



PROGRAMMABLE DISPLAY UNITS PDU-4xx-P

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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 labelled 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.

SAFETY



All operations described in this instruction manual have to be carried out by trained personnel or by an accredited person only. Warranty and post warranty service must be exclusively carried out by the manufacturer.

Improper use, installation or set-up of the sensor can lead to crashes in the application.

The manufacturer is not responsible for improper use, loss of work caused by either direct or indirect damage, and for expenses incurred at the time of installation or during the period of use of the level sensors.

1. BASIC DESCRIPTION

The PDU-4xx-P meter is equipped with one current input 0-20 / 4-20mA and one voltage input 0-5 / 1-5 / 0-10 / 2-10V. Current input has additionally overcurrent protection circuit, which protects standard resistor. The selection of active input is realised by software, and selected input can be changed at any time. Additionally the PDU-4xx-P allows user to select a conversion characteristic of several kinds: linear, square, square root, user defined (max.20 points length) and and volume characteristics of a cylindrical tank in the vertical and horizontal position. Result is showed on 4-digit LED display. Displayed values range can be selected by user, from -999 to 9999, plus decimal point. The device can be equipped with two or four relay (or OC type) outputs. Optionally PDU-4xx-P with two relays outputs can be equipped with active current output. Device PDU-4xx-P is equipped with RS-485 / Modbus RTU communication interface and sensor supply output. The meter can be ordered in two power supply versions.

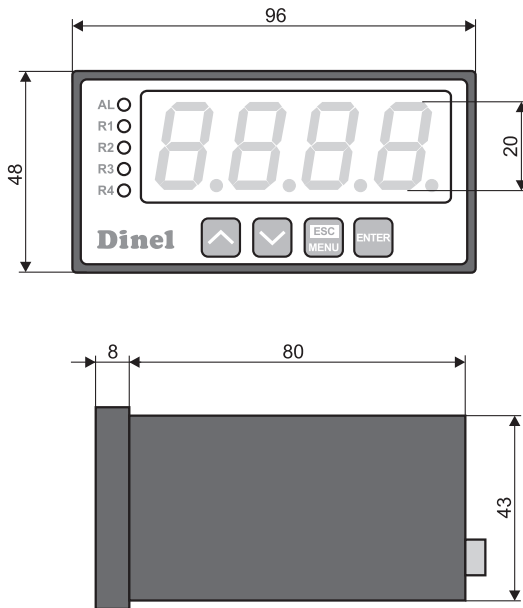
2. RANGE OF APPLICATION

PDU-4xx-P can be used for controlling and regulation of processes need proportional and threshold control like: temperature processes (heating or cooling), valves controlling or other.

3. VARIANTS OF UNITS

- **PDU-420-P** **2 independent relay outputs (2 limits)**), panel version. Power supply 230 V or 24 V, interface RS-485 / Modbus RTU.
- **PDU-421-P** **2 independent relay outputs (2 limits)**), panel version. Power supply 230 V or 24 V, interface RS-485 / Modbus RTU, analogue current output.
- **PDU-440-P** **4 independent relay outputs (4 limits)**), panel version. Power supply 230 V or 24 V, interface RS-485 / Modbus RTU.

4. DIMENSIONAL DRAWINGS



5. INSTALLATION AND PUTTING INTO OPERATION

Please follow next 3 steps:

- **MECHANICAL MOUNTING** - see chapter 6
- **ELECTRICAL CONNECTION** - see chapter 7
- **SETTINGS** - see chapter 8

6. MECHANICAL MOUNTING

In order to install the unit, a 90.5×43 mm mounting hole (Figure 1) must be prepared. The thickness of the material of which the panel is made must not exceed 5 mm. When preparing the mounting hole take the grooves for catches located on both sides of the housing into consideration (Figure 1). Place the unit in the mounting hole inserting it from the front side of the panel, and then fix it using the brackets (Figure 2). The minimum distances between the centre points of multiple units - due to the thermal and mechanical conditions of operation - are $115 \text{ mm} \times 67 \text{ mm}$ (Figure 3).



Read the basic safety requirements prior to starting the installation.

Ensure that the power supply network voltage corresponds to the nominal voltage stated on the unit's identification label.

The load must correspond to the requirements listed in the technical data.

All installation works must be conducted with a disconnected power supply.

Protecting the power supply connections against unauthorized persons must be taken into consideration.

The unit is designed for mounting inside housings (control panel, switchboard) insuring appropriate protection against surges and interference. Metal housings must be connected to ground in a way that complies with the governing regulations.

Disconnect the power supply prior to starting assembly.

Check the connections are wired correctly prior to switching the unit on.

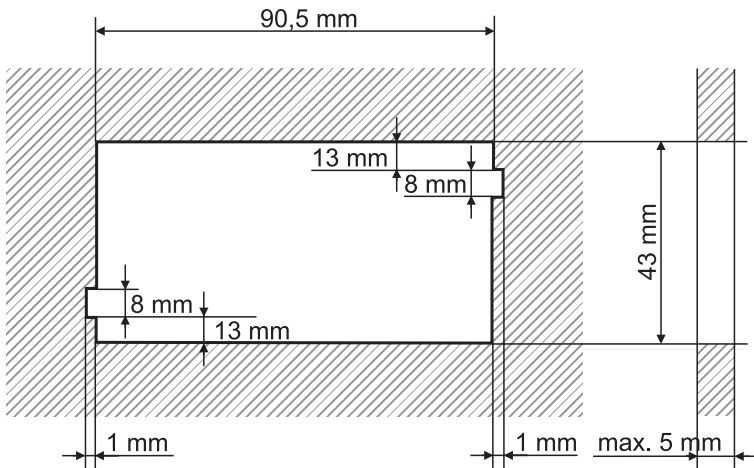


Fig. 1: Recommended mounting hole dimensions

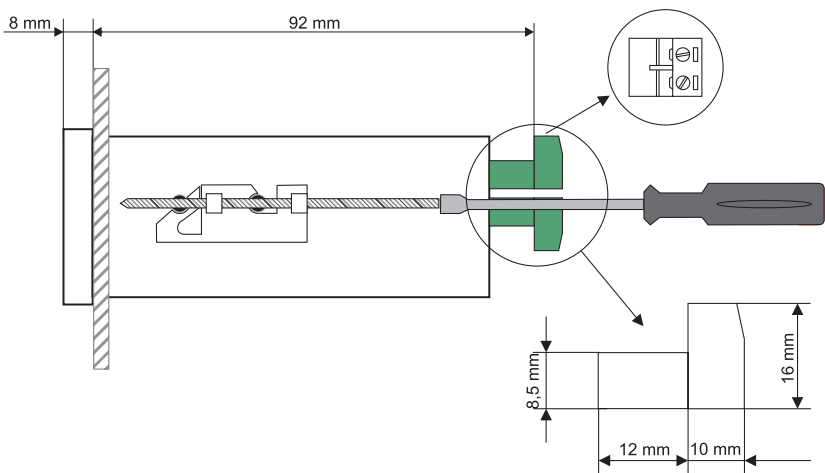


Fig. 2: Installing of brackets, and dimensions of connectors.

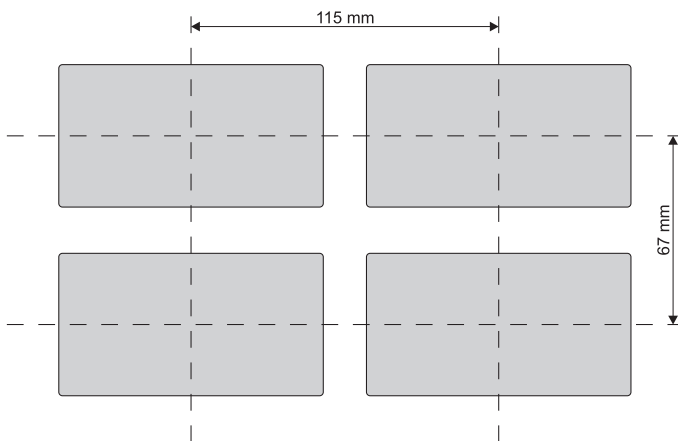


Fig. 3: Minimum distances when assembly of a number of units

The unit is not equipped with an internal fuse or power supply circuit breaker. Because of this an external time-delay cut-out fuse with a small nominal current value must be used (recommended bipolar, max. 2A) and a power supply circuitbreaker located near the unit. In the case of using a monopolar fuse it must be mounted on the phase cable (L).

The power supply network cable diameter must be selected in such a way that in the case of a short circuit of the cable from the side of the unit the cable shall be protected against destruction with an electrical installation fuse.

Wiring must meet appropriate standards and local regulations and laws.

In order to secure against accidental short circuit the connection cables must be terminated with appropriate insulated cable tips.

Tighten the clamping screws. The recommended tightening torque is 0.5 Nm. Loose screws can cause fire or defective operation. Over tightening can lead to damaging the connections inside the units and breaking the thread.

Unused terminals (marked as n.c.) must not be used for connecting any connecting cables (e.g. as bridges), because this can cause damage to the equipment or electric shock.

If the unit is equipped with housing, covers and sealing to, protecting against water intrusion, pay special attention to their correct tightening or clamping. In the case of any doubt consider using additional preventive measures (covers, roofing, seals, etc.). Carelessly executed assembly can increase the risk of electric shock.

After the installation is completed do not touch the unit's connections when it is switched on, because it carries the risk of electrical shock.

Due to possible significant interference in industrial installations appropriate measures assuring correct operation of the unit must be applied. To avoid the unit of improper indications keep recommendations listed below.

- Avoid running signal cables and transmission cables together with power supply cables and cables controlling inductive loads (e.g. contactors). Such cables should cross at a right angle.
- Contactor coils and inductive loads should be equipped with interference protection systems, e.g. RC-type.
- Use of screened signal cables is recommended. Signal cable screens should be connected to the earthing only at one of the ends of the screened cable.
- In the case of magnetically induced interference the use of twisted pair of signal cables is recommended. Twisted pair (best if shielded) must be used with RS-485 serial transmission connections.
- In the case of interference from the power supply side the use of appropriate interference filters is recommended. Bear in mind that the connection between the filter and the unit should be as short as possible and the metal housing of the filter must be connected to the earth with the largest possible surface.

6.1. TERMINAL DESCRIPTION

| UNIT TERMINAL BLOCK | | | |
|---------------------|-------------------|---------------------|-------------------|
| terminal No. | PDU-420-P | PDU-421-P | PDU-440-P |
| 1 | L / + (230 / 24V) | L / + (230 / 24V) | L / + (230 / 24V) |
| 2 | N / - (230 / 24V) | N / - (230 / 24V) | N / - (230 / 24V) |
| 3 | | - (analogue output) | RE 4 |
| 4 | | + (analogue output) | RE 4 |
| 5 | +US | +US | +US |
| 6 | GND | GND | GND |
| 7 | GND (RS 485) | GND (RS 485) | GND (RS 485) |
| 8 | B - (RS 485) | B - (RS 485) | B - (RS 485) |
| 9 | A + (RS 485) | A + (RS 485) | A + (RS 485) |
| 10 | RE 1 | RE 1 | RE 1 |
| 11 | RE 1 | RE 1 | RE 1 |
| 12 | RE 2 | RE 2 | RE 2 |
| 13 | RE 2 | RE 2 | RE 2 |
| 14 | | | RE 3 |
| 15 | | | RE 3 |
| 31 | | | |
| 32 | + IN (voltage) | + IN (voltage) | + IN (voltage) |
| 33 | + IN (current) | + IN (current) | + IN (current) |
| 34 | GND | GND | GND |
| 35 | | | |

