



Radar level meters with guided wave

EMKOTDR-60

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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.

All types

Valid for

In the border are the types EMKOTDR, for which is intended the chapter.

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 (overflowing 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

The EMKOTDR radar level meters are compact measurement devices including transmitter of microwave pulses, central processor unit and display module. The electronics transmits very short electrical pulses (0.5 ns), which are linked to a one-wire transmission line (measuring electrode). Measuring electrode can be created of rod or rope. The pulse propagates along the electrode in the form of electromagnetic wave toward the level surface, where it is partly reflected and the reflected component is returned to the receiving module of the electronics. The electronics measures the time of flight of electromagnetic wave and 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

Radar level meters with guided wave are suited to continuous level measurement of various liquid, mush and bulk-solid materials. Level meters are resistant against changes in the atmosphere (pressure, temperature, dust, steam) and to changes in medium parameters (change in dielectric constant, conductivity).

3. Features of variants

EMKOTDR-60-00

Without electrode, the electrode is made by customer (only variant 10 or 30) and connected to the electrode junction by M8 thread.

EMKOTDR-60-10

Uncoated stainless steel rod electrode, for level measurement liquids and bulk solid materials (water, water solutions, emulsion, oils, diesel, flour, sand, granulates, etc.). Maximum electrode length 8 m.

EMKOTDR-60-11

Fully coated stainless steel rod electrode (PFA Teflon®), for level measurement of aggressive liquids and very pure liquids. Maximum electrode length 2 m.

EMKOTDR-60-12

Fully coated stainless steel rod electrode (FEP Teflon®), for level measurement of aggressive liquids and drinks. Maximum electrode length 2 m.

EMKOTDR-60-20

Uncoated stainless steel rod electrode with reference tube, for accurate level measurement of liquids in cramped spaces. Maximum electrode length 3 m.

EMKOTDR-60-30

Uncoated stainless steel rope electrode and weight, for level measurement of liquids and bulk solid materials (water, grains, sand, flour, cement, etc.) in higher silos, vessels, reservoirs. Maximum electrode length 40 m.

EMKOTDR-60-32

Fully coated stainless steel rope electrode (FEP Teflon®) and coated weight, for level measurement of aggressive liquids and very pure liquids. Maximum electrode length 20 m.

EMKOTDR-60-33

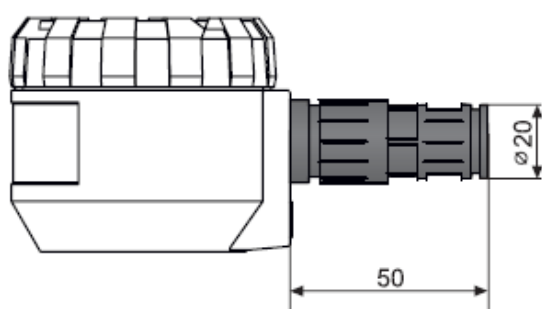
Uncoated stainless steel rope electrode with anchorage, for level measurement of bulk solid materials (grains, flour, cement, etc.) in higher silos, vessels. Maximum electrode length 40 m.

EMKOTDR-60-34

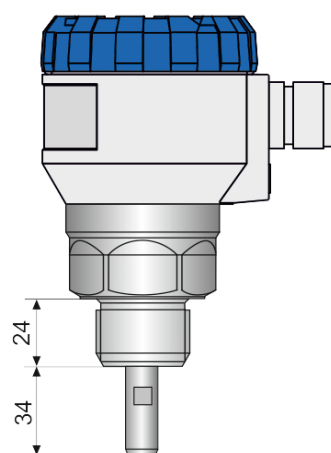
Fully coated stainless steel rope electrode (Polyamid) and coated weight, for level measurement of liquids and bulk solid materials in higher silos, vessels. Maximum electrode length 40 m.

4. Dimensional drawings

Design EMKOTDR-60 with cable gland for protection hose

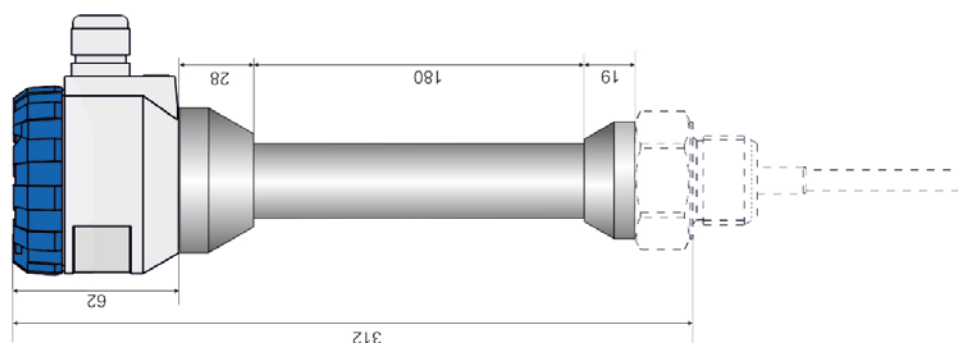


EMKOTDR-60-00

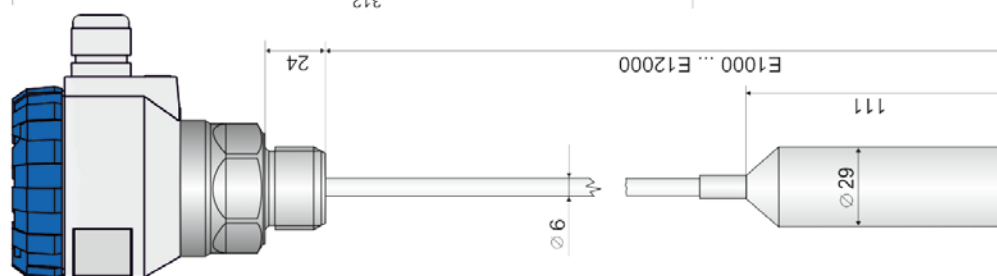


High temperature variant

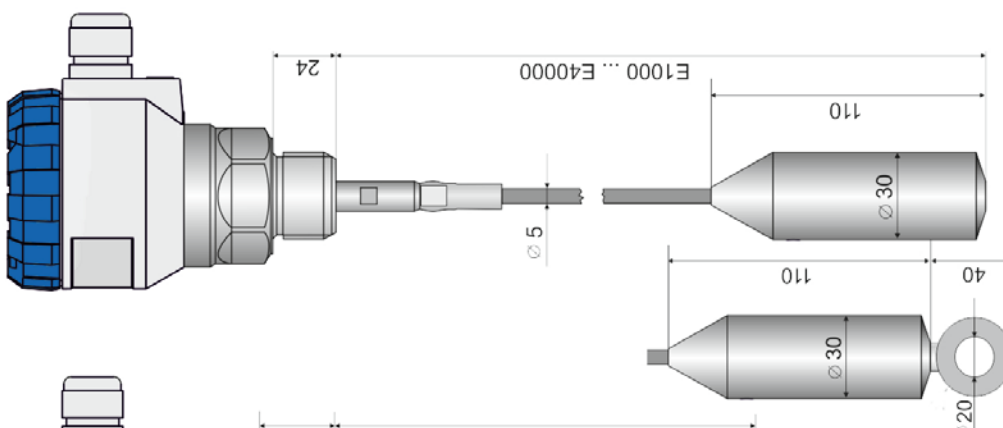
EMKOTDR-60-30-T



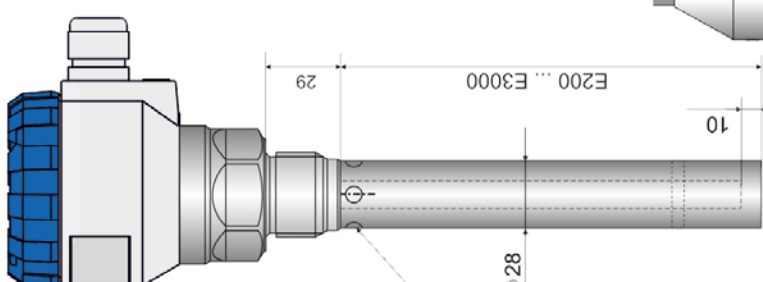
EMKOTDR-60-32



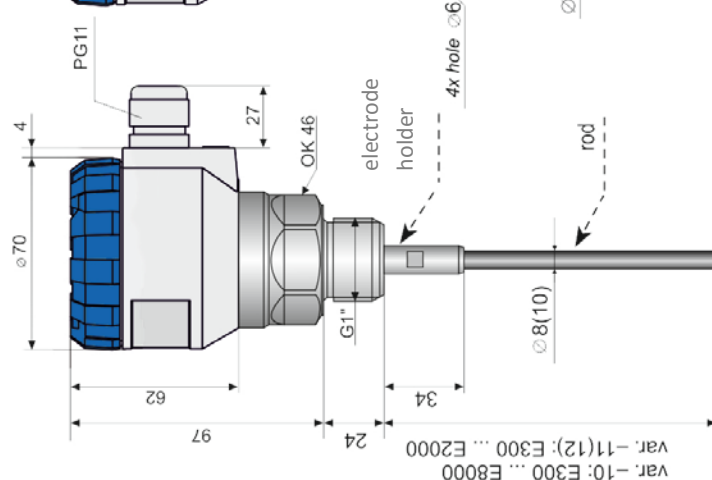
EMKOTDR-60-30(33)



EMKOTDR-60-20



EMKOTDR-60-10(11,12)



5. Installation and putting into operation

Please follow next 3 steps:

- Installation
- Electrical connection
- Setting

6. Installation instructions

BASIC INFORMATION

Install the level meter into the upper lid of the tank or reservoir using a welding flange or fastening nut.

The min. distance to install the level meter into a lid or a ceiling of a tank from the tank wall is given in table right.

