



**RIFTEK**  
Sensors & Instruments



# MULTICHANNEL DISPLACEMENT MEASUREMENT SYSTEM

**RF305 Series**

**User's manual**

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## 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 allow the batteries to discharge below 10.8 V.

## 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.

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## 3. General information

The system is designed for multi-coordinate monitoring and measurement of displacements (deformations) of complex structures (bridges, power machines, etc.).

## 4. Basic technical data

Parameter	Value
Operating ambient temperature, °C	-10...+40
Relative humidity, %	30...100
Coverage distance of the wireless communication channel of the central computer, m	500
Maximum number of subsystems, with which the central computer can operate simultaneously	4
Battery life (RS485 connection), not less, h	10
Battery life (WiFi connection), not less, h	10
Enclosure rating	IP65
Measurement range, mm	20
Frequency, not less, Hz	10
Measurement error, $\mu\text{m}$	2
Discreteness of the sensor readings, $\mu\text{m}$	0.5

## 5. Structure and operating principle

The system contains:

- Central computer.
- Two subsystems (each contains a subsystem computer and 10 absolute linear encoders).
- Software for collecting, processing, visualizing and logging of data.
- Autonomous power supplies (included into the central computer system and subsystems).
- RS485-Wi-Fi converters, wires and connectors.

## 5.1. Central computer

The central computer of the system is designed to receive data from subsystems remotely and to control subsystems via the wireless communication channel (radio channel 900 MHz), as well as to process these data.

The coverage distance of the wireless communication channel of the central computer is not less than 500 m.

The central computer of the system is equipped with an autonomous power supply (battery), has a switch.

The battery life is not less than 10 hours when two subsystems are connected.

The computer is charged from 220V AC. The charging time is about 18-20 hours.

### 5.1.1. LED indication

- "PWR" – power supply,
- "LINK" – connection via a radio channel ("LINK" lights – established, "LINK" doesn't light – not established),
- "RX" – data reception,
- "TX" – data transmission.

### 5.1.2. Battery charging procedure

- Connect the power cable to the computer.
- Connect the power cable to 220V AC.
- Turn on the power switch of the computer.

After starting the program, select "No" to the question "Continue?" in the program window. The computer will go into the charging mode.

The computer is charged with a current of 1A. During the charging procedure, the red LED is lit. The battery stops to charge when its voltage reaches 14.6V, or after 20 hours of charging. After reaching a full charge, the green LED is lit.

If the operation mode is selected, the battery does not charge.

**ATTENTION!**

Do not allow the battery to discharge below 10.8V, because this may cause the battery to malfunction.

## 5.2. Subsystem computer

The subsystem computer is designed to control, receive and process data from absolute linear encoders, and then to transmit them to the central computer via the radio channel.

The number of subsystem computers - 2.

The coverage distance of the radio channel of the subsystem computer is not less than 500 m.

The subsystem computer can simultaneously operate with 10 absolute linear encoders.

The subsystem computer keeps normal operation regardless of the number of sensors connected (from 1 to 10). The intentional removal of a sensor or a group of sensors, as well as their failure, do not affect the subsystem operation. Faulty sensors can be easily replaced (without additional configuration of the subsystem).

The connection / disconnection of sensors is implemented both at the hardware level (using the cable connector of the sensor) and the software level (by selecting the sensor channels in the software of the central computer).

The subsystem computer is equipped with an autonomous power supply (battery). The battery life is not less than 10 hours when operating via a wireless communication channel and via RS485.

### 5.2.1. LED indication

- “PWR WiFi ” – power supply (WiFi),
- “PWR ” – power supply (radio channel),
- “LINK” – connection via a radio channel (“LINK” lights – established, “LINK” doesn't light – not established),
- “RX” – data reception,
- “TX” – data transmission.

### 5.2.2. Battery charging procedure

- Connect the power cable to the computer.
- Connect the power cable to 220V AC.
- Turn on the power switch of the computer.

After starting the program, select "No" to the question "Continue?" in the program window. The computer will go into the charging mode.

The computer is charged with a current of 1A. During the charging procedure, the red LED is lit. The battery stops to charge when its voltage reaches 14.6V, or after 20 hours of charging. After reaching a full charge, the green LED is lit.

If the operation mode is selected, the battery does not charge.

**ATTENTION!**

Do not allow the battery to discharge below 10.8V, because this may cause the battery to malfunction.

## 5.3. Absolute linear encoders

Absolute linear encoders RF251T series are used as linear displacement sensors.

The user's manual is available for download at RIFTEK's official website:

[Absolute Linear Encoders RF25x Series rus.pdf](#).

## 5.4. RS485-WiFi converter

RS485-Wi-Fi converters (hereinafter - converters) are designed to provide communication between subsystem computers and displacement sensors. Converters provide connection via the Wi-Fi radio channel as well as via RS485. To ensure the autonomous operation of the sensors when working via a wireless communication channel, converters are equipped with the built-in battery.

The battery life is not less than 10 hours, the charging time is about 4-6 hours.

### 5.4.1. LED indication

- “PWR WiFi ” – power supply (WiFi converter),
- “PWR sensor” – power supply (sensor),
- “Charge” – charger state,
- “WiFi” – WiFi connection:
  - blue LED – connection to the access point of the computer,
  - red LED – connection to the software server,
  - green LED – data transmission (when connected to the access point / software server) or connection request.

### 5.4.2. Battery charging procedure

- Connect the adapter 15V to the converter.
- Connect the adapter to 220V.
- Turn on the power switch of the converter.

The converter will go into the charging mode. The converter is charged with a current of 0,25A. During the charging procedure, the red LED is lit. The battery stops to charge when its voltage reaches 14.6V, or after 6 hours of charging. After reaching a full charge, the green LED is lit.

**ATTENTION!**

During the charging procedure, the Wi-Fi connection to the subsystem computer must not be established.

If the Wi-Fi connection to the subsystem computer is established, the battery does not charge.

**ATTENTION!**

Do not allow the battery to discharge below 10.8V, because this may cause the battery to malfunction.

## 5.5. Radio 900MHz-USB unit

If necessary, it is possible to connect the subsystem computers to the laptop. To do this, you need to use the Radio 900MHz-USB converter. When you turn on the Radio 900MHz-USB unit and the subsystem computers, the connection will be established automatically.

### 5.5.1. LED indication

- “PWR ” – power supply,
- “LINK” – connection (“LINK” lights – established, “LINK” doesn’t light – not established),
- “RX” – data reception,
- “TX” – data transmission.

**ATTENTION!**

The simultaneous operation of the central computer and the Radio 900MHz-USB unit is not permitted.

### 5.5.2. Battery charging procedure

The charge level of the unit is displayed in the laptop software. The unit is charged from 220V AC. The charging time is about 8-10 hours.

The battery charging procedure:

- Connect the power cable to the unit.
- Connect the power cable to 220V AC.
- Turn on the power switch.

The unit is charged with a current of 1A. During the charging procedure, the red LED is lit. The battery stops to charge when its voltage reaches 14.6V, or after 10 hours of charging. After reaching a full charge, the green LED is lit.

**ATTENTION!**

Do not allow the battery to discharge below 10.8V, because this may cause the battery to malfunction.

