

# User manual RATEMETER STI-N118

- Firmware: v.6.00 or higher
- Input type: pulse
- Rotational / linear speed control



Read the user's manual carefully before starting to use the unit or software.  
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 environmental conditions and using the unit contrary to its assignment.**
- 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.
- If the device is equipped with PE connector, it should be connected to PE wire. Otherwise PE wire should be connected to GND connector.
- 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 unit malfunction 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 connected equipment must meet the appropriate standards and regulations concerning safety and be equipped with adequate overvoltage and interference filters.
- **Do not attempt to disassemble, repair or modify the unit yourself. The unit has no user serviceable parts. Defective units must be disconnected and submitted for repairs at an authorized service centre.**



- Do not use the unit in areas threatened with excessive shocks, vibrations, dust, humidity, corrosive gasses and oils.
- Do not use the unit in areas where there is risk of explosions.
- Do not use the unit in areas with significant temperature variations, exposure to condensation or ice.
- 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 main purpose of **STI-N118** tachometer is measuring of the rotational speed (in range 1.5 to 50 000 r/min). The device can be used as frequency meter as well.

Main feature of the tachometer is high precision of measurement (0.02% in full temperature range). User can set input divider in range 1 to 19 999 and additional scale coefficients

The device can be equipped with two relay (or OC type) outputs. Optionally **STI-N118** with one relay (or OC type) output can be equipped with active current output, passive isolated current output or active voltage output. These outputs can be controlled depend on momentary value of rotational speed. Device **STI-N118** is equipped with RS-485 / Modbus RTU communication interface and sensor supply output. The meter can be ordered in two power supply versions.

The device has 5 buttons being used for main presets programming. To get high protection level, the keyboard is mounted under transparent cover. To allow user to change presets without opening the cover, an IR sensor is mounted. Remote controller contains basic functions to handle menu of the device (Note, that remote controller is not a part of the **STI-N118** set – it is an additional equipment).

Additional features:

- settable width of measurement window ( from 0.1 to 39.9 seconds),
- possible direct access to relays thresholds values,
- additional multiply and division coefficients for result scaling.

### **3. TECHNICAL DATA**

Power supply voltage (depending on version)	85... <b>230</b> ...260V AC/DC; 50 ÷ 60 Hz (separated) or 19... <b>24</b> ...50V DC and 16... <b>24</b> ...35V AC (separated)
External fuse (required)	T - type, max. 2 A
Power consumption	max. 5 VA @ 85 ÷ 260V AC/DC max. 5 VA @ 16V ÷ 35V AC max. 5 W @ 19V ÷ 50V DC

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<b>Pulse input</b>	fully Isolated, with denouncing filter and pulse width control, max. input frequency 50.0 kHz
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Input levels	
low level:	0V ÷ 1V
high level:	10V ÷ 30V (about. 12 mA @ 24V)

Frequency measurement accuracy	± 0.02% (full temperature range)
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Rotational speed precision	Selected from range: 0 ÷ 0.00000
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Rotational speed unit	rev/min., rev/sec. or rev/hour
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Time between following pulses	settable from 0.1 to 39.9 sec.
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<b>Sensor power supply output</b>	24V +5%, -10% / max. 100 mA, stabilized
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<b>Relay output</b>	0, 1 or 2 NO, 1A/250V AC (cos φ = 1)
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<b>OC-type output</b>	0, 1 or 2; 30mA / 30VDC / 100mW
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<b>Active current output</b>	range max. 0 ÷ 24 mA
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(optional, for one relay or one OC-type output version only)

Load resistance max.	700 Ω
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<b>Passive isolated current output</b>	range max. 2.8 ÷ 24 mA
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(optional, for one relay or one OC-type output version only)

Supply voltage	Us = 9.5 ÷ 36V
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Load resistance max.	(Us – 9.5V) / 24mA [kΩ]
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<b>Active voltage output</b> (optional, for one relay or one OC-type output version only)	range max. 0 ÷ 11V
Load resistance min.	2000 Ω
Display range	0 ÷ 999999, plus decimal point
Communication interface	RS 485, 8N1 and 8N2, Modbus RTU, not separated
Baud rate	1200 bit/s ÷ 115200 bit/s
Display	LED, 6 digit, 13mm height, red
Data memory	non-volatile memory, EEPROM type
Protection level	IP 67
Housing type	wall mounted
Housing material	ABS + fibreglass
Housing dimensions	
without glands:	110 x 80 x 67 mm
with glands:	110 x 105 x 67 mm
Operating temperature	0°C do +50°C or -20°C to +50°C
Storage temperature	-10°C do +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 cross section	3 mm <sup>2</sup> (for connectors 1÷6) or 2 mm <sup>2</sup> (for connectors 7÷16)
Safety requirements	according to: PN-EN 61010-1 installation category: II pollution degree: 2 voltage in relation to ground: 300V AC insulation resistance: >20MΩ insulation strength between power supply and input/output terminal: 1min. @ 2300V insulation strength between relays terminal: 1min. @ 1350V
EMC	according to: PN-EN 61326-1



**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,

### **4.2. ASSEMBLY**



- Disconnect the power supply prior to starting assembly.
- Check the connections are wired correctly prior to switching the unit on.



To install device on the wall, a pinholes should be made. Figure 4.1 presents dimensions of the device and distances between holes. The back side of the device has four mounting holes. This part of the case should be mounted to a wall by screws.

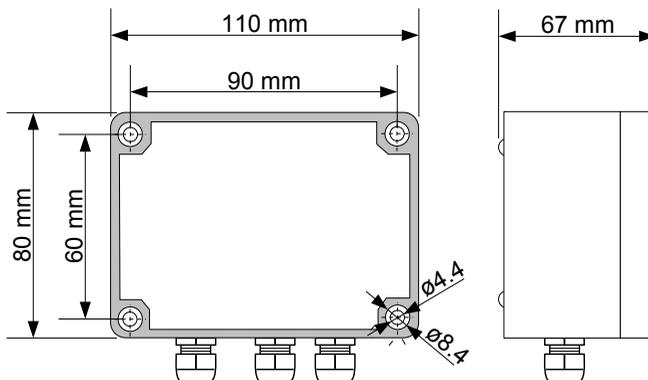


Figure 4.1. Device and assembly dimensions

### 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. 2A) 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 measurement or control signals are longer than 30m or go outside of the building then additional safety circuits are required.
- 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 clamping connections on the back of the unit's housing.

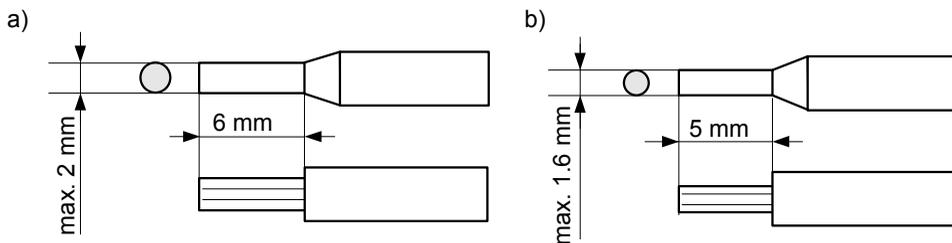


Figure 4.2. Recommended dimensions of cable stripping  
**a)** for big connectors (1 to 6), **b)** for small connectors (7 to 16)

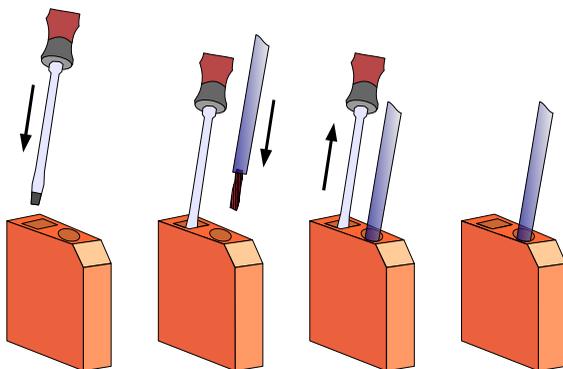


Figure 4.3. Method of connecting cables to the clamping connectors



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

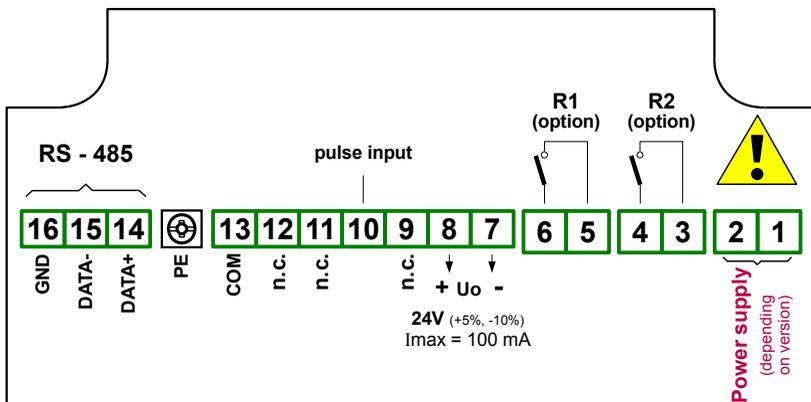


Figure 4.4. Terminals description (relay outputs)

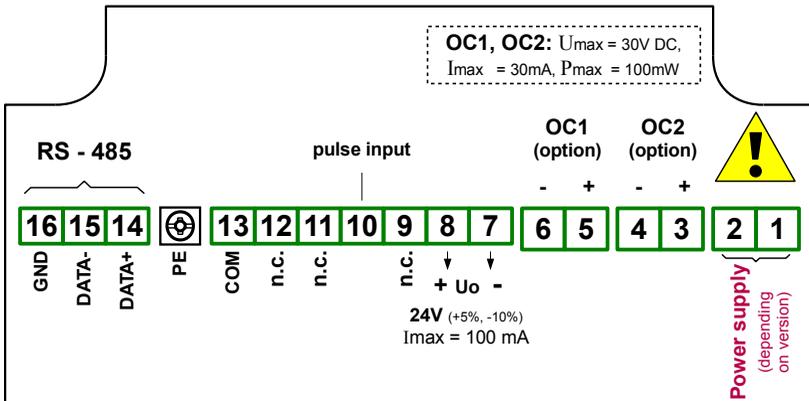


Figure 4.5. Terminals description (OC-type outputs)

