DESIGN BUREAU FIZELEKTRONPRIBOR

OKP 42 1550

Moisture analyzers (moisture meters) FIZEPR-SW100

Technical Description and Manual
operating manual
VIGT.415210.100-03 RE

Instructions for setting up and software description

SWMaster

(ed. 4.0)

Samara, 2026

CONTENT

1. Introduction

1.1 This technical description and operating manual is intended to familiarize you with the SWMaster software (hereinafter referred to as the program or software) for the FIZEPR-SW100 moisture meters, as well as with the measurement principles and setup methods for these moisture meters.

The program is designed for setting up, diagnosing, and displaying measurement results of FIZEPR-SW100 moisture meters that use firmware version 65 and higher.

(The firmware version is determined automatically when the software is launched. The moisture meter's firmware version is also specified in its data sheet.)

1.3 The program is installed on a personal computer or laptop (hereinafter referred to as a PC) running Windows XP (or higher). The minimum recommended monitor screen resolution is 1280x720 pixels. To use the program, you need the files "SWMaster.exe," "SWMaster.ini," and "TabDescr.ini." The program does not require installation and can be launched from any folder where these files are copied.

1.4 The computer communicates with the moisture meter via the RS485 interface. Standard USB-RS485 or RS232-RS485 converters can be used to connect the PC and the moisture meter.

1.5 This manual corresponds to the program "SWMaster" with the version number 4.0 (and higher). The program is not intended to be run from a CD. For proper use of the program, it must be copied to the computer or USB flash drive storage device.

2. Description of the SWMaster program

The main window of the SWMaster program (see Fig. 1) can be divided into three parts. The top part of the window contains the menu and quick-access buttons for controlling the moisture meter and software. The middle part is a field for drawing (displaying) signal graphs (spectra). The lower part of the window displays communication parameters and the measurement data received from the moisture meter, as well as the main moisture meter settings.

The program can operate in data reception mode or paused mode ("START" or "STOP"). In "START" mode, the app receives data from the moisture meter and displays it on the screen in real time. In this mode, you can also change the moisture meter's settings and operating modes.

The data obtained from the moisture meter can be saved using the “Save” button on the quick access toolbar or via the “File | Save…” menu item.

In "STOP" mode, data is not received from the moisture meter, and commands cannot be sent to the moisture meter. In this mode, you can only view previously received data.

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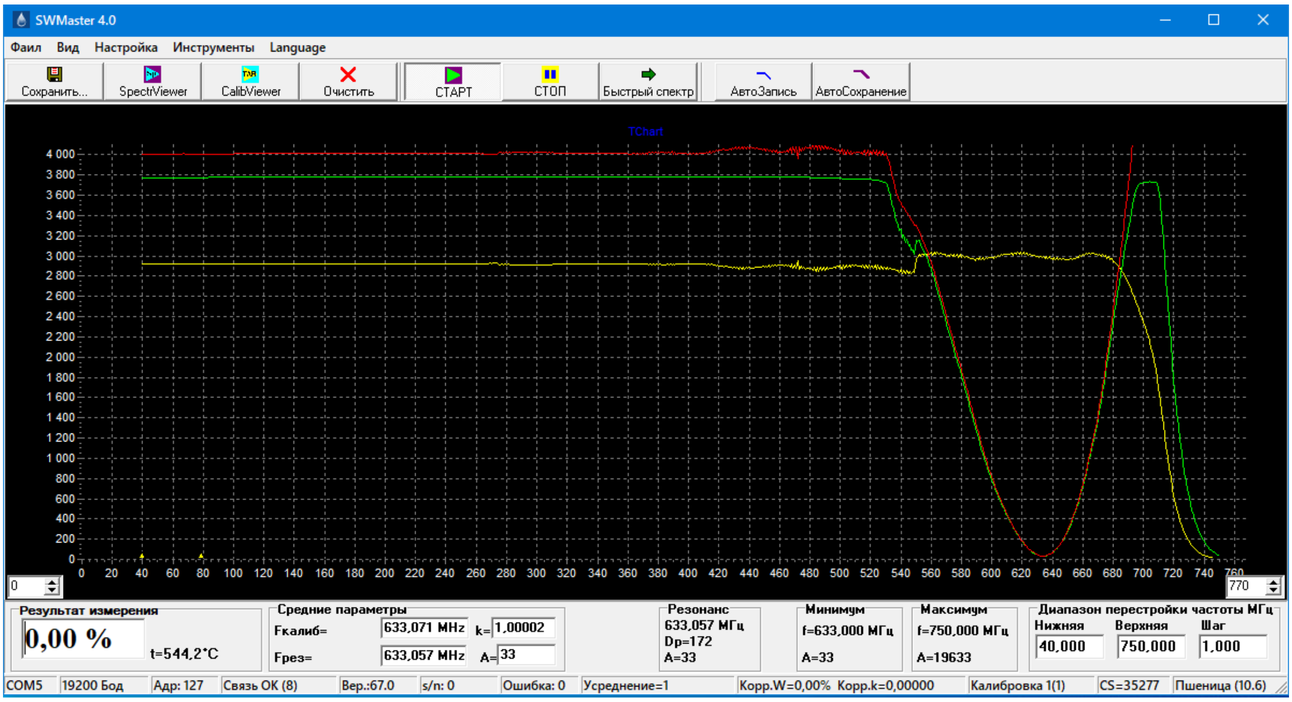

Fig. 1

Previously saved files can be opened using the "SpectrViewer" button on the quick access toolbar. Clicking this button launches the corresponding SpectrViewer application for viewing spectra.

2.1. Software identification

In the main program window, in the upper left corner, the program icon, the name (program identifier) "SWMaster" and the software version number are displayed (see Fig. 1).

2.2. Moisture meter configuration files

As mentioned above, the data received from the moisture meter is not only displayed through the SWMaster program interface, but can also be saved to a file.

Saving the configuration is done by selecting the menu item "File | Save…".

The saved configuration files have the extension ".cfg".

The saved data contains all moisture meter settings, including the number of the currently used calibration table, as well as all available calibration tables (see the chapter "Calibration tables").

In addition, the moisture change graph is saved in the form in which it is currently displayed in the "Moisture graph…" window.

The configuration file (*.cfg) contains comprehensive information about the operation of the moisture meter and can be used to diagnose the operation of the moisture meter.

The configuration file can be used to remotely configure the moisture meter or restore factory settings. To do this, load the file into the moisture meter using the "Tools | Load Configuration from File to Moisture Meter..." menu command (see Section 8.4).

The second command loads the configuration parameters into the moisture meter. Loading the configuration into the moisture meter is only possible in "START" mode, when communication with the moisture meter is established.

2.3. Remote diagnostics of the moisture meter

Saved configuration files allow you to evaluate the moisture meter's performance, including remotely.