## 6. Overall and mounting dimensions

### 6.1. Computers

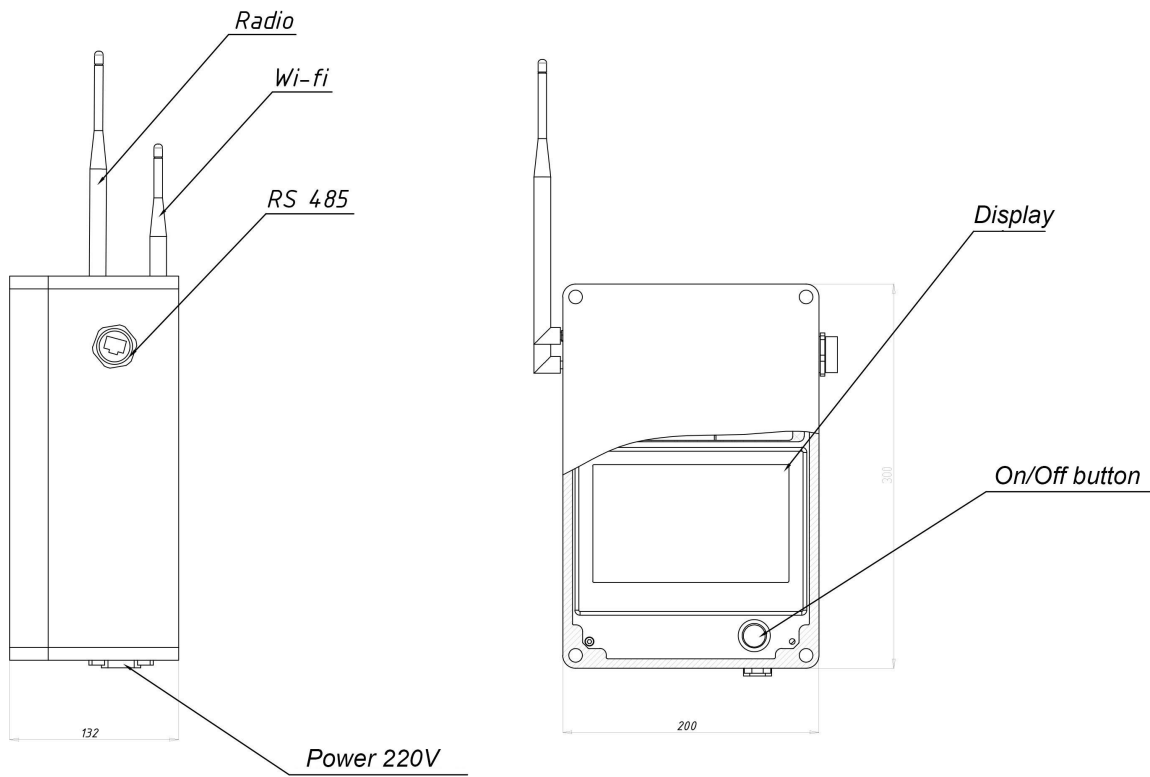


Figure 1

### 6.2. RS485-WiFi converter

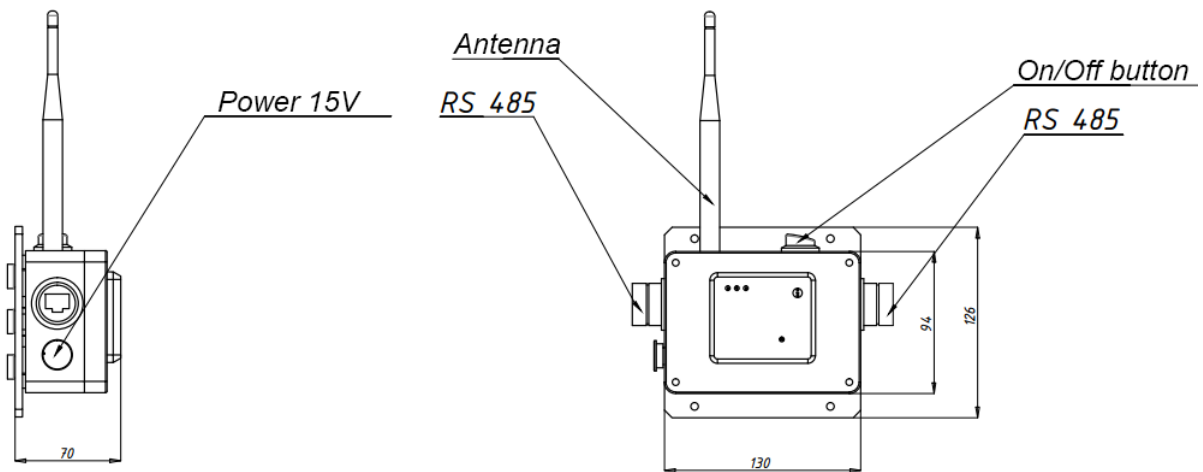


Figure 2

### 6.3. Absolute linear encoders

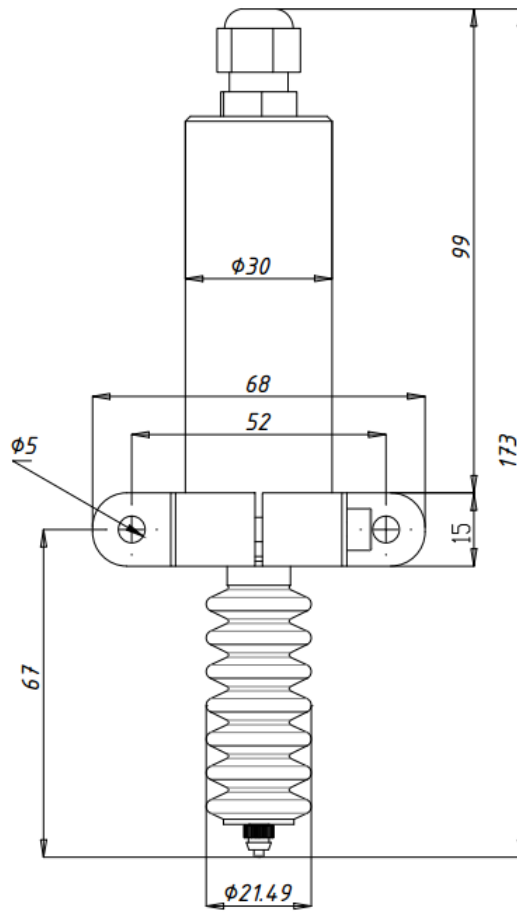


Figure 3

### 6.4. Connection adapter

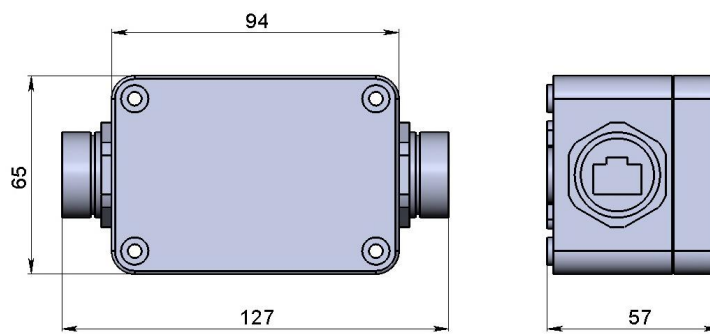


Figure 4



### 6.5. Radio 900MHz-USB unit

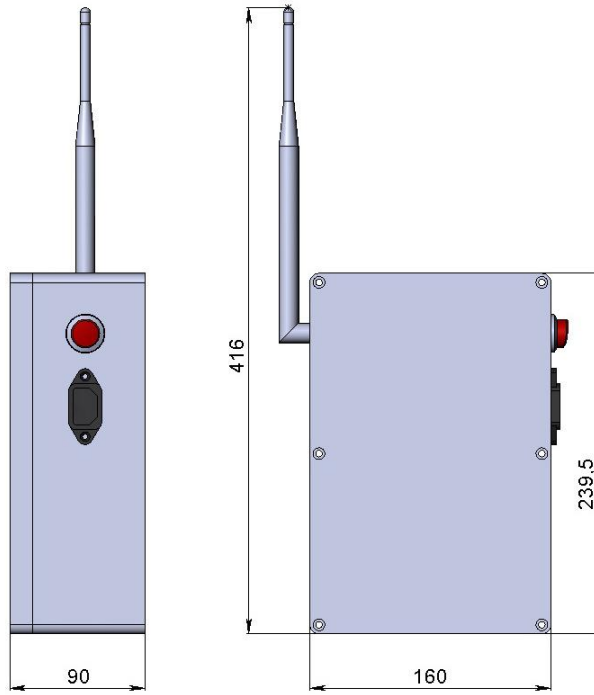


Figure 5

### 6.6. Switch box

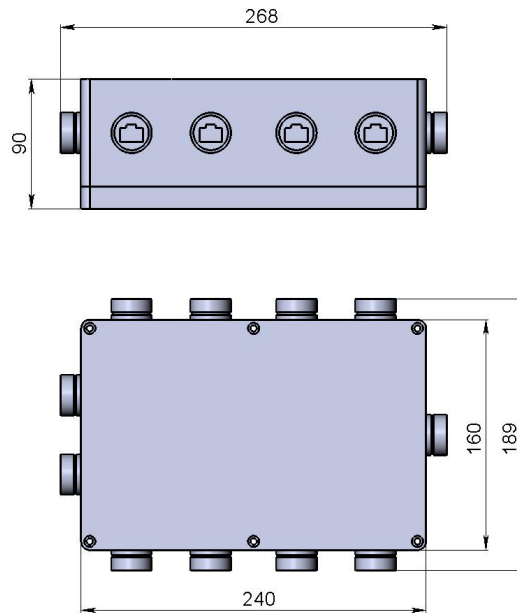


Figure 6

## 7. Connection

### 7.1. Wireless connection

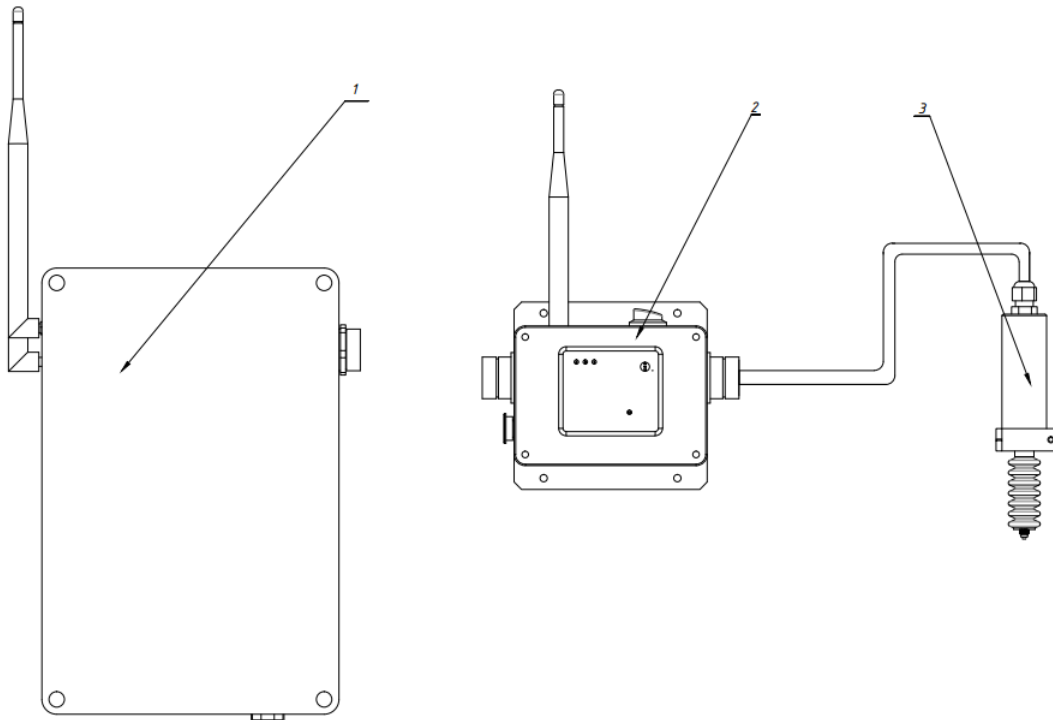


Figure 7

- 1 – Subsystem central computer.
- 2 – RS485-Wi-Fi converter.
- 3 – Absolute linear encoder.

### 7.2. RS485 connection

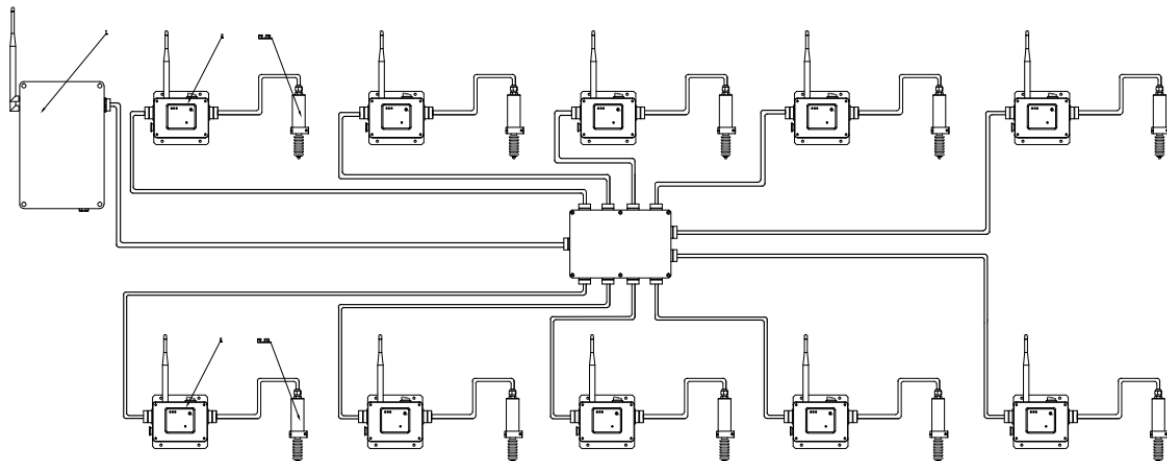


Figure 8

The cable length can be increased by means of the extension cords. The maximum cable length is 20 m. To connect sensors, you can use connecting adapters instead of WiFi-RS485 converters.

## 8. Software

### 8.1. Central computer software

The software of the central computer is implemented on the Windows CE platform.  
Main functions:

- Receiving data from all subsystems over a wireless channel.
- Simultaneous synchronous recording and storing of data from all subsystems and sensors. The time of recording is limited only by the amount of internal memory of the computer. The internal memory of the central computer is non-volatile.
- Remote switching on/off the sensors (all at once or separately).