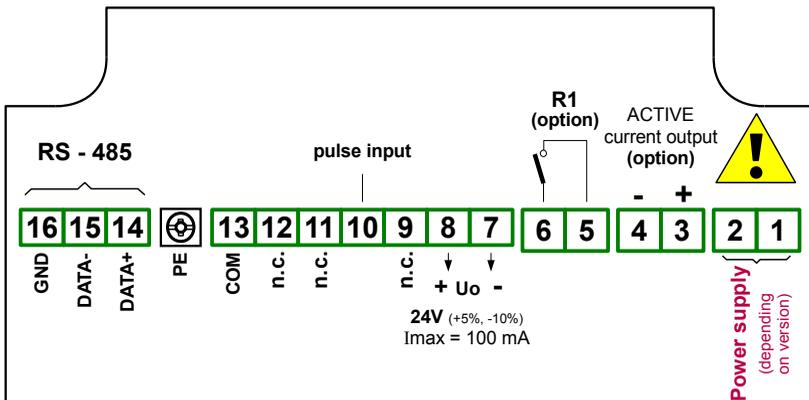


Figure 4.6. Terminals description (relay and active current outputs)

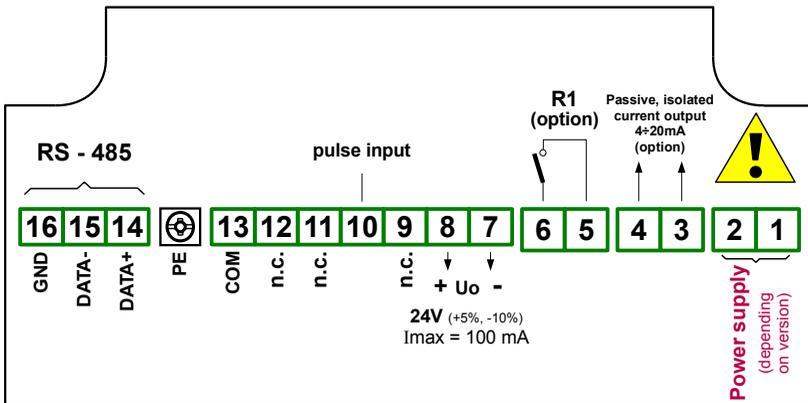


Figure 4.7. Terminals description (relay and passive current outputs)

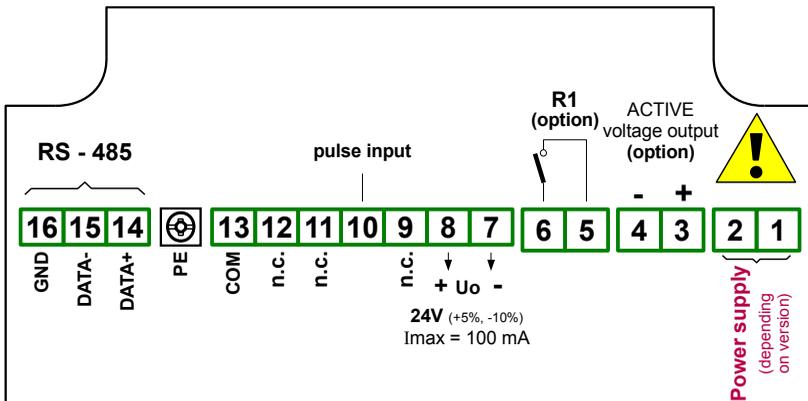


Figure 4.8. Terminals description (relay and active voltage outputs)

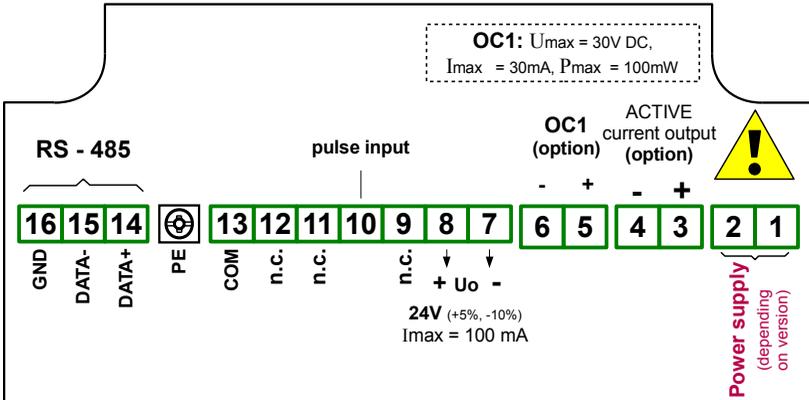


Figure 4.9. Terminals description (OC-type and active current outputs)

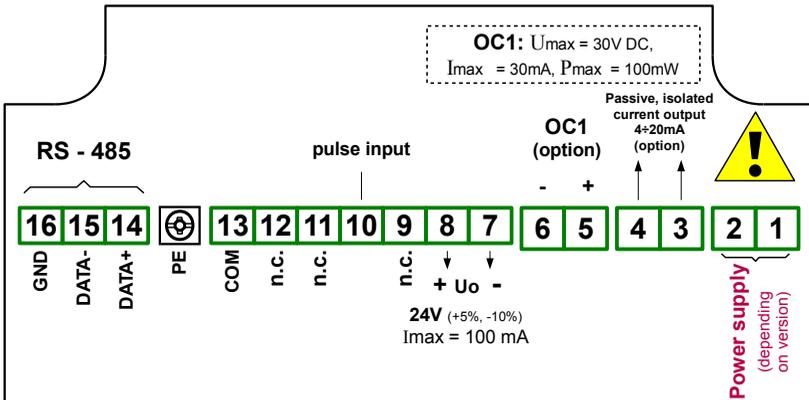


Figure 4.10. Terminals description (OC-type and passive current outputs)

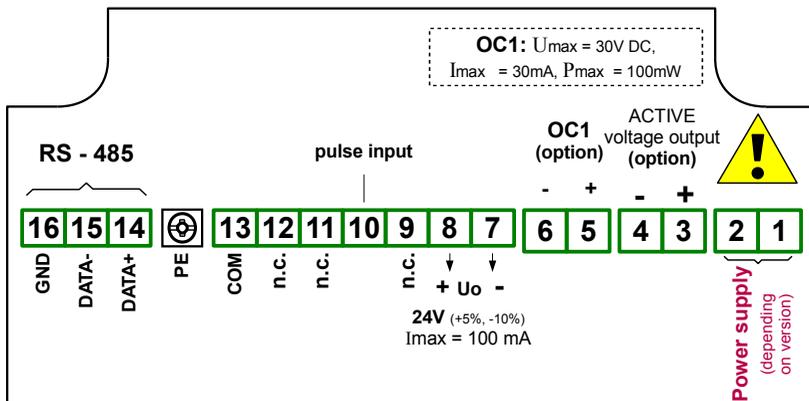


Figure 4.11. Terminals description (OC-type and active voltage outputs)

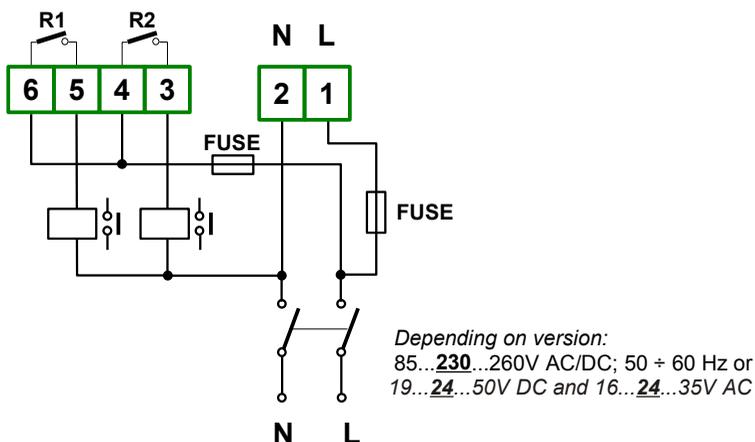


Figure 4.12. Connection of power supply and relays



Contacts of relay outputs are not equipped with spark suppressors. While use the 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 relay contacts rises.

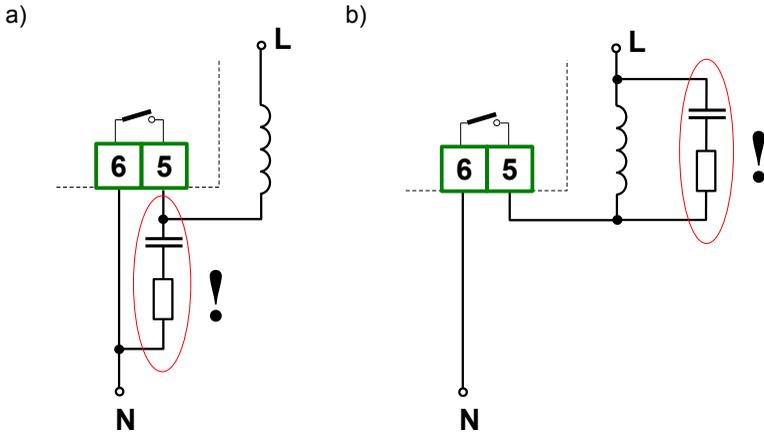


Figure 4.13. Examples of suppression circuit connection:  
a) to relay terminals; b) to the inductive load

Construction of pulse input allows connecting of inductive or optical sensor with common earth (Figure 4.14a) or common plus (Figure 4.14b), without additional intermediary circuits (sensor with NPN or PNP type output).