To do this, the configuration files should be sent via email or other means to the moisture meter manufacturer or authorized dealer. To obtain complete information, it is recommended to save several configuration files (3-5) at intervals of 1-2 minutes. Several configuration files saved at intervals allow you to understand how the moisture meter's state changes over time.

3. Setting up communication parameters

3.1. Description of moisture meter communication parameters

Receiving data from the moisture meter and setting it up is only possible in the “START” mode and only when a connection with the moisture meter is established.

Communication parameters are set in the settings window (Fig. 2), accessible from the menu item “Settings | Communication parameters…”.

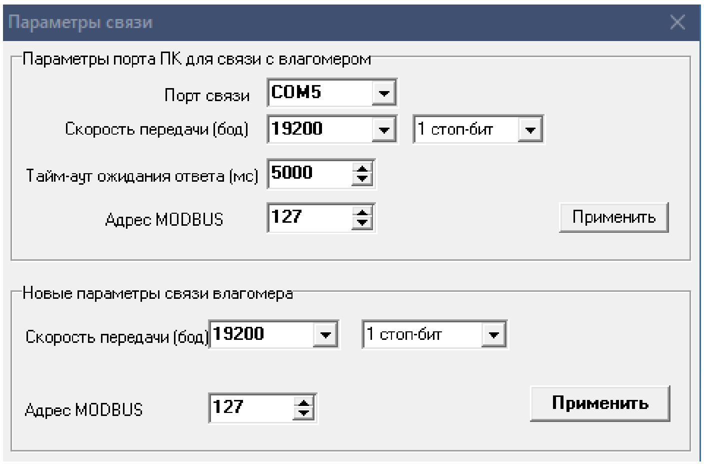

Fig. 2

All the necessary settings for establishing a connection are located at the top of the tab:

- **Communication port** – the port to which the moisture meter is connected. When using USB-RS485 interface converters (adapters), the operating system (Windows) automatically assigns a port number to each specific converter. You can find the port number and access the adapter settings (if available) using the Windows Device Manager.
- **Data transfer rate.** The number of stop bits and MODBUS address are set according to the known settings for this moisture meter. If this is a newly purchased moisture meter, the default values are used (these values are specified in the moisture meter's data sheet).
- **The "Response Timeout"** field specifies the time in milliseconds between requests sent to the moisture meter via the MODBUS protocol. The timeout should exceed the full frequency range scan time and is independent of the baud rate. By default, the timeout is set to 5000 ms, which is sufficient in most cases.

After selecting all the necessary parameters, you need to click the “Apply” button.

The currently set communication parameters, namely the selected COM port, speed, and MODBUS address, are displayed in the status bar at the bottom of the main program window (fields 1, 2, and 3, from left to right, respectively). If a nonexistent port or one occupied by another program was selected, a message appears stating that the port could not be initialized. The fields corresponding to the open port number and the set speed remain blank in this case.

If the COM port is selected correctly, the RS485 communication line is connected correctly, and the communication speed, number of stop bits, and MODBUS address are specified correctly, the second window on the right side of the status bar will display "Connection OK." Otherwise, the message "No connection" will appear.

Note 1. The specified long timeout value is determined by the moisture meter's frequency range scan time and is necessary for receiving and plotting spectra. This is because the response to a special spectrum acquisition command may be delayed during the scan. The increased timeout value is only required for SWMaster operation. Third-party equipment not tasked with spectra acquisition should use standard timeout values based on the length of the requested data. Typically, the moisture meter responds within 2-5 ms after receiving a request.

3.2. Changing the moisture meter communication parameters

If necessary, change the network address of the moisture meter or the exchange rate with it in the “New moisture meter communication parameters” window Fields are used to set these parameters. After changing a parameter, click the "Apply" button.

If, when attempting to change the moisture meter parameters, the connection with the moisture meter is lost, then you should return the connection parameters to those that were in place before the change and restore the connection.

Note 1. Changing the moisture meter's communication settings is only possible (!) when communication with the moisture meter is established.

Note 2. If communication with the moisture meter cannot be established or the moisture meter settings are unknown, you can reset the communication settings, after which the moisture meter will return to its default settings.

To reset the network settings and restore the moisture meter to its factory settings, press and hold the "Reset" button for at least 5 seconds, which is located on the right side of the lower printed circuit board of the electronic unit under the cutout on the upper board (the button is shown by the arrow in the photograph in Appendix 1).

4. Moisture meter operation, initial setup and diagnostics

The operation of the moisture meter is based on measuring the deceleration factor ***Kdec*** of the electromagnetic wave in the material being tested. The deceleration factor ***Kdec*** is the ratio of the propagation speed of the electromagnetic wave in air (i.e., the speed of light) to its propagation speed in the material being tested. For some moisture meter models (e.g., FIZEPR-SW100.10.4, FIZEPR-SW100.20.51, etc.), this parameter is equal to the square root of the dielectric permittivity ε_r of the material being tested.

As the water content of a material increases, its permittivity εr increases, and the wave propagation velocity decreases accordingly. The proportion of water contained in the material, i.e., its moisture content W, is calculated from the deceleration coefficient. Measurements are performed by probing the medium with radio waves while tuning the probing signal frequency within the operating frequency range. The choice of the operating frequency range is determined by the sensor design and the possible dielectric parameters of the material being monitored. The minimum possible operating frequency is 0.2 MHz, and the maximum is 750 MHz ***Kdec*** is determined based on the characteristic (resonant) frequencies in the sensor signal spectrum, i.e., the frequencies at which an integer number of half-waves of the electromagnetic signal fit within the length of the sensor's primary transducer. At these frequencies, the sensor signal spectrum has minima (an example spectrum is shown in Fig. 1). The electromagnetic wave deceleration coefficient in a material, Kdec, is calculated using the formula:

$$\boldsymbol{Kdec} = f0\,/\,fM, \ (1)$$

Where f0 – resonant frequency of an empty sensor (the sensor is filled only with air);

fM – the resonant frequency of the sensor when it is filled with the controlled material.

The measurement process involves periodically measuring the resonant frequency fM and calculating the retardation factor ***Kdec*** . The conversion of ***Kdec*** to moisture W is performed using calibration tables, which are correspondence tables between the retardation factor ***Kdec*** , moisture W, and temperature.

Thus, the operating principle of the moisture meter is to periodically determine the resonant (characteristic) frequency fM of the sensor, measure the temperature and calculate the moisture based on these parameters.

All main measured and calculated parameters are displayed at the bottom of the main window in the “Average parameters” and “Measurement result” panels (Fig. 3).

4.1. Resonant frequency of the sensor

The sensor's resonant frequency is determined periodically by the moisture meter using the signal attenuation graph A(f). Signal attenuation A(f) is represented on the spectrum by the red line (see Fig. 1). The vertical axis of the graph represents the attenuation value, measured in ADC counts. The horizontal axis represents the generator frequency in MHz. The resonant frequency of the sensor is the frequency at which the attenuation value reaches its minimum. If there are multiple minima, the frequency with the minimum value (the first minimum on the left in the graph) is taken as the resonant frequency.