- Zeroing of sensor readings in the current position.
- Active indication of the sensors operability (red/green program indicators).
- Selecting the material characteristics of the object to be measured (steel, concrete, etc).
- Recalculating the values of linear displacement into a voltage depending on the material characteristics.
- Graphical representation of data (dependence between displacement and time, dependence between voltage and time).
- Logging of results with displaying the ambient temperature, relative humidity, operator's name, date, time, data from the sensors.

### 8.2. Subsystem computer software

The software of the subsystem computer is implemented on the Windows CE platform.

Settings and functions of the subsystem computer are controlled over a radio channel via the central computer using a graphical interface.

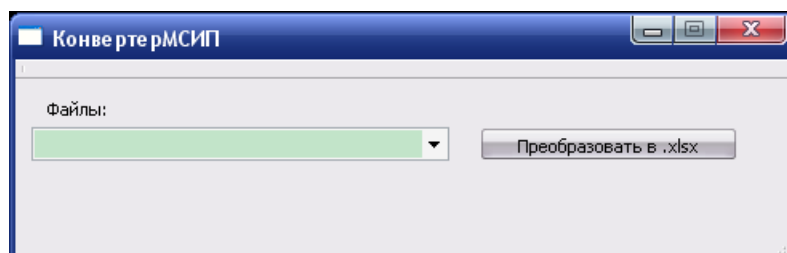
Main functions:

- Transfer of data to the central computer over a wireless communication channel.
- Temperature compensation.
- Zeroing of sensor readings in the current position.
- Simultaneous synchronous recording and storing of data from all sensors of the subsystem. The time of recording is limited only by the amount of internal memory of the subsystem computer and is not less than 3 hours. The data recorded over the last 3 hours is stored in the subsystem computer for an unlimited amount of time and is rewritten gradually as new data is received. The internal memory of the subsystem computer is non-volatile.

