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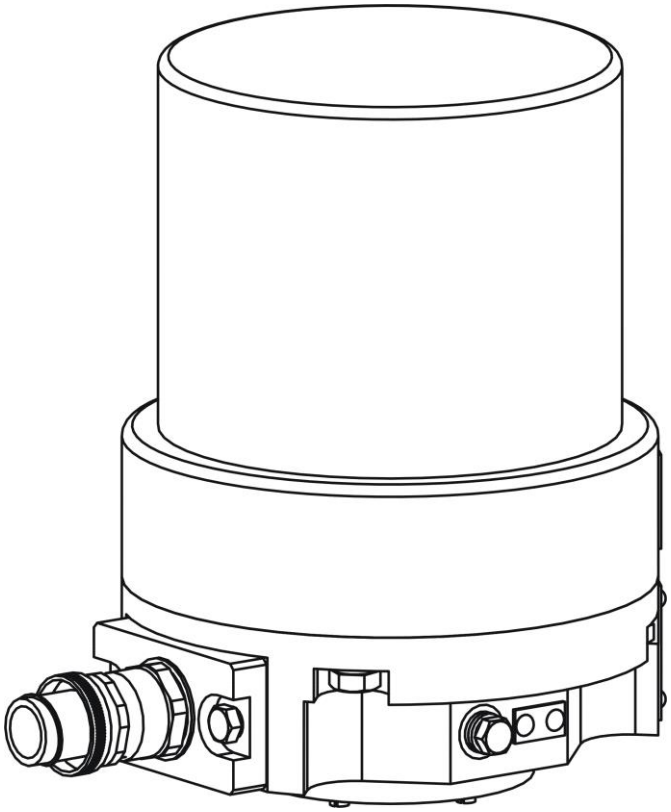
OPERATION & INSTALLATION MANUAL

FOR

NON-CONTACT RADAR LEVEL TRANSMITTERS

ULM-11, ULM-11-HF, ULM-11-HF-F, ULM-11A1, ULM-11A1-HF, ULM-11A1-HF-F.



CONTENTS

1 DOCUMENT DETAILS

1.1 Document Purpose

This Operation Manual provides information necessary for installation, connection, commissioning and setup, as well as guidelines on maintenance and trouble-shooting. Before installing and putting the level transmitter in operation, please read instructions set forth herein.

1.2 Target Group

This Operation Manual is intended for the trained personnel carrying out the level transmitter installation, commissioning, diagnostics and servicing. The personnel shall know and observe the instructions set forth herein.

1.3 Arbitrary Notations

Symbol	Meaning
! CAUTION	Failure to observe the instruction may make the instrument inoperative or result in its incorrect operation.
! WARNING	Failure to observe the instruction may cause the damage to the personnel and/or the instrument.
NOTE	The symbol means the useful information, which should be taken into account.

2 BASIC SAFETY REGULATIONS

2.1 Personnel Requirements

The personnel carrying out the level transmitter installation, commissioning, diagnostics and servicing shall study this Manual and be permitted to operate the instrument. When operating the equipment, the personnel shall use the required personal protection equipment in compliance with the standards established at the enterprise.

2.2 Purpose

Explosion-proof design level transmitters ULM-11, ULM-11A1, ULM-11-HF, ULM-11A1-HF, ULM-11-HF-F, ULM-11A1-HF-F (hereinafter referred to as **"The Level transmitter"**) is designed for continuous non-contact measuring the level of liquid, viscous and bulky products and are intended for use in the process metering systems. It is used for measuring both neutral and aggressive products, as well as during measurements in complicated conditions, such as available acids, alkalies, water solutions, food products, cement, coal, dust etc. The level transmitter represents a sophisticated fixed radar continuous-action instrument. The level transmitter is installed on tanks and hoppers and is designed for use in the explosion hazardous zones of the rooms and external installations according to PUE (Electrical Installation Code) and other guiding documents regulating the use of the electrical equipment in the explosion hazardous zones. The level transmitter with explosion protection 1Ex d IIB T6 Gb labeling is designed for use in the explosion hazardous zones of the rooms and external installations of Class 1 and 2 acc. to GOST IEC 60079-10-1-2011, acc. to GOST IEC 60079-14-2011 in accordance with explosion protection marking and other regulatory documents regulating the use of the electrical equipment in the explosion hazardous zones.

The custom-designed index HF in designation of the level transmitters ULM-11-HF, ULM-11-HF-F, ULM-11A1-HF, ULM-11A1-HF-F mean high frequency complete set of the models ULM-11, ULM-11A1 with the analog output signal.

The level transmitter with Ex tb IIIC T6 Db marking is designed for use in the explosion and dust hazardous atmospheres, for installation in the conductive dust Class 21 and 22 zones according to GOST IEC 60079-10-2-2011. The level transmitter is connected with the terminal box and with the level transmitter power supply installed outside the explosion hazardous zones using the electrical cable.

Prior to using the level transmitter in the explosion hazardous zone, make sure that its design specified in the information plate (identification nameplate), corresponds to that, which is allowed for operation in this zone.

Unintended use of the instrument can result in the emergency situation at the production facility, put the instrument out of operation and may be the potential hazard source.

2.3 Operational Safety

The instrument operational safety is ensured only in compliance with these manual guidelines.
To ensure the operational safety and to observe the guarantee obligations, it is prohibited to make any modifications in the instrument design. The operations with the instrument, except those set forth in this manual, can be performed only after the manufacturer's official authorization. The level transmitter service life – 20 years.

2.4 General Guidelines on Safety

The level transmitters ULM-11, ULM-11A1, ULM-11-HF, ULM-11A1-HF, ULM-11-HF-F, ULM-11A1-HF-F satisfy all current safety requirements and standards. The level transmitter working emission frequency makes approximately 24GHz for ULM-11A1, 77 – 94 GHz for ULM-11 and 125±5 GHz for ULM-11-HF and ULM-11A1- HF, ULM-11A1-HF-F. The emission power of these level transmitters makes milliwatt (mW) units, which is significantly lower than the admissible limit values. Therefore, the instruments are completely safe for human and animals.
To avoid the emergency situations at the production facility, it is allowed operating the the level transmitters only in good working order.

2.5 Environmental Safety

Compliance with recommendations set forth in Sections “Packaging, Transportation and Storage” and “Disposal” contributes to environmental protection.

3 PRODUCT DESCRIPTION

3.1 Scope of Supply. Ordering Details.

When ordering the level transmitter, it is necessary to fill out the questionnaire containing the basic parameters of the capacity and the process. The level transmitter complete set is selected based on the filled-out questionnaire.

The basic complete set includes:

1. The radar level transmitter
a) the level transmitter cable gland type is selected based on the type of the supply cable and its laying method:

Cable type and parameters	Laying method	Order code
Circular cross-section cable with 6.5-14 mm outer diameter	Inside the flexible metal hose of type: - R3-TsKh-20 - MRPI-20 - Flexicon FU25	ULM-11-M, ULM-11-A-M, ULM-11A1-M, ULM-11A1-A-M, ULM-11-HF-M, ULM-11A1-HF-M ULM-11A1-HF-F-M
Circular cross-section cable with 6.5-14 mm outer diameter	Inside the metal pipe 1/2", 3/4". The pipe mates the cable gland by screwing in the connector 3 (Fig.7.4). The thread acc. to GOST 6111-52 — Cone-shaped whitworth thread (NPT - USA standard) shall be available on pipe.	ULM-11-T, ULM-11-A-T, ULM-11A1-T, ULM-11A1-A-T, ULM-11-HF-T, ULM-11A1-HF-T ULM-11A1-HF-F-T
Armored circular cross-section cable with the internal sheath outer diameter 6.6-14 mm and the external sheath outer diameter 12.5-20.9 mm		ULM-11-B, ULM-11-A-B, ULM-11A1-B, ULM-11A1-A-B, ULM-11-HF-B, ULM-11A1-HF-B ULM-11A1-HF-F-B

b) the level transmitter internal configuration is selected based on the filled-out questionnaire and considers the software-hardware parameters required for reliable measuring of level at the Customer's facility. The meter configuration is not specified in the level transmitter marking

2. Setup software and the documentation on electronic medium (compact disk CD):
- Software program for Ulmcfg setup;

- Driver SW (if necessary);
- Operation Manual
- Additional documentation (certificates and permits, the other technical information, if necessary).

NOTE

The software and the documentation on the electronic medium can be supplied in 1-piece amount for the whole order complete set according to specification.

Auxiliary equipment and software that may be included in the order specification:
- The upper level software:
  "Limaco OPC Server";
  OPC Client – "Reservoir Viewer" measuring system visualization;
- Power supply;
- Interface RS-485 converters;
- Interface HART converters;
- Sealing gasket;
- Adapting flange.

NOTE

- The particular type of auxiliary equipment (interface adapters, flanges, sealing gaskets) may be of different design; it is agreed during the equipment order and is specified in the order specification.
- The adapting flange is designed for the level transmitter installation on the tank mating flange.
- As standard, the ULM level transmitters are supplied with the flanges complying with GOST requirements (see p. 14.4). There is an option for the order of ULM level transmitters with adapting flanges of various designs in accordance with different standards – shall be specified at the Supplier's.

3.2 Product Design

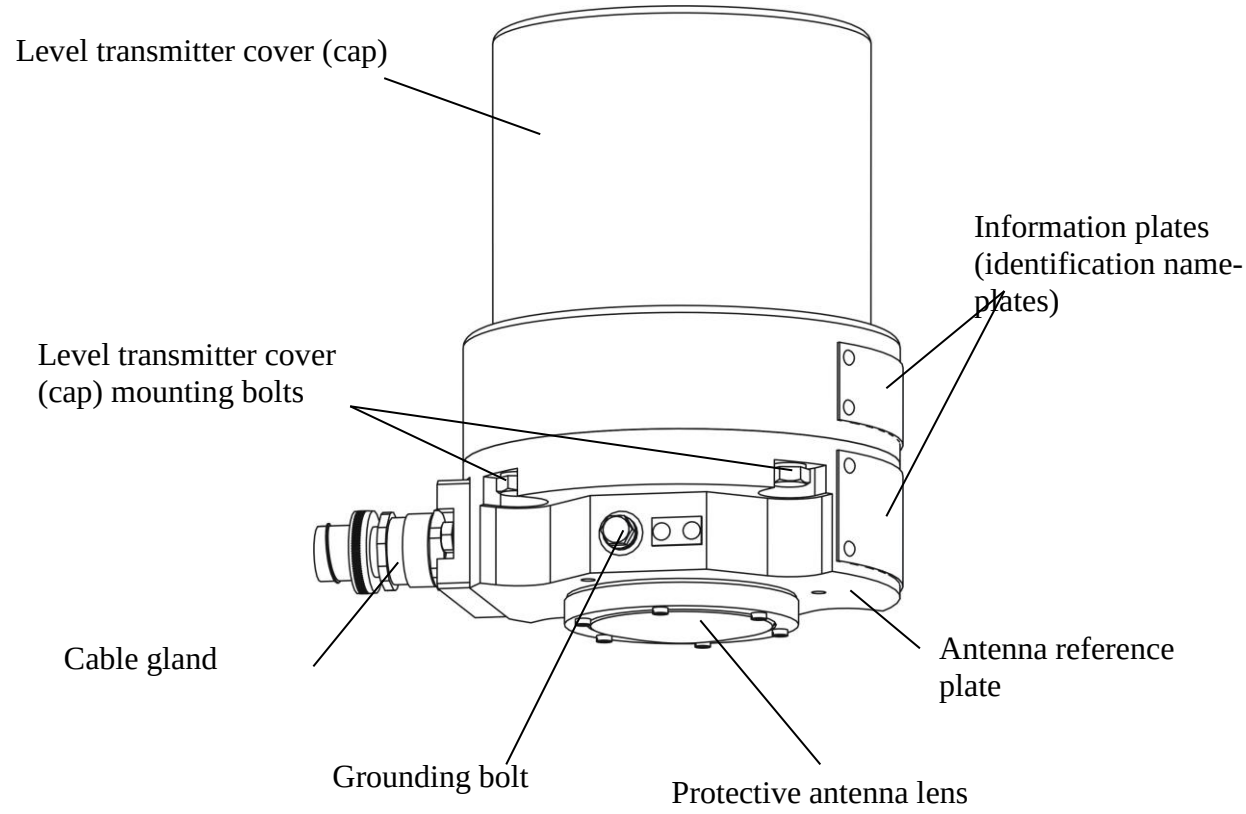


Fig. 3.1. Appearance and arrangement of basic elements

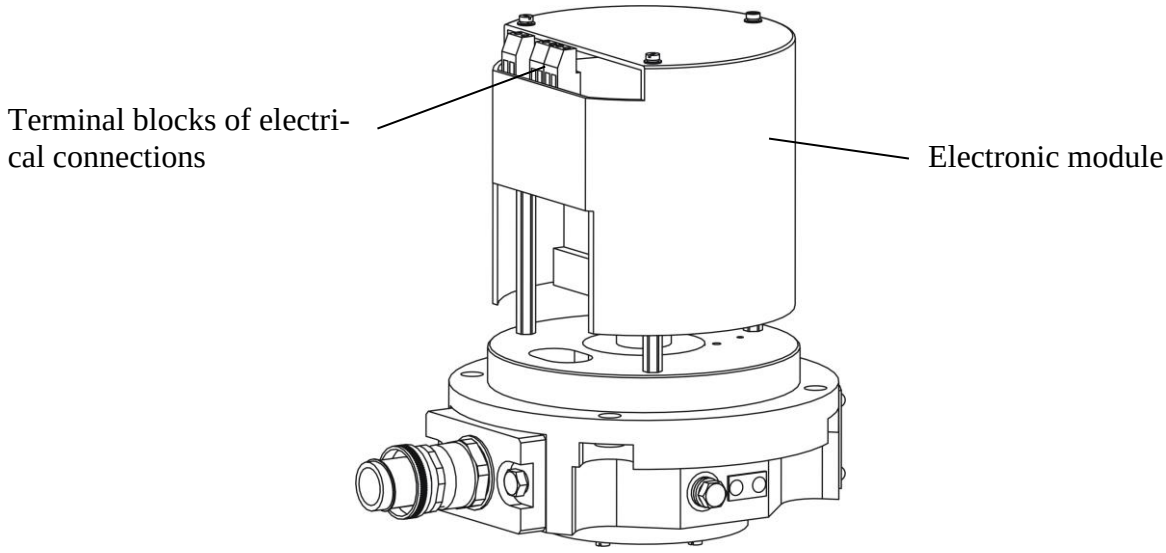


Fig. 3.2. Level Transmitter Design. Electronic Module Location.

3.3 Product Identification

The instrument identification is performed using one of possible methods:
- according to the data specified on the instrument nameplate (identification nameplate);
- according to the attached instrument certificate;
- by the request to the manufacturer with specification of the level transmitter serial numbers.

The level transmitter common-type identification nameplate (information plate) includes the following data for the instrument identification and use:
- manufacturer's logo;
- device type (level transmitter marking – custom-designed index);
- serial (manufacturing) number;
- year of manufacture;
- conformance marks;
- ingress protection rating IP;
- explosion-proof marking;
- allowable environment temperature;

Example for common-type identification nameplate is in Fig. 3.3

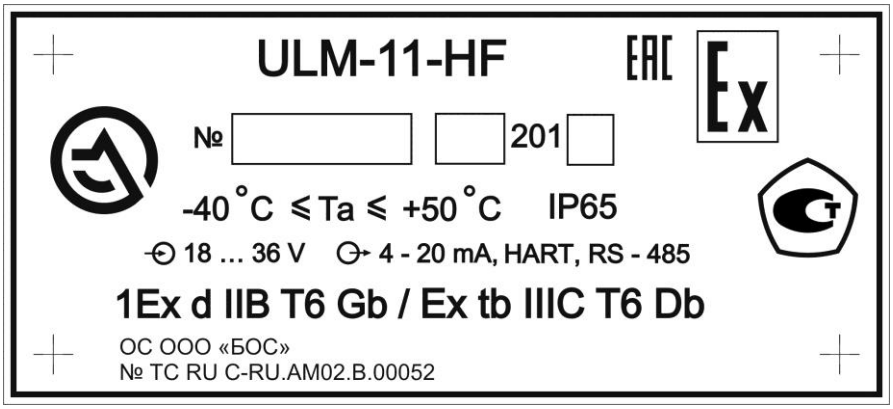


Fig. 3.3. Common-type identification nameplate

3.4 Operating Principle

The level transmitter is installed on the tank roof, on the tank pipe branch flange. At that no part of it is dipped inside the tank. The instrument measures the distance L between the antenna reference plane (Fig. 3.1) and the product surface via the opening in the flange. Then the level is computed using the formula U=H-L, where H – the installation height.
The reference plane of the level transmitter measuring range is the lower surface of the antenna installation plane (reference plane) (Fig. 3.1).

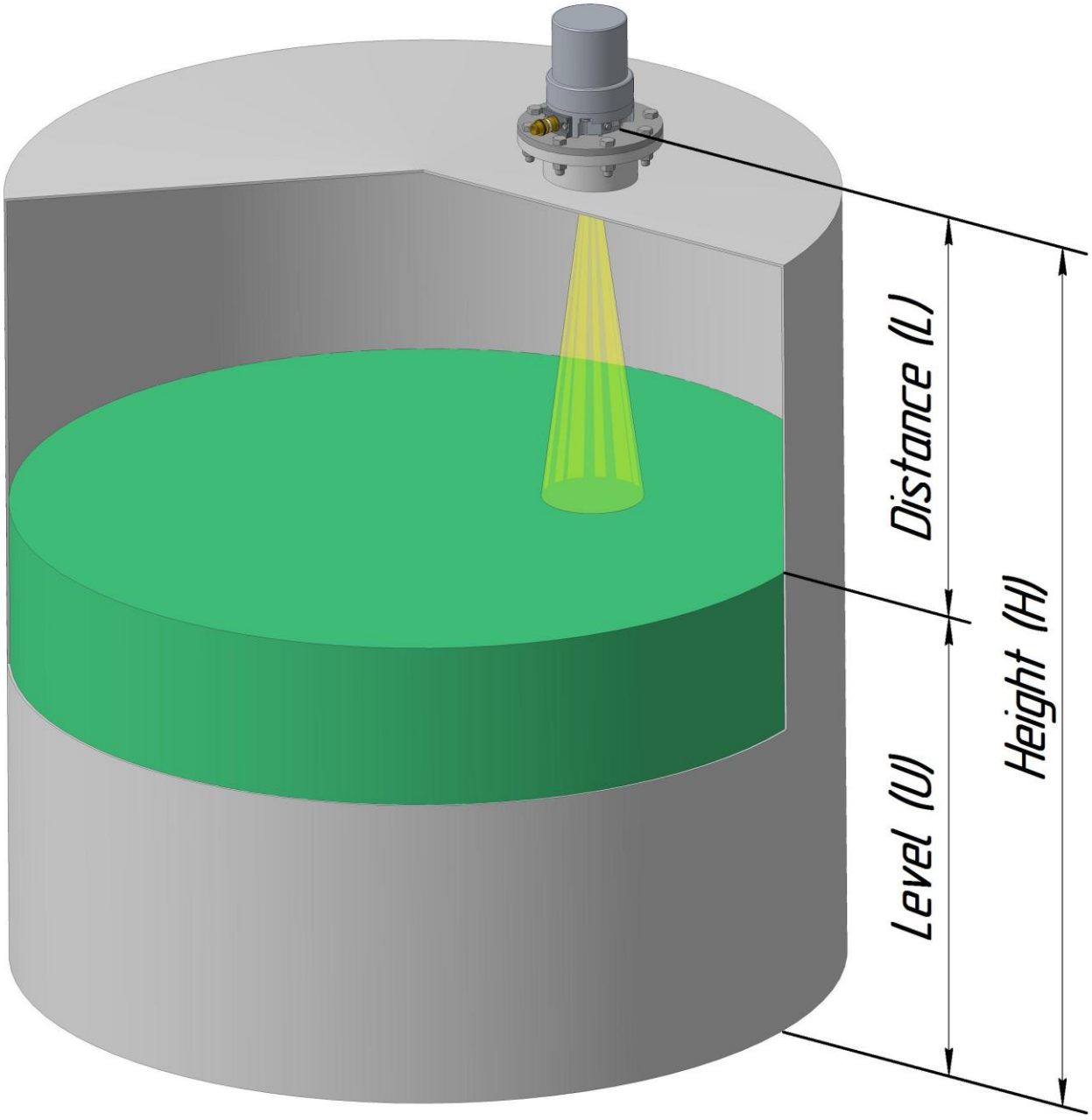


Fig. 3.4. Level Transmitter on Tank.

The level transmitter antenna sends out the radio signal and receives the echo-signal reflected from the product surface. Using the software-hardware system, the electronic unit processes the echo-signal and converts it to the corresponding output signal, which carries the information on the measured value.

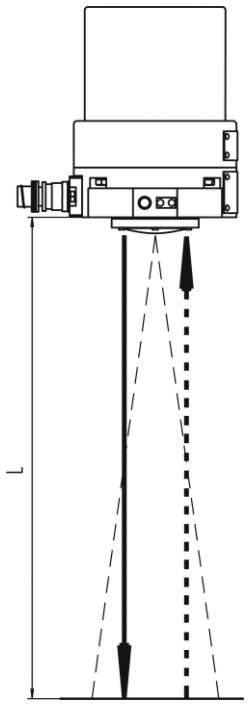


Fig. 3.5. Measuring Principle.

The level transmitter ULM-11A1 operates according to LFM (FMCW) principle - the radio locator principle. This is one of classical methods for non-contact measuring of the distance, which allows for minimizing the effect of stray interferences and interferences related to irregularities (disturbances) of the measured product surface.

Operating principle consists in the following: the low-power micro wave generator generates sounding radio signal, with its frequency growing linearly during the measuring period (solid line in Fig.3.6). This signal (let us call it direct one) is sent by the level transmitter antenna in the product surface direction. After delay time T_d, the signal reflected from the surface (the dashed line in Fig. 3.6) returns to the antenna. T_d – the time required for the radio wave to travel the distance from the antenna to the reflecting surface and back. $T_d=2L/s$, where s – the light speed. As far as the velocity of radio wave propagation is constant, so, knowing the time delay, it is possible to determine the traveled distance. Fig. 3.5 shows, that during the time T_d, the frequency of direct signal will increase by ΔF. During mixing direct and reflected signals, the low-frequency signal of differential frequency ΔF is separated out. Further on, this signal is digitized and processed by the signal processor (DSP). Using the algorithm based on Fourier transformation and the original adaptive algorithms for processing and noise suppression, DSP carries out the signal spectral analysis resulting in precise value of differential frequency. Having determined this frequency, the signal time delay is determined, and, therefore, the distance traveled by the radio wave. Further on the measured distance is used for calculation of the level and the volume.

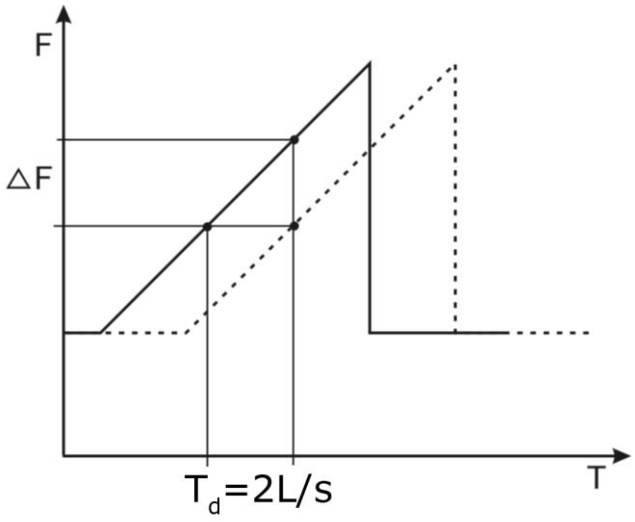


Fig. 3.6. LFM Radio Locator Operating Principle

3.5 Level Transmitter Explosion Protection

The level transmitter explosion protection is achieved by using the explosion-proof casing, which withstands the blast pressure and excludes the blast transfer in the explosion hazardous environment.

The level transmitter design is based on mating of components ensuring slot explosion protection. Such mating is performed specifying the explosion protection allowable parameters: maximal width and minimal length of slots, bearing surface finish class, creating explosion-proof slots.

Explosion protection surfaces are corrosion protected by the corrosion rust-preventive compound. Any damage or painting of these surfaces is not allowed.

The explosion-proof casing is reached through the following technical specifications: the explosion-proof connections have 12.5 mm minimal slot length; the threaded connections of the explosion-proof casing parts have at least 5 full continuous threads; the thickness of the casing walls is at least 5 mm; inside the casing, all mounting holes from the sides and the ends are no less than the allowable value of 3 mm.

The cable gland explosion-proofness is achieved by its sealing with the flexible rubber ring.

The temperature of the level transmitter explosion-proof casing outer surfaces, in the most heated locations under the ambient temperature (60+2) C does not exceed the allowable one acc. to GOST 31610.0-2014 (IEC 60079-0:2011) for electrical equipment temperature class T6 (80 ^{0}C).

All bolts, fixtures with explosion protection surfaces, as well as live and grounding clamps are protected against their self-loosening by using the spring washers GOST 6402-70.

