Dinel®

INSTRUCTION MANUAL

ULTRASONIC LEVEL METERS ULM – 70

Firmware: v.2.0

TABLE OF CONTENTS

SAFETY

> ⚠️ All operations described in this instruction manual have to be carried out only by trained personnel or an accredited person. Warranty and post warranty service must be exclusively carried out by the manufacturer.
>
> Improper use, installation or set-up of the level meter can result in crashes in the application (overfilling of the tank or damage of system components).
>
> The manufacturer is not responsible for improper use, losses of work caused by either direct or indirect damage, and for expenses incurred during installation or use of the level meter.

1. MEASURING PRINCIPLE

Ultrasonic level meter ULM® is a compact measuring device consisting of two parts - main level meter (the body with measuring electronics) and display module. Using the electroacoustic converter, the level meters transmit the sequence of ultrasonic pulses that spread towards the surface level. The converter recuperates reflected acoustic waves that are subsequently processed in the electronic module. The intelligent evaluation block filters out interfering signals, compares the cleaned received signal with the false reflection map (e.g. from mixers, ladders, reinforcement etc.) and selects a suitable reflection (echo). Based on the period during which the individual pulses spread towards the surface level and back and based on the measured temperature in the tank, the instant distance to the surface level is calculated. According to the level height, the level meter output is set and the measured value is displayed on the display.
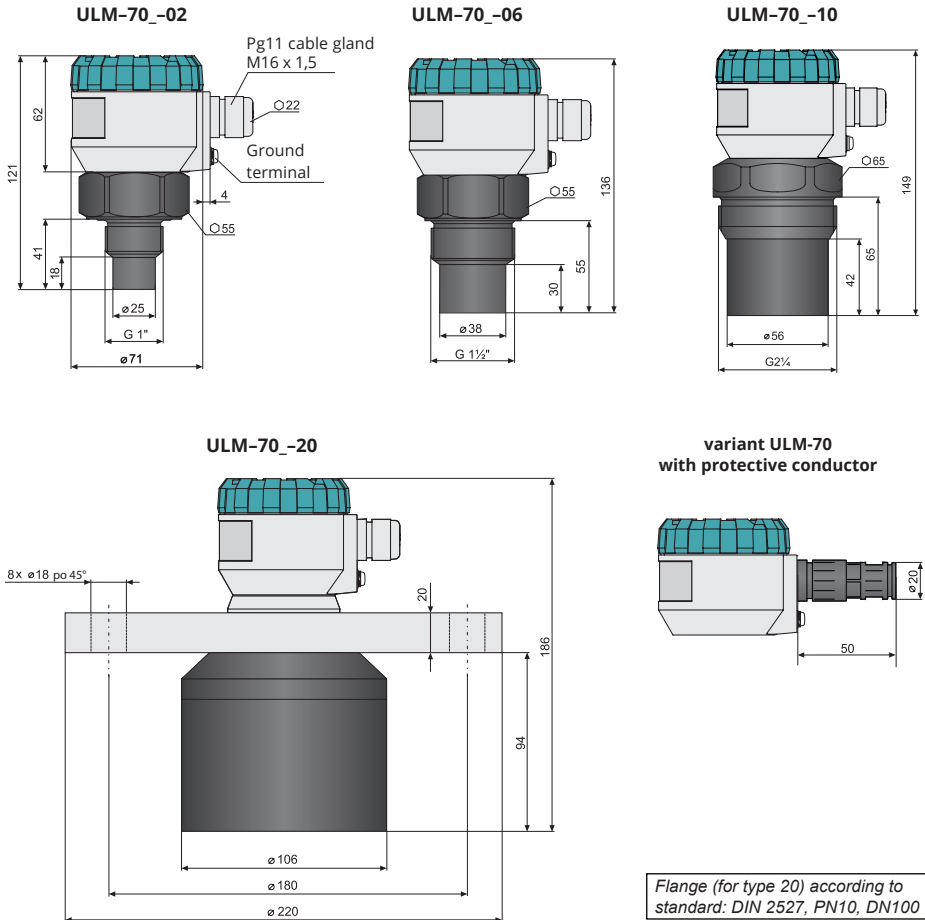
2. RANGE OF APPLICATIONS

For continuous non-contact level measurement of liquids (water solutions, sewerage water, etc.), mash and paste materials (sediments, sticks, resins etc.) in closed or open vessels, sumps, reservoirs and open channels. In case the level of bulk-solid materials is measured, the measurement range is reduced. The level meters can continuously measure levels of bulk-solid materials with a low concentration of dust particles. Consult the manufacturer on recommended use of the level meter for bulk-solid materials.

3. VARIANTS OF SENSORS

ULM–70_–02	**Measuring range from 0.15m to 2m,** plastic PVDF transmitter, mechanical connection with thread G 1".
ULM–70_–06	**Measuring range from 0.25m to 6m,** plastic PVDF transmitter, mechanical connection with thread G 1 ½".
ULM–70_–10	**Measuring range from 0.4m to 10m,** plastic PVDF transmitter, mechanical connection with thread G 2 ¼".
ULM–70_–20	**Measuring range from 0.5m to 20m,** plastic PVDF transmitter, mechanical connection with aluminium alloy flange.

4. Dimensional drawings

ULM–70_–02

Pg11 cable gland
M16 x 1,5

⌀22

Ground
terminal

121
62
41
18
4
⌀55
⌀55
⌀25
G 1"
⌀71

ULM–70_–06

136
55
30
⌀55
⌀38
G 1½"

ULM–70_–10

149
65
42
⌀65
⌀56
G2¼

ULM–70_–20

8x ⌀18 po 45°

20
186
94
⌀106
⌀180
⌀220

**variant ULM-70
with protective conductor**

⌀20
50

*Flange (for type 20) according to
standard: DIN 2527, PN10, DN100*

5. Installation and putting into operation

This procedure includes the following three steps.

• **INSTALLATION**

• **ELECTRIC CONNECTION**

• **SETTING**

6. Installation instructions

- Install the level meter in the **vertical position** into the upper lid of the tank or reservoir using a welding flange, a fastening nut or a flange so that the level meter axis can be perpendicular to the surface level of the measured liquid (Fig. 1).

- The min. **dimensional parameters** to install the level meter into a lid or a ceiling of a tank are given in Fig. 3.

- When installing in an **open channel** (reservoir, drain etc.), install the level meter onto a bracket as close as possible to the expected max. level.

- The reference plane for the measurement is the lower edge of the transducer (Fig.2). In connection with the measurement principle, no signals **reflected** in the area immediately under the level meter can be evaluated. **The zone** (Fig. 2) determines the min. distance possible between the level meter and the highest surface level. The min. distances to the medium are given in the chapter "Specifications".

- It is necessary to install the level meter so that the bin level cannot **interfere** with the dead zone when filled up to the maximum. If the measured level interferes with the dead zone, the level meter will not work properly.
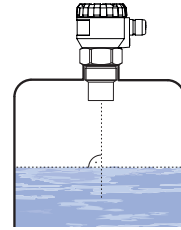

Fig. 1: Recommended installation in the tank

ULM–70– 02 ; 10	d > 1/12 c (min. 200 mm)
ULM–70–06	d > 1/8 c (min. 200 mm)
ULM–70–20	d > 1/10 c (min. 200 mm)

m – Dead zone (blind zone, blocking distance)

reference plane for the measurement

Fig. 2: Level meter dead zone

d – Distance from the tank wall

c – Maximum reach of the level meter
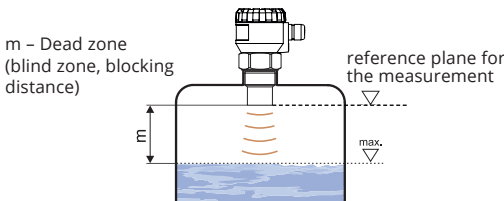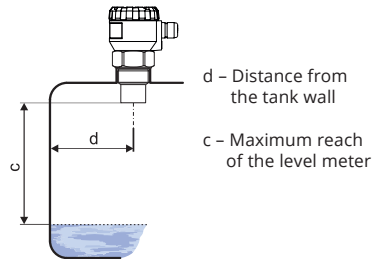

Fig. 3: Installation distance from the tank wall

- If the maximum surface level in the tank interferes with the dead zone, the level meter has to be mounted into a higher **installation neck**. In this way, the tank can be filled nearly up to the maximum volume. The inner neck surface has to be even and smooth (without edges and welded joints); the inner edge should be rounded where the ultrasonic wave leaves the pipe. The neck diameter should be as large as possible but the neck height should be as low as possible. Recommended dimensions of the input neck are given in Fig. 4.

a – Neck height
b – Neck width
m – Dead zone (blind zone, blocking dist.)

ULM–70– 02 ; 06	a < 3 b b > 100 mm
ULM–70–10	a < 1,5 b b > 100 mm
ULM–70–20	a < 1,5 b b > 150 mm

Fig. 4: Possible installation of the installation neck

ULM–70   © Dinel, s.r.o.

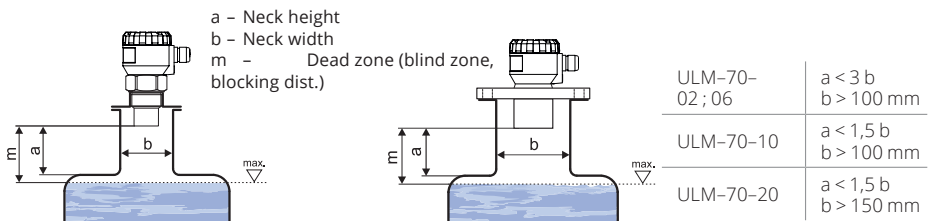- If the emitted acoustic signal of the level meter is affected by near objects (roughness on walls of the tank, various partitions, mixers etc.), it is necessary to map false reflections by activating the mode "TEACHING". In case of installed mixers, it is necessary to put the mixers to position under the level meter (direct the mixer paddle to the ultrasonic signal beam) (Fig. 5 and 6).
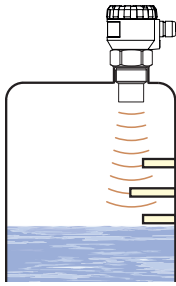
Fig. 5: False echo from obstacles in the tank   *Fig. 6: False echo from the mixer paddle*
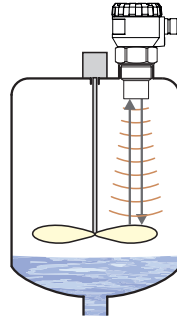
- Do not install the level meter in or above the **filling** point (Fig. 7).
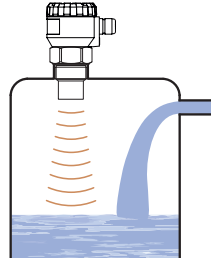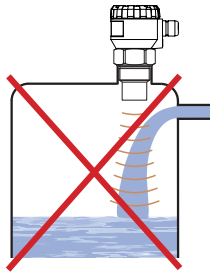
Fig. 7: Level meter installation outside the influence of filling

