Assisting the automation industry since 1986

User manual
COUNTER
SLN-94

- Firmware: v.7.13 or higher
- Input type: pulse
- Double display, easy threshold value setting



CE

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

CONTENTS

1. BASIC REQUIREMENTS AND USER SAFETY....3
2. GENERAL CHARACTERISTICS....4
3. TECHNICAL DATA....4
4. DEVICE INSTALLATION....6
4.1. UNPACKING....6
4.2. ASSEMBLY....7
4.3. CONNECTION METHOD....9
4.4. MAINTENANCE....14
5. FRONT PANEL DESCRIPTION....14
6. PRINCIPLE OF OPERATION....15
6.1. MEASUREMENT MODE....15
6.2. BATCHER FUNCTION....17
6.3. THE DIGITAL FILTER....18
6.4. CONTROL OF THE RELAY OUTPUTS (BATCHER MODE)....20
6.4.1. Driving of the relays during upcounting....20
6.4.2. Driving of the relays during downcounting....22
6.5. CONTROL OF THE RELAY OUTPUTS (STANDARD MODE)....23
7. DEVICE PROGRAMMING....24
7.1. PROGRAMMING MENU....25
7.2. PARAMETERS EDITION....25
7.2.1. Numeric parameters....26
7.2.2. Switch parameters (“LIST” type)....26
7.3. MENU DESCRIPTION....26
7.3.1. “rL1”, “rL2” menu....27
7.3.2. “rES” parameter....27
7.3.3. “Ar” parameter....28
7.3.4. “dLy” parameter....28
7.3.5. ”mod” parameter....28
7.3.6. ”dir” parameter....28
7.3.7. “FiL” parameter....29
7.3.8. ”CAL” menu....29
7.3.9. ”rS” menu....29
7.3.10. ”bri” parameter....30
7.3.11. ”SEc” menu....31
7.3.12. ”dEF” parameter....31
7.4. MENU STRUCTURE....32
8. EXAMPLES OF PRESCALER PARAMETERS CALCULATION....33
9. THE MODBUS PROTOCOL HANDLING....34
9.1. LIST OF REGISTERS....34
9.2. TRANSMISSION ERRORS DESCRIPTION....37
9.3. EXAMPLES OF QUERY/ANSWER FRAMES....37
10. DEFAULT AND USER'S SETTINGS LIST....40

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.
- GND input of device should be connected to PE wire;
- 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.**

- 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 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

Counter type **SLN-94** is designed for up-down counting of pulses in 3 decades and has single program register using for programming the batcher function. The programming of the counter is realised by push-buttons, and direction of counting can be selected by user. **SLN-94** is equipped with many modern features required in simple and advanced automatic control systems. The counter is made for hard environment conditions, and with use of modern materials and electronic components,

Located on front panel push-buttons allow manual setting of the device according to user requirements. Build in RS-485 communication interface enables controlling of all settings by host, and allows use of unit in advanced network systems. The counter is equipped with single counting, hold, stop, clear/start inputs. **SLN-94** has two build in relays (N.O.) with selectable thresholds and modes of operation. It can be used for controlling of external devices. The counter is prepared for cooperation with NPN as well as PNP type sensors, Due to internal digital denouncing filter simple contactors can be used as sensors. Additionally build in sensor supply output (24V DC) can be used to supply contactors and some types of electronic sensors. All inputs are fully separated from external power supply, relays outputs, and communication interface, and has single common terminal.

3. TECHNICAL DATA

Power supply voltage (depending on version)	85...**230**...260V AC/DC; 50 ÷ 60 Hz (separated) or 19...**24**...50V DC and 16...**24**...35V AC (separated)
External fuse (required)	T - type, max. 2 A
Power consumption	max. 4,5 VA @ 85 ÷ 260V AC/DC max. 4,5 VA @ 16V ÷ 35V AC max. 4,5 W @ 19V ÷ 50V DC

Pulse inputs	
A input	counting (terminal no. 16)
B input	hold input (terminal no. 17)
C input	stop (terminal no. 18)
D input	clear/start (terminal no. 19)
COM	common terminal (terminal no. 20)
Input levels	
low level:	0V ÷ 1V
high level:	10V ÷ 30V
Max. input frequency	electronic: 10 kHz contact: 90 Hz (adjustable filter)
Display range	
result:	000 ÷ 999
settings:	000 ÷ 999
Outputs	
relay:	2 NO, 1A/250V AC (cos φ = 1)
or OC-type:	2, 30mA / 30VDC / 100mW
sensor power supply:	24V +5%, -10% / max. 100 mA, stabilized
Communication interface	RS 485, 8N1 and 8N2, Modbus RTU, not separated
Baud rate	1200 bit/s ÷ 115200 bit/s
Display	
result:	LED, 3 digit, 13mm height, red
settings:	LED, 3 digit, 13mm height, green
Data memory	non-volatile memory, EEPROM type
Protection level	IP 65 (from front, after using waterproof cover) IP 40 (from front) IP 20 (housing and connection clips)
Housing type	panel
Housing material	NORYL - GFN2S E1
Housing dimensions	96 x 48 x 100 mm
Mounting hole	90,5 x 43 mm
Assembly depth	102 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^2

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,
- assembly brackets - 2 pieces.

4.2. ASSEMBLY

- The unit is designed for mounting inside housings (control panel, switchboard) insuring appropriate protection against surges and interference. Metal housings must be connected to ground in a way that complies with the governing regulations.
- Disconnect the power supply prior to starting assembly.
- Check the connections are wired correctly prior to switching the unit on.

In order to install the unit, a 90.5 x 43 mm mounting hole (Figure 4.1, 4.2) must be prepared. The thickness of the material of which the panel is made must not exceed 5mm. When preparing the mounting hole take the grooves for catches located on both sides of the housing into consideration (Figure 4.1, 4.2). Place the unit in the mounting hole inserting it from the front side of the panel, and then fix it using the brackets (Figure 4.3). The minimum distances between the centre points of multiple units - due to the thermal and mechanical conditions of operation - are 115 mm x 67mm (Figure 4.4).

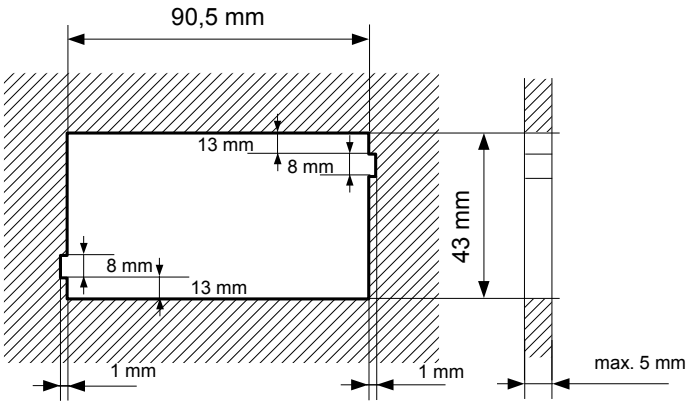


Figure 4.1. Recommended mounting hole dimensions

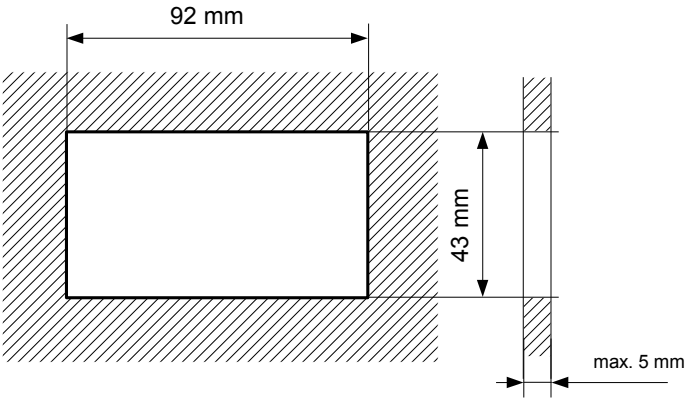


Figure 4.2. Allowable mounting hole dimensions

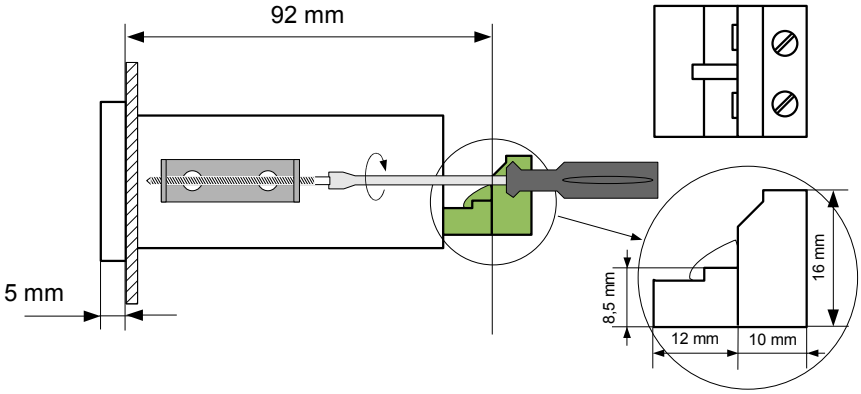


Figure 4.3. Installing of brackets, and dimensions of connectors.

