

User manual FLOW METER SPI-94

- Firmware: v.6.01 or higher
- Input type: pulse
- Batching and totalizer function



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.**



- 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

Main task of **SPI-94** is measurement of instantaneous flow (flow rate), and counting of total flow (e.g. passage of fluid or gas), The device can be used as regulator, to control industrial process.

Measurement of instantaneous flow can be indicated in range: 0 to 999999 (plus decimal point) and can be expressed in any scalable user units of flow and three time measures (second, minute, hour). Total flow can be indicated in range from 0.000 to 4294967295 user units with maximum resolution of 0.001 units. Device can operate with different flow sensors, acceptable flow factors of sensors from 0.01 to 10000.00 pulses per unit (with resolution 0.01 pulses/unit), additionally these flow sensors can be equipped with either electronic (open collector) or contact output.

Sensors can be powered from sensor supply output (stabilized, 24VDC +5%, - 10%, 100mA). The device can be equipped with two or four relay (or OC type) outputs, which can be driven due to instantaneous flow, total flow or batcher counter value. Optionally **SPI-94** with two relays outputs (or OC-type outputs) can be equipped with active current output, passive isolated current output or active voltage output. Build in RS 485 interface enables access to all internal registers, and supports MODBUS RTU communication protocol. The controller can be ordered in two power supply versions.

Modern design guarantees high operational reliability. Front panel is protected from dust and water spatters.

Additional features:

- settable width of measurement window (from 0.1 to 39.9 seconds),
- direct access to relays thresholds settings, without password,
- alarm pre-set; alarm signal is released when measurement exceeds measurement range,
- batcher mode.

Flow counters **SPI-94** can operate with flow sensors like **M1RSP**, equipped with contactron output.

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. 6.5 VA @ 85 ÷ 260V AC/DC max. 6.5 VA @ 16V ÷ 35V AC max. 6.5 W @ 19V ÷ 50V DC

Flow meter inputs:	fully Isolated
pulse input:	counting input with denouncing filter and pulse width control, max. input frequency 10.0 kHz (terminal no. 16)
counting blockade:	active edge or level (terminal no. 17)
zeroing of total counter:	active edge or level (terminal no. 18)
zeroing of batcher counter:	active edge or level (terminal no. 19)
COM:	common (terminal no. 20)
Input levels	
low level:	0V ÷ 1V
high level:	10V ÷ 30V (about. 12 mA @ 24V)
Time between following pulses	settable from 0.1 to 39.9 sec.

Sensor power supply output	24V +5%, -10% / max. 100 mA, stabilized
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Relay output	0, 2 or 4 NO 1A/250V AC (cos φ = 1)
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OC-type output	0, 2 or 4; 30mA / 30VDC / 100mW
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Active current output	range max. 0 ÷ 24 mA
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(optional, for two relays or two OC-type output version only)

Load resistance max.	700 Ω
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Passive isolated current output	range max. 2.8 ÷ 24 mA
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(optional, for two relays or two 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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Active voltage output (optional, for two relays or two OC-type output version only)	range max. 0 ÷ 11V
Load resistance min.	2000 Ω
Instantaneous flow range	0 ÷ 999999, plus decimal point
Frequency measurement accuracy	± 0.02% (full temperature range)
Precision of flow readout	equivalent to used flow sensor precision
Instantaneous flow precision	Selected from range: 0 ÷ 0.00000
Instantaneous flow unit	User unit per min. or sec. or hour
Total flow range	over 4 x 10 ⁹ units (max. 16 digits)
Total flow precision	Selected from range: 0 ÷ 0.000
Total flow unit	Any, with precision, settable by user
Batcher counter range	65536 units
Batcher counter precision	Selected from range: 0 ÷ 0,000
Batcher counter unit	Any, with precision, settable by user
Number of batches counter range	0 ÷ 999999
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 65 optional version with panel cut-out sealing available
Terminals protection	IP 20
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 cross section	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: >20M Ω 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 equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

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 4.2**).

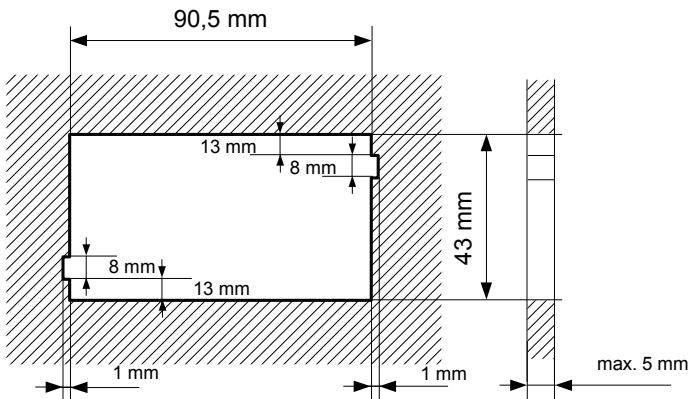


Figure 4.1. Recommended mounting hole dimensions

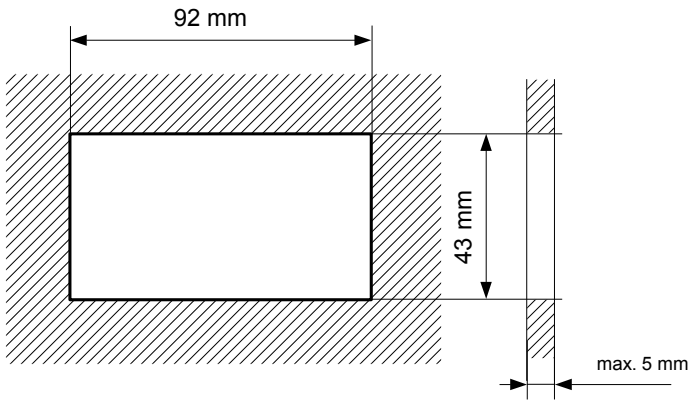


Figure 4.2. Allowable mounting hole dimensions

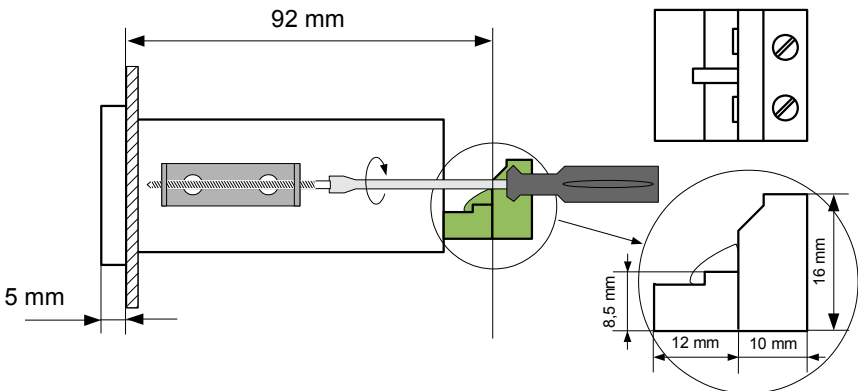


Figure 4.3. Installing of brackets, and dimensions of connectors.

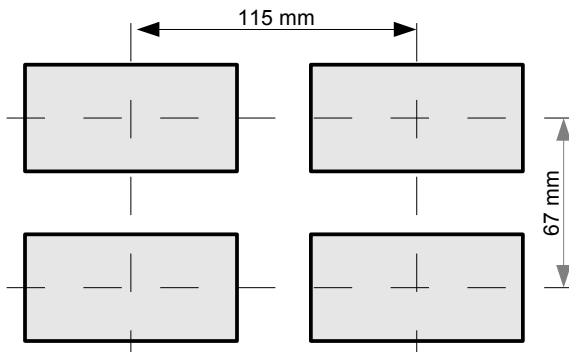


Figure 4.4. Minimum distances when assembly of a number of units

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.

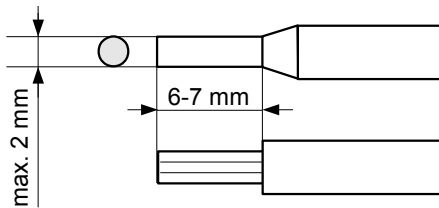


Figure 4.5. Method of cable insulation replacing and cable terminals



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.

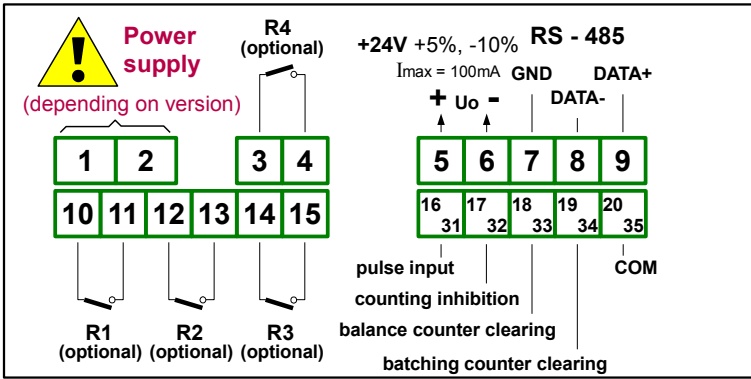


Figure 4.6. Terminals description (relay outputs)

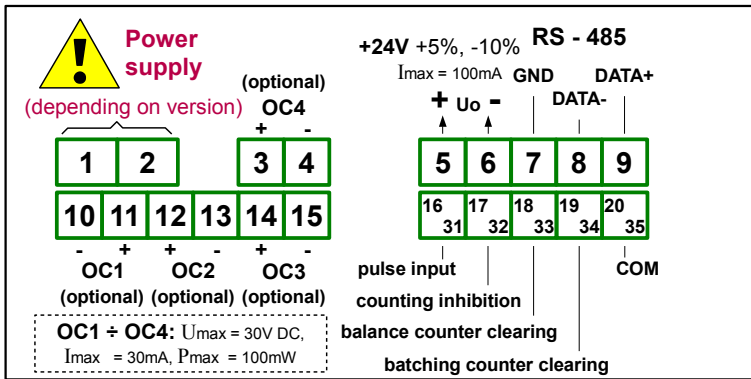


Figure 4.7. Terminals description (OC-type outputs)

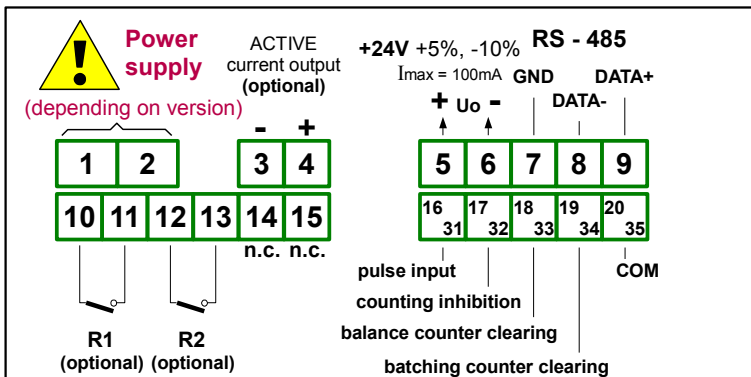


Figure 4.8. Terminals description (relay and active current outputs)

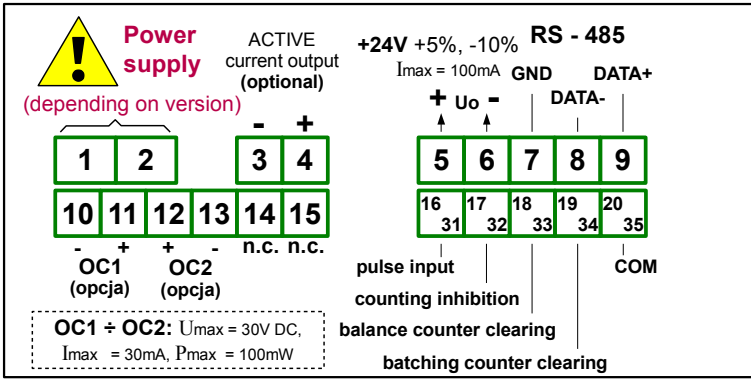


Figure 4.9. Terminals description (OC-type and active current outputs)

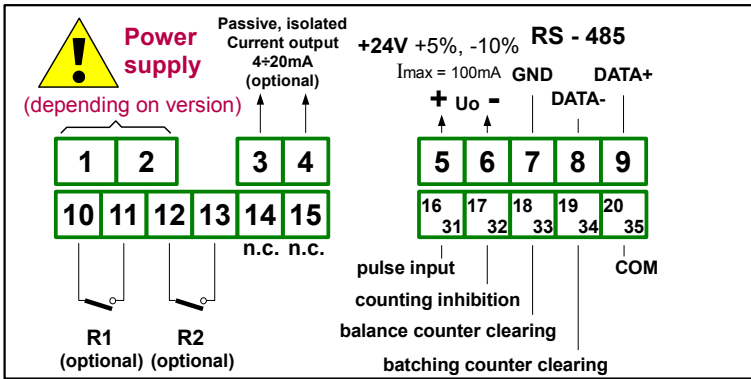


Figure 4.10. Terminals description (relay and passive current outputs)