The measured average value of the resonant frequency is displayed in the “Average parameters” panel at the bottom of the window (see Fig. 3).

The average resonant frequency ***Fres*** should roughly correspond to the frequency of the first minimum (the leftmost minimum) in the signal spectrum (see Fig. 1). If the approximate minimum frequency in the spectrum graph does not correspond (within a few MHz) to the measured frequency ***Fres***, this indicates malfunction of the moisture meter and requires intervention for diagnostics or adjustment.

Fig. 3

Average parameters:

- **Fcalib** – calibration frequency of the moisture meter or resonant frequency of the empty sensor (f0);
- **Fres** – the average resonant frequency measured by the moisture meter at a given moment (fM);
- **K** – the slowing down coefficient of an electromagnetic wave in a material (***Kdec*** = f0 / fM);

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- **A** – the level (voltage) of the output signal at the resonance point.

The “Measurement Result” window displays the moisture in percent, calculated using calibration tables, as well as the temperature measured by the moisture meter.

4.2. Calibration of the moisture meter and the calibration frequency of the moisture meter

The calibration frequency ***Fcalib*** of a moisture meter is the resonant frequency Fres of the sensor, which is measured with the sensor empty (not filled with the monitored material). For example, if the sensor is installed in a bin, ***Fcalib*** is the frequency obtained with the bin empty and the sensor clean. If the sensor is used for liquid materials, ***Fcalib*** is the frequency obtained with the sensor clean and dry.

The resonant frequency ***Fres*** is stored in the moisture meter when the "Calibrate with empty resonator" command is issued or when a known value is manually entered. Accordingly, during calibration (without material present), the calibration frequency ***Fcalib*** is equal to the resonant frequency ***Fres*** to a certain accuracy.

In this case, according to formula (1), the ***Kdec*** coefficient becomes equal to one. In most cases, during calibration, ***Kdec*** = 1.00000±0.001 or better, depending on the sensor design.

If the retardation coefficient measured by the moisture meter. ***Kdec*** If the reading differs from unity (assuming the sensor is empty) by more than 0.001, this may be due to insufficient cleaning and drying of the inner surface of the moisture meter sensor. Incorrect calibration may also be the cause, in which case the moisture meter must be recalibrated.

Calibration is performed only on a clean and dry sensor. For this calibration, the liquid moisture meter sensor is rinsed with an organic solvent or alcohol and thoroughly dried.

Calibration can be performed in two ways through the dialog box accessible through the menu item “Settings | Calibration frequency…” (Fig. 4):

Method 1. By pressing the "Empty Resonator Calibration" button, the moisture meter stores the current measured frequency in its internal memory.

Method 2. By directly entering the frequency value and clicking the "Save" button. The desired value can be obtained based on the frequency measured by the moisture meter or specified in the moisture meter's data sheet (for moisture meters with a closed resonator design).

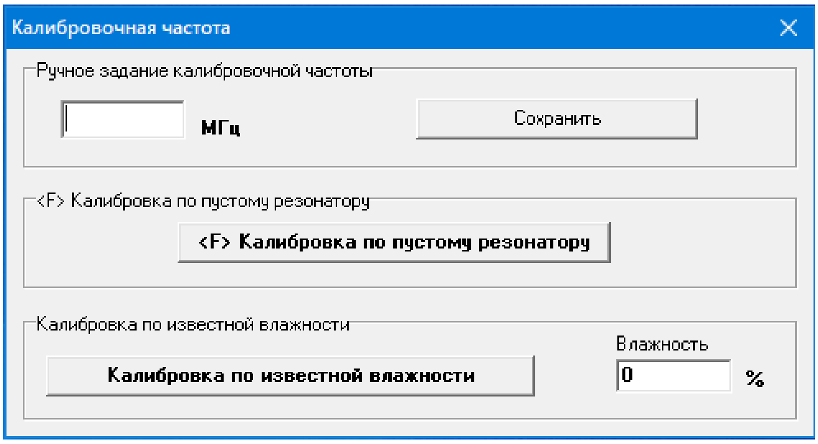

Fig. 4

The calibration frequency ***Fcalib*** does not change over time and depends only on the resonator design and dimensions. When using closed-design sensors (e.g., sensors for liquid materials), the calibration frequency set by the manufacturer generally does not require further modification or clarification. When using open-design sensors (such as the FIZEPR-SW100.10.4x pin sensors or the FIZEPR-SW100.10.21 panel sensors), whose frequency is affected by their design dimensions and the position of the bin's internal structures, mandatory calibration is required after sensor installation. In other cases, recalibration of the sensors is generally not required.

Regardless of the design of the sensor used, the criterion for the correctness of calibration is the equality of the resonant and calibration frequencies or (which is the same thing) the equality of ***Kdec*** to unity when the sensor is not filled with material.

4.3. Calibration with known moisture

Calibration using known moisture may be required to adjust the calibration characteristic, for example, when changing the grade of oil or when it is necessary to adjust it to a reference sample of material with a known initial moisture content.

The essence of calibration using known moisture is that the moisture meter automatically adds a certain value (correction factor) to the measured retardation factor. ***Kdec*** without changing the calibration table, i.e., it actually produces a parallel shift of the calibration dependence graph along the axis of the deceleration coefficient (see Fig. 5).

The value of the correction coefficient ***Kcorr*** to clarify the deceleration factor ***Kdec*** calculated automatically when you click the "Calibrate to known moisture" button. The moisture meter calculates using the following formula:

$$K_{corr} = K_{dec.\,tab} - K_{dec,\,meas}.$$

Where ***Kcorr*** – correction coefficient (the magnitude of the shift in the deceleration coefficient);

Kdec . tab.– the deceleration coefficient from the first term of the first temperature tables of current calibration;

Kdec, meas – the correction coefficient measured at the time of calibration.

After completing the calibration in the moisture meter, the measured deceleration coefficient ***Kdec, meas*** the value will always increase ***Kcorr***:

$$K_{dec,corr} = K_{dec,meas} + K_{corr}$$

Where ***Kdec .corr*** – the adjusted deceleration coefficient, according to which the moisture will be calculated from the calibration tables.

The value of the correction coefficient ***Kcorr*** can be either positive or negative. The correction coefficient is absolute ***Kcorr*** should not be greater than 0.32767.

The correction factor is associated with the selected calibration. The full list of calibrations and their corresponding correction factors can be viewed and edited in the "Calibration Tables" window.

Note. The correction factor value is too large. ***Kcorr*** (more than 0.01...0.02) may indicate that its use for this material is not advisable; instead of calibration using known moisture, it is necessary to perform a full calibration on a new material.

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5. Calibration tables

As noted above, the moisture meter calculates moisture content based on calibrations that establish a one-to-one correspondence between the measured retardation coefficient ***Kdec*** , temperature, and moisture content W. A separate calibration is created for each material being measured. If the moisture meter is used to measure multiple materials, the meter must store multiple calibrations for each material. The moisture meter can store up to 56 calibrations.