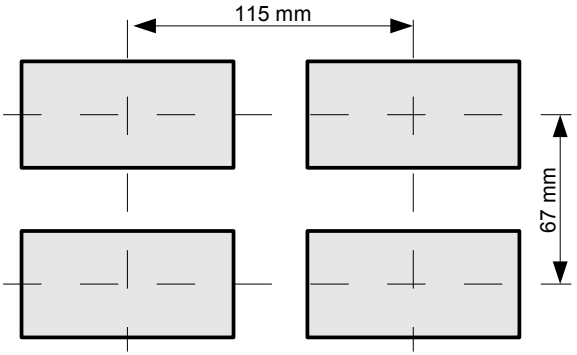


Figure 4.4. Minimum distances when assembly of a number of units

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. 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 screw connections on the back of the unit’s housing.

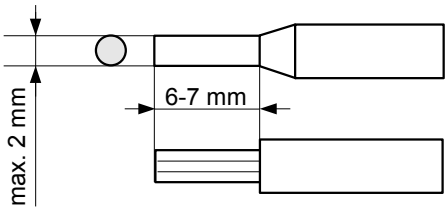


Figure 4.5. Method of cable insulation replacing and cable terminals

All connections must be made while power supply is disconnected !

16
31

Double numeration means, that depending on device version, particular terminal can be marked according to the top or bottom number.

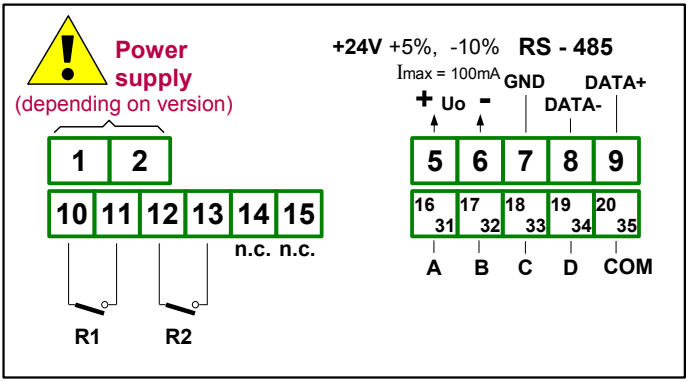


Figure 4.6. Terminals description (relay outputs)

Description of control signals' symbols.

{ A } - counting input, pulse;
{ B } - hold counting input;
{ C } - stop counting input;
{ D } - reset counter input and start new counting cycle;
{ COM } - common terminal.

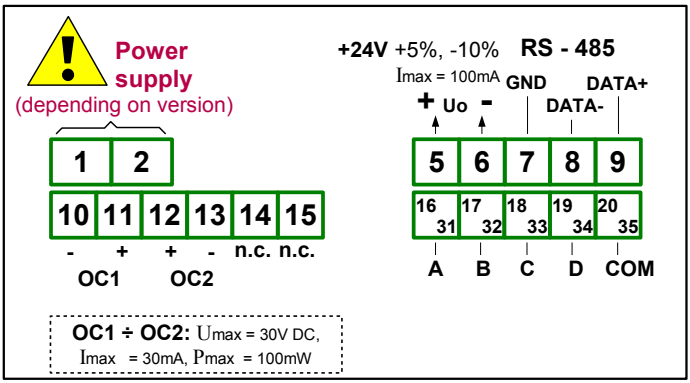


Figure 4.7. Terminals description (OC-type outputs)

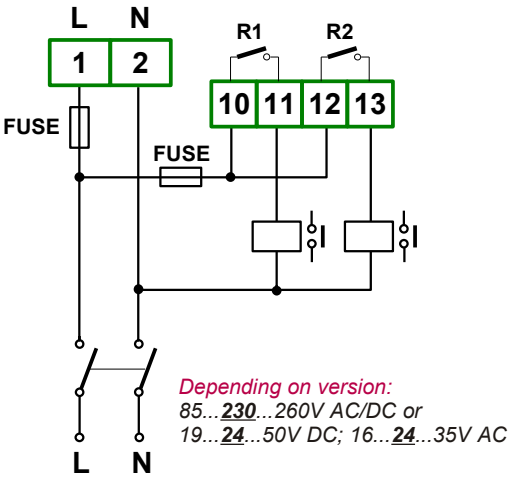


Figure 4.8. Connection of power supply and relays

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.

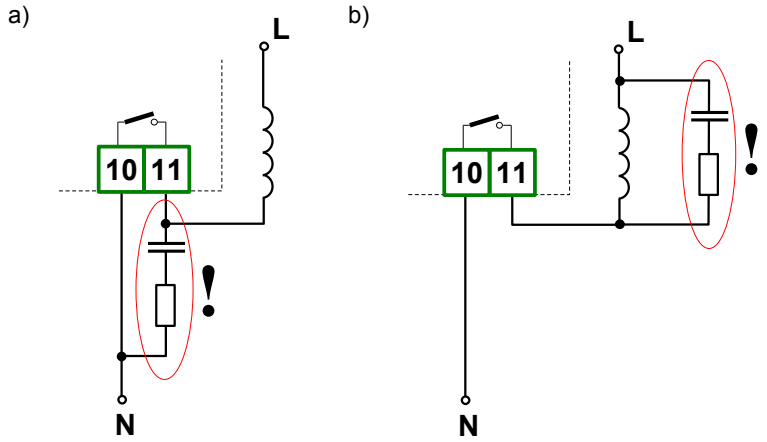


Figure 4.9. Examples of suppression circuit connection:
a) to relay terminals; b) to the inductive load

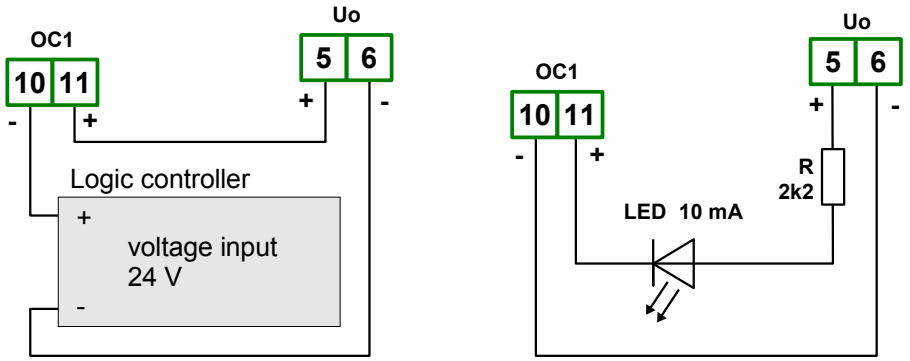


Figure 4.10. Example of OC-type outputs connection

Construction of counter's inputs allows connecting of pulser with common earth (Figure 4.11 a) or common plus (Figure 4.11 b), without additional intermediary circuits (sensor with NPN or PNP type output); for outputs of push-pull type kind of connection has no matter.

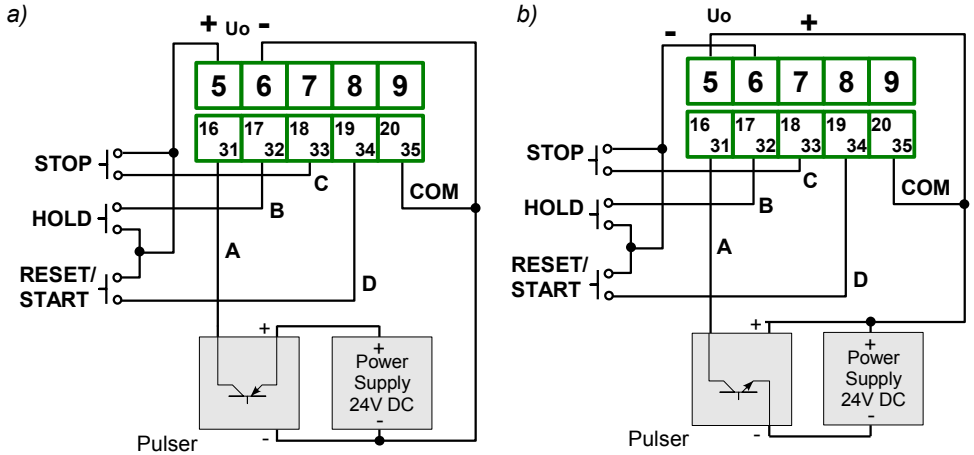


Figure 4.11. An example of pulser connection:
a) with common earth, b) with common plus.