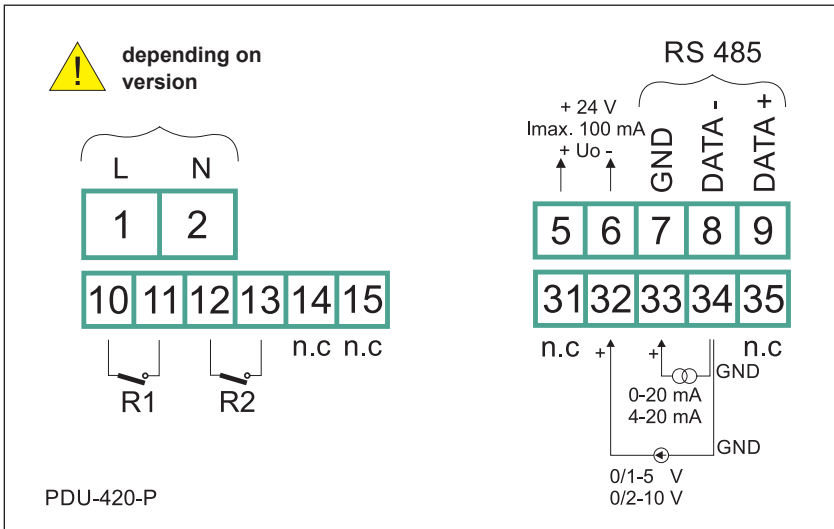


Fig. 4: Terminal description, PDU-420-P

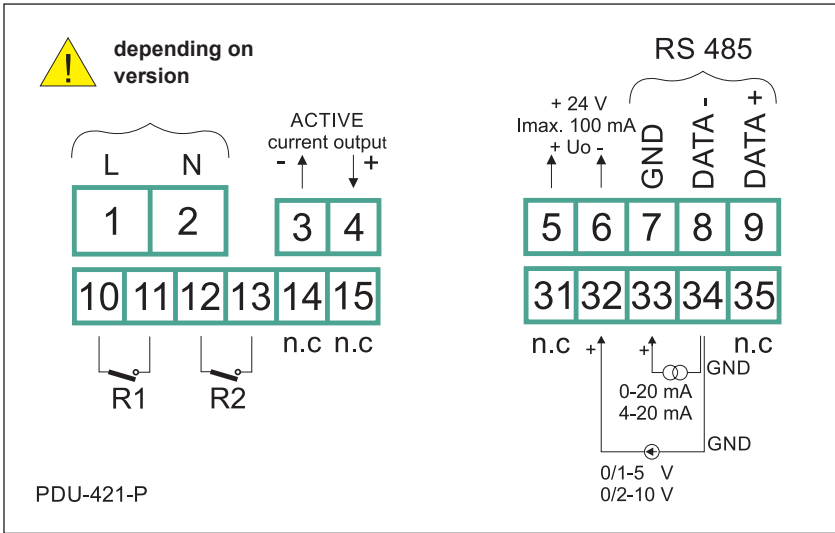


Fig. 5: Terminal description, PDU-421-P

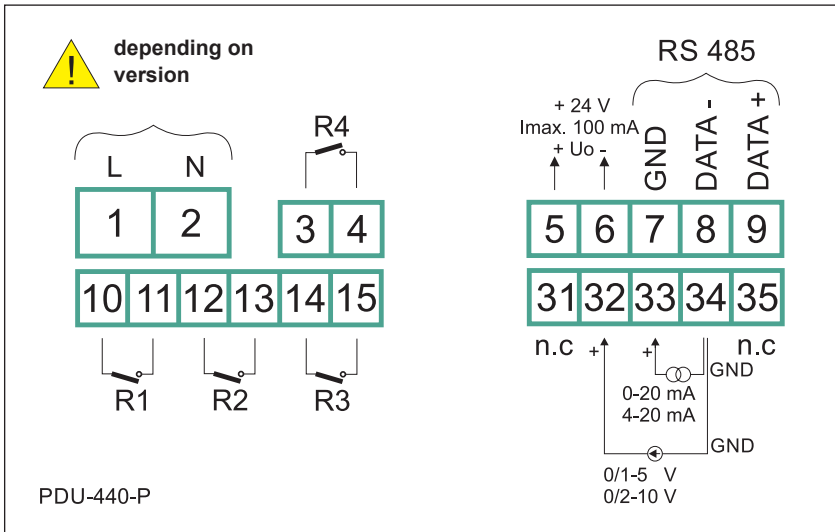


Fig. 6: Terminal description, PDU-440-P

* **applicable to 230 V version:** 85 - 260 V AC/DC, 50/60 Hz

* **applicable to 24 V version:** 19 - 50 V DC, 16 - 35 V AC, 50/60 Hz

7. ELECTRICAL CONNECTION

The unit is not equipped with an internal fuse or power supply circuit breaker. Because of this an external time-delay cut-out fuse with a small nominal current value must be used (recommended bipolar, max. 2A) and a power supply circuitbreaker located near the unit. In the case of using a monopolar fuse it must be mounted on the phase cable (L). The power supply network cable diameter must be selected in such a way that in the case of a short circuit of the cable from the side of the unit the cable shall be protected against destruction with an electrical installation fuse.

Note: In case of measurement (evaluation) of the values from the level meter located in areas with explosion hazard, it is necessary to install an isolating repeater between the PDU display unit and the level meter.

Non-explosive areas

Connection of the sensors without shielded cable

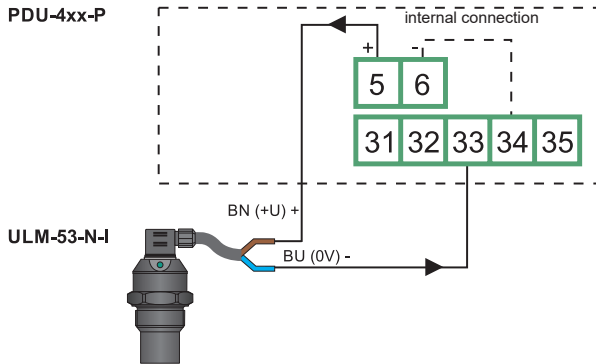


Fig. 7: Connection diagram - level meter with current output to PDU unit, using internal power source

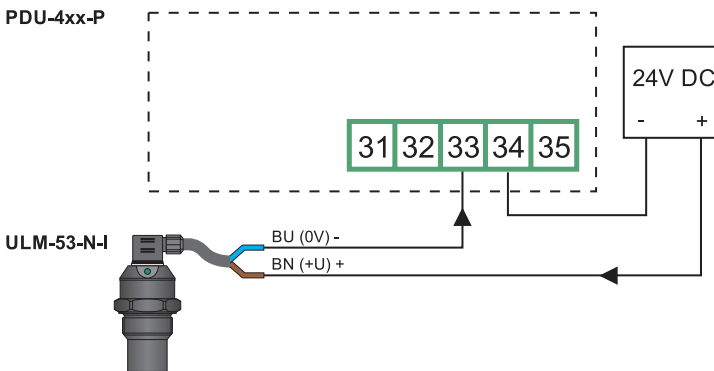


Fig. 8: Connection diagram - level meter with current output to PDU unit, using external power source

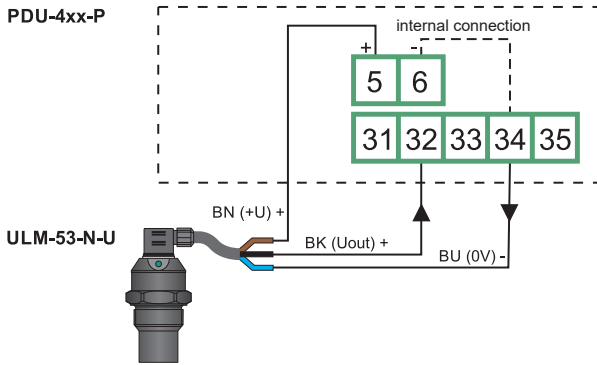


Fig. 9: Connection diagram - level meter with voltage output to PDU unit, using internal power source

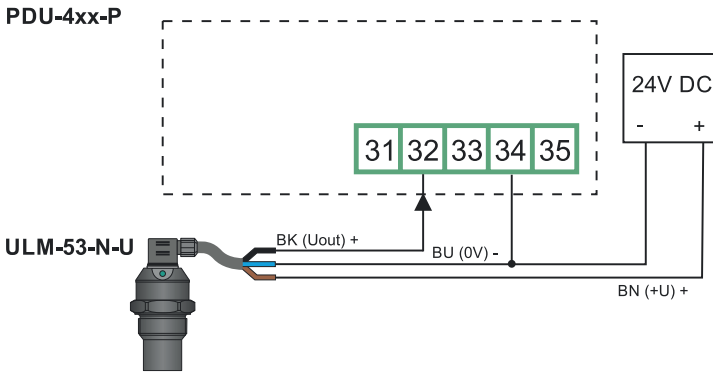


Fig. 10: Connection diagram - level meter with voltage output to PDU unit, using external power source



Connection diagram is the same for all types of level meters with current or voltage outputs.

Explosive areas

Connection of the sensors without shielded cable

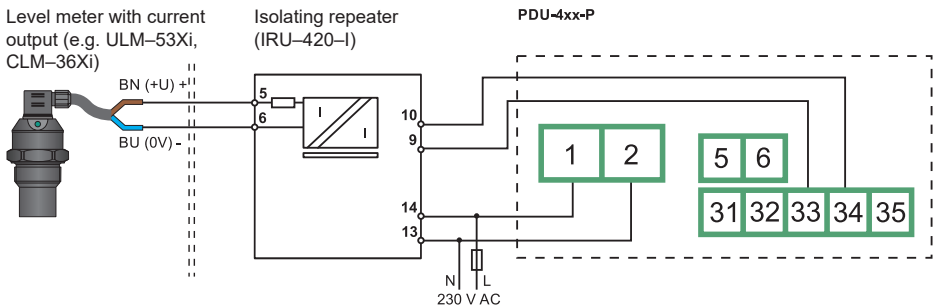


Fig. 11: Connection of the unit to the level meters with current output located in explosive areas

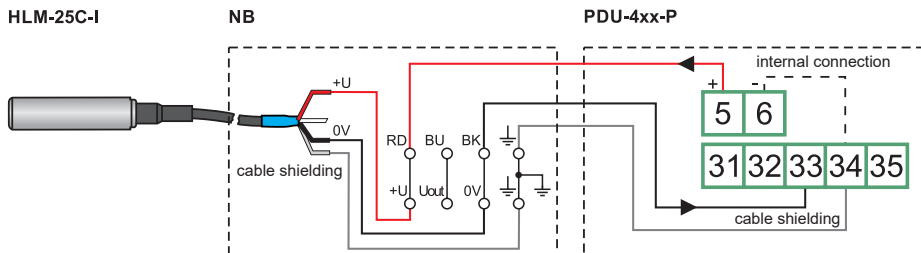


Fig. 12: Connection diagram - level meter with current output to PDU unit, using internal power source

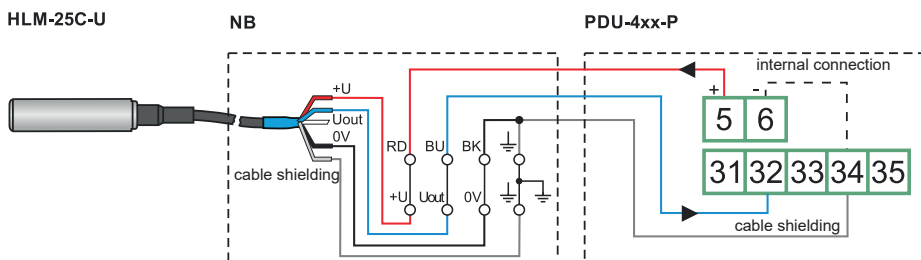


Fig. 13: Connection diagram - level meter with voltage output to PDU unit, using internal power source

Legend:
 RD – red BK – brown
 BU – blue BN – black



If junction box with integrated overvoltage protection is used, the sensor must be connected to the bottom contacts of the terminal block. These contacts are identified with SENSOR label.

| TABLE | | |
|------------------|--|--|
| Sensor | With shielded cable | Without shielded cable |
| HLM-35 | HLM-35__ K- - I- - - - - HLM-35__ K- - U- - - - - | HLM-35__ V- - I- - - - - HLM-35__ V- - U- - - - - |
| HLM-25C; HLM-25S | all types | - |
| GRLM-70 | GRLM-70__ - - -M | GRLM-70__ - - -I |
| ULM-70, ULM-53 | ULM-70__ - - -M | ULM-70__ - - -I |
| CLM-40 | CLM - 40N-40__ -CAN | CLM - 40N-40__ -I(U) |



Contacts of relay outputs are not equipped with spark suppressors. While using relay outputs for switching of inductive loads (coils, contactors, power relays, electromagnets, motors etc.) it is required to use additional suppression circuit (typically capacitor 47nF/min. 250VAC in series with 100R/5W resistor), connected in parallel to relay terminals or (better) directly on the load. In consequence of using the suppression circuit, the level of generated electromagnetic disturbances is lower, and the life of contacts rises.

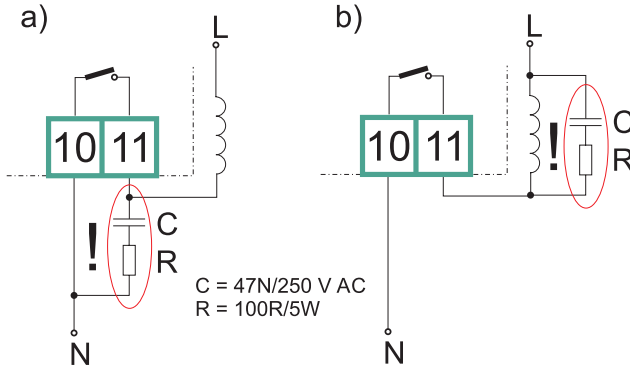
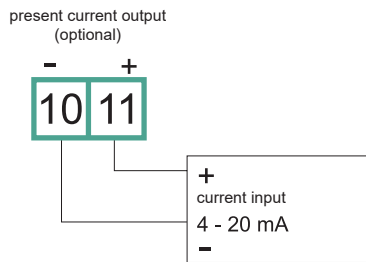
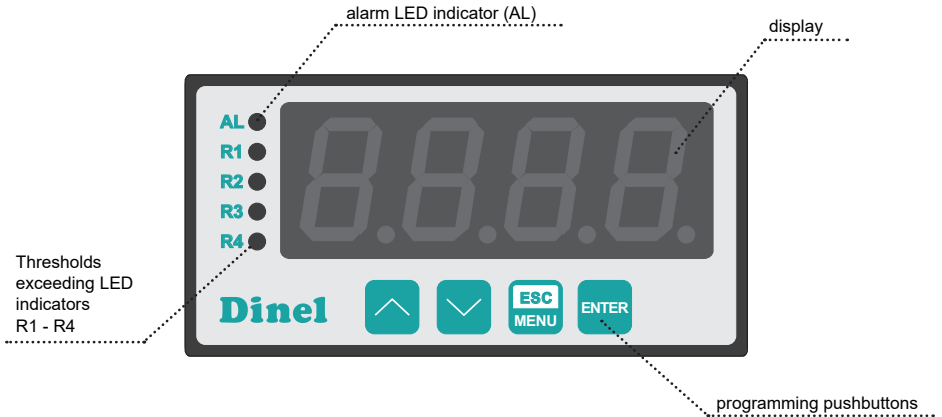


Fig. 14: Connection examples used to suppress the interference resulting from disconnection of inductive load
a) RC element on relay contacts b) RC element on inductive load



8). SETTINGS

8.1. FRONT PANEL DESCRIPTION



Indicators R1 to R4 indicate the exceeding of the threshold limits independent on the number of relays installed in the unit. Alarm indication (AL indicator) represents the condition where the input current is outside of the allowed limits.

Symbols and functions of push-buttons:



Symbol used in the manual: [ESC/MENU]

Functions:

- Enter to main menu (press and hold by at least 2 sec.)
- Exit the current level and Enter to previous menu (or measure mode)
- Cancel the changes made in parameter being edited



Symbol used in the manual: [ENTER]

Functions:

- Start to edit the parameter
- Enter to the sub-menu,
- Confirmation of changes made in parameter being edited



Symbol used in the manual: [<] [>]

Functions:



- Change of the present menu,
- Modification of the parameter value,
- Change of the display mode.