Otherwise, the level meter install as far as possible from the walls, to the middle between the wall and the vertical inlet, see Fig. 1. and 2.

type of wall	d (without ref. tube)	d (with ref. tube)
metal	≥ 300 mm	any distance
non-metal	≥ 500 mm	any distance

$$E = m + t + k$$

$$E = m + t + z$$

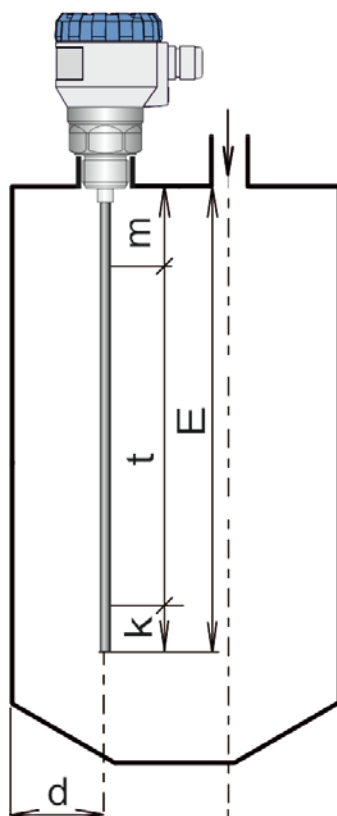


Fig. 1: Level meter installation with the rod electrode

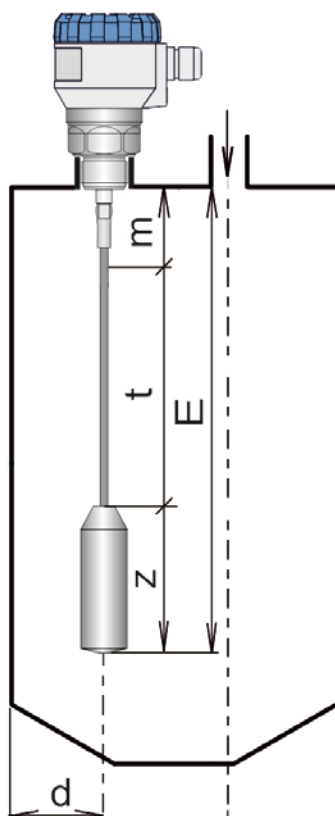


Fig. 2: Level meter installation with the rope electrode

All types

E – The length of rope electrode
t – Measuring range
m – Dead zone on the beginning of electrode
k – Dead zone on the end of electrode
z – The length of weight (110 mm)
d – The distance from the tank wall (min. 300 mm)

DEAD ZONE

In connection with the measurement principle, the signals reflected in the area just under the level meter cannot be evaluated. The zone (Fig. 3 and 4) determines the min. distance possible between the level meter and the highest surface level. 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 or deplete to the minimum. If the measured level interferes with the dead zone, the level meter will not work properly.

The size of the dead zone is affected by the set measurement sensitivity. The minimum distances to the medium (dead zones) are presented in the tables below.

measurement sensitivity	m	k (rod electrode)	k (rope electrode)
low, medium, user (1 - 4)	100 mm	0 mm	110 mm
high, user (5)	150 mm	50 mm	110 mm
user (6, 7)	200 mm	50 mm	110 mm
user (8)	250 mm	50 mm	110 mm

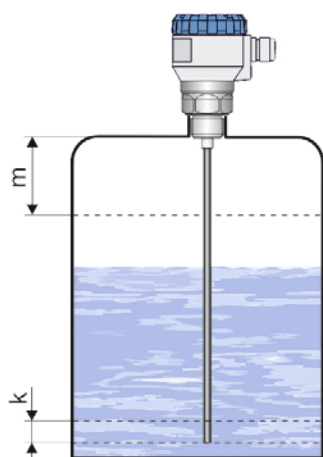


Fig. 3: Level meter dead zone with rod electrode

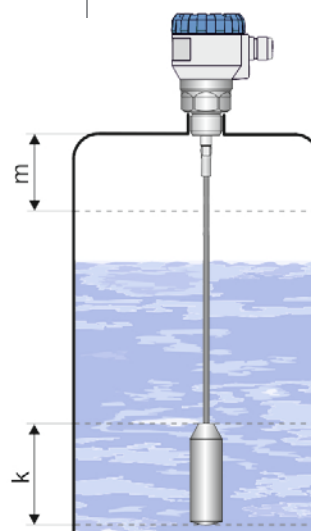


Fig. 4: Level meter dead zone with rope electrode

INPUT NECK

For correct measurement it is important to avoid installation in the high neck. For short neck are recommended next conditions: $a < b$, $b > 50$ mm, where a is the neck height and b is the neck width



If you can not eliminate all interference, which could affect the measurement of level, it is recommended to use the procedure "TEACHING" (see chap. 10.2 Service settings). This procedure sets the level meter to mode, which suppresses false reflections.

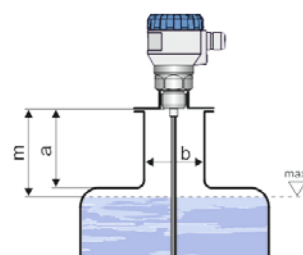
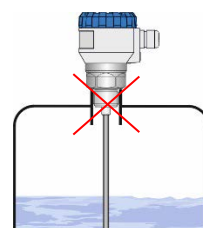


Fig. 5: Level meter installation in the input neck

The end of the socket or the welding flange must not have an extension into the tank in Fig. 6.



All types
Except
EMKOTDR-60-20

Fig. 6: Incorrect welding flange mounting to the tank

NON-METAL TANK

For level meter installation in non-conductive tanks it is necessary to use a metal sheet (diameter greater than 200 mm) beneath the process fitting when screwing it in. Make sure that the plate has direct contact with the process fitting.



All types
Except
EMKOTDR-60-20

Fig. 7: Incorrect welding flange mounting to the tank

CONCRETE SILO

For installation of the level meter on a concrete roof the diameter $\varnothing$ of the hole must be greater than the thickness a of the concrete, see Fig. 8.

If the thickness a of the concrete is greater than the diameter $\varnothing$ of the hole, install the level meter in a recess, see Fig. 9.

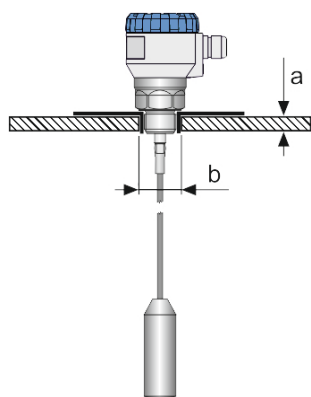
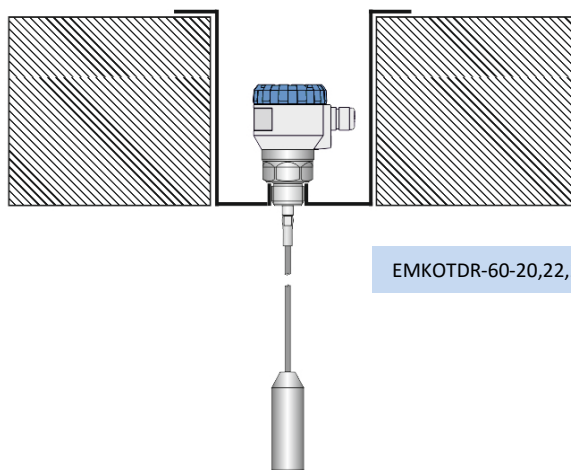


Fig. 8: Level meter installation on the roof of the concrete silo



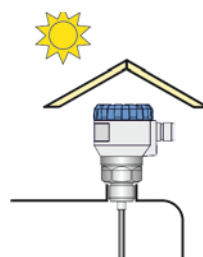
EMKOTDR-60-20,22,23

Fig. 9: Level meter installation on the roof of the concrete silo

LEVEL METER PROTECTION

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 inevitable, it is necessary to mount a **shielding cover** above the level meter.



All types

Fig. 10: Solar radiation shielding cover

OUTSIDE THE INFLUENCE OF FILLING

Do not install the level meter in or above the filling stream. The inflowing product can influence the measurement of the level meter.

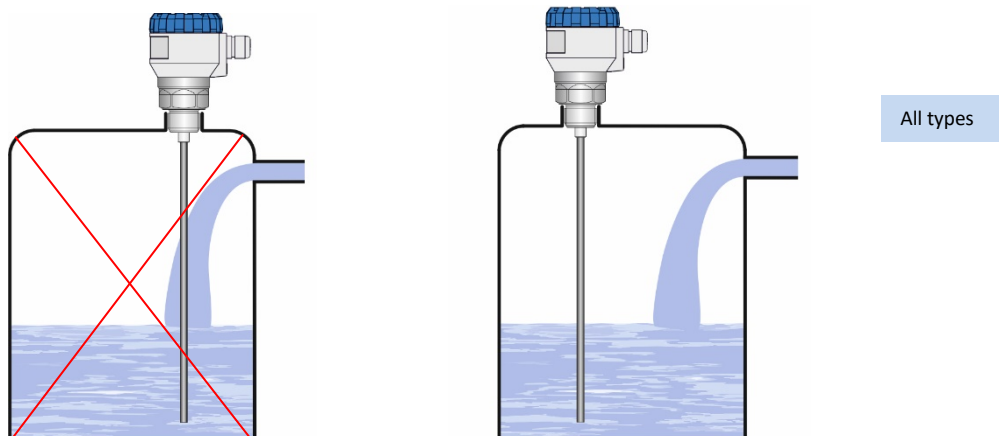


Fig. 11: Level meter installation outside the influence of filling

OBSTACLES IN THE TANK

The level meter generates electromagnetic guided wave, which creates an electromagnetic field along the electrode. Objects placed close to the electrode disturb the electromagnetic field and thus affect the measurement. Therefore, it is determined protective zone along the electrode of radius 300 mm. The level meter is recommended to install the tank so that the items placed inside the tank (ladders, various partitions, mixers, etc.) does not intervene into the protective zone, see Fig. 12.

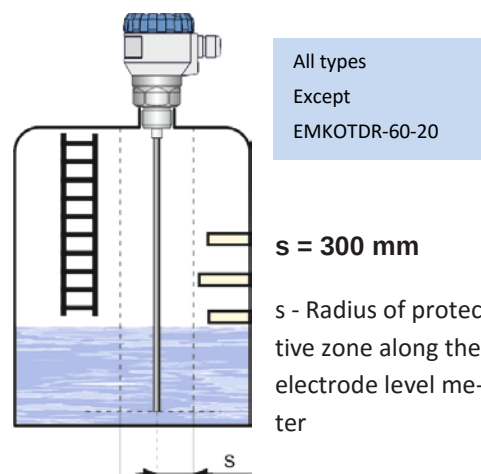


Fig. 12: Level meter installation outside obstacles in the tank

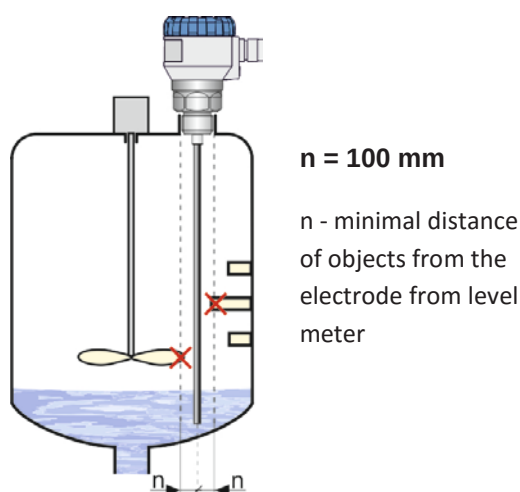
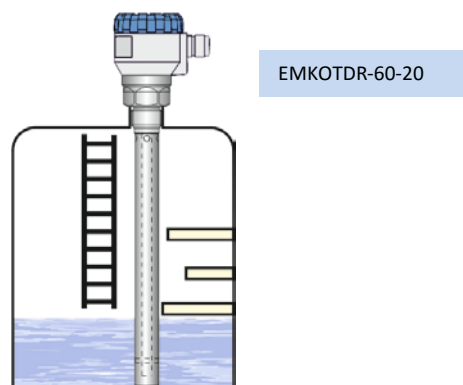


Fig. 13: Incorrect level meter installation close to obstacles

If still these objects intervene into the protective zone of the level meter, it is necessary to create a map of false reflections by activating the "TEACHING" mode (p. 16). In case of installed mixers, it is necessary to position the mixers near the level meter (turning the mixer blade to the proximity of the electrode). Items inside the tank must not be from the electrode distance of less than 100 mm, because a interference of electromagnetic field is very strong in this zone and "TEACHING" mode can not be used.