- In case the level of bulk solids is measured, the measurement range is reduced Due to absorption of acoustic waves by a bulk medium, shortening of the measuring range occurs by up to 50% depending on the grain size. We therefore recommend selecting a level meter with greater range than the maximum range of measuring the medium. It is also appropriate to use a directional horn (see image 8), which reduces the shortening of the measuring range, because it better concentrates acoustic energy while preserving the same beam angle, and improves the sensitivity when receiving the reflected echo. We recommend to consult the use with the manufacturer.

horn adapter
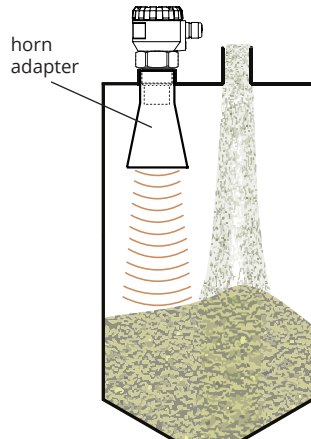
Fig. 8: Level meter installation in silo or hopper

- During filling, mixing and other processes, **foam** can arise on the surface level of the measured liquid. The foam considerably absorbs the ultrasonic signal which might cause malfunction of the level meter (Fig. 9). For such cases, it is necessary to set up "SENSITIVITY" mode to "*high*" or contact the manufacturer if need. In case of a thin layer of foam, it is also possible to use the directional horn for improving receipt of the reflected echo.
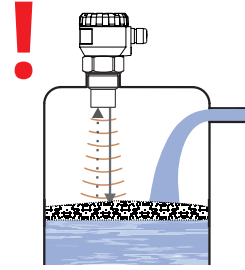
Fig. 9: Foam on the surface

- Scattering or attenuation of the ultrasonic signal can result if the surface level has been **moderately stirred** or **rippled** (by a mixer, coming liquid etc.). It can result in reduction of the measurement range or unreliable function of the level meter (Fig. 10).

- Rotating **mixer blades** can cause that the surface is stirred, which results in false reflections of the ultrasonic signal from the surface level and unreliable operation of the level meter (Fig. 13).(obr. 11). **For a rippled or swirling level, you can use the directional horn to eliminate scattering of the ultrasonic signal.**
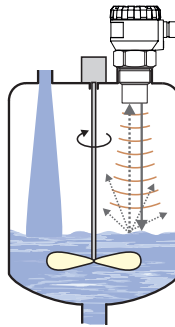
Fig. 10: Moderately stirred surface
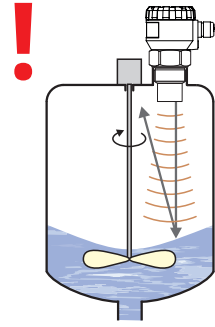
Fig. 11: Intensely stirred surface

- If the level sensor is mounted to bottlenecks and places with barriers, or near uneven walls or the filling area, where the transmission signal could be distorted, we recommend using a guide tube (acoustic horn). The tube must be made from a single material with a smooth inner surface (see image 12a, 12b). The minimum tube diameter must have the dimension "b" according to image 4 on page 5. After installing, you must perform the procedure "LEARNING". We recommend consulting with the manufacture on the construction of the guide tube.

ventilation holes

sleeves for mounting

45°
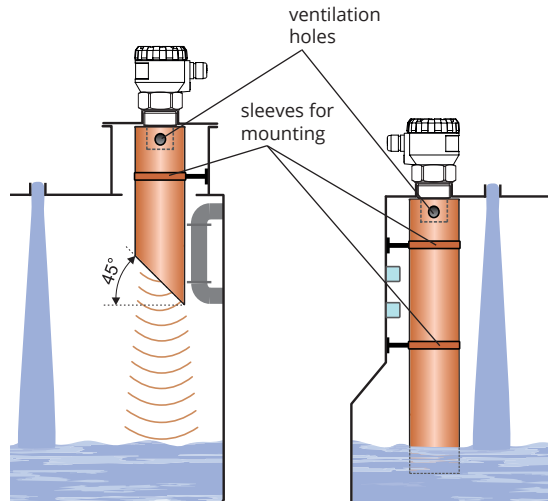
Fig. 12a: Short guide tube installation

Fig. 12b: Total guide tube installation

- The level meter must not be installed in places with direct **solar radiation** and must be protected against weather effects.
- If the installation in places with direct solar radiation is in-evitable, it is necessary to mount a **shielding cover** above the level meter(Fig. 13).
- It is suitable to run the cable under a cable bushing (obliquely down in slack) according to Fig. 14 to prevent **penetration of humidity**. Then the rain and condensing water can flow off freely.
- The cable bushing and connector have to be **sufficiently tightened** to prevent penetration of humidity.
- To lower the minimum distance to the measured medium, **a reflection board** made from solid, even and smooth material can be installed to the level meter. Then the tank can be filled nearly up to the maximum height. The solu-tion is suitable for open tanks and reservoirs (Fig. 15).
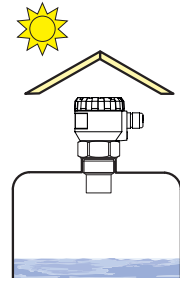
Fig. 13: Solar radiation shielding cover
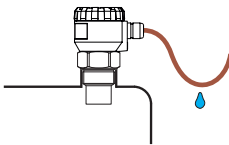
Fig. 14: Prevention to avoid intrusion of humidity
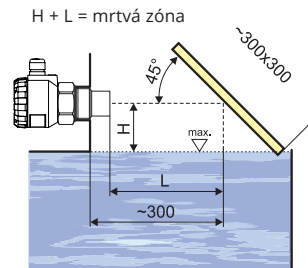
Fig. 15: Reflection board

7. ELECTRICAL CONNECTION

The level meter is connected to consequential (evaluating) device with a suitable cable with the outer diameter of 6 to 8 mm using screw terminals located under the display module. The recommended cross section of cores for the current version 2 x 0,5 ÷ 0,75 mm^2 and for the version with Modbus communication 2 x 2 x 0,25 mm^2 (twisted pair, shielded). Plus pole (+U) is connected to the terminal (+), minus pole (0 V) to the terminal (-) and the shielding (only for shielded cables) to the terminal (⏚). Communication wires A and B of the line RS-485 (for version "M" - Modbus) are connected to the terminals A and B.

Procedure to connect the cable to the level meter:

1. Unscrew the nut of the upper transparent lid.
2. Take the upper edge of the display module and take it out carefully by mild swinging up.
3. If you cannot grasp the module, you can use a small screwdriver. Insert it as far as the seam and use from several sides to slightly lift the module.
4. Release the cable outlet and thread the stripped supply cable in.
5. Connect the cable to the screw terminals according to the diagram in Fig. 17 or 18. Firmly tighten the terminals and the cable outlet.
6. If the level meter with Modbus is involved as a terminal for RS-485, we recommend (to avoid reflections on the line) to connect 120Ω termination resistor. This is done by moving a small lever of the switch marked 120Ω to the ON position. On the level meters connected to the line RS-485 as an intermediate device, the termination resistors are not connected (switch remains off).
7. Insert the display module back into the head so that the connector is properly connected.
8. Slide silicone seal on the thread of the level meter body, then tighten the nut of the upper lid. Connect the cable to consequential device.
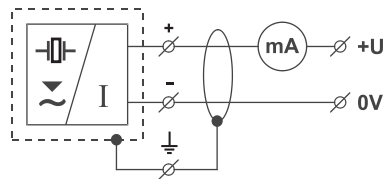
Fig. 16: Wiring diagram of the level meter with current output ULM-70 _-_- I
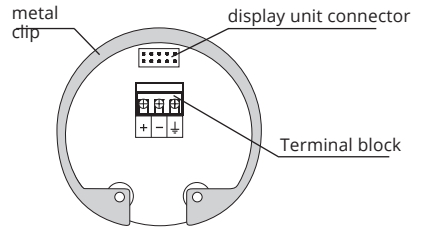
Fig. 17: Inside view of screw terminals of the level meter with current output ULM-70_-_-I
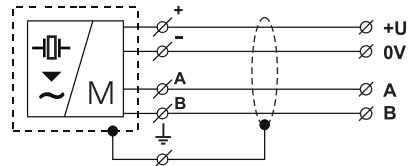
Fig. 18: Wiring diagram of the level meter with Modbus ULM-70_-_-M
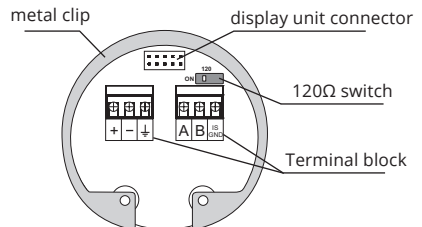
Fig. 19: Inside view of screw terminals of the level meter with Modbus ULM-70_-_-M

⚠ Electrical connection must be done in de-energized state!

With regard to possible occurrence of electrostatic charge on non-conductive parts of the level meter, all level meters for explosive spaces (ULM–70Xi type) must be grounded. It will be done using a screw placed on the head of the level meter under the cable outlet.

It is also necessary to design and take measures to reduce the effects of static electricity to a safe level in the wiring.

Installation in explosive atmospheres needs to be carried out in compliance with CSN EN 60079-14 (Electrical installations for explosive gaseous atmospheres – Part 14: Electrical installations in dangerous areas other than mining) and possibly also in compliance with other standards relating to the area concerned.

The supply voltage source should be preferably realized as a stabilized power supply unit with safe voltage from 18 to 36 V DC (18 ÷ 30 V DC for Xi version), which can be a part of the evaluation or display device.

In case of strong electromagnetic interferences (EMI), parallel cable ducting with power lines, or when cable length exceeds 30 m we recommended to use shielded cable.

