

# USER MANUAL for digital indicator with Pt100/500/1000 input

type: **PAD-73T**

firmware version: 5.14 or higher



Read the user's manual carefully before starting to use the unit.  
Producer reserves the right to implement changes without prior notice.

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### **Explanation of symbols used in the manual:**



- This symbol denotes especially important guidelines concerning the installation and operation of the device. Not complying with the guidelines denoted by this symbol may cause an accident, damage or equipment destruction.

**IF THE DEVICE IS NOT USED ACCORDING TO THE MANUAL THE USER IS RESPONSIBLE FOR POSSIBLE DAMAGES.**



- This symbol denotes especially important characteristics of the unit. Read any information regarding this symbol carefully

## **1. BASIC REQUIREMENTS AND USER SAFETY**



- **The manufacturer is not responsible for any damages caused by inappropriate installation, not maintaining the proper technical condition and using the unit against its destination.**

- Installation should be conducted by qualified personnel. During installation all available safety requirements should be considered. The fitter is responsible for executing the installation according to this manual, local safety and EMC regulations.

- The unit must be properly set-up, according to the application. Incorrect configuration can cause defective operation, which can lead to unit damage or an accident.

- **If in the case of a defect of unit operation there is a risk of a serious threat to the safety of people or property additional, independent systems and solutions to prevent such a threat must be used.**

- **The unit uses dangerous voltage that can cause a lethal accident. The unit must be switched off and disconnected from the power supply prior to starting installation of troubleshooting (in the case of malfunction).**

- Neighbouring and mating equipment must meet the requirements of appropriate standards and regulations concerning safety and be equipped with adequate anti-overvoltage and anti-interference filters.

- **Do not attempt to disassemble, repair or modify the unit yourself. The unit has no user serviceable parts. Units, in which a defect was stated must be disconnected and submitted for repairs at an authorized service centre.**



- In order to minimize fire or electric shock hazard, the unit must be protected against atmospheric precipitation and excessive humidity.

- Do not use the unit in areas threatened with excessive shocks, vibrations, dust, humidity, corrosive gasses and oils.

- Do not use the unit in explosion hazard areas.



- Do not use the unit in areas with significant temperature variations, exposed to condensation or icing.
- Do not use the unit in areas exposed to direct sunlight.
- Make sure that the ambient temperature (e.g. inside the control box) does not exceed the recommended values. In such cases forced cooling of the unit must be considered (e.g. by using a ventilator).



**The unit is designed for operation in an industrial environment and must not be used in a household environment or similar.**

## **2. GENERAL CHARACTERISTICS**

The **PAD-73T** is a simple digital panel indicator, equipped with Pt 100/Pt 500/Pt 1000 type input, with automatic connection recognition (two, three or four wire sensor). The measurement range spans from -100 °C to +600 °C, and input is fully linearised accordingly to PN-EN60751+A2:1999 standard. Result is showed on 4-digit LED display. Device **PAD-73T** is equipped with RS-485 / Modbus RTU communication interface.

The parameters (offset, baud rate) can be selected while ordering. The device can be configured via IR remote controller or optionally by PC via RS-485 interface, or using simple RS-232 to IR converter. Over more communication interface RS-485 enables data transmission in any monitoring system equipped with Modbus RTU protocol. Easy assembling, small dimensions, precision and reliability are the basic trumps of **PAD-73T** indicators.

IR remote controller is not a part of the **PAD-73T** and must be ordered separately.

## **3. TECHNICAL DATA**

Power supply voltage (depending on version)	230 V <sub>AC</sub> ± 10 %; 50 ÷ 60 Hz or 110 V <sub>AC</sub> ± 10 %; 50 ÷ 60 Hz or 24 V <sub>DC</sub> (not separated)
External fuse (required)	T - type, max. 2 A
Power consumption max.	max. 1.5 VA @ 230 V <sub>AC</sub> and @ 110 V <sub>AC</sub> max. 1 W @ 24 V <sub>DC</sub>
Measurement input	Pt 100/ Pt 500/Pt 1000 type with automatic connection recognition (2-, 3- or 4-wires)
Measurement range	-100 °C ÷ +600 °C
Measurement accuracy	± 0.25 % ± one digit
Measurement wires resistance	max. 20 Ω (every wire)
Display range	-999 ÷ 9999, plus decimal point
Accepted prolonged input overload	20 %
Communication interface	RS-485, 8N1 and 8N2, Modbus RTU, not separated