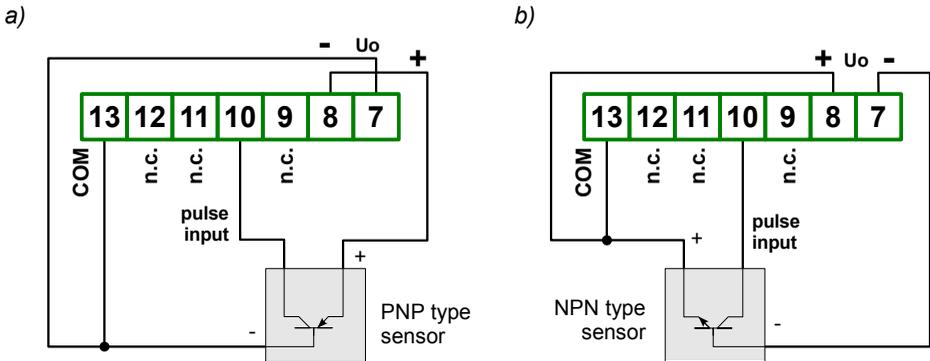


Figure 4.14. An example of sensor connection:  
a) with common earth, b) with common plus

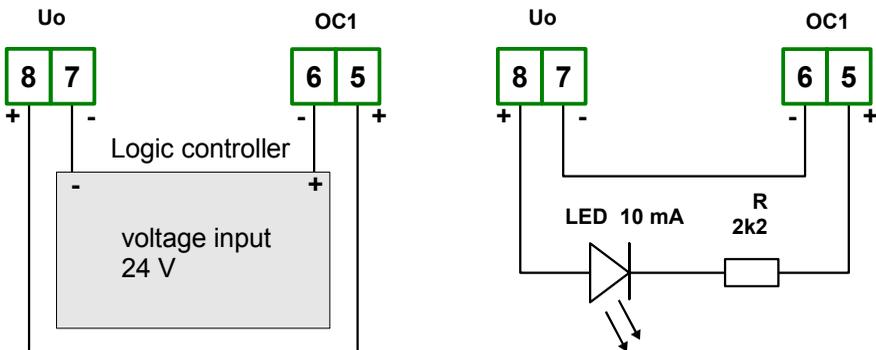


Figure 4.15. Example of OC-type outputs connection

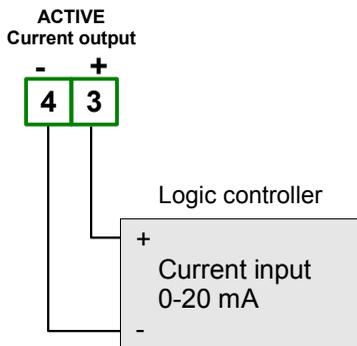


Figure 4.16. Example of active current outputs connection (for device with active current output only)

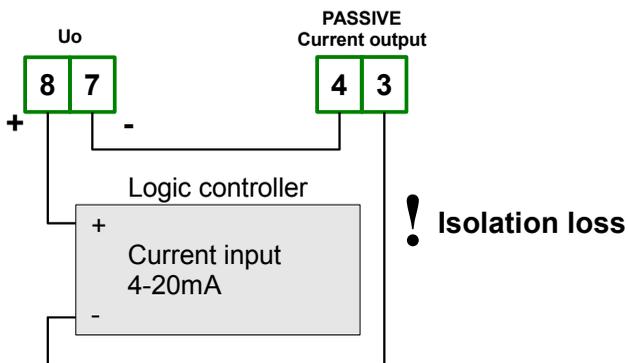


Figure 4.17. Example of passive current outputs connection (for device with passive current output only)

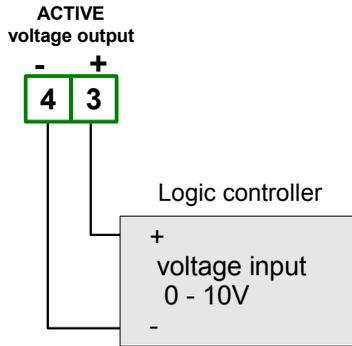


Figure 4.18. Example of active voltage outputs connection  
(for device with active voltage output only)

#### **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.

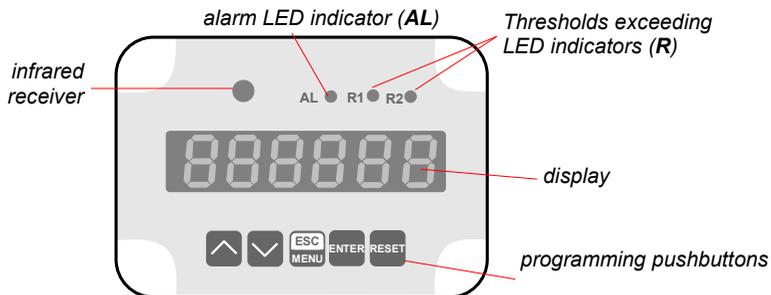


Using any other agents can cause permanent damage to the housing.



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

## 5. FRONT PANEL DESCRIPTION



### 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

In the measurement mode the device shows current measurement value (rotational speed or time per one revolution, it depends on “**F or P**” parameter) with resolution defined by “**PrEc**” parameter (max 5 digits after decimal point).

Pulses delivered to the input (Figure 4.14) are converted in manner described below:

- If duration of LOW or HIGH state is lower than time defined by parameter “**FrEq**” (see **Tab.7.2** on page 35), pulses are interpreted as disturbances and ignored.
- If duration of both states is in the defined range, but their frequency is lower than value of “**FrEq**” parameter, the device goes to alarm state - relays and analogue output (if mounted) are switched to their alarm states (defined by their “**ALArms**” parameters). In this state message “**-Hi-**” is displayed instead of measurement value.
- In other cases (during frequency and duration of the signal are in permitted ranges) pulses are delivered to internal frequency divider. The divider (see description of parameter “**PULSen**”) should be set to value equal the number of pulses per revolution – in such case one pulse goes out of the divider every revolution, and it allows to minimize errors caused by roughness of measurement element (e.g. rack if inductive detector is used). The frequency after the divider is recalculated according to selected by user measurement unit (parameter “**unit**”), and can be expressed by rev./sec, rev./min or rev./h. Final value is obtained by multiplication the measurement result by parameter “**mul**”, and division by parameter “**div**”. Parameters “**mul**” and “**div**” allow to free scaling of the measurement, and obtain automatic recalculation of rotational speed to linear speed (see example on page 38). Obtained result is displayed during measurement mode, and is the base of relays and analogue output states calculation, and is accessible via RS-485 interface with MODBUS protocol.



- If input frequency is in the permitted range but calculated value can not be fitted on 6 digits, message “**-OvLd-**” is displayed instead of the result.  
(modify parameters “**unit**”, “**PrEc**”, “**mul**” and “**div**”, to fit the result on 6 digits).
- While time per one revolution is displayed (parameter “**F or P**” = “**PERiod**”):
  - If input frequency equals 0, then message “**-StoP-**” is displayed.
  - If value of period is too high to be fitted on 6 digits, message “**-OvLd-**” (Overload) is displayed instead of the result.
  - If input frequency is different than 0 but value of period is too small to be fitted on 6 digits, message “**-UnLd-**” (Underload) is displayed instead of the result.

In the measurement mode user can check main thresholds values. After pressing [^] or [v] button, name of the threshold (e.g. “**rELPr1**”) and his value will be displayed on the display in alternating mode. If [^] or [v] will be pressed in 5 sec again, the next threshold will be displayed, else the device comes back to the measurement mode. If a **free access** is enabled (see description of “**SECu**” menu), user can change the value of particular threshold pressing button [ENTER] (see: **PARAMETERS EDITION**).

Input type, range of displaying values, characteristic of conversion, decimal point position and measure filtering ratio, are user configurable parameters. All accessible parameters can be changed by entering the menu (see: **DEVICE PROGRAMMING**). Use the local keyboard or the remote controller to do it. (Note: all parameters can be remote changed via RS-485 interface).



Configuration of the device (via menu or RS 485 interface) **does not stop measures**.

## 6.2. DETECTION OF THE PEAK VALUES

The **STI-N118** 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 **"timeE"**. 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 **"timeE"** elapses, device starts to show the current value of input signal again. If **"HdiS"="HOLD"** then setting parameter **"timeE"=0.0** causes holding peak value until **[ESC]** button is pressed. If **"HdiS"="rEAL"** then value **"timeE"=0.0** means no holding. Displaying peak value is signaled by flashing most right decimal point.

The relays/LEDs and the analogue output can be controlled depend on the current value of input signal or the peak value (see **"HOLD" menu**).

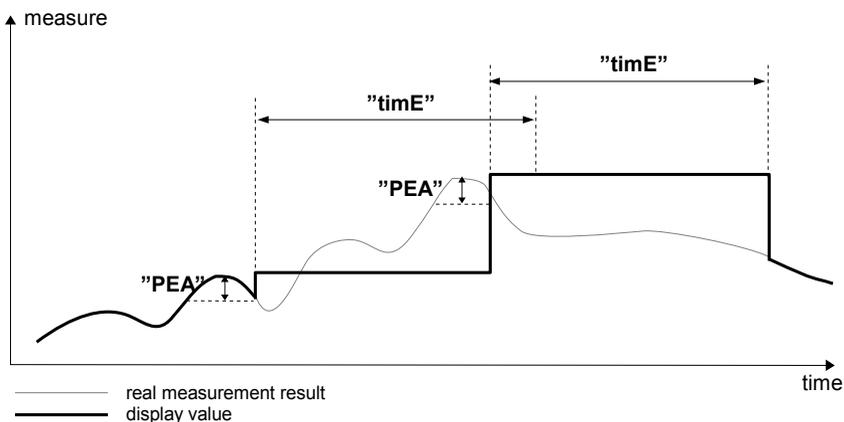


Figure 6.1. Process of peaks detection

### 6.3. 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.



If device is not equipped with one or more relay outputs, menus refer to this relays are available, but apply to LED indicators only. In such case LEDs indicates exceeding of particular thresholds.

Modes of the control can be changed depend on the values of parameters “SEt P”, “SEt P2”, “HYSt”, “modE”, “t on”, “t oFF”, “unit” and “ALArMS”. Depend on “modE” parameter, relays can be not used or controlled over one or two thresholds values.

If one threshold is used (Figure 6.2) the relay can be turned on (“modE” = “on”) or off (“modE” = “oFF”) when the input signal value is contained in **zone A**. If two thresholds are used (Figure 6.3) 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.