The external fastening bolts have countersunk heads. Their access is possible using the Allen wrench.

There is a warning notice on the level transmitter removable upper cover: “WARNING – OPEN AFTER DISCONNECTION FROM MAINS” and explosion protection marking 1Ex d IIB T6 Gb / Ex tb IIIC T6 Db.

3.6 Packaging, Transportation and Storage

The level transmitter is supplied in the package, which ensures its protection during transportation.
The package is made of cardboard, which is a recyclable material. In certain cases, it is possible to use polyethylene foam and polyethylene film, which are disposed of at dedicated processing enterprises.
The instrument transportation shall be carried out in the original package. After transportation the instrument shall be inspected for the available transport damages and completeness of the set. In case of detecting any transport damages or incompleteness of set, all revealed defects are documented in the established order.
Prior to installation, the instruments shall be stored in the original closed packages. During storage, the following conditions shall be complied with:
- storage temperature - 50…+80˚C;
- relative humidity - 20…85%;
- storage under effect of aggressive environment is not allowed;
- no storage in the open air is allowed;
- during storage no mechanical impacts on the instrument are permitted.

4 INSTALLATION

4.1 Selection of Installation Position

Stable readings and accurate level measurements depend on its correct installation.

When selecting the installation position, the following recommendations should be adhered to:

- to install the instrument in such way that in the measurement zone there are no subjects and structures making interferences to the radio wave beam propagation (pipes, valves, stirrers, tank walls, etc. (For details, see p. 4.4 Measuring Beam Zone of Action);

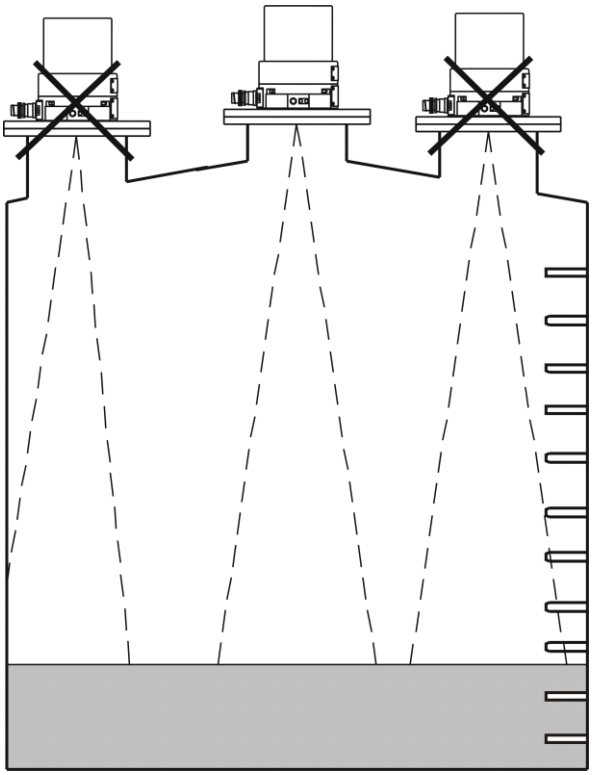


Fig. 4.1. Instrument Installation on Tank. Structural Elements

- the instrument should not be installed in such way that the stream of the product filling up the tank makes in the level transmitter measuring beam action zone. The instrument shall be located in an optimum manner away from the feeding area;

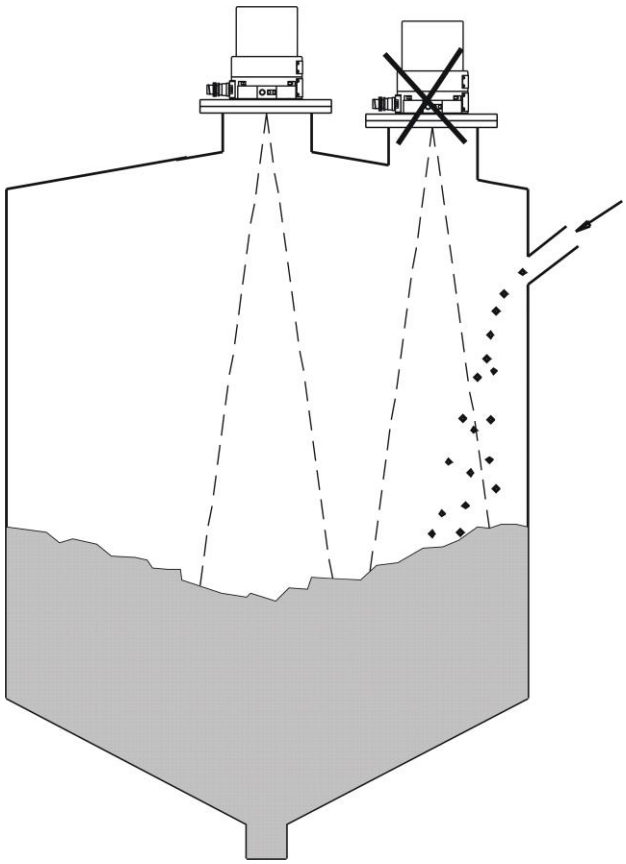


Fig. 4.2. Level Transmitter Installation on Tank. Product Feeding.

- during product discharge from the tank, the swirl can be formed on the product surface. This shall be considered when selecting the instrument location. The level transmitter shall be installed above the location with the smoothest product surface.

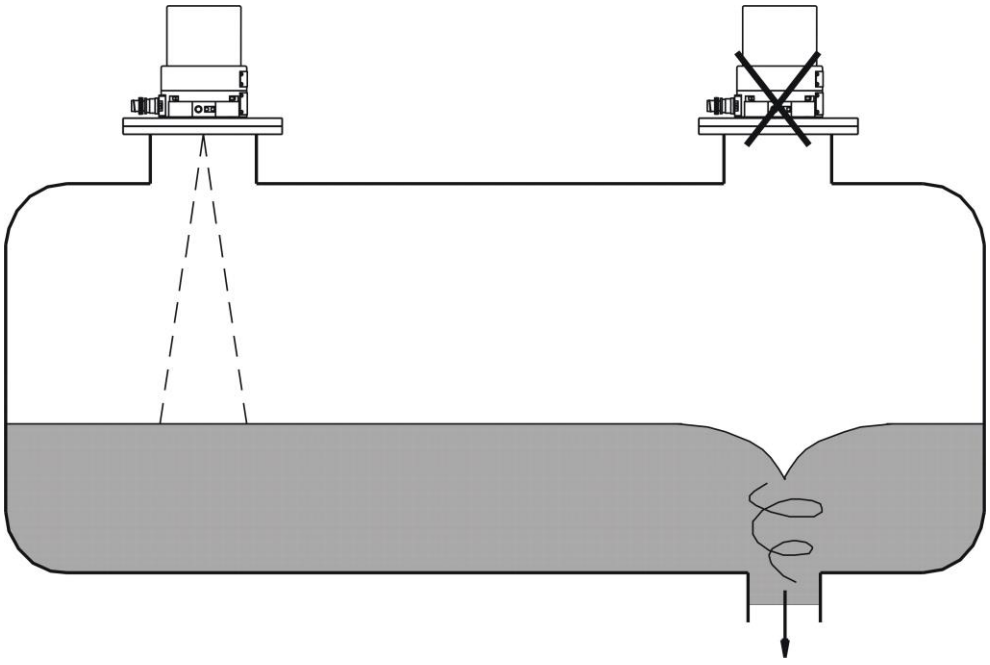


Fig. 4.3. Instrument Installation on Tank. Product Discharge.

- to provide the level measurement over the total depth of the tank, the level transmitter shall be oriented in direction of the tank lowest point. In the vertical cylindrical hoppers with the cone-shaped outlet, this is achieved by its installation in the center of the hopper roof.

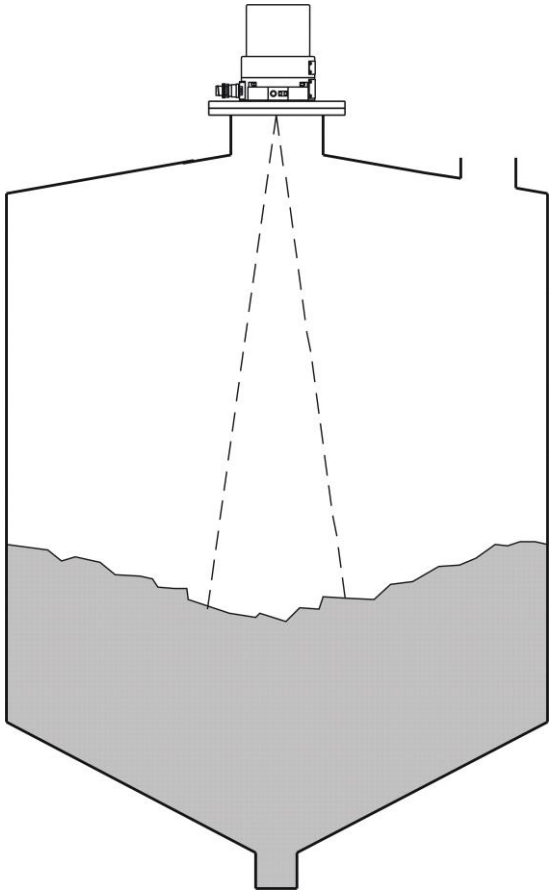


Fig. 4.4. Instrument Installation on Hopper with Cone-Shaped Bottom.

In case such way of installation is impossible, it is necessary to direct the device measuring beam to the hopper center, which is achieved by inclining the mounting pipe branch flange plane.
The required inclination angle β depends on installation position and the hopper dimensions. The inclination angle can be checked using the inclination angle sensor built in the level transmitter or using the water-level (For details, see p. 7.1 “Instrument Diagnostics”).

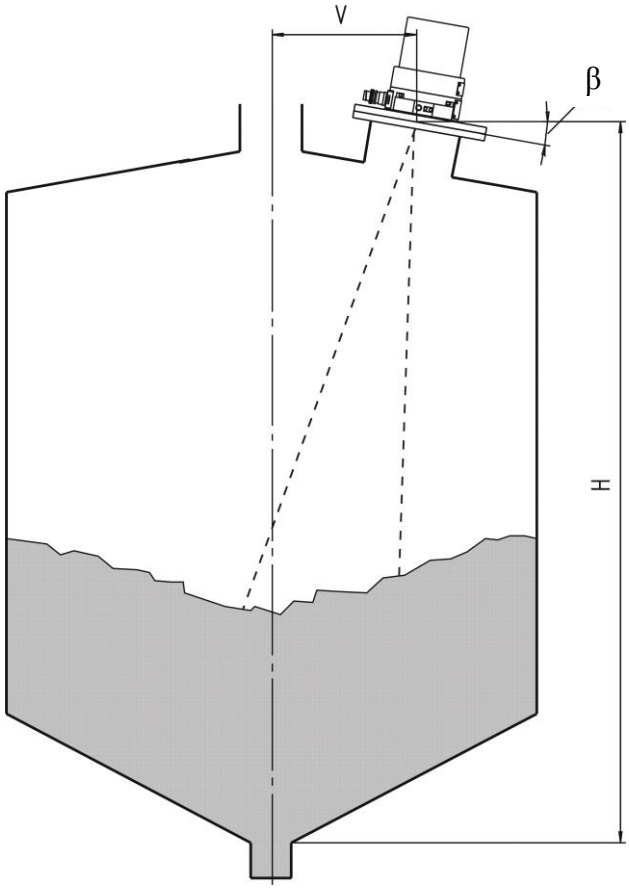


Fig. 4.5. Instrument Installation with Inclination on Hopper with Cone-Shaped Bottom.

The value of distances V, m from the tank center to the installation position is given in the following Table.

Installation height H (m)	β =2˚	β =4˚	β =6˚	β =8˚	β =10˚
2	0.1	0.1	0.2	0.3	0.4
4	0.1	0.3	0.4	0.6	0.7
6	0.2	0.4	0.6	0.8	1.1
8	0.3	0.6	0.8	1.1	1.4
10	0.3	0.7	1.1	1.4	1.8
15	0.5	1.0	1.6	2.1	2.6
20	0.7	1.4	2.1	2.8	3.5
25	0.9	1.7	2.6	3.5	4.4
30	1.0	2.1	3.2	4.2	5.3
35	1.2	2.4	3.7	4.9	6.2
40	1.4	2.8	4.2	5.6	7.1
45	1.6	3.1	4.7	6.3	7.9
50	1.7	3.5	5.3	7.0	8.8

For example, the hopper 5 m high and the level transmitter are mounted at 1.6 m distance from the center. Using the Table, let us determine the required inclination angle 6˚.

- for instrumentation protection against direct sunlight in conditions of hot climate, the protection screen or the shed should be used;

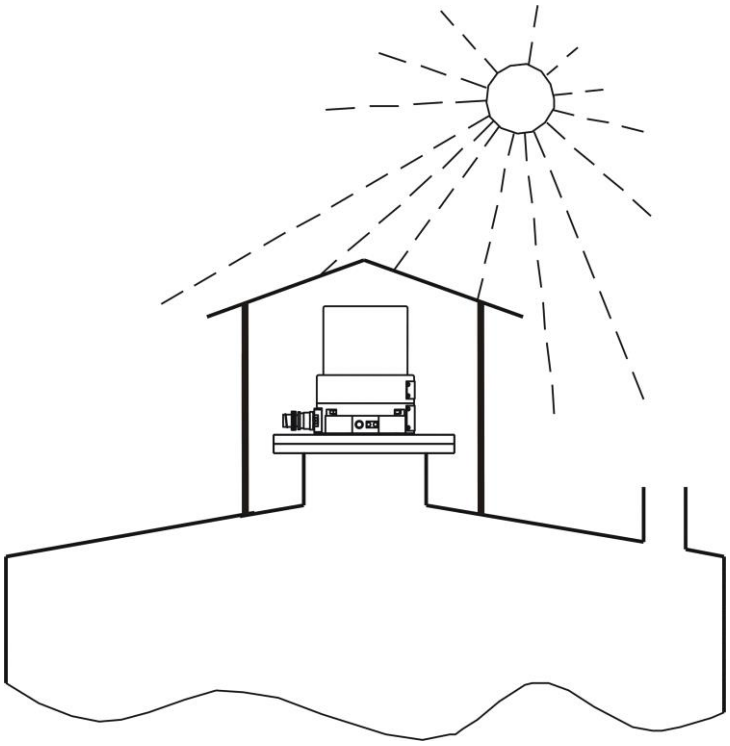


Fig. 4.6. Installation of Instrument with Protection Screen

- the temperature in the level transmitter installation location shall not exceed +50°C; the radio transparent sealing gasket should be used during the instrument installation on the tank with high ambient temperature (see pp. 14.5;

- the radio transparent sealing gasket should be used during the level transmitter installation on the tank with excessive pressure or vacuum (see p. 14.6);

NOTE

In case the instrument is used on the tank, where it is impossible to maintain the installation conditions upon the absence of structures in the measuring beam, the following recommendations should be adhered to:

- the distance between the tank wall and the level transmitter central axis shall be selected within the limits 1/2…1/3 of the tank radius (see Fig. 4.7);

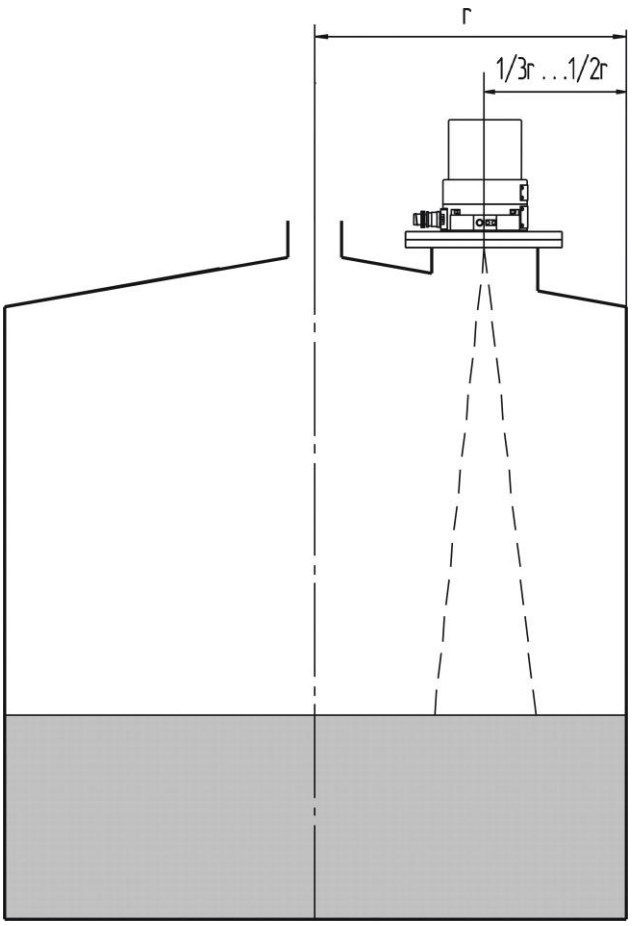


Fig. 4.7. Instrument Installation

- if the tank walls are not smooth (for example, corrugated metal, welded joints, structures), the distance from the wall shall be the longest possible.

- when measuring the level in the foam formation conditions, it is necessary to select the level transmitter installation position maximum distant from the foam formation source; it should be also considered that, depending on the foam composition and its density, the level measuring may be taken both by the upper foam boundary and by the product-foam border.

- when measuring the level in the vapor intensive formation conditions and the hazard of the condensate dropout on the level transmitter protective lens, it is recommended to use the radio transparent insulating gasket (see p. 14.5).

NOTE

In case of using the device on the tanks made of conductive material (for example, plastics), it should be taken into consideration that the structures outside the tank may hit in the measuring beam. Therefore, during installation, the installation position should be selected with account of this fact.

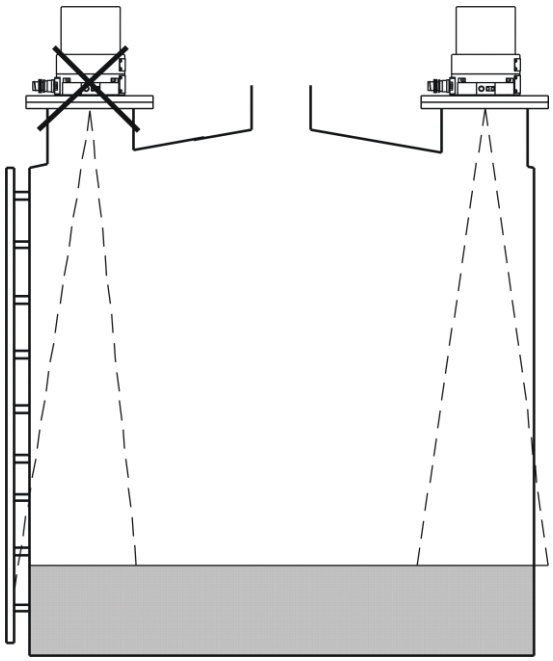


Fig. 4.8. Instrument Installation Tank Made of Conductive Material.

4.2 General Requirements for Installation on Mounting Pipe Branch

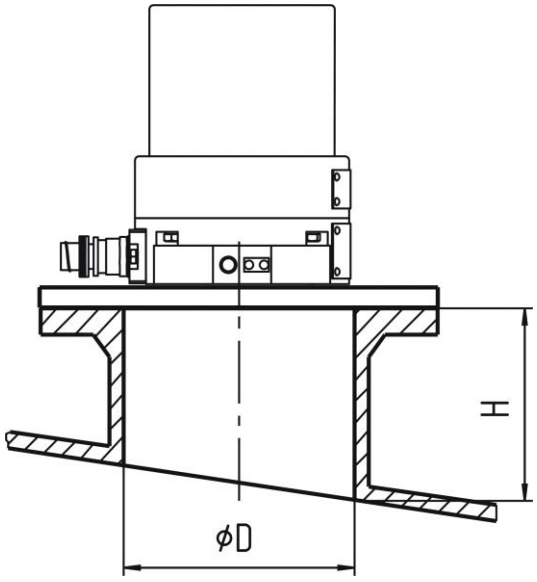


Fig. 4.9. Instrument Installation on Mounting Pipe Branch.

The pipe branch inner diameter D shall be at least 150 mm. The pipe branch axis permissible vertical deviation during measuring the level of **liquid** products - 1°.
The pipe branch height H is measured along its inner surface from the flange to the opening lower edge. The maximum permissible pipe branch height depends on its diameter. The bigger the diameter, the higher the permissible pipe branch. The formulas relating the pipe branch diameter and its height are selected based on application (see p. 4.3).

Use of higher pipe branch may result in occurrence of stray re-reflections and may hamper the process of measuring. If it is desired to use the pipe branch longer than the one estimated for application, it is necessary to agree the design with the manufacturer. The opening in the roof under the pipe branch shall be no less than the pipe branch inner diameter. The pipe branch inner surface shall not have irregularities sized above 3 mm. The stray reflections from irregularities inside the pipe branch may result in poor measurement accuracy and stability.
In case of using the rectangular section pipe branches, the pipe branch height, with account of the roof thickness in conjunction with the inner structures adjacent to the roof (stiffening ribs, etc.), shall not exceed the one calculated by the formulas given in p. 4.3, where the dimension of the rectangle narrow side is put down instead of the pipe branch diameter.

4.3 Mounting Pipe Branches

The pipe branch requirements are based on the type of application. The applications are divided into two types: with the strong reflected signal and with the low-power reflected signal.
The applications with the low-power reflected signal include the liquids with capability for foam formation >1 cm, the tanks with the stirrers, in cases, when the level transmitter beam hits the cone-shaped surface, occurring due to agitation and having inclination above 6 degrees, as well as all bulky materials.
All the rest applications refer to applications with strong reflected signal.

The requirements to the pipe branch for applications with strong reflected signal.
The permissible pipe branch height H is calculated by the formula:

$$H = D \cdot 2.5;$$

where H – the maximal pipe branch height in mm, D – the pipe branch diameter in mm.

Calculation of the common-type pipe branches is given in the next Table.

Setting pipe branch diameter, mm	Maximal setting pipe branch height, mm	Recommended setting pipe branch height, mm
150	300	150-200
200	500	200-250
300	750	500

Requirements to the pipe branch and the opening in the roof for applications with low reflected signal when measuring in the complicated conditions (it is natural

with some types of liquid and for most bulk products, as well as during measurement of the level in the foam formation conditions).
The mounting pipe branch height shall be no higher than its diameter:

$$H = D.$$

For these applications it is not recommended to use the pipe branches with the height above 250 mm.

When measuring the level in the foam formation conditions, it should be considered that, depending on the foam composition and its density, the level measuring may be taken both by the upper foam boundary and by the product-foam border.

4.4 Measuring Beam Zone of Action (directional pattern width).

The instrument main energy is radiated in the beam determined by the directional pattern.

Level transmitter model	ULM-11, ULM-11-HF-F, ULM-11A1-HF-F	ULM-11A1	ULM-11-HF	ULM-11A1- HF
Width of measuring beam α (deg)	4	15	2	2

The beam diameter W is determined based on the function from the width of the measuring beam α and the measured distance L according to the formula:

$$W = 2 \cdot L \cdot \tan\left(\frac{\alpha}{2}\right)$$

For calculation of the measuring beam zone of action, the simplified formula for the relative level transmitter model can be used:

Level transmitter model	ULM-11, ULM-11-HF-F, ULM-11A1-HF-F	ULM-11A1	ULM-11-HF	ULM-11A1- HF
Beam diameter	$W = 0.07 \cdot L$	$W = 0.263 \cdot L$	$W = 0.035 \cdot L$	$W = 0.035 \cdot L$

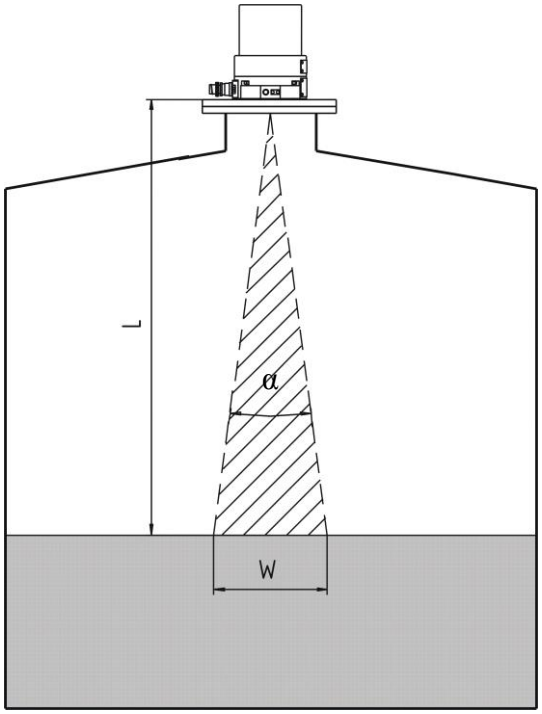


Fig. 4.10. Measuring Beam Zone of Action

4.5 Dead Zone

The level transmitters have the so-called “dead zone”. This is the zone close to the instrument antenna, measuring within which is either difficult or impossible. The “dead zone” is shown in Fig. 4.11 and it may be conventionally divided into three regions. The closest region (in the Figure on the left), in which it is impossible to take measurement. The medium one – the region of unstable measurements. The instrument can determine the distance with low accuracy and the discontinuities of reading are possible. The distant region of the “dead zone” – the measurements are stable there, but the instrument rated accuracy level is not achieved. The distance of the “dead zone” regions depends on the product reflecting capacity and the available tank structures hit by the level transmitter beam. The “dead zone” does not exceed 600 mm, provided that the regulations for the level transmitter installation in the tank are observed.