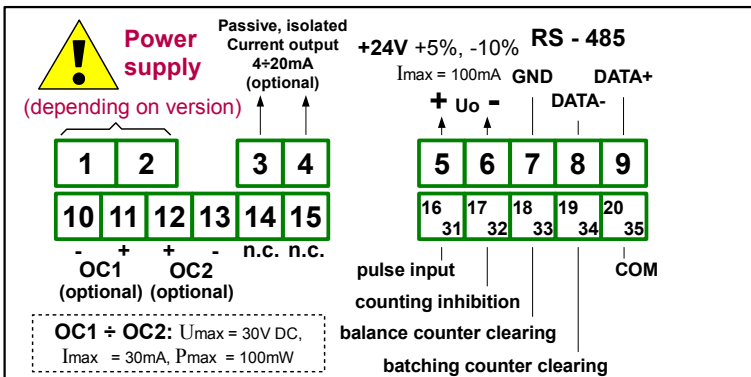


Figure 4.11. Terminals description (OC-type and passive current outputs)

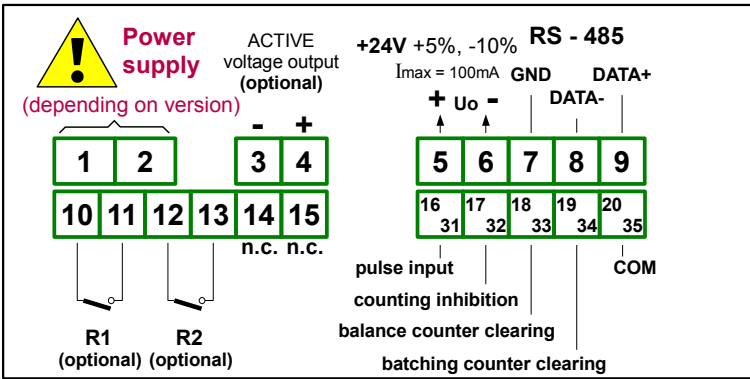


Figure 4.12. Terminals description (relay and active voltage outputs)

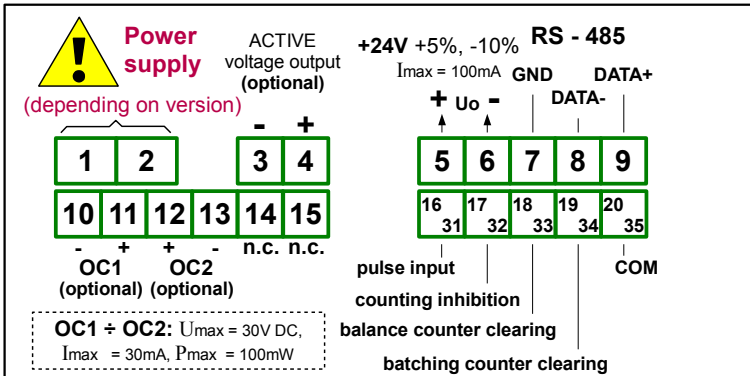


Figure 4.13. Terminals description (OC-type and active voltage outputs)

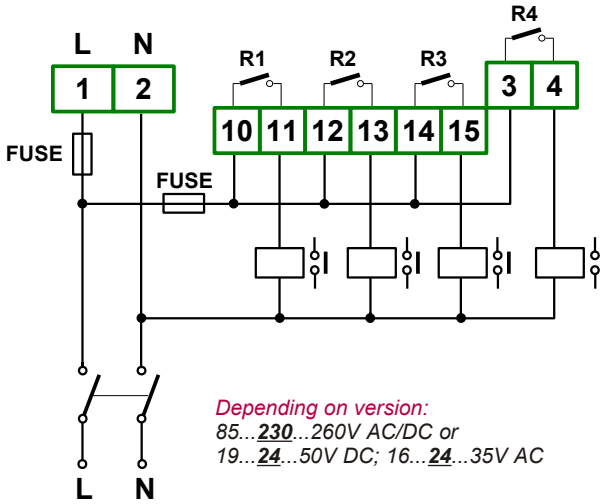


Figure 4.14. Connection of power supply and relays



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.

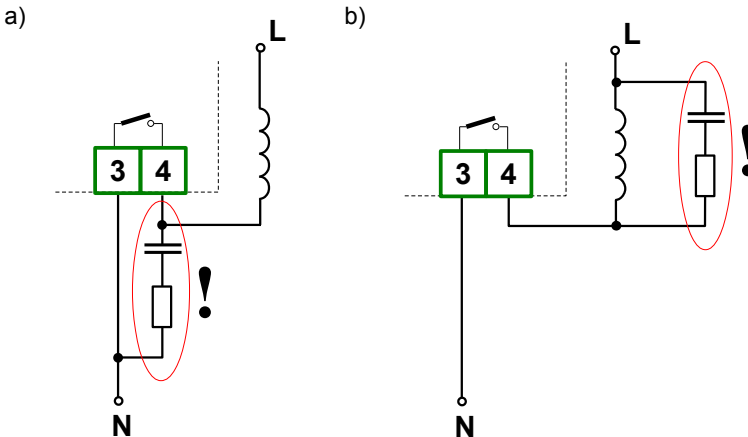


Figure 4.15. Examples of suppression circuit connection:
a) to relay terminals; b) to the inductive load

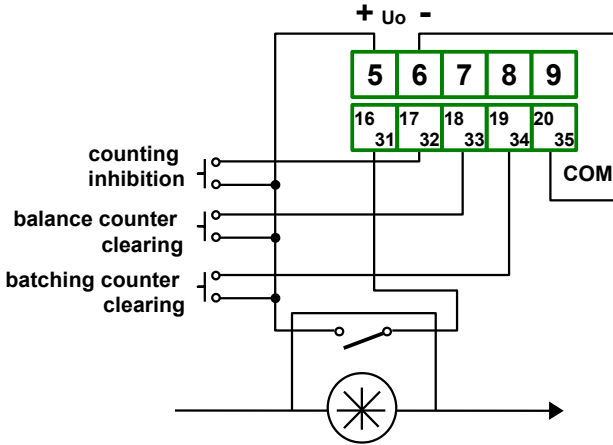


Figure 4.16. Example of connection between flow counter and flow sensor with contactron output

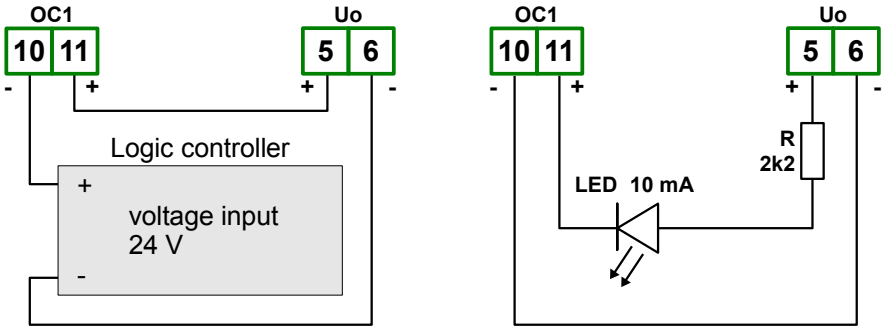


Figure 4.17. Example of OC-type outputs connection

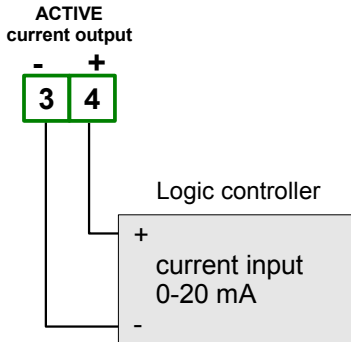


Figure 4.18. Example of active current outputs connection (for device with active current output only)

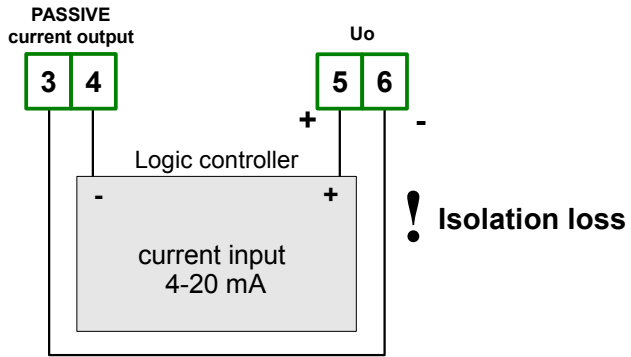


Figure 4.19. Example of passive current outputs connection (for device with passive current output only)

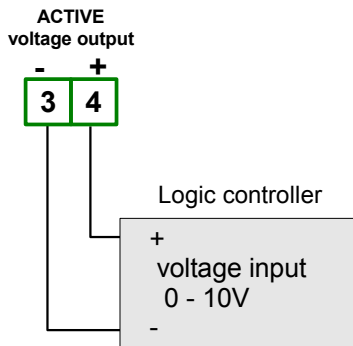


Figure 4.20. Example of active voltage outputs connection (for device with active voltage output only)

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.

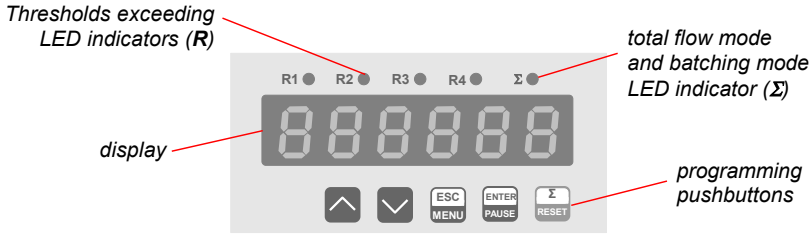


Using any other agents can cause permanent damage to the housing.



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



or



Symbol used in the manual: **[ENTER]** or **[PAUSE]**

Functions:

- Start to edit the parameter
- Enter to the sub-menu,
- Confirmation of changes made in parameter being edited
- While batcher mode: pause/start batching.



Symbol used in the manual: **[^]** **[v]**

Functions:

- Change of the present menu,
- Modification of the parameter value,
- Switching of the display between relay thresholds and number of batches counter



or



Symbol used in the manual: **[Σ]** or **[RESET]**

Functions:

- Switching of the display between total and instantaneous measurements or batcher counter (while batcher mode only)
- Zeroing the currently displayed counter (press and hold by at least 2 sec.), the zeroing must be confirmed by **[ENTER]** button.

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 measure mode, device displays instantaneous measurement (flow value or time per one unit of flow, depending on „**F or P**” parameter value) equivalent to quantity of input pulses, total flow or batcher counter value.

Displayed value presentation is defined by parameters “**F unit**”, “**t unit**” and “**b unit**” with resolution defined by parameters “**F PrEc**”, “**t PrEc**” and “**b PrEc**”.

... 879 876	543 . 219
"F unit"	"F PrEc"

... 876	543 . 219
"F unit"	"F PrEc"

Instantaneous flow (flow rate) is displayed in units defined by parameter “**F unit**” and “**Ftunit**” (min., sec. or h), with resolution defined by “**F PrEc**” (max. 5 digits after decimal point). Pulses delivered to device's input (Figure 4.16) are recalculated according with procedure showed below:



- if duration of low or high level (between pulses) is lower than time defined by parameter “**FrEq**” (see Tab.7.1 page 34), these pulses are recognized as noise (or bouncing) and will be ignored
- if duration of both levels are in acceptable range, but input frequency is higher than defined by parameter “**FrEq**”, device goes to alarming state - relays and current output are switched to their alarm states defined by parameters “**ALArMS**” of particular menus. In alarm state flow counter displays “**-Hi-**” message, in place of flow result.
- In all other cases (while frequency and pulses duty cycle gets acceptable values) input pulses are delivered to internal prescaler. The prescaler (see description of parameter “**PULSEL**”) should be set to value equal to the quantity of pulses per unit.

Frequency after prescaler is recalculated accordingly to user defined unit (parameters “**F unit**” and “**Ftunit**”), and after that final flow value in units or thousands of units (e.g. litres or cubic meters) per hour, minute or second is obtained. This result is displayed on the display and is used to determine states of relays and current output, additionally the result is accessible via RS 485 interface as a set of holding registers.





- If input frequency is in acceptable range but result is longer than 6 digits, warning message “**-Ov-**” is displayed in place of the result. In that case parameters “**F unit**”, “**Ftunit**” and “**F PrEc**” should be corrected to obtain proper result.
- While time per one unit of flow is displayed (parameter “**F or P**” = “**PERiod**”):
 - If flow value equals 0, then 0 value 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 flow value 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.


Total flow is displayed in units defined by parameter “**t unit**” with resolution defined by parameter “**t PrEc**” (max 3 digits after decimal point). If total flow counter overflows, warning “**tot ov**” is displayed alternatively with maximum counter value. Total flow counter can be zeroed using “**Clrtot**” option of “**totAL**” submenu, using [Σ] button (press and hold by at least 2 sec.), electrically via *total flow clearing input* or via RS-485 interface by writing of value 0000h to any of total flow counter result registers.