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.

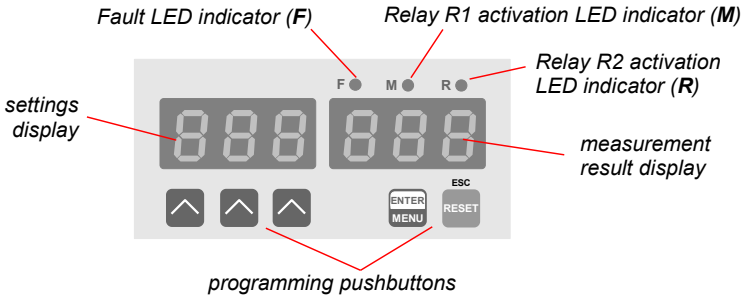


Using any other agents can cause permanent damage to the housing.



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: **[ENTER/MENU]**
Functions:
- in measurement mode: Enter to main menu (press and hold by at least 2 sec.) or pause/continue counting (short pressing, if device is paused then relays are driven to its ***inactive*** state);
- in Menu mode: Start to edit the parameter or confirmation of changes made in parameter being edited



Symbol used in the manual: **[^]**
Functions:
- in measurement mode: edition of adjuster value,
- in Menu mode: Change of the present menu or Modification of the parameter value



Symbol used in the manual: **[ESC/RESET]**
Functions:
- in measurement mode: initializes new cycle (see ***MEASUREMENT MODE*** and ***MENU DESCRIPTION***)
- in Menu mode: Exit the current level and Enter to previous menu (or measure mode), Cancel the changes made in parameter being edited

6. PRINCIPLE OF OPERATION

After turning the power supply on, device ID and software version are showed on the display, next the data **stored while power supply off** are restored and device goes to the selected operation mode.

6.1. MEASUREMENT MODE

During normal operation the counter counts pulses from input { **A** }, calculates using „**div**" and „**muL**" parameters, and shows the result on right LED display (red) with selected decimal point position (parameter „**Pnt**"). Displayed values are contained in 3 decades (000 ÷ 999). While its value exceeds 3 decades, its value turns on itself (it counts like this: 998, 999, 000, 001 or 001, 000, 999, 998 – depends on counting direction). Left LED display (green) is called adjuster, and shows current value of parameter "**Pr1**".

SLN-94 counter can be programmed to any value form range 1 ÷ 1000. Value 1000 can be obtained setting 000. In such case driving of relays is realised after counting of 1000 units (it can be more pulses depend on **„div"**). To change particular position of programmed value use [**^**] buttons. To simplify entering of the thresholds decimal point on both displays is showed on the same positions.

Device counts pulses UP as well as DOWN. The selection of counting direction is realised using programming menu.
The initialisation of counting cycle (e.g. batching) can be made in several ways:

- pushing **[ESC/RESET]** button, and apply by **[ENTER]** button,
- delivering and next removing of ***active*** state to external **clear/start** input { **D** },
- direct storing of internal registers via RS-485 interface.

When initialization of counting cycle occurs, following operations are realised by internal software: clearing of counter register (while counting UP) or loading of counter register with value equal to adjuster value showed on left (green) LED display. Next the device starts counting in selected direction, and LED marked „**F**" lights until end of counting cycle.

Together with initialization of counting cycle new relays controlling cycle starts. (see chapter: ***CONTROL OF THE RELAY OUTPUTS...***).
Depending on parameter "**Ar**" (see description: ***"Ar" parameter***) counting and controlling cycles are realised once or sequentially, allowing automatic controlling of process without user interaction. Counting cycle ends (LED „**F**" dims) after counter reach stored threshold. For counting UP this is value stored while initialisation of the cycle, for counting DOWN it is zero.

Delivering of active state to control inputs „hold" (marked { **B** }) causes holding of counting.

Active state on input { **B** } causes holding of counting, but has no influence to realisation of counting and relays controlling cycles.

Delivering of active state to **stop** input marked { **C** } causes termination of counting relays controlling cycles. Relays are driven to its ***inactive*** state (see description of parameters "**mr1**"and "**mr2**" of ***"rL1", "rL2" menu***).



The change of adjuster value during realisation of counting cycle do not change the threshold stored while initialisation of the cycle. Storing of the new value is done while initialisation of the new cycle (automatic or manual).

If ***AUTORESET*** function is active (parameter "**Ar**" = "**on**"), next cycle starts automatically with delay "**dLy**" (see description of parameter ***"dLy"***) after counter reach previously stored threshold of relay **R1** ("**Pr1**" or "**000**", depend on selected direction).



The change of parameters (except **„Pr1"**) causes that next cycle must be initialised by user (even if ***AUTORESET*** function is active).

During delay device counts pulses, and LED „**F**" flashes signalling realisation of delay. If ***AUTORESET*** function is inactive, next cycle must be initialised by user using **[ESC/RESET]** button, by control input **clear/start** marked **{ D }**, or by writing of internal registers via RS-485 interface.



While power off, device stores its current counter value and restores it it after power on. The state of counting and relays controlling cycles is not restored, it must be initialised manually after power on (even if ***AUTORESET*** is active).

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) **do not stops measures**.

6.2. BATCHER FUNCTION

To set **SLN-94** for operate as a batcher it must be connected in proper way with valves and flow sensor, additionally parameter **"mod"** must be set to ***"bAt"*** *value* (see description of ***"mod" parameter***). Producer assumes that two valves will be used (main valve with bigger diameter controlled by relay **R2,** and additional valve with small diameter – controlled by relay **R1**). In this mode value showed on adjuster display (left, green display) is equal to threshold of relay **R1** (**Pr1**), it means required volume of medium, and parameter **Pr2** is handled as constant control advance (defined from Menu level) of the process.

Depending on counting direction there are possible two methods of batcher operation. First method (while „**dir**"="**UP**"), the counter counts **UP** and shows current volume of medium. After pressing of **[RESET]** button (and confirmation), counter is zeroed and both relays are activated (e.g. both valves opened) - the batching process is in progress. In this mode relay **R2** controls main valve will be deactivated when counter reaches value **Pr1** – **Pr2**, (parameter **Pr2** is used as control advance). If **Pr2** > **Pr1**, then Relay **R2** is deactivated after reset (initialisation of new cycle). Relay **R1** will be deactivated when counter reach value stored during the initialisation (desired volume). The process can be repeated (with old or new parameters - if changed, even while realisation of previous cycle) after pressing of **[RESET]** button, or (if ***AUTORESET*** is active) automatically after delay defined by parameter „**dLy**" (0 to 99.9 sec) since counter reached previous **Pr1** threshold.



The change of parameters (except **„Pr1"**) causes that next cycle must be initialised by user (even if ***AUTORESET*** function is active).

If parameter „**dir**"=„**dn**", then counter counts down and shows how much of medium left to end of the cycle. With such settings after pressing of **[RESET]** button (and confirmation) counter will be loaded with value showed on adjuster (Left, green LED display) equal to current **Pr1** threshold, and both relays will be activated - batching process is in progress. Relay **R2** controls main valve, and will be deactivated when counter reaches value equal to parameter **Pr2**, (**Pr2** is used as control advance). If **Pr2** > **Pr1** then relay **R2** is deactivated after reset (initialisation of new cycle). Relay **R1** will be deactivated when counter reach 0 (counting **DOWN**). Similar like in first case the process can be repeated after next press of [**RESET**] button, and (if ***AUTORESET*** is active) it will be done automatically after delay defined by parameter „**dLy**", since counter reached 0.

"dir" parameter	*State of the counter after RESET (value)*	*Deactivation of R1 when counter reaches*	*Deactivation of R2 when counter reaches*
UP	0	Pr1	Pr1-Pr2
dn	Pr1	0	Pr2

Tab. 6.1. Table of batcher mode operation

Proposed in example system is showed in Figure 6.1, and proposed circuit diagram in Figure 6.2.

More details of this example are described on page 33 in example no. 3.