If no button is pressed within 1 minute, the unit automatically switches back to the measuring mode.

8.2. BASIC SETTINGS

After turning the power supply on, device ID and software version are showed on the display, next the controller goes to the measurement mode.



Pay attention when device parameters are being changed. If it is possible, turn off controlled installation (machine).

Entering and controlling the menu

To enter main menu (being in the measurement mode) operator must to press and hold at least 2 sec. **[ESC/MENU]** button. If numerical parameter is being edited, a short press of **[ENTER]** button change edited position. A long press of **[ENTER]** button (at least 2 sec.) causes of display a **"SEt?"** ask, which allow user to make sure if change of the parameter value is correct. If switch parameter is being edited, a short press of **[ENTER]** button causes of display a **"SEt?"** ask. When **[ENTER]** button is pressed again (while **"SEt?"** is displayed) the new value of the parameter is stored in EEPROM memory.



If some password different from „0000“ is set, then every enter to main menu follows the entering of password. If entered password is correct then first menu position will be displayed else warning "Err", and unit returns to measurement mode.

Setting up the measuring input for the level meter

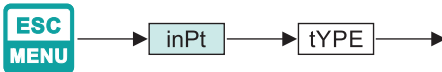
The setting defines the type of the current or voltage input, filtration, decimal point position, measuring range and extension of the nominal range.

- **Type of the input / sensor "tYPE"**

This parameter can be set to values:

0-20, 4-20 - current inputs.

0-10, 2-10, 0-5, 1-5 - voltage inputs.



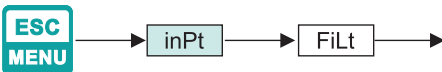
- **Filtration rate "FiLt"**

If the parameter Filtration is set to maximum values and the input current of the level meter is dropping (rising), the resulting measurement value will change slowly.

It can be set to values from 0 (no filtration) to 5.

0 = no filtration (OFF)

5 = maximal filtration

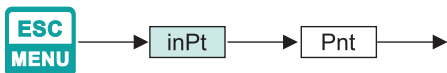


- **Decimal point position "Pnt"**

The unit enables variable setting of the decimal point position.

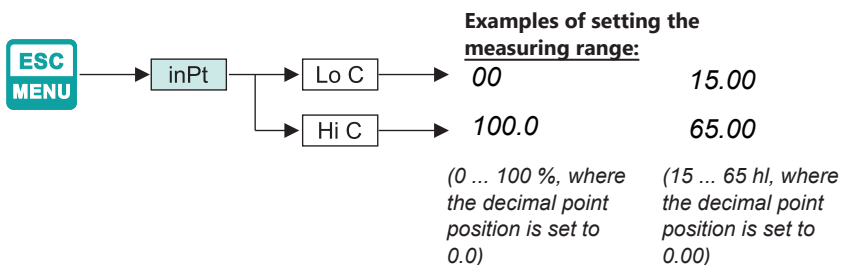
For example 4 mA input current will be shown in the display as follows:

"0" (400) "0.0" (40.0) "0.00" (4.00) "0.000" (0.400)



- **Measuring range "Lo C"; "Hi C"**

These parameters describe the values displayed for minimum and maximum input current. For example, if input type is set to 4-20 mA "Lo C" parameter defines the value displayed when input current is equal 4 mA, and "Hi C" parameter defines the value displayed for 20 mA of input current. Available range for these parameters: -999 ÷ 9999.

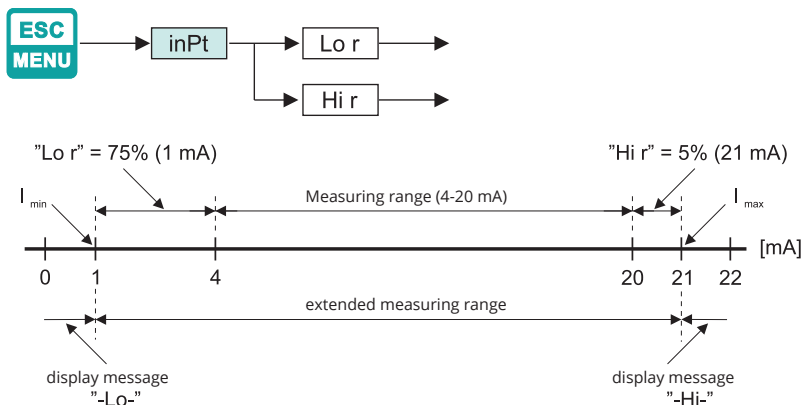


- **Extended measuring range "Lo r"; "Hi r"**

the expansion of nominal range in percent. They determine the permissible range from minimum to maximum ("Lo r" a "Hi r").

"Lo r" determines lower border of the permissible range. Lower border is calculated due to expression: $I_{\min} = 4 \text{ mA} - 4 \text{ mA} \times \text{"Lo r" \%}$. The "Lo r" value can be set from 0 to 99.9%.

"Hi r" determines the upper border of the permissible range. Upper border is calculated due to expression: $I_{\max} = 20 \text{ mA} + 20 \text{ mA} \times \text{"Hi r" \%}$. The value of "Hi r" can be set from 0 to 19.9%



If the measurement value do not exceeds permissible measurement range but displayed value exceeds range -999 ÷ 9999, the warning "-Ov-" is displayed rather than the calculated result.

Control of the relay outputs

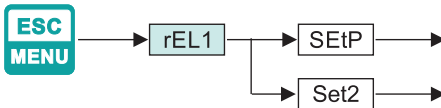
This menu enables the configuration of the function of relays Re1 to Re4. If lower number of relays is installed in the unit, the indication of the exceeding of the threshold limits applies only to indicators R1 to R2. The menu items remain without change.

- **Threshold values "SEtP" and "SEt2"**

First threshold of the relay (range -999 + 9999). Negative values can be input by selecting a "-" sign on first digit (to change value use [^] and [v] buttons). Threshold is the medium value of relay hysteresis.

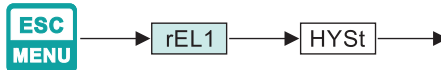
Negative values can be input by selecting a "-" sign on first digit (to change value use [^] and [v] buttons). Range -999 + 9999.

Second threshold of the relay "**SEt2**". This threshold is accessible when "modE" parameter is set to „in" or „out" value. Threshold is the medium value of relay hysteresis.



- **Hysteresis "HYSt"**

Hysteresis of relay. Full hysteresis of the relay is equal to $2x$ "HYSt" parameter (range 0 + 999).



- **"modE"**

relay operation mode:

"noAC" - the relay is not active (permanent turned OFF).

"on" - one threshold mode, the relay is turned **ON** when input signal exceeds **SEtP + HYSt** value, and is turned off back when the input signal became lower than **SEtP - HYSt (zone B)**.

"oFF" - one threshold mode, the relay is turned OFF when input signal exceeds **SEtP + HYSt** value, and is turned on back when the input signal became lower than **SEtP - HYSt (zone B)**.

"in" - two threshold mode, the relay is turned **ON** when the input signal is bigger than "**lower threshold + HYSt**" and lower than "**bigger threshold - HYSt**", and turned off when the input signal is contained in the second zone. **The bigger threshold** means bigger one of "**SEtP**" and "**SEt2**" thresholds, **the lower threshold** means lower one of "**SEtP**" and "**SEt2**" thresholds.

"out" - two threshold mode, relay is turned **ON** when the input value is bigger than "**bigger threshold + HYSt**" and lower than "**lower threshold - HYSt**", and turned on when the input signal is contained in the second zone. The bigger threshold means bigger one of "**SEtP**" and "**SEt2**" thresholds, the lower threshold means lower one of "**SEtP**" and "**SEt2**" thresholds.

"modb" - the relay is controlled via RS-485 interface, independently on the input signal.

Example of setting the relay output for single-threshold control:

(It is assumed that the measuring range of the PDU unit is set to range 0...100, i.e. 4 mA corresponds to 0.0 % and 20 mA corresponds to 100.0%)

The requirement is to activate the relay if the displayed value exceeds 75.0% and to deactivate the relay when the displayed value drops below 25.0%.

Setting the parameters: **modE** = on, **SetP** = 50, **HYSt** = 25

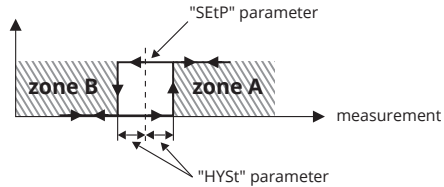


Fig. 15: Single-threshold control of relay outputs and LED R1-R4 indicators

Example of setting the relay output for two-threshold control:

(It is assumed that the measuring range of the PDU unit is set to range 15...65, i.e. 4 mA corresponds to 15.00 hl and 20 mA corresponds to 65.00 hl)

The requirement is to activate the relay if the displayed value is less than 20.00 hl and to activate the relay when the displayed value is greater than 60.00 hl.

Parameter setting: **modE** = out, **SetP** = 20.50, **Set2** = 59.50, **HYSt** = 0.5

Note: A different hysteresis value can be set, provided that $\text{SetP} - \text{HYSt} = 20$ and $\text{Set2} + \text{HYSt} = 60$.

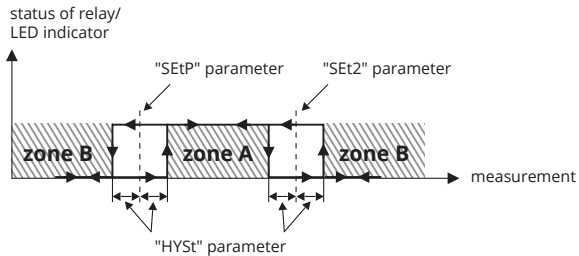


Fig. 16: Two-threshold control of relay outputs and LED R1-R4 indicators



For more details on relay functions see section 8.4 Control of relay outputs.



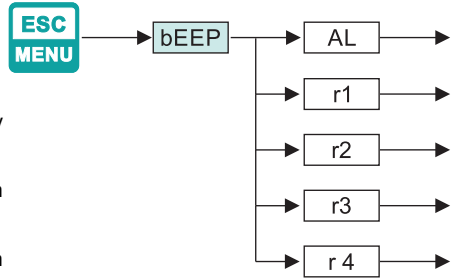
In the measuring mode, the user can check and change the main threshold values used to switch the relay. When the button "[^]" or "[v]" is pushed, the display toggles among "rEL1" to "rEL4" and their actual set values. If free access is allowed (see menu "SECu"), the user can change the threshold values by pressing the [ENTER] button.

The process is the same as when editing the menu.


8.3. EXTENDED SETUP

Menu "bEEP"

This menu contains options connected with acoustic signal:



- **"AL"** - if this parameter is set to "ON", any critical situation causes by acoustic signal.
- **"r1"** - if this parameter is set to "on", activation of relay R1 causes by acoustic signal.
- **"r2"** - if this parameter is set to "on", activation of relay R2 causes by acoustic signal.
- **"r3"** - if this parameter is set to "on", activation of relay R3 causes by acoustic signal.
- **"r4"** - if this parameter is set to "on", activation of relay R4 causes by acoustic signal

 Acoustic signal (turned on by e.g. relay) can be turned off by pressing of any button.

Menu "inPt"

- **"CHAR"**

this option presets type of the conversion characteristic, and can be set to:

| | | |
|---------------|-------------|--|
| "Lin" | linear | When one of those characteristics is chosen display range is defined by "Lo C" and "Hi C". |
| "Sqr" | square | |
| "Sqrt" | square root | |


"USER" user defined characteristic. Maximal length 20 points. Every point is defined by user. Adding, Editing and Deleting of points is done by options „AddP“, „EdtP“, „dELP“ („InPt“ menu) respectively.

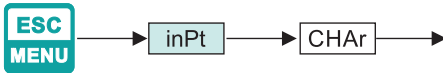
Note: Options „AddP“, „EdtP“ and „dELP“ are available only when user characteristics is selected.

"tn v" volume characteristics of a cylindrical tank in the vertical position, determined by parameters: „t h1“, „t h2“, „t h3“, „t d“, „t Sn“, „t Sh“ in „InPt“ menu (see below for details of the parameters),

"tn h" volume characteristics of a cylindrical tank in the horizontal position, determined by parameters: „t h1“, „t h2“, „t h3“, „t d“, „t Sn“, „t Sh“ in „InPt“ menu (see below for details of the parameters).

Note: Parameters "t h1", "t h2", "t h3", "td", "t Sn", "t Sh" are available only when one of volume characteristics is selected.

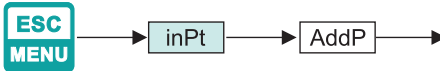
 If volume characteristics of a cylindrical tank is selected (parameter "CHAR" = "tn v" or "CHAR" = "tn h") the parameters „Lo C“ and „Hi C“ are not available.



If user defined characteristic is selected, and if number of defined points is lower than 2 then warning "Errc" is displayed in measurement mode.

• "AddP"

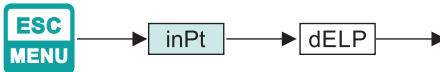
This menu allow user to add single point to the user defined characteristic. After selection of this option device waits for „X” and „Y” coordinates of new point. Modification of the coordinates is done accordingly to numerical parameters edition. Coordinate „X” defines the percentage ratio of input current to selected current range. The „X” range: $-99,9 \div 199,9$. Coordinate „Y” defines displayed value for particular „X” value. The „Y” value can be changed in range: $-999 \div 9999$, decimal point position depend on „Pnt” parameter (menu "inPt").



- User can not enter two points with the same value of „X” coordinate. If user trays to do it, "Err" warning is displayed. To modify any defined point use "EdtP" option.
- To distinguish „X” and „Y” coordinates, if „X” coordinate is displayed an additional decimal point on utmost right position is displayed.
- If user defined characteristic is selected, and if number of defined points is lowerthan 2 then warning "Errc" is displayed in measurement mode.