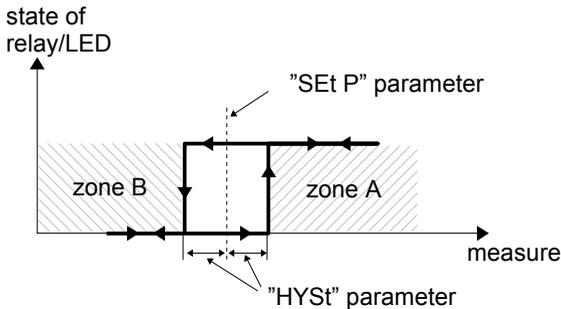


Figure 6.2. One threshold control of the relay/LED outputs

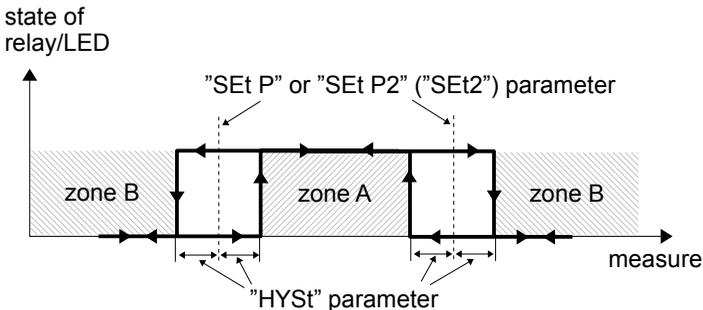


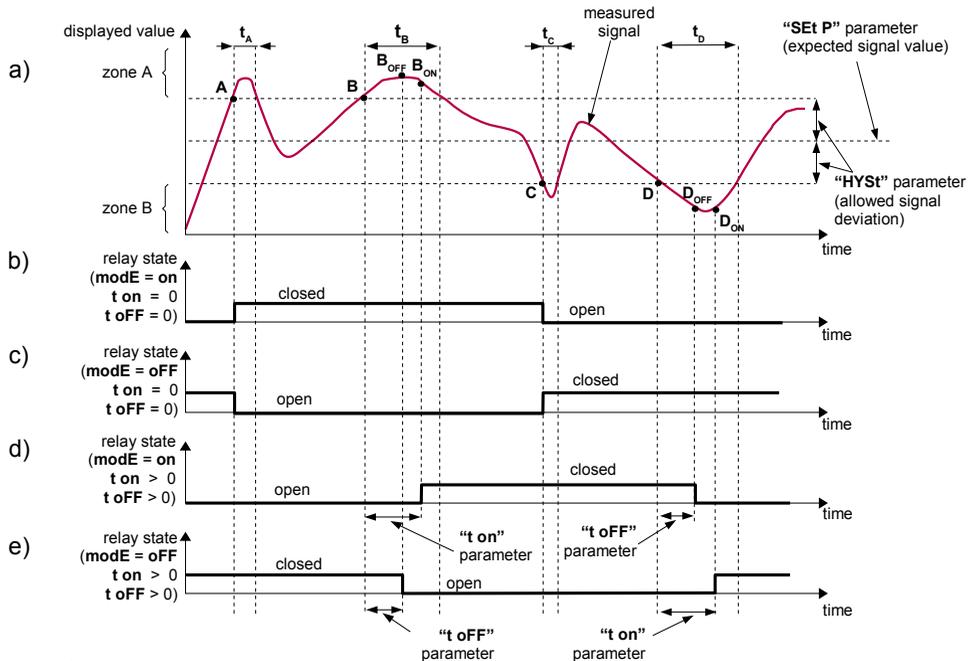
Figure 6.3. Two threshold control of the relay/LED outputs



The relay outputs and LEDs (named R) can be controlled depend on both - the current value and the peak value (when peak detection is active) of the input signal.

### 6.3.1. One threshold mode

Figure 6.4 presents the principle of relay outputs operation for one threshold mode, and an example values of other parameters.



Description:

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

**B<sub>ON</sub>, B<sub>OFF</sub>, D<sub>ON</sub>, D<sub>OFF</sub>** - relays state changes moments: (for "t on" > 0, "t oFF" > 0)

**t<sub>A</sub>, t<sub>B</sub>, t<sub>C</sub>, t<sub>D</sub>** - time periods while input signal is in zone A or zone B

Figure 6.4. Principle of LED/relay output operation for one threshold mode

Parameter "SEt P" sets a **threshold** of the relay, and parameter "HYSt" sets a **hysteresis** of the relay (Figure 6.4 a). The relay can change his state **only** when input value exceeds (over or under) **border value** and  $t_A, t_B, t_C, t_D$  times (Figure 6.4) are bigger than the time defined by parameters "t on", "t oFF" and "unit". **Border values** means values equal **threshold+hysteresis** and **threshold-hysteresis** respectively.

If "t on" and "t oFF" 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 and C, Figure 6.4 a, b, c).

If values of "t on" or/and "t oFF" 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<sub>ON</sub>, D<sub>ON</sub>, Figure 6.4 a, d, e). Similarly, the relay will be turned off if time "t oFF" elapse since the input signal value exceeds any of the **border values** (see points B<sub>OFF</sub>, D<sub>OFF</sub>, Figure 6.4 a, d, e).

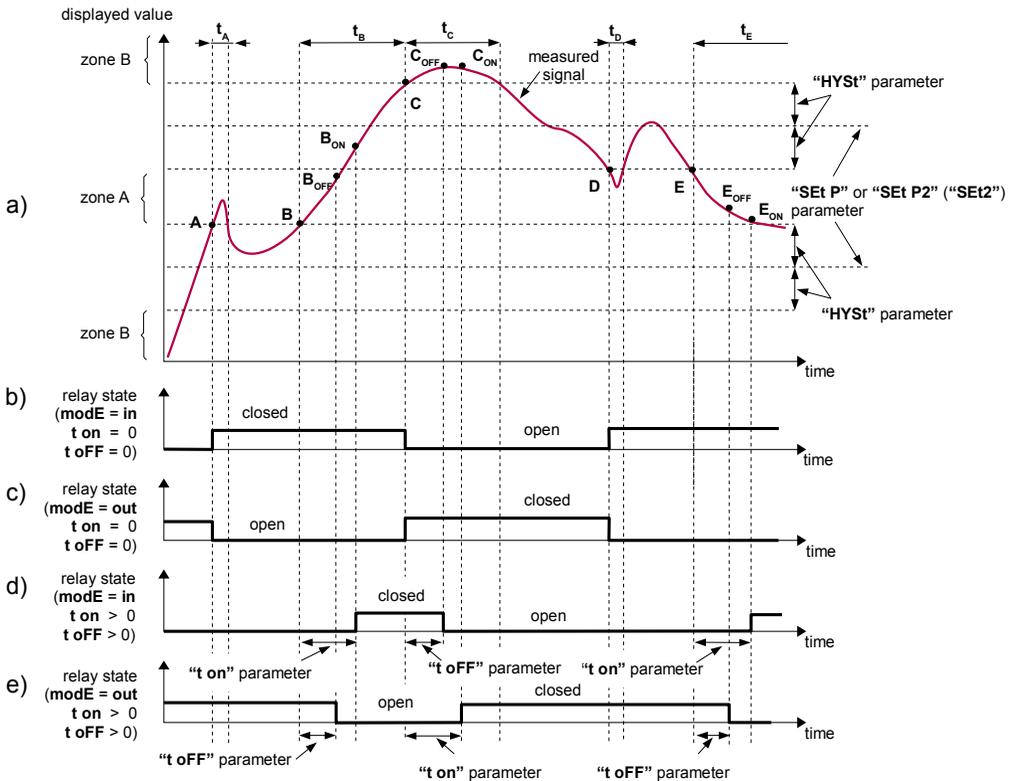
If  $t_A$ ,  $t_B$ ,  $t_C$  or  $t_D$  (when input signal stay in **zone A** or **zone B**) are lower than parameters “**t on**” or “**t off**”, the relay will not change his state (see points A and C, Figure 6.4 a, d, e).

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 6.4 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.

All parameters connected with relay outputs are described in paragraph “**rELAY1**” menu.

### 6.3.2. Two thresholds mode



Description:

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

**B<sub>ON</sub>**, **B<sub>OFF</sub>**, **C<sub>ON</sub>**, **C<sub>OFF</sub>**, **E<sub>ON</sub>**, **E<sub>OFF</sub>** - relays state changes moments: (for “**t on**” > 0, “**t off**” > 0)

**t<sub>A</sub>**, **t<sub>B</sub>**, **t<sub>C</sub>**, **t<sub>D</sub>**, **t<sub>E</sub>** - time periods while input signal is in zone A or zone B

Figure 6.5. Principle of LED/relay output operation for two thresholds mode

Figure 6.5 presents the principle of relay outputs operation for two thresholds mode, and an example values of other parameters. In this mode parameter “**Set P2**” is accessible in common with “**Set P1**”, this parameter describes a second threshold of the relay output. The parameters “**Hyst**”, “**mode**”, “**t on**”, “**t off**”, “**unit**” and “**ALArms**” are connected with both “**Set P**” and “**Set P2**” thresholds. While the controlling process, the relay output changes his state depends of both “**Set P**” and “**Set P2**” thresholds in similar way as it was described in one threshold mode.

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 6.5).



The sequence of thresholds “**Set P**” and “**Set P2**” can be set in any order, due to the control of relay outputs is done depend on difference between thresholds values (**zone A**) and outside of threshold values (**zone B**).

## **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**.

Some of the parameters can be accessed without menu entering (quick view mode). After pressing [^] or [v] button, name of the threshold (e.g. “**rELPr1**”) and his value will be displayed on the display in alternating mode. If [^] or [v] will be pressed in 5 sec again, the next threshold will be displayed, else the device comes back to the measurement mode. If a **free access** is enabled (see description of “**SECU**” menu), user can change the value of particular threshold pressing button [ENTER] (see: **PARAMETERS EDITION**).



If particular parameter has been changed and confirmed in quick view mode, its new value is displayed in alternating mode with parameter name by few seconds. Confirmed changes may be checked or user can switch viewed parameter pressing [^] or [v] button.

### **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 “**SEtcod**”, menu “**SECU**”), 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 “**Error**” in other case.



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

**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 store 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 store 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 and 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 “Error”, 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 letter “m” is used to make it more readable (example: “modE”).

### 7.3.1. “rELAy1” menu

This menu allows to configure the operation mode of relays and LEDs marked “R” (e.g. “R1”). If there are few relay outputs available, then every output has its own configuration menu (e.g. menu “rELAy2” for relay (LED) “R2”). Principle of the relays operation is described in paragraph **CONTROL OF THE RELAY OUTPUTS**.



- The relay outputs and LEDs (named “R”) can be controlled depend on both - the current value and the peak value (when peak detection is active) of the input signal.
- If device is not equipped with one or more relay outputs, menus refer to this relays are available, but apply to LED indicators only. In such case LEDs indicates exceeding of particular thresholds.

“**SEt P**” - first threshold of the relay (range 0 ÷ 999999). **Threshold is the medium value of relay hysteresis.**

“**SEt P2**” - second threshold of the relay (range 0 ÷ 999999). This threshold is accessible when “**modE**” parameter is set to „in” or „out” value. **Threshold is the medium value of relay hysteresis.**

“**HYSt**” - hysteresis of relay (range 0 ÷ 99999). Full hysteresis of the relay is equal to 2x “**HYSt**” parameter. The relay state can change when an input signal is out of **threshold-hysteresis** to **threshold+hysteresis** zone.