### 8.3. Saving parameters

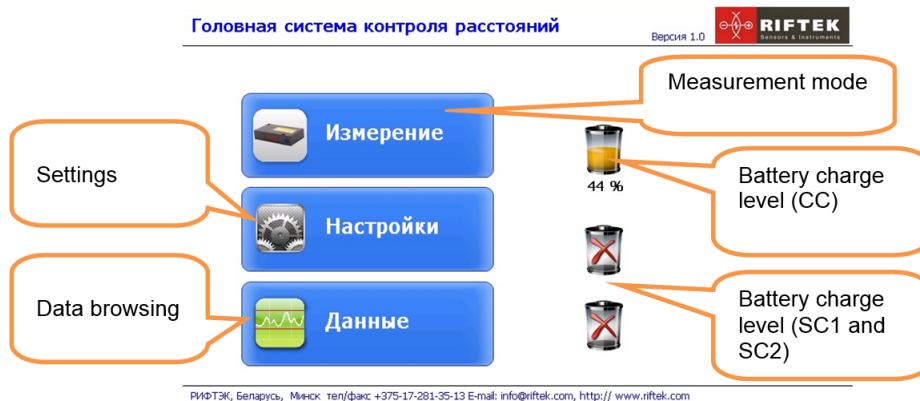
Data is saved in the text format and can be exported to Excel.

To convert the files to Excel format, use the program **converterMSIP.exe**.



## 8.4. User interface

After switching on the central computer (CC), the main program window is displayed on the screen:



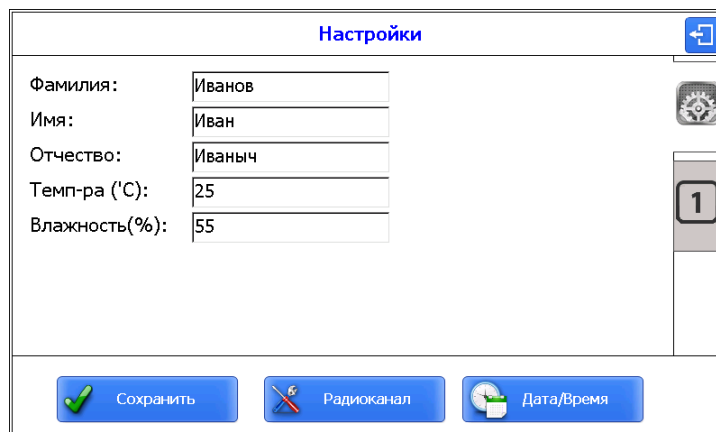
It takes some time for the CC to establish connection with subsystem computers (SC1 and SC2). The screen will display the battery charge level and the connection interface to the subsystem sensors.



### 8.4.1. System settings

Using the central computer (CC), the user can change settings of subsystem computers (SC1 and SC2). To enter the **Settings** mode, tap the **Settings** button.

In the **Settings** tab, you can enter the operator's name, temperature and relative humidity. These values are used to generate reports in TXT format.



Настройки

Фамилия: Иванов

Имя: Иван

Отчество: Иванович

Темп-ра (°C): 25

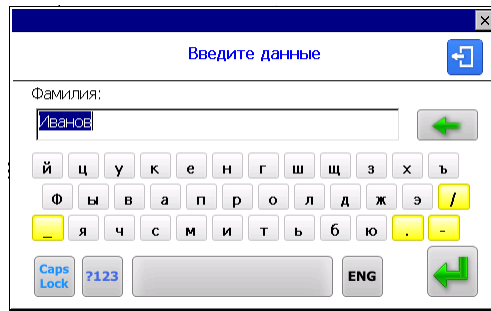
Влажность(%): 55

Сохранить

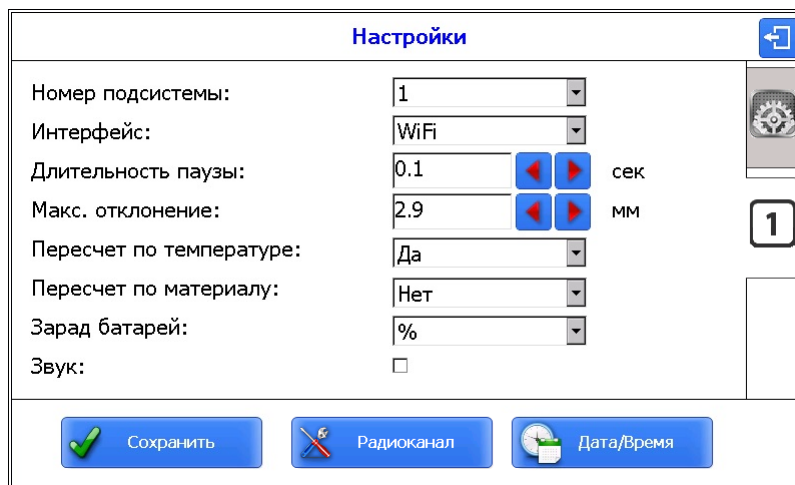
Радиоканал

Дата/Время

To edit the data, place the cursor in the required field and enter the values using the virtual keyboard.



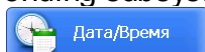
If the connection is established with the SC1 only, the program displays the Settings tab for SC1 [1]. If both subsystems are connected, the program displays two tabs (for SC1 and SC2): [1] and [2].



Parameters:

Name	Values	Description
Interface	<ul style="list-style-type: none"> <li>WiFi</li> <li>RS485</li> </ul>	Connection interface between SC and sensors. WiFi – wireless connection via WiFi; RS485 – connection via RS485 cable.
Pause	[0.1 – 9999,9] s	Pause time between two measurements.
Maximum deviation	[0.1 – 9999,9] mm	Maximum allowable deviation. If this limit is exceeded, the sensor value will be displayed in red color. If the "Alarm" option is selected, you will hear the alarm sound.
Recalculation (temperature)	<ul style="list-style-type: none"> <li>Yes</li> <li>No</li> </ul>	Recalculation of the sensor values depending on the temperature.
Recalculation (material)	<ul style="list-style-type: none"> <li>Yes</li> <li>No</li> </ul>	Recalculation of the sensor values depending on the material.
Battery charge level	<ul style="list-style-type: none"> <li>%</li> <li>V</li> </ul>	Battery charge level display: % or V.
Alarm		If this option is selected, you will hear the alarm sound when the sensor value exceeds the maximum limit.

To save changes, tap the **Save** button. Parameters will be transferred to the corresponding subsystem computer.



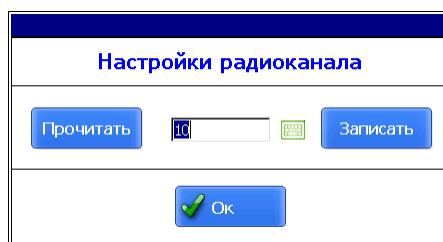
- Date/time settings.



Set the date and time using the   buttons, and then tap **Save**.

All system computers and all subsystem computers must have the same radio channel numbers.

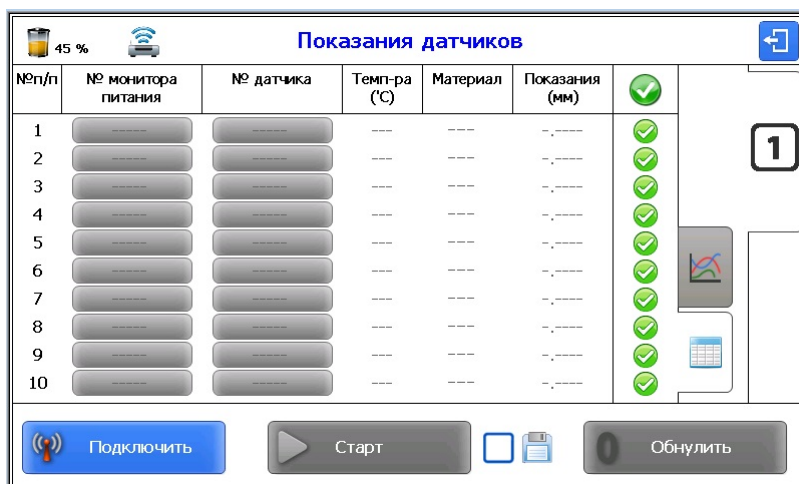
To check / change the radio channel number, press the **Radio channel** button in the **Settings** window. You will see the radio channel number in the appeared window.



Enter the required value (decimal) and tap **Write**.