Baud rate	1200 bit/sec ÷ 115200 bit/sec
Display	LED, 4 digit, 13mm height, red
Data memory	non-volatile memory, EEPROM type
Protection level	IP 40 (from front) IP 20 (housing and connection clips)
Housing type	panel
Housing material	NORYL – UL94V-0
Housing dimensions	for 24 V <sub>DC</sub> version: 72 x 36 x 77 mm for 230 V <sub>DC</sub> version: 72 x 36 x 94 mm
Mounting hole	67 x 32.5 mm
Assembly depth	for 24 V <sub>DC</sub> version: min. 78 mm for 230 V <sub>DC</sub> version: min. 95 mm
Panel thickness	max. 5 mm
Operating temperature (depending on version)	0 °C to +50 °C or -20 °C to +50 °C
Storage temperature (depending on version)	-10 °C to +70 °C or -20 °C to +70 °C
Humidity	5 to 90 % no condensation
Altitude	up to 2000 meters above sea level
Screws tightening max. torque	0.5 Nm
Max. connection leads diameter	2.5 mm <sup>2</sup>
Safety requirements	according to: PN-EN 61010-1 installation category: II pollution degree: 2 voltage in relation to ground: 300 V <sub>AC</sub>  insulation resistance: >20 MΩ insulation strength between power supply and input/output terminal: 1min. @ 2300 V
EMC	according to: PN-EN 61326



**This is a class A unit. In housing or a similar area it can cause radio frequency interference. In such cases the user can be requested to use appropriate preventive measures.**

## **4. DEVICE INSTALLATION**

The unit has been designed and manufactured in a way assuring a high level of user safety and resistance to interference occurring in a typical industrial environment. In order to take full advantage of these characteristics installation of the unit must be conducted correctly and according to the local regulations.



- Read the basic safety requirements on page 3 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 clamps against unauthorized persons must be taken into consideration.

### **4.1. UNPACKING**

After removing the unit from the protective packaging, check for transportation damage. Any transportation damage must be immediately reported to the carrier. Also, write down the unit serial number on the housing and report the damage to the manufacturer.

Attached with the unit please find:

- user's manual,
- warranty,
- assembly brackets - 2 pieces.

### **4.2. ASSEMBLY**



- The unit is designed for mounting indoor inside housings (control panel, switchboard) assuring appropriate protection against electric impulse waves. Metal housing must be connected to the grounding in a way complying with the governing regulations.
- Disconnect the power supply prior to starting assembly.
- Check the correctness of the performed connections prior to switching the unit on.



In order to assembly the unit, a 67 x 32.5 mm mounting hole (Figure 4.1) must be prepared. The thickness of the material of which the panel is made must not exceed 5 mm. Place the unit in the mounting hole inserting it from the front side of the panel, and then fix it using the brackets (Figure 4.2). The minimum distances between assembly holes' axes - due to the thermal and mechanical conditions of operation - are 91 mm x 57mm (Figure 4.3).

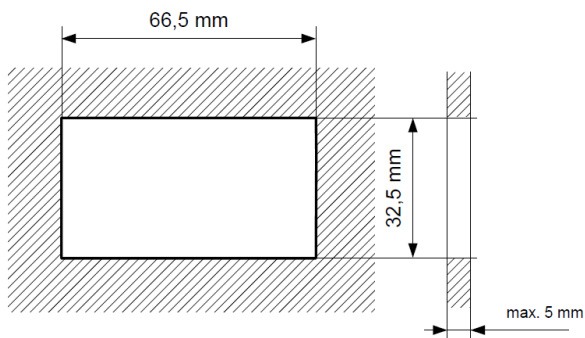


Figure 4.1. Mounting hole dimensions

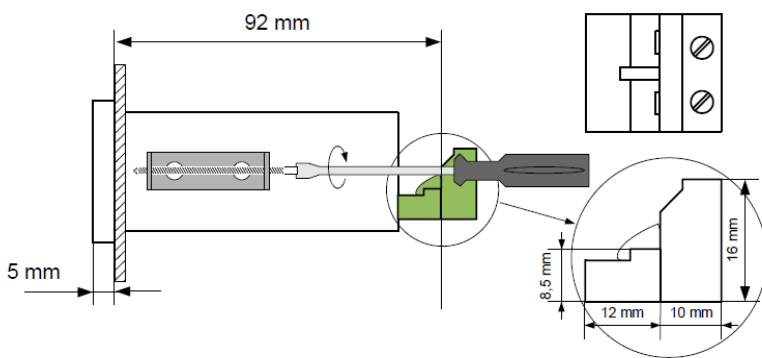


Figure 4.2. Installing of brackets, and dimensions of connectors.

