

## Ultrasonic Level Transmitter AlphaSonic

**Models 10,20,30**

## Installation and Operating Manual

v.201205

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This installation manual is intended for obtaining information necessary for users during the installation, operation and maintenance of AlphaSonic ultrasonic level transmitters of 10,20,30 models (hereafter referred to as the transmitter).

## 1 GENERAL

Only personnel familiar with this manual is permitted for installation and maintenance of the transmitter.

When carrying out the installation of the transmitter, organizational and technical measures must be taken to ensure the safety of work with compressed gas equipment, control and measuring equipment, auxiliary equipment and consumables (for more details, see section 6).

## 2 PRODUCT BASIC DATA

The transmitter is designed to measure the level of sound transparent liquids in vessels. The principle of operation of the transmitter is based on the pulse method of measuring the propagation time of acoustic signals in sound transparent liquids during ultrasonography of the liquid surface through the outer wall of vessels and tanks. Sources of acoustic signal emission and echo signal receivers are UL-1 or UL-2 meters (hereinafter referred to as the meter). Meters provide measurement of sound speed and liquid level. The UC-3 signal converter (hereinafter referred to as the converter) receives signals from the meters and on their basis calculates the liquid level, and also generates and returns the results of measurements and calculations to external devices.

Additionally, the converter can calculate such liquid characteristics as volume, density, weight, etc.

Depending on the model the transmitter consists of one or two meters connected to the converter, which in turn is connected to external switching and power lines through the spark protection unit (which is not supplied with the transmitter and is supplied as a separate independent product), as shown in Fig. 5.1.

The model range of transmitters consists of the following design versions:

- **AlphaSonic-10** – 1 meter with a temperature transmitter (UL-1) + a converter (UC-3) (Fig. 10.2)
- **AlphaSonic -20** - 1 meter with a temperature transmitter (UL-1) + 1 meter without a temperature transmitter (UL-2) + a converter (UC-3) (Fig. 10.3)
- **AlphaSonic -30** – 2 meters without a temperature transmitter (UL-2) + a temperature meter (UT-2) + a converter (UC-3) (Fig. 10.4)

In the design version of the transmitter with one meter, only the meter is installed on the bottom of the tank, and in the design version with two meters, the lower and side meters are installed.

The lower meter measures the distance to the separation of media (liquid and gaseous), and the side meter measures the properties of the medium (sound velocity) and is intended to correct the readings of the lower meter to improve measurement accuracy.

In the AlphaSonic-30 model, a UT-2 temperature meter is connected to the converter, consisting of 2 temperature transmitters, one of which is installed next to the UL-2 meter on the outside of the bottom of the vessel or tank, and the other is at a certain height relative to

the location of the first temperature transmitter. The UT-2 temperature meter is designed to improve measurement accuracy.

Before starting operation, in order to determine the speed of sound in a liquid, it is necessary to record in the transmitter memory the value of the speed base (internal diameter of the tank or cylindrical (spherical) vessel) and the type of liquid, the level of which will be measured. In this case, the filling of the tank or vessel should be more than half of its height. Recommended one is filling at 2/3 of its height. At a liquid level below half of the tank height, to correct the speed of sound the converter uses the temperature of the liquid measured by a temperature meter.

Type of climatic design version of the meters, the converter and the spark protection unit is UHL 1 according to GOST 15150 but for the range of ambient temperature from minus 40°C to plus 75°C.

Transmitters belong to single-function, renewable, repaired products.

The transmitter is powered through the spark protection unit from a power source that provides power characteristics in accordance with Table 10.1.

In the case of using the transmitter in the hazardous area, it is mandatory to use the IS barrier spark protection unit, which is the power source of the transmitter, but is not included in the scope of supply of the transmitter.

In order to transmit not only the fuel level, but also its volume, the calibration procedure is initially performed once. After calibration, the fuel level (in millimeters) is converted to volumetric quantities (liters).

The meters are installed on the side and bottom of the tank from the outside with the help of a clamp - a cable with tensioning device (hereinafter referred to as the clamp, Fig. 12.3).

The transmitter can be used jointly with the equipment that supports Epsilon Data Exchange communication protocol (see Appendix E).

### **Operational features of the ULB-30 transmitter**

Model AlphaSonic-30 is a certified measuring instrument (level gauge) and is subject to calibration every 2 years from the date of acceptance (installation).

The provision of the metrological parameters of the device is carried out as follows.

Essentially, AlphaSonic-30 is a two-channel acoustic wave propagation time meter in sound-transparent liquids and a two-channel temperature meter. The time is measured in relation to the built-in quartz-crystal-controlled oscillator, the error of which is  $\pm 50$ ppm in the range of  $-25 \dots + 55^\circ\text{C}$ . This error is multiplicative with respect to the distance and reaches its maximum absolute value at the maximum possible diameter of the tank for the transmitter ( $\pm 0.12$  mm with a diameter of 2.4 m). Time conversion into distance is carried out using an external speed base, which is the horizontal inner diameter of the tank at the point of application of the meter. The transmitter takes into account the change in the external speed base depending on the temperature for steel and aluminum. A custom linear expansion coefficient can also be entered and used as a linear function of temperature. The value of the internal diameter of the tank can be taken from the technical passport for the vessel or its inspection certificates, and can also be measured in accordance with GOST 8.346-2000 or another method that provides an error in measuring the diameter of no more than  $\pm 1$  mm. All measuring devices used in this case must be calibrated. The error in

determining the external speed base is multiplicative with respect to the measured level, therefore, the absolute error in measuring the level will be less than or equal (in proportion to the level value) to the absolute error in determining the external speed base. In fact, the error in determining the external speed base is the main error of the transmitter when measuring the liquid level. The minimum diameter of the tank, at which the declared metrological parameters are consistently achieved, is 0.6 m.

When the liquid levels in the tank are more than half the transmitter calculates the current sound speed from an external speed base and uses this value to calculate the liquid level. At liquid levels below half, the ability to measure the speed of sound is no longer available. At the same time, the transmitter saves the last values of the speed of sound and temperature of the liquid and begins to correct the speed of sound depending on the temperature according to the high-precision tables of the speeds of sound of the liquids it knows. For unknown liquids, the user can set a third-degree curve describing the dependence of the speed of sound of the liquid on temperature. The main factors influencing the error of the transmitter in this operating mode are the sound velocity gradient over temperature and the accuracy of temperature determination. It is obvious that the greater the gradient of the speed of sound with respect to temperature, the higher the accuracy of determining the temperature is required. For liquids known to the transmitter, the greatest gradient is in the propane-butane mixture and averages  $0.8\%/^{\circ}\text{C}$ . The temperature measurement error is multiplicative with respect to the liquid level; therefore, the maximum value of the absolute error is reached at the maximum usable distance, that is, at half the diameter of the tank. For a propane-butane mixture, this value is  $\pm 0.96$  mm at a height of 1.2 m with a temperature measurement accuracy of  $\pm 0.1^{\circ}\text{C}$ . Temperature transmitters UT-2, used in AlphaSonic-30, are calibrated in production against a reference high-precision temperature transmitter and have the real error of  $\pm 0.05^{\circ}\text{C}$  in the temperature range of  $- 25... + 55^{\circ}\text{C}$ , which allows achieving the required measurement accuracy. The presence of two temperature meters makes it possible to take into account the change in the temperature of the liquid according to the height. When installed, the temperature transmitters and the area around them are closed with highly efficient thermal insulators to minimize the impact of the environment. However, to ensure the metrological parameters of the transmitter, the following must be taken into account.

- The temperature transmitter, installed on the side of the tank, should be located on the side that is shady to the sun. When the tank is oriented from north to south, it is desirable to place the lateral temperature transmitter in the area of artificial shade from objects and buildings.

- When filling the tank, the temperature of the filled liquid may differ significantly from the temperature of the liquid inside. The time for the thermometers to reach an accuracy of  $\pm 0.1^{\circ}\text{C}$  is 15 minutes.

- The supplied AlphaSonic-30 thermal insulators are designed for the climatic zone of Ukraine, i.e. for daily fluctuations in ambient temperature no more than  $25^{\circ}\text{C}$ . Otherwise, it is necessary to install larger thermal insulators.

It should also be noted that when filling the tank with another liquid different from the one inside (for example, propane-butane with a different percentage), the transmitter data cannot be considered reliable (due to the unknown speed of sound of the resulting mixture) until the start of stable operation of the horizontal channel, which corresponds to approximately 60% filling of the tank in height.



### 3 BASIC TECHNICAL SPECIFICATIONS

*Table 3.1 – Basic technical specifications*

Description of characteristic or parameter		Unit of meas.	Value	Remarks
<b>Common</b>				
Resolution		mm	0.1	
Tank wall thickness		mm	4.5...16	
Operating temperature range		°C	-25...+55	
Meters and converter IP rating			IP67	
Maximum cable length		m	300	
Operating mode			continuous	
<b>Measurements*</b>				
Level measurement range		mm	100...2400**	
Error of level measurement	reduced	%	±5 (AlphaSonic-10) ±2 (AlphaSonic-20)	
	absolute	mm	±1 (AlphaSonic-30)	
Averaging period of measurement results		s	60 maximum	
Error of temperature measurement		°C	±0.1 (AlphaSonic-30)	
Code length for representation of measurement results		bit	10/12/16	level
			8/16	temperature
Data rate by serial port		bit/s	2400, 4800, 9600, 19200, 38400, 57600, 115200	Software selectable (factory setting – 19200)
<b>Power supply</b>				
Supply voltage, operating range		V	+4...+6	rated
Consumption current, max		mA	100	
<b>Spark protection marking</b>				
Meters and converter		-	II2GExibIIBT4Gb	Hazardous area
Spark protection unit BIZ-06 (separate product)		-	II(1)G[ExiaGa]IIB	Explosion-proof zone
<b>Overall dimensions:</b>				
- Converter, max		mm	73x57x21	including "ears" 73x77x21
- Meters, max		mm	78x44x23	

\* - Data is considered correct not less than 60 seconds after refueling the tank;  
 \*\* - If the fuel level is less than the lower limit of the measuring range, incorrect transmitter readings are possible. It is recommended to refuel without waiting for the fuel level to reach the lower limit of the measuring range.

#### 4 COMPOSITION OF TRANSMITTER MODELS AND ORDER DESIGNATION

- **AlphaSonic-10** – 1 meter with a temperature transmitter + a converter (Fig. 10.2)
- **AlphaSonic-20** - 1 meter with a temperature transmitter + 1 meter without a temperature transmitter + a converter (Fig. 10.3)
- **AlphaSonic-30** – 2 meters without temperature transmitter + a distributed temperature meter + a converter (Fig. 10.4)

#### 5 GENERAL VIEW AND COMPONENTS

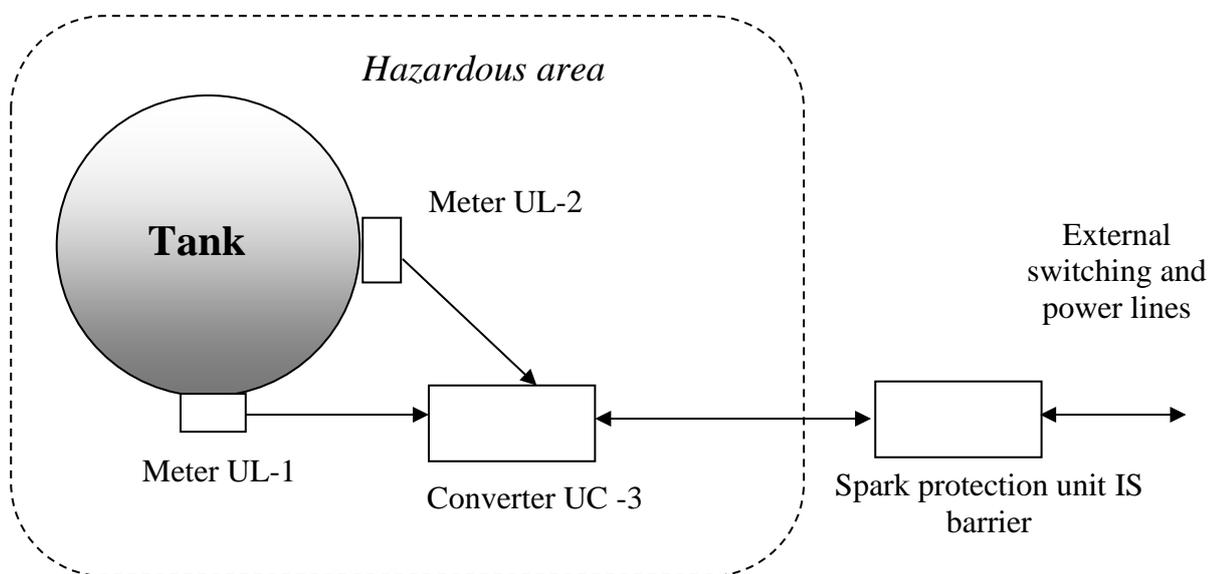
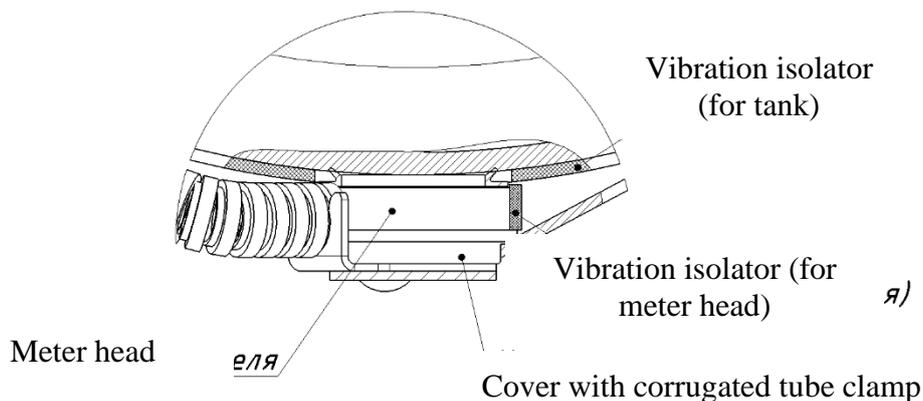


Fig. 5.1 – Connection diagram of transmitter parts using AlphaSonic-20 model as an example



*Fig. 5.2 – Meter*

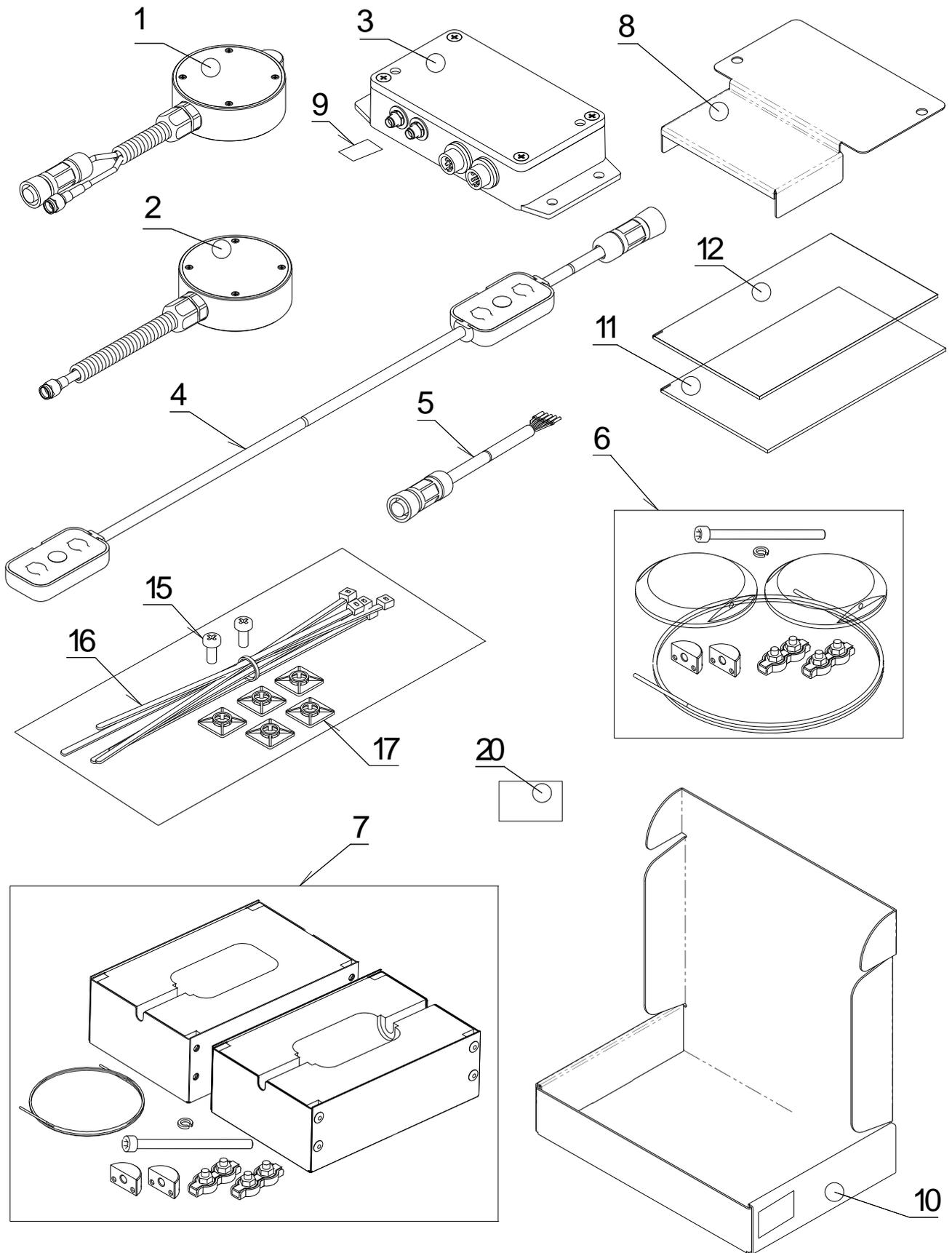
Table 5.1 – Scope of delivery

Description	QTY			Remarks	It. on Fig. 5.3
	10	20	30		
Meter UL-1	1	1	-	with temperature transmitter, 3.5 m cable length	1
Meter UL-2	-	1	2	without temperature transmitter, 3.5 m cable length	2
Temperature meter UT-2	-	-	1	cable length 3 m + 1.6 m	4
Heat insulator	-	-	1	set	7
Ground wire	-	-	2	wire length – 1 m	
Converter UC-3	1				3
Cable	1			length is determined by order	5
Meter lock	1			set	6
Connectors cover	1				8
Connector cap	1			For ULB-10 only	9
Screw M5 x 12	2				15
Cable tie	20			140 x 3.5 mm	16
Mounting area for cable ties	5				17
Grease CIATIM-221	20 g				20
Box	1			with serial number label	10
Technical Passport	1				11
Installation and Operation Manual ULB.0000 IOM	1			It is delivered in electronic form	12

All transmitter models must be connected to external data and power lines through the IS barrier spark protection unit, which is supplied as a separate product.

Table 5.2 – Products and documentation, delivered by additional order

Description	Remarks
Spark protection unit BIZ-06	
IS barrier; Spark protection units BIZ-06, BIZ-08, BIZ-10; Installation and operating manual	



*Fig. 5.3 – Scope of delivery*

## 6 SAFETY PRECAUTIONS, SPARK PROTECTION

At the place of work, the requirements of fire safety rules must be observed in accordance with GOST 12.1.004-91, "Occupational safety standards system; Fire safety; General requirements" and electrical safety in accordance with GOST 12.1.019-91, "Occupational safety standards system; Electrical safety; General requirements" or requirements, operating in the territory of the consumer.

At the place of work, the requirements of labor protection rules must be observed in accordance with the requirements for working with compressed gas equipment or the requirements of regulatory documents in force on the territory of the consumer.

Responsibility for the implementation of safety measures lies with the technical personnel who install the transmitter, as well as the employees responsible for the equipment of the work site.

Meters and converter have available with explosion-proof marking

 **II 2G Ex ib IIB T4 Gb**  
 $-40^{\circ}\text{C} \leq T_a \leq +75^{\circ}\text{C}$

Spark protection unit IS barrier has available with explosion-proof marking

 **II (1) G [Ex ia Ga] IIB**  
 $-40^{\circ}\text{C} \leq T_a \leq +75^{\circ}\text{C}$

*Table 6.1 - Parameter values of intrinsically safe electrical circuits of the UL converter*

Description of characteristic or parameter	Unit of meas.	Value
Max. input voltage, $U_i$	V	6.0
Max. input current, $I_i$	mA	500
Max. internal capacitance, $C_i$	$\mu\text{F}$	870
Max. internal inductance, $L_i$	mH	0.5

*Table 6.2 - Parameters of spark protection of the spark protection unit IS barrier (delivered as a separate product)*

Description of characteristic or parameter	Unit of meas.	Value
Max. output voltage, $U_o$	V	6.0
Max. output current, $I_o$	mA	480
Max. external capacitance, $C_o^*$	$\mu$ F	900
Max. external inductance, $L_o^*$	mH	1.0
* - the maximum values of $L_o$ , $C_o$ for the spark protection unit are set taking into account the 1.5-fold safety factor		

## 7 PREPARATION FOR INSTALLATION

7.1 Unpack and check the complete set of the product according to Table 5.1

Components of meters of transmitter models:

- AlphaSonic-10: lower UL-1;
- AlphaSonic-20: lower UL-1, side UL-2;
- AlphaSonic-30: lower UL-2, side UL-2, a temperature meter UT-2.

7.2 Prepare equipment, tools and consumables in accordance with Table 7.1:

*Table 7.1*

Description
Spanner with opening size of 10 mm, 4mm hexagon wrench, 7mm hexagon socket head.
CIATIM-221 Grease (from a delivery set) – 20 g
Oil-petrol-resistant sealant (recommended: ABRO RTV Silicone Gasket Maker, part No.12AB or similar) - at least 30 g
Marker for marking possible meter locations
Technical Passport and calibration table for the tank

7.3 Fill the tank with at least 2/3 of the volume.

## 9 PRESELECTING LOCATION FOR LOWER METER INSTALLATION

9.1 In order to achieve the optimum operating mode, the lower transmitter meter must be precisely installed at the lowest point of the tank, as shown in Fig. 9.1:

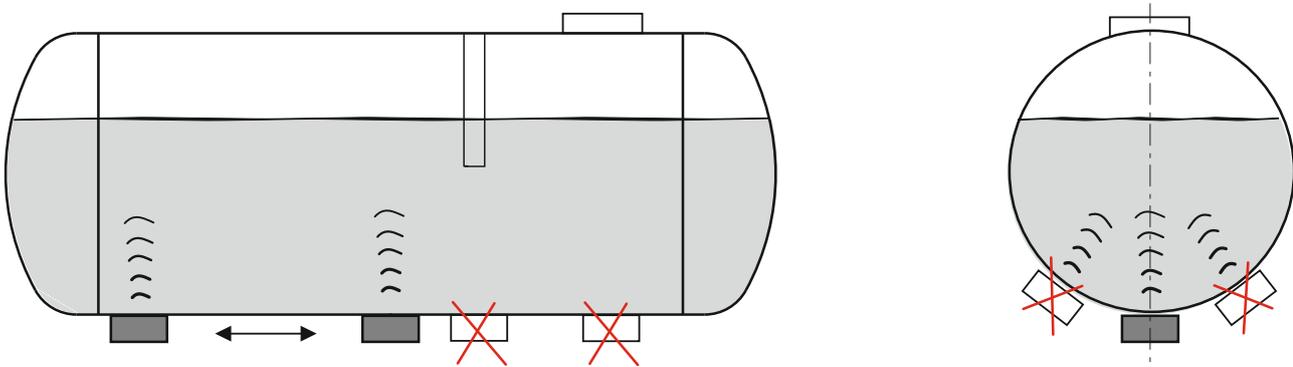


Fig. 9.1 – Correct and incorrect installation locations of the lower meter on the tank

9.2 There must be a gap of at least 10 mm between the lower meter and the surface on which the tank rests. If there is insufficient gap, a groove (slot) can be used in the supporting surface into which the meter can be placed.