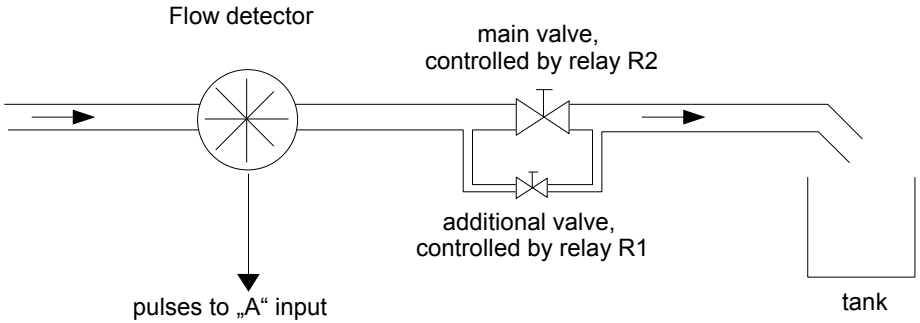


Figure 6.1. Proposed system

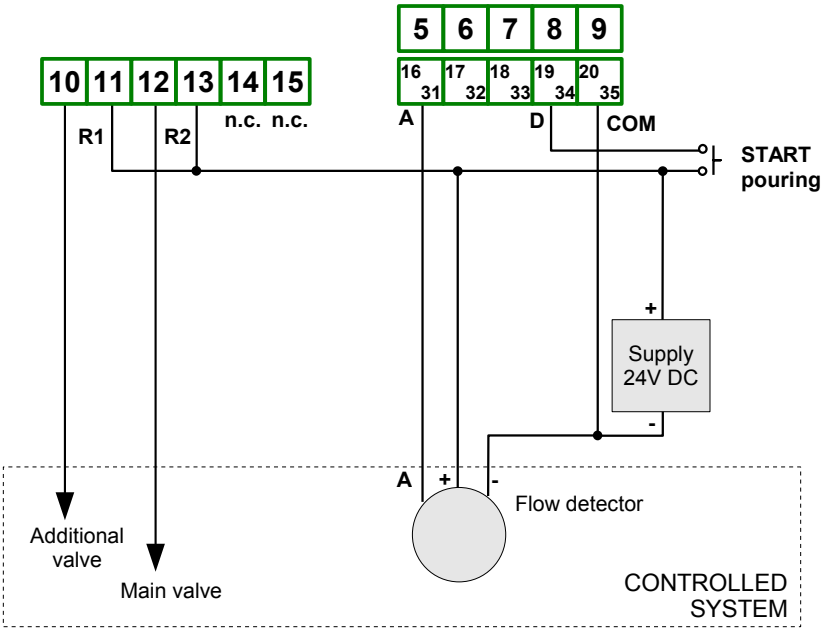


Figure 6.2. Proposed circuit diagram

6.3. THE DIGITAL FILTER

To enable the connection of the simple switches as detectors, special digital filter has been build into the device. This filter allows the counter to proper counting pulses regardless of the vibration of the contacts of the switches.

The condition of proper counting is providing of time periods of the pulses. The filter can be set to blocking frequencies higher than 10, 20, 30, 40, 50 ,60 ,70, 80 and 90Hz. The time periods of stable states "0" (t_0) and "1" (t_1) of pulses must be not shorter than 1/2F, where F the filtered frequency in Hz. See the table below (Tab. 6.2) to check proper periods for all frequencies.

filter setting (F)	*t_0, t_1*	*input signal frequency*	*input type*
OFF	50,0 µs	10 kHz	electronic input
10	50,0 ms	10 Hz	
20	25,0 ms	20 Hz	
30	16,7 ms	30 Hz	electronic
40	12,5 ms	40 Hz	or contact
50	10,0 ms	50 Hz	input
60	8,3 ms	60 Hz	
70	7,2 ms	70 Hz	
80	6,3 ms	80 Hz	
90	5,6 ms	90 Hz	

Tab. 6.2. Time periods t_0 ,t_1 depend on filtered frequency.

When the filter is turned off , time periods t0 i t1 must be longer than 50 ms (see Figure 6.3), and maximum counted frequency is equal 10 kHz.

a)

b)

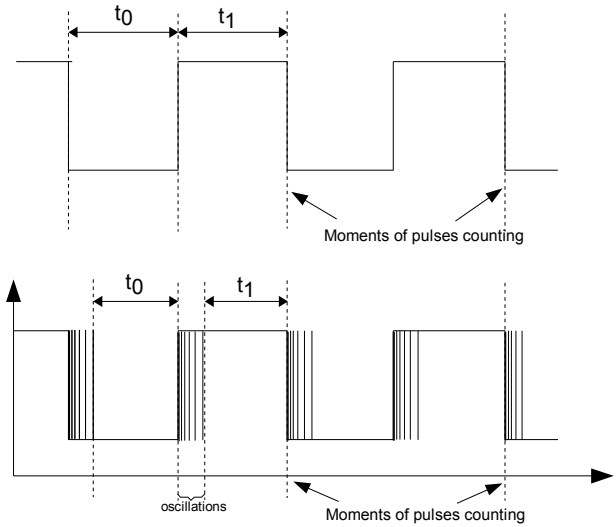


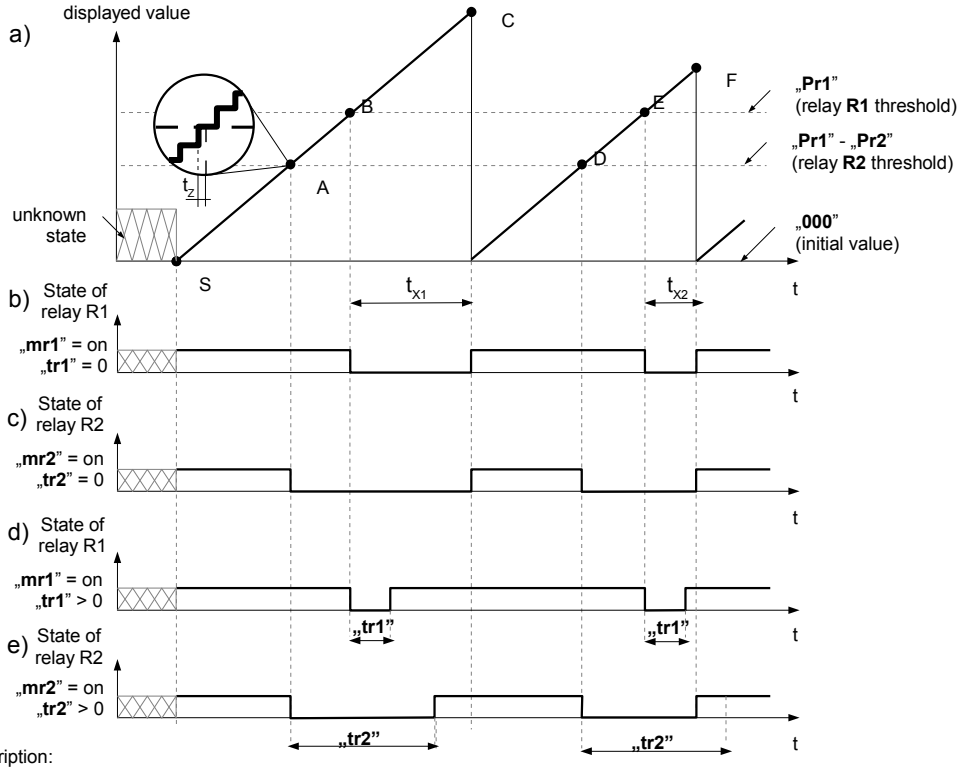
Figure 6.3. The traces of signals:
a) without contacts oscillations, b) with contacts oscillations

6.4. CONTROL OF THE RELAY OUTPUTS (BATCHER MODE)

Controlling of external devices due to state of the counter is realised using relay outputs. Operation of relay output is described by parameters: **"dir"**, **"Pr1"**, **"Pr2"**, **"tr1"**, **"tr2"**, **"mr1"**, **"mr2"**, **"dLy"** and **"Ar"**.

6.4.1. Driving of the relays during upcounting

The mode of relays operation during upcounting (parameter **"dir" = "UP"**) for example settings is showed in figure 6.4 (***AUTORESET*** function is inactive) and in figure 6.5 (active ***AUTORESET*** function).



Description:

S	- initialisation of the counting cycle,
A, B, D, E	- points while counter exceeds selected value,
C, F	- manual initialisation of counting cycle
t_{X1}, t_{X2}	- idle time (device is waiting for manual initialisation),
t_Z	- delay of relay reaction,

