Fuel level sensor
LLS 20230
(explosion-proof series)

Installation manual
Version 1.16

Models:
LLS 20230-2000
LLS 20230-2500
LLS 20230-3000
LLS 20230-4000
LLS 20230-5000
LLS 20230-6000
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LIST OF ABBREVIATIONS AND LEGEND

BIS 20240 — stabilitron-based spark protection unit;

PS — power supply unit;

OS — operating system;

PC — personal computer;

L — working length of the fuel level sensor LLS (mm);

L1 — working length of the sensor after cutting to match the specific fuel tank (mm);

M — measurement range (non-dimensional value);

N — numerical code corresponding to measured level value (non-dimensional value);

CNT1 — lower limit of level measurement (non-dimensional value);

CNT2 — upper limit of level measurement (non-dimensional value).

Vcc — DC power supply
GENERAL INFORMATION

This manual outlines the rules and procedures for installation, start-up, setting and connection of fuel level sensor LLS 20230 (hereinafter - product), as well as calibration procedure for a fuel tank with an installed sensor.

The fuel level sensor LLS 20230 is installed on special types of equipment or stationary fuel storages and tanks that are subject to explosion protection requirements and have the explosion protection marking “0ExiaIIBT6X”. The fuel level sensor LLS 20230 is used together with spark protection unit BIS 20240 produced by Omnicomm.

List of required works to install the product:

1. Product completeness check
2. Selection of location to install the product
3. Selection of location to install BIS 20240
4. Preparation of the fuel tank for installation
5. Product cutting to match the specific fuel tank
6. Product setting with the help of LLS Monitor application
7. Product installation
8. Installation of BIS 20240 (for LLS 20230)
9. Product setting depending on the interface connecting it with an external device
10. Preparation and laying of cable to connect the product with an external device
11. Fuse installation
12. Fuel tank calibration
13. Sealing

A list of required equipment and tools is provided in Appendix B (Table 1).
SAFETY

Only personnel who have completed a training course with manufacturer’s authorised service company and were subsequently certified by them are allowed to carry out installation and start-up works.

During installation and start-up works it is requested to follow safety requirements specified in operational documentation of the producer of the vehicle on which the product will be installed, as well as the requirements of regulatory documents applicable to this type of equipment.

PREPARING FOR INSTALLATION

Product supply set check
Open up the packaging. Check product supply set against the datasheet passport.

In case the product does not match the set of components listed in the datasheet, such a mismatch is resolved by the manufacturers or their representatives.

1) Perform a visual check of the product. The product must not have visual defects or damage.
2) In case damage is detected, the product is to be replaced by the manufacturers.

Selection of location to install the product
1) The product should be installed, depending on geometric shape of the tank, at the locations shown in Figures 1–3. Installation at these locations ensures fuel level independence of vehicle inclination.

![Figure 1](image1.png)

![Figure 2](image2.png)
2) When it is impossible to install the product at the locations shown in Figures 1–3, a new location should be as close to those indicated, as possible.

3) Product installation at the locations other than shown in Figures 1–3 may cause fuel level dependence on vehicle inclination. For example, for vehicles operating in a high-relief landscape this will mean either overrated or underrated fuel level values.

Installation of two products in one fuel tank allows one to reduce fuel level dependence on vehicle inclination significantly. Two products should be installed at the locations shown in Figures 4 and 5.
Selection of location to install BIS 20240 (LLS20230)

1) Installation of BIS 20240 must be carried out outside of any explosion hazard zone, on a smooth surface.
2) While selecting the location for installation, take into consideration the length of the cable intended to connect stabiltron-based spark protection unit BIS 20240 with an external device (for example, telematic module).

Note. Connection of BIS 20240 with fuel level sensor LLS 20230 should be made only by cable KTZ-XX produced by Omnicomm, where XX — cable length (which can be chosen within the range 10–25m).

Preparation of the fuel tank for product installation

1) Prepare the tank for mechanical and welding works in accordance with the requirements of the manufacturers and other regulatory safety documents applicable to these types of work.
2) Determine the fuel tank type and prepare the tank for product installation depending on the tank type. Fuel tank types are as follows:

a. Plastic tank or metal tank with wall thickness under 3 mm

Important! The tanks whose shape corresponds to Figure 2 should be prepared in accordance with Appendix E.

Prepare the tank for fixing the product by rivets.

Drill holes in the tank: the central hole - by a bi-metal crown Ø35 mm and mounting holes - by a drill Ø7 mm as shown in Figure 6.

Install the rivets in the prepared holes Ø7 mm with the help of a riveter. A detailed description of rivets installation is given in Appendix C.