8. EXAMPLES OF ULM-70 CONNECTION

8.1. WIRING DIAGRAM OF THE LEVEL METER WITH CURRENT OUTPUT AND PDU UNIT
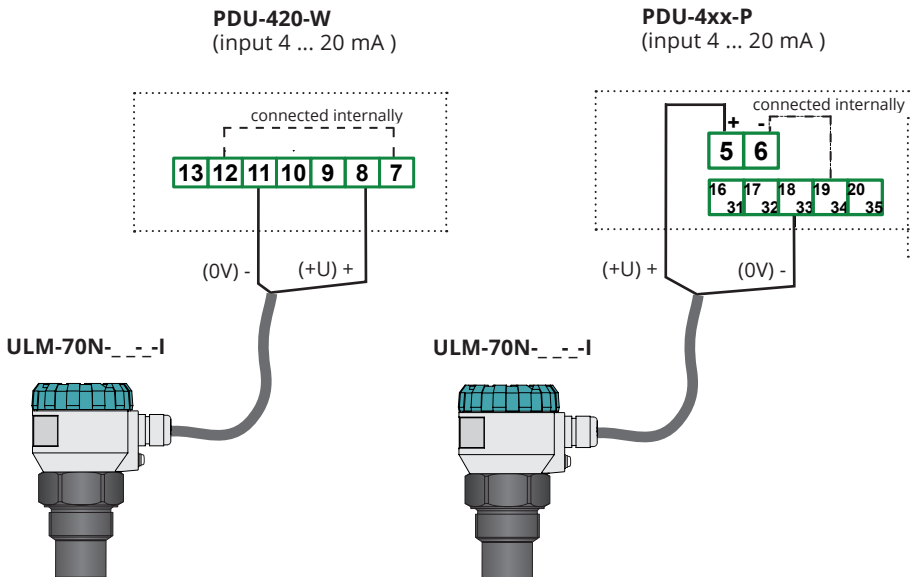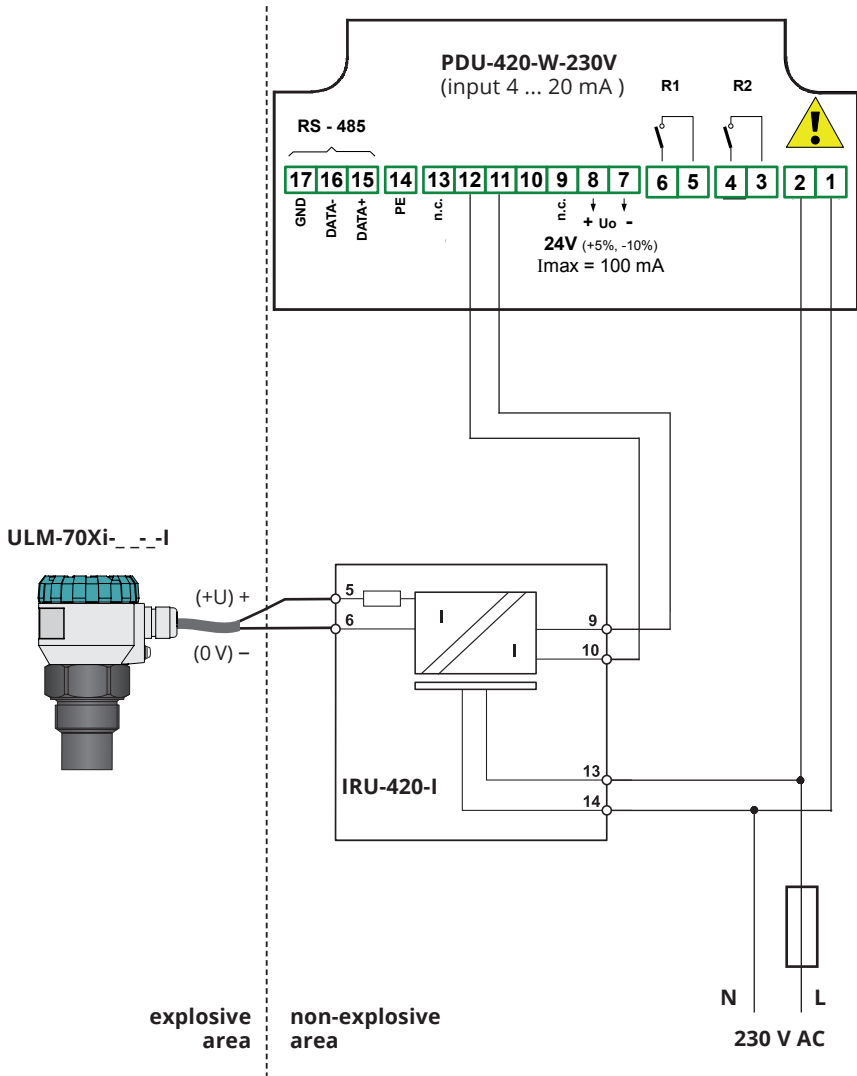
PDU-420-W
(input 4 ... 20 mA)

connected internally

| 13 | 12 | 11 | 10 | 9 | 8 | 7 |

(0V) -   (+U) +

ULM-70N-_ _-_-I

PDU-4xx-P
(input 4 ... 20 mA)

connected internally

+   -

| 5 | 6 |

| 16 | 17 | 18 | 19 | 20 |
| 31 | 32 | 33 | 34 | 35 |

(+U) +   (0V) -

ULM-70N-_ _-_-I

Connection of PDU-420-W is valid for firmware version 6.00 or higher. The older versions (up to version 5.99), the level meter output +U is connected to the terminal 7 and the output 0V to the terminal 10.

Connection of PDU-420-W is valid for firmware version 6.00 or higher. The older versions (up to version 5.99), the terminal 9 of the IRU unit is connected to the terminal 10 of the PDU unit and the terminal 10 of the IRU unit is connected to the terminal 11 of the PDU unit.

PDU-4xx-P-230V
(input 4 ... 20 mA)

R4

24V (+5%, -10%) **RS - 485**

Imax = 100mA **GND** **DATA+**

+ Uo − **DATA-**

| 1 | 2 | | 3 | 4 | | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 31 | 17 32 | 18 33 | 19 34 | 20 35 |

R1   R2   R3

ULM-70Xi-_ _-_-I

(+U) +

(0 V) −

5

6

I

I

9

10

IRU-420-I

13

14
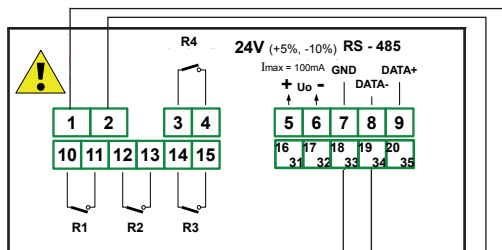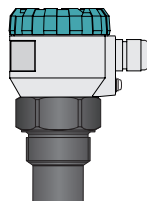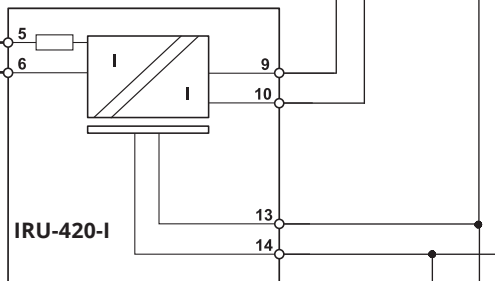
N   L

230 V AC

explosive area   **non-explosive area**

8.3. WIRING DIAGRAM OF THE LEVEL METER WITH CURRENT OUTPUT AND MGU UNIT

ULM-70N-_ _-_-I

(+U) +

(0 V) -

| 3 | GND |
| 4 | |

+24 V DC ±5%
Imax=200 mA

MGU-800
(with module IUI4)

101	A1
102	A2
103	A3
104	A4
105	GND

4x 0...20 mA

106	A5
107	A6
108	A7
109	A8
110	GND

4x 0...20 mA
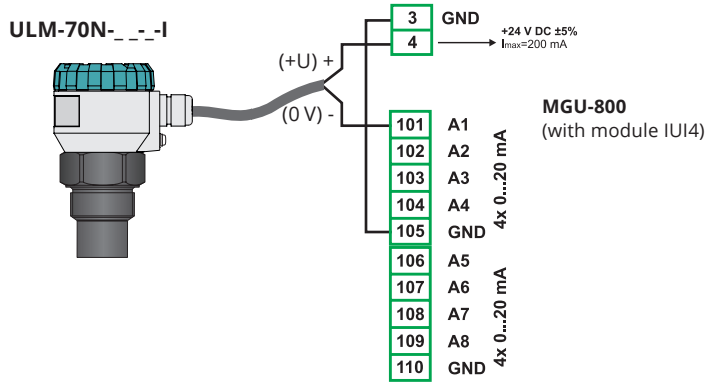
8.4. WIRING DIAGRAM OF THE LEVEL METER WITH MODBUS / RS485 AND MGU UNIT

MGU-800
(without additional modules)

ULM-70N-_ _-_-M

(0V) WH
(+U) BN

Cab.Sh.

(B) GN
(A) YE

3	GND
4	
5	
6	GND-I
7	B-
8	A+

+24 V DC ±5%
Imax=200 mA

digital input
0/15...24 V DC
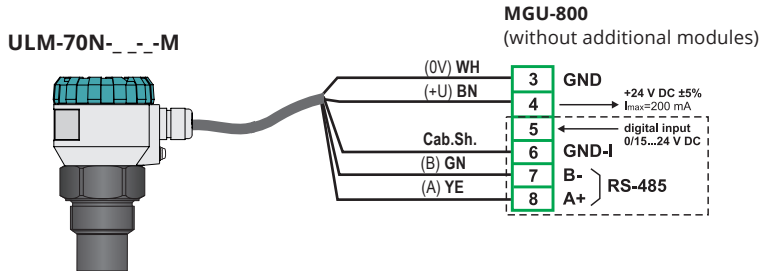
RS-485

8.5. WIRING DIAGRAM OF THE LEVEL METER WITH MODBUS / RS485 AND PDU UNIT

RS 485 - Master

| S | A | B |
| 12 | 13 | 14 |

+24V DC
Imax=120 mA

| + | – |
| 18 | 19 |

Cab.Sh.

(A) YE

(B) GN

(+U) BN

(0V) WH

ULM-70N-_ _-_-M

9. Set-up elements

Cable gland

Upper lid nut

Control buttons

OLED display

Label

Ultrasonic transmitter
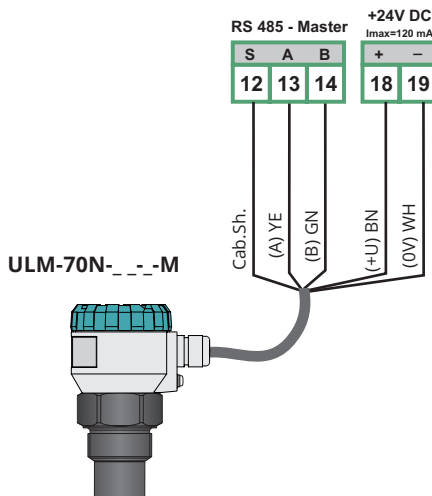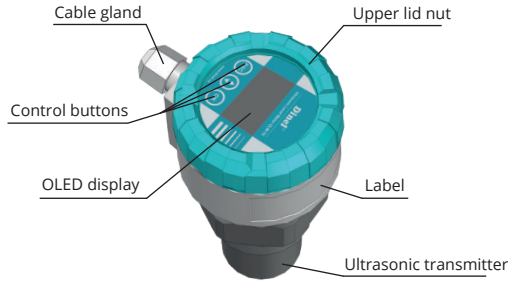
Fig. 20: Full view of the level meter

Button OK

- Set-up mode access
- Confirmation of selected item in the menu
- Move the cursor in the line
- Saving of set-up data

Button ↕

- Move in the menu
- Change of values

Button ESC

- Cancelling of carried out changes
- Shift one level up

Display of measured values

Set-up elements

Teaching mode activation

Echo receiving

Level meter locked

Units
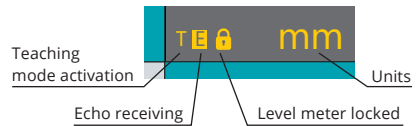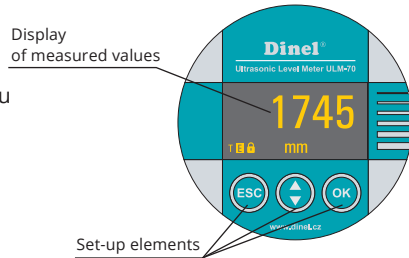
10. Status signalization

display	function
"NO ECHO"	Lighting intermittently – the level meter is not able to receive echo for a long time. Incorrect installation of the level meter
"DEAD ZONE"	Lighting intermittently – the measured level is in the "dead zone" of the level meter or the ultrasonic converter is dirty.
"NO PASSWORD"	It will appear in the item "MENU" – the level meter is protected using a password against unauthorised setting. Enter the correct password (see p. 19).
Symbol "T" [1]	Lighting permanently – "TEACHING" mode activation.
Symbol "E" [1]	Lighting intermittently – correct echo receiving (of the reflected signal) from the measured surface level.
Symbol 🔒 [1]	Lighting permanently – level meter is locked against unauthorized settings by a password. You must enter the correct password to unlock it (see page 19).