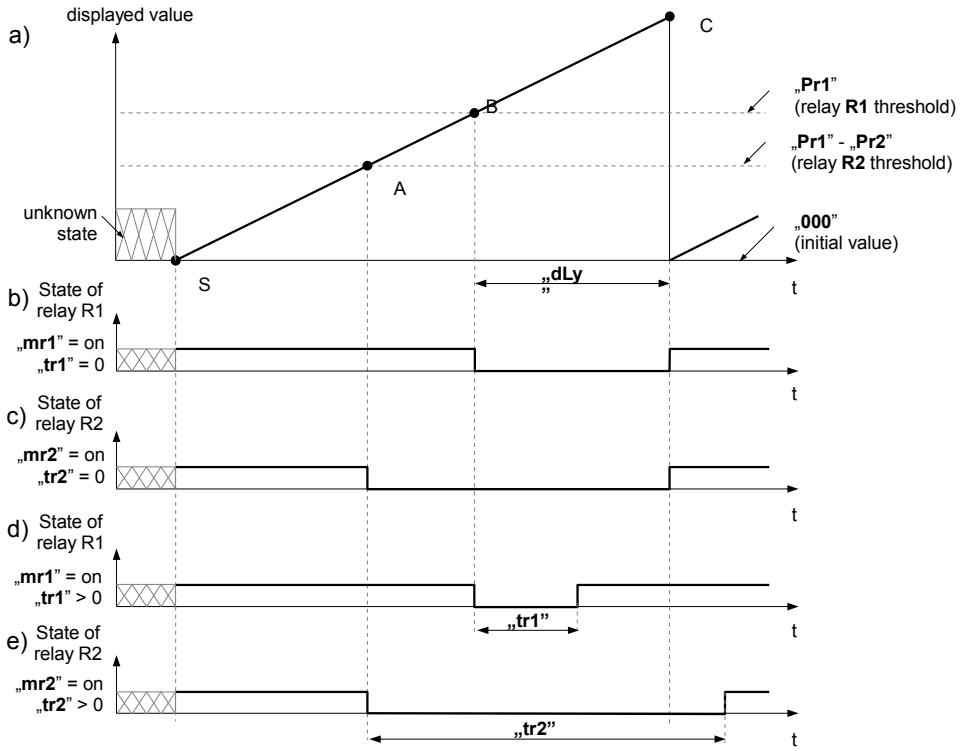
*Figure 6.4 Example of relay outputs driving during upcounting (parameter "**Ar**"="**oFF**")*

After initialisation if counting cycle (point S, plot: a) all relay outputs are set to its ***active*** state.

During controlling cycle relays outputs can change its state to ***inactive,*** **only** after counter reach stored ***threshold value*** (**"Pr1"** for relay **R1** and **("Pr1"** - **"Pr2")** for relay **R2**; points A, B, D, E in Figure 6.4a, Figure 6.5a).

Active state of the relays (**on** or **off**) is defined by parameters **"mr1"**, **"mr2"**. The reaction of the counter when it reaches ***threshold value*** is immediate. Parameters **"tr1"** and **"tr2"** defines how long the relay should stay ***inactive*** after the moment when counter reached the ***threshold value***.

- If parameter **"tr1"** or **"tr2"** is set to **"0"** then related relay stay ***inactive,*** until next initialisation of counting cycle (manual: points C, F in Figure 6.4a, b, c or automatic: point C in Figure 6.5a, b, c).



Description:
S - initialisation of the counting cycle,
A, B - points while counter exceeds selected value,
C - automatic initialisation of counting cycle

*Figure 6.5 Example of relay outputs driving during upcounting (parameter "**Ar**"="**on**")*

- If parameter **"tr1"** or **"tr2"** is set to value greater than **"0"** then related relay stay ***inactive*** during time defined by this parameter (Figure 6.4a, d, e), but no longer than to next manual initialisation of counting cycle (points C, F in Figure 6.4a, d, e). In case when ***AUTORESET*** function is active, particular relay stay inactive during time defined by parameters **"tr1"** or **"tr2"** (Figure 6.5a, d, e) regardless of automatic initialisation of new cycle.

If ***AUTORESET*** is active, then it is possible to add additional delay of automatic initialisation of next cycle (Figure 6.5a) by proper setting of parameter **"dLy"**.

When parameters **"dLy"="0"** and **"tr1"="0"** and ***AUTORESET*** function is active, relay **R1** will not change its state to ***inactive***. If in addition, parameter "**tr2"="0"** and time between exceeding of relays **R2** and **R1** thresholds is shorter than relay reaction delay (t_Z), then **R2** will not change its state to ***inactive***.

Parameters "**mr1**", "**mr2**" can be set to value ***"mb"***, allow controlling of the relays via serial interface. In this case states of relays are completely independent on counter state and its other settings. Change of their state is realised exclusively by writing of their related registers via RS-485 interface (see ***LIST OF REGISTERS***). If parameter "**mr1**" or "**mr2**" is set to *"**on**"* or *"**oFF**"*, writing of those registers has no effect, and reading gets current state of the registers.

If mode "**mb**" is active, then after power up particular relay is **open.** In other modes ("**on**" or "**oFF**") relay will be in its ***inactive*** state.

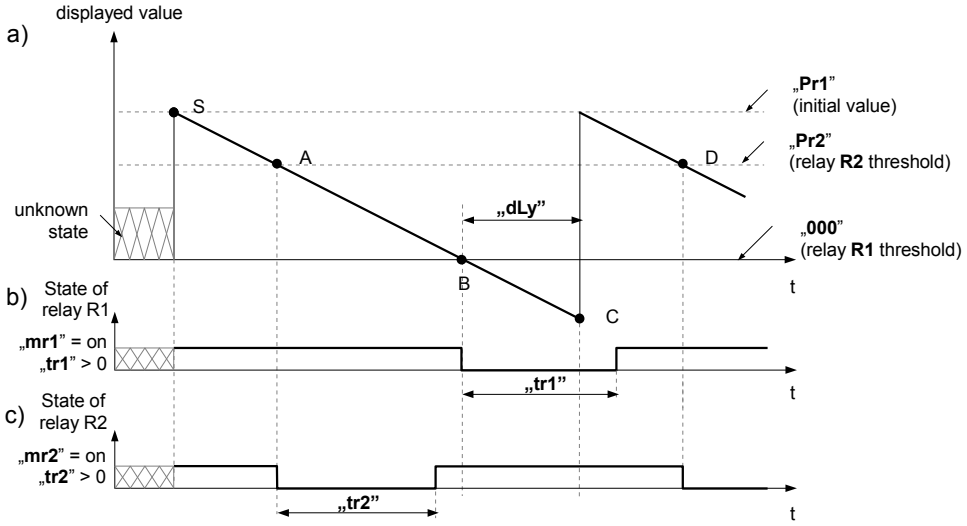
While power down device is storing its counter state, and restores it after power up. The state of cycle realisation is not stored, and after power up it must be initialised by user.

All parameters corresponding to relay outputs are described in details in chapter ***MENU DESCRIPTION***.

6.4.2. Driving of the relays during downcounting

The mode of relays operation while downcounting (parameter **"dir" = "dn"**), with example settings is showed in figure 6.6.

The principle of relays driving is the same as for upcounting, but different are starting value (while initialisation) and relays **thresholds**. Starting value for counting cycle is the value of parameter "**Pr1**" (Figure 6.6a), equal to adjuster (left, green LED display). The **threshold** of **R1** relay is „**000**", and the threshold of relay **R2** is "**Pr2**" (points: A, B, D in Figure 6.6).

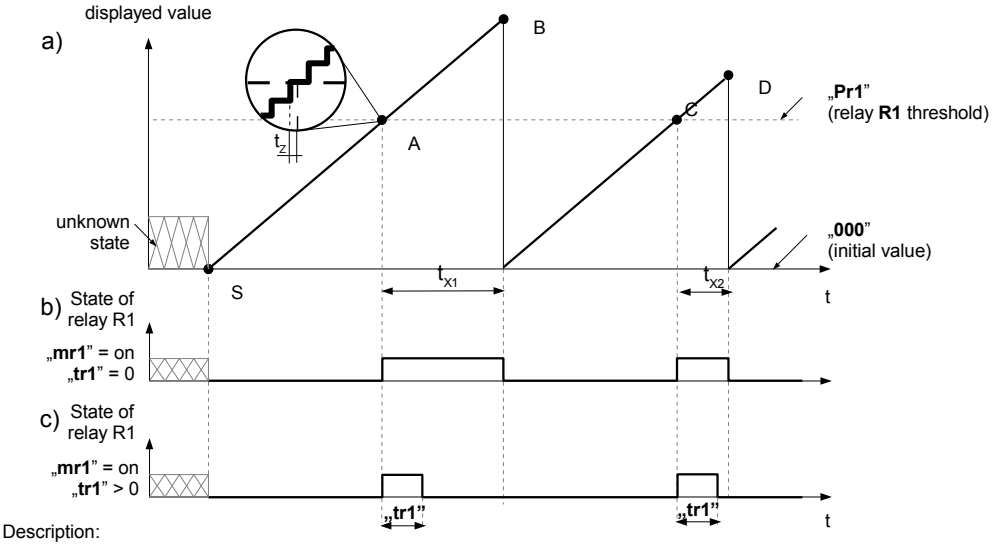


Description:
S - initialisation of the counting cycle,
A, B, D - points while counter exceeds selected value,
C - automatic initialisation of counting cycle

*Figure 6.6 Example of relay outputs driving during downcounting (parameter "**Ar**"="**on**")*

6.5. CONTROL OF THE RELAY OUTPUTS (STANDARD MODE)

In standard mode, only relay R1 is controlled by counter. The principle of control is the same as in batcher mode, so read carefully chapter 6.4. The only difference in controlling of the relay is the interpretation of parameters **"tr1"** and **"mr1"**.
In standard mode, after initialisation of counting cycle (point S, Figure 6.7a) relay output is driven to ***inactive***. During control cycle relay outputs can change its state to ***active*** **only** when the counter reach ***threshold value*** (**"Pr1"** while upcounting, and „**000**" while downcounting). Parameter **"tr1"** defines time during which relay R1 stays ***active*** after counter reach ***threshold value***.