When operating the moisture meter, it is necessary to select (activate) the calibration that corresponds to the material being measured. Calibration selection is made manually by the user, in the "Calibration Tables" dialog box (Fig. 5), or using other means connected via an external digital interface (operator panels, programmable controllers, etc.).

Viewing, editing and selecting calibration is done in the dialog box accessible through the menu item "Settings | Calibration tables".

5.1. Dialog box for working with calibration tables

The dialog box for working with calibration tables contains two tabs: “Current calibration” (Fig. 5) and “List of moisture meter calibrations” (Fig. 6).

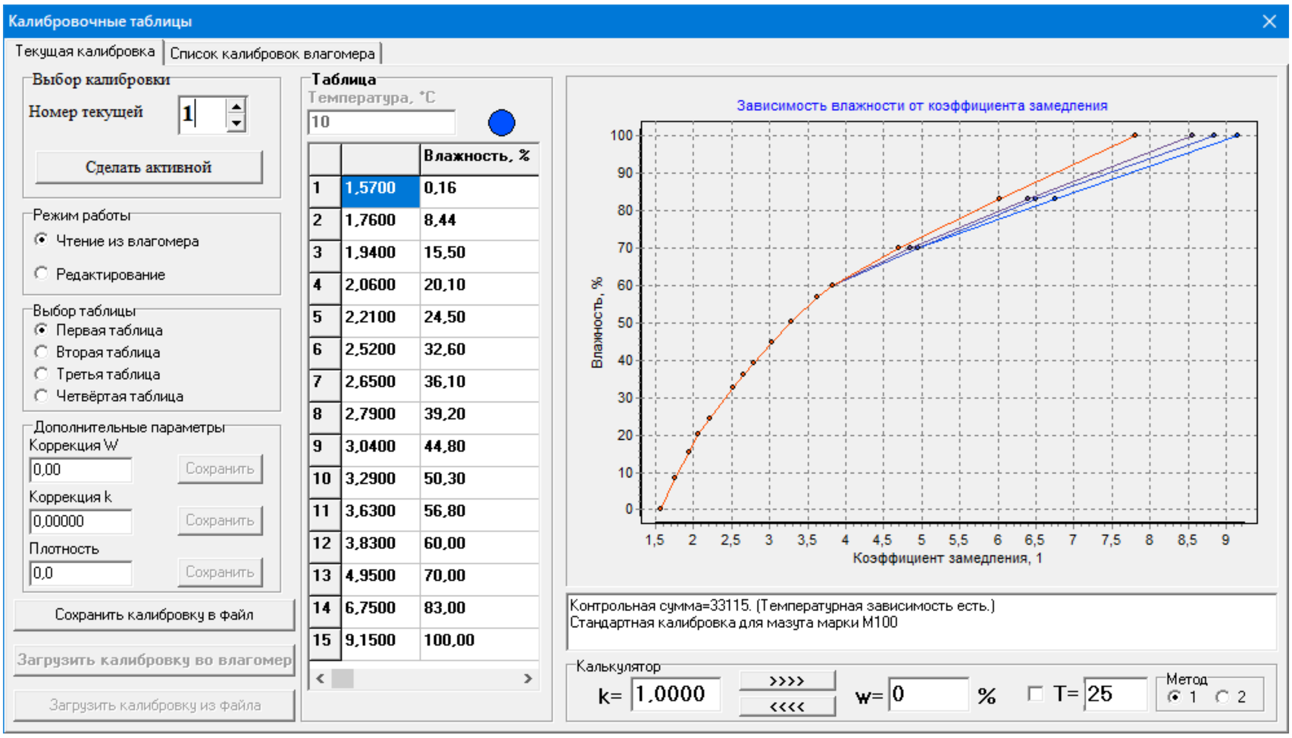

Fig. 5

The Current Calibration tab is used to sequentially view and select calibrations, as well as to load calibrations and set additional parameters.

In the "Read from Moisture Meter" mode, the "Calibration Selection" panel displays the number of the currently selected calibration. In the "Edit" mode, you can browse calibrations and manually change the number.

Each calibration consists of four temperature tables. Each temperature table represents the dependence of the retardation coefficient ***Kdec***, measured by the moisture meter, on the material's moisture content W at a specific temperature. In the moisture meter, this dependence is presented in a table (a total of four tables for four temperatures). Specific values for the points in this dependence are presented in the "Table" panel. The "Table Selection" panel allows you to select which of the four temperature tables is displayed in the table.

To the right of the table, the calibration dependence is presented as graphs. The graph displays all four temperature dependences simultaneously. If there is no temperature dependence, all four graphs merge into a single line.

Below the graph is a text field displaying the calibration checksum and a comment to help the user identify calibrations. Additionally, information about the presence or absence of a temperature dependence is indicated in parentheses. A temperature dependence is considered absent only if all four temperature tables are exactly the same.

The calibration checksum displayed in the window is a unique identifier that uniquely identifies each calibration and its contents. Any change to the calibration table will change the checksum, allowing you to quickly verify the absence of errors and the integrity of the calibration.

Comments on checksums are contained in the "TabDescr.ini" file included with the software. The contents of this file can be modified by the user for their convenience.

When the moisture meter is supplied with a set of factory calibrations, their list and corresponding checksums are provided in the passport.

Below the graph is a calculator that allows you to calculate moisture based on the currently displayed calibration, using the known deceleration factor and temperature (using the same algorithm implemented in the moisture meter itself). This feature can be used to check the moisture meter's operation or to verify the calibrations themselves.

The "List of moisture meter calibrations" tab displays a list of calibrations stored in the moisture meter, represented by their checksums, as well as additional parameters set by the user for each of them.