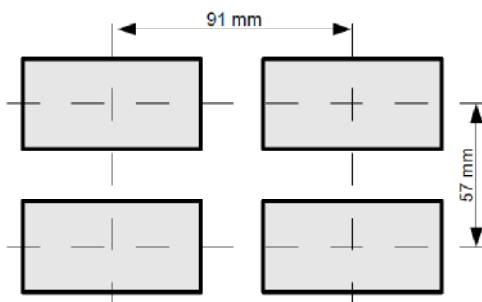


Figure 4.3. Minimum distances when assembly of a number of units

### **4.3. CONNECTION METHOD**

#### **Caution**



- Installation should be conducted by qualified personnel. During installation all available safety requirements should be considered. The fitter is responsible for executing the installation according to this manual, local safety and EMC regulations.
- 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 minimal possible nominal current value must be used (recommended bipolar, max. 2 A) and a power supply circuit-breaker 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.
- In the case of the unit being fitted with separable clamps they should be inserted into appropriate connectors in the unit, even if they are not used for any connections.
- **Unused clamps (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 packing, 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 common (parallel) leading of signal cables and transmission cables together with power supply cables and cables controlling induction loads (e.g. contactors). Such cables should cross at a right angle.
- Contactor coils and induction loads should be equipped with anti-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 couples of signal cables (so-called "spirals") is recommended. The spiral (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 anti-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 earthing with largest possible surface. The cables connected to the filter output must not run in parallel with cables with interference (e.g. circuits controlling relays or contactors).

Connections of power supply voltage and measurement signals are executed using the screw connections on the back of the unit's housing.

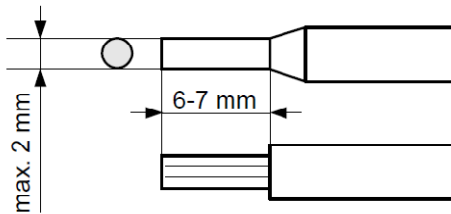


Figure 4.4. Method of cable insulation replacing and cable terminals

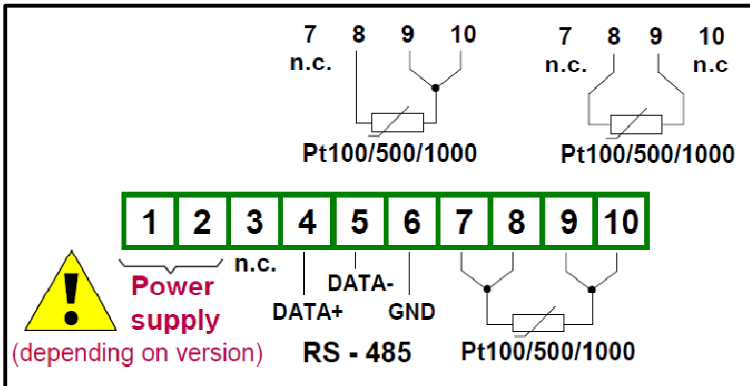


Figure 4.5. Terminals description



**All connections must be made while power supply is disconnected!**

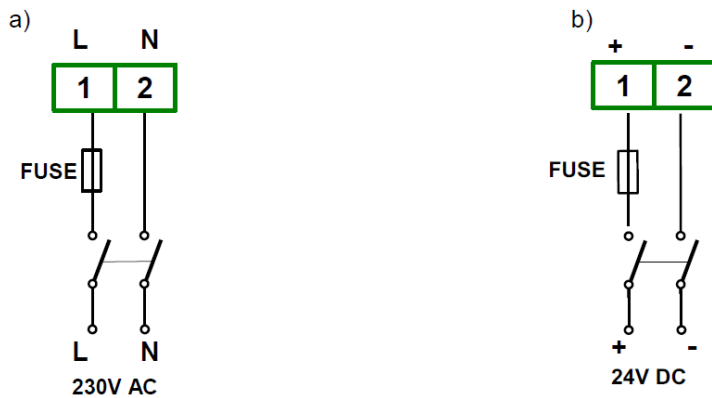


Figure 4.6. Connection of power supply  
a) for 230 V<sub>AC</sub> version; b) for 24 V<sub>DC</sub> version

Temperature sensor can be connected to the device in typical 4-wire circuit (Figure 4.7 a), 3-wire circuit (Figure 4.7 b) or 2-wire circuit (Figure 4.7 c). Due to precision of measurement 4-wire circuit is recommended.



If 2-wire circuit is used, the resistance of wires should be as small as possible, to avoid of measurement errors. Measured value can be corrected (constant correction) using “toFS” parameter from menu “inPt”. Due to low precision 2-wire connection is not recommended.

When 4- or 2-wires connection is used, the resistance of particular wires ( $R_a \div R_d$ ) **CAN BE DIFFERENT**. When 3-wires connection is used, the resistance of particular wires ( $R_a \div R_d$ ) **MUST BE IDENTICAL** to enable proper compensation of it's resistance. The resistance of particular wire **should not be greater than 20  $\Omega$** .

