

**DESIGN BUREAU "FIZELEKTRONPRIBOR"**

## **Moisture Analyzer (Moisture Meter) FIZEPR-SW100**

Technical specification and operation manual  
VIGT.415210.100 RE  
(Rev. 1.4)



**Samara, 2017**

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## 1. Introduction

1.1. This technical specification and operation manual are designed for familiarization with the device, principle of operation, installation, preparation, inspection and maintenance rules of moisture analyzer (moisture meter) FIZEPR-SW100 VIGT.415210.100-17.

1.2. The manufacturer retains the right to make changes in the design and scheme of the moisture meter that do not affect its specifications, without adjusting operating and maintenance documentation.

## 2. Purpose

2.1. The moisture meter is designed to measure moisture content (in percentage terms) of bulk materials, in particular, to control concrete mix directly in the mixer and determine consistency and mixing quality of the mix based on these measurements.

The moisture meter includes an external sensor (refer to a photo in Appendix 1) and an electronic unit (Appendices 2 and 3).

Due to the principle of operation the moisture meter is a radiowave device – dielectric moisture meter. By probing the environment with VHF band radiowaves, the moisture meter determines permittivity of the controlled material, and subsequently measures its moisture content with regard to the material temperature.

2.2. Moisture content – a parameter measured by the moisture meter – is a ratio between the water mass contained in the material and the weight of wet material defined by the following formula:

$$W = \frac{m_g - m_c}{m_g} \times 100\%$$

where  $W$  - material moisture content;

$m_g$  - weight of the wet material sample;

$m_c$  - weight of the same material sample after drying.

2.3. Moisture meter sensor is designed for installation in the wall hole or in the bottom of a concrete mixer or a hopper. The sensor may also be used to measure material on the conveyor belt, in which case the sensor is mounted on a panel placed over the conveyor belt and forced against the controlled material.

The scope of supply includes all necessary mounting hardware (Appendices 4, 5 and 6). Sensor enclosure is made of steel. Its external elements contacting the controlled material and subject to abrasion are made of corrosion-resistant steel 40H13. The temperature of medium measured is monitored by the thermocouple installed inside the sensor.

## 3. Technical requirements

### 3.1. Main parameters and characteristics

The moisture meter is manufactured in accordance with technical specifications VIGT.415210.100TU based on the set of design documentation VIGT.415210.100.

Table 1 lists main technical parameters of the moisture meter.

Table 1

TS No.	Parameter description	Characteristic value
3.1.1	Measurement range of moisture - mass water content, W, % (see Note 1)	0 to 100
3.1.2	Limits of absolute error $\Delta$ , mass water content, % calculated by formulas depending on W, where W — moisture measurement result in percentage terms (see Note 2)	$\Delta = 0.035 + 0.05 \cdot W$
3.1.3	Range of measured temperatures, °C	-40... 150
3.1.4	Temperature range of analyzer calibration, °C (see Note 3)	+5...40
3.1.5	Range of sensor operating temperatures, °C	-20...80
3.1.6	Range of electronic unit operating temperatures, °C	-20...80
3.1.7	Measurement period, sec	0.1
3.1.8	Output interface - digital - current, mA	RS485 Modbus RTU 4-20
3.1.9	Supply voltage, V nominal allowable	24 18...36
3.1.10	Current consumption, not more than, mA	200
3.1.11	Sensor dimensions, mm	Ø 108x100
3.1.12	Sensor weight, kg	3.5
3.1.13	Dimensions of electronic unit in general purpose industrial version, mm	255 x 170 x 60
3.1.14	Weight of electronic unit in general purpose industrial version, kg	2
3.1.15	Dust and moisture ingress protection rating of an electronic unit enclosure in general purpose industrial version in accordance with GOST 14254-96	IP54
3.1.16	Dust and moisture ingress protection rating of a sensor enclosure in accordance with GOST 14254-96	IP67
3.1.17	Length of communications cable between sensor and electronic unit, m (see Note 4)	1.5...2.5

3.1.18	Maximum length of RS485 digital signal cable between electronic unit and external control device (controller, computer), not less than, m	1000
3.1.19	Maximum length of 4-20 mA analog signal cable between electronic unit and external indicating device, not less than, m	100

**Notes:**

1. Moisture content for dry and plastic concrete mixes does not exceed 14%, so the maximum moisture value set in the calibration curve of moisture meters installed in the concrete mixer is equal to 20% (ratio between the water mass and the total weight of concrete mix).
2. Calculation of given mathematical expressions (formulas) provides the following values of absolute error  $\Delta$ :

Moisture range W	Limits of absolute error value $\Delta$
up to 10%	0.5%
10...20%	1%
20...50%	2.5%
50...100%	5%

3. The user can freely update moisture meter calibration with data for extension of moisture measuring temperature range using the supplied software by the method described in the operation manual.
4. The required cable length between the sensor and the electronic unit shall be agreed when ordering.

3.2. The moisture meter is designed for continuous operation.

#### **4. Scope of supply**

4.1. Analyzer scope of supply:

1. Sensor VIGT.415210.100-17;
2. Electronic unit VIGT.415210.101;
3. Mounting kit VIGT.415210.751;
4. Technical specification and operation manual VIGT.415210.100 RE.
5. Equipment certificate VIGT.415210.100-17 PS.
6. CD with SW100 software.

4.2. The items listed in Table 2 may be additionally included in the scope of supply at the customer's request.

Item description	Type, brand
Protocol converter USB – RS485 (power supply – 24 V mains)	"OVEN -AC4" by "Oven"
Protocol converter USB – RS485 (power supply – PC USB port)	"ATDR.426469.032" by RPE "Bolid"
Measuring and regulating device	"OVEN TRM-201" by "Oven"
Measuring and regulating device	"METAKON -1105" by "KontrAvt"
Power supply 24 V	"OVEN BP30B-D3-24" by "Oven"
Laptop	by agreement with the customer

4.5. Example of the moisture meter designation in the order and technical documentation of other products:

“Moisture analyzer FIZEPR-SW100 VIGT.415210.100-17“.

## 5. Moisture meter design features and operation

5.1. The moisture meter FIZEPR-SW100 consists of an electronic unit and a sensor.

5.1.1. The sensor VIGT.415210.100-17 has a cylindrical enclosure made of steel. End elements of the sensor subject to abrasion load and impacts are made of corrosion-resistant quenched steel 40H13. The sensor is mounted using the mounting kit VIGT.415210.751. Design of the mounting ensures easy installation and disassembling of the sensor while in operation.

5.2. The electronic unit is shown in Appendices 2 and 3.

The electronic unit is equipped with two LEDs mounted on its enclosure to monitor moisture meter operation. One LED is connected to the input power supply circuit + 24V, and lights up when power is supplied. The second LED is bi-color. Green light indicates interchange via RS-485 network. Red light illuminates when the instrument responds to requests from an external device (computer, controller, etc.).

The electronic unit is fixed near the sensor at a distance determined by the connection cable length specified in the order. If cable is 1.5 m long, the electronic unit is installed at a distance of no more than 1.2 m from the sensor. Appendix 7 shows a version of a mounting plate for the electronic unit.

5.3. The principle of moisture meter operation is as follows.

The moisture meter sensor probes the material located in the area of its end surface with electromagnetic signal. Due to the fact that the steel sensor transmitter contacts the controlled material directly (without protective ceramic plates), probing signal penetrates the material to the maximum depth. The output signal of the sensor determined by permittivity of the controlled material is amplified and digitized in the electronic unit of the moisture meter.