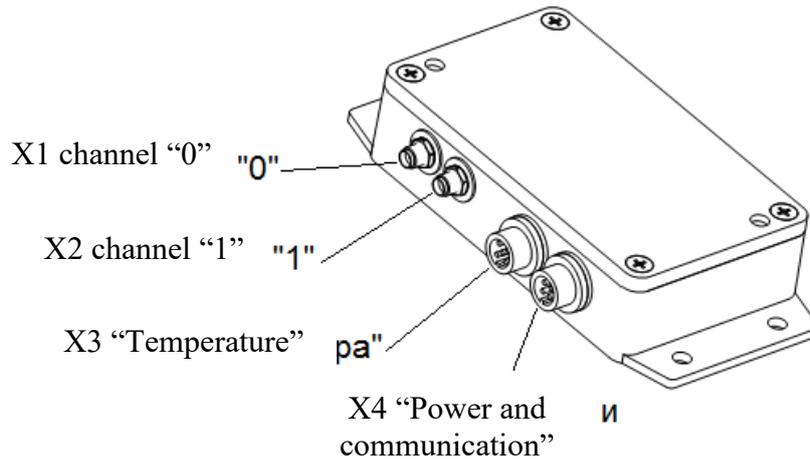
1. **Inside the tank, above the installation site of the meter, there should not be partitions or other structural elements of the tank (floats, pipes, etc.). It is not allowed installing the transmitter meter on the weld and other tank irregularities.**
2. **The tank must be earthed.**

The working surface of the meter plane should be as parallel as possible to the plane of the fuel surface, i.e. located horizontally.

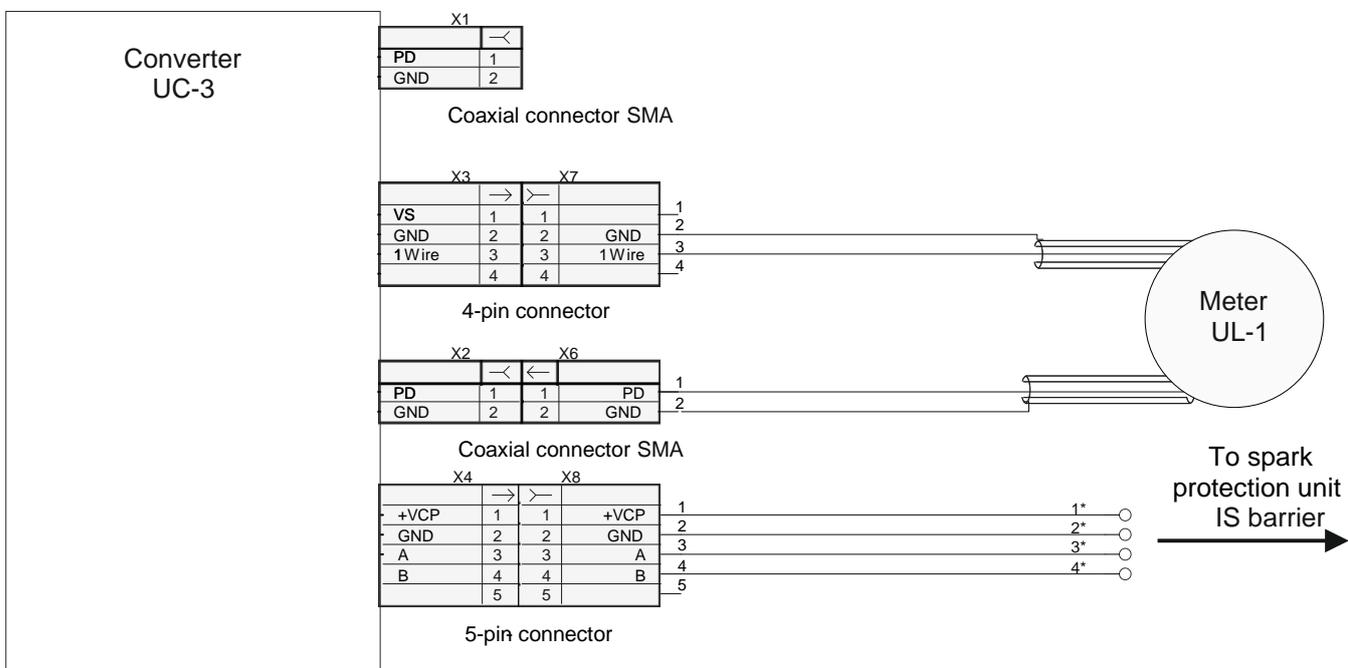
9.3 Taking into account these remarks, select two or three proposed locations for the installation of the meter, clean them of dirt and rust, degrease and mark them.

## 10 ELECTRICAL CONNECTION OF THE TRANSMITTER

10.1 The electrical connection of the transmitter includes connecting the parts of the transmitter in accordance with Fig. 10.2 to Fig. 10.4, the connection of the converter with the spark protection unit IS barrier (in accordance with the marking given in Table 10.1) and the connection of the spark protection unit to the control device and the power supply device.



*Fig. 10.1 - Converter connectors  
Connect the lower meter to channel 1  
Connect the side meter to channel 0*



*Fig. 10.2 – Connection diagram of the AlphaSonic-10 model transmitter*

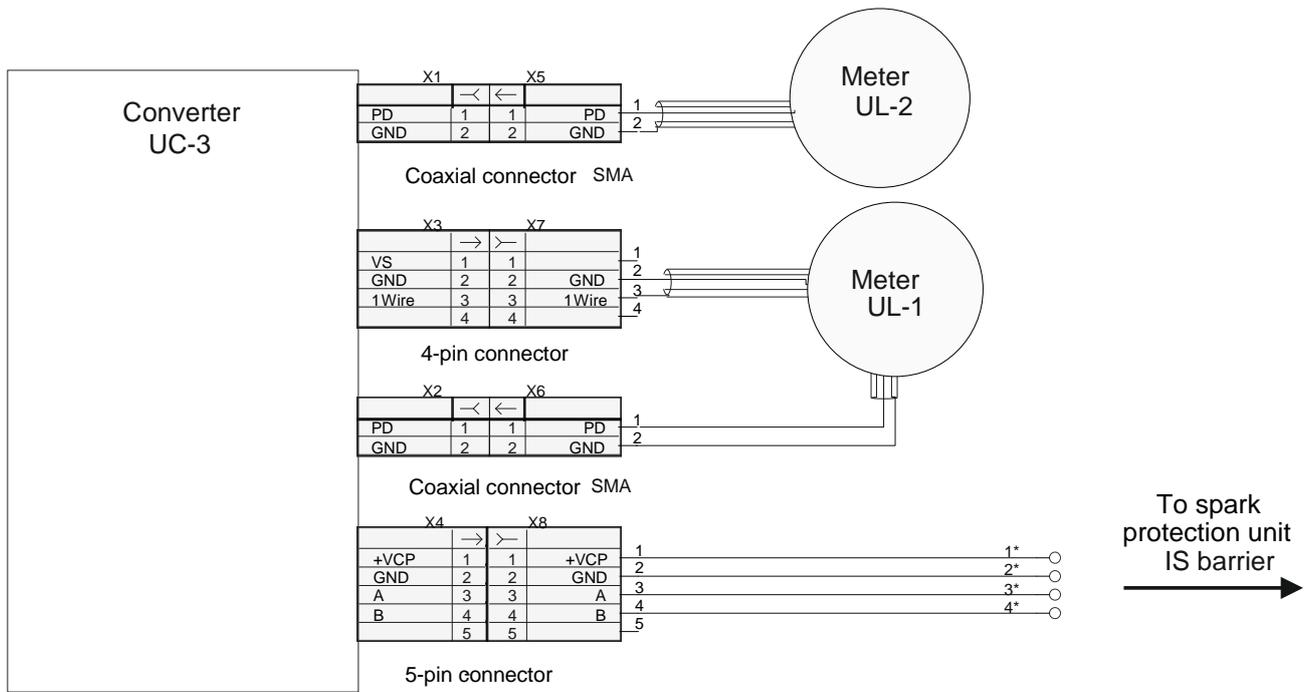


Fig. 10.3 - Connection diagram of the AlphaSonic-20 model transmitter

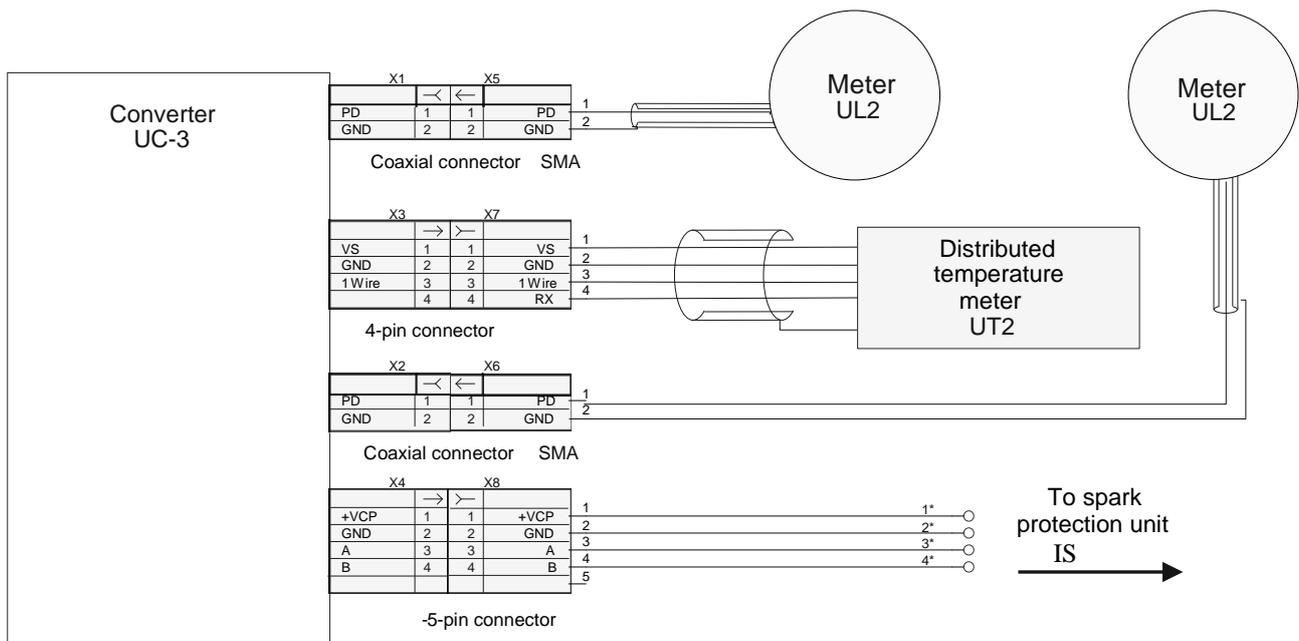


Fig. 10.4 – Connection diagram of the AlphaSonic-30 model transmitter

Table 10.1 – Service of the interface cable outputs

Wire Numbering	Service
1	U <sub>+</sub>
2	U <sub>-</sub> (common)
3	A (RS-485)
4	B (RS-485)

**In the AlphaSonic-30 model, it is mandatory to ground the UC-3 converter, the UL-2 meters fixing cable and the UT-2 temperature meter fixing cable (ground wires are included)!**

## 11 FINAL SELECTING LOCATION OF LOWER METER INSTALLATION

11.1 Further installation operations of the transmitter are carried out using a personal computer or laptop (hereinafter referred to as the PC) - with "uS40\_Install\_Service" program installed on it (see Appendix A).



**Before installing the transmitter with settings different from the factory settings, make sure that the tank height in the transmitter is correctly set. The tank height in the transmitter must not be lower than the actual tank height. The tank height in the transmitter can be changed using the uS40\_Install\_Service software (Appendix A). The factory value of the tank height is 150 cm.**

For the final determination of the installation location of the meter, it is necessary to select one of the previously marked places according to the maximum echo power controlled by the program.

For this purpose it is required to:

11.2 Lubricate with the grease, indicated in Table 7.1, clamping surface of the meter. The grease is designed to create acoustic contact between the meter and the tank.

11.3 Apply voltage to the transmitter.

11.4 Determine the operating frequency of the meter in accordance with the "Transmitter Calibration" section, Appendix A.

11.5 Fix the gain factor on the selected channel (see Appendix A) and, applying alternately the meter to the previously selected points, finally select the installation location of the meter by the magnitude of the reflected signal (see Appendix A). Slightly changing the position of the meter, achieve the maximum signal level.



- **Before each pressing of the meter it is necessary to control the presence of a lubricant layer on it (without a lubricant layer, the meter will not work)!**
- **Air bubbles and foreign particles or objects such as dust, grains of sand, etc. are not allowed in the grease.**

11.6 The best location to install the transmitter meter will be where the signal level is at its maximum. Mark this place along the perimeter of the meter with a marker.

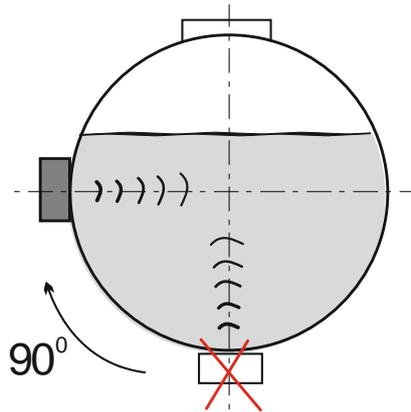
11.7 Turn off the power to the transmitter.

## 12 METERS CALIBRATION

Next, you need to calibrate the lower and side meters. Calibration of the meters is necessary to exclude the influence on the result of measuring the tank wall and the characteristics of each meter.

To perform the calibration of two meters (for example, for the AlphaSonic-30 model) you need:

12.1 After the final determination of the installation location of the lower meter, as described in it. 11, move it 90° to the side of the tank, in the same plane perpendicular to the axis of the tank (Fig. 12.1):



*Fig. 12.1 – Moving the lower meter to the side of the tank*

12.2 Lubricate with the grease, indicated in Table 7.1, the pressure surface of the meter (taking into account all the remark given in the previous section) and press it to the surface of the tank). Connect the power to this meter, run the program "uS40\_Install\_Service" and, slightly moving the meter, achieve the maximum signal level, and then fix it (press) it at this location.

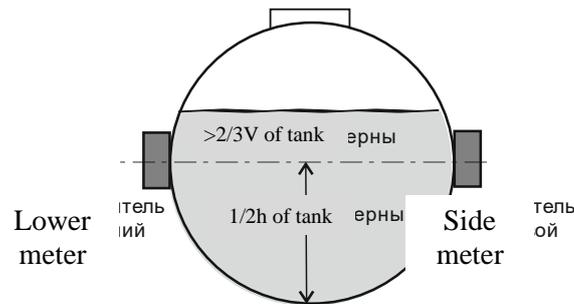
12.3 Install (taking into account all the remarks given in it. 12.2) symmetrically to this meter on the other side of the tank the second (side) meter as shown in Fig. 12.2 and also press it against the tank.



**The meters must be symmetrically located opposite each other, and the planes of the surfaces of the meters are parallel, because this may affect calibration accuracy.**

It is necessary to hold the meter in this place until it is secured with another meter with a cable clamp.

At the same time, the tank should be filled more than 2/3 of its volume and there should be no foreign objects between the meters.



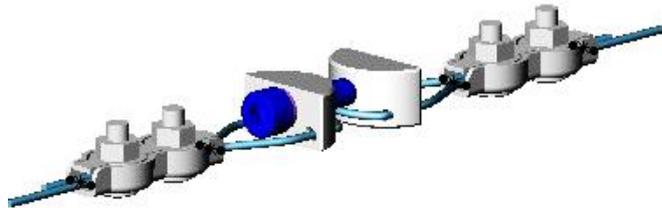
*Fig. 12.2 – Installing two meters for calibration*

12.4 Fix the meters on the tank with a cable.

A cable with a tensioning device (clamp) should cover the tank in the plane selected for installation.

12.5 Route the cable through the clamping covers of both meters.

Thread the ends of the cable through the holes in the half-sleeves of the tensioning device. Unscrew the screw of the tightening device as long as possible. Insert the cable into the clamps and slightly tighten the clamp nuts (Fig. 12.3):



*Fig. 12.3 – Tensioning device*

12.6 Holding the entire structure, pull the free ends of the cable to such a length that the distance between the pressure cap of the meter and the surface of the tank is about 20 mm. Position the clamps so that the ends of the cable out of the clamps go out no more than 2 cm. Tighten the nuts on one of the cable clamps.

12.7 If necessary (in case of the grease is worn out), apply an additional layer of grease to the meter, indicated in Table 7.1, and re-press it.

12.8 Insert the housing of the meter into the clamping cover and press the cover with your hand to the surface of the tank in the selected location (only a single touch to the surface of the tank is permissible).

Continuing to press the meter to the tank, pull the end of the cable through an incompletely tightened clamp and haul in the bight of all the cable. Tighten the nuts of the second clamp. Tighten the cable on top of the tank with the screw on the tensioning device. As the cable is tightened, excess grease will be squeezed out from under the meter.

Tighten the cable until a tight fit of the surface of the meter to the tank is ensured and the extrusion of excess lubricant stops.

12.9 Connect the meters to the converter according to the diagram for the selected model in section 10.

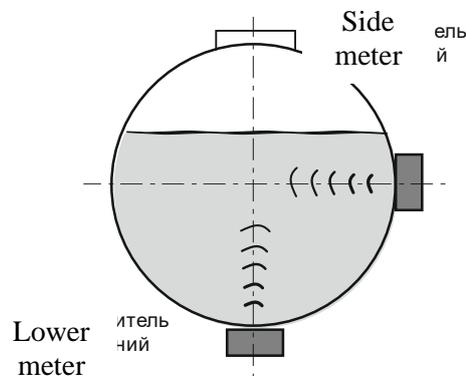
12.10 Connect power to the transmitter.

12.11 Calibrate the meters and configure the transmitter (see the "Transmitter configuring" section).

**When setting up and calibrating, the meters must not be moved!**

12.12 After completing the settings and calibration, loosen the clamp cable and move the lower meter to its previous, earlier marked place below, degrease, grease and press it again, taking into account all the remarks given in the previous section.

The location of the meters should take the form, as in Fig. 12.4:



*Fig. 12.4 – Final locations of the side and lower meters*

## 13 FINAL INSTALLATION OF METERS

13.1 Finally fix the meters in position Fig. 12.4, as described in the previous section. Ground the meter fixing cable.

13.2 Be sure to seal with the sealant, specified in Table 7.1 the external diameter of the contact zone of both meters with the tank, as well as the cable outlet, having previously removed excess grease and degreasing the corresponding surfaces.

13.3 Apply voltage to the transmitter. Using the program "uS40\_Install\_Service" (see Appendix A), verify that the signal level of the meter has not decreased or has decreased slightly.

Otherwise, repeat the selection of location and installation of the meter, starting from section 11 (or contact service support).

13.4 Disconnect power to the transmitter according to section 10.



**Upon completion of the successful installation of the meters, disconnect the transmitter from the power supply!**

## 14 INSTALLATION OF CONVERTER

14.1 Install the converter in a convenient place; fasten the corrugated cables connecting it to the meters with ties.

14.2 Route the cable from the converter connector to the control device and fix it with ties on the fixed parts of the structure every 50-60 cm. The cable should be in the corrugated pipe.

14.3 The interface cable may be shortened to the required length.

14.4 Make the electrical connection of the transmitter according to Table 10.1.

14.5 Ground the transmitter housing.

## 15 INSTALLATION OF TEMPERATURE METER

15.1 The UT-2 temperature meter consists of two temperature transmitters (A1, A2) and two heat insulators (for each of the transmitters).

15.2 The temperature transmitter A1 (passing through) should be located near the lower meter, along the horizontal axis of the tank. The temperature transmitter A2 (final) should be located at 1/4 of the tank height, which corresponds to an upward shift of  $60^\circ$  relative to the location of transmitter A1 (or  $2/3$  of the arc length between the meters) (see Fig. 15.1):

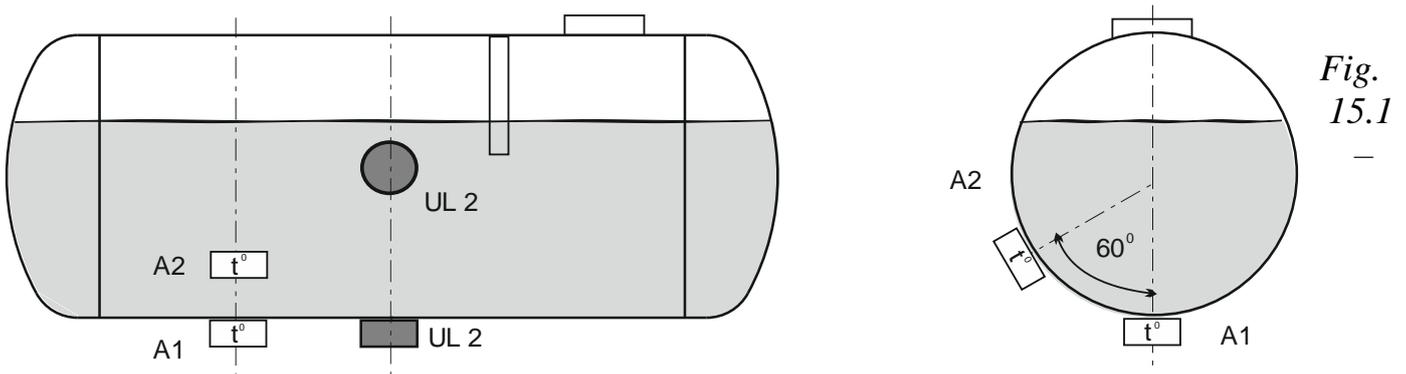


Fig.  
15.1

*Installation of the UT-2 temperature meter for the AlphaSonic-30 model: Temperature transmitters A1 and A2 and UL2 meters must be in planes, each of which is perpendicular to the axis of the tank*

15.3 Prior to installing the temperature meter on the tank, clean the installation sites of the temperature transmitters from dirt and rust.

15.4 Install the temperature transmitters in heat insulators.

15.5 Apply a layer of thermally conductive paste KPT-8 on the measuring surface of the temperature transmitters. Apply sealant to heat insulators specified in Table 7.1.

15.6 Fix the temperature meter set with a cable with the tensioning device (clamp), similar to the fastening of the meters. Ground the cable.

15.7 Connect the temperature meter to the converter and apply power to the converter.

15.8 Using the program "AlphaSonic\_DataViewFull" (see Appendix A), check for temperature readings.

15.9 Turn off power to the converter.

15.10 Route the cable from the converter connector to the temperature meter set and fix the cable with ties on the fixed parts of the structure every 50-60 cm.

## 16 TRANSMITTER CONFIGURING

To configure and control the transmitter parameters, a PC is used with the “uS40\_Install\_Service” and “AlphaSonic\_DataViewFull” programs installed on it (see Appendix A). Work with the program "uS40\_Install\_Service" is carried out as follows:

16.1 Prepare equipment, tools and consumables in accordance with Tables 7.1 and 16.1.

Table 16.1

Description	QTY
PC, minimum requirements: 1 GHz, 1 GB RAM, MS Windows 7, MS Office, at least 20 MB free hard disk space, a mouse, a free USB port	1 pc
USB/RS-485 converter: It is recommended to use MOXA UPort 1130 converters	1 pc

16.2 Prepare the transmitter for calibration according to section 12, the meters should be installed as in Fig.12.2.

16.3 When installing the transmitter in the explosion-proof area, connect the interface wires using an adapter cable to a PC via USB/RS-485 converter (see Fig. 16.1, Appendix C and Table 10.1). Apply voltage to the transmitter. The voltage of the 5 V USB port of the PC can be used as a transmitter power source.

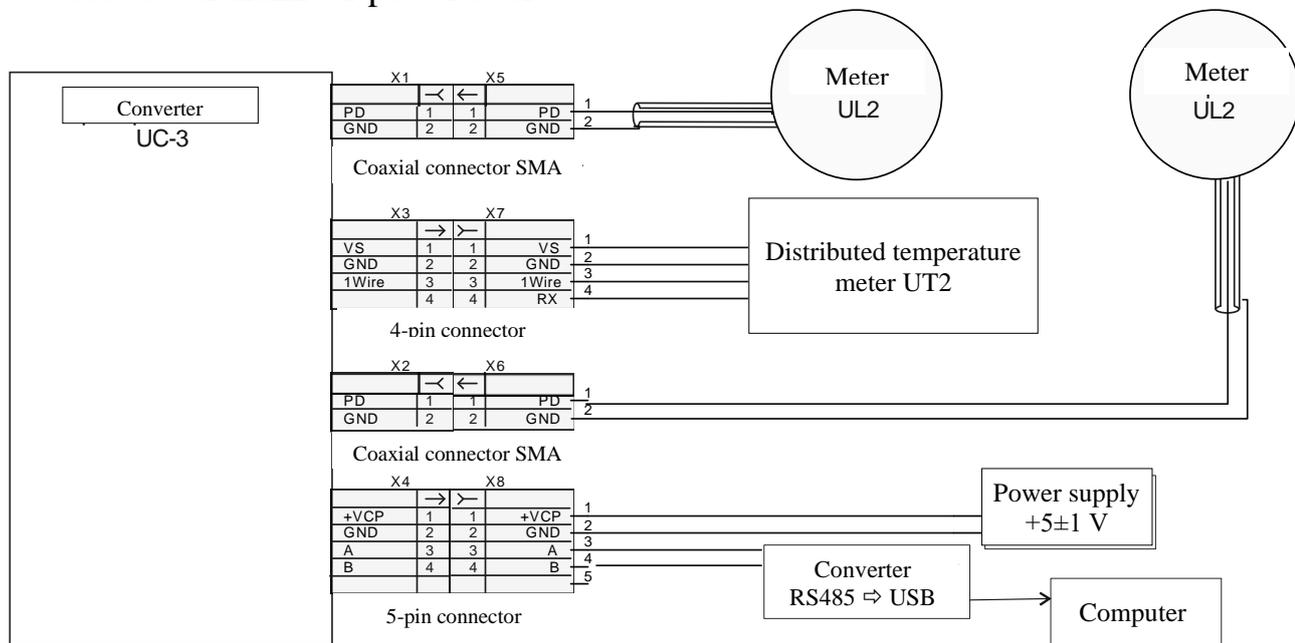


Fig. 16.1

16.4 When installing the transmitter in the hazardous area, the power and connection of the transmitter to the PC is carried out through the spark protection unit. The spark protection unit and the PC must be located in an explosion-proof area. The transmitter and spark

protection unit must be pre-set to 115,200 baud. Upon completion of the settings, the speed of the devices should be returned to the selected value of the operating speed.