Important! It is not recommended to use self-tapping screws to fix the product onto a metal or plastic tank with a wall thickness of under 3mm. This type of fixture cannot ensure the reliability of product attachment to the tank.
b. Metal tank with wall thickness over 3 mm

Prepare the tank for product installation on a threaded joint.

**Important!** The tanks whose shape corresponds to Figure 2 should be prepared in accordance with Appendix E.

Drill holes in the tank: the central hole — by a bi-metal crown Ø35 mm and mounting holes — by a drill Ø4 mm, as shown in Figure 7.

Make an M5 thread with the help of an M5 tap.
c. Plastic tank with wall thickness over 3 mm.

Drill holes in the tank: the central hole — by a bi-metal crown ø35 mm, and mounting holes — by a drill as shown in Figure 8.

![Figure 8](image)

**Cutting the product to fit the particular fuel tank**

1) Measure the depth of the tank by moving a measuring bar down into the central hole intended for the sensor.
2) On the working length of the product L, measure length L1 equal to the depth of the tank minus 20 mm.

![Figure 9](image)

3) Cut the product at length L1 by a hack-saw so that the line of the cut is strictly perpendicular to the longitudinal axis of the product (Figure 9).

**IMPORTANT! L1 cannot be less than 17 cm**

4) Put the plastic isolating cap included into the product delivery set on the central rod of the product.

**Note:** When using the sensor, it is necessary to take off the rubber transportation cap and put on the plastic isolating cap using sealant. Roughly 1/4 of the internal space of the cap must be filled with silicone. After fitting the cap you need to wait 10–15 minutes for the “surface skin” of silicone to form.
Product setting with the help of “LLS Monitor” application

1) Connect the product to the PC as per the connection diagram (Appendix D) using a REUSABLE TOOL-UNU produced by Omnicomm.

2) Start LLS Monitor application. The main window will open (Figure 10). It will show the current settings of the connected product.

![Image](image.png)

Figure 10

3) In case the program window does not show product settings and there is a message “Connecting to sensor” at the bottom of the window (Figure 11), it is necessary to change product connection settings.
Figure 11
BRIEF DESCRIPTION OF LLS MONITOR SOFTWARE

Subwindows:

• **Serial Number** — unique manufacturing number, inserted during manufacturing process, can not be changed by customers

• **Firmware** — number of current firmware of LLS

• **Defaults Data Output Mode** — three choices — no output, binary and text may be useful for integrators of our LLS(es).

• **Data Output Interval** — selectable, in seconds (integer 0…255)

• **Network Address** — selectable (integer 1…255).

• **Baud rate** — selectable by customer Speed of data transmission, (integer 4800 — 115200), default value for OMNICOMM equipment is 19200 bps.

• **Maximum Value** — selectable discrimination (integer 1-4095).

• **Minimum Value** — selectable offset of the digital scale, points (integer 0-4095).

• **Filter Length** - this value determines the number of measurements (points) that will be smoothed before issuing the data, selectable: None, Minimum, Medium, Maximum, for various using conditions.
  
  “No” no filtering. Used when filtering is performed by external device.
  
  “Minimum” filtering is used in cases of sensor installation in stationary fuel storage tanks or inactive objects (diesel generators, construction equipment).
  
  “Medium” filtering is used in cases of using vehicle under normal driving conditions (trip transportation, cargo and etc.).
  
  “Maximum” filtering is used in cases of vehicle in heavy traffic conditions (construction machines, vehicle, working in off-road conditions, agricultural machinery).

• **Hard Environment Mode** — mode, including additional filtering releases of measured values, takes into account difficult working conditions of sensor (knocks while driving on the bumps, large fluctuations of fuel, the presence of waves in the tank, etc.)
  
  “On” - performed additional filtering sensor readings.
  
  “Off” - additional filtering is not performed.

Buttons:

• **Get Parameters** — new request of data, useful (for example) when another LLS is connected

• **Set Parameters** — provides possibility to change parameters and save them accordingly.

• **Update firmware** — provides possibility to download new version of firmware.

• **LLS Adjustment** — button to start Empty — Full calibration.

• **About** — info about program.

Function keys:

• **F1** — to see the calibration chart;

• **F2** — to save the calibration table into the text file;

• **F4** — to switch on synchronisation with the LLS 20160 readings (i.e. the current reading will be recorded as a value in the table);

• **F5** — to switch off the synchronisation of the LLS 20160 (in this mode, you may complete the table manually, ignoring the sensor readings).
Establishing product connection settings

1) Select the tab “Service” (Figure 11) and then, in the opened window, select COM-port that was created during the connection of the UNU device (Figure 12).