CRAMPED SPACES

For the type of level meter **with reference tube** electromagnetic guided wave propagates inside the reference tube. This wave is not affected by the ambient environment. So for this type of radar is not intended protective zone around the electrodes and the level meter can be used for measurements in **cramped spaces**.



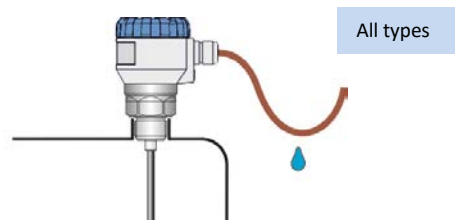
EMKOTDR-60-20

Fig. 14: Level meter installation with reference tube in cramped spaces

HUMIDITY

It is suitable to run the cable under a cable bushing (obliquely down in slack) according to Fig. 15 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.



All types

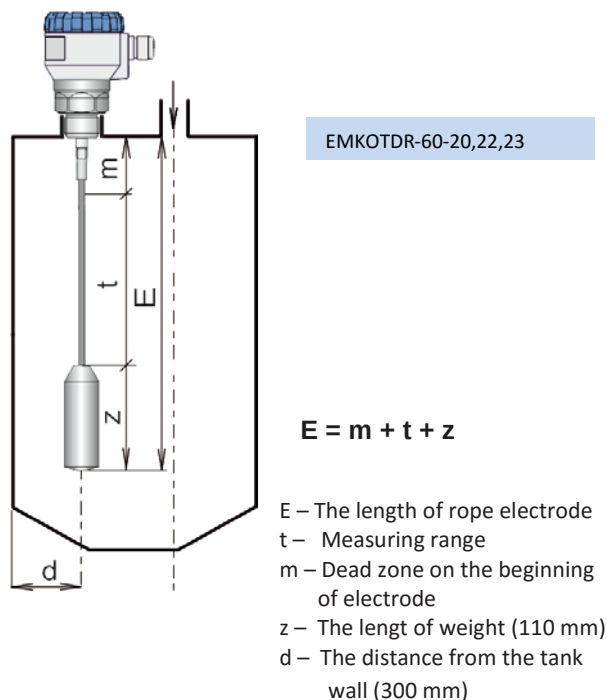
Fig. 15: Prevention to avoid intrusion of humidity through cable gland

DEEP TANKS AND SILOS

For installation of the level meter with rope electrode into deep tanks and silos the length of the electrode must be selected so that **the weight** will be below the minimum measured level, see Fig. 16.

The distance the electrode from the tank wall must be at least 300 mm. Otherwise, the level meter install as far as possible from the walls, to the middle between the wall and the vertical inlet, see Fig. 16. It must be ensured that the rope electrode could not touch the vessel wall caused by the motion of the medium.

Take care does not exceed the maximum tensile load of the rope electrode. The value of the max. tensile strength is specified in chapter "Technical specifications". High loads can break the rope. Tensile load depends on the height and shape of the tank, the density and adhesion of the medium and the rate at which the tank is emptied.



EMKOTDR-60-20,22,23

$$E = m + t + z$$

- E – The length of rope electrode
- t – Measuring range
- m – Dead zone on the beginning of electrode
- z – The length of weight (110 mm)
- d – The distance from the tank wall (300 mm)

Fig. 16: Level meter installation with the rope electrode

ROPE ELECTRODE WITH ANCHORAGE

For installation of the level meter with rope electrode with anchorage into deep tanks and silos it is recommended to place the anchorage closer to axis of the silo than is the position of level meter. See Fig. 17. This mounting will reduce the side forces of the media on the rope electrode.

In case of anchoring we recommend to preload the rope electrode by tension force of about 100 N.



Rope electrode level meter must untangle and then can be inserted into the tank.

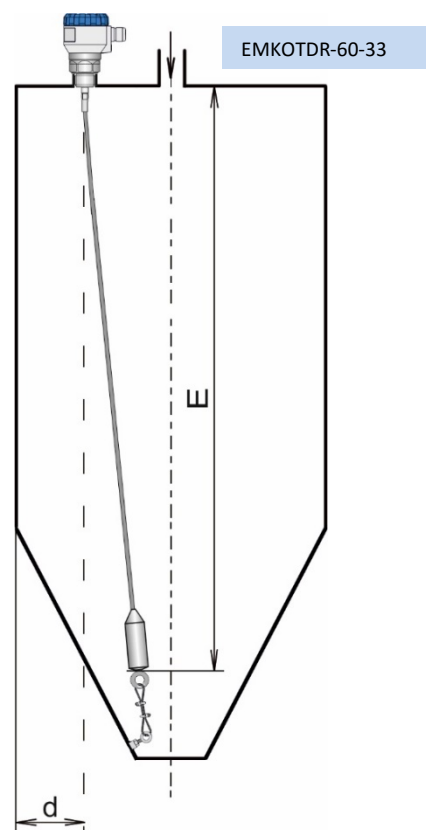


Fig. 17: Recommended Level meter installation with anchorage

VARIANT WITHOUT ELECTRODE

Type of level meter without electrode is supplied without an electrode. It is therefore necessary to a customer to mount his own made measuring electrode. The diameter of the electrode must be between 8-10 mm. For a connection it is necessary that on the electrode is made M8 thread. The connection procedure is given in Sec. 12 page 22.



For the type of level EMKOTDR-60-00 manufacturer is not responsible for failures related to the mounted measuring electrode.

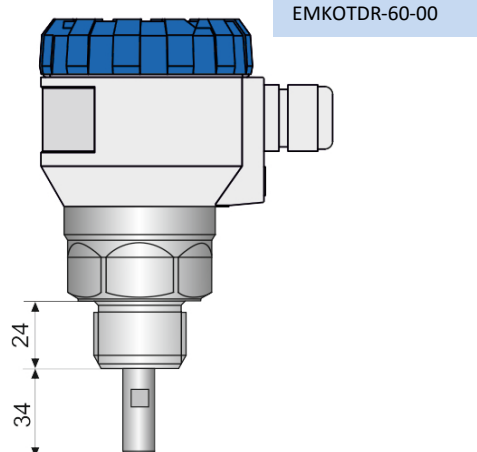


Fig. 18: Level meter without electrode

7. Electrical connection

The level meter is designed to be connected to supply unit or to controller through a cable with the outer diameter of 6 ÷ 8 mm (recommended cross-section of cores 0.5 ÷ 0.75 mm²) by means of bolted clips placed under display module. Connect the plus pole (+U) to the terminal (+), the minus pole to 0 V to the terminal (-) and the shielding to the terminal (-) and the shielding to the terminal ($\perp$) (only for shielded cables).

Procedure to connect the cable to the level meter:

1. Unscrew the nut of the upper 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 bushing and thread the stripped supply cable in.
5. Connect the cable into the bolted clips according to the diagram in Fig. 20. Tighten the bolted clips and the cable bushing.
6. Insert display module to the level meter.
7. Slip the silicone seal on thread of level meter and tighten the nut of the upper lid. Connect the cable to the sequential unit.

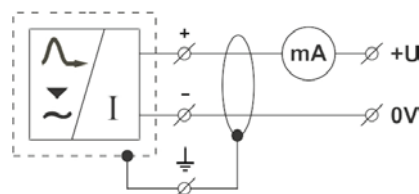


Fig. 19: Connection diagram of the level meter

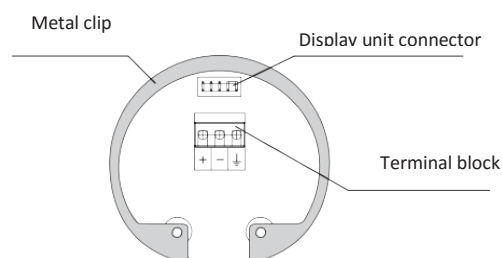
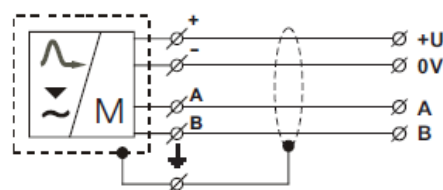
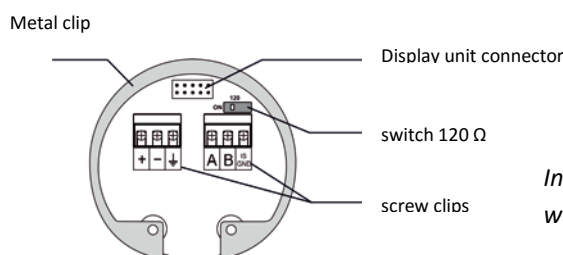


Fig. 20: Internal view of terminal block



Connection diagram of the level meter with Modbus EMKOTDR-60_--_-M



Internal view of terminal block of the level meter with Modbus communication EMKOTDR-60_--_-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 for explosive areas (EMKORDR-60Xi_--_-I), level meters must be grounded with ground terminal! It will be done using a screw placed on the head of the level meter under the cable bushing.



The voltage source should be preferably realized as a stabilized power supply unit with safe voltage from 18 to 36 V DC, 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. Set-up elements

Set the level meter using 3 buttons placed on the display module. All settings are accessible in the EMKOTDR-60 set-up mode access.

button



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

button

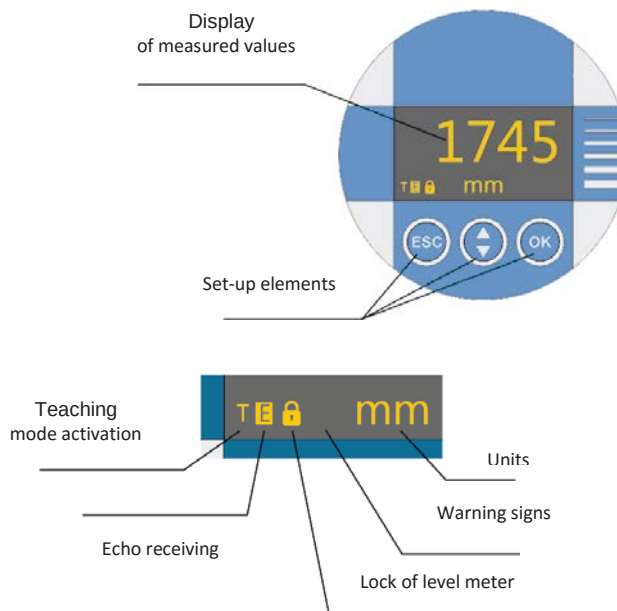


- Move in the menu
- Change of values

button



- Cancelling of carried out changes
- Shift one level up



* Slow flashing while the reflected signal (echo) is received from the measured level.