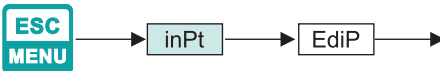
• "dELP"

This option allows user to delete any of the points of the user defined characteristic. After selection current number of points of the user defined characteristic is displayed for about approx. 1.5 sec. After that device waits for selection of point being deleted (by [^], [v] buttons). The short pressing of [ENTER] button causes by switching between X and Y value of the displayed point. The long press (press and hold at least 2 sec) of [ENTER] button causes by displaying „dEL?” ask. If [ENTER] button is pressed again, current point is deleted and new updated number of points of the user defined characteristic is displayed.



• "EdtP"

This option allows user to modify of particular point of the user defined characteristic. After selection current number of points of the user defined characteristic is displayed for about approx. 1.5 sec. After that device waits for selection of point being edited (by [^], [v] buttons). The short pressing of [ENTER] button causes by switching between X and Y value of the displayed point. The long press (press and hold at least 2 sec) of [ENTER] button causes by entering to edit the selected coordinate of the point. Modification of the coordinates is done accordingly to numerical parameters edition.



"AddP", "dELP" and "EdtP" options are available only if the user defined characteristic is used (it means when parameter "CHAr" = "USER").

- „t h1” „t h2” „t h3” „t d”

the parameters defining shape of cylindrical tank (Figure 17 and Figure 20).

a) for the cylindrical tank in the vertical position:

| | |
|-----------|--|
| „t h1” | the height of the bottom part of a tank (in the elliptic paraboloid shape), this parameter has the fixed precision - 2-decimal point |
| „t h2” | the height of the middle part of a tank in the cylindrical shape, this parameter has the fixed precision - 2-decimal point. |
| „t h3” | the height of the top part of a tank (in the elliptic paraboloid shape), this parameter has the fixed precision - 2-decimal point. |
| „t d” | the diameter of the middle part of a tank, this parameter has the fixed precision - 2-decimal point. |
| „m” | Dead zone at the beginning of the measuring range. |
| „k” | Dead zone at the end of the measuring range. |
| „h” | Distance to bottom. |
| „x=I[mA]” | Height level. |

b) for the cylindrical tank in the horizontal position:

| | |
|----------------|---|
| „t h1” | the length of the left bottom of a tank (in the elliptic paraboloid shape), this parameter has the fixed precision - 2-decimal point. |
| „t h2” | the length of the middle part of a tank in the cylindrical shape, this parameter has the fixed precision - 2-decimal point. |
| „t h3” | the length of the right bottom of a tank (in the elliptic paraboloid shape), this parameter has the fixed precision - 2-decimal point. |
| „t d” | the diameter of the middle part of a tank, this parameter has the fixed precision - 2-decimal point. |
| „t Sn”, „t Sh” | parameters defining the length and position of the sensor used to measure level of liquids, gases or solids in the tank (Figure 17, 20). |
| „t Sn” | distance between end of the sensor and bottom of the tank, this parameter has the fixed precision 2-decimal point but the unit is 100 times smaller than “t Sh” (see Info below). |
| „t Sh” | the measuring range, this parameter has the fixed precision - 2-decimal point. |



The unit value of “t Sn” parameter is 100-fold less than the unit value of other parameters defining cylindrical tank, i.e. if we set value 10.00 in “t Sh” parameter and set value 08.00 in “t Sn” parameter this mean that value of “t Sn” parameter is real has 00.08 value in preserved unit of the “t Sh” parameter.

If we set parameters of tank in [m] unit (“t Sn” parameter takes [cm] unit respectively, see above), than displays the result the volume of the tank in [m³] unit, if we set parameters of tank in [cm] unit (“t Sn” parameter takes [mm] unit respectively, see above), than displays the result the volume of the tank in [cm³] unit.

“t Sh” parameter may be greater than height (for vertical position) or diameter (for horizontal position) of the tank, which means that the total volume of the tank can be achieved by eg. such middle-current range.

If the measurement value do not exceeds permissible measurement range but displayed value exceeds range of 9999 than you can move to the right position of the decimal point if it is still

possible (see parameter Menu->"inPt"->"Pnt").

If in the volume characteristics of a cylindrical tank is exceeded the value of the volume of the tank sets by parameters available in menu "inPt" instead of the calculated result will be display warning "-Hi-".

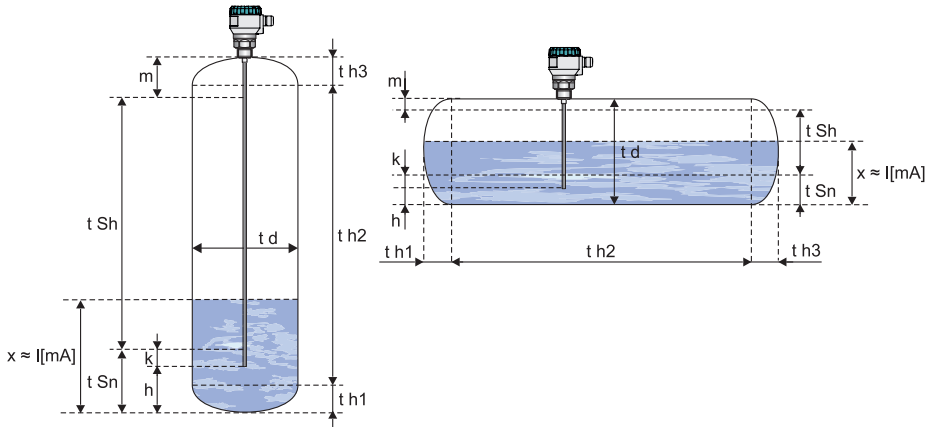


Fig. 17: Volume characteristics parameters of a cylindrical tank, where the level is measured using guided wave radar level meter

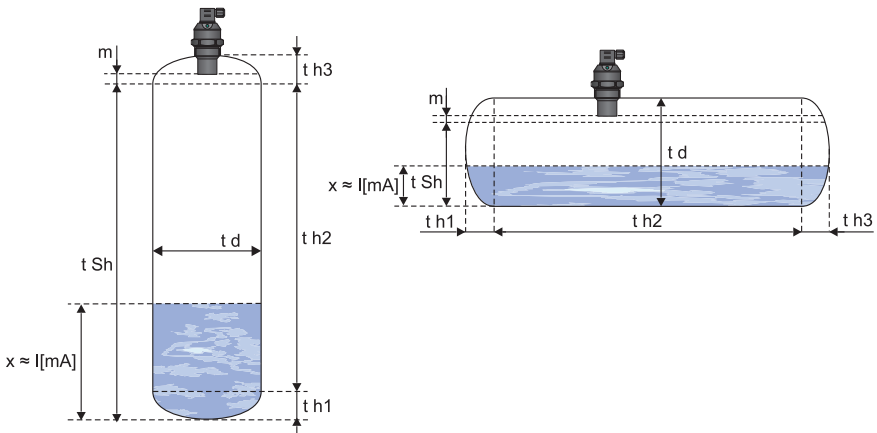


Fig. 18: Volume characteristics parameters of a cylindrical tank, where the level is measured using ultrasonic level meter

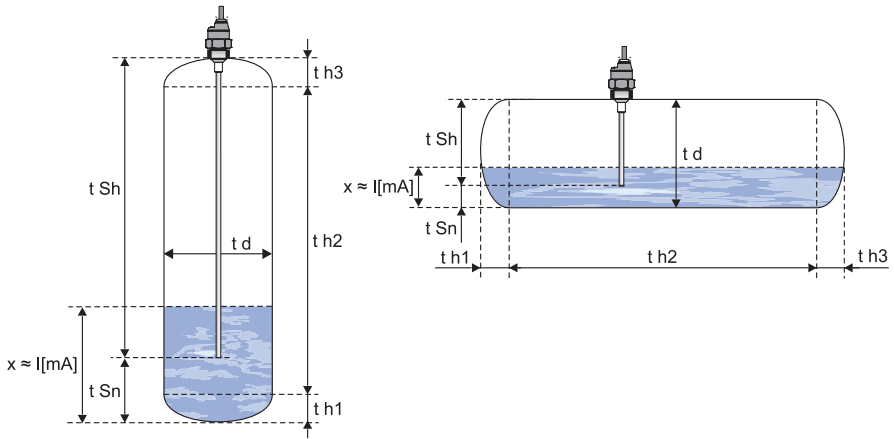


Fig. 19: Volume characteristics parameters of a cylindrical tank, where the level is measured using capacitive level meter

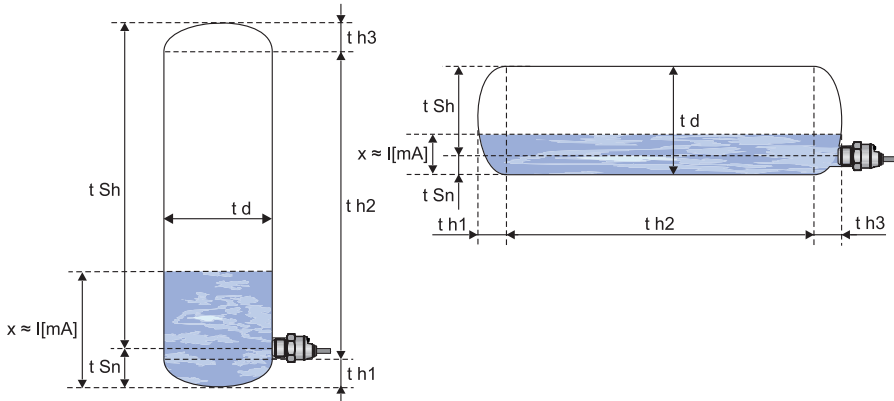


Fig. 20: Volume characteristics parameters of a cylindrical tank, where the level is measured using hydrostatic level meter

Menu "OutP"

This menu contains parameters of current output control. Menu is available if the device is equipped with current output.

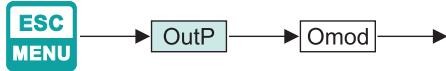


Current output can be controlled depend on both present measured value and peak value (if peak detection is enabled).

• "Omod"

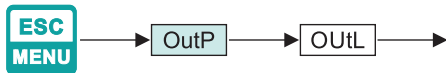
Current output mode, can be set to values:

- "oFF" - current output disabled
- "0-20" - current output enabled with 0 ÷ 20 mA mode
- "4-20" - current output enabled with 4 ÷ 20 mA mode
- "mobd" - current output controlled via RS-485 interface



• "OutL"

this parameter determines the input value for which the output current is minimal (0 mA or 4 mA depend of current output mode „Omod”).



• "OutH"

this parameter determines the input value for which the output current is equal 20mA.

The output current value is calculated due to formulas given below:

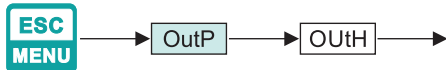
$$I_{out} = \frac{W - "OutL"}{"OutH" - "OutL"} \times 16 \text{ mA} + 4 \text{ mA}$$

for output range 4 ÷ 20mA

$$I_{out} = \frac{W - "OutL"}{"OutH" - "OutL"} \times 20 \text{ mA}$$

for output range 0 ÷ 20mA

where "W" denotes the displayed value



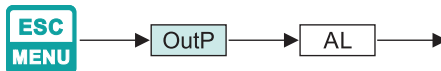
"OutL" parameter can be greater than "OutH". In this case the conversion characteristic is reversed, it means that if input value raises the output current falls.

• "AL"

this parameter determines the behaviour of current output if any critical situation occurs. The parameter can be set to one of the values.

- "noCH" current will not change
- "22.1" current will be set to 22.1 mA
- "3.4" current will be set to 3.4 mA
- "0.0" current will be set to 0 mA

When the critical situation goes, the current will be set to value calculated due to formulas given above.



Parameter "bri"

This parameter allows user to set bright of the LED display, bright can be set to conventional values from 1 to 8.



Menu "HOLd"

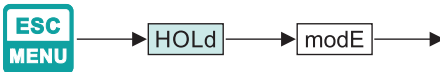
The unit is equipped with peak detection function. It is able to detect the peaks in the input signal and display the values in the display. This is set up in the "HOLd" menu. Detection of peak values is enabled when the measured signal is rising or dropping with regard to the value at least equal to the "PEA" parameter. The detected peak values are shown on display over time, defined by the "timE" parameter. If a new peak value is detected, the value is automatically displayed. The time counter shown in the display is erased. However, if no peak is detected before the "timE" expires, the device once again shows the current values of the input signal.

Relays/LED indicators and current output may be controlled depending on the value of the input signal current or peak value (see the "HOLd" menu).

- **"modE"**

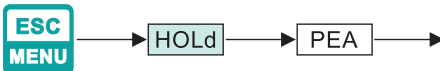
the type of detected changes of the input signal, can be set to values:

"norm" peaks, peak and next drop of the input signal of value equal at least "PEA"
"inv" drops, drop and next peak of the input signal of value equal at least "PEA"



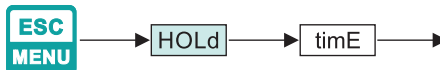
- **"PEA"**

minimal detected signal change classified as peak or drop.



- **"timE"**

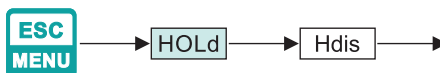
maximum time of displaying of the peak (drop) value, can be set from 0.0 to 19.9 sec, with 0.1 sec. resolution. If „HdiS”=“HOLD” then setting parameter "timE"=0.0 causes holding peak value until [ESC] button is pressed. If „HdiS”=“rEAL” then value "timE"=0.0 means no holding.



- **"HdiS"**

type of displayed values:

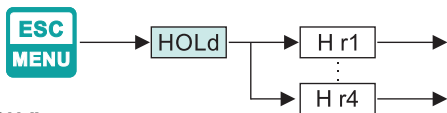
"rEAL" current value is displayed
"HOLd" peak (drop) value is displayed



- **"H r1" - "H r4"**

relay outputs operation mode:

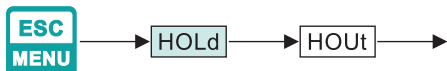
- "rEAL" - relay operates depend on the current value
- "HOLd" - relay operates depend on the peak (drop) value



- **"HOUt"**

current output operation mode:

- "rEAL" current output operates depend on the current value
- "HOLd" current output operates depend on the peak (drop) value

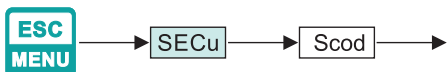


Menu "SECu"

This menu contains presets connected with availability of other parameters.