The moisture meter processor calculates moisture content in the material with allowance for its temperature using calibration tables connecting permittivity to moisture content. Moreover, a separate calibration table for each type of material is loaded into the moisture meter memory. The resulting moisture content value is transmitted from the electronic unit

output via digital interface (RS-485) to the computer and simultaneously by the 4-20 mA current signal to the external indicator or industrial controller controlling the process.

## **6. Labeling**

6.1. The electronic unit enclosure is labeled with the following markings:

Type of instrument is indicated on a cover;

Serial number of the moisture meter is indicated on the enclosure side wall.

6.2. A security seal may be installed inside the electronic unit in order to prevent unauthorized modification of factory assembly.

## **7. Transport and consumer packaging**

7.1. Transport and consumer packaging is designed to store and transport the moisture meter, and to ensure its safety during transportation for the entire storage period.

7.2. The moisture meter, parts and components included in the scope of supply, complete with operational documentation, must be packed in a transport packaging.

7.3. Supplied products and operational documentation shall be wrapped in a polyethylene film.

7.4. Together with the delivery set, transport packaging shall contain a packing list indicating description and quantity of supplied products.

## **8. General operation instructions**

8.1. The moisture meter shall be energized by a general purpose stabilized DC voltage source with an output voltage of 24 V (permissible range of supply voltage is 18-36 V). Power consumption does not exceed 3.6 W.

8.2. Information is transmitted simultaneously via two lines: digital communication – RS-485 Modbus RTU interface and 4-20 mA current loop.

8.3. After the moisture meter is energized by supply voltage, it is ready for operation in 1-2 minutes.

8.4. Unpacking requirements.

8.4.1. Upon receipt of transport packaging containing the moisture meter, perform visual inspection together with a person responsible for transportation. It is necessary to ensure complete safety of transport packaging. If transport packaging is damaged, a report shall be drawn up, signed by persons responsible for acceptance and transportation, certified by a stamp, and sent to the transport organization.

8.4.2. In the cold season transport packaging shall only be removed after 2-hour keeping in a warm room at a temperature of not lower than 18-20°C.

8.4.3. After unpacking, check package contents with the inventory specified in packing lists.

8.4.4. Completeness check is carried out in accordance with the "Kitting" section of the equipment certificate. Description, designation, serial number and quantity of products listed in the equipment certificate shall correspond to the records in packing lists.

## 8.5. Inspection procedure.

8.5.1. Perform visual inspection in order to check safety and integrity of the moisture meter enclosure. The product shall be free from scratches, cracks, dents, corrosion and other defects that can be detected by visual examination.

8.5.2. All defects and irregularities detected during unpacking, visual inspection and completeness check shall be reported in a damage complaint report that shall be signed by persons responsible for acceptance of the moisture meter, approved by the Director of the customer company, and sent to the manufacturer.

## 9. Safety precautions

9.1. Do not operate the moisture meter if the external 24V power supply is not grounded.

9.2. Do not operate the moisture meter if the electronic unit cover is removed.

9.3. Moisture meter installation (dismantling), operation, maintenance and repair works shall be carried out only by persons who have studied this technical specification and were briefed on safety rules when operating electrical devices and electronic equipment.

9.4. All types of maintenance, repair and installation works related to fuse replacement, disconnection and switching of wires, etc., as well as dismantling of the moisture meter, must only be carried out after it is disconnected from the power source.

9.5. Do not operate the moisture meter if connectors are connected poorly or the cover is removed.

## 10. Installation procedure

10.1. Safety regulations set out in Section 9 of this manual and in regulatory technical documents applicable at the customer company shall be strictly observed during the moisture meter installation.

10.2. The moisture meter supplied for on-site installation has passed acceptance testing.

10.3. First choose mounting locations for a sensor and an electronic unit. Take into account permissible operating conditions when choosing mounting locations. Prepare mounting locations for moisture meter components in accordance with overall and mounting dimensions.

10.4. The moisture meter on-site installation is carried out in the following order:

- Mount the sensor in a prepared location in accordance with Section 10.7;
- Fix the electronic unit in a prepared location in accordance with Section 10.8;
- Remove the electronic unit cover and make electrical installation.

10.5. Refer to Appendices 8 and 9 for possible moisture meter wiring diagrams.

Measurement results can be displayed on a controller or a computer via RS-485 Modbus RTU interface. Besides, measurement results can be displayed on any display device with 4-20 mA current input. For example, the measuring and regulating device OVEN TRM-201 as shown in Appendix 8 or METAKON-1105 as shown in Appendix 9 can be connected to 4-20 mA current output. Refer to Appendix 10 for calibration details of the OVEN TRM-201 measuring and regulating device.

If the moisture meter requires recalibration, connect a computer (laptop) to an electronic unit using protocol converter RS485-USB.

A voltage source must be the power supply with an output voltage of 24 V, e.g. OVEN BP 30B-D3-24.



10.6. Electrical connection of the moisture meter shall be carried out in the following order:

10.6.1. Connect sensor cable to the electronic unit (terminals IN1, IN2, connector IN3).

10.6.2. Connect temperature sensor cable to "TEMPER" terminals.

10.6.3. Connect communications cable to "RS-485" terminals (if required).

10.6.4. Connect cable to "I\_OUT" 4-20 mA current output terminals (if required).

10.6.5. Connect power wire to "24V" terminals.

**Note.** "I\_OUT" current output is not galvanically isolated from the power-supply circuit.

### ***10.7. Sensor installation and dismantling notes***

10.7.1. Choose a mounting location for the sensor in accordance with recommendations listed in Appendix 11. This is one of the most crucial points, as material at the mounting location of the sensor determines all measurement results.

The sensor must be located in a stream of mixed material and must not agglomerate material on its measuring surface.

Mark the chosen location (on the side wall or in the floor of the mixer) and make the Ø110-112 mm hole. Fix the ring made of Steel 20 included in the mounting kit (Appendix 5) on the outer side of the mixer using electric welding. It is recommended to align this ring when the sensor is installed and fixed in it.

#### ***NOTE:***

**THE MOISTURE METER SENSOR MUST BE REMOVED FROM THE MOUNTING DURING WELDING IN ORDER TO PREVENT BURNOUT OF ELECTRONIC COMPONENTS DUE TO ELECTRIC PICKUPS!**

Weld the ring on in a disassembled state.

10.7.2. Once welding is complete, install and fix the sensor:

- Screw three M10 double-end bolts in the ring until tight and tighten them with three M10 lock nuts;

- Fix the mounting ring on the sensor using two M8 bolts, and position the mounting ring so it could be further adjusted;

- Install the mounting ring assembly with the sensor on double-end bolts so that the sensor working surface is flush with the mixer wall; fix with nuts M10, washers and split washers;

- Install three M10 bolts together with three remaining lock nuts and fix the assembly so that the sensor working surface is in correct position: it must not project into the mixer beyond its walls.

Check if this requirement is met using a steel ruler by putting it on the mixer surface. After that, it is recommended to turn mixer blades manually and make sure that scrapers clean the working surface and do not contact the sensor.

10.7.3. Tighten the whole assembly including lock nuts.

10.7.4. Once the sensor is installed and adjusted, fill the clearance gap around the sensor with a silicone sealant.

#### 10.7.5. Additional installation guidelines:

- The sensor must be positioned so that it is visible through the inspection window located in the concrete mixer cover when the mixer is empty, easily accessible for maintenance and adjustment of its position;
- When the sensor is installed at the bottom of the concrete mixer, it must be located at the highest point of the mixer floor; otherwise it will overestimate the moisture value;
- The sensor must be located outside of water inlets, cement, sand, and gravel feed ends;
- If the sensor is mounted on a curved surface, e.g. on the side wall, make sure the sensor does not project inside and is not hit by blades;
- Avoid areas with high material inhomogeneity; the best signal is received where the material moves uniformly close to the sensor.

