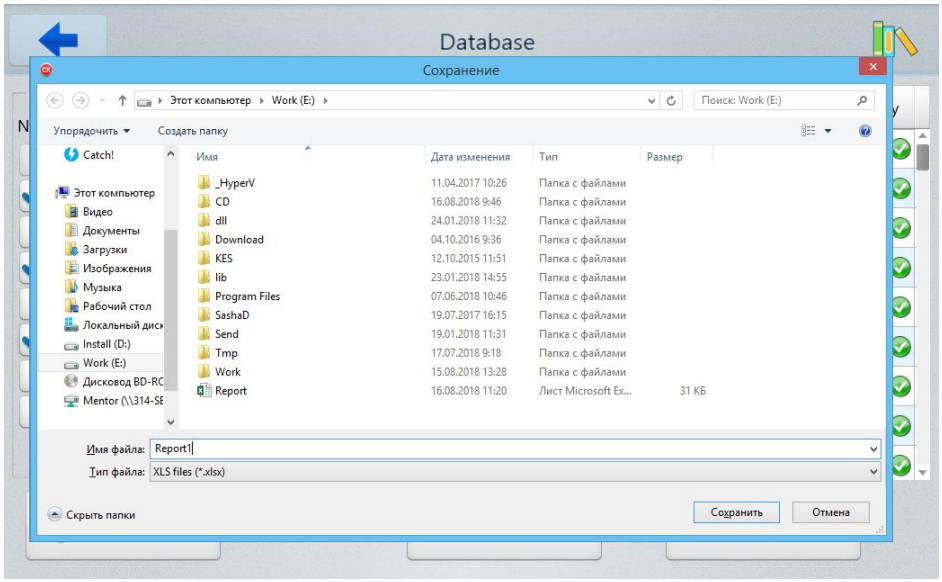
In the right part of the window there is a list of measured shafts and their parameters. In the left part of the window there are the data filter controls. You can use any combination of filters. An example of filtering is shown below (by date, diameter, state). The number of measured shafts is shown in the **Number of measurements** field.



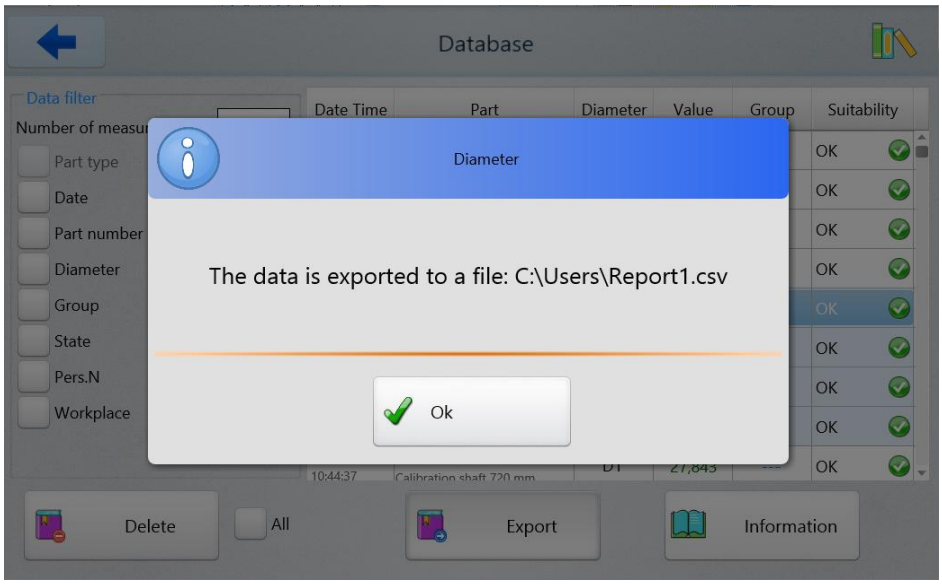
To view all parameters, select the shaft from the list by tapping on the string, and then tap the **Information** button.



To export data to a file, tap the **Export** button, select the file type and path:



If successful, you will see the following message:



9. Maintenance

9.1. General instructions

Maintenance of the machine is carried out to ensure a constant-ready status, and to prevent premature failure. Maintenance includes preventive measures aimed at identifying and eliminating the defects, and at ensuring the normal operation of the machine. It is recommended to perform the daily and annual maintenance work.

9.2. Safety precautions

Observe the safety precautions outlined in Paragraph 1 of this User's Manual.