-  Zeroing by [Σ] button can be activated using „**m CLr**” option of “**totAL**” submenu.
-  Zeroing via *total flow clearing input* can be activated using „**E CLr**” option of “**totAL**” submenu (see page 39).


Batching counter value is displayed in units defined by parameter “**b unit**” with resolution defined by parameter “**b PrEc**” (max 3 digits after decimal point). If batcher counter overflows, warning “**bAt ov**” is displayed alternatively with maximum counter value. Batching counter can be zeroed using “**CLrbAt**” option of “**bAtCH**” submenu, using [Σ] button (press and hold by at least 2 sec.), electrically via *batcher clearing input* or via RS-485 interface by writing of value 0000h to any of batcher counter result registers.

-  Zeroing by [Σ] button can be activated using „**m CLr**” option of “**bAtCH**” submenu.
-  Zeroing via *batcher clearing input* can be activated using „**E CLr**” option of “**bAtCH**” submenu (see page 37).

Switching between current flow rate, total flow counter and batcher counter can be done by pressing [Σ] button. Kind of displayed value is signalised by “Σ” LED. It lights, while total flow is displayed. If batcher counter is displayed then “Σ” LED is pulsing.

-  Batching counter can be displayed while batcher mode only (set „**Source**”=“**bAt**” in „**rELAy1**” submenu).

Functions of [^] and [v] buttons depend on kind of presently displayed value:

- If instantaneous flow (flow rate) is displayed (LED marked “Σ” is off) or batcher counter value (“Σ” LED is pulsing), user can check main threshold values and *number of batches counter* (which indicates how many times batcher was started). After pressing [^] or [v] buttons, name of the threshold (e.g. “**rELPr1**”) and its value or “**bAtCnt**” label and *number of batches counter* 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**). Using [Σ] button while *number of batches counter* is displayed and confirm „**CLEAr?**” message by [ENTER] button causes zeroing *number of batches counter*.
-  • 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.
- *Number of batches counter* is incremented after each start of batching process (every first start after batcher counter zeroing).

- If batcher counter value is displayed (“Σ” LED is pulsing) and counter value exceeds 6 digits, then decimal point of the most left digit is pulsing. To view most significant digits, it is required to decrease resolution or/and change unit.
- If total flow counter value is displayed (LED marked “Σ” is on), and its length exceeds 6 digits, buttons [^] and [v] enable switching between more and less significant digits. Positions of currently displayed digits are signaled by flashing decimal points (see example below).

Example of switching between less and more significant digits of total flow result .

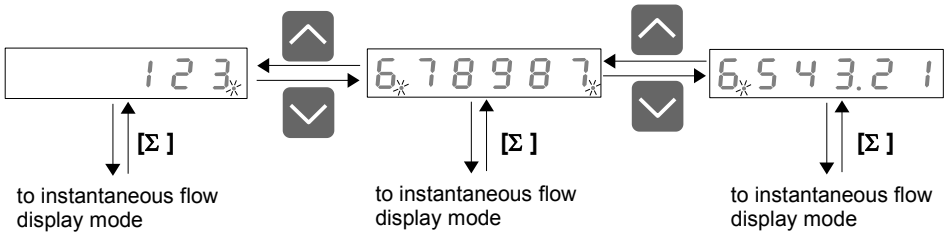


Figure 6.1. Switching between digits (screens) of total flow result.

Let, total counter result be equal 1236789876543.21:

- while less significant 6 digits are displayed, flashing most left decimal point signals that result is longer than 6 digits, to show more significant digits press [^],
- while medium digits are displayed both most left and most right decimal points are flashing (Figure 6.1). Most right decimal point signals that result has less significant digits – to see these digits press [v] button. Most left decimal point signals additional more significant digits. Press [^] button to see these digits.
- while most significant digits are displayed, most right decimal point is flashing, and signalling that result has less significant digits, to see these digits press [v].

All accessible parameters (e.g. pulse input settings, decimal point position) 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).



Counting of pulses and controlling or relays is realised regardless of operation mode (after entering to menu mode counting and controlling is continued in “background”).

6.2. DETECTION OF THE PEAK VALUES

The **SPI-94** flow meter 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 6.2). 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 signalized 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**).

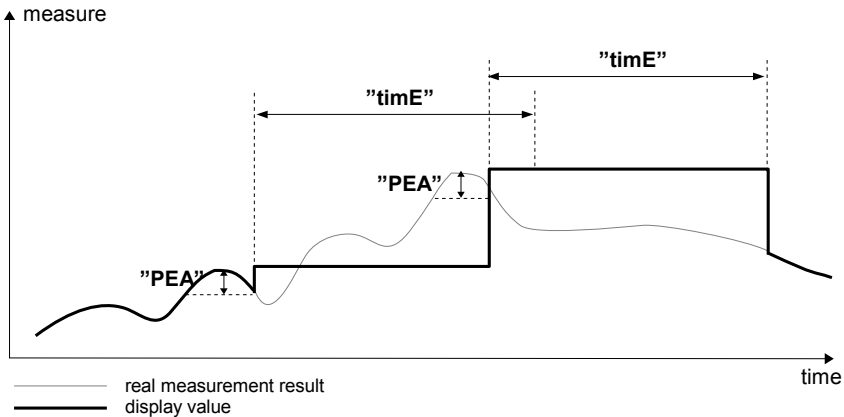


Figure 6.2. Process of peaks detection

6.3. CONTROL OF THE RELAY OUTPUTS

The control of the object (measured signal) is done due to instantaneous flow value (current flow rate), total flow counter value or batcher counter value, and 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 “**SourCE**”, “**SEt P**”, “**SEt P2**”, “**HYSt**”, “**modE**”, “**t on**”, “**t oFF**”, “**unit**” and “**ALArMS**” (available in “**rELAY1**” ÷ “**rELAY4**” menu). If relay is controlled due to total flow counter value (“**SourCE**” = “**tot**”), additional parameters are available in menu. Parameters “**t PrEC**” and “**t unit**” define the unit and resolution of displayed thresholds and hysteresis of selected relay. If relay is controlled due to batcher counter value (“**SourCE**” = “**bAt**”), in addition “**b PrEC**”, “**b coEF**” and “**b unit**” parameters are available in menu but parameters: “**SEt P2**”, “**HYSt**”, “**modE**”, “**t on**”, “**t oFF**”, “**unit**” are unavailable. Parameters “**b PrEC**” and “**b unit**” define the resolution and unit of displayed thresholds and hysteresis of selected relay. Depend on “**modE**” parameter, relays can be not used or controlled over one or two thresholds values.

If one threshold is used (Figure 6.3) 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 6.4) 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.

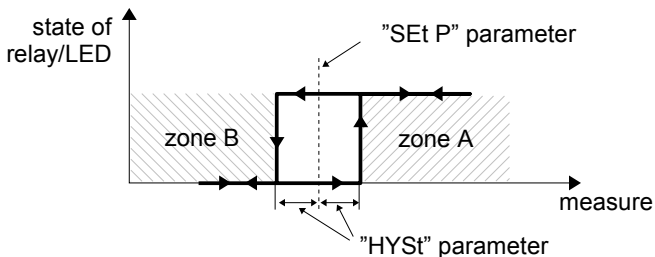


Figure 6.3. One threshold control of the relay/LED outputs

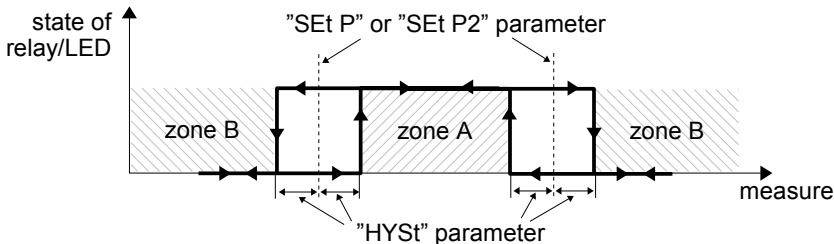


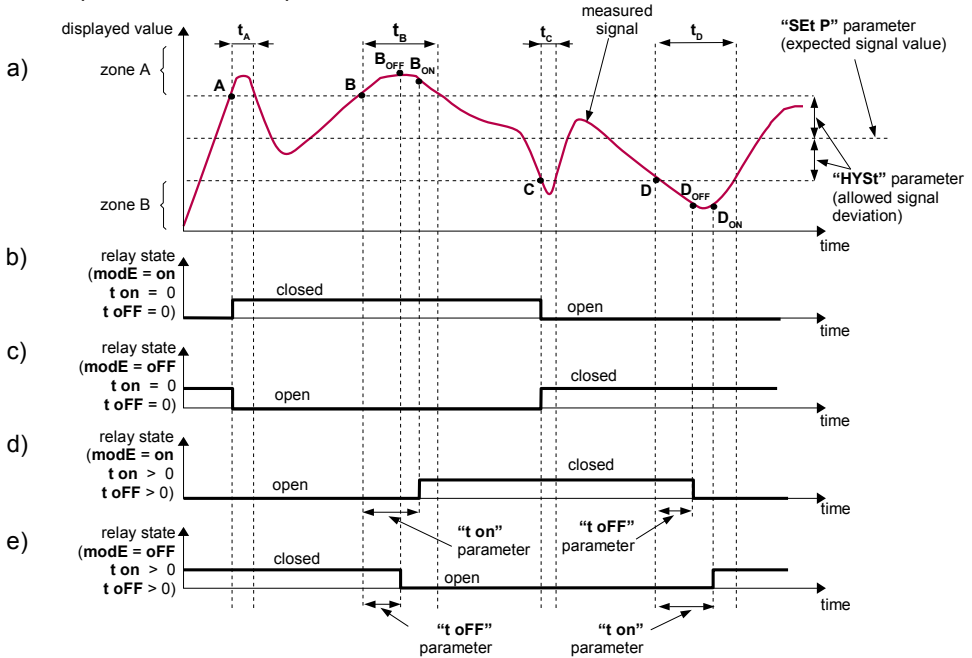
Figure 6.4. Two threshold control of the relay/LED outputs



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, for flow rate only) of the input signal.

6.3.1. One threshold mode

Figure 6.5 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_{ON}, B_{OFF}, D_{ON}, D_{OFF} - relays state changes moments: (for "t on" > 0, "t oFF" > 0)

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

Figure 6.5. 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 6.5 a). The relay can change its state **only** when input value exceeds (over or under) **border value** and t_A, t_B, t_C, t_D times (Figure 6.5) 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 6.5 a, b, c).

If values of "**t on**" or/and "**t oFF**" are positive, then relay state will be turned off on if the input value exceeds the **border values** and stay bigger (or lower) during at least "**t on**" (see points B_{ON}, D_{ON}, Figure 6.5 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_{OFF}, D_{OFF}, Figure 6.5 a, d, e).

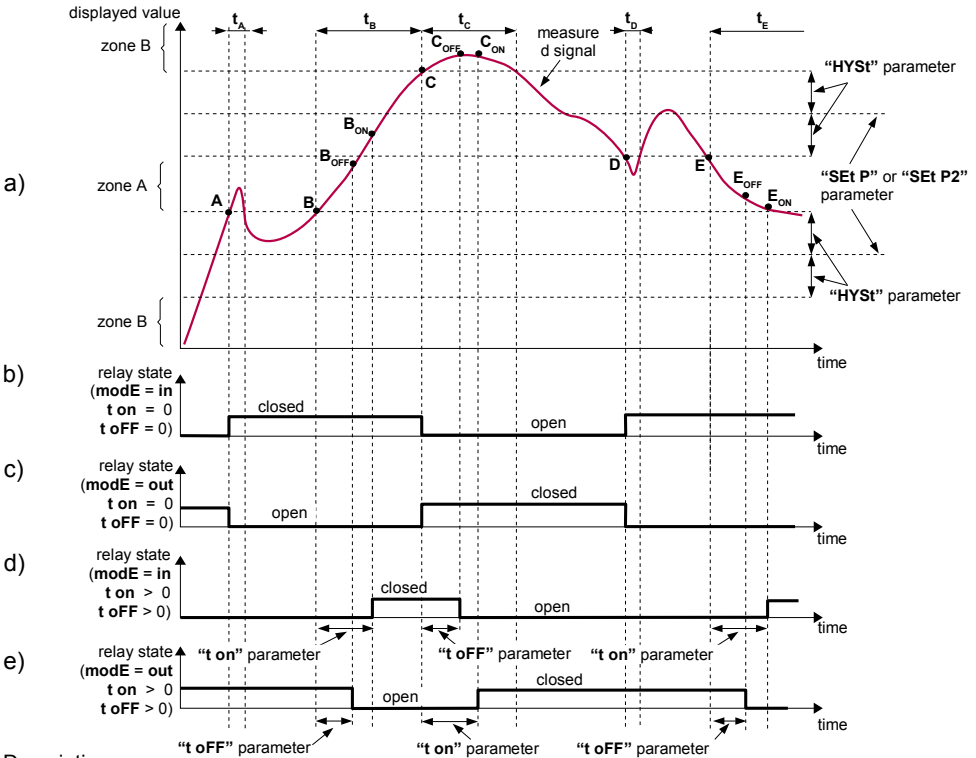
If t_A , t_B , t_C or t_D (when input signal stay in **zone A** or **zone B**) are lower than parameters “**t on**” or “**t off**”, the relay will not change his state (see points A and C, Figure 6.5 a, d, e).