10.7.6. Regularly check the sensor working surface for wear. Also observe armor wear and compensate it by adjusting sensor installation depth so that the sensor surface does not protrude over the armor. Further, the blades need additional adjustment in order to ensure efficiency of mixing and cleanliness of the sensor working surface. If the sensor surface projects into the mixer greatly, it may be damaged by the blades and gravel that gets between the blades and the sensor.

#### 10.8. Electronic unit installation and dismantling details

When choosing mounting location for the electronic unit, take into account the connecting cable length. The electronic unit shall be easily accessible. Refer to Appendix 7 for a version of the mounting plate for electronic unit installation. Refer to a photo in Appendix 3 for electronic unit appearance with the top cover removed.

### **11. Pre-starting and operation procedure, measurement procedure**

11.1. The moisture meter shall be handled by an operator who is familiar with operation of electronic equipment, studied this technical specification and operation manual and was briefed on safety rules when operating electrical equipment.

11.2. Pre-starting procedure is performed in the following order:

11.2.1. Make sure that electrical connections correspond to the connection diagram.

Check reliability of wire connection to terminal clamps.

11.2.2. Energize the moisture meter.

11.2.3. Make sure that "POWER" LED located on the electronic unit side panel is illuminated.

11.2.4. Make sure that "CONTROL" LED located on the electronic unit side panel is flashing (when RS485 line is connected).

11.2.5. Once all the above actions are performed the moisture meter is ready for operation.

11.2.6. If any moisture meter failure is detected, turn off power, identify and correct the occurred failure as described in Sections 12 and 13 of this manual.

#### 11.3. Measurement procedure

Prior to making measurements, make sure that the moisture meter sensor is completely filled with the controlled material. Measurement results shall be read from a display device (OVEN TRM-201 type measuring and regulating device or computer screen)

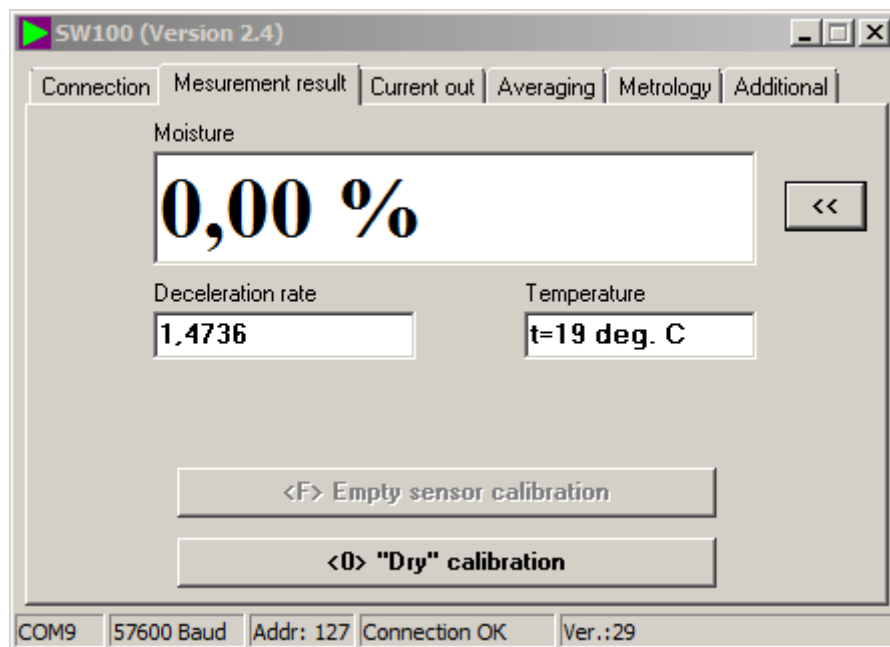
## 12. Working with SW100 software

SW100 software (hereinafter "the program") ensures the following functions:

- Displaying the current moisture value in a digital form on a computer screen;
- Displaying the measured moisture in the form of a graph indicating the current moisture value and its variation in time on a computer screen;
- Moisture meter control and setting its operating modes.

In order to use this program you need "SW100.exe" and "Vlagomer.ini" files and a computer (laptop) with Windows XP OS (or higher) installed. The program does not require installation and can be run from any location where files "SW100.exe" and "Vlagomer.ini" were copied.

The program consists of a main window displaying the current moisture value in a digital form and current moisture meter settings, and an additional window displaying the process graph (shown in Appendix 12).



The status bar at the bottom of the main window serves to display service information. It is divided into five boxes:

- 1) The first box displays the name of a serial port for moisture meter connection;
- 2) The second box displays the baud rate of this port;
- 3) The third box displays network address of the moisture meter;
- 4) The fourth box displays messages on network data exchange status;
- 5) The fifth box displays program version.

### ***"Communication parameters" Tab***

In order to receive and view data from the moisture meter, the program shall be configured to a used COM port. For this purpose choose a port the moisture meter is connected to (or will

be connected) in the "Communication port" window. Select the required communication speed in the "Baud rate" window; specify network address of the moisture meter in the "MODBUS network address" window; set time in milliseconds in the "Response timeout time" window. Once all the necessary parameters are selected, click "Apply".

If required, the user may change the moisture meter network address or communication speed by specifying these parameters in boxes located in the blue area of the "New moisture meter parameters" window. Once the parameter is changed, click "Set!".

Press and hold "Reset" button for at least 5 seconds to reset moisture meter network settings and restore factory settings. The button is located on the bottom board of the electronic unit under the cut in the top board (indicated by an arrow in the photo in Appendix 16).

### ***"Measurement process" Tab***

Boxes in this tab display actually measured parameters: "Moisture", "Refractive index" and "Temperature".

Double-clicking "Refractive index" box with the left mouse button displays controlled material permittivity.

"Empty sensor calibration" button allows fine tuning of the moisture meter after installation at the customer site.

"Dry material calibration" button shifts performance curve of the moisture meter without creating new calibration. This may be allowable if the calibration of the material used is close to the calibration set by the manufacturer but does not correspond to it (e.g. another type of oil or petroleum, etc.). Make sure that "dry" material used for this calibration does not contain moisture.

After dry material calibration the moisture meter will save the curve shift and operate with allowance for this shift. Calibration tables remain unchanged.

In order to restore an original value of the calibration curve (remove the shift), overwrite calibration tables in accordance with Section 14.3.3.

Empty sensor calibration or dry material calibration shall be performed only if you are sure that your actions are correct.

### ***"Current output" Tab***

This tab indicates calibration factors for 4-20 mA current loop: minimum moisture corresponds to 4 mA and maximum moisture corresponds to 20 mA.

It is possible to change moisture limits for current output. To do it, set new parameters of minimum and maximum moisture in the "New moisture limits for current output" field and click "Set!".

### ***"Averaging" Tab***

This tab allows the user to change the result averaging constant that specifies the number of measurements used in calculation of the average moisture value.

Please note that the time of measurement (the time required to obtain the most reliable result) is directly proportional to the averaging constant value.

### **"Metrology" Tab**

This tab contains four buttons: "Calibration tables", "Save configuration to the instrument" "Save instrument configuration to a file", "Verification mode".

If required, calibration tables can be modified. Click "Calibration tables" to open the window with a corresponding name (see Section 21).

"Save instrument configuration to a file" button saves current configuration to a file with **.cfg** extension used for diagnostics of the moisture meter state. Click this button to open a dialog box, where filename and save location can be specified. This file can be sent to the manufacturer for diagnostics of the moisture meter operation.

"Save configuration to the instrument" button saves a configuration file with **.cfg** extension to the moisture meter.