- **"Scod"**

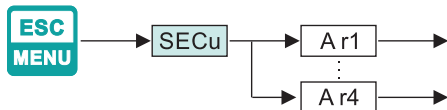
user password (4-digits number). If this parameter is set at value "0000", user password is turned off.



If the user do not remember his password, the access to the menu is possible by the "one-use password". To get this password please contact with Marketing Division. "Single use password" can be used only one time, after that it is destroyed. Entering this password causes in clearing of user password, it means sets the user password to „0000”.

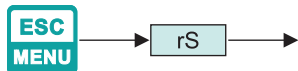
- **"A r1 - A r4"**

this option permits user ("on") or prohibits ("oFF") to modify the thresholds of the relays/ LEDs R1 ÷ R4 without knowledge about user password.



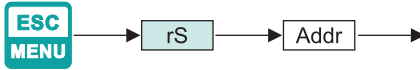
Menu "rS"

This menu is connected with RS-485 interface.



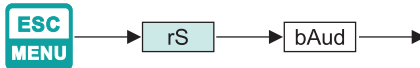
- **„Addr“**

this parameter defines the address of the device, accordingly to Modbus protocol. It can be set in range from 0 to 199. If the value 0 is set then device, responds to frames with address 255 (FFh).



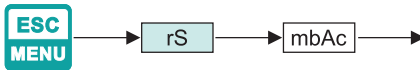
- **„bAud“**

this parameter determines RS-485 interface baud rate. It can be set to one of 8 possible values: "1.2", "2.4", "4.8", "9.6", "19.2", "38.4", "57.6", "115.2", which respond to the baud rates of 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 bit/s respectively.



- **„mbAc“**

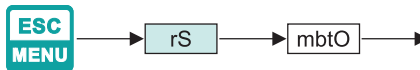
this parameter sets the access to the configuration registers of the device. Possible values:
„on“ configuration registers can be set via RS-485 interface.
„off“ configuration registers can not be set via RS-485 interface.



The access to registers no 04h i 05h cant be denied by "mbAc" parameter (see: LIST OF REGISTERS).

- **„mbtO“**

this parameter defines maximal time (sec) between following frames received by the device. If the delay will be greater than the value of "mbtO" parameter, the relays and the current output which are controlled via RS-485 interface, will set to alert state (see "OUTP" menu, "rEL1" menu description). Parameter "mbtO" can be set to values from 0 to 99 seconds. The value 0 means that the time will be not controlled.



- **„rESP“**

this parameter defines minimal (additional) delay between the Modbus message and the answer of the device (received and sent via RS-485 interface). This additional delay allows the device to work with poor RS-converters which do not works properly on baud rates higher than 19200. This parameter can be set to one of values:

„Std“ answer as quick as possible, no additional delay.
 „10c“
 „20c“
 „50c“
 „100c“
 „200c“

answer delayed of 10, 20, 50, 100 of 200 chars respectively, where one character time depends on selected baud rate



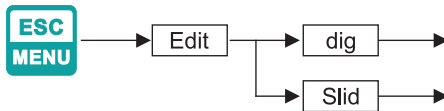
In the most cases parameter "rESP" should be set to "Std" (no additional delay). Unfortunately for some third party RS-converters "rESP" should be adjusted experimentally. Table 7.1 contains most frequently used values.

| | | | |
|------------------|--------|--------|---------|
| "bAud" parameter | "38.4" | "57.6" | "115.2" |
| "rESP" parameter | " 10c" | " 20c" | " 50c" |

Menu "Edit"

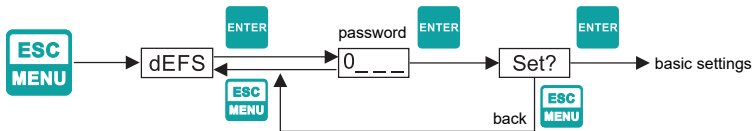
This parameter allows to change the edition mode of numerical parameters:

- **"dig"**
the change to "by digit" mode.
- **"Slid"**
slide change mode.



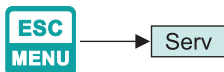
Parameter "dEFS"

This setting allows to restore the factory settings of the device. To get the access to this option special password is required: „5465“, next the device displays acknowledgment question „Set?“. Press [ENTER] to acknowledge the restoring of factory settings or [ESC] to cancel.



Menu "SErv"

This menu contains the parameters for authorized service only. To enter this menu proper service password must be entered. Improper settings can causes of damage of the device.



8.4. CONTROL OF THE RELAY OUTPUTS

The control of the object (measured signal) is realized via relay outputs. Front panel LEDs named „R” indicates the state of particular relay output.



Optical indication of the exceeding of the main thresholds is independent on the number of relays installed in the unit.

Modes of the control can be changed depend on the values of parameters “SEtP”, “SEt2”, “HYSt”, “modE”, “t on”, “toFF”, “unit” and “AL”. Depend on “modE” parameter, relays can be not used or controlled over one or two thresholds values.

If one threshold is used (Figure 21) the relay can be turned on (“modE” = ”on”) or off (“modE” = ”oFF”) when the input signal value is contained in zone A.

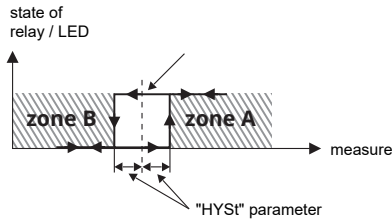


Fig. 21: One threshold control of the relay/LED outputs

If two thresholds are used (Figure 22) the relay will be turned on when value of input signal is contained in **zone A** (“modE” = ”in”) or **zone B** (“modE” = ”out”) and turned off if the signal is contained in the second one.

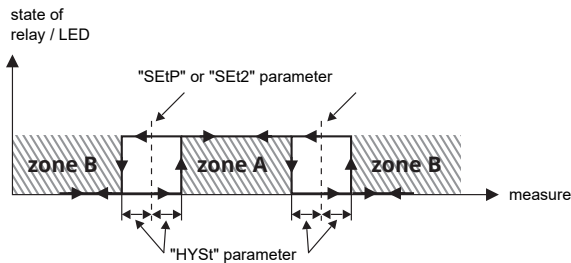


Fig. 22: Two threshold control of the relay/LED outputs

One threshold mode

Figure 6.6 presents the principle of relay outputs operation for one threshold mode, and an example values of other parameters.

Parameter “SEtP” sets a threshold of the relay, and parameter “HYSt” sets a hysteresis of the relay (Figure 6.6 a). The relay can change his state only when input value exceeds (over or under) border value and tA ,tB ,tC ,tD times (Figure 6.6) are bigger than the time defined by parameters “t on”, “toFF” and “unit”. Border values means values equal threshold+hysteresis and threshold-hysteresis respectively.

If “t on” and “toFF” parameters are set to “0”, then the relay state will be changed as soon as input value exceeds any of the border values (see points A a C, Fig. 23 a, b, c).

If values of "t on" or/and "toFF" are positive, then relay state will be turned on if the input value exceeds the border values and stay bigger (or lower) during at least "t on" (see points B_{ON} , D_{ON} , Fig. 23 a, d, e). Similarly, the relay will be turned off if time "toFF" elapse since the input signal value exceeds any of the border values (see points B_{OFF} , D_{OFF} , Fig. 23 a, d, e).

If t_A , t_B , t_C or t_D (when input signal stay in zone A or zone B) are lower than parameters "t on" or "toFF", the relay will not change his state (see points A a C, Fig. 23 a, d, e). The state of relay output while the input value exceeds the border values (points A, B, C, D) is described by parameter "modE". The relay can be turned on ("modE" = "on"), or turned off ("modE" = "oFF") when input signal value is contained in zone A (Figure 23 a).

The parameter "AL" allow user to set the relay output behaviour in critical situations (e. g. Input values exceeds permissible measurement range). User can select that the relays will be turned on, turned off, or not changed in critical situations.

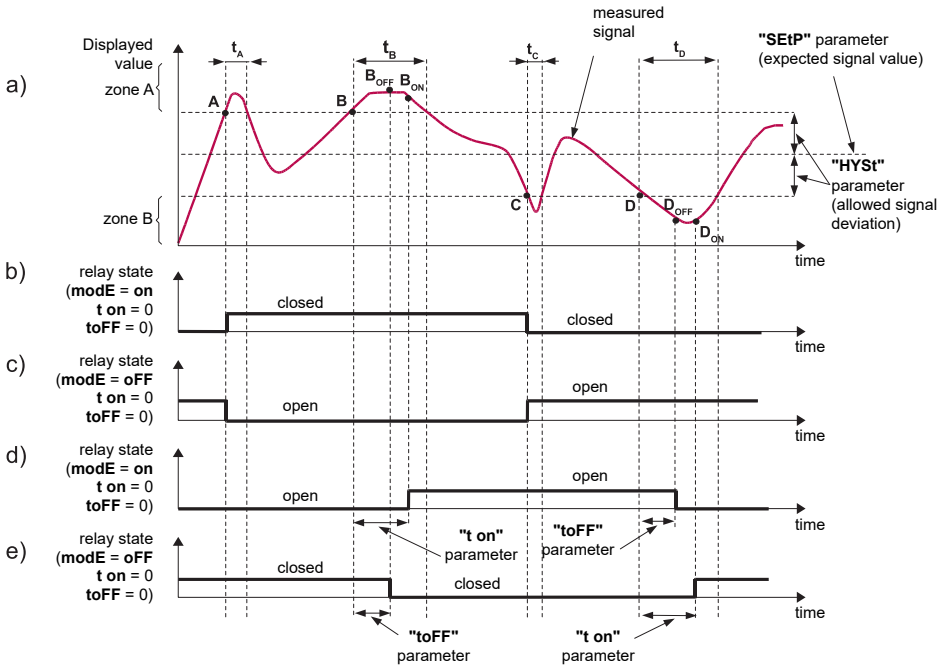


Fig 23: Principle of LED / relay output operation for one threshold mode

Description:

A, B, C, D points where measured signal exceeds border values (expected value \pm allowed deviation)

B_{ON} , B_{OFF} , D_{ON} , D_{OFF} relays state changes moments: (for "t on" > 0, "toFF" > 0)

t_A , t_B , t_C , t_D time periods while input signal is in zone A or zone B

Two thresholds mode

Fig. 24 presents the principle of relay outputs operation for two thresholds mode, and an example values of other parameters. In this mode parameter **"SEt2"** is accessible in common with **"SEtP"**, this parameter describes a second threshold of the relay output. The parameters **"HYSt"**, **"modE"**, **"t on"**, **"toFF"**, **"unit"** and **"AL"** are connected with both **"SEtP"** and **"SEt2"** thresholds.

If two threshold mode is used, **"modE"** parameter defines state of the relay output when the input value occurs in a particular zone defined by border values of both thresholds. The relay can be turned on if the input value is contained in zone A (**"modE"** = "in") or zone B (**"modE"** = "out") and turned off if it is contained in the second one (Figure 24).

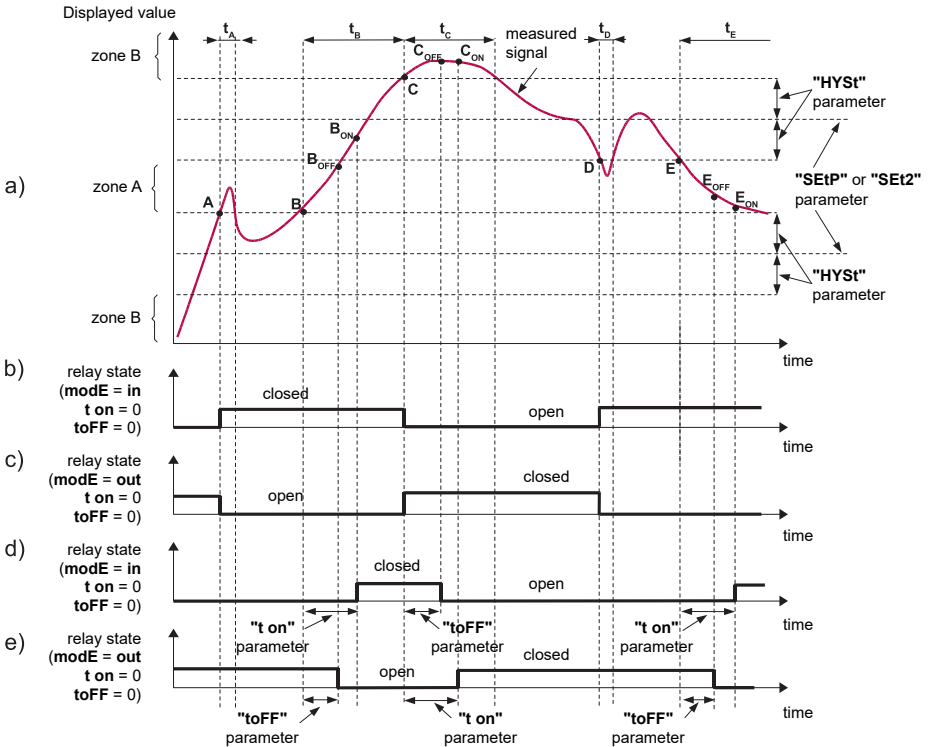


Fig. 24: Principle of LED/relay output operation for two thresholds mode

Description:

A, B, C, D points where measured signal exceeds border values (expected value \pm allowed deviation)

B_{ON}, **B_{OFF}**, **D_{ON}**, **D_{OFF}** relays state changes moments: (for **"t on"** > 0, **"toFF"** > 0)

tA, **tB**, **tC**, **tD** time periods while input signal is in zone A or zone B



If the power supply is interrupted, the device does not remember the status of relays selected using the RS 485 interface.

- **"modE"**

Relay operating modes. Individual modes are described in the previous chapters: Single-threshold and two-threshold control.