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 6.5 a).

The parameter “**ALARMS**” allow user to set the relay output behaviour in critical situations (e.g. Input values exceeds **permissible input frequency**). 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_{ON} , B_{OFF} , C_{ON} , C_{OFF} , E_{ON} , E_{OFF} - relays state changes moments: (for “**t on**” > 0, “**t off**” > 0)
- t_A , t_B , t_C , t_D , t_E - time periods while input signal is in zone A or zone B

Figure 6.6. Principle of LED/relay output operation for two thresholds mode

Figure 6.6 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 P**”, 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 6.6).



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**).

6.3.3. Batcher mode and „PrE r1” mode

To switch the device into a batcher mode in submenu „rELay1” user should set „**SourCE**=„bAt”. There are following parameters related to **R1** in this mode: “**SourCE**”, “**SEt P**”, “**b PrEC**”, “**b unit**” and “**ALArMS**”. Parameters “**SEt P**”, “**b PrEC**”, “**b unit**” define quantity of batched medium, displaying precision and the unit respectively. Parameter “**ALArMS**” allows to set behaviour of relay output in critical situations.

Pressing [**ENTER**] button while device is in batcher mode causes start of batching and set of relay **R1**. Successive pressings of [**ENTER**] button cause pause/restart of batching and switching **R1** relay off/on. When **batcher counter** reaches value equal to “**SEt P**” then relay **R1** is switched off.



If **batcher counter** is overloaded then its maximal value is displayed alternatively with “**bAt ov**” message. Overload of this counter do not change state of relays.

To start another pouring cycle, **batcher counter** must be cleared and next new cycle initiated by pressing [**ENTER**] button. **Batcher counter** can be zeroed using “**CLrBat**” option of “**bAtCH**” submenu, using [**Σ**] button (press and hold by at least 2 sec.), electrically via *batcher clearing input* or via RS-485 interface by writing of value 0000h to any of batcher counter result registers. After zeroing of **batcher counter**, currently realized pouring is stopped and relays switched off.



Zeroing electrically via *batcher clearing input* causes start of the next batching automatically. In other cases to start of the next batching it is required to use [**ENTER**] button or write of value 0001h to any of batcher counter result registers using RS-485 interface. To stop batching it is required to use [**ENTER**] button or write of value 0002h to any of batcher counter result registers using RS-485 interface.

Due to delays while closing/opening the valves decreasing of “**SEt P**” parameter (defining volume of batched medium) can be necessary. Fact that zeroing of the **batcher counter** using [**Σ**] stops the batching process and switches off the relays can be used for calculating desired value of “**SEt P**”. Note, that if relay which is controlled by **batcher counter** is used for driving the valve, then value counted after zeroing of the **batcher counter** tells how much of medium flows through valve during closing.

Number of batches is counted by another counter (**number of batches counter**) and stored into the non-volatile memory. To display the value of this counter use [^] or [v] button. After that message "bAtCnt" and content of **number of batches counter** are displayed alternatively. To clear this counter press [Σ] button while device displays it and confirm by pressing [ENTER] button. Every initialisation of batcher (start of batching) causes incrementation of **number of batches counter**.

If parameter „**SourCE**” of relay (other than **R1**) is set to „**PrE r1**” then parameters „**SEt P**” and „**SEt P2**” of particular relay means control advance of this relay in relation to threshold of relay **R1** („**SEt P**” parameter in „**rELAY1**” submenu). In other words, first threshold of relay **R2** equals $SEt P_{R1} - SEt P_{R2}$ and value of its second threshold equals $SEt P_{R1} - SEt P2_{R2}$. Thresholds of other relays (if available) are calculated in the same way. Relays working in this mode can be used to control additional valve of the batcher.



If relay other than **R1** should change its state at the end of batching (simultaneously at turning relay **R1** off), it is required to set „**modE**”=“in” or “out” and set zero value for one of its thresholds („**SEt P**” or „**SEt P2**”).

The clearing and starting of next batching can be run automatically, with defined delay between successive doses. To enable this feature it is necessary to set parameters: „**A rES**” (autoreset function), „**A dLy**” and „**Atunit**” (desired delay and unit of time) of “**bAtCH**” menu.

6.3.4. Use of the batcher counter as a marker

This feature allows to use the batcher counter for cyclic control of relays (except **R1**) by volume of flowing medium (e.g. switching relay on after counter reaches 9 litres and switch it off after counter reaches -10 litres, in other words generate one pulse every 10 litres. For example to use **R2** as marker it is required to set counter as follow:

1. Set relay **R1** to batcher mode („**SourCE**”=“**bAt**”).
2. Set „**SEt P**” of relay **R1** to desired cyclic volume (e.g. 10 litres). This value defines cycle duration expressed in units of flow (not a time) because cycle time depends on flow speed.
3. Set relay **R2** as batcher pre-trig (“**SourCE**”=“**PrE R1**”).
4. Set “**modE**” of **R2** according to desired mode of operation (in this example “**modE**” = “on”, however it can be also set to other modes). Depending on this parameter, relay will be no or off in desired phase of the cycle.
5. Set “**SEt P**” (and “**SEt P2**” if “**modE**” = “in” or “**modE**” = “out”) of relay **R2** according to desired phase within it should be on (and off). These values must be lower than threshold of **R1**. Note, that time of active state of **R2** depends on flow speed. It is recommended to set “**SEt P**” of **R2** to half of **R1** threshold but it is not necessary (in this example set “1”, what causes that **R2** will be activated when batcher counter reaches 9 litres).
6. Switch on autoreset of batcher counter („**A rES**”=„on”) and set „**A dLy**” to 0.

Note that **R1** is switched off for a short period every time batcher counter is cleared, what can be used to any purpose.

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). If current flow is displayed (LED named “ Σ ” is off) or batcher counter value (LED named “ Σ ” is pulsing) user can check main thresholds values and *number of batches* (which indicates how many times batcher was started). After pressing [**^**] or [**v**] button, name of the threshold (e.g. “**rELPr1**”) and its value or “**bAtCnt**” label and *number of batches* 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.



or



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.



or



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 by due to current flow rate, stored peak value, total flow counter or batcher counter,
- 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.

"Source" - parameter defining kind of result using to control state of this relay. It can be set to one of three values:

"Flo" - relay is controlled due to current flow rate value or stored peak of flow rate (see **"Hold"** menu),

"bAt" - relay is controlled due to batcher counter value,

"tot" - relay is controlled due to total counter result.



„**bAt**” option is available for relay **R1** only. For the rest of relays „**PrE r1**” option is available. „**PrE r1**” option means controlling in relation to „**SEt P**” of relay **R1** (see **CONTROL OF THE RELAY OUTPUTS**).

„**SEt P**” - first threshold of the relay (range 0 ÷ 999999). **Threshold is the medium value of relay hysteresis.** While batcher mode („**SourCE**=„**bAt**”) „**SEt P**” value means the quantity of pouring matter.

„**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**” do not exceeds 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 its state).

„**b PrEc**” - decimal point position (displaying precision of the relay thresholds) when relay is controlled due to batcher counter result. It can be set to:

“ 0”
 “ 0.0”
 “ 0.00”
 “0.000”

Decimal point position is changed by [**^**], [**v**] buttons.

„**b unit**” - the unit of relay thresholds when relay is controlled due to batcher counter result. It can be set to:

„**unit**” - units
 „**1000un**” - thousands of units



Parameters „**b PrEc**” and „**b unit**” are available only for relay **R1** while batcher mode („**SourCE**” = „**bAt**”) is set. When current flow rate is used to control relays, the unit and precision of the thresholds and hysteresis are defined by parameters „**F unit**”, „**Ftunit**” and „**F PrEc**” of menu „**Flouu**”. When relay (other than **R1**) is controlled in relation to „**SEt P**” threshold of relay **R1** („**SourCE**” = „**PrE r1**”), the unit and precision of the thresholds and hysteresis of relay (other than **R1**) are defined by parameters „**b unit**” and „**b PrEc**” parameters available in submenu of relay **R1**.

“t Prec” - decimal point position (displaying precision of the relay thresholds) when relay is controlled due to total flow counter result. It can be set to:

“ 0”

“ 0.0”

“ 0.00”

“0.000”

Decimal point position is changed by [**^**], [**v**] buttons.

“t unit” - the unit of relay thresholds and hysteresis when relay is controlled due to total flow counter result. It can be set to:

“unit” - units

“1000un” - thousands of units



Parameters **“t PrEc”** and **“t unit”** are available only if total flow counter is used to control relay output (**“SouRCE”** = **“tot”**). When current flow rate is used to control relays, the unit and precision of the thresholds and hysteresis are defined by parameters **“F unit”**, **“Ftunit”** and **“F PrEc”** of menu **“Flouu”**. When relay (other than **R1**) is controlled in relation to **„SEt P”** threshold of relay **R1** (**“SouRCE”** = **“PrE r1”**), the unit and precision of the thresholds and hysteresis of relay (other than **R1**) are defined by parameters **„b unit”** and **„b PrEc”** parameters available in submenu of relay **R1**.

“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 its state (see paragraph: **CONTROL OF THE RELAY OUTPUTS**).

“unit” - unit of time for **“t on”** i **“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 its 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. “bEEP” menu

This menu contains options connected with acoustic signal :

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



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

7.3.3. "inPUt" menu

This menu contains options of pulse input configuration:

"PulSEL" - flow factor (quantity of pulses per litre). This parameter can be set in range 0.00 - 9999.99 pulses/unit. **Value 0.00 is interpreted as 10 000.00 pulses/unit.**



Proper settings of this parameter is essential to device's operation.

"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.

Parameter "FrEq" (Hz)	Minimum duration of low and high states	Permitted duty cycle for max. frequency
„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 µs	5%-95%
„300"	167 µs	5%-95%
„1 000"	50 µs	5%-95%
„3 000"	33 µs	10%-90%
„10 000"	33 µs	33%-66%

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

"ZEro t" - assumed maximum delay between pulses. This parameter is defined with 0.1 second precision, in range 0 ÷ 39.9. If time between two following pulses exceeds this parameter, than device displays zero (no flow).

If parameter **"ZEro t"** is set to value lower than parameter **"mEAS t"**, the **"mEAS t"** value is used as maximum time between two following pulses.

"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.

7.3.4. “**FLou**” menu

This menu presets the measurement input and allows configuration of current flow rate displaying mode:

“**F PrEc**” - decimal point position (precision of flow rate displaying). It can be set to:

“ 0”
 “ 0.0”
 “ 0.00”
 “ 0.000”
 “ 0.0000”
 “0.00000”

Decimal point position is changed by [^], [v] buttons.



Change of displaying precision can require appropriate correction of relays thresholds and hysteresis. These parameters **are not** updated automatically, due to settings of “**F PrEc**” parameter.

“**F coEF**” - conversion coefficient. Changes pulse input unit to any unit used to calculate flow by multiplying value in “**PuISEL**” parameter by value in “**F coEF**” parameter. Firstly, parameter editing requires to enter a value (by entering a digit in each blinking display separately), secondly to select decimal point position (blinking dot on selected position). There are following decimal point position options:

000000. - integer value, no decimal places,
 00000.0 - one decimal place,
 0000.00 - two decimal places,
 000.000 - three decimal places,
 00.0000 - four decimal places,
 0.00000 - five decimal places,
 000000 - six decimal places,

For example: 1 [l] = 0,264172 [US gallon],
 so **F coEF** = 264172 (no decimal places)



Decimal point position in „**Piont**” and „**F coEF**” parameters does not affect on each other.

“**F unit**” - the unit of volume used for flow rate displaying . It can be set to: (“**unit**” - units, or “**1000un**” - thousands of units). Units expressed by “**F unit**” are conventional, and can be exchanged to any other pair of units e.g. for powders it can be **kilogram** and **tonne**, and for liquids it can be **litres** or **cubic meters**.

“**Ftunit**” - time unit used for flow rate displaying. It can be set to: (“**SEC**” - seconds, “**min**” - minutes or “**hour**” - hours).



The unit used to displaying the flow rate, depend on parameters “**F unit**” and “**Ftunit**” simultaneously, for example: L/min or m³/h etc.

“**F or P**” - type of value displayed on the display:

“**FL vAL**” - flow value,

“**PERiod**” - time per one unit of flow.

7.3.5. “**bAtCH**” menu

This menu allows to configure total flow counter displaying mode.

“**b PrEc**” - decimal point position (precision of batcher counter). It can be set to:

“ 0 ”

“ 0.0 ”

“ 0.00 ”

“0.000”

Decimal point position is changed by [**^**], [**v**] buttons.