## **13. Description of communication protocol**

13.1. Digital communication with the moisture meter is performed via MODBUS RTU protocol with the following parameters:

- Connection speed - 19200, 38400; 57600 or 115200 baud;
- Parity - none;
- Number of stop bits - 2.

Default communication parameters (factory settings):

- Connection speed – 57600 baud;
- Address – 127.

13.2. Features of MODBUS RTU protocol implementation:

- Register reading by 03 (03h) command;
- Support of echoing back testing 08 (08h) command;
- When attempting to read address range that exceeds limits specified in the table, the moisture meter gives no response.

13.3. Table 5 shows MODBUS RTU registers.

Table 5

Register address (DEC)	Register address (HEX)	Description	R/W
0000	0000	Measured moisture expressed in hundredths of a percent	R
0001	0001	Temperature in degrees Kelvin	R
0002	0002	Error code (if 0, then there are no errors)	R
0003	0003	Software version (firmware version) of the moisture meter	R
0163	00A3	Total number of moisture meter calibrations	R
0164	00A4	Number of current calibration	R/W

## 14. Moisture meter calibration, calibration tables

### 14.1. Mathematical support

Due to the principle of operation the moisture meter is a permittivity  $\varepsilon_r$  meter. Permittivity is converted to mass moisture  $W$  by the processor using calibrations with built-in relation between them. In general, there is a functional dependence between permeability and moisture for each controlled material, and the said functional dependence is tied to a specific temperature of the material.

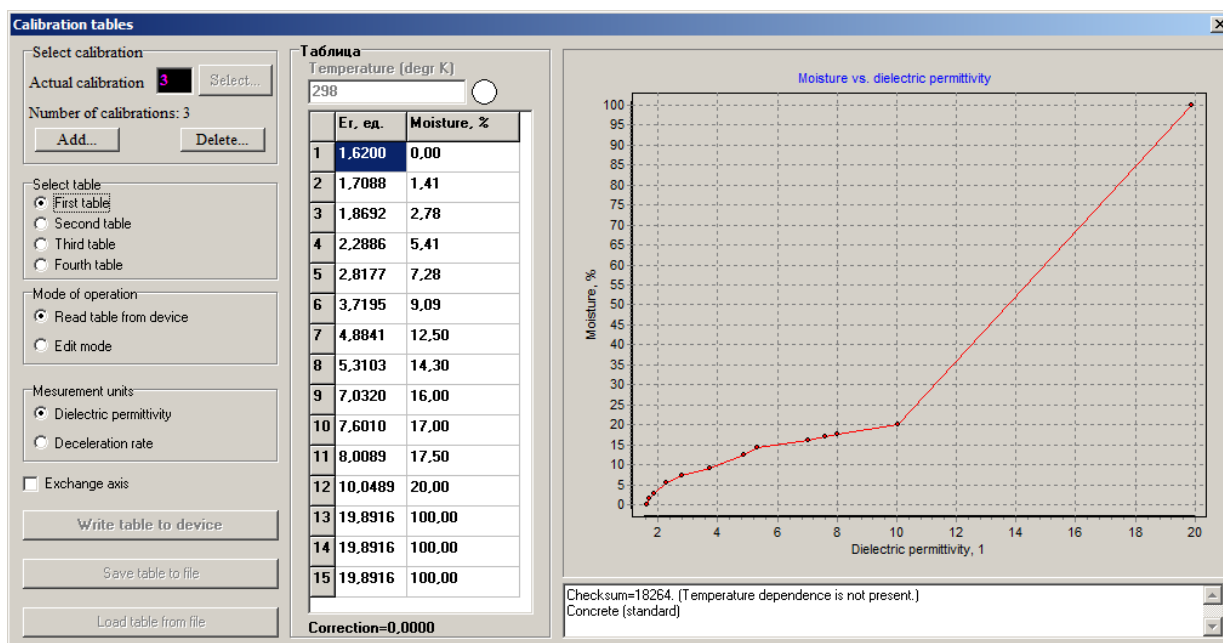
Each calibration is a correspondence table between refractive index  $k$  ( $\varepsilon_r = k^2$ ) and moisture. There are four such tables for each material, and each of them is for a particular temperature. The first table is compiled for the lowest temperature of the material measured, and the fourth is for the highest one.

The table represents a set of 15 points (pairs of  $k$  -  $W$  values) used by the processor to define the function  $w = f(k)$ . The processor calculates moisture content by linear interpolation of intermediate refractive index  $k$  values in the appropriate interval of the function  $w = f(k)$ .

### 14.2. Calibration handling window

In order to access tables, select "Metrology" tab in the SW100 program main window and click "Calibration tables" button.

This opens the "Calibration tables" window containing control and display elements required to view and modify tables.



The window can be conveniently divided into three parts:

- Window controls are located to the left;
- Current conversion table is located in the middle;

- Graphical representation of table data is located to the right.

First opening of this window displays data from the first table stored in the moisture meter memory (it is assumed that moisture meter connection was set up previously).

A table to be displayed can be selected by clicking the required item on the "Table selection" panel. In addition, the temperature related to this table is displayed at the top of the table. The "Units" panel allows the user to select whether values measured by the instrument are represented as refractive index  $k$  or relative permittivity  $\mathcal{E}_r$ .

Correction factor shows if the calibration shift calculated after "Dry material calibration" operation is used (see Section 12). For newly created or edited tables the correction factor is equal to zero.

There are two modes of table handling: "Reading" and "Editing". The user can switch between them in the relevant "Handling mode" field.

The "Reading" mode (enabled by default) allows the user to only view tables stored in the moisture meter memory.

The "Editing" mode allows the user to edit tables, save calibration to the moisture meter, save calibration to a file and open calibration from a file.

Since each calibration consists of four tables, the required calibration shall be selected first.

This is done in the upper left corner of the window by entering a calibration number in the "Current number" box.

The total number of calibrations is displayed below this box.

*Note.* Remember that calibration selected in this way is stored in the moisture meter memory and will be used for further calculations in the operating mode.

If required, it is possible to add another calibration or delete current calibration by clicking "Add" or "Delete" buttons respectively.

For quick calibration identification the program calculates the checksum of current calibration and displays it in the box below the graph. When the moisture meter is delivered, checksums of all calibrations stored in the moisture meter are specified in the equipment certificate. Thus, you can determine the integrity of calibrations without the need in their line-by-line comparison.

After calibration is selected you may start handling calibration tables.

### ***14.3. Calibration table handling procedure***

#### **14.3.1. Saving of calibration tables to the moisture meter from files**

Calibration tables are saved to the moisture meter in the following order:

- 1) Set up connection between the SW100 program and the moisture meter;
- 2) Open the calibration table handling window as specified in Section 14.2;
- 3) Switch to "Editing" mode;



- 4) Click "Open table from a file ..." and select the required file in the standard dialog box appeared;
- 5) Click "Save table to moisture meter".

*Note 1.* When creating and editing tables it should be noted that lower temperature should relate to the table with a smaller number.

*Note 2.* If a characteristic that does not depend on the temperature is used for this type of the measured material, the same data is recorded to all four tables of the moisture meter, but it is required to specify temperature for each table manually in accordance with *Note 1* before saving them to the moisture meter (Step 7).

#### 14.3.2. Saving calibration from the moisture meter to a file

In order to save tables stored in the moisture meter memory, follow these steps:

- 1) Switch to "Editing" mode;
- 2) Click "Save table to a file ..." and then specify the file name in the standard dialog box appeared;

#### 14.3.3. Updating existing tables

If required, calibration curves can be updated when operating the moisture meter in accordance with the following procedure:

- 1) Save tables stored in the moisture meter memory in accordance with Section 14.3.2;
- 2) Update the current table as required;
- 3) Save it to the moisture meter;
- 4) Save calibration to a file in accordance with Section 14.3.2.