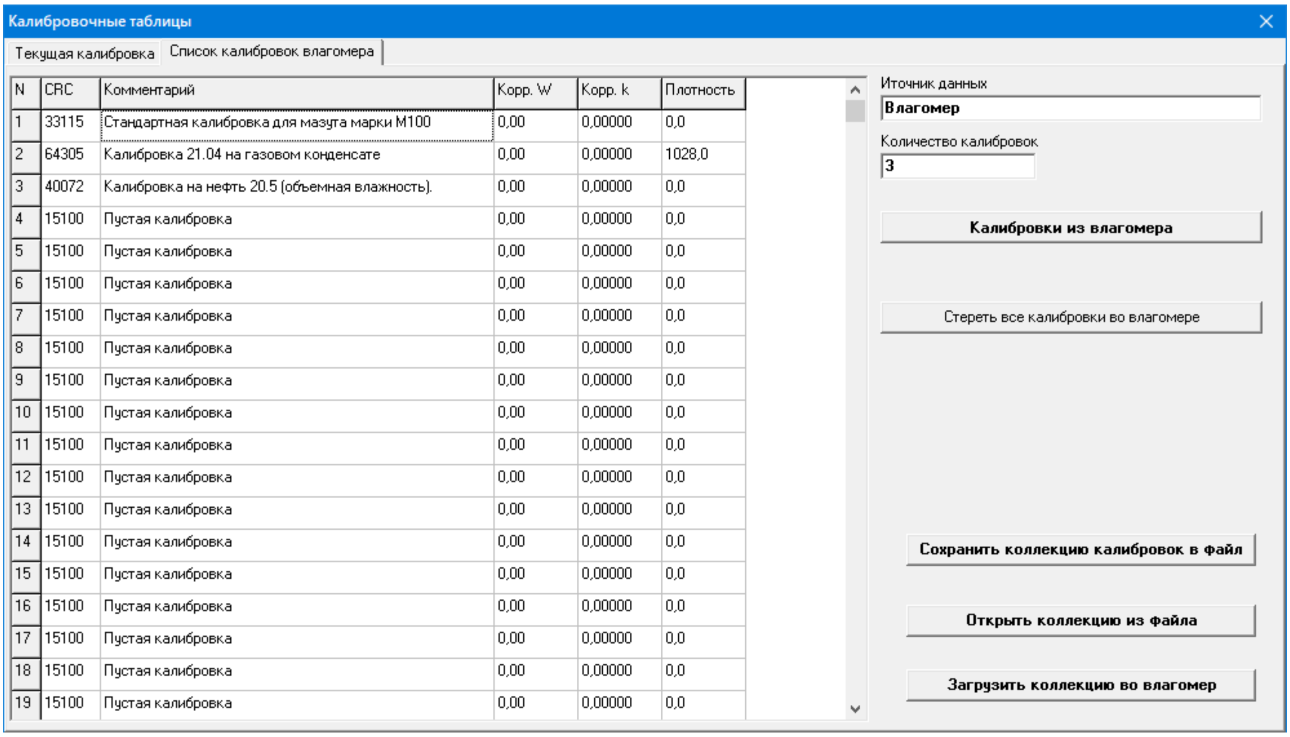

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Fig. 6

The list of calibration checksums and the checksums themselves can be saved in a single file called a calibration collection (files with the extension ".clc").

On the right side of the "List of moisture meter calibrations" tab there are corresponding buttons for working with collection files.

5.2. Additional calibration parameters

Each calibration can be associated with additional parameters that affect the moisture calculation results. These parameters are presented in the "Additional Parameters" panel of the same name:

The "W Correction" parameter is a percentage of absolute moisture (moisture correction) by which the value calculated from calibration can be shifted. This parameter is used when the moisture meter's measured values differ from the reference moisture determination method's values by a constant amount, but performing a full calibration on the material is not possible or practical. Moisture correction values can be either positive or negative.

Note. The "W Correction" parameter must be less (in absolute value) than the minimum expected moisture content of the material. Using large correction values likely indicates that the calibration is inappropriate for the material or that there are errors in the moisture meter.

The "Correction k" parameter is a correction coefficient that is added to the moisture meter's measured retardation coefficient ***Kdec*** before calculating moisture content. It allows you to shift the calibration along the retardation coefficient axis. This shift is most often used when it is possible to calibrate the moisture meter using a material with a known moisture content (see section 4.3).

The "Density" parameter allows you to specify the material density for each calibration. Density is specified in kg/m^3 with an accuracy of one decimal place. The "Density" parameter is only considered in density mode. In other modes, this parameter is ignored.

5.3 Selecting a working calibration

The selection of the working calibration is carried out in the following order:

1) in the “Operating mode” panel, select the “Editing” item;
2) in the “Calibration Selection” panel, enter the number of the desired calibration;
3) click the "Make active" button.

While the calibration number is being saved, the background of the calibration number will turn red. After saving, the background will return to its original state, indicating successful completion.

5.4. Writing (updating) calibration to the moisture meter

The moisture meter can store up to 56 calibrations. Each of these can be overwritten or updated. The moisture meter must have at least one non-empty calibration. Empty calibrations have a checksum of 15100 (see Fig. 6).

The procedure for recording calibration in a moisture meter is as follows:

1) in the “Operating mode” panel, select the “Editing” item;
2) in the “Calibration Selection” panel, select the number of the calibration that needs to be updated;
3) click the “Open table from file…” button and select the required calibration file in the standard dialog box that appears;
4) press the button “Save table to moisture meter”.

Once the recording is successfully completed, the message "Calibration loaded" will appear in the comments field.

Note 1. Although calibration can be recorded in any of the 56 designated locations, for proper operation of the moisture meter, consecutive location numbers must be used, starting with the first.

Note 2. To delete all calibrations except the first, use the "Erase all calibrations in the moisture meter" button on the "List of moisture meter calibrations" tab.

5.5. Saving calibration to a file

Any selected calibration can be saved to a file.

The procedure for saving calibration is as follows:

1) in the “Operating mode” panel, select the “Editing” item;
2) in the “Calibration Selection” panel, enter the number of the desired calibration;
3) click the “Save calibration to file” button.
4) in the window that appears, select the save path and enter the file name.

6. Processing measurement results.

Moisture meter measurement results, such as resonant frequency *fM* and moisture content *W*, can be subjected to additional processing if necessary, for example, by averaging and filtering outliers. These parameters are configured in the Measurement Processing dialog box, accessible via the Setup | Measurement Processing menu item.

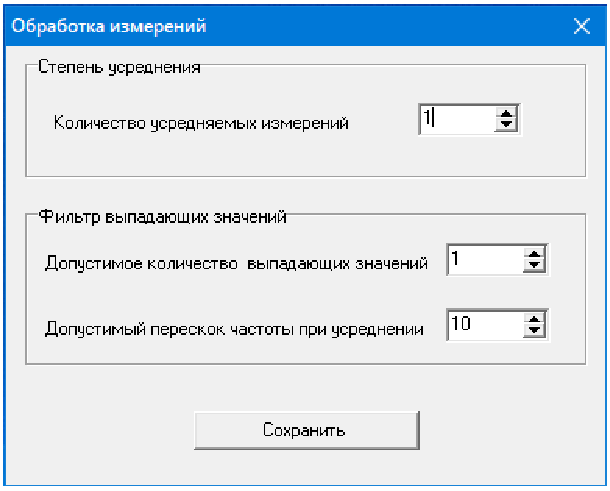

Fig. 7

6.1. Averaging measurement results

When measuring moisture, the result is influenced not only by the measured value itself, but also by external interfering factors: noise from the electronic circuits of the device and the characteristics of the technological process.

For a moisture meter, such factors may include:

- fluctuations in the properties of the measured medium, associated, for example, with the inclusion of gas bubbles or the presence of sediment in the liquid flow;
- stratification of the liquid, uneven distribution of water throughout the volume of the controlled liquid (oil).

