# H3, H7 Hydro Controller

*user manual version 1.18E*

## *Telemetry station*
## *Control unit*
## *Flowmeter*




FIEDLER
ELEKTRONIKA PRO EKOLOGII

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# 1 Safety instructions

- Dangerous voltages are present in the equipment which can cause fatal injuries. Before beginning installation or starting work to correct a fault, the equipment must be switched off without fail by disconnecting it from the power supply. Likewise, all connected or controlled equipment must be disconnected from the power source.
- Do not touch uncovered components or terminal screws when the equipment is live!
- The installation must be carried out by a person with the necessary qualifications for the installation of electrical equipment. The installer must carry out the installation in accordance with all instructions, regulations and standards relating to safety and electromagnetic compatibility.
- If the safety or health of persons or serious damage to property could be endangered as a result of a malfunction of the equipment, independent measures must be taken or equipment installed to eliminate this risk.
- For the correct operation of the device, it is necessary to make complete and correct settings of the device parameters with respect to its use and all connected devices. Incorrect or incomplete settings may cause malfunction which may result in damage or failure of the instrument or injury to the operator of the equipment.
- All connected downstream equipment must comply with the relevant standards and safety regulations and be equipped with suitable anti-interference filters and surge protection.
- Do not use in explosion hazardous areas!
- Do not use in areas of excessive vibration**.**
- The faulty equipment must be disconnected and handed over to the manufacturer for repair.
- For hygiene reasons, only clean and properly packaged products should be sent for repair.
- Observe the correct polarity when inserting or connecting batteries.
- Spilled or damaged batteries and accumulators can cause acid burns if they come into contact with the skin, so wear suitable protective gloves when handling damaged batteries.
- Batteries must not be disassembled, short-circuited or thrown into a fire. In all these cases there is a risk of explosion.
- The manufacturer is not liable for damages resulting from improper installation, improper maintenance or use contrary to the recommendations in the operating instructions.



# 2 Basic description

Hydro Controllers H3, H7 are multifunctional telemetry stations designed for data acquisition and control of technology in the water industry. They can also be advantageously used in various industrial and environmental monitoring applications.

High durability and operational reliability were decisive criteria in the development of the H3 and H7 telemetry units. For these reasons, the control electronics themselves are always housed in a robust aluminium casting, regardless of the type and size of the connection plate. The USB connector and the built-in GSM/GPRS communication module also have a high IP67 protection rating.

The software of both devices includes control routines including PID control, which allow the connected technology to be controlled using 4-20 mA current outputs and relays based on measured data. For building larger systems, several types of external I/O modules with RS485 bus are available, allowing full use of the large number of binary and analogue recording channels available on both the H3 and H7 units.

The H3, H7 units include many self-diagnostic procedures, from measuring the humidity inside the unit, to various control channels monitoring the voltages and currents flowing to the connected sensors and sensors, to integrating the measurement of the power consumed from the battery backup.

The large colour touchscreen and keypad, together with the clear and colour-coded MENU, contribute to the easy intuitive operation of the unit.

Several locking enclosure options are available for field installation, including mounting brackets and poles.

The Hydro Controllers H3, H7 are characterized by their robust mechanical design, small dimensions and modern electronic circuit concept with very low current consumption, which allows them to be operated permanently only from the battery without external mains power supply. They are suitable for direct use in outdoor environments as well as in permanently wet environments of waterworks.

## TYPICAL APPLICATIONS

- **Control and monitoring of waterworks facilities**
- **Technological process control**
- **Limnographic stations and LVS systems**
- **Weather stations**
- **Remote meter reading and data acquisition and collection in the field**
- **Wireless network data concentrators**

## 2.1. Basic concepts

***Unit*** Designation for Hydro Controller H3 or H7, including communication module and terminal board. An external power supply, solar panel with accessories or backup power battery are not included in the unit and must be ordered separately.

***Connection plate*** It is part of the H3, H7 unit and contains a number of terminals for connecting external sensors and transducers. In addition, it also contains binary and possibly analogue current outputs. Each connection board also includes the unit's power supply circuitry and terminals for connecting this external power supply. All inputs and outputs of the connection board are provided with suitable surge protection. The connection board is connected to the unit's control electronics by a detachable flat cable with connectors at both ends.

***Cabinet, box*** H3, H7 units can be housed in a protective enclosure that protects the unit, and often the power battery, from the weather. The user has the option to choose from several enclosures, which are specified in the chapter 3.2.

***Inputs*** The number and type of inputs is determined by the type of connection board. A measured signal applied to one input can be processed differently in multiple recording channels. The inputs of the unit include RS485 and SDI-12 serial buses.

***Outputs*** The number and type of outputs is also determined by the type of connection board used. The binary outputs are relay contacts or solid state relays, the analogue outputs are a controlled current source in the range of 4-20 mA.

***Data memory*** The measured values of the signals at the individual inputs, converted to the required units of measurement, are stored in the recording channels of the data memory at a set interval. The storage interval can be set with a resolution of 1 second to 1 day.

The data memory has a capacity of 6 MB and can hold up to 1 million values, including the date and time they were taken. When the memory is full, the oldest stored values are cyclically overwritten.

***Event diary*** Units H3, H7 record emergency conditions and facts in the event log - receipt or sending of SMS, occurrence of an error, network power failure, etc. The event log also records the total time of operation of the device, the time of operation with an error, the time of device shutdown and the date of device installation.

***Economical operating mode*** The power saving mode is usually set when the station is to be installed in field conditions without the possibility of a permanent external power supply. In power saving mode, the instrument is in very low power mode most of the time with the power to the sensors and all connected sensors disconnected and only wakes up at a set time interval to take measurements.

***Communication module*** The H3, H7 telemetry station transmits the measured values to the database on the server via an optional communication module (GSM/GPRS, Ethernet or WIFI). The GSM communication module can also send warning or informative SMS and receive query or control SMS. Via remote communication, parameter settings can also be changed and firmware upgrades can be performed.

***Datahosting on the server*** Hydro Controller H3, H7 uses datahosting set up on the manufacturer's server. The user does not have to set up and run his own server. Authorized users can access the data stored on the server at any time via a standard web browser. In addition to graphical and tabular visualization, the server also enables statistical calculations of balance flow rates, limit value searches, data exports in several formats to other systems, printing of monthly balance overview reports, sending of e-mails and other functions.

***Setting and changing parameters*** Parameters of the H3, H7 units can be changed locally using the keyboard and touch screen of the station, from a PC (laptop) by connecting a cable to the USB connector of the station or remotely via a web browser and data server. The MOST4 software product is designed for setting parameters via USB and data server.

The MOST4 program allows you to save the created or changed parameters in a parameter file for later possible return to the original device parameters.

***Measuring stations*** The complete unit assembly, which is placed in a suitable cabinet with the connection board and power supply system, has connected sensors, measuring probes and possibly also input/output modules and is capable of independent data acquisition and storing.

## 2.2. Overview of program procedures and functions

The following overview briefly summarizes the program procedures and functions that are fully available to the station users during its parameterization and setup. Most of these functions will be described in detail in the second part of the user manual.

***Analog measurement channels***

- Up to 32(H3) / 96(H7) recording channels for storing measured values and controlling analogue outputs, including 64 channels with counters for storing leaked volumes, rainfall or moto-hours.
- Calculation and storage of the measured quantity in set units of measurement, non-linear signals can be corrected by a 2nd order polynomial.

***Binary channels***

- Up to 64/208 recording channels for storing binary inputs and controlling binary outputs, evaluating trigger conditions, and sending data or messages.

***Alarms***

- Separate limit and gradient alarms for each recording channel.
- For the duration of the alarm on the channel, you can set a different frequency of data recording to memory and a different frequency of data sending to the server than in the normal state.

***Data transmission***

- Encrypted automatic data transmissions to the server at regular intervals via the internal communication module.
- Extraordinary sending of measured data including archived values to the data server when the trigger condition is met.
- Up to 32 contacts in the phone book can be grouped into 8 groups (adjustable permissions for queries and control for individual numbers in the list).
- Alert system based on 48 user configurable SMS alert messages. Each message can be assigned to an addressee or group of addressees and any text with the possibility of inserting the current status of the monitored variable.
- Informative SMS based on command line or query SMS (active values, max. , min. , balance, counter states, ...).
- SMS commands for control and simulation of outputs (binary and analogue), setting of selected coefficients and parameters, forced sending of data, ...).
- Execution of SMS commands is conditional on entering the correct password.

***Server services***

- Automatic switching between standard and daylight saving time, time zone selection, automatic time adjustment according to the data server.
- H3, H7 parameterization and firmware upgrade via server.
- Automatic storing of the parameter file on the server after each parameter change

***Operational diary***

- Recording of emergency operating conditions and alarms, recording of received and sent SMS messages, recording of received commands from the server, recording of GSM signal quality.

***Flowmeter***

- Up to 4 independent flowmeters for open profile flow calculations.
- Consumption equations for calculating surface flows at standard and user-defined spillways, H-Q tables.
- The flow can be corrected by the ratio of the levels before and after the overflow.
- Calculation functions for measuring flow in an open channel using level and velocity.

***Regulator***

- Up to 4 independent controllers for technology control. PID discrete controller with adjustable parameters, feedback selection and setpoint source selection.

***Authorisation levels***

- The control of the unit includes 3 levels of permissions with differentiated access to the device parameters. Login of individual users and logging of their activity.

***Set point parameters***

- Up to 48 easily user-adjustable operating parameters. Even users with operator-level permissions can enter the value of a Set point parameter.

## 2.3. Variant versions of H3, H7 and Q2, E2 units



Modular units H3, H7 are available in several versions, differing in communication modules, type of connection board and mechanical design. The basic differences between the H3 and H7 units and the derived special purpose units Q2 and E2 can be seen from the following table:

| Recording channels , SW modules and functions | H7 | H3 | Q2 | Q2/CDO | E2 |
|---|---|---|---|---|---|
| **Number of analog channels (ACH)** | 96 | 32 | 16 | 16 | 16 |
| **Number of binary channel (BCH)** | 208 | 64 | 16 | 16 | 16 |
| **Number of leaked volume and precipitation counters** | 64 | 32 | 16 | 16 | 16 |
| **Number of Flow Meters / WHO** | 4/0 | 4/0 | 4/0 | 4/1 | 0/0 |
| **Number of PID controllers** | 4 | 4 | 4 | 4 | 4 |
| **Calibration procedures for water quality sensors** | YES | YES | NO | NO | YES |

For the sake of simplicity, the following description will be devoted to the H7 unit, while everything mentioned above, with the exception of the number of recording channels and SW modules, will also be valid for the H3 unit.

*Table 1: The order code of the unit specifies its composition according to the following key:*

**Basic unit design**

| | |
|---|---|
| **H3** | Multi-channel control unit, flow meter, level meter, oximeter, pH meter, ... , 32 recording channels |
| **H7** | Multi-channel control unit, flow meter, level meter, oximeter, pH meter, ... , 96 recording channels |
| **Q2** | Quadruple level and flow meter, 16 counters and 4 PID controllers, 16 recording channels |
| **Q2/CDO** | Flow meter for KDO sensor, 3 additional flow meters, 16 counters and 4 PID controllers, 16 recording channels |
| **E2** | Control unit for water quality measurement: oximeter, pH meter, ... , 4 PID controllers, 16 recording channels |

**Communication modules [chap.8., p. 56]**

| | |
|---|---|
| U | Without communication module - USB mini only (IP67) |
| G | Internal GSM module including GSM connector and small rod antenna |
| E | Internal Ethernet module for internet connection |
| W | Internal WiFi module for internet connection including antenna connector and small WiFi antenna |

**Connection plate type [chap. 4., p. 21]**

| | |
|---|---|
| TB1 | In: 4x AIN, 4x BIN; Out: 4x relay, 2x RS485; Un= Pb battery, Uext. 14-28 V (solar), IP67 |
| TB2 | In: 4x AIN, 4x BIN; Out: 4x relays, 2x 4-20 mA, 2x RS485; Li-Ion battery, Un=12-28 V, IP67 |
| TB3 | In: 4x AIN, 4x BIN; Out: 4x relays, 2x 4-20 mA, 2x RS485; Li-Ion battery, Un=230 V AC, IP67 |
| TA4 | In: 8x AIN, 6x BIN, 1x SDI-12; Out: 2x relay, 2x RS485; Un= Pb battery, Uext. 13,8 V |
| TA4E | In: 8x AIN, 6x BIN, 1x SDI-12; 2x Pt100; Out: 4x relays, 2x RS485; Un= Pb battery, Uext. 13,8 V |
| TA5 | In: 6x 0(4).. 20 mA, 1x 0..10VDC, 8x BIN; Out: 2x relay, 2x RS485; Un= Pb battery, Uext. 13,8 V |
| TA5P | In: 6x 0(4).. 20 mA, 1x 0..10VDC, 8x BIN; Out: 2x relay, 2x RS485; Un= Pb battery, Uext. 13,8 V |

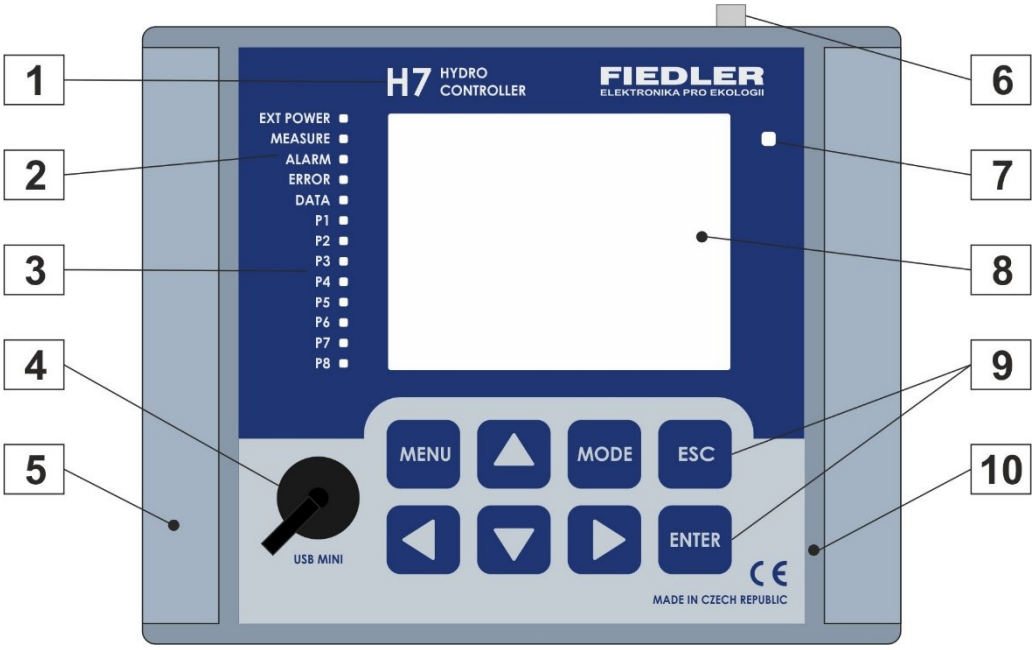
**Mechanical design [chap.0., p. 9]**

| | |
|---|---|
| B | Aluminium box 140x160x70 mm, 5x cable gland, IP67 |
| P | Without enclosure, panel mounted (in the door of the switchboard) |
| A | Enclosure ARIA 300x200x170 mm, IP66, 5x cable gland |
| AZ | Enclosure ARIA 300x200x170 mm, IP66, lockable handle, 5x cable gland |
| AK | Enclosure ARIA 300x200x170 mm, IP66, portable design with 4 connectors, handle |
| AKZ | Enclosure ARIA 300x200x170 mm, IP66, portable, 4 connectors, handle, lock |
| S | Enclosure SCH 400x300x200 mm, IP66, 5x cable gland |
| SZ | Enclosure SCH 400x300x200 mm, IP66, 2 lockable handles, 5x cable gland |
| N | Stainless steel enclosure 420x280x200 mm, IP66, 2 handles, 9x metal cable gland |
| NZ | Stainless steel enclosure 420x280x200 mm, IP66, 2 lockable handles, 9x metal cable gland |

| | |
|---|---|
| **H3 - G - TA4 - AZ** | Unit H3 with GSM communication module and possibly TA4 board in ARII with lock |

# 3 Mechanical design

## DESCRIPTION OF THE CONTROL PANEL OF THE H7 UNIT




| | |
|---|---|
| 1 | Instrument type code |
| 2 | Signalling LEDs: power, measurement, alarm activation and data communication |
| 3 | Signalling LED for switching of binary inputs |
| 4 | USB - mini connector under removable cover, connector protection IP 67 |
| 5 | Removable plastic caps to cover the unit's mounting screws |
| 6 | GSM connector type SMA-F for connection of external GSM antenna |
| 7 | Ambient light intensity measurement for automatic brightness control of the graphic display |
| 8 | Backlit graphic 3.5" touchscreen display |
| 9 | Eight fingerboards for manual control of the unit and adjustment of selected parameters |
| 10 | Aluminium box lid containing all electronics except the connection plate |











## METHODS OF MECHANICAL DESIGN

The H7 unit is available in several variants, which differ in the type of protective housing or the way the unit is mechanically mounted:

- Unit without external protective enclosure
- Unit adapted for installation on a panel or in a switchboard door
- Unit placed in one of the offered protective enclosures

*H7 unit mechanical design codes*

| | |
|---|---|
| -B | Aluminium box 140x160x70 mm, 5x cable gland, IP67 |
| -P | Without enclosure, panel or cabinet door mounting |
| -A | Enclosure ARIA 300x200x170 mm, IP66, 5x cable gland |
| -AZ | Enclosure ARIA 300x200x170 mm, IP66, lockable handle, 5x cable gland |
| -AK | Enclosure ARIA 300x200x170 mm, IP66, portable design with 4 connectors, handle |
| -AKZ | Enclosure ARIA 300x200x170 mm, IP66, portable design with 4 connectors, handle, lock |
| -S | Enclosure SCH 400x300x200 mm, IP66, 5x cable gland |
| -SZ | Enclosure SCH 400x300x200 mm, IP66, 2 lockable handles, 5x cable gland |
| -N | Stainless steel enclosure 420x280x200 mm, IP66, 2 handles, 9x metal cable gland |
| -NZ | Stainless steel enclosure 420x280x200 mm, IP66, 2 lockable handles, 9x metal cable gland |

## ENCLOSURES FOR H7 UNIT PLACEMENT

Plastic or metal enclosures are the basic mechanical protection of the H7 unit against weathering, intentional or unintentional damage and theft.

The enclosures have a high protection rating of IP 66 and are mechanically very resistant. Optionally, each type of enclosure can be supplied with a lockable handle.

## CABLE GLANDS

Power and signal lines reach the H7 unit mounted in the enclosure via metal or plastic cable glands located on the bottom of the enclosure, or via robust IP67-rated connectors on the -AK and -AKZ variants.

The number and size of cable glands are always specified in the cabinet description. The manufacturer permits the fitting of additional glands of the same type if the type and dimensions of the enclosure permit.

## SEMI-PERMEABLE FILTER

In addition to the cable glands, each enclosure is also equipped with a special semi-permeable filter, which serves to equalize the atmospheric pressure inside the enclosure with the outside environment and thus prevents condensation of water vapor inside the enclosure.

## CONNECTION PLATE

The connection board contains input and output terminals and is used to connect input signals (measuring sensors and sensors) and output signals (relay and current outputs) to the H7 unit. The H7 unit communicates with the external modules to be controlled or receives control commands from the higher-level system using the RS485 digital interface on the terminals of the connection board. The connection board is connected to the control panel of the H7 unit by a detachable 40-core flat cable.

The specific mechanical design of the unit also determines the type of connection plate used. The description of the connection plates is described in detail in chap. 4.1 on p. 21.

# 3.1. Design without external protective housing

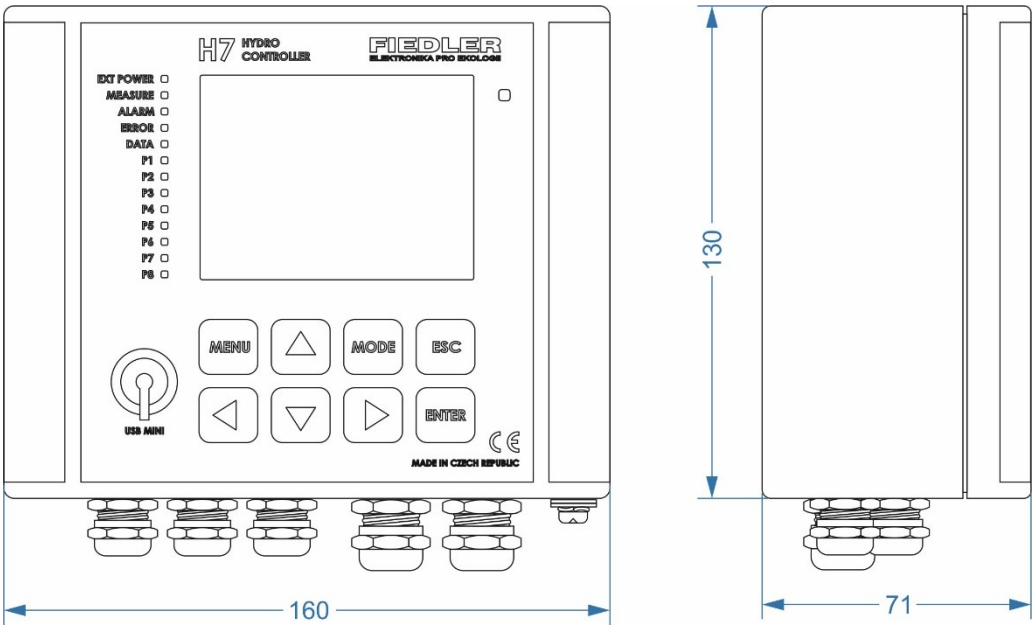
## 3.1.1. Aluminium box (-B)




The basic version of the device without external protective housing for direct installation in waterworks and industrial buildings, halls, halls and other places away from direct weather influences, especially direct sunlight.

The H7 unit is housed in a two-piece demountable aluminium alloy box, which is treated with a baked grey lacquer on the surface. The mechanical design of the box allows it to be installed directly indoors or outdoors and has a high IP67 rating, which protects the interior of the box with the H7 unit from adverse environmental influences.

Nevertheless, it is recommended to use a KRH, KRV type protective cover when placing the unit outdoors or to place the entire aluminium box with the H7 unit in one of the offered types of protective enclosures.




*Dimensions of the Al box (h x w x d): 130 x 160 x 71 mm, protection class: IP67*

### CABLE GLANDS

The metal cable glands are located on the underside of the cabinet.

1. 3x M20 gland (cable diameter 3 to 12 mm)
2. 2x M16 gland (cable diameter 4 to 8 mm)
3. 1x pressure compensator

### CONNECTION PLATE

In addition to the H7 control unit itself, the metal box also contains a connection plate. The connection plates TB1, TB2 and TB3 are available, which are adapted in shape and size for easy and quick installation in this type of enclosure. For prescribed supply voltages and other differences between the different types of connection plates, see chap. 4.1 on p. 21.

## INCREASED COVERAGE

Exceptional protection for the H7 unit and the used connection board in locations with aggressive wet environments is offered by the combination of the unit housed in an IP67 (-B) rated aluminium box, which can also be inserted into an ARIA32, Schneider or stainless steel N enclosure (all enclosure types will be described in the following text).

The lockable design of such a cabinet also protects the H7 unit from vandalism.

## BRACKET WITH COVER FOR FIXING THE CABINET

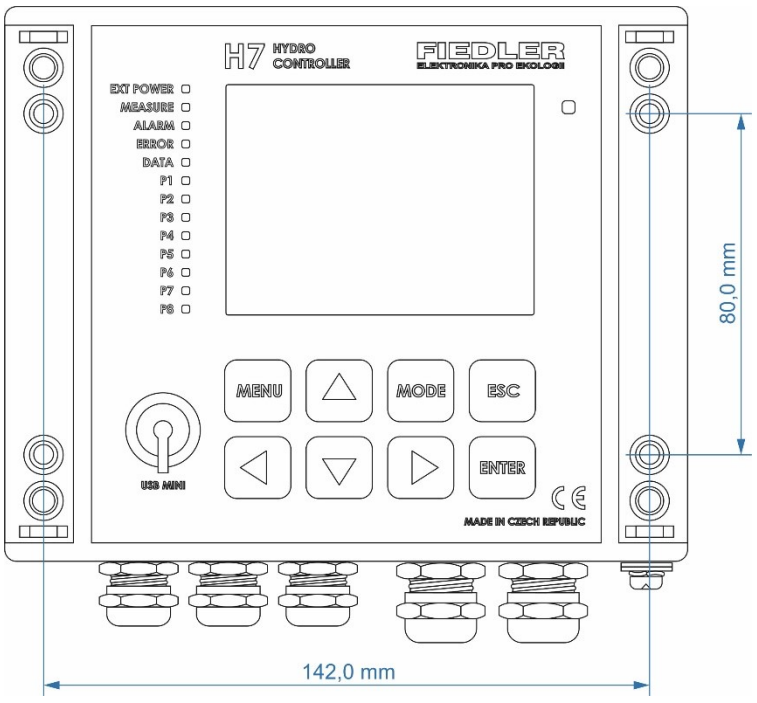
In an outdoor environment, it is advisable to protect the front of the device from sunlight and rain. The recommended installation of the cabinet is by means of KRV-2 (mounting on a vertical post) or KRH-2 (mounting on a horizontal railing) brackets, which also form the basic protection of the instrument from the weather.




When using the unit with a GSM communication module and an output antenna, the KRV-2-G and KRH-2-G holders are designed to contain an integrated GSM antenna cover.

***Mounting holes for Al box***

If box B is to be mounted directly to the walls or mounting panel without KRH-2, KRV-2 brackets, then it is mounted using mounting holes that are located outside the protected area.

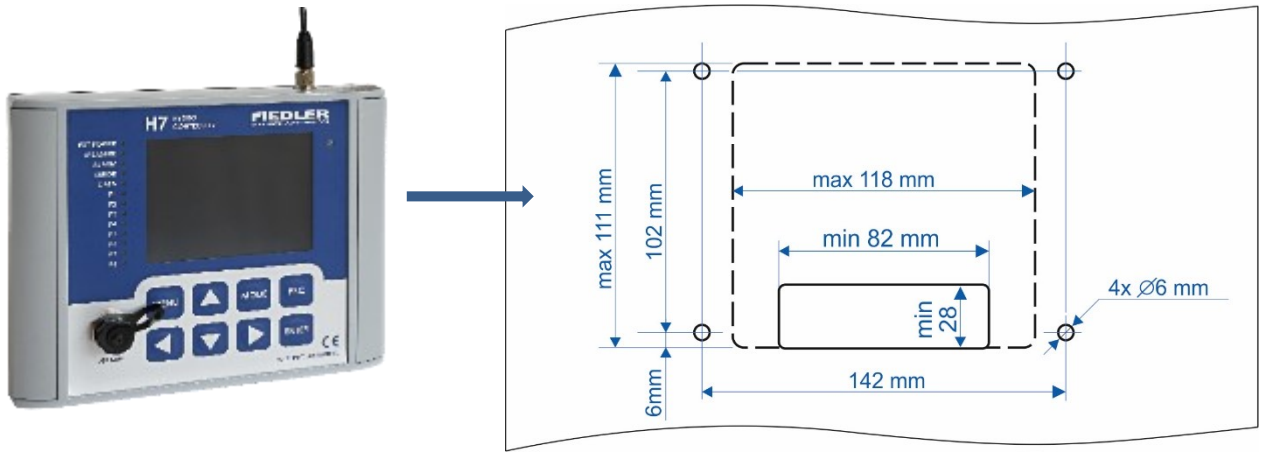



*Aluminium box mounting holes*

## 3.1.2. Design of the unit for mounting on the front panel

The TA5/P type connection board, power supply and backup battery are located behind the panel in the switchboard body. The connection board is connected to the control unit by a flat cable. The installation of the unit into the panel requires mechanical modifications to the panel - the creation of a mounting hole for stretching the 40-core interconnecting cable and 4 holes for the tightening screws.

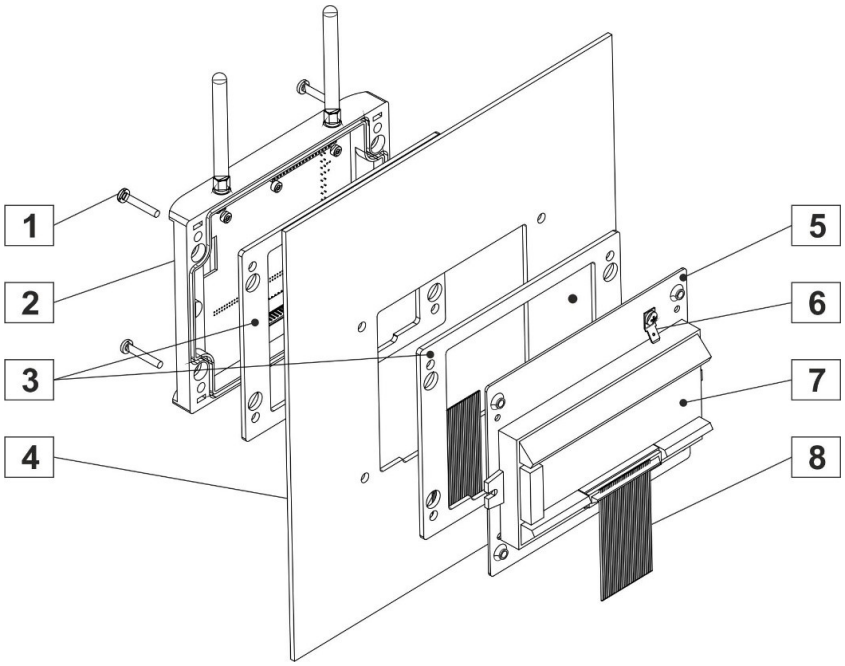
The installation of the unit on the door of the switchboard does not violate the enclosure of the switchboard, because thanks to the double sealing profile, this type of mounting achieves a high protection rating of IP67.




***Mounting hole***

The minimum dimensions of the central mounting hole for the flat cable outlet are 82 x 28 mm. The maximum dimensions are 118 x 111 mm (dashed outline in the top picture).

***Installation of the unit into the panel:***




| | |
|---|---|
| 1 | 4x M5x30 screw (included) for pulling the unit lid to the rear cover [5] |
| 2 | Metal cover of the unit with built-in control board, communication antenna and connector for connection of 40-core flat cable from TA4 connection board |
| 3 | Rubber sealing profile 3 mm thick |
| 4 | Mounting panel with screw holes and one central hole for flat cable |
| 5 | The rear metal cover carrying the TA4 connection plate has M5 mounting threads in the corners |
| 6 | Faston 6.3 x 0.8 mm for connection of protective PE conductor |
| 7 | Connection plate TA4 |
| 8 | Interconnecting flat 40 core cable with connectors at both ends. The cable will be clamped between the rear metal cover [5] and the rear rubber sealing profile [3] after installation. |

# 3.2. Enclosures for protection of H7 units

When installing units outdoors, it is often necessary to protect the H7 unit not only from the weather but also from intentional and unintentional damage and theft. There are 3 types of enclosures in the basic H7 range:

- Plastic housing ARIA32 for max. 9 Ah battery
- Schneider plastic housing for up to 45 Ah battery
- Stainless steel housing for up to 45 Ah battery

The enclosures have a high protection rating of IP 66 and are mechanically very resistant. Optionally, each type of enclosure can be supplied with a lockable handle.

## 3.2.1. General principles for installing cabinets

The cabinet is fixed to the wall or pillar using four screws and dowels, usually to a height of 150 cm from the ground, so that the unit's display is at eye level.

The mounting holes located in the corners of the station are used for mounting the device (see the dimensional sketch in the description of the individual cabinets). The mounting holes are located outside the sealed area and are inaccessible to unauthorized persons after locking the door (not applicable for stainless steel enclosure).

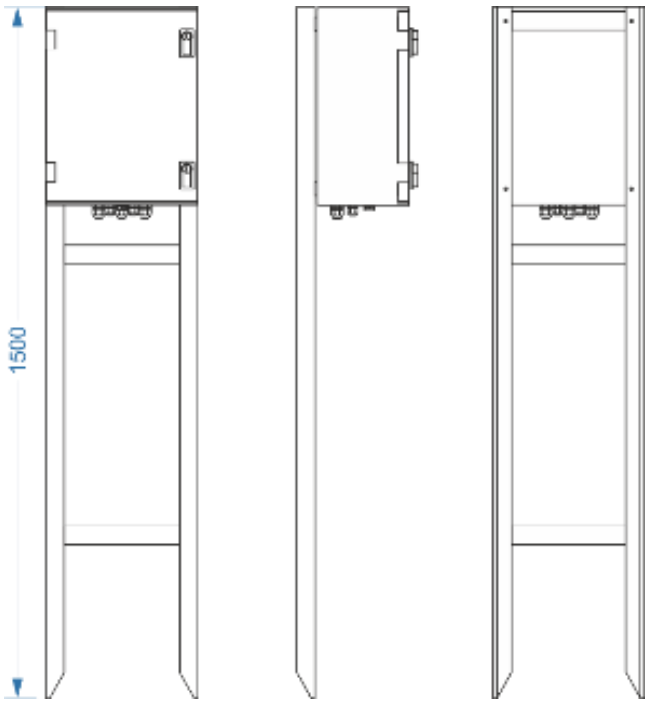
If possible, then install the cabinet with the H7 unit in a location free of persistent condensing moisture. If this cannot be avoided, extra care must be taken when closing the station door. The sealing rubber profile must not be dirty and the lock on the door, if installed, should be treated with silicone oil to seal any leaks.

Outdoor installation in an open area does not harm the station with the cabinet and it is not necessary to hide it from the rain under the canopy.

### STANDS FOR PLACING PLASTIC CABINETS

For installations of plastic enclosures in the field, the robust metal stand ST2 (ARIA enclosure) or ST3 (Schneider enclosure) with a height of 1500 mm can be supplied, which is surface treated with hot-dip galvanizing. The rack can be bolted to a railing or concrete base using clamps or otherwise suitably anchored in the open ground.

The cabinet is attached to the stand using the 4 screws supplied. The mounting holes for the screws are only accessible when the cabinet door is opened.




*Metal stand ST3 for Schneider cabinet*

## 3.2.2. ARIA32 (-A -A/Z) cabinet for fixed installation




Universal plastic protective enclosure type ARIA32 with high IP66 protection is designed for fixed installation of H7 units.

To increase the mechanical strength, the polyester material of the enclosure is hot reinforced with glass fibre. The mechanical design of the cabinet is intended for outdoor and indoor areas where the stations can be fixed on a wall, pillar or on a special stand or mast. The substation is supplied in light grey (RAL 7035).

When installing the cabinet outdoors, it is advisable to glue the supplied plastic canopy to the top edge of the cabinet on request.

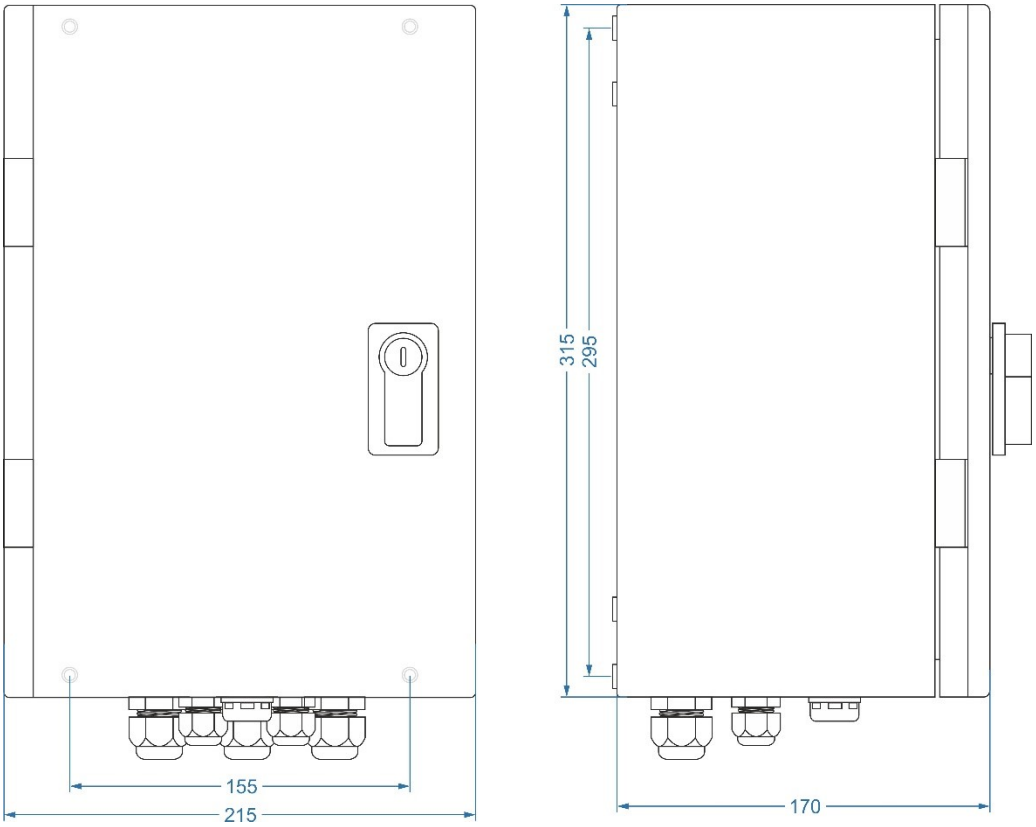
Version -A/Z indicates a cabinet with a lockable handle and IP65 protection.

### CABLE GLANDS

The plastic cable glands are located on the underside of the enclosure and are IP67 rated:

- 3x M20 gland (cable diameter 3 to 12 mm)
- 2x M16 gland (cable diameter 4 to 8 mm)
- 1x pressure compensator

On request, ARIA32 enclosures can be supplied with a different number of cable glands. The fitting of additional glands of the same type by the installer when installing the unit is also permitted.




*Dimensions of the ARIA32 enclosure (h x w x d): 315 x 215 x 170 mm, protection class: IP66*

## ACCUMULATOR

A standard 12 V/7.2 Ah maintenance-free battery pack can be placed in the ARIA32 enclosure with the H7 unit as a backup power supply for applications recharged from a mains voltage source, or a 12 V/9 Ah battery pack for applications without external power supply or applications recharged by a solar panel.

## INSTALLATION METHODS

The ARIA32 cabinet is installed on a wall, pillar or other larger substation using 4 reinforced through holes in the corners of the cabinet. These are located outside the sealed area and are only accessible when the cabinet door is opened (anti-theft protection).

The mounting holes have a horizontal spacing of 155 mm and a vertical spacing of 295 mm and are blinded by the cabinet manufacturer (the holes must be "punctured" with a screwdriver or other sharp tool before installation).



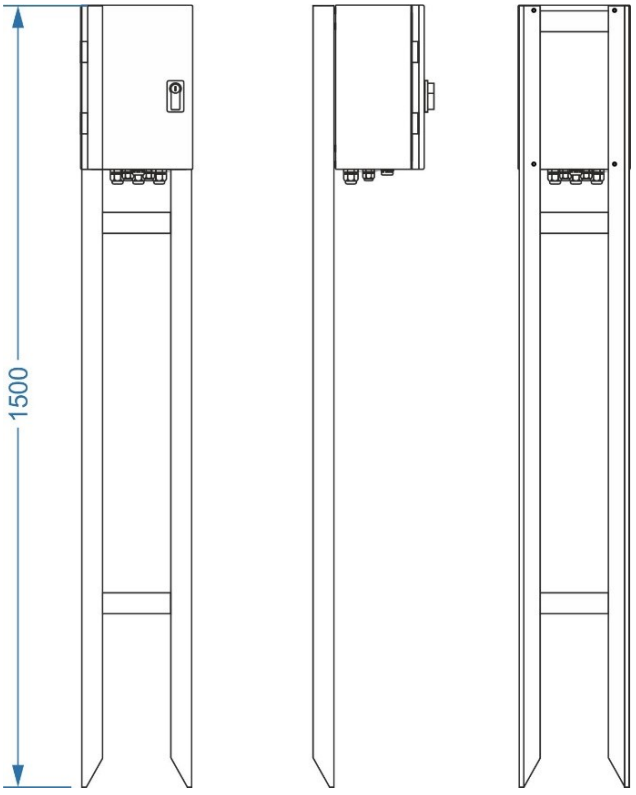
## INSTALLING THE CABINET ON THE COLUMN

The substation can be mounted on a pole or mast with a diameter greater than 40 mm using two stainless steel **DSS-2** brackets and 20 mm wide "Bandimex" strips. The brackets can be ordered already mounted on the back of the ARIA32 enclosure.

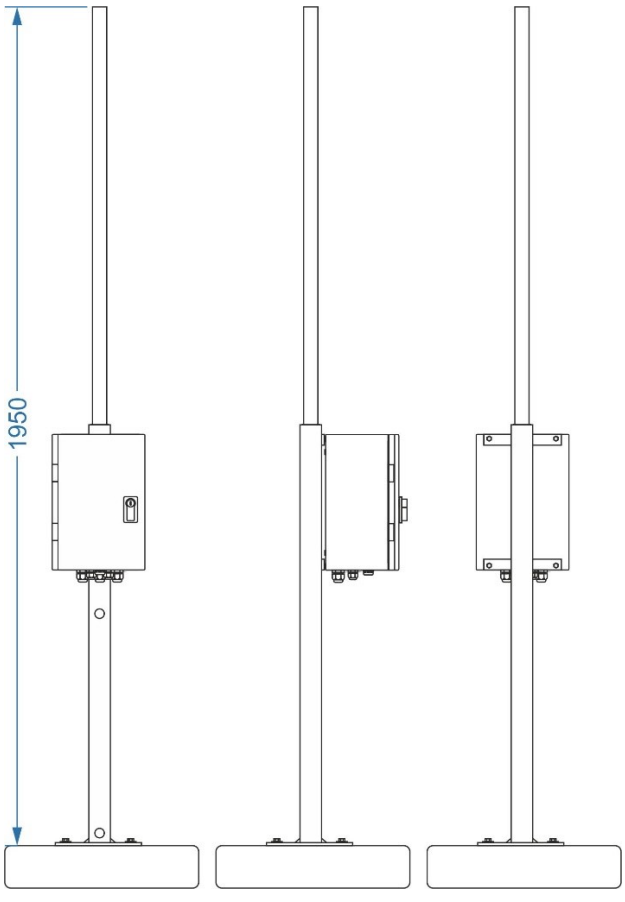
## STANDS AND POLES FOR CABINET PLACEMENT

For installation of the ARIA32 in the field, a rack marked **ST2** or a mast type **STO-MET-02** can be used. These are sturdy weldments that are protected against weathering by hot-dip galvanizing.

The enclosure is attached to these brackets using the 4 M5x30 screws supplied. The mounting holes for the screws are accessible when the cabinet door is open, and because the screw heads are hidden in the cabinet, they make it impossible to remove the cabinet without forcing it open.



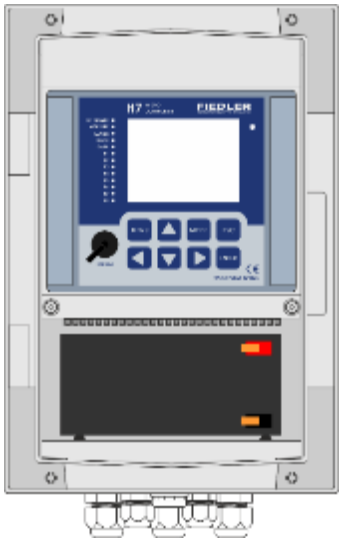

*Stand ST2*

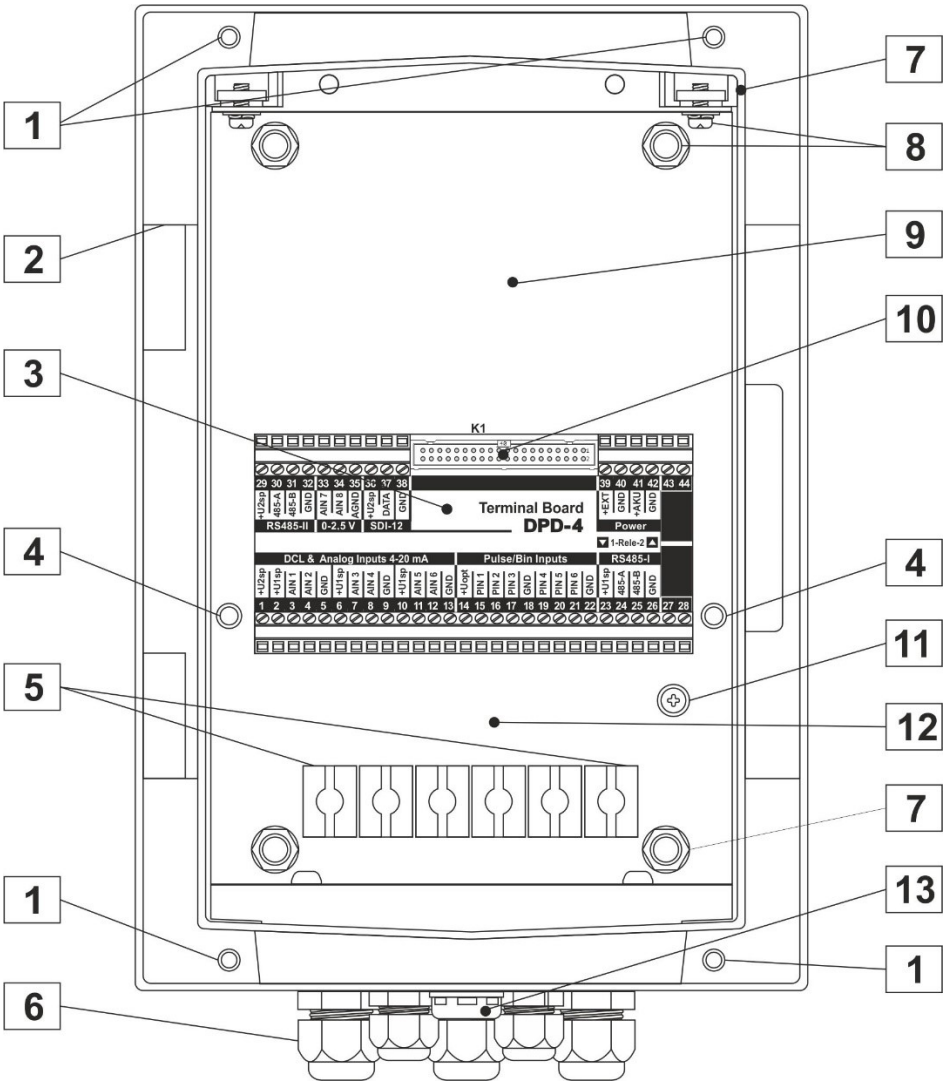



*Mast STO-MET-02*

## INTERNAL LAYOUT OF THE ARIA32 CABINET

The H7 control panel and its connection plate are mounted inside the enclosure using a set of mounting plates with a durable finish. The following figure shows the location of the connection plate inside the ARIA32 enclosure after the H7 control panel and power battery have been removed.






| | |
|---|---|
| 1 | Mounting holes with 6 mm diameter for mounting the cabinet on a wall or ST-2 stand. The blinded holes must be "punched" before mounting. |
| 2 | ARIA32 cabinet door hinge holder |
| 3 | Connection plate |
| 4 | Spacing posts for fixing the control panel of the H7 unit |
| 5 | Brackets for cables pulled to the terminals of the connection plate |
| 6 | Cable glands M20 (3 pcs) and M16 (2 pcs) |
| 7 | ARIA32 enclosure edge enclosing the enclosure interior with IP66 protection |
| 8 | Screws for mounting the mounting plates to the ARIA32 enclosure |
| 9 | Base mounting plate, space for H7 unit and I/O modules |
| 10 | Connector K1 connecting the connection board to the control panel |
| 11 | Clamp for connection of protective PE conductor |
| 12 | Space for a 12 V / 7.2 or 9 Ah power battery |
| 13 | Semi-permeable filter for pressure equalization inside and outside the enclosure |

## 3.2.3. Portable version of the ARIA32 (-AK, -AK/Z)



The portable IP66-rated ARIA32 enclosure includes a handle, rubber feet, 3 connectors for connecting sensors and 1 connector for connecting an external 13.8V power supply. The connector pins are protected against contamination by a removable sealed cap.

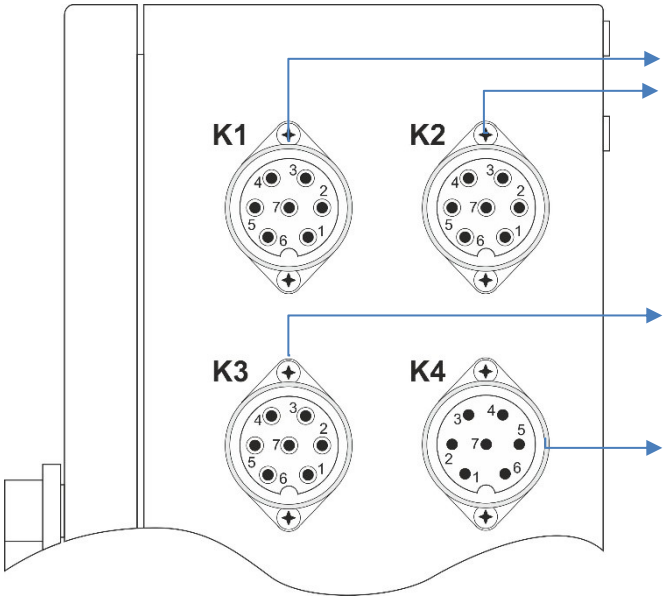
The portable design of the station is suitable for field conditions and wherever it is necessary to frequently connect or disconnect different types of measuring sensors and probes, or where the station is frequently moved from one location to another.

The dimensions of the cabinet and its internal layout are identical to the previous ARIA32 version. In addition to the H7 unit and the connection plate, the enclosure can also accommodate a 12V / 9Ah (7.2Ah) power supply battery.

Variant -AK/Z indicates a cabinet with a lockable handle and IP65 protection.

Cabinet dimensions including connectors, handle and feet: 390 x 260 x 185 mm

***Detailed layout of connectors K1 to K4***




*Connecting the contacts of connectors K1 to K4*

| Contact | K1-pipes | K2-tubes | K3-pipes | K4-pins |
|---|---|---|---|---|
| 1 | +Unap | +Unap | +Unap | +13,8 V |
| 2 | AIN1 | AIN2 | AIN3 | - |
| 3 | - | - | Relay 1 | - |
| 4 | - | - | Relay 1 | - |
| 5 | RS485-B | RS485-B | RS485-B | - |
| 6 | RS485-A | RS485-A | RS485-A | - |
| 7 | GND | GND | GND | GND |

## 3.2.4. SCHNEIDER cabinet (-S, -S/Z)



Schneider's universal polyester enclosure is suitable for applications where a larger power battery needs to be placed in the enclosure along with the H7 unit.

The Schneider enclosure is designed for indoor and outdoor use (IP66 protection). The polyester is reinforced with fiberglass for added strength and durability.

The cabinet can be supplied either with handles (-S) or with two lockable closures (-S/Z). The closures are routed outside the sealed area and therefore do not affect the enclosure's degree of protection.

For the installation of the Schneider enclosure, either the hot-dip galvanized ST3 stand or the stainless steel DSS2 brackets can be ordered for the installation of the enclosure on a mast or pole using 20 mm wide "Bandimex" strips.

***Blinded mounting holes***

The cabinet mounting holes are only marked and need to be drilled before the actual installation. As the holes are in a sealed area of the enclosure, a suitable rubber gasket must be inserted under the washers of the installation screws or bolts.

***Space for a larger battery***

A maintenance-free 12 V battery with a maximum capacity of up to 45 Ah can be installed in the Schneider enclosure together with the H7 unit.

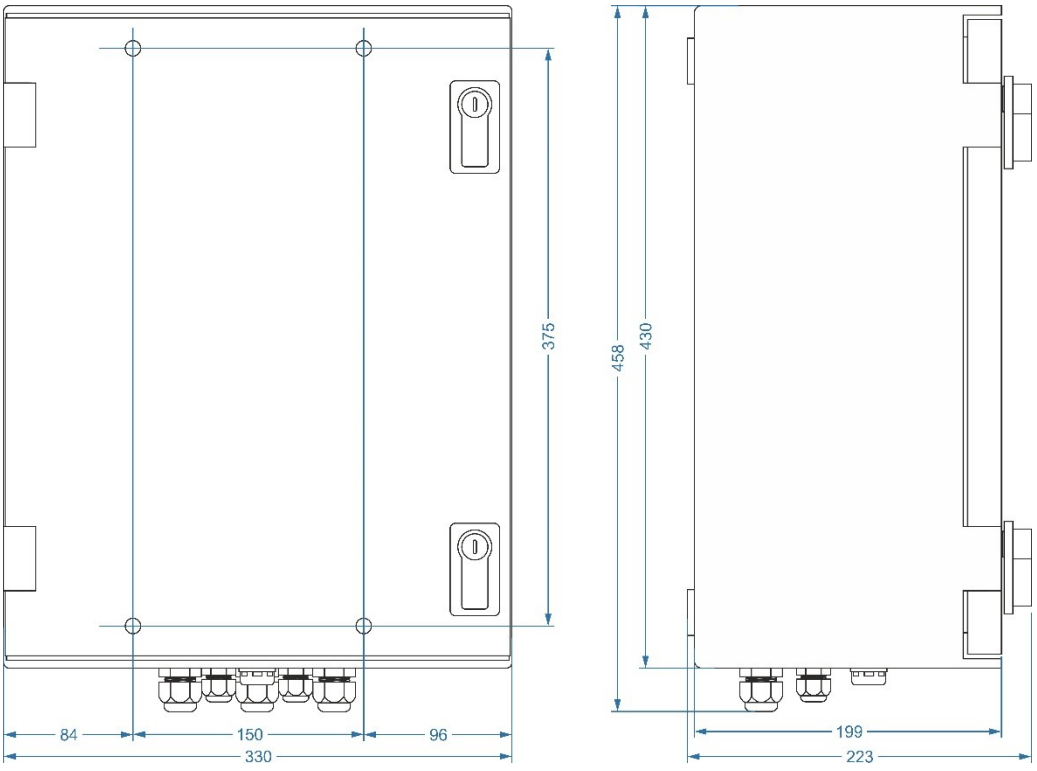
### CABLE GLANDS

The plastic cable glands are located on the underside of the enclosure and are IP67 rated:

- 3x M20 gland (cable diameter 3 to 12 mm)
- 2x M16 gland (cable diameter 4 to 8 mm)
- 1x pressure compensator

Schneider enclosures can be supplied with a different number of cable glands on request. Additional glands of the same type are also permitted.

***Cabinet dimensions and marked mounting openings***




*Schneider enclosure dimensions (h x w x d): 430 x 330 x 200 mm, protection class: IP66*

## 3.2.5. Stainless steel cabinet (-N, -N/Z)



The robust stainless steel cabinet is particularly suitable for outdoor environments. Unlike plastic enclosures, the stainless steel material does not show signs of ageing even after years of exposure to weather conditions.

The enclosure is IP66 rated and comes with 2 lockable fasteners as standard.

***Installing the cabinet***

The stainless steel enclosure is installed on a pole or mast with a diameter of up to 60 mm by means of two guides placed outside the enclosure in its vertical axis and two suitable brackets.

***External GSM antenna***

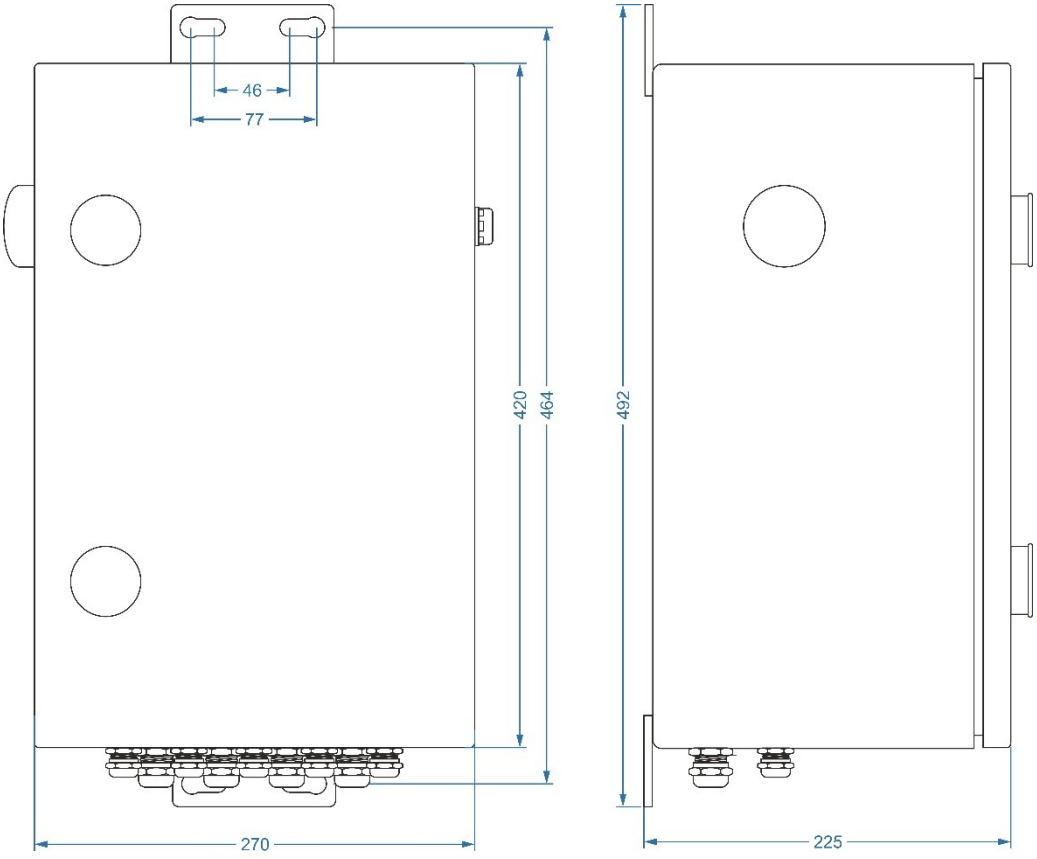
On the side of the cabinet there is a GSM antenna with cable outlet and 2 dBi gain. In case of a weak signal it is possible to try swapping it with a pressure compensator, which is located on the opposite side of the cabinet.

### CABLE GLANDS

The metal cable glands are located on the underside of the enclosure and are IP67 rated:

- 4x M20 gland (cable diameter 3 to 12 mm)
- 5x M16 gland (cable diameter 4 to 8 mm)
- 1x pressure compensator on the side of the cabinet

Additional fitting of other necessary pins of the same type by the installer during installation of the unit is also permitted.




*Dimensions of stainless steel enclosure (h x w x d): 420 x 270 x 220 mm, protection class: IP66*




# 4 Connection plates

Connection of the supply voltage, input, output and control signals to the H7 units is made via terminals located on the connection boards. There are several types of these connection boards, which differ in the number of inputs and outputs, the function of input and output signals, and above all the way the board is powered from an external voltage source.

***Connection plates***

The H3 and H7 units can be fitted with any of the connection plates type:

**TB1, TB2, TB3, TA4, TA4E, TA5**

The required type of connection board suitable for the application under consideration must be specified when ordering the H7 unit (see configuration table on page 5). 8).

Connection plates TB1 to TB3 are designed exclusively for installation of H7 units in aluminium boxes with metal glands = mechanical version B.

***Connection cable***

The H7 unit is connected to the control board by a 40-core flat cable with connectors at both ends for easy disconnection of the unit from the connection board. This disconnection of the unit from the connection board facilitates the installation of the unit and allows access to all terminals of the connection board when connecting cable runs to the inputs and outputs.

## 4.1. Types of connection boards and their power supply

The following table lists the types of connection boards, their method of power supply from an external voltage source, and the number of inputs and outputs that the connection boards contain.

*Power supply method and number of inputs and outputs on each connection board*

| | TB1 | TB2 | TB3 | TA4 | TA4E | TA5 |
|---|---|---|---|---|---|---|
| **External power supply voltage** | 14-28 V DC | 14-28 V DC | 100-240 V AC | 13.8 V DC | 13.8 V DC | 13.8 V DC |
| **Pb battery** | External | External | External | External | External | External |
| **Accumul. Li-Ion** | - | Internal | Internal | - | - | - |
| **AIN input (I+U)** | 4(I) | 4(I) | 4(I) | 6(I)+2(U) | 6(I)+2(U) | 6(I)+1(U) |
| **PIN input** | 4 | 4 | 4 | 6 | 6 | 8 |
| **Pt100 input** | - | - | - | - | 2 (4 wires) | - |
| **SDI-12** | - | - | - | 1 | 1 | - |
| **RS485** | 2 | 2 | 2 | 2 | 2 | 2 |
| **M-relay output** | 2 | 2 | 2 | 2 | 2 | 2 |
| **E-relay output** | 2 | 2 | 2 | - | 1+1 | - |
| **4-20 mA output** | - | 2 | 2 | - | - | - |

*For a detailed description of the different types of inputs and outputs, see chapter 6 Inputs on p. 38 and chapter 7 Outputs on p. 51.*

## 4.1.1. Connection plate TB1

*The TB1 connection board is designed primarily for H7 units powered only by an external 12 V battery. This can be recharged from a photovoltaic panel via a charge controller built into the board. Unlike TB2 and TB3, TB1 does not include a 4-20 mA output current source or a backup Li-Ion battery.*

### POWER SUPPLY OF THE TB1 CONNECTION BOARD

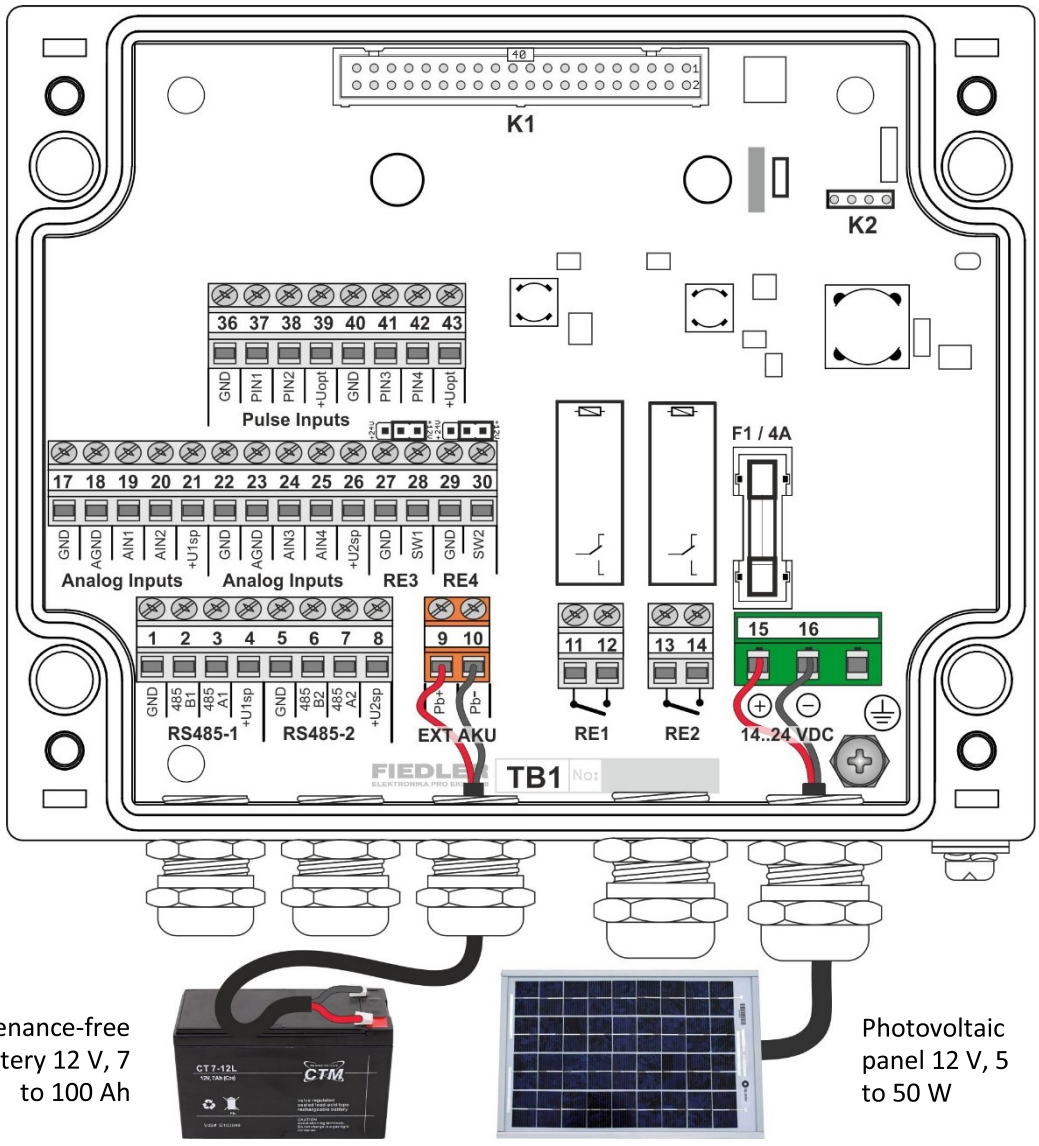
The TB1 is powered by a maintenance-free 12 V / 7 Ah to 100 Ah lead-acid battery that can be recharged from a connected 12 V / 5 to 50 W solar panel or from an external 14 to 28 VDC / 3 A voltage source.