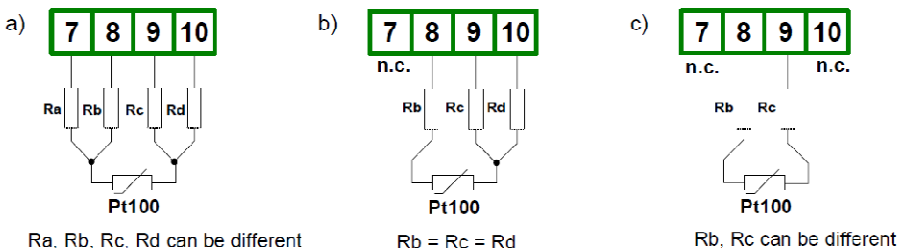


Figure. 4.7. Connection of sensors:  
a) 4-wires circuit; b) 3-wires circuit; c) 2-wires circuit;



The connection circuit should not be changed while unit is powered. Every change of connection while the unit is powered causes measurement errors by several seconds after change.

#### **4.4. MAINTENANCE**

The unit does not have any internal replaceable or adjustable components available to the user. Pay attention to the ambient temperature in the room where the unit is operating. Excessively high temperatures cause faster ageing of the internal components and shorten the fault-free time of unit operation.

In cases where the unit gets dirty do not clean with solvents. For cleaning use warm water with small amount of detergent or in the case of more significant contamination ethyl or isopropyl alcohol.

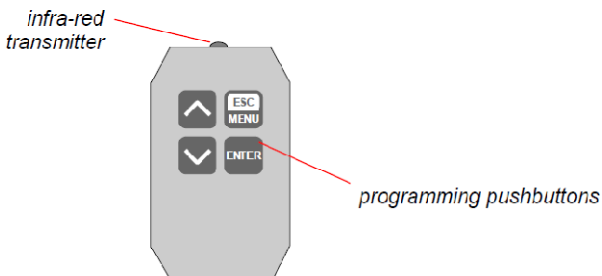


Using any other agents can cause permanent damage to the housing.



Product marked with this symbol should not be placed in municipal waste. Please check local regulations for disposal and electronic products.

## **5. DESCRIPTION OF IR REMOTE CONTROLLER AND CONTROL SOFTWARE PUSH-BUTTONS**



### ***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: **[^] [v]**

Functions:

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

## **6. PRINCIPLE OF OPERATION**

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

### **6.1. MEASUREMENT MODE**



Configuration of the device (via menu or RS-485 interface) **do not stops measures.**

## **6.2. DETECTION OF THE PEAK VALUES**

The **PAD-73T** controller is equipped with peaks detection function. It can detect a peaks of the input signal and display their values. Presets connected with this function are placed in **“HOLD”** menu (see description of **“HOLD” menu**). The detection of the peak can be done if the measured signal raises and drops of value at least equal to parameter **“PEA”**. Detected peaks are displayed during the time defined by parameter **“timE”**. If a new peak will be detected while one is displayed, this new peak will be displayed and display time counter will be cleared (Figure 6.1). If no peaks are detected while time **“timE”** elapses, device starts to show the current value of input signal again.

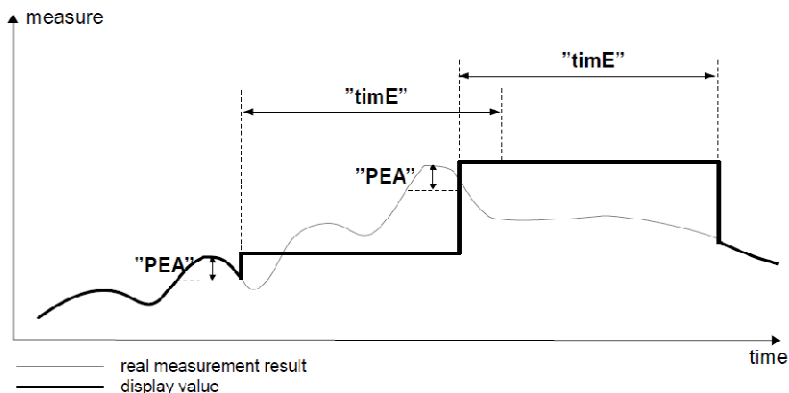


Figure 6.1. Process of peaks detection

## **7. DEVICE PROGRAMMING**

The device menu allow user to set all parameters connected to operation of measurement input, control modes, critical situations behaviour, communication via RS-485 and access settings. The meaning of the particular parameters is described in paragraph **MENU DESCRIPTION**.

### **7.1. PROGRAMMING MENU**

To enter main menu (being in the measurement mode) operator must to press and hold at least 2 sec. **[ESC/MENU]** button.