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As a result, the resonant frequency *fM* determined by the moisture meter may change from measurement to measurement, which leads to fluctuations in the calculated moisture content *W*. To reduce the influence of these factors, averaging should be used. When averaging the frequency *fM*, the average value of the last *N* measurements is used to calculate moisture content, rather than the currently measured frequency value (moving average algorithm). The parameter *N* – “Averaging degree” – is set in the “Measurement processing” window (Fig. 7). If the value of *N* is 0 or 1, averaging is not performed.

Note. When setting the averaging level, keep in mind that the measurement time (the time it takes to establish a reliable measurement result) is directly proportional to the averaging constant and is approximately equal to three times the measurement period. For example, if the measurement period is 1 second, the signal establishment time is approximately 3 seconds.

6.2. Filtering outlier measurements

Outlier filtering eliminates values from the averaging process that deviate significantly from the average values over the averaging period. This type of filtering eliminates the influence of random, large variations caused by process characteristics.

Filtering is performed according to the following algorithm.

During each resonant frequency measurement, the averaged frequency is compared with the measured frequency. If the difference is greater than the "Allowable Frequency Jump During Averaging" parameter (Fig. 7), the current average value is substituted for the currently measured ("outlier") frequency. The measurement and averaging process continues as if there had been no jump.

The parameter “Allowable frequency jump during averaging” is set in the “Algorithm settings” window in tenths of MHz.

The filtering of outlier values is controlled by the “Acceptable number of outlier values” parameter (Fig. 7).

If this parameter is zero, filtering is disabled.

If the parameter is 1, then one random "outlier" measurement is discarded and averaging continues. If the parameter is 2, then two consecutive "outlier" measurements are allowed. If the parameter is 3, then three, and so on.

If the dropout continues more times than the number set in this setting, the resonant frequency is considered to have changed and the averaging process starts over again, using the current measured values.

If filtering is disabled (“Acceptable number of outliers” = 0), then averaging starts over every time the next measured resonant frequency differs from the average by more than the “Acceptable frequency jump during averaging” parameter specifies.

Outlier filtering only works if averaging of measurement results is enabled (see section 6.1), since the decision to discard the next measurement is made by comparing it with the average value.

7. Setting the current output

To configure the moisture meter's current output parameters, select the menu item "Settings | Current output...".

After this, the corresponding dialog box will appear, shown in Fig. 8.

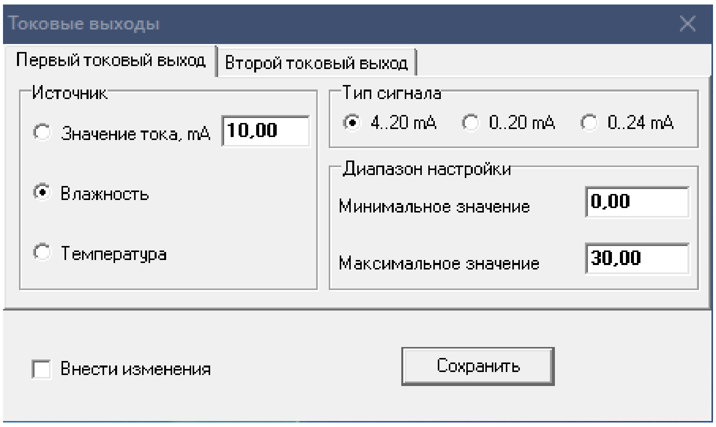

Fig. 8

This window displays the current output configuration.

In the “Source” panel, select the value that needs to be transmitted via the current output (moisture or temperature).

The "Current Value" option allows you to set a specific current value for the output. This option is used for testing the current output and verifying its operation. The test current setting accuracy is 0.01 mA.

The Signal Type panel allows you to select the current output standard (current range).

The "Setting Range" panel specifies output values corresponding to the minimum and maximum output current values in the selected range. The minimum and maximum moisture values are specified as percentages with an accuracy of 2 decimal places. The minimum and maximum temperature values are specified in degrees Celsius with an accuracy of 1 decimal place.

To make changes to the settings, you need to check the “Make changes” box, set the required values and click the “Save” button.

Note. The current output parameter settings do not affect the moisture meter measurement range or the values transmitted via the **MODBUS** interface and displayed in the main program window (Fig. 1).

8. Additional features

8.1 . Displaying the measured moisture graph

In some cases, it is convenient to see not only the current value of measured moisture, but also a graph of its change over time.

To open a window with a moisture graph, select the menu item “View | Moisture graph…”.

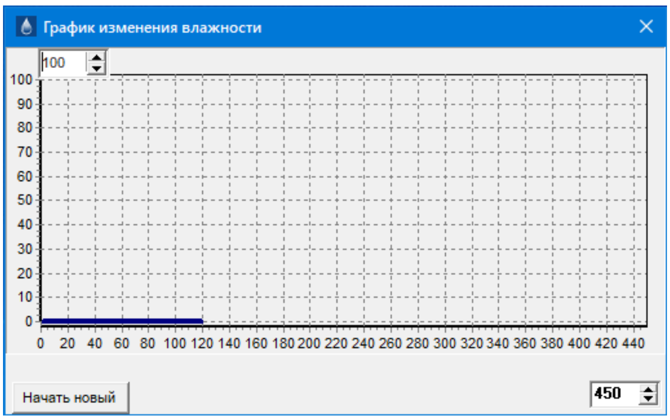

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Fig. 9

The vertical axis is the moisture axis (W). Moisture is expressed as a percentage. The horizontal axis is the time axis. Time is expressed in seconds. Each axis has a field for setting the scale in the appropriate units.

Clicking the "Start New" button starts the chart drawing process from the beginning.

8.2 Automatic saving of spectra

When researching new materials or troubleshooting a moisture meter, it may be necessary to automatically save moisture meter configuration files without operator intervention. For this purpose, an automatic configuration file saving mode is provided (configuration files are saved along with the last measured spectrum).

The automatic saving mode is controlled using a special dialog box (Fig. 10), accessible through the menu "Tools | Autosave spectra…".

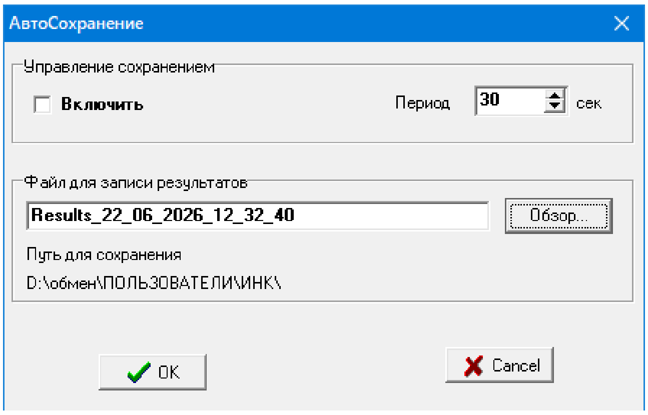

Fig. 10

In this window you can enable/disable autosave and set the saving period.