The type of level meter EMKOTDR_ _ _ _ -I-B is supplied without a display module DM-70. To set the level meter it is required to join the display module. Once set, the display module can be disconnected and the level meter can measure without him.

9. Status signalization

displej	funkce
„NO ECHO“	Lighting intermittently – the level meter is not able to receive echo for a long time. Incorrect installation of the level meter.
„NO PASSWORD“	It will appear in the item "MENU" – the level meter is protected using a password against unauthorised setting. Enter the correct password.
„LOW POWER“	Low supply voltage level meter
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.

¹⁾ symbol appears in the lower left corner of the display

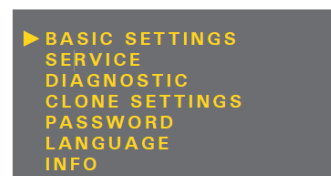
10. Setting

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  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 21. After connection of the supply voltage to the level meter the display shows the logo "EMKOMETER" and the text "Starting" (approx. 30 s). Then, the level meter goes to the measuring mode and the display shows the current measured value.



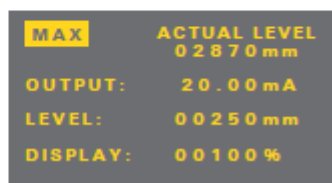
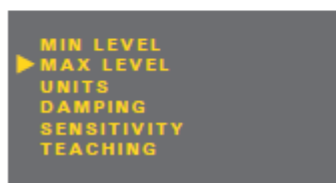
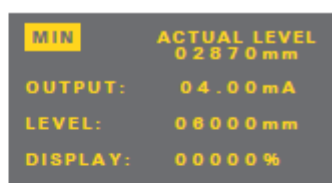
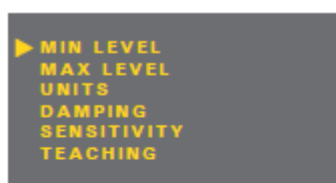
10.1. Basic settings

After the first start of the level meter it is necessary to perform the basic configuration (setting of the measuring range, choice of units, possibly damping, sensitivity and teaching). The settings are accessible in the basic menu by pressing the  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 showed 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

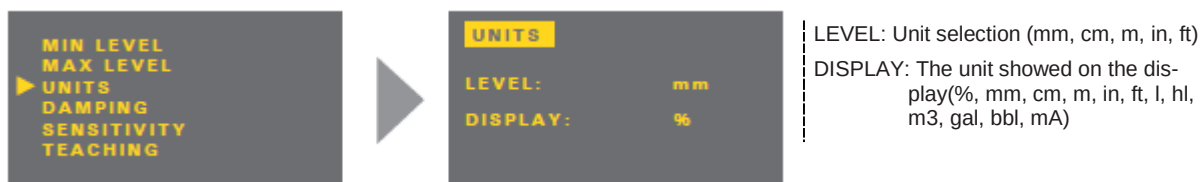
If in the bottom of the display appears (when entering the values) the inscription "OUT OF LIMITS", the value specified for the item "LEVEL" is outside the measuring range of the level meter. If the inscription "SPAN TOO SMALL" is shown, it must be specified a larger span between Min and Max values. 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  the same button to select "BASIC SETTINGS". Then, using  and  select "MIN LEVEL" or "MAX LEVEL".
2. Now it is shown the item "MIN LEVEL" ("MAX LEVEL"). By pressing  and  set the output current "OUTPUT", the distance for the defined current "LEVEL" the value on the display "DISPLAY".
3. By pressing  button save the data. By next presses of the button  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".



1. To enter to the menu press  the same button to select "BASIC SETTINGS". Then, using  and  select "UNITS".
2. Now the menu item "UNITS" is shown. By pressing the  and  button make the settings of individual items.
3. By pressing  button save the data. By next presses of the button  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.



1. To enter to the menu press  the same button to select "BASIC SETTINGS". Then, using  and  select "DAMPING".
2. Now the menu item "DAMPING" is shown. By pressing the  and  button make the settings of individual items.
3. By pressing  button save the data. By next presses of the button  leave the menu. The level meter returns to measurement mode.

SENSITIVITY

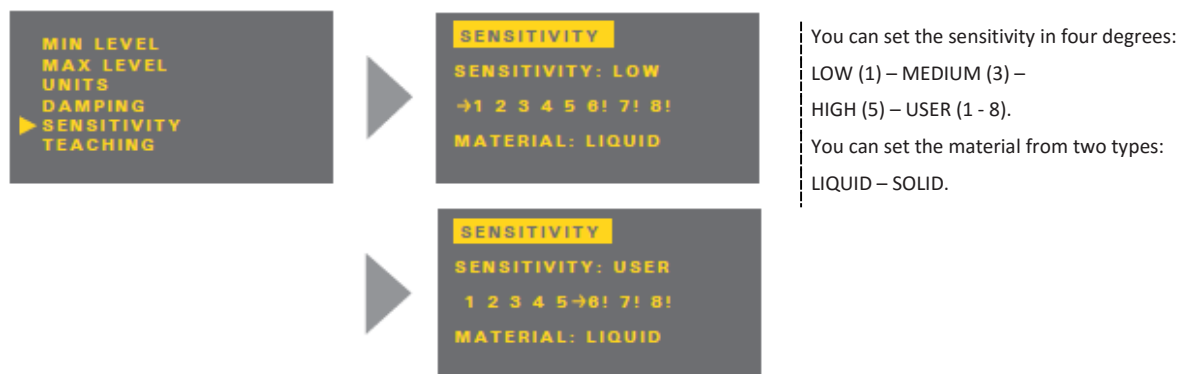
The setting is done using two parameters. At first the setting is defined in four steps of the level meter sensitivity. Three steps are basic sensitivity and fourth step contains user options.

STEP 1 - „LOW“ - Low sensitivity in case of surrounding interferences affecting the measurement.

STEP 3 - „MEDIUM“ - Medium sensitivity (suitable for most applications).

STEP 5 - „HIGH“ - Enhanced sensitivity for measured mediums partly absorbing the guided wave (foams)

STEP 1 - 8 - „USER“ - user freely adjustable sensitivity in eight steps



Then is set the the type of material. With this function, you can choose from two types of materials. If the measured material liquid (water, aqueous solutions, emulsions, oil, diesel, etc.) select LIQUID. If the medium is solid (grain, sand, flour, cement, granulates, etc.) select SOLID. Selecting the type of media takes into account the different reflective properties of the medium.

1. Pressing the button xxx is for enter the menu, press the same button to select the item "BASIC SETTINGS". Then by pressing the buttons xxx and xxx is selected the item "SENSITIVITY".
2. Using the buttons xxx and xxx set the proper sensitivity..
3. After switching the sensitivity to step "USER", the user can move through different (eight) levels of sensitivity by pressing xxx. Press xxx to confirm the selection..
4. Next using the xxx and xxx buttons is set the type of material.
5. After completion of setting pressing of the xxx button saves the setting. Continue by pressing xxx to exit a menu and the level meter returns to the measuring mode.

 Sensitivity steps 6-8 are highly sensitive, so use them only in exceptional cases for media with a low dielectric constant, or after consultation with the manufacturer.

 Table of recommended sensitivity according to rel. permittivity of the medium is given on page 32

TEACHING

The mode serves for suppressing false reflections resulting from reflection of the guided wave from roughnesses on walls of the tank, various partitions, mixers, other obstacles, or if distance electrode from the wall of tank is lower than 300 mm. 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 completely.



1. To enter to the menu press **OK** the same button to select "BASIC SETTINGS". Then, using **↕** and **OK** select "TEACHING".
2. Now the menu item "TEACHING" is shown. After pressing the button **OK** you are asked if you are sure to run the "TEACHING" procedure. By pressing **OK** button the system starts "teaching".
3. 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**.

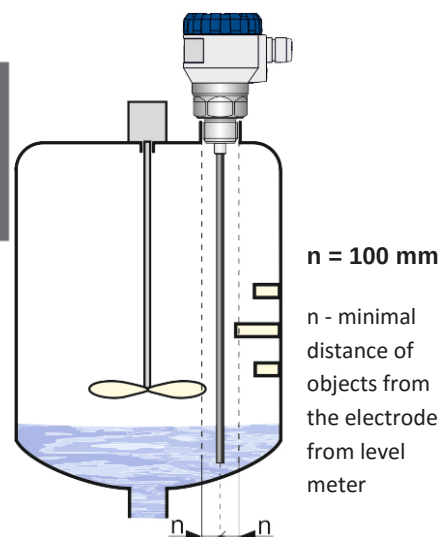


Fig. 21: Turning the mixer blade to the proximity of the electrode before activation "Teaching" mode

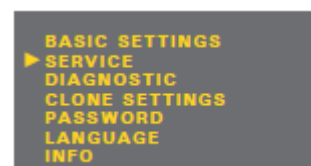
Before starting the mode, it is necessary to completely empty the tank!

In case of installed mixers, it is necessary to position the mixers near the level meter (turning the mixer blade to the proximity of the electrode).

Note: If there are significant obstacles in the upper half of the tank, multiple false reflections can occur especially in closed tanks.

10.2. Service 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".



ELECTRODE

Setting of the length and type of the electrode. The function is used when is needed to change the length (e.g. shortening of the electrode), or the type of electrodes (e.g. exchange of rod and rope type of electrode).



Before setting of the length and type of the electrode it is first necessary to empty the tank in which the level meter is placed, since in this tank will be necessary to run the procedure "TEACHING".

First, choose the type of electrode.

„ROD“ – for rod-electrodes of type 10

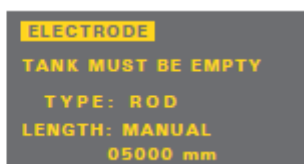
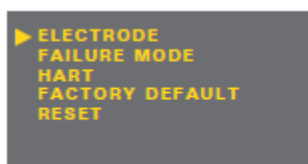
„ROPE“ – for rope-electrodes type 30

„ANCHORED ROPE“ – for anchored rope electrode type 33



The function of Autodetection can only be used for electrodes longer than 500 mm.

Then set the length of the electrode. Either select the "AUTO DETECTION" and the level meter will measure the length of the electrode itself, or select the "Manual" and the length of the electrode must be entered manually via the display module.



You can choose type of electrode from three options: ROD – ROPE – ANCHORING ROPE. You can enter the length of electrode by two ways: MANUAL – AUTO DETECTION.



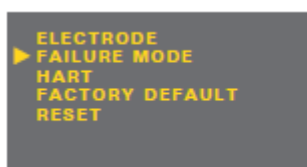
The procedure for replacing or shortening the electrode is given in chapter 12 on page 22.