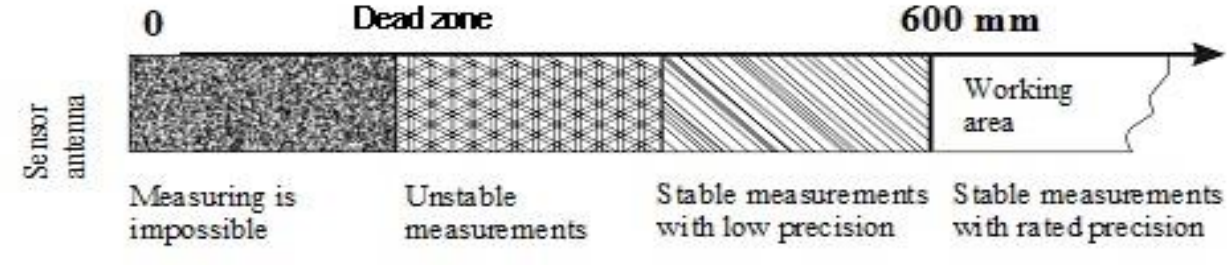


Fig. 4.11. Level Transmitter Dead Zone.

4.6 Installation Procedure

The level transmitter is placed above the tank under control and is installed immediately above the inspection window with diameter at least 140 mm at right angle to the horizon line. The level transmitter installation is carried out by means of the level transmitter adapting flange mating with the flange of the tank inspection window. Connecting dimensions for level transmitter mating with adapting flange are given in p. 12.7. The adapting flange overall dimensions and the arrangement of the holes for mating with the tank flange may be changed upon agreement with the developer at the stage of the order.

The tank inspection window hatch height in conjunction with connecting flange shall ensure excess if the level transmitter mating plane over possible upper level of the tank content for at least 0.6 m. The inspection window flange plane shall be horizontal. Deviation from the horizon line for an angle maximum 1 degree is allowable. During level transmitter installation between the adapting flange and the tank flange, the the radio transparent sealing membrane (fluoroplastic willingly), excluding the level transmitter contact with the tank inner volume, can be installed. The Customer determines its method of attachment. The membrane material and thickness are agreed upon with the developer.

When placing on the tank, the level transmitter installation location shall be selected on the ground of considerations that there shall be no items or structures (pipes, tubing or tank wall, etc.) creating interference for radar impulse propagation in the measuring zone (solid angle equal to the level transmitter antenna directional pattern width (see p. 4.4) plus 5 degrees).

4.7 Installation Examples

The examples for the level transmitter installation designed in accordance with this instruction requirements are shown in Fig. 4.12 in positions A and B. Fig. 4.12 Variant A shows the level transmitter installation on the tank flange without using the pipe branch, and Variant B – with the pipe branch. Variants C-E show the installation typical errors, which should be paid attention to.

Variant C – the roof edge under the pipe branch extends inside the pipe branch. Besides, the opening in the roof is smaller than the minimum permissible one.
Variant D - the pipe branch lower edge is embedded in relation to the roof, due to which the pipe branch length is longer than the permissible one.
Variant E - the level transmitter is installed with high displacement in relation to the pipe branch vertical axis. The instrument should be installed based on the pipe branch central axis.

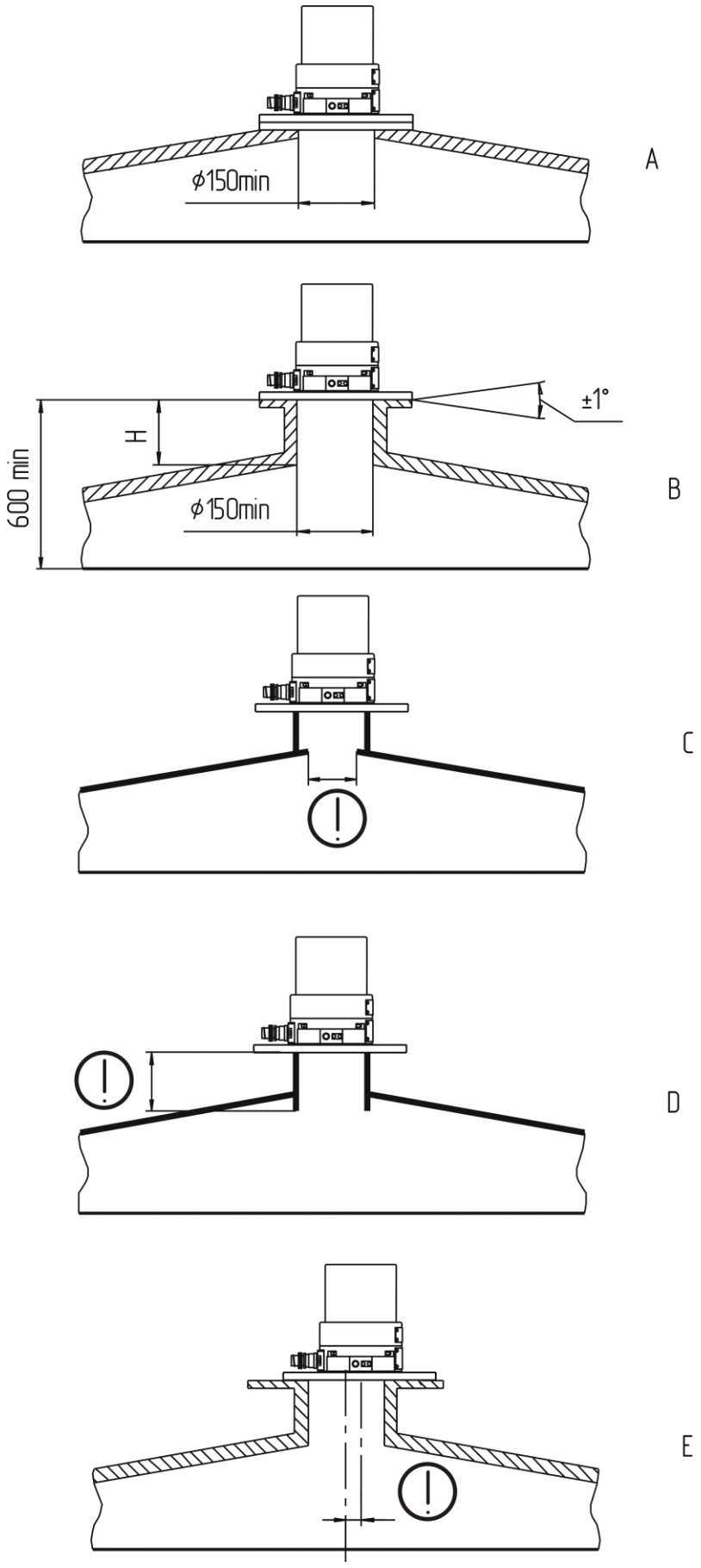


Fig. 4.12. Installation Examples

4.8 Structures in Tank

The structures located in the tank - tubes, valves, stirrers, tank corrugated walls, level alarms and other subjects may be the sources of the stray signal. The installation position of the level transmitter shall be selected in such way that there are no obstacles on the radio signal propagation way. If it is impossible to meet this condition due to the tank design features, you should address the manufacturer's technical support desk.
The impact of the design features can be reduced by using the inclined reflectors, which dissipate the radio signal. The reflectors can be made of sheet metal.

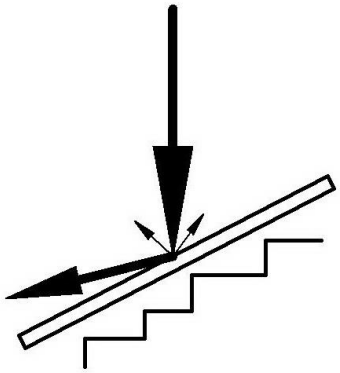


Fig. 4.13. Example of inclined reflector above the structure in the tank

5 ELECTRICAL CONNECTION

5.1 General Guidelines

! WARNING

All connections shall be made in the de-energized line.
The electrical connection operations shall be performed only by the qualified personnel having the permit for this type of works.

! CAUTION

It is prohibited:
- to leave the level transmitter on the installation position without the connected cable;
- to leave level transmitter the level transmitter on the installation position with the connected cable, but with the loose cable gland.

5.2 Connecting Cable.

To connect the 4-20 mA analog output, use a standard pair of conductors in a separate shield.

To connect the RS-485 digital interface, it is necessary to use a pair of conductors in the shield, it is allowed to use a cable with a common shield. The use of round section cable is required. In order to ensure stated IP grade with regard to dust and moisture protection, the use of cable with diameter suitable for particular cable gland is required. The types of used options for connecting to the cable network are given in p. 3.1.1 of this manual. The cable GERDA-KVng 4x2x0.5 (with no armor, individual shield of each pair) and the cable GERDA-KVKng 4x2x0.5 (with armor, individual shield of each pair) S 16.K13-033-2005 or the cable analogous to the corresponding parameters given in p.3.1 are recommended for use as the connecting cable.

! CAUTION

Do not input several cables into the instrument via one cable gland.

NOTE

For instrument moisture penetration inside protection, it is recommended to bend the connecting cable downwards in the immediate proximity from the cable gland for rain and condensate moisture running-off (Fig.5.1).

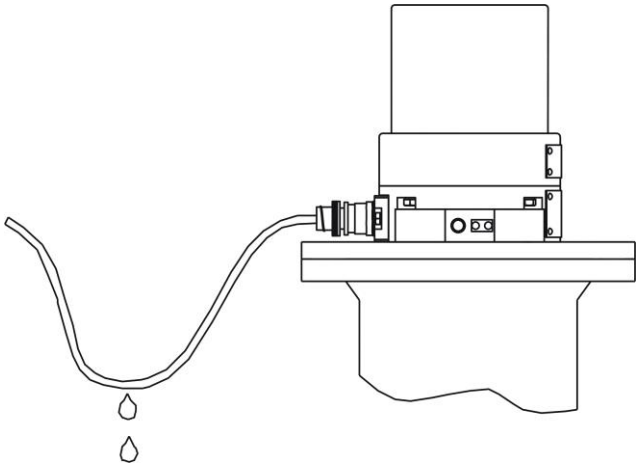


Fig. 5.1. Recommendation on laying the cable

5.3 Shielding and Earthing.

It is recommended to connect a cable shield to earth potential on one side. Use grounding terminal on the output signal receiver side.
The device must be grounded. There is external grounding terminal on the device casing, which is connected to tank grounding.

5.4 Cable Connection Procedure.

The persons trained in safety regulations during work with electrical devices, having electrical safety access Group II or higher and familiar with this Manual are allowed for work on installation and operation.
The cable connection shall be performed in accordance with the wiring diagram given in Fig. 5.5-5.8.
The level transmitter cable gland type is selected based on the type of the supply cable and its laying method. The corresponding cable gland supplied in complete set with the level transmitter shall be used for level transmitter connection with the required cable (see p. 14.11-14.13).

5.5 Purpose of Terminals. Connection.

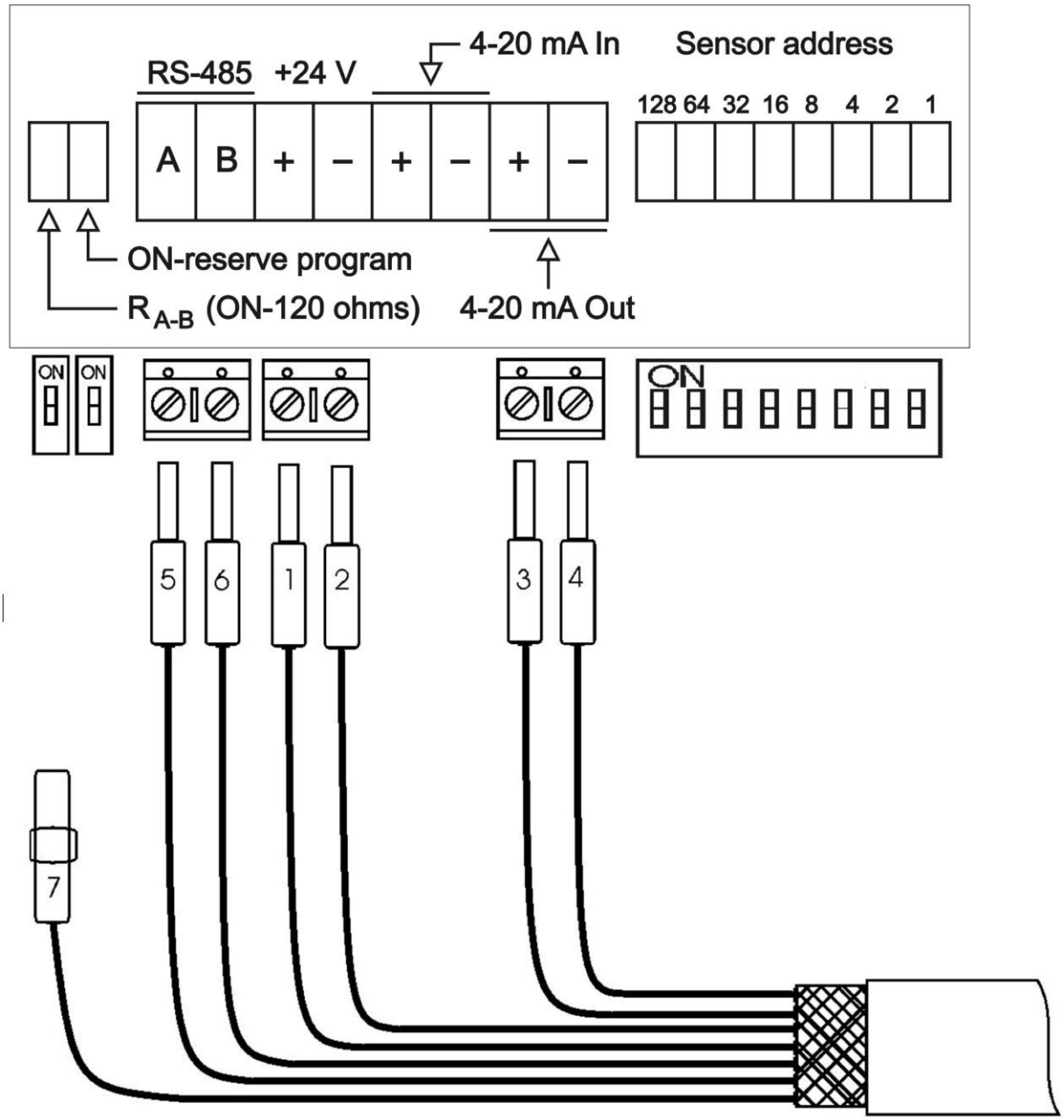


Fig. 5.5. Connection to level transmitters ULM-11

Circuit	
1	(+) U supply
2	(-) U supply
3	(+) Output 4-20mA
4	(-) Output 4-20mA
5	(A) RS-485 data+
6	(B) RS-485 data-
7	-

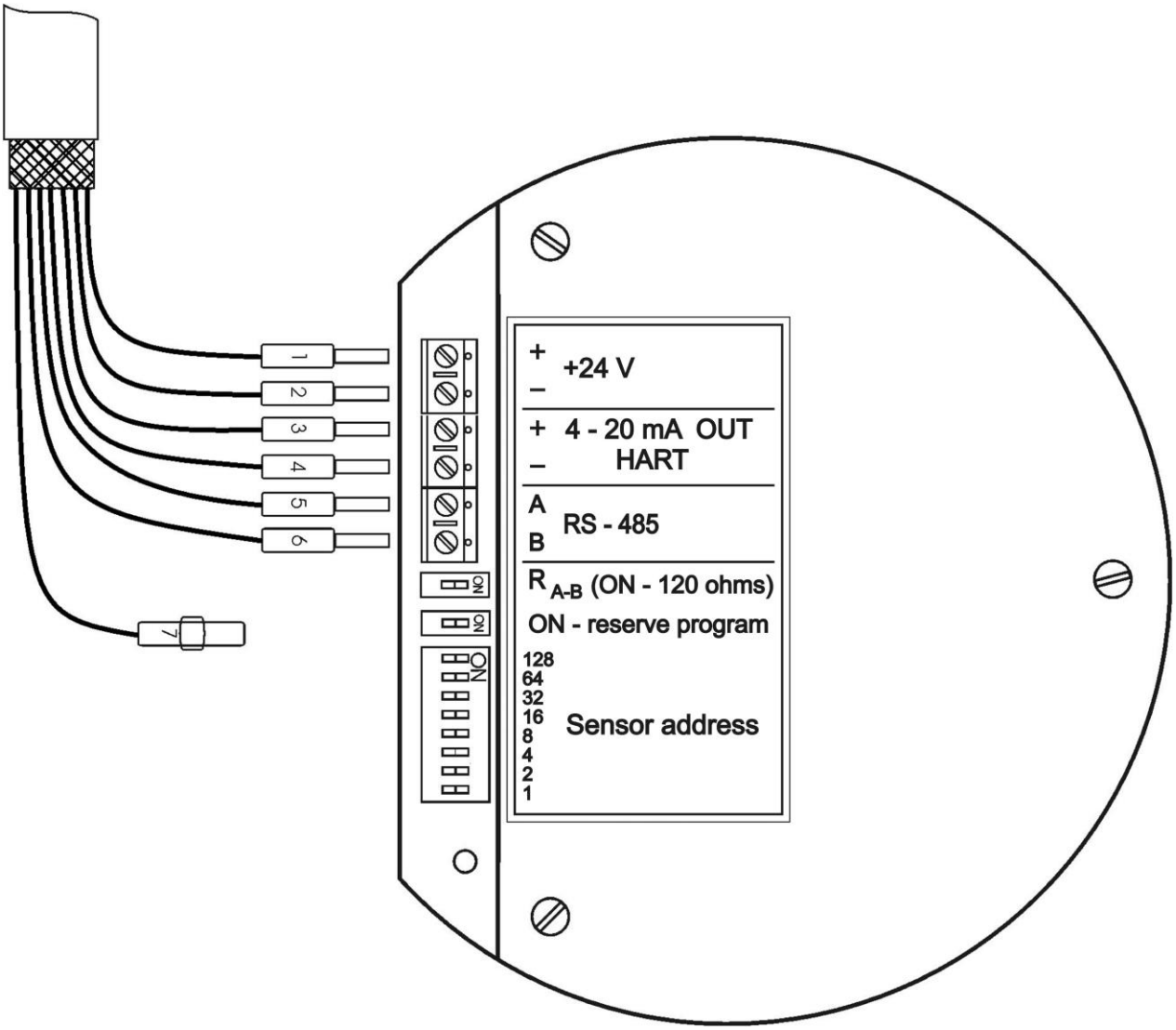


Fig. 5.6. Connection to level transmitters ULM-11A1, ULM-11A1-HF, ULM-11A1-HF-F, ULM-11-HF, ULM-11-HF-F. Design 1.

Circuit	
1	(+) U supply
2	(-) U supply
3	(+) Output 4-20mA
4	(-) Output 4-20mA
5	(A) RS-485 data+
6	(B) RS-485 data-
7	-

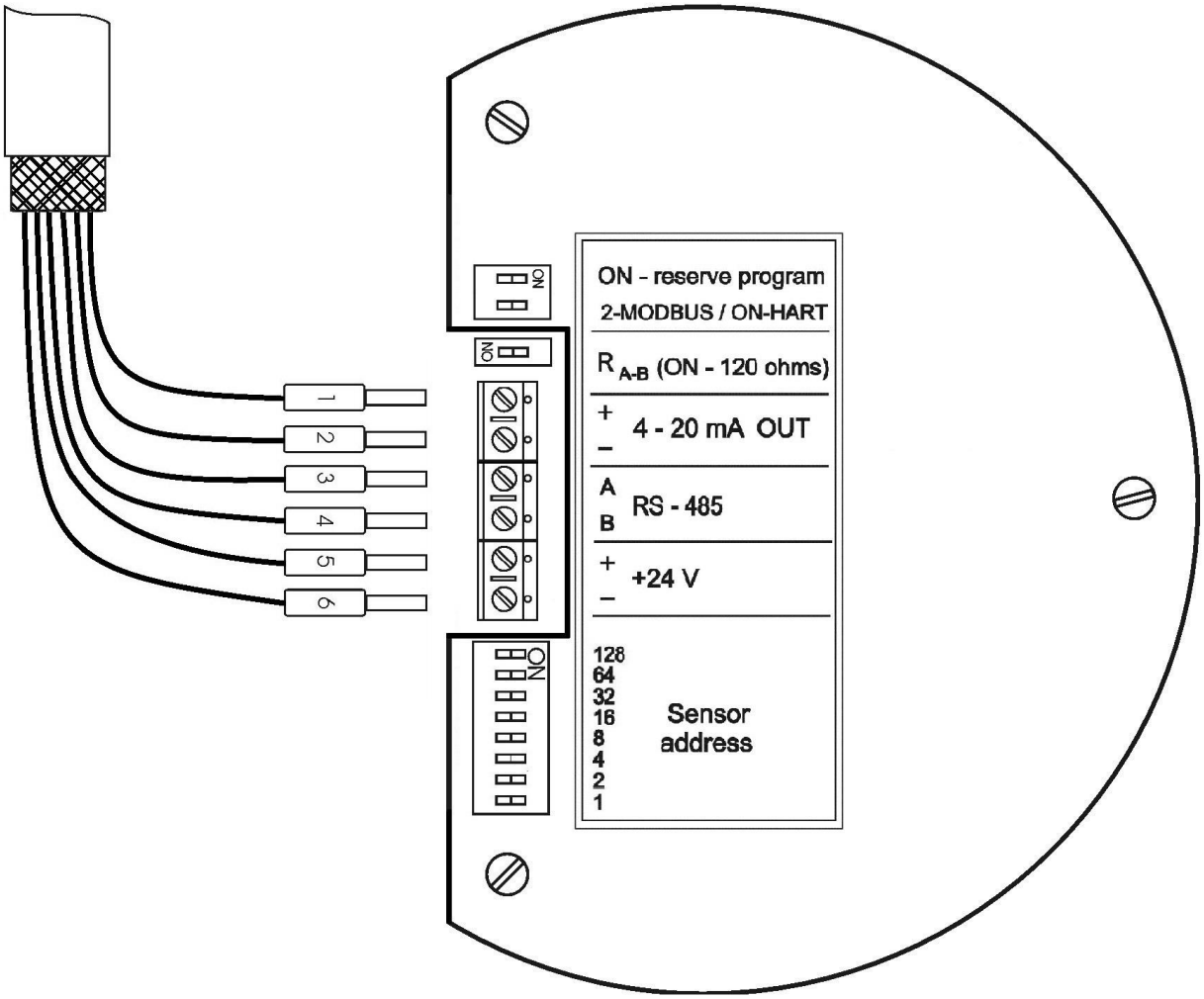


Fig. 5.7. Connection to level transmitters ULM-11A1, ULM-11A1-HF, ULM-11A1-HF-F, ULM-11-HF, ULM-11-HF-F. Design 2.

Circuit	
1	(+) Output 4-20mA
2	(-) Output 4-20mA
3	(A) RS-485 data+
4	(B) RS-485 data-
5	(+) U supply
6	(-) U supply

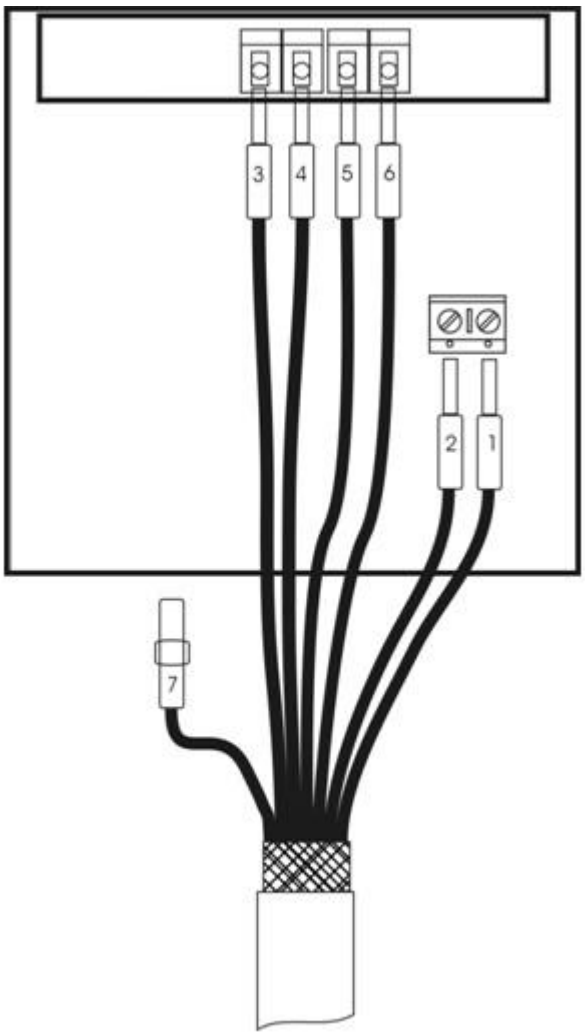


Fig. 5.8. Connection to level transmitters ULM-11A1-A.