[1] symbol appears in the lower left corner of the display

11. OPERATION AND SETTING

Set the level meter using 3 buttons placed on the display module (see Chapter Set-up elements). After 5 min. of inactivity, the level meter automatically returns back to the measurement mode. If the password is active, the level meter will be also locked. The values that have not been confirmed using the button (OK) will not be saved! After the meter is locked, you cannot change the setting! When you attempt to edit, the words "NO PASSWORD" will appear on the display. How to unlock the level meter is given on page 16.

After connection of the supply voltage to the level meter the display shows the logo "Dinel" and the text "Starting" (approx. 15 s). Then, the level meter goes to the measuring mode and the display shows the current measured value.
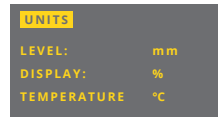
11.1. BASIC CONFIGURATION

After the first start of the level meter it is necessary to perform the basic configuration (setting of the measuring range, choice of units and possibly damping). The settings are accessible in the basic menu by pressing (OK) the "BASIC SETTINGS".
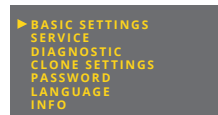
MIN LEVEL and MAX LEVEL

You can freely define the **minimum / maximum distance from the front surface of the level meter** (item "LEVEL"for currents 4 / 20 mA). The "DISPLAY" is intended to set the value displayed on the display. Setting the units is done in the "UNITS".
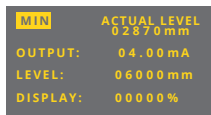
ACTUAL LEVEL: Actual distance to level

OUTPUT: current 4 mA / 20 mA

LEVEL: Definition of the min / max level

DISPLAY: The value showed on the display
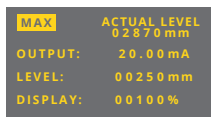
If in the bottom of the display appears (when entering the values) the inscription "OUT OF LIMITS", the value specified for the item "LEVEL" is outside the measuring range of the level meter. If the inscription "SPAN TOO SMALL" is shown, it must be specified a larger span between Min and Max values. For more information, see chapter "Specifications".

The decimal point position of the item 'LEVEL' is firmly set (according to the selected units), in the item "DISPLAY" it is freely adjustable

1. To enter to the menu press (OK) the same button to select "BASIC SETTINGS". Then, using (▲▼) and (OK) select "MIN LEVEL" or "MAX LEVEL".

2. Now it is shown the item "MIN LEVEL" ("MAX LEVEL"). By pressing (OK) and (▲▼) set the output current "OUTPUT", the distance for the defined current "LEVEL" the value on the display "DISPLAY".

3. By pressing (OK) button save the data. By next presses of the button (ESC) leave the menu. The level meter returns to measurement mode.

UNITS

Level meter can process and convert a large number of different **physical values**. The setting is done in the item "UNITS".

MIN LEVEL		UNITS	
MAX LEVEL		LEVEL:	mm
▶ UNITS		DISPLAY:	%
DAMPING		TEMPERATURE	°C
SENSITIVITY			
TEACHING			
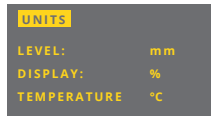
LEVEL: Unit selection (mm, cm, m, in, ft)

DISPLAY: The unit showed on the display (%, mm, cm, m, in, ft, l, hl, m³, gal, bbl, mA)

TEMPERATURE: Temperature unit (°C, °F)

1. To enter to the menu press (OK) the same button to select "BASIC SETTINGS". Then, using (▲▼) and (OK) select "UNITS".

2. Now the menu item "UNITS" is shown. By pressing the (OK) and (▲▼) button make the settings of individual items.

3. By pressing (OK) button save the data. By next presses of the button (ESC) leave the menu. The level meter returns to measurement mode.

DAMPING

Setting the **response time** of the measurements. The function is useful for suppressing level fluctuations, waves and rapid changes of the level. The reaction time will depend on the exponential function. Damping with a defined delay in seconds represents the time when exponential reaches 2/3 of its maximum value.

MIN LEVEL		DAMPING	
MAX LEVEL			
UNITS		05	
▶ DAMPING			
SENSITIVITY			
TEACHING			

The damping time can be set in the interval from 0 to 99 s.

1. To enter to the menu press (OK) the same button to select "BASIC SETTINGS". Then, using (▲▼) and (OK) select "DAMPING".

2. Now the menu item "DAMPING" is shown. By pressing the (OK) and (▲▼) button make the settings of individual items.

3. By pressing (OK) button save the data. By next presses of the button (ESC) leave the menu. The level meter returns to measurement mode.

SENSITIVITY

The setting is defined in three steps of the level meter **sensitivity**.

"LOW"   – Low sensitivity in case of surrounding interferences affecting the measurement.
"MEDIUM"   –   Medium sensitivity (suitable for most applications).
"HIGH"   – Enhanced sensitivity for measured media partly absorbing the ultrasonic signal

```
MIN LEVEL
MAX LEVEL
UNITS
DAMPING
▶ SENSITIVITY
TEACHING
```

```
SENSITIVITY

    MEDIUM
```

You can set the sensitivity in three degrees:

LOW – MEDIUM – HIGH.

TEACHING

The mode serves for **suppressing false reflections** resulting from reflection of the ultrasonic signal from roughnesses on walls of the tank, various partitions, mixers or other obstacles. The sensor starting this mode detects false reflections and save them in the memory. Then these false reflections will not affect the subsequent measurement (they are masked).

Before starting the mode it is necessary to empty the tank as much as possible (preferably completely).

```
MIN LEVEL
MAX LEVEL
UNITS
DAMPING
SENSITIVITY
▶ TEACHING
```

```
TEACHING

SET LEVEL DISTANCE:
    06000 mm

        START
```

If there are no above obstacles in the tank, it is not necessary to start this mode.

1. To enter to the menu press (OK) the same button to select "SERVICE". Then, using (⬍) and (OK) select "TEACHING".

2. Now it is shown the item "TEACHING". By pressing (OK) set the value "LEVEL DISTANCE" (distance to the level) – supposed distance from the face of the sensor to the medium level. If the distance to the level is not precisely known, enter a value rather lower (in the tolerance field as shown in Fig. 19).

3. After entering the "SET LEVEL DISTANCE" by pressing (OK) button the system starts "teaching" (false reflection mapping). During the mapping, the display shows flashing sign "RUNNING".

4. The mapping of false echoes can be completed when you see the inscription "Press OK to stop" and you press (OK).

5. The procedure is completely finished when you can see the inscription "DONE". It is then possible to exit the menu by repeated pressing the button (ESC).

```
TEACHING

SET LEVEL DISTANCE:
    06000 mm
        RUNNIN
```

```
TEACHING

SET LEVEL DISTANCE:
    06000 mm
        DONE
PRESS ESC TO EXIT
```

The mode "TEACHING" will stop automatically after ca. 1000 measurements.

If during the scanning of the tank in the bottom of the display appears the dialog "press OK to stop" (see figure) the level meter already found no further obstacles and "TEACHING" mode may be terminated. If it is not terminated, the level meter is still ready for the possible presence of obstacles (e.g. paddles of the agitator). Once it registers a further obstacle, the dialogue disappears and the obstacle is erased. This process may be repeated up to 1000 cycles. After this the "TEACHING" mode is automatically stopped.

```
TEACHING

SET LEVEL DISTANCE:
    06000 mm
        RUNNIN
PRESS OK TO STOP
```

In case of installed mixers, it is **necessary** to position the mixers under the level meter (direct the mixer blade to the ultrasonic signal beam).

Note: If there are significant obstacles in the upper half of the tank, **multiple false reflections** can occur especially in closed tanks. In such cases it is necessary to reduce the level in the tank as much se possible to correctly mask these possible multiple false reflections.
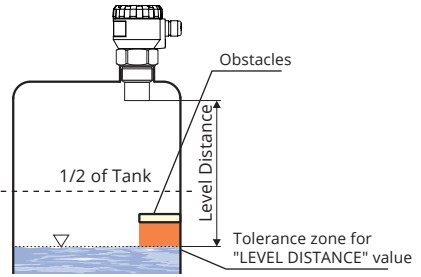
Fig. 21: Level distance zone

11.2. SERVICES SETTINGS

In the supplemented configuration, you can set parameters of sensitivity, mapping of false reflections, temperature difference compensation, behaviour in case of fault conditions or HART® communication. Here, you can set the sensor into the initial state or reset it as well. The settings are accessible in the basic menu under the item "SERVICE".

. . . .
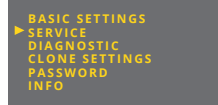
MEDIUM TEMPERATURE

The level meter is equipped with **automatic temperature compensation**. If for instance in the tank there is a difference of 10°C between the temperature of the measured material (medium) and the temperature at the mounting site of the level meter (see the mode "DIAGNOSTICS, page 20), the measuring accuracy will be reduced by around 1% of the set range. If this function is activated, this temperature difference can be compensated. If in the tank (open channel) is a big difference between the temperature of the measured medium (liquid) and temperature in the place of installation of the ULM (see mode, "DIAGNOSTICS" page 20), it is advised to improve the precision of the measurement by the zone temperature compensation. Otherwise, this mode is **not necessary to run**.
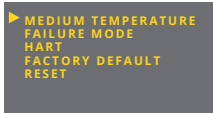
Inactive compensation (initial state), the word "NO" appears on the display.

See the "UNITS" menu for temperature unit selection (°C or °F).

After start of the **zone temperature compensation** mode it is necessary to set the temperature of the surface of the medium. The level meter then calculates the average value from the medium temperature and the temperature at the installation place of the level meter. With such an average temperature it counts in calculating of the velocity of acoustic waves propagation and for determination of the level position.

. . . .

FAILURE MODE

It **defines the output current** of the level meter when the measured medium level is in the dead zone ("DEAD ZONE") or outside the measurement range in case of echo loss ("NO ECHO").
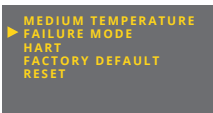
NO ECHO: Current in case of echo loss

DEAD ZONE: Dead zone current

The values can be set in three steps: 3.75 mA, 22 mA and LAST (last measured data).