“**b coEF**” - conversion coefficient. Changes analogue input unit to any unit used to calculate batcher by multiplying current flow measurement value (after calculating user characteristics in “**I CHAr**” parameter) by value in “**b coEF**” parameter. Firstly, parameter editing requires to enter a value (by entering a digit in each blinking display separately), secondly to select decimal point position (blinking dot on selected position). There are following decimal point position options:

000000. - integer value, no decimal places,

00000.0 - one decimal place,

0000.00 - two decimal places,

000.000 - three decimal places,

00.0000 - four decimal places,

0.00000 - five decimal places,

000000 - six decimal places,

For example: 1 [**l**] = 0,264172 [US gallon],

so **b coEF** = 264172 (no decimal places)



Decimal point position in “**Piont**” and “**b coEF**” parameters does not affect on each other.



If batcher counter value in **not converted** units reaches limit value (which is **65535 999. 999**), then batcher counter value in converted units will be automatically set on **65535 999, 999** value and overload status in Modbus register will be also set. This situation can occur when “**b coEF**” parameter is greater than 1. In order to resume counting a user should reset the batcher.



If batcher counter value in **converted** units reaches limit value (which is **65535 999. 999**), then value in registers and on display will be locked on **65535 999. 999** overload status in Modbus register will be also set. This situation can occur when “**b coEF**” parameter is equal or lower than 1. In order to resume counting a user should reset the batcher. Not converted batcher value will be still counted according to settings.

“b unit” - the unit of volume used for batcher counter displaying . It can be set to: (**“unit.”** - units, or **“1000un”** - thousands of user units). Units expressed by **“b unit”** are conventional, and can be exchanged to any other pair of units e.g. for powders it can be **kilogram** and **tonne**, for liquids it can be **litre** or **cubic meter**.

“CLrbAt” - this option allows zeroing of batcher counter. After selection of this option ask **“CLEAR?”** is displayed. If user press **[ENTER]** batcher counter is cleared, else action is cancelled.

Zeroing of **batcher counter** is possible via RS-485 interface too. It can be done as write of 0000h to any one of registers referred to **batcher counter** (0Dh ÷ 0Fh) using RS 485 interface.



To protect batcher counter of unauthorised zeroing, it is recommended to set password to menu access (see menu **“SECU”**).

“E Clr” - this parameter allows selection of active level/edge of batcher counter zeroing input (see Figure 4.16). After zeroing next batching cycle starts. It can be set to one of following:

“oFF” - input disabled,

“HI” - zeroing while high level on the input and start batching if low level on the input appears,

“LO” - zeroing while low level on the input and start batching if high level on the input appears,

“LO-HI” - zeroing and start batching while rising edge on the input,

“HI-LO” - zeroing and start batching while falling edge on the input.



For settings “zeroing while high/low level” the selected level must be longer than 5ms.

“m CLR” - this parameter allows to activate manual zeroing of **batcher counter** using **[Σ]** button:

“oFF” - manual zeroing disabled,

“on” - manual zeroing enabled.

“A rES” - this parameter allows to activate autoreset function (automatic **batcher counter** zeroing and start next batching):

“oFF” - autoreset disabled,

“on” - autoreset enabled.

“Atunit” - time unit of autoreset delay:

“SEC” - seconds,

“min” - minutes.

“A dLy” - autoreset delay - it defines delay between last finished batching and execution of batcher autoreset function. Parameter **“A dLy”** is expressed with precision 0.1 of sec. or minutes depend on **“Atunit”** parameter.



Due to delays during valves closing, too small value of “**A dLy**” can cause counting error while next batching cycle. It is recommended to set parameter “**A dLy**” as much as valve closing time (or more), to preserve complete close of valves before start of next batching cycle.

7.3.6. “**totAL**” menu

This menu allows to configure total flow counter displaying mode.

“**t PrEc**” - decimal point position (precision of total flow counter). It can be set to:

“ 0 ”

“ 0.0 ”

“ 0.00 ”

“0.000”

Decimal point position is changed by [**^**], [**v**] buttons.

“**t coEF**” - conversion coefficient. Changes analogue input unit to any unit used to calculate total flow by multiplying current flow measurement value (after calculating user characteristics in “**I CHAr**” parameter) by value in “**t coEF**” parameter. Firstly, parameter editing requires to enter a value (by entering a digit in each blinking display separately), secondly to select decimal point position (blinking dot on selected position). There are following decimal point position options:

000000. - integer value, no decimal places,

00000.0 - one decimal place,

0000.00 - two decimal places,

000.000 - three decimal places,

00.0000 - four decimal places,

0.00000 - five decimal places,

000000 - six decimal places,

For example: 1 [l] = 0,264172 [US gallon],

so **t coEF** = 264172 (no decimal places)



Decimal point position in “**t PrEc**” and “**t coEF**” parameters does not affect on each other.



If total flow counter value in **not converted** units reaches limit value (which is **4294967295 999. 999**), then total flow counter value in converted units will be automatically set on **4294967295 999, 999** value and overload status in Modbus register will be also set. This situation can occur when “**t coEF**” parameter is greater than 1. In order to resume counting a user should reset the total flow counter.



If total flow counter value in **converted** units reaches limit value (which is **4294967295 999. 999**), then value in registers and on display will be locked on **4294967295 999. 999** overload status in Modbus register will be also set. This situation can occur when “**t coEF**” parameter is equal or lower than 1. In order to resume counting a user should reset the total flow counter. Not converted total flow value will be still counted according to settings.

“t unit” - the unit of volume used for total flow counter displaying . It can be set to: (**“unit”** - units, or **“1000un”** - thousands of units). Units expressed by **“t unit”** are conventional, and can be exchanged to any other pair of units e.g. for powders it can be **kilogram** and **tonne**, for liquids it can be **litre** or **cubic meter**.

“CLrtot” - this option allows zeroing of total flow counter. After selection of this option ask **“CLEAR?”** is displayed. If user press **[ENTER]** total flow counter is cleared, else action is cancelled
Zeroing of **total flow counter** is possible via RS-485 interface too. It can be done as write of 0000h to any one of registers referred to **total flow counter** (09h ÷ 0Ch) using RS 485 interface.



To protect total flow counter of unauthorised zeroing, it is recommended to set password to menu access (see menu **“SECU”**).

“E Clr” - this parameter allows selection of active level/edge of total flow zeroing input (see Figure 4.16). It can be set to one of following:

- “oFF”** - input disabled,
- “HI”** - zeroing while high level on the input
- “LO”** - zeroing while low level on the input
- “LO-HI”** - zeroing while rising edge on the input
- “HI-LO”** - zeroing while falling edge on the input



For settings “zeroing while high/low level” the selected level must be longer than 5ms.

“m Clr” - this parameter allows to activate manual zeroing of **total flow counter** using **[Σ]** button:
“oFF” - manual zeroing disabled,
“on” - manual zeroing enabled.

7.3.7. “bL inP” parameter

This parameter allows selection of active level/edge of blockade input (see Figure 4.16). When **active state** is delivered to blockade input, it causes to stop counting by total flow counter and batcher counter. It can be set to one of following:

- “oFF”** - input disabled,
- “HI”** - stop counting while high level on the input,
- “LO”** - stop counting while low level on the input,
- “LO-HI”** - successive rising edges alternatively stops/starts counting,
- “HI-LO”** - successive falling edges alternatively stops/starts counting.



For settings “stop counting while high/low level” the selected level must be longer than 5ms.

7.3.8. "Init d" parameter

This parameter defines type of the value displayed after power on the meter. It is possible to set it to:

- "Flo"** - current flow rate (instantaneous flow),
- "bAt"** - batcher counter,
- "tot"** - lowest part of total flow counter (less significant digits),
- "tot2"** - medium part of total flow counter,
- "tot3"** - highest part of total flow counter (most significant digits),



If value **"tot2"** or **"tot3"** is selected, meter automatically switches display to non-zero part of total counter result. Flashing (or not, if result is shorter than 6 digits) decimal points indicates which one part is actually displayed.

7.3.9. "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 (temporarily) 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).

7.3.10. "OutP" 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).

"OUTmod" - 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,
- "modbuS"** - 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,
- "modbuS"** - 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,
- "**modbus**" - voltage output controlled via RS-485 interface.

"**Source**" - this parameter defines kind of analogue output controlling parameter, and can be set to one of three values:

- "**Flo**" - analogue output is controlled due to instantaneous flow (flow rate),
- "**bAt**" - analogue output is controlled due to batcher counter result,
- "**tot**" - analogue output is controlled due to total flow counter result.



If parameter „**Source**“=„**bAt**“ and batcher mode is disabled, then analogue output will be set to its alarm state defined by „**AL**“ parameter in „**OutPUt**“ menu.

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

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

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

$$Out = \frac{W - "OUt LO"}{"OUt HI" - "OUt LO"} \times (B - A) + A$$

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



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

"**b Prec**" - decimal point position (displaying precision of parameters "**Out LO**" and "**Out HI**") when analogue output is controlled due to batcher counter result. It can be set to:

- " 0 "
- " 0.0 "
- " 0.00 "
- " 0.000 "

Decimal point position is changed by [**^**], [**v**] buttons.

"**b unit**" - the unit of parameters "**Out LO**" and "**Out HI**", while analogue output is controlled due to batcher counter result. It can be set to one of two values:

- "**unit**" - units
- "**1000un**" - thousands of units



Parameters "**b PrEc**" and "**b unit**" are available only if batcher counter is used to control current output ("**SourCE**" = "**tot**"). When current flow rate is used to control it, the unit and precision of "**OUT LO**" and "**OUT HI**" parameters are defined by parameters "**F unit**", "**Ftunit**" and "**F PrEc**" of menu "**Flouu**".

"**t PrEc**" - decimal point position (displaying precision of parameters "**OUT LO**" and "**OUT HI**") when analogue output is controlled due to total flow counter result. It can be set to:

" 0"
 " 0.0"
 " 0.00"
 "0.000"

Decimal point position is changed by [^], [v] buttons.

"**t unit**" - the unit of parameters "**OUT LO**" and "**OUT HI**", while analogue output is controlled due to total flow counter result. It can be set to one of two values:

"unit" - units
 "1000un" - thousands of units



Parameters "**t PrEc**" and "**t unit**" are available only if total flow counter is used to control current output ("**SourCE**" = "**tot**"). When current flow rate is used to control it, the unit and precision of "**OUT LO**" and "**OUT HI**" parameters are defined by parameters "**F unit**", "**Ftunit**" and "**F PrEc**" of menu "**Flouu**".

"**Lo r**", "**Hi r**" - these 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 define 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 50 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:

"noCHAN" - 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:

- "noCHAn"** - 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:

- "noCHAn"** - 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.

7.3.11. "briGHt" parameter

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

7.3.12. "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 6.2)

"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”=”rREAL” then value **"time"**=**0.0** means no holding.

"HdiS" - type of displayed values:

"rEAL" - current value is displayed,

"HOLd" - peak (drop) value is displayed,

"H r1" ÷ "H r4" - relay/LED outputs (R1÷R4) 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.

7.3.13. "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 r4" - this option permits user (**"on"**) or prohibits (**"oFF"**) to modify the thresholds of the relays/LEDs R1 ÷ R4 without knowledge about user password.

7.3.14. "rS-485" menu

This menu is connected with RS-485 interface, and sets its 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 analogue 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"** } - answer delayed of 10, 20, 50, 100 of 200 chars respectively, where
- "20c"** } one character time depends on selected baud rate
- "50c"** }
- "100c"** }
- "200c"** }



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.

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

Tab.7.2. Settings of **"rESP"** parameter

7.3.15. "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.

7.3.16. "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.

7.3.17. "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. UNITS CALCULATIONS EXAMPLES

During work with the device, there could be a need to recalculate measured value in a unit into another. In the device there is a possibility to do so independently for flow, total flow and batcher using parameters “F coEF”, “t coEF”, “b coEF” respectively. Examples of recalculations for some measurement units are shown below.