16.5 Configure the transmitter in accordance with Appendix A.

16.6 Turn off the power to the transmitter, disconnect the PC and make the electrical connection in accordance with section 10.

16.7 Put the protective tubes on the connectors of the meters on the converter housing and then install the protective cover of the connectors (it. 8 in Fig. 5.3).

## **17 TRANSPORTATION AND STORAGE**

Transportation of the transmitter in the manufacturer transport packaging is allowed by all types of closed land and sea transport (in railway cars, containers, closed vehicles, holds, etc.). Transportation in airtight compartments of aircraft is allowed.

When transporting products in factory packaging by open transport, measures must be taken to protect them against the effects of precipitation, dust and dirt.

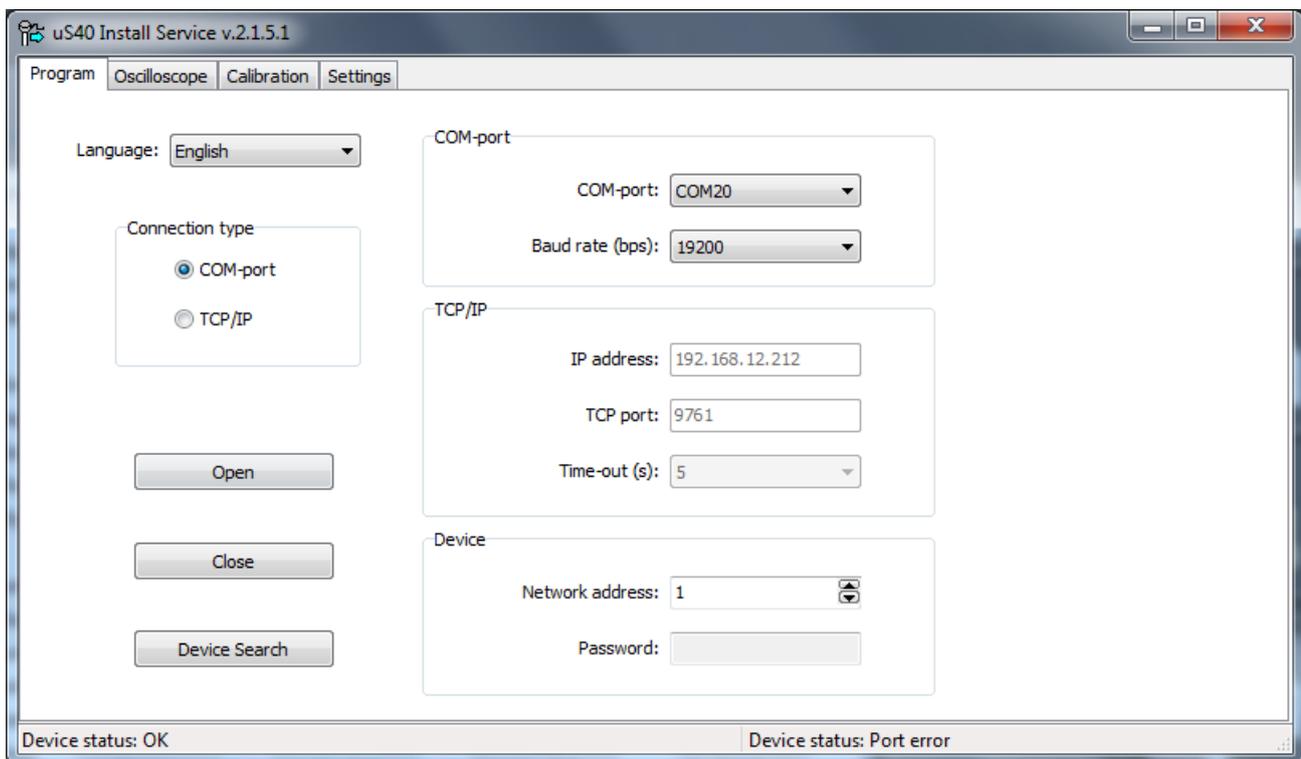
During transportation and storage, the requirements of the handling signs on the group transport packaging must be observed.

## APPENDIX A

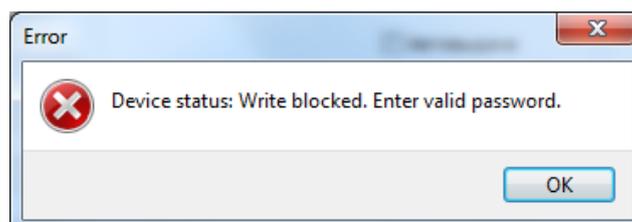
**BRIEF MANUAL FOR CONFIGURING THE ALPHASONIC-30 TRANSMITTER USING US40 Install Service PROGRAM AND DISPLAYING THE PARAMETERS USING THE ALPHASONIC\_DataViewFull PROGRAM**

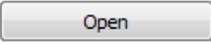
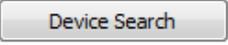
The AlphaSonic-xx transmitter is configured using the US40\_Install\_Service program. After starting the program, on the "Program" tab, select the type of communication and the required parameters.

A transmitter with factory settings has the following parameters: "Baud rate (bps)" - 19200 bps, "Network address" - 1, "Password" - without a password (Fig. A.1):

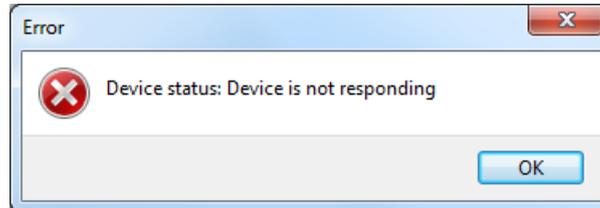
*Fig. A.1*

**Attention!** If the port with the wrong password is opened (with the password set), the changes made to the transmitter settings will not be saved in the device. The program will display a message (Fig. A.2):

*Fig. A.2*

To start work, click on the button . If the settings for the **band rate and the network address** of the transmitter are unknown, you can use the button . When you click on this button, the program sends a request to the port with the broadcast address.

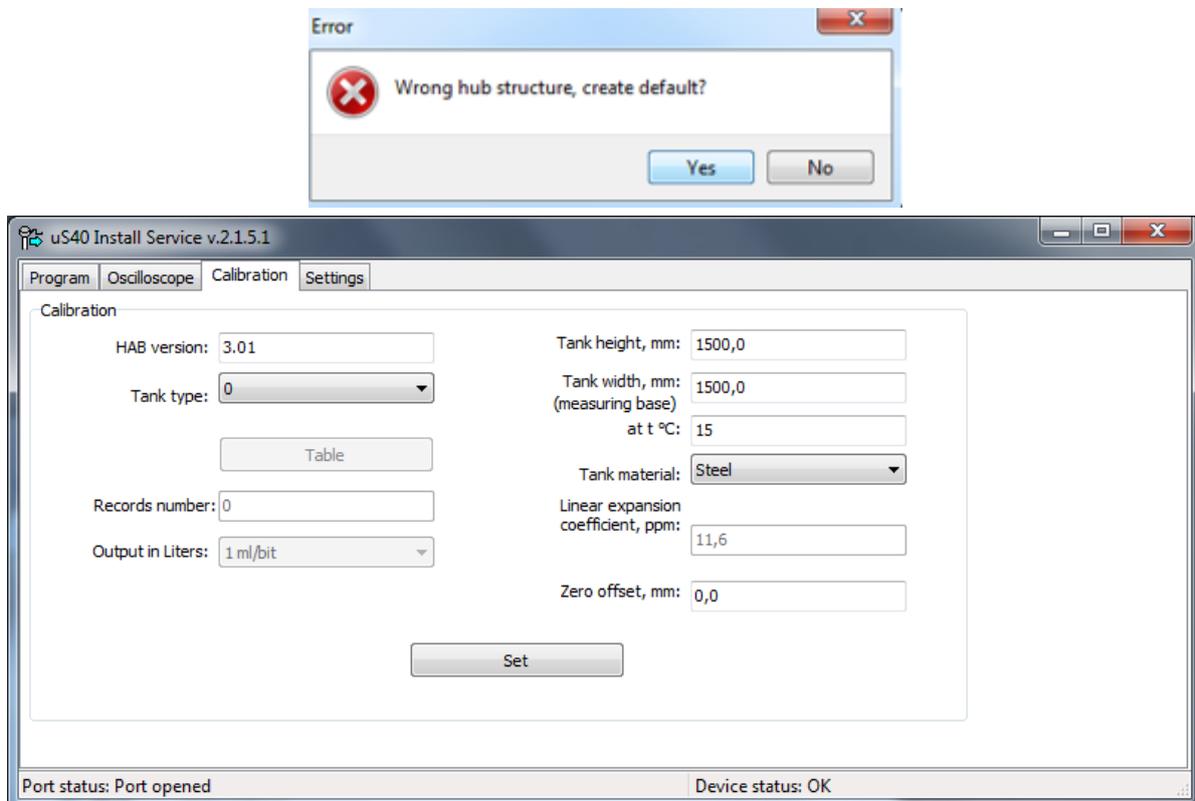
In the absence of communication with the transmitter, the following message is displayed (Fig. A.3):



*Fig. A.3*

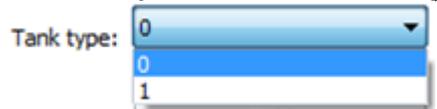
### Transmitter calibration

Go to the tab "Calibration" (Fig. A.4). When you turn on the product with the zero configuration for the first time, when you go to this tab, a pop-up window will appear asking you to create a default calibration table. Click the "Yes" button.



*Fig. A.4*

On the tab “Calibration” from the drop-down list “Tank type”



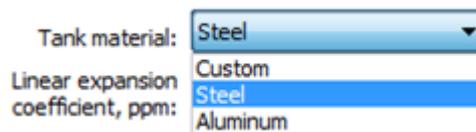
1) select the value **1** if the calibration table is loaded into the transmitter. The output data will be recalculated into the volume and weight of the measured substance. The value **0** is selected if the calibration table is not loaded into the transmitter. In this case, the output data will in millimeters reflecting the current level of the liquid fraction.

2) In the "Tank height" field, enter the inner diameter of the tank in millimeters.

3) In the field "Tank width, mm (measured base)" also enter the inner diameter of the tank in millimeters.

**Attention!!!** The accuracy of setting this value affects the accuracy of determining the speed of sound and, ultimately, the accuracy of determining the gas level in the tank. Therefore, it is advisable to set the “Tank Width” with an accuracy of  $\pm 1$  mm. The value of the internal diameter of the tank can be obtained from its technical passport or to measure the external diameter in the horizontal plane using special measuring equipment and subtract the doubled wall thickness.

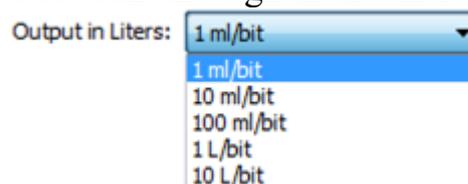
4) From the drop-down list "Tank Material"



select the appropriate option. If the "Custom" option is selected, then in the "Linear expansion coefficient, ppm" field, enter the values corresponding to the material of the tank walls. For steel and aluminum, the coefficient will be set by default.

5) In the "Zero offset" field, enter the calculated offset value " $\Delta$ ". To calculate, perform the following steps (first, the side meter must be calibrated according to the “Transmitter Calibration” section of this manual):

- In any way possible, identify and mark the middle of the tank;
- Measure the distance “ $x$ ” in mm from the middle of the tank to the lower meter (estimated installation location); measure liquid level “ $h_1$ ” in mm at a given point;
- Install the lower meter in a mirror-like manner relative to the middle of the tank at a distance “ $x$ ” in mm; measure the liquid level “ $h_2$ ” in mm at the second point;
- Calculate the offset value according to the formula  $\Delta = (h_2 - h_1) / 2$  and enter the resulting value taking into account the sign in the “Zero offset” field



6) From the drop-down list “Issue in liters” select the division price of the least significant bit of the volume data, which is output by the transmitter (usually 1 l/bit).

7) Download the calibration table as an Excel file<sup>1</sup> (\*.xls, \*.xlsx). The calibration table should be prepared in advance from the calibration table of the tank. The data structure of the prepared file:

column "A" - liters, column "B" - millimeters, text "caps" of fields are absent, zero record (0 liters, 0 mm) is absent.

To download, click the button . Next, in the "Calibration table"

window that appears, click .

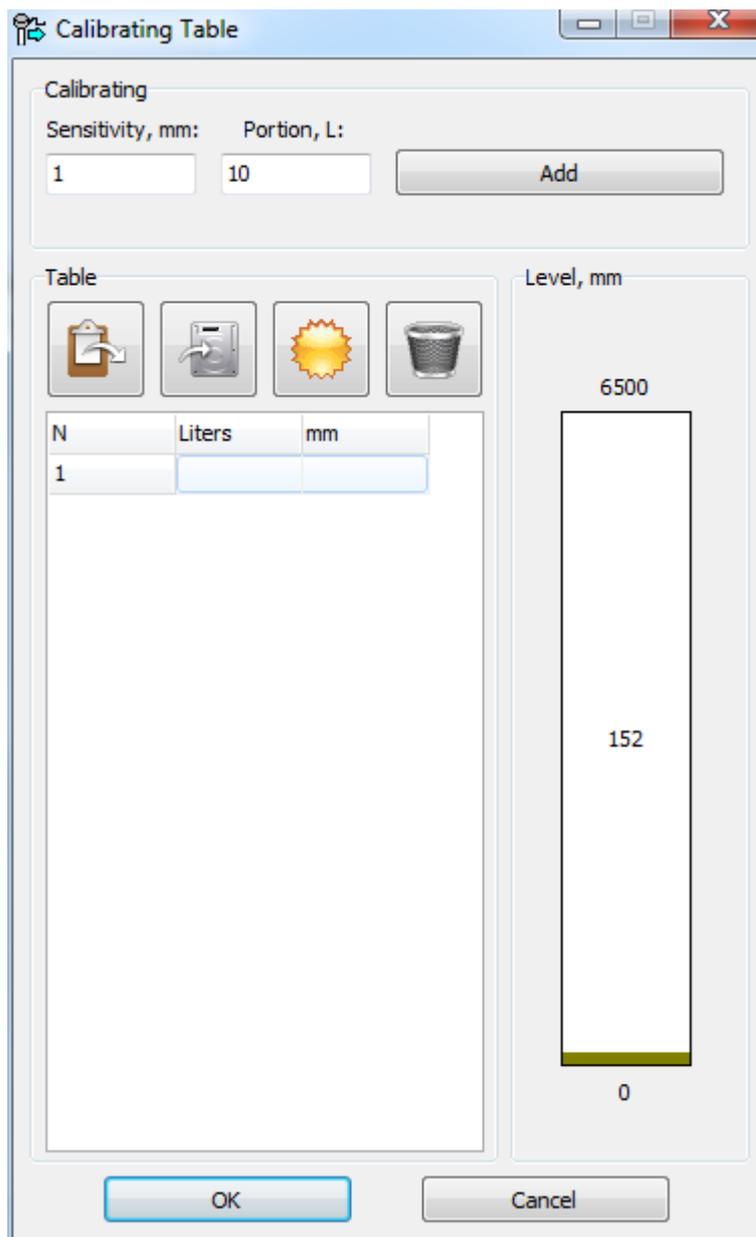
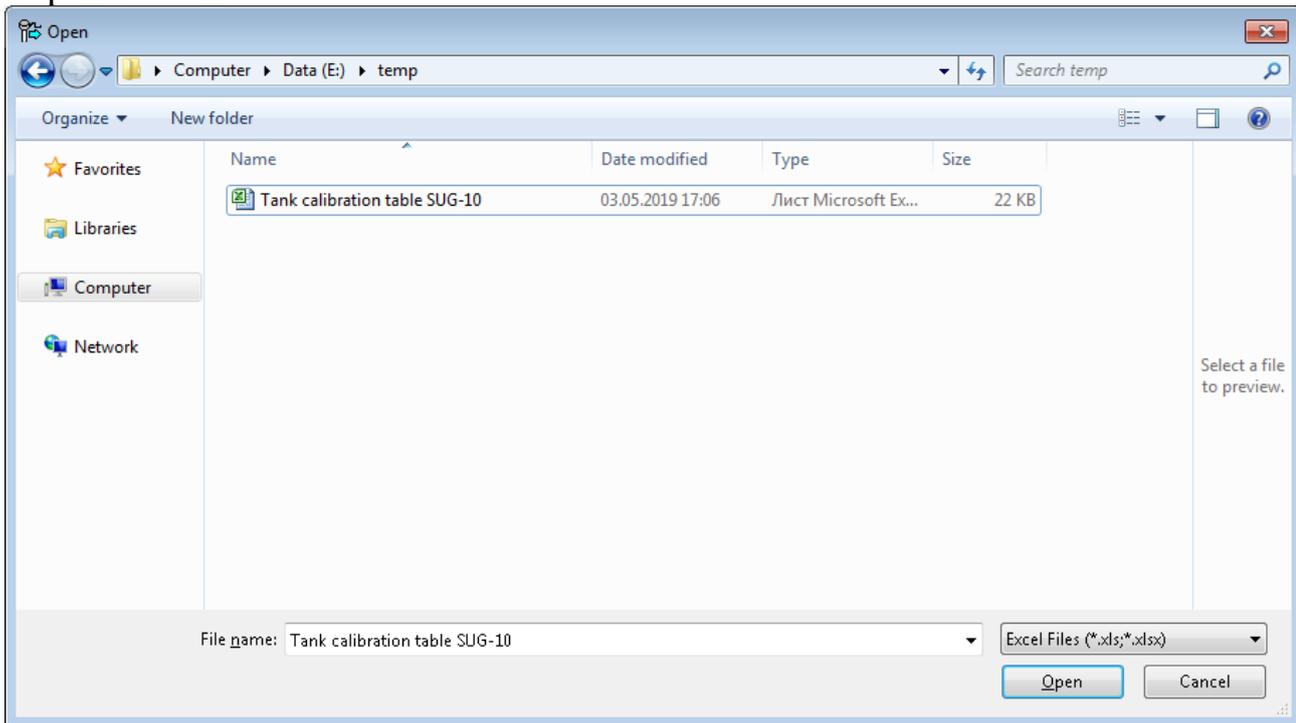


Fig. A.5

<sup>1</sup> The Excel file containing the calibration table: the first column should contain the volume of the tank, and the second column should contain the level of the measured substance corresponding to it.

In the window that appears, select the file with the calibration table and click the "Open" button.



*Fig. A.6*

Then, in the "Calibration table" window, click the "OK" button.

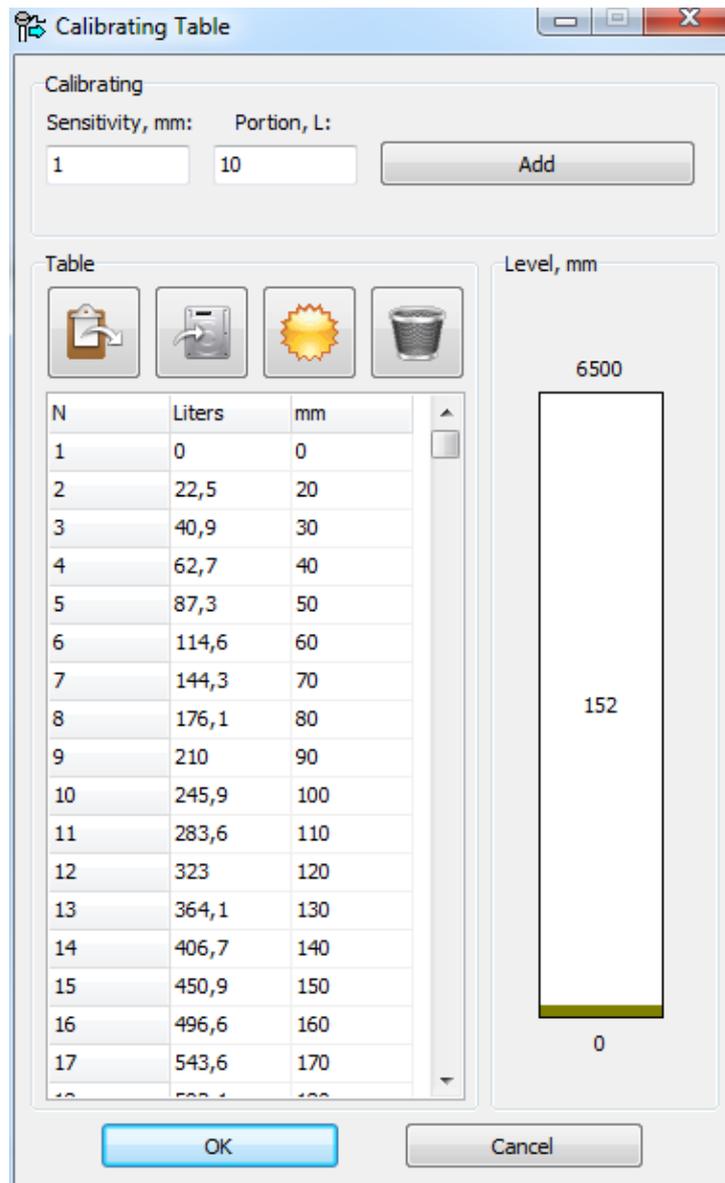
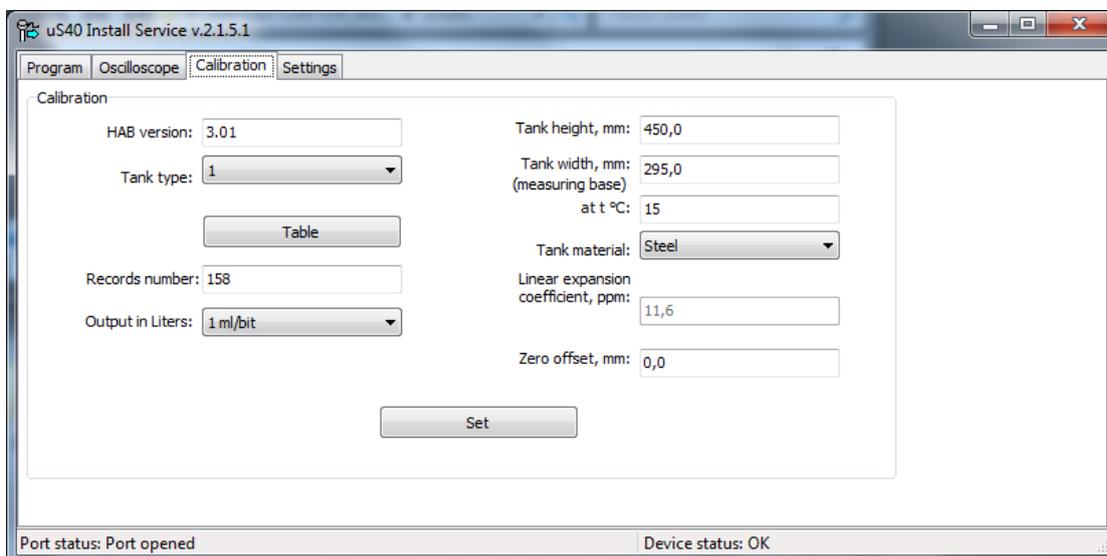


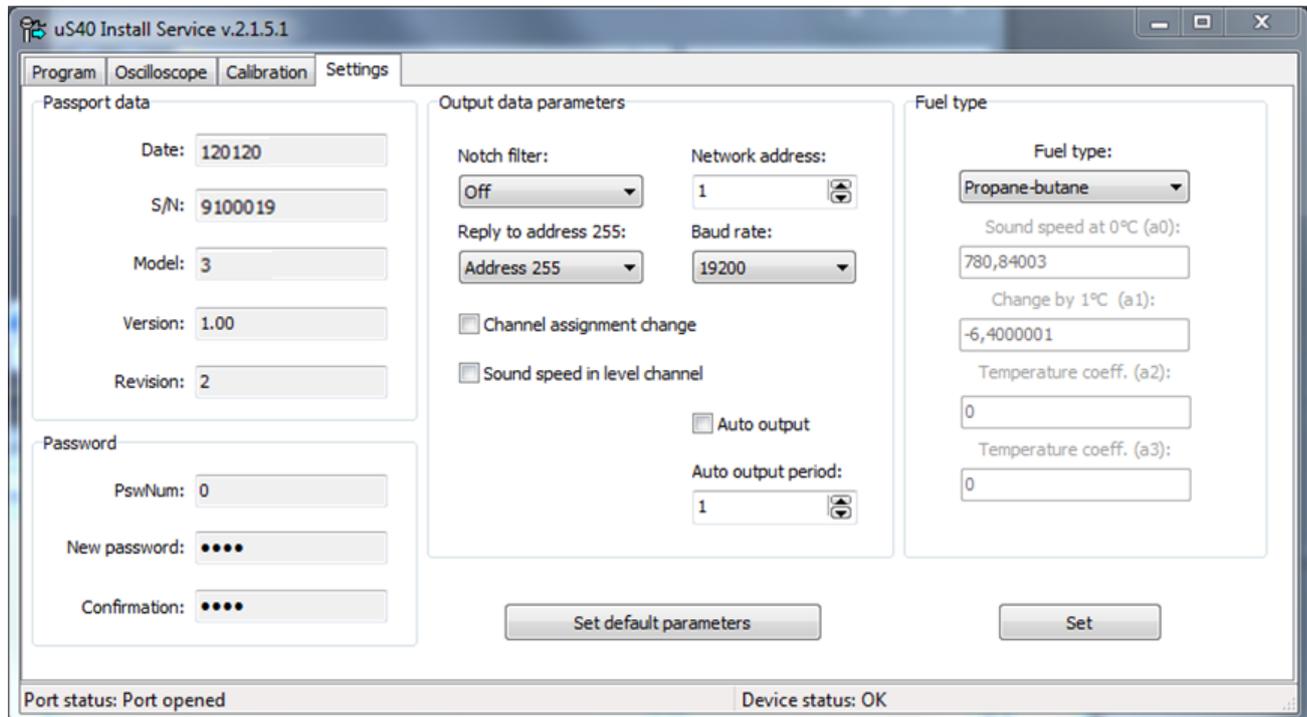
Fig. A.7

8) Click the “Set” button to save all installed parameters.