HART

HART® mode (point to point, multidrop) and multidrop mode **address setting**. Up to 15 units can be connected to one two-wired cable in the multidrop mode.

```
MEDIUM TEMPERATURE
FAILURE MODE
► HART
FACTORY DEFAULT
RESET
```

```
HART
POLLING ADDRESS

        00
```

In case of the address "00", the point to point mode is enabled. The range from "01" to "15" is reserved for addresses in the multidrop mode.

MODBUS

This item is part of a menu with Modbus output level meter ULM-70 _-_-_- M. Modbus mode is intended for the settings of the level Modbus addresses, baud rate and parity settings.

```
MEDIUM TEMPERATURE
FAILURE MODE
► MODBUS
FACTORY DEFAULT
RESET
```

```
MODBUS

ADDRESS:    001
BAUD RATE: 9600
FORMAT:    8N1
```

ADDRESS: 1 to 247 (default 1)
BAUD RATE: 4800, 9600, 19200
(default 9600)
FORMAT : 8N1, 8O1, 8E1, 8N2 (default 8N1)

FORMAT:

number of stop bits: 1
parita:N – non parity   2
O – odd parity
E – even parity
data: 8 – number of bits

FACTORY DEFAULT

To **reset the initial values** of the level meter set by the manufacturer, press the button (OK) (see the Factory default table, p. 28).

```
MEDIUM TEMPERATURE
FAILURE MODE
MODBUS
► FACTORY DEFAULT
RESET
```

```
FACTORY DEFAULT

ARE YOU SURE?
```

After you press the button (OK) "RUNNING" will be displayed for about 3 sec. After the initial values are set, "DONE" will be appear on the display.

```
FACTORY DEFAULT

RUNNING
```

```
FACTORY DEFAULT

DONE
PRESS ESC TO EXIT
```

RESET

Complete restart of the level meter. The same effect has also a short-time interruption of the supply voltage. To enable the resetting, press the button (OK) .

```
MEDIUM TEMPERATURE
FAILURE MODE
MODBUS
FACTORY DEFAULT
► RESET
```

```
RESET

ARE YOU SURE?
```

During the restart process, "RUN-NING" will be displayed. Then the level meter will be automatically turned off and on.

Additional functions include modes to display temperature in the tank or to find out the actual flowing current in the loop. Besides, to lock modifications using a password and information about the level meter version. All of the functions are accessible from the main menu.

DIAGNOSTICS

It contains information about the actual temperature inside the tank (or about the compensated temperature) "TEMPERATURE" and current flowing through the loop "CURRENT". If the temperature compensation ("MEDIUM TEMPERATURE") is activated, the corrected temperature is displayed.

```
BASIC SETTINGS
SERVICE
▶ DIAGNOSTIC
CLONE SETTINGS
PASSWORD
LANGUAGE
INFO
```

```
▶ DISTANCE TO LEVEL
  TEMPERATURE
  CURRENT
```
```
DISTANCE TO LEVEL

    01220 mm
```
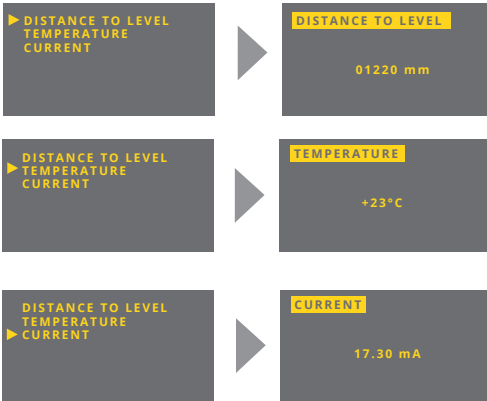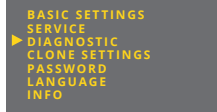
The temperature is measured inside the tank where the level meter is installed.

```
  DISTANCE TO LEVEL
▶ TEMPERATURE
  CURRENT
```
```
TEMPERATURE

    +23°C
```

If the temperature of the measured medium is different, we recommend you to carry out the temperature compensation "MEDIUM TEMPERATURE" because of accuracy (see p. 15). Then the displayed temperature is an average value from the temperature set in the "MEDIUM TEMPERATURE" and the actual temperature measured by the sensor.

```
  DISTANCE TO LEVEL
  TEMPERATURE
▶ CURRENT
```
```
CURRENT

    17.30 mA
```

CLONE SETTINGS

This mode is intended for **copying** of the level meter (ULM–70 body) **configuration into the display module** (DM–70) and back. The display module can then be removed from the level meter body and put into another level meter and make there the settings transfer (cloning).

```
BASIC SETTINGS
SERVICE
DIAGNOSTIC
▶ CLONE SETTINGS
PASSWORD
INFO
```
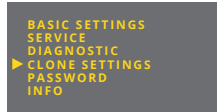
The "CLONE SETTINGS" mode transfers all data, excluding setting of the "Teaching" and HART®.

```
CLONE SETTINGS

▶ SENSOR       DISPLAY
               MODULE
  DISPLAY      SENSOR
  MODULE
```
```
CLONE SETTINGS

▶ SENSOR       DISPLAY
               MODULE
  DISPLAY      SENSOR
  MODULE
  ARE YOU SURE?
```
```
CLONE SETTINGS

    NOW CLONING
```
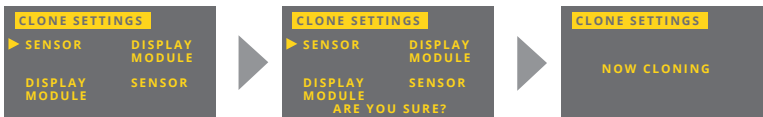
1. Press OK to enter the menu and select the item "CLONE SETTINGS". Copying of the settings from the body of the level meter to display module is done by selecting "SENSOR - DISPLAY MODULE". To transfer the settings from the display module to another level meter select the item DISPLAY MODULE - SENSOR.

2. The selected mode starts by pressing button OK During transmission the display shows "NOW CLONING".

3. After completing the process in the middle of the screen displays "DONE". It is then possible to leave the menu and the mode by pressing the button ESC .

CLONE SETTINGS WARNING–CLONING IS NOT POSSIBLE WRONG SENSOR TYPE PRESS ESC TO EXIT	Incompatible type of level meter. Transfer of the settings can be realized only with the same type of level meter (e.g. ULM–70–02 - ULM–70-02, ULM–70–10 - ULM–70–10) and with the firmware version 2.0 and later.
CLONE SETTINGS WARNING–CLONING IS NOT POSSIBLE NO SETTINGS SAVED PRESS ESC TO EXIT	The data set is not stored into the display module (DM–70). The transfer can not be done. It is necessary to repeat the procedure of the copying the settings in the mode "CLONE SETTINGS".
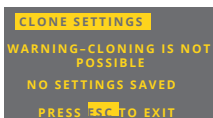
....

PASSWORD

You can **lock** the level meter data against **unauthorized editing**. After activating the password the data may be read, but can not be edited. If you try to edit the settings (without true password) the display shows "NO PASSWORD".

The password can be any 5-digit numeric combination. The combination of numbers 00000 is reserved for disabling the password.

```
TEACHING
SET LEVEL DISTANCE:
        06000 mm
          START
NO PASSWORD
```

1. Use the buttons (OK) and (⬍) in the menu "PASSWORD" to select the mode "ENTER" for entering the password or the mode "CHANGE" for changing the password (when activated, the words are displayed inversely). Press the button (OK) once again to confirm the selection. You can change the password only when the level meter is unlocked. Otherwise, the words "NO PASSWORD" will be displayed.

2. Now you can edit the password. The actual edited item is displayed inversely. Press the button (OK) to move to the next position (clockwise direction), button (⬍) serves to change the values (0 ... 9).

3. After the operation is completed, confirm the edited data by pressing the button (OK) .
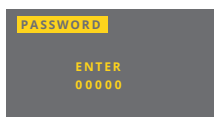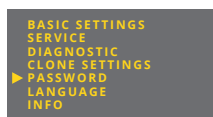
BASIC SETTINGS SERVICE DIAGNOSTIC CLONE SETTINGS ► PASSWORD LANGUAGE INFO	**PASSWORD** ENTER 00000	Display of status information to confirm data: "YES" – correctly edited password "NO" – incorrectly edited password "OK" – the password saved (only in case of "CHANGE")
	PASSWORD CHANGE 00000	The password is automatically hidden after it is edited or changed ("00000" will appear). To deactivate the password, edit the numerical combination "00000" in the mode "CHANGE".

The level meter with activated password will be automatically locked after 5 minutes of inactivity or after 5 min. from switching to measuring mode. Locking of level meter is indicated in the lower left corner of the screen by the letter "L".

If the password is lost, contact the manufacturer.

LANGUAGE

Setting the language of display menu.

```
BASIC SETTINGS
SERVICE
DIAGNOSTIC
CLONE SETTINGS
PASSWORD
►LANGUAGE
INFO
```

```
LANGUAGE

    ENGLISH
```

You can set three kinds of language:
ČESKY – ENGLISH – по русски

INFO

Information about the type, serial number and production date of the level meter (type, serial number – SN and firmware version – SW).

```
BASIC SETTINGS
SERVICE
DIAGNOSTIC
CLONE SETTINGS
PASSWORD
LANGUAGE
►INFO
```

```
►SENSOR
 DISPLAY MODULE
```

```
SENSOR
ULM-70N-06-I HART
SN: 140025
SW: 2.0
```

```
SENSOR
►DISPLAY MODULE
```

```
DISPLAY MODULE
DM-70
SN: 140041
SW: 4.1
```
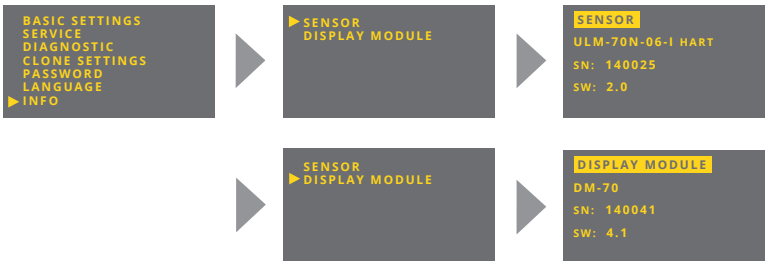
12. PROTOCOL HART®

Universal communication interface for data communication of peripheral devices with the level meter. Data transmission runs through the same line as the 4 ÷ 20mA current loop without impact on analog communication. For setting the level meter and collection of measured data, it is necessary to have available a HART communicator, by which it is possible to communicate directly with the level meter, or using it, to mediate communication with a peripheral device, see image 22.