![Figure 12](image)

2) Set up a data exchange rate. It is also possible to select the language of program interface. Press the button “Save”.

1. A default value of the data exchange rate preset in the product is — 19200 bit/sec.

![Figure 13](image)

3) If all the parameters are set correctly, the main program window will show the current settings, and the message “Connected” will appear at the bottom of the window (Figure 10).
Setting up the upper and lower limits of level measurement

Important! Sensor adjustment should be provided for the fuel with which the vehicle or machine is really working; no other fuel! The fuel must be clean (no visible particles or additives), fresh, drained from fuel tank, or, in case of taken from storage, must be shaken well before calibration procedure.

1) Press the button “LLS Adjustment” (Figure 10). To carry out the setting, use the fuel that will be used with the product.

2) Put the product into the measuring container.
3) Pour fuel into the measuring container in such a way that the product is submerged at all length L1. Wait at least 2–3 minutes for reading stabilisation.
4) Press the button “Full” in the program window (Figure 14). You will see the message “Set” (Figure 15) opposite the button “Full”.

5) Take the product out of the container and let the fuel flow off during 2–3 minutes.
6) Press the button “Empty” in the program window (Figure 15). You will see the message “Set” opposite the button “Empty” (Figure 16).

7) Press the button “Finish Adjustment”.
**Updating built-in software**

**Note:** It may be necessary to update the built-in software in case some faults are detected in product operation or if you are willing to improve its technical and functional characteristics.

1) Check the availability of a new version of built-in software on the manufacturers’ Web-site www.omnicomm-online.com or contact OMNICOMM’s Technical Support Department.

In case a new version of software is available, the previously installed software can be updated.

2) Save the new version of built-in software on your PC.

**Important!** Built-in software updating is possible only at the speed of 19200 bit/sec.

3) Press the button “Change firmware” in LLS Monitor window (Figure 10). You will see the window (Figure) where you will need to show the path to the file with the new version of built-in software. After that press “Open”.

![Figure 17](figure17.png)

If the selected file is not built-in software, the following window (Figure 18) will open.

![Figure 18](figure18.png)

Press “OK”, select the built-in software file and press “Open”.

The built-in software updating process will be reflected at the bottom of the main program window (Figure 19).
If built-in software updating is successfully completed, the following window (Figure 20) will open.

If there was a mistake in the updating process, you will see the following dialogue window (Figure 21).

Press “OK” and repeat the actions from the beginning.
INSTALLATION AND UNINSTALLATION

Important! For smooth operation, it is recommended to perform product setting prior to installation works.

Product installation

Important! For tanks whose shape corresponds to Figure 2, installation should be carried out in accordance with Appendix E.

1) Place the gasket included into the product delivery set on the measuring part of the product (Figure 37). Some small amount of silicone sealant must be applied to both sides of rubber gasket before final fitting (Figure A):

![Figure A. Rubber gasket with applied silicone sealant](image)

After applying and before final fitting, 10–15 minutes wait time is required for the “surface skin” of silicone to form.

2) Install the product in the tank.

3) Fix the product to the tank by bolts, having preliminarily installed the washer and the spring washer as shown in Figures 22 and 23. The bolts should be tightened by a spanner.

![Figure 22](image)  ![Figure 23](image)

4) When the product is installed on plastic tanks with wall thickness over 3 mm, the product must be fixed by a self-tapper included with the delivery set. The self-tapper tightening strength should be such that the rubber washers put on the self-tapping screws are not crumpled or burst.

5) When installing products with the length of measuring part over 1.5 m in the fuel tanks of the vehicle (petrol tankers, diesel locomotives), it is necessary to ensure that there are no fuel wave shocks during sharp acceleration and breaking operations of the vehicle. For this purpose, it is recommended to install the products near wave suppressing partitions or in protective metal tubes with 50–100mm diameter welded to the bottom or top of the tank.

Important! It is forbidden to weld the tubes both to the bottom and to the top of the tank at a time. A gap should be provided between the edge of the tube and upper wall of the tank, because tanks of such a size may deform while being filled (Figure 24).

Important! It is a must to ensure access for the fuel and air at the edges of the tube leaving a gap or making perforation.
During installation, it is necessary to ensure that there is no contact between the product and the protective tube or internal partitions of the tank.

![Tank deformation](image)

**Figure 24**

**Installation of BIS 20240 (For LLS 20230)**

1) Fix BIS 20240 on selected surface by self-tapping screws or bolts according to installation dimensions (Figure 46, Appendix F)

2) 1. Make an electric connection of BIC 20240 body with the body of the vehicle or Ground bus terminal (with an earthed element of stationary fuel storage structure) by a copper wire of at least 4mm² cross-section.