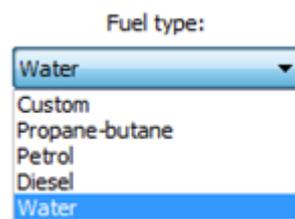
*Fig. A.8*  
**Selection of measured medium type**

Go to the “Settings” tab (Fig. A.9):



*Fig. A.9*

1) In the drop-down list “Fuel Type”



select the type of liquid to be measured.

If you select a value other than the fuel type “Customized”, the fields below the drop-down list will be filled by default.

Sound speed at 0°C (a0):  
  
 Change by 1°C (a1):

When choosing the value of the fuel type "Customized" in the field  enter the sound velocity value for the user-defined type of liquid and the gradient of the change in the speed of sound per degree for this liquid.

For more accurate measurement of customized liquid type in fields

Sound speed at 0°C (a0):

Change by 1°C (a1):

Temperature coeff. (a2):

Temperature coeff. (a3):

enter gradients **a0**, **a1**, **a2**, **a3**, corresponding to a polynomial of the third degree, which describes the temperature dependence of the speed of sound in the customized liquid:

$$c = a0 + a1*t + a2*t^2 + a3*t^3$$

- 2) If necessary, you can change the following interface parameters: network address of the transmitter, interface speed, auto-output parameters. These parameters must be configured as required by an external control device.

Notch filter:

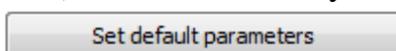
3) In the drop-down list, you can select on/off the rejection filter depending on the external conditions of the electromagnetic environment in which the transmitter operates. In conditions of increased electromagnetic interference, the filter must be turned on.

4) In the absence of a checkbox  Смена назначения каналов, channel 0 measures the speed of sound in a liquid, channel 1 measures a liquid level.

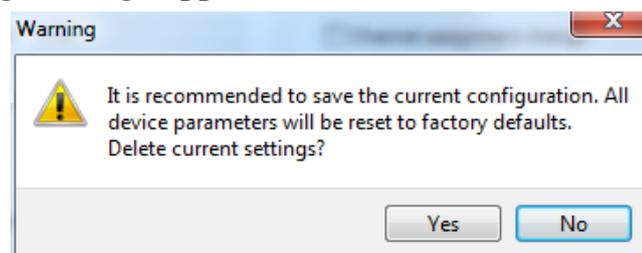
When the checkbox is selected  Смена назначения каналов, channel 0 measures the level of the liquid, channel 1 measures the speed of sound in the liquid.

5) When the checkbox is selected  Скорость звука по каналу уровня on the channel, in addition to the level measurement function, the sound velocity measurement function is added.

- 6) To set the factory settings for the transmitter, press the button



At the same time, a warning message appears to delete the current settings:



To set the factory parameters, click the "Yes" button.

Password

PswNum: 0

New password: ●●●●

Confirmation: ●●●●

7) Fields are used to set a new password.

If the transmitter configuration is zero, you do not need to enter a password.

The PswNum field displays how many times the password has been changed using the password generator (the permissible number is 5 times).

**Attention!** In case of losing the password, for full work in the program, you need to get a temporary password in the service center, for this you need to inform the serial number of the transmitter and the number from the PswNum field. After receiving a temporary password, it is recommended to replace it with a new one.

8) To save the settings, click the button

УСТАНОВИТЬ

uS40 Install Service v.2.1.5.1

Program Oscilloscope Calibration Settings

Passport data

Date: 120120

S/N: 9100019

Model: 3

Version: 1.00

Revision: 2

Password

PswNum: 0

New password: ●●●●

Confirmation: ●●●●

Output data parameters

Notch filter: Off

Network address: 1

Reply to address 255: Address 255

Baud rate: 19200

Channel assignment change

Sound speed in level channel

Auto output

Auto output period: 1

Fuel type

Fuel type: Water

Sound speed at 0°C (a0): 780,84003

Change by 1°C (a1): -6,4000001

Temperature coeff. (a2): 0

Temperature coeff. (a3): 0

Set default parameters Set

Port status: Port opened Device status: OK

Fig. A.10

## Transmitter calibration

The transmitter is calibrated at the place of its installation on a specific tank in order to take into account the delay in the passage of ultrasound through the tank walls and adjust the operating frequency of the meters.

To carry out the calibration, it is necessary that the tank is filled for more than 2/3 of the volume. The meters are located diametrically opposite to each other, in the same plane perpendicular to the axis of the tank (see Fig. 12.2). It is assumed that the tank has the same wall thickness in the side and bottom of the tank.

### Setting the operating frequency of the meters

To set the operating frequency, go to the “Oscillograph” tab (Fig. A.11):

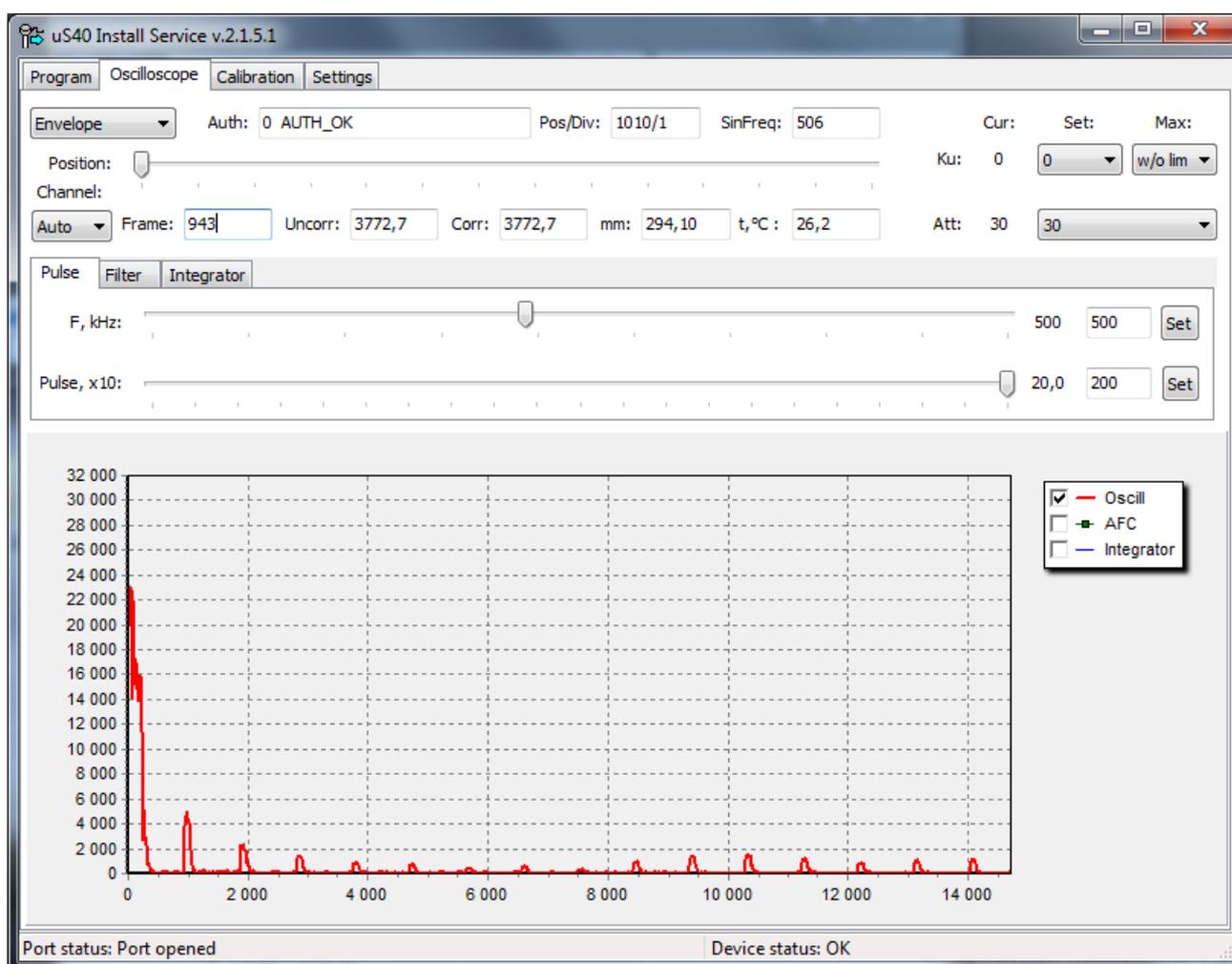
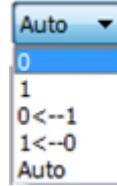
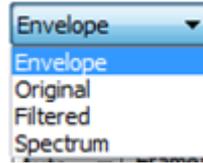


Fig. A.11

### Selecting the operating frequency for channel 0 (side meter):



a) In the drop-down menu, select channel 0.



In the drop-down menu for displaying the oscillograph record, select the "Envelope" mode.

b) On the "Pulse" tab, in the "F, kHz" field, enter the value **1000**. Press the "Set" button. In the field "Imp, x10:" enter the value **5**. Press the "Set" button. Check the change of the entered values in the position to the left of the input field (Fig. A.12):

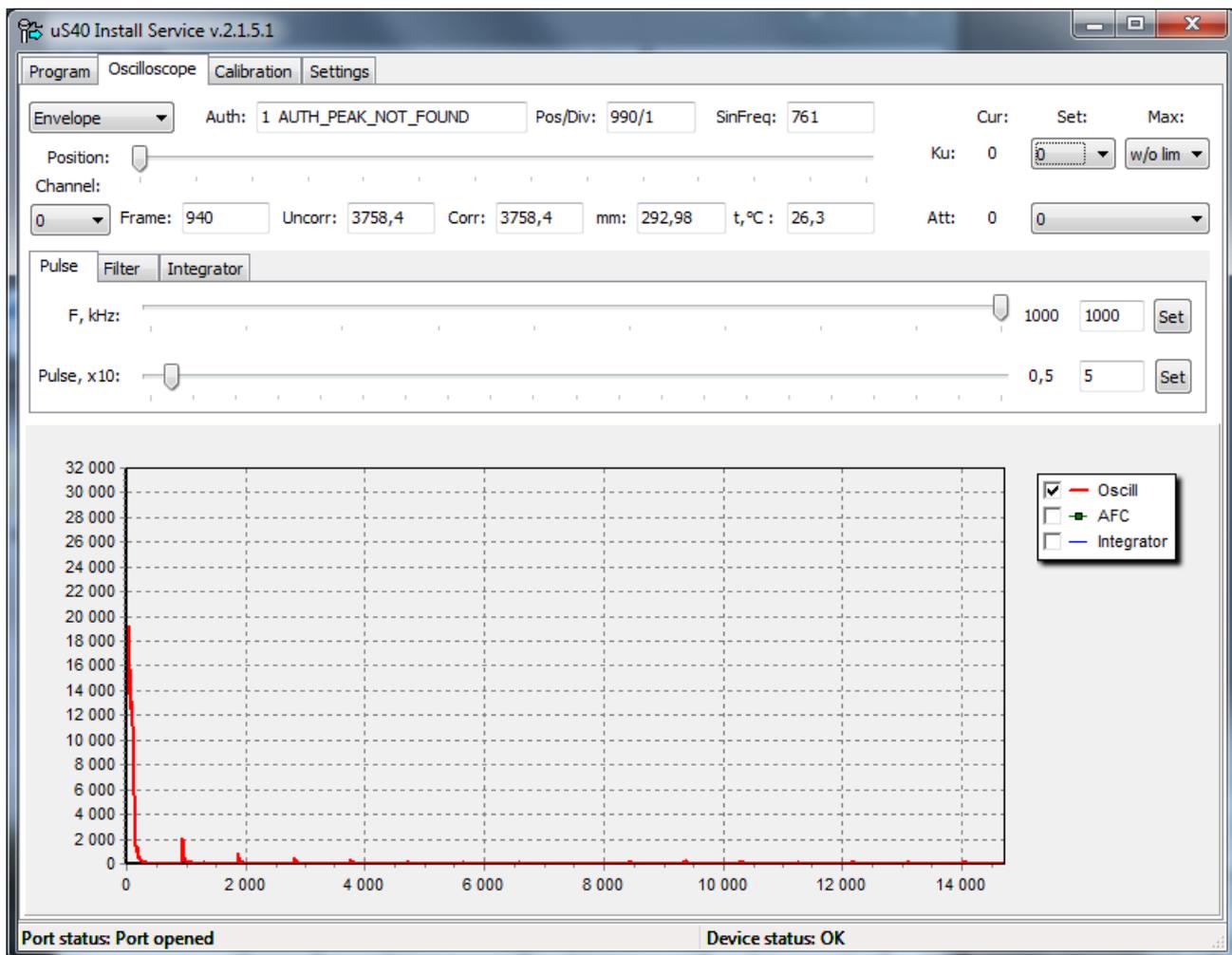


Fig. A.12

c) On the “Filter” tab (Fig. A.13) in the “F, kHz” field, select the **WideBand** value (wideband filtering) from the drop-down menu. In the offset field “Z pos,/10” set the value to **0**. Press the “Set” button.

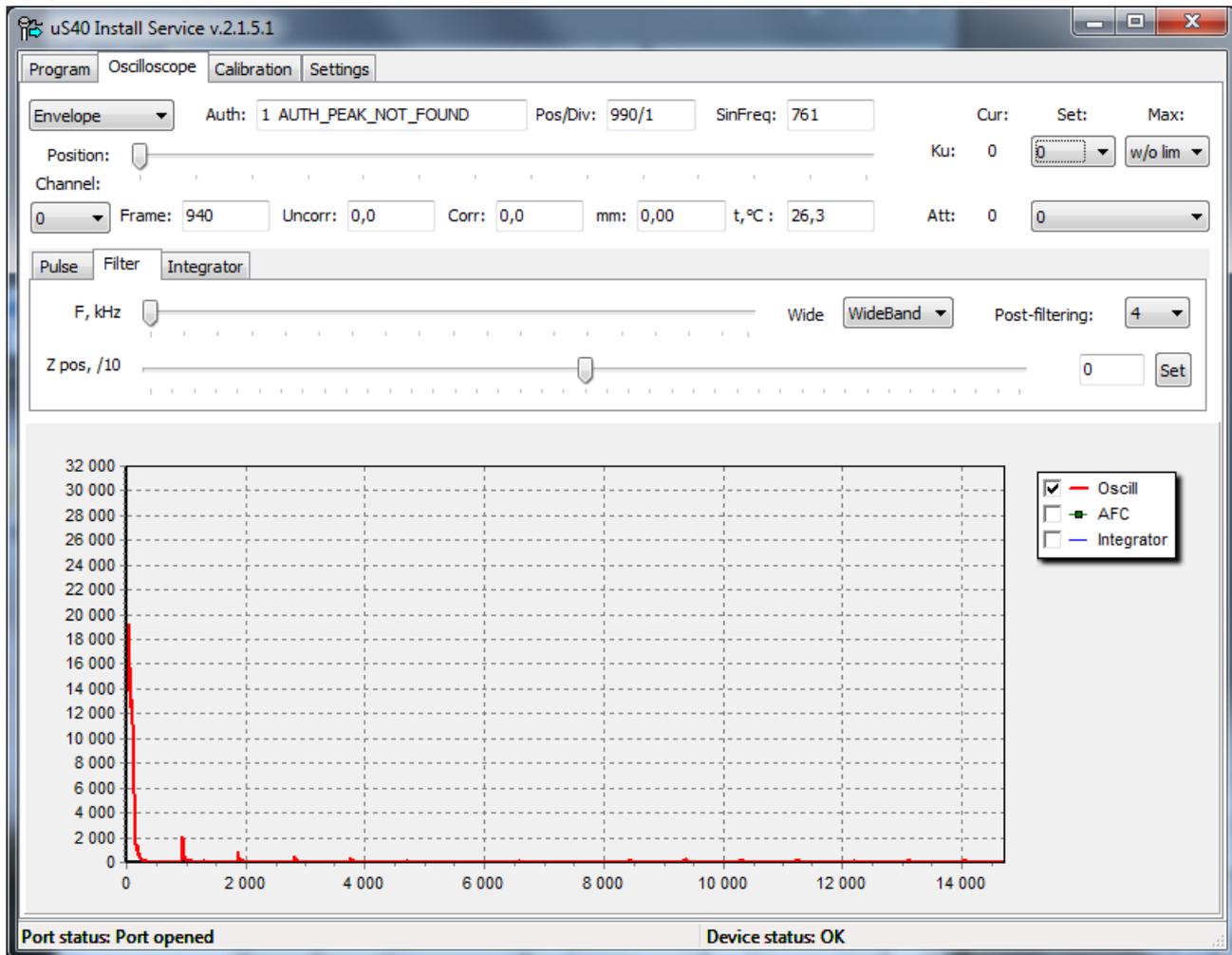


Fig A.13

d) In the field of amplification of the signal “Ku:” in the drop-down menu, increase the gain until the value “0\_AUTH, OK” appears in the field “Auth:” (Fig. A.14):

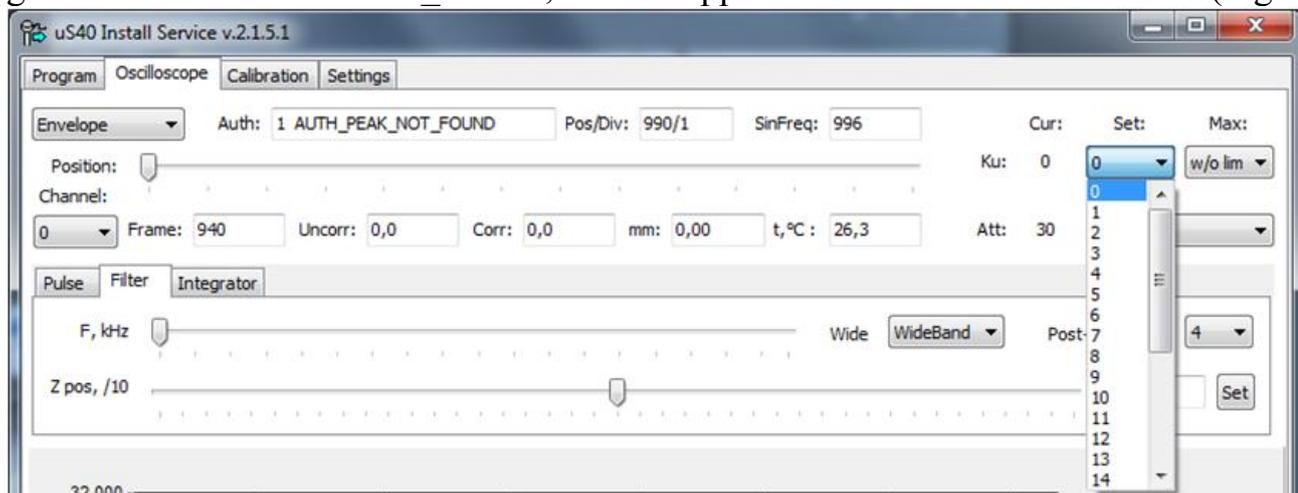
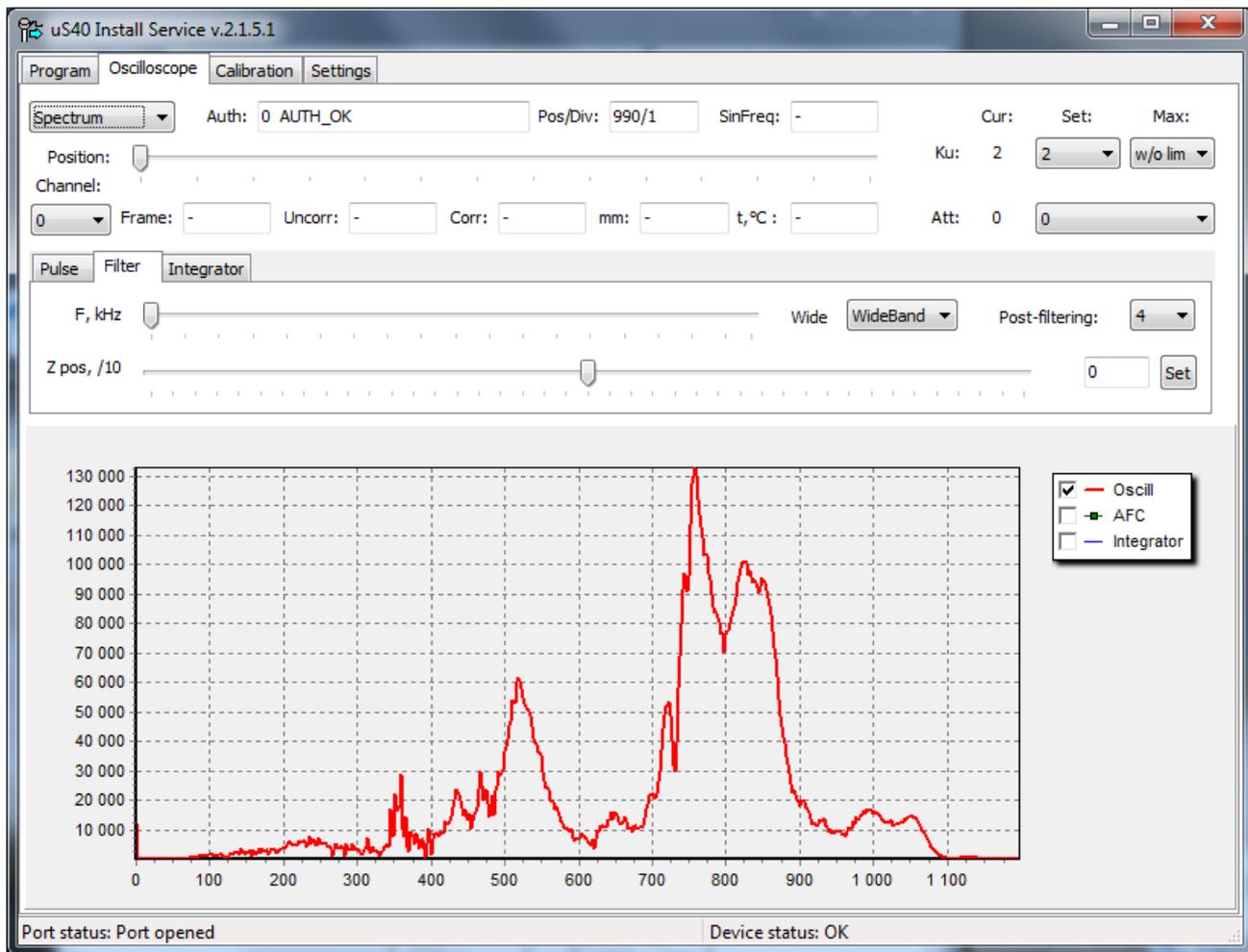


Fig. A.14

e) Select the “Spectrum” oscillograph mode (Fig. A.15).