## 8.4.2. Measurement

After you tap the **Measurement** button, the screen displays the sensor readings window. If the connection is established with the SC1 only, the program displays a tab for SC1 [1]. If both subsystems are connected, the program displays two tabs (for SC1 and SC2): [1] and [2].



Parameters:

Name	Description
#	Sensor ordinal number in the subsystem [1..10].
power monitor #	If the connection interface is WiFi, the serial number of the detected power monitor (WiFi module) is displayed.
sensor #	Sensor serial number.
Temperature (°C)	Current sensor temperature.
Material	If the <b>Recalculation (material)</b> option is selected, the button with the material type is displayed.
Readings (mm)	Current sensor readings.

Other elements:


Name	Description
	Battery charge level and connection interface of the current subsystem.
	Display / do not display the sensor readings.
	Connect / disconnect the sensors. When the sensors are connected, the <b>Start</b> and <b>Zero</b> buttons are active.
	Start / stop the measurement.
	Reset the readings of active sensors.
	Save / do not save results to the database. This element is not active during the measurement process.
	Switch between the digital and graphical representation of results.


Connecting the sensors:

№п/п	№ монитора питания	№ датчика	Темп-ра (°C)	Материал	Показания (мм)	Статус
1	№ 614	№ 4214	26.5	---	---	✓
2			---	---	---	✓
3			---	---	---	✓
4			---	---	---	✓
5	№ 1014	№ 3814	25.0	---	---	✓
6	№ 1114	№ 3514	23.9	---	---	✓
7			---	---	---	✓
8			---	---	---	✓
9			---	---	---	✓
10			---	---	---	✓


Starting the measurement process:

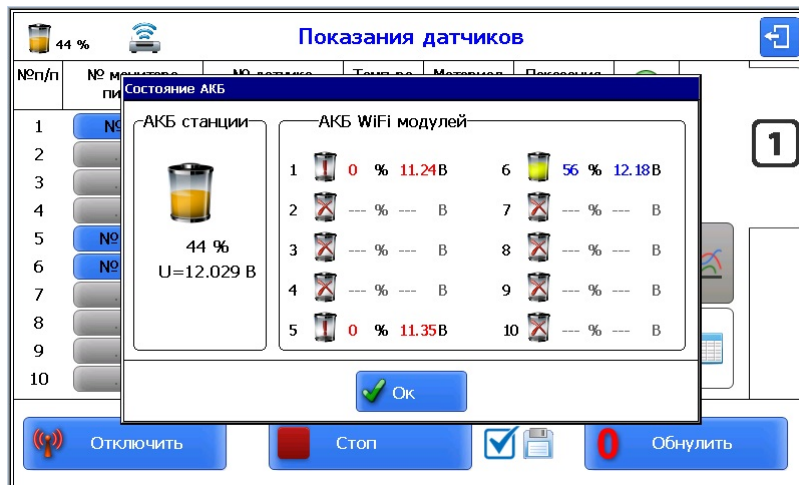


The value of sensor #4214 is displayed in red because it exceeds the permissible limit. The readings of sensor # 3814 are not displayed because this sensor is not selected - .

The results are saved to the database - .

### 8.4.3. Browsing the battery charge level

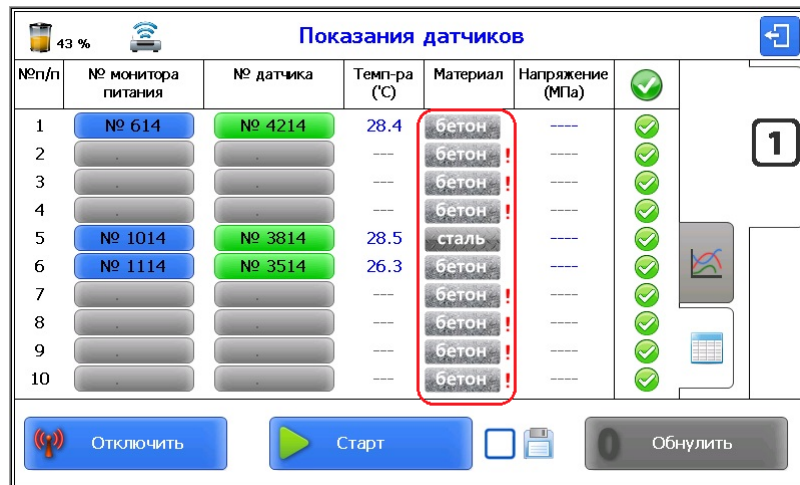
The program allows to browse the battery charge levels of all connected modules (for WiFi interface only). Tap the battery icon in the upper left corner of the screen .





#### 8.4.4. Recalculation (material)

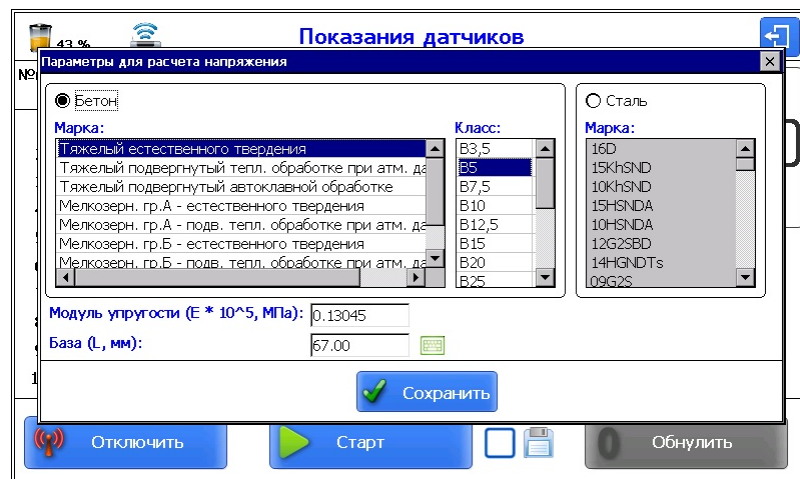
If the **Recalculation (material)** parameter is selected, the program displays the special buttons for setting the material type for each sensor.



If the material type is not specified, the button is displayed with an exclamation mark

- бетон !

To set the recalculation parameters, tap the **Concrete** button:




Next:

- select the material type: **Concrete** or **Steel**;
- select the material brand;
- select the material class (for concrete only);
- the **Elastic modulus** field will display the value for the selected material;
- if there is no needed material in the list, you can set the value of the **Elastic modulus** parameter manually;
- set the base value in mm.




To enter the values, use the on-screen keyboard - .

### 8.4.5. Graphic display of results

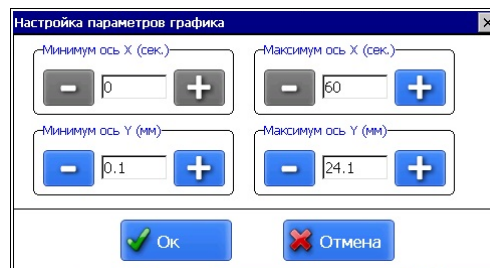
To browse the sensor readings in a graphic form, go to the **Graphs** tab - .



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Element	Description
 № 4214 —	Sensor status and serial number. Line color on the graph.
	Zoom on/off the graph.
	Set the graph parameters.

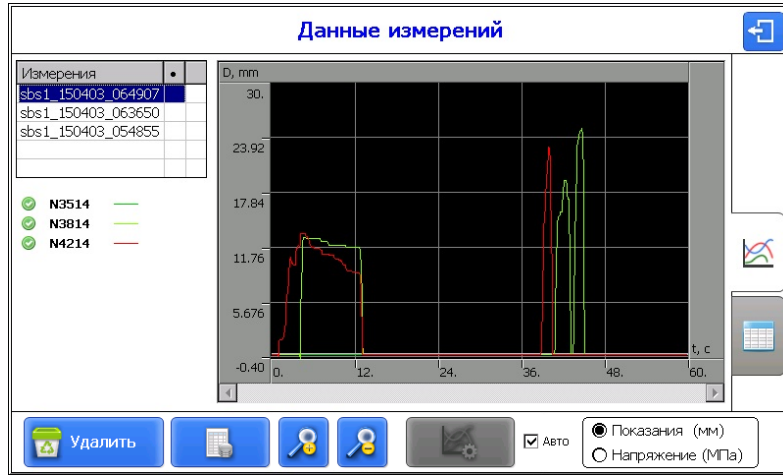
After you press the **Settings** button, the screen displays the **Settings** window, where you can customize the X and Y axes:



**ATTENTION:** The **Settings** button is not active during the measurement process.

### 8.4.6. Browsing the database

To browse the saved measurement results, tap the **Database** button.