Circuit	
1	~220V
2	~220V
3	(+) Output 4-20 mA
4	(-) Output 4-20 mA
5	(A) RS-485 data+
6	(B) RS-485 data-
7	-

5.6 Power Supply

It is recommended to use the stabilized DC power supply with the output voltage $U_{ИП}$ =24..36V. Several level transmitters may be connected to one power supply.
The power supply shall provide the load current based on maximum 3 A for each level transmitter.
IPS$=3\cdot n$, where n – the number of level transmitters connected to the power supply.
The power supply capacity shall be at least $P_{PS}=U_{PS}$ x I_{PS} .

! CAUTION

As the level transmitter ULM-11A1 uses internal automatic heating system, the maximal consumed current in the cold season time nay have adequately significant value (up to 3 A), therefore, it is recommended to use one power supply for only one level transmitter connection.

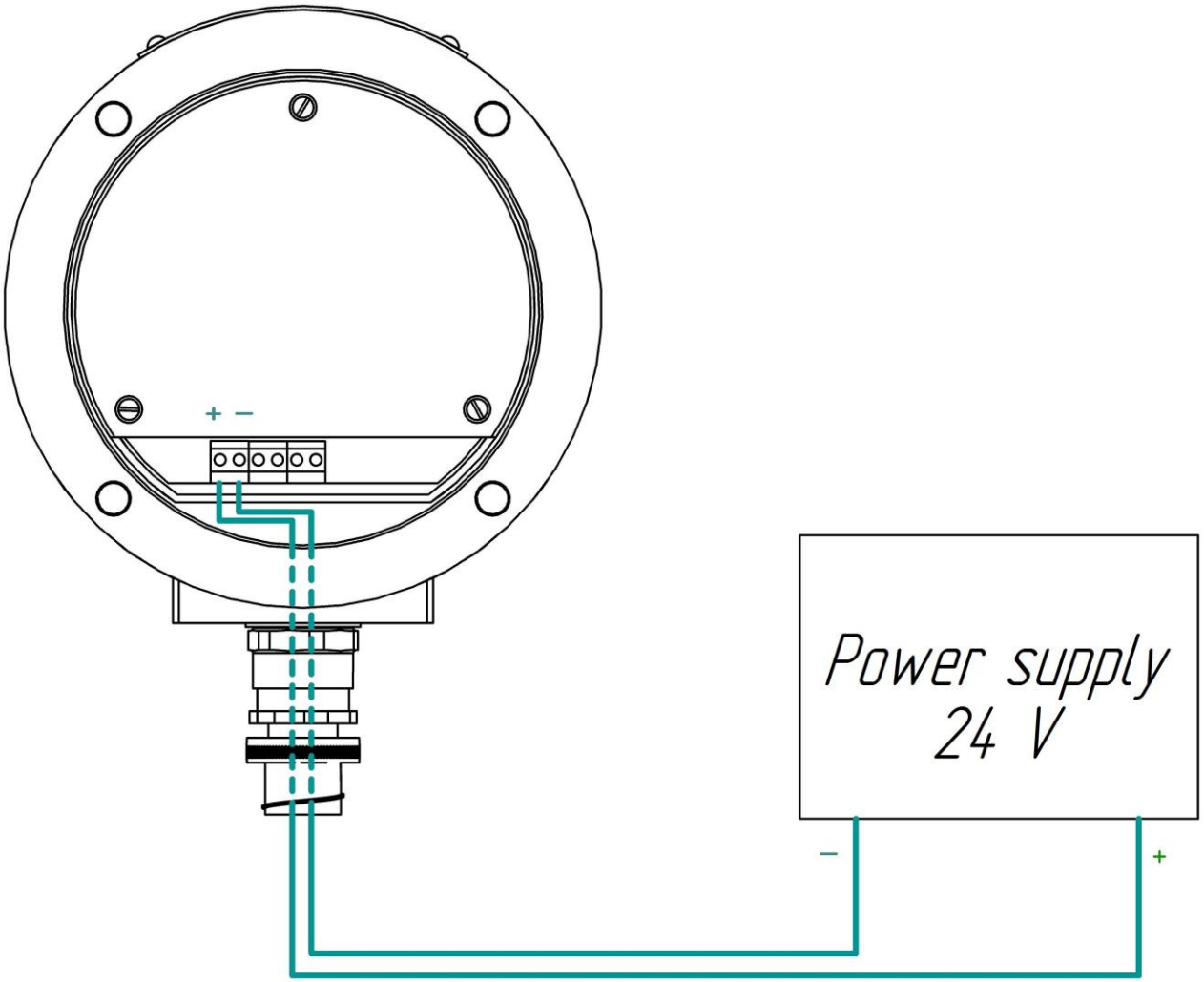


Fig. 5.9 Level Transmitter Wiring Diagram to Power Supply.

With long power supply line, the voltage drop in the connecting leads due to their own resistance shall be considered.

The wire resistance calculation formula:

$$R = \frac{2l\rho}{S}, \text{ where}$$

l – the length of the rated cable section, m;

ρ – the specific resistance, copper specific resistance is usually taken as equal to 0.0175

S – the wire cross-section area, mm^2.

For easy level transmitter connection, it is recommended to use the intermediate terminal box, where the branching of the control cable at the instrument outlet to the power cable and data cable (Fig. 5.9.).

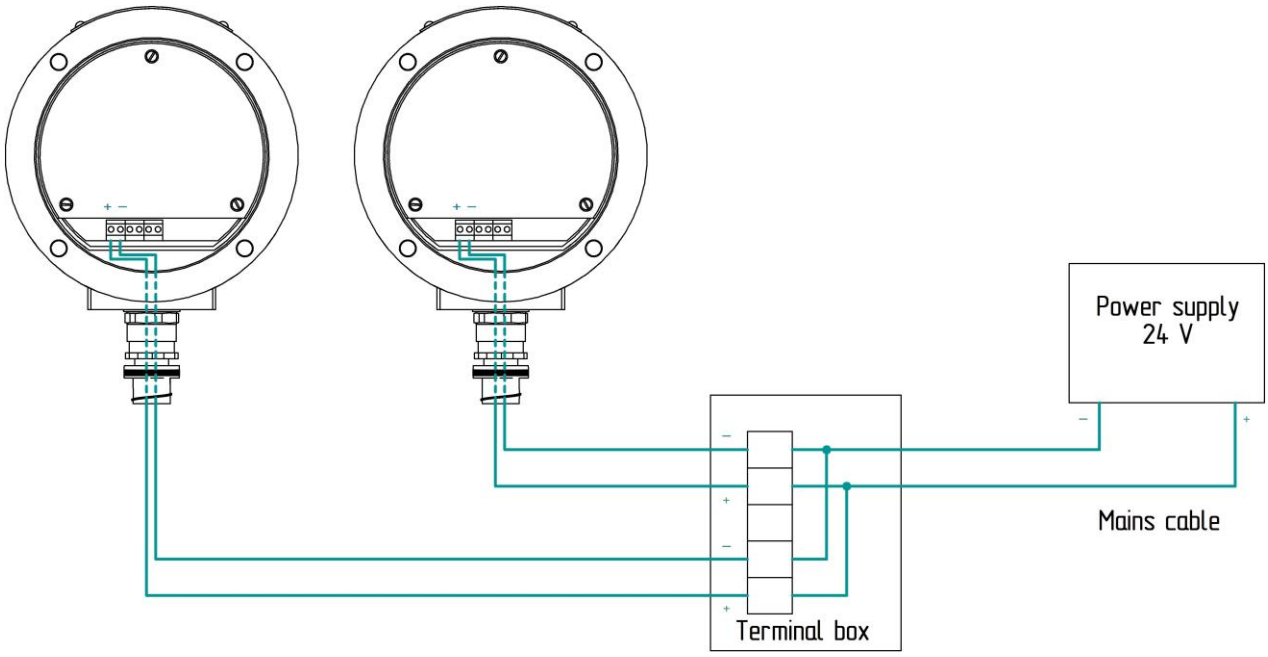


Fig. 5.10 Level Transmitter Wiring Diagram to Instruments Using Terminal Box.

5.7 Explosion Protection during Installation

During level transmitter installation it is necessary to be guided by:

- Ch. 3.4 “Electrical Installations in Explosion Hazardous Zones” of the The Rules for Operation of Consumers' Electrical Installations (PEEP);
- “Instruction on electric equipment installation of power and lighting networks in explosive zones VSN 332-74/MMSS USSR”;
- “Electric Installation Code (PUE)”;
- this Technical Description and Operating Instruction.

The level transmitter shall be installed in the zones according to the guidelines of Section 2.2 “Purpose” of this manual. The level transmitter shall be examined before installation. With that, it is necessary to pay attention to explosion protection marking and warning notice, to absence of damages on the explosion-proof casing of the parts (scratches, cracks, dents and other defects are not allowable), available fasteners (bolts, washers), available cable sealing facilities. During installation, pay attention to no damages of the cable (wire) external insulation. Special attention shall be paid to location of the cable input in the cable gland assembly, where the damage is most probable. All fastening bolts shall be tightened, the removable parts shall fit to the explosion-proof casing tightly, how much the design allows. The parts with the threaded fastening shall be screwed up to the whole thread length and

locked. The cable sealing shall be designed very thoroughly, because the casing explosion-proofness depends on that.
The level transmitter installation shall be carried out in strict conformance with the guidelines of this Manual Section 4.
In accordance with PUE requirements, the cable line laying shall be carried out in the steel pipe.
The level transmitter shall be grounded. The location of the earthing conductor connection shall be thoroughly cleaned up and coated with the layer of the corrosion rust-preventive compound.
After completion of installation, the correctness of electrical connections and the resistance of the earthing conductor, to which the level transmitter casing is connected shall be checked. This resistance shall be maximum 4 Ω.

5.8 Instrument Connection Procedure

! WARNING

- the safety regulations established at the enterprise shall be strictly followed;
- all works shall be carried out in the de-energized line;
- the voltage power supply shall comply with the instrument technical specifications;
- prior to voltage power supply, it is necessary to connect the instrument external grounding terminal.

Required tools:
- flat-tipped screwdriver 3 mm;
- flat-tipped screwdriver 6 mm;
- wrench 12x13;
- stripper or any suitable tool for clean-up of wires;
- it is recommended to use the lugs when using multi-core wires.

The instrument connection is carried out in the following procedure:

1. Unscrew the fastening bolts of the level transmitter cover.
2. Remove the level transmitter cover.
3. Loosen the cable gland collet nut in accordance with the used cable gland type.
4. Prepare the cable and insert it inside the level transmitter in accordance with the used cable gland type (see p. 5.4-5.5).

! CAUTION

Absence of the cable gland elements disturbs the level transmitter protection and may result in its failure or to violation of the explosion protection requirements.

5. Remove the wire insulation up to 4-6 mm from the edge. When using the multi-core wires, it is recommended to crimp the cleaned-up ends in the lugs.
6. Connect the cable in accordance with the contact pin assignment diagram. According to p. 5.4 and guided by directions on the instrument identification nameplate. Tighten the screw terminals with 3 mm screwdriver.

! CAUTION

Incorrect connection may result in the instrument failure.

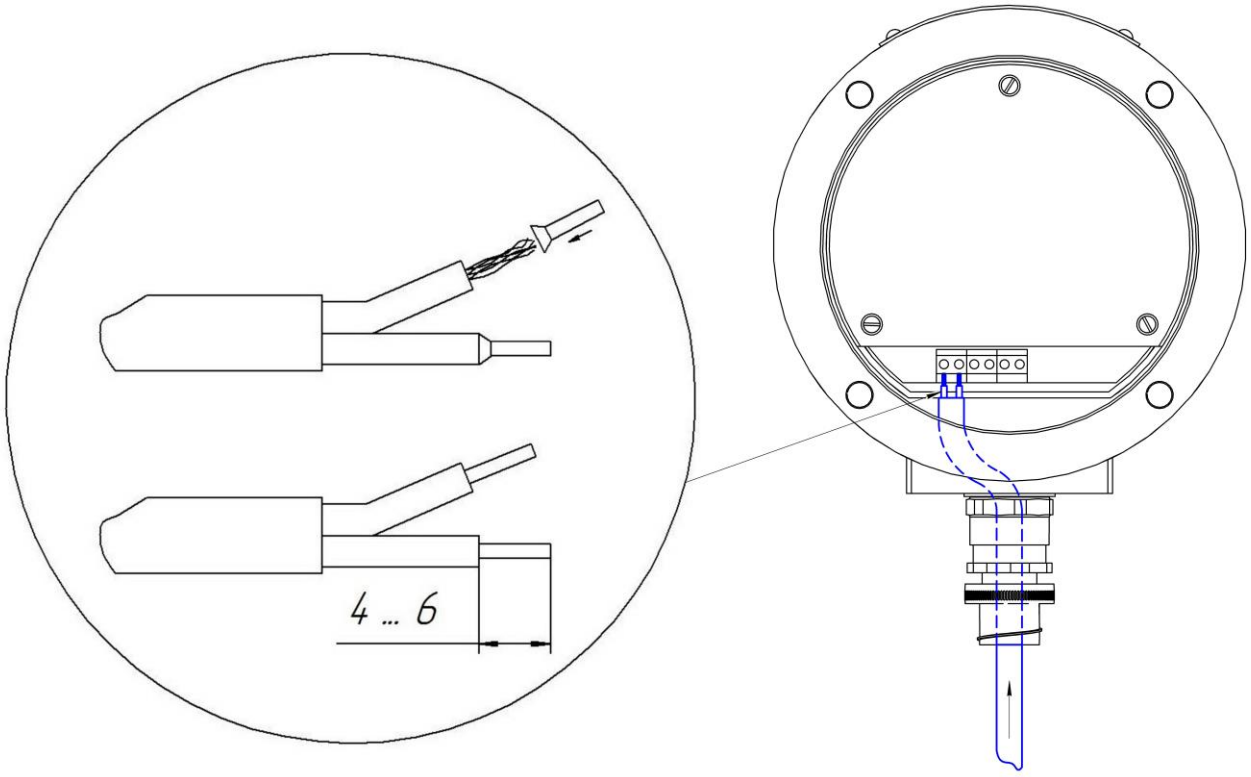


Fig. 5.11 Level Transmitter Connection.

7. Pull on the wires slightly, thus checking the reliable fixation in the terminal block contacts.
8. Regulate the required cable length necessary for its connection to the terminals and fix the cable in the cable gland in accordance with selected cable gland type - draw up the cable gland nut tightly.
9. Put the cover in place and and screw it down on the level transmitter.
10. Connect the external grounding terminal to the tank earthing system.

After connection, it is recommended to check the quality of performed works according to the following items:

- the absence of cable damages;
- the absence of mechanical stress as a result of cable tension;
- the cable gland is installed, screwed up and properly tightened;
- the cover is installed and the level transmitter casing cover fastening bolts are tightened reliably.

6 INITIAL SETUP AND COMMISSIONING

! CAUTION

The persons having at least Group III qualification for personnel servicing the electrical installations, who have studied this Operation Instruction and have passed the corresponding safety briefing may be allowed for the level transmitter operation.
During operation, the service personnel shall monitor particularly the condition of facilities ensuring the level transmitterexplosion protection. Only the person responsible for servicing may open the explosion-proof casing cover.
The level transmitter is not the source of hazard for the service personnel and the environment.
It is strictly forbidden to open the level transmitter, to perform mounting and dismounting works with the energized level transmitter.

The instrument setup before its commissioning can be carried out as follows:

1) by means of PC with the use of RS-485 interface (exchange protocol Modbus RTU; for the protocol detailed description see “Exchange Protocol for ULM Level Transmitters”) and the configuration utility ulmcfg;
2) by means of PC with the use of HART interface.

6.1 Level Transmitter Address Setup

In accordance with the applied exchange protocol, each instrument is assigned with unique address - number from 1 to 255. The address is assigned in binary notation using 8-digit DIP-switch located in the level transmitter of lettering on the identification nameplate “Transmitter address”. The address turns out as an amount in digits specified in the identification nameplate opposite the switch with the digits raised to the unit of power.

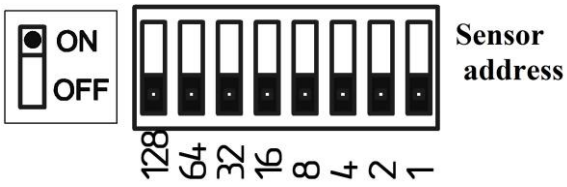


Fig. 6.1. All zeros position address switch

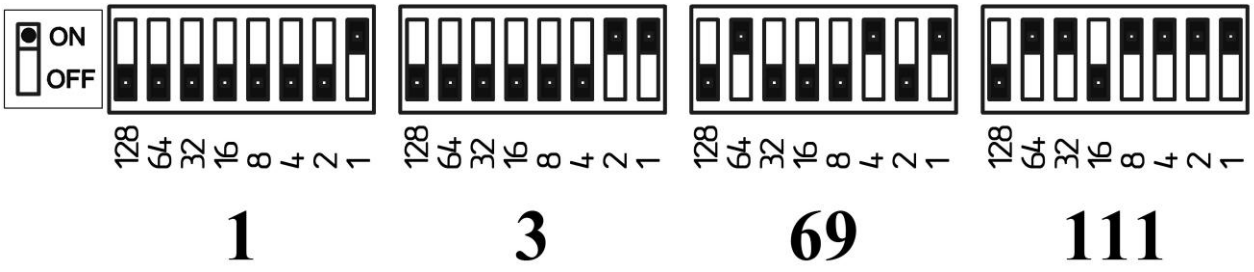


Fig. 6.2. Examples for installation of different addresses

When all switches are in position "0" (Fig. 6.1), the level transmitter will be assigned with "default number" specified in the instrument software. The address change will occur after its rebooting.
In order to change the level transmitter address, it is necessary to set the corresponding position of switches, to switch off and then to switch on the instrument.

6.2 Connection to PC via interface RS-485.

The digital interface provides the user with access to the level transmitter readings and gives and option to set up and troubleshoot the level transmitter. The level transmitter digital interface is implemented in the shape of double-wired series line RS-485. Data exchange protocol Modbus RTU. For protocol description see "Exchange Protocol for ULM Level Transmitters". The advantages for using RS-485 consist in information network construction simplicity; in possibility to transmit the readings of dozens of level transmitters via one line, with no loss of accuracy, for a distance up to several kilometers; in an option to configure the level transmitter from the workplace or to integrate its system of industrial automatics under PLC (programmable logic controller) control.
For level transmitter connection to RS-485 line, the terminals "A" and "B" are output on its terminal block. Each level transmitter has a unique Modbus address. The address is set up by the 8-digit DIP switch or it is determined by the level transmitter inherent software program, if the "0" address is set up.
For level transmitter connection to the computer via the digital interface, the transducer USB/RS-485 is used. The instrument terminal "A" is connected to terminal "+", terminal "B"- to terminal "-".

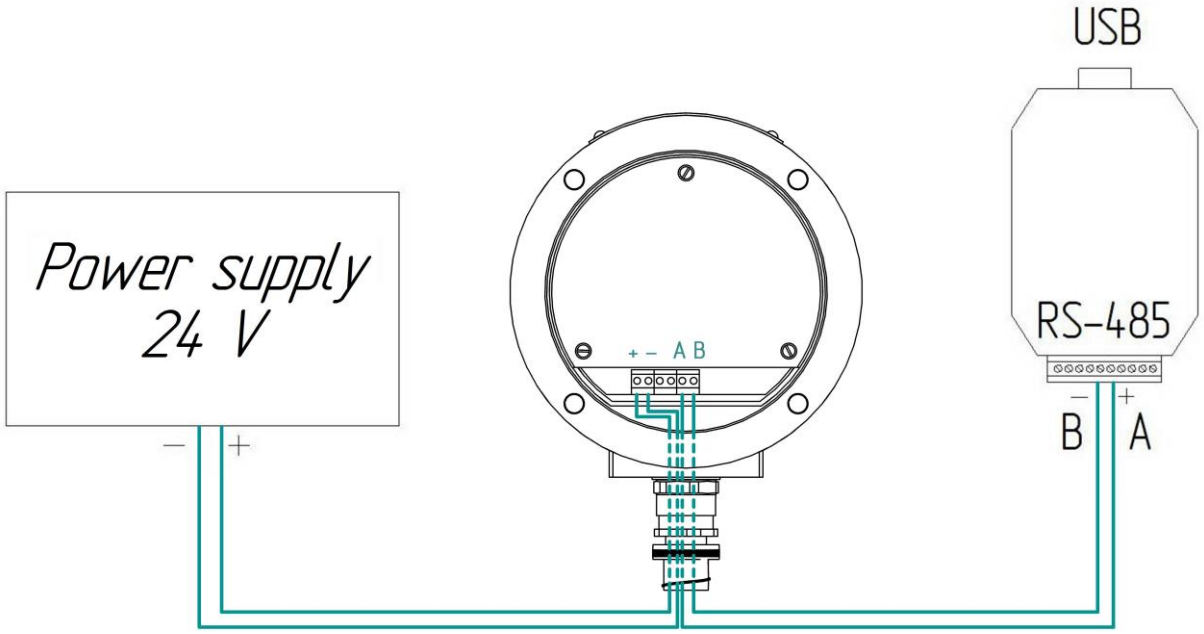


Fig. 6.3 Connection to Level Transmitters ULM-11A1, ULM-11A1-HF, ULM-11A1-HF-F, ULM-11-HF, ULM-11-HF-F.

It is necessary to use the transducers with transmission direction automatic determination. The standard devices of this type are presented in a great number. The most widely used are: MOXA series 1100 (uPort-1150i, uPort-1130), ADAM-4561, ICP DAS series I-7561. In some transducers, it is required to set the data exchange parameters prior to commencement of operation. In this case, it is necessary to set up: transfer rate - 9600 bits per second, parity – Even, number of data bits – 8, number of stop bits - 1 or 2.

! CAUTION

After interface transducer connection to USB, install the device driver, if necessary. Click the shortcut "My computer" with the right-hand button; select "Properties" in the context menu. Press the button "Devices Dispatcher" (procedure of actions for in XP) in the opened window "System Properties" in the tab "Equipment". In the List of Equipment, open the "COM and LPT Ports" Section. Find the COM-port corresponding to the connected device, open the "Properties" window of the selected port by double-clicking and make sure that the device operates properly.

The RS485 information line is laid with the patch cord type cable of 120 Ω wave impedance. The cable external insulation shall ensure adequate mechanical and electrical strength for the Customer process and climatic conditions. The total line length may reach several kilometers.

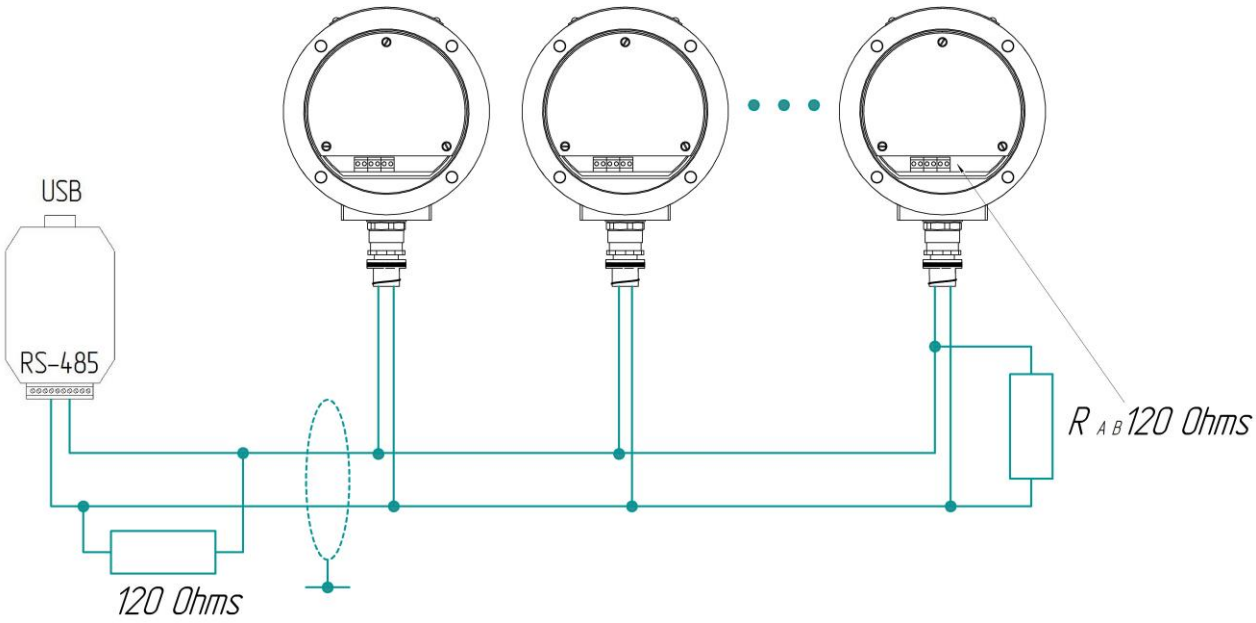


Fig. 6.4 RS-485 Line Laying Traditional Method

The diagram of the line laying traditional method, complying with the general requirements of RS-485 standard, designed at the high-rate data transfer in conditions of industrial interferences, is shown in Fig. 6.4. With long length of line, it is recommended to install the 120 Ω matching resistors at the line ends between the wires "A" and "B". In order to do so, there is a switch in the level transmitter, which connects this resistor to the line. It has "R_{A-B}" designation on the identification nameplate. It shall be taken into account that this resistor is also installed inside some transducers. With the line length above 800 m or the number of devices in the line above 32 pieces, it is recommended to use the standard repeaters for RS-485, for example, ADAM-4510.