- **"t on"**

turn on delay time, the relay is turned on with delay equal **"t on"** if the input value exceeds appropriate border value (defined with threshold and hysteresis), at least **"t on"** time. **"t on"** range 0 ÷ 99.9, defined with 0.1 sec. resolution. Unit of this parameter is set by **"unit"** parameter.

- **"toFF"**

turn off delay time, the relay is turned off with delay equal **"toFF"** if the input value exceeds appropriate border value (defined with threshold and hysteresis), at least **"toFF"** time. **"toFF"** range 0 ÷ 99.9, defined with 0.1 sec. resolution. Unit of this parameter is set by **"unit"** parameter

- **"unit"**

unit of time for **"t on"** i **"toFF"** parameters. Can be set on one of two values:

"min" minutes

"sec" seconds

- **"AL"**

this parameter defines the relay reaction when some critical situations occurs:

"noCH" relay do not change his state

"on" relay will be turned on

"oFF" relay will be turned off

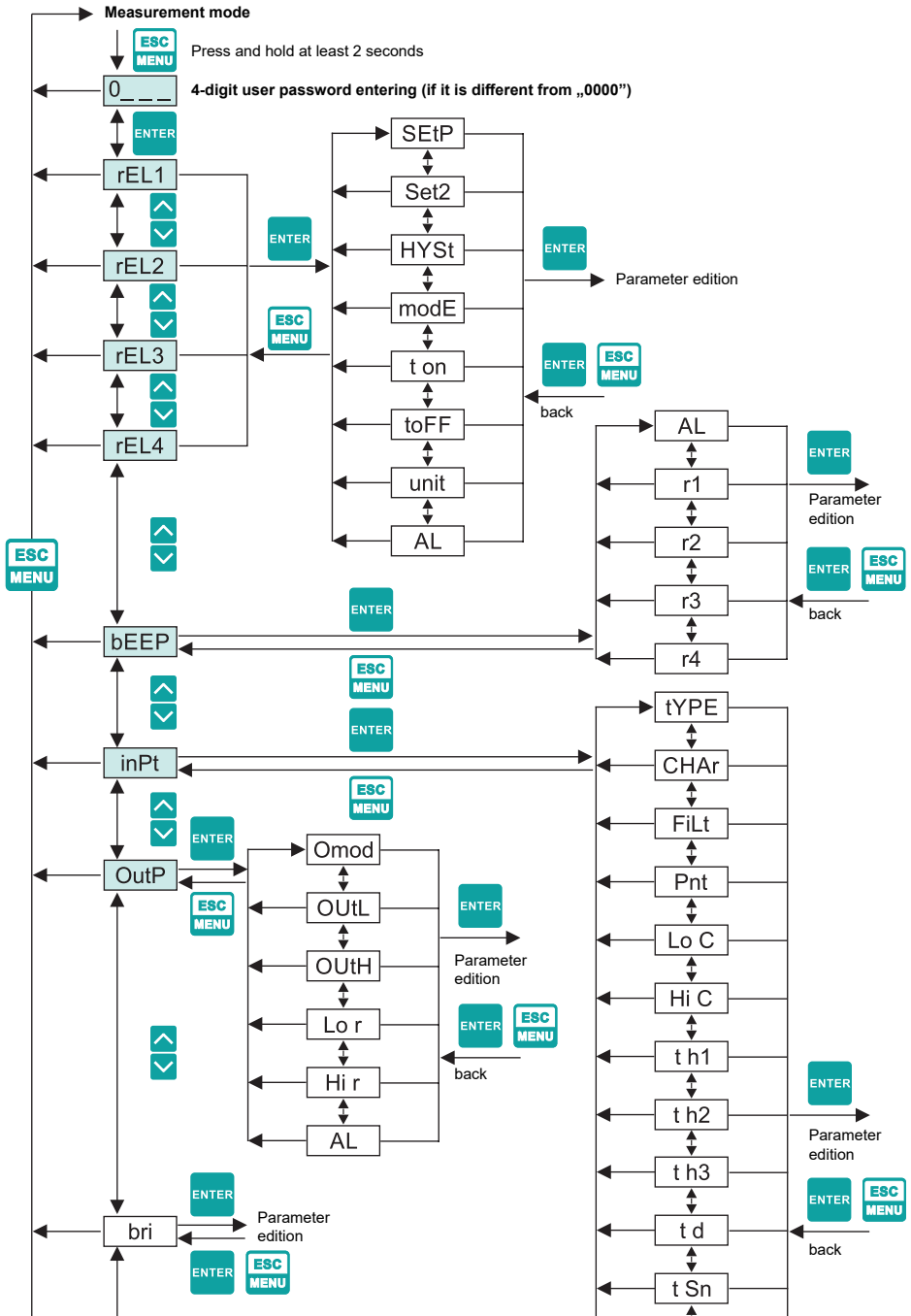
If parameter **"modE"** is set to **"on"**, **"oFF"**, **"in"** or **"Out"** the **"critical situation"** means that allowable measurement range is exceeded.

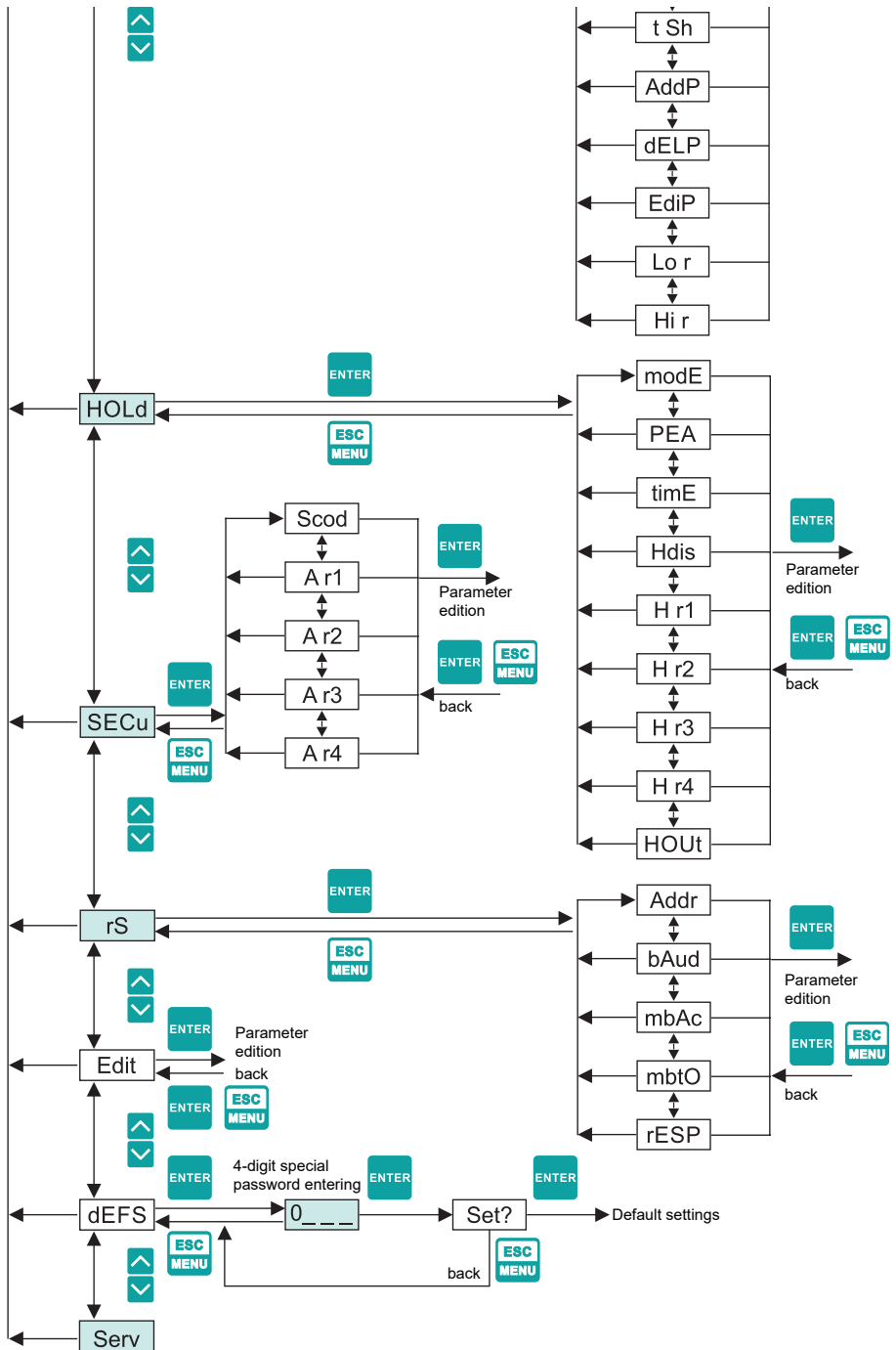
If parameter **"modE"** is set to **"modb"**, the **"critical situation"** means communication delay (when no data is received) longer than **"mbtO"** parameter (see description: **"rS"** menu).



*If parameter **"AL"** = **"on"**, the relay will be turned on in the critical situations, even if his parameter **"modE"** = **"noAC"**.*

8.5. MENU STRUCTURE





8.6. OVER-CURRENT PROTECTION

The current input of the device is equipped with over-current protection circuit. This circuit protects the standard resistor against damage. Maximum input current is set to 40mA (typical). When temperature of the standard resistor falls, the protection circuit will turn on automatically, and the device will measure the input current again. Due to thermal phenomenon in the standard resistor, precision of the measurement may be lower until to the standard resistor temperature will falls to the environment temperature.

9. DISPLAYED VALUES CALCULATION

For simplicity of examples it's assumed that current input is selected, and all calculations are related to this input. When voltage input is selected calculations are similar (be sure of particular ranges and units). The first step to compute the result of measure is the calculation of the normalized result (it means result of 0-1 range). To do it, the begin of the input range (0 mA for 0-20mA range, and 4mA for 4-20mA range) must be subtracted from measured value. Next, received result must be divided by the width of the input range (it means 20mA for 0-20mA range, and 16mA for 4-20mA range). So normalized result can be expressed by expressions:

$$I_n = \frac{I_{inp.} - 4}{16} \quad \text{for } 4 + 20\text{mA range}$$

$$I_n = \frac{I_{inp.}}{20} \quad \text{for } 0 + 20\text{mA range}$$

where $I_{inp.}$ Means input current (in mA), and I_n – normalized result.



If measured value exceeds the nominal input range (0-20mA or 4-20mA), and do not exceed the permissible input range, then received normalized I_n result exceeds 0-1 range, e.g. input range 4-20 mA, input current = 3 mA – the normalized result is equal -0,0625, and for input current = 22 mA, the normalized result is equal 1,125. In such cases presented expressions are still correct.

9.1. ADDITIONAL CALCULATIONS (USED CONVERSION CHARACTERISTIC)

The manner of the additional computation of the displayed result depends on selected conversion characteristic. All presented charts are connected with the input range 4 - 20 mA.

LINEAR CHARACTERISTIC

The normalized result is converted by fixed coefficients determined by “**Lo C**” and “**Hi C**” parameters (when the normalized results is equal 0, then value “**Lo C**” is displayed, and when the normalized results is equal 1, then value “**Hi C**” is displayed). Expression presented below shows the manner of result calculation:

$$W = I_n \times ("Hi C" - "Lo C") + "Lo C"$$

where **W** means the displayed value.



*The value of the “**Lo C**” parameter can be higher than the value of “**Hi C**” parameter. In such a case, for an increasing value of input current the displayed value decreases.*

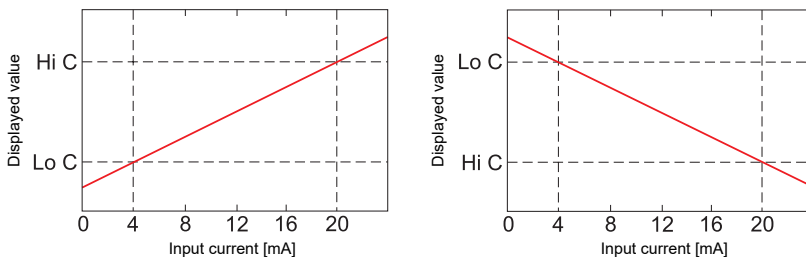


Fig. 25: Normal („Lo C” < ”Hi C”) and inverted („Lo C” > ”Hi C) characteristic

SQUARE CHARACTERISTIC

The normalized result is squared and further conversion is done as for linear characteristic. Conversion is made accordingly with the expression:

$$W = I_n^2 \times (”Hi C” - ”Lo C”) + ”Lo C”$$

where **W** means the displayed value.

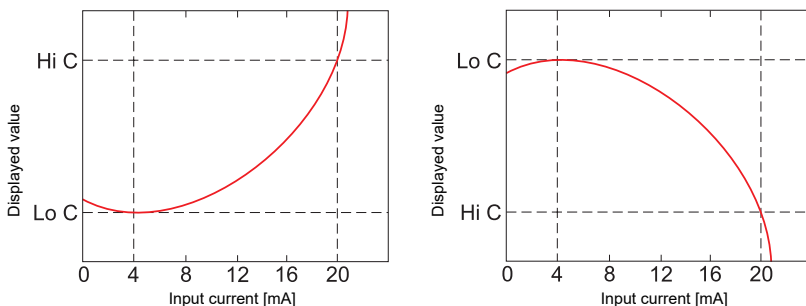


Fig. 26: Normal („Lo C” < ”Hi C”) and inverted („Lo C” > ”Hi C) characteristic

SQUARE ROOT CHARACTERISTIC

The normalized result is rooted and further conversion is done as for linear characteristic. Conversion is made accordingly with the expression:

$$W = \sqrt{I_n} \times (”Hi C” - ”Lo C”) + ”Lo C”$$

where **W** means the displayed value.



Showed above expression is not valid when normalized result is negative. It is possible for 4-20 mode only. In this case ($I_n < 0$) the displayed result is equal “Lo C” (see graphs below).