On the left side of the screen, you can see a list of saved measurement sessions. An example – **sbs1\_150403\_064907**, where:

**Sbs1** – number of the subsystem, from which the data were received (**sbs1/sbs2**).

**150403** – date of measurement (in the given example, 03.04.15).

**064907** – time of measurement (in the given example, 06:49:07).

Below the table is a list of sensors, which were used to perform measurements – **N3514, N3814, N2114**.

Element	Description
№ 4214 —	Sensor status and serial number. Line color on the graph.
	Zoom on/off the graph.
	Set the graph parameters.
<input type="checkbox"/> Авто	Set the graph parameters automatically.
Удалить	Delete the selected measurement.
	Generate the reports in the form of text files.
<input checked="" type="radio"/> Показания (мм) <input type="radio"/> Напряжение (МПа)	Select what to display on the graph: Readings (mm) or Voltage (MPa).
	Switch between digital and graphical display of results.

Data in a table form:

Измерения	№	Дата и время	Показания(мм)	Напряжение (V)
sbs1_150403_064907	127	03.04.2015 06:49:20:2	11.8474	32981
sbs1_150403_063650	128	03.04.2015 06:49:20:3	11.8470	32979
sbs1_150403_054855	129	03.04.2015 06:49:20:4	11.6405	32405
	130	03.04.2015 06:49:20:5	9.4344	26263
	131	03.04.2015 06:49:20:6	6.3039	17549
	132	03.04.2015 06:49:20:7	1.3904	3871
	133	03.04.2015 06:49:20:8	0.0000	0
	134	03.04.2015 06:49:20:9	0.0000	0
	135	03.04.2015 06:49:21:0	0.0000	0
	136	03.04.2015 06:49:21:1	0.0000	0
	137	03.04.2015 06:49:21:2	0.0000	0
	138	03.04.2015 06:49:21:3	0.0000	0
	139	03.04.2015 06:49:21:4	0.0000	0
	140	03.04.2015 06:49:21:5	0.0000	0
	141	03.04.2015 06:49:21:6	0.0000	0

N3514  
 N3814  
 N4214

The table contains up to 500 entries. Use the arrow buttons to navigate.

Element	Description
<input type="button" value="← Начало"/> <input type="button" value="Конец →"/>	Go to the beginning / end.
<input type="button" value="← Назад"/> <input type="button" value="Вперёд →"/>	Go to 50 entries backwards / forwards.
<input type="button" value="Удалить"/>	Delete the selected measurement.

## 8.5. Error messages

Error	Action
An error occurred while connecting to the power module!	Check if the system number is set correctly.
No response from the subsystem	It may occur when controlling the SC from the CC, for example, when pressing the button. Press the button again.
An error occurred while saving the voltage calculation parameters!	Try saving the values again.
Sensors reset error	Try pressing the Reset button again.

## 8.6. Laptop software

The software is implemented on the Windows platform.

Main functions:

- Receiving data from all subsystems over a wireless channel.
- Simultaneous synchronous recording and storing of data from all subsystems and sensors. The time of recording is limited only by the amount of internal memory of the computer. The internal memory of the central computer is non-volatile.
- Remote switching on/off the sensors (all at once or separately).
- Zeroing of sensor readings in the current position.
- Active indication of the sensors operability (red/green program indicators).
- Selecting the material characteristics of the object to be measured (steel, concrete, etc).

- Recalculating the values of linear displacement into a voltage depending on the material characteristics.
- Graphical representation of data (dependence between displacement and time, dependence between voltage and time).
- Logging of results with displaying the ambient temperature, relative humidity, operator's name, date, time, data from the sensors.

### 8.6.1. Operating procedure

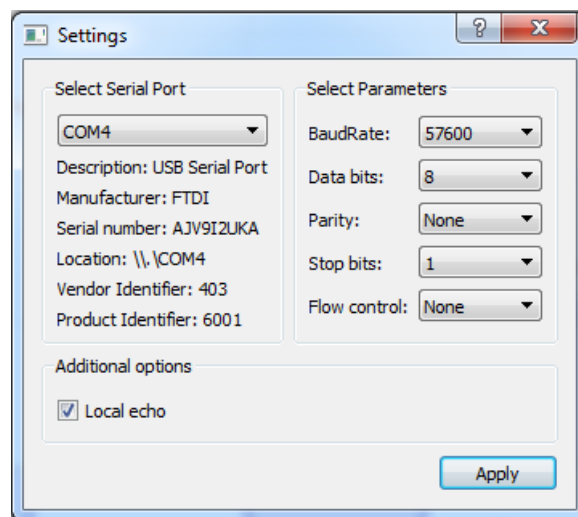
A PC or laptop can be used as a central computer of the system. To connect the laptop to the system, use the Radio 900MHz-USB unit. Connect the USB adapter to the laptop and to the Radio 900MHz-USB unit. Switch on the Radio 900MHz-USB unit. Make sure that the red LED ("LINK") is lit. Switch on the subsystem computers and make sure that the red LEDs ("LINK") are lit, which means that the subsystem computers are connected to the radio channel.



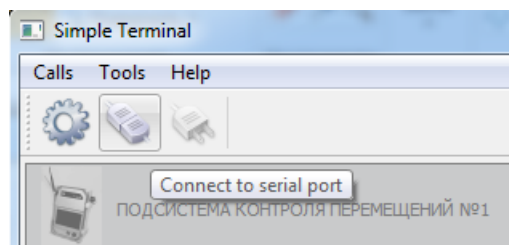
#### ATTENTION!

The simultaneous operation of the central computer and the Radio 900MHz-USB unit is not permitted.

Start **MSIP.exe**. Configure the port settings in the **Settings** window.



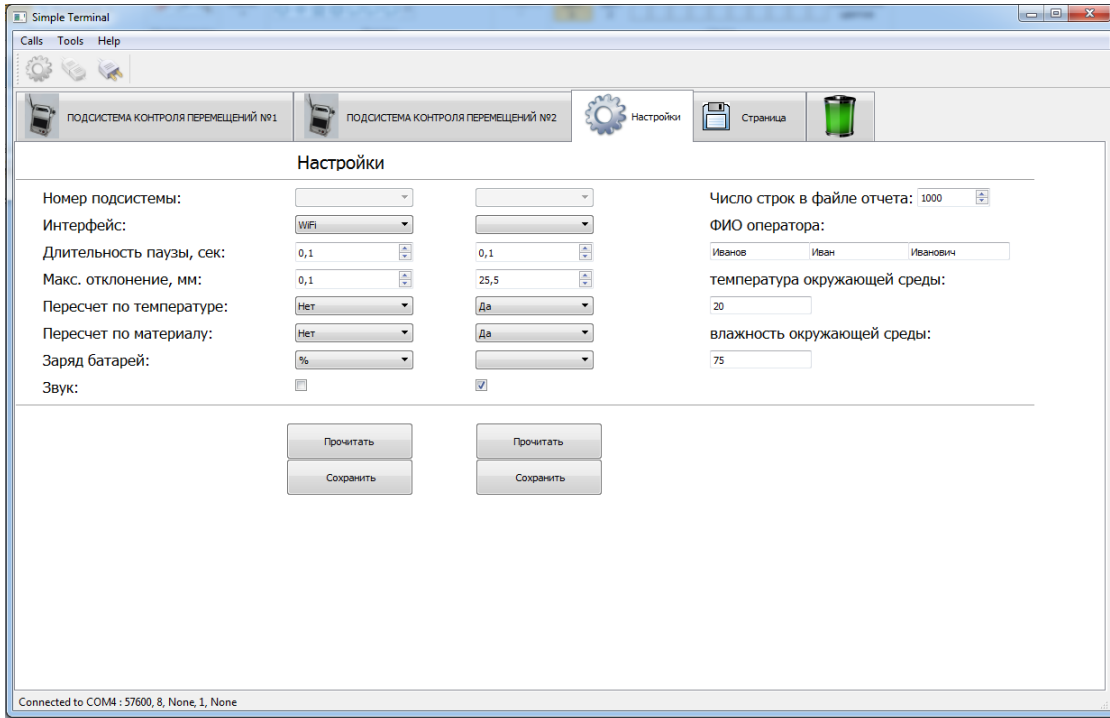
Connect to the Radio 900MHz-USB unit by clicking the **Connect to serial port** button.