! CAUTION

The devices with the data exchange protocol different from Modbus RTU should not be connected to the level transmitter information line.

No level transmitters with the same Modbus addresses shall be in one information line.

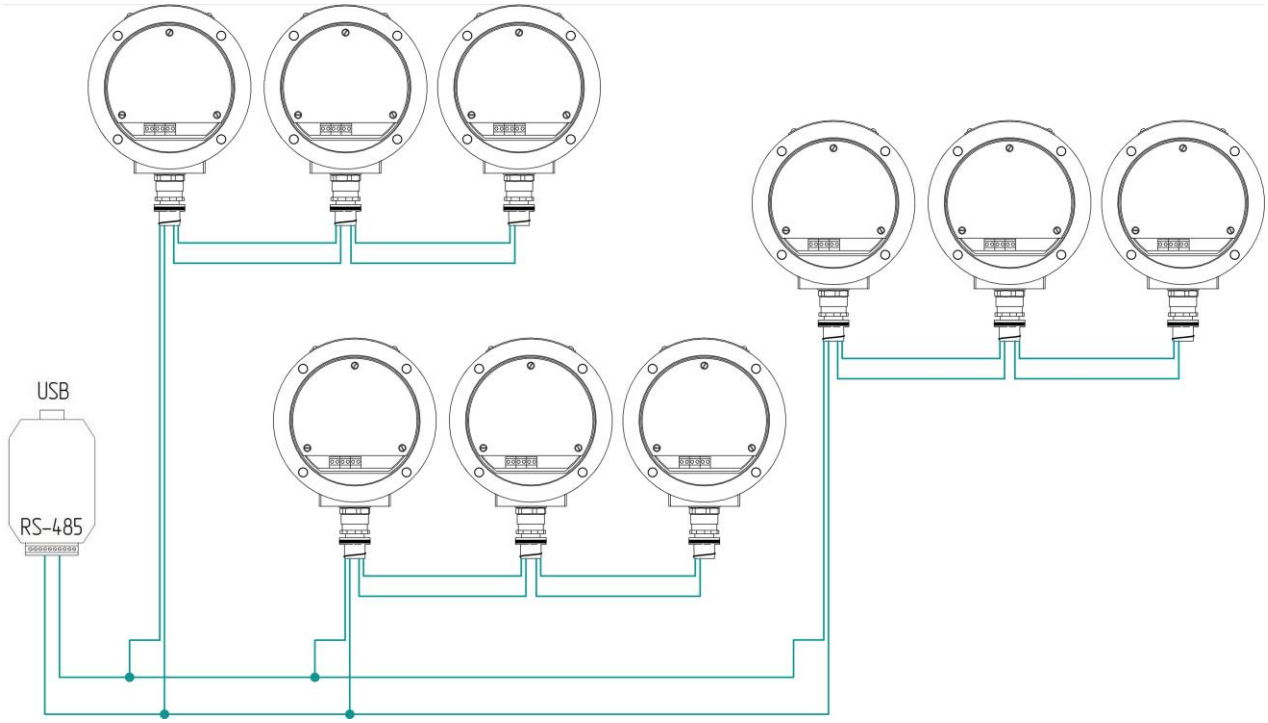


Fig. 6.5 “Star” Method for RS-485 Line Laying

The transfer rate of 9600 bit/sec used in the level transmitter allows for provision of satisfactory communication line interference protection and use of different cable laying options, including the so-called “star” method. (see Fig. 6.5). The user selects the suitable option based on considerations of cable laying easiness and their length minimization. As a rule, during plotting such type of line, the installation of the mating resistors is not required.
Few communication errors may occur in the long and multi-terminal lines. These communication errors do not result in obtaining unreliable data on the level, because the exchange protocol Modbus used in the level transmitter does not contain the computation of control totals allowing for determining the readings unreliability. Such data will be ignored.

6.3 Setup of Level Transmitter Basic Parameters using PC via RS-485.

PC minimal requirements: Pentium II, 256 Mb RAM, 800x600 monitor, USB or COM-port, OS Windows at or above 95 Version.

The software program “CONFIGURATOR” (ULMCFG) is used for set up of level transmitters.
The program allows for:
- getting and changes basic data;
- troubleshooting the level transmitter operation;
- uploading the configuration from the file into the level transmitter;
- recording on the disk and reviewing the debugging information (photos of signals);

- updating the level transmitter software program;
- obtaining access to the level transmitter registers.

The program does not require installation; just copy the file ULMCFG.EXE into the folder created on the hard disk preliminarily.

The program detailed description is given in the document “Configurator. User's Manual”. The issues necessary for initial instrument setting are given below.

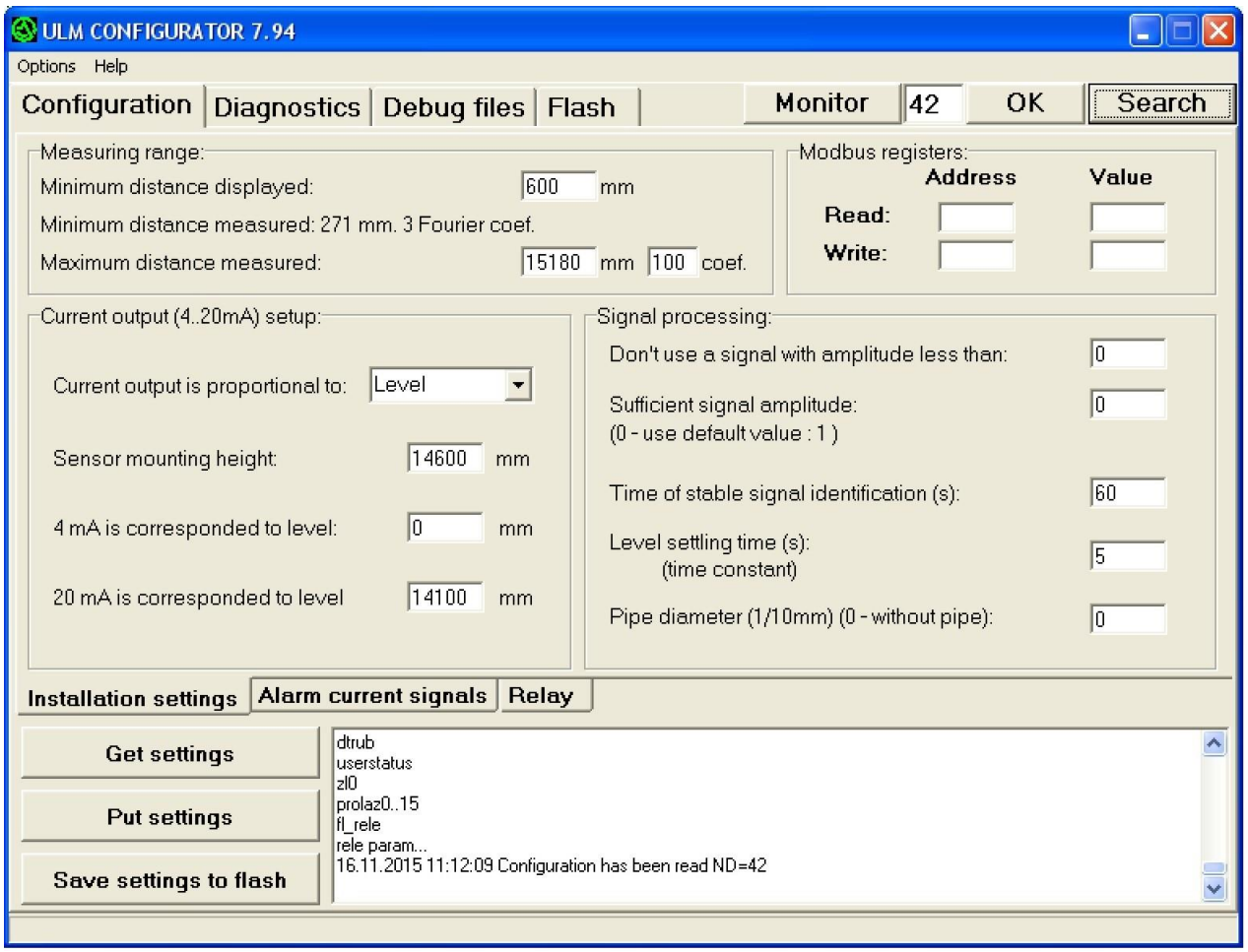


Fig. 6.6 “Configurator” Program Main Window

Level Transmitter Connection Procedure:

1. In the Main menu [Options], specify the number of the COM-port, to which USB/RS-485 transducer is connected

[Options]>[COM port] – allows the user to select the port COM1-COM20, to which the network of level transmitter is connected. The item AUTO is selected by default for automatic search of COM ports.

2. The immediate connection to the level transmitter can be carried out using two methods:

1) enter its unique number in the ModBus addresses field and press “OK” button.

Fig. 6.7 Example for connection to the level transmitter with the address 62

2) pressing the “Search” button activates the automatic requesting of the level transmitters generating the addresses from the 1st to the one specified in the field “Search up to Modbus No.” The window shown in Fig.6.8 is highlighted on the screen. The program adds the found level transmitters in the list. After requesting all ModBus numbers (if the “Loop search” checkbox is not activated). the search terminates. For connection to one of the found instruments for further operation, select it in the list and press the key “ENTER” or the button - “OK”.

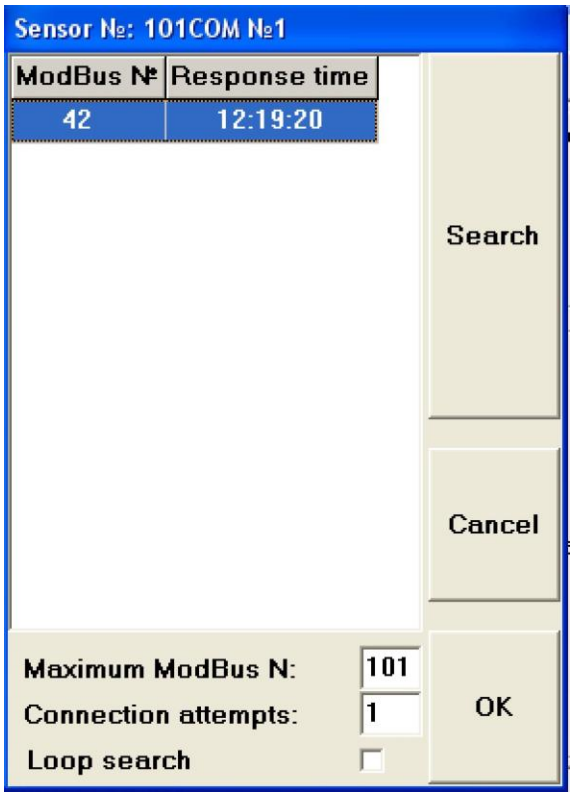


Fig. 6.8 Level Transmitter Search Field

The level transmitter parameters are configured prior to supply based on the data specified by the Customer in the questionnaire the level transmitter order (available on the website www.limaco.ru). The settings are stored in the instrument non-volatile memory. They shall be checked during the initial setup and changed, if necessary.

“Measuring range” - determines the range of the measured and displayed distance.

Fig. 6.9 Measuring Range Setup

"Minimum distance displayed" – the instrument does not issue the readings below this value. It is set in the range of stable measurements. By default, it is set on the boundary of the "dead zone" (600 mm), which is optimal for the most of applications. Upon agreement with LIMACO CJSC, if it is necessary to measure the smaller distances, this parameter can be decreased. The main thing is that its value remains in the range of stable measurements, which is described in p. 4.5.
After entering this parameter value, press "Enter". The **"Minimum distance measured"** will be computed automatically (the next line on the panel),- this is the left-hand (nearest) boundary of the zone for searching the reflected signal (N0 – the number of the spectral coefficient, starting from which the instrument determines the valid signal).
"Maximum distance displayed" - the instrument operation range upper boundary. As a rule, it is selected equal to the level transmitter installation height. It allows for elimination of the effect of the signal from the tank bottom occurring in some cases. Press "Enter" after entering the value. The right boundary of the insensitivity zone will be computed (N_{max} – the number of the spectral coefficient, up to which (including) the level transmitter will search and analyze the signal). After N_{max} computation, the final value of the maximum distance displayed in millimeters will appear in the field.

"Current output (4-20mA) setup" - configures the output 4-20mA of the level transmitter

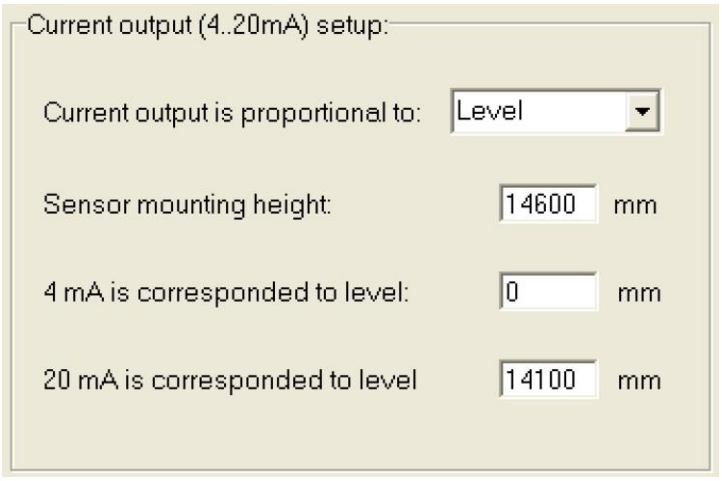


Fig. 6.10 Output 4-20 mA setup

Select **“Issued to 4-20 mA output”**, to which the current signal shall correspond to the product level in the tank or the distance to the product (see Fig. 3.4.).
“Sensor monitoring height” specifies the distance (H) in millimeters from the level transmitter installation flange to the tank bottom. H value is used for computing the level of the tank filling (see Fig. 3.4.).
The current **“4 mA corresponds to the level (distance)”**, mm. It sets up the conformance of the minimal current 4 mA and the product level in the tank (distance to product).
The current **“20 mA corresponds to the level (distance)”**, mm. It sets up the conformance of the maximal current 20 mA and the product level in the tank (distance to product).

Signal processing – the instrument parameterization for measuring conditions.

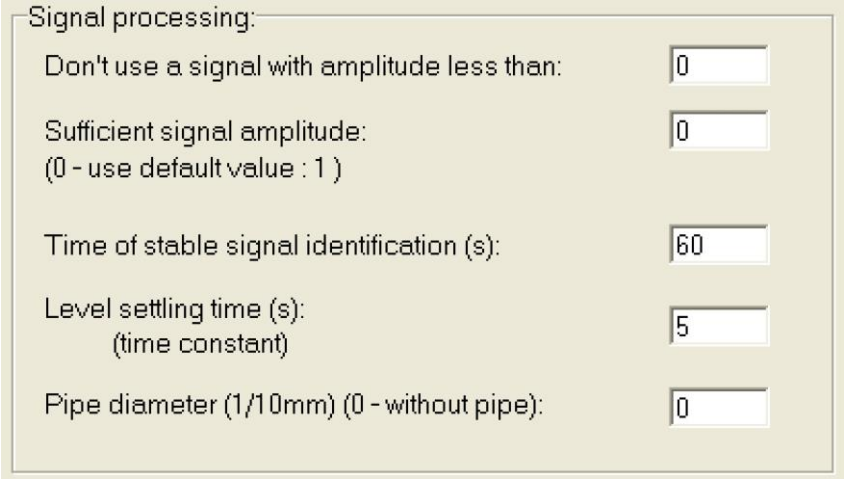


Fig. 6.11 Setup of parameters for signal processing

“Don't use signals with amplitude less than” - the minimal threshold value of the signal amplitude, which can be used for estimate.
“Signal quality amplitude criterion” - used during the instrument self-diagnostics according to the reflected signal amplitude as a criterion.
“Time of stable signal identification” - the time for damping of abrupt jumps in the readings. During abrupt and significant change of distance to the reflecting surface, the instrument will issue the value of the distance no sooner than after the specified time. The instrument reluctance to respond immediately to the change of the distance in the steady-state mode – this is the standard phenomenon, because the product level in the tank does not change by sudden jerks. Such behavior is the consequence of the algorithm operation for elimination of product surface instability effect on the instrument readings.
“Reading setting time” – the parameter, which determines the dynamic features of the level transmitter and is set based on the maximum rate of level change in the tank.

! CAUTION

*Excessive decrease of the **"Reading setting time"** parameter improves the dynamic features, but it increases the dispersion in the readings and impairs the level transmitter operation with available disturbance on the product surface in the tank, for example, during the product boiling and the product charging from the top of the tank.*

"Pipe diameter" - the setting used for other type of ULM series level transmitters during product level measuring in the guiding pipe (do not confuse with on-pipe branch installation). It is necessary to specify the pipe inner diameter in tenths of millimeter (for 200 mm of the pipe "2000"). In all the rest cases (including on-pipe branch installation), this field value shall be equal to "0".

The other parameters are set up, if necessary, in accordance with the manufacturer's recommendations based on the provided diagnostic information (see Section 7).
The detailed description of other parameters changing is given in "Configurator. User's Manual" program description.

6.4 Current output 4-20mA. Setup of Alarm Signals.

The level transmitter has an active current output 4-20mA for connection of standard receivers.

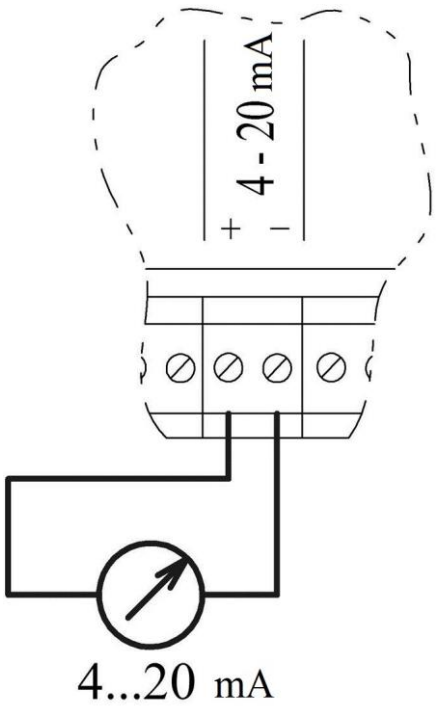


Fig.6.12 Current output 4-20mA connection diagram

Based on the level transmitter configuration, it can display the readings of the product level in the tank, the distance to the product surface or the alarm current signals 3mA, 4mA or 21mA.

The example of the setup window for the alarm signals is given in Fig.6.13. The list of controlled parameters is in the panel right-hand part. There is the number of its

bit in the status register opposite each parameter. The more detailed information on the status register is given in Section 7.

4 columns with 16 checkbox switches for each generating mask words for formation of the status register and the alarm current signals are located in the window left-hand part. The checkbox setup raises the corresponding word mask bit to the unit degree – the marked parameter will be considered. The checkbox clearing zeros (masks the bit. The masked parameters are not used in formation of the measurement and the alarm current signal status.

! CAUTION

The current signals have the priority for the readings of the alarm signals: 21mA, 3mA, 4mA. Upon any alarm signal appearance, the level (distance) readings on the current output are not displayed. This shall be considered during setup of the current signals.

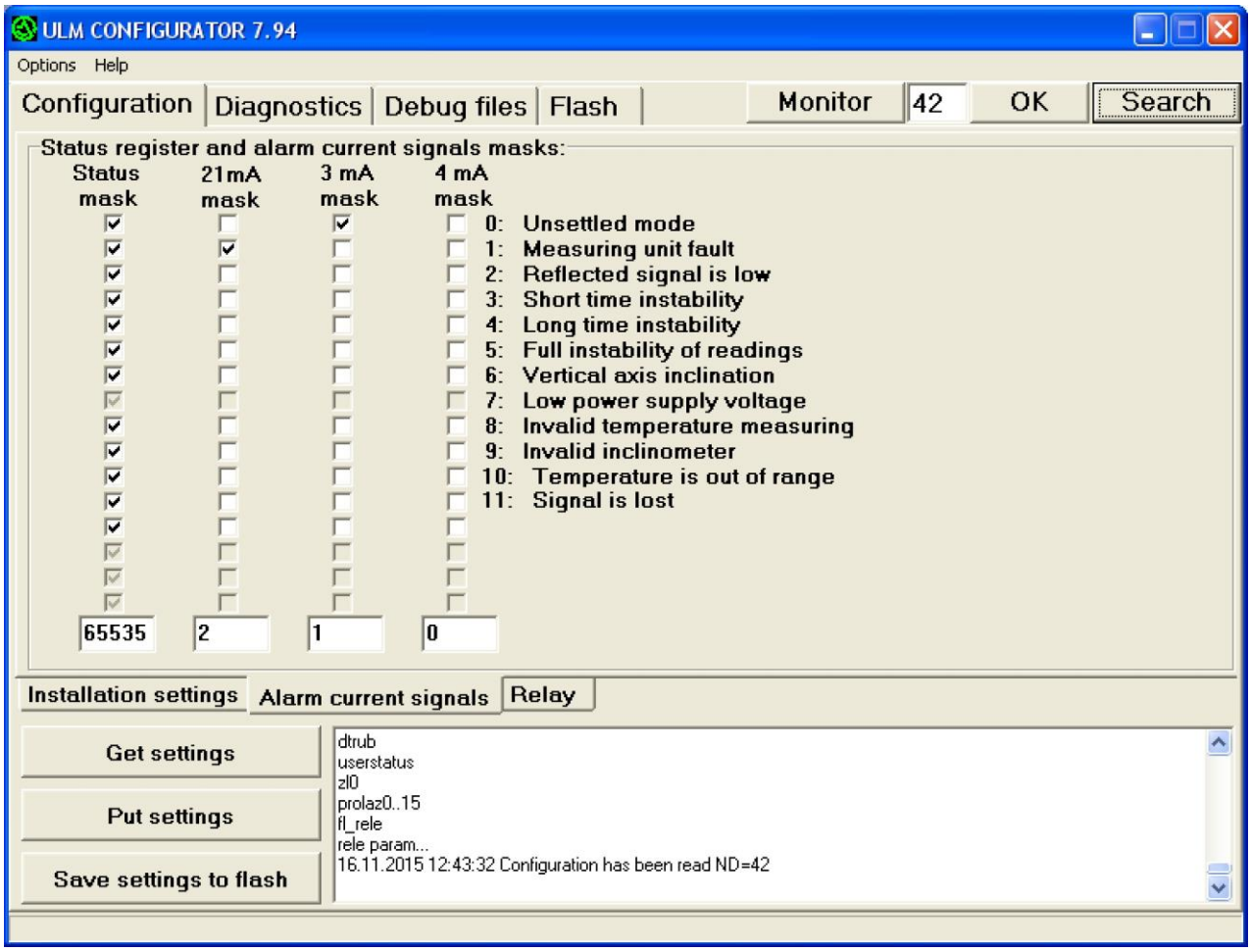


Fig. 6.13 Setup of alarm current signals

For example, in Fig. 6.13 it is specified that the following is displayed at the current output:

- 21mA during measuring part of internal diagnostics;

- 3 mA upon excess of temperature inside the level transmitter.

6.5 Explosion Protection during Operation.

During level transmitter operation, it is necessary to conform with Ch. 3.4 “Electrical Installations in Explosion Hazardous Zones” (PEEP) and this Technical Description and Operation Instruction. The level transmitter operation shall be carried out in such way that all the instrument explosion protection requirements and parameters are followed.

In the course of operation, it is necessary to monitor the condition of facilities ensuring the level transmitter explosion protection and its systematic external inspection and revision.

During inspection, pay attention to:

- the available explosion protection marking;
- the cable connection reliability;
- the level transmitter and the construction external elements fastening strength;
- the absence of the dust and dirt build-ups on the level transmitter;
- the absence of dents, visible mechanical damages on the level transmitter casing.

Operation of the level transmitter with the damaged elements and other faults is strictly forbidden.

During preventive inspections the following operations shall be performed at least once a year:

- check up of cabling integrity;
- check up of tightening for the level transmitter cover bolt connections;
- check up of the antenna lens outer surface cleanliness (if necessary, clean it thoroughly without disturbing and deforming the lens surface profile);
- check up and control of the explosion protection parameters (where it is possible) in accordance with p.5.6.

The level transmitter repair shall be carried out in accordance with RD 16407-89 “Explosion-Proof Electrical Equipment. Repair.”

Depositions of dust on the level transmitter casing shall be limited by the surface cleaning. The level transmitter maintenance level shall conform with the one established at the enterprise on the whole, but no lower the sufficient level according to GOST IEC 60079-10-2-2011.

It must be considered that the dust layer self-ignition temperature on the level transmitter casing shall not be lower the maximum surface temperature for the electrical equipment Class T6 according to GOST 31610.0-2014 (IEC 60079-0:2011).

7 INFORMATION ON INSTRUMENT OPERATION.

Control of the level transmitter parameters is performed by means of own test software programs for ULM level transmitters. The level transmitter does not require any adjustments and settings after installation works and in the course of further operation.