Presented parameters should be set to ensure that “**SEt P**” + “**HYSt**”, “**SEt P2**” + “**HYSt**”, “**SEt P**” - “**HYSt**” or “**SEt P2**” - “**HYSt**” does not exceed the measure range. Additionally, in two threshold mode (“**modE**” = “in” or “out”), the hysteresis for both thresholds must not cover each other (in other case relay can't change his state).

“**modE**” - relay operation mode:

“**noAct**” - the relay is not active (permanent turned off)

“**on**” - one threshold mode; the relay is turned “**ON**” when input signal exceeds “**SEt P**” + “**HYSt**” value, and is turned off back when the input signal became lower than “**SEt P**” - “**HYSt**”,

“**oFF**” - one threshold mode; the relay is turned “**OFF**” when input signal exceeds “**SEt P**” + “**HYSt**” value, and is turned on back when the input signal became lower than “**SEt P**” - “**HYSt**”,

“**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 “**SEt P**” and “**SEt P2**” thresholds, the **lower threshold** means lower one of “**SEt P**” and “**SEt P2**” thresholds.

“**Out**” - two threshold mode; relay is turned “**OFF**” 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 “**SEt P**” and “**SEt P2**” thresholds, the **lower threshold** means lower one of “**SEt P**” and “**SEt P2**” thresholds.

“**modbuS**” - the relay is controlled via RS-485 interface, independently on the input signal.



- **LEDs light when relays are closed**, independently of relays' mode.
- When power supply fail, unit do not store relays state selected by RS-485 interface.

**“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.

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



If time when the input signal exceeds some border value is shorter than **“t on”** or **“t oFF”** time, the relay do not change his state (see paragraph: **CONTROL OF THE RELAY OUTPUTS**).

**“unit”** - unit of time for **“t on”** and **“t oFF”** parameters. Can be set on one of two values:

**“min”** - minutes,  
**“SEC”** - seconds.

**“ALArMS”** - this parameter defines the relay reaction when some critical situations occurs:

**“noCHAn”** - 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 **permissible input frequency** is exceeded.

If parameter **“modE”** is set to **“modbuS”**, the “critical situation” means communication delay (when no data is received) longer than **“mbtime”** parameter (see description: **“rS-485” menu**).

### **7.3.2. “inPUt” menu**

This menu contains options of pulse input configuration:

**“FrEq”** - maximum permitted frequency of pulses delivered to the input. This parameter is expressed in Hz. And can be set to one of all values showed in **Tab.7.1**.

Minimum permitted duration time of Low and High states are related to every value of **“FrEq”** parameter. If particular state is shorter than showed in **Tab.7.1**, it is interpreted as disturbance and ignored.

<b>Parameter "FrEq" (Hz)</b>	<b>Minimum duration of low and high states</b>	<b>Permitted duty cycle for max. frequency</b>
"10"	5 ms	5%-95%
"15"	3,4 ms	5%-95%
"20"	2,5 ms	5%-95%
"30"	1,7 ms	5%-95%
"40"	1,3 ms	5%-95%
"50"	1 ms	5%-95%
"100"	500 $\mu$ s	5%-95%
"300"	167 $\mu$ s	5%-95%
"1 000"	50 $\mu$ s	5%-95%
"3 000"	33 $\mu$ s	10%-90%
"10 000"	33 $\mu$ s	33%-66%
"50 000"	not controlled	not controlled

*Tab.7.1. Allowable settings of "FrEq" parameter, and related with them minimum durations of logical states*

**"PULSen"** - input divider, can be set in range 1 to 19 999. This parameter defines the number of pulses per single revolution . **Value 0 is interpreted by firmware as 1 pulse/rev.**



**This parameter must be set correctly to let device works properly.**

**"PrEc"** - precision of result displaying. There are available settings from **"0"** (precision of 1 unit) to **"0.00000"** (precision with 5 digits after decimal point)

**"unit"** - The unit of rotational speed used for recalculation of current measurement can be set to:

- "SEC"** - result expressed in revolutions / second
- "min"** - result expressed in revolutions / minute
- "hour"** - result expressed in revolutions / hour

**"F or P"** - kind of value shown on the display:

- "Freq"** - frequency (rotational speed),
- "PEriod"** - period (time per one revolution).

**“mul”** - multiplication coefficient. The value by which current measurement result is multiply to recalculate it to desired unit (e.g. linear speed); can be set in range 0 to 999 999, value **0 is interpreted as 1 000 000**.

**“div”** - divide coefficient. The value by which current measurement result is divided to recalculate it to desired unit (e.g. linear speed); can be set in range 0 to 999 999, value **0 is interpreted as 1 000 000**.

Parameters **“mul”** and **“div”** can be used to rescale of measurement value - setting proper values recalculation of rotational speed to linear speed can be done automatically.

**“ZEro t”** - maximum delay time of successive revolution. This parameter is defined with 0.1 second precision, in range 0 ÷ 39.9. If delay between successive revolutions are longer than defined value, device displays „0” instead of current measurement. If parameter **“ZEro t”** is set to value lower than parameter **“mEAS t”**, the **“mEAS t”** value is used as maximum delay to next revolution time.



Expression „successive revolution” means the number of input pulses equals to value of parameter **“PULSen”**.

**“mEAS t”** - minimum *measurement window* width. The *“measurement window”* means the time period after which counted pulses are recalculated and displayed, and it is similar to refresh rate. This parameter can be set with 0.1 sec. resolution in range 0 ÷ 19.9 sec.



If time delays between successive pulses are longer than **“mEAS t”** time, then measurement window width is automatically fitted to input frequency.

### **7.3.3. “FiLteR” menu**

This menu contains parameters referred to additional data (result) filtration.

**“vALUE”** - this parameter sets filtration rate. It can be set to values from 0 (no filtration) to 5 (strongest filtration – time window about 3.5 sec.).

**“droP”** - this parameter defines minimum percentage change of measured value which turns off (temporally) data filtration. Value of this parameter can be changed in range: 0 ÷ 199,9%. Main purpose of this parameter is acceleration of displaying data changes, when sudden changes of instantaneous measurements value occur (while parameter **“vALUE”** is set to high values).

### 7.3.4. "OutPUt" menu

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



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

**"Omod"** - analogue output mode. Depending on version of the device there are following options:

For active current output:

- "oFF"** - current output disabled,
- "0-20"** - current output enabled with 0 ÷ 20 mA mode,
- "4-20"** - current output enabled with 4 ÷ 20 mA mode,
- "modb"** - current output controlled via RS-485 interface.

For passive current output:

- "oFF"** - current output disabled,
- "4-20"** - current output enabled with 4 ÷ 20 mA mode,
- "modb"** - current output controlled via RS-485 interface.

For active voltage output:

- "oFF"** - voltage output disabled,
- "0-5"** - voltage output enabled with 0 ÷ 5V mode,
- "1-5"** - voltage output enabled with 1 ÷ 5V mode,
- "0-10"** - voltage output enabled with 0 ÷ 10V mode,
- "2-10"** - voltage output enabled with 2 ÷ 10 V mode,
- "modb"** - voltage output controlled via RS-485 interface.

**"OutL"** - this parameter determines the input value for which the output signal is **minimal** (depend of output mode „**Omod**“).

**"OutH"** - this parameter determines the input value for which the output signal is **maximal** (depend of output mode „**Omod**“).

The analogue output value is calculated due to formula given below:

$$Out = \frac{W - "OutL"}{"OutH" - "OutL"} \times (B - A) + A$$

- where: **W** – displayed value,  
**Out** – analogue output value,  
**B** – higher range limit (20mA / 5V / 10V),  
**A** – lower range limit (0mA / 4mA / 0V / 1V / 2v),



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

**"Lo r", "Hi r"** - this parameters define the output value range. If calculated output value **Out** exceeds defined range then analogue output generates signal equal to upper or lower border of the defined range. These parameters defines the percentage extension of nominal analogue range (with 0,1% resolution).

Parameter **"Lo r"** defines lower border of the range due to formula:

$Out_{min} = A - (A \times \text{"Lo r"} \%)$ , where:

**A** – lower signal value range limit.

This parameter can be set from 0 to 99.9% (for active current output and active voltage output) or from 0 to 29.9% (for passive current output).

Parameter **"Hi r"** defines higher border of the range due to formula:

$Out_{max} = B + (B \times \text{"Hi r"} \%)$ , where:

**B** – higher signal value range limit.

This parameter can be set from 0 to 19.9% (for active and passive current output) or from 0 to 9.9% (for active voltage output).

In example on page 39 of the **DISPLAY VALUES CALCULATION** paragraph the procedure of the analogue outputs determining is presented in details.

**"AL"** - this parameter determines the behaviour of analogue output if any critical situation occurs. According to version of the device, this parameter can be set:

For active current output:

- "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.

For passive current output:

- "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,

For active voltage output:

- "noCH"** - voltage will not change,
- "11.0"** - voltage will be set to 11 V,
- "5.5"** - voltage will be set to 5.5 V,
- "1.2"** - voltage will be set to 1.2 V.
- "0.6"** - voltage will be set to 0.6 V,
- "0.0"** - voltage will be set to 0 V.

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

If parameter **"Outmod"** is set to **"oFF"**, **"4-20"**, **"0-20"**, **"0-5"**, **"1-5"**, **"0-10"** or **"2-10"** the "critical situation" means that **permissible measurement range** is exceeded.

If parameter **"Outmod"** is set to **"modbuS"**, the "critical situation" means communication delay (when no data is received) longer than **"mbtimE"** parameter (see description: **"rS-485" menu**).



Before turning off the device it is recommended to first disable the current output's power supply, and then the device itself. If the current output is supplied while the device itself is turned off, the output current will be about 27.5 mA.

### **7.3.5. "briGHt" parameter**

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

### **7.3.6. "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 0.0 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 r2"** - relay/LED outputs ( R1, R2) operation mode:

- "rEAL"** - relay/LED operates depend on the current value,
- "HOLd"** - relay/LED 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.

### **7.3.7. "SECU" menu**

This menu contains presets connected with availability of other parameters:

**"SEtcod"** - 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.

“**Acc r1 ÷ Acc r2**” - this option permits user (“**on**”) or prohibits (“**oFF**”) to modify the thresholds of the relays/LEDs **R1 ÷ R2** without knowledge about user password.

### 7.3.8. “rS-485” 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: “**1200**”, “**2400**”, “**4800**”, “**9600**”, “**19200**”, “**38400**”, “**57600**”, “**115200**”.