If the user password is defined (see parameter **“Scod”**), operator have to enter correct one before proceeding to menu options. Entering of the passwords is similar to the edition of numeric parameters (see: **PARAMETERS EDITION**), however presently editing digit is showed only on the display, other digits are replaced by **“-”** sign.

After entering of last digit of the password first menu position will be displayed (if the password is correct) or warning **“Err”** in other case.

## Functions of the buttons while sub-menu and parameters choice:



Selection of sub-menu or parameter for editing. Name of selected item (sub-menu or parameter) is displayed.



Operation of **[ENTER]** button depend on present menu position:

- if the name of some sub-menu is displayed - enter this sub-menu; name of the first parameter (or next level sub-menu) is displayed,
- if the name of some parameter is displayed - enter the edition of this parameter; present value of the parameter is displayed,



**[ESC/MENU]** button allow user to exit present menu level and goes to upper level menu (or measurement mode).



After about 1 min. since last use of the buttons, device exits the menu mode and returns to the measurement mode (only if no parameters are in editing mode).

## 7.2. PARAMETERS EDITION

To start edition of any parameter user should select name of desired one using **[^]** **[v]** buttons and then press **[ENTER]**.

### 7.2.1. Numeric parameters (digit change mode)

Numerical parameters are displayed as decimal numbers. The mode of its new value entering depends on chosen edit method (see parameter “**Edit**”).

In mode “by digit” (“**Edit**”=“**dig**”) pressing one of the keys **[^]** or **[v]** causes change of current position (flashing digit) or the sign (+/-). Short pressing of the **[ENTER]** button causes change of the position (digit).

Press **[ENTER]** at least 2 seconds to accept the changes, after that question “**Set?**” is displayed, and user must to confirm (or cancel) the changes. To conform changes (and story it in EEPROM) press **[ENTER]** button shortly after “**Set?**” is displayed. To cancel the changes press **[ESC]** button shortly after “**Set?**” is displayed. After that device returns to the menu.

### 7.2.2. Numeric parameters (slide change mode)

In “slide change” mode (“**Edit**”=“**Slid**”), buttons **[^]** and **[v]** has different functions.

To increase edited value press (or press and hold) **[^]** button only, the increasing became quickest as long as button **[^]** is pressed. To slow down the increasing, button **[v]** can be used. If **[v]** is pressed shortly (and button **[^]** is still pressed), increasing slow down for a moment only, if **[v]** is pressed and held while button **[^]** is still pressed the increasing slow down and will be kept on lower speed.

To decrease edited value press (or press and hold) **[v]** button only. The decreasing became quickest as long as button **[v]** is pressed. To slow down the decreasing, button **[^]** can be used. If **[^]** is pressed shortly (and button **[v]** is still pressed), decreasing slow down for a moment only, if **[^]** is pressed and held while button **[v]** is still pressed the decreasing slow down and will be kept on lower speed.

Press **[ENTER]** at least 2 seconds to accept the changes, after that question “**Set?**” is displayed, and user must to confirm (or cancel) the changes. To conform changes (and story it in EEPROM) press **[ENTER]** button shortly after “**Set?**” is displayed. To cancel the changes press **[ESC]** button shortly after “**Set?**” is displayed. After that device returns to the menu.

### **7.2.3. Switch parameters (“LIST” type)**

Switch parameters can be described as a sets of values (a lists) out of which only one of the options available on the list can be selected for the given parameter. Options of switching parameter are selected using [**^**], [**v**] keys.

Short pressing of [**ENTER**] causes in displaying of the acknowledge question (“**SEt?**”). If key [**ENTER**] is pressed again, the changes are accepted, stored in EEPROM end the edition process finished. Pressing the key [**ESC**] after “**SEt?**” causes in cancelling of made changes and returning to menu.

#### **Functions of buttons when editing numeric and switching parameters:**



While editing numeric parameter:

- change of current (flashing) digit
  - slide change of value (acceleration, deceleration, direction change)
- While editing switch parameter - selection of switch parameter.



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.



Pressing this button operator can cancel the changes done up to now (if they were not approved by [**ENTER**] button after the “**SEt?**” ask) and come back to menu

### **7.3. MENU DESCRIPTION**

“- - - -” - password checking. 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.



Due to problem with direct displaying of “m” letter, it is exchanged with special sign “ñ”. Independently in user manual letters “m” is used to make it more readable (example: “modE”).

#### **7.3.1. “inPt” menu**

This menu presets the measurement input:

“tYPE” - type of the input / sensor. This parameter can be set to values:

“Pt 1” - Pt-100 input,

“Pt 5” - Pt-500 input,

“Pt10” - Pt-1000 input.