In the "File for saving results" field, you can control the path to which the saving will be carried out and the current template for the name of the saved *.cfg file.

You can quickly turn the autosave mode on/off using the "Autosave" button in the main program window.

Note. The path for saving files is the same as the path of the last saved configuration file, so to change the save path, you need to save the spectrum manually using the main menu "File | Save…" or click the "Browse…" button (Fig. 10).

8.3. Automatic saving of measurement results

Moisture meters do not contain an internal archive of measurement results. However, the "SWMaster" program provides automatic saving of measurement results to a CSV (comma-separated values) text file, which can be opened and processed in MS Excel. To control automatic recording, use the dialog box (Fig. 11), accessible through the menu "Tools | Auto-record…".

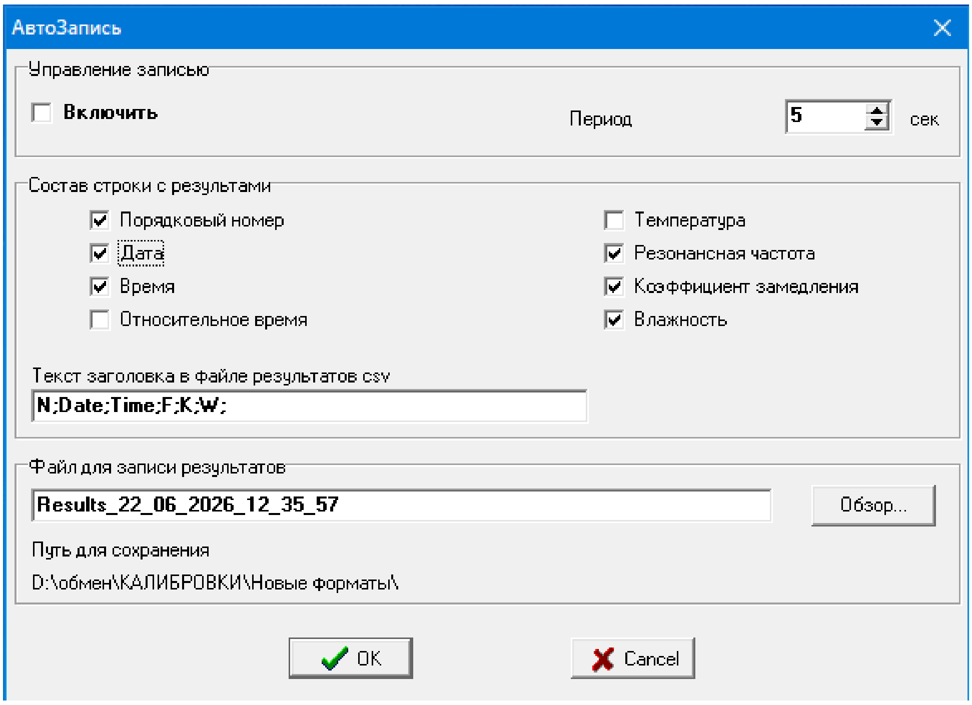

Fig. 11

Recording of measurement results into the file is performed line by line with the period specified in the corresponding “Period” field.

The presence and purpose of individual columns is specified in the "Results Row Contents" field. The file may contain the following parameters, written in the corresponding columns:

Data (column)	Description	Unit of measurement	Symbol in the title line
Serial number	The serial number of the measurement from the moment the mode was turned on	-	N
Date	Date of measurement according to the computer clock	Year, month, day	Date
Time	Computer clock time	Hours, minutes, seconds	Time
Relative time	Time since recording mode was turned on	Seconds	RTime
Temperature	Temperature measured by a moisture meter	Degrees Celsius	T
Resonant frequency	Resonant frequency measured by a moisture meter	MHz	F
Deceleration coefficient	Deceleration coefficient	-	K
Moisture	Calculated moisture	%	W

The text in the line "Header text in the results file" is written as the first line so that the composition of the data in the file can be determined later.

In the "File for saving results" field, enter the file name (without extension). The .csv extension will be added automatically.

You can quickly turn the “auto-recording” mode on/off using the “Auto-recording” button in the main program window (Fig. 1).

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Note 1. The file save path is the same as the folder where the configuration file was last saved. Therefore, to change the save path, you must save the spectrum manually using the "File | Save..." menu or the "Browse..." button (Fig. 11).

Note 2. After stopping recording, carefully monitor the column composition. Accidentally changing them can cause data confusion. The solution is to specify a new file name to continue recording.

Note 3. It is not recommended to open a file being recorded to with "auto-recording" enabled. This may result in an access error and program crash.

8.4. Loading the configuration into the moisture meter

As indicated in paragraph 2.2, the moisture meter configuration, including a copy of all its settings and calibration tables, can be written into the moisture meter.

The configuration is recorded through a dialog box accessible via the main menu item “Tools | Load configuration from file to moisture meter…”.

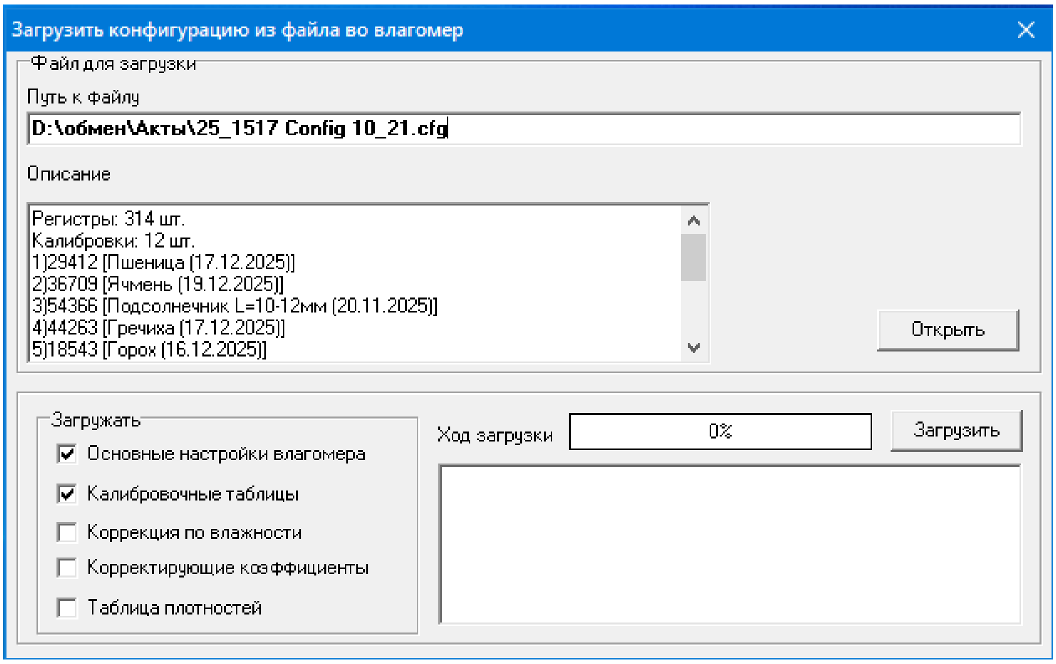


Fig. 12

The window that opens (Fig. 12) will indicate the full path to the loaded configuration file and a brief description of its contents (the number of saved registers and the list of calibrations).