When the setting of the type and length of the electrodes is carried out outside the tank it is required to insert a metallic plate (with diameter greater than 200 mm) in the place of process connection (thread) before this setting - see Fig. 7. The metal plate must be in good electrical contact with the thread.

FAILURE MODE

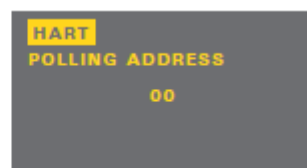
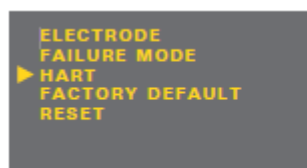
It defines the output current of the level meter in case of echo loss ("NO ECHO").



NO ECHO: Current in case of echo loss
The values can be set in five steps:
3,75 mA – 4 mA – 20 mA –
– 22 mA – LAST (last measured data).

HART

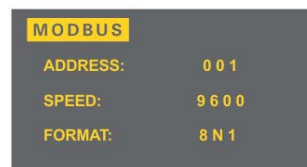
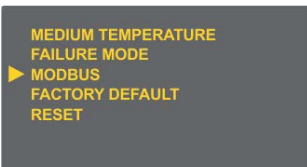
HART® mode (point to point, multidrop) and multidrop mode address setting. Up to 15 units can be connected to one two-wired cable in the multidrop mode.



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.

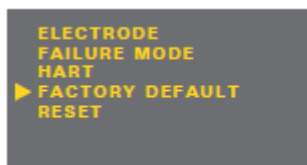
MODBUS

This item is a part of the level meter menu which has a MODBUS output (e.g. EMKOSONIC-60_ _ _ -M). There is a possibility to adjust an MODBUS address of the level meter, data rate and parity settings.



FACTORY DEFAULT

To reset the initial values of the level meter set by the manufacturer, press the button  (see the Factory default table, p. 32).



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



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 .



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

10.3. Additional functions

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, language version and information about the level meter version. All of the functions are accessible from the main menu.

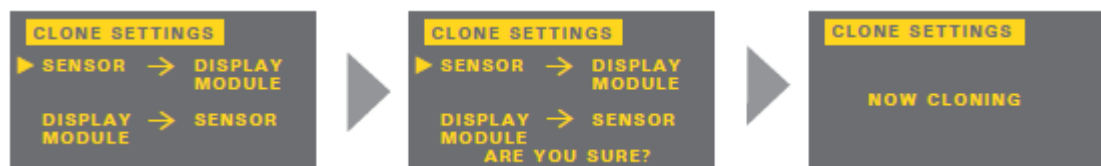
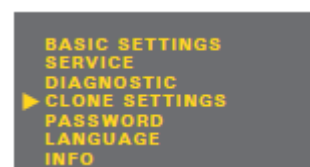
DIAGNOSTIC

It contains informations about actual value of distance to level from level meter "DISTANCE TO LEVEL" and about current flowing through the loop "CURRENT". It can be used for example to check the settings of the connected evaluation device or diagnose any problem with the measurement level.



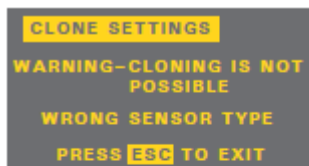
CLONE SETTINGS

This mode is intended for copying of the level meter (EMKOTDR-60 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). The "CLONE SETTINGS" mode transfers all data, excluding setting of the "Teaching" and HART®.

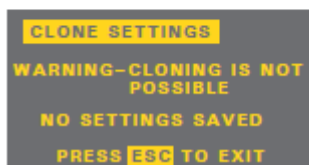


1. Press  to enter the menu and select the item "CLONE SETTINGS". Copying of the settings from the body of the level meter to display module is done by selecting "SENSOR → DISPLAY MODULE". To transfer the settings from the display module to another level meter select the item DISPLAY MODULE → SENSOR.
2. The selected mode starts by pressing button  During transmission the display shows "NOW CLONING".

- 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 .



Incompatible type of level meter and length of electrode. Transfer of the settings can be realized only with the same type of level meter and with same length of electrode.



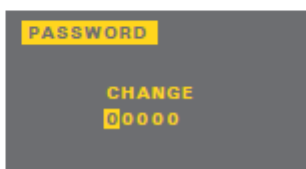
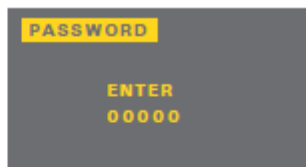
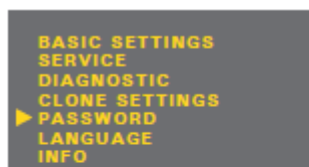
The data set is not stored into the display module (DM-70). The transfer can not be done. It is necessary to repeat the procedure of the copying the settings in the mode "CLONE SETTINGS".

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.

- Use the buttons  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  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.
- Now you can edit the password. The actual edited item is displayed inversely. Press the button  to move to the next position (clockwise direction), button  serves to change the values (0 ... 9).
- After the operation is completed, confirm the edited data by pressing the button .



Display of status information to confirm data:

"YES" – correctly edited password

"NO" – incorrectly edited password

"OK" – the password saved (only in case of "CHANGE")

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".

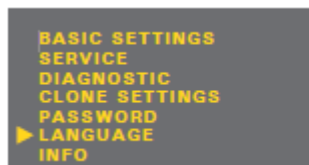


The level meter with activated password will be automatically locked after 5 minutes of inactivity or after 5 min. from switching to measuring mode. Locking of level meter is indicated in the lower left corner of the screen by the symbol .



If the password is lost, contact the manufacturer.

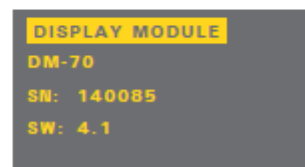
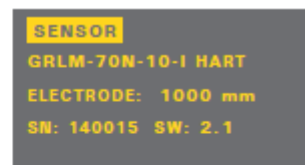
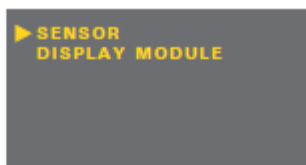
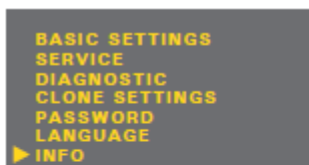
LANGUAGE



Setting the language of display menu.
You can set three kinds of language:
ČESKY – ENGLISH – по русски

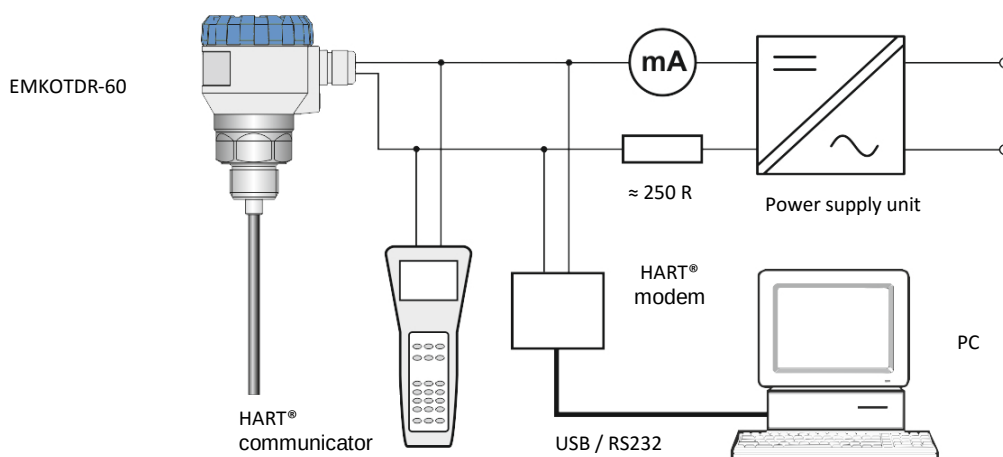
INFO

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



11. HART® communication protocol

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.



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.

12. The installation of the custommeasuring electrode, exchange or shortening of the electrode

The installation of the custom measuring electrode, - applies to type 00

1. Create your own electrode as shown on Fig. 24. The length of the electrode must be about 7 mm shorter than the dimension "E" in figure 23. The material of the electrode is recommended to be used stainless steel type 1.4571 (AISI 316 Ti) or similar depending on the application.
2. On the thread of prepared electrode, apply thread glue for securing threaded fasteners (glue quantity is specified by the manufacturer). The adhesive must meet the requirements depend on the specific application, for example: withstanding high temperatures, corrosive chemicals, resp. contact with food.
3. Screw the electrode using suitable pliers or a spanner (on the side of the electrode) and a flat spanner 10 mm (on the side of the electrode holder) firmly into the electrode holder.
4. Let the glued junction to harden, as recommended by the glue manufacturer, then the level meter is ready for installation.
5. After an installation into an empty tank, set a new level meter electrode type and the length - see Chap. 10.2. ELECTRODE
6. If necessary, enter a new range of level measurement - see Chap. 10.1. MIN / MAX LEVEL.

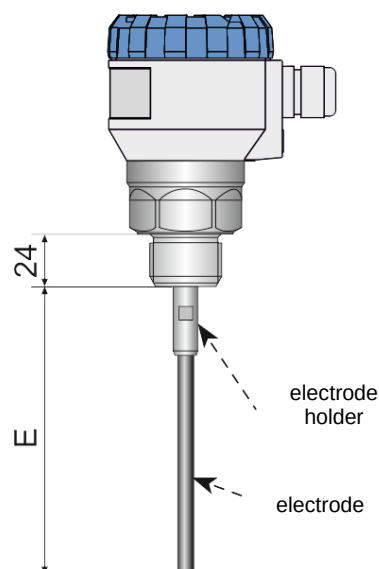


Fig. 23: Drawing of the level meter with size "E"

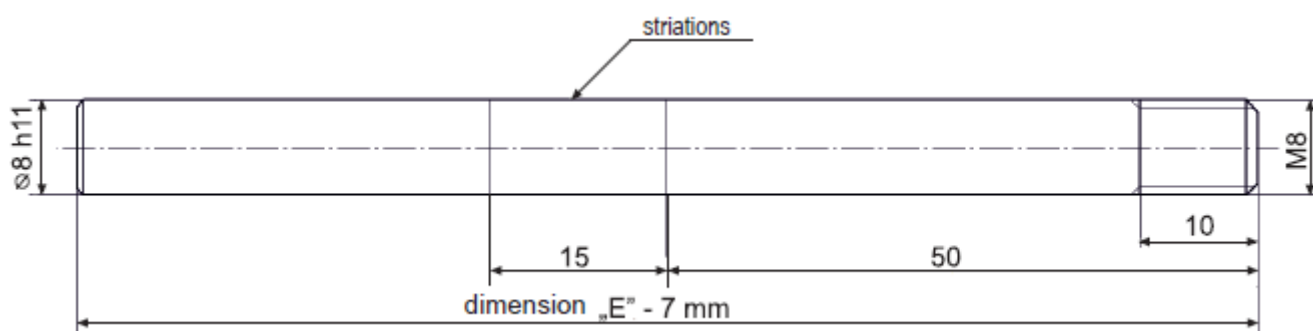


Fig. 24: The drawing of the measuring electrode marked with the threaded connection and grooving

The procedure of replacement of the measuring electrode - applies only to versions 10, 30, 33

1. Heat the junction place (threaded connection) of the electrode and the electrode holder (see Figures 25 and 26) using a heat gun at about 120-150 ° C (or 220-250 ° C for high temperature version).
2. Unscrew the electrode using suitable pliers (for rod electrodes) or flat spanner 7 mm (in case of rope electrode) and a flat spanner 10 mm (on the side of the electrode holder) away from the electrode holder.
3. Apply the glue for securing of threaded fasteners (glue quantity specified by the manufacturer) to the thread of the new electrode (made acc. Fig. 24.). The used glue must meet the requirements depend on the specific application, for example: withstanding high temperatures, corrosive chemicals, resp. contact with food.