Description:

S	- initialisation of the counting cycle,
A, B, D, E	- points while counter exceeds selected threshold value,
C, F	- manual initialisation of counting cycle
t_{X1}, t_{X2}	- idle time (device is waiting for manual initialisation),
t_z	- delay of relay reaction,

*Figure 6.7 Principle of relay outputs operation (parameter "**Ar**"="**oFF**")*

In standard mode it is possible to set automatic initialisation of the cycle. (parameter "**Ar**"="**on**") with additional delay (parameter "**dLy**">0).

All parameters corresponding to relay outputs are described in details in chapter ***MENU DESCRIPTION***.

7. DEVICE PROGRAMMING

The Menu allows to set all parameters of the device (among others, controlling of relays, source of the cycle initialisation, method of results displaying, access settings). The meaning of parameters is described in chapter ***MENU DESCRIPTION***.

Selected parameters are available without entering the menu. To change value of particular decades use [**^**] buttons, located under left display. To simplify reading of adjuster decimal point on both displays is showed on the same position

The change of the adjuster value while realisation of current cycle, has no influence to stored threshold – the new value is being stored while next initialisation of the cycle (manual or automatic).

7.1. PROGRAMMING MENU

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

If the user password is defined (see parameter **"Cod"**), operator have to enter correct one before proceeding to menu options . Entering of the passwords is being made by changing of particular digits by **[^]** buttons, and accepting of password by **[ENTER/MENU]** button.
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.



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:



Buttons signed **[^]** are used to change value of particular digit (digit above particular button) and change of current menu position. The name of selected option is displayed on the left (green) display. The right (red) display shows current menu name or is dimmed.



Operation of **[ENTER/MENU]** 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,

After pressing of **[ENTER/MENU]** button, name of current menu is scrolled from the left to the right display, and on the left display name of submenu or current value of selected parameter is displayed.



[ESC/RESET] 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 **[^]** buttons and then **[ENTER/MENU].**

Presently edited numerical value, or list-type value flashes on the left (green) display. The right (red) display shows the name of edited parameter at the same time.

7.2.1. Numeric parameters

Numeric parameters constitute a series of digits that form a number in decimal format. Entering a new parameter value consists of changing the values of selected digits within the allowable range (using the **[^]** keys).

7.2.2. 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 **[^]** keys.

Functions of buttons when editing numeric and switching parameters:



Change of digit value referred to particular **[^]** key (numerical values e.g.: parameter **"Adr"**) or state of list-type parameters (e.g.: parameter **"bAu"**).



Press of **[ENTER/MENU]** button causes of display a **"SEt ?"** ask, which allow user to make sure if change of the parameter value is correct. When **[ENTER/MENU]** button is pressed again (while **"SEt ?"** is displayed) the new value of the parameter is stored in EEPROM memory. Next, present parameter value is displayed and edition stops.



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

7.3. MENU DESCRIPTION

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



Due to problem with direct displaying of "**m**" letter, it is exchanged with special sign " ṁ ". Independently in user manual letter „**m**" is used to make it more readable (example: **"mod"**).

7.3.1. "rL1", "rL2" menu

This menu contains options of configuration of operation of relay **R1** and **R2**. Principle of the relay operation is described in paragraph ***CONTROL OF THE RELAY OUTPUTS...***.

"Pr1", "Pr2" - selection of relays thresholds (range 0 ÷ 999).

*a) in standard mode („**mod**" = „**Std**")*

For upcounting relay **R1** is driven to ***active*** state when counter reaches value "**Pr1**", and for downcounting when counter reaches "**000**". Relay R2 is unavailable in standard mode

*b) in batcher mode („**mod**" = „**bAt**")*

While upcounting relay **R1** is driven to its ***inactive*** state when counter reaches "**Pr1**" value, and relay **R2** when counter reaches value ("**Pr1**" - "**Pr2**"). For downcounting relay **R1** is driven to its ***inactive*** state when counter reaches value „**000**", and relay **R2** when counter reaches value "**Pr2**".

"tr1", "tr2" - In standard mode („**mod**" = „**Std**") this is time while relays stay in their ***active*** states, in batcher mode („**mod**" = „**bAt**") this is time while relays stay in their ***inactive*** state.
Available range: "0.0" ÷ "99.9" express time in seconds.
Selection of "0.0" causes holding relays in their states (inactive and active respectively depending on mode) until next initialisation of the cycle.

"mr1", "mr2" - method of relays operation. This parameters defines ***active*** state of the relays. In standard mode („**mod**" = „**Std**") ***active*** state means the state of the relay set after counter reaches selected threshold. In batcher mode („**mod**" = „**bAt**") ***active*** state of the relay is set directly after initialisation of the cycle. There available 4 possibilities:

"noA" - relay is disabled, always open;
"on" - relay is closed in active state;
"oFF" - relay is open in active state;
"mb" - relay is driven via serial RS 485 interface, independently of counter state parameters "**Pr1**", "**Pr2**", "**tr1**" and "**tr2**".

- When contacts of relay are closed, particular LED lights,
- If "**mb**" mode is active then after power up particular relay is open, in other modes ("**on**"and "**oFF**") relay will be set to its ***inactive*** state.

7.3.2. "rES" parameter

This parameter determines the counter zeroing (reset) sources, and can be set to one of the values:

"ALL" - this option enables both manual (using **[ESC/RESET]** button) and electronic reset.

”mAn” - enables manual initialisation of the cycle using button **[ESC/RESET]** on the counter front panel. This operation requires confirmation by **[ENTER]** button. In this mode clearing by control input { **D** } is unavailable;

”EL” - allows activation of additional control input { **D** }. Delivering of active state to this input causes initialisation of the cycle. Active state on this input must stay at least 10 ms. In this mode clearing by **[ESC/RESET]** button is unavailable;

”no” - this option disables both manual and electronic reset.



It is possible to clear the counter via RS-485 interface, by writing value 000h to some registers. This method of clearing is available regardless of selected value of parameter ”**rES**”.

7.3.3. “Ar” parameter

This parameter enables ***AUTORESET***, and allows automatic initialisation of next cycle, loading the starting value to the counter (”**000**” or ”**Pr1**” depending on counting direction). Available settings:

“on” - ***AUTORESET*** function is active,
“oFF” - ***AUTORESET*** function is inactive.



The change of parameters (except **„Pr1”**) causes that next cycle must be initialised by user (even if ***AUTORESET*** function is active).

7.3.4. “dLy” parameter

This parameter allows to add some delay after moment when counter reach threshold value to automatic initialisation of the next cycle while ***AUTORESET*** function is active (***AUTORESET*** = ***”on”***). Parameter is expressed in seconds and can be set in range „0.0” to „99.9”. Detailed description of relays operation principle is showed in chapter ***CONTROL OF THE RELAY OUTPUTS...***.

7.3.5. ”mod” parameter

This parameter defines device principle of operation:

”Std” - the device operates as standard counter, only R1 relay is controlled,
”bAt” - the device operates as a batcher, both relays are controlled

Principle of the relay operation is described in paragraph ***CONTROL OF THE RELAY OUTPUTS...***.

7.3.6. ”dir” parameter

This parameter defines direction of counting, after new cycle initialisation:

”UP” - upcounting , from „**000**”,
”dn” - downcounting, form „**Pr1**”.

7.3.7. "FiL" parameter

This parameter enables the digital filter, which filters the contacts oscillations of switches (mechanical detectors). Digital filter eliminates the counting errors when mechanical detectors are used. This parameter can be set to values: **"OFF"**, **"10"** ÷ **"90",** where its value express the maximum passed frequency, if **"OFF"** is set the filter is disabled (see ***DIGITAL FILTER***, page 18).

7.3.8. "CAL" menu

This menu contains parameters which define method of pulses recalculation and presentation.

"muL" - internal multiplier, range: 1 to 999.

"div" - internal divider, range: 1 to 999 (this is internal modulo N counter, it means counter which counts from 0 to selected value, and after that turns to 0 and counts again),

The displayed value is calculated according to formula:

$$D_{UP} = integer\ part\ of\ \left(\frac{A_{pulses}}{"div"} \times "mUL" \right)$$

$$D_{DN} = round\ up\ of\ \left(\left[integer\ part\ of\ \left(\frac{"Pr1"}{"muL"} \times "div" \right) - A_{pulses} \right] \times \frac{"muL"}{"div"} \right)$$

where: D_{UP} - displayed result while counting UP,
D_{DN} - displayed result while counting DOWN,
A_{pulses} - number of pulses from counting input { **A** }.