Flow, Tot, Bat: Input:	litre [l]	US gallon [gallon]	UK gallon [gallon]	US ounce [US fl oz]	UK ounce [UK fl oz]	US beer barrel [bbl]	UK beer barrel [imp. bl.]
litre [l]	1	0,264172	0,219969	33,814	35,1957	0,00629	0,00611
US gallon [gallon]	3,78541	1	0,832675	128	133,23	0,02381	0,02313
UK gallon [gallon]	4,54608	1,20094	1	153,721	160,003	0,028594	0,027778
US ounce [US fl oz]	0,029574	0,007812	0,006505	1	1,04086	0,000186	0,000181
UK ounce [UK fl oz]	0,028413	0,007506	0,00625	0,960742	1	0,000179	0,000174
US beer barrel [bbl]	158,987	42	34,9723	5376	5595,68	1	0,971454
UK beer barrel [imp. bl.]	163,659	43,2341	36	5533,98	5760,11	1,02938	1

Tab.7.3. Coefficients for volume units

Flow, Tot, Bat: Input:	kilogram [kg]	ounce [oz]	pound [lb]	stone [st]	gran [gr]	UK ton [t]	US ton [t]
kilogram [kg]	1	35,2739	2,20462	0,157473	15432,3	0,000984	0,001102
ounce [oz]	0,02835	1	0,0625	0,004464	437,5	0,000028	0,000031
pound [lb]	0,453592	16	1	0,071429	7000	0,000446	0,0005
stone [st]	6,35029	224	14	1	98000	0,00625	0,007
gran [gr]	0,000065	0,002286	0,000143	0,00001	1	-	-
UK ton [t]	1016,04	35840	2240	160	-	1	1,12
US ton [t]	907,184	32000	2000	142,857	-	0,892857	1

Tab.7.4. Coefficients for weight units

7.4.1. Units recalculating examples

Task:

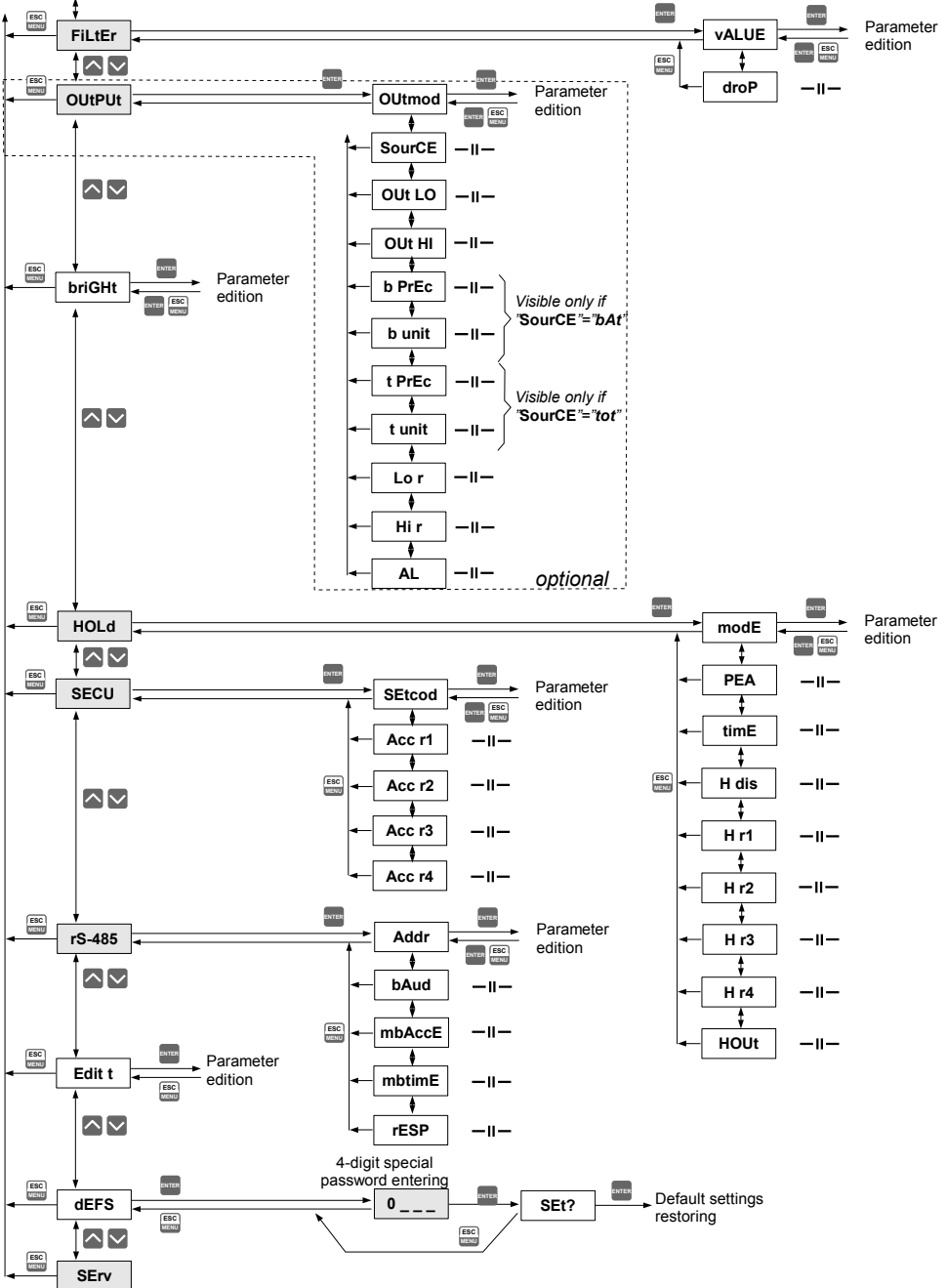
Lets assume that we have a device which woks with sensor scaled in litres. We want, that flow measurement is displayed in US ounces, total flow in hundreds of US gallons and batcher in US gallons.

Solution:

Using Tab.7.3 (number value in table corresponds to number of input units – left column, in one output unit – upper row) set:

“**F coEF**” parameter as: 33,814,
“**t coEF**” parameter as: 0,002641,
and “**b coEF**” parameter as: 0,264172.

See previous page



8. 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 41:

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

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

b) D = „20.5”

According to formula from page 41:

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

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

c) D = „30.0”

According to formula from page 41:

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

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).

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

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 ¹ 02h ¹	No	0 ÷ 999999	Measurement value (no decimal point)
03h	No	0-FFh	The status of the current measurement. 0 – data valid; 20h – device waits for first pulse; A0h – alarm state, allowable frequency range is exceeded
04h	Yes	0 ÷ 5	“ F PrEc ” parameter in “ FLouu ” menu. The same as 12h register
05h	Yes	0 ÷ 31	State of the relays and alarm LED (binary format) (1 - on, 0 - off): 00000000 000edcba a - relay R1; b - relay R2; c - relay R3; d - relay R4; e - alarm state indicator; If written, only a, b, c, d bits are important (others are ignored) these bits allows user to control the relays via RS-485 interface
06h ²	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 ¹ 08h ¹	No	0 ÷ 999999	Peak (drop) value (no decimal point)
09h ¹ 0Ah ¹	No	0+FFFFFFFFh	Total flow component expressed in thousands of units e.g.: 999999999 999 . 999
0Bh ¹	No	0+999	Total flow component expressed in units e.g.: 999999999 999 . 999
0Ch ¹	No	0+999	Total flow component expressed in thousandths of units e.g.: 999999999 999 . 999
0Dh ¹	No	0+FFFFh	Batcher component expressed in thousands of units e.g.: 65535 999 . 999
0Eh ¹	No	0+999	Batcher component expressed in units e.g.: 65535 999 . 999
0Fh ¹	No	0+999	Batcher component expressed in thousandths of units e.g.: 65535 999 . 999

Register	Write	Range	Register description
10h	Yes	0 ÷ 10	“FrEq” parameter in “inPUt” menu (input filter): 0 - 10Hz; 1 - 15Hz; 2 - 20Hz; 3 - 30Hz; 4 - 40Hz; 5 - 50Hz; 6 - 100Hz; 7 - 300Hz; 8 - 1kHz; 9 - 3kHz; 10 - 10kHz
12h	Yes	0 ÷ 5	“F PrEc” parameter in “FLouu” menu (precision of flow rate displaying): 0 - “ 0”; 1 - “ 0.0”; 2 - “ 0.00”; 3 - “0.000”; 4 - “0.0000”; 5 - “0.00000”;
13h	Yes	0 ÷ 2	“Ftunit” parameter in “FLouu” menu (the unit of time while flow rate displaying): 0 - SEC; 1 - min; 2 - hour;
14h	Yes	0 ÷ 1	“F unit” parameter in “FLouu” menu (the unit of volume while flow rate displaying): 0 - unit; 1 - 1000un;
16h 17h	Yes	0 ÷ 999999	“PULSEl” parameter in “inPUt” menu, flow sensor factor (quantity of pulses per unit) expressed in 0.01 pulses/lighter. Value 0 is interpreted as 10 000.00 pulses/unit
18h	Yes	0 ÷ 399	“ZERO t” parameter in “inPUt” menu expressed in tenth of seconds
19h	Yes	0 ÷ 199	“mEAS t” parameter in “inPUt” menu expressed in tenth of seconds
1Ah	Yes	0 ÷ 199	“vALUE” parameter in “FiLTeR” menu (measurement filtering rate)
1Bh	Yes	0 ÷ 1999	“droP” parameter in “FiLTeR” menu expressed in tenth of percent
1Ch	Yes	0 ÷ 1	“t unit” parameter in “totAL” menu (the unit of volume while total flow counter result displaying): 0 - unit; 1 - 1000un;
1Dh	Yes	0 ÷ 3	“t PrEc” parameter in “totAL” (precision of total flow counter result displaying): 0 - “ 0”; 1 - “ 0.0”; 2 - “ 0.00”; 3 - “0.000”
1Eh	Yes	see descr.	Upper byte: “E CLr” parameter in “totAL” menu: 0 - “oFF”; 1 - “HI”; 2 - “LO”; 3 - “LO-HI”; 4 - “HI-LO” Lower byte: “m CLr” parameter in “totAL” menu: 0 - “oFF”; 1 - “on”
1Fh	Yes	0 ÷ 3	“init d” parameter (kind of value displayed after power on): 0 - “FLo”; 1 - “tot”; 2 - “tot2”; 3 - “tot3”
20h ³	Yes	0 ÷ 199	Device address
21h	No	2083h	Device identification code (ID)
22h ⁴	Yes	0 ÷ 7	“bAud” parameter in “rS-485” 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 ⁵	Yes	0 ÷ 1	“mbAccE” parameter in “rS-485” menu (permission to write registers via RS-485 interface); 0 - write denied ; 1 - write allowed
24h	Yes	see descr.	Parameters of “SECU” menu (binary format (0 - „oFF”, 1 - „on”): bit 0 - “Acc r1” parameter; bit 1 - “Acc r2” parameter; bit 2 - “Acc r3” parameter; bit 4 - “Acc r4” parameter;

Register	Write	Range	Register description
25h	Yes	0 ÷ 5	“rESP” parameter in “rS-485” menu (additional response delay); 0 - no additional delay; 1 - “10c” option; 2 - “20c” option; 3 - “50c” option; 4 - “100c” option; 5 - “200c” option;
27h	Yes	0 ÷ 99	“mbtimE” parameter in “rS-485” menu (maximum delay between received frames); 0 - no delay checking; 1 ÷ 99 - maximum delay expressed in seconds
28h	Yes	0 ÷ 1	“AL” parameter in “bEEP” menu: 0 - off; 1 - on
29h	Yes	0 ÷ 1	“r1” parameter in “bEEP” menu: 0 - off; 1 - on
2Ah	Yes	0 ÷ 1	“r2” parameter in “bEEP” menu: 0 - off; 1 - on
2Bh	Yes	0 ÷ 1	“r3” parameter in “bEEP” menu: 0 - off; 1 - on
2Ch	Yes	0 ÷ 1	“r4” parameter in “bEEP” menu: 0 - off; 1 - on
2Dh	Yes	1 ÷ 8	“briGHt” parameter (display brightness); 1 - the lowest brightness; 8 - the highest brightness
2Fh	Yes	0 ÷ 1	“Edit” parameter (numerical parameters edit mode); 0 - „dig” mode; 1 - „SLid” mode
Parameters or relay R1 operation			
30h 31h	Yes Yes	0 ÷ 999999	“SET P” parameter in “rELAY1” menu, no decimal point included
32h 33h	Yes Yes	0 ÷ 99999	“HySt” parameter in “rELAY1” menu, no decimal point included
34h	Yes	0 ÷ 5	“modE” parameter in “rELAY1” menu: 0 - “noAct” mode; 1 - “on” mode; 2 - “oFF” mode; 3 - “in” mode; 4 - “out” mode; 5 - “modbus” mode
35h	Yes	0 ÷ 999	“t on” parameter in “rELAY1” menu, expressed in tenth of seconds or tenth of minutes depend on “unit” parameter
36h	Yes	0 ÷ 999	“t oFF” parameter in “rELAY1” menu, expressed in tenth of seconds or tenth of minutes depend on “unit” parameter
37h	Yes	0 ÷ 1	“unit” parameter in “rELAY1” menu: 0 - seconds; 1 - minutes
38h	Yes	0 ÷ 2	“ALArMS” parameter in “rELAY1” menu: 0 - no changes; 1 - on; 2 - off
39h 3Ah	Yes Yes	0 ÷ 999999	“SET P2” parameter in “rELAY1” menu, no decimal point included
3Bh	Yes	0 ÷ 2	“SouRCE” parameter in “rELAY1” menu (kind of value controlled relay): 0 - “FLo”; 1 - “bAt”; 2 - “tot”;
3Ch	Yes	0 ÷ 3	“t PrEc” parameter in “rELAY1” menu (precision of thresholds and hysteresis while relay is controlled due to total flow counter value): 0 - “0”; 1 - “0.0”; 2 - “0.00”; 3 - “0.000”
3Dh	Yes	0 ÷ 1	“t unit” parameter in “rELAY1” menu (the unit of thresholds and hysteresis while relay is controlled due to total flow counter value): 0 - unit; 1 - 1000un;