4. Screw the electrode using suitable pliers or a spanner (on the side of the electrode) and a flat spanner 10 mm (on the side of the electrode holder) firmly into the electrode holder..
5. Let the glued junction to harden, as recommended by the glue manufacturer, then the level meter is ready for installation.
6. After an installation into an empty tank, set a new level meter electrode type and the length - see Chap. 10.2. ELECTRODE
7. If necessary, enter a new range of level measurement - see Chap. 10.1. MIN / MAX LEVEL.

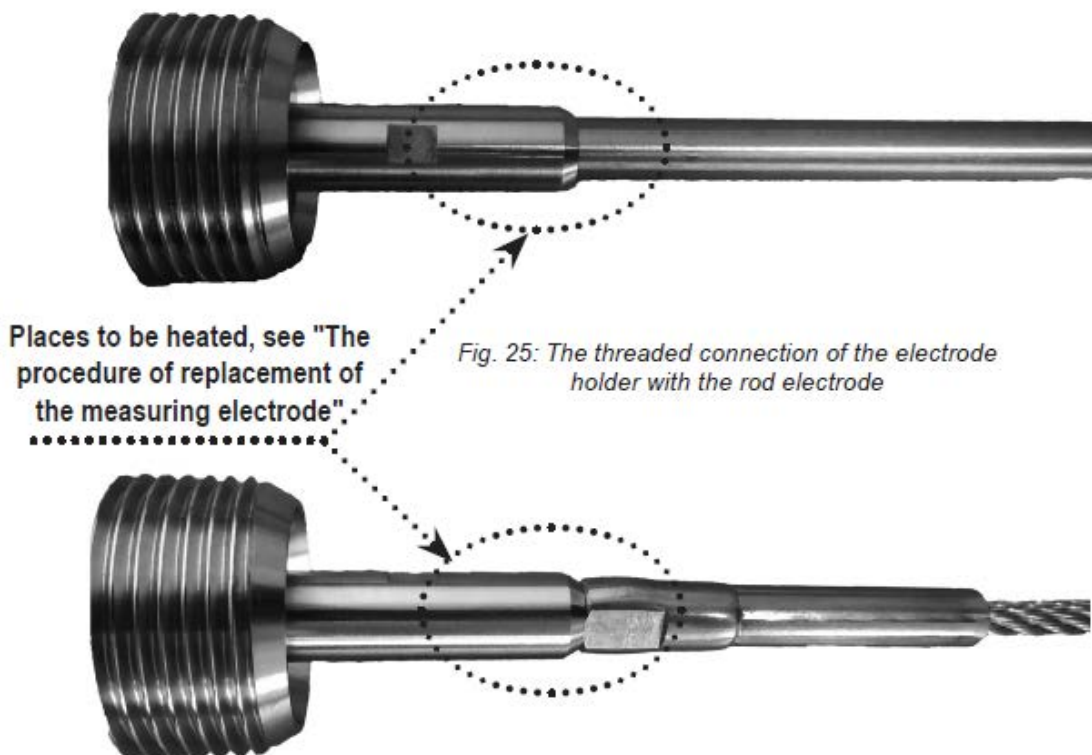


Fig. 25: The threaded connection of the electrode holder with the rod electrode

Fig. 26: The threaded connection of the electrode holder with the rope electrode

Shortening of the measuring electrode - applies only to versions 10, 30, 33

1. If necessary, remove the rod or rope electrode from the electrode holder - see points 1 and 2 of "The procedure of replacement of the measuring electrode"
2. Rod electrodes are advised to be shortened by using a suitable hacksaw and deburr the end of the electrode. For the rope electrode is needed to loosen three fixing screws on the weight and pull out the rope end, see Figure 27. Make sure that the rope length after trimming is correct - the cable is embedded in weight to approx. 60 mm. Shortening the rope is best done by means of side cutting pliers. Take care to avoid fraying of the rope end.
3. Insert the end of the rope into the weight again and secure by tightening of the three screws.
4. If you unmounted the electrode from the electrode holder, re-assemble them - see paragraphs 3 to 7 of "The procedure of replacement of the measuring electrode"

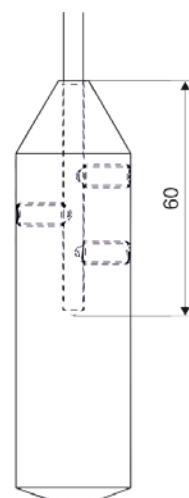


Fig. 27: Scheme of the weight for the rope electrode

Maximum output parameters of intrinsically safe units must correspond with limit input parameters of the level meter. In the evaluation of intrinsic safety of the circuit must be taken into account the parameters of the connected cable (especially its inductance and capacitance).

The electrode part of the EMKOTDR-60Xi (XiT) can be placed in zone 0, the body with electronics can be placed in zone 1. In zone 20 can be placed whole level meter.

16. 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.



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



It is forbidden to perform any modifications or interventions into the EMKOTDR-60 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 EMKOTDR-60 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.

17. Marking of labels

Level meters label data

EMKOTDR-60N(T)

Symbol of producer: logo Emkometer

Internet address: www.emkometer.cz

Country of origin: Made in Czech Republic

Level meter type: EMKOTDR-60N__-G-I E_____ or EMKOTDR-60N__-G-M E_____

Serial number: Ser. No.: _____ – (from the left: production year, serial production number)

Supply voltage: $U = 18 \dots 36 \text{ V}$

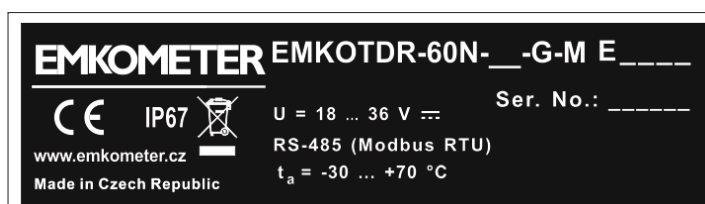
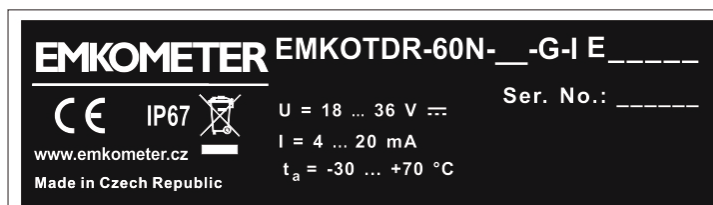
Output current range: $I = 4 \dots 20 \text{ mA}$

Ambient temperature range: $t_a = -30 \dots +70 \text{ }^{\circ}\text{C}$

Protection class: IP67

Compliance mark:

Electro-waste take-back system mark:



Level meters label data

EMKOTDR-60Xi (XiT):

Symbol of producer: logo Emkometer

Internet address: www.emkometer.cz

Country of origin: Made in Czech Republic

Level meter type: EMKOTDR-60Xi-__-G-I E ____

Serial number: Ser. No.: ____ (from the left: production year, serial production number)

Supply voltage: $U = 18 \dots 36 \text{ V}$

Output current range: $I = 4 \dots 20 \text{ mA}$

Limit operating parameters: $U_i = 30 \text{ V}$, $I_i = 132 \text{ mA}$; $P_i = 0,99 \text{ W}$; $C_i = 370 \text{ nF}$; $L_i = 0,9 \text{ mH}$

Ambient temperature range: $t_a = -30 \dots +70 \text{ }^\circ\text{C}$

Label of non-explosive device: 

Performance: II 1/2 G Ex ia IIB T5 Ga/Gb

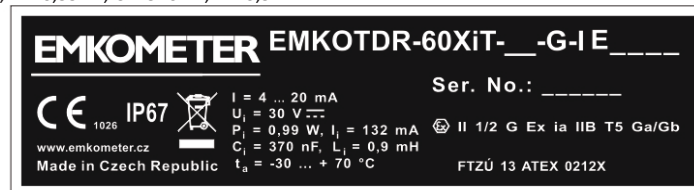
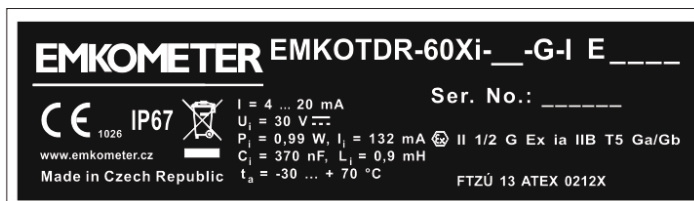
Number of certificate of intrinsically safety:

FTZÚ 13 ATEX 0212X

Protection class: IP67

Compliance mark:  , No. of authorized person examining control of system quality: 1026

Electro-waste take-back system mark: 



Level meters label data

EMKOTDR-60Xd (XdT):

Symbol of producer: logo Emkometer

Internet address: www.emkometer.cz

Country of origin: Made in Czech Republic

Level meter type: EMKOTDR-60Xd-__-G-I E ____

or EMKOTDR-60Xd __-__-G-M E ____

Serial number: Ser. No.: ____ (from the left: production year, serial production number)

Supply voltage: $U_i = 18 \dots 36 \text{ V}$

Output current range: $I = 4 \dots 20 \text{ mA}$ or

Data communication: RS-485 (Modbus RTU)

Ambient temperature range: $t_a = -30 \dots +70 \text{ }^\circ\text{C}$

Label of non-explosive device: 