"Pnt" - decimal point position. It changes decimal point position on both displays

7.3.9. "rS" menu

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

"Adr" - 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).

"bAu" - 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"**, which respond to the baud rates of 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 bit/s respectively.

”Acc” - 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.

”tim” - this parameter defines maximal time (sec) between following frames received by the device. If the delay will be greater than the value of **”tim”** parameter, the relays which are controlled via RS-485 interface, will set to alert state (see ***“rL1” menu*** description). Parameter “**tim**” can be set to values from 0 to 99 seconds. The value 0 means that the time will be not controlled.

”dLy” - 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

” 10”
” 20”
” 50”
”100”
”200” } - 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 **”dLy”** should be set to **”Std”** (no additional delay). Unfortunately for some third party RS-converters **”dLy”** should be adjusted experimentally. Table 7.1 contains most frequently used values.

”bAu” parameter	“38.4”	“57.6”	“115”
”*dLy*” parameter	“ 10”	“ 20”	“ 50”

Tab.7.1. *Settings of ”*dLy*” parameter*

7.3.10. ”bri” parameter

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

7.3.11. ”SEc” menu

This menu contains presets connected with availability of other parameters:

“Cod” - 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”.

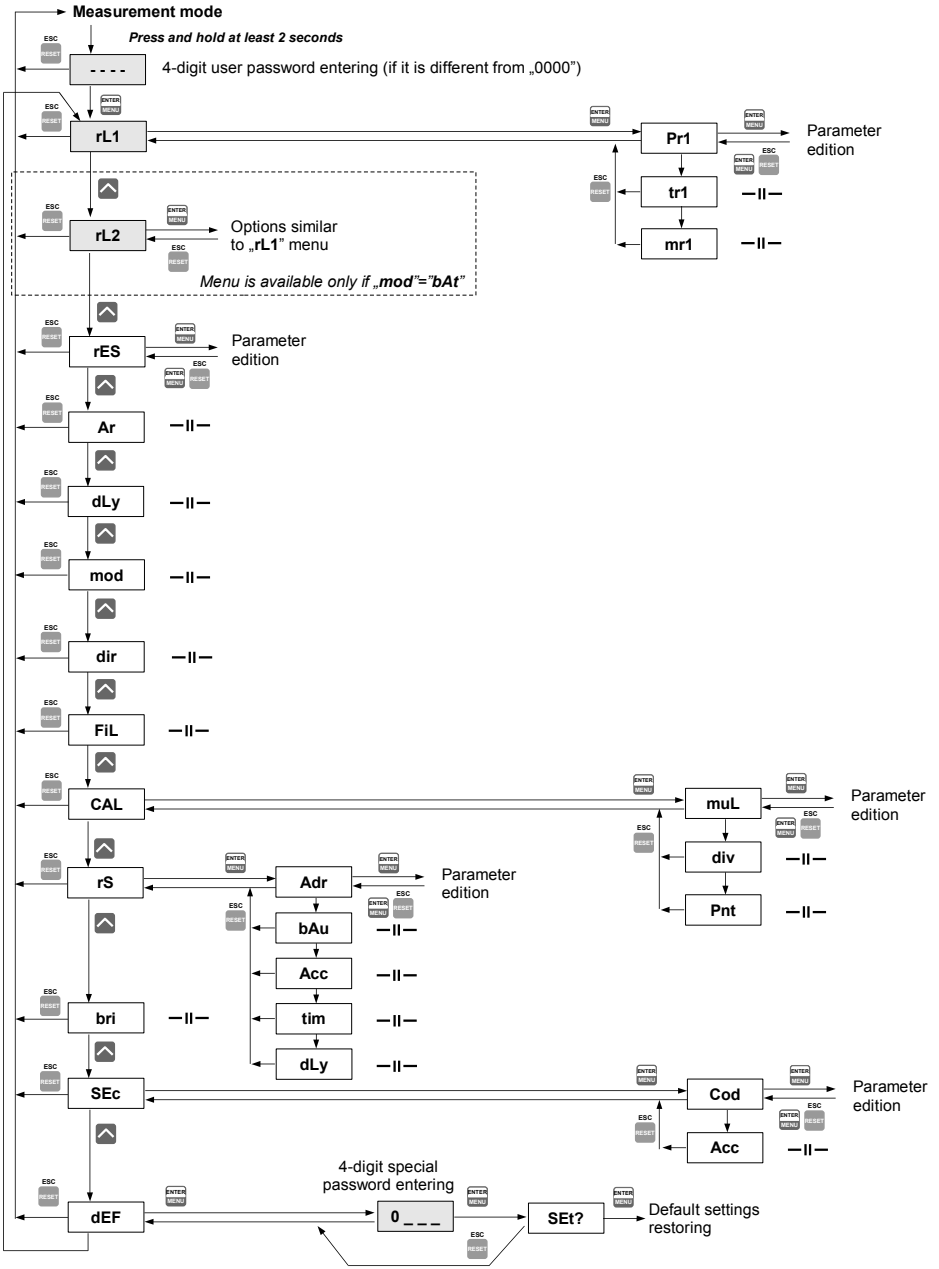
The “one-use password” can be used **ONE TIME ONLY**, it is impossible to use it again! The “one-use password” can be restored by Service Division only.

“Acc” - this option permits user (**”on”**) or prohibits (**”oFF”**) to modify the thresholds of the relay R1 without knowledge about user password.

7.3.12. ”dEF” 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.

7.4. MENU STRUCTURE



8. EXAMPLES OF PRESCALER PARAMETERS CALCULATION

Problem: to measure length of the line with assumed precision.
Essential data:- number of pulses per revolution given by sensor
- circumference of measurement circle
- assumed measurement resolution

Example 1

Data:
- circumference of measurement circle: **25** cm
- number of pulses: **100** pulses/revolution
- resolution **1 cm**

25 cm = 1 revolution = 100 pulses
it means 1 cm=4 pulses

Settings :
mul="1"
div = "4"
decimal point = "0."
Obtained range of measured distances 1 cm to 10 m.

Example 2

Data:
- circumference of measurement circle: **10** cm
- number of pulses: **100** pulses/revolution
- resolution **10 cm**

10 cm = 1 revolution = 100 pulses

Settings:
mul="1"
div = "100"
decimal point = "0.0"
Obtained range of measured distances 10 cm to 100 m.

Example 3 - counter **SLN-94** used in batcher function (see: Figure 6.1, 6.2)
Data:
– flow meter: **100** pulses / L
– main valve flow (valve 1): about **10** L / sec.
– additional valve flow (valve 2): about **1** L / sec.
– measurement precision: up to **0,1** L.
– valves are open while relays are closed

Settings:
mul="1"
div = "10"
decimal point = "0.0"
Pr2 = "1.0" - control advance (main valve will be closed when counter reach **Pr1**-**Pr2**)
Pr1 - desired volume of medium

"mod" = ***" bat"*** - batcher mode
„dir" = ***„UP"*** - upcounting – counter shows current volume of medium

Pouring starts after pressing of external button [**START pouring**] (Figure 6.2).

Principle of operation of batcher function from example 3

After press of [**START pouring**] button (Figure 6.2) value "0" is showed on the display. It causes of closing of both relays (only if **Pr1 > Pr2** – both valves are opened). Flow meter generates pulses delivered to counting input { **A** }, so counter increases it's value. When counter up counts over **Pr1-Pr2** value, then relay **R2** will be opened – main valve will start to close itself. Pouring is being continued, via additional valve. When counter reach **Pr1** threshold value, relay **R1** will be opened – additional valve will be closed. Pouring is finished.

Next pouring cycle can be initiated by [**START pouring**] button.

9. 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 can not exceeds 16 registers (for single frame).