A charge controller is integrated on the TB1 board to ensure that the battery is not over-charged and that the solar panel energy is used with maximum efficiency. In addition, the battery charging voltage is controlled according to the ambient temperature in the range of 13.25 to 14.9 V to optimally match the temperature-dependent charging characteristics of the connected battery.



**!** **Follow the safety instructions in Chapter 5 before handling terminals containing other than safe low voltages (especially power terminals or binary output relay terminals).**

***Connecting the terminals of the connection plate TB1***




Maintenance-free gel battery 12 V, 7 to 100 Ah

Photovoltaic panel 12 V, 5 to 50 W

## MECHANICAL DESIGN TB1

The TB1 connection board is supplied together with the H7 unit control board in an IP67 high protection aluminium enclosure. The two boards are connected inside the enclosure with a K1 connector.

There are 5 cable glands for connecting the external power cable and all sensors and transducers. Therefore, if more measuring inputs or relay outputs are required, multi-core cables must be used.

The external power supply battery can be housed in a separate cabinet connected to the H7 unit by a detachable cable for easy replacement of a dead battery, or the H7 unit and battery can be housed in a single Schneider-type cabinet. The first solution is used, for example, for measurements in sewer manholes, the second solution for meteorological stations with a connected photovoltaic panel.

## INPUTS AND OUTPUTS OF CONNECTION BOARD TB1

The connection board contains all the basic inputs and outputs of the H7 unit, except for the current outputs Iout1 and Iout2, which are operationally energy intensive and are more suitable for units connected to a mains voltage supply.

*Overview table of the TB1 connection board:*

| Name | Mark | Clarification |
|---|---|---|
| **Supply voltage** | 14..24 VDC | Photovoltaic panel or voltage 14-28 V DC |
| **Accumulator** | EXT AKU | Maintenance-free gel 12 V/ 7 Ah to 100 Ah |
| **AIN input** | AIN1-AIN4 | 4-20 mA, 0-20 mA, 1-5 mA, 0-5 mA, DCL |
| **PIN input** | PIN1-PIN4 | Pulse-binary inputs switched against GND |
| **RS485** | RS485-I,-II | Serial buses for connecting probes and sensors |
| **M-relay output** | RE1, RE2 | Relay switching contact 48 VDC / 5 A |
| **E-relay output** | RE3, RE4 | Electronic relay, output 12 VDC / 1 A |

## POWER SUPPLY FOR CONNECTED PROBES AND SENSORS

The TB1 board allows the connection of measuring sensors and probes to two voltage sources connected to terminals +U1sp and +U2sp. The H7 parameters allow to set both voltages independently in the range from 6 to 24 V with a consumption of up to 500 mA from each source (up to HW: 406 only 6... 16 V).

In the power saving mode of the H7 station, the voltage is only present at these terminals for the duration of the measurement. The user can also use the station parameter to set the length of time that the connected measurement sensors and probes are to be energized before the H7 starts the measurement cycle. Permanent power to the sensors can also be set, but is not used for battery powered stations.

## AUTODIAGNOSTICS

The TB1 board monitors:

- Current drawn from terminals +U1sp and +U2sp
- Size of supply voltage at terminals +U1sp and +U2sp
- Supply voltage size
- Current drawn from the supply voltage source
- Power battery voltage
- Current drawn from the power battery
- Temperature on the TB1 board

The measured values are available to the H7 unit and can be continuously monitored and archived in the same way as other connected sensors.

## 4.1.2. Connection plate TB2

*The main use of the TB2 connection board is in industrial applications powered by 24 V DC. Unlike the TB1 board, the TB2 board implements a dual 4-20 mA output current source and an internal Li-Ion battery including rechargeable electronics.*

### POWER SUPPLY OF THE TB2 CONNECTION BOARD

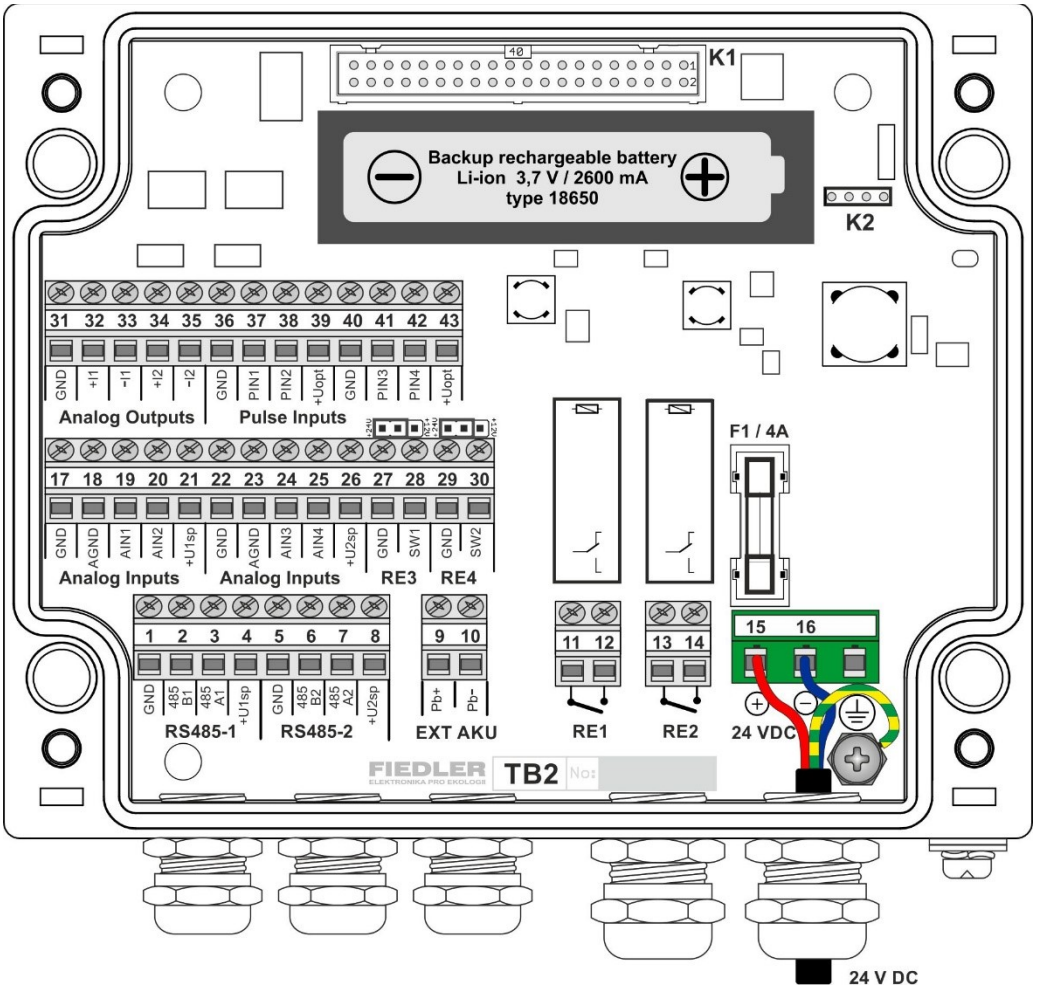
The TB2 connection board is designed for industrial supply voltage of 24 VDC (14 to 28 VDC). A Li-Ion battery located on the board provides backup operation of the H7 unit in the event of a power failure. In the event of extended power outages, an external maintenance-free 12 V / 7 to 100 Ah gel battery can also be connected to the EXT AKU terminals.

Both batteries are continuously recharged from a 24 VDC supply voltage by electronics located on the TB2 board.



**Follow the safety instructions in Chapter 5 before handling terminals containing other than safe low voltages (especially power terminals or binary output relay terminals).**

***Fuse F1*** The supply voltage is protected by fuse F1 / 4A. Before replacing the fuse, make sure that the supply voltage is disconnected. A blown fuse indicates a fault in the connection board or the H7 unit control board.



## MECHANICAL DESIGN TB2

For the mechanical fixing of the connection plate TB2, the description given for plate TB1 applies.

As an external lead-acid battery is not normally used for this connection plate, the entire station is placed under the KR2-V or KR2-H outdoor stainless steel housing, which also forms the mechanical bracket for the unit (see chap. 3.1.1 Aluminium box (-B) on p. 11).

## INPUTS AND OUTPUTS OF THE TB2 CONNECTION BOARD

An overview of all input and output signals is given in the table below. Unlike the TB1 connection board, the TB2 board also contains two 4-20 mA current outputs that are active and galvanically isolated from the unit's supply voltage.

Since the unit enclosure contains only 5 cable glands, multi-core cables must be used if more measurement inputs or outputs are required.

*Overview table of the TB2 connection board:*

| Name | Mark | Clarification |
|---|---|---|
| **Supply voltage** | 24 VDC | Distribution DC voltage 14 to 28 VDC |
| **Accumulator** | Internal | Li-Ion battery 2600 mAh |
| **(Accumulator)** | External | Maintenance-free gel 12 V / 7 Ah to 100 Ah |
| **AIN input** | AIN1-AIN4 | 4-20 mA, 0-20 mA, 1-5 mA, 0-5 mA, DCL |
| **PIN input** | PIN1-PIN4 | Pulse-binary inputs switched against GND |
| **RS485** | RS485-I,-II | Serial buses for connecting probes and sensors |
| **M-relay output** | RE1, RE2 | Relay switching contact 48 VDC / 5 A |
| **E-relay output** | RE3, RE4 | Electronic relay, output 12 VDC / 1 A |
| **Output Iout** | Iout1, Iout2 | Galvanically isolated 4-20 mA active output |

## INTERNAL LI-ION BATTERY

The TB2 and TB3 connection boards are backed up against external power failure by a rechargeable 18650 Li-Ion battery (3.7V / 2600 mAh), which ensures basic operation of the instrument for up to 24 hours depending on the set frequency of measurements and the interval of data transmission to the server.

In the basic operating mode, the 4-20 mA current outputs are not active and the H7 unit automatically enters the preset power saving mode during an external power interruption.

When the mains voltage is restored, the Li-Ion battery automatically recharges to a maximum capacity of 2600 mAh.

## AUTODIAGNOSTICS

The TB2 board monitors:

- Current drawn from terminals +U1sp and +U2sp
- Supply voltage magnitude at terminals +U1sp and +U2sp
- Supply voltage size
- Current drawn from the supply voltage source
- Power battery voltage
- Current drawn from the power battery
- Temperature on the TB2 board
- Li-Ion battery charging capacity

The measured values are available to the H7 unit and can be continuously monitored and archived in the same way as other connected sensors.

## 4.1.3. Connection plate TB3

*The TB3 connection board is designed for industrial application of the H7 unit supplied from 230 V/50 Hz mains voltage. Like the two previous connection plates TB1 and TB2, the connection plate TB3 is exclusively designed for installation of the H7 unit in an aluminium box with metal glands = mechanical version B.*

*Except for the supply voltage, the other functions of the TB2 are identical to the TB2 (internal Li-Ion battery, 4- 20 mA outputs).*

### POWER SUPPLY OF THE TB3 CONNECTION BOARD



**!** **Follow the safety instructions in Chapter 5 before handling terminals containing other than safe low voltages (especially power terminals or binary output relay terminals).**

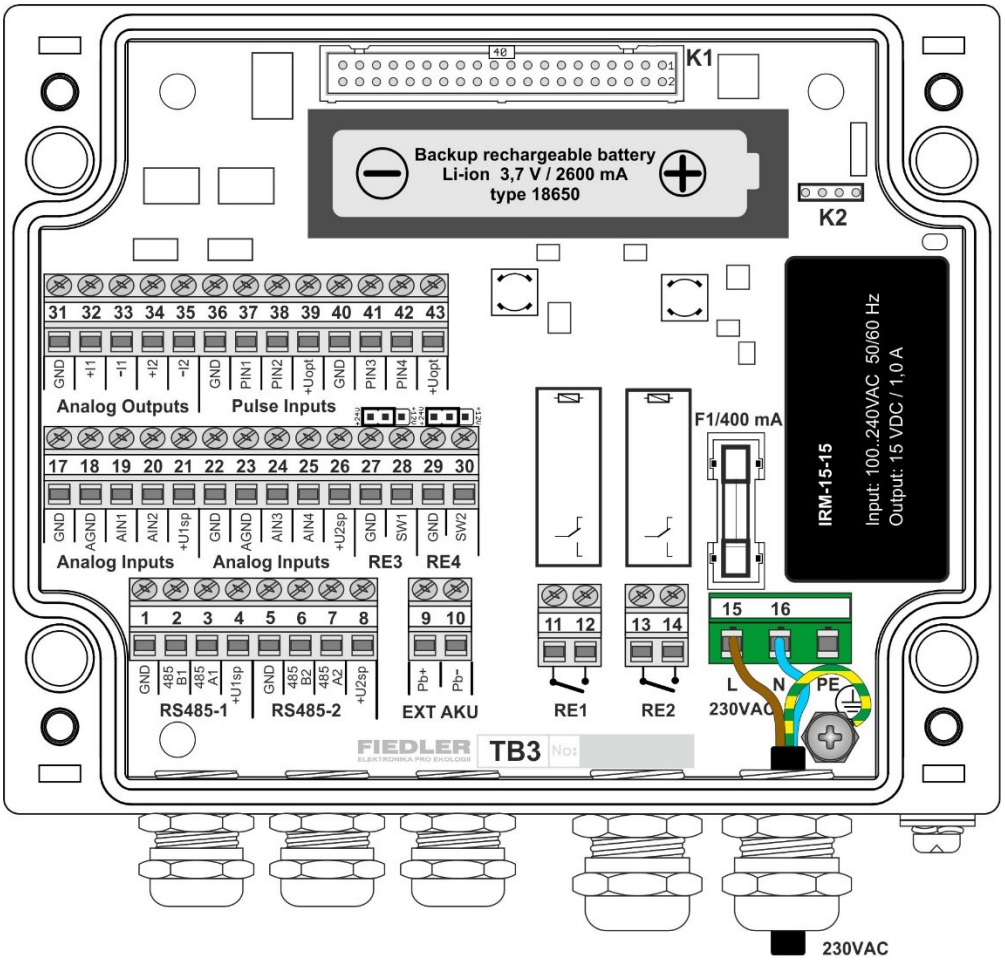
***Other recommendations:*** We recommend using a standard 3-core power cable to connect the input terminals to the mains voltage.

The unit does not contain its own switch, and therefore it is necessary to add circuit breakers and switching elements to the supply line.

***Fuse F1*** The mains supply voltage of 100-240 VAC is protected by fuse T1 / 400 mA. This fuse can be accessed on the TB3 board by unscrewing and removing the lid of the aluminium box containing the H7 unit control board.



**!** **Before replacing the fuse, make sure that the supply voltage is disconnected.**



## MECHANICAL DESIGN TB3

For the mechanical fixing of the connection plate TB3, the description given for plate TB1 applies.

As this connection board does not normally use an external lead-acid battery, the entire station is placed under the KR2-V or KR2-H outdoor stainless steel housing, which also forms the mechanical bracket for the unit.

## INPUTS AND OUTPUTS OF THE TB3 CONNECTION BOARD

As the unit enclosure contains only 5 cable glands, it is necessary to use multi-core shielded communication cables when a larger number of measuring inputs or outputs are required.

*Overview table of the TB3 connection board:*

| Name | Mark | Clarification |
|---|---|---|
| **Supply voltage** | 230 VAC | Mains power supply 100 to 240 VAC |
| **Accumulator** | Internal | Li-Ion battery 2600 mAh |
| **(Accumulator)** | External | Maintenance-free gel 12 V / 7 Ah to 100 Ah |
| **AIN input** | AIN1-AIN4 | 4-20 mA, 0-20 mA, 1-5 mA, 0-5 mA, DCL |
| **PIN input** | PIN1-PIN4 | Pulse-binary inputs switched against GND |
| **RS485** | RS485-I,-II | Serial buses for connecting probes and sensors |
| **M-relay output** | RE1, RE2 | Relay switching contact 230 VAC / 5 A |
| **E-relay output** | RE3, RE4 | Electronic relay, output 12 VDC/ 1 A |
| **Output Iout** | Iout1, Iout2 | Galvanically isolated 4-20 mA active output |

## BACKUP TRAFFIC

***Li-Ion battery***

Backup operation of the device in the event of a mains power failure is solved by the 18650 Li-Ion battery (3.7 V / 2600 mAh), which ensures basic operation of the device for up to 24 hours.

In the basic operating mode, the 4-20 mA current outputs are not active and the H7 unit automatically enters the preset power saving mode during an external power interruption. When mains power is restored, the Li-Ion battery automatically recharges to a maximum capacity of 2600 mAh.

***Lead acid maintenance free battery***

If a back-up power supply is required for a long-term power failure of several days, an external maintenance-free 12 V / 7 to 100 Ah gel battery can be connected to the EXT AKU terminals. In the presence of mains supply voltage, both batteries are continuously recharged. The charging voltage of 13.5V for the lead acid battery is not temperature compensated as with the TB1 and TB2 connection plates.

## 4.1.4. Connection plate TA4

*The TA4 Universal Connection Plate is designed for all mechanical versions of the Hydro Controller H7 except for aluminium boxes (version -B) which require connection plates type TB1 to TB3. The TA4 plate can be used both when installing the H7 unit in a cabinet door and when installing the unit in one of the enclosures offered.*

### POWER SUPPLY OF THE TA4 CONNECTION BOARD

The power supply of the H7 unit with the TA4 connection plate is usually provided by an attached maintenance-free 12 V lead-acid battery of suitable capacity (usually from 7 Ah to 45 Ah).

***Operation without external power supply***

In field conditions without the possibility of recharging, the power battery must be changed regularly. In addition to the capacity of the battery, the replacement interval depends on the number and type of probes and sensors connected, the frequency of measurements and the interval at which data is sent to the server. The usual replacement time of the battery without external recharging ranges from 2 weeks to 3 months.

***External power supply***

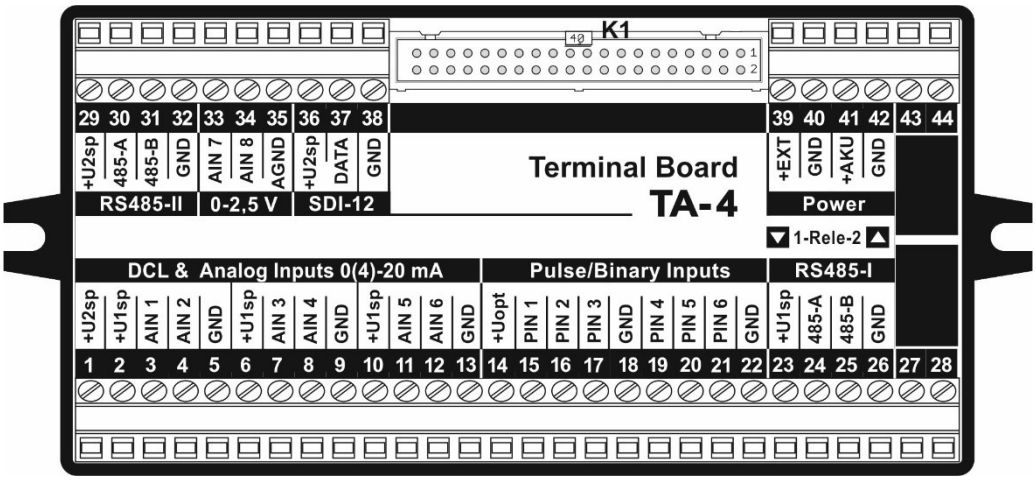
Together with the H7 unit, a suitable power supply with an output voltage of 13.8V can be ordered from the station supplier, adapted for installation on a DIN rail or as a rechargeable adapter for a socket. Another method of power supply is the use of a photovoltaic panel together with an RS13 battery charge controller.

**The external power supply of the connection boards is described in detail in chap. 5.**

### INPUTS AND OUTPUTS

***Connection terminals***

The connection terminals are placed in two rows on the TA4 board at the bottom and top edge of the board as shown in the following figure:




*Connector board overview table*

| Name | Mark | Clarification |
|---|---|---|
| **Supply voltage** | 13.8 VDC | Output from mains voltage source or RS13 |
| **Accumulator** | External | Maintenance-free gel 12 V/ 7 Ah to 100 Ah |
| **AIN inputs** | AIN1-AIN6 | 4-20 mA, 0-20 mA, 1-5 mA, 0-5 mA, DCL |
| **AIN inputs** | AIN7, AIN8 | Voltage inputs 0 to 2.5 VDC |
| **PIN inputs** | PIN1-PIN6 | Pulse-binary inputs switched against GND |
| **RS485** | RS485-I -II | Serial buses for connecting probes and sensors |
| **SDI-12** | SDI-12 | Serial buses for connecting probes and sensors |
| **M-relay output** | RE1, RE2 | Relay switching contact 48 VDC / 5 A |

***SDI-12 bus***

Unlike other connection boards, the TA4 (and TA4E) is equipped with the SDI-12 serial bus, often used in environmental probes and sensors imported from the USA.

## 4.1.5. TA4E Connection Plate

*The expanded TA4 connector board with an expander is called TA4E. It is a connection board suitable for use in meteorological stations, large-scale environmental data acquisition systems and wherever there is a need to measure temperature using standard Pt100 sensors in addition to analogue current or voltage inputs, or wherever a large number of probes and sensors need to be connected to the H7 unit via the RS485 interface.*

*The TA4E connection plate is designed for all mechanical versions of the Hydro Controller H7, except for aluminium boxes (version -B) which require connection plates of type TB1 to TB3.*

### POWER SUPPLY OF THE TA4E CONNECTION BOARD

For the power supply of the TA4E, all the information in the previous chapter on the TA4 busbar fully applies.

### INPUTS AND OUTPUTS

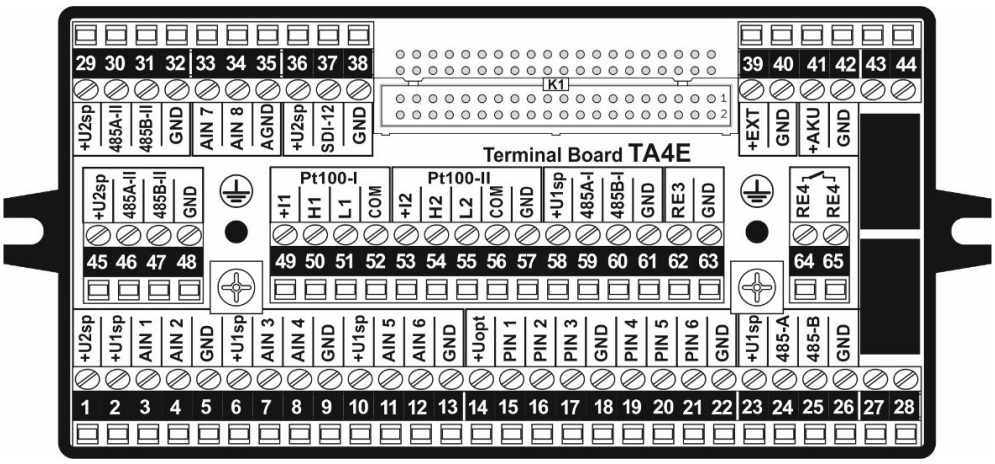
***Expander connection terminals***

The TA4E connector board is based on the TA4 board with a socket expander containing one horizontal row of terminals located in the middle of the expander. To the terminals of this expander, 2 Pt100 temperature sensors can be connected in four wires, as well as other sensors and transducers communicating via RS485-I bus, if the terminals of this bus on the TA4 base board are already occupied.

***Electronic relays RE3, RE4***

The expander also contains an electronic relay RE3 with an output voltage equal to the voltage of the supply battery (12 VDC) and an electronic relay RE4 with a pair of switching contacts without polarity differentiation. Each electronic relay has an on-state draw from the supply battery of ≤ 0.5 mA.

The connection clamp of the TA4 custom base plate are placed in two rows at the bottom and top edge of the plate as described in the previous section.




*Overview table of the TA4E connection board:*

| Name | Mark | Clarification |
|---|---|---|
| **Supply voltage** | 13.8 VDC | Output from mains voltage source or RS13 |
| **Accumulator** | External | Maintenance-free gel 12 V/ 7 Ah to 100 Ah |
| **AIN inputs** | AIN1-AIN6 | 4-20 mA, 0-20 mA, 1-5 mA, 0-5 mA, DCL |
| **AIN inputs** | AIN7, AIN8 | Voltage inputs 0 to 2.5 VDC |
| **PIN inputs** | PIN1-PIN6 | Pulse-binary inputs switched against GND |
| **Resistive inputs** | Pt100-I, II | Four-wire connection of Pt100 temperature sensors |
| **RS485** | RS485-I -II | Serial buses for connecting probes and sensors |
| **SDI-12** | SDI-12 | Serial buses for connecting probes and sensors |
| **M-relay outputs** | RE1, RE2 | Mechanical relay switching contact 48 VDC / 5 A |
| **E-relay outputs** | RE3<br>RE4 | Relay output terminal (voltage: +AKU, Imax: 2A)<br>Electronic switch without polarity (Umax: 24 VDC; Imax: 75 mA; Rmax-ON: 10 Ω, Rmin-OFF>25 MΩ) |

## 4.1.6. Connection plate TA5

*The TA5 connection plate is designed for all mechanical versions of the Hydro Controller H7 except for aluminium boxes (version -B) which require connection plates type TB1 to TB3. Thus, the TA5 can be used when installing the H7 unit in one of the available plastic or stainless steel enclosures, as well as in the cabinet door (TA5/P connection plate variant).*

***8 PIN inputs*** *The TA5 connection board contains 8 pulse-binary PIN inputs (the most of any connection board offered) and is therefore suitable for installation of the instrument in waterworks (WWTP, WTP, DHW and CS) and many other industrial applications.*

***1 input 0..10 VDC*** *The TA5 board allows, unlike other connection boards, to connect a sensor or measuring instrument with a voltage output of 0.. 10 VDC.*

***2 NAMUR 1.5 mA inputs*** *The pulse-binary inputs PIN1 and PIN2 can be set to switch with an external current ≥ 1.5 mA (NAMUR compatibility except for intrinsic safety) using jumpers.*

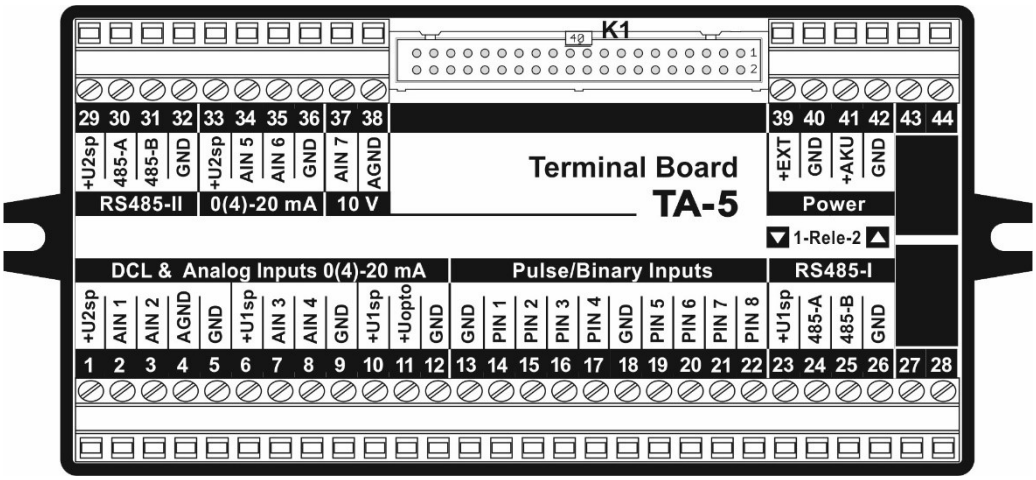
### POWER SUPPLY OF THE TA5 CONNECTION BOARD

For the power supply of TA5, all the information in the TA4 section applies in full.

**The external power supply of the connection boards is described in detail in chap. 5.**

### INPUTS AND OUTPUTS

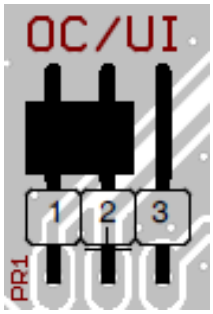
***Connection terminals*** The connection terminals are placed in two rows on the TA5 board at the bottom and top edge of the board as shown in the following figure:




*Overview table of the TA5 connection board:*

| Name | Mark | Clarification |
|---|---|---|
| **Supply voltage** | 13.8 VDC | Output from mains voltage source or RS13 |
| **Accumulator** | External | Maintenance-free gel 12 V / 7 Ah to 100 Ah |
| **AIN inputs** | AIN1-AIN6 | 4-20 mA, 0-20 mA, 1-5 mA, 0-5 mA, DCL |
| **AIN7 input** | AIN7 | Voltage input 0 to 10 V DC (0-2.5 V DC on AV8) |
| **PIN inputs** | PIN1-PIN8 | Pulse-binary inputs switched against GND |
| **Inputs PIN1, PIN2** | PIN1, PIN2 | Using jumpers PR1 and PR2, PIN1 and PIN2 inputs can be set to be activated by input current > 1.5 mA (position 2-3). The PR1 and PR2 jumpers are located under the top plate of the connection board. In position 1-2, inputs PIN1 and PIN2 are activated by connecting to GND, similar to inputs PIN3 to PIN8 |
| **RS485** | RS485-I, -II | Serial buses for connecting probes and sensors |
| **M-relay output** | RE1, RE2 | Relay switch contacts; Umax:48 VDC; Imax: 5 A |

***Connecting line PR1***



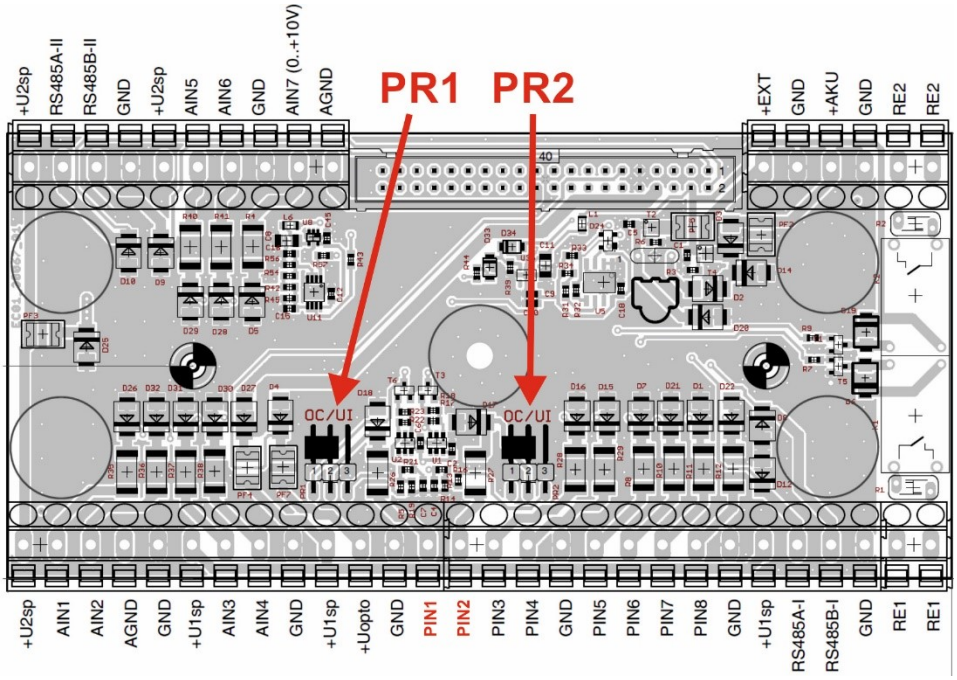
## PULSE BINARY INPUTS PIN1 AND PIN2 ON THE TA5 BOARD

From the factory, the pulse inputs PIN1 and PIN2 are set to switch against GND, as are inputs PIN3 to PIN8. The switching of the input can thus be activated by a sensor with an open collector against GND or by a potential-free contact with one side connected to the GND ground terminal - for example, an auxiliary contact on a contactor.

Moving the PR1 or PR2 short-circuit jumper from position 1-2 (OC) to position 2-3 (UI) will transform the PIN1 (PR1 jumper) or PIN2 (PR2 jumper) input to activation by input current greater than 1.5 mA, i.e. input voltage greater than 3 V DC. With the exception of intrinsic safety, PIN1 and PIN2 inputs are thus compatible with NAMUR-type sensors (the decision level of the current flowing from the sensor is 1.5 mA).

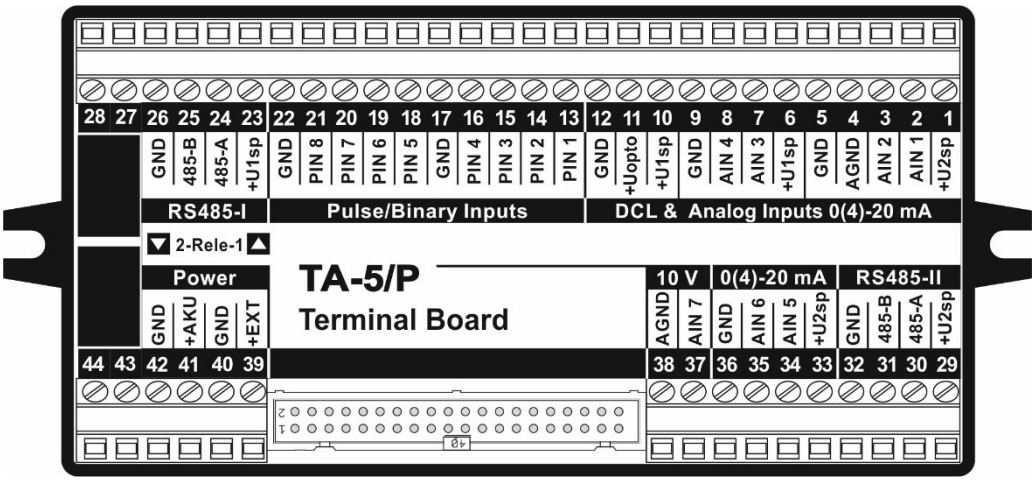
Connectors PR1 and PR2 are located under the top plate of the TA5 connection board.

***Location of jumpers PR1 and PR2 on the TA5 connection board***




## CONNECTION PLATE TA5/P FOR PANEL MOUNTING

When installing an H3 or H7 unit on a switchboard panel, the connection plate is usually located on the back of the panel. Since the interconnecting flat cable is then connected to the connection plate from below, it is necessary to rotate the connection plate by 180 compared to its normal position. In order to avoid upside down terminal descriptions and numbering, the TA5/P connection board is used for such installations (differing from the TA5 board only in the design of the top label with terminal descriptions).



## 4.2. Automatic board detection

The H7 (H3) unit performs automatic detection of the type of the connected connection board after the power supply voltage is switched on. The number and type of inputs and outputs of the H7 (H3) unit are automatically set according to the detected type of connection board.

### 1. IDENTIFICATION OF THE CONNECTION BOARD ON THE UNIT DISPLAY

The name of the automatically detected board is displayed in the bottom line of the unit's welcome screen, which appears briefly on the unit's display when power is applied to the unit.

| Connection plate | Inscription on the display | Note |
|---|---|---|
| **TB1** | TB-ver: TB1-xxx | |
| **TB2** | TB-ver: TB2-xxx | |
| **TB3** | TB-ver: TB3-xxx | |
| **TA4** | TB-ver: TA4 | |
| **TA4E** | TB-ver: TA4E | TA4 connection plate with expander |
| **TA5** | TB-ver: TA5 | |

xxx is the FW version designation of the connection board equipped with its own microprocessor.

***Displaying the type of connection board***

After the initial self-detection of a busbar and its display within the welcome screen, the detected busbar type can be called up at any later time in the unit's Information and Diagnostics menu (chapter 11.6. Information and diagnostics on p. 224):

**Information and diagnostics > VersionHW > VersionHW of the unit / Connection board type**

### 2. IDENTIFICATION OF THE CONNECTION BOARD IN THE MOST4 APPLICATION

After loading the parameters of the connected station it is necessary to select the menu in the main control bar:

**Main menu > Station name > List of available settings**

Clicking on the station nameplate with the cursor will display the type of the detected backplane in the Device Information help and in the HW Identification/Version item.

### 3. IDENTIFICATION OF THE CONEC BOARD IN THE CLOUDFM WEB APPL

After logging into the Cloud, you must select the Station Configuration option and then load the desired station. Then proceed as in the previous MOST4 application, i.e. by selecting the menu:

**Main menu > Station name > List of available settings**

### 4. REPLACEMENT OF CONNECTION PLATES

The unit's connection board can be replaced with the same type of connection board (for example, when replacing a damaged board) or with a different type of connection board with a different number of inputs and outputs (when expanding the number or types of input and output signals.

***Same type of PD*** In the first case, the initialization of the unit after power-up detects the type of the board and its FW if the board contains its own microprocessor.

***Different type of PD*** When replacing the boards with another type of board, there may be a mismatch between the HW capabilities of the connection board and the set parameters of the H7 (H3) unit. This possible mismatch will be indicated by a configuration error on the corresponding analogue or binary channel.

***Example:*** *If the H7 with TA4E connection board is set to Output-Local(relay) mode for binary channels BCH1 - BCH4, then after replacing the TA4E connection board with TA4, an error will be signaled for binary channels BCH3 and BCH4 (because TA4 board has only two output relays).*

***Example:*** *If the H7 with the TB2 connection board is set to 4-20mA current output mode for the analog channels ACH1 and ACH2, then after replacing the TB2 board with TB1, a configuration error will be signaled for the analog channels ACH1 and ACH2 (because the TB1 does not have current outputs).*

## 4.3. Compatibility H3, H7 with DPD-I,-III connection plates

The H3 and H7 units are also backward compatible with the older **DPD-I** and **DPD-III** connection boards, if required, which are used to connect signal and power wires to the M4016 units and are housed with these units in ARIA32 enclosures.

This backward compatibility can be advantageously applied when upgrading or replacing outdated measuring stations, where it is sufficient to install a new unit type H3 or H7 instead of the M4016 unit and thus keep the original connection board with the cabinet and all connected sensors and transducers **without the need to reconnect individual signal and power cables** to the new connection board.

***Mechanical compatibility***

Both the mechanical mounts of both M4016 and H7 units on the ARIA32 base plate are compatible, as well as the connector connection between the connection plate and the unit. However, when replacing the H7 unit with the M4016, we still recommend using a new flat cable to connect the H7 unit to the original connection plate for increased reliability.




*Inserting a new H3, H7 unit into the ARIA32 cabinet instead of the original M4016 unit*

***Electrical compatibility***

Replacing the controller itself does not allow these older boards to work with a second RS485-II serial line or SDI-12 interface, because these interfaces are not available on older boards (RS485-II) or are mapped to different control signals (SDI-12).

*Compatibility of DPD-I and DPD-III connection plates with H7, H3 type unit*

| Marking H7 | DPD-I | DPD-III | Note |
|---|---|---|---|
| **RS485-I** | It works | works | Functions without limitations |
| **RS485-II** | - | - | The boards don't have a second RS485 lead out |
| **SDI-12** | - | - | Does not work even on DPD-III (cannot be used) |
| **Usp1** | +17V | +17V | Voltage setting max. 16 VDC |
| **Usp2** | +Unap | +Unap | Do not set higher voltage than 14 VDC |
| **Uopto** | - | - | Voltage is not output |
| **AIN** | DAV1-DAV6 | DAV1-DAV6 | Functions without limitations |
| **PIN** | PV1-PV8 | PV1-PV4 | Functions without limitations |
| **-** | DCL-OUT | DCL-OUT | Non-functional - leave the clamp free |
| **AIN7, AIN8** | +-AIN7 | - | Inputs work only with DPD-I board |



# 5 Connecting the power supply voltage

The connection of the external supply voltage to the connection boards of the H7 units must be given special attention for the safety of the operation of the units and for their reliable function. Therefore, this issue has been included in a separate chapter.

The following table clearly shows the allowable range of external power supply voltage according to the type of connection board used and the possibility of backup power supply to the unit in case of external power failure.

*Supply voltage size and type of backup power supply according to the type of connection board*

| Connection plate | TB1 | TB2 | TB3 | TA4, TA4E, TA5 |
|---|---|---|---|---|
| **External power supply voltage** | 14-28 VDC (solar panel) | 14-28 VDC (24 V distribution) | 100-240 VAC (line voltage) | 13.8 VDC (AKU charger) |
| **Pb battery** | External | optional ext. | optional ext. | External |
| **Accumul. Li-Ion** | - | Internal | Internal | - |

## IMPORTANT NOTICES

**!** **The connection of the 230 VAC mains voltage to the terminals of the H7 unit's connection plate must only be carried out by an authorised person with the appropriate valid certificate for this activity.**

**!** **Before handling terminals containing other than safe small voltages (in particular power supply terminals or binary output relay terminals), always ensure that the relevant cable is disconnected from the voltage source in such a way that it cannot be accidentally connected by another means (e.g. by another worker).**

**!** **If the device is to be installed outdoors or in wet areas, the device must be disconnected from the mains voltage, for example by means of a current protector.**

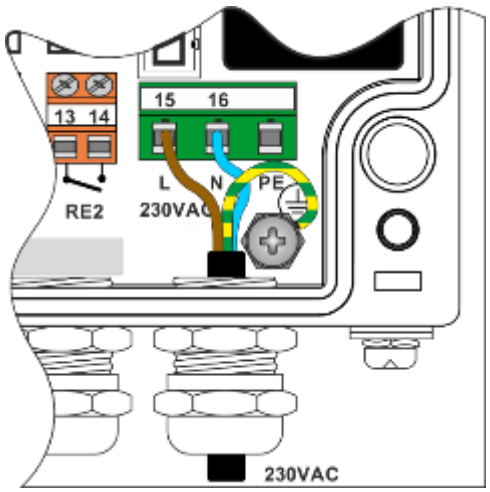
**The device does not contain its own switch. It is therefore necessary to add switching elements to the supply line in addition to the circuit breakers.**

### OTHER IMPORTANT INSTRUCTIONS

- Do not connect the 230 VAC mains voltage to terminals that are not designed for this purpose (note the power supply terminals of connection boards designed for 12 VDC; 13.8 VDC or 24 VDC power supply).
- For connection boards requiring a supply voltage of 24 VDC or 100-240 VAC, always include a PE ground protection terminal. An inadequately grounded PE conductor can cause electric shock as well as malfunction of the instrument due to induced electrical interference. Make sure that the PE terminal of the instrument is always connected to ground.
- Install the device in a location and position that allows good access and operation of the device and easy disconnection of the power supply.
- The power supply line of the device can be made with a fixed cable or a movable power cord. If the protective conductor is not part of the cable, it must have a cross-section of at least 2.5 $mm^2$ Cu if protected from mechanical damage, otherwise 4 $mm^2$ Cu .
- The mains supply line must be provided with a sufficiently sized surge protector against the negative effects of induced voltage spikes before connection to the instrument.
- When installing the unit in places with strong electromagnetic interference (e.g. near frequency converters, etc.), we recommend including a suitable mains filter in the power supply circuit before the unit.
- When installing cable lines, make sure that communication cables and power lines are laid separately.
- Blind the unused cable glands.

## 5.1.1. Connection of supply voltage to connection boards TB1, TB2, TB3

Follow the steps below to connect the power cable:



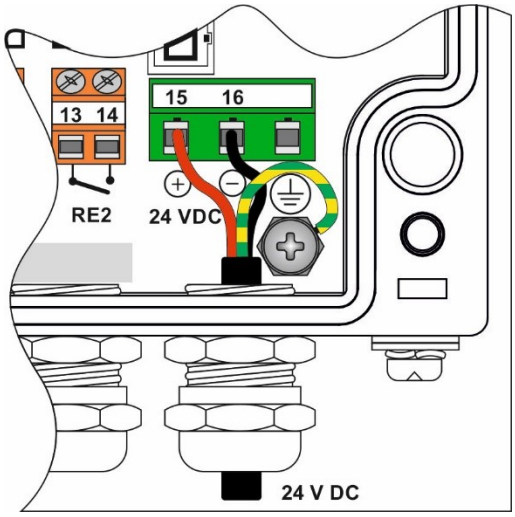

1. Make sure the power cord is not live.
2. Pull the power cable through the outermost cable gland.
3. Remove the insulation from the cable and shorten the individual conductors so that the protective PE conductor is 2 cm longer than the other conductors in the cable.
4. Press the cable glands onto the stripped ends of the stranded wires.
5. Insert both power wires into the corresponding terminals according to TAB 1 or TAB 2 up to the insulation and tighten the terminals.

*TAB 1: 230 VAC power terminal markings (TB3)*

| Clamp | Description of terminals | Colour coding |
|---|---|---|
| **15** | Working wire (L) | Brown |
| **16** | Middle conductor (N) | Blue |
| **PE** | Protective wire | Green and Yellow |

6. Insert the protective PE wire into the hole of the grounding clamp as shown and tighten the clamp. Make sure that the screw of the ground clamp is in contact directly with the conductor of the protective cable and not just with its insulation.

Another variant of connecting the protective PE conductor is to connect it to the ground terminal by means of a loop pressed onto the end of the




protective PE conductor and pulling this loop under the screw of the ground terminal.

The length of the protective PE conductor must always be longer than the length of the other conductors in the cable so that the protective conductor is the last to be disconnected from the device when the cable is pulled out.

*TAB 2: 24 VDC power terminal markings (TB1, TB2)*

| Clamp | Description of terminals | Colour coding |
|---|---|---|
| **15** | + 24 VDC | Red |
| **16** | - 24 VDC | black |
| **PE** | Protective wire | Green and Yellow |

7. Make sure that the individual wires are firmly seated in the terminals by pulling on them.

8. Tighten the outer nut of the cable gland to secure the cable in the gland. When the cable is pulled, it must not move.

## 5.1.2. Connection of supply voltage to connection boards TA4, TA4E, TA5

Connection Connection plates TA4, TA4E and TA5 are designed to power the H7 unit from the connected maintenance-free lead-acid battery. In addition to periodic replacement of the power battery by the unit operator, the power battery can also be operated in continuous charging mode from an external voltage source (mains supply or solar panel).

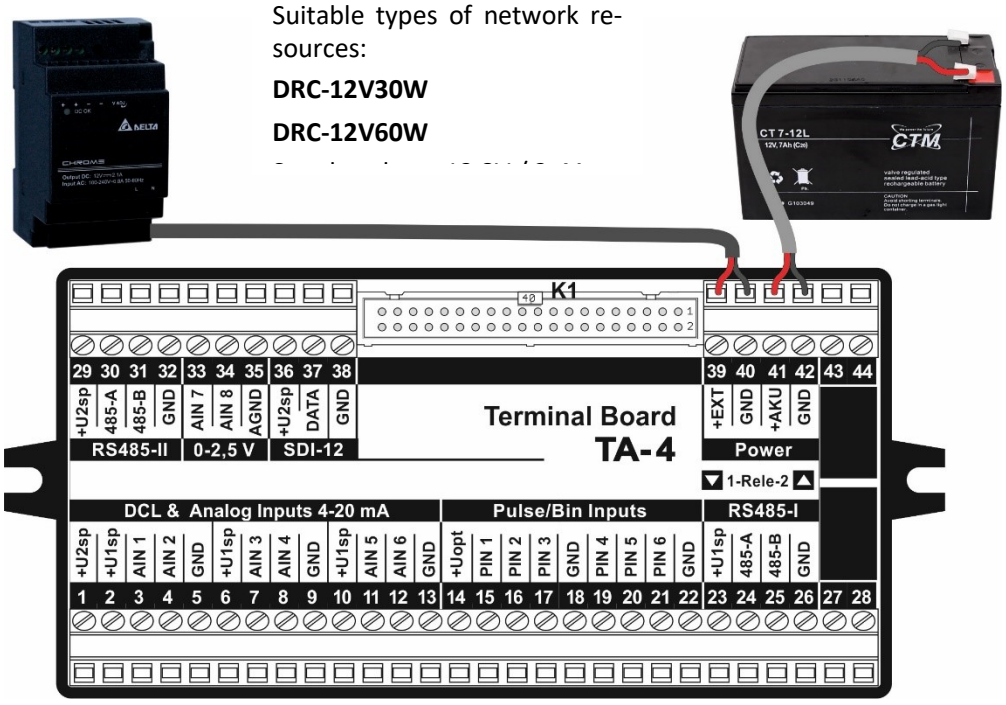
Because the TA4, TA4E, and TA5 boards do not include a power battery recharge controller like the TB1 to TB3 boards, they require an external supply voltage equal to 13.8 VDC ± 0.2 V. The 13.8 V supply voltage can be used to permanently recharge a 12 V battery without overcharging the battery and consequently shortening its life. The external supply voltage of 13.8 VDC is connected to terminals 39 (+EXT) and 40 (GND).

The connected unit is powered by a 12 V battery that can be externally recharged from a 13.8 V mains supply. The battery is connected to terminals 41 (+AKU), 42 (GND). The external 13.8 V supply voltage is connected to terminals 39 (+EXT), 40 (GND).

Suitable types of network resources:

**DRC-12V30W**

**DRC-12V60W**




Power supply of the TA4 connection board from a 13.8 VDC power supply

### *13.8 DIN rail power supply*

A suitable Class II power supply with an output voltage of 13.8 V and a power output of 30 W (type DRC-12V30W) or 60 W (type DRC-12V60W) can be obtained from the H7 supplier. Both types of power supplies are designed to be installed on the DIN rail of an existing or newly installed rack from which a safe supply voltage of 13.8 VDC is routed to the H7 unit.



**The installation of the network power supply must only be carried out by an authorised person with the appropriate valid certificate for this activity.**

### *13,8V charger for socket*

A battery charger with an output voltage of 13.8 V for so-called permanent connection to the battery can also be a suitable power supply for the H7 unit with the TA4 connection board. Such a charger can be ordered from the unit supplier under the designation JS-25-138/CH

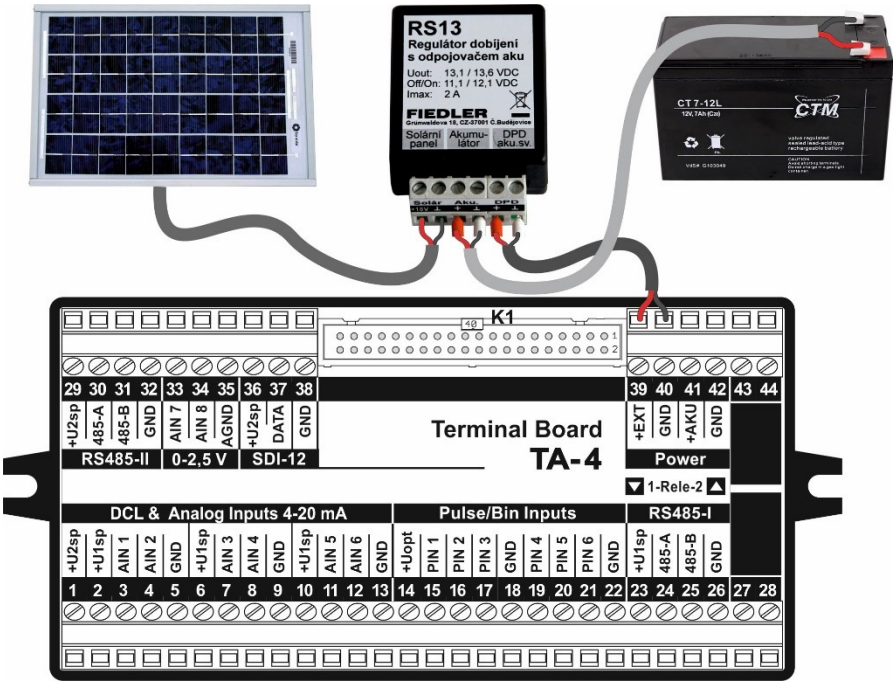


### *Grounding of GND terminals*

For overvoltage protection, we recommend connecting the GND terminal of the TA4 connection board to the main protective busbar with the CY4zž conductor.

## POWER SUPPLY OF THE TA4 CONNECTION BOARD FROM A PHOTOVOLTAIC PANEL

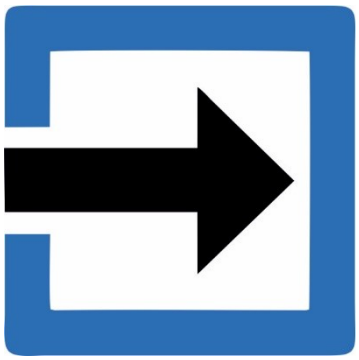
The 13.8 V mains power supply can be replaced in field conditions by a 12 V / 5 to 40 W photovoltaic panel with an RS13 charge controller.




### *Recharge controller RS13*

The RS13 charging regulator performs a dual function: it prevents overcharging of the battery when charging and, on the other hand, it ensures that the battery is disconnected from the load when the battery voltage drops below 11.1 V. A deep discharge of the battery severely reduces its overall lifetime.

The RS13 controller has been designed with low current consumption in mind, so that it does not burden even small 12 V/ 7-9 Ah batteries with unnecessary consumption and does not shorten the operation time of the station in times without external power supply (e.g. in winter after covering the solar panel with a snow blanket). The RS13 controller can be used to recharge a 12 V battery from 7 Ah to 100 Ah and a solar panel up to 50 W.



# 6 Inputs

The marking of the terminals of the connection plates for the connection of sensors, transmitters and measuring probes is given in the following overview table. Some special inputs, such as the SDI-12 serial interface, are only included on some connection boards.

*Marking of inputs on connection plates*

| Mark | Name of input | Signal type |
|---|---|---|
| **AIN** | Analog input | Current 4(0)-20 mA, DCL |
| **PIN** | Pulse-binary input | Pulses, binary states |
| **RS485-I** | Primary serial line | Finet and MODBUS RTU protocols |
| **RS485-II** | Secondary serial line | Finet and MODBUS RTU protocols |
| **SDI-12** | Serial interface | SDI-12 protocol |
| **Pt100-I, -II** | Resistive input | 4-wire connection Pt100 |
| **AIN7, AIN8** | Voltage analog input | Voltage 0-1 V, 0-2.5 V |

## 6.1. Common properties of inputs

***Measuring channels***

Any input of the unit, if it is to be active, must first be set up, i.e. it must be assigned a recording channel set to measure the monitored physical quantity, including the choice of measurement units, measurement interval, alarms, ....

***Channels and inputs***

In general, for all measurement channels, one input can be assigned to each channel. However, the reverse is not true and several measurement channels can be assigned to one input.

***Surge protection of inputs***

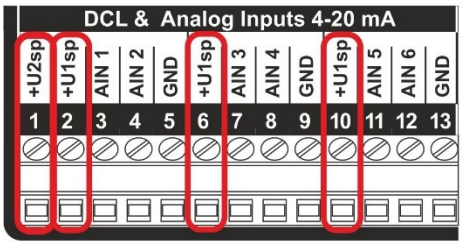
All input and power supply terminals of the station's connection board are equipped with surge protection, which limits the transfer of interfering induced voltages from the connected cables to other circuits of the station.

For a good function of the surge protector, it is necessary to ensure a reliable connection between the station's ground terminal and the protective conductor of the power supply system or another metal structure well connected to the ground.

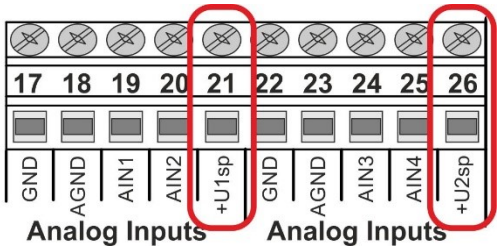
## 6.2. Power supply for connected sensors

***Power clamps***

Each connection board contains terminals for powering the connected sensors and transducers, which are labeled +U1sp, +U2sp and +Uopt. The terminals with the same designation are interconnected on the connection board and therefore any of the nearest power terminals can be used to power the sensor.




*Connection plate part TA4*




*Connection plate part TB1 (TB2, TB3)*

The number of power supply terminals on the connection board is limited, so when connecting a large number of sensors to one station, it is necessary to connect several power supply wires to one power supply terminal.

***Surge protector PO2D***

If the supply cables from the sensors are longer than 50 m or if there is a possibility of induced overvoltage in these cables (partial overlap with power cables, overhead lines, ...), then it is recommended to place a suitable surge protector between the supply cable and the terminals of the connection board. A combined surge protector for power and data lines type PO2D can be ordered from the station supplier.




***Switched supply voltage***

In economy mode, the sensor supply voltage is automatically switched on only during the measurement period. If required by the nature of the connected sensors, the H7 allows the power supply to be switched on for a predefined time interval before the actual measurement of the output signal of the connected sensors begins.

***Dual adjustable supply voltage***

The H7 has the ability to set the supply voltage individually in two mutually separated supply branches. In this way, selected sensors can be supplied with a higher supply voltage of up to 24 V, unlike low power probes, which usually only need a supply voltage of 6 VDC. This solution can significantly extend the time to replace the power battery in non-external charging mode.

*Supply voltage of sensors and transducers*

| Mark | Switch-on time | Voltage range |
|---|---|---|
| **+U1sp, +U2sp** (from HW:407) | During the measurement period | 6 to 24 VDC / max. 500 mA |
| **+U1sp, +U2sp** (to HW:406) | During the measurement period | 6 to 16 VDC / max. 500 mA |
| **+Uopt** (to HW:409) | Permanently On/Off | 3.7 VDC / max. 50 mA |
| **+Uopt** (from HW:410) | Permanently On/Off | 12 VDC / max. 500 mA |

The set magnitude of the supply voltages +U1sp and +U2sp is not dependent on the magnitude of the voltage of the power supply (accumulator, battery) because the instrument contains voltage boost converters. All power supply voltage settings are made by software configuration of the instrument parameters. The power supply system and its parameterization are discussed in detail in chap. 2-2 Power on p. 107.

***Power supply for OPTO sensors***

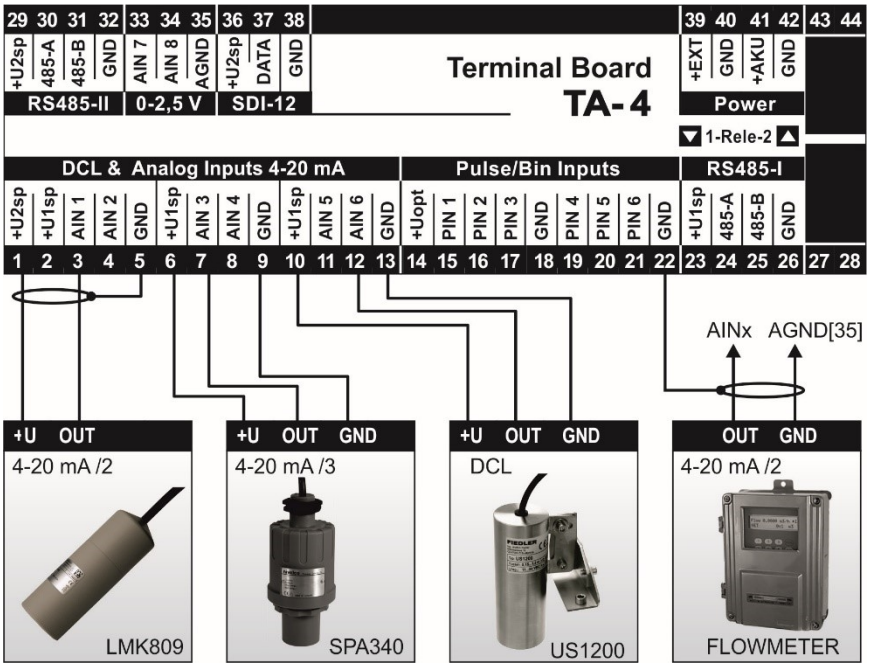
A separate power supply branch +Uopt consists of the supply voltage for OPTO sensors of water meters or other similar sensors (gas meters, electricity meters), which require a permanent power supply even when the station is hibernating in economical operation, when only its pulse inputs are functional.

# 6.3. Analog Inputs (AIN)

All types of connection boards contain 4 or more analog AIN inputs (see overview table on p. 21). The AIN analog inputs allow connection of sensors with current output (0-20 mA, 4-20 mA, 0-1mA, 0-5mA, 1-5mA) as well as sensors with 0/20 mA Digital Current Loop (DCL) output.

***Technical parameters of inputs***

The input impedance of inputs AIN1 to AIN6 is 110 Ω. The maximum voltage drop across the input can thus be up to 2.2 V at a current of 20 mA. This must be taken into account when selecting the supply voltage magnitude (+U1sp, +U2sp) of the connected sensors with passive current output.




*Examples of different sensor connections to the AIN inputs of the TA4 connection board*

***AIN7, AIN8***

These two inputs are contained only in the TA4 connection board. The inputs do not contain measuring resistors and can therefore also be used to measure DC voltages in the range 0 to 2.5 VDC. The H7 with the TA4 connection board also allows differential voltage measurements between the two inputs. The programmable gain of each AIN input in eight steps ranging from 20 mV to 2.5 V allows high measurement accuracy.

***Measurement accuracy***

The instrument's measuring transducer achieves high accuracy in measuring analog signals thanks to its internal 24-bit resolution, regular self-calibration and very low non-linearity over the entire measuring range. The typical measurement error is therefore less than 0.05% of the range. To achieve this high measurement accuracy, active 0-20 mA or 4-20 mA current signals, which have their own power supply, need to be connected to the analog ground AGND (terminal 35).

### DCL 0/20 FINET

The FINET protocol based on the 0/20 mA current loop (DCL for short) is placed in the H7 station for backward compatibility with previously manufactured sensors. For new sensors and transducers equipped with an RS485 bus, it is recommended to use the widely used RS485 bus instead of the obsolete DCL bus.

The DCL bus was used by a number of sensors manufactured by FIEDLER AMS. For example, ultrasonic probes such as the US1200 or the electrochemical sensors ESK11 (oximeter) and ESP11 (pH meter) can transmit measured data via the DCL.