Performance: II 1 D Ex ta IIIC T85°C...T300°C Da

or II 1 D Ex ta IIIC T100°C...T300°C Da

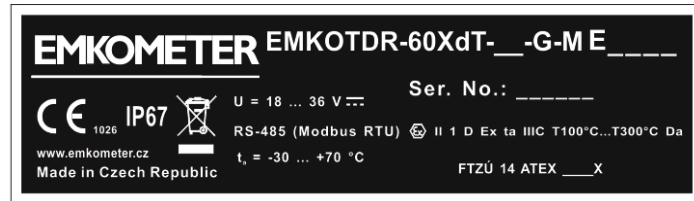
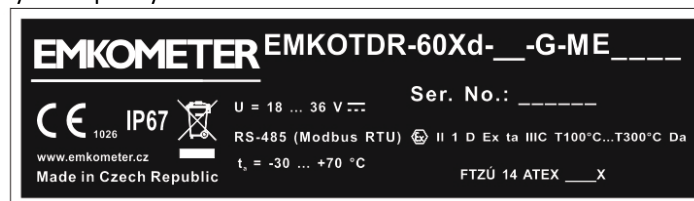
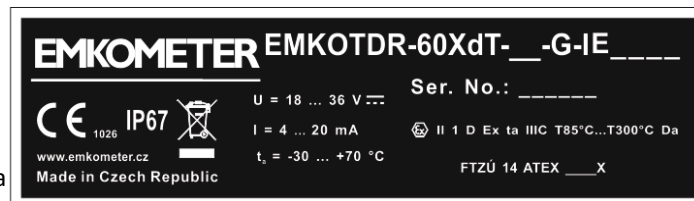
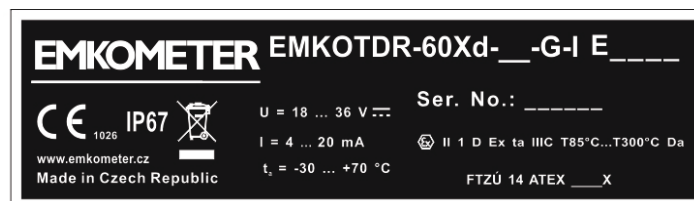
Number of certificate of intrinsically safety: FTZÚ 14 ATEX ____X

Protection class: IP67

Compliance mark:  ,

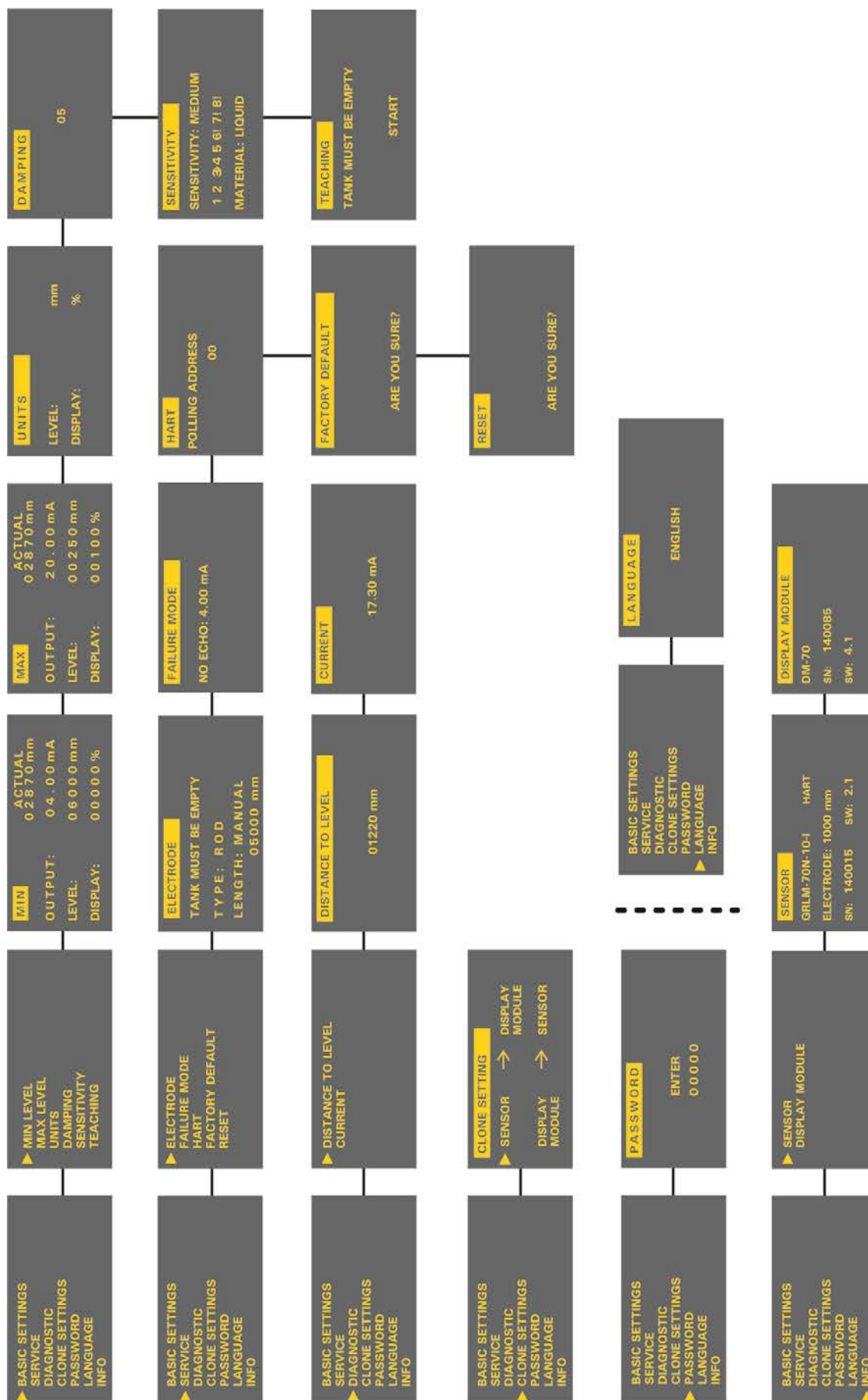
No. of authorized person examining control of system quality: 1026

Electro-waste take-back system mark: 



Real label size is 70x20mm.

18. Menu structure



19. Specifications

Technical specifications - level meter		
Supply voltage	EMKOTDR-60N-__	18 ... 36 V DC
	EMKOTDR-60Xi-__	18 ... 30 V DC
	EMKOTDR-60Xd-__	18 ... 36 V DC
Output	EMKOTDR-60-__-_-I	4 ... 20 mA, HART®
	EMKOTDR-60-__-_-M	linka RS-485 s Modbus RTU
Input	EMKOTDR-60-__-_-I	4 ... 20 mA / max. 22 mA
	EMKOTDR-60-__-_-M	30mA
Basic error ¹⁾ (for reference reflector)		
- EMKOTDR-60_-20 in area 0,1 – 0,2 m / 0,2 – 2,0 m / 2,0 – 40 m		± 5 mm / ± 3 mm / ± 2 mm
- other types in area 0,1 – 0,2 m / 0,2 – 2,0 m / 2,0 – 40 m		± 10 mm / ± 4 mm / ± 2 mm
Resolution		1 mm
Maximal length of measuring electrode	EMKOTDR-60_-10	8 m
	EMKOTDR-60_-11 (12)	2m
	EMKOTDR-60_-20	2 m
	EMKOTDR-60_-30 (33)	40 m
	EMKOTDR-60_-32	12 m
Dead zone ²⁾ - for measur. sensitivity	- low, medium, user (1 - 4)	100 / 0 mm ³⁾
	- high, user (5)	150 / 50 mm ³⁾
	- user (6, 7)	200 / 50 mm ³⁾
	- user (8)	250 / 50 mm ³⁾
Electrical parameters for variants Xi (XiT) – max. internal values		U _i =30V DC; I _i =132mA; P _i =0,99W; C _i =370nF; L _i =0,9mH
Measurement sensitivity (8 degrees)		low (1) - medium (3) - high (5) - user (1 - 8)
Failure indication (echo loss, internal failure)		Adjustable in modes: 3,75 mA, 4 mA, 20 mA, 22 mA, LAST ⁴⁾
Damping		1 .. 99 s
Warm up time		cca 60 s
Internal resistance / Electric strength (Electrode - Housing)		10 kΩ
Coupling capacity / Electric strength (Housing - Supply leads)		5 nF / 500 V AC
Maximal current output load resistance for	U = 24 V DC	R _{max} = 270 Ω ⁵⁾
	U = 22 V DC	R _{max} = 180 Ω
	U = 20 V DC	R _{max} = 90 Ω
Maximum tensile strength of the rope electrode		1400 kg
Utahovací moment kabelové vývodky	EMKOTDR-60N(NT,Xi,XiT)	3 Nm (plastic)
	EMKOTDR-60Xd(XdT)	7 Nm (metal)
Protection class		IP67
Process connection		screwing with thread G1"
Recommended cable	EMKOTDR-60-__-_-I	PVC 2 x 0,75 mm ²
	EMKOTDR-60-__-_-M	PVC 2 x 2 0,25 mm ² (twisted pair, electromagnetic shielding)
Weight (without electrode)		cca 0,5 kg (1 kg variant NT)

- 1) Error is larger at the beginning and end of the rod or rope electrode. More detailed informations can be found in Fig. 28 and 29.
- 2) Dead zone = Blind zone = Blocking distance
- 3) The length of dead zone at the begining / at the end of the electrode. (The length of dead zone is 110 mm at the end of rope electrode.)
- 4) Level meter displays last measured value.
- 5) Including 250R resistor in case of HART connection.
- 6) hatched space applies for set measurement sensitivities: low (1), moderate (3) or user (1-4). When the sensitivity set to high (5), or custom (5-8), the dead zone at the beginning and at the end of the electrode extends, see "Table of sensitivity of the measurement" on page 28.

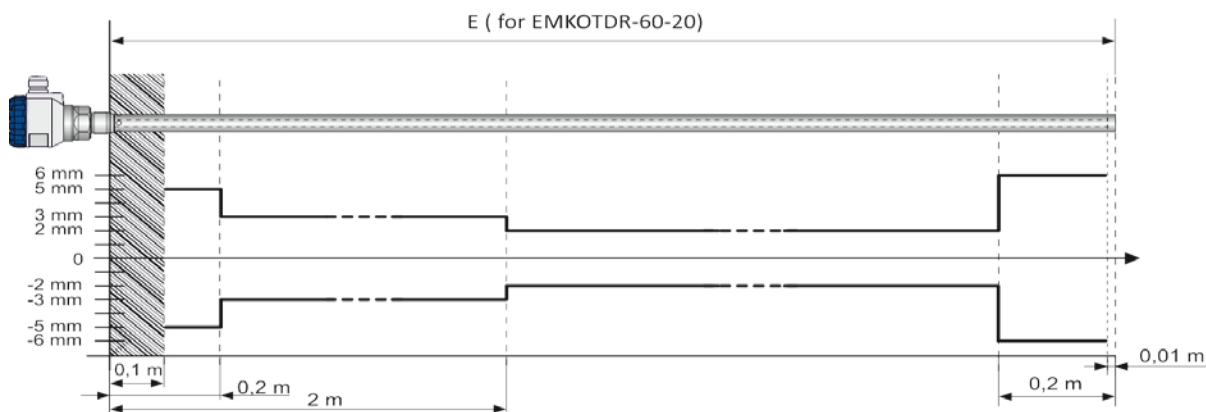


Fig. 28: The graph of the measurement errors along the rod electrode with reference tube