2. **Important!** The electrical resistance of the conductor between the body of BIS 20240 and the body of the vehicle or Ground bus terminal should not exceed 0.1 Ω.

**SET-UP AND CONNECTION**

**Setting up products connected through interface EIA-485**

**Important!** In case that the data transmission speed is set over 19200 bit/sec and the length of connecting cables between the external device and the most distant product is over 30 m, it is necessary to install terminating resistors.

Installation of terminating resistors should be performed in accordance with the diagrams in Appendix F.

**Setting up while connecting one product to an external device**

1) If needed, change the data output mode to automatic data output by default (after the product is energised) in symbolic and binary form (Figure 10).

2) Set the data output interval (from 1–255 s) for periodic and automatic data output (Figure 10). The default value is 1 s.

3) Set the measurement range (from 1 to 4095: Figure 10). The default value is 1023. Set the measurement range offset value (from 0 to 1023: Figure 10).

The default value is 0. (An example of the offset and measurement range usage is given in Appendix I).

4) If needed, change the value of data exchange rate (Figure 10). The default value is 19200 bit/sec.

Possible rate values: 1200, 2400, 4800, 7200, 9600, 14400, 19200, 38400, 57600, 115200 bit/sec.

5) Press the button “Save parameters”.
Setting up while connecting several products to an external device

1) Connect the products to the PC one by one and perform the set-up.
2) Activate networking mode of the product in the main program window (Figure 10).
3) Set the network address of the product in the main program window (Figure 10). The network address must be different for every product. The range of network address values is from 1 to 254.
4) Set a value of data output interval (from 1 to 255 s) for periodic and automatic data output (Figure 10). The default value is 1 s.
5) Set a measurement range value (from 1 to 4095: Figure 10). The default value is 4095.
6) Set the measurement range offset value (from 0 to 1023: Figure 10). The default value is 0. (An example of the offset and measurement range usage is given in Appendix I).
7) If needed, change the value of data exchange rate (Figure 10). The default value is 19200 bit/sec. Possible rate values: 1200, 2400, 4800, 7200, 9600, 14400, 19200, 38400, 57600, 115200 bit/sec.
8) Press the button “Set Parameters”.

Setting up products connected through interface RS-232

Products connected through interface RS-232 are set up similar to one product connected through interface EIA-485.

REQUIREMENTS FOR LAYING CONNECTION CABLES

Recommendations for cable laying

1) For installation, use the cables produced by Omnicomm - either those included into the delivery set or those purchased separately.
2) To connect the fuel level sensor LLS 20230 with an external device, use the cable in a crinkled hose from the delivery set. The cable length is 7 m and, if necessary, it can be either extended or cut.
3) To connect the fuel level sensor LLS 20230 and stabiliton-based spark protection unit BIS 20240, use only cable KTZ-XX (where XX — the cable length determined at the time of purchase request).

Important! Use of self-made cables, as well as cutting or extending of the standard cables, is FORBIDDEN.

4) connect the stabiliton-based spark protection unit BIS 20240 and an external device, use a crinkled cable produced by Omnicomm (to be purchased separately). If needed, the cable connecting with the external device can be either extended or cut.
5) Ensure that cable laying routes are free of heated parts and units of the vehicle to avoid cable insulation fusing.
6) Ensure that cable laying routes are free of moving parts and units of the vehicle.
7) The purpose of socket outputs and wire colours of the cable connecting with an external device is shown in Figure 25.
Fuse installation

1) The fuse is intended to protect the on-board network of the vehicle against short circuit caused by a breakdown in product wiring.
2) Connect the fuse holder to the feeding cable of the product in the immediate vicinity of the power circuit of the vehicle.
3) Install the fuse into the fuse holder.
4) In case the fuel level sensor LLS 20230 is installed together with BIS 20240, the fuse is installed in the power circuit of BIS 20240.

FUEL TANK CALIBRATION

Fuel tank calibration is required to ensure that the numerical code produced by the product corresponds to the fuel volume in a given fuel tank.

Fuel tank calibration is the process of filling the empty tank with fuel until the tank is full with certain step of filling, and recording product readings in a calibration table.

If two products are installed in the fuel tank, it is necessary to produce a calibration table per product.

The filling step is selected by the user depending on the fuel tank shape — the more complex the shape, the fewer filling steps “n”. If needed, the filling step can be changed during the calibration process. Recommended filling steps depending on the fuel tank volume are given in Table 1.