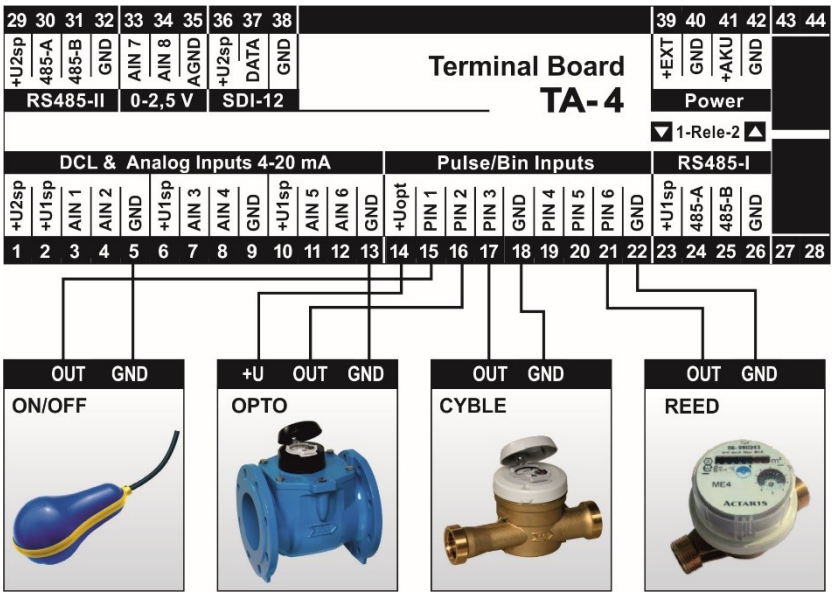
Sensors with DCL output are connected by a three-wire cable, where 2 cores are used for power supply and the third wire for data transmission of measured values. The data is transmitted digitally at a low baud rate of 1200 Bd, which allows the use of a connection cable up to 300 m long. The DCL, unlike the similar SDI-12 bus, does not allow two-way communication.

# 6.4. Pulse-Binary Inputs (PIN)

***Programming of inputs*** Each pulse PIN input can be programmed as a binary input or as a pulse input. A binary input records state changes from logic 0 (open) to logic 1 (closed) and vice versa. A pulse input increments the appropriate internal pulse counter each time a pulse arrives at the input terminal of that input.

***States*** In the idle state, there is a high level (+5V) at the PIN input terminal. The PIN input is activated by switching it on, i.e. by connecting the PIN input to the GND ground terminal. The switching can be done by a potential-free contact (relay, contactor auxiliary contacts, ...) or by an open collector of a solid-state switch (proximity sensors, OPTO sensors, ...). For reliable switching of the binary input, the internal resistance of the switch used must be < 250 Ω and the voltage at the switched input < 1 V. The maximum current flowing through the switch is less than 5 mA.

***Signaling*** Switching off the corresponding input is indicated by the yellow LED P1 - P8.




## BINARY INPUT

The binary inputs can be used to monitor, for example, contactor auxiliary contacts, two-state flood probe signal, building security system contacts, etc.

***Alarm SMS*** Disconnection or disconnection of any of the binary inputs can activate a warning SMS message. In order to avoid false alarms, the sending of the corresponding SMS message can be conditioned by the continuous duration of the active state of the binary input for a preset period of time.

***storing status*** Any state change on the binary input can be recorded in the event memory including date and time with resolution in seconds.

***Motor Hours*** If the H7 unit is to monitor the switching time of the individual binary inputs - motor hours, then the selected analogue channel must be set using the procedure described in chap. 25 Measurement method: Binary channel on page 260.

## PULSE INPUT

Each pulse input has an associated pulse counter with a capacity of more than 4 billion pulses. The actual pulse count or the corresponding recalculated flow rate value (number of pulses multiplied by the pulse weight) is always recorded in the internal data memory after the set storing interval has elapsed. The unit display can show the calculated instantaneous flow rate value.

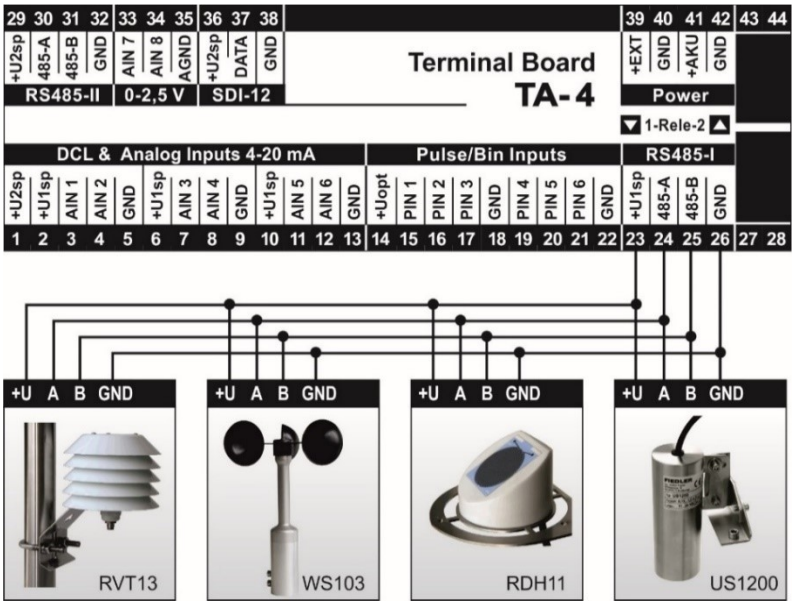
***Pulse duration*** The minimum pulse length is 2 ms. The parameters of the pulse inputs are identical to the bin inputs.

***Calculation of instantaneous flow rate*** In practice, pulse inputs are used to connect propeller water meters. Special software allows to continuously calculate the instantaneous flow rate in l/s from the pulse weight and the frequency of their occurrence. This is then converted by the unit into, for example, a 4-20 mA current output or displayed on the display, sent via SMS messages, etc.

# 6.5. RS485 serial interface

## 6.5.1. Master operating mode

Both RS485-I and RS485-II serial input/output interfaces allow connection of sensors and probes equipped with RS485 bus under MODBUS RTU or FINET communication protocols. In master mode, the H7 unit reads data from the measurement channels of individual sensors or writes control signals to controlled I/O modules, PLCs and transmitters.




***Communication protocols***

MODBUS RTU and FINET communication protocols can also be operated together on one RS485-I or RS485-II line. However, it is advisable to use a different Baudrate for each protocol for trouble-free operation.

The choice of communication protocols and the selection of one of the RS485 buses and their settings are described in detail in chapter. ***4-4*** Connecti on p. 206.

***Measuring methods***

Examples of setting the Modbus RTU Master operating mode parameters are given in the description of the measurement methods in chapter ***12. Measurement methods in examples***. The main measurement methods include:

- **10. Measuring method: probe RS485 / FINET (pg. 244)**
- **11. Measuring method: probe RS485/MODBUS (pg. 245)**

In addition to these two main measurement methods, the chapter contains 12. description and setup examples, there are several other measurement methods based on reading or writing data via the RS485 bus in master mode. A complete list of measurement methods is given in chap. 3-1-5 Measurement method on p. 125.

***Address***

When setting ACH or BCH channel parameters, it is necessary to enter the serial number of the internal channel of the measuring probe in addition to the address of the connected probe.

***Communication address***

If multiple probes of the same type are required to be connected to a single H7 unit on the same network, it is necessary to set up a unique address for each probe in advance using appropriate software and hardware, or order this service from the H7 probe and station supplier.

***Power supply for connected sensors***

When powering a large number of sensors from the H7 unit, it is necessary to make sure that the maximum current draw of 500 mA from the +U1sp and +U2sp terminals is not exceeded. At the same time, it is advisable not to unnecessarily exceed the recommended minimum supply voltage of a given probe or sensor for battery-powered stations in terms of energy saving (i.e. use the possibility of the H7 unit to set the size of the supply voltages Unap1 and Unap2 differently).

***Overview table of probes and sensors***

The overview table on the following page shows the default communication address, the minimum Unap size, the type of communication protocol and the occupancy of the individual measurement channels inside the measuring probe/sensor for the most commonly used probes and sensors.

## 6.5.2. Overview table of frequently used sensors and probes

**Addresses and measurement channels of sensors and transmitters with RS485 output**





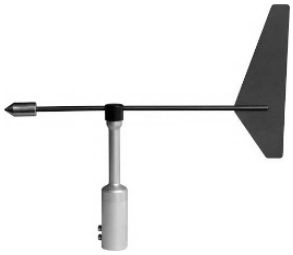






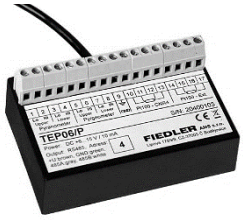
| Type Sensors | Address | Unap* [V] | FINET*** | MODBUS | Channel | Measured variable | Resolu-tion | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **US1200** ultrasonic sensor. | 5** | 12 | ✓ A* | ✓ 1* | K1 | Level (1200 mm from probe = 0 mm) | 1 | mm |
| | | | | | K2 | Air temperature | 0,1 | °C |
| | | | | | K3 | Book now | - | - |
| **TSH22** pressure level sensor | 14 | 6 | ✓ A* | ✓ 1* | K1 | Level | 1 | mm |
| | | | | | K2 | Water temperature | 0,1 | °C |
| | | | | | K5 | Level only at t> 0°C (from FW 1.05) | 1 | mm |
| **PSH30** float hunger sensor. | 15 | 6 | ✓ A* | | K1 | Level | 1 | mm |
| | | | | | K2 | Book now | - | - |
| | | | | | K3 | Temperature inside the sensor | 0,1 | °C |
| **Water quality sensors** | | | | | | | | |
| **PH485** pH meter | 6 | 6 | ✓ A* | ✓ 1* | K1 | pH | 0,01 | pH |
| | | | | | K2 | Water temperature | 0,01 | °C |
| | | | | | K3 | pH not temperature compensated | 0,01 | pH |
| | | | | | K4 | Electrode voltage output | 0,01 | mV |
| **ORP485** re-dox meter | 7 | 6 | ✓ A* | ✓ 1* | K1 | Redox potential | 0,01 | mV |
| | | | | | K2 | Water temperature | 0,01 | °C |
| **ISE485** chlo-rine dissolved sensor | 7 | 6 | ✓ A* | ✓ 1* | K1 | Dissolved chlorine | 0,01 | mg/l |
| | | | | | K2 | Water temperature | 0,01 | °C |
| | | | | | K3 | Electrode voltage output | 0,01 | mV |
| **ISE485** ISE electrode | 7 | 6 | ✓ A* | ✓ 1* | K1 | Electrode voltage output | 0,01 | mV |
| | | | | | K2 | Water temperature | 0,01 | °C |
| **ESP11** pH meter | 6 | 12 | ✓ A* | | K1 | Water temperature | 0,1 | °C |
| | | | | | K2 | pH | 0,01 | pH |
| **ESK11** oximeter | 8 | 12 | ✓ A* | | K1 | Water temperature | 0,1 | °C |
| | | | | | K2 | Dissolved oxygen | 0,01 | mg/l |
| **ESKO12** opt.oximeter | 10 | 12 | | ✓ 1* | K1 | Water temperature [°C] | 0,1 | °C |
| | | | | | K2 | Dissolved oxygen | 0,01 | mg/l |
| **ESV11** conductivity sensor | 9 | 8 | ✓ A* | | K1 | Water temperature | 0,1 | °C |
| | | | | | K2 | Conductivity linearly temperature comp | 1 | µS/cm² |
| | | | | | K3 | Conduc. of non-linear comp. EN27888 | 1 | µS/cm² |
| | | | | | K4 | Conductivity without temperature comp | 1 | µS/cm² |
| **NTU S461** The stopwatch | 14 | 12 | | ✓ 1* | K4 | Turbidity on float register 4 (+5) | 1 | NTU |
| **Temperature and humidity transmitters and sensors** | | | | | | | | |
| **TEP1** | 11 | 6 | ✓ A* | ✓ 1* | K2 | Temperature, Pt100-A sensor | 0,01 | °C |
| **TEP06** | 4 | 6 | ✓ A* | | K1-K6 | Temperature on channel K, Pt100-A sensors | 0,01 | °C |
| | 11 | 6 | ✓ A* | ✓ 1* | K1 | Relative humidity | 0,1 | % |
| | | | | | K2 | Air temperature SHT (RVT01,RVT11) | 0,1 | °C |
| | | | | | K3 | Air temperature Pt100 (RVT11) Dew point temperature ( RVT13) | 0,01 | °C |











| Type Sensors | Address | Unap* [V] | FINET*** | MODBUS | Channel | Measured variable | Resolu-tion | Units |
|---|---|---|---|---|---|---|---|---|
| **Wind speed and wind direction sensors** | | | | | | | | |
| **WS103** Wind speed sensor | 7 | 8 | ✓ A* | ✓ 1* | K1 | Average wind speed per interval | 0,01 | m/s |
| | | | | | K2 | Minimum wind speed in the interval | 0,01 | m/s |
| | | | | | K3 | Maximum wind speed in the interval | 0,01 | m/s |
| | | | | | K4 | Instantaneous wind speed | 0,01 | m/s |
| | | | | | K5 | Sensor body temperature | 0,1 | °C |
| | | | | | K6 | Heating ON/OFF | 1 | - |
| | | | | | K7 | Interval length | 1 | s |
| | | | | | K8 | Scatter | 1 | - |
| | | | | | K9 | Number of wind gusts in the interval | 1 | - |
| | | | | | K10 | Supply voltage | 0,1 | V |
| **WD360** Wind direc-tion sensor | 8 | 8 | ✓ A* | ✓ 1* | K1 | Average wind direction per interval | 0,5 | ° |
| | | | | | K2 | Minimum wind direction in the interval | 0,5 | ° |
| | | | | | K3 | Maximum wind direction in the interval | 0,5 | ° |
| | | | | | K4 | Immediate wind direction | 0,5 | ° |
| | | | | | K5 | Sensor body temperature | 0,1 | °C |
| | | | | | K6 | Heating ON/OFF | 1 | - |
| | | | | | K7 | Interval length | 1 | s |
| | | | | | K8 | Scatter | 1 | - |
| | | | | | K9 | reserve | - | - |
| | | | | | K10 | Supply voltage | 0,1 | V |
| **4310** Ultrasonic wind speed and direction sensor | 6 | 12 | | ✓ 2* | K51 | Wind speed | 0,01 | m/s |
| | | | | | K50 | Wind direction | 0,5 | ° |
| | | | | | K61 | Air temperature | 0,1 | °C |
| | | | | | | | | |
| | | | | | | | | |
| **Other meteorological sensors and transmitters** | | | | | | | | |
| **ATM01 ATM11** atm. air pres-sure sensor | 10 | 6 | ✓ A* | ✓ 1* | K1 | Atmospheric air pressure | 0,1 | mbar |
| | | | | | K2 | Pt100 air temperature (ATM11) | 0,01 | °C |
| | | | | | K3 | Air temperature sensor | 0,1 | °C |
| | | | | | K5 | Air pressure, delta= -500,00 mbar | 0,01 | mbar |
| | | | | | K6 | Air pressure converted to main sea | 0,1 | mbar |
| | | | | | | | | |
| **TEP06/P** Converter for globe sen-sors. Radia-tion Optimised for Net Radiome-ter **CNR4** | 4 | 6 | ✓ A* | | K1 | Shortwave Radiation Pyranometer-Up | 0,1 | W/m² |
| | | | | | K2 | Shortwave radiation pyranometer-Down | 0,1 | W/m² |
| | | | | | K3 | Longwave Radiation Pyrgeometer-Up | 0,1 | W/m² |
| | | | | | K4 | Longwave Radiation Pyrgeometer-Down | 0,1 | W/m² |
| | | | | | K5 | Internal temperature (Pt100)) | 0,1 | °C |
| | | | | | K6 | External temperature (Pt100) | 0,1 | °C |
| | | | | | K13 | 4th power of temperature K5 | 0,1 | °C |
| | | | | | K14 | 4th power of temperature K6 | 0,1 | °C |









| Type Sensors | Address | Unap* [V] | FINET*** | MODBUS | Channel | Measured variable | Resolution | Units |
|---|---|---|---|---|---|---|---|---|
| **TM4** transmitter for soil strain gauges | 15 | 6 | ✓ **A*** | ✓ **1*** | K1-K4 | Tensometric soil suction pressure - 90... +80 | 0,01 | kPa |
| | | | | | K5-K8 | Soil temperature | 0,1 | °C |
| | | | | | K9 | Atmospheric air pressure | 0,1 | mbar |
| | | | | | K10 | Air temperature | 0,1 | °C |
| **RT-03** precipitation heating controller. SR03/V | 16 | 6 | ✓ **A*** | | K1 | Temperature of the lower section of the rain gauge | 0,1 | °C |
| | | | | | K2 | Surface temperature of the upper section - funnel | 0,1 | °C |
| | | | | | K3 | Reserve - temperature of external temperature sensor | 0,1 | °C |
| | | | | | K4 | External power supply voltage size | 0,1 | V |
| **RDH11** Rain detector with rainfall intensity indication and binary output | 9 | 10 | ✓ **A*** | ✓ **1*** | K1 | Approximate rainfall intensity (0-100%) | 1 | % |
| | | | | | K2 | Ambient temperature | 0,1 | °C |
| | | | | | K3 | Temperature of the heated sensor | 0,1 | °C |
| | | | | | K4 | Binary information HEATING (ON/OFF) | 1 | - |
| | | | | | K5 | Binary information LENGTH (ON/OFF) | 1 | - |
| | | | | | K6 | Approximate rainfall intensity - frequency | 1 | Hz |
| **Wireless modules** | | | | | | | | |
| **WL-BASE** | | 6 | ✓ | | K1-K23 | Measurement channels of wireless sensors | | |
| **WL-AI2** 2x 4-20 mA | 21 | | | | K1 | 1. current input 4-20 mA | 0,01 | % |
| | | | | | K2 | 2. current input 4-20 mA | 0,01 | % |
| **WL-AU2** 2x voltage | 22 | | | | K1 | 1. voltage input 0-2 V DC | 0,01 | % |
| | | | | | K2 | 2. voltage input 0-2 V DC | 0,01 | % |
| **WL-PI2** 2x pulses | 23 | | | | K1 | 1. pulse input | - | pulses |
| | | | | | K2 | 2. pulse input | - | pulses |
| **WL-485** | 24 | | | | K1-K12 | Value taken from the connected sensor over RS485 | | |
| **WL- AI2-PI2-485** Combined wireless modem | 40 | | | | K1 | 1. current input 4-20 mA | 0,01 | % |
| | | | | | K2 | 2. current input 4-20 mA | 0,01 | % |
| | | | | | K3 | 1. voltage input 0-2 V DC | 0,01 | % |
| | | | | | K4 | 2. voltage input 0-2 V DC | 0,01 | % |
| | | | | | K5-K16 | Value taken from the connected sensor over RS485 | | |

** The Unap voltage magnitude represents the smallest supply voltage magnitude at which the sensor can still operate reliably. The maximum permissible supply voltage is greater than 15 V for all sensors listed in the table (they can be powered directly from the Unap terminals).*

*** US1200 sensors manufactured before 2008 have communication address 1.*

**** When ordering the required probes and sensors, it is necessary to specify which protocol type should be set as default (FINET or MODBUS RTU) in the probe/sensor. Only some types of sensors/probes can be reconfigured and special software and HW equipment is required.*

**1*** ..... default setting: MODBUS RTU, 19200 Bd, no parity, 1 stop bit

**2*** ..... default setting: MODBUS RTU, 19200 Bd, even parity, 1 stop bit

**A*** ..... default: FINET, 19200 Bd, no parity, 1 stop bit

## 6.5.3. Slave operating mode on RS485-I

In this mode of operation, the H7 unit will transmit measured data from individual recording channels to the parent system on demand and can also receive control data to control its outputs.

### SETTING THE SLAVE WORKING MODE

***SLAVE mode settings***

In chapter ***11.5.4-4*** Connecti on p. 206 The parameters important for setting the SLAVE operating mode on the RS485-I bus are listed. This mainly concerns the selection of parameters in the *Port 2* group, whose settings control this operating mode (**chap**. ***Ports*** on p. 206).

On pg. 209 also shows Example 27. : Setting H7 to MODBUS RTU SLAVE mode.

***Measuring method for remote control***

As will be shown later in the description of the individual parameters of the unit, the operation of the unit is controlled by an important parameter called the *Measurement Method*, among many other parameters.

A complete list of all measurement methods is given in chap. 3-1-5 *Measurement* method on p. 125 and a description of the measurement methods with examples of setting additional parameters is given in chapter 12. Measurement methods in examples on p.233**.**

The Modbus RTU Slave operating mode, in which it will be possible to write the required data to the H7 unit from the parent PLC or from another control unit (H7, E2, Q2) operating in the master mode, is determined, among other things, by the measurement method:

- **12.26. Measurement method: Remote input 258 on page. 261**

In addition to this special measurement method for Slave mode, the chapter contains 12. a description and examples of setting up many other measurement methods based on reading or writing data over the RS485 bus in master mode.

***Disabling power saving mode***

From the principle of SLAVE operation, it is clear that H7 must operate in continuous operation and must not go into power saving mode (chapter 11.3.2-2-1 Power mode on p. 108).

***Map of registers***

In the appendix of this manual, on p. 280 The complete **register map of the H3, H7 unit** for MODBUS RTU Slave communication is given on the page.

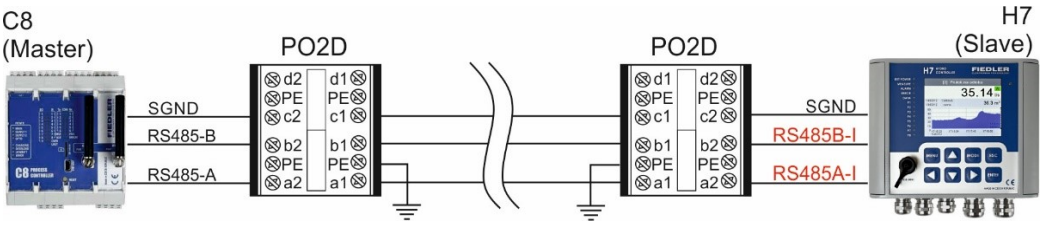
### RS485 BUS CONNECTION IN SLAVE OPERATING MODE

Operation of the H7 unit in MODBUS RTU Slave mode is only possible using the RS485- I serial bus (terminals 23 to 26 on the TA4, TA5 board, terminals 1 to 4 on TB1-3 boards).

If the MODBUS RTU Slave operating mode is not set, the RS485-I bus can be used in the same way as the RS485-II bus.

***Surge arrester PO2D***

If the wiring between the control system and the H7 unit is long and is routed in an aboveground outdoor or industrial environment, then we strongly recommend that surge arresters designed for the RS485 line be placed at both ends of the interconnecting cable. For example, a surge arrestor type PO2D-12V is suitable and can be ordered with the H7 unit.




*Connection of PO2D surge protectors between 2 devices communicating via RS485*

***RS485-I***

The RS485-II bus does not allow MODBUS RTU Slave mode. Therefore, RS485-II can only be used to collect measured data from connected sensors in MODBUS RTU Master mode or to control external input/output expansion modules.

## 6.5.4. General rules for RS485 bus wiring




***PO2D***

*surge protection of RS485 data and power wires*

Smooth use of the RS485 serial link requires compliance with established rules for this type of communication. The main requirements for proper RS485 bus wiring include:

### SHIELDED TWISTED DATA CABLE

Use a suitable shielded 4-conductor data cable with an impedance of 50 Ω, consisting of 2 pairs of twisted wires. For the 4-wire cable, one pair is used for data and the other pair is used either to power the connected sensor or to connect the signal grounds (see below).

Suitable cable types include, for example:

**PAAR-TRONIC-Li-2YCY 2x2x0,34 QMM**

### SINGLE-SIDED SHIELDED CABLE CONNECTION

The cable shield is only connected on the side - usually on the master side, because no current can flow through the cable shield. In the case of a double-sided grounded shield, differing ground potentials could induce this unwanted current through the cable shield. The current flowing through the shield would be induced into the internal conductors of the cable and cause noise on the data bus.

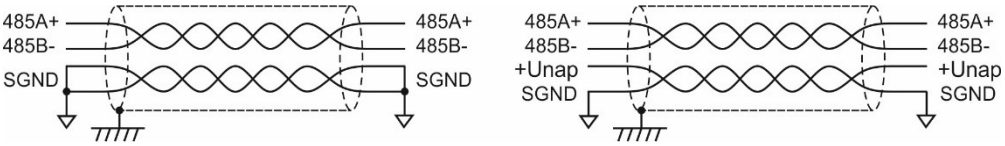
### CONNECTING SIGNAL COUNTRIES

A 2-wire interface does not mean 2 wires. Although the RS485 bus is referred to as a 2-wire interface, it requires the connection of signal grounds on both sides of the interconnect cable for proper operation in order to shut off the current flowing through the data wires back to the exciter.

Usually this requirement is fulfilled in a short line when the master and slave are located close to each other or have a common supply voltage, i.e. their SGND signal grounds are connected.

***Enhanced interconnection of signal countries***

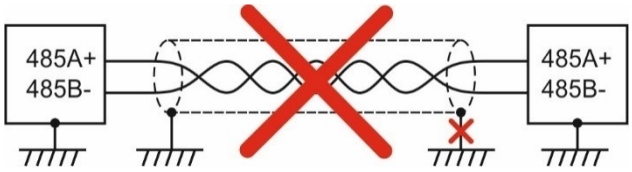
The lack of interconnection of signal lands also has a significant impact on the **reliability of data communication**, sometimes working and sometimes "inexplicably" dropping out. If the second twisted pair of the data cable is not used to power the slave-sensor (the sensor is powered by a separate source at its installation location), then it is advisable to connect the two loose cores of the data cable and use them to connect the signal grounds of both devices (the lower ohmic resistance of the line will reduce the differential potential of the signal grounds).




*Correctly connected interconnection cable without sensor power supply and with power supply voltage*

***Missing signal ground***

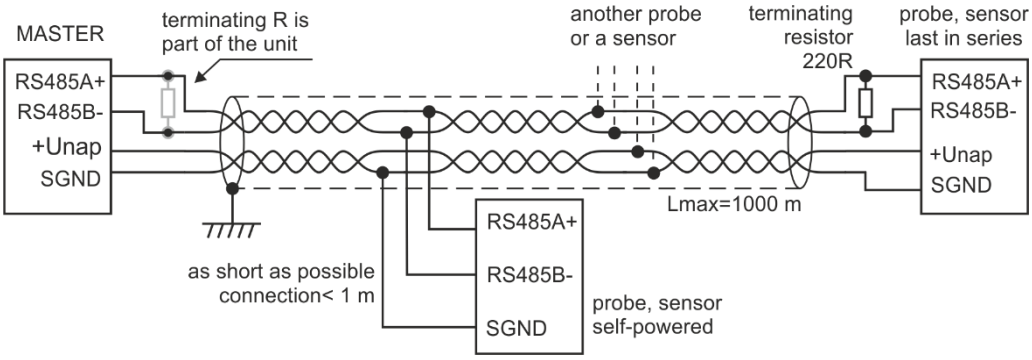
If no wire is used to connect the signal grounds of both communicating devices, the ground buffer current will be closed via the protective diodes of the RS485 exciters, which have only limited current immunity.




*Incorrect RS485 bus wiring with signal ground connection via ground loop*

As the length of the data cable increases, the ground potential difference between the two sides of the cable can increase, especially in industrial environments. If at least one device

is floating, i.e. galvanically isolated from the earth potential at the installation site, this potential difference between the cable ends will not be a problem.




*Proper RS485 bus connection with floating device does not allow ground loop closure*

## GALVANIC SEPARATION OF RS485 BUSES

If the two communicating devices are connected with different ground potential at the place of their installation, which can be in the order of tens of volts, then it is necessary, in terms of reliability of operation, to insert a suitable galvanic isolator of RS485 buses between them - e.g. the MIG485 module.

## SEPARATOR/BREAKER - MIG485

The MIG485 isolator/splitter enables mutual galvanic isolation of RS485 buses up to 1 kV DC, while the individual buses are also isolated from the supply voltage of the MIG485 isolator.

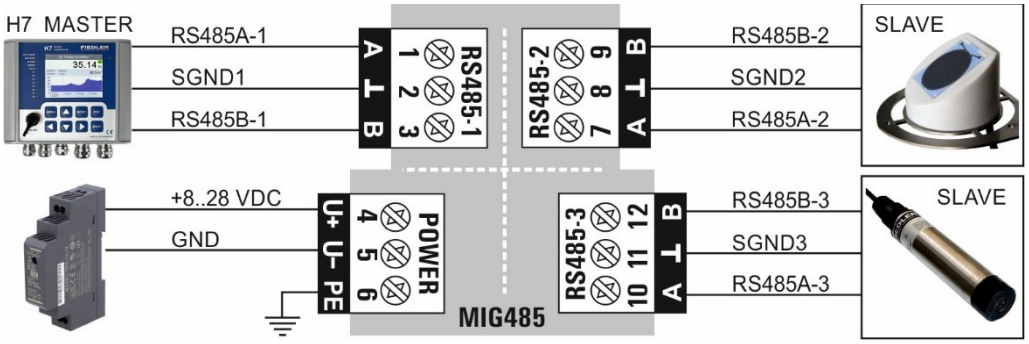
The MIG485 module contains two secondary RS485 buses in addition to one primary RS485 bus and can therefore be used not only for galvanic isolation of the buses but also for their branching into two different directions.

The splitter also protects against complete blocking of communication in case of a short circuit in one secondary RS485 branch, when the remaining buses can still be functional.

Last but not least, this type of separator/breaker regenerates incoming data packets before they are sent.

***Connecting the terminals of the MIG485 separator***

The following figure shows how the MIG485 module is connected between the H7 unit (master) and the measuring sensors connected to the two secondary RS485 buses.



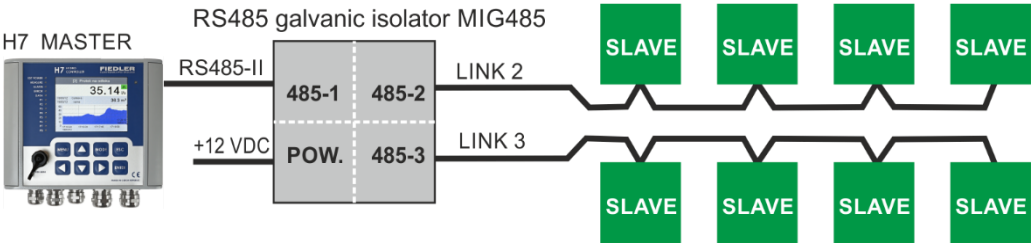

*Connection of terminals of galvanic isolator/breaker MIG485*

## SUITABLE TOPOLOGY

Connecting more than one measuring probe to the unit requires care to ensure that the connection cable is pulled correctly. It is not advisable to connect a star-shaped network, but due to the requirements for suppression of reflections, it is advisable to connect the individual probes in series from the first to the last.




The following diagram shows the use of the MIG485 splitter to create two mutually separated branches. Each branch can be grounded at one point without balancing the currents through the ground loops due to galvanic isolation.




## REST POTENTIALS OF TERMINALS A, B

The potentials of both RS485-A and RS485-B data lines must be voltage defined on the master side. The wiring of the H7 register unit already contains circuitry to define the quiescent state of the line: the RS485-A wire is held at a higher potential than the RS485-B wire by internal resistors.

## TERMINATING RESISTORS

Both ends of the RS485 network must be terminated with an impedance close to the impedance of the cable used to suppress reflections. On the H7 side, both RS485-I and RS485-II serial lines are terminated with internal resistors.

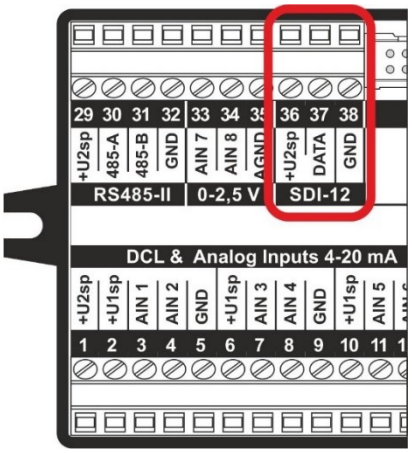
In the case of a long line, it is advisable to strengthen this internal terminating resistor on the H7 side with an additional external resistor of 150 to 330 Ω located between the RS485-A and 485-B terminals. The other end of the RS485 line should always be supplemented with a terminating resistor. A 220 Ω resistor is connected between the RS485-A and RS485-B terminals.

# 6.6. SDI-12 serial interface

SDI-12The SDI-12 serial interface communicates with a range of sensors from many different manufacturers, primarily focusing on water quality monitoring and soil moisture measurement.

***Connection plate TA4***

The TA4 and TA4E boards contain an SDI-12 serial communication line at terminal 37 DATA. Next to this terminal is the positive power terminal U2sp (36) and the GND ground terminal (38).




***Supply voltage 12 V DC***

The SDI-12 type sensors are connected to the H7 unit via a 3-wire line, which also supplies the SDI-12 sensors with 12 V DC from the +U2sp (or U1sp) terminal.

The size of the 12 V supply voltage must be set in the unit parameters - chap. 2-2 Power on p. 107 and is common for all SDI12 type sensors.

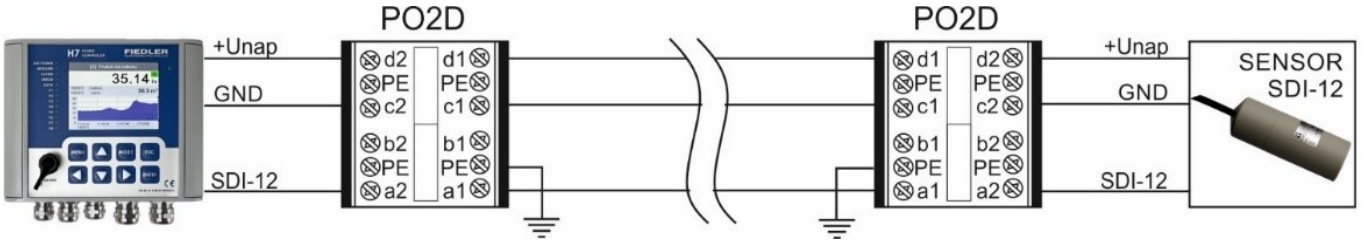
***Measuring network***

The low Baudrate of the 1200 Bd SDI-12 bus theoretically allows sensors to be connected at distances up to hundreds of meters from the H7 unit.

However, the size of the network and its vastness will be limited by the danger of induced atmospheric overvoltage during storms and possibly also by the loss of supply voltage and the corresponding "lifting" of the negative supply voltage (GND) on the ohmic resistance of the supply cores of the interconnecting cable, rather than by the transmission Baudrate. Therefore, we recommend using a shielded cable with a minimum core cross section of 0.35 $mm^2$ for the measurement network connection and not to exceed a distance of 100 m between the unit and the sensor.

***Surge protectors***

A large measurement network needs to be protected by a suitable type of surge protector. A PO2D-12V surge protector can be ordered from the H7 unit supplier to protect one power and up to 2 data communication lines.




***Address***

A larger number of sensors in one network brings with it the requirement to set unique addresses for individual sensors, similar to the RS485 bus. Changing the communication addresses of individual SDI-12 sensors can also be done in the field using the H7 unit command.

The communication address of the sensor connected to the H7 unit must be in the range from 1 to 99.

***Network topology***

Due to the very low Baudrate, it is not critical with the SDI-12 bus whether the individual sensors and transducers are connected in star or series, because any reflections at the end of the unmatched line are damped before the 0/1 bus state is evaluated.

***Example of parameter settings***

For a description of how to set the SDI-12 serial interface parameters of the H7 unit, see chapter 17 Measuring method: Probe SDI-12 on p. 253, where the Example 54. Reading data from the CS650 soil moisture sensor using the SDI-12 protocol.

***Useful injunction***

More information regarding SDI-12 standards can be found at:

h ttp://www.sdi-12.org

In addition to the technical standards of the SDI-12 serial bus, the communication protocol and its individual commands are described in detail on this website.

A list of relevant SW commands for reading and writing is also included in the documentation of the sensors and transducers used.

# 7 Outputs

In addition to power and input terminals, the connection boards also contain several terminals for controlling the connected technology. The most common is the mechanical relay switching contact, boards TB1 to TB3 also contain electronic relays and boards TB2, TB3 also contain 4-20 mA current outputs. The designation of these output signals and their basic meaning is given in the following overview table:

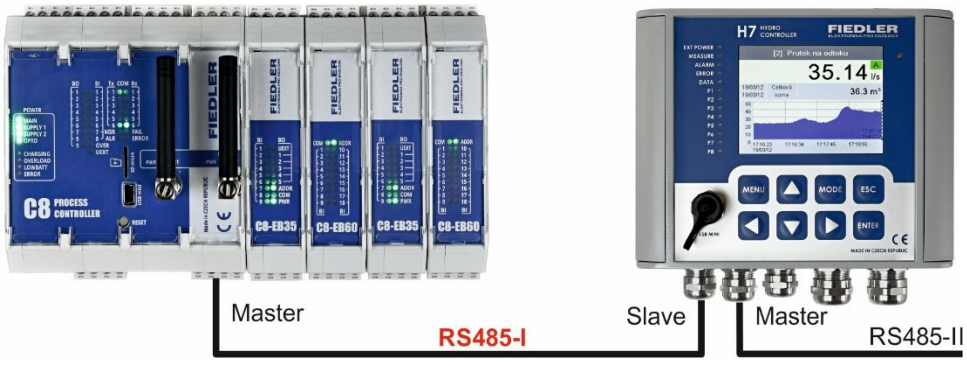
*Marking of outputs on connection boards*

| Mark | Name of output | Signal/protocol type |
|---|---|---|
| **RS485-I** | Primary serial line | MODBUS RTU Slave |
| **M-relief** | Mechanical relays | Potential-free switching contact |
| **E1-relay** | Electronic relays | Voltage output 12 or 24 VDC |
| **E2-relay** | Electronic relays | Electronic switch, Rmax: 12 Ohms |
| **Iout** | Current output | Active output 4-20 mA |

## 7.1. RS485-I bus

Only the RS485-I primary bus allows operation in Slave mode. All current values and states of the H7 unit are then available to the master system under MODBUS RTU protocol. Slave mode requires continuous operation of the H7 unit without going into power saving mode [see chap. 11.3.2-2-1 Power mode, p. 108].

The register table depends on the specific parameterization of the H7 unit. The current registers can be found in the H7 unit register map at the end of this manual.




If the RS485-I bus is occupied by communication with a higher-level system, the secondary RS485-II bus can be used to collect data from the connected probes. The same is true for reading data and controlling external I/O modules.

## 7.2. Relay binary outputs

The binary relay outputs can be used to control pumps, blowers, solenoid valves, heating elements, audible and light alarms, fans and many other actuators of the connected technology.

Both preset limit states of the recording channels and binary inputs of the unit can be used to control the relay. The H7 controller's sophisticated evaluation algorithm allows various logical combinations of input and output signals, including time functions and embedded programmable PID controllers.

The parameterization and setting of binary outputs (relays) is covered in detail in chap. 11.4.3-2 Binary IOs, p. 143.

### 7.2.1. Safety instructions

**Always disconnect the instrument from the power supply when connecting the relay outputs**

**The relay switching contacts are not rated for switching inductive loads.**

**The relay switching contacts are not protected against overload. The load circuit must be current protected so that the maximum current does not exceed 5 A.**

**Do not use different wires of one cable to connect the relay contacts to the 230 VAC mains voltage and at the same time to supply the unit with 12 .. 24 VDC.**

**The H7 instrument with connection board TB3, powered by 100 - 240 VAC mains voltage, is designed to connect the mains voltage to the contacts of relays RE1 and RE2.**

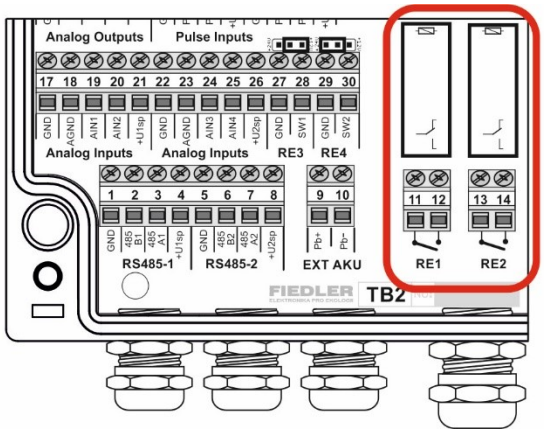
**The H7 instrument with connection board TB1 and TB2, powered by 24 VDC, is designed for low voltage (24 VAC or 48 VDC) connection to relay contacts RE1 and RE2 only.**

**The current load on untightened terminals can cause overheating and subsequent fire. Ensure that the relay terminals are properly tightened. Also, take extra care to tighten the cable glands sufficiently to prevent the cable from shifting in the gland and subsequently pulling the cable end out of the terminals.**

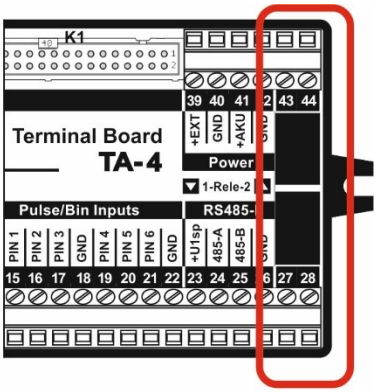
## 7.2.2. Mechanical M-relief

The number of mechanical relays and the voltage and current loading of the contacts is specified in the description of the individual connection boards [chap. 4.1. Types of connection boards and their power supply, p. 21].

**TB1:**
**TB2:**
**TB3:**




**TA4:**
**TA4E:**
**TA5:**




*Placement of mechanical relays on TB and TA connection boards*

In summary, the two mechanical relays RE1 and RE2 on the connection boards TA4, TA5, TB1 and TB2 have contacts capable of switching up to 5 A into a resistive load at 48 V DC. Relays RE1 and RE2 on connection board TB3 are capable of switching the same current at 230 V AC line voltage.

*Mechanical relays:*

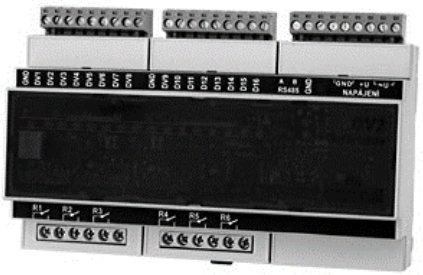
| Connection plate: | TB1, TB2 | TB3 | TA4, TA4E, TA5 |
|---|---|---|---|
| **Number of M-trees** | 2 (RE1, RE2) | 2 (RE1, RE2) | 2 (RE1, RE2) |
| **Max. current** | 5 A | 5 A | 5 A |
| **Max. voltage** | 48 V DC | 230 V AC | 48 V DC |
| **Quiescent state** | Disconnected | Disconnected | Disconnected |

***M-relay and power failure***

The status of the M-relay after an external supply voltage failure depends on whether an external 12V battery is connected to the connection board. Units with an external battery will continue to be controlled by the algorithm from the H7 unit after an external supply voltage failure, because the relay coils are powered by the voltage of this battery.

### RELAY IN EXTERNAL MODULE DV2

A limitation, which may be the small number of mechanical relays on most connection boards or their allowable switching voltages, can be solved by connecting the DV2 I/O modules to the RS485 bus of the H7 controller [chap. 9. Expansion I/O modules, p. 72].



Each DV module contains 6 mechanical relays capable of switching a current of 5 A at 230 V AC.

Up to 8 DV2 modules can be connected to a single H7 unit, i.e. a total of 48 relays can be controlled.

## 7.2.3. Electronic E-relay

The electronic relay does not contain a mechanical contact. The relay is switched off either by applying a voltage to the relay output terminal (E1 relay type), where the second pole of the relay is the negative power supply terminal GND, or by electronically connecting the two relay terminals (E2 relay type).

The E1 relay is basically an electronic voltage switch, including current limiting and built-in overvoltage protection of the switched output.

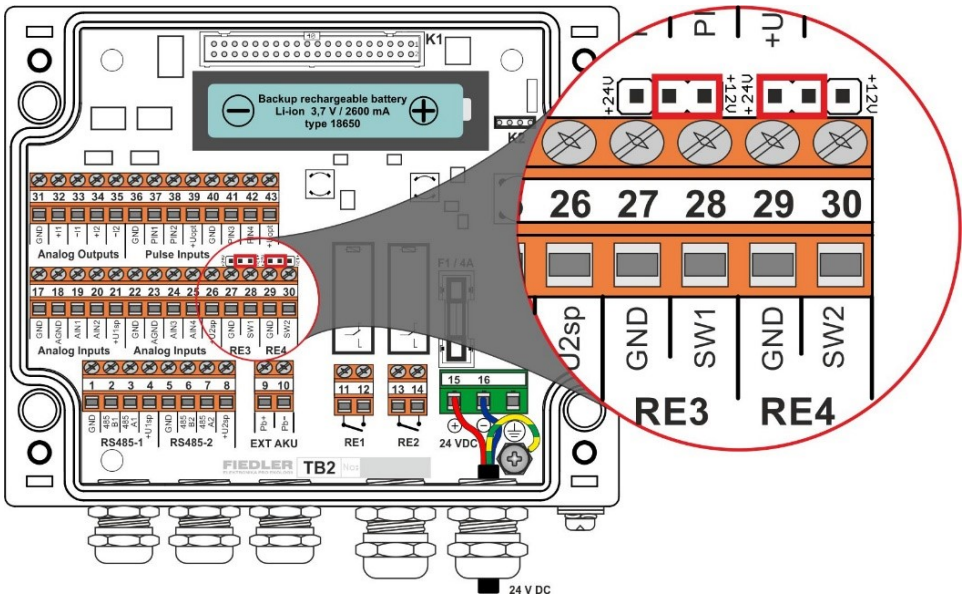
Relay type E2 contains an electronic switch independent of the polarity of the applied voltage. However, the limitation may be the resistance in the switched state (which can be up to 10 Ω) and the limited size of the switching voltage (max 28 V).

*Number and permissible contact loads of electronic relays:*

| Connection board | TB1 | TB2 | TB3 | TA4 | TA4E | TA5 |
|---|---|---|---|---|---|---|
| **E1-relay** | RE3, RE4 | RE3, RE4 | RE3, RE4 | - | RE3 | - |
| **E2-relay** | | | | - | RE4 | - |
| **Max. current** | 1 A DC | 1 A DC | 1 A DC | - | 1 A DC | - |
| **Voltage** | 12 V DC | 12V/24 VDC | 15 V DC | - | 12 V DC | - |

***Switching voltage size selection***

When the command to switch on the respective relay type E1 is given, a voltage appears on terminals SW1 or SW2, the magnitude of which is determined by the position of the optional jumper located above the terminal block. The left position of the jumper brings the supply voltage of the connection board to the E-relay, i.e. a voltage of 24 or 15 VDC depending on the type of board (see previous table), the right position of the jumper then a uniform operating voltage of the connection board of 12 VDC.




E-relay output voltage selection on TB2 board

***E-relay and power failure***

E-relays can remain in the on state even after an external power failure.

For the E1 relay type, it depends on how the unit is powered and whether an external 12V battery is connected to it. Units with an external battery and the switching voltage selector jumper set to 12V (right position) will remain in the switched state even after the external supply voltage fails, because the relays switch the voltage from the battery.

The electronic relays type E1 and E2 on the TA4E connection board are not affected by any failure of the external supply voltage and their status depends only on the control algorithm of the H7 unit.

# 7.3. Current outputs I1, I2

Connection boards TB2 and TB3 contain two active current outputs I1 and I2. These outputs can operate in the 4-20 mA, 0-20 mA and 0-24 mA range.

The parameter settings associated with the current output control are shown in chap. 23 Measurement methods: Current output 4-20 mA; 0-20 mA on p. 258.

*Current outputs 4-20 mA, 0-20 mA or 0-24 mA:*

| Connection plate: | TB1 | TB2 | TB3 | TA4, TA5 |
|---|---|---|---|---|
| **Number of outputs** | - | 2 (+I1, -I1; +I2, -I2) | 2 (+I1, -I1; +I2, -I2) | - |
| **Active output** | - | 4-20 mA | 4-20 mA | - |
| **Galv. department** | - | 1 kV | 1 kV | - |
| **Max. load. resistance** | - | < 500 Ω | < 500 Ω | - |

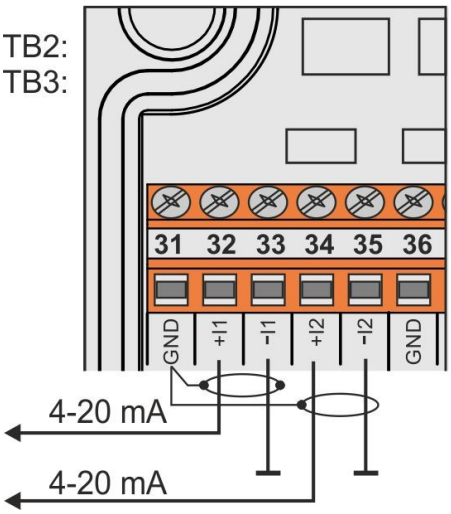
The outputs can not only be used to control frequency converters for pumps and blowers and many other actuators of the downstream technology, but can also be used, for example, to transmit the measured values to a higher-level system.

***PID control***

Similarly to relay control, the H7 unit can use the programmable PID controllers built into the H7 unit to parameterize the control algorithm for analog outputs Example 20, p. 168).

***Connecting the terminals***

The adjacent picture shows the wiring of the current output terminals of the TB2 (TB3) connection board. The active current outputs are at terminals 32 and 34. Terminals 33 and 35 are used to connect the negative input terminal of the connected device (frequency converter, PLC, ...). The GND terminals on the connection board are used to connect the shielding of the cables used.




***Technical parameters***

- The two active current outputs are galvanically isolated from the supply voltage of the H7 unit. The maximum permissible isolation voltage is 1 kV.
- To avoid conversion error at higher output currents, the load resistance of the connected input must not exceed 500 Ω.
- The output current is generated by a precision 16-bit converter with a conversion error of less than 0.05%.

***Power failure***

An interruption of the H7 unit supply voltage will cause all relays to open and the current output to switch off (set to 0 mA) for the duration of the power failure.

For the duration of the power failure, the unit will display the error message E46 - current output error (see table on p. 273).

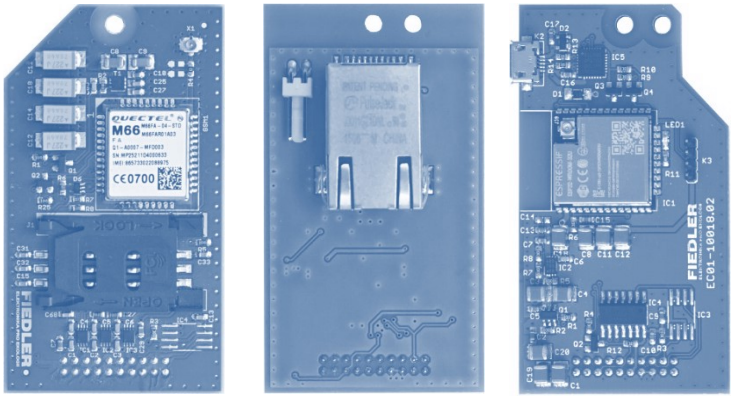
## EXTERNAL MODULES MAV421 AND MAV422

External modules MAV421 and MAV422 can be connected to the H7 Controller using the RS485-I or RS485-II serial bus. These modules can be used to expand the number of analog output signals.

The MAV421 module contains 1 galvanically isolated 4-20 mA active current output, the MAV422 module contains two such outputs

External modules are described in detail in the chapter 9. on p. 72.





# 8 Communication modules

The H3 and H7 units can operate automatically and independently according to a defined program, without human intervention. For many applications, however, the advantage is the ability to transmit measured data to higher-level systems, or to offer remote change of the program and unit settings. Communication modules are used to exchange data with remote systems.

Depending on the needs of the application, one can choose between several IoT transmission technologies. Thus, one can build a system with extreme battery life operating in remote landscapes, ready to transmit important measurements to the user in seconds wherever he is, or, on the contrary, obtain a powerful control platform allowing immediate response to user requests and real-time monitoring.

***Internal communication modules***

The H7 unit includes space for up to three internal slots for the installation of independent communication modules. Among the communication transmission technologies, modules with GSM/GPRS, WiFi and Ethernet support are available. As communication technologies are constantly expanding, please check with the manufacturer for the current range of communication modules.

***External communication modules***

In addition to the internal modules, the unit also supports communication with external modules from other manufacturers, such as the module for data transmission via the INMARSAT satellite network, etc. For information on currently available technologies and approved countries of use, please contact the manufacturer.

All modules and slots are not interchangeable, so it is advisable to choose one of the recommended assemblies according to the following table or consult the supplier before ordering the unit.

When configuring the instrument, the following menu of communication modules is available (part of the configuration table from page 7):

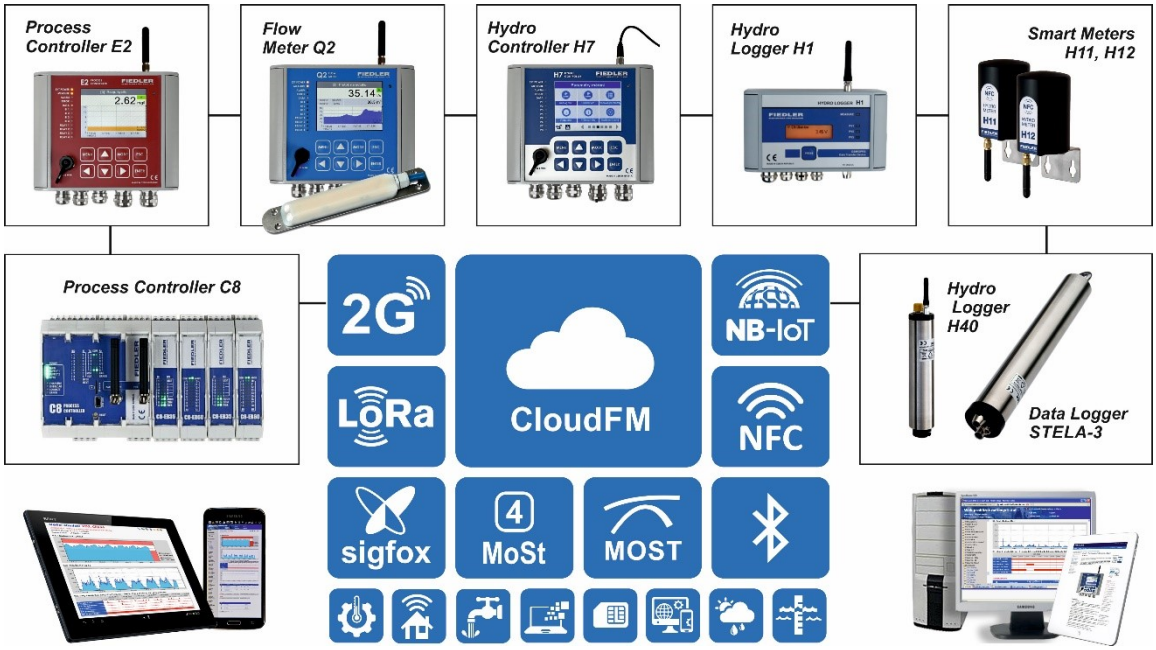
| | |
|---|---|
| U | Without communication module - USB mini only (IP67) |
| G | Internal GSM module including GSM connector and small rod antenna |
| E | Internal Ethernet module for internet connection |
| W | Internal WiFi module including antenna connector and small WiFi antenna |

## 8.1. Automatic data collection from stations

A significant added value of H7 units equipped with one of the offered communication modules is remote data collection, i.e. sending measured data to the cloud or customer information system, the possibility of remote parameterization of the H7 unit and online access to the units in real time.

### 8.1.1. System architecture

Units can be set to periodically send measured data to the cloud where the user can view it in graphs, tables or printed reports and summaries. Communication between the station and the cloud is typically done over the network of a provider such as mobile network operators or IoT networks.




### 8.1.2. Active stations system

The telemetry stations of FIEDLER AMS s.r.o. are characterized by a long lifetime of the power supply batteries and very low operating costs with regular data transmission to the server. This has been achieved thanks to the system of active stations and passive server:

The server is always on and waiting for data from the individual telemetry stations, which themselves determine when the data will be transmitted to the server. Cloud services allow data to be received from multiple stations simultaneously.

The communication module in the station can operate in several modes depending on the preference of response speed or battery saving. In the case of long-term battery priority, the communication module is switched on only for the time necessary to transfer data from the station to the server.

If an emergency occurs at the measurement site, the station can immediately transmit this information to the server even outside the regular communication interval - the delay usual with cyclical calling of stations by the server is eliminated.

### 8.1.3. Communication modes with the parent system

Depending on the selected transmission technology, the units can be operated in several communication modes. The communication mode used is either determined by the limitations of the technology, typically for low-power networks, or one of the modes can be user-selectable in the unit's settings, typically for advanced transmission technologies.

H3, H7 units support the following transmission modes:

- **power saving mode:** The device continuously measures, but only connects to the master system at regularly predefined intervals or on an emergency basis based on an evaluation of an alarm situation. This option is suitable for units operating without a permanent external power supply. The mode allows long-term operation of the unit on battery power.

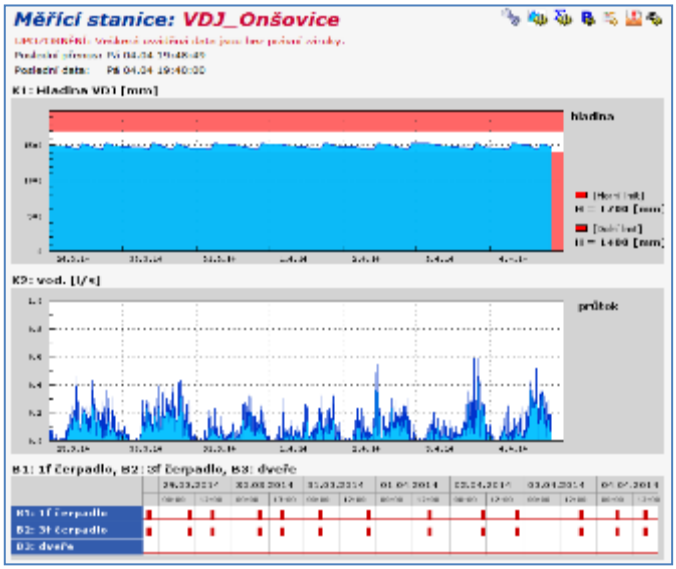
- **standby mode:** The device is permanently connected by the communication module to the network, in a limited mode that allows a fast connection to be established, as opposed to the power saving mode where it may take a few seconds to establish a connection. In case of need, it is easy to communicate or, for example, to receive and immediately process an SMS (in case of GSM/GPRS). In this mode, a connection cannot be requested from cloud services.
- **permanent mode:** Variant suitable for control devices with permanent external power supply. The device is permanently connected to the network and can provide real-time data to the parent system. Depending on the type of communication module and protocol, a persistent connection i.e. a tunnel between the unit and the cloud can be established, allowing site control with minimal response time. Requests can be sent or fresh data can be continuously retrieved from the parent system. Typical use is for SCADA systems, control rooms and applications with a need for continuous monitoring or remote control. Only robust transmission technologies support continuous mode.

When using multiple communication modules, you can specify the priority of each interface. The unit then selects the communication interface/module according to these priorities. For example, modules can be used for the purpose of ensuring high availability of the connection, i.e. if one of the networks is not available, the unit automatically tries to establish a connection via the other communication channel.

## 8.2. Cloud Services

Measured data from individual devices is sent to the cloud for further processing. The cloud is a group of powerful servers securely interconnected, running a modern virtualization environment. The servers are located in server rooms with state-of-the-art HW and SW provisioning, high connectivity and data is permanently backed up to other machines with different geographical locations. The system is designed for maximum user comfort in accessing data and also to eliminate data loss.

### 8.2.1. Data visualization

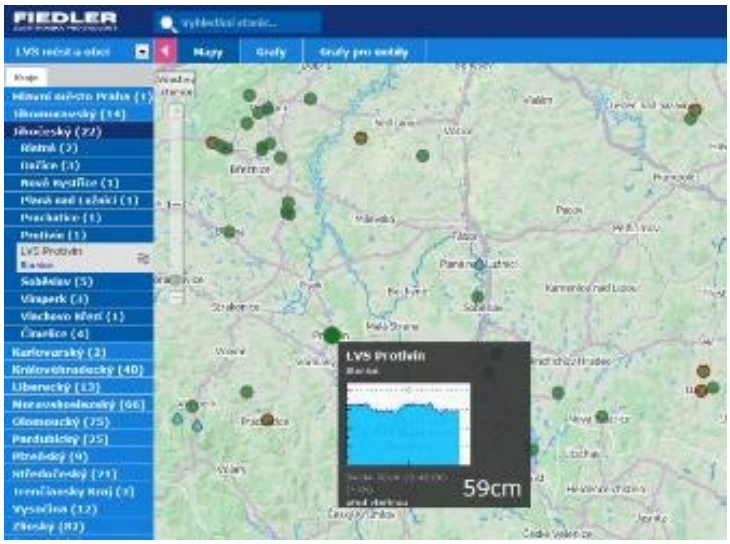



Device data is published by default through a single data visualisation and management portal operated by the device manufacturer. It is a graphical superstructure for administration and monitoring, which is suitable for administrators and maintenance dispatchers. Optionally, a comprehensive data visualisation service can be offered directly to end customers, e.g. for water network operators. The visualisation can be tailored to individual needs - for example, daily, monthly and yearly consumption reports, predictions, emergency alerts by email or SMS. The basic variant of data processing and publishing is the establishment of web services for integration with the customer's information system.

The data cloud is accessible to users via a standard web browser or mobile app. After logging in, the user can use the services of the data server, which include:

- generation of graphs and tables of measured values

- exports measured values for the selected period to the user's PC
- automatic forwarding of received data from the station to the customer's information system
- printing of graphs and monthly reports including statistical summaries
- creating user views that can contain differently averaged, summed or otherwise adjusted data from different actual stations in one graph
- automatic sending of e-mails to preset addresses after meeting the set conditions (exceeding or dropping of the measured value over the set limits, switching on/off of the binary channel, error conditions, ...)
- technological and process SCADA screens, dispatching and monitoring systems




FIEDLER AMS s.r.o. also develops its own visualization elements for data presentation in the cloud environment. The possibilities of visualization and the number of already prepared elements are huge, if you are interested in a specific form of visualization, you can study the CloudFM service manual or contact the manufacturer.

For example, in some applications it may be advantageous to display data from the device as a map. The location of the station and its current status is placed on the map base. The status may be both information about the trouble-free operation of the station and the measured values of the selected channel. As an example of the implementation of one of the projects with map bases, the freely accessible server **www.hladiny.cz displays** measured data from hundreds of stations installed on rivers and streams across the country. Incorporation of a station into the system is done by the server administrator at the request of the station owner.

## 8.2.2. Parameterization of the station remotely

The cloud allows the built-in Most4 web application to change any parameter of the unit remotely, directly via the web interface, without the need to install special software.

Access to parameters is controlled by the rights of several levels, so permissions can be controlled by individual roles. The unit administrator or technologist can thus gain full control over the unit settings, unlike, for example, maintenance personnel.

In addition, all previous and current parameter files remain backed up in the cloud database on the servers, including the date and time of their change and the login name of the specific user who made the parameter change.

## 8.2.3. Data hosting service

All these services of visualization, data processing and remote unit management are available to station users as part of the Datahosting package for a low annual fee, which is incomparable to the investment in equipping your own server and its regular maintenance. This makes the data collection system accessible to users of one or two telemetry stations as well as to operators of a large monitoring network.

# 8.3. Transmission Technologies

## 8.3.1. GSM/GPRS technology




GSM/GPRS technology is a universally applicable technology with excellent local and global coverage. It offers low running costs and unlimited data volumes with good battery life.

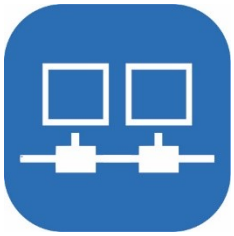
### SIM CARD RENTAL

The owner of the telemetry station can use any SIM card for data transmissions, which will be enabled for GPRS data transmissions and SMS messages.

The data server operator also offers long-term loan of its own SIM cards together with delivery of the station. These borrowed SIM cards have a low monthly fee optimized for operation in the devices. They provide a data volume covering the vast majority of applications, sufficient for the normal operation of the station.

The system allows the use of operationally cheap types of tariff SIM cards without a fixed IP address in the stations. The fixed IP address is usually charged for, which increases the overall operating costs.

## 8.3.2. Ethernet technology



The Ethernet technology is very reliable thanks to the wired connection and enables a fast permanent connection to the higher-level system. The communication module with Ethernet interface can be used for communication with cloud services or external communication modems can be connected via it to transfer data to other networks. In the supplied version, the module does not offer a web server service, so the user cannot directly access the interface with a web browser and view data from the unit.