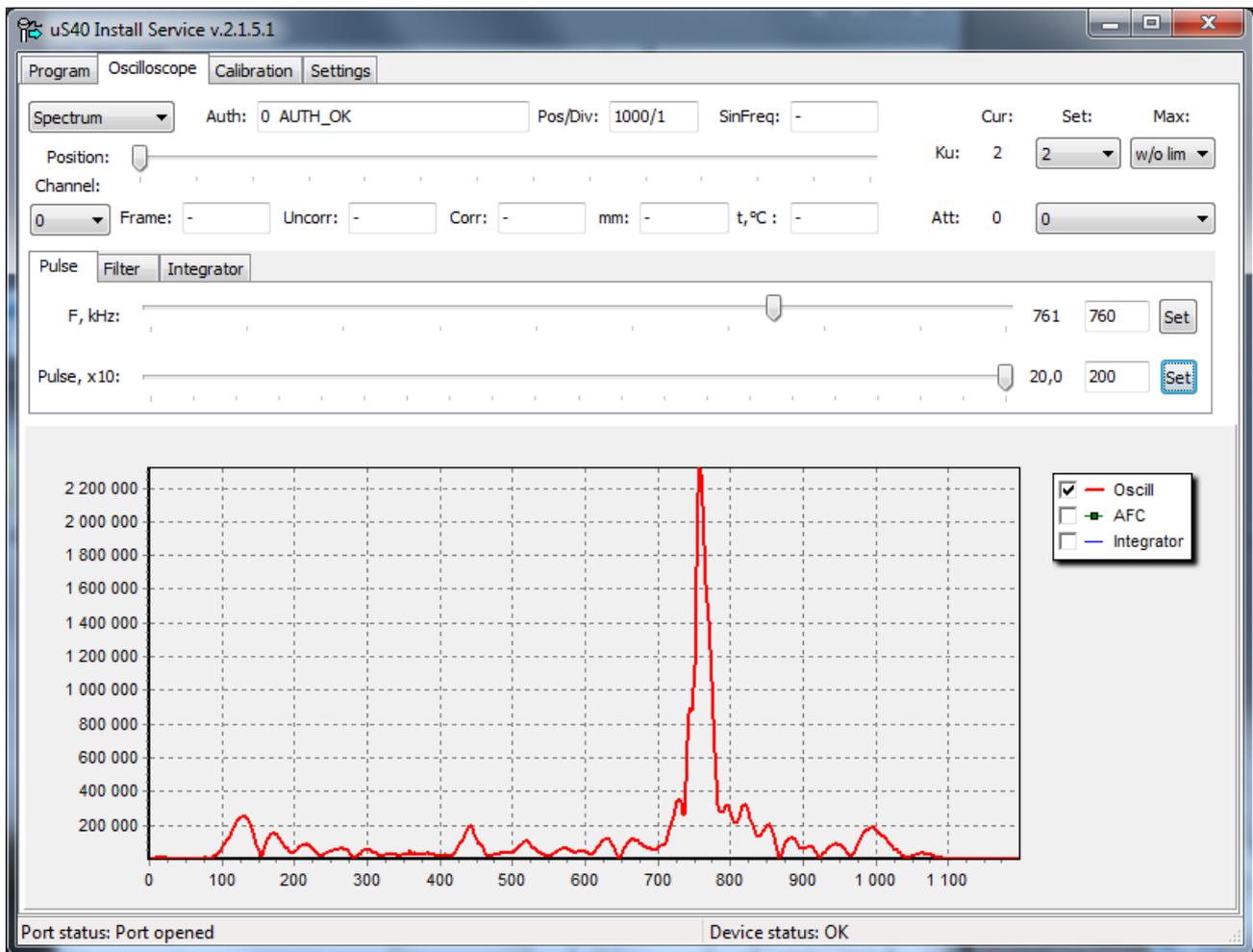
Determine the **operating frequency** of the meter. To do this, select the signal with the largest amplitude on the oscillograph record of the signal spectrum (Fig. A.15). To accurately determine the frequency, increase the spectrum.

To increase the spectrum in the field of the oscillograph, select the region of interest by holding the left mouse button and pulling from left to right. To decrease, hold the left mouse button and drag from right to left. To move - hold the right mouse button to move it in the right direction.



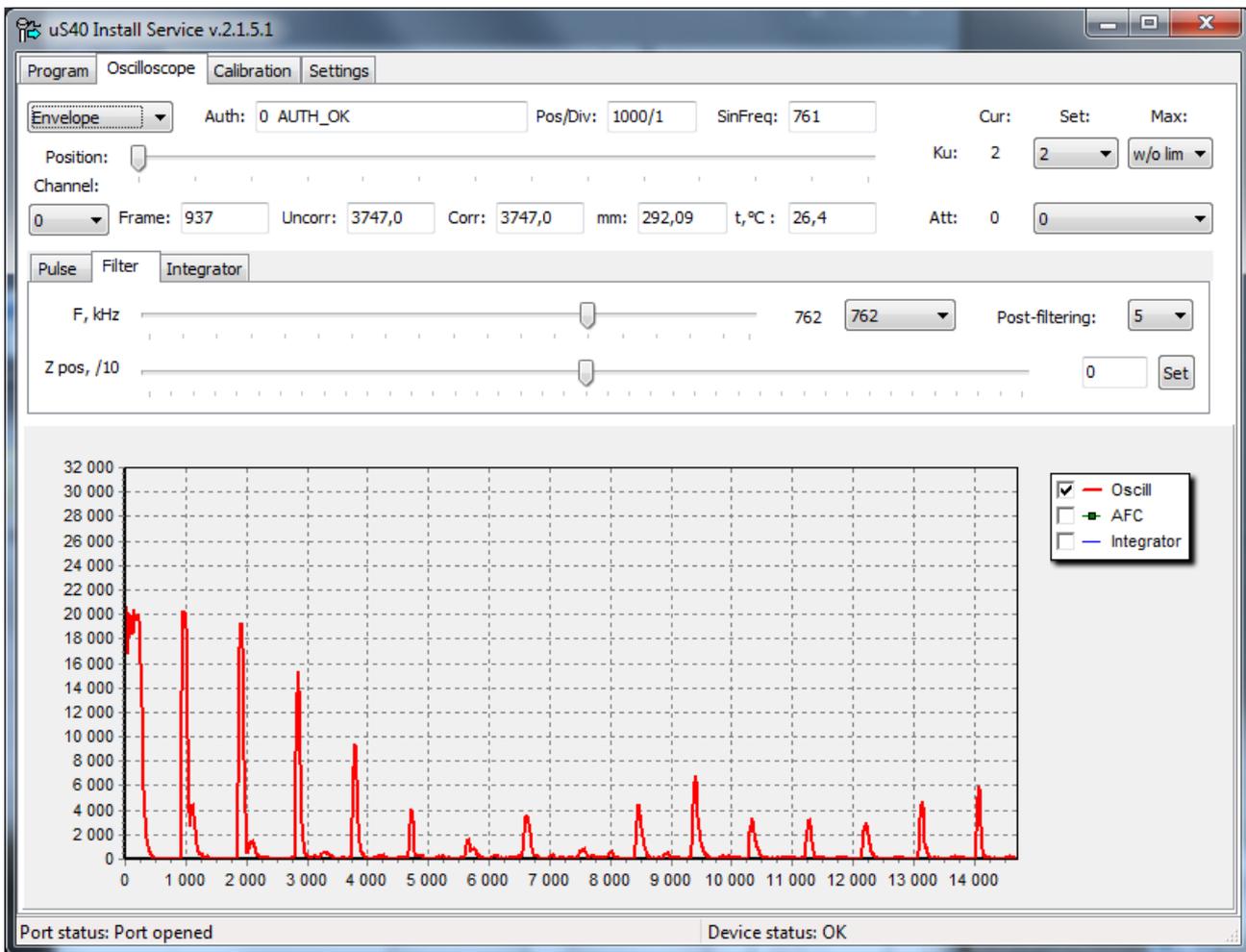
*Fig. A.15*

f) Go to the “Impulse” tab, in the field “F, kHz” **enter the value of the operating frequency**. Press the “Set” button. In the field “Imp, x10:” enter the value **200**. Press the “Set” button (Fig. A.16):



*Fig. A.16*

g) Go to the “Filter” tab (Fig. A.17), in the “F, kHz” field, select the closest value to the operating frequency in the drop-down menu. In the display mode of the oscillograph record, select "Envelope" (Fig. A.12). The parameter "Post-filtering" - select **5**; if the value in the "Uncorr" field is unstable, increase the post-filtering parameter.



*Fig. A.17*

h) Go to the “Filter” tab again, in the field “F, kHz” **enter the value of the operating frequency** the same as was entered on the “Filter” tab. Press the “Set” button.

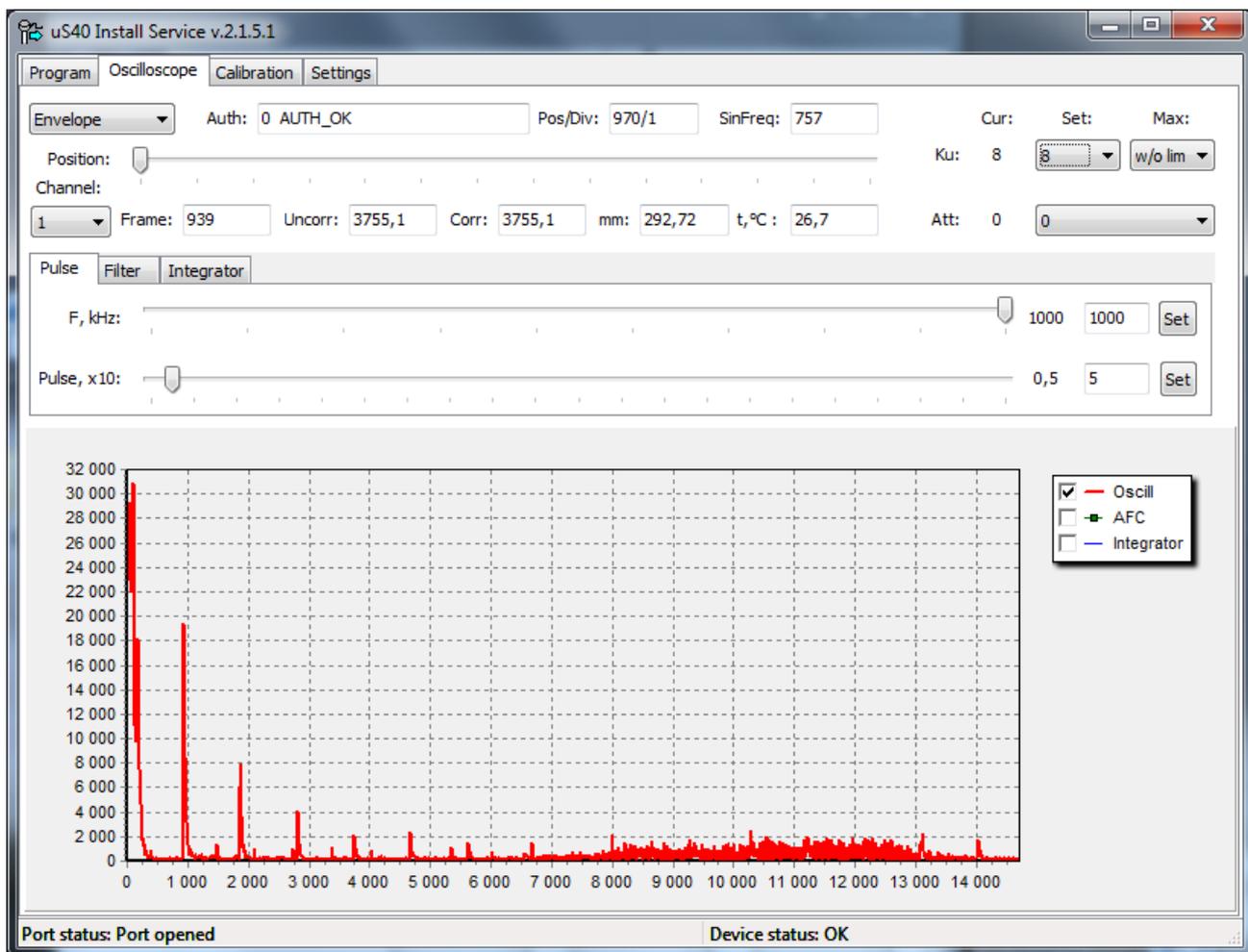
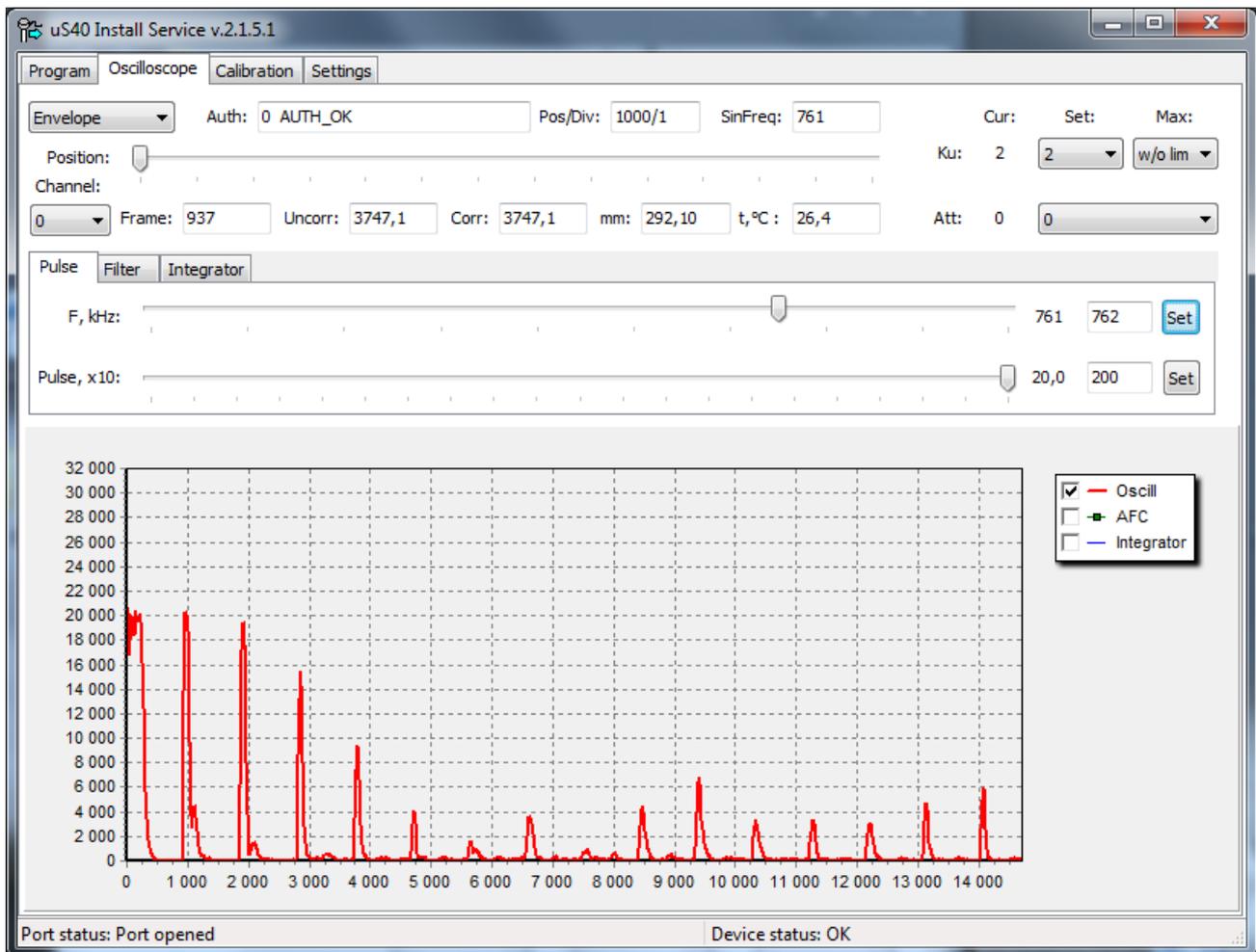


Fig. A.18

### Selecting the operating frequency for channel 1 (lower meter):

- In the drop-down menu “Channel:” select channel 1 (Fig. A.19). In the drop-down menu for displaying the oscillograph record, select the "Envelope" mode (Fig. A.12).
- On the “Pulse” tab, in the “F, kHz” field, enter the value **1000**. Press the “Set” button. In the field “Imp, x10:” enter the value **5**. Press the “Set” button. Install “Att:” 0.
- On the “Filter” tab, in the “F, kHz” field, select the **WideBand** value (wideband filtering) in the drop-down menu. In the offset field "Z pos,/10" set the value to **0**. Press the "Set" button.
- In the field of amplification of the signal “Ku:” in the drop-down menu, increase the gain until the value “0\_AUTH, OK” appears in the field “Auth:”.

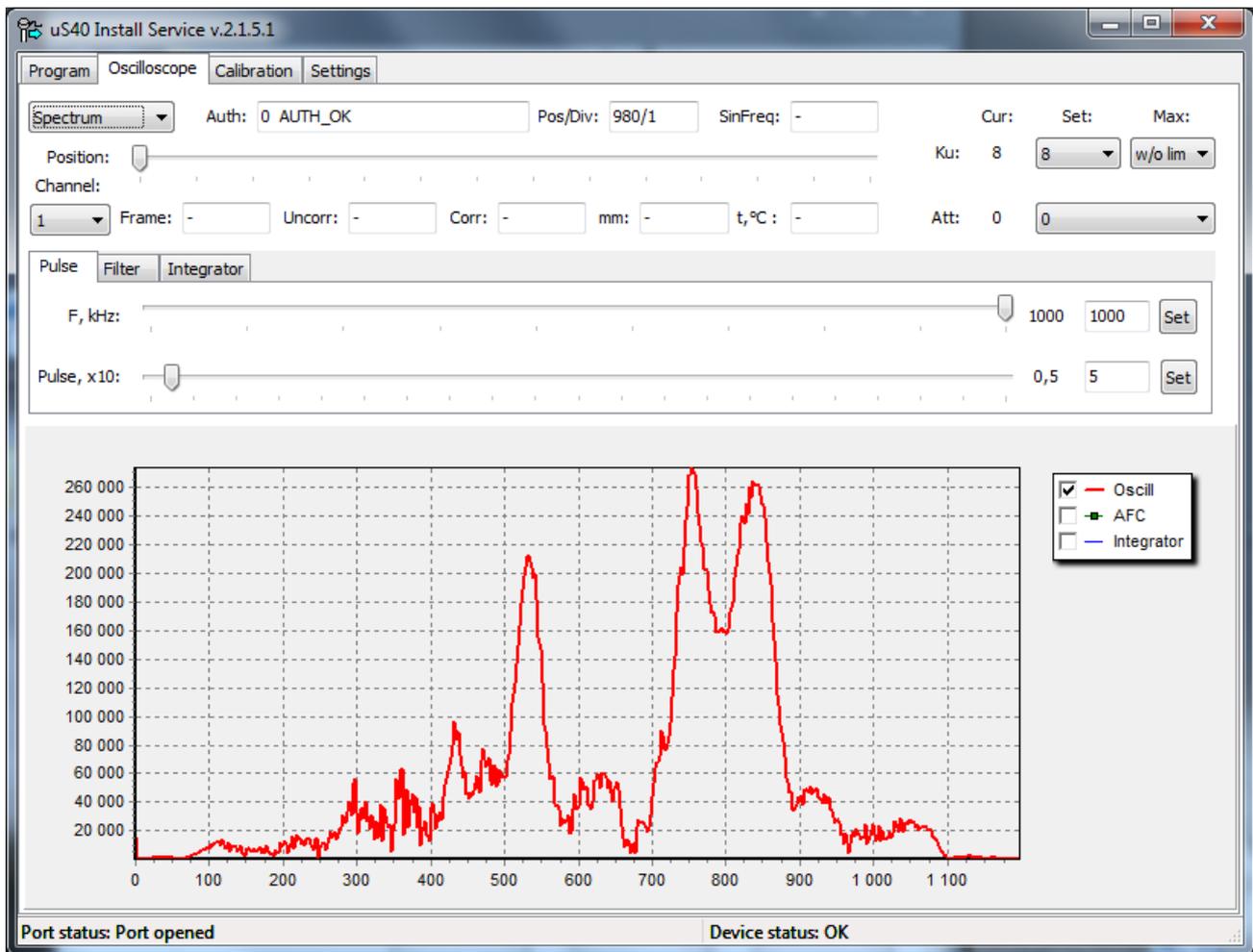


*Fig. A.19*

e) Select the “Spectrum” oscillograph mode.

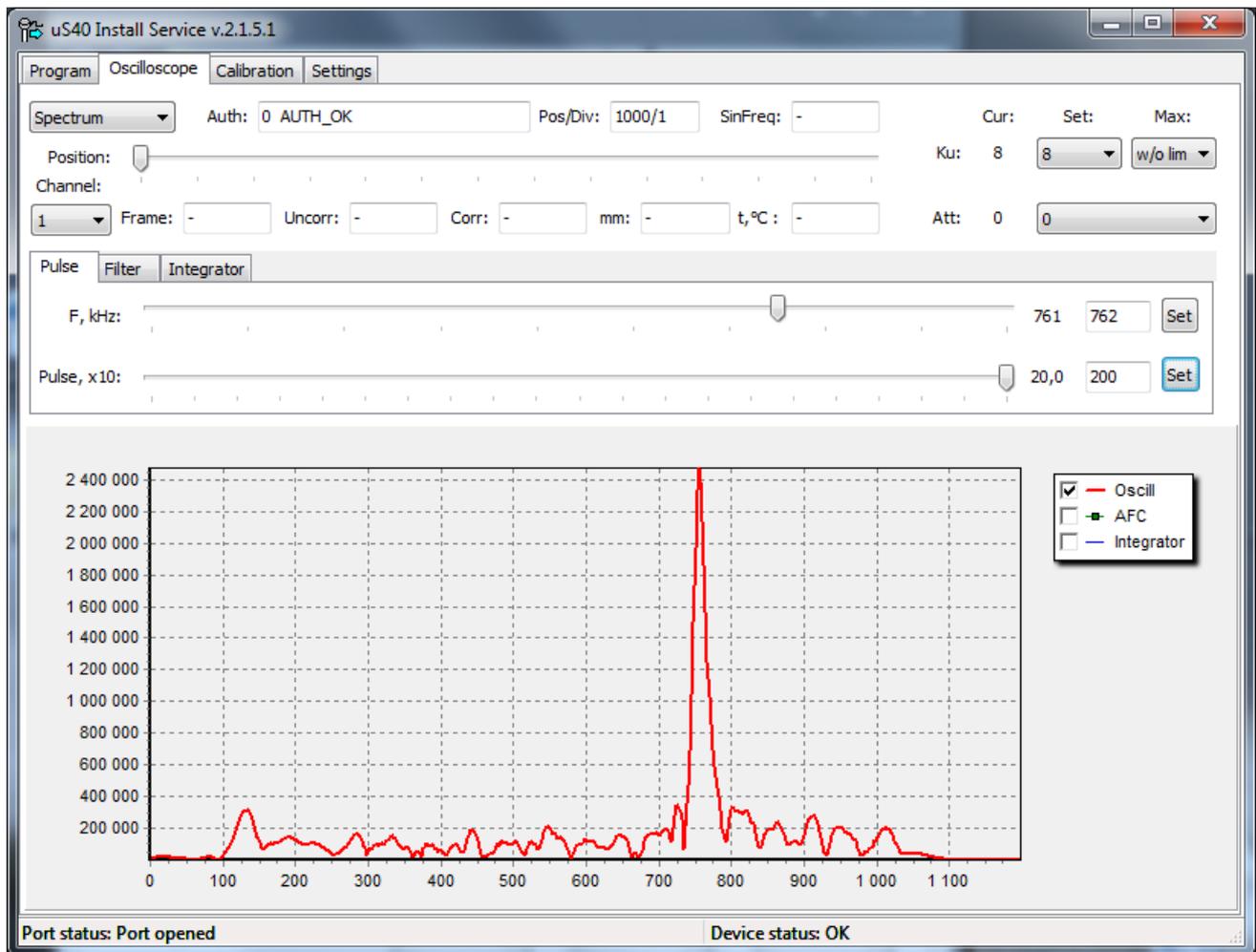
Determine the **operating frequency** of the meter. To do this, select the signal with the largest amplitude on the oscillograph record of the signal spectrum (Fig. A.20). To accurately determine the frequency, increase the spectrum.