<table>
<thead>
<tr>
<th>Volume of the tank V, litres</th>
<th>Filling step n, litres</th>
<th>Number of control points, ( m = \frac{V}{n} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–60</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>61–100</td>
<td>5</td>
<td>12–20</td>
</tr>
<tr>
<td>101–500</td>
<td>10</td>
<td>10–50</td>
</tr>
<tr>
<td>501–1000</td>
<td>20</td>
<td>20–50</td>
</tr>
<tr>
<td>Over 1000</td>
<td>As possible</td>
<td></td>
</tr>
</tbody>
</table>

Table 1

**Important!** To ensure precision of the readings, it is recommended to have at least 20 control points.

Fuel tank calibration when one product is installed

1) Empty the fuel tank
2) Connect the fuel level sensor to the PC according to Appendix D.
3) Start LLS Monitor application. The main program window will open (Figure 26). It will show the current settings of the connected product.
Open the tab “Sensor 1” (Figure 27).
4) Specify the initial volume of fuel in the tank in the first row of the column “Litres”. If you are using calibration tables in Dalcon, this value should be “0”.

5) Synchronise fuel level in the tank with the sensor readings by pressing “F4”.

6) Use a measuring container to fill the tank with a given step or use a fuel flow-meter. Fill out the table as follows:

   Specify the amount of litres that corresponds to filled volume in column “Litres”. You will obtain the value corresponding to the filled volume in the column “Sensor readings”.

   Record sensor readings corresponding to this filled volume by pressing the following buttons: “Down arrow”, “Enter” or “Tab”. As a result, a new line will be added to the table.

   After you enter three first values, the column “Litres” starts to be filled automatically in accordance with the selected filling step.

   To delete a line you entered, press «Del».

   Stop the synchronisation of fuel level in the tank with the sensor readings by pressing “F5”.

**Important!**
1) Relative level values must monotonically increase in the filling process.

2) Recurrent values of relative level are not recorded in the table.

To save the calibration table as an xml-file, press “F2”.

(Do not forget to fill in Vehicle ID and Registration number, otherwise saving will be impossible: see screenshot below).

![ Calibration table data are used for working with server applications. ](image)
Fuel tank calibration when two products are installed

**Important!** If two or more fuel level sensors LLS are used, their readings, converted into litres according to individual calibration tables, are summed.

**Calibration of a fuel tank with regular geometric shape**

Calibration of a fuel tank with a regular geometric shape means producing a calibration table for every product (Figure 29), as shown in Figure 30.

Figure 29, where \( n \) — filling step (litres), \( m \) — number of control points, \( mn \) — fuel tank volume (V, litres)

Calibration table for product “S1” Calibration table for product “S2”

<table>
<thead>
<tr>
<th>Control point number, ( i )</th>
<th>Filled fuel volume, litres</th>
<th>Calibration table column “Litres”, litres</th>
<th>Readings of Sensor 1 “LLS1”</th>
<th>Readings of Sensor 2 “LLS2”</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>( n )</td>
<td>0.5 ( n )</td>
<td>( 0.5 n )</td>
<td>( 0.5 n )</td>
</tr>
<tr>
<td>2</td>
<td>( 2n )</td>
<td>( n )</td>
<td>( n )</td>
<td>( n )</td>
</tr>
<tr>
<td>3</td>
<td>( 3n )</td>
<td>1.5 ( n )</td>
<td>( 1.5 n )</td>
<td>( 1.5 n )</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>( m )</td>
<td>( mn )</td>
<td>0.5 ( mn )</td>
<td>0.5 ( mn )</td>
<td>0.5 ( mn )</td>
</tr>
</tbody>
</table>

Figure 30, where \( n \) — filling step (litres), \( m \) — number of control points, \( mn \) — fuel tank volume (V, litres).

**Important!** If calibration tables are used in Dalcon or other device, sensor readings corresponding to a full tank volume (\( mn \)) should not exceed 1023.

1) Empty the fuel tank
2) Connect fuel level sensor “LLS1” to the PC in accordance with Appendix D.
3) Start LLS Monitor application. The main program window will open (Figure 31). It will show the current settings of the connected product “LLS1”.
Add calibration table template for the second product. Press “F7”. You will see the following window (Figure 32) with calibration table templates for both products in the tabs “Sensor 1” and “Sensor 2”.
4) Synchronise the fuel volume in the tank with the sensor readings by pressing “F4”.

5) Open the tab “Sensor 1” (Figure 27).

6) Specify the values corresponding to the figure (Figure 27) in the column “Litres”.

7) Pour the fuel volume corresponding to the first control point (Figure 30). You will see product “LLS1” readings corresponding to this fuel volume in the column “Sensor readings”.