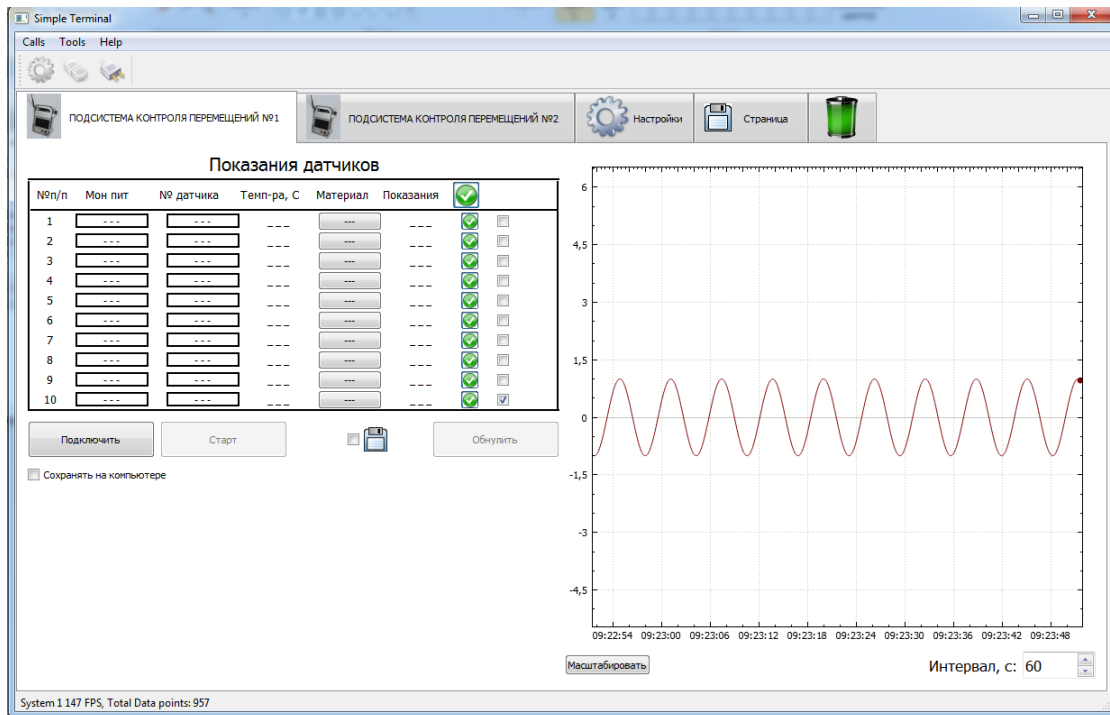
The system is ready to operate.

### 8.6.2. User interface

To configure the system parameters, go to the **Settings** tab. Parameters are the same as in the central computer software.

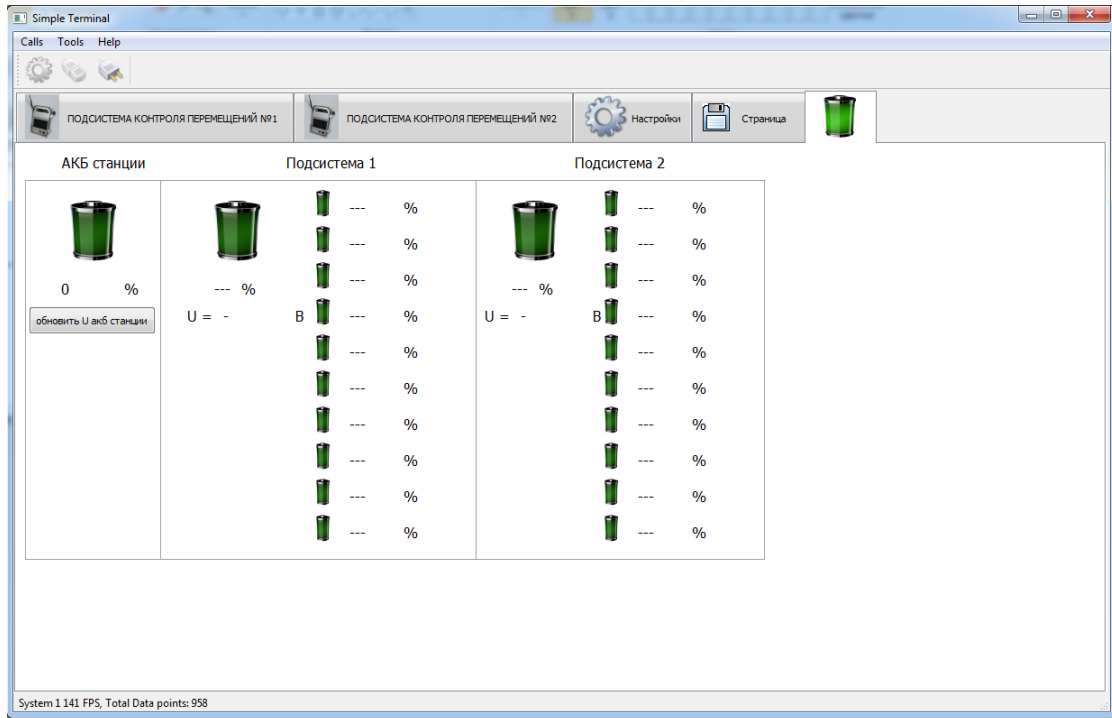


The **Subsystem #1** tab and the **Subsystem #2** tab are intended to work with subsystem #1 and subsystem #2 respectively.

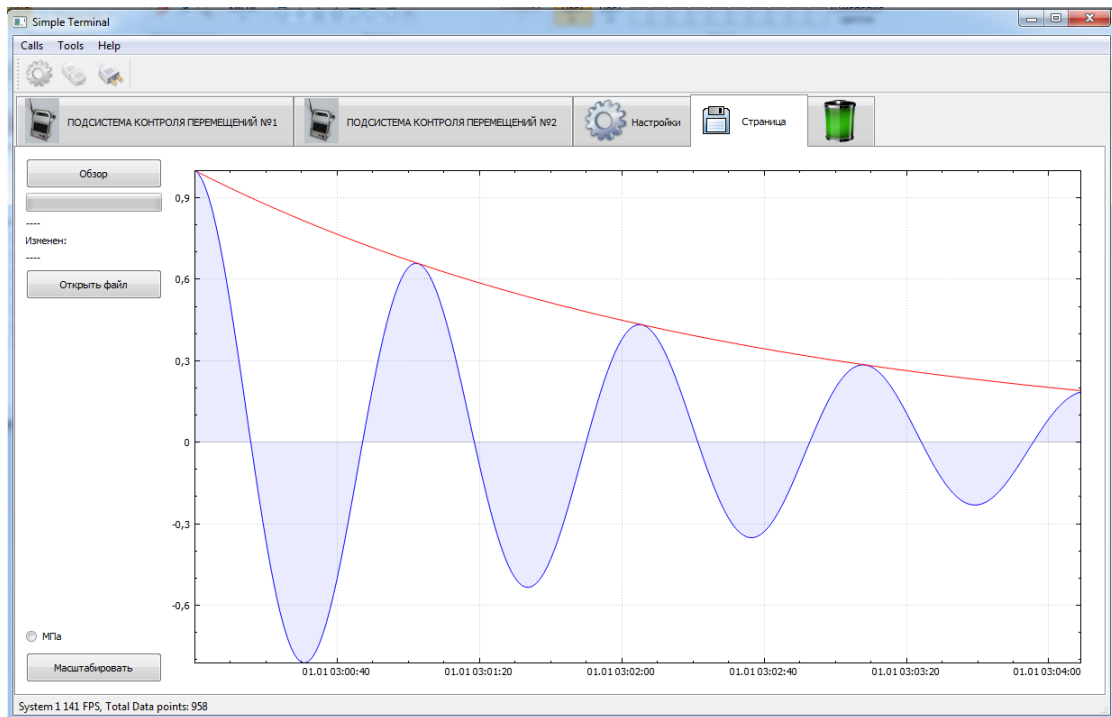


The tab with the battery icon displays information about the battery charge level of the Radio 900MHz-USB unit, subsystem computers and RS485-WiFi converters.