#### 14.3.4. Creating calibration tables

In order to create a new calibration curve it is much more convenient to create a table using MS Excel, and save it in a format suitable for saving to the moisture meter using the SW100 program.

Tables are saved and stored by the SW100 program using standard CSV format (variables separated by commas) supported, in particular, by the spreadsheet program MS Excel.

#### 14.3.5. Calibration table format

Moisture meter calibrations are a set of four tables, either of which consists of fifteen control points that define relation between deceleration factor and moisture.

Each point of the set corresponds to a single line in a CSV or Excel file.

The table in Excel format shall look like the one shown below:

<b>F</b>	<b>283</b>	
1	1,57	0,16
2	1,76	8,44
3	1,94	15,5
4	2,06	20,1
5	2,21	24,5
6	2,52	32,6
7	2,65	36,1
8	2,79	39,2



9	3,04	44,8
10	3,29	50,3
11	3,63	56,8
12	3,83	60
13	4,95	70
14	6,75	83
15	9,15	100
<b>F</b>	<b>298</b>	
1	1,57	0,16
2	1,76	8,44
3	1,94	15,5
4	2,06	20,1
5	2,21	24,5
6	2,52	32,6
7	2,65	36,1
8	2,79	39,2
9	3,04	44,8
10	3,29	50,3
11	3,63	56,8
12	3,83	60
13	4,95	70
14	6,75	83
15	9,15	100
<b>F</b>	<b>308</b>	
1	1,57	0,16
2	1,76	8,44
3	1,94	15,5
4	2,06	20,1
5	2,21	24,5
6	2,52	32,6
7	2,65	36,1
8	2,79	39,2
9	3,04	44,8
10	3,29	50,3
11	3,63	56,8
12	3,83	60
13	4,95	70
14	6,75	83
15	9,15	100
<b>F</b>	<b>318</b>	
1	1,57	0,16
2	1,76	8,44
3	1,94	15,5
4	2,06	20,1
5	2,21	24,5
6	2,52	32,6
7	2,65	36,1
8	2,79	39,2
9	3,04	44,8
10	3,29	50,3
11	3,63	56,8
12	3,83	60
13	4,95	70
14	6,75	83
15	9,15	100

Calibration is performed subject to a set of rules.

The first line indicates temperature (in degrees Kelvin) this table corresponds to. The first cell contains a service character F (Latin letter). The second cell contains a temperature value in degrees Kelvin. The third cell is empty.

All subsequent lines are used to represent reference points of the calibration curve. Each line consists of three elements. The first cell contains the index number of the point – from 1 to 15. The second one contains the value of material refractive index. The third cell contains the related moisture value in percentage terms. The table shall be compiled in a way so that a cell with a lower index number corresponds to a point with a smaller refractive index value.

Specify refractive index with maximum four characters after the decimal point and moisture with maximum two characters after the decimal point when compiling tables.

Each table shall consist of 15 points. If the number of calibration points is less than fifteen, tables are filled with all available points in accordance with the above rules, and deficit lines shall be formed by copying the line with a higher refractive index in this table.

An Excel table created according to these rules is saved in CSV format. Thereafter, the table is ready for use by the SW100 program.

## **15. Maintenance check**

Table 6 contains the list of main maintenance checks.

Table 6

Checking procedure	Technical specifications
1. Grounding check with an ohmmeter	Transitional resistance value standard for wires and grounding contacts determined by the in-plant regulatory documents and Electrical Installation Code.
2. Insulation resistance check with a megger	Not less than 20 MΩ at relative humidity from 30 to 80% and temperature of 20°C.
3. Visual inspection	See Section 17 "Maintenance".

## **16. Troubleshooting**

16.1. On-site correction of failures is only allowed if the moisture meter is disconnected from the power supply.

16.2. When replacing broken-down components, strictly follow instructions set out in Section 17 "Maintenance" of this manual.

16.3. Replacement of broken-down components and moisture meter inspection once a detected failure is corrected shall be carried out by a maintenance specialist.

16.4. Table 7 contains a list of the most possible failures.

Table 7

Failure description, outer indicators and additional symptoms	Possible cause	Troubleshooting method
1. Power LED is off when the moisture meter is energized. Additional symptoms: - supply voltage at the input of communication line power cable is 24VDC; - power supply circuit current is absent or less than 20 mA.	Broken power wire.  Blown-out FU1 fuse.	Persons responsible for electrical installation and operation of communication lines shall correct the failure in accordance with regulations in force.  Disconnect the moisture meter from mains. Open the electronic unit cover and replace the FU1 fuse.
2. Power LED is off when the moisture meter is energized.	Short circuit of moisture meter power supply	Persons responsible for electrical installation and operation of communication lines, as well as for moisture meter operation, shall correct the failure in accordance with regulations in force.
3. No connection with the moisture meter.	Network cable breakage, incorrect network settings of the moisture meter	Persons responsible for electrical installation and operation of communication lines, as well as for moisture meter operation, shall check the network cable and its connection. If cable is OK, but there is still no connection, check network settings of the moisture meter. Press and hold "Reset" button for at least 5 seconds to reset moisture meter network settings (restore default network settings). The button is located on the bottom board of the electronic unit under the cut in the top board. Button location is shown in Appendix 16 and marked with an arrow.

## 17. Maintenance

### 17.1. General instructions.

17.1.1. Maintenance is carried out to ensure normal operation and preserve operational and technical characteristics of the moisture meter throughout its service life.

17.1.2. Maintenance consists in systematic monitoring of the moisture meter technical condition, regular technical inspection and correction of occurring failures.

17.1.3. Once failures are corrected, perform maintenance check to ensure normal operation.

### 17.2. Types and frequency of maintenance.

17.2.1. Depending on frequency and scope of work the following maintenance types are specified as listed in Table 8.

Table 8

Maintenance types	Frequency	Person responsible for maintenance
1. Scheduled maintenance: - weekly maintenance - preventative maintenance	Once a week  Every six months	Operator handling the moisture meter  Specialist handling the moisture meter
2. Unscheduled maintenance	When a moisture meter failure is detected	Specialist handling the moisture meter

17.2.2. The time of preventative maintenance can be changed and brought into line with production plans and terms adopted in the company operating the moisture meters. At the same time, preventative maintenance frequency shall be at least once a year.

17.2.3. Weekly maintenance includes visual inspection to ensure:

- Connection reliability, as well as continuity or integrity of connecting cables;
- No dents and visible physical damage to the moisture meter enclosure.

17.2.4. Preventative maintenance includes the following works:

- Dust and dirt removal from external surfaces of the moisture meter electronic unit and sensor;

- Visual inspection;
- Inspection of communications cable and connecting wire condition;
- Measurement of consumption current and supply voltage.

17.2.5. Unscheduled maintenance is performed in case of failure and includes works associated with the moisture meter repair.

## 18. Storage and transportation

Storage and transportation conditions of the moisture meter are in accordance with GOST 15150-69 for Groups 3 and 5 respectively.

18.1. Depending on the term, the moisture meter components in the manufacturer's package can be stored under conditions of heated hard-wall rooms with the air free from acid vapors, alkalis and other hazardous substances that cause corrosion.

18.2. Moisture meter shelf life in the manufacturer's package is 1 year.

18.3. The moisture meter packed in a transport package can be transported by any means of transport in closed vehicles over all distances.

18.4. The moisture meter shall be transported with observance of all precautionary measures; master boxes shall not be thrown and shall be handled with care.