Select the operating frequency. The value of the operating frequency for the channel 1 should be the same or close as for the channel 0.



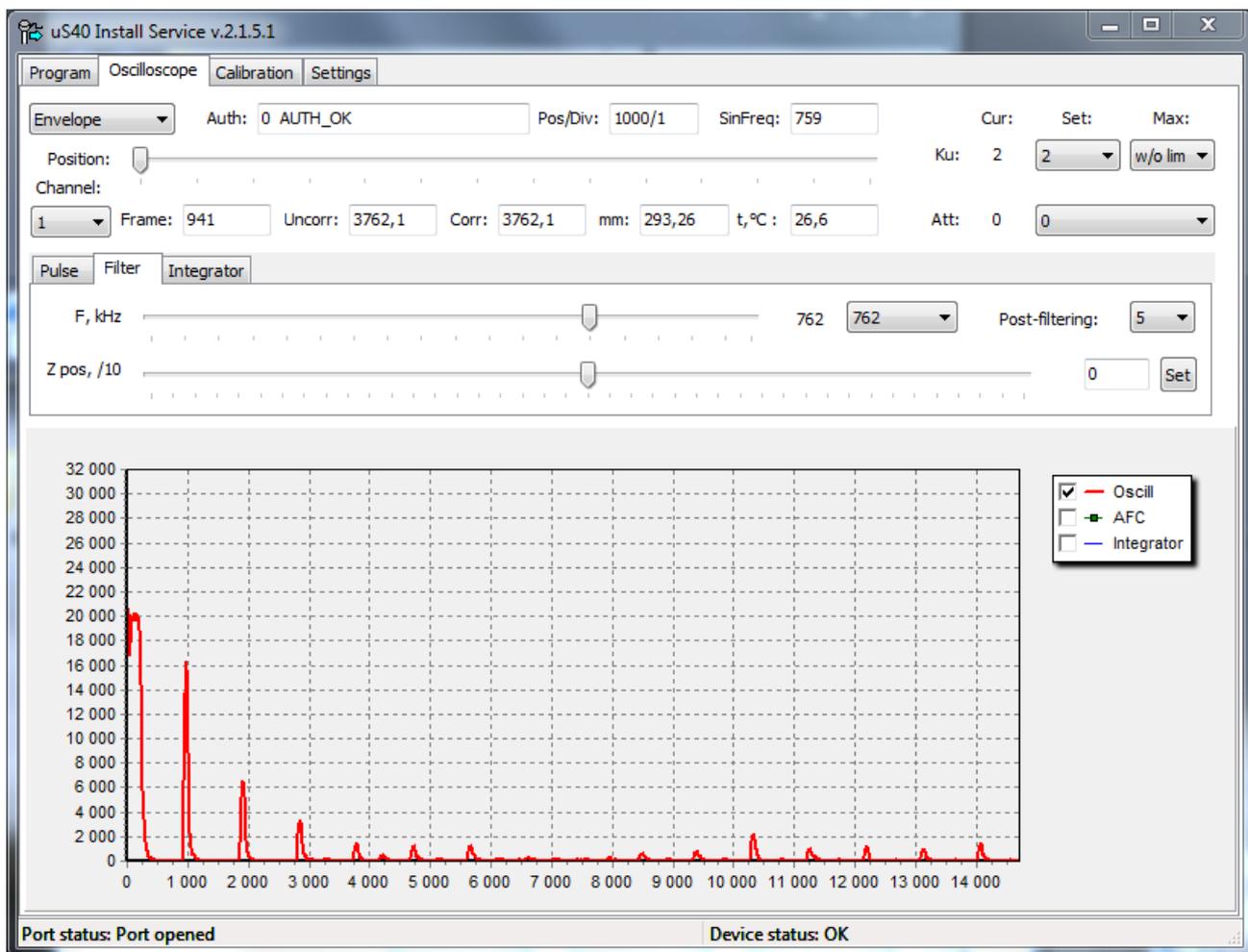
*Fig. A.20*

f) Go to the “Pulse” tab, in the field “F, kHz” **enter the value of the operating frequency**. Press the “Set” button. In the field “Imp, x10:” enter the value **200**. Press the “Set” button (Fig. A.21).



*Fig. A.21*

g) Go to the “Filter” tab (Fig. A.22), in the “F, kHz” field, select the closest value to the operating frequency in the drop-down menu. In the display mode of the oscillograph record, select "Envelope" (Fig. A.20). Select “Post-filtering” parameter **5**, if the value is unstable in the “Uncorr” field, increase the post-filtering parameter.



*Fig. A.22*

h) Calculate the arithmetic mean of the working frequencies of the zero and first channels. Set this value for each channel by completing steps f - h for each channel.

**Note.** Fig. A.20, A.21, A.22, A.25 are made for a different (in relation to channel “0”) wall thickness. With equal thicknesses, the operating frequencies of the channels should practically coincide, and may differ within a few percent.

### Setting the delay time for channel 0:

a) In the drop-down menu “Channel:” select channel 0. Set the gain Ku so that the signal amplitude is in the range 4000...10000. Wait until the value in the “Uncorr” field becomes stable, and write the Uncorr ”0” value from the “Uncorr” field for channel 0.

b) Then, in the drop-down menu “Channel:” select the channel mode “0 <-1”. Make sure that the signal amplitude is less than 16000, otherwise reduce the Ku gain and repeat the previous paragraph.

Wait a certain time until the value “0\_AUTH\_OK” appears in the field “Auth:” and the value that is two times less than the written value Uncorr ”0” appears in the “Uncorr” field (Fig.

A.21). Wait until the value in the “Uncorr” field becomes stable and write out the value “Uncorr” from the “Uncorr” field for the channel “0<-1”.

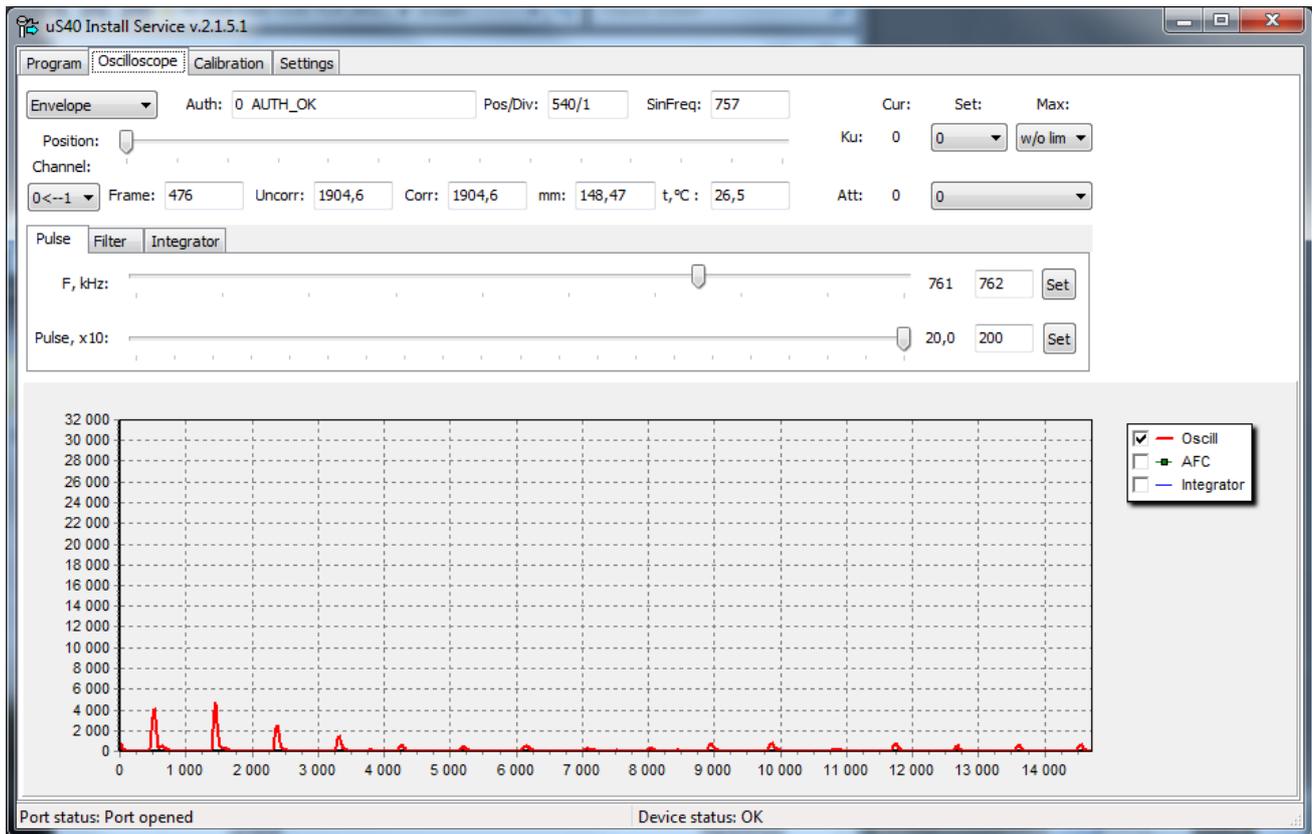


Fig. A.23

c) Calculate the offset value according to the formula:

$$\Delta = (a - 2 \cdot b) / 4 ,$$

$$Z_{pos} = \Delta \cdot 10 ,$$

where: **a** - is the value “Uncorr” of the channel “0”, **b** - is the value “Uncorr” of the channel “0<-1”.

**The calculated value should be negative.**

d) In the field "Zpos, /10" enter the obtained value of **Zpos**. Press the “Set” button (Fig. A.22).

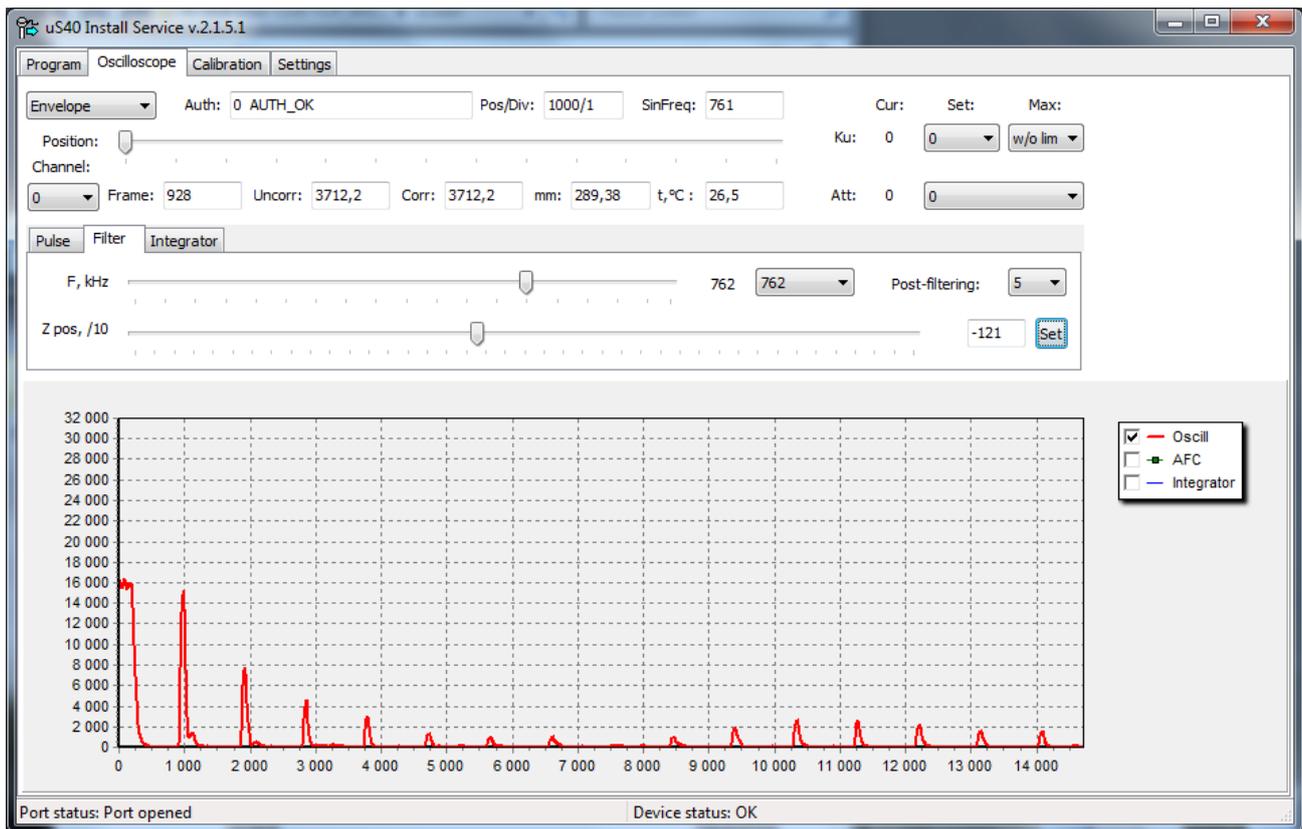


Fig. A.24

### Setting the delay time for channel 1:

a) In the drop-down menu “Channel:” select channel 1 (Fig. A.20). Set the gain of Ku so that the signal amplitude is in the range of 4000...10000. Wait until the value in the Uncorr field becomes stable, and write the Uncorr ”1” value from the Uncorr field for channel 1.

b) Then, in the “Channel:” drop-down menu (Fig. A.9), select the channel mode “1 <- 0”. Make sure that the signal amplitude is less than 16000, otherwise reduce the Ku gain and repeat the previous paragraph.

Wait a certain time until the value “0\_AUTH\_OK” appears in the field “Auth:” and the value “Uncorr” shows a value half as large as the written value of Uncorr ”1” (Fig. A.23). Wait until the value in the “Uncorr” field becomes stable and write out the value of Uncorr ”1<-0” from the “Uncorr” field for the channel “1<-0”.

c) Calculate the offset value according to the formula:

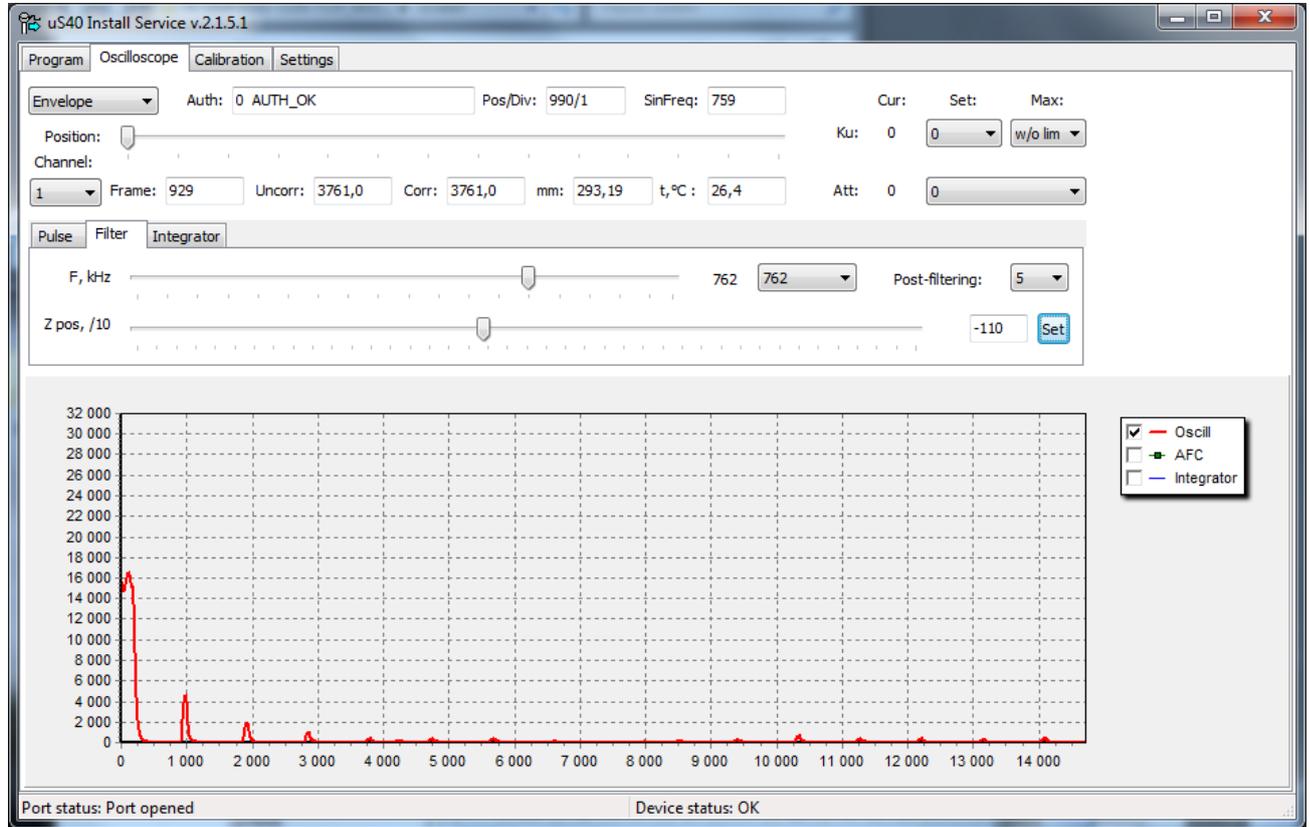
$$\Delta = (a-2*b)/4 ,$$

$$Zpos=\Delta*10,$$

where: **a** = value “Uncorr” of channel “1”, **b** = value “Uncorr” of channel “1<-0”.

**The calculated value should be negative.**

d) In the field "Zpos, /10" enter the obtained value of **Zpos**. Press the "Set" button (Fig. A.25):



*Fig. A.25*

Select channel "0". Select "Ku" gain "Auto". In the "Att" field, set 30. In the "Post-filtering" field, select "7".

Select channel "1". Select "Ku" gain "Auto". In the "Att" field, set 30. In the "Post-filtering" field, select "7".

Put the transmitter in automatic operation mode. To do this, select "Auto" mode in the "Channel:" field (Fig. A.26).

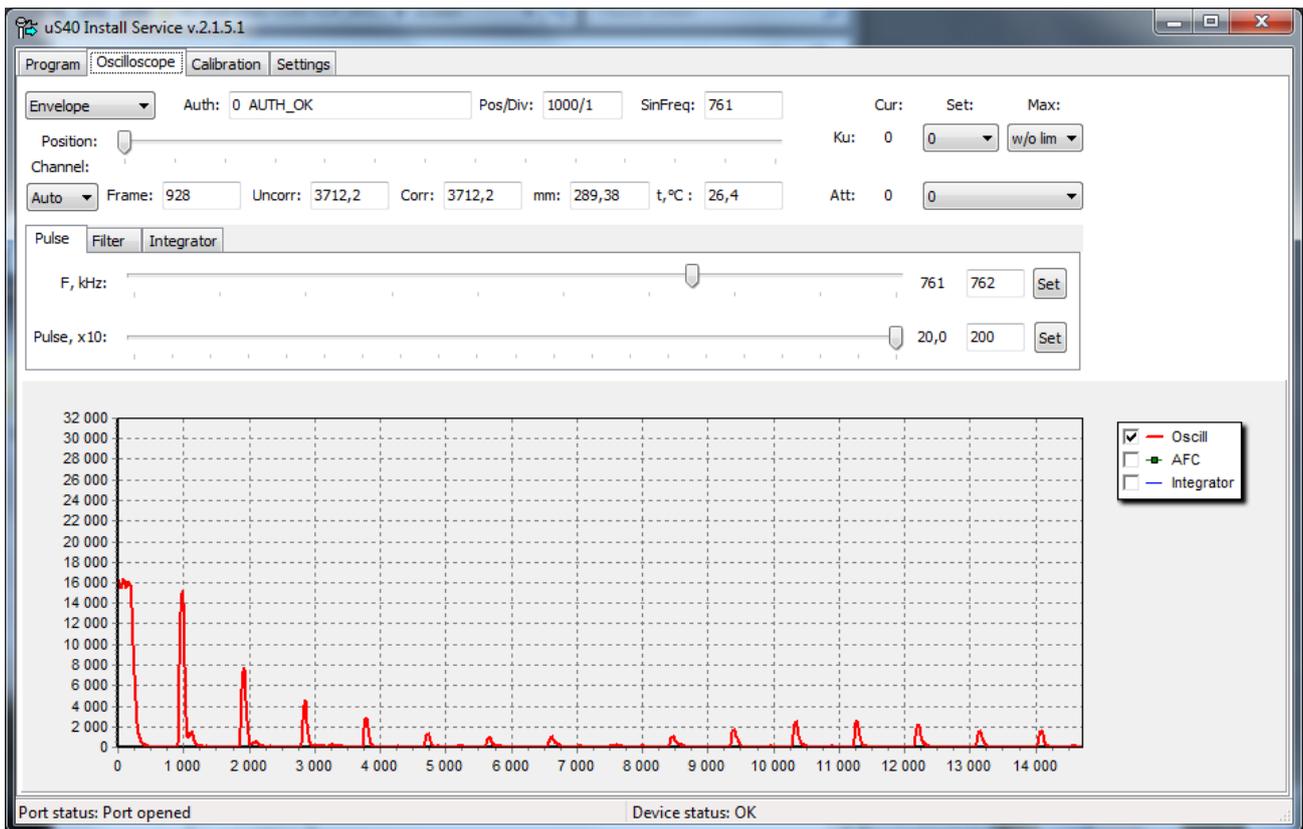


Fig. A.26

**Note:** when resetting the transmitter power, the mode in the “Channel” field is set to “Auto” by default.

Go to the “Program” tab, click the “Close” button.