7.1 Instrument diagnostics.

The software "Configurator" on the tab "Diagnostics" (see Fig.7.1) includes the basic information on the level transmitter operation. It is visually divided into seven panels, in which the instrument operation parameters are displayed. The majority of lines are displayed in black font; the parameters beyond the allowable criteria or the recommended conditions are in red; the lines with no data to fill out, because this level transmitter modification, as regards hardware and software, does not allow for controlling the relative parameter, are in grey.

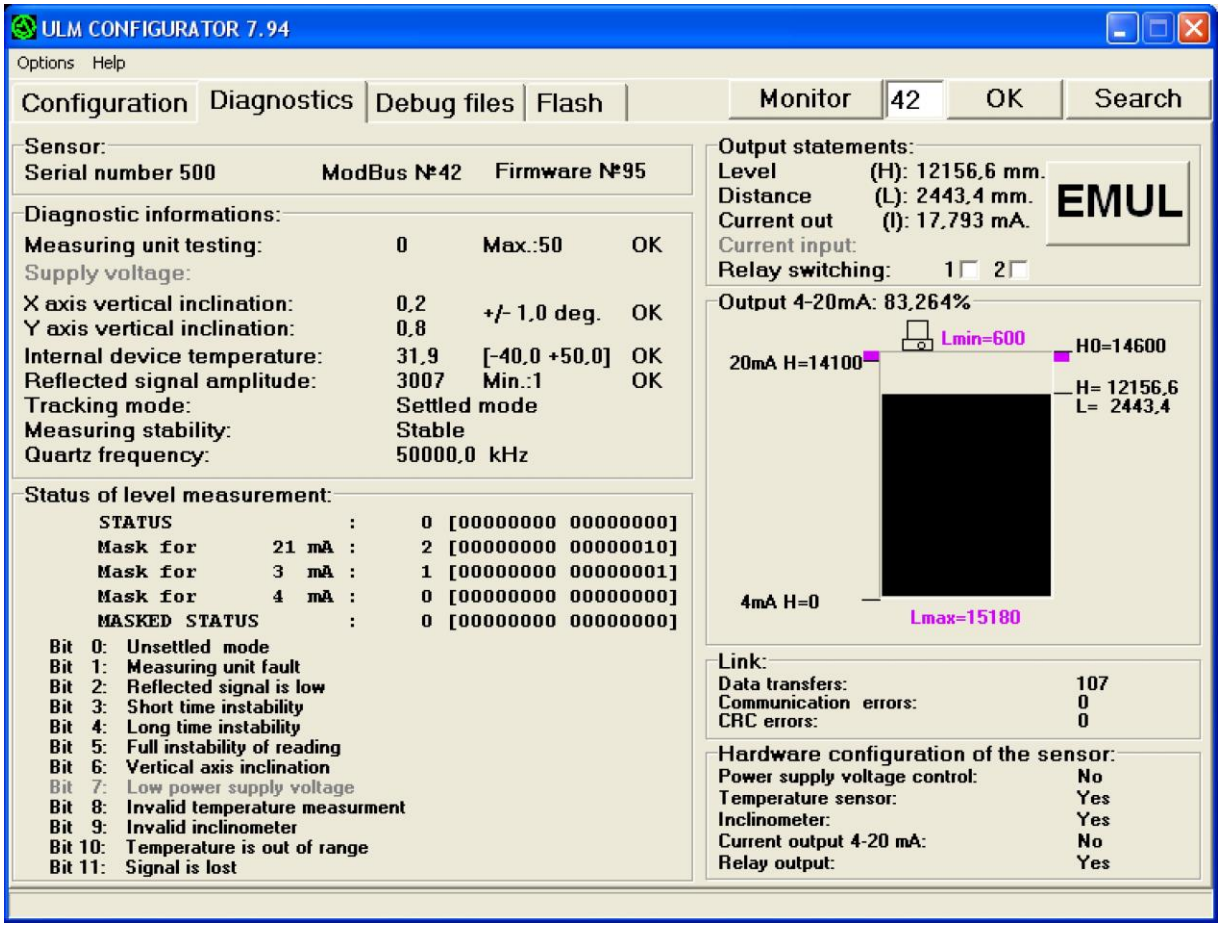


Fig. 7.1 "Diagnostics" Tab Appearance

The **"Sensor"** panel displays:
- the level transmitter serial num

- address acc. to Modbus;
- firmware (level transmitter internal software program) number.

The **“Instrument operation information”** panel shows:
- current signal amplitude and to the right side, after the word “Min:” - amplitude criterion (“Sufficient signal amplitude” on tab “Configuration”). If the amplitude is less the criterion, the 2nd bit is raised to the unit in the status register.
- “Meter testing” - the measuring system operability parameter, to the right side – maximum allowable value, under which excess the 1st bit of the status register is raised to the unit.

! CAUTION

Excess of the maximum allowable value for “Meter testing” parameter means the level transmitter electronic sensor fault. Carry out the repair registration procedure according to p. 11 of this Manual.

- “Readings stability” - the parameter of the total (short-term and long-term) stability.
- “Mode” - the steady-state mode, if the level transmitter detected the sustainable signal, otherwise – unsteady – the mode of testing after activation.
- “Power supply voltage” - current and minimum allowable in Volts (the status 7th bit). The level transmitter temperature inside the casing in degrees Celsius and the allowable temperature range (the status 10th bit).

“Sensor vertical inclination” in two planes in degrees and the allowable inclination (the status 6th bit). Upon excess of allowable inclination, the level transmitter shall be leveled.

“Status” panel. For more details see “Configurator - User's Manual”.

“Communication” panel allows for communication line condition estimation. Continuous data exchange with the level transmitter occurs till the tab “Diagnostics” is active. The “Data exchange” field value shall increase permanently (from 0 to 999; then it is zeroed); the “Communication error” and “CRC errors” field values, when using the high-quality communication line, shall not be increased. The single errors are possible at the real facilities with long distance information line.

The **“Equipment”** panel shows the additional optional assemblies, power supply, temperature and inclination angles (inclinometer) control available in the instrument.

The **“Output 4-20mA”** panel visualizes the current output settings: reference height (H0 - on the right side), levels / distances corresponding to 4 and 20 mA currents (4ма_H = , 20ма_H= on the left side), as well as the level and the distance current values. In addition, the measuring range boundaries are marked lilac from the top and the bottom.

The **“Readings”** panel displays the level, the distance, the input and output currents and the position of the relay contacts.

7.2 Output Signal Emulation.

The “EMUL” button switching on the level transmitter signal emulation.

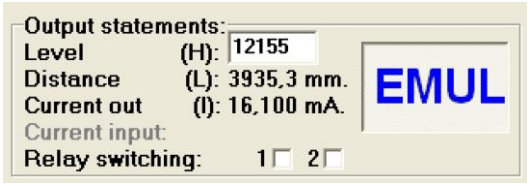


Fig. 7.2 Output Signal Emulation

The output signal emulation is the debug mode, which provides possibility to check the settings and the current output operation. After “EMUL” button pressing, the level transmitter shall be switched to emulation mode; it will take up to 4 seconds. The button is fixed in depressed position; the wording will be discolored to lilac. After that, the level and the distance values may be edited. When changing these parameters, the output current signal shall also change in accordance with this panel data. For emulation switching off click the “EMUL” button once again; the instrument will change to the standard mode in 4 seconds.

7.3 Photos. Level Transmitter Remote Setup and Diagnostics.

The more detailed information on the instrument operation may be obtained from the so-called “Photos”. The Photos – the “ fot.” files containing the records of signals and additional data received from the level transmitter. They carry the vast information on the instrument operation conditions. The photos analysis allows for consideration of particular application specifics, optimization of the instrument installation and its configuration for maximum accurate and reliable operation of the level measuring system. For details see “Configurator - User's Manual”. “Work with photos” Section.
In case of the need to get the level transmitter manufacturer's support, the “photos” obtained by means of Configurator can be sent to the Service Desk. Based on analysis of the data obtained from the “photos”, LIMACO CJSC Service Desk can provide the remote the level transmitter setup and diagnostics.

7.4 Level Transmitter Factory Settings.

The Configurator allows for uploading new versions of firmware to the flash memory, selecting the software program loaded by default, matching the blocks of parameters with installed programs (the totality of values for different registers determining the level transmitter operation, i.e. set up for particular application, which the instrument uses in the course of its operation).
The program with the level transmitter factory settings is recoded in the flash memory zero sector. For maintaining the level transmitter operability, it cannot be re-written, it can be always uploaded upon occurrence of any problems with the new firmware. For uploading the instrument with the factory settings, the level transmitter shall be de-energized first and switched to the corresponding DIP-switch from position “1” to position “ON” (see p. 5.5 of this Manual). The instrument will start operation under program control from “0” after power supply. After that, the new program can be uploaded, can be made loadable by default, the level transmitter shall be de-energized and the DIP-switch put back to the earlier position. After power supply, the newly loaded program will be uploaded, which can be checked by pressing the “Information” button. The more detailed information is given in the document “Configurator. User's Manual”.

8 TROUBLE-SHOOTING

8.1 Inspection of Level Transmitter Technical Condition**.**

Inspected Parameters	Technical Requirements	Inspection Frequency
1. Level transmitter external inspection, preventive works	The level transmitter shall not have any dust and dirt build-ups. The seal on the upper cover shall be intact; the explosion protection marking shall not be damaged. The level transmitter casing shall have no mechanical damages. The level transmitter fastening bolts and nuts shall be tightened to the stop. The tube with the cable shall be mated with the level transmitter reliably.	Once a month
2. Level transmitter external inspection, preventive works	There shall be no dust and dirt build-ups and foreign formations on the level transmitter and the level transmitter antenna lens. The explosion protection marking shall not have damages. The casing shall have no mechanical damages. The fasteners shall be tightened reliably. The tube with the cable shall be mated with the level transmitter reliably.	Once a year
3. Preventive works with the level transmitter in the explosion hazardous dust atmospheres for conducting dust.	Depositions of dust on the level transmitter casing shall be limited by the casing surface cleaning.	The level transmitter maintenance frequency shall conform with maintenance level established at the enterprise on the whole, but no lower the sufficient level according to GOST IEC 60079-10-2-2011

The personnel responsible for the level transmitter operation shall take measures for elimination of emerged malfunctions. It is prohibited to use the level transmitter in non-serviceable condition.
The level transmitter failure source may be the following:
- the instrument fault;
- the reception device displaying the information;
- the level transmitter power supply;
- the process in the tank.

In case of failure, it is necessary to localize the fault source to the maximum.
When using the analog signal, the available and correctly formed output signal shall be checked at the immediate level transmitter output; the attention shall be paid to the available alarm signals 3 mA, 4mA or 21mA and the voltage power supply shall be inspected.

The vastest possibilities for searching and elimination of measuring problems shall be received using PC and “Configurator” program. We recommend using an option for obtaining the “photos” (see p. 7.3. and “Configurator - User's Manual”, Section “Work with photos”.

NOTE

In the most of cases this allows for determining the cause of failures in the operation and for eliminating the measurement problem.

8.2 Inspection and Trouble-Shooting Operations

Operations on level transmitter inspection and fault elimination are summarized in the following Table.

Failure	Cause	Remedy
No 4-20mA signal	The level transmitter power supply voltage is absent or it is outside the limits of allowable values (see p. 14.1 Technical Specifications)	Check up the power supply, electrical connection; eliminate the fault in case of inconformity detection.
	The output 4-20mA electrical connection is broken or the line resistance is too high (see p. 12.1 Technical Specifications)	Restore the connection or eliminate the increased load in the line.
	The level transmitter electronic unit fault.	Send the instrument for repair.

Failure	Cause	Remedy
4-20mA corresponds to one of alarm values	One or few level transmitter controlled parameters are beyond the allowable values:	Connect to the level transmitter using PC. Check up the alarm signal value and its mask for compliance (p. 6.4).
	- the temperature in the level transmitter is beyond the range limits	Eliminate the overheating cause; isolate the level transmitter from the increased temperature process using the radio-transparent plug (see p. 14.5); use the level transmitter blow-off; install the sun-visor.
	- the level transmitter vertical axis inclination (for liquid products applications)	Eliminate by leveling the instrument.
	- unreliable temperature or inclination angle measurement	The relative channels in the instrument electronic module are faulty. Further operation is possible provided there is no overheating option. In other cases, send the instrument for repair.
	- no stability of readings - disturbance on the product surface, unstable surface.	Reference parameter; the operation can be continued.
	- unsteady mode - no stable reflective product surface or the level transmitter is at the initial loading stage	The level transmitter initial start up mode; after switching on the instrument shall exit this mode in 1-2 minutes. If it does not occur, the specter records should be made (see p. 7.3.) and sent to the Technical Support address.
	- the meter fault – the level transmitter electronic unit failure	Send the instrument for repair.

Failure	Cause	Remedy
	- the reflected signal amplitude is small – application with low dielectric permeability products, bulky products application, electronic unit failure	Make the specter records (see p. 7.3.) and send them to the Technical Support address Follow further recommendations.
	- signal loss - abrupt changes in the reflected surface properties: foam formation, bulky product slides, measuring beam breaking by the product stream	It is provided for reference. The current signal shall restore after appearance of the stable reflected signal and the process normalization. If it does not occur, the specter records should be made (see p. 7.3.) and sent to the Technical Support address.
4-20mA signal does not correspond to the controlled value actual magnitude.	The level transmitter electronic unit fault.	Check up the current signal operability using emulation (p. 7.2). In case of non-compliance, send the instrument for repair.
4-20mA signal does not correspond to the controlled value actual magnitude; the electronic unit is operable	Incorrect initial settings of measuring parameters (p. 6.3.); the installation requirement are violated (p. 4).	Make the specter records (see p. 7.3.) and send them to the Technical Support address Follow further recommendations.
With available 4-20mA signal, there is no connection via RS-485.	Line electrical connection is broken.	Check up and restore the line or eliminate the non-compliance with the requirements and wiring diagram (see p. 5).

Failure	Cause	Remedy
With available 4-20mA signal, there is no connection via RS-485; the communication line is operable	The required driver is not installed or USB/RS-485 transducer incorrect initial settings	Check up the transducer operation in PC operational system (device manager); install necessary transducer settings.
	The level transmitter Modbus address is set up incorrectly or there are some level transmitters with one address in the line.	Install different Modbus addresses for the level transmitters in the line, specify the level transmitter correct number during searching in "Configurator" program. (see p. 6.1)
	COM-port is busy with other application.	Check up, whether there are applications, which occupy the COM-port, turn them off, and reload PC, if necessary.

8.3 List of Possible Critical Failures

The list of possible critical failures, personnel (user) possible errors resulting in emergency modes of the equipment and the actions preventing the specified errors, are given in the following Table:

Fault Description	Probable Cause	Elimination Methods
Casing Mechanical Damages (dents, cracks, damages of threaded connections)	Damage during installation	The products with the damaged level transmitter explosion protection facilities (p. 3.5) are subjects to replacement.
Cable gland mechanical damages (dents, cracks, damages of threaded connections)	Damage during installation	The products, with their restoration impossible, shall be replaced
No output signals	Cable network damage	Check up and restore the electrical connections
	Electronic unit failure	Disassemble the instrument and send it to the manufacturer for repair

9 MAINTENANCE

The level transmitter does not require any special maintenance. Due to operational conditions, only periodical cleaning of the antenna surface may be required.
During level transmitter cleaning from contamination, the substances, which may have aggressive effect on the casing materials, seals, plugs and cable glands, should not be used.
When using the level transmitter in the explosion hazardous dust atmospheres for conducting dust, cleaning of the level transmitter surface should be carried out. It is necessary to provide sufficient level of maintenance according to GOST IEC 60079-10-2-2011.

9.1 Routine Inspection, Performance of Preventive Operations.

Inspect the level transmitter, clean it up from dirt and dust, check up for tightness the bolts and the nuts for the level transmitter fixation on the tank and the attachment of the supply line in the metal hose or steel pipe with the cable to the level transmitter cable gland. Check up the level transmitter casing for no mechanical damage and for no explosion protection marking damage.
Inspect the cable gland for no mechanical damage and for cable gland nut tightening by means of visual examination.

9.2 Routine Inspection with Level Transmitter Removal, Performance of Preventive Operations.

Perform the works in accordance with p. 9.1.
De-energize the level transmitter. Remove the level transmitter carefully. Inspect the antenna lens condition. Wipe the lens with tampon carefully, if necessary. Check up the cable glands for tightness integrity and for condition of treaded connections. Install the level transmitter in place following the requirements of p. 5.6. Check up the tightness of the fasteners.

10 DISMANTLING

10.1 Dismantling procedure

The instrument dismantling shall be carried out with observation of all current safety standards and rules used at the enterprise. Special attention should be paid to work on height and on tanks with aggressive and poisonous products.

The dismantling is carried out with reverse execution of actions described in p. 5.6. Instrument Connection Procedure.

11 REPAIRS

The repair can be performed only at the manufacturer's or in the authorized representative offices.

If it is necessary to return the equipment for repair to the manufacturer's, the special service log “Repair Request” available at website www.limaco.ru should be filled out

Procedure of actions required for instrument sending for repair:
- fill out the “Repair Request”;
- clean the instrument off contaminations, pack it in the package ensuring its safety during transportation;
- send the equipment and the “Repair Request” at the address specified on the website in the “Contacts Details” Section.

The repair may be carried out with the level transmitter replacement with the operable one.

12 ACCEPTANCE, STORAGE AND TRANSPORTATION REGULATIONS

During equipment acceptance, the compliance with the following requirements is established:
- the level transmitter completeness complies with the one specified in the passport certificate;
- there are no mechanical damages in the level transmitter hindering its use;
- the level transmitter number conforms with the number specified in the instrument passport certificate;
- the wordings and designations on the level transmitter are clear and comply with operational manual requirements;
- there is QCD stamp and the state calibration decal, in case of verification, in the passport certificate.

The level transmitter, which did not pass the external inspection, is not allowed for operation.

The level transmitter storage in the manufacturer's and consumer's warehouse shall be carried out according to storage conditions No. 3 according to GOST 15150-69. Shelf life in the original package – 20 years.
The level transmitter in package shall be stored on the racks.
During storage at the railway station yard, the level transmitter shall not be exposed to precipitation.
The level transmitter shall be transported only in the package and in the closed railway cars, containers, in the enclosed vehicles according to the storage conditions No. 5 according to GOST 15150-69 following the rules for goods carriage of the relative Ministry of Transport.
The arrangement and fastening of boxes with the packaged level transmitters during loading and transportation shall ensure stable position of boxes and exclude their displacement and striking in between them.
During loading and unloading, the level transmitter shall not be exposed to shocks and precipitation.
The requirements to manipulation signs on the tare shall be strictly followed during loading and transportation.
According to GOST 9.014-78, the level transmitter preservation shall be carried out by an option of temporary corrosion protection B3-15.

13 GUIDELINES ON DE-COMMISSIONING AND DISPOSAL

Upon expiry of the assigned lifetime, the level transmitters are subject to disposal in accordance with regulations applicable at the enterprise operating the article.
The instrument casing is entitled to secondary processing. The casing secondary processing can be carried out at the special-purpose enterprises.
The disposal excludes negative environmental impact and allows for second use of materials.

14 APPENDICES

14.1 Technical Specifications

Description	Value	
General Data		
Casing Material	Aluminum casting alloy, anodized, powder painting	
Antenna Shield Material	Fluorine Plastic	
Cable Gland Material	Brass or stainless steel	
Weight without flange	max 8 kg	
Overall dimensions mm, max	ULM-11(-A, A1-A): 235x170x290	
	ULM-11-HF, ULM-11A1(-HF): 235x170x230	
Operation mode	continuous[1]	
Type of mechanical connection	Flange, min diameter (mm)	
	HF	100
	HF-F	50
Output signals		
Analog		
4-20mA	Active	
Alarm signals	3mA, 4mA, 21mA (set)	
Load	Max 300 Ω	
Error	max 0.25% of measuring range	
Digital		
HART	Version 7.0	
RS-485	Modbus RTU	
Resolving capability	0.1 mm	

Description	Value
Instrument performance features	
Absolute measurement error (mm)	ULM-11, ULM-11-HF, ULM-11-HF-F: ±1
	ULM-11A1, ULM-11A1-HF, ULM-11A1-HF-F: ±3
Measuring range	0.6…30 m
Measuring range with reduced accuracy	0.3…0.6 m
Operating principle	Radar instrument for level measuring us-

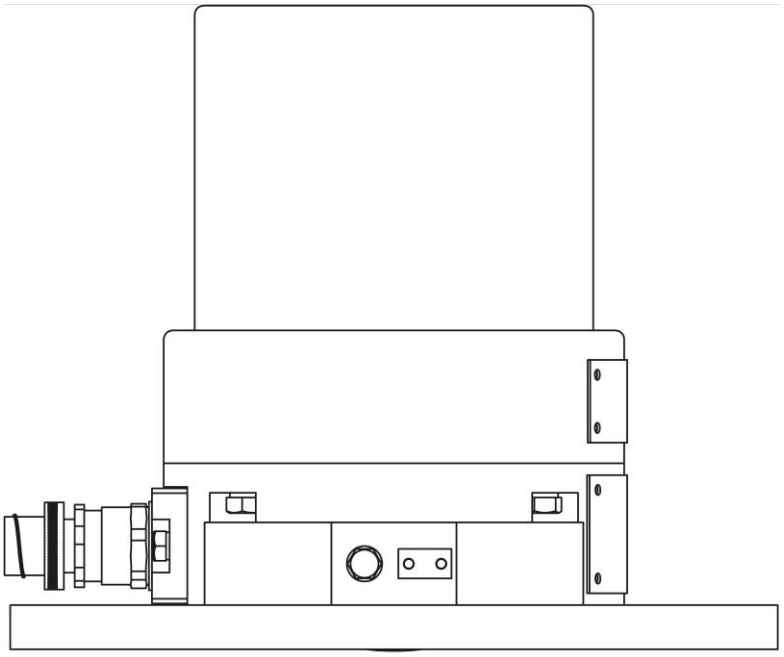
[1] From the moment of feed voltage supply under temperature below 0 ^{0}C, the level transmitter requires warm-up. The output signals will be available no later than 5 minutes after warm-up under the ambient temperature 0 ^{0}C and no later than 18 minutes after warm-up under the ambient temperature -60 ^{0}C

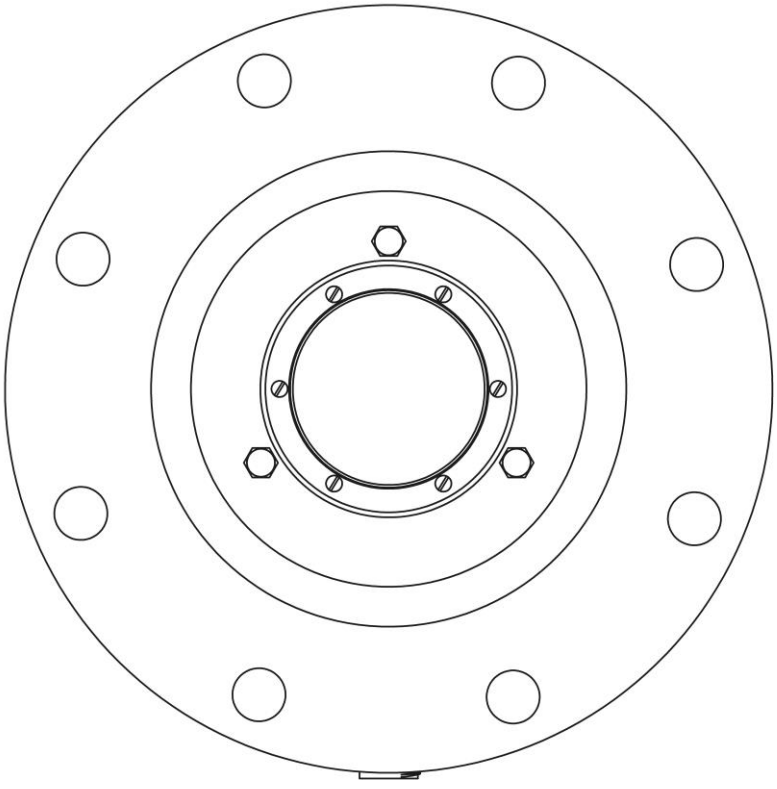
	ing the frequency-modulated continuous-wave (FMCW)
Operating frequency	24GHz for ULM-11A1; 77 – 94 GHz for ULM-11; 125±5 GHz for ULM-11-HF ULM-11-HF-F and ULM-11A1-HF, ULM-11A1-HF-F
Directional pattern width	15˚ for ULM-11A1; 4˚ for ULM-11, ULM-11A1-HF-F, ULM-11-HF-F; 2˚ for ULM-11-HF and ULM-11A1- HF
Operating Conditions	
Ambient temperature in the level transmitter installation location	-60…+50˚C
Relative humidity, %	Not more than 95 at 35˚C and lower temperatures, without moisture condensation
Under temperature at the level transmitter flange at above 50˚ C level	Installation of the radio-transparent insulating gasket is required (see p. 14.5)
Atmospheric pressure	84.0…106.7 kPa (630-800 mm Hg)
Relative humidity in the level transmitter installation location	Not more than 95% at 35˚ C and lower temperatures, without moisture condensation
Excessive pressure or vacuum in the tank	It is provided with installation of the insulating membrane (for example, fluorine plastic) – the gasket dimensions and applicability are agreed upon with the level transmitter manufacturer.
Mechanical impacts - amplitude vibration - frequency vibration	 Maximum 0.1 mm 5…25Hz
Maximum vertical inclination of operating position (during liquid level measurement)	1 degree (regulated only for use with liquid products)
Protective measures	
Enclosure protection rating according to GOST 14254-2015 (IEC 60539-0:2013)	IP65
Design	1Ex d IIB T6 Gb / Ex tb IIIC T6 Db
Power supply	
Power supply voltage: - **Option 1.** Voltage at the level transmitter terminal block (from mains or secondary power supply) direct current, V.	 24±20%