9.3. Maintenance procedure

9.3.1. Daily maintenance work

Daily maintenance work includes:

- visual inspection of the machine,
- checking the completeness of the machine,
- checking for any damage to structural elements, power and instrument cables, display and connectors,
- checking for the presence of contamination on the linear guide, and, if necessary, wiping with a clean lint-free cloth,
- checking the loosening of screw connections,
- optical signal quality control.

9.3.1.1. Checking the loosening of screw connections

Check the screw connections of the linear translation system, micrometer, and table. Tightening force should provide the backlash-free connection and not lead to destruction of the threaded connection.

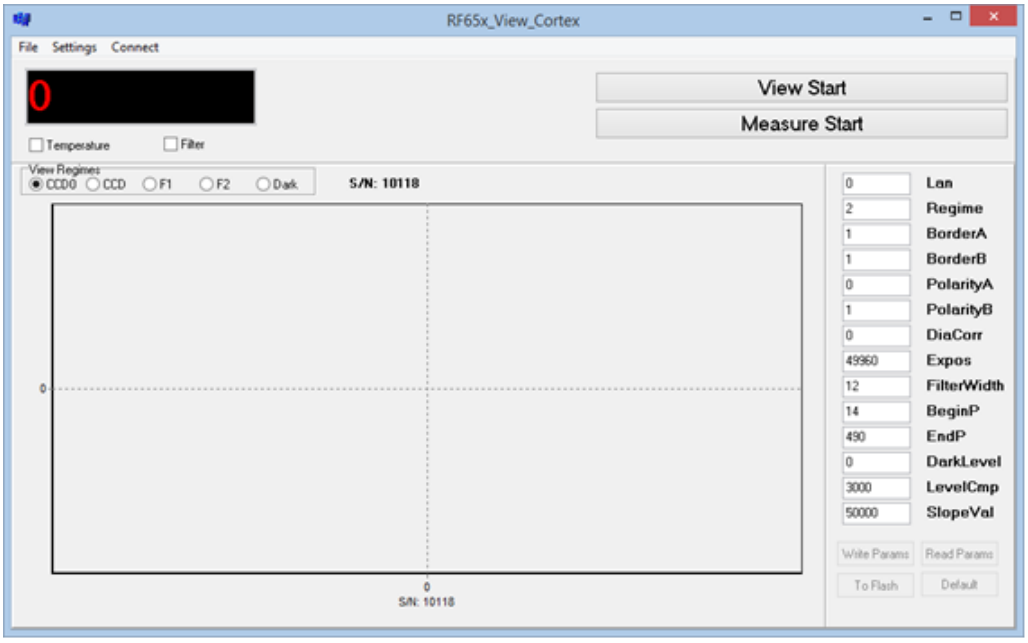
Tight the fixing screws of the racks until there are no gaps, but apply a force no more than 1.3 N•m.

9.3.1.2. Optical signal quality control

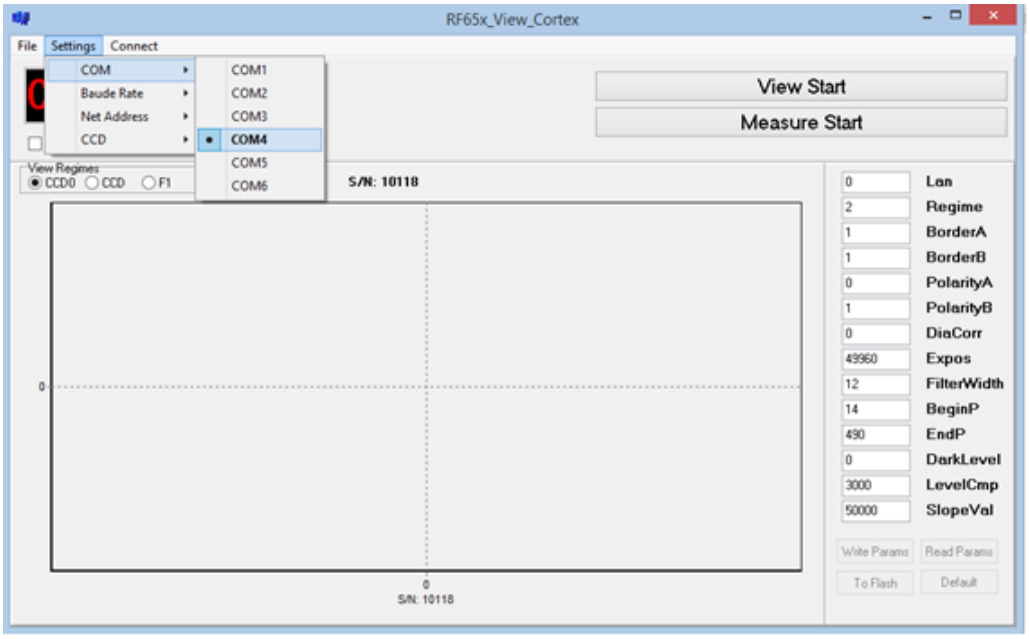
To ensure the required measurement accuracy, the optical windows of the micrometer should not have any contamination or damage. Controlling the quality of the optical signal allows to assess the degree of contamination.