## 19. Recycling

19.1. The moisture meter contains no precious metals and other substances subject to mandatory recycling.

19.2. The moisture meter poses no hazard to human life, health and the environment. After expiry of its operational life (service life) it can be disposed by the technology adopted in the company operating the moisture meter.

## **20. Warranty liabilities**

Warranty life is 12 months.

Warranty liabilities shall be valid provided that operation, transportation and storage rules and conditions set out in this manual are observed.

## 21. Appendices

### *List of appendices*

1. Appearance of the sensor VIGT.415210.100-17 with a mounting kit
2. Appearance of the electronic unit VIGT.415210.101
3. Appearance of the electronic unit VIGT.415210.101 with the top cover removed
4. Mounting VIGT.415210.751
5. Ring included in the mounting kit
6. Mounting VIGT.415210.751
7. Mounting plate of the electronic unit VIGT.415210.101
8. Diagram of moisture meter connection to the OVEN TRM-201 measuring and regulating device
9. Diagram of moisture meter connection to the METAKON-1105 measuring and regulating device
10. Setting actuation parameters for the OVEN TRM-201 measuring and regulating device relay
11. Recommendations on choosing the sensor mounting location
12. Process flow chart of concrete preparation with specified moisture

**Appearance of the sensor VIGT.415210.100-17  
with a mounting kit**

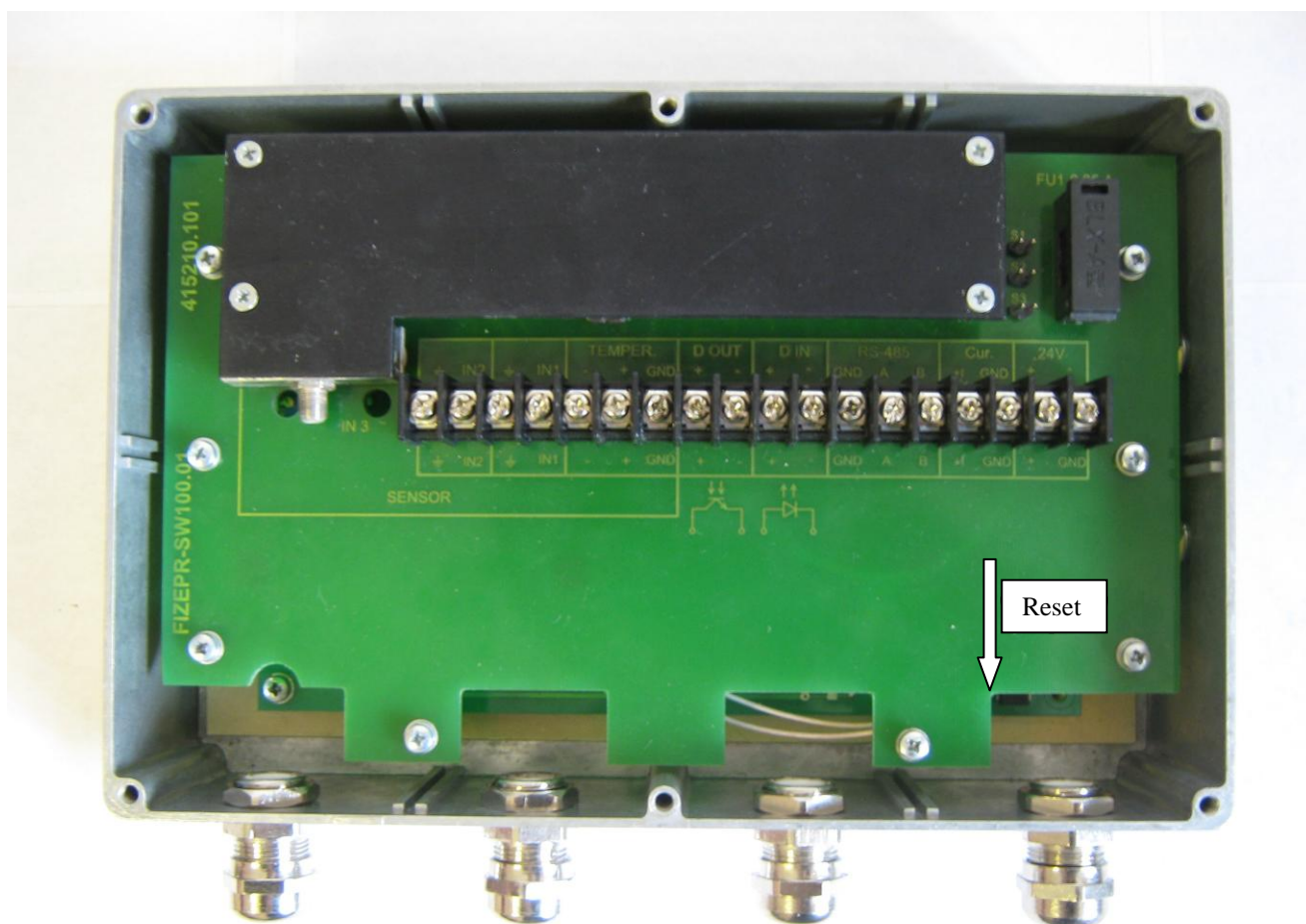


## Appearance of the electronic unit VIGT.415210.101





**Appearance of the electronic unit VIGT.415210.101 with the top cover removed**



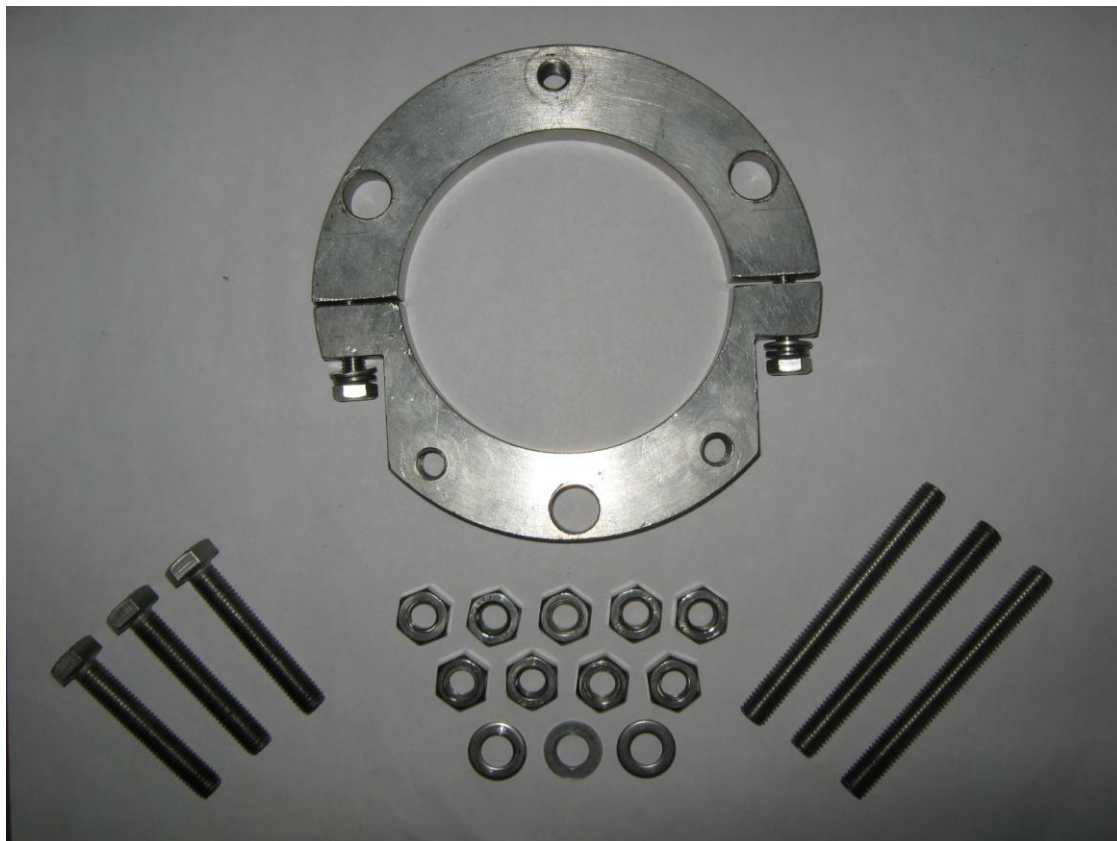
## Mounting VIGT.415210.751



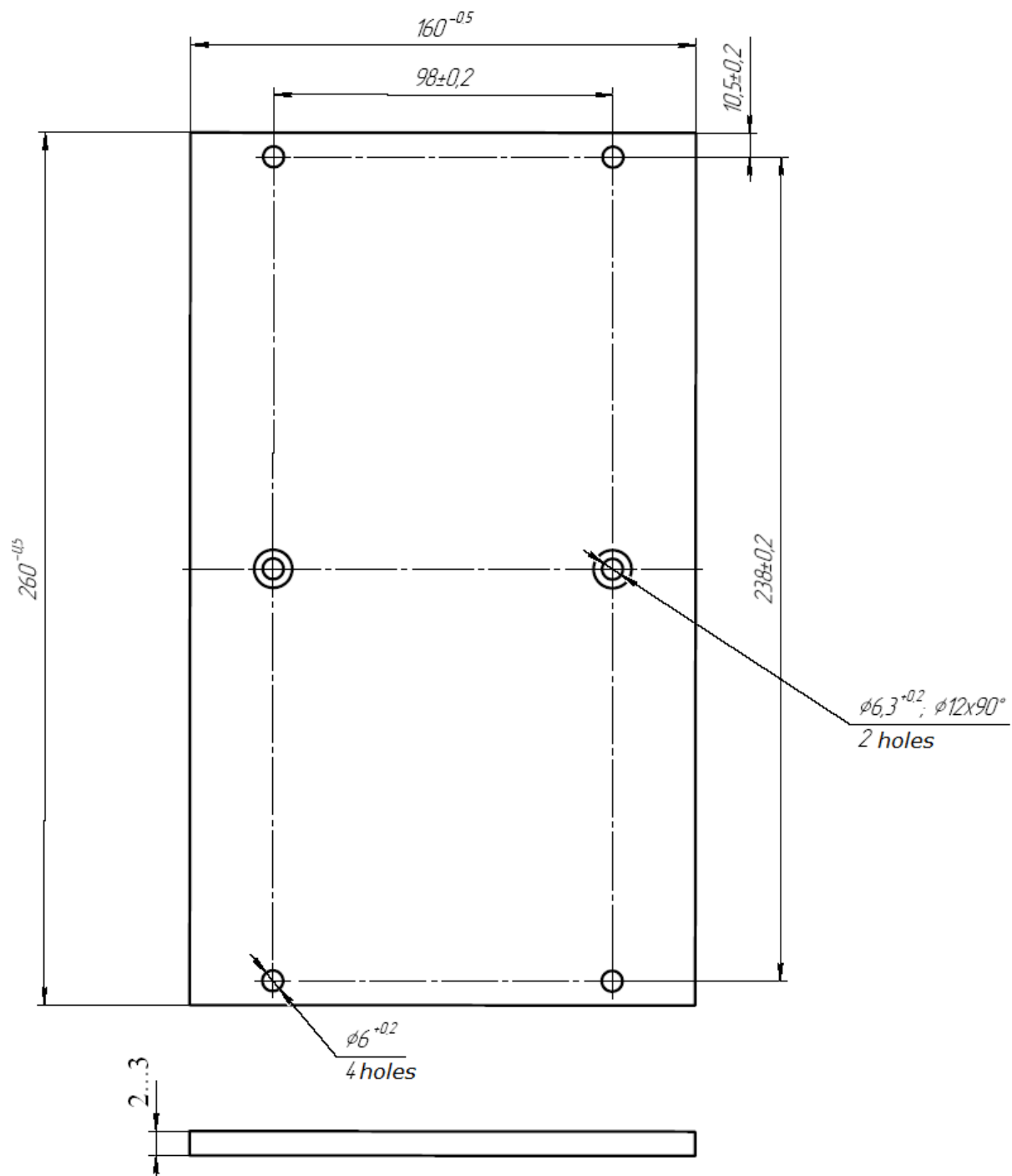
**The ring included in the mounting kit**