## 8.3.3. WiFi technology




The unit can contain an internal WiFi communication module in the internal slot 3 position. The configuration of the unit parameters allows you to connect such a unit to an existing WiFi network or build your own WiFi network. To transmit the measured data to the Internet using the WiFi module, a permanent power supply of the unit including the communication module and real-time transmission is usually set up without the need for regular logging to a server as typical for applications with other wireless transmission technologies such as GSM or IoT.

Wifi technology is affordable and cheap with easy setup and good security. Suitable installations of units with a wifi communication module are in areas with permanent network power supply.

## 8.3.4. NB-IoT technology




NB-IoT technology is a modern standard for wireless data transmission over the same network, which uses existing GSM networks. NB-IoT technology is suitable as a lightweight replacement for GSM/GPRS where frequent data transmissions are required with an emphasis on long battery life. NB-IoT supports full duplex data transfer and is a good choice for medium-sized applications with units to tens of sensors.

# 8.4. Installation of the communication modules

## 8.4.1. Location and installation of communication modules

Communication modules are usually ordered together with the new instrument. There are several types to choose from, especially wireless modules. Some modules are interchangeable, others can work in parallel. Some modules require mechanical preparation in the housing of the unit and must be planned for at the time of ordering the unit.

### ADDITIONAL ADDING A COMMUNICATION MODULE

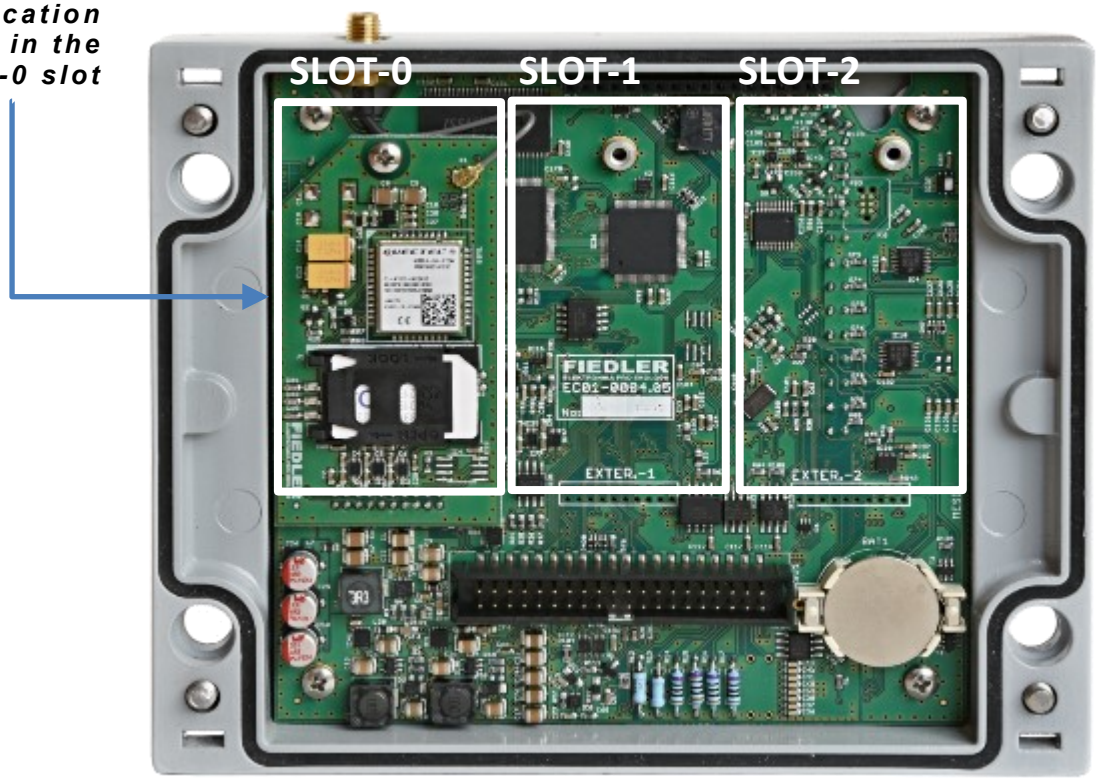
Updating/upgrading an existing module type is possible and can be done on site.

It is also possible to order suitable communication modules for existing units and install them in the device. However, such retrofitting usually requires a firmware update and often mechanical modifications to the unit and is therefore generally not recommended. The addition of a new communication module should only ever be carried out by an experienced technician who is fully familiar with the unit's functions. It is generally recommended that the unit be sent to the manufacturer for additional addition and update of the communication module.

In the case of retrofitting, it is necessary to first make sure that the version of the unit supports the required communication module. As all communication modules and slots are not interchangeable, it is therefore advisable to either select one of the recommended assemblies or consult the supplier before ordering the required communication module.

The following figure shows the location of the GSM communication module with SIM card in slot 0 (EXTER.-0.)

***Positioning of the GSM communication module in the EXTER.-0 slot***



# 8.5. GSM/GPRS communication module (-G-)




Only one communication module for GSM network can be operated in the unit. The module can only be inserted in position SLOT-0 [chap. 8.4.1, p. 61]. The module includes a U.FL coaxial connector for connecting an antenna reducer U.FL/SMA and usually a SIM card holder if the module does not already contain a SIM card.

The U.FL/SMA antenna reducer is already included in the mechanical design of the H7-G-XX unit and its SMA-F connector is located in the top edge of the H7 unit cover. This shows that the additional installation of the communication module in the H7 unit requires rather complex mechanical modifications to the H7 unit itself, if ordered without preparation for the GSM module.

The most common GSM/GPRS communication module of the unit has the type designation KM-G-V3. This module supports sending and receiving SMS messages, data communication via 2G network (GPRS) and includes a flip-up holder for a standard size SIM card.

The new version of the GSM/GPRS communication module KM-G-V4 includes a chip SIM. This eliminates the procedure of installing a SIM card.

## 8.5.1. Installing a SIM card

### SIM CARD AND TARIFF PARAMETERS

The station communication module can work with all types of prepaid and tariff SIM cards, including SIM deployment in roaming traffic, i.e. abroad.

The unit supports sending/receiving SMS and two-way data communication including GPRS transmissions.

***SIM without data*** The SIM card used can only support SMS without data, then information about alarms will be sent from the unit and you can also communicate with the unit via SMS messages on a limited basis.

***SIM including data*** If a SIM card with data transfer is used, all measured data can be transferred and the unit can also be fully parameterised remotely.

In order to fully use the unit's capabilities, the SIM card used should be able to send SMS and data communication, or at least data transfers. The use of SIM cards with only SMS messages is not recommended.

***Volume of transmitted data*** The amount of data transferred depends on the number of measurement channels set in the unit and the intensity of data storing. For typical applications, the monthly data consumption is in units of MB. For extensive and complex applications, data consumption can be up to hundreds of MB per month.

***Foreign SIM traffic*** Operation of the unit abroad can be solved by using the local SIM card of the country. Then it is typically necessary to set up the unit according to the requirements of the local/local operator (APN parameters) or it is possible to use a SIM card of the unit manufacturer with permitted permanent operation in another country, i.e. roaming. When the unit is roaming, higher operating costs for the SIM and the application of the regulations of the country can be expected.

Before operating units in roaming, it is advisable to check the current situation in the country. Some local regulations prohibit or partially restrict the long-term operation of foreign SIM cards on their networks. Brazil, China, Russia and Turkey, for example, have specific rules in place.

***SIM rental from the unit manufacturer*** The FIEDLER units can be ordered with a permanent loan SIM card with a suitably set tariff according to the intended application of the unit. For further information and questions about the loan or the selection of a suitable tariff, please contact the manufacturer of the unit.

## SIM CARD ACTIVATION

The SIM card must be activated with the operator before use in the unit. Some operators activate the SIM with the sale, others only on a specific date they set or when it is inserted into the mobile phone.

If the SIM card is to transfer data, you must also activate this service with your operator (for example, by enabling MMS) or activate a suitable data package.

Long-term rental SIM cards, supplied directly with the units, are already activated and have data traffic enabled.

## UNBLOCKING PIN

Before inserting the SIM card into the station, it must be unblocked to request the PIN code after power on (can be done on the mobile phone).

Long-term loaner SIM cards, supplied directly with the units, have their PIN unlocked.

## TO INSERT A SIM CARD

***Disconnected power supply*** When handling the SIM card, the central control unit of the station must be disconnected from the power supply, which is ensured by the mechanical design of the station itself (disconnected flat cable connecting the unit with the connection board).

***SIM card location*** The flip-out connector-holder for a standard size SIM card is accessible after removing the control unit from the station cabinet and is located on the bottom side of the GSM communication module PCB.

**!** **Take extra care when handling the unit and do not touch the electronic parts and circuit boards.**

**!** **Avoid touching the metal surfaces of the SIM card. Moisture, grease or dirt can lead to an immediate or delayed communication failure.**

**Follow these instructions to insert or remove the SIM card:**

1. Turn off the unit's external power supply if the unit is connected to it. Disconnect and remove the maintenance-free lead-acid battery if the unit is powered from it.
2. Release the central unit with display by loosening the appropriate screws according to the type of mechanical design (box, cabinet, panel design, ...).
3. Disconnect the flat cable connecting the central unit to the connection board before disconnecting the green-yellow ground wire connecting the unit to the board.
4. If the central display unit is mounted on a mounting plate, remove the plastic screw caps on the right and left sides of the unit and loosen the 4 screws under the caps. Remove the central unit from the mounting plate.
5. Tilt the SIM card holder. The SIM card holder contains a mechanical lock that can be locked. If the holder cannot be tipped out, slide the holder in the plane of the circuit board, there should be a slight shift to release the lock.
6. Insert the pre-unlocked SIM card into the holder. The holder and the SIM card are asymmetrical, respect the shapes so that the card can be inserted completely into the holder. The SIM card must have data transmissions activated and a suppressed PIN query when switched on.
7. Secure the SIM card holder with the mechanical lock, i.e. slide the holder again as described in point 5, but now in the opposite direction. Make sure that the holder is secure.
8. Assemble the station in reverse order. Before connecting the central unit to the connection board with a flat 40-core cable, first connect both parts of the station with a green-yellow ground wire. Connect the power battery last.

## 8.5.2. Antenna and its location

The stations equipped with a built-in wireless GSM/GPRS communication module include an antenna. It is worth taking care to position the antenna well. With a better signal, the current consumption of the device is significantly reduced. The unit can communicate with lower transmit power, there is no connection dropout, no repeated connection attempts and the unit can go into power saving mode earlier.

***Battery-powered units*** When the unit is battery operated, it is recommended to always install the best possible antenna to reduce energy consumption and extend the unit's operating time, even for situations where the signal is above the critical threshold.

***Enclosed spaces*** When installing the station, it is important to take care of the appropriate location of the GSM antenna also from the point of view of its surroundings. Placing the equipment including the antenna in enclosed concrete spaces or all-metal cabinets rapidly reduces the characteristics and reception capabilities of the signal. In these cases, it is advisable to move the antenna out of the enclosure.

***Minimum GSM field strength*** Reliable GPRS and SMS communication requires a GSM field strength at the antenna location of at least 25% of the optimum required strength measured by the unit during installation.

In case of lower signal strength, it may happen that some GPRS data sessions will not take place at the set time, but only on other days with better conditions for GSM signal propagation.

***Antenna cable*** Antennas are typically supplied with an antenna coaxial cable of defined length. This cable can be extended if necessary. However, with each metre of cable, signal attenuation occurs and it is recommended to use low attenuation per metre cables for extension.

### OVERVIEW OF GSM ANTENNAS

Depending on the type of mechanical design of the H7 unit housing, the station is supplied with one of the following list of available GSM antennas with SMA-M connector:

| AGSM-3dB-SMA | AGSM-9dB-SMA | AGSM-1dB-SMA | AGSM-3dB/P-SMA |
|---|---|---|---|
|  |  |  |  |
| attachment: magnet, cable: 3m<br>Suitable for:<br>**-A, -AZ, -AK,-S, -SZ** | attachment: magnet,cable: 3.5m<br>Suitable for:<br>**-S, -SZ** | attachment: -<br>Cable.<br>Suitable for panel mounting: **-P** | Mounting: M12<br>cable: 3m<br>Suitable for:<br>**-N, -NZ** |

***Standard rod antenna*** The basic and most common type of antenna supplied is AGSM-3dB-SMA. It is a dual-band rod antenna with a magnetic mount and a 3 m long cable terminated with an SMA-M connector. This antenna is usually placed inside a -A or -S type plastic enclosure and only in case of weak GSM signal it is necessary to place the antenna in a suitable place outside the enclosure and feed the coaxial cable to the unit through one of the cable glands.

The antenna is usually placed vertically because of the vertical polarization in the GSM network. If the signal level is not good, it is recommended to try horizontal placement of the antenna.

***External antenna for metal enclosures***

When installing the station outdoors, it is often the case that the station is placed in a metal enclosure, in the head of a borehole or otherwise shielded from the external GSM field. In this case, the station is supplied with a special hemispherical AGSM-3dB/P-SMA antenna, which is placed on the outer side surface of the metal enclosure. The antenna is mounted in a 12 mm diameter hole and secured against theft from the inside of the enclosure with an overmolding nut.

***More powerful GSM antennas***

In locations with very weak GSM signal, the usually supplied magnetic antenna with 3 dB gain can be replaced by a larger omnidirectional magnetic antenna with 9 dB gain type AGSM-9dB-SMA, or a small directional antenna with 12 dB gain type AGSM-12dB-SMA. The long directional antenna puts high emphasis on precise antenna pointing and homogeneity of the electromagnetic field, and its use has not been successful in practice. Beware of the usual vertical polarization in GSM networks when installing directional antennas! A small directional antenna (60 cm long) together with its bracket can be ordered from the manufacturer of the telemetry set.



*Directional antenna AGSM-12dB-SMA*

***Underground objects***

In underground objects such as sumps, transfer shafts and similar objects equipped with a metal inlet cover, it has proven useful to simply attach the magnetic antenna to the lower metal part of the inlet cover frame (the rod antenna points downwards).

Only when this simple and surprisingly often successful solution fails, it is necessary to proceed to the external antenna placement. A suitable solution may be, for example, a plastic capped protector that contains the supplied rod antenna. The positioning of the shield above the ground should be made taking into account the height of the snow cover at the installation site.

***Extension Cables***

Finding the optimal antenna location often requires experimentation, sometimes with SIM cards from other operators. A coaxial extension cable, which can be ordered from the station supplier as an option, can also help. The length of this extension cable can range from 3 m to 10 m.



*Extension cable PKGSM-5-SMA*

***Coaxial surge protector***

When using an external larger rod or directional antenna outdoors, it is generally recommended to terminate the coaxial line just before the unit with a coaxial surge protector that must be well grounded.

## ANTENNA INSTALLATION

When installing the antenna, the current **GSM signal strength** at the antenna installation site can be displayed on the unit's display to optimize the final antenna placement with this measurement.

***GSM field strength display***

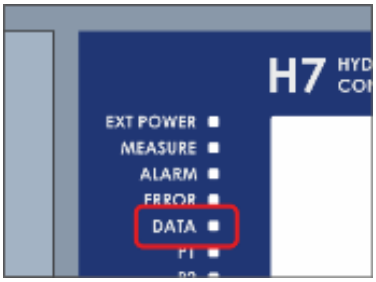
In the basic menu "Manual control - GSM status", the item "Signal strength" is in the 3rd position. If the GSM modem is switched on, the last detected GSM field strength at the location of the GSM antenna will be displayed for this item. The field strength is expressed as a percentage from 0% to 100% (older unit series use a number in the range 0 to 31). The stronger the field, the higher the number. Data transmissions require an intensity of 25% (or 8 or more), SMS communications can get by with an intensity of around 10% (or 4 ticks).

**Antenna installation procedure**

- Connect the GSM antenna to the device and place it in the expected location of the highest GSM field strength. The rod antennas should be positioned vertically, the element directional antennas should be pointed to the nearest BTS with the elements positioned vertically (vertical polarization of the GSM field).
- In the basic menu, select the "Manual Control - GSM Status" menu and install the antenna with a view to achieving the highest possible value of the "[3] Signal Strength" indicator.

  If the GSM module is not switched on, switch it on temporarily using the "Send data" command in the Manual control menu.

## 8.5.3. Signalling of communication module operating states -G-




If the H7 unit parameters are set to permanently power the GSM communication module [1-1 Power mode, pg. 218], the unit will start to log in to the GSM operator's network after power is connected, called network registration. The ongoing registration is indicated by flashing of the "DATA" LED with a period of 0.5 sec (see the following overview table).

You can also force a login to the network by selecting the menu Manual control -> Send data.

If the correct SIM card is inserted, the antenna is connected and the GSM signal is strong enough at the location of the station, the unit will log into the network after about 15 seconds.

The progress of GSM/GPRS modem login to the network, data transfers with the server and detection of incoming or outgoing SMS is signalled by the DATA LED.

***Signalling LED***

| Status of the DATA signalling LED | GSM/GPRS modem operating status |
|---|---|
| periodic flashing 500 ms | logging the modem to the network |
| periodic flashing 250 ms | creating a connection to the server |
| periodic flashing 125 ms | ongoing data transfer |
| short flash 100 ms | modem switched on, SMS receipt verification |
| short flash 300 ms | SMS reception signalling |
| short flash 1000 ms | outgoing SMS signalling |
| flashing off | modem switched off or permanently logged on |

If the station is not "logged in" to the GSM network within two minutes of being connected to the power supply, the modem will automatically shut down briefly and the DATA LED will go out. The station will then try to connect again at regular intervals. The number of attempts for logging to the network is one of the configurable parameters of the station [4-3 TCP, p. 203].

## 8.5.4. Parameterization of the unit with communication module -G-

The presence of the communication module in the H7 unit activates a number of parameters. Most of them are already preset from the factory and do not need to be changed.

The parameters of the GSM/GPRS communication module that need to be set or at least checked by the user include:

**TCP parameters [4-3, p. 203]:**

- Date of first data upload [1-5 Date of first transfer [YYYY/MM/DD], p. 204]
- Time of first dispatch [1-6 Time of first transfer [HH:MM:SS], p. 204]
- Basic interval for sending data [1-8 Regular interval [DD-HH:MM], p. 204]

**GSM/GPRS parameters [4-5, p. 218]**

- Power mode [1-1 Power mode, p. 218]
- Change APN, default setting "internet" [1-13 APN 1 (primary), p.219]

and, if necessary, setting the conditions for **sending or receiving SMS [p. 194]**:

# 8.6. WIFI communication module (-W-)

Only one communication module for WiFi network can be operated in the unit. The module can be inserted as a third module, i.e. only in the SLOT-2 position [chap. 8.4.1, p. 61The WiFi module contains a U.FL coaxial connector for connecting a U.FL/SMA antenna reducer.

The additional fitting of a WiFi module is only possible if the unit has been supplied with a preparation for the WiFi antenna.

A suitable WiFi communication module for the H7 unit has the type designation KM-W-V1. This module can be used as a data tunnel to connect the unit to the cloud. The initiator of the connection is always the module or the unit and the data receiver listens/waits for the connection.




The module supports power saving sleep modes and data communication over 2.4 GHz network in IEEE 802.11 standard.

The protocols used for communication are TCP and UDP implemented on the IP network layer version 4.

The user can set the level of communication security or adapt the behaviour of the unit according to the network settings. The network configuration can be taken directly from the network, if it allows it, or the parameters can be set manually.

## 8.6.1. Antenna and its location

Stations equipped with a built-in wireless WiFi communication module include an antenna. For its location and installation, the rules in chap. 8.5.2 Antenna and its location on p. 64, which deals with the appropriate placement of GSM antennas.

## 8.6.2. Parameterization of the unit with communication module -W-

The unit is supplied with a standard WiFi communication module setup with respect to the typical default factory settings of most WiFi routers on the market. The unit's factory settings thus allow easy and fast connection to common, simply configured WiFi networks.

The presence of the communication module in the unit activates a number of parameters. Most of them are already preset from the factory and do not need to be changed. The parameters of the WiFi communication module that need to be user configured as part of the basic parameterization include, in particular, the network name and password for access.

### BASIC PARAMETERIZATION

**WiFi/Ethernet parameters [4-6, p. 221]:**

- set Network Name [1-10 Network SSID, pg.222]

  *The network name must be known e.g. from the network administrator and entered explicitly. The unit does not provide the ability to search for available networks in the vicinity as is common on personal computers.*

- Set Network Password [1-13 Securw key, p. 223]

For simple home networks or simplified configuration networks, where the network infrastructure automatically provides network configuration information to newly connected devices and everything is set to default, there is no need to make any further changes to the unit WiFi / E parameters in the unit.

However, it is still advisable to check the settings of the following parameters:

- Check the DHCP Mode parameter [1-4 DHCP mode, pg. 222] to ensure that the 2. Dynamic.

  *The DHCP protocol is a globally recognized standard that is used to automatically retrieve network configuration and settings directly from the network. This automatic mode is referred to as Dynamic Host Configuration Protocol (DHCP) mode. On the other hand, Static Mode means that all configuration must be done manually on the unit i.e. DHCP is not applied.*
- Check the Security setting to make sure the option is selected 2. WPA2 [1-12, Secure mode, p. 223]
- Check the Power Mode parameter to make sure the option is selected 1 Always on [1-1 Power mode, p. 221].

  *For a battery/battery powered station, you can also set one of the power saving modes. In this case, however, it must be ensured that the power is switched on while the communication of the module to be set is being verified. In the power saving mode, the power supply of the module is switched on at the time when the communication via the module is scheduled.*

## SPECIFIC PARAMETERIZATION

***Specific WiFi networks***

However, many enterprise WiFi networks have specific configurations and will require more complex parameterization of WiFi communication in the unit. Typically, interaction with the IT department at the installation site is also required to authorise the unit to connect to the local WiFi network - i.e. in addition to the unit's own setup, changes must also be made to the local network. This requires synergy and time for the processing and approval process, which must be accounted for prior to installation.

***Overview of WiFi parameters***

For enterprise networks, it is typical to set the DHCP protocol to the option 3. Static and the unit settings must be reviewed and all parameters listed in WiFi/Ethernet Communications Parameters [Ch. 4-6 WiFi / E, p. 221].

***MAC address***

To accept the unit in the local network, it is typically necessary to provide the local network administrator with the device's MAC address, which can be obtained in the unit's Manual Control - WiFi Status menu.

Parameterizing the unit for specific WiFi networks requires knowledge of networking issues and the correct settings of the network to which the unit should log in.

Troubleshooting typically lies in diagnosing the local network and carefully checking the settings of all necessary parameters.

## TCP PARAMETERS

In addition to the settings WiFi / E parameters it is still necessary to set TCP parameters for controlled transfer of measured data to the server in the Internet.

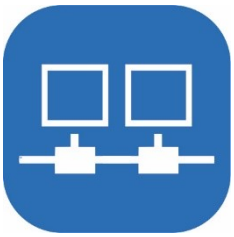
**Important TCP parameters [4-3, p. 203]:**

- Date of first data upload [1-5 Date of first transfer [YYYY/MM/DD], p. 204]
- Time of first dispatch [1-6 Time of first transfer [HH:MM:SS], p. 204]
- Basic interval for sending data [1-8 Regular interval [DD-HH:MM], p. 204]

## COMMUNICATION VERIFICATION

In the main menu on the Manual Control screen, you can verify the communication by selecting Send Data.

## 8.7. ETHERNET communication module (-E-)

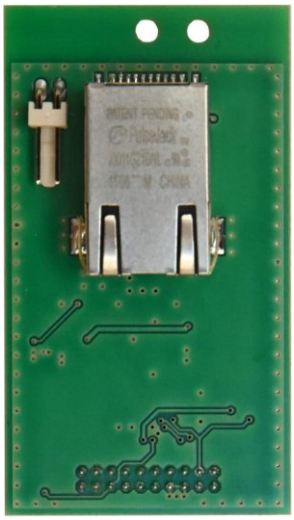


Only one KM-E-V1 communication module can be operated in the unit for Ethernet networking, i.e. for physical/cable connection of the unit to an active network element. The module is inserted in the third module position, i.e. only in the SLOT-2 position [chap. 8.4.1, p. 61].

The module can be used as a data tunnel to connect the unit to the cloud. The initiator of the connection is always the module or unit, and the data receiver listens/waits for the connection. The module supports power saving sleep modes of the unit and data communication via Fast Ethernet 10/100 Mbps network in 100BASE-TX standard. However, the actual connection speed is significantly lower due to the power saving configuration of the unit.

The protocols used for communication are TCP, UDP implemented on the IP network layer version 4.

The current Ethernet communication module of the unit has the type designation KM-E-V1.



### CONNECTING THE MODULE TO THE ETHERNET NETWORK

***UTP cable***

The Ethernet communication module contains an RJ-45 socket for connecting a UTP cable directly on the PCB. UTP cable standard 5 and higher is supported. Since the module does not support automatic Ethernet cable crossover detection, a non-crossed cable must be used to connect to a network element (hub, switch, router) and a crossed Ethernet cable must be used to connect directly to an end element (e.g. PC).

***UTP cable connection method***

Depending on the unit's enclosure design or the installation location, it may be necessary to provide the UTP cable with a connector at the installation site, e.g. due to cable pulling after operation, switch cabinets or narrow cable glands. The H7 unit can also be supplied with the required length of cable already laid out. Please contact the manufacturer for delivery options.

***Additional module installation***

Additional installation of the Ethernet communication module into the existing H7 unit is possible. As with all previous communication modules, it is recommended that the module is fitted into the unit by the manufacturer when the unit is assembled.

### 8.7.1. Parameterization of the unit with communication module -E-

The H7 unit parameterization and network configuration can be taken directly from the network, if it allows it, or the parameters can be set manually.

The H7 unit comes with a standard Ethernet communication module setup, taking into account the typical factory default settings of most Ethernet network routers on the market. This allows the unit to connect to common, simply configured networks quickly and easily - just plug a physical UTP cable into a local DHCP-enabled router or switch and verify the connection.

***Specific networks***

However, many enterprise networks have specific configurations and will require more complex parameterization of Ethernet communication in the unit. Typically, interaction



with the IT department at the installation site is also required to authorise the unit for connection to the local network i.e. in addition to the actual unit setup, changes must also be made to the local network. This requires synergy and time for the processing and approval process, which must be accounted for prior to installation. To accept the unit on the local network, it is typically necessary to provide the local network administrator with the device address, i.e. the MAC address, which can be obtained in the unit's Manual Control menu [Wifi/Ethernet Status].

Conventional Ethernet-standard networks allow instant login to the network without the need for further authentication and authorization. However, most administrators of larger networks and infrastructure use port/connector locking according to the IEEE 802.1X standard. In this case, a newly connected unit to the Ethernet connection of the local network will not be authorized to communicate. Further information should be obtained from the local network administrator.

Setting up an Ethernet network requires knowledge of networking issues and the correct network settings for the unit to log into. Troubleshooting typically lies in diagnosing the local network and carefully checking the settings of all necessary parameters.

## SETTING BASIC PARAMETERS

For simple home networks or simplified configuration networks, where the network infrastructure automatically provides network configuration information to newly connected devices and everything is set to default, there is no need to make further changes to the unit. However, it is still advisable to check these settings:

- Check the DHCP Mode parameter [1-4 DHCP mode, pg. 222] to ensure that the 2. Dynamic.

  *The DHCP protocol is a globally recognized standard that is used to automatically retrieve network configuration and settings directly from the network. This automatic mode is referred to as Dynamic Host Configuration Protocol (DHCP) mode. On the other hand, Static Mode means that all configuration must be done manually on the unit i.e. DHCP is not applied.*

- Check the Power Mode parameter to make sure the option is selected 1 Always on [1-1 Power mode, p. 221]

  *For a battery/battery powered station, you can also set one of the power saving modes. In this case, however, it is necessary to ensure that the power supply is switched on while the communication of the module being set up is being verified. In the power saving mode, the power supply of the module is switched on at the time when communication is scheduled via the module.*

## OVERVIEW OF SPECIFIC PARAMETERS

For enterprise networks, it is typical to set the DHCP protocol to the option 3. Static and the unit settings must be reviewed and all parameters listed in WiFi/Ethernet Communications Parameters [Ch. 4-6 WiFi / E, p. 221].

## TCP PARAMETERS

In addition to the settings WiFi / E parameters it is still necessary to set TCP parameters for controlled transfer of measured data to the server in the Internet.

**Important TCP parameters [4-3, p. 203]:**

- Date of first data upload [1-5 Date of first transfer [YYYY/MM/DD], p. 204]
- Time of first dispatch [1-6 Time of first transfer [HH:MM:SS], p. 204]
- Basic interval for sending data [1-8 Regular interval [DD-HH:MM], p. 204]

## COMMUNICATION VERIFICATION

***Network status inquiry***

In the main menu on the Manual Control -> WiFi Status screen you can check the current status of the Ethernet module. If set correctly, the following will be displayed:

Network name: ETHERNET

Module power status: On

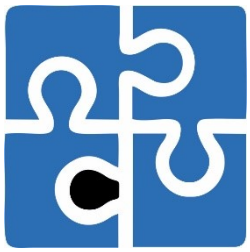
Network connection status: On

The network connection status will be in the On state if a connection has been established at the Ethernet layer. If the Module Power State is On and the Network Connection State is Off, then the problem may be either an insufficiently tucked Ethernet cable, a disabled peer device, or an MDI/MDI-X crossover (see chap. Connecting the module to the Ethernet network, p. 69).

***Sending data*** In the main menu on the Manual Control screen, you can verify the communication by selecting Send Data.

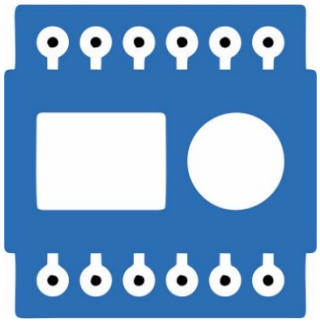
By looking at the port/connector on the Ethernet communication module or on the active network element, you can see if the LEDs are lit. When set up correctly, one LED (LINK/ACT) should flash, i.e. detecting data exchanges in progress, and the other LED (SPEED) should be steadily lit. The most common colours encountered are LINK orange-yellow and SPEED green, but the colours may vary. It can take many seconds to activate and negotiate the link between network elements.

## 8.8. Troubleshooting



When looking for the cause of a malfunctioning connection of the unit via a communication module connected to the local network (typically for modules based on the IP standard, i.e. especially for Wifi or Ethernet communication modules), it is recommended to first check for potential typos when manually entering values. For a large number of entries, typos are the most common source of errors. Another common pitfall is getting the correct parameters from the local network administrator. It is also recommended to check the following items chronologically:

- Power - is the communication module switched on and powered?
- Network availability - can be verified from another PC on the same network, including an internet access test.
- IP address - the unit has obtained or has set an IP address and the address is available from another device in the network (the address can be obtained from the unit menu and then the availability can be verified from the PC by the ping command).
- Default Gateway and Network Mask - verify the settings according to the given local network parameters.
- First DNS setup - on another PC verify the same DNS settings and try the possibility of resolving FQDN server names to IP addresses (e.g. nslookup or dig).



# 9 Expansion I/O modules

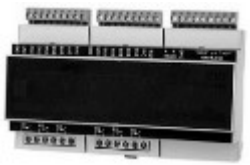
The Hydro Controller H7 itself has a limited number of input/output signals, determined by the type of connection board used [see table on p. 21]. However, the H7 software has no such limitation and the central unit is capable of storing up to 96 measurement recording channels and up to 208 binary input/output channels. The Hydro Controller H3 operates with a limited number of 32 measurement recording channels and 64 binary channels [see table pg. 8].

***Expanding the number of inputs and outputs***

Larger monitoring and control systems built on H3 or H7 units can therefore use external I/O modules adapted for DIN rail mounting to replace the lack of inputs or outputs on the unit's connection board.

***Communication over RS485***

The external I/O modules communicate with the H7 unit via RS485-I or RS485-II bus, which can be used simultaneously for data acquisition from connected sensors under both FINET and MODBUS RTU **Master** protocols**.**



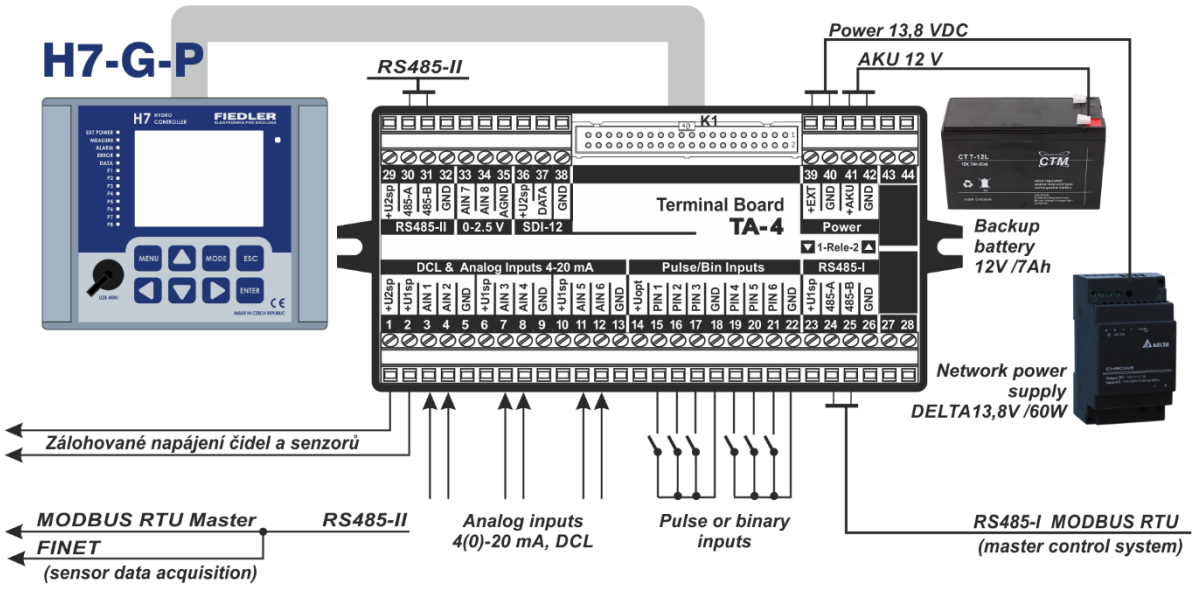


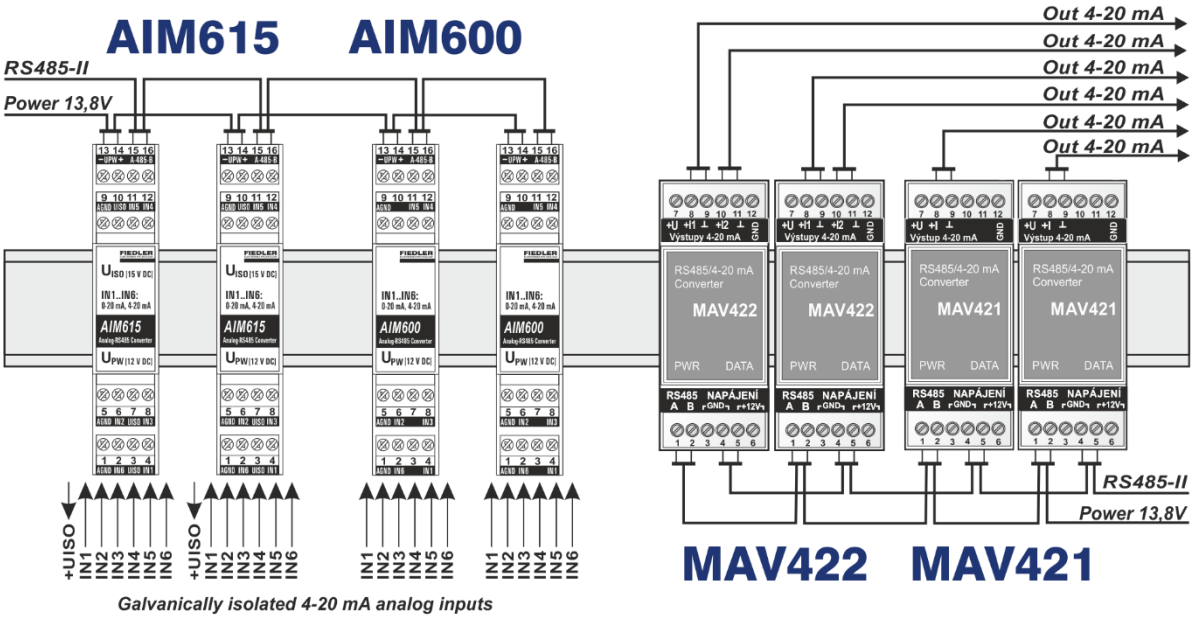


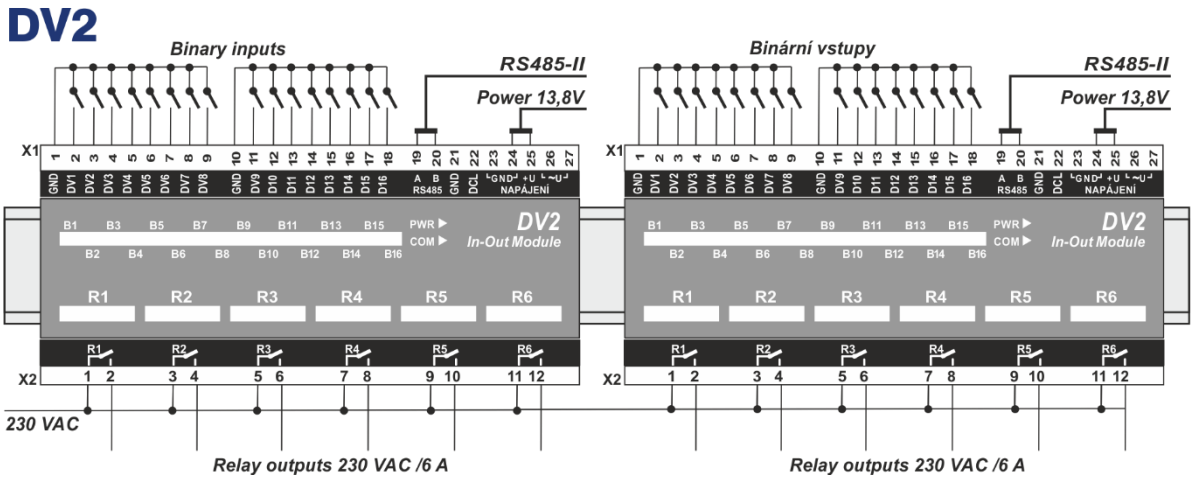
*Overview table of external input/output modules:*

| I/O type Module | Module address | Unap [V] | FINET | MODBUS | Channel | Inputs and outputs | Resolu-tion | Units |
|---|---|---|---|---|---|---|---|---|
| **Binary modules** | | | | | | | | |
| **DV2** Binary mod-ule - 16 in-puts - 6 out-puts | 1-15 | 12 V up to 24 V DC | ✓ | ✓ | K1 | Binary inputs DV1 to DV16 | 1 | - |
| | | | | | K2 | Binary outputs R1 to R6 | 1 | - |
| **Analog modules galvanically isolated from the supply voltage and RS485** | | | | | | | | |
| **AIM600 AIM615** Input module 4-20 mA (0-20 mA) | 60 - 75 | 12 V DC | ✓ | ✓ | K1 | 1. current input AIN1 (4-20 mA) | 0,01 | % |
| | | | | | K2 | 2. current input AIN2 (4-20 mA) | 0,01 | % |
| | | | | | K3 | 3. current input AIN3 (4-20 mA) | 0,01 | % |
| | | | | | K4 | 4. current input AIN4 (4-20 mA) | 0,01 | % |
| | | | | | K5 | 5. current input AIN5 (4-20 mA) | 0,01 | % |
| | | | | | K6 | 6. current input AIN6 (4-20 mA) | 0,01 | % |
| **MAV421, 2** 4-20mA out-put module | 121 - 136 | 12 to 18 V DC | ✓ | | I1 | 1. current output 0(4)-20 mA | 0,01 | mA |
| | | | | | I2 | 2. current output 0(4)-20 mA (MAV422 only) | 0,01 | mA |

# 9.1. Connecting I/O modules to the H7 unit



## Basic rules for powering I/O modules

The power terminals of the I/O modules connect to the output terminals of a 13.8 V DC or 24 V DC power supply. This can be either the power supply used to power the H7 unit itself or an additional power supply dedicated to external sensors and I/O modules. The use of two or more power supplies in a single rack requires interconnection of their negative output terminals (common ground).

***Ground loop issues***

Larger systems with many sensors and transducers spaced at distances of 10 meters or more from the H7 unit can have significantly different ground potentials. To avoid balancing them via communication cables, we recommend not connecting the negative power terminals in this case and to power the remote I/O modules with an external power supply located near the sensor/sensor.

**Never use the switched terminals U1sp or U2sp on the H7 unit connection boards to power the I/O modules.**

The U1sp or U2sp terminals are exclusively for powering the connected sensors and have a limited current capacity. Also, the voltage at these terminals is usually only present for a short period of time during the measurement. Even in the continuous power supply mode of the sensors, these terminals can be disconnected from the internal power supply in case of external power failure or low battery voltage.

### 9.1.1. Rules for connecting I/O modules to H7 via RS485

The I/O modules connect to the RS485-II or RS485-I serial bus used by the H7 unit's connection board. It is recommended to connect all I/O modules located in the rack together with the H7 unit to one RS485 serial line and use the other serial line to connect sensors and transducers located outside the rack.

***Communication protocols***

From the point of view of communication reliability, it is advisable to connect I/O modules communicating under one common communication protocol - either FINET or Modbus RTU - to one RS485 bus.

If necessary, I/O modules with different communication protocols can be connected to one bus. In this case, however, it is necessary to set different communication speeds for the two communication protocols.

***RS485 data cable routing***

The distance between the H7 control unit and the DV2 module can be up to 500 m, while maintaining the rules for data wiring (signal wiring without concurrence with the power wiring, twisted pair wiring in a suitable shielded cable with an impedance of 50 Ω, minimizing reflections at the ends of the wiring by using serial interconnection of devices in a star instead of connecting them in series, ...).

***Parameter settings***

The setting of parameters of the H7 control unit for communication with I/O modules is dealt with in chapters:

- 4-4-1 Ports, p. 206 (selection of communication protocol, baud rate, communication time delays, ...).
- 4-4-2 IO Module, p. 210 (setting the type of binary I/O module, selecting the RS485 line, setting the communication address, setting the read/write interval from/to the module).

***Unique communication address***

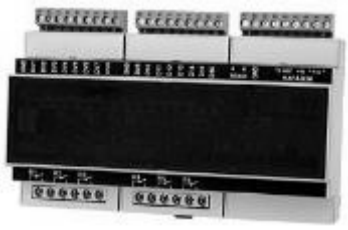
Each I/O module must have a unique communication address in one RS485 network. The address is set individually for each module using mechanical switches. Some I/O modules automatically add a constant given by the module type to the set address (see the technical parameters listed for each I/O module).

***SLAVE mode***

In some larger measurement setups, the H7 unit can be subordinated to the master control system and operate in SLAVE mode. The following rule must then be observed for the functional connection of I/O modules and measuring probes and sensors to the RS485 buses:

**If the RS485-I bus is set to MODBUS RTU Slave mode, then no I/O module, encoder or sensor can be connected to it.**

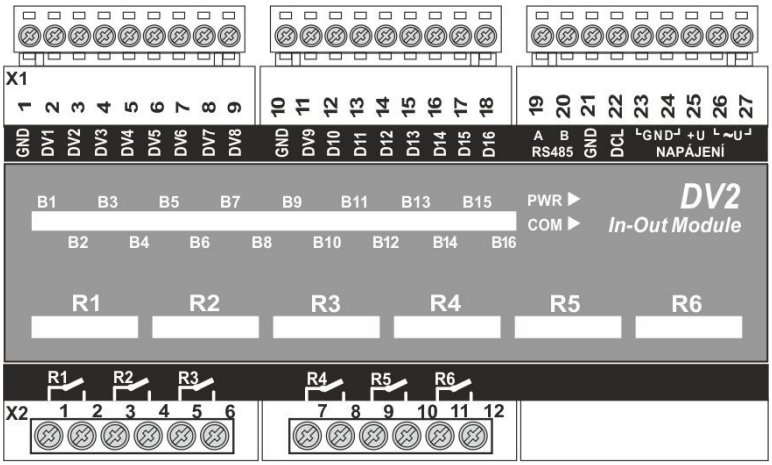
# 9.2. DV2 Binary Input/Output Module



The external I/O module DV2 expands the number of binary inputs (+16) and relay outputs (+6) of the H7 unit. Up to 16 DV2 modules can theoretically be connected to one H7 unit via RS485-I or RS485-II interface (max. 8 DV2 modules to one RS485 serial interface). However, for clarity of the set parameters, we recommend not to connect more than 5 to 6 DV2 modules to one H7 unit. A larger number of connected I/O modules also affects the computational performance of the unit (slowing down the measuring loop, prolonging the response to the relay on/off command).

### CHARACTERISTICS OF DV2

- 16 binary inputs and 6 relay outputs 250V / 5 A.
- Signalling LEDs of switched inputs and outputs on the module panel.
- Supply voltage range from 12 to 24 VDC. Current draw when all six relays are energized less than 250 mA.
- Mechanical design suitable for installation on DIN rail 35 mm, width 9 modules.




## 9.2.1. 16 binary inputs

- The inputs of the DV2 module are activated by externally switching the input with the GND ground terminal.
- The auxiliary contact of the contactor, the free contact of the relay or the sensor with open collector can be used for switching. In the idle state, the DVx input voltage is 5 V DC, in the switched state the input voltage is less than 0.5 V and the switching current is less than 5 mA. For reliable switching of the binary input, the internal resistance of the external switch Ri < 250 Ω is required.
- To connect remote sensors to the binary inputs, we recommend using a galvanically isolated relay controlled by the output of the remote sensor near the DV2 unit and connecting only the contact of this auxiliary relay to the binary input of the DV2 unit.
- The binary inputs are not galvanically isolated from the supply voltage.
- All 3 binary input terminals are detachable (plug/socket design) for easy connection of multiple input signal wires or for quick replacement of a damaged DV2 unit.

**!** **No external voltage must be connected to the binary inputs of the DV2 unit.**

The DV2 module's binary inputs can be used for monitoring motor runs and failures, reading motor hours, controlling facility entrances, sensing servo limit states, etc.

**!** **Binary inputs do not allow pulse registration, so it is not possible to monitor e.g. the output of a water meter.**

### PARAMETERIZATION OF BINARY INPUTS

All binary input settings are made in the connected H7 unit by setting the binary channel parameters [3-2 Binary IOs, p. 143].

***Link to examples*** Setting the reading of the binary input of the DV2 module: Example 6., p. 147; Example 56., p. 255.

### ERROR MESSAGES

When the DV2 module is functioning correctly, its binary outputs can take the value 0 or 1. In case of disconnection of the module from the control unit or in case of incorrect parameter setting, the H7 controller reads the error value instead of the binary value 0/1 (see Table 1). List of selected error codes on p. 273).

## 9.2.2. 6 binary outputs

The binary output is the switching contact of the mechanical relay. The contacts can be loaded with 230 V AC and current up to 5 A. The relay switching contacts are not rated for switching inductive loads.

**! Always disconnect the leads from the power supply when connecting the relay outputs**

**! The relay switching contacts are not protected against overload. The load circuit must be current protected so that the maximum current does not exceed 5 A.**

For controlling remote switching elements, we recommend using suitably sized surge protectors at the ends of the interconnecting lines. The use of auxiliary relays located close to the DV2 unit is also suitable. DIN rail mounted auxiliary relays are easier to replace in the event of a switching contact failure than relays inside DV2 units (relay replacement requires repair of the DV2 unit by the manufacturer).

In total, up to 60 relay outputs in 10 external DV2 modules can be controlled by one H7 unit.

**! When connecting the binary outputs, follow all safety instructions on p.53.**

Unlike binary inputs, the terminal block of binary outputs is not disassembled.

### PARAMETERIZATION OF BINARY OUTPUTS

All settings of the switching conditions of the binary outputs are made in the connected H7 unit by setting the binary channel parameters [3-2 Binary IOs, p. 143].

***Relay switching conditions*** Other binary inputs and outputs can enter the switching conditions for controlling the DV2 binary outputs [12-11 Logic function, p.160] as is the case with other programmable PLCs.

In addition, various time functions and set limit values of the analog recording channels can be applied to control the output relays:

- 12-2 Limit output type 1, p. 149
- 12-3 Limit output type 2, p. 150
- 12-4 Limit output type 3, p. 152
- 12-5 Limit output of counter, p. 153, p. 154
- 12-7 Periodic pulses, p. 155
- 12-8 Up time / Down time, p. 156
- 12-9 Switching timer, p. 157
- 12-10 Auxiliary group, p. 158
- 12-11 Logic function, p. 160
- 12-12 Security, p. 162

The H7 unit also allows setting the name of individual binary inputs and outputs of the DV2 module (binary channels) and storing changes of binary states on these channels.

***Remote monitoring and control via SMS***

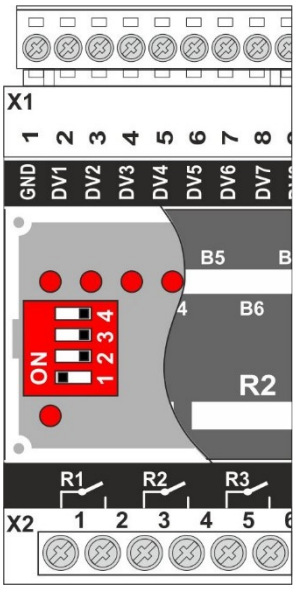
A change in the status of a binary input or output can also activate the sending of a warning or informative SMS message (for units equipped with a GSM communication module). The communication module also allows to change the switching conditions by remote access via the Internet and also to control individual binary outputs remotely via SMS command.

***Link to examples***

Setting the binary output of the DV2 module: Example 10., p. 151; Example 57, p. 255.

## 9.2.3. Connection of DV2 to the H7 control unit via RS485

The DV2 module communicates with the H7 unit over the RS485 bus under the MODBUS RTU protocol in the basic setting, i.e. at 19200 Bd, 1 stop bit, no parity.




***Communication address 1***

Each DV2 module is factory set to basic communication address = 1 (see figure). The user can use the 4-pole switch bits on the module board to set communication addresses in the range 1 to 15. The address is set binary, i.e. as the sum of the weights of the switched bits.

***Examples of Communication address settings***

| Address<br><br>Bit/weight | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | .. | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. / 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | | 1 |
| 2. / 2 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | | 1 |
| 3. / 4 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | 1 |
| 4. / 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | | 1 |

The number of DV2 modules connected to one H7 unit should be limited to 8 for practical purposes.

***Links to important parameters***

The setting of communication parameters for communication with the DV2 module is dealt with in chapters:

- 4-4-1 Ports, p. 206 (selection of communication protocol, baud rate, communication time delays, ...).
- 4-4-2 IO Module, p. 210 (setting the type of binary I/O module, selecting the RS485 line, setting the communication address, setting the read/write interval from/to the module).

***Examples of parameter settings***

**Example 6.** (p. 147): Reading the binary state from the input of the external module DV2

**Example 18**. (p. 161): Setting the dosing relay in the DV2 module in conditional operation

**Example 29**. (p. 214): Reading and writing binary states from/to the external DV2 module

**Example 56.** (p. 255): Reading the binary state from the input of the external module DV2

**Example 57**. (p. 255): Controlled pumping of water into the VDJ using the external module DV2

## 9.2.4. Technical parameters DV2

| TECHNICAL PARAMETERS | |
|---|---|
| Binary inputs | 16 inputs; quiescent state $U_{IN}$ = 5V; switching $U_{IN}$ < 0.5V, $R_{max}$<250 Ω |
| Binary outputs | 6 relays, switching contact 230 VAC / 5 A; non-inductive load |
| RS485 | Channels K1, K2 on RS485; MODBUS RTU or FINET protocol |
| Com. address | 0 + switch on board (1 to 15) |
| Supply voltage | 10 to 26 V DC / I < 250 mA |
| Temper. range | -25 °C to +60 °C |
| Dimensions / IP | 109 x 160 x 58 mm / IP 20 (9 module width, DIN rail) |

# 9.3. Analog input modules AIM600, AIM615




The AIM600 and AIM615 measurement modules are used to convert 4-20 mA or 0-20 mA current signals to RS485 data output under FINET or MODBUS RTU protocol.

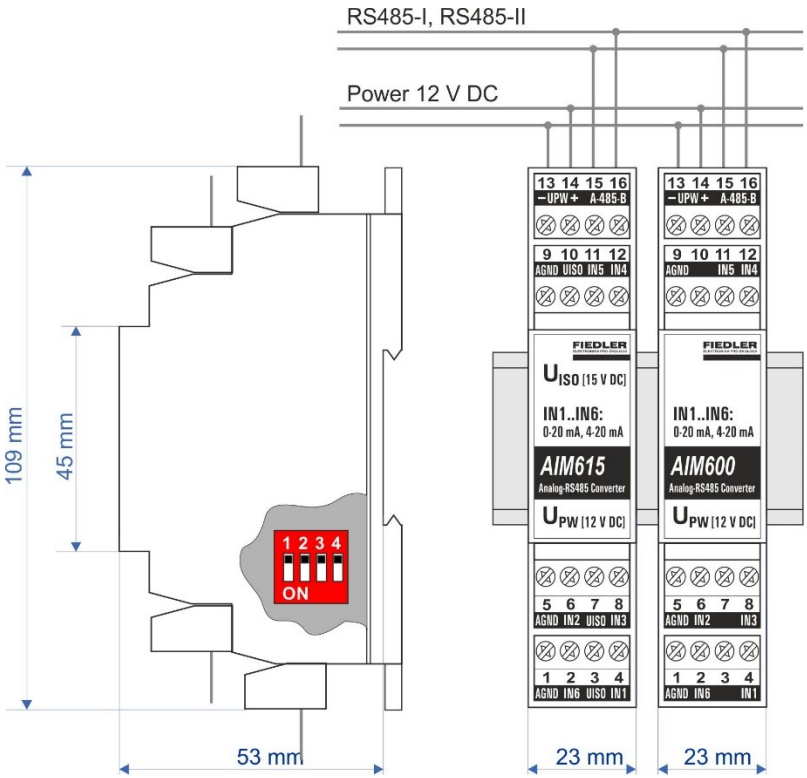
The register table and other parameters important for communication with these I/O modules under MODBUS RTU protocol are described in the APL-116 application note on the manufacturer's website.

## CHARACTERISTICS

- 6 analogue 4(0)-20 mA inputs galvanically isolated from the supply voltage and RS485 serial line
- Measuring channels with a range of 0-100% of the measured value for each input
- Accurate 24 bit converters, conversion error < 0.05%
- Fault condition detection above 20.75 mA and below 3.75 mA (for 4-20 mA ranges)
- FINET or MODBUS RTU protocol, adjustable address range 60 to 75
- Low current consumption suitable for battery-powered applications
- Surge protection of inputs and outputs
- Mechanical adaptation for installation on 35 mm DIN rail
- Removable clamps for easy installation and service, module width only 23 mm

## MEASURING INPUTS IN1 TO IN6

All 6 measurement inputs IN1 to IN6 are set by the manufacturer to measure current in the range of 4- 20 mA. Using the software utility available on the manufacturer's website, the measuring ranges of the individual inputs can be switched between 4-20 mA and 0-20 mA under MODBUS RTU protocol. The actual measuring range of the converter allows to process current signals in the range of 0 to 22 mA.




## MEASURING CHANNELS K1 TO K6

Each of the inputs IN1 to IN6 is assigned 1 measurement channel K1 to K6. The AIM6xx modules thus contain 6 measurement channels accessible via the RS485 bus. The value of each channel takes on a value in the range of 0 to 100% depending on the set measurement range of 0-20 mA (0 mA=0%) or 4-20 mA (4 mA=0%).

## ERROR MESSAGES:

An increase in the measured current above 20.75 mA is signalled by the error code E25 on the relevant channel. In the 4-20 mA measuring range, a drop in current below 3.75 mA is also signalled by this error code. Input current below 3 mA (or input disconnection) is indicated by error code E13.

## UISO OUTPUT VOLTAGE

The AIM615 module contains a galvanically isolated voltage source UISO = 15 V DC, designed to supply power to the connected measuring sensors and transducers. The total current draw from this source must not exceed 120 mA to avoid measurement error.

The AIM600 module does not include a UISO voltage source and therefore only allows connection of active current signals supplied from another external voltage source.

## CONNECTION TO THE MASTER CONTROL UNIT VIA RS485

The AIM600 and AIM615 modules communicate with the H7 controller in the basic configuration over the RS485 bus under FINET protocol at 19200 Bd, 1 stop bit, no parity.

***Communication address 60***

From the factory, each module is set to the base communication address ADR=60. The user can use the 4-pole switch on the module board to set 16 combinations in the range of 0 to 15 that are added to the base communication address of 60. The combinations are set in binary, i.e. as the sum of the weights of the individual switched bits 1, 2, 4 and 8 (see. address table in chapter 9.2.3 on p. 77). The address switch is accessible by removing the bottom cover of the box.

The individual communication address setting is used, for example, when connecting multiple AIM6XX modules to one RS485 bus (each module in the network must have a unique communication address).

***Measuring channels***

When parameterizing and setting the recording channels of the H7 unit, it is necessary to enter the number of the measuring channel K1 to K6 in addition to the communication address of the module. Thus, the number of AIM6XX modules that can be connected to one H7 unit is practically limited only by the number of recording channels of the H7 unit.

***Parallel communication over one RS485***

The AIM6XX modules connect to the RS485-II or RS485-I serial bus. On the same bus, the H7 can communicate sequentially with other types of I/O modules and also with measurement probes under FINET and MODBUS RTU Master protocols.

***Examples of parameter settings***

**Example 58**. (p. 256): Reading the analogue pressure value from the AIM600 external module.

**Example 59.** (p. 256): Reading the analogue level value from the external module AIM615.

## EXAMPLES OF USE

- Expansion of the number of analog inputs of measuring and telemetry stations
- Connecting an analogue signal to a fibre optic line or radio network
- Supplementing simple PLCs with the necessary number of analogue inputs

| TECHNICAL PARAMETERS | AIM600 | AIM615 |
|---|---|---|
| Inputs | IN1 to IN6, measuring range 4(0)-20 mA | |
| Measur. error | < ±0.05% of range, accurate 24-bit converter | |
| Measur. time | < 0.3 s / 1 measurement channel | |
| Input resistance | 50 Ω | |
| RS485 output | Channels K1 to K6 on RS485 under FINET protocol (MODBUS RTU) | |
| Com. address | 60 + switch on board (0 to 15) | |
| Measuring range | 0 to 100% [ - ] of the range 0(4)-20 mA, float format (10000 = 100%) | |
| Supply voltage | 6 to 26 V DC / I < 15 mA | 11 to 13 V DC / I < 180 mA |
| UISO output | - | 15 VDC / compartment 1000 V |
| Temper. range | -25 °C to +60 °C | |
| Dimensions / IP | 109 x 23 x 57 mm / IP 20 (width 1 module/DIN rail) | |

# 9.4. Analog output modules MAV421, MAV422




External modules MAV421 and MAV422 are RS485 converters under FINET protocol to galvanically isolated active current outputs 4-20 mA or 0-20 mA. The MAV421 module has 1 current output I1, the MAV422 module contains 2 current outputs I1 and I2.

## CHARACTERISTICS

- 1 or 2 active current outputs 4-20 mA or 0-20 mA
- Galvanic isolation of outputs from the supply voltage and RS485 serial line
- Precision 16-bit converter ensures high output signal accuracy
- Possibility to supply external power supply for analogue outputs
- FINET and FINET_SO protocols, configurable address range 121 to 136
- Integrated surge protection for inputs and outputs
- Supply voltage range from 12 to 24 V DC
- Mechanical adaptation for DIN rail installation, width 2 standard modules

## SELECTION OF OUTPUT RANGE AND COMMUNICATION PROTOCOL

When the top lid of the box is opened, 2 configuration switches are available.

Position 1 of the double smaller switch located at the right side of the box is used to set the desired current output:

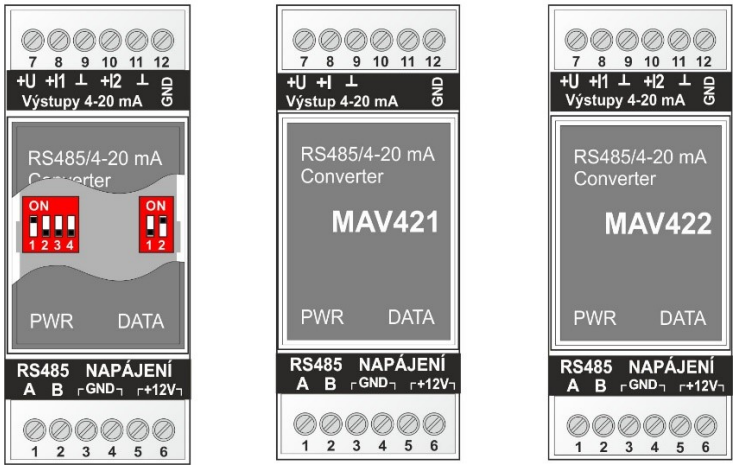
**1-OFF** current output 4-20 mA

**1-ON** current output 0-20 mA

Position 2 (near the wall of the box) of this switch is used to select the communication protocol:

**2-OFFprotocol** FINET_SO, Baudrate 2400Bd/8/N/1 (not to be used with H7)

**2-ONprotocol** FINET, communication rate 19200 Bd, 1 stop bit, no par.




*Location of setting switches and terminal connections of MAV421 and MAV422 modules*

## CONNECTION TO THE MASTER CONTROL UNIT VIA RS485

***Communication address 121***

The user can set 16 combinations in the range of 0 to 15, which are added to the base communication address 121, using a larger quadruple switch on the module board. address table in chapter 9.2.3 on p. 77).

If two MAV421 or MAV422 modules are to have identical current outputs, it is not possible to set one identical communication address for them, but each module must be controlled by a separate ACH channel from the H7 unit using two different communication addresses.

Up to 2x 16 MAV421 or MAV422 modules, i.e. up to 64 current outputs (valid for MAV422), can be connected to one H7 unit via two RS485 buses.

***MAV422***

The MAV422 module contains two current outputs I1 and I2 with one common communication address and communicates with the H7 unit, like the MAV421 module, under the FINET protocol. The number of the current output I1 or I2 is set as the "Interface refine" parameter in the ACH parameters [chap. 11.4.3-19-2 Interface a, p. 129].

***Example of settings***

**Example 60.** (pg. 257): 4-20 mA current output control of the MAV422 external module.

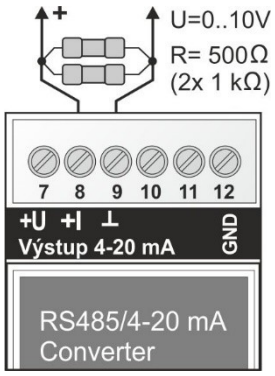
***Parallel communication over one RS485***

The H7 can also communicate sequentially with other types of I/O modules and measuring probes over the RS485 bus under the FINET protocol. If another I/O module or measuring probe under MODBUS RTU protocol is to be connected to the same RS485 bus, then it is necessary to set different Baudrates for both communication protocols.

If the RS485-I bus is set to MODBUS RTU Slave mode, then neither the MAV42X module nor any other I/O module can be connected to it.

## VOLTAGE OUTPUT 0-10 V

Some technology control applications require a 0 to 10 V voltage output instead of a current output (for example, some actuators). Such a voltage output can also be generated using the MAV421 or MAV422 module and a precision 500 Ω load resistor (parallel combination of two common 1 kΩ resistors).