Please follow the steps below:

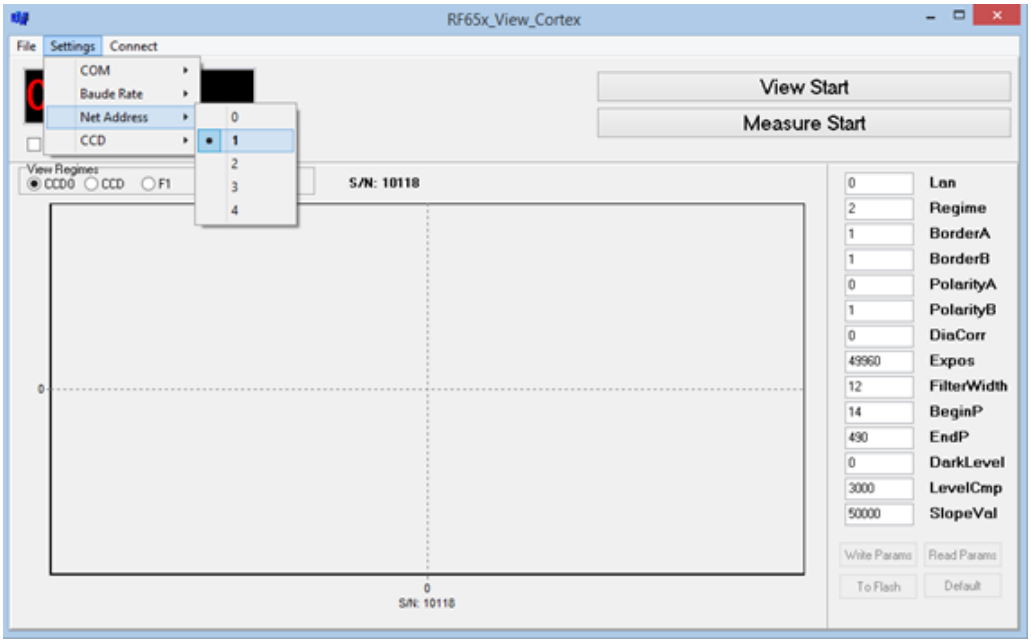
1. Run the executable file **RF65x_View_Cortex.exe**, which you can find in the **Riftek install\RF65x_View_Cortex** directory on the desktop of the mini-PC.



2. In the **Settings** menu, select **COM > COM4**.



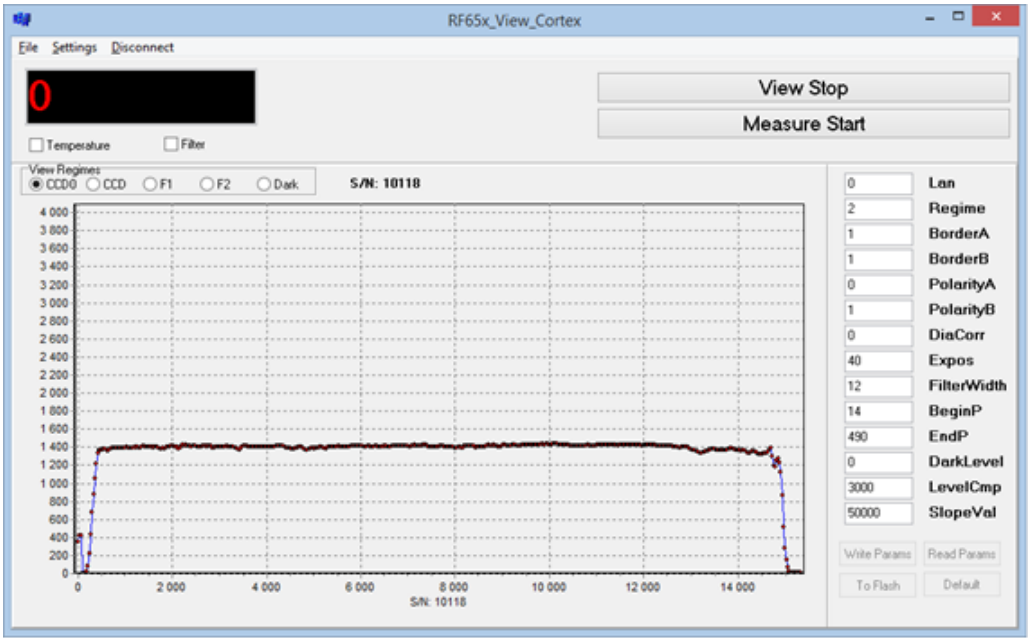
3. In the **Settings** menu, select **Net Address > 1** in order to connect to the X channel of the micrometer.