Register	Write	Range	Register description
3Eh	Yes	0 ÷ 3	“ b PrEc ” parameter in “ rELAy1 ” menu (precision of thresholds while relay is controlled due to batcher counter value): 0 - “0”; 1 - “0.0”; 2 - “0.00”; 3 - “0.000”
3Fh	Yes	0 ÷ 1	“ b unit ” parameter in “ rELAy1 ” menu (the unit of thresholds while relay is controlled due to batcher counter value): 0 - unit; 1 - 1000un;
Parameters or relay R2 operation			
40h 41h	Yes Yes	0 ÷ 999999	“ SEt P ” parameter in “ rELAy2 ” menu, no decimal point included
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
4Bh	Yes	0 ÷ 2	“ SourCE ” parameter in “ rELAy2 ” menu (kind of value controlled relay): 0 - “FLo”; 1 - “bAt”; 2 - “tot”;
4Ch	Yes	0 ÷ 3	“ t PrEc ” parameter in “ rELAy2 ” menu (precision of thresholds and hysteresis while relay is controlled due to total flow counter value): 0 - “0”; 1 - “0.0”; 2 - “0.00”; 3 - “0.000”
4Dh	Yes	0 ÷ 1	“ t unit ” parameter in “ rELAy2 ” menu (the unit of thresholds and hysteresis while relay is controlled due to total flow counter value): 0 - unit; 1 - 1000un;
Parameters or relay R3 operation			
50h 51h	Yes Yes	0 ÷ 999999	“ SEt P ” parameter in “ rELAy3 ” menu, no decimal point included
52h 53h	Yes Yes	0 ÷ 99999	“ HySt ” parameter in “ rELAy3 ” menu, no decimal point included
54h	Yes	0 ÷ 5	“ modE ” parameter in “ rELAy3 ” menu: 0 - “ noAct ” mode; 1 - “ on ” mode; 2 - “ oFF ” mode; 3 - “ in ” mode; 4 - “ out ” mode; 5 - “ modbuS ” mode
55h	Yes	0 ÷ 999	“ t on ” parameter in “ rELAy3 ” menu, expressed in tenth of seconds or tenth of minutes depend on “ unit ” parameter

Register	Write	Range	Register description
56h	Yes	0 ÷ 999	“ t OFF ” parameter in “ rELAy3 ” menu, expressed in tenth of seconds or tenth of minutes depend on “ unit ” parameter
57h	Yes	0 ÷ 1	“ unit ” parameter in “ rELAy3 ” menu: 0 - seconds; 1 - minutes
58h	Yes	0 ÷ 2	“ ALArMS ” parameter in “ rELAy3 ” menu: 0 - no changes; 1 - on; 2 - off
59h 5Ah	Yes Yes	0 ÷ 999999	“ SET P2 ” parameter in “ rELAy3 ” menu, no decimal point included
5Bh	Yes	0 ÷ 2	“ SourCE ” parameter in “ rELAy3 ” menu (kind of value controlled relay): 0 - “FLO”; 1 - “bAT”; 2 - “tot”;
5Ch	Yes	0 ÷ 3	“ t PrEc ” parameter in “ rELAy3 ” menu (precision of thresholds and hysteresis while relay is controlled due to total flow counter value): 0 - “ 0”; 1 - “ 0.0”; 2 - “ 0.00”; 3 - “0.000”
5Dh	Yes	0 ÷ 1	“ t unit ” parameter in “ rELAy3 ” menu (the unit of thresholds and hysteresis while relay is controlled due to total flow counter value): 0 - unit; 1 - 1000un;
Parameters or relay R4 operation			
60h 61h	Yes Yes	0 ÷ 999999	“ SET P ” parameter in “ rELAy4 ” menu, no decimal point included
62h 63h	Yes Yes	0 ÷ 99999	“ HySt ” parameter in “ rELAy4 ” menu, no decimal point included
64h	Yes	0 ÷ 5	“ modE ” parameter in “ rELAy4 ” menu: 0 - “noACT” mode; 1 - “on” mode; 2 - “oFF” mode; 3 - “in” mode; 4 - “out” mode; 5 - “modbus” mode
65h	Yes	0 ÷ 999	“ t on ” parameter in “ rELAy4 ” menu, expressed in tenth of seconds or tenth of minutes depend on “ unit ” parameter
66h	Yes	0 ÷ 999	“ t OFF ” parameter in “ rELAy4 ” menu, expressed in tenth of seconds or tenth of minutes depend on “ unit ” parameter
67h	Yes	0 ÷ 1	“ unit ” parameter in “ rELAy4 ” menu: 0 - seconds; 1 - minutes
68h	Yes	0 ÷ 2	“ ALArMS ” parameter in “ rELAy4 ” menu: 0 - no changes; 1 - on; 2 - off
69h 6Ah	Yes Yes	0 ÷ 999999	“ SET P2 ” parameter in “ rELAy4 ” menu, no decimal point included
6Bh	Yes	0 ÷ 2	“ SourCE ” parameter in “ rELAy4 ” menu (kind of value controlled relay): 0 - “FLO”; 1 - “bAT”; 2 - “tot”;
6Ch	Yes	0 ÷ 3	“ t PrEc ” parameter in “ rELAy4 ” menu (precision of thresholds and hysteresis while relay is controlled due to total flow counter value): 0 - “ 0”; 1 - “ 0.0”; 2 - “ 0.00”; 3 - “0.000”

Register	Write	Range	Register description
6Dh	Yes	0 ÷ 1	“ t unit ” parameter in “ rELAY4 ” menu (the unit of thresholds and hysteresis while relay is controlled due to total flow counter value): 0 - unit; 1 - 1000un;
70h	Yes	0 ÷ 1	“ modE ” parameter in “ HOLd ” menu (type of detected changes): 0 - peaks; 1 - drops
71h 72h	Yes	0 ÷ 999999	“ PEA ” parameter in “ HOLd ” menu (minimum detectable change, no decimal point included)
73h	Yes	0 ÷ 199	“ time ” parameter in “ HOLd ” menu, maximum peaks' (or drops') display time expressed in seconds
74h	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
75h	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;
76h	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;
77h	Yes	0 ÷ 1	“ H r3 ” parameter in “ HOLd ” menu (the control mode of relay R3 and LED R3) : 0 - control depends on current measurement values; 1 - control depends on peaks (or drops) values;
78h	Yes	0 ÷ 1	“ H r4 ” parameter in “ HOLd ” menu (the control mode of relay R4 and LED R4) : 0 - control depends on current measurement values; 1 - control depends on peaks (or drops) values;
79h	Yes	0 ÷ 1	“ HOUt ” parameter in “ HOLd ” menu (the control mode of current output): 0 - control depends on current measurement values; 1 - control depends on peaks (or drops) values;
A0h ²	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
	Yes	0 ÷ 2	“ OUTmod ” parameter in “ OUTPUT ” menu (passive current output mode) 0 - current output disabled; 1 - current output enabled with 4÷20mA mode; 2 - current output controlled via RS-485 interface

Register	Write	Range	Register description
	Yes	0 ÷ 5	“ Outmod ” parameter in “ OutPUT ” menu (active voltage output mode) 0 - voltage output disabled; 1 - voltage output enabled with 0÷5V mode; 2 - voltage output enabled with 1÷5V mode; 3 - voltage output enabled with 0÷10V mode; 4 - voltage output enabled with 2÷10V mode; 5 - voltage output controlled via RS-485 interface
A1h ² A2h ²	Yes	0 ÷ 999999	“ Out LO ” parameter in “ OutPUT ” menu, no decimal point included
A3h ² A4h ²	Yes	0 ÷ 999999	“ Out HI ” parameter in “ OutPUT ” menu, no decimal point included
A5h ²	Yes	0 ÷ 999	“ Lo r ” parameter in “ OutPUT ” menu, for active current output and active voltage output, expressed in 0.1%
	Yes	0 ÷ 299	“ Lo r ” parameter in “ OutPUT ” menu for passive current output, expressed in 0.1%
A6h ²	Yes	0 ÷ 199	“ Hi r ” parameter in “ OutPUT ” menu for active and passive current output, expressed in 0.1%
	Yes	0 ÷ 99	“ Hi r ” parameter in “ OutPUT ” menu for active voltage output, expressed in 0.1%
A7h ²	Yes	0 ÷ 3	“ AL ” parameter in “ OutPUT ” menu (active current output value on critical exception): 0 - no change; 1 - 22.1 mA; 2 - 3.4 mA; 3 - 0 mA
	Yes	0 ÷ 2	“ AL ” parameter in “ OutPUT ” menu (passive current output value on critical exception): 0 - no change; 1 - 22.1 mA; 2 - 3.4 mA
	Yes	0 ÷ 5	“ AL ” parameter in “ OutPUT ” menu (active voltage output value on critical exception): 0 - no change; 1 - 11 V; 2 - 5.5; 3 - 1.2 V; 4 - 0.6 V; 5 - 0 V
A8h ²	Yes	0 ÷ 2	“ SourCE ” parameter in “ OutPUT ” menu (kind of value controlled active current output): 0 - “FLo”; 1 - “bAt”; 2 - “tot”;
A9h ²	Yes	0 ÷ 3	“ t PrEc ” parameter in “ OutPUT ” menu (precision of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to total flow counter value): 0 - “ 0”; 1 - “ 0.0”; 2 - “ 0.00”; 3 - “0.000”
AAh ²	Yes	0 ÷ 1	“ t unit ” parameter in “ OutPUT ” menu (the unit of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to total flow counter value): 0 - unit; 1 - 1000un;
ABh ²	Yes	0 ÷ 3	“ b PrEc ” parameter in “ OutPUT ” menu (precision of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to batcher counter value): 0 - “ 0”; 1 - “ 0.0”; 2 - “ 0.00”; 3 - “0.000”
ACH ²	Yes	0 ÷ 1	“ b unit ” parameter in “ OutPUT ” menu (the unit of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to batcher counter value): 0 - unit; 1 - 1000un;
D0h	Yes	0 ÷ 1	“ b unit ” parameter in “ bAtCH ” menu (the unit of volume while batcher counter result displaying): 0 - unit; 1 - 1000un;

Register	Write	Range	Register description
D1h	Yes	0 ÷ 3	“ b PrEc ” parameter in “ bAtCH ” (precision of batcher counter result displaying): 0 - “0”; 1 - “0.0”; 2 - “0.00”; 3 - “0.000”
D2h	Yes	see descr.	Upper byte: “ E CLr ” parameter in “ bAtCH ” menu: 0 - “oFF”; 1 - “HI”; 2 - “LO”; 3 - “LO-HI”; 4 - “HI-LO” Lower byte: “ m CLr ” parameter in “ bAtCH ” menu: 0 - “oFF”; 1 - “on”
D3h ¹ D4h ¹	Yes	0 ÷ 999999	Number of batches counter
D5h	Yes	0 ÷ 1	“ A rES ” parameter in “ bAtCH ” menu (batcher autoreset): 0 - disabled, 1 - enabled
D6h	Yes	0 ÷ 1	“ Atunit ” parameter in “ bAtCH ” menu (time unit of autoreset delay): 0 - „SEC”, 1 - „min”
D7h	Yes	0 ÷ 999	“ a dLy ” parameter in “ bAtCH ” menu (autoreset delay) expressed in tenth of seconds or tenth of minutes depend on “ Atunit ” parameter)
D8h	Yes	0 ÷ 1	“ F or P ” parameter in “ Flouu ” submenu (type of value displayed on the display): 0 - flow value; 1 - time per one unit of flow;
D9h	Yes	0 ÷ 4	“ bL inP ” parameter (active level/edge of blockade input): 0 - “oFF”; 1 - “HI”; 2 - “LO”; 3 - “LO-HI”; 4 - “HI-LO”
E0h E1h	Yes	0 ÷ 999999	Value of “ F coEF ” parameter in “ Flouu ” submenu, without decimal point. Value of 0 in interpreted as 1 000 000.
E2h	Yes	0 ÷ 6	Decimal point of “ F coEF ” parameter in “ Flouu ” submenu 0 - “0”; 1 - “0.0”; 2 - “0.00”; 3 - “0.000”; 4 - “0.0000”; 5 - “0.00000”, 6 - “0.000000”;
E3h E4h	Yes	0 ÷ 999999	Value of “ F coEF ” parameter in “ total ” submenu, without decimal point. Value of 0 in interpreted as 1 000 000.
E5h	Yes	0 ÷ 6	Decimal point of “ F coEF ” parameter in “ total ” submenu 0 - “0”; 1 - “0.0”; 2 - “0.00”; 3 - “0.000”; 4 - “0.0000”; 5 - “0.00000”, 6 - “0.000000”;
E6h E7h	Yes	0 ÷ 999999	Value of “ b coEF ” parameter in “ bAtCH ” submenu, without decimal point. Value of 0 in interpreted as 1 000 000.
E8h	Yes	0 ÷ 6	Decimal point of “ b coEF ” parameter in “ bAtCH ” submenu 0 - “0”; 1 - “0.0”; 2 - “0.00”; 3 - “0.000”; 4 - “0.0000”; 5 - “0.00000”, 6 - “0.000000”;
E9h EAh	No	0 ÷ 999999	Calculated flow (multiplied “ PuLSEL ” and “ F coEF ” values) expressed in user units (value without decimal point)