ULM–70_-_ _-_-I

mA

≈ 250 R

Power supply unit

HART® communicator

RS232 / USB
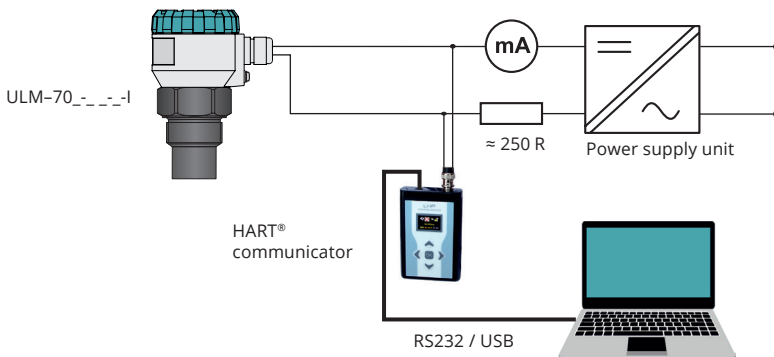
Obr. 22: Typical hardware configuration with HART

HART Specifications

The version of the HART Protocol is revision 5.
Universal Commands: 0, 1, 2, 3, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19 and
Commons Practice Commands: 34, 35, 40, 42, 44, 49.

13. Protocol Modbus

Data communication takes place along a series line of a standard RS-485 with protocol Modbus RTU. A list of relevant variables is provided in a separate annex. To set up the level meter and collect measured data, you can use the software application "Basic SCADA level", which is freely available at the Website www.dinel.cz. Connecting the level meter to a peripheral device can be performed using a converter URC-485, see image 23.
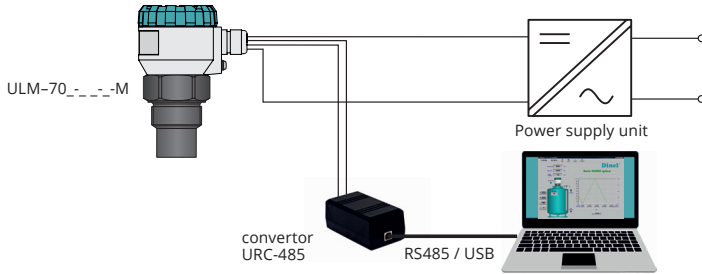
Obr. 23: Typical hardware configuration with Modbus

14. Order code

PRODUCT							
ULM-70							
	PERFORMANCE						
	N	**Normal – usable in non-explosive areas only**					
	Xi	**Ex. proof – suitable for explosive areas**					
		MAXIMUM REACH					
		02	0,15 ... 2 m				
		06	0,25 ... 6 m				
		10	0,4 ... 10 m				
		20	0,5 ... 20 m				
			PROCESS CONNECTION				
			G	thread			
			F	flange			
				OUTPUT TYPE			
				I	current output		
				M	RS-485 (Modbus RTU)		
					ELECTRICAL CONNECTION		
					B	short cable outlet	
					H	outlet for protective conductor	
						SET-UP ELEMENTS	
						D	basic version with display
						C	basic version with LCD display
						L	without display, metal lid
ULM-70	**N**	**- 06 -**	**G**	**- I -**	**B**	**- D**	**POSSIBLE PRODUCT VARIANT**

15. ACCESSORIES

Standard – *incl. in the price of the level sensor*   **Optional** – *for extra charge*

- 1 pc of Seal (for ULM–70_–02–I, 06–I)
- free-to-download programme Basic Scada Level (for the Modbus version)

- Fixing nuts G1" and G1 ½" and G2 ¼
- Horn adapter ST–G1, STG1,5 and ST–G2,25
- for version Modbus convertor URC-485

16. SAFETY, PROTECTION, COMPATIBILITY AND EXPLOSION PROOF

The level meter ULM–70 is equipped with protection against reverse polarity and output current overload.

Protection against dangerous contact is secured by low safety voltage that complies with EN 33 2000-4-41.

Electromagnetic compatibility according to EN 55022/B, EN 61326/Z1 and EN 61000-4-2 to 6.

Explosion proof of ULM–70Xi type complies with the following standards: EN 60079-0 : 2007; EN 60079-11 : 2007 ; EN 60079-26 : 2007 and examined by FTZÚ-AO 210 Ostrava - Radvanice certificate No.: FTZÚ 09 ATEX 0277X.

Special conditions for safe use ULM–70Xi:

The device is designed for connection to the isolating repeater IRU-420. When the other approved supply unit is used, whose output parameters satisfy above mentioned output parameters, it is necessary to have a galvanic separation or, if supply unit without galvanic separation is used (Zener barriers), it is necessary provide potential equalization between sensor and point of barrier earthing.

For application in zone 0 the present explosive atmospheres - mixture of air with flammable gases, vapour or mists must comply: 0,8 bar < p < 1,1 bar. The device must be installed in such a way, to prevent mechanical damage of sensor face. It is necessary carried out earthing by screw which is placed on head of level meter.

⚠️ **The device must be installed in such a way, to prevent mechanical damage of sensor face.**

17. Use, manipulation and maintenance

The level meter does not require any personnel for its operation. Follow-up displaying device is used to inform the technological entity operating personnel on the measured substance level height during the operation.

Maintenance of this equipment consists in verification of integrity of the level meter and of the supply cable. Depending on the character of the substance measured, we recommend to verify at least once per year the clarity of the ultrasound transducer emitting field and to clean it, respectively. In case any visible defects are discovered, the manufacturer or reseller of this equipment must be contacted immediately.

⚠️ It is forbidden to perform any modifications or interventions into the ULM–70 level meter without manufacturer's approval. Potential repairs must be carried out by the manufacturer or by a manufacturer authorized service organization only.

Installation, commissioning, operation and maintenance of the ULM–70 level meter has to be carried out in accordance with this instruction manual; the provisions of regulations in force regarding the installation of electrical equipment have to be adhered to.

Installation in areas with potentially explosive atmospheres must be carried out in accordance with standard EN 60079-14 (Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas other than mines) and respectively in accordance with other standards that apply to a given area.

The device must be installed to prevent tensile overload rope electrode level meter.

18. Marking of labels

Labels for type of ULM-70N-_ _-_-I-_-_:
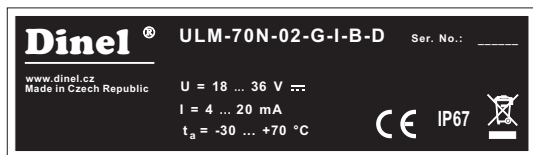
Dinel ®   **ULM-70N-02-G-I-B-D**   Ser. No.: _____

www.dinel.cz
Made in Czech Republic

U = 18 ... 36 V ⎓
I = 4 ... 20 mA
t$_a$ = -30 ... +70 °C   C€   IP67 🔲

Example of label for type of ULM-70N-02-G-B-D

Temperature range according to type:	
02	ta = -30 ... +70°C
06	ta = -30 ... +70°C
10	ta = -30 ... +60°C
20	ta = -30 ... +60°C

Symbol of producer: logo Dinel®
Internet address: www.dinel.cz
Level meter type: ULM–70N-_ _-_-I-_-_
Serial number: Ser. No.: xxxxx – (from the left: production year, serial prodution number)
Supply voltage: U$_i$ = 18 ... 36 V =
Output current range: I = 4 ÷ 20 mA
Ambient temperature range: t$_a$ = -30 ... +_ _ °C (see. Temperature range according to type)
Protection class: IP67
Compliance mark: C€
Electro-waste take-back system mark: 🔲

Labels for type of ULM-70Xi-_ _-_-I-_-_:

Dinel ® ULM-70Xi-02-G-I-B-D   Ser. No.: _____
www.dinel.cz
Made in Czech Republic

I = 4 ... 20 mA   ⟨Ex⟩ II 1/2 G Ex ia IIB T5 Ga/Gb
U_i = 30 V ⎓   FTZÚ 09 ATEX 0277X
P_i = 0,99 W, I_i = 132 mA
C_i = 370 nF, L_i = 0,9 mH
t_a = -30 ... + 70 °C   CE 1026   IP67

Clasification non-explosive performance:

02	⟨Ex⟩II 1/2G Ex ia IIB T5 Ga/Gb
06	⟨Ex⟩II 1/2G Ex ia IIB T5 Ga/Gb
10	⟨Ex⟩II 1/2G Ex ia IIA T5 Ga/Gb
20	⟨Ex⟩II 2G Ex ia IIA T5 Gb

Example of label for type of ULM-70Xi-02-G-I-B-D

Symbol of producer: logo Dinel®
Internet address: www.dinel.cz
Level meter type: ULM–70Xi–_ _–_–I–_–_
Serial number: Ser. No.: xxxxx –
(from the left: production year, serial prodution number)
Output current range: I = 4 ... 20 mA
Max. internal values: U_i = 30 V =, I_i = 132 mA; P_i = 0,99 W; C_i = 370 nF; L_i = 0,9 mH
Ambient temperature range: t_a = -30 ... +_ _ °C (viz. Teplotní rozsah dle typu)
Label of non-explosive device: ⟨Ex⟩ , Performance: II _G Ex ia II_ T5 _/_
Number of certificate of intrinsically safety: FTZÚ 09 ATEX 0277X
Protection class: IP67
Compliance mark: CE, No. of authorized person examining control of system quality: 1026
Electro-waste take-back system mark: 🗑

Temperature range according to type:

02	t_a = -30 ... +70°C
06	t_a = -30 ... +70°C
10	t_a = -30 ... +60°C
20	t_a = -30 ... +60°C

Labels for type of ULM-70N-_ _-_-M-_-_:

Dinel ® ULM-70N-10-G-M-B-D   Ser. No.: _____
www.dinel.cz
Made in Czech Republic

U = 18 ... 36 V ⎓
RS-485 (Modbus RTU)
t_a = -30 ... +60 °C   CE   IP67

Temperature range according to type:

02	ta = -30 ... +70°C
06	ta = -30 ... +70°C
10	ta = -30 ... +60°C
20	ta = -30 ... +60°C
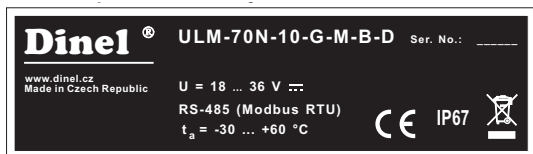
Example of label for type of ULM-70N-10-G-M-B-D

Symbol of producer: logo Dinel®
Internet address: www.dinel.cz
Level meter type: ULM–70N–_ _–_–I–_–_
Serial number: Ser. No.: xxxxx – (from the left: production year, serial prodution number)
Supply voltage: U= 18 ... 36 V =
Data output: RS-485 (Modbus RTU)
Ambient temperature range: t_a = -30 ... +_ _ °C (see. Temperature range according to type)
Protection class: IP67
Compliance mark: CE
Electro-waste take-back system mark: 🗑

(i) | Real label size is 70x20mm.

19. MENU STRUCTURE

DAMPING
05

SENSITIVITY
SENSITIVITY: MEDIUM
1 2 -3 4 5 6 !7! 8!
MATERIAL: LIQUID

TEACHING
TANK MUST BE EMPTY
START

UNITS
LEVEL: mm
DISPLAY: %

HART
POLLING ADDRESS
00

FACTORY DEFAULT
ARE YOU SURE?

RESET
ARE YOU SURE?