- **Option 2[1].** Voltage at the level transmitter terminal block (from power supply network), alternating current, frequency 50Hz, V	220±20%
Maximal consumption power	70 W
Screw contacts for electrical connection of wires with cross-section	maximum 2.5 mm (AWG 14)
Permits and certificates	
This documentation can be uploaded from the website www.limaco.ru	

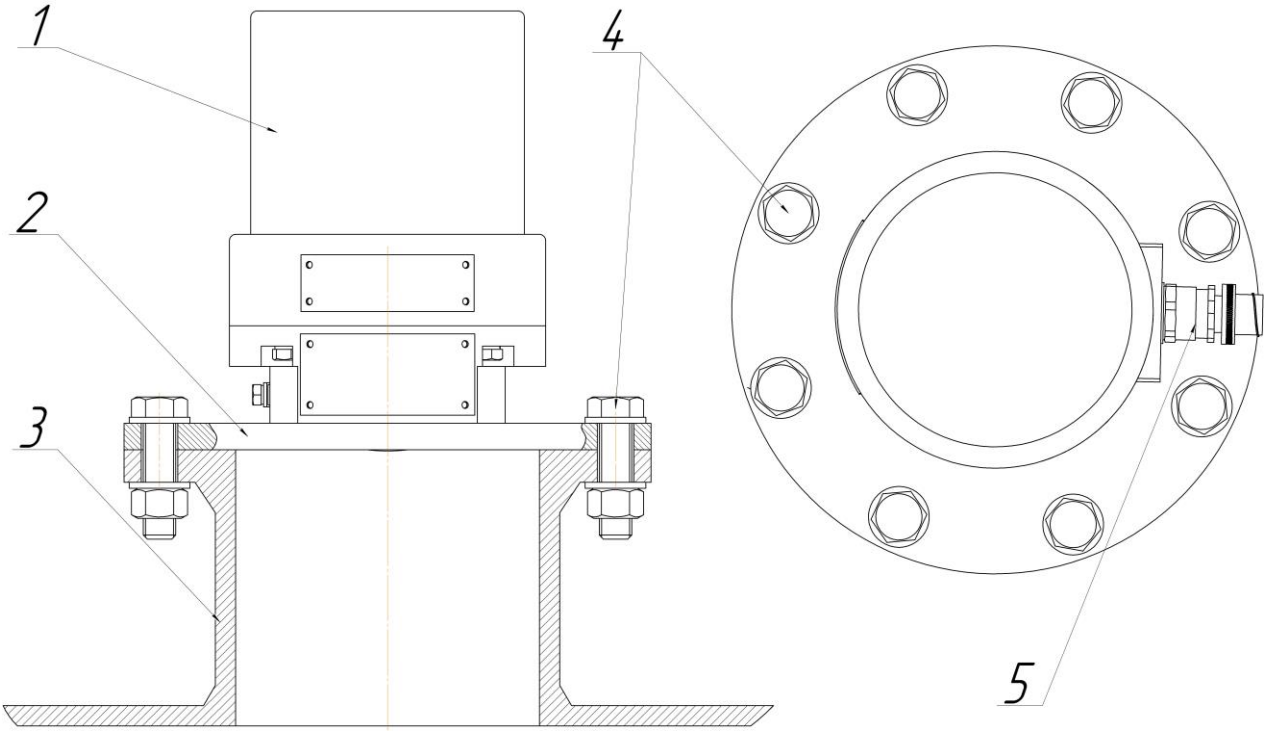
[1] Only for design ULM-11(-A), ULM-11A1(-A)

14.2 LEVEL TRANSMITTER WITH MOUNTING FLANGE



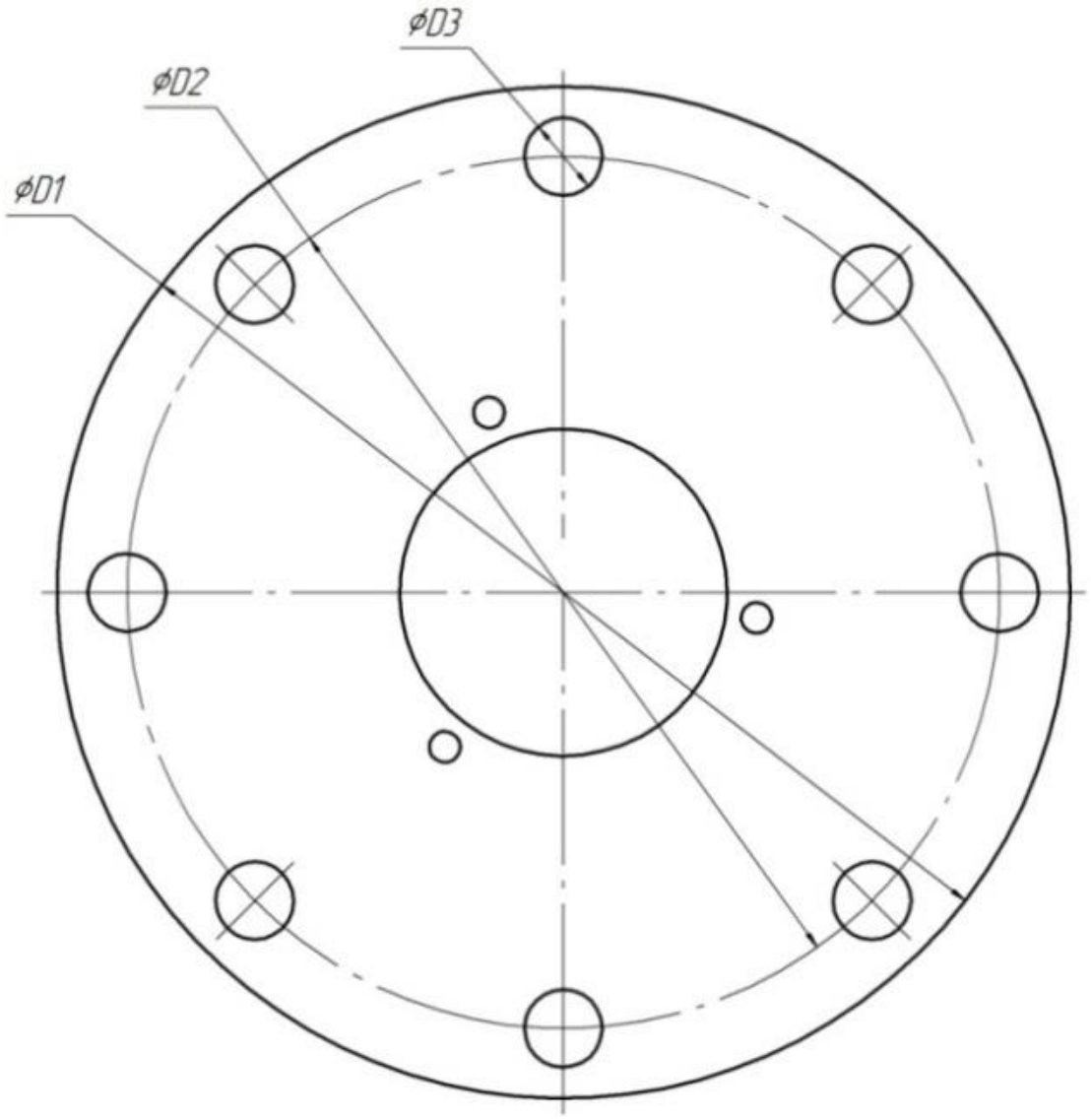


14.3 LEVEL TRANSMITTER ON TANK INSTALLATION DIAGRAM



1	Sensor
2	Adapting flange
3	Product tank flange
4	Bolt M20 8 pcs.
5	Cable gland

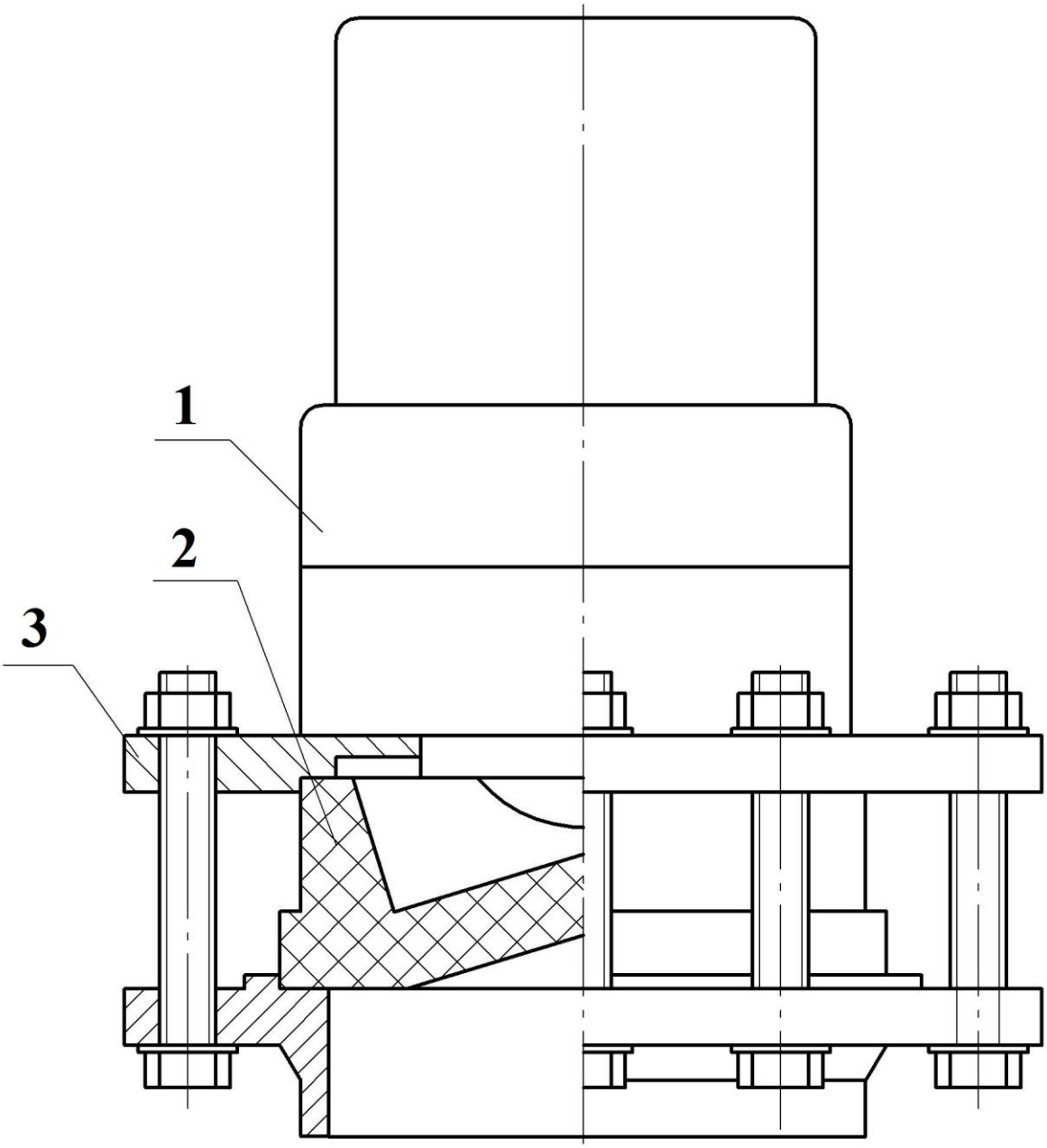
14.4 MOUNTING (ADAPTING) FLANGE FOR LEVEL TRANSMITTERS ULM-11, ULM-11-HF, ULM-11-HF-F, ULM-11A1, ULM-11A1-HF, ULM-11A1-HF-F.



Installation dimensions in accordance with GOST 12821-80.

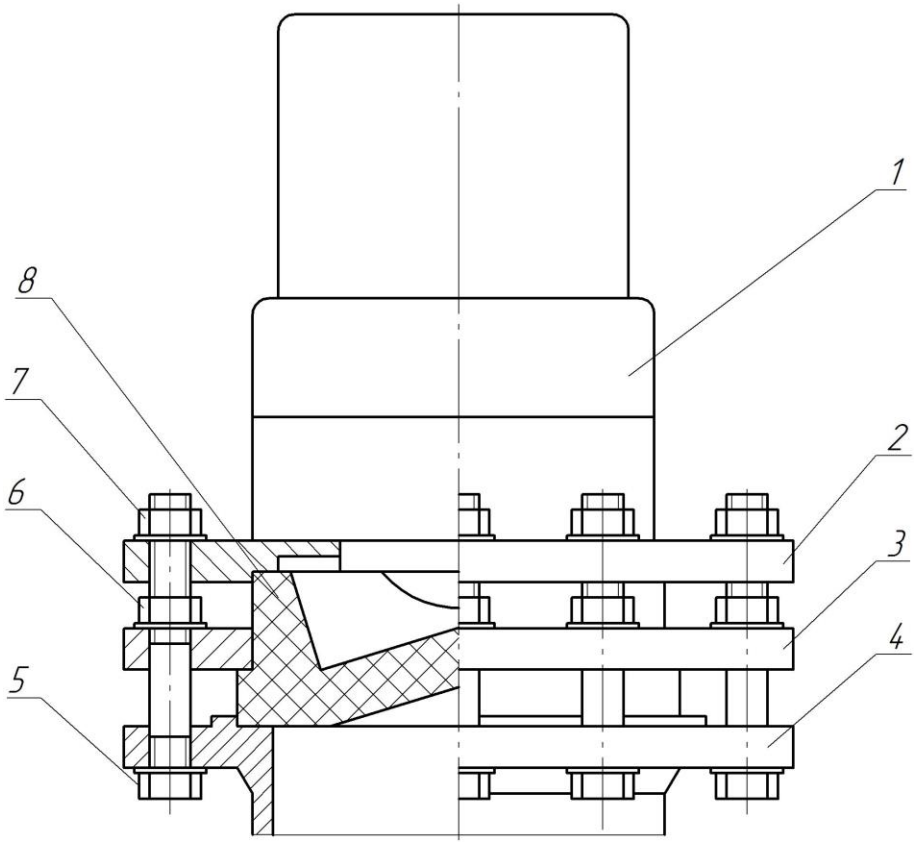
Flange	D1, mm	D2, mm	D3, mm
DN150, RN6	260	225	18
DN150, RN16	280	240	22

14.5 LEVEL TRANSMITTER INSTALLATION ON PIPE BRANCH WITH INSULATING GASKET



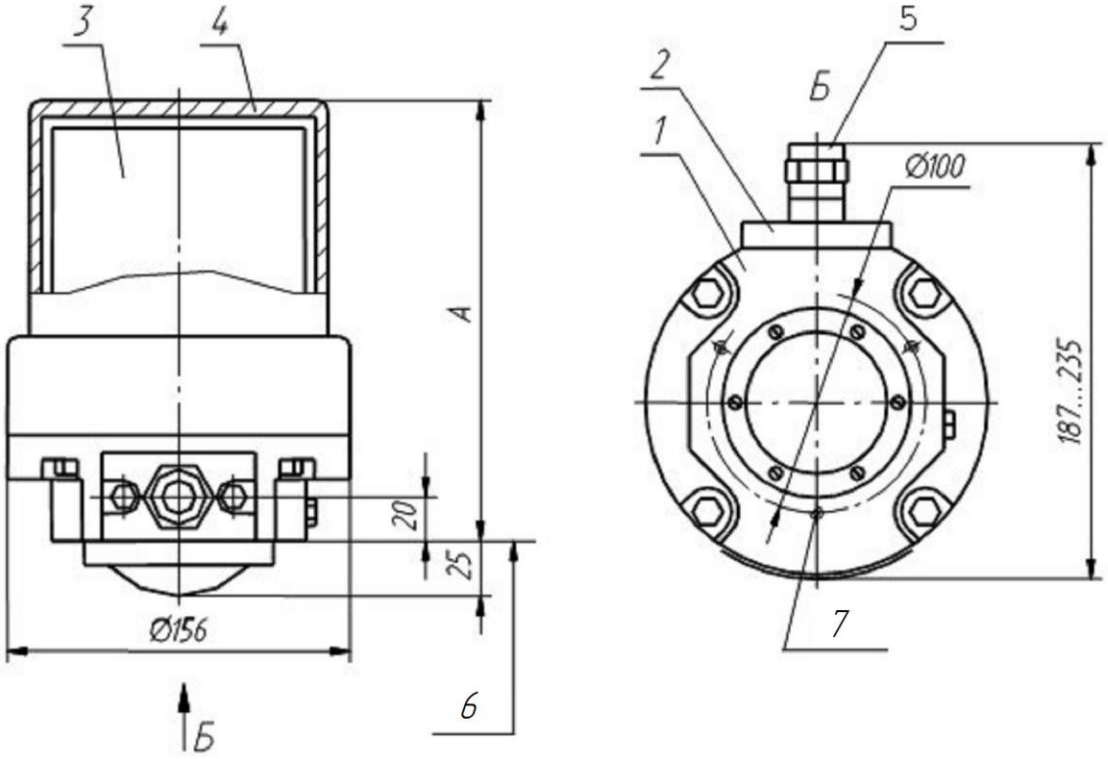
1	Level transmitter
2	Insulating gasket
3	Flange

14.6 INSTALLATION OF LEVEL TRANSMITTERS ULM-11, ULM-11-HF, ULM-11-HF-F, ULM-11A1, ULM-11A1-HF, ULM-11A1-HF-F ON PRESSURIZED TANKS



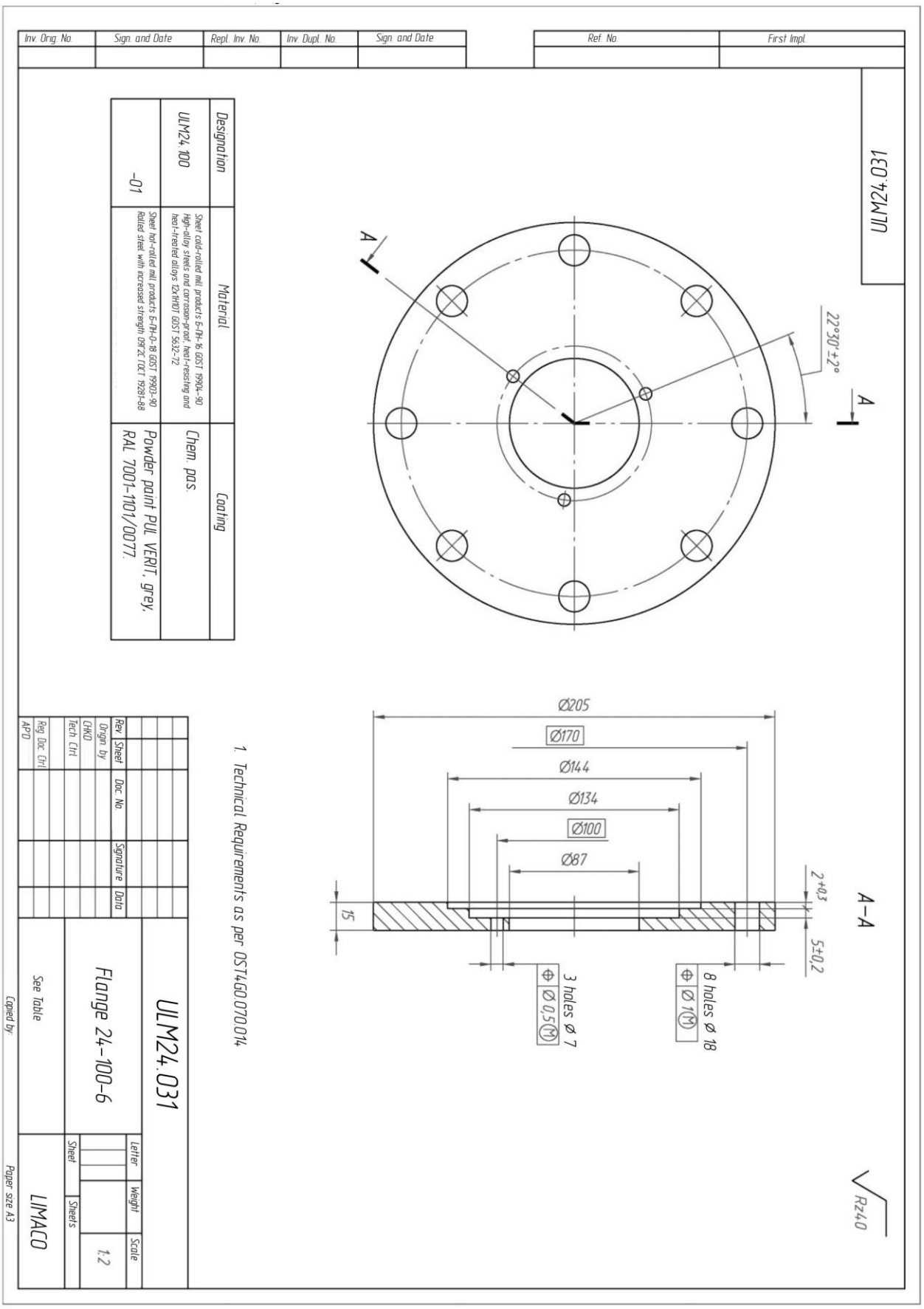
Installation sequence:
Sealing gasket 8 is installed on the tank flange 4.Then the fixing flange 3 is put on it, and then tightening of the gasket was carried out by means of the flange 6 turned on the bolts 5. During gasket tightening, it is necessary to monitor the uniformity of fixing flange screwing on. For this, tightening of nuts is carried out gradually by the flange circumference. After gasket tightening until stop, the nuts 6 are fixed using any method preventing its self-loosening. The level transmitter 1 is mounted on the adapting flange 2 with three bolts; it is installed on flange 3 and is fixed with nuts 7.