Register	Write	Range	Register description
EBh ECh	No	0 ÷ 999999999	Calculated total flow component (multiplied “PuLSEL” and “t coEF” values) expressed in thousands of user units (value without decimal point): 999999999 999 . 999
EDh	No	0 ÷ 999	Calculated total flow component (multiplied “PuLSEL” and “t coEF” values) expressed in user units (value without decimal point): 999999999 999 . 999
EEh	No	0 ÷ 999	Calculated total flow component (multiplied “PuLSEL” and “t coEF” values) expressed in thousandths of user units (value without decimal point): 999999999 999 . 999
EFh	No	0 ÷ FFFFh	Calculated batcher component (multiplied “PuLSEL” and “b coEF” values) expressed in thousands of user units (value without decimal point): 65535 999 . 999
F0h	No	0 ÷ 999	Calculated batcher component (multiplied “PuLSEL” and “b coEF” values) expressed in user units (value without decimal point): 65535 999 . 999
F1h	No	0 ÷ 999	Calculated batcher component (multiplied “PuLSEL” and “b coEF” values) expressed in thousandths of user units (value without decimal point): 65535 999 . 999

- 1 - it is recommended to read these registers simultaneously – (1,2) and (7,8), (D3h,D4h) in 2-registers frames, and registers (9h,Ah,Bh,Ch) in 4-registers frames. If single registers are read, data errors are possible because of changes of read value between successive registers readings. Zeroing of **total flow counter** is possible by preset of 0000h to any one of it's registers (09h ÷ 0Ch). Controlling of **batcher counter** is possible by writing appropriate value (0 - zeroing, 1 - start/continue, 2 - pause) into one of the **batcher counter** registers (0Dh ÷ 0Fh). Zeroing of **number of batches counter** is possible by preset of 0000h to any one of it's registers (D3h ÷ D4h).
- 2 - these registers are active only if device is equipped with active 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.

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 (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)

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 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 (“**F 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	83	E0	25

DATA - identification code (2083h)

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.

10. DEFAULT AND USER'S SETTINGS LIST

Parameter	Description	Default value	User's value	Desc. page
Parameters of relay R1 operation ("rELAy1" menu)				
SourCE	Kind of value controlled relay state	FLo		30
SEt P	Relay first threshold	20.0		31
SEt P2	Relay second threshold	30.0		31
HYS	Hysteresis of relay	0.0		31
b PrEc	Precision of thresholds displaying (while relay is controlled due to batcher counter value)	0		31
b unit	The unit of thresholds displaying (while relay is controlled due to batcher counter value)	unit		31
t PrEc	Precision of thresholds and hysteresis displaying (while relay is controlled due to total flow counter value)	0		32
t unit	The unit of thresholds and hysteresis displaying (while relay is controlled due to total flow counter value)	unit		32
modE	Operation mode of relay	„in”		32
t on	Turn on delay of relay	0.0 (sec.)		33
t oFF	Turn off delay of relay	0.0 (sec.)		33
unit	Unit of “t on” , “toFF” parameters of relay	„SEC”		33
ALArMS	Reaction for critical situation of relay	„oFF”		33
Parameters of relay R2 operation ("rELAy2" menu)				
SourCE	Kind of value controlled relay state	FLo		30
SEt P	Relay first threshold	40.0		31
SEt P2	Relay second threshold	50.0		31
HYS	Hysteresis of relay	0.0		31
t PrEc	Precision of thresholds and hysteresis displaying (while relay is controlled due to total flow counter value)	0		32
t unit	The unit of thresholds and hysteresis displaying (while relay is controlled due to total flow counter value)	unit		32
modE	Operation mode of relay	„in”		32
t on	Turn on delay of relay	0.0 (sec.)		33
t oFF	Turn off delay of relay	0.0 (sec.)		33
unit	Unit of “t on” , “toFF” parameters of relay	„SEC”		33
ALArMS	Reaction for critical situation of relay	„oFF”		33

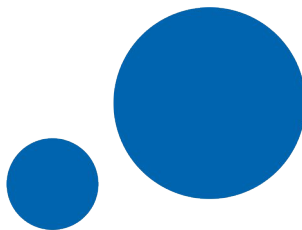
<i>Parameter</i>	<i>Description</i>	<i>Default value</i>	<i>User's value</i>	<i>Desc. page</i>
Parameters of relay R3 operation ("rELAY3" menu)				
SourCE	Kind of value controlled relay state	FLo		30
SEt P	Relay first threshold	60.0		31
SEt P2	Relay second threshold	70.0		31
HYSt	Hysteresis of relay	0.0		31
t PrEc	Precision of thresholds and hysteresis displaying (while relay is controlled due to total flow counter value)	0		32
t unit	The unit of thresholds and hysteresis displaying (while relay is controlled due to total flow counter value)	unit		32
modE	Operation mode of relay	„in”		32
t on	Turn on delay of relay	0.0 (sec.)		33
t oFF	Turn off delay of relay	0.0 (sec.)		33
unit	Unit of “t on”, “toFF” parameters of relay	„SEC”		33
ALArmS	Reaction for critical situation of relay	„oFF”		33
Parameters of relay R4 operation ("rELAY4" menu)				
SourCE	Kind of value controlled relay state	FLo		30
SEt P	Relay first threshold	80.0		31
SEt P2	Relay second threshold	90.0		31
HYSt	Hysteresis of relay	0.0		31
t PrEc	Precision of thresholds and hysteresis displaying (while relay is controlled due to total flow counter value)	0		32
t unit	The unit of thresholds and hysteresis displaying (while relay is controlled due to total flow counter value)	unit		32
modE	Operation mode of relay	„in”		32
t on	Turn on delay of relay	0.0 (sec.)		33
t oFF	Turn off delay of relay	0.0 (sec.)		33
unit	Unit of “t on”, “toFF” parameters of relay	„SEC”		33
ALArmS	Reaction for critical situation of relay	„oFF”		33
Activation of acoustic signal ("bEEP" menu)				
AL	Activation of acoustic signal by critical situation	„oFF”		33
r1	Activation of acoustic signal by relay R1	„oFF”		33
r2	Activation of acoustic signal by relay R2	„oFF”		33
r3	Activation of acoustic signal by relay R3	„oFF”		33

Parameter	Description	Default value	User's value	Desc. page
r4	Activation of acoustic signal by relay R4	„oFF”		33
Configuration of measurement input (“inPUT” menu)				
PULSEL	Flow sensor factor (quantity of pulses per unit)	1.00		34
FrEq	Maximum input frequency	300 (Hz)		34
ZErO t	Maximum time between two following pulses	1.0 (sec.)		34
mEAS t	Width of <i>measurement window</i>	0.5 (sec.)		34
Configuration of current flow display (“FLouu” menu)				
F PrEc	Decimal point position (precision of flow rate displaying)	0.0		35
F coEF	Flow calculation coefficient	1.000		35
F unit	The unit of volume (Cubic measure) for flow rate displaying	unit		35
Ftunit	The unit of time for flow rate displaying	min		35
F or P	Kind of value visible on the display	„FLvAL”		36
Configuration of Batcher Counter reset and displaying mode (“bAtCH” menu)				
b PrEc	Decimal point position (precision of batcher counter displaying)	0.0		36
b coEF	Batch calculation coefficient	1.000		36
b unit	The unit of batcher counter displaying	unit		37
E Clr	Active level/edge of batcher counter zeroing input	oFF		37
m CLr	Manual zeroing of total flow counter	oFF		37
A rES	Batcher autoreset function	oFF		37
Atunit	Time unit of autoreset delay	SEC		37
A dLy	Batcher autoreset delay	0		37
Configuration of Total Flow Counter reset and displaying mode (“totAL” menu)				
t PrEc	Decimal point position (precision of total flow counter displaying)	0.000		38
t coEF	Total flow calculation coefficient	1.000		38
t unit	The unit of total flow counter displaying	unit		39
E Clr	Active level/edge of total flow zeroing input	oFF		39
m CLr	Manual zeroing of total flow counter	oFF		39
Blockade input configuration				
bL inP	Active level/edge of blockade input	oFF		39
Power on initialization configuration				
Init d	Kind of value displayed after device power on	FLo		40

Parameter	Description	Default value	User's value	Desc. page
Configuration of data filtration ("FiLteR" menu)				
vALUE	Filtering ratio	0		40
droP	Measured value change causing of temporal filtering deactivation	20.0 (%)		40
Active current output configuration ("OuTpuT" menu)				
OUTmod	Active current output mode	„0-20" (mA)		40
SourCE	Kind of value controlled active current output	FLo		41
OUT LO	Display value for 0 mA or 4 mA current output	0.0		41
OUT HI	Display value for 20 mA current output	100.0		41
b PrEc	Precision of "OUT LO" and "OUT HI" parameters displaying, while active current output is controlled due to batcher counter value.	0		41
b unit	The unit of "OUT LO" and "OUT HI" parameters displaying, while active current output is controlled due to batcher counter value.	unit		41
t PrEc	Precision of "OUT LO" and "OUT HI" parameters displaying, while active current output is controlled due to total flow counter value.	0		42
t unit	The unit of "OUT LO" and "OUT HI" parameters displaying, while active current output is controlled due to total flow counter value.	unit		42
Lo r	Extension of the bottom of the nominal output range	5.0 (%)		42
Hi r	Extension of the top of the nominal output range	5.0 (%)		42
AL	Current output value on critical exception	22.1 (mA)		42
Passive current output configuration ("OuTpuT" menu)				
OUTmod	Passive current output mode	„4-20" (mA)		40
SourCE	Kind of value controlled active current output	FLo		41
OUT LO	Display value for 4 mA current output	0.0		41
OUT HI	Display value for 20 mA current output	100.0		41
b PrEc	Precision of "OUT LO" and "OUT HI" parameters displaying, while active current output is controlled due to batcher counter value.	0		41
b unit	The unit of "OUT LO" and "OUT HI" parameters displaying, while active current output is controlled due to batcher counter value.	unit		41
t PrEc	Precision of "OUT LO" and "OUT HI" parameters displaying, while active current output is controlled due to total flow counter value.	0		42

Parameter	Description	Default value	User's value	Desc. page
t unit	The unit of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to total flow counter value.	unit		42
Lo r	Extension of the bottom of the nominal output range	5.0 (%)		42
Hi r	Extension of the top of the nominal output range	5.0 (%)		42
AL	Current output value on critical exception	22.1 (mA)		42
Active voltage output configuration (“OutPUt” menu)				
OUtmod	Active voltage output mode	„0-10” (V)		40
SourCE	Kind of value controlled active current output	FLo		41
OUt LO	Display value for 0 V, 1 V or 2 V voltage output	0.0		41
OUt HI	Display value for 5 V or 10 V voltage output	100.0		41
b PrEc	Precision of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to batcher counter value.	0		41
b unit	The unit of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to batcher counter value.	unit		41
t PrEc	Precision of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to total flow counter value.	0		42
t unit	The unit of “ Out LO ” and “ Out HI ” parameters displaying, while active current output is controlled due to total flow counter value.	unit		42
Lo r	Extension of the bottom of the nominal output range	5.0 (%)		42
Hi r	Extension of the top of the nominal output range	5.0 (%)		42
AL	Voltage output value on critical exception	11.0 (V)		42
Display parameters				
briGHt	Display brightness	„bri 6”		43
Configuration of peaks detection function (“HOLD” menu)				
modE	Kind of detected changes	„norm”		43
PEA	Minimum detected change	0.0		43
timE	Maximum time of peak displaying	0.0 (sec.)		43
HdiS	The type of displayed value	„rEAL”		44
H r1	Source of relay R1, and LED R1 control	„rEAL”		44
H r2	Source of relay R2, and LED R2 control	„rEAL”		44
H r3	Source of relay R3, and LED R3 control	„rEAL”		44
H r4	Source of relay R4, and LED R4 control	„rEAL”		44

<i>Parameter</i>	<i>Description</i>	<i>Default value</i>	<i>User's value</i>	<i>Desc. page</i>
HOUt	Source of current output control	„rEAL”		44
Settings of access to the configuration parameters (“SECU” menu)				
Acc r1	Permission to changes of relay R1 threshold without of the user password knowledge	on		44
Acc r2	Permission to changes of relay R2 threshold without of the user password knowledge	on		44
Acc r3	Permission to changes of relay R3 threshold without of the user password knowledge	on		44
Acc r4	Permission to changes of relay R4 threshold without of the user password knowledge	on		44
RS 485 interface configuration (“rS-485” menu)				
Addr	Device address	0		44
bAud	Baud rate	9600 (b./sec.)		44
mbAccE	Permission to changes of configuration registers	„on”		44
mbtimE	Maximum delay between received messages	0		45
rESP	Additional delay of answer transmission	„Std”		45
Configuration of numerical parameters edition				
Edit t	Numerical parameters edit mode	dig		45



**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**