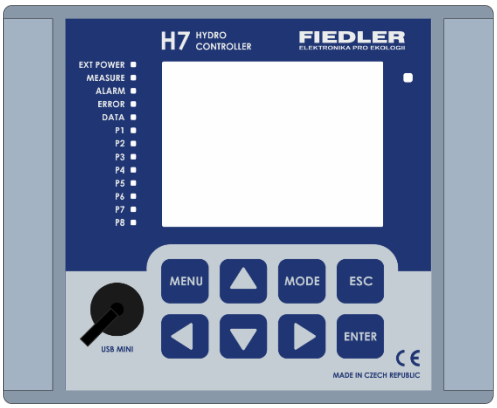

A current flowing through this load resistor in the range of 0 to 20 mA will cause a voltage drop across its terminals of the required 0 to 10 V. The 0-20 mA output current range is set on the double switch by switching position 1 to the ON position.

By changing the value of the load resistor, the resulting voltage range can be changed. The MAV421 modules cannot produce output voltages higher than 10 VDC without an external supply voltage.

## EXAMPLES OF USE

- Extending the number of analogue outputs in control systems
- Transmission of measured values to the higher-level system
- Control of frequency converters and servo-valves; continuous machine control

| TECHNICAL PARAMETERS OF | MAV421 | MAV422 |
|---|---|---|
| Outputs | 1x 4(0)-20 mA | 2x 4(0)-20 mA |
| Output error | < ±0.05% of range, accurate 16-bit converter | |
| Running speed | < 0.5 s over the entire range | |
| Load resistance | < 500 Ω | |
| RS485 output | Channels K1, K2 on RS485, FINET protocol | |
| Com. address | 120 + switch on board (0 to 15) | |
| Supply voltage | 12 to 16 V DC / I < 50 mA | 12 to 16 V DC / I < 80 mA |
| Temperat. range | -25 °C to +60 °C | |
| Dimensions / IP | 109 x 25 x 57 mm / IP 20 (width 2 modules, DIN rail) | |




# 10 H7 control

The unit is controlled by an 8-fret membrane keyboard and a graphic 3.5" touchscreen display. These can be used to call up current, statistical and archived values, set instrument parameters and display required information.

***The meaning of the individual fingerboards of a membrane keyboard:***

| | |
|---|---|
| MENU | ▪ Calling up the main menu of the device |
| MODE | ▪ Instrument status bar display (battery capacity, ...)<br>▪ Long press - recall Set point parameters (only when entering values into the calculator) |
| ESC | ▪ Move up a level in the menu<br>▪ Exit menu and start cyclic channel display<br>▪ Cancellation of a parameter<br>▪ Long press - manual switching off of the display (if enabled) |
| ENTER | ▪ Move down a level in the menu<br>▪ Confirmation of the entered parameter |
| ◀ ▶ | ▪ Scroll through the groups in the menu<br>▪ Scroll by groups in the displayed channels<br>▪ Code in the following text: *LEFT*, *RIGHT* |
| ▼ ▲ | ▪ Scroll through the menu items<br>▪ Scroll through the individual displayed channels<br>▪ Code in the following text: *UP*, *DOWN* |

### Touch screen display

The touch screen offers intuitive operation of the device. It is used not only to move around the instrument display, but also to enter values for parameters. By touching the arrows in the lower right corner of the display, the user switches between the individual windows of the basic menu.

Touching the display and pressing the fingerboard may be indicated by a short beep.

### Display saving mode

Automatic battery or battery-powered measuring stations do not usually require the display to be permanently on, and for such cases, as will be shown later, a power saving display mode can be set. In power saving mode the display is switched off. The display is switched off either by long pressing the ESC button or after a set time interval has elapsed since the last touch of the fingerboard/display.

To wake up the display again, press one of the keyboard pads.

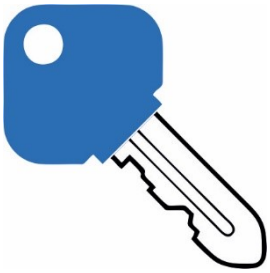
## 10.1.1. Access permissions

The H7 unit has a three-level authorization system ranging from simply viewing measured values and some basic information data to full parameterization and calibration of the instrument and connected sensors and probes.

***Authorisation levels***

Access to individual menu items is controlled by permission level.

The current permission level is indicated by the lock icon in the lower left corner of each MENU screen.





The locked lock indicates the basic zero level of authorization, which allows only viewing the measured values and calling up basic informative data about the unit in the 5-information menu.



The unlocked lock icon already allows changes to the device settings, so unlocking the device is subject to knowing the corresponding password. The unlocked lock symbol indicates the current authorisation level by its numerical value.

Clicking on the lock will lock/unlock the device. A password is required to unlock. The password is set as an integer of 1 to 15 digits.

*Authorisation levels*

| | | |
|---|---|---|
| **0** | **Viewing data** | Switching the displayed channels, calling up basic information about the instrument in the main menu 5-Information |
| **1** | **Service** | Manual control and setting of Set point parameters |
| **2** | **Report** | Parameterization of most parameters |
| **3** | **Calibration and service** | Full parameterization and calibration |

Depending on the password entered, the device will unlock to the level to which the password is assigned. If 2 or all 3 levels have the same password, then the device will unlock to the higher permission level. Setting and changing passwords is described in the chapter 5-6 on p. 227.

Setting the password to 0 (zero) will not disable the password (it is a valid one-number password). To disable the password, you need to delete all characters in the input window when changing the password. From the manufacturer, permission levels 0 to 2 are disabled (access without password) and level 3 has password = 1234.

When setting the password, you can also enable the automatic logout function, which automatically locks the device control after a selected period of time (sets the permission level to zero).

## 10.1.2. View measured values

In the basic operating mode, the unit's display shows the measured values of selected analog and binary channels. The number of displayed channels and the way they are displayed is user adjustable.

The unit enters the basic operating mode immediately after the display is switched on or automatically after a set period of inactivity since the last keyboard or display press. From the menu, the user enters the basic operating mode by repeatedly pressing the ESC knob. The number of presses depends on the depth of nesting in a given parameter window.

The display of the measured values of analog and binary channels can be either **Cyclic** or **Static**, depending on the unit parameter settings.

Selecting the basic display mode is described in chap. 2-6-4 "Start screen " on p.117.





### CYCLIC IMAGING

In the cyclic display mode, the screens of selected analogue channels, binary channels and, if necessary, the diagnostic screen with an overview of error messages and overview screens with counter states or motor hours are regularly alternated.

The selection of channels for display, the type of display for the analog channel (time graph, bargraph, hand pointer), the period of cycling of individual screens and several other parameters are user adjustable variables.

The unit's display cyclically displays the current values of the selected channels, counter statuses and error messages in the default screen in the form of graphs. The analog and binary channel screens to be displayed in cyclic display are specified by parameterizing the respective channels.

The display shows the instantaneous values of the individual analogue channels.

The channel name is written in the top bar of the window. Below the name, the measured value with units is displayed in large font. The capital letter indicates the type of value displayed, see Indication on the chart screen. The following is the graph window.

*Indication on the chart screen*

| | | |
|---|---|---|
| A | Automatically | The value is set automatically, i.e. the value on the sensor. |
| M | Manually | The value is set manually |
| H | History | Historical value |
| E | Error | Channel error |
| S | Sum | Graph of summary historical values |

When you press ENTER, the cyclic display is interrupted and the last analog channel remains displayed for the set period of time.

### STATIC IMAGING

The static display is used to permanently display the measured value of one, two or four variables on the instrument display. A description of the parameter settings for this type of display is given in chap. 2-6-4 "Start screen " on p.117.

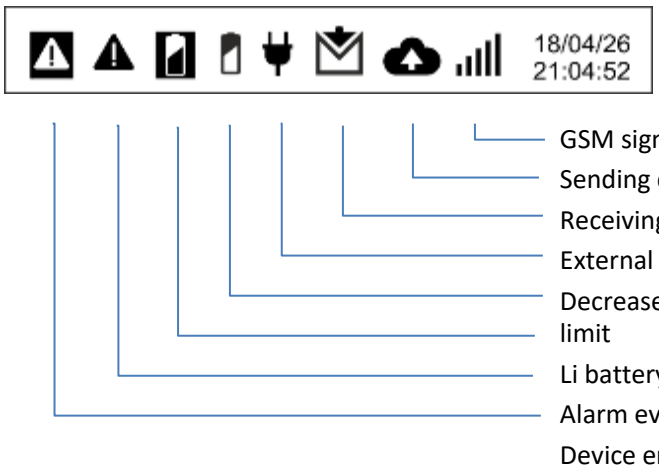
## 10.1.3. Error messages

At the bottom edge of the display screen, there is space for a warning icon next to the lock icon. The display of this icon alerts you to the unit's error condition.

The error condition can be read in more detail from the diagnostic screen, which will appear periodically in a cyclic display mode after the error occurs.

***Invoking error states***

The MODE button can be used to call up the diagnostic infolist along with the strip of warning icons that appears at the top of the diagnostic screen.



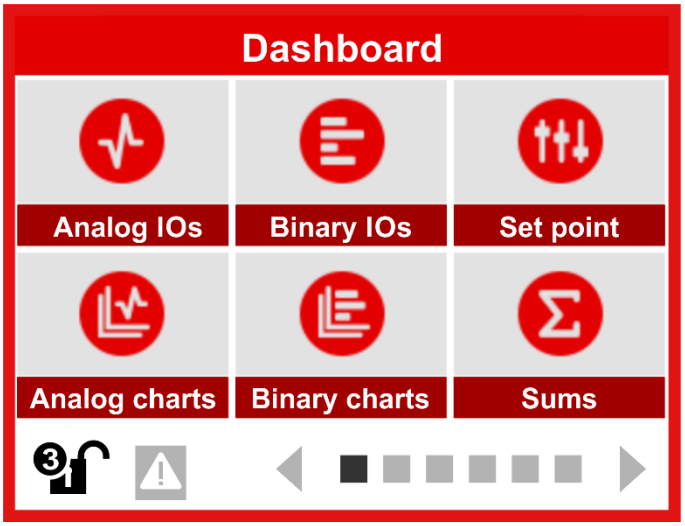
## GLOSSARY OF TERMS:

| | |
|---|---|
| Analog channel ACH | Recording input/output channel of the instrument for storing the measured analog value or controlling the analog output with adjustable Analog label and many other parameters. (see chap. 3-1 on p. 123). |
| Binary channel BCH | Instrument recording I/O channel for storing a binary measured value or controlling a binary output with an adjustable Binary label and many other parameters. 3-2, p. 143). |
| Counter | Recording register of a quantity that is incremented over time: flow volume from flow, rainfall, motor hours, kWh, ... |
| Global alarm | The result of the logical sum of the alarms of each recording channel. |
| Global disorder | The result of the logical sum of the individual error states of the instrument and the error states of the recording channels. |
| Main menu | Offer 6 basic screens with icons for control and parameterization of the unit. The menu is displayed when the MENU key is pressed. |
| Consumption equation | A function expressing the dependence between the level height and the instantaneous value of the flow in a defined gauge profile. |
| Parameter | The asterisk after the parameter name indicates the parameters that can be changed and set using the SP Set point parameters. |
| Set points SP | Defines a numeric, time, or text value with a specific name that can be assigned as a variable to another parameter requiring a value. It is used as an input variable in a control algorithm or as a global value for use in multiple parameters. Unlike the rest of the configuration, the value of the Set point parameter SP can be changed by the user with the lowest privilege 1 |
| Flowmeter | In the following description of the parameters, it is a SW function that defines the parameters for calculating the instantaneous flow in the flow profile. The output of this function is linked to the selected analog channel. The configuration is accessible under the highest privilege level 3. |
| Regulator | A software function designed to continuously influence the regulated technology in order to maintain its desired state. The controller is of PID type, consisting of proportional, integration and derivative parts. |
| Relay | Output action member. The relay can be mechanical with one switching contact or electronic with current output. |
| I/O module | External input/output module for expanding the inputs and outputs of the device. The module connects to the unit via RS485-I or RS485-II bus. |
| Entering the parameter Value | Entering by value means entering a numeric value for a parameter using the keypad or buttons in the set units of measure. |
| Entering a parameter Link | Entering by Reference means selecting the desired parameter value from the list offered |
| Default settings | The default value of the parameter set in the production plant. The default value of all parameters can be called up in bulk with the command Production parameters (accessible only to users with the highest privileges). |
| [FW-CPU:1.18.44; FWDISP-: 4.1.25] | The FW-CPU or FW-DISP designation (version of the control unit or display software) from which the described procedure, function or parameter is implemented in the unit. |

# 10.2. Main menu - overview

## 10.2.1. Dashboard - overview

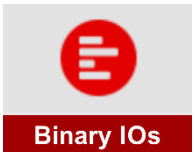
The first red window of Main menu is used to view graphs and to quickly adjust operating parameters by the instrument operator.







Display the current value of the analogue channel. You can step through the channels using the UP and DOWN buttons or the arrow in the upper right corner of the screen. Press the ENTER key to go to the parameterization of the currently displayed analog channel. More chap. 10.3.1, p. 92.




Display the current states of up to eight binary channels. You can navigate between the binary channel screens using the LEFT, RIGHT buttons or the arrow in the upper left corner of the channels. The ENTER key can be pressed to move to the parameterization of the displayed binary channel. More chap. 10.3.2, p. 93.




Quick change of selected SP Set point parameters. The operating parameters can be used for setting the operating points of the technology, e.g. setting the limit value for limit state signalling. Changing the Set point parameters can be conditioned by entering a password. Each Set point parameter must first be defined in the parameterization (3rd blue menu). More chap. 11.2, p. 101.




Viewing historical data of individual analogue channels. The configurable viewing conditions include specifying the start date for display and the sampling frequency of the archived data to be displayed. Use the RIGHT, LEFT knobs to move the time axis cursor and read the measured value at a given date and time. More chap. 10.3.3, p. 94.



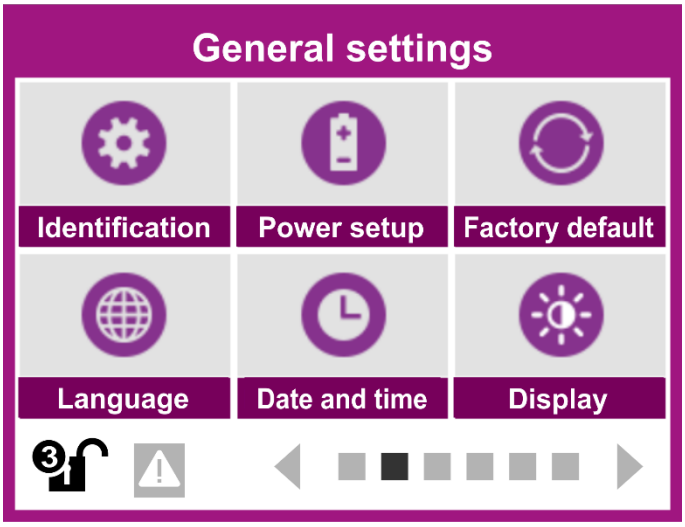

View historical data of individual binary channels. Configurable viewing conditions include specifying the start date for viewing and the sampling frequency of the archived data to be viewed. Use the RIGHT, LEFT knobs to move the timeline cursor and read the binary status at a given date and time. More chap. 10.3.4, p. 95.




Displaying the graphical progression of an integral quantity over a selected time period. The user selects a channel and chooses from what date and how often (sampling) to calculate the sum. On the displayed graph, the Sum is indicated by a large "S" above the units of the quantity. Sum values can only be displayed for integral quantities (leaked volume, rainfall). More chap. 10.3.5, p. 96.

## 10.2.2. General settings - overview

The purple main menu window is used to define the General settings of the instrument.







Setting the basic parameters of the instrument, which include identification parameters, parameters for setting the storing of measured data and the defined location of the unit (GPS coordinates, installation altitude). The submenu also allows the setting of special units of measure not found in the list. *[more chap. 11.3.1; p. 103]*




Set parameters for controlling the power saving mode of the device and parameters for controlled power supply of connected sensors and sensors and control of external supply voltage. The submenu also includes setting warning levels for controlling the voltages and currents drawn from the instrument's power supply branches and from the power battery itself. *[more chap. 2-2 on p. 107]*




The "Production Settings" submenu requires access with higher privileges and allows initialization of both instrument parameters and data memory, including both instantaneous and accumulated values. *[more chap. 11.3.2-3; p. 113]*




Select the language version for all descriptions, notifications, and messages displayed on the instrument display. *[more chap. 11.3.2-4; p. 114*]



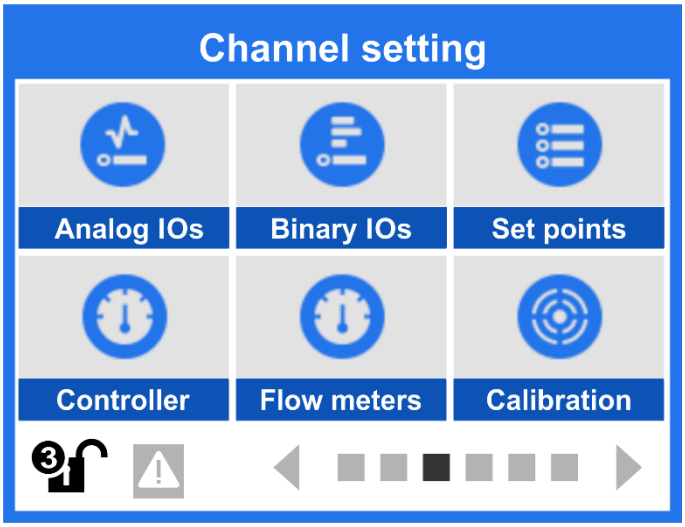

Parameters for setting and adjusting the real time of the instrument. Switching between daylight saving time and standard time is automatic and can be disabled. Setting the *Start of Day* parameter can be used, for example, when calculating the daily flow volumes in shift operation.




Set the display operating parameters such as the display backlight intensity or power saving mode with automatic display shutdown. The second group of parameters in this submenu consists of parameters for setting the default display for cyclic and stationary display of recording channels and status information. *[more chap. 11.3.2-6; p. 116*]

## 10.2.3. Channel settings - overview

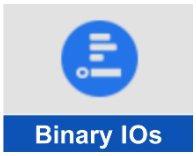
The blue window of the main menu is used to define parameters of monitored and control signals, create control algorithms and calibrate sensors.







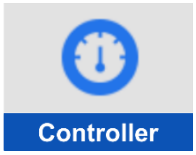
Use this submenu to set the parameters of the analog input/output channels. The list of individual parameters is extensive so that for each channel and measurand you can set specific conditions for its measurement, calculation and display *[more chap. 0; p. 123]*.



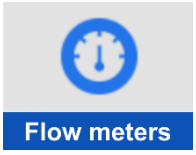

This option displays a list of all set I/O binary channels, similar to how the previous option displays a list of binary I/O channels. After selecting the selected channel, it allows setting all its parameters. Also in this case we recommend to use the MOST4 program for setting *[more chap. 11.4.3-2; p. 143]*.




Submenu for creating up to 48 SP Set point parameters. The Set point parameters can be used, for example, to set and change the Set point points of the controlled technology by a normal user and can be accessed from the first red menu of the instrument without the need to know the structure and meaning of the parameters of the individual recording channels *[more chap. 11.4.3-3; p. 163 and chap. 11.2; p. 101]*.




Set parameters of programmable PID controllers that can be used to control the coupled technology. The PID control parameters are set using this submenu or better using the MOST4 program *[more chap. 11.4.3-4; p. 166]*.



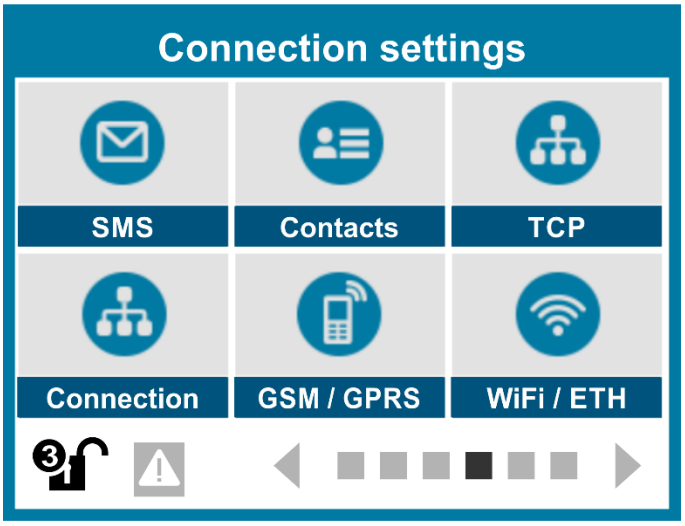

Parameter settings of independent flow meters for measuring instantaneous flow and leaked volume in an open gauge profile. Each flowmeter can use a different measurement method, ranging from a consumptive equation with predefined gauge troughs, to a generically specified gauge profile, to a KDO sensor with a velocity probe *[more chap. 11.4.3-5; p. 169]*.




Submenu for quick adjustment of level sensors, calibration of oxygen or pH probe, conductivity probe and some others. During calibration, the desired value, e.g. level, has to be set into the instrument and the program procedure automatically calculates the difference between the actual and the desired value and saves this as a parameter to the corresponding measurement channel *[more chap. 11.4.3-6; p. 180]*.

## 10.2.4. Connection settings - overview

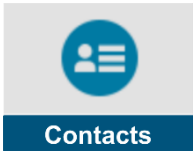
This submenu allows you to set parameters for using the communication modules installed in the device, including SMS messages.







Submenu for setting up warning and informative SMS. In addition to triggering conditions such as switching on or off a specific binary channel or reaching the measurement limit on an analogue channel, you can set the SMS text and enable the insertion of the instrument Analog label or the time of sending the SMS *[more in chap. 11.5.1; p. 194].*




Contacts are used to create a phone list of SMS recipients. In addition to Name and phone number or address, each person can be assigned to one of 8 separate groups and the SMS message can be addressed to the entire selected group with one command. The parameters of this submenu include the definition of users with access permissions *[more chap. 11.5.4-2; p. 201].*




Set the primary and secondary data server parameters for sending data from the station and receiving commands from the server. Parameters include APN selection, server URL and port settings, setting active days of the week for data transmission, time of first data send, setting the interval for data send, and other parameters *[more chap.11.5.4-3; p. 203].*




Setting the parameters of the 4 communication ports of the device. The preset communication ports are used both by the serial interface of the RS485-I, RS485-II, SDI-12 connection boards and by the communication modules installed in the instrument. Setting the communication parameters with external I/O modules. Setting of communication parameters with slave or superior systems *[more chap. 4-4 on p. 206].*



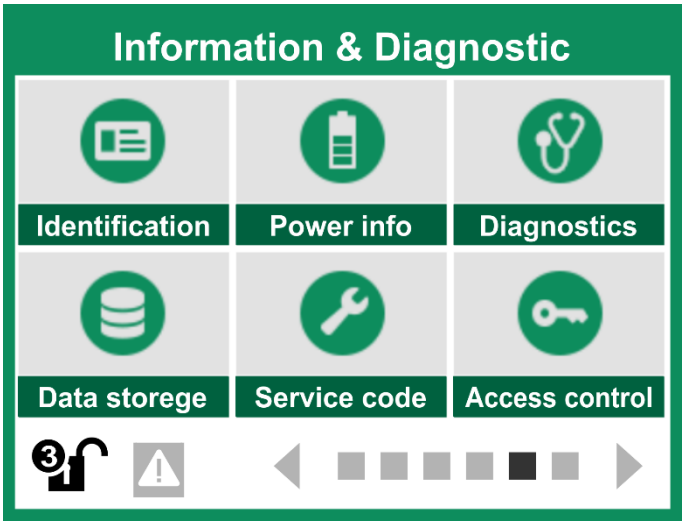

Setting the GSM/GPRS communication module parameters. The submenu offers setting of several economical modes of operation of the communication module, setting of SMS handling, for example, by forwarding unprocessed SMS and last but not least, monitoring the credit limit of sent SMS *[more in chap. 11.5.4-5; p. 218].*

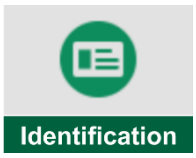



Setting Ethernet and WiFi parameters from the WiFi module power mode, control binary channel, IP address, Gateway, network mask, first and second DNS address, SSID and WiFi channel to security and security key selection *[more chap. 11.5.4-6; p. 221].*

## 10.2.5. Information & Diagnostics - overview

This green group of main menu items displays production information, current status and current instrument settings *[more chap. 11.6; p. 224].*




An informative report that displays the device type and serial number, hardware and firmware version, communications modem type, installation date, device nameplate, and unique device identification number.




Displays the currently measured voltages and currents flowing to/from the battery*, the capacity and current of the internal battery*, the voltage and current of the individual supply branches for sensors and sensors, the voltage and current draw of the Uopto output and the magnitude of the external supply voltage.

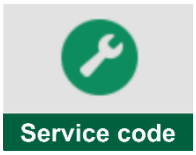
* *valid only when using connection plates TB1 to TB3*



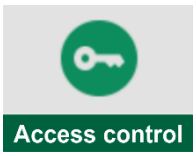

Overview of all error messages with the possibility of resetting them. The code of each such error is stored in the error stack along with the date and time of the error. The significance of the stack is especially important for servicing the unit.




Information about the total size of the data memory and the amount of free memory space. Other information includes the date the memory was last initialized (cleared), instrument run time and error run time, instrument shutdown time, and instrument installation date.




This option allows you to enter text commands similar to SMS. The user completes the command in the "Enter command" option with a maximum length of 45 characters and sends the command by pressing the "Send!" button. After the command is executed, the user is shown the result.

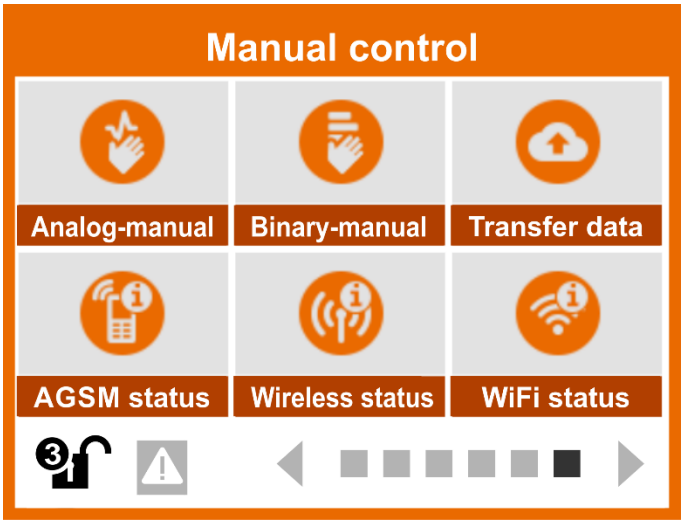



The "*Permissions*" item allows you to change passwords for each permission level. Setting the password to 0 (zero) will disable the requirement to enter it. From the manufacturer, all passwords are set to zero.

## 10.2.6. Manual control - overview

The last orange window of the main menu allows you to force the analog or binary channel to the desired value. Manual control commands can also be entered by remote access.

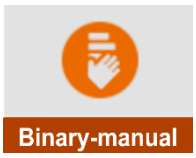
Access to the manual control can be conditioned by knowing the password and thus preventing changes to output values important for the operation of surrounding devices that depend on the station.



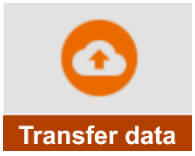




Option for manual control of analog outputs. The desired output value can be forced to the selected analog output using a special input window. The indication that an analog output is operated in manual mode and not in automatic mode is indicated by an orange indicator with the letter M displayed in the analog channel window.




Option for manual control of binary channels. The selected binary channel can be manually switched on or off. The channel status is indicated by the AUT (auto set state) or MAN (manual set state) flag displayed in the channel screen.




Command to manually send data to the server. The "*Upload Status*" menu item shows the status of the data upload, i.e. whether the data is being uploaded and whether it has already been uploaded. The instrument also displays in kB the total amount of data already sent and received in the last session. When the "Send Data" button is clicked, the data is sent to the server.




Display of the current GSM modem status: modem power ON/OFF, operator name, signal strength, remaining credit and number of sent and received SMS.




The Radio Status option is not supported in the current version of the unit software.

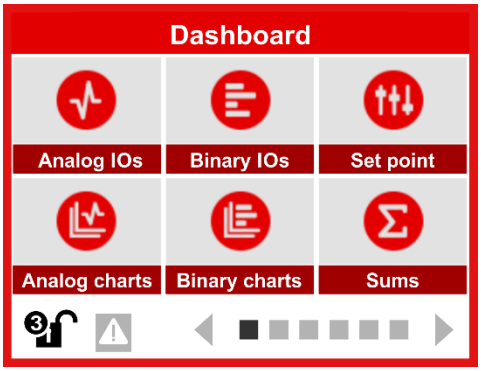



Display the accrual status of the WiFi module: module power ON/OFF, network connection status and name, module IP address and module MAC address. Also, this submenu can be used to get information about the current status of the Ethernet module if it is used instead of the WiFi module.

# 10.3. Display of measured and historical values

Chapter 10.3 describes the different options of the 1. red MENU screen. This contains frequently used user buttons for displaying current measured values, historical graphs and leaked volume sizes (totals) of analogue channels, binary channel states and also allows quick changes of preset operating parameters.

A detailed description of all instrument parameters is given in the extensive chapter 11 *Parameters* on p. 99.




## 10.3.1. Display the current analog channel value




Button to display the current analog channel value including a graph of the last 280 values. The screen contains a channel selection arrow in the upper right corner. The UP and DOWN buttons can also be used to step through the analog channels. By pressing the ENTER key, you can go to the parameterization of the currently displayed analog channel.




| | |
|---|---|
| 1 | Serial number and Name of the analogue channel |
| 2 | Space for warning messages in case of measurement error |
| 3 | Inserted line to display counter or limit value (max, min) |
| 4 | Lower and Upper Alarm Limits |
| 5 | Adjustable measuring range |
| 6 | Timeline chart |
| 7 | Analog channel selection button (similar function: UP, DOWN) |
| 8 | Channel status information: M =manual, A =automatic, E =error |
| 9 | Instantaneous measured channel value including units of measure. If an alarm is set and the limits are exceeded, the digit color changes from black to orange. |
| 10 | Counter status or limit values (max., min.) including units and time stamp |
| 11 | Graphical waveform of the measured value of the analogue channel. Graph type (line, filled) and graph colors are adjustable parameters of the analog channel. |
| 12 | Time stamp of last measurement |
| ENTER | Quickly navigate to the parameters of the displayed channel |

***Browsing individual screens***

In cyclic mode, the UP and DOWN arrow buttons are used to scroll through a group of individual measurement channel screens or a group of overview screens, and the LEFT and RIGHT arrow buttons are used to scroll through individual cyclic mode screens, i.e. ACH screens alternate with overview screens.

## 10.3.2. Display current binary channel values




Display current statuses and recent short history of up to eight binary channels. If more than 8 binary channels are set in the unit, the RIGHT, LEFT knobs can be used to switch between the binary channel screens.

Selecting individual channels is done by using the UP and DOWN buttons or by touching the channel labels. The currently selected channel is indicated by a lighter grey colour below the binary channel label (point 7 in the lower picture).

***Parameterization of BCH***

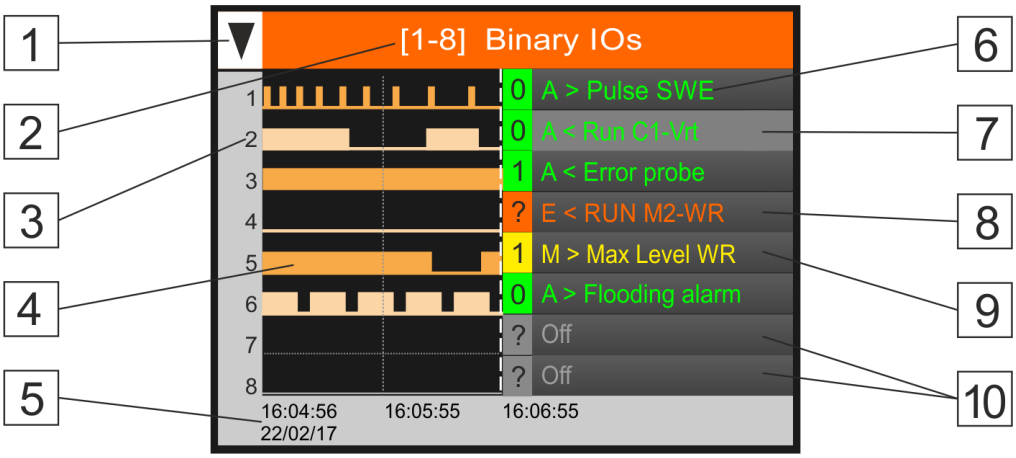
By pressing **ENTER** key you can go to the parameterization of the selected binary channel. The parameterization menu of all set binary channels (not only the selected channel) can be accessed by pressing the arrow in the upper left corner of the screen.

You can get back to the display of the current binary channel values by pressing the ESC knob.

***Manual control of BCH***

A prolonged press of the **MODE** button (> 0.5 sec) takes you to the manual control screen, which allows you to set the desired value of 0 (open) or 1 (on) on the selected binary channel. You can get back to the display of the current binary channel values by pressing the MODE knob again (the manual control mode of the binary channels is dealt with in chap. 6-2 Binary- on p. 229).

***Binary channels screen***




| | |
|---|---|
| **1** | Button to navigate to the list and parameterization of binary channels. |
| **2** | List of displayed binary channels of the current screen. |
| **3** | The serial number of the binary channel on the screen. |
| **4** | Graphical display of the last 120 binary channel records. To make the graphs clearer, odd and even channels are painted in different colors. |
| **5** | Timeline of the chart with date (bottom) and time displayed. |
| **6** | Channel selection buttons with channel label and other information:<br>- prefix A ... automatic mode (green colour of the BCH tag)<br>- prefix M ... manual mode (yellow colour of the BCH tag)<br>- prefix E ... error on BCH (red color of BCH tag)<br>binary channel type: < ... input channel; > ... output channel) |
| **7** | The selected BCH binary channel is indicated by a lighter button background. Pressing the ENTER knob allows you to navigate to the parameters of this selected channel. |
| **8** | The binary channel in failure (prefix E) is marked in red. |
| **9** | The binary channel in Manual mode (prefix M) is marked in yellow. |
| **10** | Unset binary channels are indicated by the grey color of the "Off" tag and the ? sign instead of the current BCH value. |
| **MODE** | Quickly switch to manual binary channel control mode (and back). |
| **ENTER** | Quick switch to setting the parameters of the selected channel (ESC ...back). |

## 10.3.3. Display of archived analog channel values




This option allows you to view historical data for individual analog channels in timeline graphs. The user selects the channel and chooses the date from which the graph should be displayed. When the *Display Graph!* button is pressed, the unit scans the archived data area and plots the measured values stored in memory as a line graph on the display.

Up to 2,048 records are loaded into the unit's memory from the specified date and time in a single read, with the first 280 recorded values displayed on the unit's screen. Use the LEFT, RIGHT, UP, DOWN arrow buttons and the time pointer on the graph to scroll through the records and find a specific record, including displaying the date and time it was taken.

### 1-1-1 Analog Charts

#### 1-1 Select channel

Select an analog channel to view from a list of all analog channels on the unit. For occupied channels, the parameters *Analog label*, *Measurement Method and Units of Measurement* are displayed.

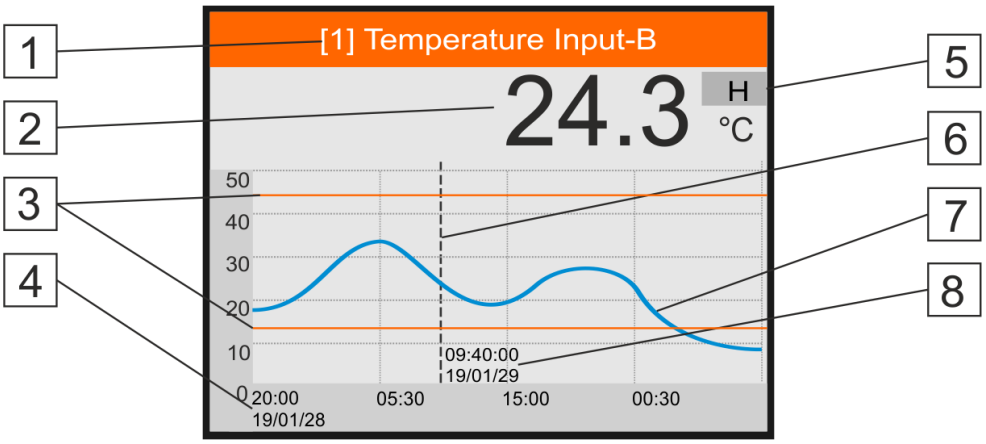
#### 1-2 From date [YYYY/MM/DD]

#### 1-3 From time [HH:MM:SS]

Set the start date and time for displaying the measured value of the selected channel.

#### 1-4 Show chart !

Button to call up a graph of archived values:




| | |
|---|---|
| 1 | Serial number and Name of the selected analog channel |
| 2 | Measured value at a point on the moving time axis (fingerboard LEFT, RIGHT) |
| 3 | Preset alarm limit limits |
| 4 | Start date and time entered |
| 5 | Indication that this is a chart of historical (archived) data |
| 6 | Movable pointer of the timeline - movement by the fingerboard LEFT, RIGHT |
| 7 | Quantity waveform |
| 8 | Date and time of the timeline pointer in HH:MM, YY/MM/DD format |

It takes a few seconds to prepare about 2,000 archived records for display, and during this time the top line of the graph displays the percentage of the processed data.

***Time pointer movement in the chart***

Use the LEFT, RIGHT knobs to move the time axis cursor and read the measured value on a given day and time. A longer press of the LEFT, RIGHT knobs causes automatic accelerated scrolling of the graph in the selected direction.

The UP and DOWN knobs speed up scrolling through the recorded data by scrolling through the individual screens (280 records), which is indicated by moving the horizontal cursor over the displayed graph.

## 10.3.4. View archived binary channel values




This menu allows you to view the historical data of individual binary channels in timeline charts. The user selects the channel and chooses the date from which the chart should be displayed.

Up to 2,048 records are loaded into the unit's memory from the specified date and time in a single read, with the first 120 recorded values displayed on the unit's screen.

Using the LEFT, RIGHT, UP, DOWN arrow buttons and the time pointer [1] in the chart, you can scroll through the records and search for a specific record, including the date and time of its creation.

### 1-1-1 Binary Charts

#### 1-1 Select channel

Select a binary channel to display from a list of all binary channels of the unit. For busy channels, the following parameters are displayed: *Binary label and input/output type*. Unlike analog channels, binary channels are displayed in groups of eight channels.

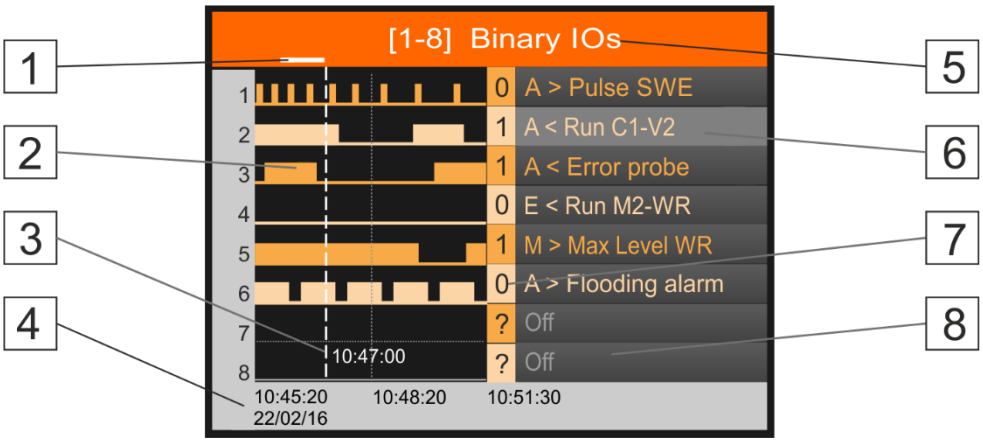
#### 1-2 From date [YYYY/MM/DD]

#### 1-3 From time [HH:MM:SS]

Set the start date and time to display the binary state of the selected channel.

#### 1-4 Show chart !

Button to call up a chart of archived values:




| | |
|---|---|
| 1 | Pointer to the position of the display screen in the data memory for displaying |
| 2 | Binary channel progression in time |
| 3 | Movable pointer of the timeline - movement by the fingerboard LEFT, RIGHT |
| 4 | Date and time of each timeline of the displayed graphical overview |
| 5 | Displaying the numbers of the selected eight binary channels |
| 6 | Selected binary channel; other adjacent channels complete the display up to eight |
| 7 | The state of the binary channel at the moment given by the timeline |
| 8 | Undefined or disabled channels displayed by the figure of eight are marked with "?" |

***Processed %*** Creating the chart takes a few seconds and during this time the percentage of the data processed so far is displayed in the top line of the chart.

***Time pointer movement in the chart*** Using the LEFT, RIGHT knobs, you can move the time axis cursor and read the binary state on a given day and time. A longer press of the LEFT, RIGHT knobs causes automatic accelerated scrolling of the chart in the selected direction.

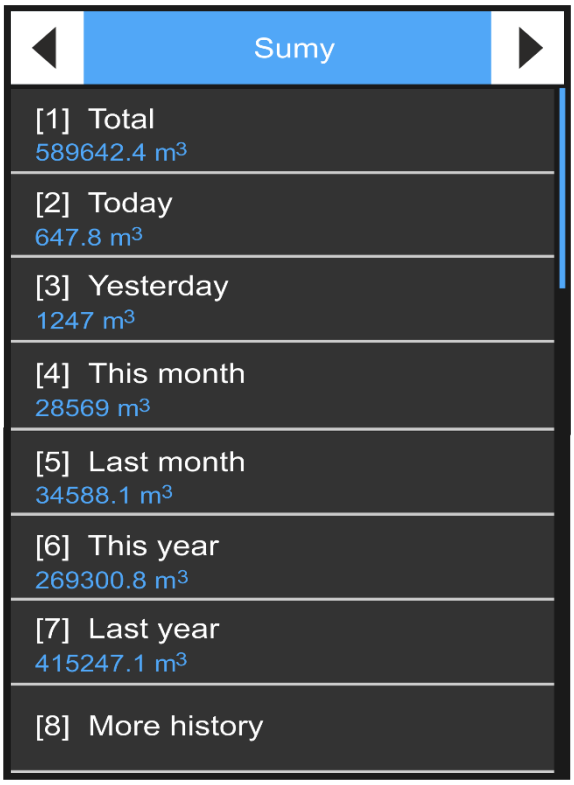
The UP and DOWN knobs speed up scrolling through the recorded data by scrolling through the individual screens (120 records), which is indicated by moving the cursor [1] in the top row of the screen.

### 10.3.5. View totals




Button for displaying the status of the counters for leakage rate, rainfall, energy and other variables where counters can be set in addition to recording instantaneous values.

In addition to the numerical value of the fixed counters such as total, daily, monthly or annual totals shown in the following overview, the progress of daily, weekly or monthly leaked volumes (totals) for a specified time period can also be displayed graphically.




## Channel selection

In the first step you need to select the channel whose counters (totals) are to be displayed from the menu of all analogue channels.

Show totals only for analog channels) that have an active counter [*3-1-7 Counter [0/1] on pg. 128*] (i.e. channels set to measure and record flow, rainfall, motor hours, energy consumed, etc.).

## 1-1-1 Totals

Summary display of all counters of the selected analog channel in informative lines of the screen. The individual lines contain the counter name (sum) given in white font color and then in blue font at the bottom of the informative line the status of the counter assigned to the displayed analog channel, including the set units of measure and the displayed Floating points.

The start and end of the day can be shifted by the parameter 2-5-5 Midnight offset [HH:MM:SS] on pg. 115., which may affect the overall state of individual counters compared to other measurements made with regular midnight readings (except for the overall counter, whose state is not affected by shifting the end and start of the day).

### 1-1 Total

The sum from the installation of the instrument, or from its last initialization, to the present.

### 1-2 Today

Sum from the beginning of the day to the present.

### 1-3 Yesterday

The total for yesterday.

### 1-4 This month

The amount in this month calculated from the 1st of the month to the present.

### 1-5 Last month

Last month's total.

### 1-6 This year

Amount in this year calculated from 1.1 to the present.

### 1-7 Last year

The amount for last year.

### 1-8 More history

The "More History" button is used to calculate and graphically display the archived daily, weekly and monthly totals (leaked volumes) from the set date to the current moment or until the screen is full (280 partial values on the timeline).

#### 1 From date [YYYY/MM/DD]

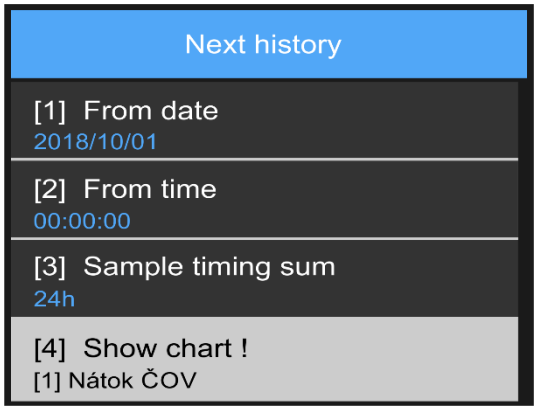
#### 2 From the time of [HH:MM]

Setting the start date for displaying the chart of summary values

#### 3 Sampling

The choice of 3 sampling menus determines how long a period will be represented by one bar of the full chart or line chart point. The usual value of this parameter is 24 hours, i.e. displaying a chart of daily totals (sums).

- **24 hours**
- **7 days**
- **1 month**



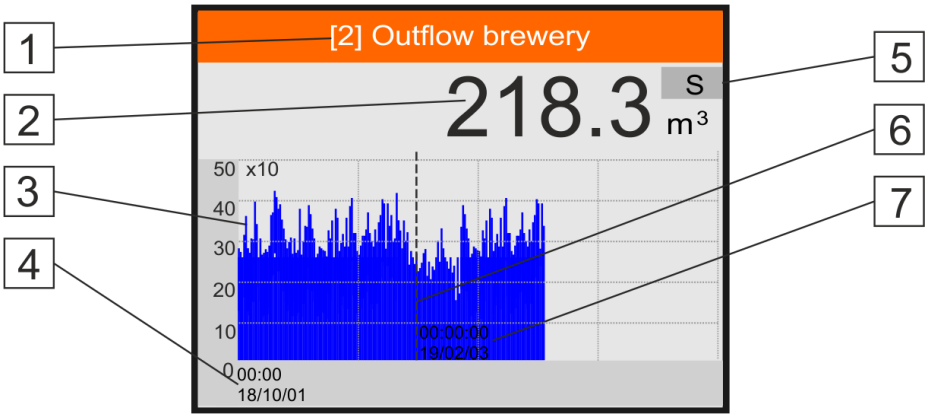

The weekly and monthly totals are calculated from the archived daily totals before displaying the chart, so it may take a few seconds to prepare a longer time period.

#### 4 Show chart!

Button to call up a chart in which one point will represent the sum of the period specified by the Sampling option. It takes a few seconds to create the chart and during this time the percentage of the data processed so far is displayed in the top line of the chart.

The chart type (line or solid, chart color, ...) are parameters that the chart sum takes from the analog channel settings (see Parameters *11-7 Chart style ,* p. 134).

Using the LEFT, RIGHT buttons, you can move the pointer on the timeline to display the numerical size of the sum in individual days (weeks, months) for the selected time period (shown in Figure 218.3 $m^3$ on February 3, 2019):




| | |
|---|---|
| **1** | Serial number and Name of the selected analog channel |
| **2** | The size of the daily (weekly, monthly) sum corresponding to the current position of the moving time pointer |
| **3** | Sum values at each displayed point from the specified day to the present (or until the display is full) |
| **4** | Start date and time entered |
| **5** | Indication that it is a sum chart |
| **6** | Movable pointer of the timeline - movement by the fingerboard LEFT, RIGHT |
| **7** | Date and time of the timeline pointer in HH:MM, YY/MM/DD format |




# 11 Parameters

This extensive chapter is devoted to the setup and description of individual instrument parameters. The parameters are divided into several groups accessible via the basic MENU screen or via the MOST4 program.

Str. 101 **Set point parameters**
Change the value using predefined Set point parameters

Str. 103 **Basic Setup Parameters**
Unit identification, power, display, language and time settings

Str. 123 **Measurement parameters**
Analog and binary channel settings, calibration of measuring probes

Str. 194 **Parameters of communications**
Setting communication ports, GSM, SMS, WiFi and contacts

Str. 224 **Information and diagnostics**
Information menu with access and password settings

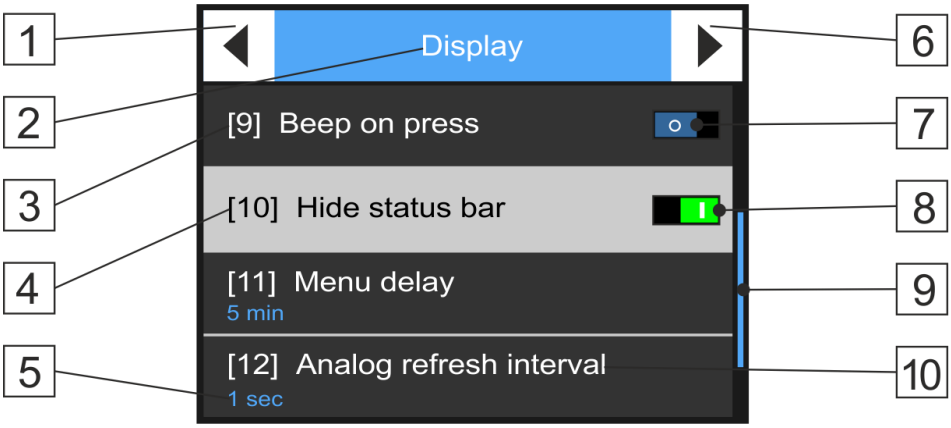
Str. 228 **Manual steering**
Commands for sending data to the server and setting analog and binary channels to the desired value

## 11.1. Setting and changing parameters

Settings and changes to parameters can only be made by users with permission level 2 or 3. Users with permission level 1 can also change the value of SP Set point parameters.

The following figure shows a typical screen used for setting and changing parameters. In addition to the header, one screen contains a maximum of 4 parameters accessible either by touching the display directly or by using the UP, DOWN and ENTER knobs. Subsequent or previous quartet of parameters at the same level is accessible by the arrows in the upper left and right corners of the display or by the LEFT, RIGHT buttons.

A useful and frequently used function when setting parameters is to return to the parent menu after pressing the blue button in the header of the screen [2].




| | | |
|---|---|---|
| **1** | Button to recall the previous quartet of parameters | **LEFT** |
| **2** | The name of the submenu or list from which the selection is made; **The button to return from a submenu one level** up | **UP** |
| **3** | Binary parameter button. The binary parameter is disabled. | |
| **4** | The selected parameter is indicated by a grey colour. Repeatedly pressing the binary parameter turns it on/off. | **UP, DOWN, ENTER** |
| **5** | Current set value of the parameter | |
| **6** | Button to recall the subsequent quartet of parameters | **RIGHT** |
| **7** | Graphic marker of disabled binary parameter | |
| **8** | Graphic marker of the enabled binary parameter | |
| **9** | Screen position indicator in the list of submenu screens | |
| **10** | Name of the parameter and its serial number in the submenu or list | |

Once set, there is no need to confirm or write the parameters to the unit's memory. The parameters remain stored in the unit even after the power supply is switched off.

# 11.2. Set point parameters SP




The Set point parameters can be used for quick reconfiguration of selected instrument parameters by the operator according to the current requirements of the monitored or controlled technology, without the need to know the structure of the parameters and their breakdown.

All Set point parameters are contained in a single clear list accessible via the first "red" menu "Dashboard".

When changing the value of the selected operating parameter, the operator does not need to know the structure of the analogue or binary channels of the unit and is guided only by the name or serial number of the operating Set point parameter whose value needs to be changed. The operating Set point parameters can be used not only when changing the settings of analogue and binary channels but also, for example, when changing the conditions for sending SMS messages, when parameterizing controllers, etc.

***Marking*** A list of all instrument parameters that can be changed by a Set point parameter is indicated by an asterisk after the parameter name later in this manual.

In order to use the operating parameters, there are 2 basic steps to take when setting up the unit:

- **Define Set point parameter**
- **Incorporate the selected operating Set point parameter into the analog or binary channel being set**

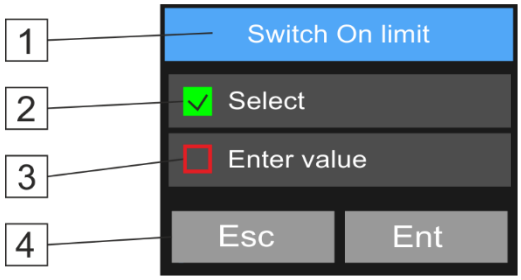
## 11.2.1. Definition of Set Point parameters

For a description of the creation of individual Set point parameters and their structure, see chap. 3-3 Set points on p. 163. A Set point parameter can be a decimal number, a date and time, or just plain text.

## 11.2.2. Incorporation of Set point parameters into the unit

The Set point parameter is inserted into the unit structure when setting the parameters of an analogue or binary channel. As mentioned above, the Set point parameter can only be used to replace some of the set parameters marked with * at the end of their name.

A detailed description of all instrument parameters is given later in this manual. The parameter description is often accompanied by an illustrative example of its setting. If the parameter currently being set can be replaced by a Set point parameter from the list of predefined Set point parameters, you can tell by the fact that when setting the parameter, instead of just a numeric or text keypad, a pane appears on the display with a choice of whether the parameter currently being set should be entered from the List or by Value:

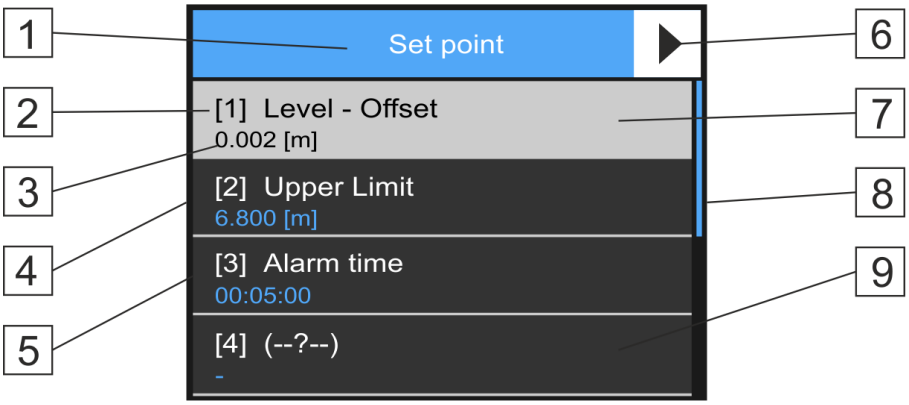



| | | |
|---|---|---|
| 1 | Name of the parameter currently set | |
| 2 | Button to select from the list of Set point parameters | **UP** |
| 3 | Button for setting the parameter by value (from the keyboard) | **DOLU** |
| 4 | To cancel or confirm a choice | **ESC, ENTER** |

## 11.2.3. Setting the value of Set point parameters

Each Set point parameter must first be defined (see chap. 3-3 Set points on p. 163).

The following figure shows an example of a screen with a list of 3 predefined Set point parameters of the unit, whose value can be easily and quickly changed by the operator.




| | |
|---|---|
| **1** | Button to return to the main MENU **ESC** |
| **2** | Serial number and name of the Set point parameter |
| **3** | Set point parameter value and unit of measurement |
| **4** | Window of the Set point parameter type Decimal number |
| **5** | Time type Set point parameter window |
| **6** | Button to move to the next four parameters **RIGHT, LEFT** |
| **7** | The selected parameter is indicated by a light grey colour. Repeatedly pressing the binary parameter turns it on/off. **UP, DOWN,** ENTER |
| **8** | Bargraph for signalling the position of the selected SP among other SPs |
| **9** | Undefined Set point parameter window - cannot be set or changed |

The setting of the desired value of the selected Set point parameter is done through windows that open after the confirmed selection of the parameter to be set.




*Numeric value setting* *Time setting* *Date setting*

To prevent unauthorized interference with the device settings, the change of Set point parameters can be conditioned by entering a password (the right to change Set point parameters is granted to the operator with permission 1 and higher).

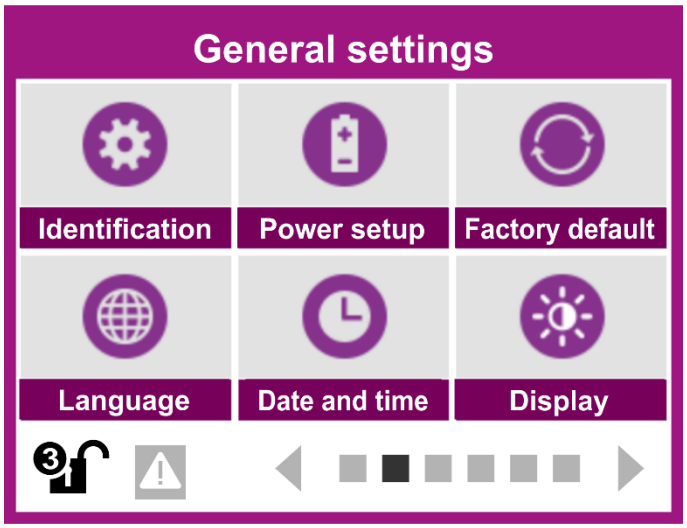
On p. 165 is given Example 19. describing the procedure for setting the operating parameters for controlling the on and off limits of the pump.

***Setting up SP by SMS***

The operating parameters can also be set to the desired value by SMS command in the form:

**PASSWORD,WPTX=V (**setting the value of the Set point parameter X to the value V).

A description of command SMS is given in chap. 4-1-4 Command and control SMS on p. 199.




## 11.3. General settings




# 2-1 Identification

Setting basic device identification parameters and some specific installation parameters. The submenu also allows setting special units of measure not listed.

### 2-1-1 Device label

The basic parameters include the device label, which can store a maximum of 25 characters characterizing the device.

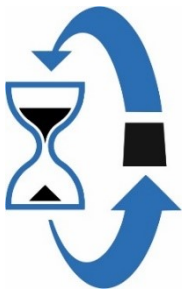
The Analog label is used to visually check the affiliation of the open parameter file to the connected device. The Analog label can also be seen at the beginning of the *.dt3 data file and in the header of the data display table.

### 2-1-2 Station ID

The identification number is stored together with the data in a single data file and thus uniquely identifies the origin of the measured data. The ID can take a value in the range 1 to 4 294 967 295. Usually the ID number is the serial number of the unit.

When using GPRS data transfers to a server on the Internet, the value of this parameter is assigned by the server administrator. It is normally not recommended to change this number.

### 2-1-3 Global measure interval [HH:MM:SS]

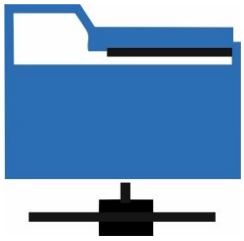


This parameter is mainly used for controlled wake-up of battery-powered stations operating in power saving mode. The value of the parameter corresponds to the time interval in which the station wakes up, makes one pass through the measuring loop of connected sensors and transducers, and then goes back to sleep for a period of time determined by the length of this interval.

Parameter "Global measure interval [HH:MM:SS]" can also control the storing of measured data for those analog channels that have Basic or Exceptional storing set to Global Interval. For more information on storing, see the section on analog channel settings 3-1-12 on p. 135. The parameter can be set from 1 sec to 1 day. In power saving mode (chap. 2-2-1 Power mode, p. 108), the lower range of this parameter is limited to 1 min.

**Default setting:** 10 min

## 2-1-4 Errro stack [0/1]



Allows you to archive instrument error states or error states of connected probes and sensors in the data memory. Enabling this binary parameter enables the storage of extraordinary and unexpected error conditions, which can be, for example, a mains power failure or an error signal from a smart probe, etc.

Along with the error condition code, the time stamps for the start and end of the error condition are stored in the instrument's memory.

*Note: The event memory is automatically loaded along with the reading of the data memory and its contents are stored in the event file. The name of the event file is the same as the name of the measured data file *.dt3*

**Default setting:** on

## 2-1-5 Alert stack [0/1]

Enable to archive instrument warning states in the data memory. Warning conditions include, for example, a drop in supply voltage below the set limit or an increase in humidity inside the instrument above the allowed limit. A warning condition, unlike an error condition, does not significantly affect the proper operation of the instrument.

Along with the warning status code, the time stamps for the start and, if applicable, the end of the warning status are stored in the instrument's memory.

**Default setting:** on

## 2-1-6 Debug stack [0/1]

Enable to archive FW changes when debugging the program. For normal users this parameter is not relevant.

**Default setting:** off

## 2-1-7 Incoming SMS stack [0/1]

Allows you to store information related to received SMS in the data memory. The time of receipt, message text and sender's phone number are recorded.

**Default setting:** on

## 2-1-8 Outgoing SMS stack [0/1]

Allows you to store information related to sent SMS in the data memory. The time of sending, the text of the message and the recipient's phone number are recorded.

**Default setting:** on

## 2-1-9 Commands stack [0/1]

Enable to store command and query commands entered by the user via the unit's on-screen keyboard into the data memory.

**Default setting:** on

## 2-1-10 Latitude

The user has the possibility to write the latitude of the fixed installed unit into the memory for the possibility of subsequent automatic display of the unit in the map base in the format N(S)XX.xxxxxx degrees north (south) latitude without minutes and seconds, e.g. N48.928.

**Default setting:** 48.97°



## 2-1-11 Longitude

The user has the option to write the longitude of the fixed unit into the memory of the unit for the possibility of subsequent automatic display of the unit in the map base in the format E(W)XX.xxxxxx degrees East (West) longitude without minutes and seconds e.g. E15.759

**Default setting:** 14.47°

## 2-1-12 Elevation [m]

User configurable parameter. It can be used, for example, when measuring groundwater level converted to altitude or when measuring atmospheric air pressure and its subsequent conversion to sea level.

**Default setting:** 384,00

## 2-1-13 Custom units [U1]

## 2-1-14 Custom units [U2]

If the predefined list of units does not offer the required unit of measure, it is possible to user-define 2 additional units of measure with a maximum length of 5 characters.

## 2-1-15 Number of analog channels

Setting the maximum number of analog channels used

Reducing the number of analog channels by unused channels will reduce the amount of data transferred to the server. Allowed parameter range: 16 .. 96.

**Factory settings: 32**

## 2-1-16 Number of binary channels

Setting the maximum number of binary channels used

Reducing the number of binary channels by unused channels will reduce the amount of data transferred to the server. Allowed parameter range: 16 .. 208.

**Default setting: 64**

## 2-1-17 Installed

## 2-1-18 Installed time

Setting the date and time of the device installation. This parameter determines from what starting date and time the data for visualization (charts) or integral quantities (sums of leaked volumes since installation) will be read.

## 2-1-19 Counters arch in interval [0/1)

This parameter enables storing of the total quantity counter states at intervals specified by the setting of the analog channel instantaneous value storing intervals. The storing condition is that the counter is switched on when setting the analog channel.

***Automatic recording of integral quantity***

In addition to this user option of regular storing of the total counter states of the analogue channel, the unit also records the increment of the accumulated value of the measured integral variable (flow, rainfall, energy,...) on a separate auxiliary channel, which is internally "connected" to each analogue channel measuring one of the above mentioned integral variables. The increments are measured over a period of time given by a set storing interval - the time between two records of the instantaneous value.

***View*** This auxiliary recording channel containing only "increments" is automatically read out during data acquisition (via USB, GSM, NB-IoT, Ethernet) and then displayed in the form of a table or chart, together with the current value of the connected analogue channel.

The automatic recording of integral quantity increments described above does not affect the setting of this parameter. However, turning the parameter on affects the total amount of recorded and transmitted data, so the default value of the parameter is set to off.

**Default setting:** on

## 2-1-20 Counters arch in midnight [0/1]

This parameter enables storing of all set total counters only once a day at midnight.