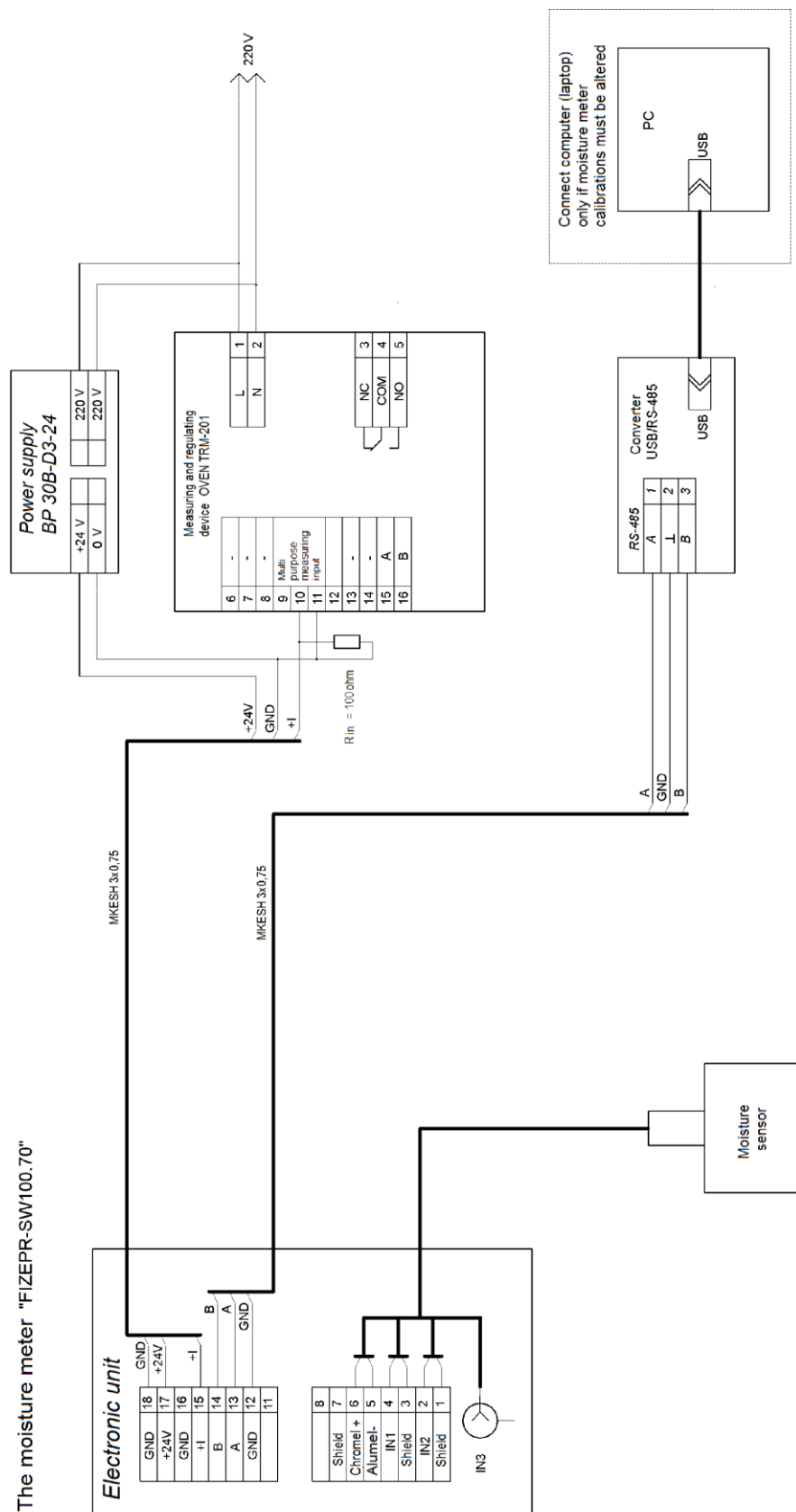
## Mounting VIGT.415210.751



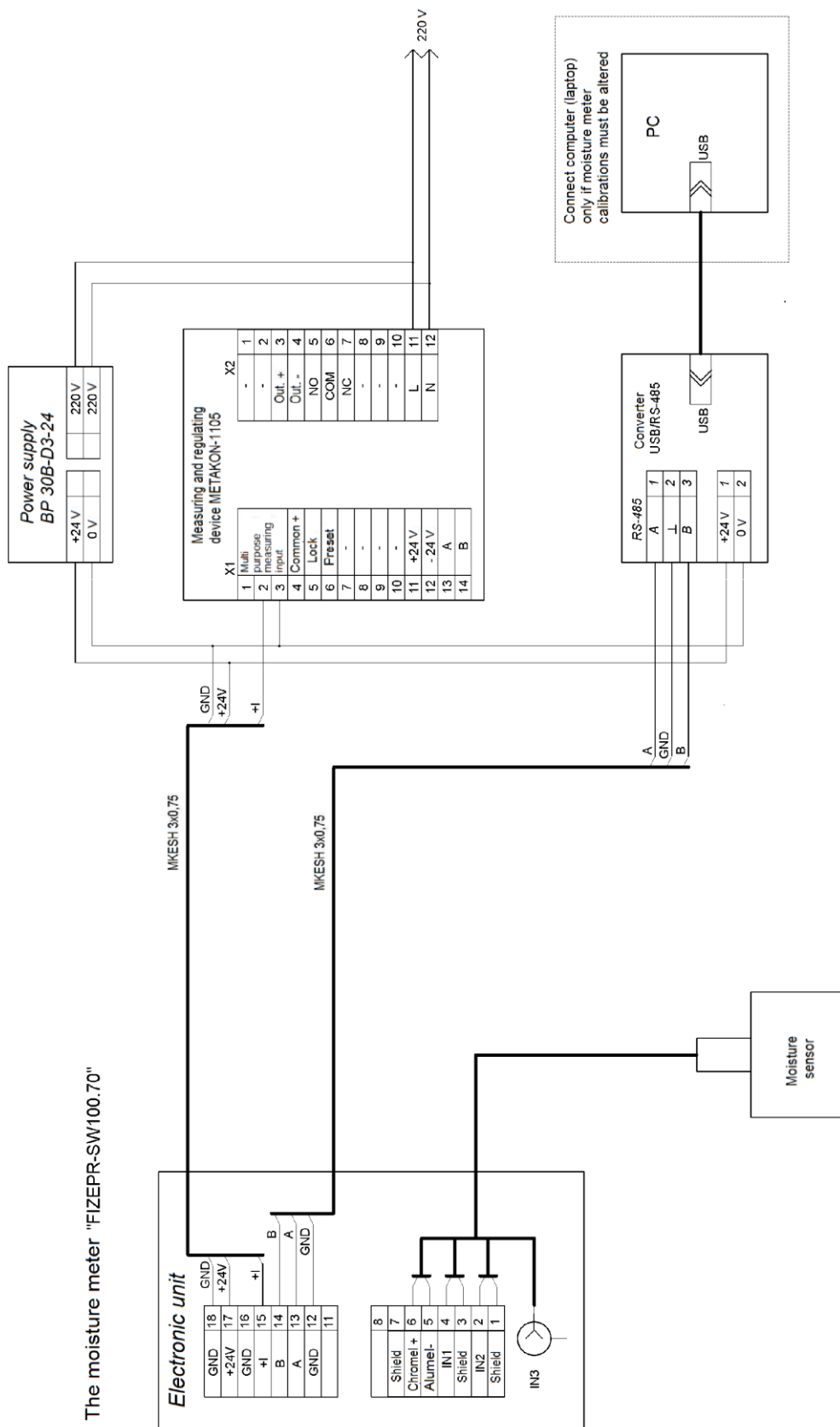
# Mounting plate of the electronic unit VIGT.415210.101



## Diagram of moisture meter connection to the OVEN TRM-201 measuring and regulating device



## Diagram of moisture meter connection to the METAKON-1105 measuring and regulating device





## Setting actuation parameters for the OVEN TRM-201 measuring and regulating device relay

The following example shows how to program the measuring and regulating device in order to control the water valve depending on the moisture content in diesel oil emulsion.

Let us consider the following case:

The water valve must be closed if moisture content in diesel oil emulsion rises to 15% or higher;

If moisture content in emulsion drops to 10% or lower, the water valve must be opened.

For this case the OVEN-TRM201 measuring and regulating device is set as follows: **threshold - 12.5%; hysteresis - 2.5%.**

### 1. *Selection of the trigger threshold* (trigger threshold value is displayed on the lower green display).

- 1.1. The required trigger threshold can be set with "up" and "down" arrow buttons. We set the threshold value of 12.5 (press and hold to speed up searching process).
- 1.2. Briefly press "PROG." button.

### 2. *Hysteresis setting*

- 2.1. Enter the menu by pressing and holding "PROG." button for 3 - 6 sec.

The upper display will indicate the 'nEnU' caption (the first letter is 'n' with an overscore); the lower display shall indicate the 'LuōP' caption (menu items are indicated on the green display).

- 2.2. Press "Up" button repeatedly to find 'LuōU' menu item.
- 2.3. Briefly press "PROG." button ('SL.L' caption appears on the upper red display).
- 2.4. Press (repeatedly) "PROG." button to find a submenu item labeled 'HYS' on the upper red display.
- 2.5. Use "up" and "down" arrow buttons to set the required hysteresis value. We set the value of **2.5**.
- 2.6. Briefly press "PROG." button.
- 2.7. To exit to the initial menu:
  - 2.7.1. Press and hold "PROG." button until the following captions appear: 'nEnU' – on the upper red display (the first letter is 'n' with an overscore), 'LuōU' – on the lower display).
  - 2.7.2. Use "down" arrow button to find 'LuōP' menu item.
  - 2.7.3. Press "PROG." button (switch to indication mode: the red display shows the measured parameter value, the green display shows the trigger threshold).

### 3. *Setting relay actuation method*

Go through Sections 2.1 - 2.3.

- 3.1. Briefly press "PROG." button until the 'CnP' caption appears ('n' letter with an overscore) on the upper display.
- 3.2. Use arrow buttons to select parameter value: 1. If 1 is selected, the relay is actuated (relay contacts 3,4 are open, the valve is open) if the moisture value is below 10%, and disabled (valve closed) if the moisture value is above 15%.



*Note. When the specified parameter value is set to 2, the relay is disabled if moisture drops below the threshold, and actuated if moisture exceeds the threshold.*

3.3. Briefly press "PROG." Button.

3.4. Go through Section 2.7.

*Please note that if zero voltage is applied to the valve, water supply is cut off. The valve is connected to normally open relay contacts (5, 6) in accordance with the diagram below.*