“FiLt” - this parameter sets filtration rate. It can be set to values from 0 (no filtration) to 5 (strongest filtration – time window about 2 sec).

“toFS” - offset (expressed in 0.1 °C, range  $\pm 9.9$  °C.). This parameter allows shifting of measurement scale, and express value added to calculated (measured) result.

#### **7.3.2. “bri” parameter**

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

#### **7.3.3. “HOLd” menu**

This menu contains parameters connected with peak detection function. See also full description of the peak detection function in paragraph: **DETECTION OF THE PEAK VALUES**

“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 (see Figure 6.1)

“time” - maximum time of displaying of the peak (drop) value, can be set from 0.1 to 19.9 sec, with 0.1 sec. resolution

“HdiS” - type of displayed values:

“rEAL” - current value is displayed

“HOLd” - peak (drop) value is displayed



### **7.3.4. "Scod" parameter**

This parameter defines 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".**



The "one-use password" can be used **ONE TIME ONLY**, it is impossible to use it again! The "one-use password" can be restored by Service Division only.

### **7.3.5. "rS" menu**

This menu is connected with RS-485 interface, and sets his properties:

**"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/sec 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 cannot be set via RS-485 interface.

**"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.

<b>“bAud” parameter</b>	“38.4”	“57.6”	“115.2”
<b>“rESP” parameter</b>	“10c”	“20c”	“50c”

Tab.7.1. Settings of “**rESP**” parameter

### **7.3.6. “Edit” parameter**

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

- “**dig**” - the change to “by digit” mode,
- “**Slid**” - slide change mode.

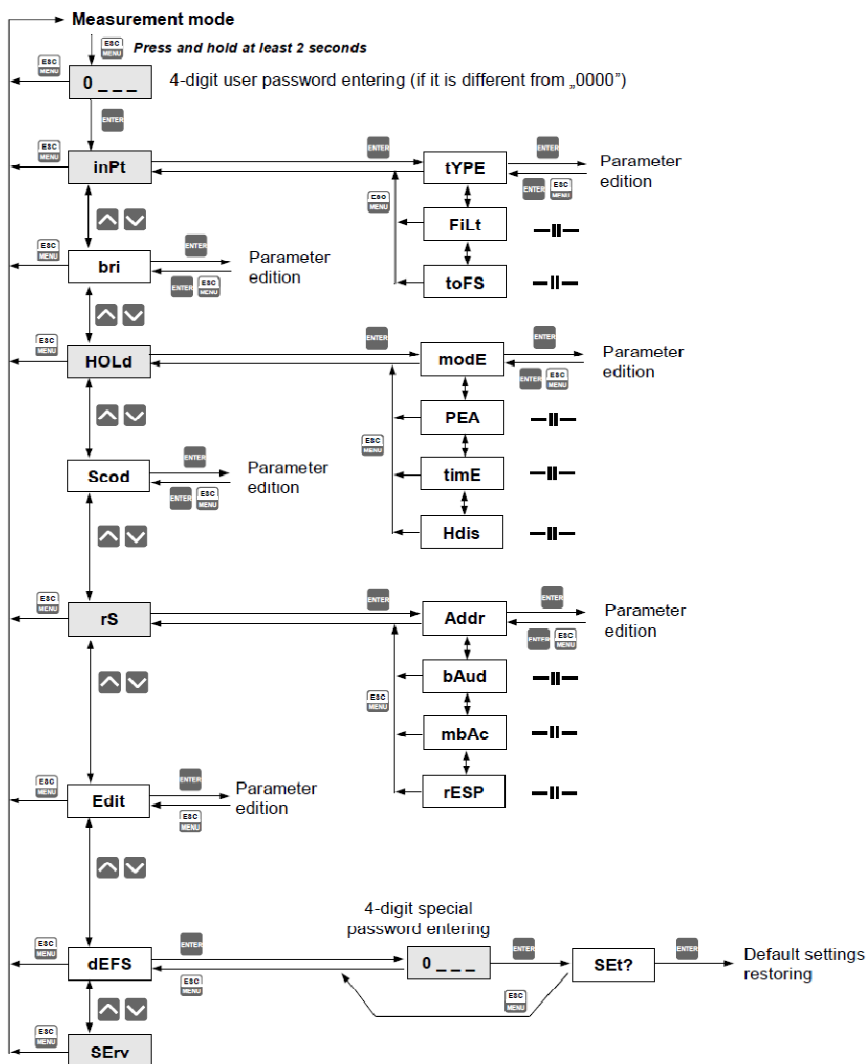
### **7.3.7. “dEFS” parameter**

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 acknowledge question “**SEt?**”. Press [**ENTER**] to acknowledge the restoring of factory settings or [**ESC**] to cancel.