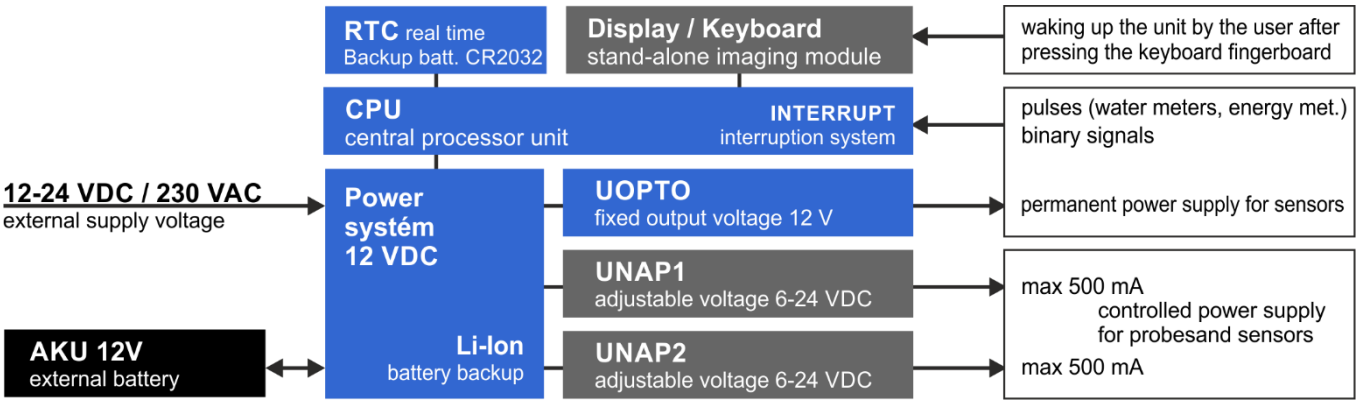
This is similar to the above parameter with the difference that the total state of the enabled counters is archived only once at midnight and not regularly at the interval specified by the *storing Interval* parameter, which saves data memory and the total volume of transferred data.

**Default setting:** off




# 2-2 Power

Menu for setting power supply parameters in continuous and power saving mode including settings for controlled power supply of connected probes and sensors. This group of parameters also includes setting limits for self-diagnostics of the entire power system.




The H7, H3 unit can operate in two basic power modes: in **Continuous operation** and in **Power Saving mode.** Only the blocks highlighted in blue are fully functional in power saving mode.

## PERMANENT OPERATION

**In continuous operation** the unit is permanently switched on and performs continuous cyclic measurements of the set analogue channels including control of the established technology. Continuous operation is the basic setting of the unit powered from a 12 to 24 VDC or 230 VAC power source.

## SAVING MODE

**Saving mode** is is suitable for those devices that are powered only by the battery. The current draw of the unit in power saving mode is less than 0.3 mA when the unit is "asleep".

***Frequency of measurements***

In Economy mode, the display is turned off and measurements are only taken at the intervals specified by the parameter 2-1-3 "Global measure interval [HH:MM:SS]=". This is assuming that the configured analog channels have their own storing intervals set to be longer than or equal to the Global Measurement Interval. If any of the storing intervals for an analogue channel is set to a shorter time than the Global Measurement Interval, then the frequency of the measurements is determined by this shortest storing interval.

***Measurement signalling***

The current measurement loop is indicated by the MEASURE LED on the front panel of the instrument. When the unit wakes up from power saving mode, the entire measurement cycle is always performed involving the successive measurement of all set analogue channels.

***Storing data in power saving mode***

During the power saving mode, the measured values will be archived depending on the storing parameters set for each measurement channel. The storing parameters are described in chapter 3-1-12 "" on p. 135.
Depending on the unit's parameter settings, the Energy Saver mode may be invoked even for units powered from a mains voltage source (by failure of the external supply voltage, low voltage of the external battery or by switching on the control binary channel).

***Outputs in power saving mode***

The active current outputs are disabled for the duration of the power saving mode 4-20 mA IOUT1, IOUT2 and electronic relays RE3, RE4 on connection boards TB2 and TB3. Mechanical relays relays are not switched off during the transition to power saving mode and continue to be controlled according to the set conditions (however, the frequency of control is determined by the frequency of measurements in power saving mode).

The appropriate display mode setting is a prerequisite for the unit to enter power saving mode, which can block the unit from entering power saving mode (the display power mode is controlled by the parameter 2-6-1 "Display mode").

***Waking up the user***

A sleeping unit can be awakened from Sleep mode at any time by pressing any key on the unit. 2-6-3 "Time to LCD switch off [HH:MM:SS]".

## 2-2-1 Power mode



Set the conditions for the unit to enter power saving mode.

In economy mode, the measurement only takes place at the intervals specified by the parameter 2-1-3 "Global measure interval [HH:MM:SS]" or other shorter storing interval of any analog channel. Upon wake-up, the entire measurement loop of the set ACH channels will always run and then the instrument will be put to sleep.

**Important limitation:** in power saving mode, the unit cannot operate with a measurement interval of less than 1 min.

### 1-1 Always on

Continuous measurement regardless of battery status or external power failure. Option for units powered by a backup power supply.

### 1-2 Saving while no ext.power

Switch to power saving mode when external power fails. Setting the external power limit value to activate this option is described in chapter *2-2-8 External power* supply .

### 1-3 Saving while low power

Switches to power saving mode when the voltage of the backup power supply battery drops below the set value. Enabling the unit to enter power saving mode and setting the limit value is described in chap. 2-2-7 "External battery".

### 1-4 Saving based on BCH

Switch to power saving mode when the selected binary channel is switched.

### 1-5 Saving always

Basic operating mode of the unit powered only by the battery.

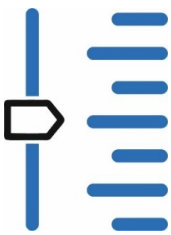
**Default setting: Always on**

## 2-2-2 Controlled input [BCH]

Specifying a binary channel to control the transition to the unit's power saving mode according to the parameter 1-4 "Saving based on BCH". The unit remains in power saving mode for the duration of the binary channel switching. The binary channel can be controlled, for example, by a cabinet door switch, a time function, etc.

A value of 0 disables the function of this parameter.

## 2-2-3 UNAP1 power



Parameters for control and self-diagnostics of the 1st branch of the supply voltage UNAP1. In addition to the supply voltage magnitude, the delay required for the first measurement from the supply voltage switch-on and the warning level when the current drawn exceeds or the supply voltage magnitude of UNAP1 drops can be set in this submenu.

### 3-1 Enable power [0/1]

Enabling the 1st branch of the UNAP1 supply voltage.

**Default setting:** on

### 3-2 Voltage [V]

Selection of the supply voltage in units of V. The supply voltage magnitude can be set from 6 to 24 VDC with a resolution of 0.1V (up to HW:406 6 to 16 VDC).

Setting a higher supply voltage than required by the connected sensors and transducers reduces the operating time when the unit is powered from the battery. The minimum supply voltage ratings for selected sensors are listed in 6.5.2 Overview table of frequently used sensors and probes on p. 43.

**Default setting:** 12 V

### 3-3 Delayed power-on [sec]

Setting the delay for the start of the measurement from the moment the power supply voltage is switched on to UNAP1. The delay is set in seconds with a resolution of 0.1 s. The delay for switching on the power supply can be set from 0 to 120 sec.

Some types of sensors require a delay of tens of seconds after switch-on (e.g. ultrasonic or radar level sensors powered by a 4-20 mA current loop).

Setting a longer delay than required by the connected sensors and transducers reduces the operating time when the unit is powered from the battery.

### 3-4 Voltage alert threshold [V]

UNAP1 supply voltage warning level setting in units of V. When the supply voltage drops below the set level, an error message is triggered and appears on the unit display and is stored in the event table. A list of error messages is given in chapter 2-5 Input - Diagnostics bits on p. 144.

A drop in the UNAP1 supply voltage below the warning level may be caused by excessive current draw of the connected sensors (> 500 mA) from the UNAP1 terminals, damage to the boost DC/DC converter in the instrument, or discharge of the power supply battery.

The warning voltage level can be set from 6 to 24 VDC with a resolution of 0.1V.

**Default setting:** 11 V

### 3-5 Current alert threshold [A]

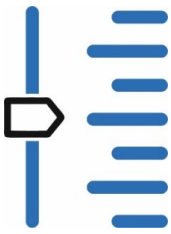
Set the warning level of the current drawn from the UNAP1 terminals in mA units. If the current drawn exceeds the set level, an error message is triggered, displayed on the unit's display and stored in the event table. A list of all error messages is given in chapter 2-5 Input - Diagnostics bits on p. 144.

A gradual increase in the current drawn by the connected sensors over time can signal in advance, for example, a sensor failure, moisture penetration into cable connections, etc.

The warning current level can be set from 0 to 500 mA with a resolution of 1 mA.

**Default setting:** 0,25 A

## 2-2-4 UNAP2 power



Parameters for control and self-diagnosis of the 2nd branch of the UNAP2 supply voltage.

For these parameters, everything listed in 2-2-3 "UNAP1 power ".

The set parameters of UNAP2 may differ from those of UNAP1. In terms of the operating time of a battery-powered instrument, it is advisable to leave one supply voltage permanently switched off for a small number of connected sensors of a similar type.

Sensors requiring higher supply voltage or longer delay after switching on should be powered from a different supply branch than the rest of the sensors.

**Default setting:** on

## 2-2-5 UOPTO power

Parameters for switching and self-diagnosis of UOPTO supply voltage.

The UOPTO power supply voltage can be used e.g. for powering OPTO sensors of pulse water meters and all other sensors and transducers that require continuous power supply for proper operation even in the unit's power saving mode, when the UNAP1 and UNAP2 power supply voltages are switched only briefly during the measurement period.

The UOPTO voltage value and the maximum possible current draw are set to 12 VDC / 500 mA from the hardware version of the HW: 410 unit onwards (approximately year of manufacture 2021). Older versions of the unit use a UOPTO voltage of 3.7 V / 50 mA.

The UOPTO power supply is only fully functional even if the external power supply fails when using an external 12 V backup battery.

### 5-1 Emable power [0/1]

Enabling the UOPTO supply voltage.

**Default setting:** off

### 5-2 Voltage [V]

Setting the delay for starting the measurement from the moment the UOPTO supply voltage is switched on. The delay is set in seconds with a resolution of 0.1 sec. The power-on delay can be set from 0 to 120 sec.

**Default setting:** 0 sec

### 5-3 Voltage alert threshold [V]

Setting the power supply warning level UOPTO voltage warning setting in units of V. When the supply voltage drops below the set level, an error message is triggered, displayed on the unit's display and stored in the event table. A list of all error messages is given in chapter 2-5 Input - Diagnostics bits on p. 144.

The warning voltage level can be set from 0.1 to 3.8 V DC with a resolution of 0.1 V.

**Default setting:** 10.0 V (from HW: 410 inclusive)

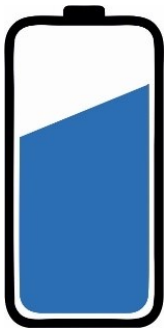
### 5-4 Current alert threshold [A]

Set the warning level of the current drawn from the UOPTO terminals in mA units with a resolution of up to 0.1 mA. If the current drawn exceeds the set level, an error message is triggered, displayed on the unit's display and stored in the event table. A list of all error messages is given in chapter 2-5 Input - Diagnostics bits on p. 144.

The warning current level can be set from 0.1 to 500 mA with a resolution of 0.1 mA.

**Default setting:** 0,01 A

## 2-2-6 Internal Li-Ion battery



This setting applies only to units with TB2 connection board and TB3that include a power backup Li-Ion battery 3.7V / 2600 mAh.

### 6-1 Battery test enable [0/1]

Enable continuous monitoring and calculations of the remaining capacity of the backup Li-Ion battery.

**Default setting:** On

### 6-2 Battery capacity threshold [%]

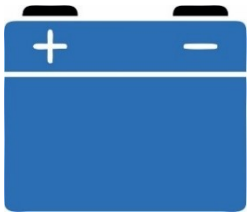
Setting the Li-Ion battery capacity at which the Li-Ion battery discharge signal will occur.

If the capacity of the Li-Ion backup battery drops below the set value, the display will show a symbol indicating low battery capacity. The warning battery capacity is set as a % compared to a fully charged battery (=100%). A drop in battery capacity below the set value activates an error message, which is displayed on the unit's display and stored in the event table. A list of all error messages is given in chapter 2-5 Input - Diagnostics bits on p. 144.

The warning level can be set from 10 to 100% with a resolution of 1%.

**Default setting:** 30%

## 2-2-7 External battery



Setting warning limits for voltage and current draw of the external 12 V / 7 to 100 Ah lead-acid battery.

### 7-1 AKU test enable [0/1]

Enable voltage and current measurement of the backup Pb battery.

**Default setting:** on

### 7-2 Alert while pwr under [V]

Set the minimum voltage magnitude at the +AKU (TA4) or EXT AKU (TB1 to TB3) terminals of the external battery. When the battery voltage drops below this limit, an error message is triggered, displayed on the unit's display, and stored in the event table. A list of all error messages is given in chapter 2-5 Input - Diagnostics bits on p. 144.

The warning voltage level can be set from 5 to 14 V DC with a resolution of 0.1 V.

**Default setting:** 11.8 V

### 7-3 Ignore while voltage above [V]

Setting the low voltage warning trip level at the terminals of the external battery +AKU (TA4) or EXT AKU (TB1 to TB3). When the set voltage level is reached, the previous warning message is deactivated and the power restoration message including the time stamp is saved in the event table.

The warning voltage level can be set from 5 to 14 V DC with a resolution of 0.1 V.

**Default setting:** 11.8 V

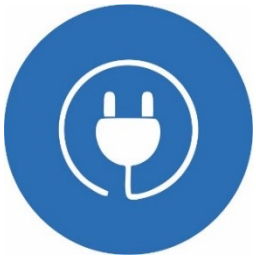
### 7-4 Current limit [A]

Setting the maximum amount of current drawn from the terminals of the external battery +AKU (TA4) or EXT AKU (TB1 to TB3) at which the warning message is activated. The current limit is set in mA with a resolution of 0,001 A.

The warning current level can be set from 0 to 5 A.

**Default setting:** 1,500 A

## 2-2-8 External power supply



### 8-1 Enable measurement [0/1]

Enables measurement and monitoring of the external power supply status at the +EXT terminals of the used connection board. A drop in the external power supply size below the set threshold size may, depending on the value of the parameter *1-2 Saving while no ext.power* parameter will cause the unit to enter power saving mode.

If no external power is supplied, set this parameter to Off.

**Default setting:** on

### 8-2 Alert while pwr under [V]

The value of this parameter determines the decision level when measuring the external supply voltage. If the external voltage drops below the set level, the display will show The symbol indicating an external power supply failure is displayed, a warning message is activated and the The warning message is stored in the event table external power failure including a time stamp.

The UExt voltage warning level can be set from 0 to 20 V DC with a resolution of 0.1 V.

**Default setting:** 11.5 V



### 8-3 Delay alert for [HH:MM:SS]

The length of this time parameter determines the delay for setting the external supply voltage failure flag. Thanks to this parameter, the station does not send warnings during short power failures. For the warning flag to be set, the mains power failure must last continuously for the set period of time.

This parameter is used to filter short power failures.

*Note: The active 4-20 mA current outputs IOU1 and IOU2 and the electronic relays RE3, RE4 on the connection boards TB2 and TB3 operated without an external lead-acid battery are powered directly from the external power supply, and therefore the proper operation of these current outputs and relays will be immediately interrupted upon failure of this external power supply.*

The UExt warning delay can be set from 0 sec to 16:40:00.

**Default setting:** 00:01:00

### 8-4 Hold on alert [HH:MM:SS]

This is similar to the previous parameter. The length of this time parameter determines the delay for dropping the external supply voltage failure flag. Thanks to this parameter, the station sends the external power failure notification only once even in case of several short repeated external power failures.

This parameter is used to filter short power refreshes.

The UExt warning extension can be set from 0 sec to 16:40:00.

**Default setting:** 00:01:00

### 8-5 Current limit [A]

The value of this parameter is the warning level of the current drawn from the external source. When the loaded current limit is exceeded, a warning message is activated and displayed on the unit's display and also stored in the event table. A list of all error messages is given in chapter 2-5 Input - Diagnostics bits on p. 144.

The UExt current limit can be set from 0 to 5 A with a resolution of 0,001 A.

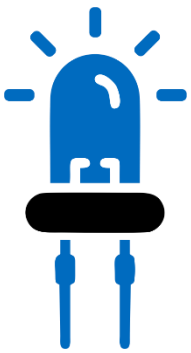
**Default setting:** 1.500 A

## 2-2-9 Brightness of status LED [%]

Setting of the intensity of the signal LEDs on the front panel of the unit from 0 to 100%. A lower percentage value extends the life of the power supply battery. A zero value turns off the signaling completely.

**Default setting:** 80%

## 2-2-10 Status LED mode



Set the mode of the indicator LEDs located on the front panel of the unit to the left of the display.

**Default setting:** continuous operation

### 10-1 Always on

Permanent operation of the pulse input indicator LEDs regardless of the set power mode.

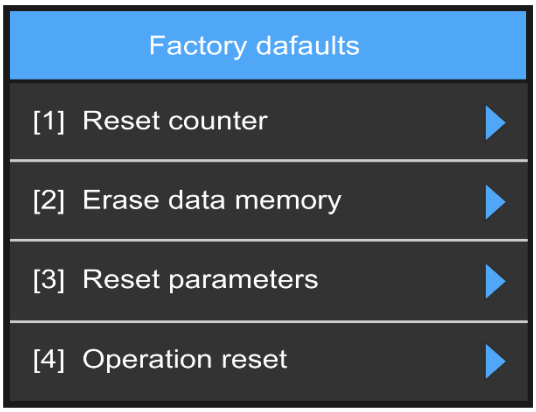
### 10-2 Low power

Saving mode Indicating LEDs of the pulse inputs. The indicating LEDs are switched off/on together with the display of the unit.




# 2-3 Factory default

The "Production Setup" submenu requires access with the highest privilege and allows you to initialize both the operating parameters of the instrument and clear the accumulated value counters and data memory, including archived values of analog ACH and binary BCH channels.






## 2-3-1 Reset counters

This option deletes all values of all counters (sums) in the data memory. The option is only available to users with the highest level of permissions

## 2-3-2 Erase data memory

This option deletes all data archived in the data memory, i.e. measurement records of all analog ACH and all binary BCH channels. The option is only available to users with the highest level of permissions

## 2-3-3 Reset parameters

This option sets all instrument parameters to the default values, including the unit ID. This option is only available to users with the highest level of permissions.

## 2-3-4 Operation reset

This option sets all parameters to their default values, including the unit ID. This option is only available to users with the highest level of permissions. [FW-CPU:1.18.44; FW-DISP: 4.1.25]

### 4-1 Clears data memory and totalizers

This option deletes all data archived in the data memory. This option is only available to users with the highest level of permissions

### 4-2 Clear operating hours

This option deletes all data archived in the data memory. This option is only available to users with the highest level of permissions

### 4-3 Setup install date

This option deletes all data archived in the data memory. This option is only available to users with the highest level of permissions

### 4-4 Operation reset!

This option deletes all data archived in the data memory. This option is only available to users with the highest level of permissions




# 2-4 Language

Language selection for all parameter names and descriptions, notifications and messages displayed on the instrument display. Some versions of the unit firmware may contain a limited number of language versions (English and Czech only).

## 2-4-1 english

Switching the device language to English.

## 2-4-2 čeština

Switching the language mutation of the device to Czech.

## 2-4-3 slovenčina

Switching the device language to Slovak.

## 2-4-4 deutsch

Switching the device language to German.






# 2-5 Date and time

Setting the real date and time of the device. Once set, the time can deviate from the real time by a maximum of 90 s/year. If the instrument is equipped with a communication module for transmitting the measured data to a server on the Internet, the time correction takes place automatically when communicating with the server. Switching between daylight saving time and standard time is automatic and can be disabled.

## 2-5-1 Date [YYYY/MM/DD]

Setting the current date.

## 2-5-2 Time [HH:MM:SS]

Setting the current time.

## 2-5-3 Time zone UTC

Time zone selection. This parameter sets the real time offset of the unit compared to UTC international time. For the Czech Republic, set the value of this parameter to [14] +1h.

**Default setting:** +1 hour

## 2-5-4 Autom daylight saving [0/1]

Enabling this will move all set times (binary outputs, data uploads, etc.) 60 minutes ahead of the time corresponding to the selected time zone during daylight saving time.

**Default setting:** on

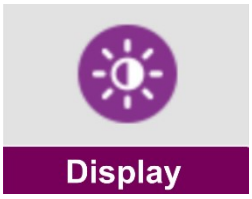
## 2-5-5 Midnight offset [HH:MM:SS]

This parameter advances the end of the day by the set interval after the actual midnight. At the end of the day, e.g. the evaluation of daily statistics (totals of flowing volumes, minima, maxima, etc.) is performed. All daily, monthly and yearly counters of the instrument will be controlled according to the setting of this parameter.

This parameter may find further use, for example, in monitoring and controlling shift operations. This parameter can be used to align the start of the day with the start of the respective work shift.

**Default setting:** 00:00:00

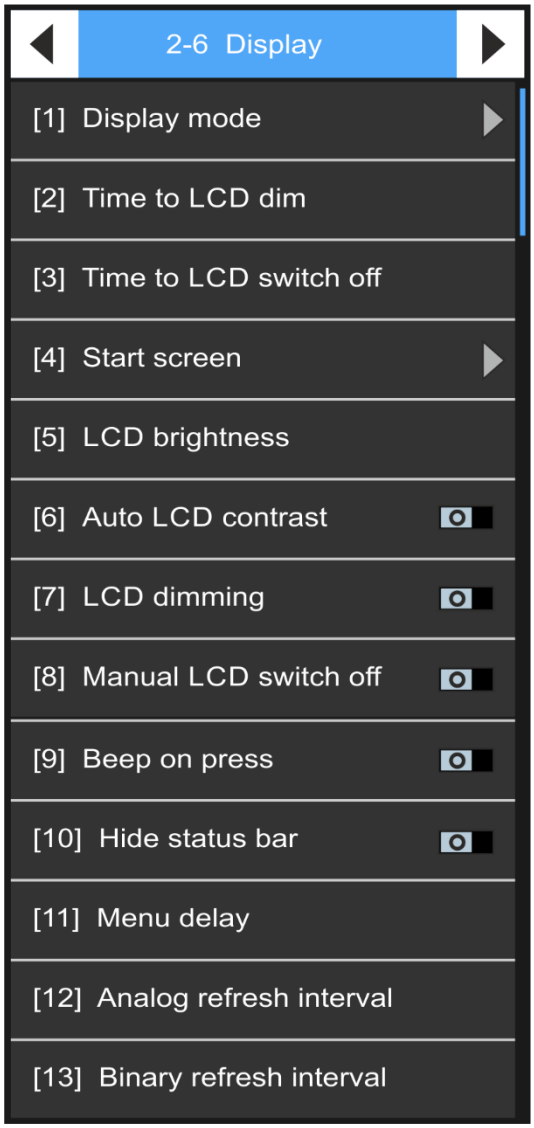





# 2-6 Display

Menu for setting the global H7 display parameters common to all configured analog ACH and binary BCH channels and counter and sum reports. This includes setting the time intervals for displaying individual screens in cyclic mode, controlling the intensity and backlighting of the display, as well as an option to turn the unit's keyboard keypad audio off/on.

In addition to the parameters listed in this chapter, it is also possible to set more detailed parameters for individual analog ACH channels concerning the predominantly cyclical display of individual ACH channels. These parameters are listed in chap. *3-1-11 Display ACH, page.* 131.




## 2-6-1 Display mode

The choice of the display operating mode has a major impact on the total current consumption of the instrument and thus on the total operating time of the instrument powered only by an external lead-acid battery or an internal Li-Pol battery.

**Default setting:** permanently on



### 1-1 Always on

Operating mode suitable only for devices powered from a mains voltage source. A permanently switched on backlight with a high brightness value shortens the life of the power supply battery and the display itself.

### 1-2 Balanced

After the set time has elapsed 2-6-2 "Time to LCD dim [HH:MM:SS]" from the last key press or touch screen, the display brightness is reduced to minimum.

### 1-3 Low power

After the set time has elapsed 2-6-3 "Time to LCD switch off [HH:MM:SS]" from the last key press or touch screen press, the display will turn off.



## 2-6-2 Time to LCD dim [HH:MM:SS]

The time delay from the last time you pressed the keyboard or touched the display before the display enters reduced power mode. This parameter can only be set in the display modes "Reduced power" and "Power saving mode".

**Default setting:** 00:02:00

## 2-6-3 Time to LCD switch off [HH:MM:SS]

The time delay from the last time the keyboard was pressed or the display touched before the display power is turned off. This parameter can only be set in the "Power Saving Mode" display mode.

**Default setting:** 00:05:00

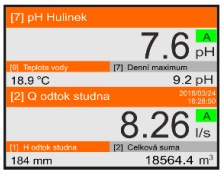
## 2-6-4 Start screen

Set the basic display of the measured data on the instrument display. The "Default Display" option offers the choice between a cyclical display of selected graphic and overview screens or a static display of one, two or four selected analogue channels.




Cycle mode







Static display: Single; Dual; Quad

### 4-1 Standby delay

In the cyclic mode of displaying individual screens of analog channel charts, counter overview screens and other variables, it is possible to temporarily stop the cyclic scrolling of the screens using the arrow keys (LEFT, RIGHT) or (UP, DOWN) and use the arrow keys to scroll through the individual graphic screens of the measured channels.

The amount of time the selected screen remains in static mode is determined by the value of this parameter.

The Display delay parameter can be set to 10 sec, 30 sec, 1 min, 5 min.

**Default setting:** 1 min

### 4-2 Standby mode

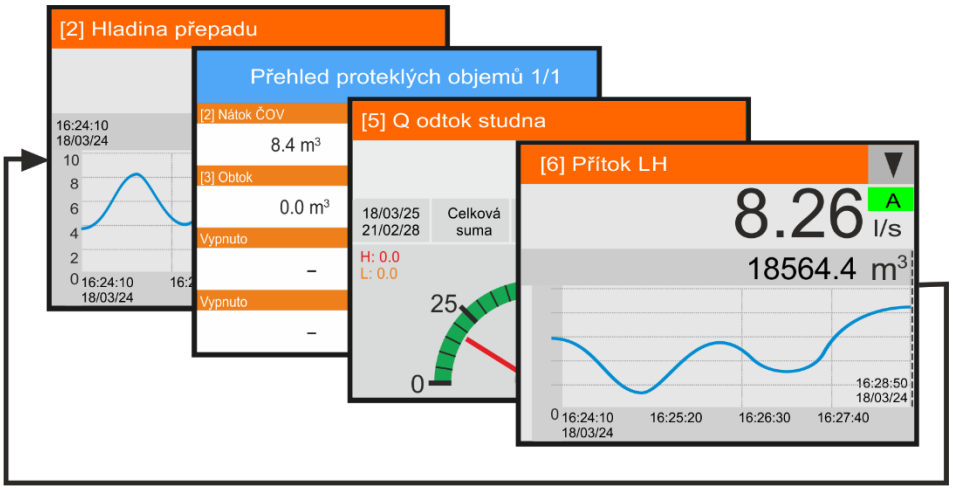
Set the default display type of the measured channels.

#### 1 Off

The display will not show any measured channel. When the instrument is turned on or the ESC knob is pressed, the main menu screen will be displayed.

#### 2 Cycle

Enable cyclic alternation of selected screens of measured channels. During cyclical zo-scrambling, only those channels that have zo-scrambling enabled in the analog channel settings menu are successively displayed ( 3-1-11 Display ACH, p. 131). The display of each ACH channel can be disabled, enabled, or enabled in this menu only when an alarm is triggered on that channel.




*Examples of displaying channels and summaries in Start screen->Cycle mode*

The display time of one screen on the device display is determined by the parameter 4-3 Cycle mode step [sec], page 118.

***Overview screens***

In the cyclic display mode, only the screens of the individual can be displayed in graphic or hand pointer form (parameter 11-5 Presentation mode, page 131).

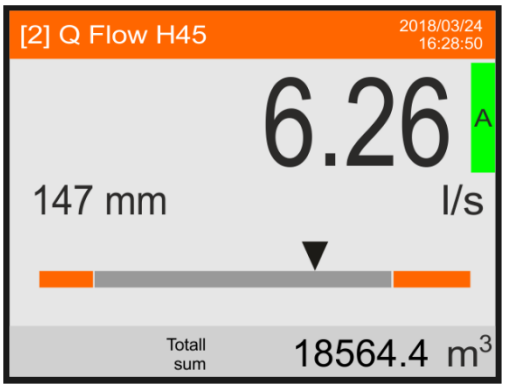
In Cyclic Display Mode, overview screens with the motor hours of selected binary channels or screens with the total leaked volumes (sums) of counter-enabled analog ACH channels can also be automatically included among the individual analog ACH channels displayed.

The display of the desired summary data screens must first be enabled by setting binary parameters 4-5 Flow volume overview [0/1] through 4-9 Other counter overview [0/1] on page 120.

**STATIC IMAGING MODES**

### 3 Single

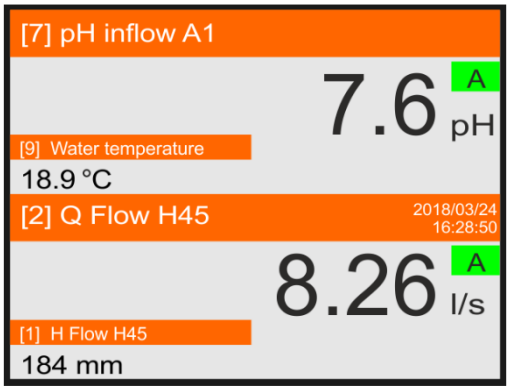
Cyclic display mode off. The display will permanently show the selected 1. Main channel accompanied by a simple bargraph. The value 1 can be displayed in a smaller font at the same time as the 1st Main Channel. Secondary channel (see Parameters 4-4 Standby setup, p. 119).




### 4 Dual

Cyclic display mode off. The halved display will continuously show the measured values of the 1st Main and 2nd Main channels.

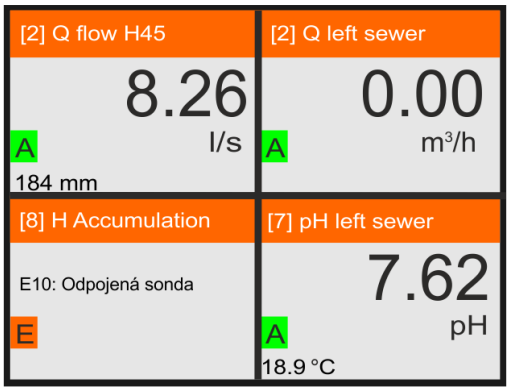
The values of the Secondary channels can be displayed in a smaller font at the same time as the Main channels (see Parameters 4-4 Standby setup, p. 119).




### 5 Quard

Cyclic display mode off. The quarter-split display will continuously display the measured values of Main Channel 1, 2, 3 and 4.

The values of the Secondary channels can be displayed in a smaller font at the same time as the Main channels (see Parameters 4-4 Standby setup, p. 119).




**Default setting:** Cycle

## 4-3 Cycle mode step [sec]

Setting the time period of alternating individual analogue channel screens and summary screens of summary values on the unit display in a cyclical or even static display. The period can be set in 1 sec increments from 2 to 20 sec.

**Default setting:** 3 sec

## 4-4 Standby setup

Option for assigning analog ACH channels to the unit's screens in static "Single", "Dual" or "Quad" menu Standby mode. Depending on the type of static screen, you need to specify 1 to 4 main ACH channels and possibly 1 to 4 secondary ACH channels.

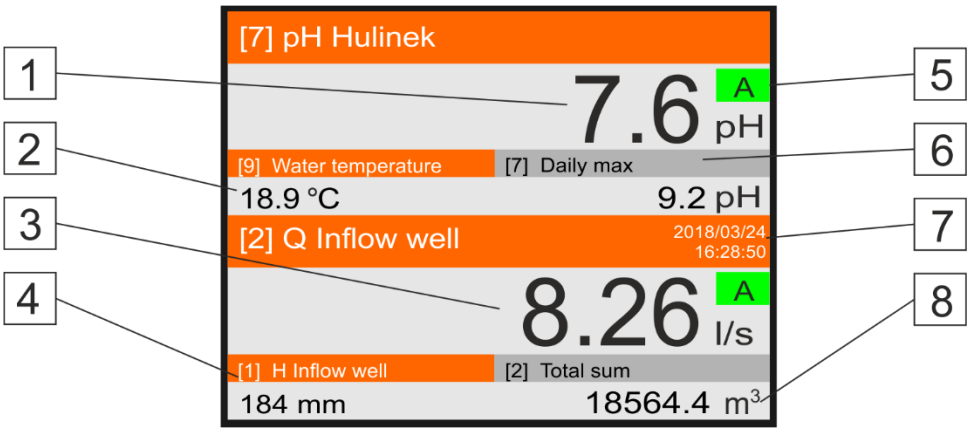
The main channel is dominant on the screen. The measured value of the main channel is displayed in a larger font than the measured value of the secondary channel, and in the case of the "Single Channel" screen, is supplemented by a simple bar graph (see top image on previous page)

Setting up this menu requires assigning selected analog ACH channels to these parameters:

1 1. main
2 1. minor
3 2. main
4 2. minor
5 3. main
6 3. minor
7 4. main
8 4. minor

The 1. main channel was assigned to the analogue channel ACH[7] with pH measurement and the water temperature channel ACH[9] was assigned to the 1. minor channel. Similarly, the channel showing the water flow through the measuring trough ACH[2] was assigned to the 2. main channel and the channel showing the water height in this trough ACH[1] was assigned to the 2. Minor adjacent channel.

In addition, there was a requirement to display the daily maximum of the 1. main channel (pH) and the total flow volume (sum) for the 2. main channel (Flow). These settings already fall within the para-meters of the individual ACH analog channels and are described in chap.




| | |
|---|---|
| 1 | 1. main channel (pH). Analog label in coloured bar, value in high font |
| 2 | 1. minor channel (temperature). Analog label and measured value in small font |
| 3 | 2. main channel (flow). Analog label in coloured bar, value in high font |
| 4 | 2. minor channel (level height). Analog label and measured value in small font |
| 5 | Channel status information: M =Manual, A =Auto, E =Error |
| 6 | Name of the selected additional value (state of the selected counter, max., ..) |
| 7 | Date and time corresponding to the event of the selected additional value |
| 8 | Counter status or limit values (max., min.) |

If a secondary channel is not assigned to any static screen, only the measured value of the main channel will be displayed on the screen.

***Restrictions***

The main and secondary channels must be from the same common group of 16 ACH channel serial numbers.
If the main channel is at position 5, then the secondary channel must be in the range 1-16.
If the main channel is at position 20, then the secondary channel must be in the range 17-32.

## DISPLAY OF OVERVIEW SCREENS

Use the following options to enable the display of selected types of overview screens in both cyclic and static display modes. One screen displays the ac-current daily counter status and another displays a selected sum of up to 4 analog ACH channels with the counter set. The total number of screens of one type of overview is determined by the number of set ACH channels in the unit (e.g., two overview screens 1/2 and 2/2 for 5 to 8 set ACH channels).

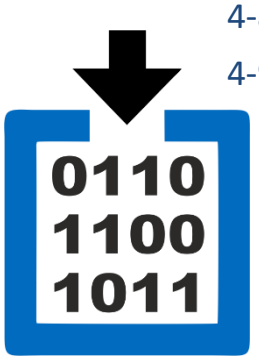
### 4-5 Flow volume overview [0/1]

### 4-6 Overview of operating hours [0/1]

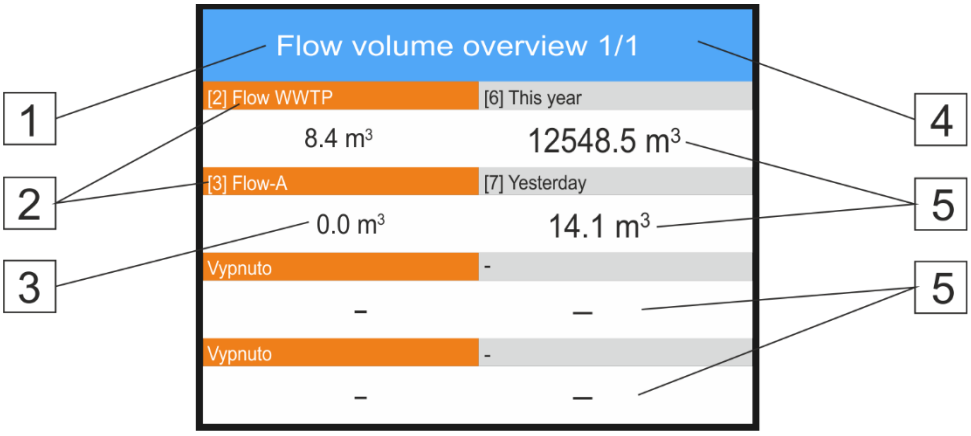
### 4-7 Energy overview [0/1]

### 4-8 Precipitation overview [0/1]

### 4-9 Other counter overview [0/1]



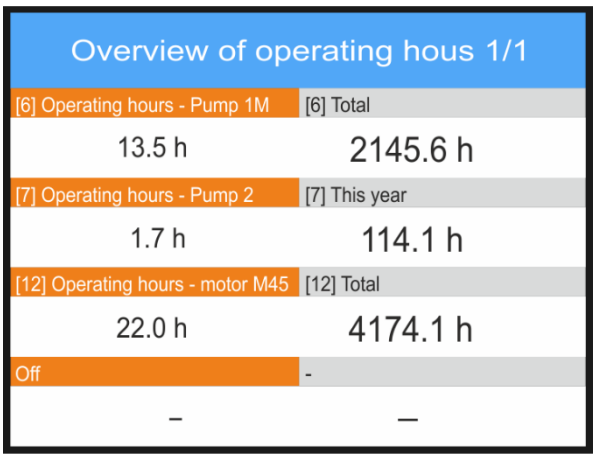

The most commonly used overview screen with leaked volumes is shown in the following figure. The screen contains leaked volumes for two analog ACH channels - one counter per channel at a time.




| | |
|---|---|
| 1 | Overview screen name and type |
| 2 | Analog labels of set ACH channels selected for counter status display |
| 3 | Daily counter value of the selected analog ACH channel |
| 4 | Designation of the sequence number of a single type lookup table |
| 5 | Selected counter value of the selected analog ACH channel |
| 6 | Reserve position for displaying selected counters of other ACH channels |

In order to display the status of the selected analog ACH channel counter in the corresponding overview screen, it is also necessary to select the appropriate display mode (3 Counter overview or 4 Chart + overview on page 132 on menu 11-5 Presentation mode).

The speed of alternation of individual overview screens in basic cyclic or static display mode is determined by the parameter 4-3 Cycle mode step [sec] on page 118.




*"Overview of operating hours" screen*

## 2-6-5 LCD brightness [%]

Display backlight intensity setting in the range of 10 .. 100%.

The parameter value can be changed in 10% increments. When the parameter is activated 2-6-6 "Auto LCD contrast [0/1]" is activated, this parameter becomes irrelevant.

**Default setting:** 80%

## 2-6-6 Auto LCD contrast [0/1]

Enable automatic control of the display brightness according to the ambient light intensity. When this parameter is enabled, automatic brightness control takes precedence over the fixed brightness value set by the 2-6-5 "LCD brightness [%]".

**Default setting:** on

## 2-6-7 LCD dimming [0/1]

If the display is in Power Saving mode or Reduced Power mode, you can enable Automatic Display Dimming. Automatic Display Dimming can alert the user to the impending shut-down of the display and trigger a response (key press, touch of the display) to continue working with the unit.

**Default setting:** off

## 2-6-8 Manual LCD switch off [0/1]

After enabling this parameter, the display can be turned off manually by holding down the ESC key.

**Default setting: on**

## 2-6-9 Beep on press [0/1]

This parameter turns off/on the sound signal accompanying the pressing of the membrane keyboard fretboard or the touch of the display button.

**Default setting:** off

## 2-6-10 Hide status bar [0/1]

Suppress the display of the status bar when an event or error condition occurs.

**Default setting:** off

## 2-6-11 Menu delay [sec]

The time delay in seconds from the last keyboard press or touch of the display after which the set menu will be popped up. After the set period of inactivity, the display will show the main menu screen.

The parameter can take values of 30 sec, 1 min, 5 min and 10 min.

**Default setting:** 5 min

## 2-6-12 Analog refresh interval [sec]

Setting the binary channel data refresh interval on the station display

The size of this parameter affects the refresh rate of the displayed measured values of the graphic and static screens of the analogue channels.

The parameter can take the values listed in the following table, in which besides the set refresh interval there is also the corresponding time period reserved for the graphical representation of the measured waveform. As the refresh period is extended, the time period

of the displayed graph is extended, because the full graphic screen always contains the same number of the last 280 displayed values.

If the set sampling interval is shorter than the data storing interval, each archived value of the measurand will be displayed in the chart.

*Dependency between the set data refresh period and the time length of the ACH chart*

| Analog value recovery [sec] | 1 sec | 2 sec | 3 sec | 5 sec | 10 sec |
|---|---|---|---|---|---|
| Time length of the chart [mm:ss] | 04:40 | 09:20 | 14:00 | 23:20 | 46:40 |

**Default setting:** 1 sec

## 2-6-13 Binary refresh interval [sec]

Setting the binary channel data refresh interval on the station display

The size of the parameter affects both the refresh rate of the displayed binary channel values and the time length of the chart on the binary screen.

The parameter can take the values listed in the following table, in which besides the set refresh interval there is also the corresponding time period reserved for the graphical representation of the measured waveform. As the refresh period is extended, the time period of the displayed chart is extended, because the full graphic screen always contains the same number of the last 140 displayed values.

If the set sampling interval is shorter than the data storing interval, each archived value of the measured variable will be displayed in the chart.

*Dependency between the set data refresh period and the time length of the BCH chart*

| Analog value recovery [sec] | 1 sec | 2 sec | 3 sec | 5 sec | 10 sec |
|---|---|---|---|---|---|
| Time length of the chart [mm:ss] | 02:20 | 04:40 | 07:00 | 11:40 | 23:20 |

**Default setting: 1 sec**

***Setting ACH display parameters***

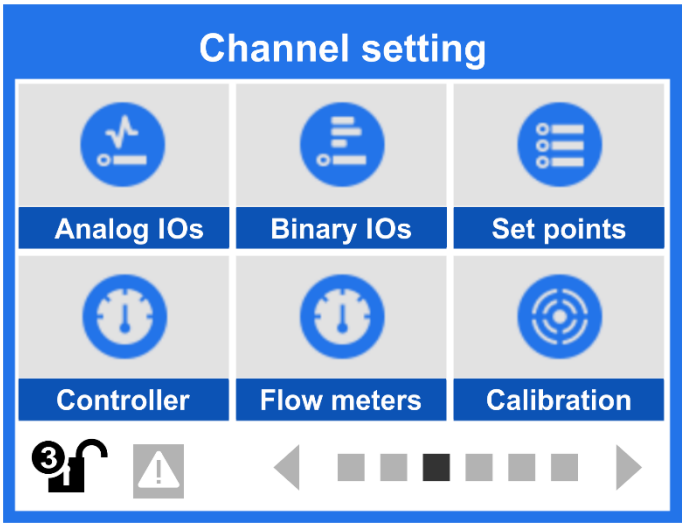
**Example 1.**

*The analogue channel ACH1 measures and records the level, ACH2 the instantaneous flow rate and the leaked volume. Set the instrument display to permanently display a bargraph of instantaneous flow with information about the level and monthly leaked volume.*

***Menu: General settings***

**Set:**

- ***Display -> Display mode:*** *Always on*
- ***Display -> Start screen -> Standby mode:*** *single channel*
- ***Display -> Start screen -> Standby setup -> 1. main:*** *2*
- ***Display -> Start Screen -> Standby setup -> 1. minor:*** *1*




## 11.4. Channel settings

This extensive chapter is devoted to the description of individual parameters important for the correct setting of analog ACH and binary BCH channels. Separate chapters are devoted to setting the operating Set point parameters of SP, PID controllers and up to four flow meters. The last part of the chapter is devoted to the calibration of connected probes and sensors.

# ACH settings




## 3-1 Analog IOs

Parameters for setting the selected analog ACH channel to measure the desired physical quantity. In the first step, you need to select the input/output channel number from the ACH channel menu and then set the parameters relevant for the measurement of the desired physical quantity.

For easier understanding of the individual parameters and their settings, the table of measurement methods contains a reference to typical, frequently repeated ACH settings for level, temperature, precipitation, pH.

### 3-1-1 Quantity

Unit H7 contains a list of forty predefined physical quantities. This list, called "Measured Value", is the first choice when setting up any analog ACH channel.

The selection of a specific physical quantity determines the subsequent menu of units of measurement, which are selected in the menu 3-1-3 Units on p. 125.

If the required physical quantity is not included in the "Measured quantity" list, the user has the option to select the "17. Optional" option and then select an existing unit of measure for it, or define the unit of measure himself using the parameters 2-1-13 Custom units [U1] or 2-1-14 Custom units [U2].

***List of predefined physical quantities and their units of measurement:***

| | | |
|---|---|---|
| 1. | Off | |
| 2. | Flow | [l/s; hl/s; $m^3$ /s; l/h; hl/h; $m^3$ /h; l/min; GPS; GPM, IGPS] |
| 3. | Level height | [m; dm; cm; mm; µm; in; ft.] |
| 4. | Volume | [m3; hl; dl; l; ml; cl; gal.; igal.] |
| 5. | Temperature | [°C; K; °F] |
| 6. | Humidity | [$g/m^3$; g/kg; %; ppm] |
| 7. | pH | [pH] |
| 8. | Redox potential | [mV] |
| 9. | Dissolved oxygen | [%; ppm; mg/l] |
| 10. | Conductivity | [S; mS; µS; 1/Ω] |
| 11. | Pressure | [Pa; kPa; hPa; MPa; Atm; Bar; $N/m^2$] |
| 12. | Rainfall | [mm] |
| 13. | Current | [A; mA; µA] |
| 14. | Voltage | [V; mV; µV] |
| 15. | Frequency | [Hz; kHz; MHz] |
| 16. | Pulses | [-; pulse] |
| 17. | Optional | list of all units of measure in the instrument |
| 18. | Binary state | [-] |
| 19. | Speed | [m/s; km/h] |
| 20. | Angle of rotation | [°; rad] |
| 21. | Solar radiation | [$W/m^2$; $mW/m^2$] |
| 22. | Rainfall intensity | [mm/h] |
| 23. | Power | [W; mW; kW; MW; VA; kVA; MVA; J/s; hp] |
| 24. | Energy | [Wh; kWh; MWh; J; kJ; MJ; cal; kcal] |
| 25. | Time / Period | [ms; s; min; h; h:m:s; d:h:m:s; d:h:m] |
| 26. | Contents / Area | [$m^2$; $dm^2$; $cm^2$; $mm^2$] |
| 27. | Weight | [kg; dkg; g; mg; q; t] |
| 28. | Mass flow rate | [kg/s; kg/min; kg/h; g/s; g/min; g/h] |
| 29. | The Power of | [N; kN; $kg*m/s^2$] |
| 30. | Water turbidity | [NTU; ZF] |
| 31. | Water hardness | [°F; °dH] |
| 32. | Alkalinity | [mmol/l mol/l] |
| 33. | Substance quantity | [mol mmol] |
| 34. | Impedance | [Ω; mΩ; kΩ; MΩ; V/A] |
| 35. | Inductance | [µH; mH; H] |
| 36. | Capacity | [µF; mF; F] |
| 37. | Luminous flux | [lm; mlm] |
| 38. | Illuminance | [lx; mlx] |
| 39. | Luminosity | [cd; mcd] |
| 40. | Density | [$kg/m^3$; $mg/m^3$] |
| 41. | Angular velocity | [1/s; rad/s] |

## 3-1-2 Analog label

The naming of the analog I/O ACH channel is displayed on the unit's display, appears in the text of the SMS message, and is transmitted along with the measured values to the PC and server for further processing.

The Analog label can contain up to 25 characters, including numbers and special characters. Switching between the alphanumeric keys is done in the bottom line of the screen.

## 3-1-3 Units

The submenu offers a list of predefined units of measurement based on the selected measurand. Some quantities, such as pressure, have a rich list of units in which the desired quantity can be measured, archived and displayed. Other quantities, such as pH, offer only one type of unit of measure.

Special units of measure that are not included in the predefined list of units can be predefined using the parameters 2-1-13 Custom units [U1] or 2-1-14 Custom units [U2].

## 3-1-4 Floating points

User adjustable Floating points in the range of 0 to 0.000.

Each unipolar measurand on the ACH channel can take on values in the range of 0 to 524288 integer units of measure, and this range decreases decadally as the number of decimal places increases. For example, when 0.000 (3 decimal places) is selected, the measurement range of the ACH channel decreases to 0 to 524,288 set units of measure.

Bipolar quantities, such as temperature or voltage, can take values from -524288 to +524288 and are subject to a similar reduction in measuring range when set to a non-zero number of decimal places as in the unipolar example above.

## 3-1-5 Measurement method

An important parameter of the H7 unit is called Measurement Method. The list of measurement methods includes all measurement and data acquisition options for the set input channel and the calculation type for the output channels.

From the list of measurement methods listed in the following table, select the method that is intended for the connected measuring probe or sensor. For example, when measuring the level in a VDJ with a submersible pressure transducer with a standard current output, the measurement method "Current 4...20 mA" should be selected. When measuring flow with a propeller water meter using an OPTO or REED sensor, the Measurement Method is "Pulse Counter", etc.

In the case of probes with RS485 digital output, it is necessary to select the measuring method and the appropriate communication protocol contained in the name of the measuring method after the slash. To make the selection of the measuring method for a particular application easier to understand, a link to an example of its typical use including the setting of other important parameters is also provided for each measuring method.

A list of examples is provided at the end of this manual, starting on page 233.

***Overview of measurement methods in examples***

| | Measurement method | Use | Example | |
|---|---|---|---|---|
| | | | Cap. | Str. |
| 1 | **Off *)** | Unset channel - disabling measurement, display and storing of the channel while maintaining the set par. | - | - |
| 2 | **Custom channel** | Calculation of the current channel value based on the current values of other channels | 6 | 239 |
| 3 | **Flow meter** | Measurement of flow in the open profile using the consumption equation or the Q/h table (max. 4 flow meters) | 4 | 236 |

| | | | | |
|---|---|---|---|---|
| 4 | **Remote input** | ACH channel value setting via SMS or GSM data communication | 26 | 261 |
| 5 | **Probe DCL / ASCII-U** | Level measurement with USX200 series ultrasonic transducers | 18 | 254 |
| 6 | **Probe DCL / ASCII-S** | Level measurement with the US3000 ultrasonic transducer | 18 | 254 |
| 9 | **Internal sensors** | Measurement of internal sensors of the instrument operating conditions (self-diagnostics). | 9 | 243 |
| 10 | **Binary channel** | Tracking motor hours, engine run times or fault duration | 25 | 260 |
| 11 | **Custom functions** | Calculation of the current channel value based on archived source channel data or mathematical operations | 8 | 242 |
| 12 | **Regulator** | PID controller output (parameters of max 4 controllers can be set) | 6 | 239 |
| 13 | **Pulse counter** | Measurement of instantaneous flow rate and leaked volume by reading pulses from a water meter, measurement of rainfall by a boat rain gauge, ... | 5 | 237 |
| 14 | **Voltage 0...2.50 V** | Unipolar Voltage Measurement | 2 | 234 |
| 15 | **Voltage 0...1.25 V** | Unipolar Voltage Measurement | 2 | 234 |
| 16 | **Voltage 0...600 mV** | Unipolar Voltage Measurement | 2 | 234 |
| 17 | **Voltage 0...300 mV** | Unipolar Voltage Measurement | 2 | 234 |
| 18 | **Voltage 0...150 mV** | Unipolar Voltage Measurement | 2 | 234 |
| 19 | **Voltage 0...80 mV** | Unipolar Voltage Measurement | 2 | 234 |
| 20 | **Voltage 0...40 mV** | Unipolar Voltage Measurement | 2 | 234 |
| 21 | **Voltage 0...20 mV** | Unipolar Voltage Measurement | 2 | 234 |
| 22 | **Voltage -2.50 V... +2.50 V** | Bipolar Voltage Measurement | 2 | 234 |
| 23 | **Voltage -1.25 V... +1.25 V** | Bipolar voltage measurement | 2 | 234 |
| 24 | **Voltage -600mV..+600 mV** | Bipolar voltage measurement | 2 | 234 |
| 25 | **Voltage -300mV..+300 mV** | Bipolar voltage measurement | 2 | 234 |
| 26 | **Voltage -150mV..+150 mV** | Bipolar Voltage Measurement | 2 | 234 |
| 27 | **Voltage -80 mV...+80 mV** | Bipolar Voltage Measurement | 2 | 234 |
| 28 | **Voltage -40 mV...+40 mV** | Bipolar voltage measurement | 2 | 234 |
| 29 | **Voltage -20 mV...+20 mV** | Bipolar voltage measurement | 2 | 234 |
| 30 | **Voltage 0...1 V** | Unipolar Voltage Measurement | 2 | 234 |
| 31 | **Voltage 0...2 V** | Unipolar Voltage Measurement | 2 | 234 |
| 32 | **Battery voltage** | Measuring the volt. of the power batt. | 3 | 235 |
| 33 | **Current 0...20 mA** | Current measurement at AIN inputs | 1 | 233 |
| 34 | **Current 4...20 mA** | Current measurement at AIN inputs | 1 | 233 |
| 35 | **Current 0...24 mA** | Current measurement at AIN inputs | 1 | 233 |
| 36 | **Current 4...24 mA** | Current measurement at AIN inputs | 1 | 233 |
| 37 | **Current 0...50 mA** | Current measurement at AIN inputs | 1 | 233 |
| 38 | **Current 0...1 mA** | Current measurement at AIN inputs | 1 | 233 |

| | | | | |
|---|---|---|---|---|
| 39 | **Current 1...5 mA** | Current measurement at AIN inputs | 1 | 233 |
| 40 | **Current 0...5 mA** | Current measurement at AIN inputs | 1 | 233 |
| 41 | **Probe RS485 / FINET** | Data acquisition from sensor connected via RS485 under FINET protocol | 10 | 244 |
| 42 | **Probe RS485 / MODBUS** | Data acquisition from a sensor connected via RS485 under MODBUS RTU | 11 | 245 |
| 43 | **Probe SDI-12** | Data acquisition from a sensor connected via SDI-12 interface | 17 | 253 |
| 44 | **Probe RS485 / HART** | Data acquisition from a sensor connected via RS485 under HART protocol | 12 | 248 |
| 45 | **Probe RS485 / PONSEL** | Data acquisition from a sensor connected under the PONSEL protocol | 15 | 250 |
| 46 | **Probe RS485 / CHEMITEC** | Data acquisition from sensor connected via RS485 under ESKO12 prot. | 14 | 250 |
| 47 | **Probe RS485 / KDO** | The method is not included in the H7 | | |
| 48 | **Sampler ISCO21xx** | Data acquisition from an ISCO sampler connected via RS485 | | |
| 49 | **Peripheral input** | Data acquisition from devices connected via RS485 under MODBUS RTU | 16 | 251 |
| 50 | **MBUS** | Data acquisition from sensors connected via M-BUS/RS485 converter | 13 | 249 |
| 51 | **Probe RS485 / Hydreka DVP** | The method is not included in the H7 unit | | |
| 52 | **Output RS485 / FINET** | Control channel for transferring the value to the external output module under the FINET protocol. | 22 | 257 |
| 53 | **Output RS485 / MODBUS** | Control channel for transferring the value to the external output module under MODBUS RTU protocol. | 24 | 259 |
| 54 | **Output RS485 / MAV** | Control channel for the 4-20 mA analog output function of the MAV421 (MAV422) external module in percent. | 22 | 257 |
| 55 | **Current output 4-20 mA** | Control channel for the 4-20 mA analog output function on the connection board as a percentage of the specified range | 23 | 258 |
| 56 | **Current output 0-20 mA** | Similar to the previous measur. method | 23 | 258 |
| 57 | **Current output 0-24 mA** | Similar to the previous measur. method | 23 | 258 |

**) The first measurement method "Off" can be used to switch off a temporarily unused analogue channel while maintaining all its other settings (for example, when disconnecting a non-functioning sensor from the unit).*

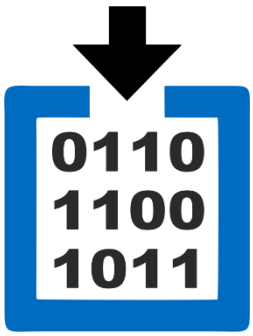
## 3-1-6 Bipolar [0/1]

Selection of the type of the measured variable: bipolar [0]; or unipolar [1]. A typical bipolar quantity is temperature and a unipolar quantity is level.

The unipolar quantity can only take positive values in the range 0 to 524288 (=$2^{19}$) units of measure, the bipolar quantity can also take negative values in the range -524288 .. +524288 units of measure.

The scaling range of the ACH channel being set decreases decadically as the number of decimal places increases (see parameter description 3-1-4 Floating points on page 125).

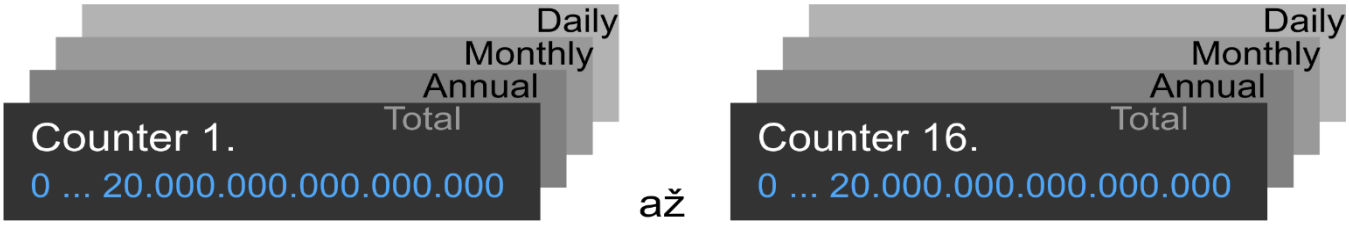
## 3-1-7 Counter [0/1]




The counters are used to calculate the volume of integral quantities such as the amount of leaked water, gas, electricity or the sum of rainfall or the energy of incident solar radiation. A counter is always assigned to a specific analogue channel. If the "Counter" option is enabled, a menu for setting the counter parameters becomes available.

Unit type H7 allows to set the Counter function for the first 64 analogue channels. Other types of units have a lower number of counters. The term counter includes 4 sub-counters that separately record daily, monthly, annual and total volume since the unit was installed and one rainfall counter.

The maximum capacity of each counter is 9,000,000,000,000,000,000,000 units of measure. This maximum range decreases decade by decade as the number of decimal places increases (see parameter 8-2 Decimal points in the following text).




## 3-1-8 Counter - set

This option is available only after the counter has been enabled (previous parameter 3-1-7 Counter [0/1]).

### 8-1 Units counter

Selection of preset units of measure. Usually $m^3$ is selected for flow measurement and mm for precipitation measurement.

### 8-2 Decimal points

Set the number of decimal places for displaying counter values in the selected units of measure. The option allows you to set 0 to 3 decimal places. The total counter range decreases decade by decade as the number of decimal places increases. Due to the huge capacity of the counters (9,000,000,000,000,000,000 units of measure), 3 decimal places are usually set to increase the counter resolution even at low flow rates.

### 8-3 Setup counters

This option is only available to users with the highest access permissions.

#### 1 Total counter setup

Setting the counter value from the installation of the device. The set counter value is saved after the last option "Write changed values" is selected.

#### 2 Year counter setup

Set the counter value for the current year.

#### 3 Month counter setup

Set the counter value for the current month.

#### 4 Day counter setup

Set the counter value for the current day.

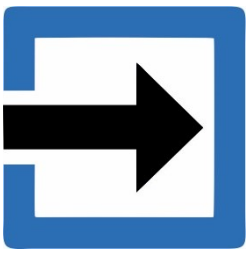
#### 5 Reset all counters

Resets the states of all counters of a given channel. As with the previous options in this submenu, resetting the counters of a given channel is done after the last option "Write changed values" is selected.

#### 6 Write changed values !

The option saves the newly set counter values of the channel to the device memory.

## 3-1-9 Inputs



This submenu contains several options for setting the communication address or the input or output number on the instrument connection board or external I/O module.

### 9-1 Interface

Selection of the communication interface type for those measurement methods that use a digital communication protocol. The submenu lists these communication interfaces:

1 Off
Option for all measurement methods that do not use any communication protocol (voltage and current input signals, pulses, ...).

2 RS485-1

3 RS485-2
Selection of the RS485-I or RS485-II serial communication bus for data acquisition from instruments and probes using measurement methods that have RS485 in their name (RS485 / FINET probe, RS485 / MODBUS probe, ...).

4 SDI12
Option for SDI-12 measuring method.

5 Radio 1
6 DCL_RX
7 INT_UART_1
8 INT_UART_2
9 EXT_UART_1
10 EXT_UART_2
11 EXT_UART_3
12 EXT_UART_4

Options 5 to 12 are not used and form a reserve for future FW expansion of the device.

**Default setting:** off

### 9-2 Interface advanced

The meaning of this parameter takes many different forms depending on which digital measurement method is chosen. The detailed setting of the "Interface advanced" parameter is given in the description of the Measurement Method. If the setting is not specified in the description of the Measuring Method, or if it is an analog or pulse Measuring Method, then set the value of this parameter = 0.

**Default setting:** 0

### 9-3 Address -A

Setting the communication address of the connected probe or sensor. An overview table of communication addresses of frequently used probes and sensors is given in chapter 6.5.2 Overview table of frequently used sensors and probes 43.

This parameter has a different meaning when using measurement methods that use an internal software IO Module (chap. 4-4-2 IO Module on p. 210), where the *Address-A* parameter specifies the serial number 1 to 10 of the selected IO Module.

### 9-4 Input-A

AIN number of the input or output. Flowmeter serial number. The meaning depends on the measuring method used. If the input is not used, set to 0.

**Default setting:** 0

### 9-5 Input-B

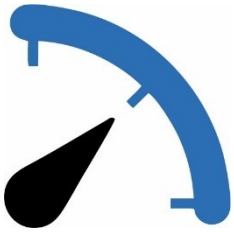
Number 2. input or output. The meaning depends on the measurement method used.

**Default setting:** 0

### 9-6 Input-C

Number 3. input or output. The meaning depends on the measurement method used.

## 3-1-10 Signal



The submenu contains options for modifying the input signal from the connected sensor or transducer.

### 10-1 Offset Delta*

The Offset Delta parameter is an additive coefficient designed for quick installation of those probes that measure level height or distance. The value of the coefficient is added to the measured value, and therefore the Delta can be used to compensate for the probe's height setting. The Delta parameter can take both positive and negative values. This parameter can be used to shift the zero level value. The additive coefficient A0 of the correction equation has a similar meaning (see below parameter 13-2 Coefficient A0*).

**Default setting:** 0

### 10-2 Signal amplification *

This parameter specifies the maximum value of the measured quantity at the maximum intensity of the measured signal for analogue measurement methods. The value of the parameter is set in selected units of measurement (previous parameter 0).

*Example: when measuring the level using a sensor with a range of 0 to 6 m water column and a current output of 4-20 mA, the value of the parameter Signal Gain = 6000 (mm units).*

**Default setting:** 1

### 10-3 Reversion [0/1]

When this binary parameter is enabled, the value of the measurand will decrease from the maximum value to zero as the input signal increases.

**Default setting:** off

### 10-4 Zero on error [0/1]

When this parameter is enabled, the zero value will be displayed on the instrument display and stored in the memory for the duration of the error condition of the measured variable (error condition for sensors with digital output, current < 4 mA for sensors with 4-20 mA output, broken communication cable, ...).

Disabling the parameter allows the corresponding error code to be displayed and stored in the instrument memory for the duration of the error condition of the measured variable. The list of error codes is given in the table on page 2. 273.