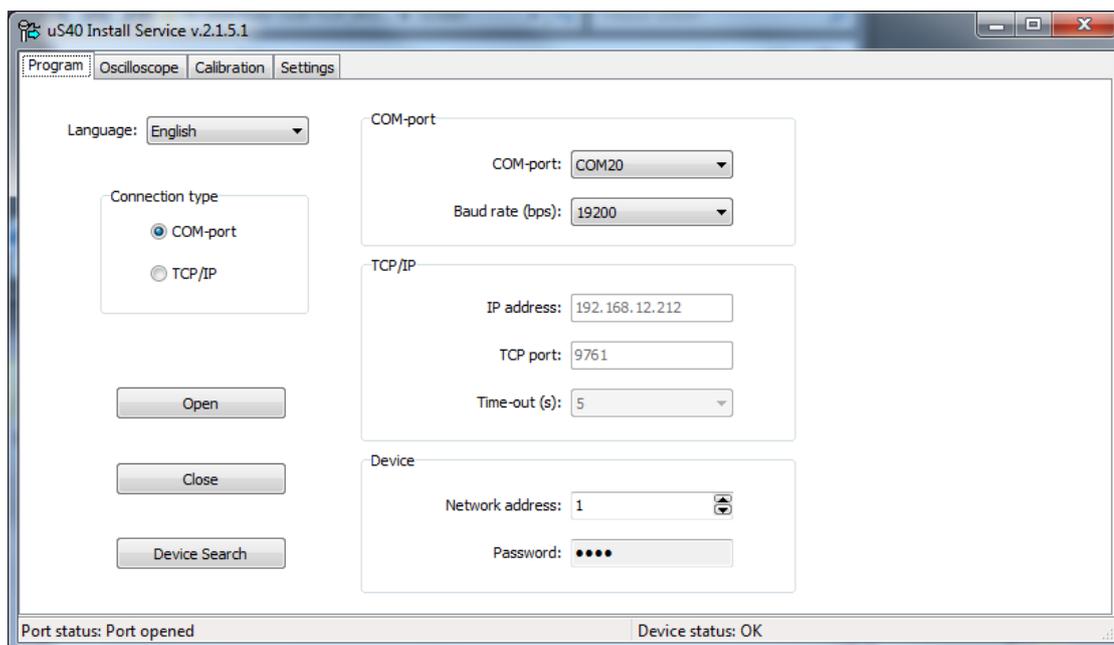
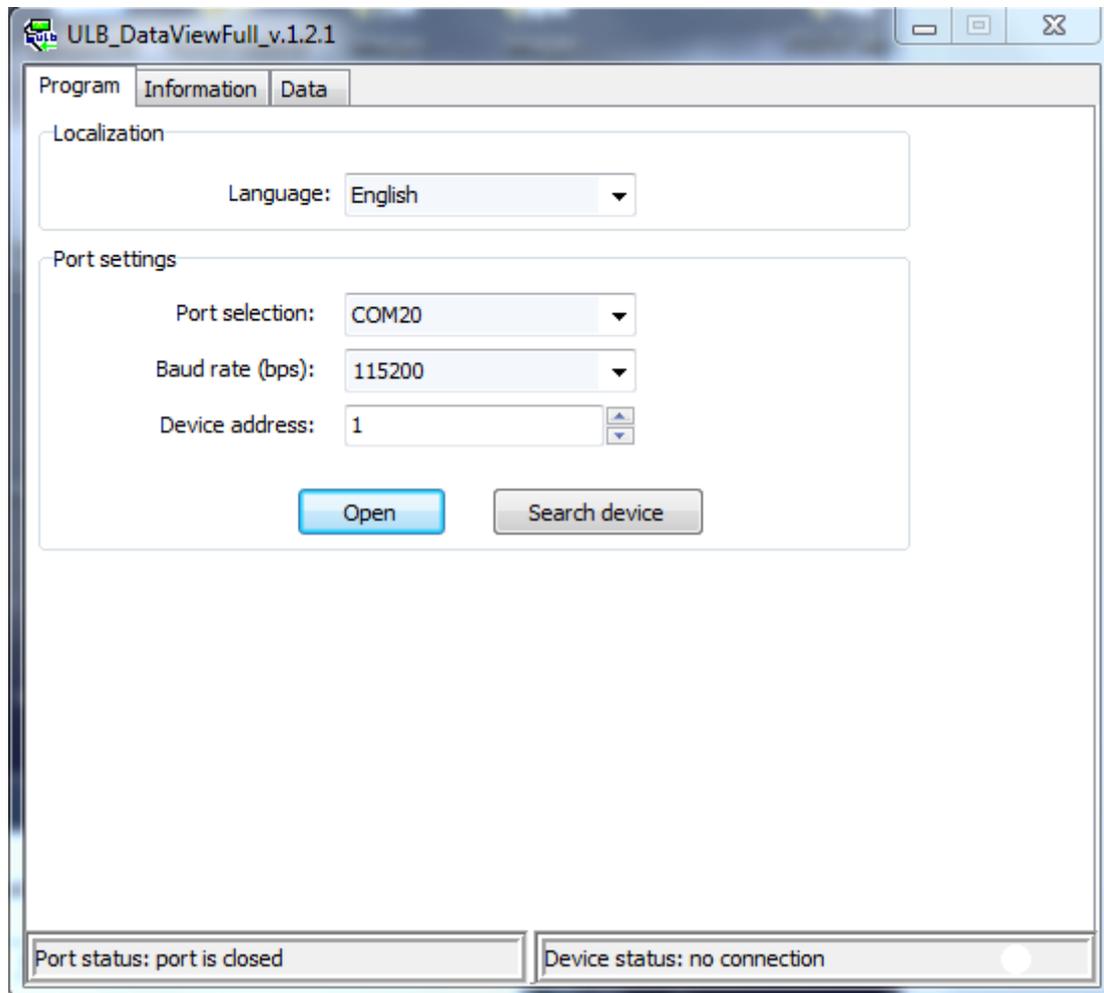


Fig. A.27



## Transmitter data control

Run the program AlphaSonic\_DataViewFull (detailed description of this program is in Appendix B).



*Fig. A.28*

Configure the port, speed, device address and search for the device by clicking the "Search for device" button. Go to the "Data" tab.

Observe the measured values of the liquid temperature in the fields "Temperature, °C" and "Temperature 2, °C", velocities in the liquid in the field "Speed, m/s", liquid level in the field "Level, mm" (Fig. A.27).

If the calibration is carried out correctly, the liquid level must coincide with the internal diameter of the tank, set in the "Calibration" section, with an error of not more than 0.5 mm, otherwise the meters need to be re-calibrated. For this, before recalibration of the meters, it is necessary to adjust the contact angle to the tank so that the Uncorr "0" and Uncorr "1" parameters (see Fig. A.15 and A.20) are maximum for each channel.

When the tank is calibrated, there will also be non-zero values of volume, weight of liquid and total weight.

The screenshot displays the 'Data' tab of the 'ULB\_DataViewFull\_v.1.2.1' application. The interface is organized into several sections for parameter input and display:

- Basic parameters:** Temperature, °C: 25,79; Temperature 2, °C: 25,79; Speed, m/s: 1499,1; Reference speed, m/s: 1497,0.
- Liquid density:** Density, g/cm³: 0,9969; Density at T=15 °C, g/cm³: 0,9991; Density at T=20 °C, g/cm³: 0,9982.
- Liquid parameters:** Level, mm.: 250,2; Volume, l.: 967; Weight, kg.: 964.
- Steam parameters:** Pressure, atm.: 0,000; Density, kg/m³: 0,000; Volume, l.: 2470; Weight, kg.: 0.
- Mixture parameters:** Propane-butane, %: 0,00; Propane-butane (dens.), %: 0,00.
- Total weight, kg.:** 964.

At the bottom, the status bar shows 'Port status: port is open' and 'Device status: connected' with a green indicator light.

*Fig. A.29*

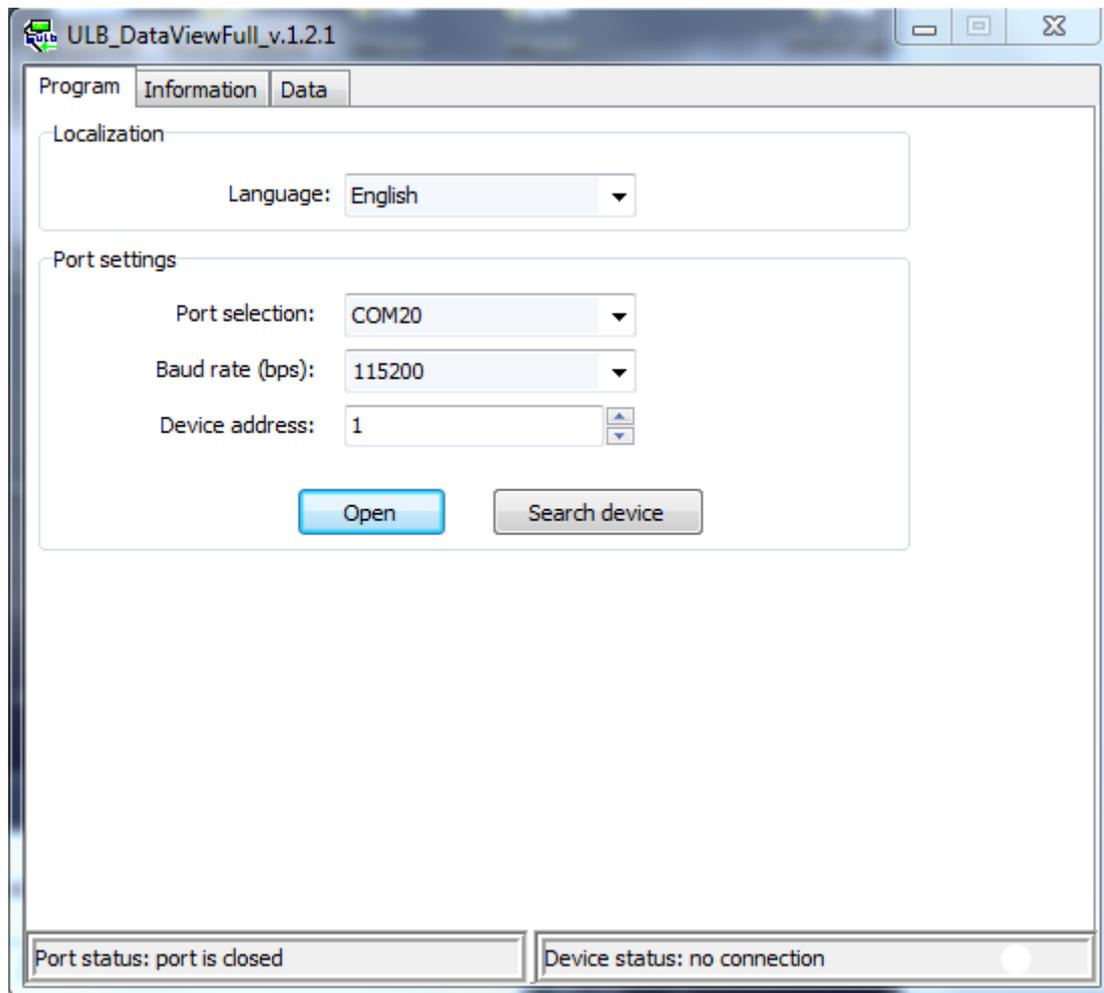
**APPENDIX B****AlphaSonic-xx TRANSMITTER DATA CONTROL USING  
AlphaSonic\_DataViewFull PROGRAM**

The AlphaSonic\_DataViewFull program is used to display data from the AlphaSonic-xx transmitter. The program is designed to work with the operating systems Windows 7, Windows 8, Windows 10.

Run the AlphaSonic\_DataViewFull program (Fig. B.1). To connect to the transmitter, select the required communication type and the corresponding parameters in the "Connection type" group and click the "Open" button.

The transmitter with factory settings has an exchange rate of 19,200 bps, the network address is 1.

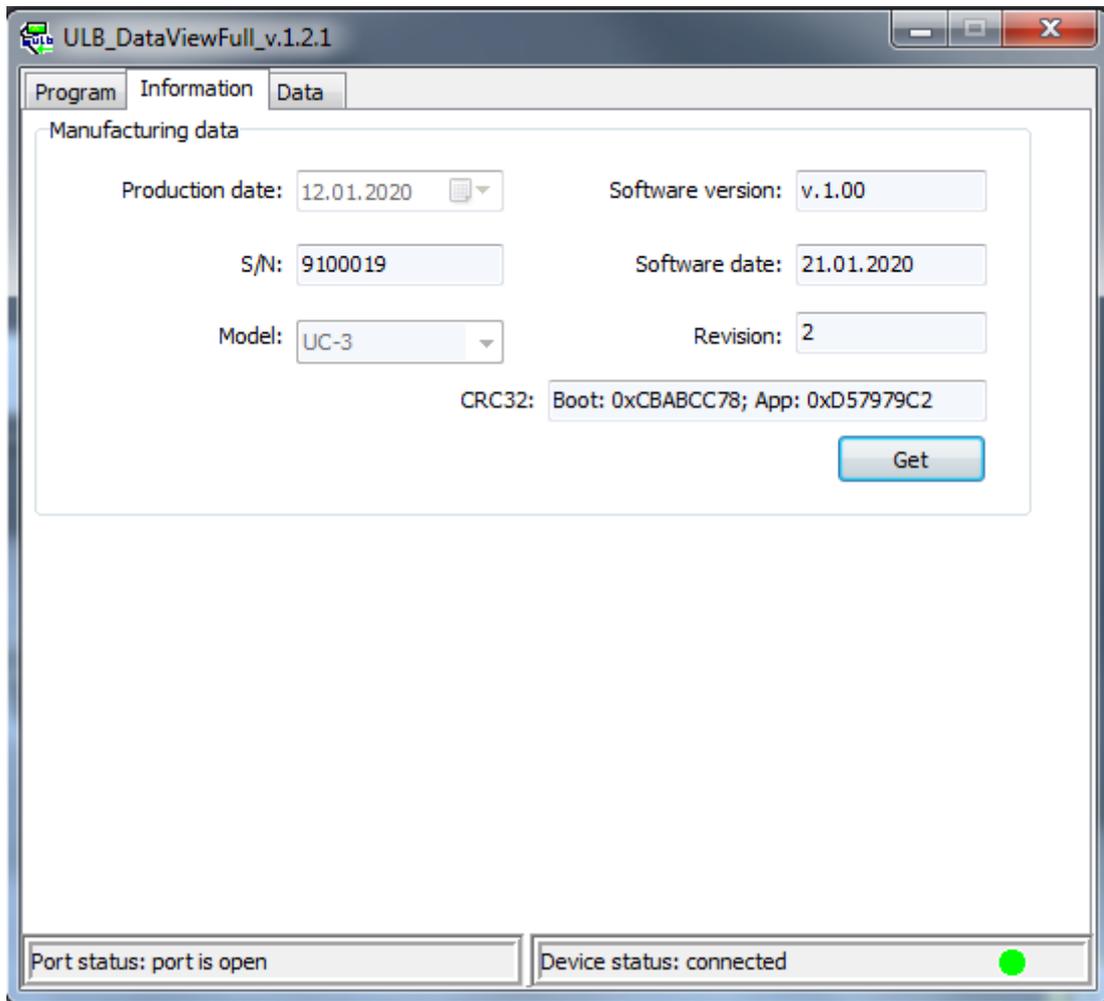
If the speed and network address are unknown, then after selecting the port, click the "Search for device" button.



*Fig. B. 1*

After a successful connection with transmitters, the program window will look like Fig. B.2: at the bottom of the program should be: "Device status: connected" and once a second an

indicator should appear in the right corner in the form of a green circle, which indicates updating data on the “Data” tab.



*Fig. B. 2*

In the event that the connection to the transmitter is failed, you should check the correct connection of the transmitter to the power supply and the connection to the port in accordance with "Installation and Operating Manual".

After connecting to the transmitter, go to the “Data” tab (Fig. B.3) and check the data from the transmitter.

When the program starts, a log file is created with the name:

ULB\_DataViewFull\_YYYY\_MM\_DD.log

where YYYY – current year;

MM – current month;

DD – current day.

For example, the log file name ULB\_DataViewFull\_2019\_12\_01.log is created on December 1, 2019.

Log files are created by default in the same directory in which the AlphaSonic\_DataViewFull\_v.xxx.exe program is located.

The directory for the log files can be changed. After closing the program, the configuration file ULB\_DataViewFull\_v.x.x.x.ini is created, in which the path to the folder with the log files can be edited in the LOG\_FILE\_PATH parameter. This path is applied only once after starting the program.

The program uses the system clock to determine the current time and date. A log file is created each time with a new name when the system date changes (i.e. at 00:00:00 on a new day) and contains data for the past day. In the case when the log file with the current name exists when the program is opened, the data from the transmitter is added to the end of the file.

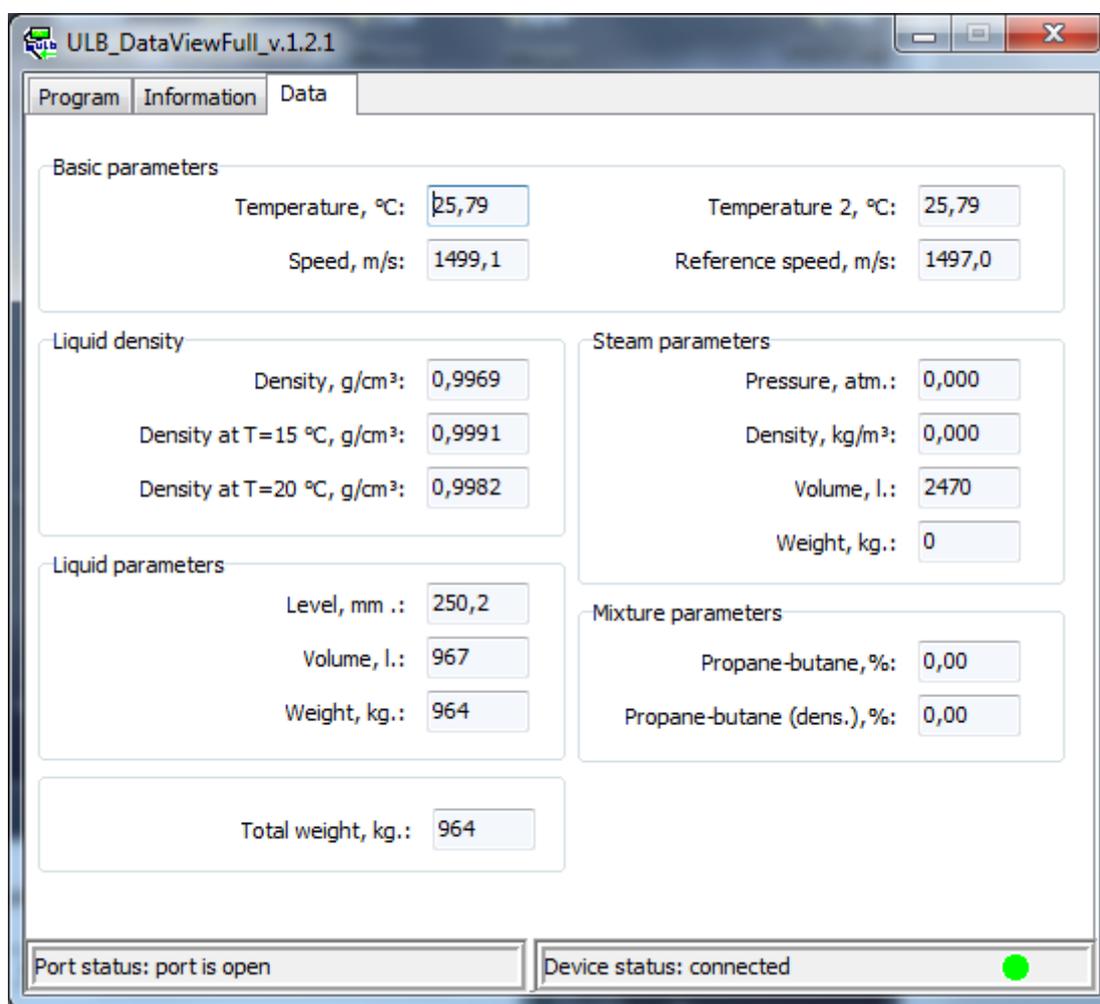


Fig. B. 3

The log file looks like in Fig. B.4 - in text format.

First, the first two lines contain data on the creation of the file and the data format. Next are the program data in two formats:

“Time(hh:mm:ss) Message” for program messages or

“Time(hh:mm:ss) CurT(C) CurC(m/s) RefT(C) RefC(m/s) CurRo(g/cm3) T15Ro(g/cm3) T20Ro(g/cm3) SteamP(atm.) SteamRo(kg/m3) PartPercRo(%) PartPerc(%) LiquidLev(mm.) LiquidVol(l.) LiquidMass(kg.) SteamVol(l.) SteamMass(kg.) TotalMass(kg.)” - for transmitter data through the space character.

At the end of each message is a pair of characters “\r\n” of the end of the line.

Program messages (Message) can be "Open Com port", "Close Com port", or "Close program".

The program receives the transmitter data once per second. The data for the current second is located on one line and separated by a space, at the end of each line a pair of characters “\r\n”. The fractional part of the number is separated from the integer by the dot symbol “.”. Transmitter data messages are decoded in Table B.1.

Example log file contents:

ULB\_DataViewFull\_2019\_12\_23.log created at 23.12.2019 10:04:15

Time(hh:mm:ss) CurT(C) CurC(m/s) RefT(C) RefC(m/s) CurRo(g/cm3) T15Ro(g/cm3) T20Ro(g/cm3) SteamP(atm.) SteamRo(kg/m3) PartPercRo(%) PartPerc(%) LiquidLev(mm.) LiquidVol(l.) LiquidMass(kg.) SteamVol(l.) SteamMass(kg.) TotalMass(kg.)

10:16:47 Open Com port.

```
10:16:52 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:16:53 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:16:54 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:16:55 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:16:56 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:16:57 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:16:58 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:16:59 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:00 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:01 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:02 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:03 23.54 790.2 23.79 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:04 23.54 790.2 23.79 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:05 23.54 790.2 23.79 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:06 23.54 790.2 23.79 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:07 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:08 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:09 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:10 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:11 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:12 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:13 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:14 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:15 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:16 23.54 790.2 23.78 780.8 0.5258 0.5355 0.5298 8.529 17.591 60.95 50.00 157.2 0 0 0 0 0
10:17:18 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:19 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:20 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:21 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
10:17:22 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0
```

10:17:23 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:24 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:25 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:26 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:27 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:28 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:29 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:30 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:31 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:32 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:33 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:34 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:35 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:36 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:37 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:38 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:39 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:40 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:41 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:17:42 23.56 790.0 23.78 780.8 0.5258 0.5355 0.5298 8.533 17.598 60.95 50.00 157.1 0 0 0 0 0  
10:53:57 Close Com port.  
11:10:02 Close program.

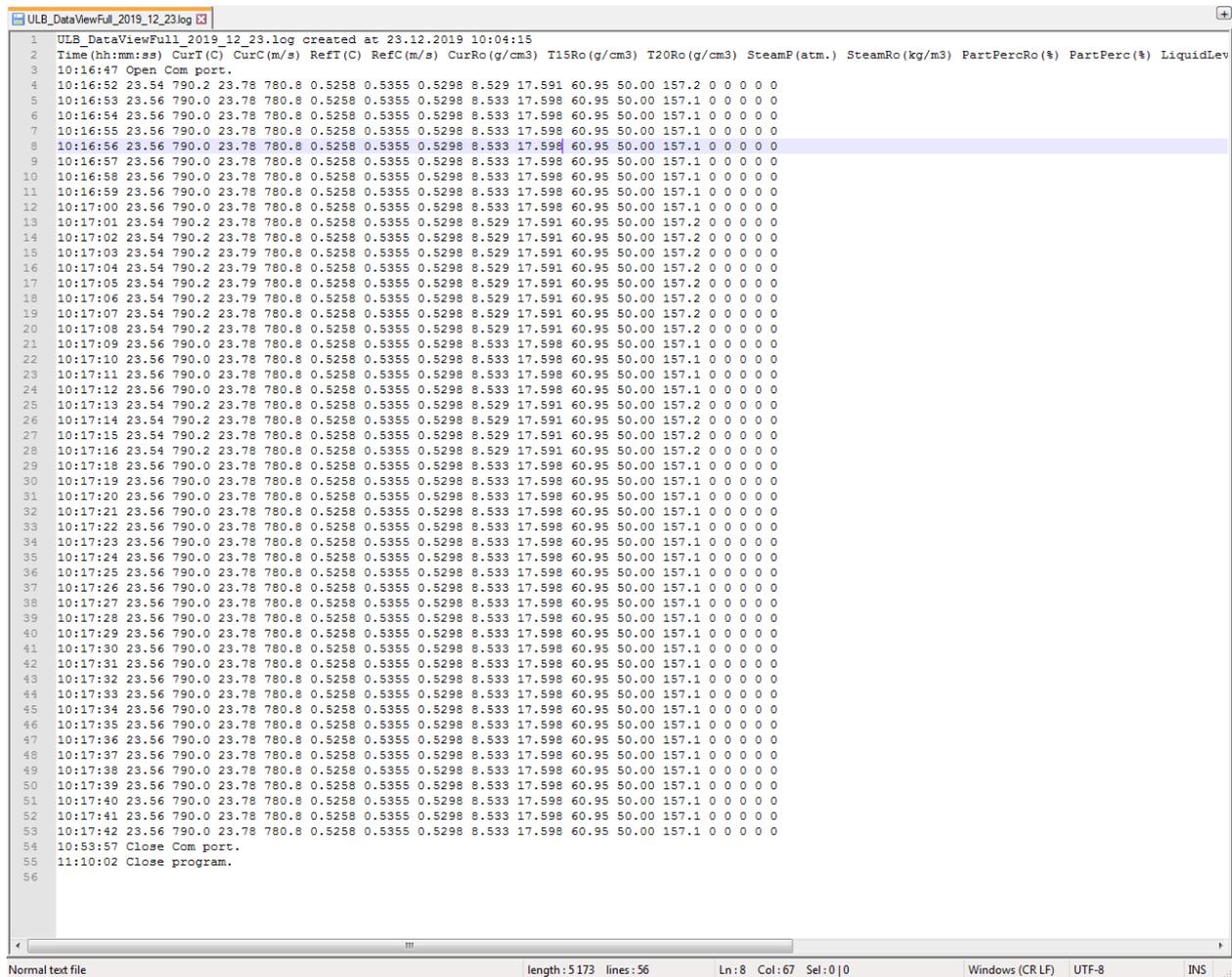


Fig. B. 4 - Contents of the log file



Table 1 - Transmitter data decoding

Designation	Value	Description
Time(hh:mm:ss)	00:00:00 ... 23:59:59	Message time
CurT(C)	-130, -128.00 ... 127.00	Temperature 1 (°C) - two characters of the fractional part
CurC(m/s)	0.0 ... 6553.5	Current speed of sound (m/s) - one character of the fractional part
RefT(C)	-130, -128.00 ... 127.00	Temperature 2 (°C) - two characters of the fractional part
RefC(m/s)	0.0 ... 6553.5	Reference speed of sound (at 25°C) (m/s) - one character of the fractional part
CurRo(g/cm <sup>3</sup> )	0.0 ... 6.5535	Current density (g/cm <sup>3</sup> ) – four characters of the fractional part
T15Ro(g/cm <sup>3</sup> )	0.0 ... 6.5535	Density at 15°C (g/cm <sup>3</sup> ) – four characters of the fractional part
T20Ro(g/cm <sup>3</sup> )	0.0 ... 6.5535	Density at 20°C (g/cm <sup>3</sup> ) – four characters of the fractional part
SteamP(atm.)	0.0 ... 65.535	Vapor pressure (atm.) – three characters of the fractional part
SteamRo(kg/m <sup>3</sup> )	0.0 ... 65.535	Vapor density (kg/m <sup>3</sup> * 1000) – three characters of the fractional part
PartPercRo(%)	0.00 ... 100.00	Percentage of propane-butane by density (%) – two characters of the fractional part
PartPerc(%)	0.00 ... 100.00	Percentage of propane-butane (%) - two characters of the fractional part
LiquidLev(mm.)	0.0 ... 6553.5	Liquid level (mm) – one character of the fractional part
LiquidVol(l.)	0 ... 65535	Volume of liquid (l) – without fractional part
LiquidMass(kg.)	0 ... 65535	Mass of liquid (kg) - without fractional part
SteamVol(l.)	0 ... 65535	Steam volume (l) - without fractional part
SteamMass(kg.)	0 ... 65535	Mass of steam (kg) - without fractional part
TotalMass(kg.)	0 ... 65535	Total mass (kg) - without fractional part

When closing, a confirmation is issued about closing the program (Fig. B.5), and a message about closing is recorded in the log file.