### **7.3.8. “SErv” menu**

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.

## 7.4. MENU STRUCTURE



## **8. THE MODBUS PROTOCOL HANDLING**

Transmission parameters: 1 start bit, 8 data bits, 1 or 2 stop bit (2 bits are send, 1 and 2 bits are accepted when receive), no parity control  
Baud rate: selectable from: 1200 to 115200 bits/sec  
Transmission protocol: MODBUS RTU compatible

The device parameters and display value are available via RS-485 interface, as HOLDING-type registers (numeric values are given in U2 code) of Modbus RTU protocol. The registers (or groups of the registers) can be read by 03h function, and wrote by 06h (single registers) or 10h (group of the registers) accordingly to Modbus RTU specification. Maximum group size for 03h and 10h functions cannot exceeds 16 registers (for single frame).



The device interprets the broadcast messages, but then do not sends the answers.

**8.1. LIST OF REGISTERS**

Register	Write	Range	Register description
01h	No	-999 ÷ 9999	Measurement value (no decimal point)
02h	No	0h, A0h, 60h	The status of the current measurement; <b>0h</b> - data valid; <b>A0h</b> - top border of the measurement range is exceeded; <b>60h</b> - bottom border of the measurement range is exceeded;
03h	No	1	" <b>Pnt</b> " parameter (decimal point position), constant value <b>1</b> - " <b>0.0</b> "
06h	No	-999 ÷ 9999	Peak (drop) value (no decimal point)
10h	Yes	0 ÷ 2	" <b>tyPE</b> " parameter in " <b>InPt</b> " menu (input type). <b>0</b> - Pt-100; <b>1</b> - Pt-500; <b>2</b> - Pt-1000
12h	Yes	0 ÷ 5	" <b>Filt</b> " parameter in " <b>InPt</b> " menu (measurement filtering rate)
18h	Yes	-99 ÷ 99	" <b>toFS</b> " parameter in " <b>InPt</b> " menu (shift of measurement scale ), expressed by 0.1 °C
20h <sup>2</sup>	Yes	0 ÷ 199	Device address
21h	No	20B2h	Device identification code (ID)
22h <sup>3</sup>	Yes	0 ÷ 7	" <b>bAud</b> " parameter in " <b>rS</b> " menu (baud rate); <b>0</b> - 1200 baud; <b>1</b> - 2400 baud; <b>2</b> - 4800 baud; <b>3</b> - 9600 baud; <b>4</b> - 19200 baud; <b>5</b> - 38400 baud; <b>6</b> - 57600 baud; <b>7</b> - 115200 baud
23h <sup>4</sup>	Yes	0 ÷ 1	" <b>mbAc</b> " parameter in " <b>rS</b> " menu (permission to write registers via RS-485 interface); <b>0</b> - write denied; <b>1</b> - write allowed
25h	Yes	0 ÷ 5	" <b>rESP</b> " parameter in " <b>rS</b> " menu (additional response delay); <b>0</b> - no additional delay; <b>1</b> - " <b>10c</b> " option; <b>2</b> - " <b>20c</b> " option; <b>3</b> - " <b>50c</b> " option; <b>4</b> - " <b>100c</b> " option; <b>5</b> - " <b>200c</b> " option;
2Dh	Yes	1 ÷ 8	" <b>bri</b> " parameter (display brightness); <b>1</b> - the lowest brightness; <b>8</b> - the highest brightness
2Fh	Yes	0 ÷ 1	" <b>Edit</b> " parameter (numerical parameters edit mode); <b>0</b> - „ <b>dig</b> " mode; <b>1</b> - „ <b>SLid</b> " mode
50h	Yes	0 ÷ 1	" <b>modE</b> " parameter in " <b>HOLd</b> " menu (type of detected changes): <b>0</b> - peaks; <b>1</b> - drops
51h	Yes	0 ÷ 9999	" <b>PEA</b> " parameter in " <b>HOLd</b> " menu (minimum detectable change, no decimal point included)
52h	Yes	1 ÷ 199	" <b>time</b> " parameter in " <b>HOLd</b> " menu, maximum peaks' (or drops') display time expressed in seconds
53h	Yes	0 ÷ 1	" <b>HdiS</b> " parameter in " <b>HOLd</b> " menu: <b>0</b> - " <b>rEAL</b> " mode; <b>1</b> - <b>HOLd</b> mode

2  
3  
4

- after writing to register no 20h the device responds with an "old" address in the message.

- after writing to register no 22h the device responds with the new baud rate.

- the value of the "mbAc" parameter is also connected to write to this register, so it is possible to block a writes, but impossible to unblock writes via RS-485 interface, The unblocking of the writes is possible from menu level only.