**Default setting:** off

***Level measurement with 4-20 mA sensor output***

**Example 2.**

*Set the analogue channel ACH1 to measure the level in the sump in metres with cm resolution. The 4-20 mA signal from the 0 to 4 m strain gauge level sensor is connected to the AIN4 input of the connection board.*

**Set ACH1:**

- ***Quantity:*** *level height*
- ***Analog label:*** *sump level*
- ***Units:*** *m*
- ***Floating points:*** *0.00*
- ***Measurement method:*** *Current 4.. 20 mA*
- ***Inputs -> Input-A:*** *4 (input AIN4)*
- ***Signal -> Signal amplification:*** *1*
- ***Signal -> Offset Delta:*** *0*



## 3-1-11 Display ACH

Set the conditions for displaying the measured value of the ACH channel being set on the display.

### 11-1 Display always [0/1]

Enabling this binary parameter puts the screen with the current analog channel value into the cyclic display mode of the instrument. The display of the channel value in static display mode is not affected by this parameter.

### 11-2 Display while alarm [0/1]

Enabling the binary parameter puts the channel value screen into the cycling mode of the instrument, provided that a limit or steep alarm has been triggered on the analog channel. The display of the channel value in static display mode is not affected by this parameter.

### 11-3 Display lower limit *

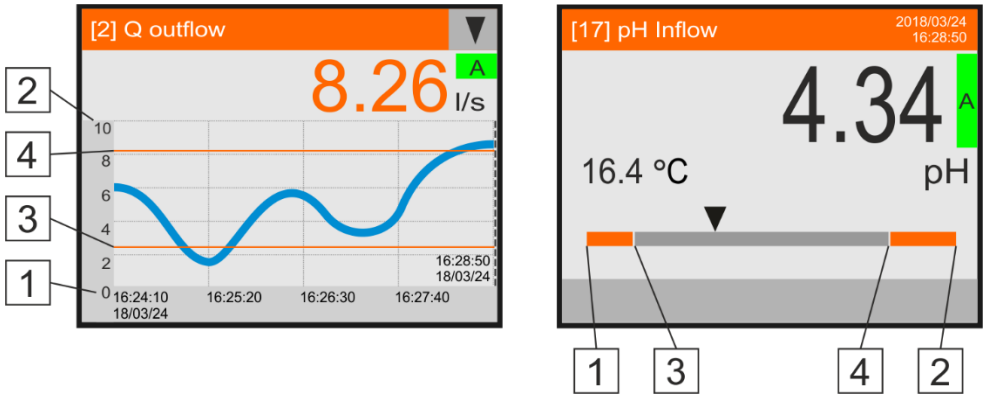
Set the minimum value on the vertical Y-axis of the graphic screen or the left edge of the static screen bargraph.

*Note: The value of this parameter (and some other parameters) can be set either numerically using the keyboard or it can be selected from a predefined list of Set point parameters. The second option is usually used when the unit is operated by a user with lower privileges, who is then usually not able to set the parameter to an inappropriate value.*

*Parameters that can be changed using predefined Set point parameters are marked with * in the following description.*

### 11-4 Display upper limit *

Set the maximum value on the vertical Y-axis of the graphic screen, the maximum value of the hand pointer or the right edge of the static "Sindle" screen bargraph.




| | |
|---|---|
| 1 | Parameter 11-3 Display lower limit * (page 131) |
| 2 | Parameter 11-4 Display upper limit |
| 3 | Parameter 14-2 Alarm lower limit* (page 140) |
| 4 | Parameter 14-3 Alarm upper limit* |

### 11-5 Presentation mode

Selecting this parameter determines how the analog channel being set will be displayed on the instrument's display.

**Default setting:** graphic display

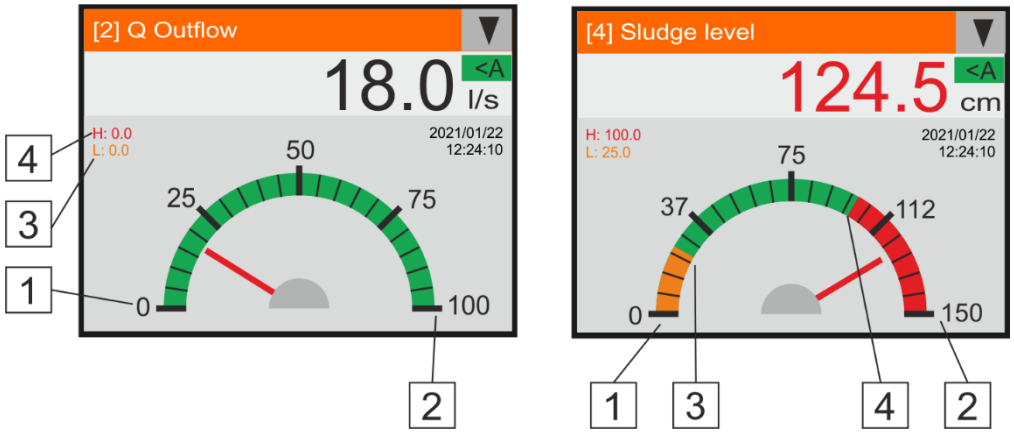
#### 1 Chart

Basic type of analog channel display with historical chart plotting.

The graphical representation of the analog channel is shown in the left screen of the previous figure.

## 2 Gauge

Alternate display mode allows a quick preview of the magnitude of the measurand in the set measuring range.




| | |
|---|---|
| 1 | Parameter 11-3 Display lower limit * (page 131) |
| 2 | Parameter 14-2 "Alarm lower limit*" |
| 3 | Parameter 14-3 "Alarm upper limit*" |
| 4 | Parameter 14-4 "Display upper limit" |

***Alarm display***

The left screen shows the needle pointer without alarm limit limits set, the right screen with alarm limit limits set and the measured value above the upper alarm limit.

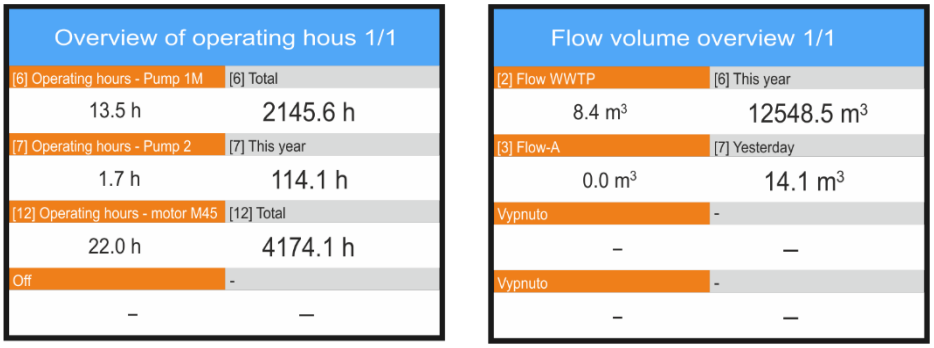
The occurrence of an alarm is indicated by a change in the colour of the digits of the measured variable, which changes from the black colour of the normal state to orange below the lower limit and to red above the upper limit for the duration of the alarm.

Setting the lower and upper alarm limits is described in 3-1-14 Alarms, p. 140.




## 3 Counter overview

Option to display the counter status of the ACH channel being set in the overview screen. To make the overview screen active, you must first enable its display with binary parameters 4-5 Flow volume overview [0/1 to 4-9 Other counter overview [0/1] on pg. 120.




## 4 Chart + overview

Option to display a graphical screen of the ACH channel being set and also an overview screen with the selected counter.

The type of report displayed (motor hours, leaked volumes, .... ) is automatically set according to the measurement type of the ACH channel variable.

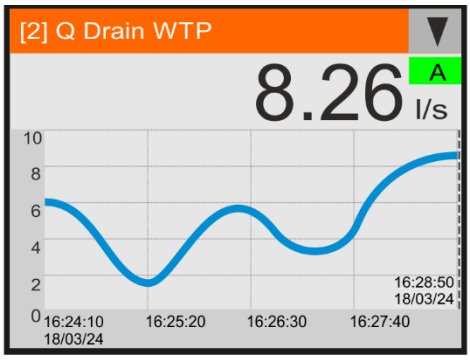
The permission to display the respective overview screen is determined by the parameters 4-5 Flow volume overview [0/1 to 4-9 Other counter overview [0/1] on p. 120.

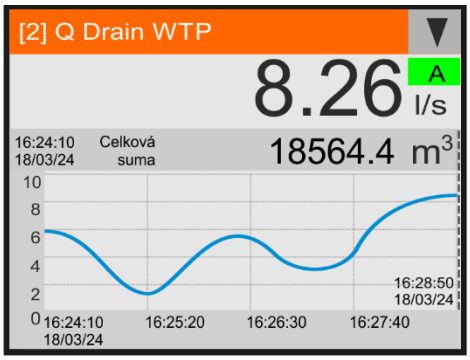
## 11-6 Display sum

Tato this option determines whether the status of one of the counters of this channel or the daily maximum or minimum of the measured hour-note will be displayed on the screen of the set channel. On the left of the pictures the mentioned parameter

*4-2 Standby mode:*
**Cycle**

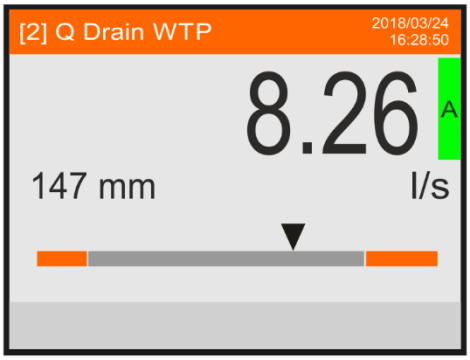
*11-5 Presentation mode:*
**Chart**

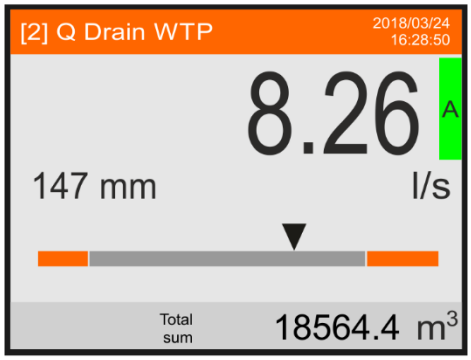



*4-2 Standby mode:*
**Single**

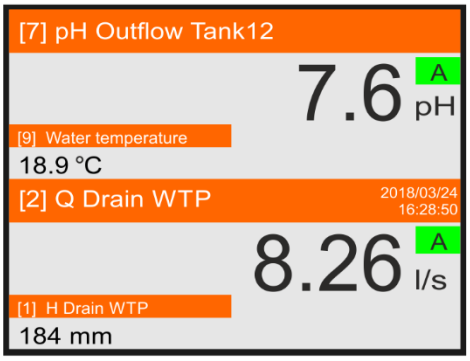
*11-5 Presentation mode:*
**Free**

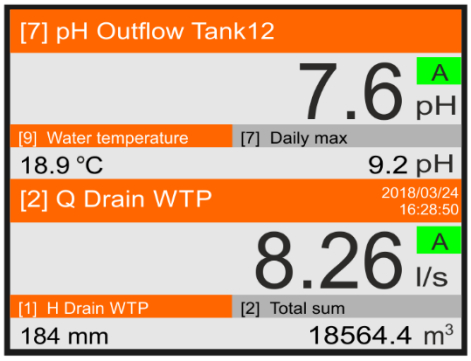



*4-2 Standby mode:*
**Dual**

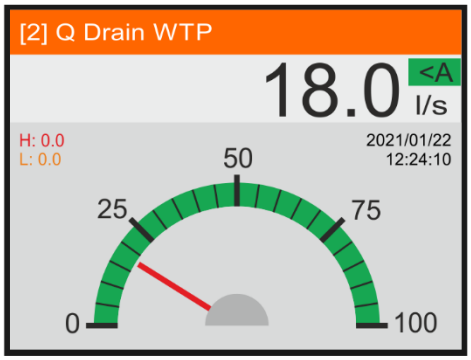
*11-5 Presentation mode:*
**Free**

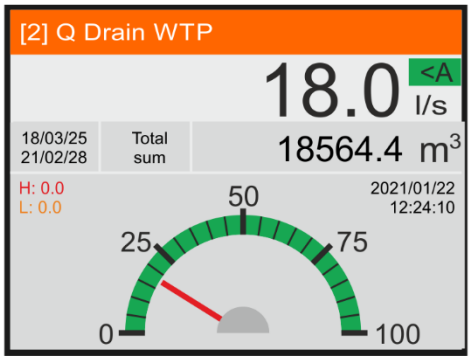



*4-2 Standby mode:*
**Cycle**

*11-5 Presentation mode:*
**Gauge**




***Screens without counter*** ***Screens with counter***

The end of the day, and therefore the start of the next day, can be changed with the parameter 2-5-5 Midnight offset [HH:MM:SS] on p. 115. This option can be used when displaying daily minimums, maximums or daily pro-flow volumes (totals).




1 Off
The analog channel screen will only contain the current measured value.

2 Day sum
The analog channel screen will be updated to display the current value of the daily sum counter. The start of the day for the sum calculation can be set differently from 00:00 (see parameter 2-5-5 Midnight offset [HH:MM:SS] on p. 115).

3 Month sum
The analogue channel screen will be supplemented by the display of the current month counter value.

4 Annual sum
The analogue channel screen will be supplemented by the display of the current year counter value.

5 Total sum
The analog channel screen will be supplemented by a counter value display showing the total volume flowed or measured rainfall since the meter was installed.

6 Day maximum
The analogue channel screen will be supplemented by a display of the maximum value of the measured variable reached on the current day.

7 Day minimum
The analogue channel screen will be supplemented by a display of the minimum value of the measured variable reached on the current day.

**Default setting:** off

## 11-7 Chart style



Menu for selecting the type of analog channel display in the graphical display. The type of chart is obvious from the name of each option of this parameter. The user can thus select the background color of the graphic display (white, black) and the type of chart.

1 White - line
2 White - bold line
3 White - filled dotted
4 White - filled
5 Black - line
6 Black - bold line
7 Black - filled dotted
8 Black - filled

## 11-8 Chart colour

Selecting the color for displaying the chart curve of the set analog channel in the graphical display.

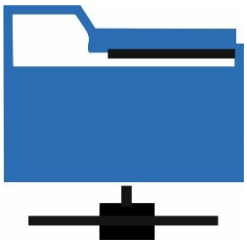
**1-Orange, 2-Brown, 3-Khaki green, 4-Bright green, 5-Light blue, 6-Light purple, 7-Light red, 8-Light grey, 9-Light blue, 10-Bright green, 11-Yellow, 12-Orange, 13-Light brown, 14-Dark orange, 15-Light purple, 16-Light red.**

## 11-9 Cooperative channel

Set the serial number of the Secondary Analog Channel to display its value on the Main Analog Channel graphic screen.

Typical application: display of the water level on the graphic screen of the flowmeter.

## 3-1-12 Storing



Setting the conditions for storing the measured values of the set channel.

Each analog channel has two separately configurable storing modes, which can have differently set storing intervals:

- **Regular storing** (record of the regular course of the measured variable**)**
- **Exceptional storing** (usually more frequent recording of incidents)

**The Regular storing** is intended for recording the measured value in a normal situation and when setting its storing interval, either one common interval for all analogue channels can be selected from the menu (parameter 2-1-3 Global measure interval [HH:MM:SS]), or select and set your own Regular storing Interval for each analog channel (parameter 12-2 Regular storing interval [HH:MM:SS]).

**Exceptional storting** is typically used to record more frequent recording of limit values and other interesting states of the measurand. The unit parameters allow you to set your own Exceptional storing interval for each analog channel for the Exceptional storing mode (parameter 12-4 Exceptional storing interval [HH:MM:SS]).

The transition from Regular storing to Exceptional storing can be triggered by a limit alarm (i.e. exceeding/underrunning the measured value above/below the set limits), a steep alarm (rapid increase or decrease of the measured value in time) and also by switching on a specified control binary channel. When the trigger condition of Exceptional storing is over, the unit automatically switches to the Regular storing mode

The real storing time is automatically calculated to coincide with the beginning of the minute, hour and day, if possible.

**Note:** In power saving mode (chap. 2-2-1 Power modeIn the power-operated mode, p. 108), no storing interval can be shorter than 1 min.

### 12-1 Regular storing

Submenu for enabling Regular storing of the measured value of the set channel into the instrument memory and for setting the storing interval.

#### 1 Off

The measured value of the channel to be set is only shown on the display (if this option is enabled by the parameter *11-1 "Display always [0/1]* " on p.131) and is not stored in the instrument memory.

#### 2 Global interval

Enables storing of the measured value of the channel being set at the time interval specified by the parameter *2-1-3 "Global measure interval* [HH:MM:SS]" parameter in the Identification section on p. 103.

#### 3 Regular interval

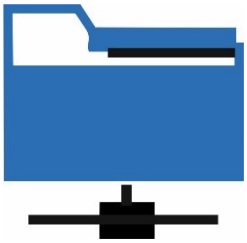
Enables storing of the measured value of the channel being set at the individual time interval specified by the parameter *12-2 Regular storing interval [HH:MM:SS]*.

Note: The value of the Regular storing Interval can be set for each analogue channel to a longer interval than the Global Interval (i.e. to measure and record less important variables such as battery voltage or slowly changing temperature), or to a smaller value = shorter time, so that a channel containing an interesting and rapidly changing variable is recorded more frequently).

#### 4 Bin. channel trigger

storing at the interval specified by the parameter 12-2 Regular storing interval [HH:MM:SS] is only for the duration of the BCH binary channel switching (parameter 12-5 Trigger channel for storing, page 136).

**Default setting:** global interval



## 12-2 Regular storing interval [HH:MM:SS]

Set the time interval for saving the measured data of the channel being set to the instrument memory in the mode *12-1 Regular storing*.

**Default setting:** 00:10:00

## 12-3 Exceptional storing

This is a conditional channel storing mode triggered, for example, by a bridge or limit alarm. Typically, Exceptional storing is used to record more frequently the incident that caused the alarm to be set.

### 1 Off

The Exceptional storing interval of the current channel is permanently inactive.

### 2 On

The Exceptional storing interval of the current channel is permanently active, i.e. it is the only valid storing interval of the channel being set. The Regular storing parameters are suppressed while this option is enabled.

### 3 Global alarm

Switch the storing interval of the current channel to the Exceptional storing interval for the duration of the global alarm.

### 4 Limit alarm

Switching the storing interval of the current channel to a Exceptional storing interval for the duration of the limit alarm of the currently set channel.

### 5 Gradient alarm

Switching the storing interval of the current channel to a Exceptional storing interval for the duration of the current channel's steep alarm.

### 6 Limit/Gradient alarm

Switching the storing interval of the current channel to a secondary interval for the duration of a limit or steep alarm of the current channel.

### 7 Bin. trigger

storing is performed when the binary channel is switched (parameter 12-5 Trigger channel for storing, page 136) and then periodically at the 12-4 Exceptional storing interval [HH:MM:SS], page 136.

**Default setting:** off

## 12-4 Exceptional storing interval [HH:MM:SS]

Set the Exceptional storing interval. The time interval of the Exceptional storing can be set from 1 sec to 24 hours (from 1 min in the economy mode). Each I/O channel can have its own "Exceptional storing interval [HH:MM:SS]".

**Default setting:** 00:10:00

## 12-5 Trigger channel for storing

The storing of the measured values of the ACH channel being set will only take place while the binary channel is triggered. The condition is the setting of the parameter 12-1 Regular storing or parameter 12-3 Exceptional storing to the option "Bin. trigger").

## 12-6 Aggregation before storing

This option sets the conditions for aggregating (= merging into one value) the measurement results at the end of the storing interval.

### 1 Average

The value of the calculated arithmetic mean of all measurements taken during the storing interval will be stored in the memory of the instrument

### 2 Last value

The last measured value will be saved and all previous measurements during the storing interval will be lost.

### 3 Max. value

The maximum measured value during the storing interval will be stored.

### 4 Min. value

The minimum measured value during the storing interval will be stored.

### 5 Samp count

The number of samples used for aggregation will be stored.

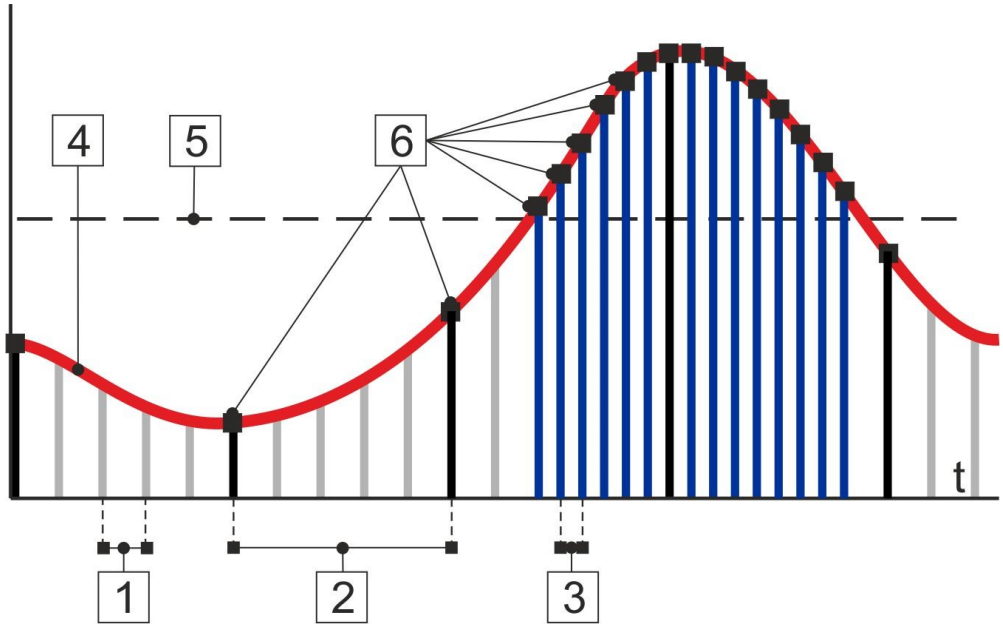
**Default setting:** Average

***Setting measurement and storing parameters ACH***

**Example 3.**

*Set the ACH2 analogue channel storing to wake the unit from power saving mode every 2 minutes and take a measurement. Every 10 minutes, it then stores (archives) the average of the previous measurements and, when the measured value exceeds the set limit value, it measures and archives the data at 1 min intervals for the duration of the alarm.*

*This example is illustrated in the image on this page. The vertical bars in the chart show the unit being switched on and the measurements being taken. The bars ending with a black square show the data storing.*




| | |
|---|---|
| 1 | Parameter 2-1-3 Global measure interval [HH:MM:SS] (2 min, grey column) |
| 2 | Parameter 12-2 Regular storing interval [HH:MM:SS] (10 min, black bar) |
| 3 | Parameter 12-4 Exceptional storing interval [HH:MM:SS] (1 min, blue column) |
| 4 | Measured value waveform of the analog channel being set |
| 5 | Parameter 14-3 Alarm upper limit* |
| 6 | Moments of data storing into memory |

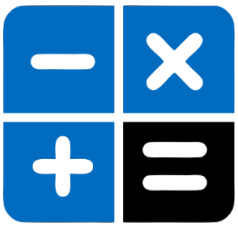
***Menu - General settings:***

- ***Identification -> Global measurement interval:*** *00:02:00*
- ***Power -> Power mode:*** *Saving always*

**Set ACH2:**

- ***Storing -> Regular storing:*** *Regular storing interval (Storing every 10th minute)*
- ***Storing -> Regular storing interval:*** *00:10:00*
- ***Storing -> Exceptional storing:*** *Limit alarm (Storing every 1st minute)*
- ***Storing -> Exceptional storing interval:*** *00:01:00*
- ***Storing -> Aggregation before storing:*** *Average*
- ***Alarms -> Alarm Limit:*** *1 (enabling the limit alarm of the channel being set)*
- ***Alarms -> Alarm upper limit:*** *50 (set limit value)*

## 3-1-13 Processing

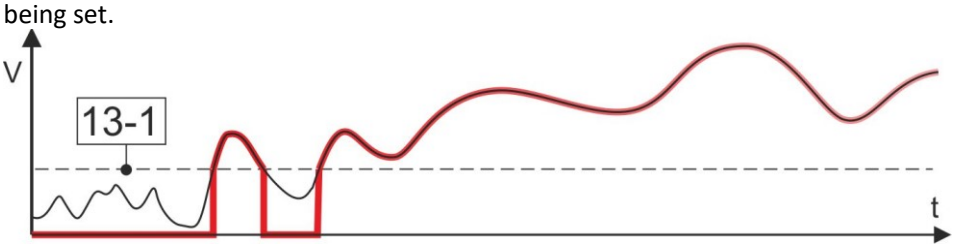


The coefficients A0, A1, A2 are related to the calculation and adjustment of the measured values. Except for the flow rate calculated from the surface, in all other cases these parameters can be viewed as coefficients of the 2nd order polynomial Y= A0+A1*X+A2*$X^2$ (preset form of the correction equation).

The value of the selected coefficient can be entered manually via the instrument's touch screen, or it can be set using the SP operating Set point parameter, whose value the coefficient will take.

### 13-1 Zero band

The size of the parameter determines the value of the zero (dead) band in which the input signal will be forcibly held at zero. The parameter value is set in units of the analog channel being set.




This parameter is used, for example, in the measurement of flow and leakage volume in an open channel by means of calculation via the consumption equation from the measured level, where even a small clogging of the measuring trough by sediments can cause, at zero flow and long-term exposure, a non-negligible false increase in leakage volume. The usual value of this parameter in these cases is usually set in the range of 5 mm to 15 mm.

### 13-2 Coefficient A0*

Additive coefficient A0 of the correction equation. The size of the coefficient can take negative values and is set in the units of the channel being adjusted.

**Default setting:** 0

### 13-3 Coefficient A1*

Multiplicative coefficient A1 of the correction equation.

**Default setting:** 1

### 13-4 Coefficient A2*

The second order multiplicative coefficient of the A2 correction equation. The default value of this dimensionless coefficient is 0.

This parameter is of special importance when one of the correction equations 6. to 13. intended for filtering the measured variable is selected in the following menu. These equations use the coefficient A2 as a reference value for whether the measurand should be replaced by the flag "Measurement error" or "Last valid value".

**Default setting:** 0

### 13-5 Correction function

This option contains both a menu of correction equations for adjusting the measured value of the analog channel and correction equations for filtering the measured value based on its comparison with the preset constant stored in parameter A2.

#### BASIC CORRECTION EQUATION

Basic preset correction equation for adjustment of the measured variable:

1 $A_0$ +$A_1$*X+$A_2$*X^2

This is a 2nd order polynomial equation: **$Y = A_0 + A_1*X + A_2*X^2$**, where Y is the calculated resultant measurand and X is the measured or read value of the input signal.

For the usual setting of the coefficients A0=0, A1=1 and A2=0, this first correction equation takes the form Y = X, i.e. no correction is performed.

### CORRECTION EQUATION USING THE VALUE OF THE CORRECTION CHANNEL

A more complex form of the correction equation is represented by items 2. to 5. of this menu, which contain, in addition to the coefficients A0, A1 and A2, the number of the analogue correction channel $ACH_{corr.}$ The instantaneous measured value of this correction channel enters the calculation of the resulting measured variable either linearly, exponentially or logarithmically, depending on the type of the selected correction equation.

2 $A_0 + A_1 * X * (1 + A_2 * ACH_{corr})$

3 $A_0 + A_1 * X + A_2 * ACH_{corr}$

4 $A_0 + A_1 * X * ACH_{corr} \wedge A_2$

5 $A_0 + A_1 * X * \exp(A_2 * ACH_{corr})$

The ACH analog correction channel $number_{corr}$ is set using the parameter 13-6 Correction channel ACHcorr on pg. 139.

The use of correction equations 2 to 5 is for example in calculations of temperature correction of the output signal of some types of sensors, where $ACH_{corr}$ determines the number of the channel measuring the required temperature for correction.

### CORRECTION EQUATION FOR FILTRATION

In addition to the adjustment of the final value of the measured variable, the other items of this menu (correction equations 6 to 13) can also be used for possible filtering of over- or under-limit measurements to ensure that extreme fluctuations of the measured variable do not get into the set of measured and archived values in the unit.

***Identical ACH and ACHcorr channels***

For such a function of the correction equations, the same number as the currently evaluated corrected channel is selected as the correction channel of the $ACH_{corr}$ (the corrected and correction channel are identical). In this case, the unit first precomputes the resulting value of the linear equation $\mathbf{A_0 + A_1 * X}$ and then compares this value with the value of the coefficient A2. If there is an overstep, understep, equality or inequality of this comparison, the current measured value will be replaced by either an error flag or the last valid measured value based on the selected correction equation.

In special cases, the $ACH_{corr}$ correction channel may be different from the corrected channel. Again, the A2 coefficient of the corrected channel is compared with the value of the correction channel $ACH_{corr}$ .

***Flag Error 23***

Correction equations 6. to 9. allow, in the case of failure to meet the condition specified in the name of the correction equation, to replace the current measured value $\mathbf{A_0} + A_1 * X$ with the error flag Err:23 (exceeding the limits of the digital filter).

6 IF(ACHcorr> A2; A0+A1*X; Err23)

7 IF(ACHcorr< A2; A0+A1*X; Err23)

8 IF(ACHcorr<>A2; A0+A1*X; Err23)

9 IF(ACHcorr==A2; A0+A1*X; Err23)

***Last valid value***

Correction equations 10 to 13 allow, in case of failure to meet the condition specified in the name of the correction equation, to replace the current value with the last measured valid value.

10 IF(ACHcorr> A2; A0+A1*X; LAST)

11 IF(ACHcorr< A2; A0+A1*X; LAST)

12 IF(ACHcorr<>A2; A0+A1*X; LAST)

13 IF(ACHcorr==A2; A0+A1*X; LAST)

**Default setting: $A_0 + A_1 * X + A_2 * X^2$**

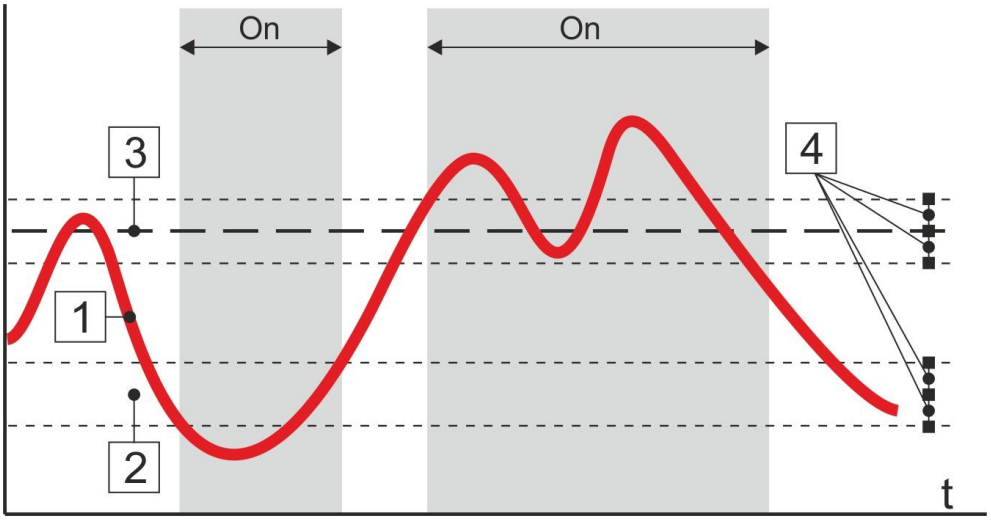
## 13-6 Correction channel ACHcorr

This parameter represents the analog correction channel number $ACH_{corr}$ , the value of which will enter correction equations 2 to 13. The size of this parameter $ACH_{corr}$ can therefore only take integer values in the range 0 to 255. The correction channel $ACH_{corr}$ can also be the analog ACH channel currently being set (the usual case of using correction equations 6 to 13).

## 3-1-14 Alarms



Setting the conditions for triggering limit and steepness alarms on the analog channel being set. The evaluation of the conditions for the steady state alarm is always performed at the end of each measurement loop.
The evaluation of the steep alarm conditions is carried out at an interval of 1 min. If the unit is operating in power saving mode and the set storing interval is longer than 1 minute, the evaluation of the steep alarm is performed at an interval equal to the storing interval.




### 14-1 Alarm limit [0/1]

Enable or disable activation of the limit alarm. The set limit values and hysteresis will remain after this parameter is disabled.

**Default setting:** off

### 14-2 Alarm lower limit*

### 14-3 Alarm upper limit*

### 14-4 Alarm hysteresis*

The setting limits define the area in which the measured value can move. A drop in the instantaneous value below the Lower Limit reduced by the Hysteresis or, conversely, a rise in the instantaneous value above the Upper Limit increased by the Hysteresis will cause an immediate activation of the limit alarm.

The alarm can be switched off again only after the instantaneous value returns to the allowed band narrowed on both sides by the value of the Hysteresis parameter.

### 14-5 Gradient limit [0/1]

Enable or disable the activation of the steep alarm. The set rise or fall limits will remain after this parameter is disabled.

**Default setting:** off

### 14-6 Increase limit*

### 14-7 Decrease limit*

The parameter value indicates the maximum allowable change in the monitored variable over the storing interval. If any of these parameters is exceeded, either by a rise or fall of the measured variable, in a time shorter than or equal to the set storing interval, a steep alarm will be activated on the channel.

### 14-8 Global alarm enable [0/1]

Binary parameter, after setting of which the activated limit or binary alarm of the set analog channel is reflected in the activation of the global alarm of the device.

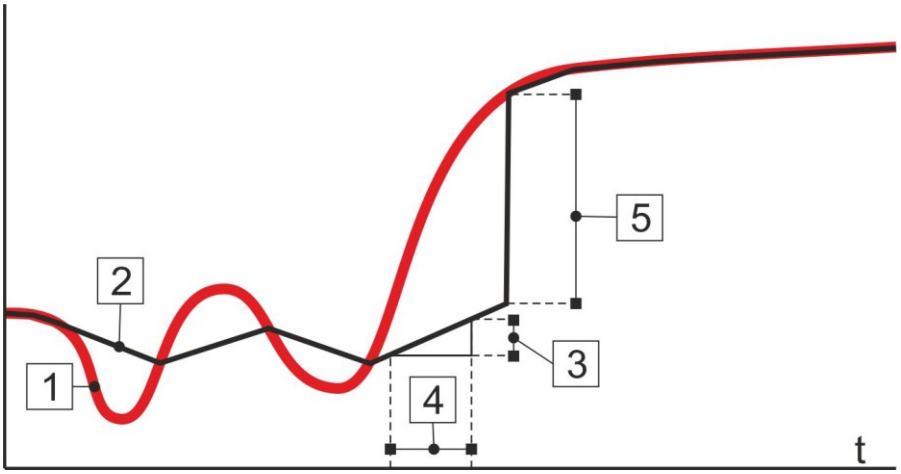
**Default setting:** off

## 3-1-15 Damping



Parameter settings to limit rapid changes in the measured variable in control processes or to automatically filter exceptional fluctuations of the measured variable in the display and storing process.

A typical use of the damping parameter is, for example, to suppress rapid changes in the measured dissolved oxygen value in the activation tanks after the blowers have been switched on, where without the damping setting the blowers would be switched on and off frequently.




| | |
|---|---|
| 1 | Actual waveform of the measured quantity |
| 2 | Dimmed waveform of the measured variable |
| 3 | parameter "Damping coefficient", maximum change of value for the storing Interval |
| 4 | parameter "Storing interval" |
| 5 | the parameter "Damping Limit" as the difference between the actual and the damped value |

### 15-1 Damping enable [0/1]

Enable/Disable to perform damping of rapid changes in the measured value of the channel being set.

### 15-2 Result filter [0/1]

Enable/Disable filtering of extraordinary fluctuations of the measured value of the set channel.

### 15-3 Damping coefficient*

Setting the numerical value of the parameter in the measurement units of the given channel, which determines the maximum permissible change (increase, decrease) of the measured variable in 1 sec.

If the measurand is actually increasing or decreasing faster than the value of this parameter, this increase or decrease will be slowed down to the value given by the size of the parameter.

The usual value of this parameter for a channel recording the dissolved oxygen value is 0.005 mg/l, i.e. the permissible change in the measured value is 1 mg/l per 200 sec.

### 15-4 Damping limit*

The parameter value sets a limit value between the actual and the damped quantity expressed in the measurement units of the channel being adjusted, after which the damped value equals the actual measured value by a jump. The setting of this parameter is important, for example, in calibrating the sensor in the above example of controlling the blowers according to the amount of dissolved oxygen in the activation tank. The calibration is usually performed on air oxygen by removing the probe from the activation tank. Without adjusting this coefficient to the usual value of 2 to 3 mg/l, it would take a disproportionately long time to align the measured and actual values.

***Setting the ACH damping parameters***

**Example 4.**

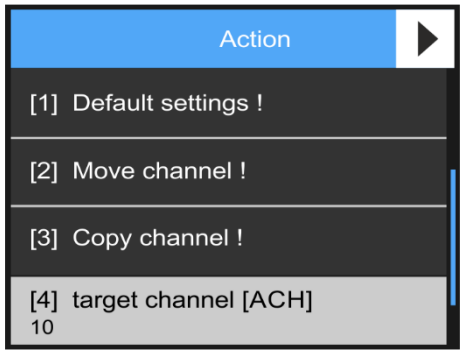
*Adjust the damping of the ACH5 channel to which the dissolved oxygen sensor ESK11 is connected. The damping should allow a maximum change in the measured value of 1 mg/l over a period of 3 minutes (to avoid frequent switching on and off of the blowers). To automatically "turn off" the damping during sensor calibration, set the Damping Limit to 3.5 mg/L.*

**Set ACH5:**

- ***Damping enable:*** *1*
- ***Result filter:*** *0*
- ***Damping coeficient:*** *0.005 (1 mg/l / 180 sec = 5.55 -> rounded to 0.005)*
- ***Damping limit:*** *3.5*

## 3-1-16 Actions

A list of options that allow more efficient setting of analog ACH recording channel parameters by moving, copying, or disabling them (= option 16-1 Dafault settings).




*ATTENTION - after setting a non-zero value in the parameter 16-4 Target channel the requested action will be performed without further confirmation queries.*

### 16-1 Dafault settings !

This option initializes all parameters of the recording channel and the channel becomes inactive (turns off).

### 16-2 Move channel !

This option transfers all settings of the current channel to the position of the target channel given by the parameter 16-4 "Target channel". The original channel is switched off.

### 16-3 Copy channel !

This option transfers all settings of the current channel to the position of the target channel given by the parameter 16-4 "Target channel". The original channel with all parameters set will be retained.

### 16-4 Target channel [ACH]

The number of the destination analog channel to move or copy the analog channel being set. The default value of this parameter is 0 and a valid value of this parameter must be entered before any action (channel move, channel copy, production channel setup).

### 16-5 Lock channel´s setting [0/1]

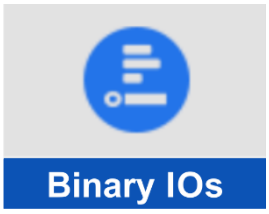
A binary coefficient that blocks changes to the parameters of the channel being set for users with privilege 2 or lower. Only a user with permission 3 or higher can activate this parameter.

### 16-6 Lock counter´s settings [0/1]

Similar to the previous parameter only for blocking the setting and resetting the counters.

**Default setting:** off

# BCH settings




## 3-2 Binary IOs

Parameters for setting the selected BCH binary channel.

The first step is to select the number of the input/output binary channel and then to set the important parameters.

### 3-2-1 Binary label

This parameter has the same meaning as for analogue channels, i.e. it is displayed on the display, appears in the text of the SMS message and is transmitted together with the measured values to the PC and the server for further processing.

The Analog label of a binary can contain up to 25 characters, including numbers and special characters. Switching between the alphanumeric keys is done in the bottom line of the screen

### 3-2-2 Mode

Select the desired mode of the binary channel being set.

#### 2-1 Off

The binary channel is disabled. Set parameters remain set for later enabling of the channel.

#### 2-2 Input - Local

Input binary channel assigned to one of the PIN inputs of the current connection board. The PIN number of the input is set with the parameter 3-2-4 Input/Output on p. 146 (see. Example 5. on page. 147).

#### 2-3 Input - IO Module

Input binary channel assigned to one of the binary inputs of an external module (DV2, PLC, other unit E2, Q2, H7, ...). The input number of the external module is set by the parameter 3-2-4 Input/Output on p. 146 (see Example 6. on p. 147).

#### 2-4 Input – Remote

Input binary channel controlled from the text of the incoming SMS, by a command coming from the server or under MODBUS RTU protocol. This mode therefore sets the binary channel as input for remote control. The remote controlled input can enter other binary channels as part of a logic condition or as a control or error input.

The input is permanently in false mode if it is switched to automatic. It then ignores the Interface, Input, Address, etc. parameters (it doesn't matter what is filled in the parameters).

## 2-5 Input - Diagnostics bits

The input binary channel will be controlled by some status bit of the unit's self-diagnostics.

Setting the input number (parameter 3-2-4 Input/Output on p. 146) to a value between 0 and 31 (left column of the table), it is possible to determine which unit state the binary channel will monitor (see Example 8. on p. 147).

| | |
|---|---|
| **0** | Global alarm |
| **1** | Parameter lock - cannot save new parameters |
| **2** | Measurement lock - measurement cannot be corrected |
| **3** | Function suspended due to low voltage of all sources |
| **4** | Initialization (restart) in progress - no data available |
| **5** | Display sleep lock |
| **6** | Global Technology Failure - User |
| **7** | Book now |
| **8** | Presence of external power supply at the terminals of the connection board |
| **9** | Recharging the external battery is in progress |
| **10** | The internal battery is being recharged |
| **11** | GSM module power is on |
| **12** | GSM module is logged into the network |
| **13** | SMS reception in progress |
| **14** | Sending SMS is in progress |
| **15** | Data transfer over TCP is in progress |
| **16** | At least 1 analog channel has an error longer than the storing Interval |
| **17** | Error on binary channels |
| **18** | Invalid time detected in RTC |
| **19** | GSM module error (SIM, PIN, etc.) |
| **20** | RF module error |
| **21** | WiFi module error |
| **22** | External power supply error |
| **23** | Warning when the external battery voltage is low |
| **24** | Discharging the external battery |
| **25** | Low internal battery voltage warning |
| **26** | Draining the internal battery |
| **27** | Discharging the internal CR2032 lithium battery |
| **28** | Error in power supply of UNAP1 sensors |
| **29** | Error in power supply of UNAP2 sensors |
| **30** | Error in power supply of UNAP3 sensors |
| **31** | Error in power supply of UOPTO sensors |

## 2-6 Input - Analog channel bits

Input binary channel controlled by the state or value of the selected analog channel of the H7 unit.

Parameter 3-2-4 Input/Output (pg. 146) set to the value in the left column of the table indicates the bit number or state to be monitored for the selected analog channel.

The analog control channel number is set using the parameter *3-2-3 Address* -B (pg. 146).

| | |
|---|---|
| **0** | 0th bit of analog channel converted to UNIT32 |
| **1** | 1st bit of analog channel converted to UNIT32 |
| **X** | x. bit of analog channel converted to UNIT32 |
| **31** | 31st bit of analog channel converted to UNIT32 |
| **40** | Analog channel value below lower limit |
| **41** | Analog channel value above upper limit |
| **42** | Limit for growth exceeded |
| **43** | Drop limit exceeded |
| **44** | Analog channel error longer than storing interval |
| **45** | Book now |
| **46** | Book now |
| **47** | Channel switched to manual mode |

## 2-7 Input - regulator bits

The current version of FW does not allow this option.

## Input modes

## Output modes

## 2-8 Output - Local (relay)

Output binary channel for controlling the binary output-relay on the current connection board.

## 2-9 Output - IO Module

Output binary channel for controlling the selected binary output-relay in external modules DV2, PLC, other unit E2, Q2, H7, ... The serial number of the output (relay) in the external module is set by parameter 3-2-4 Input/Output.

## 2-10 Output - SMS/GPRS

Binary output channel for direct control of the remote device. This parameter is not supported programmatically in the current FW version.

## 2-11 Output - Virtual

Auxiliary output binary channel without a specific connection to the real physical output. A virtual channel can be used, for example, to simplify a complex logic function that can be split into several virtual BCHs and then logically merged into the desired output.

## 3-2-3 Address -B

Depending on the parameter setting 3-2-2 "Mode" setting, the numeric value of the parameter determines the analog input channel number or the communication address of the external I/O module.

This parameter is of further importance when setting the internal software IO Module (chap. 4-4-2 IO Module on p. 210), where the parameter *Address-B* specifies the serial number 1 to 10 of the IO Module being set.

*The Address-B* parameter can take values in the range 0 to 65535.

## 3-2-4 Input/Output

The numeric value of this parameter corresponds to the input, output, or register number, depending on which mode the binary channel being set is switched to.

The Input/Output parameter can take values in the range of 0 to 255.

## 3-2-5 Storing [0/1]

Setting this parameter enables storing of the binary channel in the instrument's data memory. During storing, each change of the binary channel is stored including a time stamp with a resolution of 1 sec. In contrast to the storing of analog channels, the storing of binary channels does not take place at regular storing intervals, but only when the state changes.

## 3-2-6 Negation [0/1]

Setting this parameter causes the binary channel state to be negated.

The binary input is inactive in the normal state, i.e. logic zero. When the input is connected to the ground terminal (relay contact, open collector), the input is activated and the binary channel is set to logic one. When the switching is complete and the input returns to normal state, the logic channel is also deactivated and becomes logic zero. In some cases, it is appropriate to swap the logic symbols so that a logic zero is stored at the beginning of the pulse and vice versa. For these cases, the "Negation" option is available. The resulting state of the binary channel after negation can enter various control routines or logic functions and can also be archived.

## 3-2-7 Reset on error [0/1]

This parameter specifies whether to set the channel value to zero [Disable on error = 1] or keep the last value [Disable on error = 0] when an error occurs.

## 3-2-8 Global ALARM [0/1]

Select whether the channel status should be included in the station's Global ALARM.

## 3-2-9 Global FAIL [0/1]

Select whether the channel status should be included in the Global Station Fault.

## 3-2-10 Display while On [0/1]

If this binary parameter is enabled and the following parameter 3-2-11 is off, the status of the binary channel will only be displayed in the cyclic mode of the screen for the duration of its activation (logic one). The status of a deactivated channel will not be displayed.

## 3-2-11 Display always [0/1]

Enabling this parameter causes that regardless of the status of the previous parameter 3-2-10parameter, the current state of the BCH being set will always be displayed in the cyclic display mode.

***BCH float control in the sump***

**Example 5.**

*Setting BCH1 to turn on when the maximum level in the sump is reached. The sump will be equipped with a float sensor connected to the PIN3 input of the connection board. The float sensor will disengage in its top position when the max level is reached.*

**BCH1 settings:**

- ***Mode:*** *Input - Local*
- ***Binary label:*** *H-MAX float*
- ***Input/Output:*** *3 (binary input number on the unit's connection board)*
- ***Function:*** *Binary input*
- ***Storing:*** *on*
- ***Negation:*** *on*
- ***Global ALARM:*** *on (activates diagnostic bit 0)*
- ***Display while on:*** *on*

***Reading the binary state from the input of the external module DV2***

**Example 6.**

*Set BCH8 to signal pump operation from the auxiliary contactor switch contact connected to the DV11 binary input of the DV2 external module. The communication address of the DV2 module is set in the selected IO Module (see. 4-4-2 IO Module on p. 210).*

**BCH8 settings:**

- ***Mode:*** *Input - IO module*
- ***Binary label:*** *M1 stroke: pump CS*
- ***Address-B:*** *8 (serial number of the selected IO Module in the range 1 to 10)*
- ***Input/Output:*** *11 (DV2 binary input number)*
- ***Function:*** *Binary input*
- ***Storing:*** *on*
- ***Negation:*** *off*
- ***Display while on:*** *on*

***Writing the binary state to the output of the DV2 external module***

**Example 7.**

*Set BCH9 as the control channel to control the RE3 relay in the external module DV2 according to the state of the binary channel BCH5. The communication address of the DV2 module is set in the selected IO Module (see. 4-4-2 IO Module on p. 210).*

**BCH9 settings:**

- ***Mode:*** *Output - IO module*
- ***Binary label:*** *control RE3 acc. to BCH5*
- ***Address-B:*** *8 (serial number of the selected IO Module in the range 1 to 10)*
- ***Input/Output:*** *3 (DV2 binary output-relay number)*
- ***Function: Logic function > Logic function in prefix:*** *B5 (= copy of BCH5)*
- ***Storing:*** *disabled*
- ***Negation:*** *off*
- ***Display while on:*** *on*

***Setting BCH according to the state of the selected diagnostic bit***

**Example 8.**

*Set up BCH1 to signal an external power failure detected by H7. A disconnected binary channel BCH1 can then, for example, trigger the sending of a warning SMS.*

**BCH1 settings:**

- ***Mode:*** *Input - Diagnostics bits*
- ***Binary label:*** *Power failure*
- ***Input/Output:*** *22*
- ***Function:*** *Binary input*
- ***Storing:*** *on*
- ***Negation:*** *off*
- ***Global FAIL:*** *On (activates diagnostic bit 6)*
- ***Display while on:*** *on*

## 3-2-12 Function

Extensive menu offering a choice of 12 different binary channel setup functions.

For Input *Modes*, you need to set the *BCH Functions* menu to the first option *Binary Input*.

Output *Modey* (*2-8 Output - Local (relay)* up to *2-11 Output - Virtual*) require setting one of the output functions 2 to 12 as listed in the following table.

*A brief overview of the individual functions with a short description of their operation:*

***List of functions***

| | Function name | Function description | I/O | Cap. | Str. |
|---|---|---|---|---|---|
| 1 | **Binary input** | Input function controlled by another physical or virtual binary state | In | 12-1 | 148 |
| 2 | **Limit output type 1** | Sequencing by control ACH outside preset limits, adjustable hysteresis | Out | 12-2 | 149 |
| 3 | **Limit output type 2** | Shutdown according to control ACH and switching and tripping limit | Out | 12-3 | 150 |
| 4 | **Limit output type 3** | Switching according to control ACH and 2 switching and 2 expansion limits | Out | 12-4 | 152 |
| 5 | **Limit output counter** | Switching off after reaching the limit value of the ACH control counter | Out | 12-5 | 153 |
| 6 | **Sampler based on counter** | Pulse generation after incrementing the control channel counter and the set volume value | Out | 12-6 | 154 |
| 7 | **Periodic pulses** | Pulse generation conditioned by the state of the ACH control limits | Out | 12-7 | 155 |
| 8 | **Up time/Down time** | Long and short pulse generator without conditions | Out | 12-8 | 156 |
| 9 | **Switching timer** | Switching clock for 8 time events per day, possibility to set active days of the week | Out | 12-9 | 157 |
| 10 | **Auxiliary group** | Control of 1 or more groups of pumps or blowers, including stand-by in case of failure of one of the motors | Out | 0 | 158 |
| 11 | **Logic function** | Output according to the evaluation of logical conditions between BCH, ACH and H7 unit status flags | Out | 12-11 | 160 |
| 12 | **Security** | Exit with exit delay for building security | Out | 12-12 | 162 |

### 12-1 Binary input

Function for input modes designed to  to monitor physical and virtual logic inputs.




#### 1 Acknowledged error [0/1]

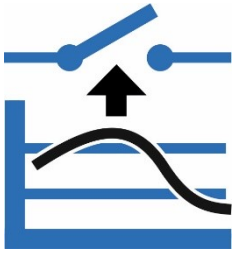
Option ready for later expansion of the FW unit.

#### 2 Delayed On [sec]

#### 3 Delayed Off [sec]

Parameters for setting the desired delay of the binary input change from the time of the control output change. The parameters can be set in the range of 0 to 86400 sec with a resolution of 0.1 sec.

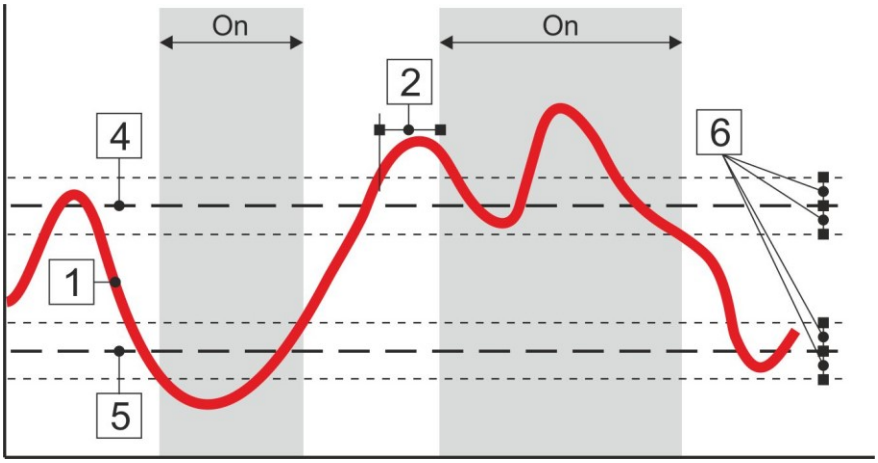
**Default setting:** 0 sec



## 12-2 Limit output type 1

The binary channel switches on when the values of the control analogue channel are outside the set limits with respect to the set hysteresis value (hysteresis shifts the limits in the direction of movement of the variable).

In the following figure, the active (switched) output of this function is marked in grey above the time axis of the chart (time periods marked On).




### 1 Channel reference

Enter the analog control channel number. The measured value of this analog channel (curve 1 in the figure) controls the binary output channel being set.

### 2 Delayed On* [sec]

Setting the time delay for switching on the output from the moment the switch-off condition is met. The *Delayed trip* parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (1 day).

Differently set short delays of a few seconds can reduce the load on power circuit breakers when multiple pumps or blowers are switched on simultaneously.

### 3 Delayed Off* [sec]

Setting the time delay for shutting down the output from the moment the shutdown condition is met. The *Delayed Shutdown* parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (1 day).

### 4 Upper limit*

The upper limit value specified by number or by reference to a Set point parameter. If the value of the monitored analog channel rises above the upper limit, the output will be active. The evaluation of the upper limit is done with respect to hysteresis. If the monitored value increases, the output will turn ON at the upper limit value plus hysteresis. If the monitored value is decreasing, the output will turn off at the upper limit value minus the hysteresis.

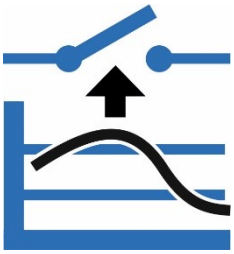
### 5 Lower limit*

The lower limit value specified by a number or a reference to a Set point parameter. If the value of the monitored analog channel falls below the lower limit, the output will be active. The evaluation of the lower limit is done with respect to hysteresis. If the monitored value decreases, the output turns ON at the lower limit value minus the hysteresis. If the monitored value is increasing, the output will turn off at the lower limit plus hysteresis.

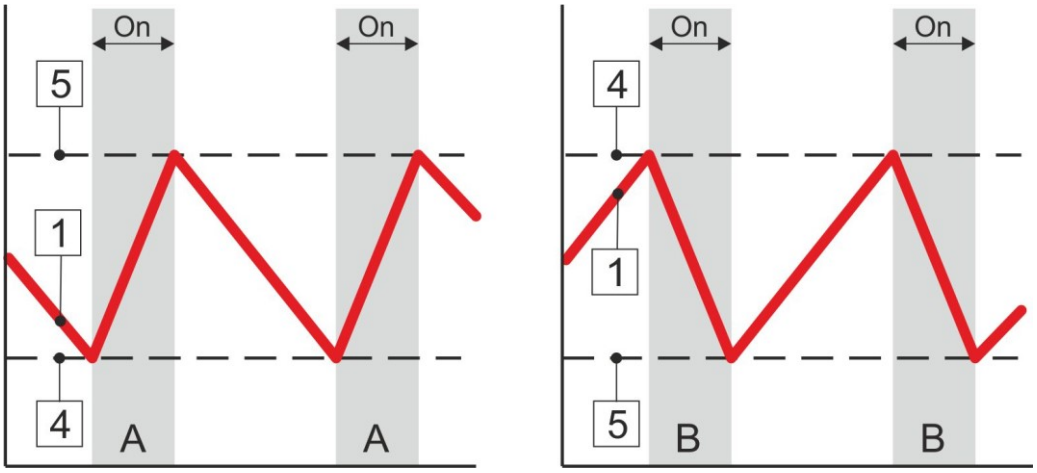
### 6 Hysteresis*

Hysteresis prevents frequent repetitive switching of the binary output when the control channel value slowly changes when the set limit values are exceeded. The limit values are shifted by the hysteresis in the direction of control channel movement. Hysteresis is applied when both the lower and upper limits are exceeded.

## 12-3 Limit output type 2



Switching and tripping limits for quick setting of the two-state controller. If the switching limit is less than the Switching Off limit, it is used for pumping control (A in the following figure). If the switching limit is greater than the Switching Off limit, it is used for pumping control (B).




### 1 Channel reference

Enter the analog control channel number. The measured value of this analog channel (curve 1 in the figure) controls the binary output channel being set.

### 2 Delayed On* [sec]

Setting the time delay for switching on the output from the moment the switch-off condition is met. The Delayed trip parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (1 day).

Differently set short delays of a few seconds can reduce the load on power circuit breakers when multiple motors, pumps or blowers are switched on simultaneously.

### 3 Delayed Off* [sec]

Setting the time delay for shutting down the output from the moment the shutdown condition is met. The Delayed Shutdown parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (1 day).

### 4 Switching On limit*

Setting the level to switch the binary channel.

### 5 Switcching Off limit*

Setting the level to turn off the binary channel.

***Relay control on the connection board by level***

**Example 9.**

*Set binary channel BCH2 so that its output controls the sump pump via RELE1 of the connection board according to the level measured on channel ACH3 in m. The pump switches on at a level of 2 m and switches off at a level of 0.5 m.*

**Setting BCH2:** *(relay output)*

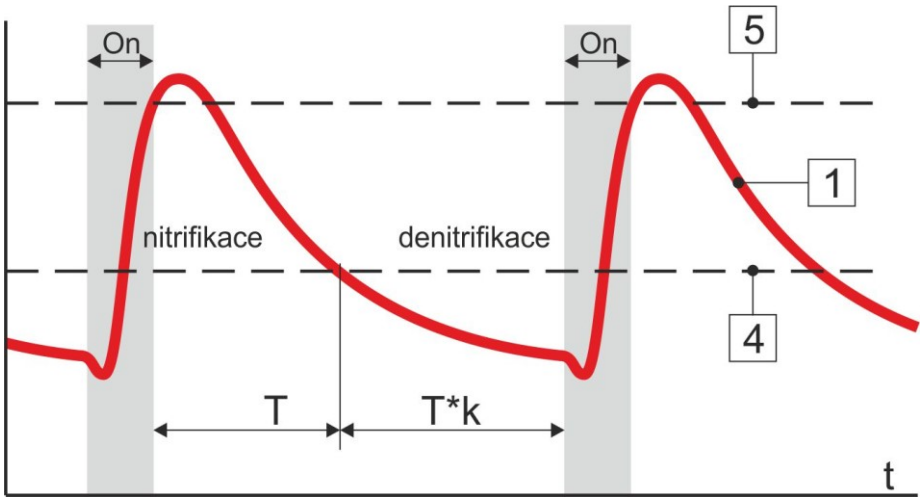
- ***Mode:*** *Output-Local (relay)*
- ***Input/Output:*** *1 (RELE1)*
- ***Function:*** *Limit output type 2*
- ***Channel reference:*** *3 (ACH3 level measurement)*
- ***Switching On limit:*** *2 (in units of ACH3)*
- ***Switching Off limit:*** *0.5 (in ACH3 units)*

*A similar case describes Example 19. on p. 165 using the operating parameters to set the switching and tripping limits.*

## 6 Delayed On factor K*

This parameter is mainly used to control the blowers according to the amount of dissolved oxygen measured in the activation tank of the WWTP.

**This parameter extends the shutdown time** by K times the time that elapses between the blowers shutting down at the time the shutdown level is reached and the switch-on level is reached. Extending the blower off time increases the time required for the denitrification phase.




If delayed switching of the blowers is not required, the parameter K = 0 is set

**Default setting:** 0

*Note on the picture:*
*The oxidation of ammoniacal nitrogen to nitrite and nitrate (nitrification) and the subsequent dissimilatory reduction by denitrification of nitrate to elemental nitrogen (denitrification) are important in the wastewater treatment process. Nitrification is the process of biochemical oxidation of ammonia to nitrite and then to nitrate. Under oxic conditions, it is carried out without problems by nitrifying bacteria. Denitrification is the process of biochemical reduction of nitrite to nitrogen oxides and then elemental nitrogen. Denitrification should always follow nitrification in order to achieve the final processing of nitrogen by nitrate degradation. Without denitrification, there would be no nitrogen degradation in the wastewater, but only a change of form from ammonia to nitrate. (Vera Jedličková: Controlling the nitrification and denitrification process at wastewater treatment plants).*

***Relay control in the external module DV2 according to the amount of dissolved oxygen***

**Example 10.**

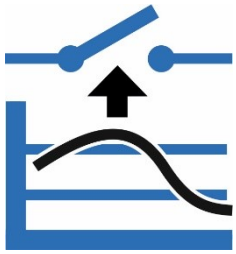
*Set the BCH22 so that its output controls the blower of the activation tank via RELE5 of the external module DV2 (module address = 1) according to the dissolved oxygen value measured on ACH3. The blower should switch off at 1,8 mg/l and switch on after 1,5 times the time elapsed from the moment of switching off the blower until the oxygen value drops to 1,2 mg/l.*

***Setting parameters for communication with DV2:*** *4-4-2 IO Module on page 210.*

**Setting BCH22: (relay in DV2)**

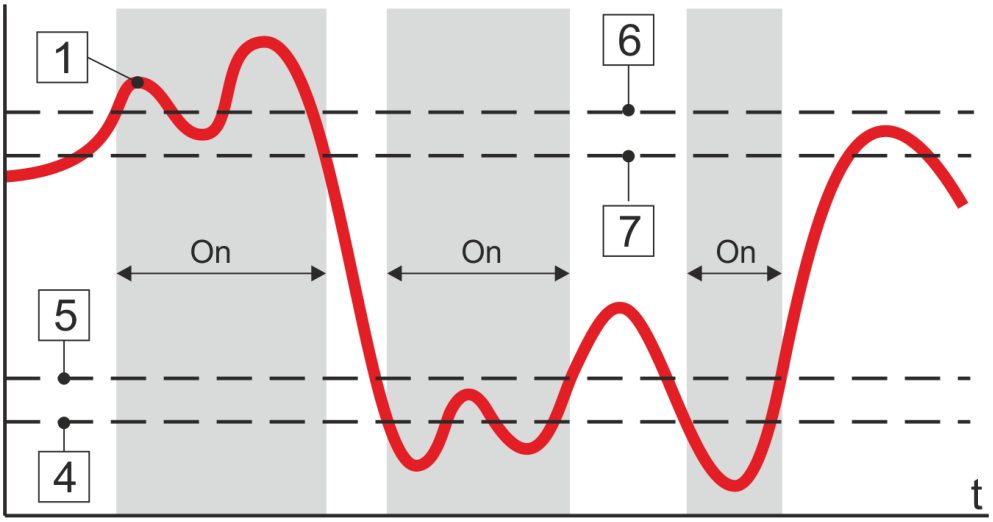
- ***Mode:*** *Output-IO Module*
- ***Input/Output:*** *5 (RELE5)*
- ***Address-B:*** *1 (serial number of the selected IO Module in the range 1 to 10)*
- ***Function:*** *Limit output type 2*
- ***Channel reference:*** *3 (dissolved oxygen measurement)*
- ***Switching On limit:*** *1.2*
- ***Switching Off limit:*** *1.8*
- ***Delayed On factor K:*** *0.5*

## 12-4 Limit output type 3



Limit relay for monitoring the analog channel value above the upper switching limit or below the lower switching limit. By setting separate Switching Off limits, it prevents frequent switching on and off of the output when the measured value of the control channel moves close to the Switching Off limits.

The function also allows you to set a delayed on and off time.




### 1 Channel reference

Enter the analog control channel number. The measured value of this analog channel (curve 1 in the figure) controls the binary output channel being set.