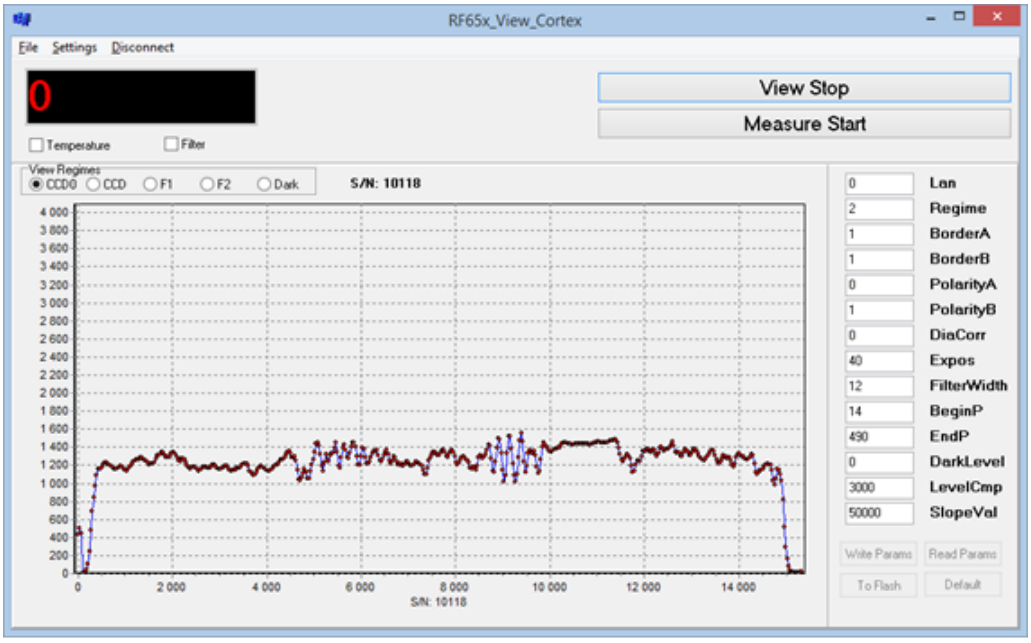
4. Tap **Connect** to establish connection with the micrometer.
5. Tap **View Start** to run the **Optical signal view** mode.

Windows are considered clean if the amplitude of signal irregularity does not exceed 150 units (vertical scale).

An example of the signal when the windows of the micrometer are clean:



An example of the signal when the windows of the micrometer have contamination:



6. If necessary, clean the windows. **ATTENTION:** Cleaning is best done with a soft dry lint-free cloth. In order to remove fingerprints or grease, use the alcohol or alcohol-ether mixture. Do not use scratching cleaners or other aggressive media.
7. In the **Settings** menu, select **Net Address > 2** in order to connect to the Y channel of the micrometer (see step 3).
8. Repeat steps 3-5 for the Y channel of the micrometer.

9.3.2. Annual maintenance work

Annual maintenance work includes:

- lubrication of the Morse tapers,
- metrological verification of the machine.

10. Warranty policy

Warranty assurance for Shafts Geometry Measurement Machine RF800 Series - 12 months from the date of putting in operation; warranty shelf-life - 12 months.

11. Revisions

Date	Revision	Description
01.08.2018	1.0.0	Starting document.