“**mbAccE**” - 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 “**mbAccE**” parameter (see: **LIST OF REGISTERS**).

“**mbtimE**” - this parameter defines maximal time (sec) between following frames received by the device. If the delay will be greater than the value of “**mbtimE**” parameter, the relays and the current output which are controlled via RS-485 interface, will set to alert state (see “**OUtPut**” menu and “**rELAy1**” menu description). Parameter “**mbtimE**” 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 7.2 contains most frequently used values.

<b>“bAud” parameter</b>	<b>“38400”</b>	<b>“57600”</b>	<b>“115200”</b>
<b>“rESP” parameter</b>	<b>“ 10c”</b>	<b>“ 20c”</b>	<b>“ 50c”</b>

Tab.7.2. Settings of **“rESP”** parameter

### 7.3.9. “Edit t” parameter

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

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

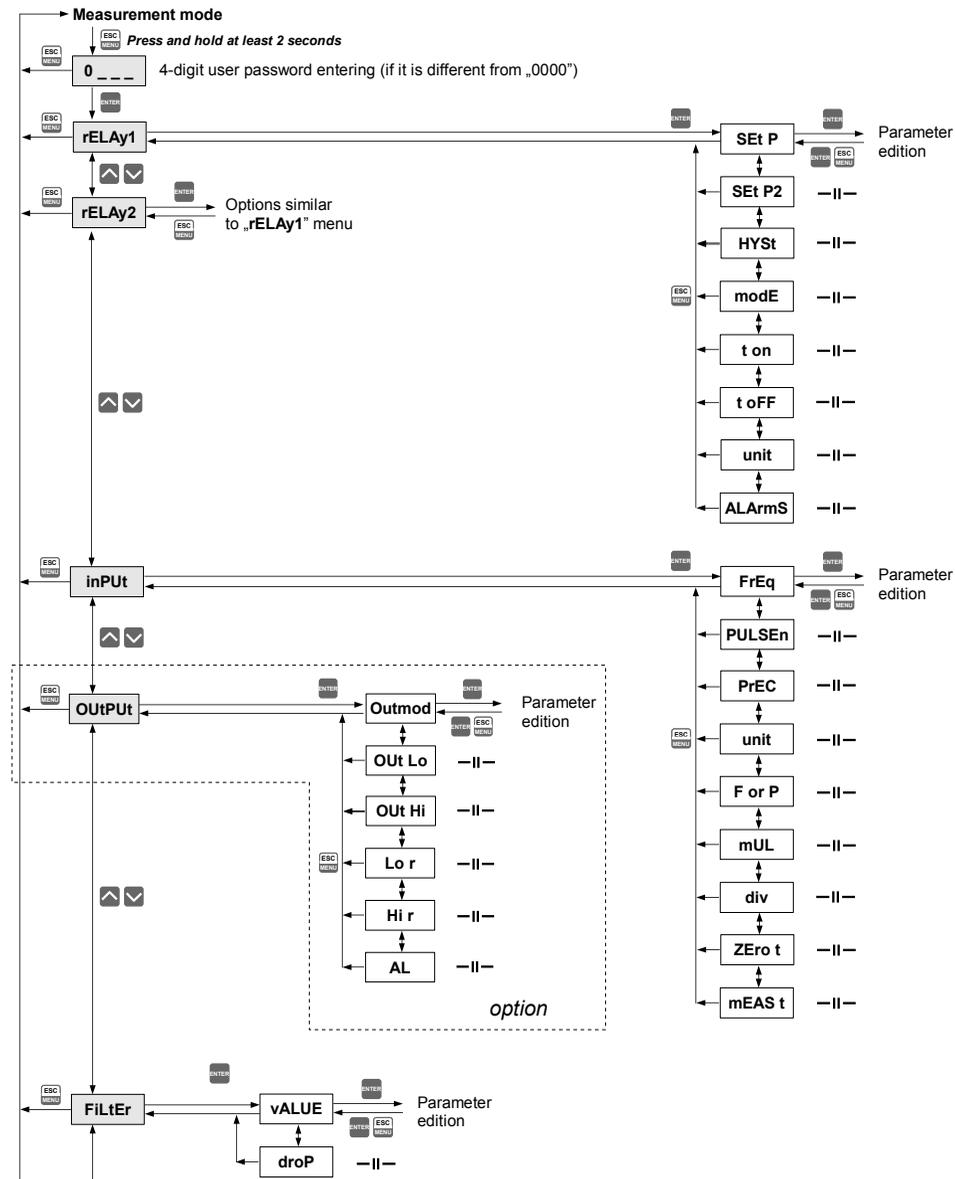
### 7.3.10. “dEFS” parameter

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.

### 7.3.11. “SErv” menu

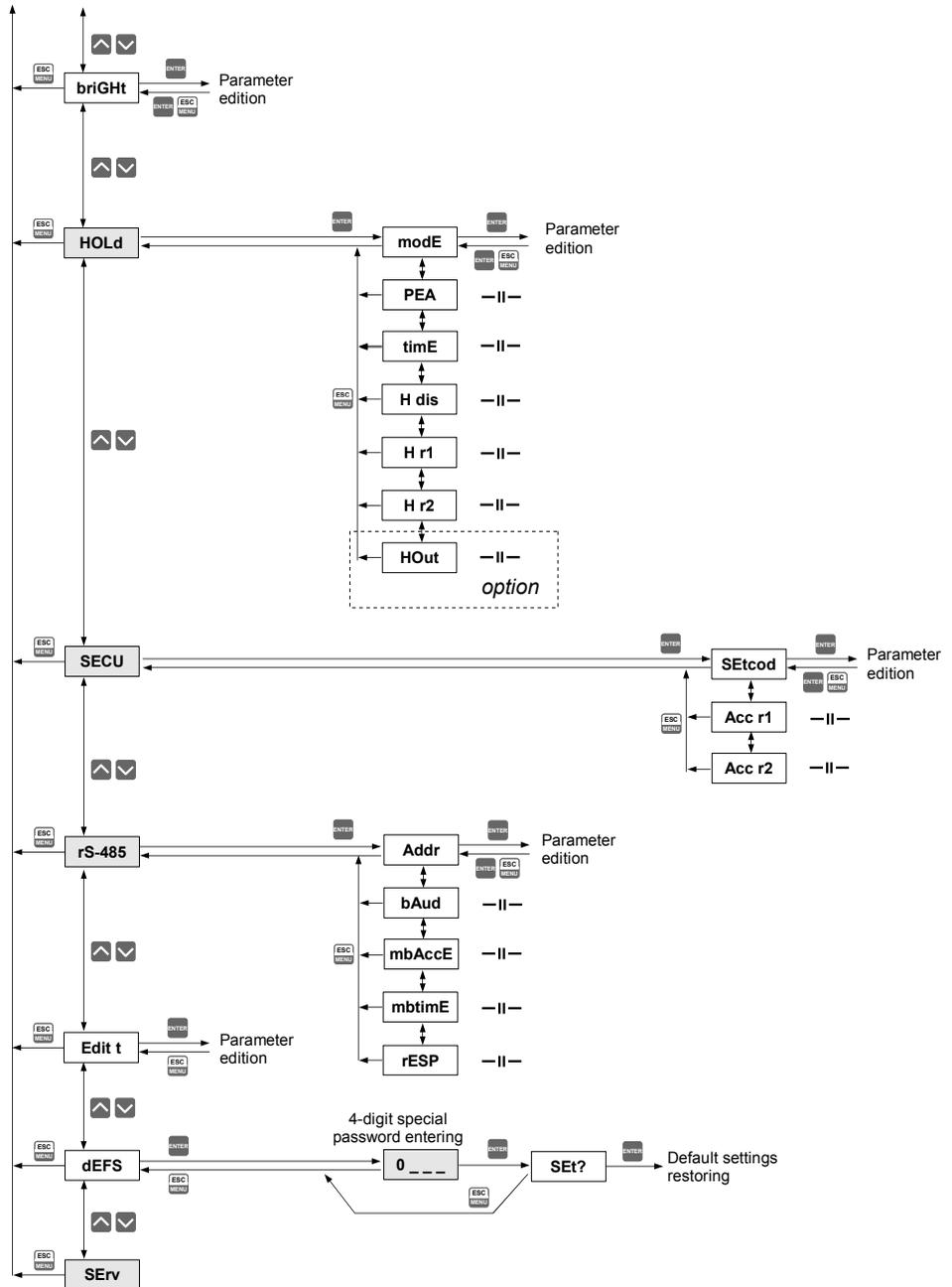
This menu contains the parameters for authorized service only. To enter this menu proper service password must be entered. Improper settings can causes of damage of the device.

## 7.4. MENU STRUCTURE



See next page

See previous page



## **8. EXAMPLES OF “MUL” AND “DIV” PARAMETERS CALCULATION**

1. Let's assume that user wants to multiply rotational speed by 12.34. Then parameters “mUL” and “div” should be set :  
“mUL” = 1234, “div” = 100
2. Let's assume that user wants to divide rotational speed by 5.678. Then parameters “mUL” and “div” should be set :  
“mUL” = 1000, “div” = 5678
3. Let's assume that user wants to display linear speed of moved material. Measurement wheel radius is 5 cm. To determine parameters “mUL” and “div” a circumference of measurement wheel must be calculated (it means linear distance equals to single revolution)

$$\text{circumference} = 2 \times 3,14 \times 5 \text{ cm} = 31,40 \text{ cm} = 0,314 \text{ m}$$

To obtain linear speed multiply rotational speed by determined coefficient:

$$\text{“mUL”} = 314, \text{“div”} = 1000$$

After storing these parameters, device displays linear speed of material movement expressed in m/s , m/min. or m/h ( depend on “unit” parameter), with precision selected by “PrEc” parameter.

4. Let's assume that user wants to know how much time is required for backing a bun at current speed of production line. While backing the bun is moving on the production line through the oven.

Input data:

- number of pulses per 1 meter = 10 pulses
- the way of bread while backing = 12.33m

User have to set following parameters:

- “inPUt” -> “F or P” = “PEriod”
- “inPUt” -> “PULSen” = 10 pulses
- “inPUt” -> “div” = 37 (because we want to N\*12.33 be an integer value)
- “inPUt” -> “mUL” = N

Since now the time (required for backing a bun at current speed of production line) is shown on the display (in units selected by “inPUt” -> ”unit” parameter).