LANGUAGE
ENGLISH

	ACTUAL 02870 mm
MAX	
OUTPUT:	20.00 mA
LEVEL:	002 50 mm
DISPLAY:	00100 %

FAILURE MODE
NO ECHO: 4.00 mA

TEMPERATURE
+23°C

CURRENT
17.30 mA

DISPLAY MODULE
DM-70
SN: 140085
SW: 4.1

	ACTUAL 02870 mm
MIN	
OUTPUT:	04.00 mA
LEVEL:	06000 mm
DISPLAY:	00000 %

MEDIUM TEMPERATURE
YES
+20°C

DISTANCE TO LEVEL
01220 mm

SENSOR
GRLM-70N-10-I HART
ELECTRODE: 1000 mm
SN: 140015   SW: 2.1

MIN LEVEL
MAX LEVEL
UNITS
DAMPING
SENSITIVITY
TEACHING

MEDIUM TEMPERATURE
FAILURE MODE
HART
FACTORY DEFAULT
RESET

DISTANCE TO LEVEL
CURRENT

CLONE SETTING
SENSOR   DISPLAY
              MODULE
DISPLAY   SENSOR
MODULE

PASSWORD
ENTER
00000

SENSOR
DISPLAY MODULE

BASIC SETTINGS
SERVICE
DIAGNOSTIC
CLONE SETTINGS
PASSWORD
LANGUAGE
INFO

BASIC SETTINGS
SERVICE
DIAGNOSTIC
CLONE SETTINGS
PASSWORD
LANGUAGE
INFO

BASIC SETTINGS
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CLONE SETTINGS
PASSWORD
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BASIC SETTINGS
SERVICE
DIAGNOSTIC
CLONE SETTINGS
PASSWORD
LANGUAGE
INFO

BASIC SETTINGS
SERVICE
DIAGNOSTIC
CLONE SETTINGS
PASSWORD
LANGUAGE
INFO

20. Technical specifications

Technical specifications – Level meter		
Measuring range [1]	ULM–70_–02 ULM–70_–06 ULM–70_–10 ULM–70_–20	0.15 ... 2 m 0.25 ... 6 m 0.4 ... 10 m 0.5 ... 20 m
Adjustable measuring range (SPAN)		Min. 200 mm
Supply voltage	ULM–70N–_ _ ULM–70Xi–_ _	18 ... 36 V DC 18 ... 30 V DC
Output	ULM–70_–_ _-I ULM–70_–_ _-M	4 ... 20 mA (Limit values 3.9 ... 20.5 mA), HART® RS-485 with protocol Modbus RTU
Current consumption	ULM–70_–_ _-I ULM–70_–_ _-M	4 ... 20 mA / Max. 22 mA Max. 20 mA
Resolution	ULM–70_–02 ; 10 ULM–70_–06 ULM–70_–20	< 1 mm < 2 mm < 2.5 mm
Accuracy (within the total range)		0.15 %
Temperature error		Max. 0.04% / K
Operating frequency	ULM–70_–02 ULM–70_–06 ULM–70_–10 ULM–70_–20	120 kHz 75 kHz 50 kHz 30 kHz
Beamwidth (-3 dB)	ULM–70_–02 ; 10 ULM–70_–06 ULM–70_–20	10° 14° 12°
Ambient temperature range	ULM–70_–02 ; 06 ULM–70_–10 ; 20	-30 ... +70 °C -30 ... +60 °C
Short-time temperature stress resistance		+90 °C / 1 hour
Max. operation overpressure (on transmission surface)		0.1 MPa
Sensitivity		3 steps (low – medium – high)
Damping		0 ... 99 s
Measuring period		1 ... 4 s
Rise time		ca. 30 s
Additional technical data for Ex proof [2] – Max. internal values		U_i=30 V DC; I_i=132 mA; P_i=0.99 W; C_i=370 nF; L_i=0.9 mH
Failure indication (echo loss, level in dead zone [3], internal failure)		Adjustable in modes: 3.75 mA ; 22 mA ; Last measured value
Maximal resistance of current output load (U = 24 V DC)		R_{max} = 270 Ω [4]
Mechanical connection	ULM–70_–02 ULM–70_–06 ULM–70_–10 ULM–70_–20	Screwing with thread G 1'' Screwing with thread G 1½'' Screwing with thread G 2¼'' Aluminium alloy flange

[1] In case the level of bulk-solid materials is measured, the measurement range is reduced.
[2] Allowed pressure range in the zone 0: 80 ... 110 kPa.
[3] Dead zone = Blind zone = Blocking distance
[4] Including 250Ω resistor in case of HART® connection.

TECHNICAL SPECIFICATIONS – LEVEL METER

Protection class		IP67
Weight	ULM–70_–02 ULM–70_–06 ULM–70_–10 ULM–70_–20	0.3 kg 0.4 kg 0.6 kg 3.1 kg

TECHNICAL SPECIFICATIONS – DISPLAY MODULE

Display type		Matrix OLED, LCD[1]
Resolution		128 x 64 pixel
Character height / Number of digits measured value		9 mm / 5 Digits
Display colour	OLED	Yellow
	LCD	black with white background light
Buttons		Membrane switch panel
Ambient temperature range	OLED	-30 ... +70 °C
	LCD	-20 ... +70 °C
Weight		46 g

1) OLED- suitable for indoor and low-light applications. LCD – suitable for outdoor applications particularly with direct sunlight.

USED MATERIALS

Sensor part	Variants	Standard material
Lid	All types	aluminium alloy with powder coating
Glass	All types	polycarbonate
Body	All types	aluminium alloy with powder coating
Housing with thread	All types	plastic PP
Electroacoustic converter	All types	plastic PVDF
Display module	ULM-70_...-D (with display)	plastic POM
Cable gland	All types	plastic PA
Flange	ULM-70-20-F	aluminium alloy with powder coating

FACTORY DEFAULT

	ULM–70_–02	ULM–70_–06	ULM–70_–10	ULM–70_–20
MIN LEVEL (Distance to min. level)	2 000	6 000	10 000	20 000
MAX LEVEL (Distance to max. level)	150	250	400	500
UNITS	mm; %; °C	mm; %; °C	mm; %; °C	mm; %; °C
DAMPING	2	5	10	10
SENSITIVITY	MEDIUM	MEDIUM	MEDIUM	MEDIUM
MEDIUM TEMPERATURE	NO	NO	NO	NO
FAILURE MODE – NO ECHO	3.75 mA	3.75 mA	3.75 mA	3.75 mA
FAILURE MODE – DEAD ZONE [1]	22 mA	22 mA	22 mA	22 mA
POOLING ADDRESS (HART®)	00	00	00	00
PASSWORD	No password	No password	No password	No password

1) Dead zone = Blind zone = Blocking distance

AREA CLASSIFICATION (according to EN 60079-10 and EN 60079-14)	
ULM–70N–_ _	Performance for non-explosive areas
ULM–70Xi–02 ULM–70Xi–06	Explosive proof – suitable for explosive areas (combustible gases or vapours) ⬡II 1/2G Ex ia IIB T5 Ga/Gb with Isolating repeater (IRU–420), the whole level meter – zone 1, front head part – zone 0
ULM–70Xi–10	Explosive proof – suitable for explosive areas (combustible gases or vapours) ⬡II 1/2G Ex ia IIA T5 Ga/Gb with Isolating repeater (IRU–420), the whole level meter – zone 1, front head part – zone 0
ULM–70Xi–20	Explosive proof – suitable for explosive areas (combustible gases or vapours) ⬡II 2G Ex ia IIA T5 Gb with Isolating repeater (IRU–420), the whole level meter – zone 1

21. PACKAGING, SHIPPING AND STORAGE

The device DLM–35 is packaged in a polyethylene bag, and the entire consignment is placed into a cardboard box. A suitable filler material is used in the cardboard box to prevent mechanical damage during transport. Remove the device from the packaging only just before using, thereby protecting it from potential damage.

A forwarding company will be used to ship goods to the customer. Upon prior agreement, ordered goods can be picked up in person at company headquarters. When receiving, please check to see that the consignment is complete and matches the order, or to see if any damage has occurred to the packaging and device during transport. Do not use a device clearly damaged during transport, but rather contact the manufacturer in order to resolve the situation.

If the device is to be further shipped, it must be wrapped in its original packaging and protected against impact and weather conditions.

Store the device in its original packaging in dry areas covered from weather conditions, with humidity of up to 85 % without effects of chemically active substances. The storage temperature range is -20°C to +60°C.

⚠ **Level meters of variants ULM–53_ – 02, 06, 10 are fitted with protective caps to prevent damage to the ultrasonic transducer. Remove the cover prior to putting into operation.**

22. USED SYMBOLS

To ensure maximum safety of control processes, we have defined the following safety instructions and information. Each instruction is labeled with the appropriate pictogram.

⚠ **Alert, warning, danger**

This symbol informs you about particularly important instructions for installation and operation of equipment or dangerous situations that may occur during the installation and operation. Not observing these instructions may cause disturbance, damage or destruction of equipment or may cause injury

ⓘ **Information**

This symbol indicates particularly important characteristics of the device.

✎ **Note**

This symbol indicates helpful additional information.

Dinel ®

industrial electronics

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The lastest version of this instruction manual can be found at www.dinel.cz
Version: 06/2019