 - hatched place shows dead zone⁶⁾

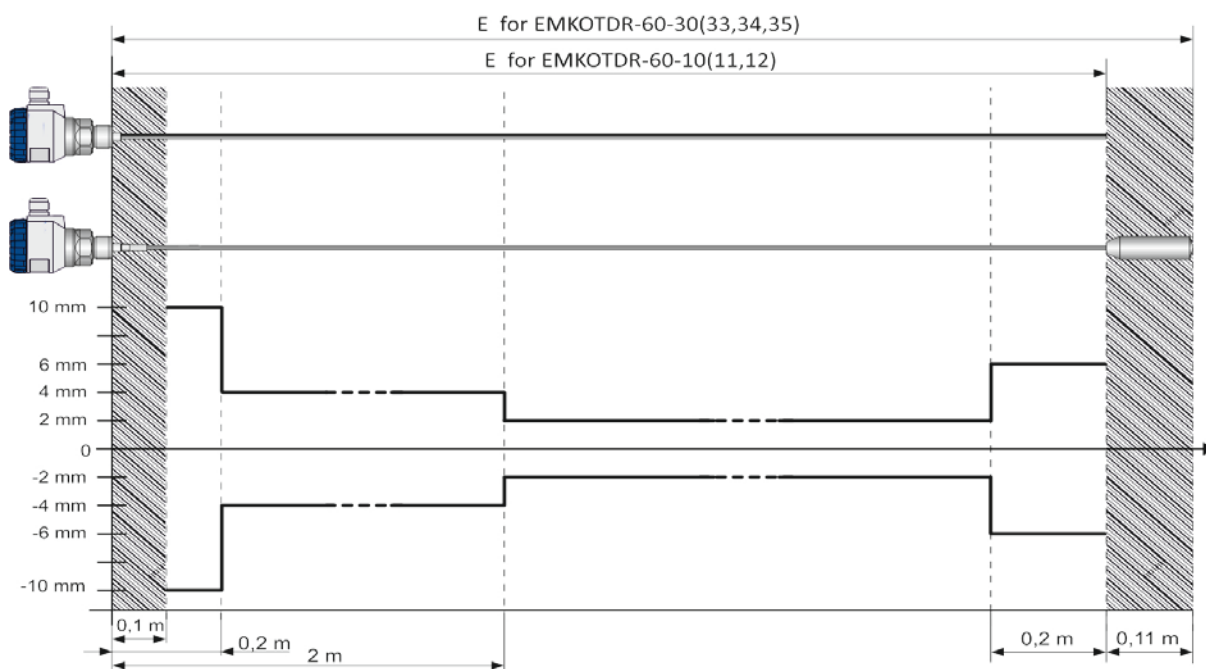


Fig. 29: The graph of the measurement errors along the rod and wire electrode

 - hatched place shows dead zone⁶⁾

Technical specifications - display modul

Type of display	matrix OLED
Resolution	128 x 64 pixels
Height of digits/ Number of display digits of measured values	9 mm / 5 digits
Colour of display	yellow
Type of buttons	membrane
Ambient temperature range	-30 ... +70°C
Weight	46 g

Used materials

Sensor part	Variants	Standard material
Lid	All types	aluminium with powder coating
Glass	All types	polycarbonate
Body	All types	aluminium with powder coating
Housing with thread	All types	St. Steel W. Nr. 1.4571 (AISI 316 Ti)
Electrode	EMKOTDR-60-10(11,20) EMKOTDR-60-12 EMKOTDR-60-30(32,33)	St. Steel W. Nr. 1.4571 (AISI 316 Ti) St. Steel W. Nr. 1.4301 (AISI 304) St. Steel W. Nr. 1.4404 (AISI 316 L)
Electrode coating	EMKOTDR-60-11 EMKOTDR-60-12 EMKOTDR-60-32 EMKOTDR-60-34,35	PFA FEP FEP PA
Reference tube	EMKOTDR-60-20	St. Steel W. Nr. 1.4301 (AISI 304)
Weight	EMKOTDR-60-30	St. Steel W. Nr. 1.4301 (AISI 304)
Weight coating	EMKOTDR-60-32	PTFE
Anchorage	EMKOTDR-60-33	St. Steel W. Nr. 1.4301 (AISI 304)
Display module	All types	plastic material POM

Device classification (according to en 60079-10-1 and en 60079-10-2)

EMKOTDR-60N	Basic design for non-explosive areas
EMKOTDR-60NT	High temperature performance for non-ex areas (max. 200°C)
EMKOTDR-60T Xi(XiT)	Performance for explosive areas (gases or vapour) II 1/2 G Ex ia IIB T6 Ga/Gb with ISSU electrode part zone 0, housing zone 1 and whole level meter zone 20
EMKOTDR-60Xd(SdTT)	Intrinsically safe version for potentially denegous area of dust ignition II 1D Ex ta IIIC T85 °C ... T300 °C Da (current) II 1 D Ex ta IIIC T100 °C ... T300 °C Da (Modbus), whole level meter zone 20

Temperature and pressure durability (performance N, Xi)

Variants / Performance	Temperature t_m	Temperature t_p	Temperature t_a	Max. operation pressure for temp. t_p	
				to 30°C	to 85°C
EMKOTDR-60-10(20)	-40°C ... +300°C	-40°C ... +85°C	-30°C ... +70°C	15 MPa	10 MPa
EMKOTDR-60-11(12)	-40°C ... +200°C	-40°C ... +85°C	-30°C ... +70°C	4 MPa	1,5 MPa
EMKOTDR-60-30(33)	-40°C ... +200°C	-40°C ... +85°C	-30°C ... +70°C	15 MPa	10 MPa
EMKOTDR-60-32	-40°C ... +130°C	-40°C ... +85°C	-30°C ... +70°C	1 MPa	0,5 MPa
EMKOTDR-60-34(35)	-40°C ... +95°C	-40°C ... +85°C	-30°C ... +70°C	15 MPa	10 MPa

Temperature durability (performance NT, XiT)

Variants / Performance	Temperature t_m	Temperature t_p	Temperature t_a
EMKOTDR-60T-10(20)	-40°C ... +300°C	-40°C ... +200°C	-30°C ... +70°C
EMKOTDR-60T-11(12)	-40°C ... +200°C	-40°C ... +200°C	-30°C ... +70°C
EMKOTDR-60T-30(33)	-40°C ... +200°C	-40°C ... +130°C	-30°C ... +70°C
EMKOTDR-60T-32	-40°C ... +130°C	-40°C ... +130°C	-30°C ... +70°C
EMKOTDR-60T-34(35)	-40°C ... +95°C	-40°C ... +130°C	-30°C ... +70°C

Note.: For proper function of the level meter must not exceed any of the following ranges of temperature (t_p , t_m or t_a).

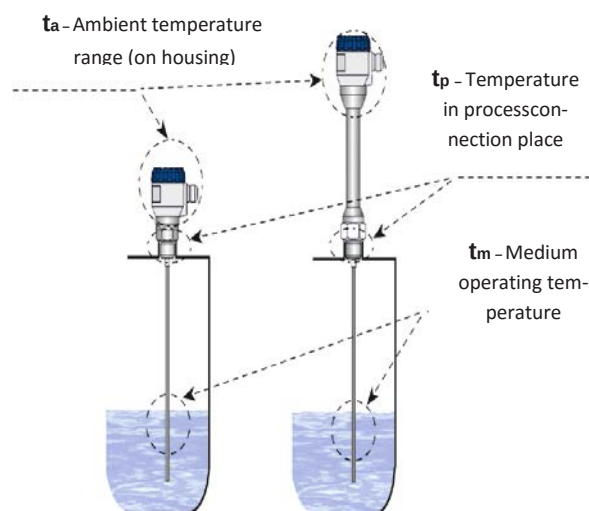
Maximal temperatures for performance

Xi(XiT) category 1/2G

Temp. class	Temperature t_p	Temperature t_m	Temperature t_a
T5	-40°C ... +90°C	-40°C ... +98°C	-30°C ... +70°C
T4	-40°C ... +125°C	-40°C ... +133°C	-30°C ... +70°C
T3	-40°C ... +190°C	-40°C ... +198°C	-30°C ... +70°C
T2	-40°C ... +200°C	-40°C ... +298°C	-30°C ... +70°C
T1	-40°C ... +200°C	-40°C ... +300°C	-30°C ... +70°C

Temperature of the device surface for performance Xd (XDT) category 1D

Part of the level meter	Temperature of the device surface
Electrode	
EMKOTDR-60_ _ _ -I	Medium temperature t_m +5°C
EMKOTDR-60_ _ _ -M	Medium temperature t_m +10°C
Head, electronic module	
EMKOTDR-60_ _ _ -I	t_p +15°C t_a +15°C
EMKOTDR-60_ _ _ -M	t_p +30°C t_a +30°C



The maximum allowable temperature of the medium, process connection and ambient temperature depends in EMKOTDR-60Xi (XiT) at the desired temperature class (see tab. Maximum temperatures for the performance Xi (XiT) category 1/2G and tab.). The temperature value can not be exceeded, because the hot surface of the device could cause ignition of an explosive or flammable atmosphere. At the same time can not exceed the maximum temperature for the different variants of the electrodes (Table of temperature durability).

Pressure durability (performance NT, XiT)					
Variants / Performance	Max. operation pressure for temp. tp				
	to 30°C	to 85°C	to 130°C	to 160°C	to 200°C
EMKOTDR-60T-10(20)	15 MPa	10 MPa	3 MPa	2 MPa	1 MPa
EMKOTDR-60T-11(12)	4 MPa	1,5 MPa	2 MPa	1,5 MPa	0,3 MPa
EMKOTDR-60T-30(33)	15 MPa	10 MPa	3 MPa	-	-
EMKOTDR-60T-32	1 MPa	0,5 MPa	0,1 MPa	-	-

Factory default	
EMKOTDR-60_ _ _	
MIN LEVEL (Distance to min. level)	according to the length of the rod (rope) electrode
MAX LEVEL (Distance to max. level)	100 mm
UNITS	mm; %; °C
DAMPING	2
SENSITIVITY	MEDIUM
MEDIUM	LIQUID
FAILURE MODE – NO ECHO	4,00 mA
POOLING ADDRESS (HART®)	00
PASSWORD	No password

Recommended sensitivity depending on the dielectric constant of the medium			
Degrees	Sensitivity	Dielectric constant of the medium	
		for length of electrode to 20	for length of electrode over 20 m
8!	USER (extreme)	1,8 .. 1,9	2 .. 3
7!	USER (extreme)	1,9 .. 2	4 .. 6
6!	USER (extreme)	2 .. 3	6 .. 8
5	HIGH	3 .. 4	8 .. 10
4	USER	4 .. 6	10 .. 13
3	MEDIUM	6 .. 8	13 .. 16
2	USER	8 .. 10	16 .. 20
1	LOW	10 and more	20 and more