## **9. OUTPUT VALUE CALCULATION**

Lets assume that we have active current output and its parameters are:

“**OUTmod**” = “4-20”, “**OUT LO**” = 100, “**OUT HI**” = 200, “**Lo r**” = 5.0, “**Hi r**” = 5.0

Parameters “**Lo r**” and “**Hi r**” define working range of current output to  $3.8 \div 21$  mA.

Output current will be calculated for three displayed values „D”:

a) D = „17.5”

According to formula from page 31:

$$I_{out} = (17.5-10.0) / (20.0-10.0) \times 16 \text{ mA} + 4 \text{ mA} = 0.75 \cdot 16 + 4 = 16 \text{ mA}$$

Calculated  $I_{out}$  does not exceed the output working range (3.8 - 21 mA).

b) D = „20.5”

According to formula from page 31:

$$I_{out} = (20.5-10.0) / (20.0-10.0) \times 16 \text{ mA} + 4 \text{ mA} = 1.05 \cdot 16 + 4 = 20.08 \text{ mA}$$

Calculated  $I_{out}$  does not exceed the output working range (3.8 - 21 mA).

c) D = „30.0”

According to formula from page 31:

$$I_{out} = (30.0-10.0) / (20.0-10.0) \times 16 \text{ mA} + 4 \text{ mA} = 2 \cdot 16 + 4 = 36 \text{ mA}.$$

Calculated  $I_{out}$  exceeds the output working range (3.8 - 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. 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/second

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 does not exceed 16 registers (for single frame).



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

## 10.1. LIST OF REGISTERS

Some parameters are located on two registers (higher word in first register, and lower word in next one). After writing of one of them device controls result of their 32-bit value, and if it is necessary corrects value of second register automatically. If appropriate modification is impossible, both registers stay unaffected and device responds with error code 03h (see: **TRANSMISSION ERRORS DESCRIPTION**).

Register	Write	Range	Register description
01h <sup>1</sup> 02h <sup>1</sup>	No	0 ÷ 999999	Measurement value (no decimal point)
03h	No	0-FFh	The status of the current measurement. <b>0</b> – data valid; <b>20h</b> – device waits for first pulse; <b>A0h</b> – alarm state, allowable frequency range is exceeded
04h	Yes	0 ÷ 5	<b>“PrEc”</b> parameter in <b>“inPUt”</b> menu. The same as 12h register
05h	Yes	0 ÷ 31	State of the relays and alarm LED (binary format) (1 - on, 0 - off): <b>00000000 000e00ba</b> <b>a</b> - relay R1; <b>b</b> - relay R2; <b>e</b> - alarm state indicator; If written, only <b>a</b> , <b>b</b> bits are important (others are ignored) these bits allows user to control the relays via RS-485 interface
06h <sup>2</sup>	Yes	0h ÷ 1800h	State of active current output, expressed in 1/256 mA units – it means that high byte express integer part, and low byte fractional part of desired output current.
	Yes	2CCh+1800h	State of passive current output, expressed in 1/256 mA units – it means that high byte express integer part, and low byte fractional part of desired output current.
	Yes	0h ÷ 1600h	State of active voltage output, expressed in 1/512 V units – it means that high byte express integer part, and low byte fractional part of desired output voltage.
07h <sup>1</sup> 08h <sup>1</sup>	No	0 ÷ 999999	Peak (drop) value (no decimal point)
10h	Yes	0 ÷ 11	<b>“FrEq”</b> parameter in <b>“inPUt”</b> menu (input filter): <b>0</b> - 10Hz; <b>1</b> - 15Hz; <b>2</b> - 20Hz; <b>3</b> - 30Hz; <b>4</b> - 40Hz; <b>5</b> - 50Hz; <b>6</b> – 100Hz; <b>7</b> - 300Hz; <b>8</b> - 1kHz; <b>9</b> - 3kHz; <b>10</b> - 10kHz; <b>11</b> - 50kHz
11h	Yes	0 ÷ 19999	<b>“PULSeN”</b> parameter in <b>“inPUt”</b> menu. Value 0 is interpreted as 1
12h	Yes	0 ÷ 5	<b>“PrEc”</b> parameter in <b>“inPUt”</b> menu <b>0</b> - “0”; <b>1</b> - “0.0”; <b>2</b> - “0.00”; <b>3</b> - “0.000”; <b>4</b> - “0.0000”; <b>5</b> - “0.00000”;
13h	Yes	0 ÷ 2	<b>“unit”</b> parameter in <b>“inPUt”</b> menu <b>0</b> -rev./sec.; <b>1</b> - rev./min; <b>2</b> - rev./hour.;
14h 15h	Yes	0 ÷ 999999	<b>“mUL”</b> parameter in <b>“inPUt”</b> menu Value 0 is interpreted as 1 000 000
16h 17h	Yes	0 ÷ 999999	<b>“div”</b> parameter in <b>“inPUt”</b> menu Value 0 is interpreted as 1 000 000
18h	Yes	0 ÷ 399	<b>“ZEro t”</b> parameter in <b>“inPUt”</b> menu expressed in tenth of seconds

Register	Write	Range	Register description
19h	Yes	0 ÷ 199	“ <b>mEAS t</b> ” parameter in “ <b>inPUt</b> ” menu expressed in tenth of seconds
1Ah	Yes	0 ÷ 199	“ <b>vALUE</b> ” parameter in “ <b>FILtEr</b> ” menu (measurement filtering rate)
1Bh	Yes	0 ÷ 1999	“ <b>droP</b> ” parameter in “ <b>FILtEr</b> ” menu expressed in tenth of percent
20h <sup>3</sup>	Yes	0 ÷ 199	Device address
21h	No	205Ch	Device identification code (ID)
22h <sup>4</sup>	Yes	0 ÷ 7	“ <b>bAud</b> ” parameter in “ <b>rS-485</b> ” menu (baud rate); 0 - 1200 baud; 1 - 2400 baud; 2 - 4800 baud; 3 - 9600 baud; 4 - 19200 baud; 5 - 38400 baud; 6 - 57600 baud; 7 - 115200 baud
23h <sup>5</sup>	Yes	0 ÷ 1	“ <b>mbAccE</b> ” parameter in “ <b>rS-485</b> ” menu (permission to write registers via RS-485 interface); 0 - write denied ; 1 - write allowed
24h	Yes	see descr.	Parameters of “ <b>SECU</b> ” menu (binary format (0 - „ <b>oFF</b> ”, 1 - „ <b>on</b> ”): <b>bit 0</b> - “ <b>Acc r1</b> ” parameter; <b>bit 1</b> - “ <b>Acc r2</b> ” parameter;
25h	Yes	0 ÷ 5	“ <b>rESP</b> ” parameter in “ <b>rS-485</b> ” menu (additional response delay); 0 - no additional delay; 1 - “ <b>10c</b> ” option; 2 - “ <b>20c</b> ” option; 3 - “ <b>50c</b> ” option; 4 - “ <b>100c</b> ” option; 5 - “ <b>200c</b> ” option;
27h	Yes	0 ÷ 99	“ <b>mbtime</b> ” parameter in “ <b>rS-485</b> ” menu (maximum delay between received frames); 0 - no delay checking; 1 ÷ 99 - maximum delay expressed in seconds
2Dh	Yes	1 ÷ 8	“ <b>briGht</b> ” parameter (display brightness); 1 - the lowest brightness; 8 - the highest brightness
2Fh	Yes	0 ÷ 1	“ <b>Edit</b> ” parameter (numerical parameters edit mode); 0 - „ <b>dig</b> ” mode; 1 - „ <b>SLid</b> ” mode
30h 31h	Yes Yes	0 ÷ 999999	“ <b>SEt P</b> ” parameter in “ <b>rELAy1</b> ” menu, no decimal point included
32h 33h	Yes Yes	0 ÷ 99999	“ <b>HySt</b> ” parameter in “ <b>rELAy1</b> ” menu, no decimal point included
34h	Yes	0 ÷ 5	“ <b>modE</b> ” parameter in “ <b>rELAy1</b> ” menu: 0 - “ <b>noAct</b> ” mode; 1 - “ <b>on</b> ” mode; 2 - “ <b>oFF</b> ” mode; 3 - “ <b>in</b> ” mode; 4 - “ <b>out</b> ” mode; 5 - “ <b>modbuS</b> ” mode
35h	Yes	0 ÷ 999	“ <b>t on</b> ” parameter in “ <b>rELAy1</b> ” menu, expressed in tenth of seconds or tenth of minutes depend on “ <b>unit</b> ” parameter
36h	Yes	0 ÷ 999	“ <b>t oFF</b> ” parameter in “ <b>rELAy1</b> ” menu, expressed in tenth of seconds or tenth of minutes depend on “ <b>unit</b> ” parameter
37h	Yes	0 ÷ 1	“ <b>unit</b> ” parameter in “ <b>rELAy1</b> ” menu: 0 - seconds; 1 - minutes
38h	Yes	0 ÷ 2	“ <b>ALArMS</b> ” parameter in “ <b>rELAy1</b> ” menu: 0 - no changes; 1 - on; 2 - off
39h 3Ah	Yes Yes	0 ÷ 999999	“ <b>SEt P2</b> ” parameter in “ <b>rELAy1</b> ” menu, no decimal point included
40h 41h	Yes Yes	0 ÷ 999999	“ <b>SEt P</b> ” parameter in “ <b>rELAy2</b> ” menu, no decimal point included