QMS
ISO 9001

Ex C E

Address	Address [hex]	Data type	Read/Write	Register Name	Note
				Commands type 16-bit Integer (measuring value + info)	
100	0x64	Word	R	DISTANCE	Measured level distance from the level meter - units see LEVEL UNIT (205)
101	0x65	Word	R	LEVEL	Height of the measured level from set lower level LEVEL MIN see Fig.1 - units see LEVEL UNIT (205)
102	0x66	Word	R	PERCENTAGE	Percentage level (between set low (0%) and set high (100%) level) - value x 100
103	0x67	Signed Word	R	TEMPERATURE	Measured temperature in the storage tank in whole °C or °F - units see TEMPERATURE UNIT (207)
104	0x68	Word	R	STATUS1 ECHO – OK LEVEL HIGH LEVEL LOW TEACHING RUNNING [1] TEACHING ACTIVE [1] LOW POWER	Last measuring state bit 0 =1 ECHO captured in the last measurement bit 1 =1 The level is above measurement range or in the dead zone bit 2 =1 Level is below to measurement range bit 3 =1 TEACHING is currently running (creation of a curve for an empty storage tank) bit 4 =1 TEACHING is active (a newly created curve of an empty storage tank is being used) bit 5 =1 Low power voltage - necessary to check voltage on the level meter terminal clamps
105	0x69	Word	R	RANGE [2]	Maximum measuring range (bigger distance) – units see LEVEL UNIT (205)
106	0x6A	Word	R	DEAD ZONE [2]	Dead zone (minimum measuring range) – units see LEVEL UNIT (205)
107	0x6B	Word	R	ID (Sensor Type)	Identification number (2 for type 02, 6 for type 06, 10 for type 10 and 20 for type 20)
108	0x6C	Word	R	Serial No. – MSB	Serial number – upper byte
109	0x6D	Word	R	Serial No. – LSB	Serial number – lower byte
110	0x6E	Word	R	Firmware No.	In the format xy, where x is the version number and y is the subversion number (e.g. 10 = 1.0)
111	0x6F	Word	R	ULM-70 TYPE	Type level meter (2 for type 02, 6 for type 06, 10 for type 10 a 20 for type 20)
				16-bit Integer type commands (level meter setting)	
200	0xC8	Word	R/W	LEVEL MIN	Lower level measuring setting (Distance from level meter) - level farther away from the level meter see Fig.1 - units see LEVEL UNIT (205)
201	0xC9	Word	R/W	LEVEL MAX	Upper level measuring setting (Distance from level meter) - level closer to the level meter see Fig.1 - units see LEVEL UNIT (205)
202	0xCA	Word	R/W	DAMPING	Damping - response time setting in seconds (0-99)
203	0xCB	Word	R/W	STATUS2 RESERVE MEDIUM COMP [3] FACTORY DEFAULT RESET RESERVE RESERVE START TEACHING [1] STOP TEACHING [1]	Measurement settings bit 0 (When reading returns 0) bit 1 =1 Another temperature correction respecting the entered media temperature in the storage tank will be performed see MEDIUM TEMPERATURE (DEFAULT = 0) bit 2 =1 Starts FACTORY DEFAULT (load all factory settings except for MODBUS communications settings) bit 3 =1 Performs RESET of the level meter bit 4 (When reading returns 0) bit 5 (When reading returns 0) bit 6 =1 Starts TEACHING mode (creation of a curve for an empty storage tank - TEACHING LEVEL must be entered before starting- see address 215 or 410) bit 7 =1 Stops the TEACHING mode (can only be performed if the TEACHING mode is running - indicated by TEACHING RUNNING and at the same time the empty storage tank curve is already created - indicated by TEACHING ACTIVE)
204	0xCC	Signed Word	R/W	MEDIUM TEMPERATURE [3]	Set media temperature in storage tank in whole °C or°F - units see TEMPERATURE UNIT (207)
205	0xCD	Word	R/W	LEVEL UNIT	Level units - see table units
206	0xCE	Word	R/W	QUANTITY UNIT	Quantity units - see table units
207	0xCF	Word	R/W	TEMPERATURE UNIT	Temperature units- see table units
208	0xD0	Word	R/W	RESERVE	When reading returns 0
209	0xD1	Word	R/W	MODBUS ADRESS	MODBUS address (1 – 247), DEFAULT=1 ; after registration the device responds with old address
210	0xD2	Word	R/W	MODBUS BAUDRATE	Baudrate (4800, 9600, 19200), DEFAULT=9600; after registration the device responds with new baudrate
211	0xD3	Word	R/W	MODBUS PARITY	Parity (0 = NONE+1STOPBIT, 1 = ODD, 2 = EVEN, 3 = NONE+2STOPBITS), DEFAULT=0 ; after registration the device responds with new parity
212	0xD4	Word	R/W	RESERVE	When reading returns 0
213	0xD5	Word	R/W	SENSITIVITY	Measurement sensitivity in steps 1 to 3, 1 - lowest (liquid media), 3 - highest (bulk-solid media)
214	0xD6	Word	R/W	DISPLAY DECIMAL POINT	Number of decimal places shown on the display (0- 4), DEFAULT = 0
215	0xD7	Word	R/W	TEACHING LEVEL [1]	Distance of the face of the level meter from the surface level of the media for TEACHING mode (must be in the range between LEVEL MIN and LEVEL MAX, see Fig. 1)

Address	Address [hex]	Data type	Read/Write	Register Name	Note
				32-bit Floating point type commands (measuring value)	
300	0x12C	DWord	R	DISTANCE IEEE754	Distance level from level meter – units see LEVEL UNIT (205)
302	0x12E	DWord	R	LEVEL IEEE754	Height of measured level from set lower level LEVEL MIN see Fig.1 – units see LEVEL UNIT (205)
304	0x130	DWord	R	QUANTITY IEEE754	Quantity of the medium in the tank (value 0 - 99999) – units see QUANTITY UNIT (206)
306	0x132	DWord	R	PERCENTAGE IEEE754	Percentage level (between set low and set high level)
308	0x134	DWord	R	TEMPERATURE IEEE754	Temperature in the tank in full°C or °F - see parameter TEMPERATURE UNIT (207)
310	0x136	DWord	R	RANGE IEEE754 [2]	Maximum measurement range of the level meter (greater distance) – units see LEVEL UNIT (205)
312	0x138	DWord	R	DEAD ZONE IEEE754 [2]	Dead zone [mm] (minimum measuring range) – units see LEVEL UNIT (205)
				32-bit Floating point type commands (level meter setting)	
400	0x190	DWord	R/W	LEVEL MIN IEEE754	Lower level measuring setting (Distance from level meter) - level farther away from the level meter see Fig.1 - units see LEVEL UNIT (205)
402	0x192	DWord	R/W	LEVEL MAX IEEE754	Upper level measuring setting (Distance from level meter) - level closer to the level meter see Fig.1 - units see LEVEL UNIT (205)
404	0x194	DWord	R/W	QUANTITY MIN IEEE754	Min. medium quantity set in tank (adequate LEVEL MIN see Fig.1) in value 0 - 99999 - number of decimal places see DISPLAY DECIMAL POINT (214), units see QUANTITY UNIT (206)
406	0x196	DWord	R/W	QUANTITY MAX IEEE754	Max. medium quantity set in tank (adequate LEVEL MAX see Fig.1) in value 0 - 99999 - number of decimal places see DISPLAY DECIMAL POINT (214), units see QUANTITY UNIT (206)
408	0x198	DWord	R/W	MEDIUM TEMPERATURE IEEE754 [3]	Set media temperature in storage tank in whole °C or °F - units see TEMPERATURE UNIT (207)
410	0x19A	DWord	R/W	TEACHING LEVEL IEEE754 [1]	Distance of the face of the level meter from the surface level of the media for TEACHING mode (must be in the range between LEVEL MIN and LEVEL MAX, see Fig. 1)

1. TEACHING mode is used when it is necessary to suppress false reflections created by the reflection of an ultrasound signal from the unevenness of storage tank walls, various partitions, mixing devices and other obstacles. Before starting it, it is necessary to drain the storage tank as much as possible (ideally entirely) and enter the distance from the face of the sensor to the surface level - see TEACHING LEVEL (address 215 or 410). The mode can be started using the bit START TEACHING (address 203). The mode that is running is indicated by bit TEACHING RUNNING (address 104) and the level meter is creating a curve for the empty storage tank. Its creation is indicated by bit TEACHING ACTIVE (address 104). Now, it may be stopped using the bit STOP TEACHING (address 203). If it is not stopped, the curve creation will continue for a period of 1000 measurements and then the mode will end automatically.

2. Depending on the level meter type – see technical specifications of the level meter.

3. For improving measurement accuracy in cases where the temperature measured in the area of the storage tank lid differs significantly from the temperature of the actual media.

   The average temperature in the storage tank is calculated from the entered temperature of the media and the measured temperature at the lid.

More detailed description - see manual

Additional technical data ULM–70 Modbus

Communication	Galvanically separated RS–485 without 120 Ω termination resistor, MODBUS RTU (Slave)
Specification	MODBUS over serial line specification and implementation guide v1.02; MODBUS application protocol specification v1.1b
Support commands	03 (0x03h), 06 (0x06h), 16 (0x10h)
Broadcast	YES
Data	Saved in holding registers
Data format	WORD (16- bit Integer, Transfer No.: HIGH byte, LOW byte) Signed Word (16- bit Integer with symbol, transmission order: HIGH byte, LOW byte) DWORD (32-bit Floating point IEEE754, Transfer No.: Sign+Exponent, Exponent+Mantisa(high), Mantisa, Mantisa(low)
Baud rate	4800, 9600, 19200 **(default = 9600)**
Data	8 bits
Parity	NONE+1STOPBIT, ODD, EVEN, NONE+2STOPBITY **(default = NONE+1STOPBIT)**
Address	1 – 247 **(default = 1)**

Units table ULM–70 Modbus

For LEVEL UNIT	44 (ft); 45 (m); 47 (in); 48 (cm); 49 (mm) The data contained in registers 100, 101, 105, 106, 200, 201 and 217 (variables Word) is for increasing resolution multiplied by these coefficients (according to the selected unit): 　　　　　　mm:　　x1 　　　　　　cm:　　x10 　　　　　　m:　　　x1000 　　　　　　in:　　　x100 (for type 02, 06, 10), x10 (for type20) 　　　　　　ft:　　　x1000 (for type 02, 06, 10), x100 (for type 20)
For QUANTITY UNIT	40 (gal); 41 (litr); 43 (m³); 44 (ft); 45 (m); 46 (bbl); 47 (in); 48 (cm); 49 (mm); 57 (%); 236 (hl)
For TEMPERATURE UNIT	32 (°C), 33 (°F)

DEAD ZONE **(312; 106)**

LEVEL MAX **(402; 201)**
QUANTITY MAX **(406)**

LEVEL MIN **(400; 200)**
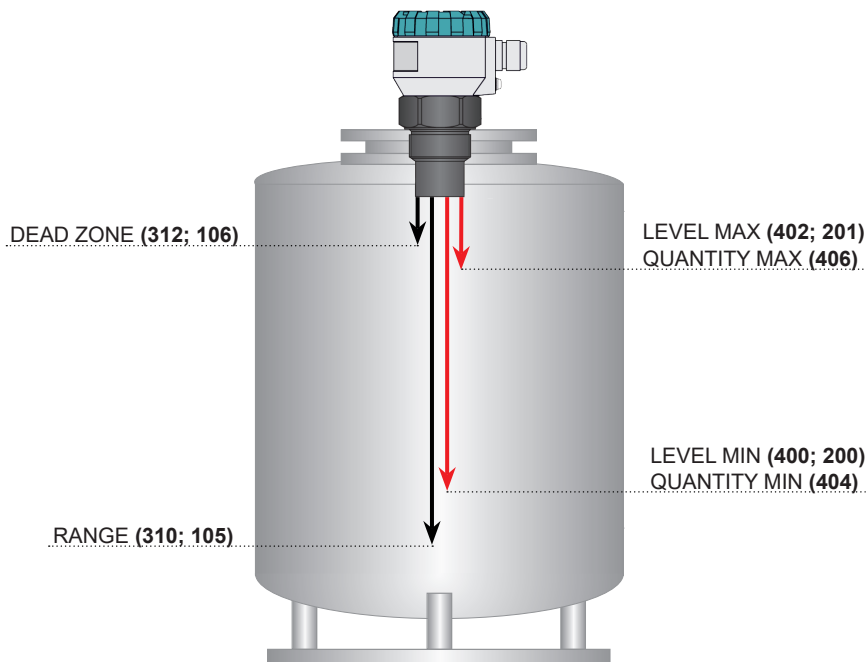QUANTITY MIN **(404)**

RANGE **(310; 105)**

Fig. 1: Basic level meter commands

The freeware **Basic Scada system** software for level meter settings and communications is available after purchasing.

Version for the Windows OS is available for download at www.dinel.cz.