8) Stop the synchronisation of fuel level in the tank with the sensor readings by pressing “F5”.

9) Save the readings by pressing “F2”.

10) Disconnect product “LLS1” from the PC.

11) Connect product “LLS2” to the PC in accordance with Appendix D.

12) Start synchronisation of fuel volume in the tank with the sensor readings by pressing “F4”.

13) Open the tab “Sensor 2” (Figure 32). Specify the fuel volume corresponding to the first control point (Figure 27) in the column “Litres”. You will see product “LLS1” readings corresponding to this fuel volume in the column “Sensor readings”.

14) Save the readings by pressing “F2”.

15) Disconnect product “LLS2”.

16) Stop the synchronisation of fuel level in the tank with the sensor readings by pressing “F5”.

17) Repeat steps 1)-16) for each control point of the calibration table.

**Calibration of a fuel tank with irregular geometric shape**

Calibration of a fuel tank with an irregular geometric shape is performed in three stages depending on the zones (Figure 33), and means producing a calibration table for every product.

![Diagram of fuel tank with irregular geometry](image)

Figure 33, where \( n \) — filling step (litres), \( m \) — number of control points, \( mn \) — fuel tank volume (V, litres).
<table>
<thead>
<tr>
<th>Number of control point, i</th>
<th>Filled fuel volume $V_i$, litres</th>
<th>Calibration table column “Litres” $L_i$, litres</th>
<th>Readings of Sensor 1 “LLS1”</th>
<th>Calibration table column “Litres” $L_i$, litres</th>
<th>Readings of Sensor 2 “LLS2”</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
<td>Zone 1</td>
<td></td>
<td>Zone 1</td>
</tr>
<tr>
<td>1</td>
<td>$n$</td>
<td></td>
<td>Zone 2</td>
<td></td>
<td>Zone 2</td>
</tr>
<tr>
<td>2</td>
<td>$2n$</td>
<td></td>
<td>Zone 2</td>
<td></td>
<td>Zone 2</td>
</tr>
<tr>
<td>3</td>
<td>$3n$</td>
<td></td>
<td>Zone 2</td>
<td></td>
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<td>Zone 2</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td></td>
<td>Zone 3</td>
<td></td>
<td>Zone 3</td>
</tr>
<tr>
<td>$m$</td>
<td>$mn$</td>
<td></td>
<td>Zone 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 34, where $n$ — filling step (litres), $m$ — number of control points, $mn$ — fuel tank volume ($V$, litres).

**Important!** If you use the calibration tables in Dalcon, the sensor readings corresponding to a full tank volume ($mn$) should not exceed 1023.

Tank calibration in zone 1 should be carried out only for product “LLS2” similar to calibration of the tank with one installed product. The column “Litres” of the calibration table should be filled in similarly.

Making the transition from zone 1 to zone 2 for every control point, it is necessary to connect not only product “LLS2” but product “LLS1” as well and, when the value “0” of product “LLS1” changes, record the obtained value in the column “Sensor readings” of the calibration table of product “LLS1”. In this case the values of the column “Litres” are filled in the following way — previous value of the column “Litres” is summed up with half-value of the filling step.

Tank calibration in zone 2 should be performed for two products similar to the calibration of the tank with a regular geometric shape with two installed products excluding the process of filling the columns “Litres” in the product calibration tables. In this case the values of the column “Litres” of the calibration table are filled in the same way as during the transition from zone 1 to zone 2 (see above).

During the transition from zone 2 to zone 3 calibration table filling for product “LLS2” stops, as soon as its readings stop changing. In this case the column “Litres” of the calibration table in zone 1 is filled in.

Tank calibration in zone 3 is performed for product “LLS1” only, similar to calibration of the tank with one installed product. The values of the column “Litres” of the calibration table in zone 1 are filled in.
COMMISSIONING OF INSTALLED AND CONNECTED EQUIPMENT

Sealing

Installation of a protective seal on the product

**Important!** Installation of the seal is intended only for the products fixed with bolts.

1) Overlap the holes of the inner ratchet with external holes of the seal.
2) Pass the sealing wire through the holes in two bolts, wrap the wire around the metal hose as shown in Figure 35, and pass the ends of the wire through the holes of the seal.
3) Spin the wire by rotating the handle of the ratchet clockwise to achieve complete tension.
4) Break off the ratchet handle.

![Figure 35](image)

Installation of protective seals on the connectors

For fuel level sensor LLS 20230 — install a protective seal on the connector (Figure 36). For fuel level sensor LLS 20230 - install protective seals on both connectors of BIS 20240, similar to the protective seal installation for fuel level sensor LLS 20230.
1) Pass the sealing wire through the holes of the product connectors and the female connector so that the wire runs from different ends of the connectors (Figure 36).