## **8.2. TRANSMISSION ERRORS DESCRIPTION**

If an error occurs while write or read of single register, then the device sends an error code according to Modbus RTU specifications (example message no 1).

Error codes:

- 01h** - illegal function (only functions 03h, 06h and 10h are available),
- 02h** - illegal register address
- 03h** - illegal data value
- 08h** - no write permission (see: “**mbAc**” parameter)
- A0h** - exceed of upper border of input range
- 60h** - exceed of lower border of input range

A0h and 60h codes can appear only during reg. 01h is reading by 03h function (read of a single register).

## **8.3. EXAMPLES OF QUERY/ANSWER FRAMES**

Examples apply for device with address 1. All values are represent hexadecimal.

Field description:

- ADDR** Device address on modbus network
- FUNC** Function code
- REG H,L** Starting address (address of first register to read/write, Hi and Lo byte)
- COUNT H,L** No. of registers to read/write (Hi and Lo byte)
- BYTE C** Data byte count in answer frame
- DATA H,L** Data byte (Hi and Lo byte)
- CRC L,H** CRC error check (Hi and Lo byte)

### **1. Read of the displayed value (measurement), PAD-73T device address = 01h:**

ADDR	FUNC	REG H,L		COUNT H,L		CRC L,H	
01	03	00	01	00	01	D5	CA

a) The answer (we assume that the measure result is not out of range):

ADDR	FUNC	BYTE C	DATA H,L		CRC L,H	
01	03	02	00	FF	F8	04

DATA H, L - displayed value = 255, no decimal point.  
 Decimal point position can be read from reg. 03h.

The answer (if an error occur):

ADDR	FUNC	ERROR	CRC L,H	
01	83	60	41	18

ERROR - error code = 60h, bottom border of the measurement range is exceeded

## 2. Read of device ID code

ADDR	FUNC	REG H,L		COUNT H,L		CRC L,H	
01	03	00	21	00	01	D4	00

The answer:

ADDR	FUNC	BYTE C	DATA H,L		CRC L,H	
01	03	02	20	B2	21	F1

DATA - identification code (20B2h)

## 3. Change of the device address from 1 to 2 (write to reg. 20h)

ADDR	FUNC	REG H,L		DATA H,L		CRC L,H	
01	06	00	20	00	02	09	C1

DATA H - 0

DATA L - new device address (2)

The answer (the same as the message):

ADDR	FUNC	REG H,L		DATA H,L		CRC L,H	
01	06	00	20	00	02	09	C1

## 4. Change of baud rate of all devices connected to the net (BROADCAST message).

ADDR	FUNC	REG H,L		COUNT H,L		CRC L,H	
00	06	00	22	00	04	29	D2

DATA H - 0

DATA L - 4, new baud rate 19200 baud



Device do not reply to BROADCAST-type messages.

**5. Read of the registers 1, 2 and 3 in one message (example of reading a number of registries in one frame):**

ADDR	FUNC	REG H,L		COUNT H,L		CRC L,H	
01	03	00	01	00	03	54	0B

COUNT L - the count of being read registers (max.16)

The answer:

ADDR	FUNC	BYTE C	DATA H1,L1		DATA H2,L2		DATA H3,L3		CRC L,H	
01	03	06	00	0A	00	00	00	01	78	B4

DATA H1, L1 - reg. 01h (10 - displayed value "1.0"),

DATA H2, L2 - reg. 02h (0 - no errors),

DATA H3, L3 - reg. 03h (1 - decimal point position "0.0").



**There is no full implementation of the Modbus Protocol in the device. The functions presented above are available only.**



## **9. DEFAULT AND USER'S SETTINGS LIST**

<i>Parameter</i>	<i>Description</i>	<i>Default value</i>	<i>User's value</i>	<i>Desc. page</i>
<b>Configuration of measurement input ("inPt" menu)</b>				
tYPE	Input type	„Pt 1”		16
FiLt	Filtering ratio	0		16
toFS	Shifting of measurement scale	0.0		16
<b>Display parameters</b>				
bri	Display brightness	bri6		16
<b>Configuration of peaks detection function ("HOLd" menu)</b>				
modE	Kind of detected changes	norm		16
PEA	Minimum detected change	0.0		16
timE	Maximum time of peak displaying	0.0		16
HdiS	The type of displayed value	HOLd		16
<b>RS-485 interface configuration (menu "rS")</b>				
Addr	Device address	0		17
bAud	Baud rate	9.6		17
mbAc	Permission to changes of configuration registers	on		17
rESP	Additional delay of answer transmission	Std		17
<b>Configuration of numerical parameters edition</b>				
Edit	Numerical parameters edit mode	dig		18







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