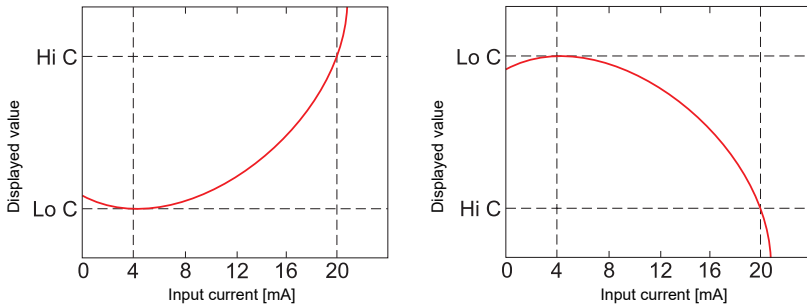


Fig.. 23 Normal („Lo C” < ”Hi C) and inverted („Lo C” > ”Hi C) characteristic

USER DEFINED CHARACTERISTIC

User defined characteristic is defined as set of X-Y points. Number of the points is variable and may be set from 2 to 20 points which make linear segments (see graph and see **Menu "inPt"**).

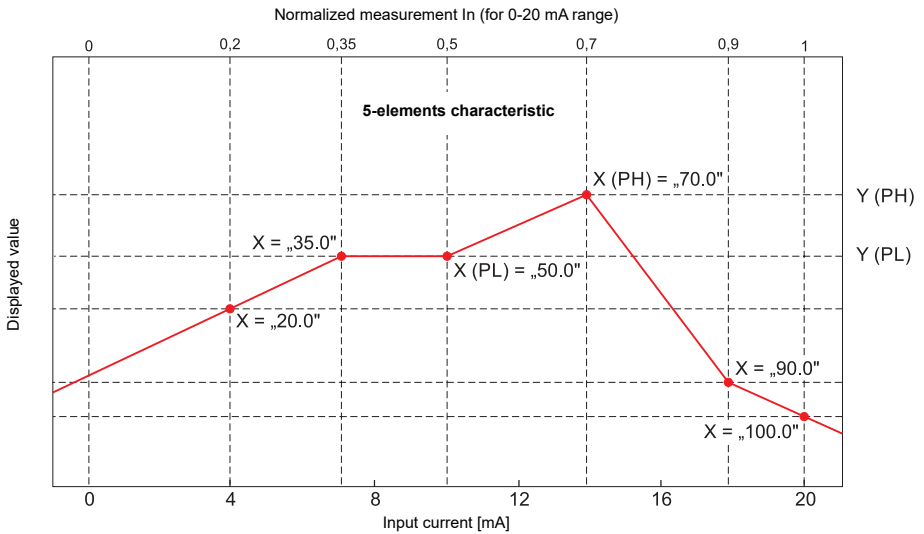


Figure 28: Example of user defined characteristic

Due to the normalized result In , the device computes specific segment, e.g. for characteristic from figure below, and $In = 0,65$ the segment between points $X = "50.0."$ and $X = "70.0."$ will be chosen.

Let's mark those points as PL (point low) i PH (point high) - in this example PL = **"50.0."** and PH = **"70.0."**, and the normalized result In for the point PL as Ip (in this example $Ip = In(PL) = 0,5$). The displayed result is calculated accordingly to the expression:

$$W = (I_n - I_p) \times \frac{[Y (PH) - Y (PL)]}{[X (PH) - X (PL)]} \times 100 + Y (PL)$$

where Y(PH), X(PH), Y(PL), X(PL) mean values of X and Y coordinates of PH i PL points.



If the normalized result exceeds the user defined characteristic values, then specific utmost segment, defined by two next points, is used for calculations. If characteristic from figure below is used, and if $I_n > 1$ then segment defined by points $X(PL) = \text{"90.0."}$, $X(PH) = \text{"100.0."}$ will be used.

9.2. EXAMPLES OF CALCULATIONS

Example 1: Selection of the permissible input range ("4-20" mode)

If in "4-20" mode the user sets "Lo r" = 20,0% and "Hi r" = 10,0%, then permissible input currents range will be equal: 3,2 mA ÷ 22 mA. Lower border of the range is the result of calculations: 4 mA - 4 mA × 20%, and the higher : 20 mA + 20 mA × 10%.

Example 2: The normalized In result calculation

Let the input mode = 4-20 mA. The normalized I_n result is calculated accordingly to the expression on page 37, so if $I_{in} = 10$ mA then 10 mA - 4 mA = 6 mA, and this result should be divided by the width of input range (16 mA). Finally the normalized result: $I_n = 6/16 = 0,375$.

In case when input current exceeds nominal measurement range, calculations are similar. For example if input current is equal 2,5 mA then $I_n = (2,5 - 4)/16 @ -0,0938$, and if input current is equal 20,5 mA then $I_n = (20,5 - 4)/16 @ 1,0313$.

Example 3: The linear characteristic

Let the input mode = 4-20 mA, and parameters "Lo C" and "Hi C" equal to -300 and 1200 respectively. The calculations will be done for three different input currents from example 2.

a). $I_{in} = 10$ mA a $I_n = 0,375$

Accordingly to expression on page 38 for linear characteristic:

$$0,375 \times [1200 - (-300)] \approx 562 \text{ and next, the "Lo C" value is added to the result, so the displayed value:}$$

$$W \approx 562 + (-300) = 262$$

b). $I_{in} = 2,5$ mA a $I_n = -0,0938$

$$W \approx -441$$

c). $I_{in} = 20,5$ mA a $I_n = 1,0313$

$$W \approx 1247$$

Example 4: The square characteristic

Let the input mode = 4-20 mA, and parameters "Lo C" and "Hi C" equal to -300 and 1200 respectively. The calculations will be done for there different input currents from example 2.

a). $I_{in} = 10 \text{ mA}$ a $I_n = 0,375$

Accordingly to expression on page 38 for square characteristic:

$(0,375)2 \times [1200 - (-300)] \approx 211$. and next, the "Lo C" value is added to the result , so the displayed value:

$$W \approx 211 + (-300) = -89$$

b). $I_{in} = 2,5 \text{ mA}$ a $I_n = -0,0938$.

$$W \approx -287$$

c). $I_{in} = 20,5 \text{ mA}$ a $I_n = 1,0313$

$$W \approx 1295$$

Example 5: The square root characteristic

Let the input mode = 4-20 mA, and parameters "Lo C" and "Hi C" equal to -300 and 1200 respectively. The calculations will be done for there different input currents from example 2.

a). $I_{in} = 10 \text{ mA}$ a $I_n = 0,375$

Accordingly to expression on page 39 for square root characteristic:

$$\text{sqrt}(0,375) \times [1200 - (-300)] \approx 919$$

and next, the "Lo C" value is added to the result , so the displayed value:

$$W \approx 919 + (-300) = 619$$

b). $I_{in} = 2,5 \text{ mA}$ a $I_n = -0,0938$, normalized result is negative , so the displayed value is equal to "Lo C" parameter: $W \approx \text{"Lo C"} = -300$.

c). $I_{in} = 20,5 \text{ mA}$ a $I_n = 1,0313$

$$W \approx 1223$$

Example 6: The user defined characteristic

Let the input mode = 4-20 mA, and the user selected the 10 segment characteristic. To do this it is necessary to enter X and Y coordinates of 11 points (see Menu "inPt"). The calculations will be done for three different input currents from example 2, so in calculations some of the segments will be used only.

Let the following points will be given:

$$X1 = \text{"00.0."}, Y1 = \text{"-50.0"}$$

$$X2 = \text{"10.0."}, Y2 = \text{"-30.0"}$$

....

$$X6 = \text{"30.0."}, Y6 = \text{"30.0"}$$

$$X7 = \text{"40.0."}, Y7 = \text{"80.0"}$$

.....

$$X10 = \text{"90.0."}, Y10 = \text{"900.0"}$$

$$X11 = \text{"100.0."}, Y11 = \text{"820.0"}$$

Additionally all other points must to be defined and stored in the device memory.

a). $I_n = 10 \text{ mA}$ a $I_n = 0,375$

The segment defined by X6 = "30.0." and X7 = "40.0." for this I_n will be selected. Accordingly to expressions given for user defined characteristic (see page 39) X6(PL) = 30, Y6(PL) = 30, X7(PH) = 40, Y7(PH) = 80 and $I_p = 0,3$, the displayed value :

$$W = (I_n - I_p) \times \frac{[Y(PH) - Y(PL)]}{[X(PH) - X(PL)]} \times 100 + Y(PL)$$

$$= (0,375 - 0,3) \times \frac{[80 - 30]}{[40 - 30]} \times 100 + 30 \cong 67$$

b). $I_n = 2,5 \text{ mA}$ and $I_n = -0,0938$, because of the normalized I_n value is lower than 0, the segment defined by X1 and X2 will be selected. X1(PL) = 0, Y1(PL) = -50, X2(PH) = 10, Y2(PH) = -30 and $I_p = 0$. For these values the displayed value W @ -69.

c). $I_n = 20,5 \text{ mA}$ and $I_n = 1,0313$, because of the normalized I_n value is higher than 1, the segment defined by X10 and X11 will be selected, and X10(PL) = 90, Y10(PL) = 900, X11(PH) = 100, Y11(PH) = 820 and $I_p = 0,9$ for these values the displayed value W @ 795.

Example 7: Current output value calculation

Let the current output parameters be:

"modE" = "on", "OUTL" = 100, "OUTH" = 200, "Lo r" = 5.0, "Hi r" = 5.0 Parameters "Lo r" and "Hi r" define working range of current output to 3.8 ÷ 21 mA. Output current will be calculated for three displayed values „D“:

a). D = 175

According to formula from page 24:

$$I_{out} = (175-100) / (200-100) \times 16 \text{ mA} + 4 \text{ mA} = 0,75 \times 16 + 4 = 16 \text{ mA}$$

Calculated I_{out} do not exceeds the output working range (3.8 - 21 mA).

b). D = 205

According to formula from page 24:

$$I_{out} = (205-100) / (200-100) \times 16 \text{ mA} + 4 \text{ mA} = 1,05 \times 16 + 4 = 20,08 \text{ mA}$$

Calculated I_{out} do not exceeds the output working range (3.8 - 21 mA).

c). D = 300

According to formula from page 24:

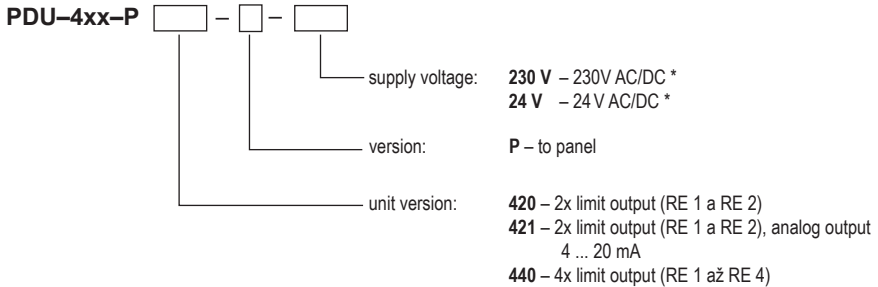
$$I_{out} = (300-100) / (200-100) \times 16 \text{ mA} + 4 \text{ mA} = 2 \times 16 + 4 = 36 \text{ mA.}$$

Calculated I_{out} exceeds the output working range (3 - 21 mA), so current output will generate current equal to the upper border of range defined by parameter "Lo r" i "Hi r" (it means 21 mA).

10. FUNCTION AND STATUS INDICATION

| <i>LED control</i> | <i>colour</i> | <i>function</i> |
|--------------------|---------------|--|
| „AL“ | red | lit – input current (voltage) on the terminals "+ IN" is outside of the allowed range (adjustable) dark – correct function |
| 1: | red | lit – relay RE 1 is energized (threshold status value exceeded) dark – relay RE 1 de-energized (threshold status value not reached) |
| 2: | red | lit – relay RE 2 is energized (threshold status value exceeded) dark – relay RE 2 de-energized (threshold status value not reached) |
| 3: | red | lit – relay RE 3 is energized (threshold status value exceeded) dark – relay RE 3 de-energized (threshold status value not reached) |
| „R 4“ | red | lit – relay RE 4 is energized (threshold status value exceeded) dark – relay RE 4 de-energized (threshold status value not reached) |

11. ORDER CODE



* for accurate range of power supply voltage see table "Technical specification".

12. CORRECT SPECIFICATION EXAMPLES

PDU-421-P-230V

(421) 2x limit output (2 relays); (P) panel version; (230V) power supply voltage 85 ... 260 V AC/DC.

PDU-440-P-24V

(440) 4x limit output (4 relays); (P) panel version; (24V) power supply voltage 19 ... 50 V DC (16 ... 35 V AC).

13. ACCESSORIES

standard - included in the price of the unit

- 2x metallic brackets for panel mounting

optional - extra charge

(see catalogue sheet for accessories)

- 2x metallic brackets for panel mounting

14. SAFETY, PROTECTIONS, COMPATIBILITY AND EXPLOSION PROOF

PDU-4xx-P display unit is equipped with power supply voltage polarity reversal, protection against overcurrent and protection against short-term overvoltage.

Protection against hazardous contact is provided through small safe voltage, according to EN 33 2000-4-41.

The electrical equipment of the protection class II. Connected to 230 V power supply only through fuse or breaker (max. 2A).

The electrical equipment of the protection class II. Electrical safety according to EN 61010-1.

The electromagnetic compatibility is ensured by compliance with standards EN 61326.

15. USE, MANIPULATION AND MAINTENANCE

To reduce the risk of fire or electric shock, protect the unit from atmospheric effects and excessive moisture.

Do not use the unit in areas with a risk of vibration, dust, moisture, corrosive gases and oils.

Do not use the unit in explosive environment.

Do not use the unit in areas with significant temperature changes where it will be exposed to condensation or freezing.

Do not use the unit in areas where it may be exposed to direct sunlight.

If the temperature inside the cabinet exceeds the recommended values, use forced cooling (e.g. fan).