2) Pass the ends of the wire through the holes of the seal.

3) Spin the wire to achieve complete tension and break off the handle of the ratchet.

List of commissioning documents and document processing procedure

1) Once the product is sealed, an Installation Certificate is produced. The Certificate should contain the following information:
   — Name of the company for which the product was installed;
   — Name of the company that performed the installation;
   — Installation date;
   — List of performed works;
   — Vehicle make;
   — State number of the vehicle;
   — Installation object failures;
   — Serial number of the product(s);
   — Seal numbers;
   — Full name(s) and signatures of the person who performed the installation and the person who accepted the work.
APPENDIX A

TERMS AND DEFINITIONS

Working length of the product — length L shown in Figure 37.

Scale — virtual component of the product representing a ranked row of marks corresponding to a sequential row of magnitudes of physical quantities along with associated numbering.

Product measurement range (M) — number of product measurement intervals belonging to the range 0–4095. \( M = \frac{L}{d} \), where \( L \) — working length of the product (mm), \( d \) — scale factor (mm).

Offset (OFFSET) — offset of the reference point of the measurement range. \( OFFSET = \frac{l}{d} \), \( l \) — offset value (mm), \( d \) — scale factor (mm).

Figure 37
APPENDIX B

LIST OF REQUIRED EQUIPMENT AND TOOLS

<table>
<thead>
<tr>
<th>No</th>
<th>Equipment Item</th>
<th>Quantity</th>
<th>IM Section</th>
<th>Notes</th>
</tr>
</thead>
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<tr>
<td></td>
<td><strong>Tools:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Bimetal crown ø35 mm</td>
<td>1</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Shank for the crown</td>
<td>1</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Metal drill ø7 mm or ø4 mm</td>
<td>1</td>
<td>3.4</td>
<td>ø7 mm for rivets, ø4 mm for bolts</td>
</tr>
<tr>
<td>4</td>
<td>Measuring bar</td>
<td>1</td>
<td>3.5</td>
<td>Length not less than the length of the tank</td>
</tr>
<tr>
<td>5</td>
<td>Hacksaw</td>
<td>1</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Wrench, 8 mm</td>
<td>1</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Riveter</td>
<td>1</td>
<td>3.5</td>
<td>To install on rivets</td>
</tr>
<tr>
<td>8</td>
<td>Screw tap M5 with a holder</td>
<td>1</td>
<td>3.5</td>
<td>To install on bolts</td>
</tr>
<tr>
<td></td>
<td><strong>Accessories:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Protective seal</td>
<td>2</td>
<td>7.1</td>
<td>+1 item for BIS 20240</td>
</tr>
<tr>
<td>10</td>
<td>Sealing wire ø0.7 mm</td>
<td>under 0.8 m</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Personal Computer IBM, compatible with OS Windows XP</td>
<td>1</td>
<td>3.6</td>
<td>Produced by Omnicomm</td>
</tr>
<tr>
<td>12</td>
<td>LLS Monitor application</td>
<td>1</td>
<td>3.6</td>
<td>Produced by Omnicomm</td>
</tr>
<tr>
<td>13</td>
<td>Universal Setting Device (UNU) along with a set of wires</td>
<td>1</td>
<td>3.6</td>
<td>Supplied together with UNU</td>
</tr>
<tr>
<td>14</td>
<td>D.C. Power supply unit: 10–15 V, 0.5 A</td>
<td>1</td>
<td>3.6</td>
<td>Produced by Omnicomm</td>
</tr>
<tr>
<td>15</td>
<td>Measuring container</td>
<td>1</td>
<td>3.6</td>
<td>Length ≥L1</td>
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<td>16</td>
<td>Fuel</td>
<td></td>
<td>3.6, 6</td>
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<td>17</td>
<td>Container for calibration</td>
<td>1</td>
<td>6</td>
<td>See Section 6 for recommended volume</td>
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<td>18</td>
<td>Silicone sealant for external works</td>
<td>100 g</td>
<td>App. E</td>
<td>For sensor fitting</td>
</tr>
</tbody>
</table>

Table 1
APPENDIX C

INSTALLATION INSTRUCTION FOR A SCREW-TYPE RIVET

Screw the rivet into the shaft of the nut riveter (Figure 38). The rivet should be screwed to the full depth.

Install the rivet in the hole (Figure 39) so that it is strictly perpendicular to the plate of the sensor and the wall of the tank and any skewing is avoided.