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Browsing the saved data:



## 9. Accessories

The device for fixing the sensors:

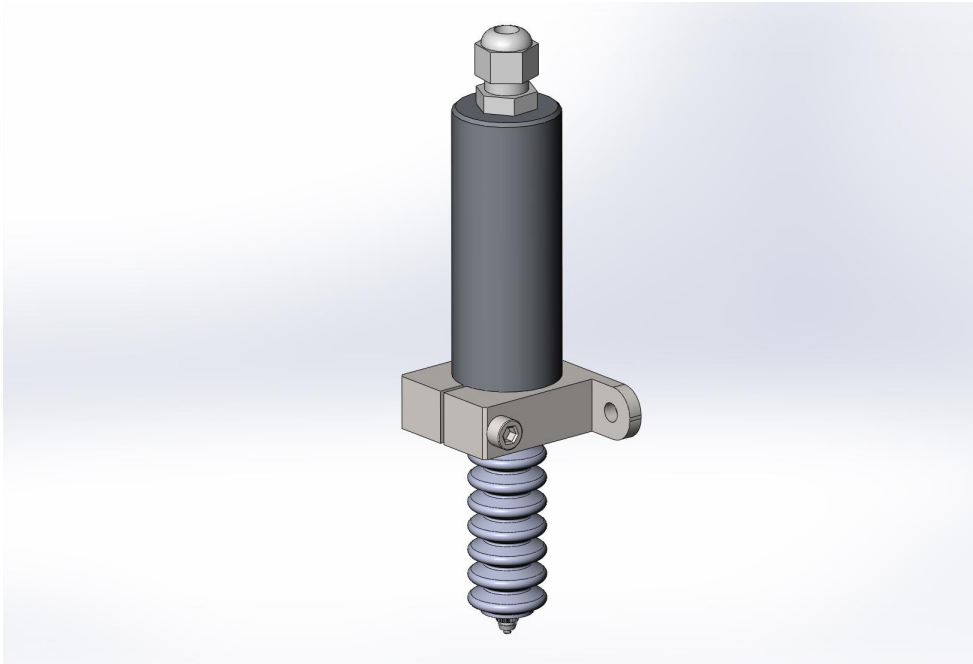


Figure 9. View of the fixing device with the sensor

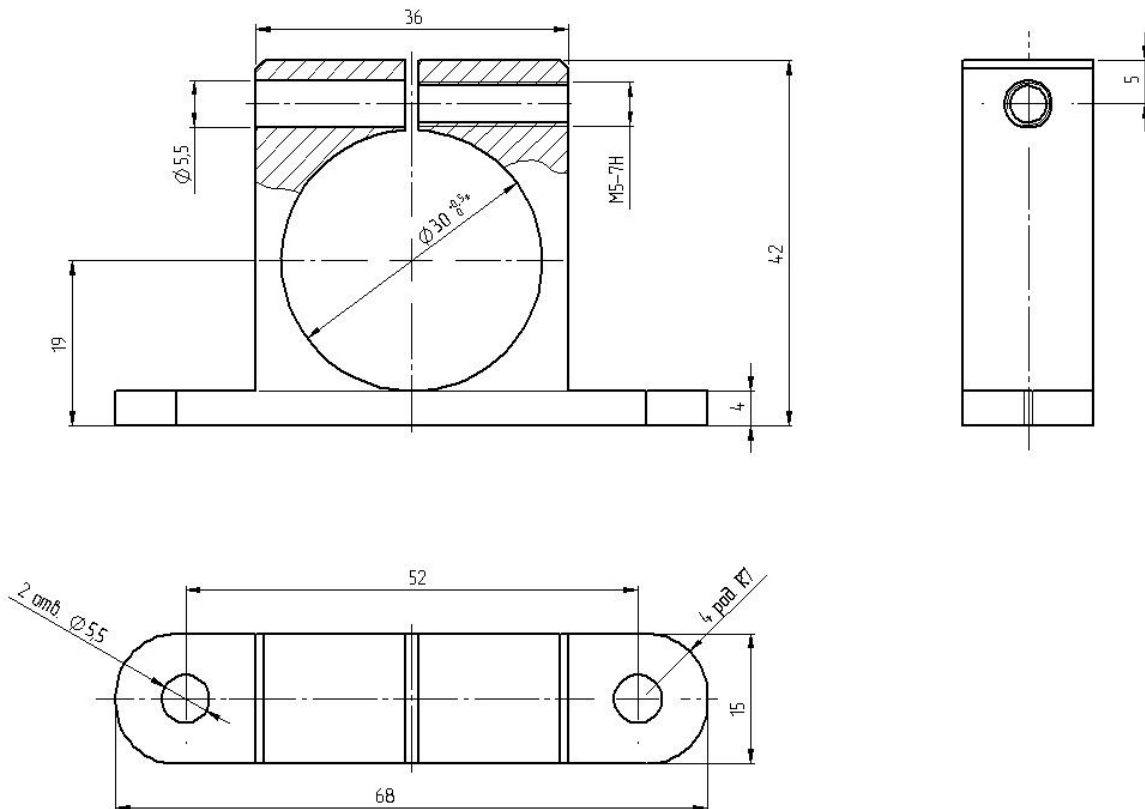


Figure 10. Overall dimensions of the fixing device



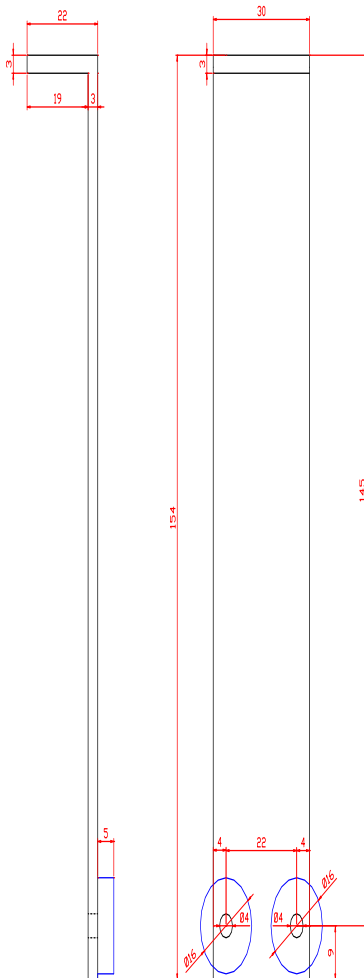


Figure 11. Overall dimensions of the support

## 10. Technical maintenance

### 10.1. Common instructions

Maintenance of the system 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 system. It is recommended to perform the daily and annual maintenance work.

Daily maintenance work includes:

- visual inspection of the system,
- checking the completeness of the system,
- checking for any damage to structural elements, cables, indicators and connectors.

Annual maintenance work includes:

- metrological verification of the system.

### 10.2. Safety precautions

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

## 11. Warranty policy

Warranty assurance for Multichannel Displacement Measurement System RF305 Series - 12 months from the date of putting in operation; warranty shelf-life - 6 months.

Warranty repair is not provided in the following cases:

- mechanical damage caused by impacts or falling from height;
- damage caused by opening the housing, incorrect connection, or absence of grounding.

## 12. Revisions

Date	Revision	Description
20.10.2015	1.0.0	Starting document.