The manufacturer is not responsible for any damages caused by improper installation, operation of the device in unsuitable technical conditions or in contradiction with its purpose of use.

The unit should be installed by qualified personnel. During installation, appropriate safety regulations should be adhered to.

Optional equipment must meet the requirements of the relevant safety standards and regulations. They must be equipped with adequate surge and interference suppression filters.

Do not attempt to remove, repair, or modify the unit yourself. The unit has no serviceable parts. If a fault has been detected, disconnect the unit from the power supply and contact an authorized service center.

The unit is intended for operation in an industrial environment. Do not use it for home applications.

The unit has no internal interchangeable or adjustable features that are freely accessible to the user. Pay attention to the ambient temperature in the room where the unit is to be operated. Significantly higher temperatures result in faster ageing of the internal elements and reduced trouble-free operation.

Do not use thinners and other reagents when cleaning. Clean the unit with warm water and a small amount of detergent. In case of major contamination, use ethyl or isopropyl alcohol.

Using reagents can cause permanent damage to the unit casing.

After the end of the service life, hand over the product to a specialized company for recycling or contact the manufacturer for recovery.

16). GENERAL, CONDITIONS AND WARRANTY

The manufacturer guarantees from the supply that this product will have established properties given in the technical conditions for a period of 3 years.

The manufacturer is responsible for the faults that have been identified during the warranty period and were claimed in writing.

The warranty does not apply to defects resulting from improper handling or failure to comply with the technical specifications.

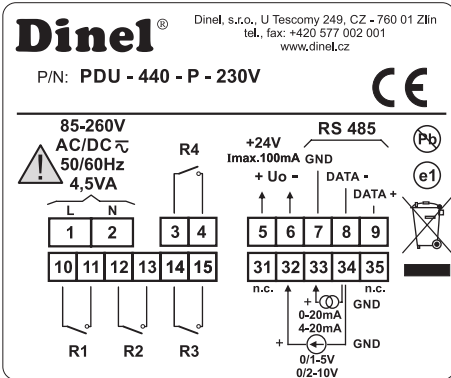
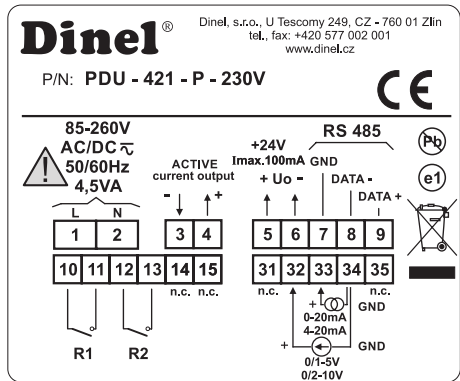
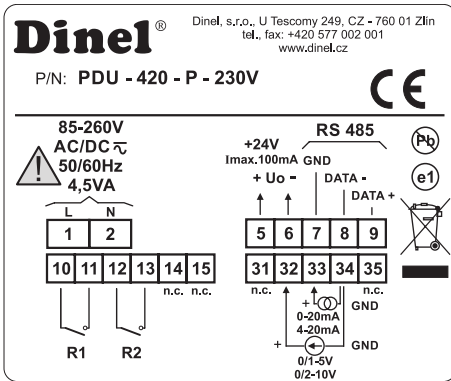
The warranty shall expire if the customer or a third party carries out changes or modifications of the product, if the product is mechanically or chemically damaged, or if the production number is not legible.

For the application of a claim, it is necessary to submit the certificate of warranty.

In the event of justified complaint, we repair the defective product, or replace

17. MARKING OF LABELS

Data on the plate of the unit of **PDU-4xx-P** series



- The manufacturer's mark: logo Dinel®; Contact: Dinel, s.r.o., U Tescomy 249, CZ - 760 01 Zlín, tel., fax: +420 577 002 001; www.dinel.cz
- Unit type:
 - P/N: PDU - 420 - P - 230V: 2 relay outputs
 - P/N: PDU - 421 - P - 230V: 2 relay outputs, 1 current output
 - P/N: PDU - 440 - P - 230V: 4 relay outputs
- 85-260V; AC/DC; 50/60Hz; 4,5VA
- The conformity mark: **CE**; The symbol for the return of WEEE:

18. TECHNICAL SPECIFICATIONS

| BASIC TECHNICAL DATA | | |
|------------------------------|-------------------------------|--|
| Location | | panel version |
| Power supply voltage | version 230 V version 24 V | 85 ... 260 V AC/DC 19 ... 50 V DC; 16 ... 35 V AC |
| Power consumption | version 230 V version 24 V | 4,5W (4,5VA) |
| Voltage input | | current 0/4 ... 20 mA (limited input current to 40 mA) voltage 0/1 ... 5 V; 0/2 ... 10 V |
| Voltage input resistance | | < 65 Ω (current input) > 50 kΩ (voltage input) |
| Display range | | -999 ÷ 9999, plus decimal point |
| Voltage measurement accuracy | | ± 0.25 % (± one digit over the entire measuring range) |
| Display | | 4-digit, seven-segment, LED, red |
| Outputs relay | | 2 or 4 (relay 1A / 250V AC) |
| Sensor power supply outputs | version 230 V version 24 V | 24 V DC + 5 % - 10 % / max. 100 mA |
| Outputs | | 0 ... 24 mA |
| Communication interface | | RS-485, 8N1 and 8N2, Modbus RTU, no galvanic separation |
| Baud rate | | 1 200 ... 115,200 sec |
| Operating temperature | | 0 ... +50°C |
| Storage temperature | | -10 ... +70 °C |
| Protection | Front panel Terminal | IP40 (standard); IP65 (optional)* IP20 |
| Housing material | | Noryl – GFN2S E1 |
| Weight | | cca 210g |

* with sealing gasket

DEFAULT AND USER'S SETTINGS LIST

| Parameter | Description | Default value | User's value | Desc. page |
|---|---|---------------|--------------|------------|
| Parameters of relay R1 operation ("rEL1" menu) | | | | |
| SEtP | Relay R1 threshold | 20.0 | | 17 |
| SEt2 | Relay R1 second threshold | 40.0 | | 17 |
| HYSt | Hysteresis of relay R1 | 0.0 | | 17 |
| modE | Operation mode of relay R1 | on | | 17 |
| t on | Turn on delay of relay R1 | 0.0 | | 32 |
| toFF | Turn off delay of relay R1 | 0.0 | | 32 |
| unit | Unit of "t on", "toFF" parameters of relay R1 | SEC | | 32 |
| AL | Reaction for critical situation of relay R1 | OFF | | 32 |
| Parameters of relay R2 operation ("rEL2" menu) | | | | |
| SEtP | Relay R2 threshold | 40.0 | | 17 |
| SEt2 | Relay R2 second threshold | 60.0 | | 17 |
| HYSt | Hysteresis of relay R2 | 0.0 | | 17 |
| modE | Operation mode of relay R2 | on | | 17 |
| t on | Turn on delay of relay R2 | 0.0 | | 32 |
| toFF | Turn off delay of relay R2 | 0.0 | | 32 |
| unit | Unit of "t on", "toFF" parameters of relay R2 | SEC | | 32 |
| AL | Reaction for critical situation of relay R2 | OFF | | 32 |
| Parameters of relay R3 operation ("rEL3" menu) | | | | |
| SEtP | Relay R3 threshold | 60.0 | | 17 |
| SEt2 | Relay R3 second threshold | 80.0 | | 17 |
| HYSt | Hysteresis of relay R3 | 0.0 | | 17 |
| modE | Operation mode of relay R3 | on | | 17 |
| t on | Turn on delay of relay R3 | 0.0 | | 32 |
| toFF | Turn off delay of relay R3 | 0.0 | | 32 |
| unit | Unit of "t on", "toFF" parameters of relay R3 | SEC | | 32 |
| AL | Reaction for critical situation of relay R3 | OFF | | 32 |
| Parameters of relay R4 operation ("rEL4" menu) | | | | |
| SEtP | Relay R4 threshold | 80.0 | | 17 |
| SEt2 | Relay R4 second threshold | 100.0 | | 17 |
| HYSt | Hysteresis of relay R4 | 0.0 | | 17 |
| modE | Operation mode of relay R4 | on | | 17 |
| t on | Turn on delay of relay R4 | 0.0 | | 32 |
| toFF | Turn off delay of relay R4 | 0.0 | | 32 |
| unit | Unit of "t on", "toFF" parameters of relay R4 | SEC | | 32 |
| AL | Reaction for critical situation of relay R4 | OFF | | 32 |

DEFAULT AND USER'S SETTINGS LIST

| Parameter | Description | Default value | User's value | Desc. page |
|---|---|---------------|--------------|------------|
| Activation of acoustic signal (menu "bEEP") | | | | |
| AL | Activation of acoustic signal by critical situation | „oFF" | | 19 |
| r1 | Activation of acoustic signal by relay R1 | „oFF" | | 19 |
| r2 | Activation of acoustic signal by relay R2 | „oFF" | | 19 |
| r3 | Activation of acoustic signal by relay R3 | „oFF" | | 19 |
| r4 | Activation of acoustic signal by relay R4 | „oFF" | | 19 |
| Configuration of measurement input ("inPt" menu) | | | | |
| tYPE | Input mode | „4-20" | | 15 |
| CHAr | Conversion characteristic mode | Lin | | 19 |
| FiLt | Filtering ratio | 0 | | 15 |
| Pnt | Decimal point position | 0.0 | | 16 |
| Lo C | Minimum displayed value (for nominal range) | 000.0 | | 16 |
| Hi C | Maximum displayed value (for nominal range) | 100.0 | | 16 |
| t h1 | Height (length) first part of the tank | 00.00 | | 21 |
| t h2 | Height (length) second part of the tank | 00.00 | | 21 |
| t h3 | Height (length) third part of the tank | 00.00 | | 21 |
| t d | Tank diameter | 00.01 | | 21 |
| t Sn | Distance between sensor and bottom of the tank | 00.00 | | 21 |
| t Sh | Height of the sensor | 20.00 | | 21 |
| Lo r | Extension of the bottom of the nominal input range | 5.0 (%) | | 16 |
| Hi r | Extension of the top of the nominal input range | 5.0 (%) | | 16 |
| Active current output configuration ("OuT" menu) | | | | |
| Omod | Current output mode | „0-20" (mA) | | 24 |
| OUtL | Display value for 0 mA or 4 mA (depend „Omod") current output | 0.0 | | 24 |
| OUtH | Display value for 20 mA current output | 100.0 | | 24 |
| Lo r | Extension of the bottom of the nominal output range | 5.0 (%) | | - |
| Hi r | Extension of the top of the nominal output range | 5.0 (%) | | - |
| AL | Current output value on critical exception | 22.1 (mA) | | 24 |

DEFAULT AND USER'S SETTINGS LIST

| Active current output configuration ("OUTP" menu) | | | | |
|--|--|-------------|--|----|
| Omod | Current output mode | „4-20" (mA) | | 24 |
| OutL | Display value for 0 mA or 4 mA (depend „Omod") current output | 0.0 | | 24 |
| OutH | Display value for 20 mA current output | 100.0 | | 24 |
| Lo r | Extension of the bottom of the nominal output range | 5.0 (%) | | - |
| Hi r | Extension of the top of the nominal output range | 5.0 (%) | | - |
| AL | Current output value on critical exception | 22.1 (mA) | | 24 |
| Display parameters | | | | |
| bri | Display brightness | bri6 | | 25 |
| Configuration of peaks detection function ("HOLd" menu) | | | | |
| modE | Kind of detected changes | norm | | 25 |
| PEA | Minimum detected change | 0.0 | | 25 |
| timE | Maximum time of peak displaying | 0.0 | | 25 |
| HdiS | The type of displayed value | HOLd | | 25 |
| H r1 | Source of relay R1, and LED R1 control | rEAL | | 26 |
| H r2 | Source of relay R2, and LED R2 control | rEAL | | 26 |
| H r3 | Source of relay R3, and LED R3 control | rEAL | | 26 |
| H r4 | Source of relay R4, and LED R4 control | rEAL | | 26 |
| HOUT | Source of current output control | rEAL | | 26 |
| Settings of access to the configuration parameters ("SECu" menu) | | | | |
| A r1 | Permission to changes of relay R1 threshold without of the user password knowledge | On | | 26 |
| A r2 | Permission to changes of relay R2 threshold without of the user password knowledge | On | | 26 |
| A r3 | Permission to changes of relay R3 threshold without of the user password knowledge | On | | 26 |
| A r4 | Permission to changes of relay R4 threshold without of the user password knowledge | On | | 26 |

DEFAULT AND USER'S SETTINGS LIST

| RS 485 interface configuration (menu "rS") | | | | |
|---|--|-----|--|----|
| Addr | Device address | 0 | | 27 |
| bAud | Baud rate | 9.6 | | 27 |
| mbAc | Permission to changes of configuration registers | On | | 27 |
| mbtO | Maximum delay between received messages | 0 | | 27 |
| rESP | Additional delay of answer transmission | Std | | 27 |
| Configuration of numerical parameters edition | | | | |
| Edit | Numerical parameters edit mode | dig | | 28 |

19. PACKING, SHIPPING AND STORAGE

The PDU-4xx-P is wrapped in a polyethylene bag and the whole consignment is placed in a card box. In the carton box, appropriate padding is used to prevent mechanical damage during transport. Remove the device from the packaging just before its use, you may avoid possible damage.

The transport to the customer is realized by means of a forwarding company. After a prior agreement, personal taking of the ordered goods from headquarters is also possible. When taking over, please make sure that the consignment is complete and corresponds to the extent of the order, and that no damage occurred to the equipment when transporting. Do not use a device obviously damaged during transport, but contact the manufacturer in order to address the situation.

If the device is to be transported further, then only wrapped in the original packaging and protected against shocks and weather conditions.

Store the device in the original packaging in dry areas covered from the weather conditions, with a moisture up to 85 % without any effects of Chemically active substances. Storage temperature range is -10 °C to +50 °C.

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Version: 04 / 2019



QMS
ISO 9001