Important! Make sure there is no gap between the plate of the fuel level sensor LLS and the rivet.
Unscrew the nut riveter shaft out of the rivet (Figure 41).

Checks rivet installation quality. To do so, take the bolt included in the installation elements kit and drive a test bolt. If the bolt is tight to drive or cannot be driven to the maximum depth, it is necessary to drill the rivet out and install a new one.
APPENDIX D

DIAGRAM OF PRODUCT CONNECTION WITH PC

Figure 42

a) Connector of LLS 20230

b) Connectors of BIS 20240: Connector for an external device and connector for the product, respectively.

Figure 43 a) LLS 20230 b) BIS 20240
APPENDIX E

PROCEDURE FOR CIRCULAR TANK PREPARATION FOR PRODUCT INSTALLATION

Mark the holes for mounting the product taking into account the tank curvature. Place the bolt into the hole for product mounting so that the bolt is perpendicular to the surface of the tank (Figure 44).

Drill holes in accordance with the selected type of the tank and method of fixing the product to the tank.

Apply a thin layer of sealant between the plate of the product body and the rubber gasket. Place the gasket on the product. Apply hermetic to the prepared tank as shown in Figure 45. The thickness of sealant layer should be at least 5 mm.

Important! Visually check the leak tightness of the connection. If there are gaps between the gasket and the tank, fill them out with sealant.
APPENDIX F

INSTALLATION DIMENSIONS OF BIS 20240

Figure 46
APPENDIX G

DIAGRAM OF LLS 20230 CONNECTION WITH AN EXTERNAL DEVICE

Figure 47 Diagram of sensor connection to an external device through interface EIA-485

**Note.** The numbering of connector X1 contacts is given schematically.

Figure 48 Diagram of sensor connection to an external device through interface RS-232

**Note.** The numbering of connector X1 contacts is given schematically.
Figure 49 Diagram of connection of several sensors to an external device through interface EIA-485.

Note. The numbering of connector X1 contacts is given schematically.

The number of products connected to one external device in this diagram is 2–4.
APPENDIX H
CONNECTION DIAGRAMS WITH INSTALLED TERMINATING RESISTORS

Note. The numbering of connector X1 contacts is given schematically.

Terminating resistors must be installed as close to the connectors of the external device and the product as possible.

The external device may include a terminating resistor. In such cases, it is not required to install a terminating resistor from the external device side. The presence of a terminating resistor in the external device is determined on the basis of the external device documentation.
Figure 51

Note.
The numbering of connector X1 contacts is given schematically.
The number of products connected to one external device in this diagram is 2–31.
The external device may include a terminating resistor. In such cases, it is not required to install a terminating resistor from the external device side. The presence of a terminating resistor in the external device is determined on the basis of the external device documentation.
APPENDIX I

AN EXAMPLE OF SETTING OFFSET VALUES AND MEASUREMENT RANGE

Initial data:
Fuel tank with an installed product (Figure 52)
Tank depth — 700 mm
Working length of the sensor — 680 mm
It is required to set the product in such a way that the fuel level is measured in millimetres with the scale factor of 0.5 mm.

Solution:
Set measurement range value — 1360,
Offset value — 40,
Therefore, the level value is reduced to millimetres with the scale factor of 0.5 mm.
APPENDIX J

ADVICE ON ASSEMBLY OF FUEL LEVEL SENSORS LLS 20230 WITH LENGTH 3–6 METRES

Determine the necessary length of the fuel level sensor LLS 20230 and cut off the sensor extension part. **Attention!** The sensor extension part should be cut off only from the side without a thread.

Place the fuel level sensor LLS 20230 and the sensor extension part, as shown in Figure 53. Measure 50 mm from the end of each part and make marks.

![Figure 53](image)

Put the nut, the ring, and the coupling on the fuel level sensor LLS 20230; put the nut and the ring on the sensor extension part (Figure 54).

![Figure 54](image)

Shift the nut, the ring, and the coupling according to the fuel level sensor LLS in a way to provide obstacle-free access to the thread of the extension part of the fuel level sensor LLS. Match and tighten the central pivots (Figure 55). The gap between the tubes should not exceed 10 mm.

![Figure 55](image)

Set the rings and the coupling according to the marks. Consecutively tighten the nuts by a nut wrench of size 32, holding the coupling.
Make sure that there is no backlash or rotation between the tubes of the sensor.

Attention! It is prohibited to carry the fuel level sensor LLS by holding it by the sensor extension part (Figure 58).

**REVISION HISTORY**

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<thead>
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<th>Date</th>
<th>Version</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
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<td>1.16</td>
<td>Initial Release</td>
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