14.7 CONNECTING DIMENSIONS FOR LEVEL TRANSMITTER MATING WITH ADAPTING FLANGE

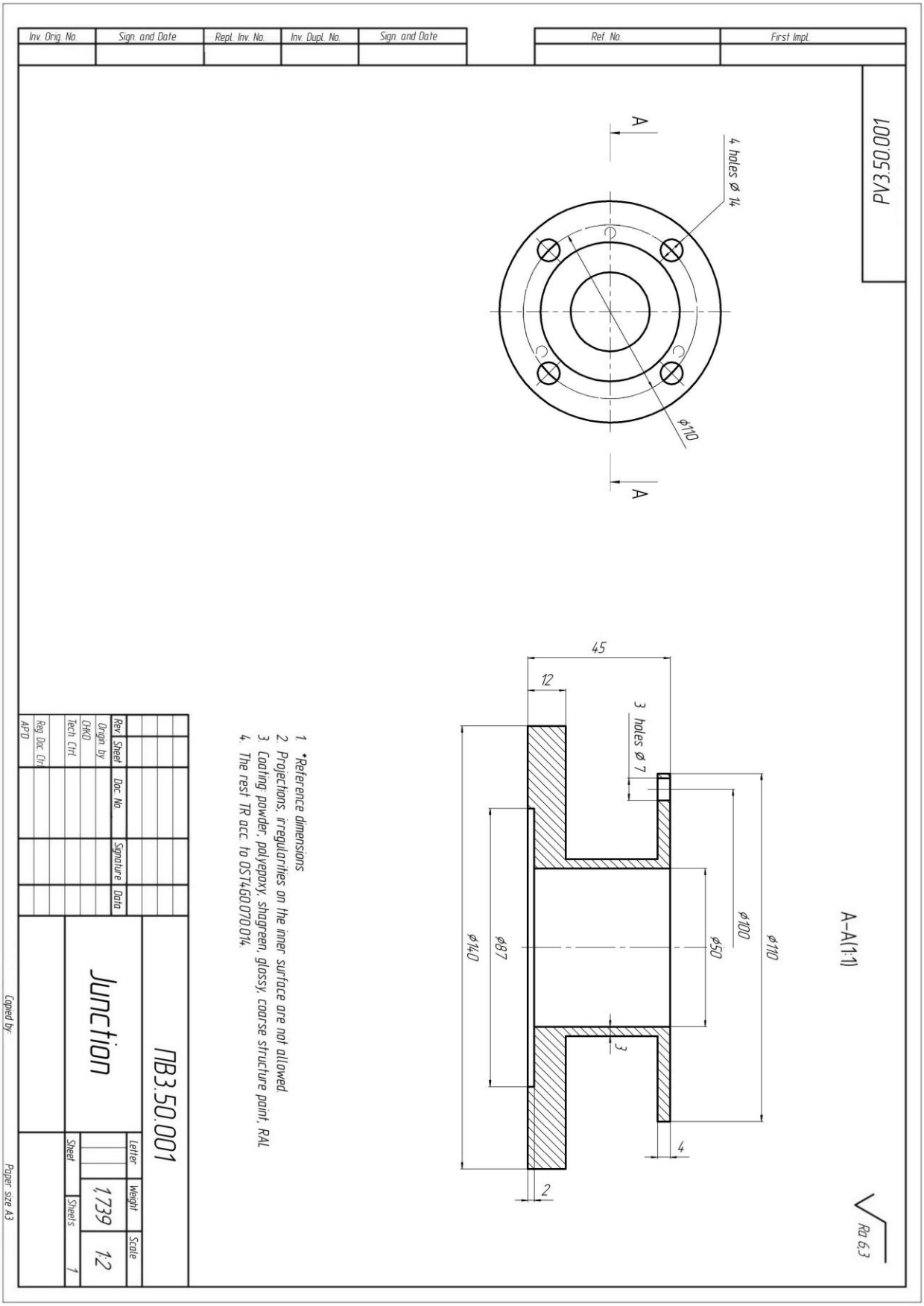


1	Antenna
2	Cable gland casing
3	Electronic unit
4	Upper cover
5	Cable gland
6	Mating face
7	3 holes M6x16

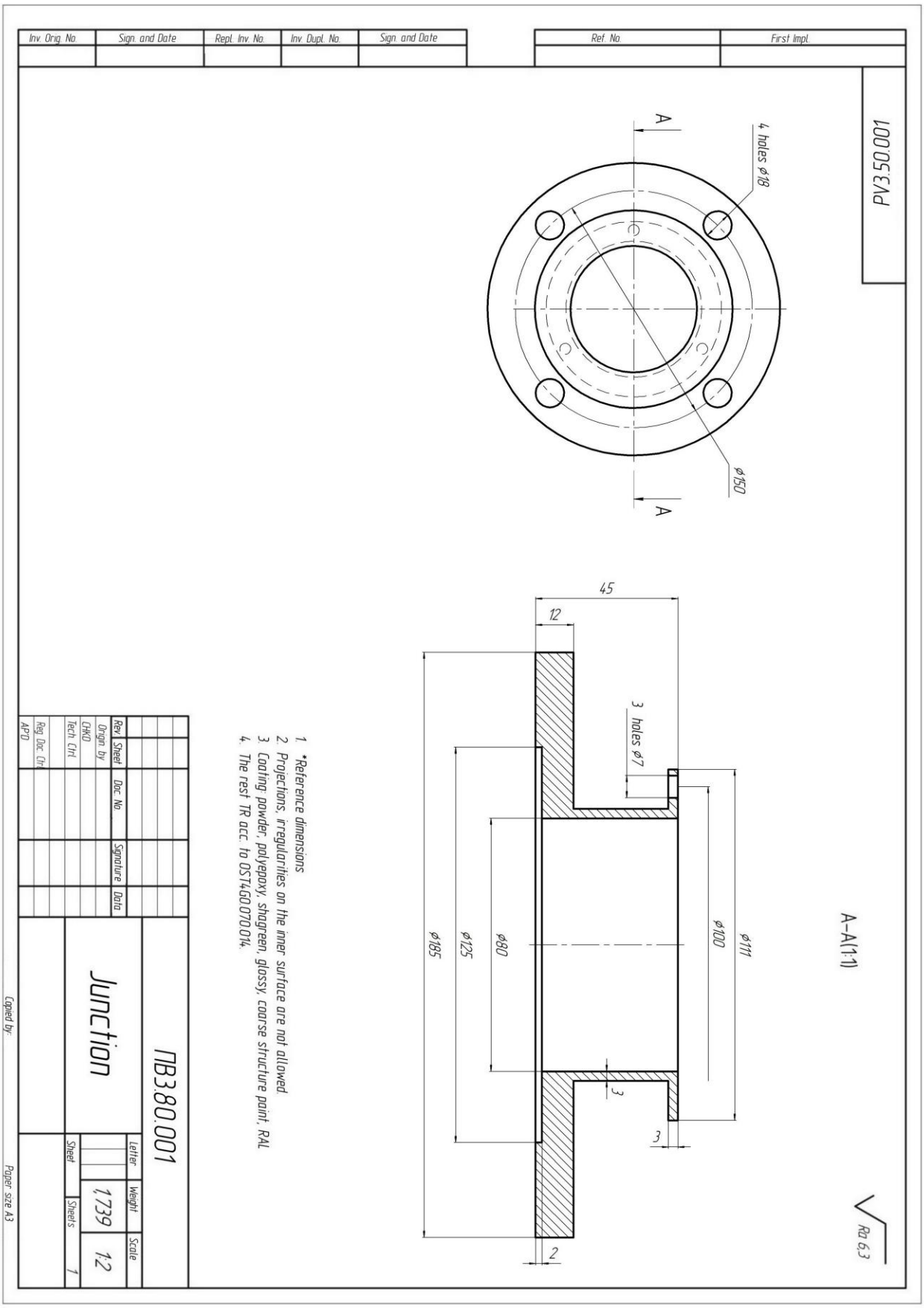
14.8 ADAPTING FLANGE FOR LEVEL TRANSMITTERS ULM-11-HF, ULM-11A1-HF ON PIPE BRANCH DN100-R6



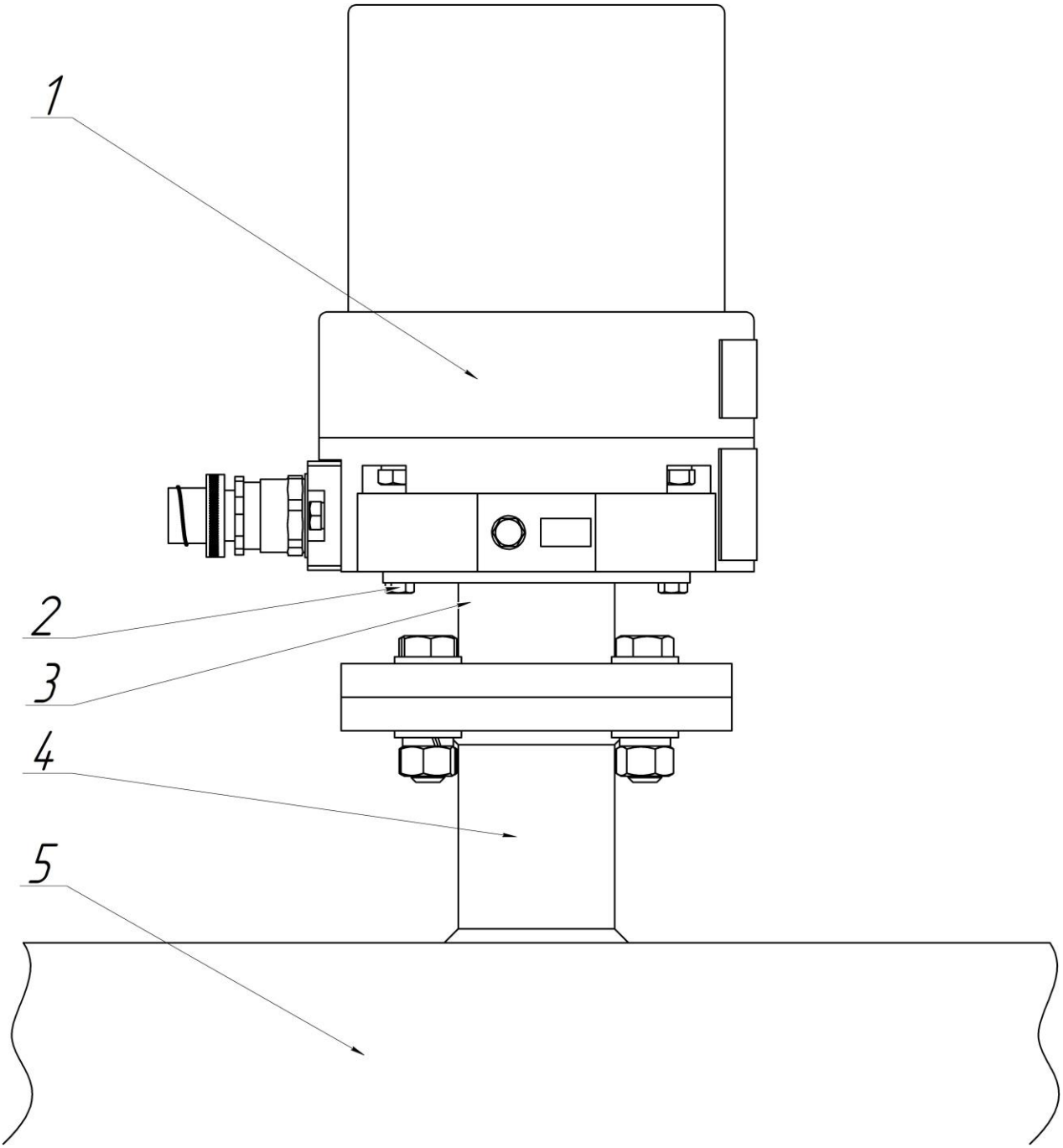
14.9 ADAPTING FLANGE FOR LEVEL TRANSMITTERS ULM-11-HF-F, ULM-11A1-HF-F ON PIPE BRANCH DN50-R6



14.10 ADAPTING FLANGE FOR LEVEL TRANSMITTERS ULM-11-HF-F, ULM-11A1-HF-F ON PIPE BRANCH DN80-R6



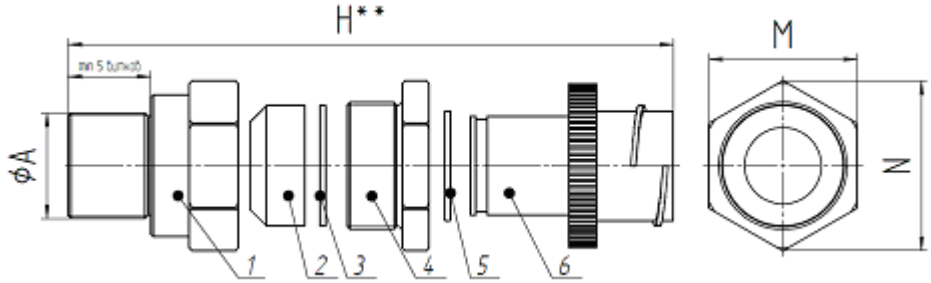
14.11 MOUNTING LEVEL TRANSMITTERS ULM-11-HF-F, ULM-11A1-HF-F ON PIPE BRANCH THROUGH ADAPTING FLANGE DN50-R6



1	Level transmitter
2	Bolt M6
3	Adapting flange
4	Tank flange
5	Product tank

14.12 USE OF CABLE GLAND FOR LEVEL TRANSMITTER CONNECTION VIA CIRCULAR CROSS-SECTION CABLE WWITH METAL HOSE PROTECTION

For level transmitter connection via circular cross-section cable with metal hose protection, it is necessary to use the relative cable gland supplied in complete set with the level transmitter.



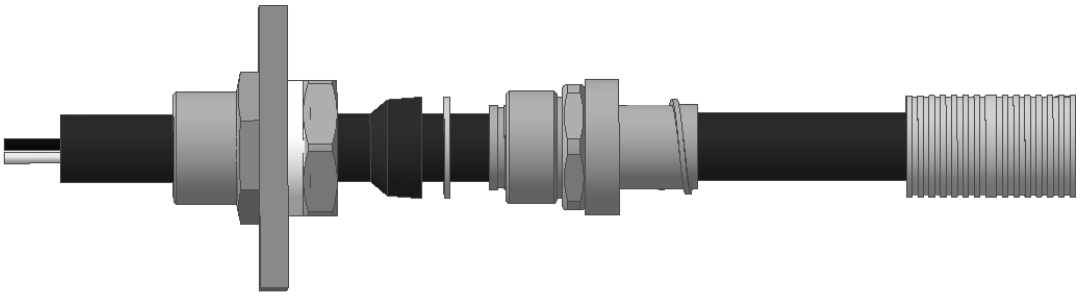
Pos.	*Designation*	*Description*	*Q-ty*
1	*HK1*	*Input element*	*1*
2	*C*	*Sealing element*	*1*
3	*P3*	*Skid-washer*	*1*
4	*PK2*	*Packing nut*	*1*
5	*PK4*	*Retaining ring*	*1*
6	*CK*	*Metal hose attachment device*	*1*

Fig.12.8 Composition of cable gland for connection of circular cross-section cable with metal hose protection.

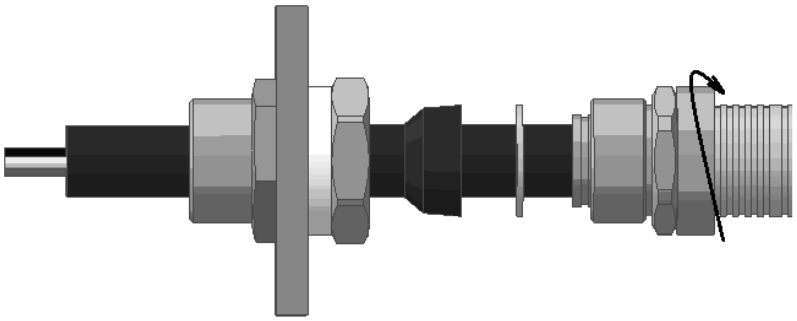
Type of thread	*Cable sheath diameter min-max, mm*	*Tightening torque, N*m*
M20	*6.5 – 13.9*	*53*

Tightening torques

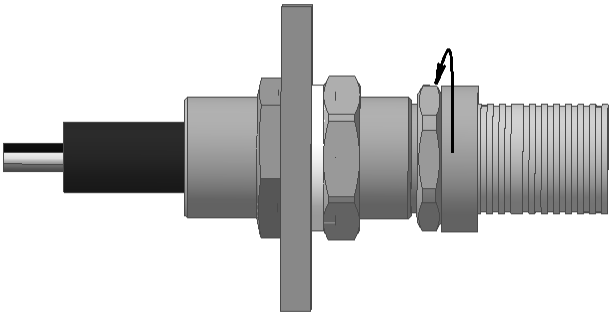
1. Unscrew the main cable gland. If it is screwed up to the level transmitter leaving the input element (1, HK1) in the level transmitter casing or screw in the cable gland input element into the level transmitter casing, if the cable gland is supplied separately.
2. Disassemble the cable gland.
3. Put the following on the cable in this sequence – the packing nut (4) with the metal hose fastening device (6), the skid-washer (3) and the sealing element (1).
4. Draw out the installed cable in the casing for the length necessary for installation.



5. Fasten the metal hose on the metal hose fastening device (6).



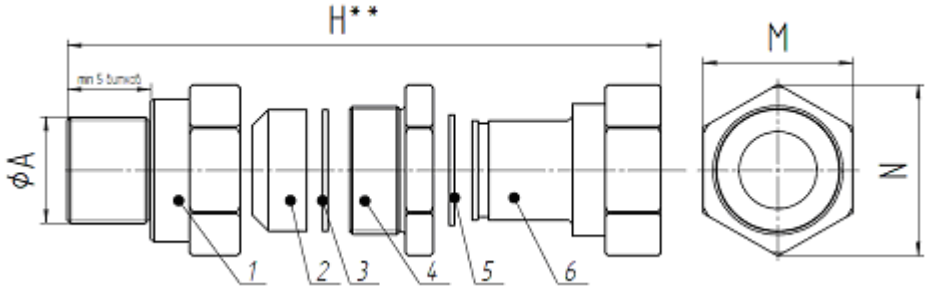
6. Screw down the packing nut (4) into the input element with the torque specified in the Table of tightening torques.



7. After final installation of the cable gland, check the tightening torque of the packing nut (4) for compliance with the value specified in the Table of tightening torques.

14.13 CONNECTION OF LEVEL TRANSMITTER VIA CIRCULAR CROSS-SECTION CABLE WITH METAL TUBE PROTECTION

For level transmitter connection via circular cross-section cable with metal tube protection, it is necessary to use the relative cable gland supplied in complete set with the level transmitter.



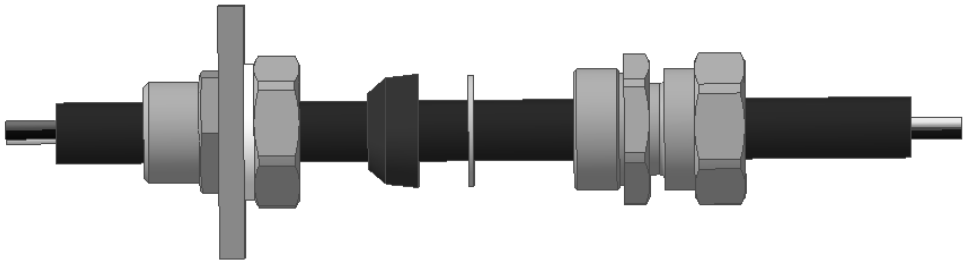
Pos.	*Designation*	*Description*	*Q-ty*
1	*HK1*	*Input element*	*1*
2	*C*	*Sealing element*	*1*
3	*P3*	*Skid-washer*	*1*
4	*PK2*	*Packing nut*	*1*
5	*PK4*	*Retaining ring*	*1*
6	*PK3*	*Tube coupling*	*1*

Composition of cable gland for connection
of circular cross-section cable with metal tube protection.

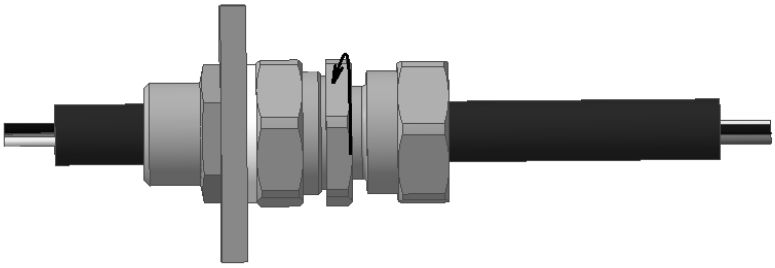
Type of thread	Cable sheath diameter min-max, mm	Tightening torque, N*m
M20	6.1 – 11.7	28

Tightening torques

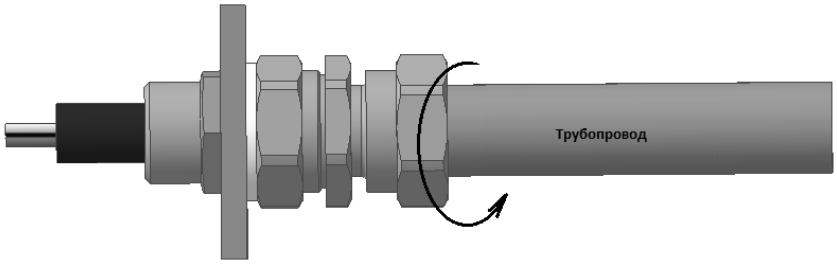
1. Unscrew the main cable gland. If it is screwed up to the level transmitter leaving the input element (1, HK1) in the level transmitter casing or screw in the input element into the level transmitter casing, if the cable gland is supplied separately.
2. Disassemble the cable gland.
3. Put the following on the cable in this sequence – the packing nut (4) with the tube coupling (6), the skid-washer (3) and the sealing element (2).
4. Draw out the installed cable in the casing for the length necessary for installation.



5. Screw down the packing nut (4) into the input element with the torque specified in the Table of tightening torques.



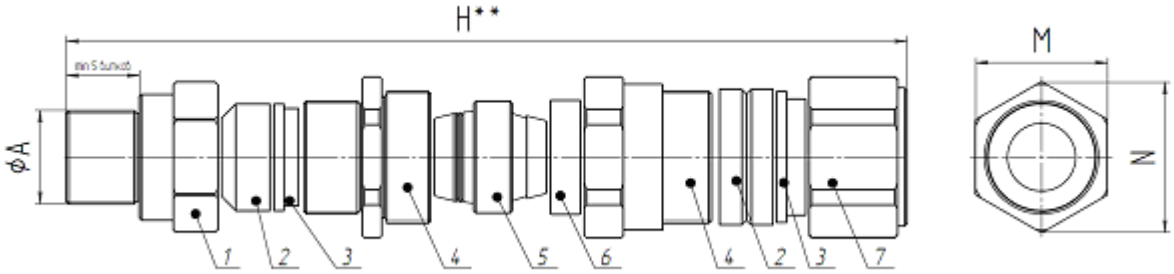
6. Bring the pipeline to the tube coupling (6) and tighten it securely.



7. After final installation of the cable gland, check the tightening torque of the packing nut (4) for compliance with the value specified in the Table of tightening torques.

14.14 USE OF CABLE GLAND FOR LEVEL TRANSMITTER CONNECTION VIA THE ARMORED CABLE

The corresponding cable gland supplied in complete set with the level transmitter shall be used for level transmitter connection with the armored cable.



Pos.	*Designation*	*Description*	*Q-ty*
1	*HK1*	*Input element*	*1*
2	*C, K*	*Sealing element*	*2*
3	*P1, P2*	*Plastic insert*	*2*
4	*AK2, AK5*	*Packing nut*	*2*
5	*AK3*	*Armor fastening device*	*1*
6	*AK4*	*Armor fixation ring*	*1*
7	*AK6*	*Sealing nut*	*1*

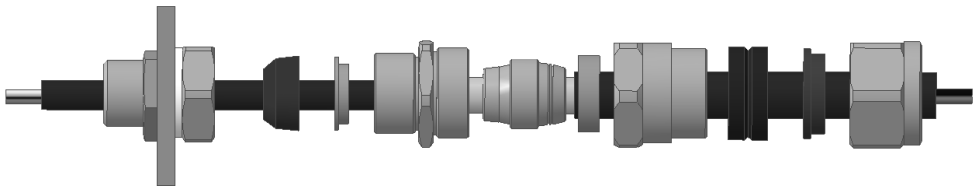
Composition of cable gland for armored cable connection.

Type of thread	*Diameter of cable internal sheath min-max, mm*	*Tightening torque, N*m*	*Diameter of cable external sheath min-max, mm*	*Tightening torque, N*m*
M20	*6.5 – 13.9*	*53*	*12.5 – 20.9*	*78*

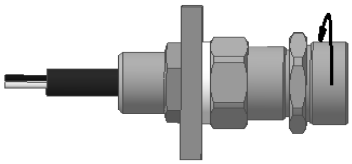
Tightening torques

Prepare the cable for entry in the level transmitter removing the outer insulation and releasing from the armor preliminarily. The armor shall extend beyond the external sheath maximum for 18 mm. For easy installation, the tape armor edges shall be undercut.

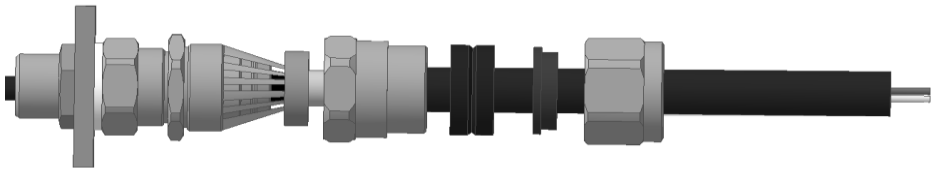
1. Unscrew the main cable gland. If it is screwed up to the level transmitter leaving the input element (1, HK1) in the level transmitter casing or screw in the cable gland input element into the level transmitter casing, if the cable gland is supplied separately.
2. Disassemble the cable gland.
3. Put the following on the cable in this sequence - the sealing nut (7), the plastic insert (3,P2), the sealing element (2, K), the packing nut (4, AK5), the armor fixation ring (6,AK4), the armor fastening device (5, AK3), the packing nut (4, AK2), the plastic insert (3,P1), the sealing element (2, C) and the input element (1, HK1).
4. Draw out the installed cable in the casing for the length necessary for installation



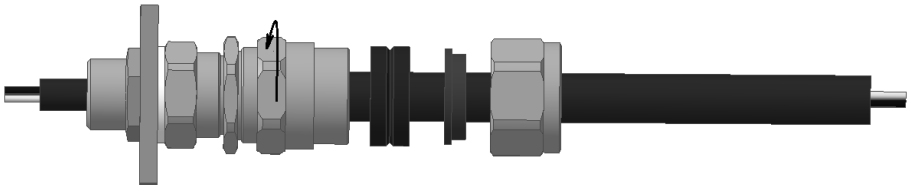
5. Screw down the packing nut (4) into the input element with the torque specified in the Table



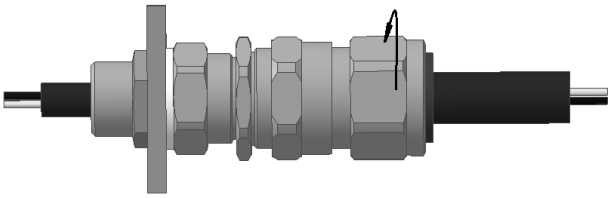
6. Install the armor fastening device (5) into the packing nut (4), draw the cable until armor stop in the fastening device. Distribute the armor uniformly.



7. Pressing on the cable permanently, screw down the packing nut (4, АК2) until stop (with minimum torque 20N*m). Check up the armor fastening.



8. Screw down the sealing nut (7) with the torque specified in Table 3 till full clamping of the outer sheath.



9. After final installation of the cable gland, check the tightening torque of the packing nuts АК2, АК5 и АК6 for compliance with the values specified in the Table of tightening torques.