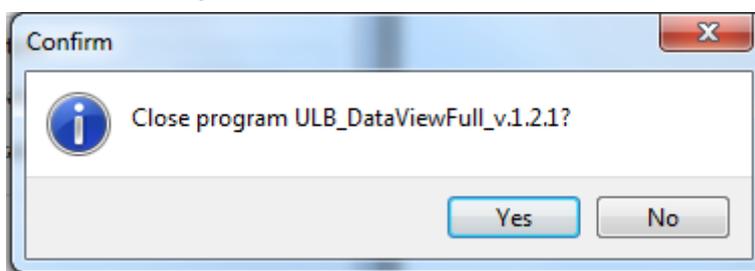


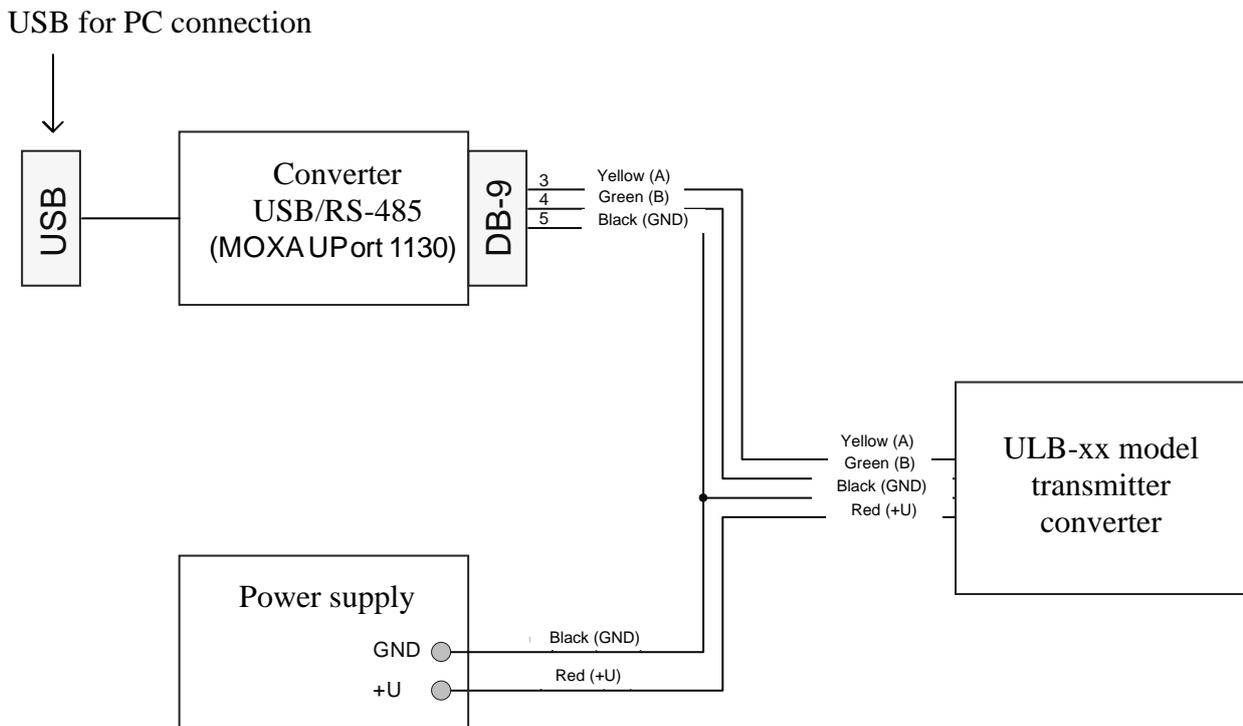
Fig. B. 5

### Note.

If you use the AlphaSonic-30 device as a measuring instrument, you must use the version of the AlphaSonic\_DataViewFull program for displaying the data, which is included in the current revision of the certificate of verification of the “UA.TR.001 36-20” pit. At the time of publication of this document, the approved program is “ULB\_DataViewFull\_v.1.2.1”.

## APPENDIX C

### DIAGRAM OF TRANSMITTERS CONNECTION TO PC



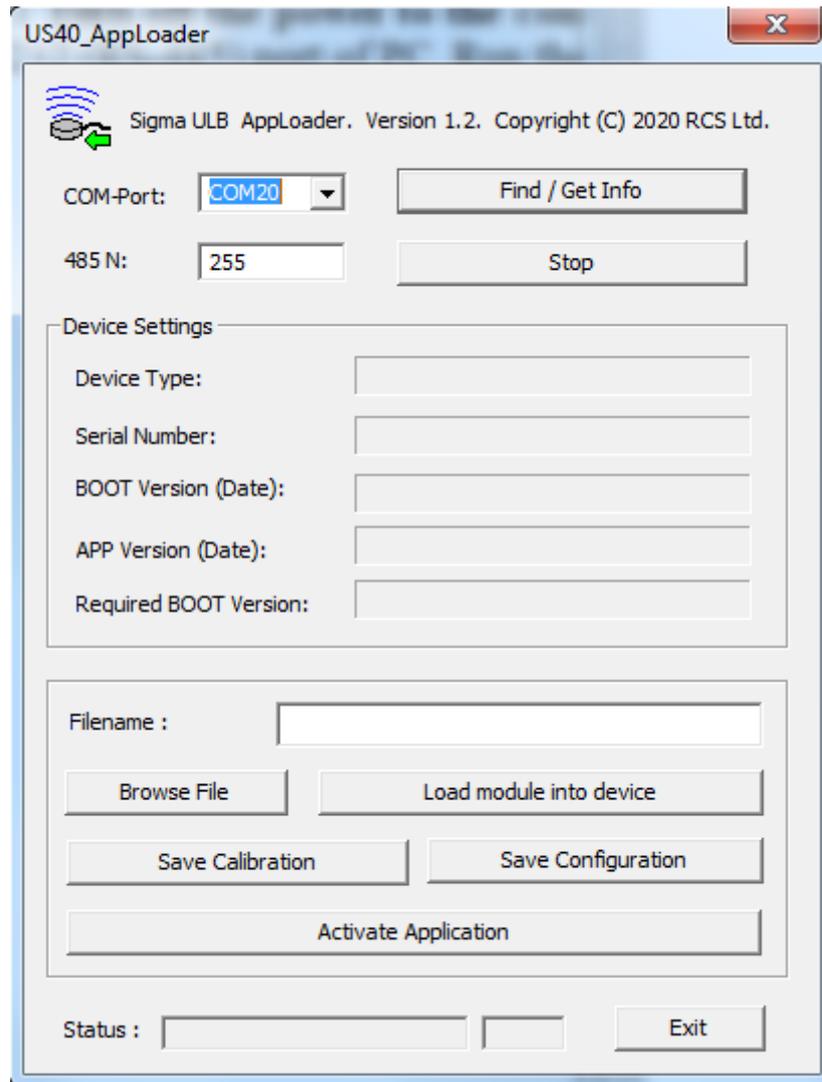
*Fig. C.1*

## APPENDIX D

### UPDATING THE FIRMWARE, SAVING AND RESTORING CONFIGURATION DATA USING US40\_AppLoader

D.1 For updating firmware, as well as saving to a file and restoring configuration data from a file, the US40\_AppLoader bootloader is used. To do this, perform the following sequence of operations:

D.1.1 **Turn off the power to the converter.** Connect the transmitter converter to the RS-232 (RS-485) port of PC. Run the program "US40\_AppLoader" (Fig. D.1):



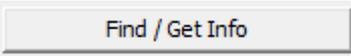
*Fig. D.1*

D.1.2 Select a COM port. When connecting 2 or more transmitters to the network, indicate the network address of the device in the “485 N” field.

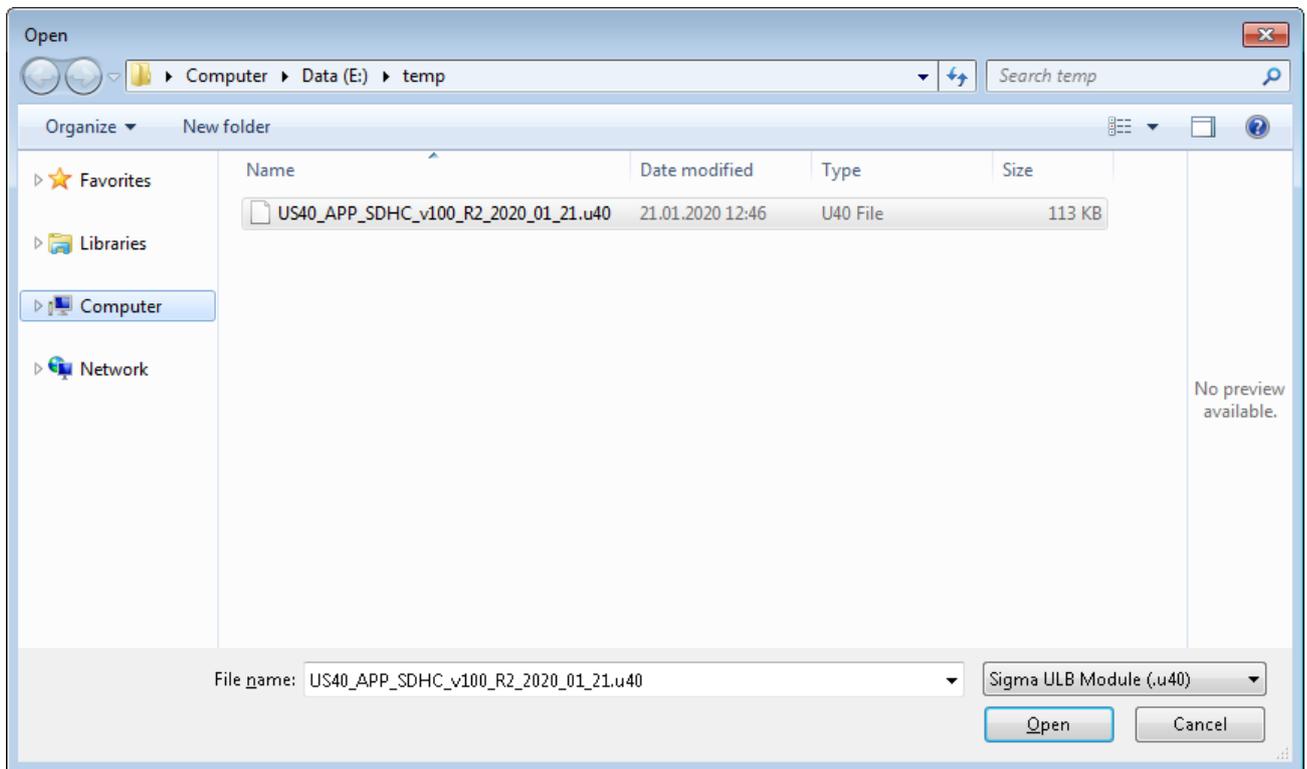
D.1.3 In the US40\_AppLoader program, click the button .

Find / Get Info

D.1.4 Power on the transmitter. After ~ 1 s, the technological parameters will be read from the transmitter:

after which the button  will become active again.

D.1.5 Then select the firmware file using the button  (Fig. D.2):



*Fig. D.2*

D.1.6 Download firmware to the device by pressing a button .

The loading process is indicated in percent:

Status :

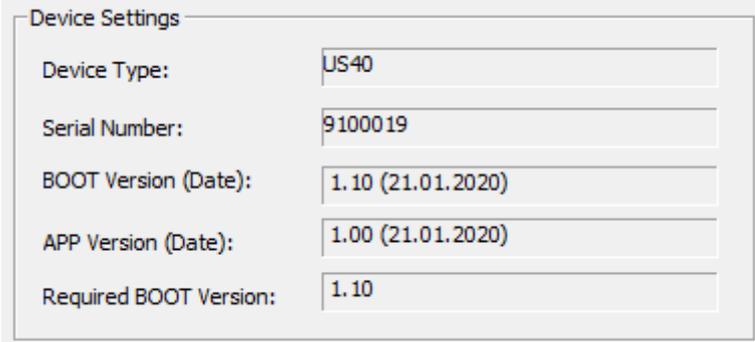
After the download is completed, a message will be displayed:

Status :

## D.2 Saving and restoring calibration and configuration data

D.2.1 To save the configuration data to a file, click the button .

D.2.2 In the file selection window that opens, select the folder to save and the file name, click the "Save" button (Fig. D.3):



Device Settings	
Device Type:	US40
Serial Number:	9100019
BOOT Version (Date):	1.10 (21.01.2020)
APP Version (Date):	1.00 (21.01.2020)
Required BOOT Version:	1.10

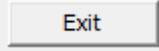
*Fig. D.3*

D.2.3 Calibration data is saved in the same way, but instead of the “Save configuration” button, the “Save calibration” button is used.

D.2.4 The restoration of configuration (calibration) data is carried out similarly to the firmware download, but instead of the firmware file, the configuration (calibration) file is selected.

### D.3 Activation of firmware

D.3.1 To activate the new firmware, press the button  or turn off and then turn on the power of the transmitter converter again.

D.3.2 To exit the bootloader program, press the button  or close the program window.

### D.4 Note

D.4.1 The US40\_AppLoader program works with communication ports COM1...COM9.

D.4.2 Availability and port numbers on a PC can be found here:

"Computer\Properties\Device Manager\Ports (COM and LPT)".

D.4.3 Assign the required number to the COM port from the available ones here:  
"Computer\Properties\Device Manager\Ports (COM and LPT)\Serial Port (COMx)\Properties\Port Settings\Advanced\ COM Port Number".

D.4.4 For ULB-30 transmitters, data writing to the device by the "US40\_AppLoader" program is possible only when the converter cover is removed.

## APPENDIX E

### DATA EXCHANGE PROTOCOL

(User part)

#### E.1 General

This document contains a description of the data exchange protocol of the AlphaSonic ultrasonic fuel level transmitter with peripherals (hereinafter referred to as Ps).

#### E.2 Physical level

Exchange with the peripherals is carried out by means of RS-232 or RS-485 interfaces. The exchange rate is selected from the range: 2400, 4800, 9600, 19200 (by default), 38400, 57600, 115200 bps;

Data width – 8 bits;

Parity is absent;

Stop bit – 1;

Flow control - none.

#### E.3 Logical level

Data exchange is carried out by packets based on the "Query-Response" principle. The master (initiator of the exchange) is the peripherals.

Each transmitter is assigned a network address. The valid address range is 0x00 - 0xFE, the address 0xFF is used for broadcast queries to which the transmitter responds regardless of the address set. The default address is 0x01.

The protocol uses the following packet types:

- "Query" packet - the packet contains a command and is transmitted to the peripherals;
- "Response" packet - the packet contains the response to the command and is transmitted to the transmitter.

#### Query packet format

Prefix	Device Network Address	Command Code	Parameters	CRC
0x31	0x00..0xFF	see description of commands	see E4	Calculated according to Application note 27 from Dallas

## Response packet format

Prefix	Device Network Address	Command Code	Device Response	CRC
0x3E	0x00..0xFE	see description of commands	see description of commands	Calculated according to Application note 27 from Dallas

Multibyte command parameters are transferred in order from low byte to high one (“Little endian”).

The following intervals are used in the protocol:

- Timeout between bytes - the maximum interval between transmitted bytes within the packet;
- Delay in transmitting the response - the minimum interval between the completion of the reception of the “Query” packet and the beginning of the transmission of the “Response” packet;
- Response timeout - the maximum interval between the reception of the “Query” packet and the beginning of the transmission of the “Response” packet;
- The delay before the start of the transmission of the “Query” packet after the reception of the “Response” packet or an unidentified - the minimum interval between the completion of the reception of the “Response” packet, or an unidentified packet and the beginning of transmission of the “Query” packet;

The values of the listed parameters are given in Table 3.

The sequence of bytes that does not have a packet format, or with an interval between bytes exceeding the maximum allowed, a packet with a data field of more than 150 bytes, a packet with an erroneous checksum is unidentified and is ignored.

## Time intervals

Parameter	Value for various exchange rates, ms						
	2400	4800	9600	19200	38400	57600	115200
Timeout between bytes	15	8	4	2			
Response transmission delay	15	8	4	2			
Response timeout	100						
Delay before starting the transmission of "Query" packet after reception of "Response" packet	15	8	4	2			

## E.4 Description of the commands

### E.4.1. Single data reading (command 06h)

The command is intended for reading current data: temperature, liquid level value and liquid volume.

#### Command format

Offset, byte	Field width, byte	Value	Description
0	1	31h	Prefix
+1	1	00h...FFh	Recipient network address
+2	1	06h	Command code
+3	1	00h...FFh	CRC8

#### Response format

Offset, byte	Field width, byte	Value	Description
0	1	3Eh	Prefix
+1	1	00h...FFh	Sender network address
+2	1	06h	Command code
+3	1	-128...127	Temperature in degrees Celsius
+4	2	0000h...FFFFh	Liquid level value in one tenth of a millimeter
+6	2	0000h...FFFFh	Liquid volume value in liters
+8	1	00h...FFh	CRC8

### E.4.2. Single reading extended data (command A6h)

The command is intended for reading an extended set of current data of the measurement process.

#### Command format

Offset, byte	Field width, byte	Value	Description
0	1	31h	Prefix
+1	1	00h...FFh	Recipient network address
+2	1	A6h	Command code
+3	1	00h...FFh	CRC8

#### Response format

Offset, byte	Field width, byte	Value	Description
0	1	3Eh	Prefix
+1	1	00h...FFh	Sender network address
+2	1	A6h	Command code
+3	2 (signed)	-12800...+12700	Temperature 1 (°C *100)
+5	2	0000h...FFFFh	Sound speed (m/s *10)
+7	2 (signed)	-12800...+12700	Temperature 2 (°C *100)
+9	2	0000h...FFFFh	Reference sound speed (m/s *10)
+11	2	0000h...FFFFh	Current density (g/cm <sup>3</sup> *10000)
+13	2	0000h...FFFFh	Density at 15°C (g/cm <sup>3</sup> *10000)
+15	2	0000h...FFFFh	Density at 20°C (g/cm <sup>3</sup> *10000)
+17	2	0000h...FFFFh	Steam pressure (atm.)

+19	2	0000h...FFFFh	Steam density (kg/m <sup>3</sup> *1000)
+21	2	0000h...FFFFh	Propane-butane ratio by volume (%*100)
+23	2	0000h...FFFFh	Propane-butane ratio by weight (%*100)
+25	2	0000h...FFFFh	Liquid level (mm*10)
+27	2	0000h...FFFFh	Liquid volume (l)
+29	2	0000h...FFFFh	Liquid weight (kg)
+31	2	0000h...FFFFh	Steam volume (l)
+33	2	0000h...FFFFh	Steam weight (kg)
+35	2	0000h...FFFFh	Total weight (kg)
+36	1	00h...FFh	CRC8

### E.4.3. Reading technological parameters (command 41h)

The command is intended for reading the technological parameters of the transmitter: date of manufacture, serial number, model code, firmware version, data output mode.

#### Command format

Offset, byte	Field width, byte	Value	Description
0	1	31h	Prefix
+1	1	00h...FFh	Recipient network address
+2	1	41h	Command code
+3	1	00h...FFh	CRC8

#### Response format

Offset, byte	Field width, byte	Value	Description
0	1	3Eh	Prefix
+1	1	00h...FFh	Sender network address
+2	1	41h	Command code
+3	1	01h...31h	Date of manufacture in BCD format: 1...31
+4	1	01h...12h	Month of manufacture in BCD format: 01h – January, ... , 12h – December
+5	1	00h...99h	Year of manufacture in BCD format: 00h corresponds to 2000
+6	3	000001h...FFFFFFh	Serial number (1... 16777215)
+9	1	01h...03h	Model code (see next table)
+10	2	XX.XX	Version of firmware, in BCD format
+12	3	DD.MM.YY	Date of version of firmware, in BCD format
+15	1	00h...FFh	Board revision
+16	1	00h...0Fh	Number of used one-time passwords
+17	1	00h...FFh	Network address

+18	1	-	Reserved
+19	1	00h...FFh	Automatic data output period (sec.)
+20	1	00h...FFh	Device Mode
+21	1	00h...FFh	CRC8

### Transmitter model code decoding

Model Code (HEX)	Model name
01	ULB-10
02	ULB-20
03	ULB-30

### Decoding the device mode code

Bit	Service	Description	Default value
7	Turning on band-elimination filter	0: filter is disabled 1: filter is enabled	0
6	Alignment of speed detection by distance detection channel	0: alignment is disabled 1: alignment is enabled	0
5	Response to broadcast query	0: by own address 1: by address 255	0
4,3,2	Serial port exchange rate, bps	001 – 2400; 010 – 4800; 011 – 9600; 100 – 19200 (default setting); 101 – 38400; 110 – 57600; 111 – 115200	100 (19200 bps)
1	Change of channel assignment	0: standard assignment 1: change of assignment	0
0	Periodic data output after restart	0: disabled 1: enabled	0

### E.4.4. Reading the serial number and date of manufacture (command 42h)

The command is intended for reading the following parameters of the transmitter: date of manufacture, serial number, model code, firmware version.

#### Command format

Offset, byte	Field width, byte	Value	Description
0	1	31h	Prefix
+1	1	00h...FFh	Recipient network address
+2	1	42h	Command code
+3	1	00h...FFh	CRC8

#### Response format

Offset, byte	Field width, byte	Value	Description
0	1	3Eh	Prefix

+1	1	00h...FFh	Sender network address
+2	1	42h	Command code
+3	1	01h...31h	Date of manufacture in BCD format: 1...31
+4	1	01h...12h	Month of manufacture in BCD format: 01h – January, ... , 12h – December
+5	1	00h...99h	Year of manufacture in BCD format: 00h corresponds to 2000
+6	3	000001h...FFFFFFh	Serial number (1... 16777215)
+9	1	01h...02h	Model code
+10	2	XX.XX	Version of firmware
+12	1	00h...FFh	CRC8

#### E.4.5. Reading the device type (command 80h)

The command is designed to determine the type of connected device.

##### Command format:

Offset, byte	Field width, byte	Value	Description
0	1	31h	Prefix
+1	1	00h...FFh	Recipient network address
+2	1	80h	Command code
+3	1	00h...FFh	CRC8

##### Response format:

Offset, byte	Field width, byte	Value	Description
0	1	3Eh	Prefix
+1	1	00h...FFh	Sender network address
+2	1	80h	Command code
+3	4	'US40'	Device type US40. The data type is – char [4].
+7	1	00h...FFh	CRC8

#### E.4.6. Reading the firmware checksum (command 84h)

The command is used to read the checksum (CRC32, polynomial: 04C11DB7h) of the firmware.

##### Command format:

Offset, byte	Field width, byte	Value	Description
0	1	31h	Prefix
+1	1	00h...FFh	Recipient network address
+2	1	84h	Command code
+3	1	00h...FFh	CRC8

##### Response format:

Offset, byte	Field width, byte	Value	Description
0	1	3Eh	Prefix
+1	1	00h...FFh	Sender network address

+2	1	84h	Command code
+3	4	00000000h...FFFFFFFh	CRC32 of built-in application loader
+7	4	00000000h...FFFFFFFh	CRC32 of built-in application
+11	1	00h...FFh	CRC8