To select the file to download, click the "Open" button.

In the "Load" panel, you can select individual configuration sections to load. Typically, only the basic moisture meter settings and calibration tables are copied. When performing a full restore, for example, from a backup of a given moisture meter, all configuration sections are selected.

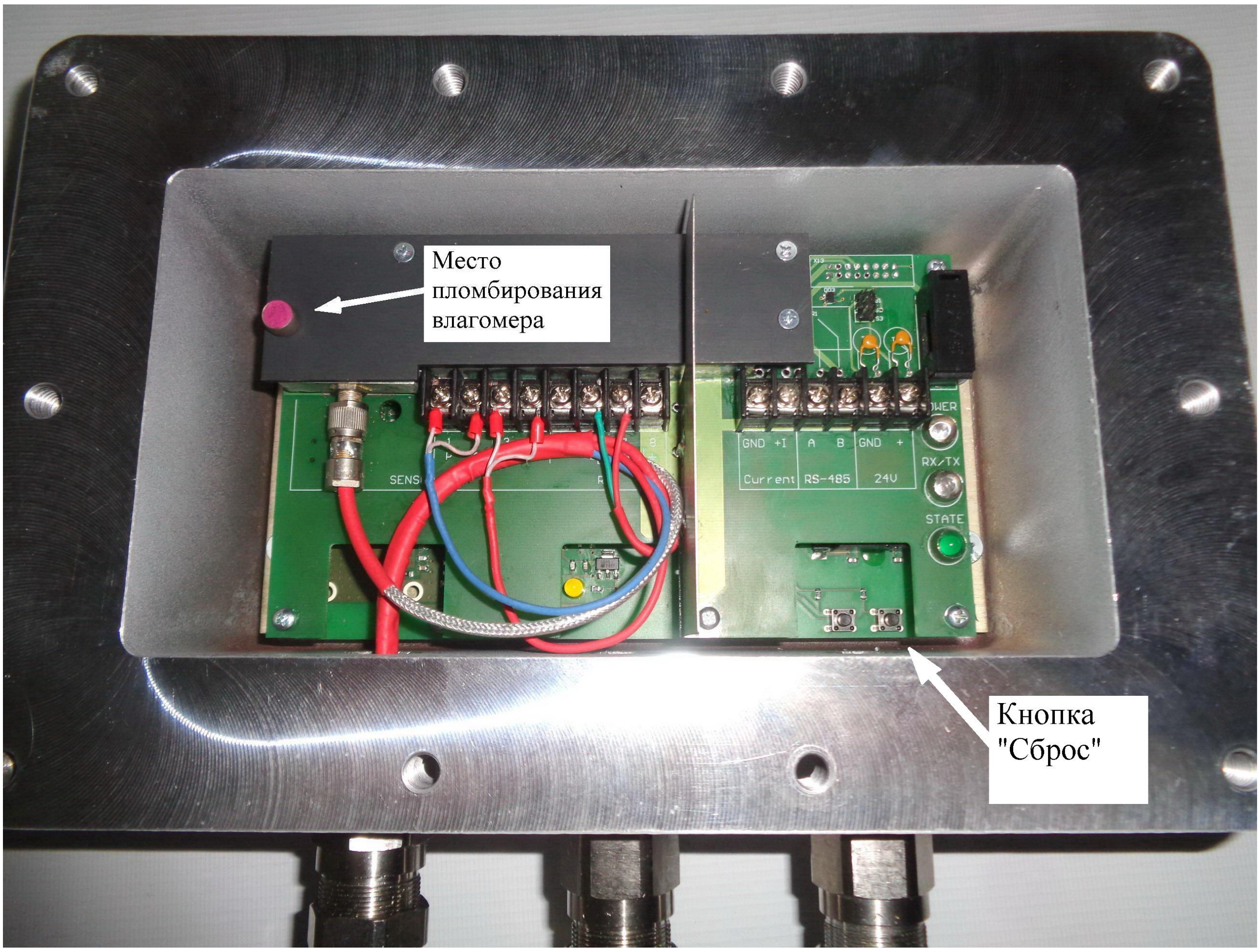
The download begins after you click the "Download" button. Configuration file download time depends primarily on the number of calibration tables. The download is complete when the "Download Progress" indicator reaches 100%.

After this, the window can be closed.

9. Appendices

Appendix 1

Electronic unit type VIGT.415210.101-02 (explosion-proof design)
with the top cover removed



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MODBUS RTU communication protocol

Digital communication with the moisture meter is carried out via the RS485 interface using the **MODBUS RTU** protocol with the following parameters:

- communication speed – 9600, 14400, 19200, 38400; 57600 or 115200 baud;
- parity – not checked;
- number of stop bits – 2 or 1.

Default communication parameters (factory settings):

- communication speed – 19200 baud;
- number of stop bits – 2;
- address – 127.
- timeout between requests 100ms.

Features of the **MODBUS RTU** protocol implementation:

- reading of registers is performed by command 03 (03h);
- echo-return test command 08 (08h) is supported;
- when attempting to read a range of addresses that is outside the limits specified in the table, the moisture meter does not respond;
- writing of registers is performed by command 16 (10h);
- Writing to registers is only possible in those registers for which writing is enabled. When attempting to write to read-only registers, the moisture meter does not respond.

MODBUS RTU register map

Register address (DEC)	Register address (HEX)	Description	R/W
0000	0000	Measured moisture expressed in hundredths of a percent. True moisture should be calculated using the formula: W = reg[0000] / 100 with an accuracy of two decimal places.	R
0001	0001	Temperature in whole degrees Kelvin. Calculation of temperature in degrees Celsius should be done using the formula: t = reg[0001] – 273	R
0002	0002	Error code	R
0003	0003	The version number of the internal software (firmware) of the moisture meter	R
0004	0004	Number of calibrations used in a moisture meter	R
0005	0005	Moisture meter serial number	R
0006 0007	0006 0007	Specified deceleration factor (x100000). The deceleration factor is calculated using the formula: k = (reg[0007]+reg[0006]*65536) / 100000 accurate to 5 decimal places	R
0020	0014	Temperature in tenths of a Kelvin. Calculation of temperature in degrees Celsius should be done using the formula: t = reg[0020] / 10 – 273 accurate to tenths	R
0163	00A3	Number of calibrations used in a moisture meter	R
0164	00A4	Current calibration number	R/W
0224	00E0	Temperature in whole degrees Celsius. ***(The register value is only relevant for positive temperatures)***	R

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