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

9.1. LIST OF REGISTERS

Register	*Write*	*Range*	*Register description*
01h	No	depending on settings	Display value - higher word.
02h	No		Display value - lower word.
03h	No	see descr.	The status of the displayed value: **0000h** - data valid, **0080h** - overflow **0040h** - underflow
04h[2]	Yes	see descr.	State of precounter - this is internal modulo **N** counter, where **N = "div"**, overfill of this counter causes increasing/decreasing of main counter.
05h[2]	Yes	see descr.	Main counter value - high word
06h[2]	Yes	see descr.	Main counter value - low word.
07h[3]	Yes	see descr.	**"Pr1"** parameter in **"rL1"** menu (higher word).
08h[3]	Yes	see descr.	**"Pr1"** parameter in **"rL1"** menu (lower word). Cumulative value of registers 07h i 08h: from 0 to 999

Register	*Write*	*Range*	*Register description*
09h	Yes	see descr.	**High byte** - **"mr1"** parameter in **"rL1"** menu (operation mode of R1 relay); **0** - mode **"noA"**; **1** - mode **"on"**; **2** - mode **"oFF"**; **3** - mode **"mb"** **Low byte** - state of relay R1 when **"mb"** mode is selected **00h** - relay turn off; **FFh** - relay turn on regardless of **"tr1"** parameter value
0Ah	Yes	0 ÷ 999	**"tr1"** parameter in **"rL1"** menu (the time period of the relay ***active state***, range 0÷999 x 0.1 sec.);
0Bh[3]	Yes	see descr.	**"Pr2"** parameter in **"rL2"** menu (higher word).
0Ch[3]	Yes	see descr.	**"Pr2"** parameter in **"rL2"** menu (lower word). Cumulative value of registers 0Bh i 0Ch: from 0 to 999
0Dh	Yes	see descr.	**High byte** - **"mr2"** parameter in **"rL2"** menu (operation mode of R2 relay); **0** - mode **"noA"**; **1** - mode **"on"**; **2** - mode **"oFF"**; **3** - mode **"mb"** **Low byte** - state of relay R2 when **"mb"** mode is selected **00h** - relay turn off; **FFh** - relay turn on regardless of **"tr2"** parameter value
0Eh	Yes	0 ÷ 999	**"tr2"** parameter in **"rL2"** menu (the time period of the relay ***active state***, range 0÷999 x 0.1 sec.);
17h	Yes	see descr.	**High byte** - **"Ar"** option (main counter autoreset): **0** - **"on"**, enabled **1** - **"oFF"**, autoreset disabled **Low byte** - **"rES"** option (main counter reset source): **0** - mode **"ALL"**; **1** - mode **"EL"**, reset with { **D** } input and RS-485 interface; **2** - mode **"mAn"**, reset with **[ESC/RESET]** button and RS-485 interface; **3** - mode **"no"**, reset with RS-485 interface only.
18h	Yes	0 ÷ 999	**"dLy"** parameter (automatic initialisation delay, range 0÷999 x 0.1 sec.),
19h	Yes	see descr.	**High byte** - **"mod"** parameter (operation mode); **0 - "Std"**, standard mode (one relay) **1 - "bAt"**, batcher mode (two relay) **Low byte** - **"dir"** parameter (counter direction): **0** - mode **"UP"**, **1** - mode **"dn"**
1A	Yes	see descr.	**High byte** - read as 0 **Low byte** - **"FiL"** option (filtering rate): **00** - for input signal up to 10kHz frequency; **10** - up to 10Hz; **20** - up to 20Hz; **30** - up to 30Hz; **40** - up to 40Hz; **50** - up to 50Hz; **60** - up to 60Hz; **70** - up to 70Hz; **80** - up to 80Hz; **90** - up to 90Hz;

Register	*Write*	*Range*	*Register description*
1Bh	Yes	1 ÷ 999	**"div"** parameter in **"CAL"** menu (input divider, precounter); content of main counter is incremented by 1 every **n** pulses on input { A}, where **n** is content of register 1Bh
1Ch	Yes	1 ÷ 999	**"muL"** parameter in **"CAL"** menu (input multiplier);
1Eh	Yes	0 ÷ 2	"**Pnt** " parameter in "**CAL**" menu (decimal point position) **0** - " 0"; **1** - " 0.0"; **2** - " 0.00"
1Fh	Yes	1 ÷ 8	"**bri**" parameter (display brightness); **1** - the lowest brightness; **8** - the highest brightness
20h[4]	Yes	0 ÷ 199	Device address.
21h	No	20C8h	Device identification code (ID)
22h[5]	Yes	0 ÷ 7	**"bAu"** parameter in **"rS"** 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[6]	Yes	0 ÷ 1	**"Acc"** parameter in **"rS"** menu (permission to write registers via RS-485 interface); **0** - write denied ; **1** - write allowed
24h	Yes	see descr.	"**Acc**" parameter of "**SEc**" menu (binary format (0 - „**oFF**", 1 - „**on**")
25h	Yes	0 ÷ 5	**"dLy"** parameter in **"rS"** menu (additional response delay); **0** - no additional delay; **1** - "**10**" option; **2** - "**20**" option; **3** - "**50**" option; **4** - "**100**" option; **5** - "**200**" option;
27h	Yes	0 ÷ 99	**"tim"** parameter in **"rS"** menu (maximum delay between received frames); **0** - no delay checking; **1 ÷ 99** - maximum delay expressed in seconds

1 - if overflow or underflow occurs (**"-Hi-"** or **"-Lo-"**), read of registers 01h and 02h (single registers) gets suitable error code (exception code)

2 - Preset of 0000h to these registers (04h, 05h and 06h) causes reset and start new cycle. Preset of 0001h to these registers causes resume of paused cycle. Preset of 0002h to these registers causes to pause current cycle.

3 - Numbers written to holding registers of relays thresholds are interrelated with each other auto-correction. For example. Preset to reg. 08h (threshold lower word) of value, which together with content of register 07h (threshold higher word) gets value from behind of allowable range, will fails. Over more preset to reg 07h of value which together with content of register 08h gets value from behind of allowable range, will modify the content of register 08h, in that way to it's value together with register 07h be located in allowable range. If appropriate modification is impossible, write fails.
It is recommended to write threshold values in presented manner: first preset of threshold higher word, and next threshold lower word.

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

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

6 - the value of the "**Acc**" 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.

9.2. 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.

Error codes:
01h - illegal function (only functions 03h, 06h and 10h are available),
02h - illegal register address
03h - illegal data value

9.3. 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 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	C8	A0	12

DATA - identification code (20C8h)

2. 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

3. 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.

4. Read of the displayed value (higher word):

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

a) Response, while normal operation (no errors):

ADDR	FUNC	BYTE C	DATA H,L		CRC L,H	
01	03	02	00	00	B8	4C

DATA H, L - higher word of displayed value = 00

b) The answer (if counting error occur):

ADDR	FUNC	ERROR	CRC L,H	
01	83	80	40	90

ERROR - error code = 80h, overload

5. Read of the displayed value (high and low word),

ADDR	FUNC	REG H,L		COUNT H,L		CRC L,H	
01	03	00	01	00	02	95	CB

Response, while normal operation (no errors):

ADDR	FUNC	BYTE C	DATA H1,L1		DATA H2,L2		CRC L,H	
01	03	04	00	00	00	57	BB	CD

DATA - 00000057h = 87, displayed value = 87

6. Preset of relay: ”mr1”=“oFF”

ADDR	FUNC	REG H,L		DATA H,L		CRC L,H	
01	06	00	09	01	00	58	58

The answer (the same as the message):

ADDR	FUNC	REG H,L		DATA H,L		CRC L,H	
01	06	00	09	01	00	58	58

7. Preset of relay : ”mr1”=“mb”, turn relay on

ADDR	FUNC	REG H,L		DATA H,L		CRC L,H	
01	06	00	09	02	FF	18	E8

The answer (the same as the message):

ADDR	FUNC	REG H,L		DATA H,L		CRC L,H	
01	06	00	09	02	FF	18	E8

After this command relay will be set to external control (via RS-485), and will be closed

8. Try to write illegal data value into baud rate register

ADDR	FUNC	REG H,L		DATA H,L		CRC L,H	
01	06	00	22	00	09	E9	C6

DATA L = 9 - value exceeds allowable range (0÷7)

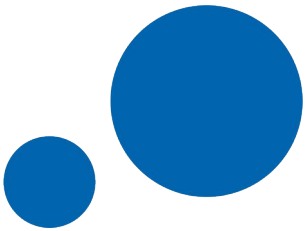
The answer (exception code 03h - illegal data value):

ADDR	FUNC	ERR	CRC L,H	
01	86	03	02	61

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

10. DEFAULT AND USER'S SETTINGS LIST

Parameter	*Description*	*Default value*	*User's value*	*Desc. page*
Parameters of relay R1 operation (“r1” menu)				
Pr1	Relay threshold	100		27
tr1	The time period of the relay *active state*	0		27
mr1	Operation mode of relay	on		27
Parameters of relay R2 operation (“r2” menu)				
Pr2	Relay threshold	20		27
tr2	The time period of the relay *active state*	0		27
mr2	Operation mode of relay	on		27
Settings of control mode, zeroing, filtering, and counting direction				
rES	Clearing (zeroing) source of main counter	ALL		27
Ar	Autoreset function	oFF		28
dLy	Automatic initialisation delay	1.0		28
mod	Device control mode	Std		28
dir	Counting direction	UP		28
FiL	Filtering ratio	0		29
Prescaler settings (”CAL” menu)				
muL	multiplier	1		29
div	divider	10		29
Pnt	Decimal point position	0.00		29
RS 485 interface configuration (“rS” menu)				
Adr	Device address	1		29
bAu	Baud rate	9.6		29
Acc	Permission to changes of configuration registers	on		30
tim	Maximum delay between received messages	0		30
dLy	Additional delay of answer transmission	Std		30
Display parameters				
bri	Display brightness	6		30



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