Register	Write	Range	Register description
42h 43h	Yes Yes	0 ÷ 99999	"HySt" parameter in "rELAy2" menu, no decimal point included
44h	Yes	0 ÷ 5	"modE" parameter in "rELAy2" menu: 0 - "noACT" mode; 1 - "on" mode; 2 - "oFF" mode; 3 - "in" mode; 4 - "out" mode; 5 - "modbuS" mode
45h	Yes	0 ÷ 999	"t on" parameter in "rELAy2" menu, expressed in tenth of seconds or tenth of minutes depend on "unit" parameter
46h	Yes	0 ÷ 999	"t oFF" parameter in "rELAy2" menu, expressed in tenth of seconds or tenth of minutes depend on "unit" parameter
47h	Yes	0 ÷ 1	"unit" parameter in "rELAy2" menu: 0 - seconds; 1 - minutes
48h	Yes	0 ÷ 2	"ALArmS" parameter in "rELAy2" menu: 0 - no changes; 1 - on; 2 - off
49h 4Ah	Yes Yes	0 ÷ 999999	"SEt P2" parameter in "rELAy2" menu, no decimal point included
70h	Yes	0 ÷ 1	"modE" parameter in "HOLd" menu (type of detected changes): 0 - peaks; 1 - drops
71h	Yes	0 ÷ 999999	"PEA" parameter in "HOLd" menu (minimum detectable change, no decimal point included)
72h	Yes	0 ÷ 199	"timE" parameter in "HOLd" menu, maximum peaks' (or drops') display time expressed in seconds
73h	Yes	0 ÷ 1	"HdiS" parameter in "HOLd" menu (the type of values displayed on the display): 0 - current measurement value; 1 - peaks (or drops) values
74h	Yes	0 ÷ 1	"H r1" parameter in "HOLd" menu (the control mode of relay R1 and LED R1) : 0 - control depends on current measurement values; 1 - control depends on peaks (or drops) values;
75h	Yes	0 ÷ 1	"H r2" parameter in "HOLd" menu (the control mode of relay R2 and LED R2) : 0 - control depends on current measurement values; 1 - control depends on peaks (or drops) values;
78h <sup>2</sup>	Yes	0 ÷ 1	"HOut" parameter in "HOLd" menu: 0 - "rEAL" mode ; 1 - "HOLd" mode
88h	Yes	0 ÷ 1	"F or P" parameter in "inPUt" menu (kind of value visible on the display): 0 - frequency; 1 - period
A0h <sup>2</sup>	Yes	0 ÷ 3	"OUtmod" parameter in "OUtPUt" menu (active current output mode) 0 - current output disabled; 1 - current output enabled with 4÷20mA mode; 2 - current output enabled with 0÷20mA mode; 3 - current output controlled via RS-485 interface

Register	Write	Range	Register description
	Yes	0 ÷ 2	“ <b>OUTmod</b> ” parameter in “ <b>OUTPUT</b> ” menu (passive current output mode) <b>0</b> - current output disabled; <b>1</b> - current output enabled with <b>4÷20mA</b> mode; <b>2</b> - current output controlled via RS-485 interface
	Yes	0 ÷ 5	“ <b>OUTmod</b> ” parameter in “ <b>OUTPUT</b> ” menu (active voltage output mode) <b>0</b> - voltage output disabled; <b>1</b> - voltage output enabled with <b>0÷5V</b> mode; <b>2</b> - voltage output enabled with <b>1÷5V</b> mode; <b>3</b> - voltage output enabled with <b>0÷10V</b> mode; <b>4</b> - voltage output enabled with <b>2÷10V</b> mode; <b>5</b> - voltage output controlled via RS-485 interface
A1h <sup>2</sup> A2h <sup>2</sup>	Yes	0 ÷ 999999	“ <b>Out LO</b> ” parameter in “ <b>OUTPUT</b> ” menu, no decimal point included
A3h <sup>2</sup> A4h <sup>2</sup>	Yes	0 ÷ 999999	“ <b>Out HI</b> ” parameter in “ <b>OUTPUT</b> ” menu, no decimal point included
A5h <sup>2</sup>	Yes	0 ÷ 999	“ <b>Lo r</b> ” parameter in “ <b>OUTPUT</b> ” menu, for active current output and active voltage output, expressed in 0.1%
	Yes	0 ÷ 299	“ <b>Lo r</b> ” parameter in “ <b>OUTPUT</b> ” menu for passive current output, expressed in 0.1%
A6h <sup>2</sup>	Yes	0 ÷ 199	“ <b>Hi r</b> ” parameter in “ <b>OUTPUT</b> ” menu for active and passive current output, expressed in 0.1%
	Yes	0 ÷ 99	“ <b>Hi r</b> ” parameter in “ <b>OUTPUT</b> ” menu for active voltage output, expressed in 0.1%
A7h <sup>2</sup>	Yes	0 ÷ 3	“ <b>AL</b> ” parameter in “ <b>OUTPUT</b> ” menu (active current output value on critical exception): <b>0</b> - no change; <b>1</b> - 22.1 mA; <b>2</b> - 3.4 mA; <b>3</b> - 0 mA
	Yes	0 ÷ 2	“ <b>AL</b> ” parameter in “ <b>OUTPUT</b> ” menu (passive current output value on critical exception): <b>0</b> - no change; <b>1</b> - 22.1 mA; <b>2</b> - 3.4 mA
	Yes	0 ÷ 5	“ <b>AL</b> ” parameter in “ <b>OUTPUT</b> ” menu (active voltage output value on critical exception): <b>0</b> - no change; <b>1</b> - 11 V; <b>2</b> - 5.5; <b>3</b> - 1.2 V; <b>4</b> - 0.6 V; <b>5</b> - 0 V

- 1 - it is recommended to read these registers simultaneously – in 2-registers frames. If single registers are read, data errors are possible because of changes of read value between successive registers readings.
- 2 - these registers are active only if device is equipped with current or voltage output
- 3 - after writing to register no 20h the device responds with an “old” address in the message.
- 4 - after writing to register no 22h the device responds with the new baud rate.
- 5 - the value of the “**mbAccE**” 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.

## 10.2. 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 5).

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: “**mbAccE**” parameter)

### 10.3. EXAMPLES OF QUERY/ANSWER FRAMES

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

#### Field description:

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

#### 1. Read of the displayed value (measurement) and status, the device address = 01h:

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

The answer :

ADDR	FUNC	BYTE C	DATA H1,L1		DATA H2, L2		DATA H3.L3		CRC L,H	
01	03	06	00	01	86	A0	00	00	2A	B4

DATA H1, L1 - reg. 01h (1 - high word of measurement value)

DATA H2, L2 - reg. 02h (86A0h - low word of measurement value ),

DATA H3, L3 - reg. 03h (0 - measurement status).

In this example measurement value is equal 186A0h (100 000 in decimal format).



Decimal point position is not included in measurement value (reg. 01h and 02h).  
 Decimal point position can be read from reg. 04h ("PrEc" parameter).

#### 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	5C	A1	BD

DATA - identification code (205Ch)

### 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. Try to write improper data to register (register 04h):

ADDR	FUNC	REG H,L		DATA H,L		CRC L,H	
01	06	00	04	00	10	C9	C7

DATA H, L written value (10h = 16) out of allowable range (0 ÷ 5)

Device response ( with exception code 03h):

ADDR	FUNC	ERR	CRC L,H	
01	86	03	09	C1

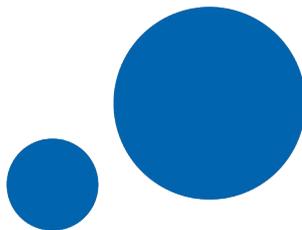


**There is no full implementation of the Modbus Protocol in the device. The functions presented above are available only.**

**11. 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>Parameters of relay R1 operation ("rELAY1" menu)</b>				
SEt P	Relay first threshold	20.0		27
SEt P2	Relay second threshold	30.0		27
HYSt	Hysteresis of relay	0.0		27
modE	Operation mode of relay	„in”		27
t on	Turn on delay of relay	0.0 (sec.)		28
t oFF	Turn off delay of relay	0.0 (sec.)		28
unit	Unit of “t on”, “toFF” parameters of relay	„SEC”		28
ALArmS	Reaction for critical situation of relay	„oFF”		28
<b>Parameters of relay R2 operation ("rELAY2" menu)</b>				
SEt P	Relay first threshold	40.0		27
SEt P2	Relay second threshold	50.0		27
HYSt	Hysteresis of relay	0.0		27
modE	Operation mode of relay	„in”		27
t on	Turn on delay of relay	0.0 (sec.)		28
t oFF	Turn off delay of relay	0.0 (sec.)		28
unit	Unit of “t on”, “toFF” parameters of relay	„SEC”		28
ALArmS	Reaction for critical situation of relay	„oFF”		28
<b>Configuration of measurement input ("inPUt" menu)</b>				
FrEq	Maximum permitted frequency	300 (Hz)		28
PULSEn	Input pulse divider	1		29
PrEc	Measurement result displaying precision	„0.0”		29
unit	Rotational speed unit	„min”		29
F or P	Kind of value visible on the display	„FrEq”		29
mUL	multiplier	1		30
div	divider	1		30
ZERo t	Maximum delay between successive revolutions	1.0 (sec.)		30
mEAS t	Measurement window width	0.5 (sec.)		30
<b>Configuration of displayed value filtering ("FiLteR" menu)</b>				
vALUE	Filtering ratio	0		30
droP	Measurement value change switching off the filter	20.0 (%)		30

<i>Parameter</i>	<i>Description</i>	<i>Default value</i>	<i>User's value</i>	<i>Desc. page</i>
<b>Current output configuration ("OUTPUT" menu)</b>				
Outmod	Current output mode	„4-20" (mA)		31
OUt Lo	Display value for 4 mA current output	0.0		31
OUt Hi	Display value for 20 mA current output	100.0		31
Lo r	Extension of the bottom of the nominal output range	5.0 (%)		32
Hi r	Extension of the top of the nominal output range	5.0 (%)		32
AL	Current output value on critical exception	22.1 (mA)		32
<b>Display parameters</b>				
briGHT	Display brightness	bri6		33
<b>Configuration of peaks detection function ("HOLD" menu)</b>				
modE	Kind of detected changes	„norm"		33
PEA	Minimum detected change	0.0		33
timE	Maximum time of peak displaying	0.0 (sec.)		33
H diS	The type of displayed value	„rEAL"		33
H r1	Source of relay R1, and LED R1 control	„rEAL"		33
H r2	Source of relay R2, and LED R2 control	„rEAL"		33
HOut	Source of current output control	rEAL		33
<b>Settings of access to the configuration parameters ("SECU" menu)</b>				
Acc r1	Permission to changes of relay R1 threshold without of the user password knowledge	on		34
Acc r2	Permission to changes of relay R2 threshold without of the user password knowledge	on		34
<b>RS 485 interface configuration (menu "rS-485")</b>				
Addr	Device address	0		34
bAud	Baud rate	9600 (b./sec.)		34
mbAccE	Permission to changes of configuration registers	„on"		34
mbtimE	Maximum delay between received messages	0		34
rESP	Additional delay of answer transmission	„Std"		35
<b>Configuration of numerical parameters edition</b>				
Edit t	Numerical parameters edit mode	dig		35



**SIMEX Sp. z o.o.  
ul. Wielopole 11  
80-556 Gdańsk  
Poland**

**tel.: (+48 58) 762-07-77  
fax: (+48 58) 762-07-70**

**<http://www.simex.pl>  
e-mail: [info@simex.pl](mailto:info@simex.pl)**