### 2 Delayed ON* [sec]

Setting the time delay for shutting down the output from the moment the shutdown condition is met. The Delayed trip parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (1 day).

### 3 Delayed OFF* [sec]

Setting the time delay for shutting down the output from the moment the shutdown condition is met. The Delayed Shutdown parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (1 day).

### 4 Upper ON limit*

Setting the lower limit level for binary channel switching. The parameter value is set in control channel units.

### 5 Upper OFF limit*

Setting the lower limit level to turn off the binary channel. The parameter value is set in control channel units.

### 6 Lower ON limit*

Setting the upper limit level to turn off the binary channel. The parameter value is set in control channel units.

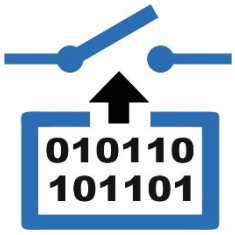
### 7 Lower OFF limit*

Setting the upper limit level for binary channel switching. The parameter value is set in control channel units.

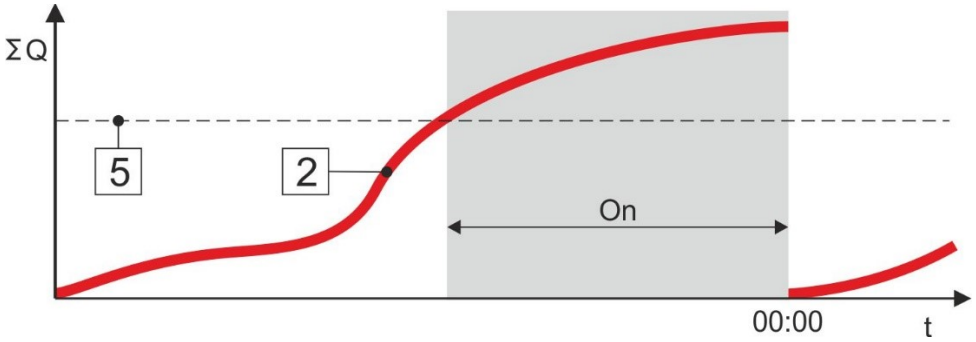
For the above 4 limiting parameters, the condition must apply:

**Lower ON limit < Lower OFF limit < Upper OFF limit < Upper ON limit**

## 12-5 Limit output of counter




Turns off when the selected counter value is exceeded. You can choose to monitor the daily, monthly or yearly counter of the selected analog channel. Allows you to specify delayed switch on, switch off. This function is useful for monitoring leakage limit volumes or rainfall totals.




### 1 Channel reference

Entering the counter control channel number. The counter value assigned to this analog channel (curve 1 in the figure) controls the binary output channel being set.

### 2 Select counter

- Precipitation counter
- Daily counter
- Monthly counter
- Annual counter

### 3 Delayed On* [sec]

Setting the time delay for switching the output from the moment the switching condition is met. The Delayed switching parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (1 day).

### 4 Delayed Off* [sec]

The binary output is switched off for daily, monthly or yearly counters with the transition to the new day of the new period. Setting the parameter allows you to delay that point in time. The Delayed Shutdown parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (1 day).

### 5 Switch On limit Counter*

Entering the counter value of the control analogue channel in the corresponding units of measurement, after reaching which the set binary output is switched. The value of this parameter can be set from 0 to 4 294 967 295 (i.e. 0 to $2^{32}$ ).

***Activation of warning SMS after the set volume has expired***

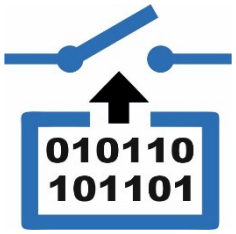
**Example 11.**

*Set binary channel BCH10 so that its output can trigger an SMS alert if the daily leaked volume counter on channel ACH5 reaches 80 $m^3$.*

**BCH10 settings:**

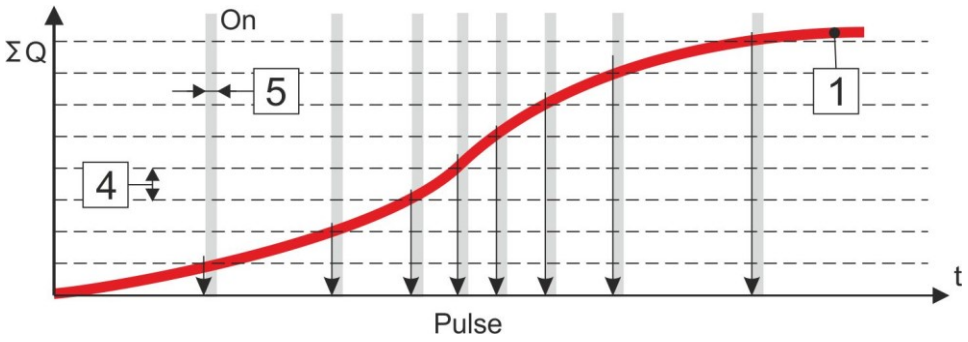
- ***Binary label:*** *exceeding 80m3 on ACH5*
- ***Mode:*** *Output - Virtual*
- ***Function:*** *Limit output counter*
- ***Channel reference:*** *5 (ACH5 is set as flow meter in l/s including counters in $m^3$ )*
- ***Select counter:*** *Daily counter (at midnight the daily counter is reset and then the set channel BCH10 is switched off)*
- ***Delayed On:*** *0*
- ***Delayed Off:*** *0*
- ***Switch On limit Counter:*** *80*

## 12-6 Sampler based on counter




This option is mainly intended for transmitting information about the leaked volume to the master control system using pulses with defined weight ($m^3$/puls) or for controlling the autosampler according to the leaked volume.

The function causes the binary output to switch on for a set period of time (*Pulse Length*) whenever the counter value of the selected *Control Channel* is increased by the set value (*Volume per pulse*). Lower and upper limits can be specified that define the range of values of the monitored analog channel in which the output is active.




### 1 Channel reference

Enter the number of the analog control channel from which the counter value is taken.

### 2 Upper limit*

### 3 Lower limit*

Setting the limit values on the control channel that condition the calculation of the sliding flow volume. Below the Lower Limit and above the Upper Limit, the leaked volume will not be incremented (pulse generation will be suppressed).

### 4 Pulse interval samp*

The increment value of the analog control channel counter. When the set increment is reached, a pulse is generated.

### 5 Pulse length* [sec]

Setting the pulse duration in seconds with a resolution of 0.1 sec.

The pulse should not be longer than half the time required to fill the set float size at the highest possible flow rate on the control channel. The minimum pulse duration is 0.5 sec. Maximum pulse duration up to 86400 sec (1 day). There is always a 2 sec delay after each pulse in which the output is at zero (open).

### 6 Initial date [YYYY:MM:DD]

### 7 Initial time [HH:MM:SS]

Possibility to set the time of pulse generation start.

### 8 Reset channel

Resetting the continuous counter of the binary channel being set. The option is suitable for e.g. synchronization of pulse outputs.

***Conditional control of the sampler according to the leaked volume***

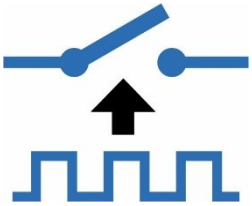
**Example 12.**

*Requirement to sample water from the stream every time 50 m3 is flowed. Do not sample at flows less than 0.8 l/s or greater than 20 l/s. To take a sample it is necessary to switch on relay RELE1 for 2 s. The flow measurement is set to ACH5.*

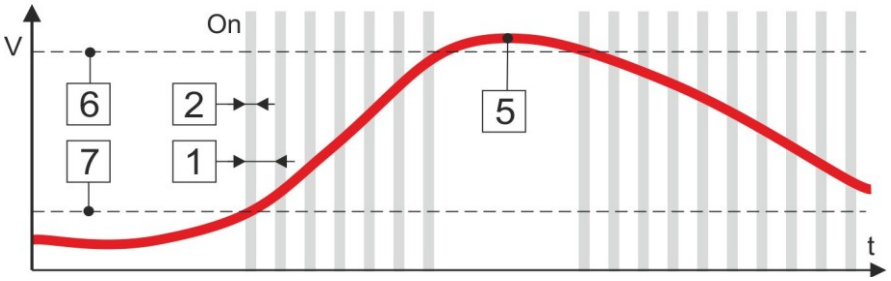
**Set BCH:**
**(control relay1)**

- ***Mode:*** *Output - Local (relay)* ***Input/Output:*** *1 (RELE 1)*
- ***Function:*** *Sampler based on counter* ***Channel reference:*** *5*
- ***Upper limit:*** *20 (flow in l/s, above this limit the flow will not be incremented)*
- ***Lower limit:*** *0.8 (flow in l/s, below this limit the flow will not be incremented)*
- ***Pulse interval samp:*** *50 (in counter units, i.e. in $m^3$)* ***Pulse length:*** *2 (sec)*

## 12-7 Periodic pulses



Switches the output for the set switching time with the specified time period. Lower and upper limits can be specified that define the range of values of the analog channel being monitored in which the output is active. For real-time synchronization, the time and date of the first switching can be specified.




### 1 Pulses interval* [sec]

Set the time period of the generated pulses (includes pulse length + gap between pulses). The parameter is set in sec in the range 0 to 2678400 (=31days).

### 2 Pulse length* [sec]

Setting the pulse duration (channel switching). The parameter is set in seconds in the range 0 to 2678400 (=31 days).

### 3 Start time by Setpoint [0/1]

Enable parameter change using the Set point parameter.

Enabling this parameter replaces the "Initial date" and "Initial time" with the Set point parameter SP. This allows quick time changes to be made by the instrument operator.

### 4 Start time setpoint

Time parameter for the ability to quickly change the time of the first pulse by the instrument operator.

### 5 Channel reference

Number of the analogue control channel for possible conditioning of the generation of periodic pulses depending on the current value of the control channel. A zero value of this parameter disables limit conditional control of the binary output.

### 6 Upper limit*

### 7 Lower limit*

Setting the limits of the analog control channel. Pulse generation is enabled inside the limits, suppressed outside the limits.

### 8 Initial date [YYYY:MM:DD]

### 9 Initial time [HH:MM:SS]

Possibility to set the start of pulse generation (first switching).

***Maintaining the temperature above the set point with the Periodic Pulse function***

**Example 13.**

*Requirement to switch on the heating (RELE2) once per hour for 10 minutes with the condition that the temperature measured on ACH5 is below 3 °C.*

**BCH settings:**

- ***Mode:*** *Output - Local (relay)*
- ***Function:*** *Periodic pulses*
- ***Pulse length:*** *300*
- ***Upper limit:*** *3*
- ***Input/Output:*** *2 (RELE2)*
- ***Pulse interval:*** *3600*
- ***Channel reference:*** *5*
- ***Lower limit:*** *-500*

***Regularly run the blower twice a day for 30 minutes***

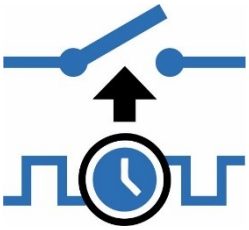
**Example 14.**

*Regular startup independent of anything else*

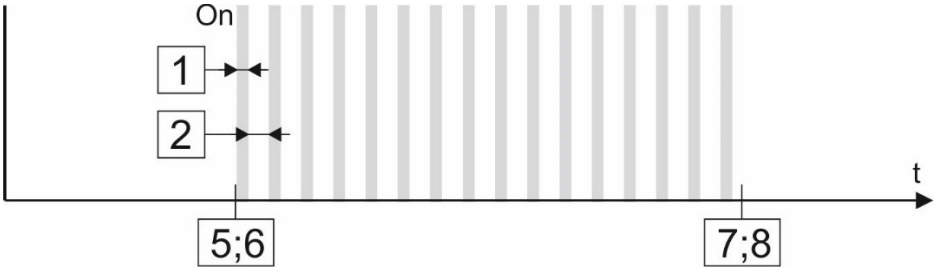
**BCH settings:**

- ***Mode:*** *Output - Local (relay)*
- ***Function:*** *Periodic pulses*
- ***Pulse length:*** *1800*
- ***Input/Output:*** *2 (RELE2)*
- ***Pulse interval:*** *43200*
- ***Channel reference:*** *0*

## 12-8 Up time / Down time



Function for repeated alternating switching on and off of the binary output according to the specified on-time and off-time. For synchronization with real time, the time of the first switching can be specified.




### 1 Up time* [sec]

Set the duration of the binary channel switching time in seconds with a resolution of 1 sec. The value of the parameter can take values in the range of 0 to 2678400 (=31days).

### 2 Down time* [sec]

Set the duration of the binary channel shutdown time in seconds with 1 sec resolution. The value of the parameter can take values in the range 0 to 2678400 (=31days).

### 3 Start time by Setpoint [0/1]

Enabling this parameter replaces the "Initial date" and "Initial time" with the Set point parameter SP. This allows quick changes to be made to the time of the first switching of the binary output from the start of the day by the instrument operator.

### 4 Start time setpoint

Serial number of the Set point parameter SP for the possibility of quick change of the time of the first switching of the output by the device operator.

### 5 Initial date [YY:MM:DD] ]

### 6 Initial time [HH:MM:SS]

Possibility to set the date and time from which pulse generation will be enabled.

These two parameters can be used to delay the start of the pulse generator to the desired date and time.

***Time control of the blower using the relay on the connection board***

**Example 15.**

*Set binary channel BCH13 to control the aeration blower in 10 min run / 50 min rest mode using internal relay 1. The blower should always be switched on at the full hour.*

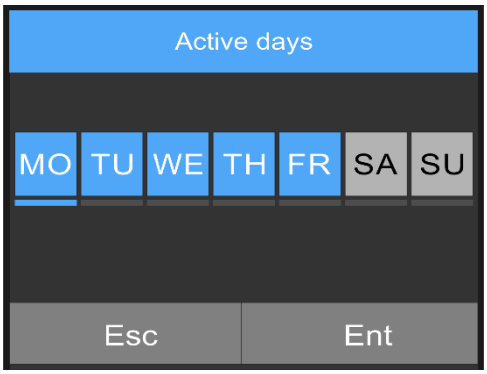
**Set BCH13:**

- ***Mode:*** *Output - Local relay*
- ***Binary label:*** *10zap50vyp*
- ***Input/Output:*** *1*
- ***Storing:*** *on*
- ***Function:*** *Up time / Down time*
- ***Up time:*** *600 (sec)*
- ***Down time:*** *3000 (sec)*
- ***Initial date:*** *01.01.2015*
- ***Initial time:*** *08:00:00*

## 12-9 Switching timer



Set the desired output state at up to eight preset times per day. Possibility to set active days of the week.




### 1 Active days

Set the days of the week when the function should be active.

To set the days, click on the symbol of the selected day. Once set, the day symbol will turn blue and after leaving this option, the bottom menu line will display a list of the set days of the week in the form:

**MO - TU - WE - TH - FR - - - - - -**

Inactive days will be replaced by a dash (Saturday, Sunday) in this overview.

### 2 1. function and time

Selection of the action to be performed at the 1st time over the binary channel being set.

#### 1. function

**1. Off**
No action

**2. On Change**
The set binary output changes the state from Off to On and vice versa.

**3. Switch Off**
Adjustable binary output Turns off regardless of the previous state.

**4. Switch On**
Set binary output Turns on regardless of the previous state.

#### 1. time [HH:MM:SS]

Setting the time to execute the 1st function.

### 3 2. function and time

### 4 3. function and time

### 5 4. function and time

### 6 5. function and time

### 7 6. function and time

### 8 7. function and time

### 9 8. function and time

***Heating control with relays using the switching clock function***

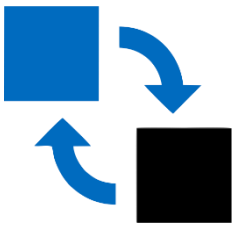
**Example 16.**

*Set BCH1 to control the building heating on weekdays only for 4 hours in the morning and 2 hours in the evening. The heating is controlled by RELE1 on the connection board.*

**Setting BCH1:**
**(RELE1 control)**

- ***Mode:*** *Output - Local (relay)*
- ***Input/Output:*** *1 (RELE1)*
- ***Function:*** *Switching timer*
- ***Active days:*** *Mo-Th-We-Th-Fr----*
- ***1. Function:*** *Switch On*
- ***1. Time:*** *05:00:00*
- ***2. Function:*** *Switch Off*
- ***2. Time:*** *09:00:00*
- ***3. Function:*** *Switch On*
- ***3. Time:*** *17:00:00*
- ***4. Function:*** *Switch Off*
- ***4. Time:*** *19:00:00*

## 12-10 Auxiliary group



Mode for groups of outputs that alternate with each other based on specified time and logic conditions. The H7 unit allows you to set up to 10 alternating groups and control the number of relays in each group limited only by the number of available BCHs.

Typical application: controlled alternation of sludge pumps.

### 1 Group number

Setting the same number for all output binary channels (relays) assigned to one group, which alternate with each other.

### 2 Alternating input

Number of the binary channel that is to control the sequential alternation of relays in the group. The relay alternation takes place when this binary channel is switched (leading edge). The switching of an AC input, i.e. the command to alternate, can be triggered by an external influence on the PIN input of the connection board, but more often by a time function (alternation by days) or a limit function (alternation after exhaustion) running on the selected AC input.

### 3 Next in alternating

Number of the binary output channel for controlling the relay that is to alternate the currently set binary output channel.

### 4 1. reference input

Binary channel for controlling the set output channel of the relay. Disconnecting the 1st control input will result in the set relay output channel being switched in alternating mode and vice versa (disconnecting the input will turn the pump off). The control channel for the 1st control input is usually one for all relays in the group and usually a float level switch or a binary channel in Limit Output 2 mode is used to control it.

### 5 1. error input

Switching off the fault input results in removing the set output channel from the alternation procedure and the next relay in the group is switched instead of the relay in the fault. The fault input is usually connected to the fault contacts (overload, water ingress, ...) of the pump control circuits.

### 6 2. reference input

### 7 2. error input

### 8 3. reference input

### 9 3. error input

### 10 4. reference input

The 2nd, 3rd and 4th control input have the same function as the 1st control input, with the difference that the 3rd and 4th inputs work in negation. Switching off any of the control inputs results in switching of the set relay output channel (logic function OR) in alternating mode. If any Control input is not used, it should be set to 0.

### 11 4. error input

The same function as the 1st error input is also provided by the 2nd, 3rd and 4th error inputs with the difference that the 3rd and 4th inputs work in negated mode. Disconnecting any of the error inputs results in the set relay output channel being removed from the alternation (logic OR function). If any Error input is not used, it should be set to 0.

### 12 Delayed ON* [sec]

### 13 Delayed OFF* [sec]

Setting the time delay for switching on or off the output from the moment the switch-off condition is met. The On/Off Delay parameter is set in seconds with a resolution of 0.1 sec in the interval 0 to 86400 sec (=1 day).

Typical use: inserting a delay between the moment of switching off and the subsequent switching on of the next pump during alternation (avoiding parallel operation).

***Regular pump changes with backup***

**Example 17.**

*The two sump pumps in the sump are to be changed regularly after each sump emptying. The respective pump shall switch on whenever the level reaches 2,5 m and switch off when the level drops to 0,8 m. If any of the pumps is in a faulty or manual mode, it will be excluded from the alternation. The pumps will be switched by the first two relays in the external module DV2 with communication address 3. The level in the sump is measured by the previously set channel ACH1.*

*Assume existing binary channel settings:*

*BCH1: M1 Automatic (on = M1 pump is not in manual mode)*
*BCH2: M1 Fault (open = M1 pump not in failure)*
*BCH3: M2 Automatic (on = M2 pump is not in manual mode)*
*BCH4: M2 Fault (open = pump M1 not in failure)*

**Setting BCH7: (level control)**

***Output control channel for pumping. BCH7 will be on for the duration of the pumping request.***

- ***Mode:*** *Output-virtual*
- ***Function:*** *Limit output type 2*
- ***Channel reference:*** *1 (level measurement ACH1)*
- ***Switching On limit:*** *2.5 (in units of ACH1)*
- ***Switching Off limit:*** *0.8 (in units of ACH1)*

**Setting BCH11: (1st relay control)**

***Output binary channel for switching the M1 pump.***

- ***Mode:*** *Output-IO Module*
- ***Binary label:*** *ZAP! M1:pump*
- ***Address-B:*** *1 (serial number of the selected IO Module in the range 1 to 10)*
- ***Input/Output:*** *1 (1st relay in DV2 unit)*
- ***Function:*** *Auxiliary group*
- ***Group number:*** *1*
- ***Alternating input:*** *7 (switching BCH7, i.e. alternating after exhaustion)*
- ***Next in alternating:*** *12 (BCH12)*
- ***1. reference input:*** *7 (switching BCH7 = command to pump)*
- ***1. error input:*** *2 (BCH2 switching = fault = BCH11 out of alternation)*
- ***3. error input:*** *1 (negated input, disconnection of BCH1 = switching to manual mode = disconnection of BCH11 from alternation)*
- ***Delayed On:*** *3 (to prevent simultaneous operation of pumps)*

**Setting BCH12: (2nd relay control)**

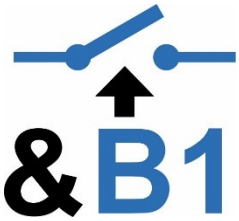
***Output binary channel for switching the M2 pump.***

- ***Mode:*** *Output-IO Module*
- ***Binary label:*** *ZAP! M2:pump*
- ***Address-B:*** *1 (serial number of the selected IO Module in the range 1 to 10)*
- ***Input/Output:*** *2 (2nd relay in DV2 unit)*
- ***Function:*** *Auxiliary group*
- ***Group numbers:*** *1*
- ***Alternating input:*** *7 (switching BCH7, i.e. alternating after exhaustion)*
- ***Next in alternating:*** *11 (BCH11)*
- ***1. reference input:*** *7 (switching BCH7 = command to pump)*
- ***1. error input:*** *4 (BCH4 - meaning similar to the description of BCH11)*
- ***3. error input:*** *3 (BCH3 - Meaning similar to BCH11)*
- ***Delayed On:*** *3 (to prevent simultaneous operation of pumps)*

*Similarly, another channel BCH13 can be inserted after BCH12 to control the third pump. The sequence in the alternation will then be set so that BCH12 refers to BCH13 and BCH13 to BCH11.*

*If the alternating input is controlled instead of BCH7 by, for example, a time binary output channel with a switching period of 24 hours, the alternation of individual pumps will also take place with this period.*

## 12-11 Logic function




Output mode for evaluating logic conditions composed of values from other binary and analog channels.

### 1 Logic function in prefix

The logical expression of the Logical function parameter must be entered in PREFIX form! The following table explains the difference between the more familiar INFIX and PREFIX form of the logical expression:

| | | | | |
|---|---|---|---|---|
| **PREFIX** | & B1\|B3B2 | \|\|B1B2B3 | \|< A1F2.5B3 | \|>A2P7&B5!B8 |
| **INFIX** | B1&(B2\|B3) | B1\|B2\|B3 | (A1< F2.5)\|B3 | (A2>P7)\|(B5&(!B8)) |

The logical expression can contain the parameters listed in the following summary table. The maximum length of a logical expression is limited to 17 characters.

| | |
|---|---|
| **AX** | Analog channel value X |
| **aX** | Analog channel alarm X |
| **eX** | Analog channel error X |
| **PX** | Set point parameter X value (FLOAT only) |
| **CX** | Analog channel X counter value per measurement interval |
| **MX** | Status of manual control of analogue channel X |
| **BX** | Binary channel value X |
| **bX** | Binary channel error X |
| **mX** | X binary channel manual control status |
| **SX** | SMS status (fulfilled / not fulfilled) |
| **sX** | SMS confirmation: 0=confirmed, 1=waiting for confirmation |
| **I12** | Integer constant in the range -1024 to 1023 (I12 = 12) |
| **F3.21** | Decimal constant of 3.21 |

| | |
|---|---|
| **!** | Negation of a logical expression |
| **&** | AND operator of a logical expression |
| **\|** | OR logical expression operator |
| **^** | XOR logical expression operator |
| *** / + -** | Mathematical operations between numbers (integer and decimal form of a number) |
| **<>** | Number comparison operators (integer and decimal forms of numbers) |
| **=** | Number equality operator (integer and decimal forms of numbers) |
| **~** | Number inequality operator (integer and decimal forms of numbers) |

### 2 Output function

Binary output signal mode setting

- **Direct**
  The binary output copies the evaluation of the logic function.
- **Monostable (pulse)**
  Monostable flip-flop circuit with pulse length determined by the value of parameter *3Delayed -switching* with repeated start from the rising edge of the logic function being evaluated.

- **Bistable (RS)**
  Satisfying the logic condition of this function switches the binary output. The output remains switched until the reset command arrives, i.e. until the parameter *5-Reseting input* parameter on pg. 161.
- **Delay**
  The switching on or off of the binary output is delayed by the value given by the corresponding parameter (*3-delayed switching on, 4-delayed switching off*) from the moment of the change of the logic function state.
- **Oneshot**
  Monostable flip-flop circuit with a switching time given by parameter *3-Delayed switching* from the first rising edge of the logic function being evaluated.
- **Type T - divider 2**
  Each rising edge of the evaluated logic function changes the state of the output.



### 3 Delayed On* [sec]

Setting the time delay for switching the output from the moment the switching condition is met. The Delayed switching parameter is set in seconds with a resolution of 0.1 sec in the range of 0 to 86400 sec (=1 day).

### 4 Delayed Off* [sec]

Setting the time delay for shutting down the output from the moment the shutdown condition is met. The Delayed shutdown parameter is set in seconds with a resolution of 0.1 sec in the range of 0 to 86400 sec (=1 day).

### 5 Reseting input

Reset input for selection 12-11-2 "Output function - Bistable (RS)". Disabling the reset input disables the enabled binary output and also prevents it from being enabled again for the duration of the reset input being enabled.

***Setting the dosing relay in the DV2 module in conditional operation***

**Example 18.**

*Set relay 4 in the external module DV2 with address 1 to switch the dosing pump in a 5 sec run / 55 sec pause only if the sump level (ACH2) is at least 150 cm high and the pH value (ACH3) falls below 5.3 pH. These level and pH limit values should be quickly adjustable via the operating parameters.*

**Set SP:**

| ***Set point parameter SP[1]:*** | ***Set point parameter SP[2]:*** |
|---|---|
| • ***SP type:*** *Float number* | • ***SP type:*** *Float number* |
| • ***Set point label:*** *limit level* | • ***Set point label:*** *pH limit* |
| • ***Units:*** *m* | • ***Units:*** *pH* |
| • ***Floating points****: 0.00* | • ***Floating points:*** *0.00* |
| • ***Value:*** *0.15* | • ***Value:*** *5.30* |

**Set:** ***Setting parameters for communication with DV2:*** *4-4-2 IO Module on page 210.*

**Set BCH16:**

- ***Binary label:*** *5s-course, 55s-pause (auxiliary virtual BCH)*
- ***Mode:*** *Output-virtual*
- ***Storing:*** *on* ***Function:*** *Up time/Down time*
- ***Up time:*** *5* ***Down time:*** *55*

**Set BCH17:**

- ***Binary label:*** *DV2-ADR1-RELE4 (output BCH for controlling relay 4 in the DV2 unit)*
- ***Mode:*** *Output - IO Module* ***Storing:*** *on*
- ***Address-B:*** *1 (IO module order)* ***Input/Output:*** *4*
- ***Function:*** *Logic function* ***Output Function:*** *Direct*
- ***Logic function in prefix:*** *&> A2P1&B16< A3P2 ( the level value on ACH2 will be > Set point parameter SP[1] and at the same time BCH16 will be switched on and at the same time the pH value on ACH3 will be < SP[1])*

### 12-12 Security



Output mode for object security (binary output for alarm notification).

#### 1 Outgoing delay* [sec]

The exit delay blocks the alarm for the time required to leave the building from the moment the blocking input is deactivated. The parameter can take values in the interval from 0 to 86400 sec (=1 day).

#### 2 Incoming delay* [sec]

The arrival delay blocks the alarm for the time required to activate the blocking input. The parameter can take values in the interval from 0 to 86400 sec (=1 day).

#### 3 1. alarm input
#### 4 2. alarm input
#### 5 3. alarm input
#### 6 4. alarm input

The logical OR of four alarm inputs (any switched input) activates the switching of the set binary output. The output can be deactivated in the long term by means of a latching input or in the short term by setting an exit or arrival delay.

#### 7 Blocking input

The set binary output will not be switched on (alarm is declared) during the time the interlock input is switched on.

## 3-2-13 Actions



List of options that allow more efficient setting of the parameters of the recording binary channels by moving, copying or disabling them (= option 13-1 Default settings !).

**Note that all subsequent selections are made immediately after selection without further confirmation questions.**

### 13-1 Default settings !

This option initializes all binary channel parameters and the channel becomes inactive (turns off).

### 13-2 Move channel !

This option transfers all settings of the current channel to the position of the target channel given by the parameter 13-4"Target channel". The original channel becomes inactive (switches off).

### 13-3 Copy channel !

This option transfers all settings of the current channel to the position of the target channel given by the parameter 13-4 "Target channel". The original channel with all parameters set will be retained.

### 13-4 Target channel

The number of the target binary channel to move or copy the binary channel being set. The default value of this parameter is 0 and a valid value of this parameter must be entered before any action (channel move, channel copy, production channel setup).

### 13-5 Channel setting lock [0/1]

A binary coefficient that blocks changes to the parameters of the channel being set for users with privilege 2 or lower. Only a user with permission 3 or higher can activate this parameter.

# SP settings




## 3-3 Set points

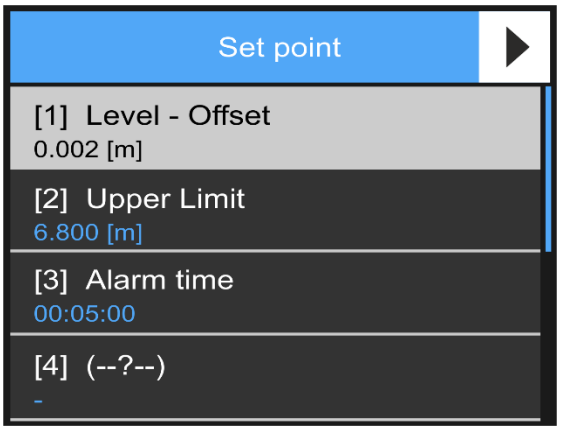
Option for initial definition of up to 48 Set point parameters.

In order to change a Set point parameter, it is first necessary to define its properties: the type of the parameter (decimal number, time, date, text), its name, units of measure, number of decimal places and set the initial value of the defined parameter.

For more information on the operating parameters, see chap. 11.2 Set point on p. 101.

### 3-3-1 Set point parameters

Select one of 48 Set point parameters. The individual Set point parameters are marked with an ascending numerical series [1] to [48]. Undefined and unnamed parameters are indicated by a Set point label with the symbol (--?--).




#### 1-1 Mode SP

Parameter type selection.

##### 1 Disabled

Deactivation of a Set point parameter already set. The Set point label and other options will be preserved, only the SP cannot be changed from the 1st MENU of the instrument.

##### 2 Float number

The parameter will be changed and set as a number with a fixed Floating points. The number of decimal places will be determined by the setting of the parameter 3-1-4 Floating points on page 125. This option is also used to change the time interval entered in seconds.

##### 3 Time (24h)

Option for setting the Set point parameter as a time interval. The parameter will be changed and set in the format HH:MM:SS in the interval from 0 sec to 24 hours.

#### 4 Time (31d)

Option for setting the Set point parameter as a time interval. The parameter will be changed and set in the format DD-MM:SS in the interval from 0 minutes to 31 days.

#### 5 Date and Time

Option to set the Set point parameter to a specific date and time. The parameter will be changed and set in the format YYYY/MM/DD and HH:MM:SS.

#### 6 Binary

Setting 0/1. Parameter usable for example as input for a logical condition.

#### 7 Float ENG

The parameter will be changed and set in the scientific format x.xxxxxE±yy in the range from 3.4E-38 to 3.4E+38.

#### 8 Label

Only the parameter Set point label can be filled in, which then serves, for example, as a parameter group separator in the list of 48 Set point parameters.

### 1-2 Set point label

Name of the Set point parameter - up to 25 characters adjustable from the keyboard displayed on the instrument display.

### 1-3 Units

Setting the measurement units of the Set point parameter by selecting from a wide list of more than 160 predefined units of measure.

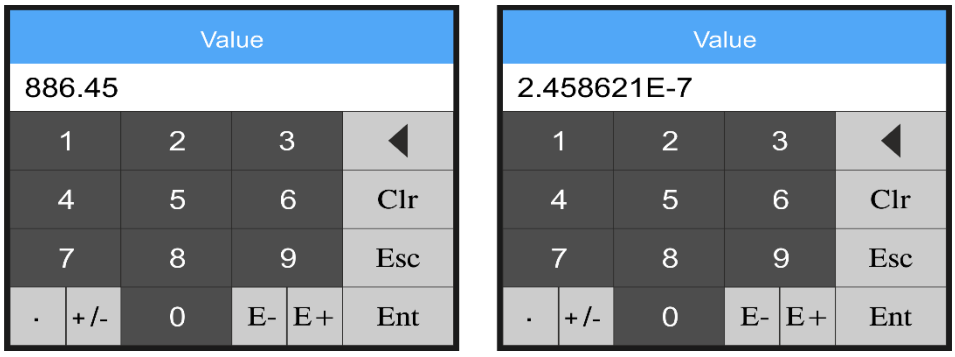
Special units of measure not included in the list can be specified by setting text parameters *2-1-13 Custom units [U1]* or *2-1-14 Custom units [U2]* on p. 105.

### 1-4 Floating points

Set the number of decimal places of the Set point parameter by selecting from 0 to 3 decimal places (0; 0.0; 0.00 and 0.000) for the Set point parameter type *2 Float number*.

### 1-5 Value

Set the desired numeric value of the Set point parameter for Set point parameter types *2-Float number* or *7-Float ENG* .




*Windows for setting the numeric value of the Set point according to the parameter type.*

- If the Set point parameter is of type *2-Float number*, then the number of decimal places of the Set point parameter being set is given by 3-1-4 Floating points on page 125 and the parameter can take values from 0.000 to 100,000,000,000.
- If a Set point parameter of type *7-Float ENG* , then this Set point parameter can take values from 3.4E-38 to 3.4E+38.

### 1-6 Value binary

Set the desired binary value (0/1) of the Set point parameter type *6-Binary* .

### 1-7 Time (interval 24h) [HH:MM:SS]

Setting the time interval for the Set point parameter type *3-Time (24h)* in the range of hours, minutes and seconds. The parameter value setting window allows setting the time in the interval from 00:00:00 to 24:00:00.

### 1-8 Time (interval 31d) [DD-HH:MM]

Setting the time interval for the Set point parameter type *4-Time (31d)* in the range of days, hours and minutes. The parameter value setting window allows setting the time in the interval from 0 minutes to 31 days.

### 1-9 Date [YYYY/MM/DD]

Setting the date of the Set point parameter type *5-Date and Time* .

### 1-10 Time [HH:MM:SS]

Setting the time of the Set point parameter type *5-Date and Time in the range 00:00:00 to 23:59:59*.

***SP Set point parameters setting***

**Example 19.**

*Set the binary channel so that its output controls the sump pump via RELE1 of the connection board according to the level measured on channel ACH3 in metres. The pump will turn on at the level given by SP "On Level" and turn off at the level given by SP "Off Level". The initial setting of these two SPs will be 2.4 m and 0.2 m (see figure on previous page).*

**Set SP:** ***Setting the 1st Set point parameter:***

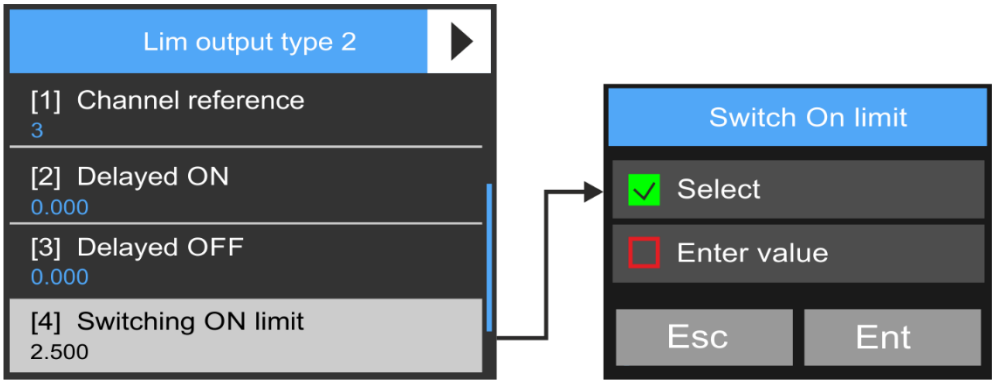
- ***Mode SP:*** *Float number*
- ***Set point label:*** *Switch-on level*
- ***Units****: m* ***Floating points:*** *0.0*
- ***Value:*** *2.4*

***Setting the 2nd Set point parameter:***

- ***Mode SP****: Float number*
- ***Set point label:*** *Switch-off level*
- ***Units****: m* ***Floating points:*** *0.0*
- ***Value:*** *0.2*

***Binary channel settings:***

- ***Mode:*** *Output - Local (relay)*
- ***Input/Output:*** *1 (RELE1)*
- ***Function:*** *Limit output type 2*
- ***Channel reference:*** *3 (ACH3 level measurement)*
- ***Switching On limit:*** *From the list:* ***Switch-on level*** *(SP[1])*
- ***Switching Off limit:*** *From the list:* ***Switch-off level*** *(SP[2])*






# 3-4 Controller

The H7 unit's software allows independent parameter setting of up to 4 programmable controllers. The following overview shows the parameters of one of the controllers. The parameters of all 4 controllers are identical and can be set independently.

**The PID controller** belongs to the continuous controllers, consisting of proportional, integration and derivative parts. In control systems it is placed before the controlled system. A setpoint value (setpoint parameter) enters the controller.

The output of the controller is an analogue channel with the measurement method set: controller.

In practice, it is not always necessary to set up a complete PID control, but often a simpler P or PI control is sufficient:

The P controller is usually chosen for less demanding applications where permanent control deviation is not a problem and a simple and inexpensive solution is preferred.

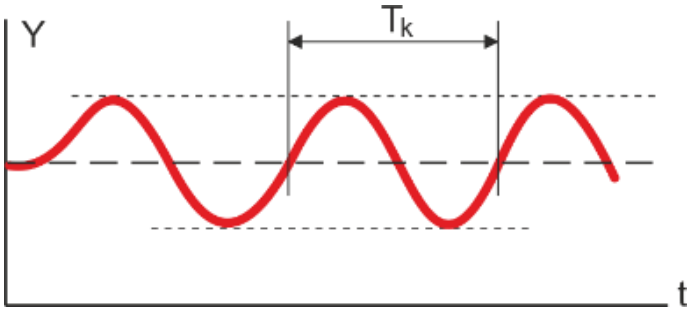
The PI controller is one of the most commonly used controllers and is chosen for medium duty applications where it is required to operate without permanent control deviation.

The PD controller is not used very often; as far as the permanent control deviation is concerned, it behaves the same as the P controller, but the D component amplifies its response to the rate of change of the control deviation, so it is suitable for not very demanding control of fast processes.

The PID controller is suitable for demanding applications, works without permanent control deviation and is able to regulate well even fast processes.

## SETTING CONTROLLER PARAMETERS ACCORDING TO ZIEGLER AND NICHOLS

1. Disable the I and D component of the controller (set these parameters = 0)
2. Gradually increase the gain of the controller (parameter P) until the circuit begins to oscillate with undamped oscillations in response to a fault. The gain thus obtained is called the Critical Gain $P_k$
3. Subtract the period of undamped oscillations T from the waveform of the controlled variable $_k$.




The course of the regulated variable with undamped oscillations to obtain $P_k$ and $T_k$

4. Use $P_k$ and $T_k$ to calculate the P, I and D factors from the equations in the following table, depending on which type of controller will be set (PI controller has D factor=0).
5. Insert the new P, I, D factors calculated in this way into the controller parameters in the ACH.

| Type of controller | P factor | I factor | D factor |
|---|---|---|---|
| **P** | 0,50 * $P_k$ | 0 | 0 |
| **PI** | 0,45 * $P_k$ | 0.54 * $P_k$ /$T_k$ | 0 |
| **PID** | 0,62 * $P_k$ | 1.24 * $P_k$ /$T_k$ | 0.194 * $T_k$ /$P_k$ |

*Empirical findings and frequently used constants for the calculation of PID factors according to ZN*

## 3-4-1 Controller mode

Switching off or selecting the mode of the controller being set.

### 1-1 Off

The controller is off.

### 1-2 PID

PID controller selection.

## 3-4-2 PID



### 2-1 Set value*

Set the desired magnitude of the regulated variable. The parameter can be a specific number or operating parameter or a value from another analog channel. The last option, where the controller is controlled by the value of a given analog channel, requires setting the parameter 2-10 "Set value A channel".

### 2-2 P factor* [%]

Proportional control parameter that determines the response of the controller to the magnitude of the control deviation. Increasing the proportional constant of the controller increases the gain of the controller, i.e. the control deviation decreases at the cost of possible controller instability.

### 2-3 I factor* [sec]

An integral control parameter that determines the response of the controller to the duration of the control deviation. The parameter value is set in sec.

### 2-4 D factor* [sec]

Derivative control parameter that determines the response of the controller to the rate of change of the control deviation. The parameter value is set in sec.

### 2-5 Max. Iterm

Parameter limiting the integral component of the controller. It is entered as a positive number and the unit adjusts it to a bipolar quantity (e.g. setting the parameter Max_I_component=100 will limit the integration at -100 and at +100).

### 2-6 Output Offset

After resetting the unit, the controller output is set to the size of this parameter. By default this parameter is = 0.

### 2-7 Error gain

Amplification of control deviation. By default this parameter is = 1.

### 2-8 B reset channel

Setting the binary channel blocking number. If the specified binary channel is switched, the PID output will be set to 0 and the integration component of the controller will be reset at the same time.

### 2-9 Feedback A channel

Selection of the analog channel whose value is to be equal to the parameter using a controller-controlled process 2-1 "Set value*", or the value of the analogue control channel specified by the parameter 2-10 "Set value A channel".

### 2-10 Set value A channel

Selection of analog channel for PID controller control. The size of the analog value on this channel enters the control as the desired value to be acquired by the controlled variable.

A zero value for this parameter disables control according to the channel value and returns control of the controller being set to the value specified by the parameter 2-1 "Set value*".

***Pump control by frequency converter during pumping tests***

**Example 20.**

*Set up the PID controller and ACH needed to control the frequency converter of the pump located in the borehole. The pump will be controlled to a constant flow rate regardless of the borehole level by a 4-20 mA signal from the H7 unit. A flow meter with pulse output (ACH1) is connected to the H7 unit. Analog channel ACH2 will be the controller output, channel ACH3 will control the 4-20 mA current output.*

**Setting ACH1: (Flow)**

***Important parameters:***

- ***Quantity:*** *flow*
- ***Measuring method:*** *Pulse counter*
- ***Units:*** *l/s*
- ***Floating points:*** *2*
- ***Counter:*** *on*
- ***Units Counter:*** *l (litres)*
- ***Decimal points:*** *2*
- ***Input-A:*** *1 (PIN1 input on the connection board)*
- ***Signal Amplification:*** *1 (pulse weight - 1 liter /pulse)*
- ***Aggregation before storing:*** *last value*

**Setting ACH2: (controller output)**

***Important parameters:***

- ***Quantity:*** *Optional*
- ***Measuring method:*** *Regulator*
- ***Input-A:*** *1 (1st controller out of 4)*

**Setting ACH3: (4-20 mA output)**

***Important parameters:***

- ***Quantity:*** *Optional*
- ***Units:*** *%*
- ***Measurement method:*** *Curren output 4-20 mA*
- ***Inputs->Interface advanced:*** *1 (IOUT1 output number)*
- ***Inputs->Input-A:*** *2 (reference analog channel number)*
- ***Signal->Signal amplification:*** *20000 (max range of reference ACH values)*
- ***Signal->Offset Delta:*** *-10000 (zero offset)*

**Regulator settings:**

***Initial setting of controller parameters:***

- ***Controller mode:*** *PID*
- ***Set value:*** *e.g. 0.5 l/s*
- ***P factor:*** *100*
- ***I factor:*** *0*
- ***D factor:*** *0*
- ***Max Iterm:*** *10000*
- ***Output Offset:*** *0*
- ***Error gain:*** *1*
- ***B reset channel:*** *0*
- ***Feedback A channel:*** *1 (channel number with flow measurement)*
- ***Set value A channel:*** *0 (setpoint is controlled directly, see 2nd item above)*

**Tuning the controller**

*Gradually increase the gain by the P factor until the system reaches steady undamped periodic oscillations. This gives the critical gain Pk and the period Tk.*

*In our case, this occurred at the amplification "P factor =400" with period "Tk=5sec".*

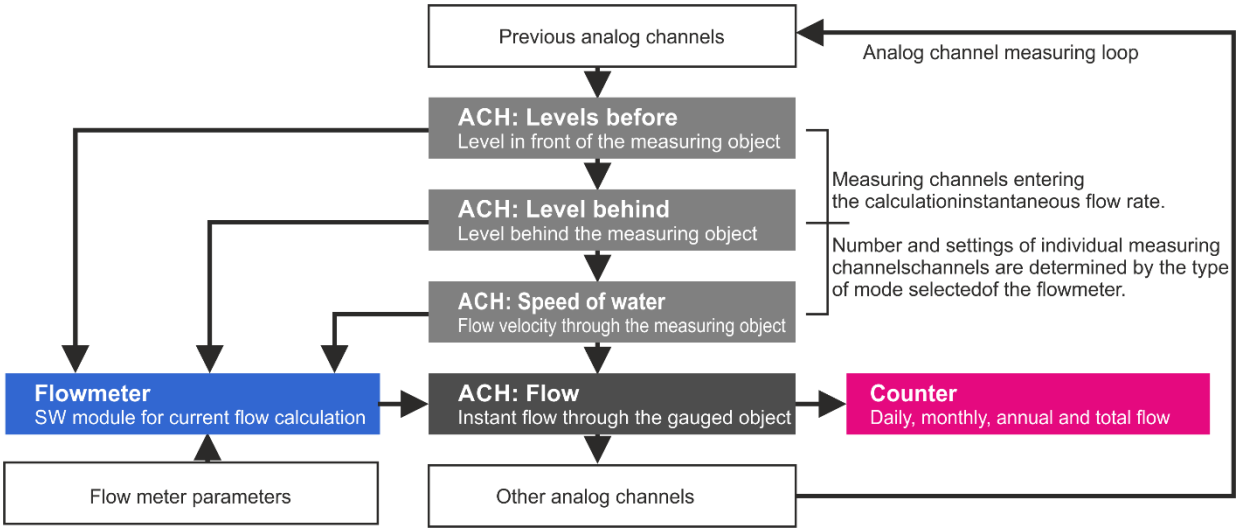
*From the empirical table above, we calculate the new coefficients:*

- ***P factor*** *= 0,62 * Pk = 0,62 * 400 =* ***248***
- ***I factor*** *= 1,24 * Pk/Tk = 1,24 * 400/5 =* ***99,2***
- ***D factor*** *= 0.194 * Tk/Pk = 0.194 * 5/400 =* ***0*** *(round 0.002 to 0)*

Flow meters

# 3-5 Flow Meters

Menu for setting the parameters of up to 4 instantaneous flow meters in open profiles or in a piping system. The adjustable flow meter parameters allow flow rate calculation using the consumption equation and the velocity probe. The parameters of all 4 flowmeters are independent of each other. The following figure illustrates the setup and calculation sequence of each analog channel required to correctly calculate instantaneous flow and leaked volume.




*Block diagram of analog channel setup for open profile flow measurement*

For the correct operation of the flowmeter it is important to maintain the sequence so that the input values (level, velocity) are measured first and then the flow rate is calculated.

### CHANNEL FOR CALCULATION OF INSTANTANEOUS FLOW AND VOLUME

Flow rate is set as Measured variable, Flow meter is set as Measuring method. Next, in the Input submenu, the input number must be entered according to the number of the flowmeter used in the range 1... 4. As long as the flowmeter is not completely and error-free set, the analogue flow channel displays a measurement error.

## 3-5-1 Flowmeter mode

Choice of how to measure instantaneous flow in one of the four available modes.

### 1-1 Off

The selected flowmeter will be switched off.

### 1-2 Weir

Calculation of instantaneous flow using the consumption equation from the water level measured in a gauged spillway or flume. The method includes predefined commonly used Parshall and Venturi gauged troughs and gauged spillways.

### 1-3 Area - Velocity

Calculation of flow rate as the product of cross-sectional area and cross-sectional flow velocity.

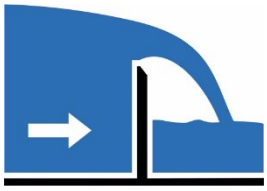
### 1-4 KDO

Calculation of instantaneous flow rate using a velocity probe and level sensor in a defined open or pipe profile. This mode is only functional in the Q2/KDO unit and even in this unit a maximum of one flow meter can be set in KDO mode.

### 1-5 DVP

Calculation of the flow rate as the product of the cross-sectional area and the cross-sectional flow velocity measured by the DVP.

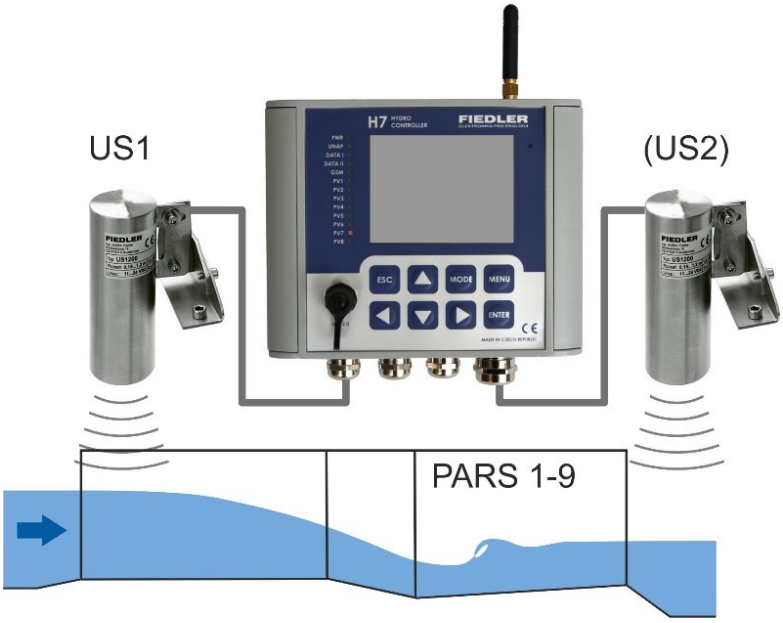
## 3-5-2 Weir



Flowmeter mode The outlet object calculates the instantaneous flow based on the Q/h curve. This can be entered using a table of values with up to 50 rows, one of five consumption equations, or by selecting a typed specific flow object from a list.

### 2-1 Level channel

Set the number of the analogue channel that measures the level in the measurement profile (ultrasonic level sensor US1 in the adjacent picture).




In addition to the ultrasonic level sensor, a submersible strain gauge level sensor is also often used with a measuring range adapted to the height of the measuring trough/spillway (the sensor can have a measuring range of 0.4 m; 0.6 m and 1.0 m).

### 2-2 Correction channel

The measurement of the second level after the measuring profile (ultrasonic sensor US2) can eliminate the flow measurement error caused by backflow on the outlet of the measuring profile (e.g. during floods or after clogging of the outlet channel by debris) according to ČSN ISO 9826. In the vast majority of installations, the correction channel does not need to be measured or adjusted. In this case, the parameter "*Correction channel*" must be set to 0. For the correct function of the flow correction in case of imperfect overflow, the coefficients C1 to C3 must also be entered (see description of these parameters in the following text).

### 2-3 Computation type

Choice of consumption equation type, table Q=f(H) or predefined simple and composite trough/overflow.

#### 1 Table

Setting the dependency between level and instantaneous flow rate with a table dependency of 50 rows. The table can only be entered using Most4. Both level and flow rate are set in the selected units of measure as a floating point number.

#### 2 Custom 1

The instantaneous flow rate will be continuously calculated by a consumption equation of the form:

$$\mathbf{Q = A1*(h+A3)^{A2}}\ [m3/s\ ,\ m]$$

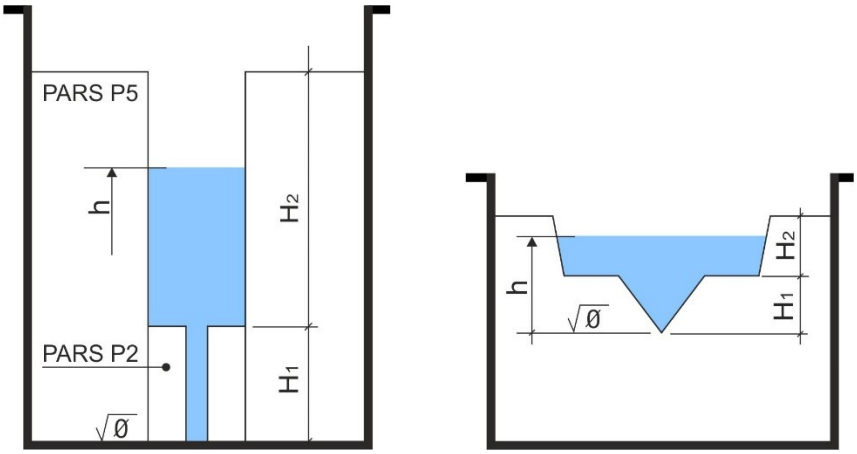
This is the most commonly used equation Q=f(H) for non-compounded gauge gutters and overflows. This consumptive equation is used to calculate the flow rate for all predefined gauge structures listed in this list of weir types.

#### 3 Custom 1+2

Option for two composite gauge troughs or overflows.

The flow is loaded until the lower gauge object of height H1 is filled according to the consumption equation given in the previous section (coefficients A1, A2, A3).

After the lower gauge is filled, the total flow of the composite gauge object will be increased by the flow measured by the upper gauge object (coefficients A4, A5, A6).




*Examples of two combined measurement objects. The first figure shows the Parshall trough P2 built into the larger trough P5. The second figure shows a Cipoletti spillway combined with an equilateral triangular spillway.*

The consumption equation of such a composite gauge object has the form:

**Q=(A1*(h+A3)^A2)+A4*(h-H1+A6)^A5) [**m3/s , m]

Coefficients A1 to A6 and H1 are entered in the Coefficients submenu. If the level is less than H1, the coefficient A4 is set to zero.

## 4 Custom 1+2+3

Option for three composite gauge troughs or overflows.
The instantaneous flow rate will be continuously calculated by a consumption equation of the form:

**Q=(A1*(h+A3)^A2)+(A4*(h-H1+A6)^A5)+(A7*(h-H2+A9)^A8) [**m3/s , m]

The coefficients A1 to A9 , H1 and H2 are entered in the Coefficients submenu. If the level of h is less than H1, the coefficient A4 and A7 are set to zero. If the level of h is less than H2, the coefficient A7 is set to zero.

## 5 Custom 1or2

Sequential switching of two curves according to the parameter Level H1.
The instantaneous flow will be continuously calculated by the consumption equations of the form:

| | | |
|---|---|---|
| for Hmin < h < H1: | **$Q = A1*(h+A3)^{A2}$** | [m3/s , m] |
| for h > H1: | **$Q = A4*(h-H1+A6)^{A5}$** | [m3/s , m] |

## 6 Custom 1or2or3

Sequential switching of three curves according to the parameter Level H1 and Level H2.
The instantaneous flow rate will be continuously calculated by a consumption equation of the form:

| | | |
|---|---|---|
| for Hmin < h < H1: | **$Q = A1*(h+A3)^{A2}$** | [m3/s , m] |
| for H1 < h < H2: | **$Q = A4*(h-H1+A6)^{A5}$** | [m3/s , m] |
| for h > H2: | **$Q = A7*(h-H2+A9)^{A8}$** | [m3/s , m] |

The coefficients A1 to A9 , H1 and H2 are entered in the Coefficients submenu.

The following list of predefined standardized gauge troughs and overflows contains the preset coefficients A1, A2 and A3.



## PARSHALL TROUGHS

The Parshall metering flume is classified as a long-neck flume and is used primarily on sites with a balanced range of flows. For larger flow ranges, combination Parshall flumes are appropriate.

The advantage of this measuring trough is that the overflow depth (head) is measured in a tapering profile where the velocity increases and the streamlines are more stable. Any sediment is deposited on the bed of the channel prior to the gauge flume and therefore this method of measurement is not susceptible to sedimentation and during increased flows the suspended solids will be washed away behind the Parshall flume.

Use the following option 7 to 15 to automatically adjust the coefficients A1, A2 of the consumption equation according to the size of the Parshall trough P1 to P9.

| | | | | | |
|---|---|---|---|---|---|
| 7 | PARS P1 | 10 | PARS P4 | 13 | PARS P7 |
| 8 | PARS P2 | 11 | PARS P5 | 14 | PARS P8 |
| 9 | PARS P3 | 12 | PARS P6 | 15 | PARS P9 |

The Parshall trough consumption equation**:**

$$Q=A1*h^{A2}\ [m^3/s; m]$$

The preset coefficients A1 and A2 are for an ultrasonic level sensor located in the centre of the flume in the direction of flow **at a distance B'** from the beginning of the flume neck. At this point, there is still a minimal drop in level and the reflected ultrasonic signal is correctly returned to the transducer.

For easy and quick installation of the ultrasonic transducer, the transducer holder DUP1 to DUP9 can be ordered together with the transducer and adapted to the dimensions of the Parshall trough and the technical requirements of the ultrasonic transducer (measuring range of the transducer, size of the deadband, radiation angle).

**Example 21.**

***Flow meter setting for Parshall trough P2***

*Set the analog channels for flow measurement through the Parshall trough P2. The level will be measured by the ultrasonic transducer US1200 connected to input AIN4. The outflow conditions downstream of the flume are satisfactory and therefore no correction for backwash will be made.*

**Important parameters:**

***Channel settings ACH5 - Level:***

- ***Quantity:*** *level*
- ***Analog label:*** *PARS P2 level*
- ***Units:*** *m*
- ***Floating points:*** *0.000*
- ***Measuring method:*** *probe ASCII/U*
- ***Input-A:*** *4 (AIN4)*
- ***Offset Delta:*** *according to zero calibration*
- ***Regular storing:*** *global*

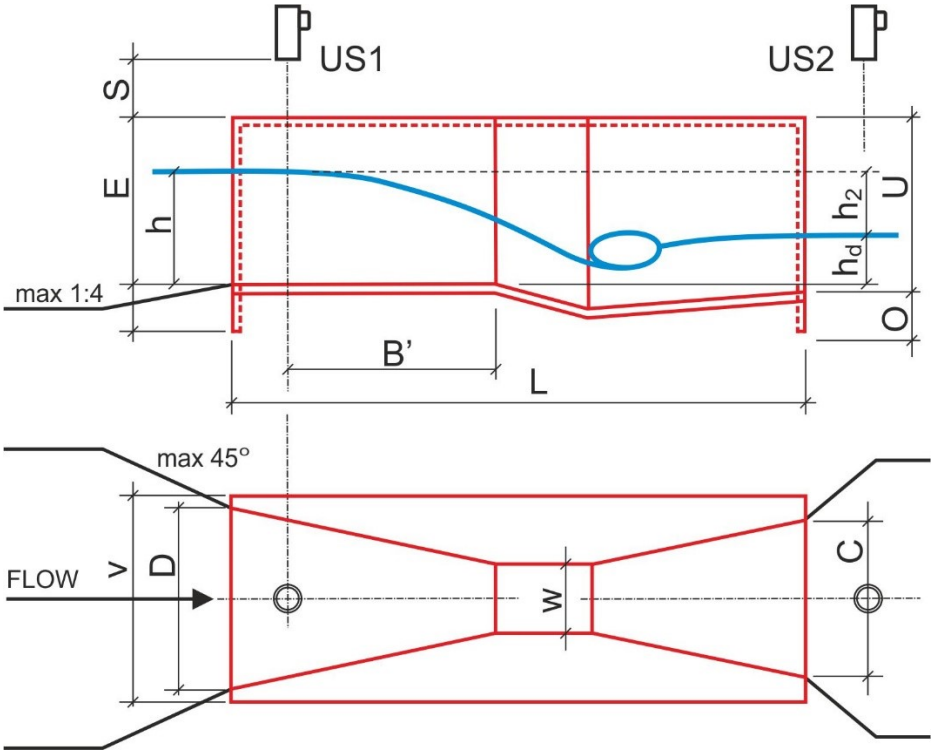
***Channel settings ACH6 - Flow:***

- ***Measured quantity:*** *flow rate*
- ***Analog label:*** *Outflow*
- ***Units:*** *m3*
- ***Floating points:*** *0.000*
- ***Measurement method:*** *Flowmeter*
- ***Counter:*** *on*
- ***Unit Counter:*** *$m^3$*
- ***Decimal points:*** *0.0*
- ***Input-A:*** *1 (Flow Meter 1)*

***Flowmeter 1. settings:***

- ***Flowmeter mode:*** *Weir*
- ***Level channel:*** *5 (ACH5)*
- ***Correction channel:*** *0 (not measured)*
- ***Computation Type:*** *PARS P2*

### *Parshall gauge troughs P1-P9:*




### *Dimensional table P1-P9:*

| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 |
|---|---|---|---|---|---|---|---|---|---|
| **Qmin [l/s]** | 0,26 | 0,52 | 0,78 | 1,52 | 2,25 | 2,91 | 4,40 | 5,80 | 8,70 |
| **Qmax [l/s]** | 6,22 | 15,1 | 54,6 | 168 | 368 | 598 | 898 | 1211 | 1841 |
| **$h_d$ / h [-]** | | 0,5 | | | 0,6 | | | 0,7 | |
| **W [mm]** | 24,4 | 50,8 | 76,2 | 152,4 | 228,6 | 304,8 | 457 | 610 | 914 |
| **B' [mm]** | **300** | **340** | **390** | **530** | **725** | **1200** | **1300** | **1350** | **1500** |
| **C [mm]** | 92,9 | 135 | 178 | 394 | 381 | 610 | 762 | 9144 | 1219 |
| **D [mm]** | 168 | 214 | 259 | 397 | 575 | 845 | 1026 | 1207 | 1572 |
| **E [mm]** | 230 | 264 | 467 | 620 | 800 | 925 | 925 | 925 | 925 |
| **L [mm]** | 635 | 775 | 915 | 1524 | 1626 | 2867 | 2943 | 3019 | 3169 |
| **U [mm]** | 248 | 286 | 492 | 696 | 876 | 1001 | 1001 | 1001 | 1001 |
| **V [mm]** | 307 | 354 | 399 | 540 | 800 | 1000 | 1200 | 1400 | 1800 |
| **O [mm]** | 46 | 64 | 82 | 191 | 191 | 176 | 176 | 176 | 176 |
| **S [mm]** | 180 | 180 | 180 | 200 | 200 | 200 | 220 | 250 | 250 |
| **m [kg]** | 9 | 10,6 | 19,1 | 49 | 81 | 146 | 183 | 231 | 252 |
| **Holder US** | DUP1 | DUP2 | DUP3 | DUP4 | DUP5 | DUP6 | DUP7 | DUP8 | DUP9 |

### *Legend to figure and table:*

**US1** ultrasonic level sensor entering the ACH: Level channel
**US2** ultrasonic level sensor entering the ACH: Correction channel
**Qmin** minimum measurable flow [l/s]
**Qmax** maximum measurable flow [l/s]
**h** depth of water at distance B' in front of the throat [mm]
**$h_d$** depth of water behind the trough (to the level of the bottom of the front part of the trough) [mm]
**$h_d$ / h** maximum groundwater flooding ratio [-]



## VENTURI GAUGES

troughs are classified as throatless troughs, where the behaviour of the streamline is less stable than in troughs with a throat. The level measurement at the spillway is placed at a greater distance in front of the flume - usually 3*h (three times the spillway depth). In principle, Venturi flumes require longer stilling and transition lengths than Parshall flumes.

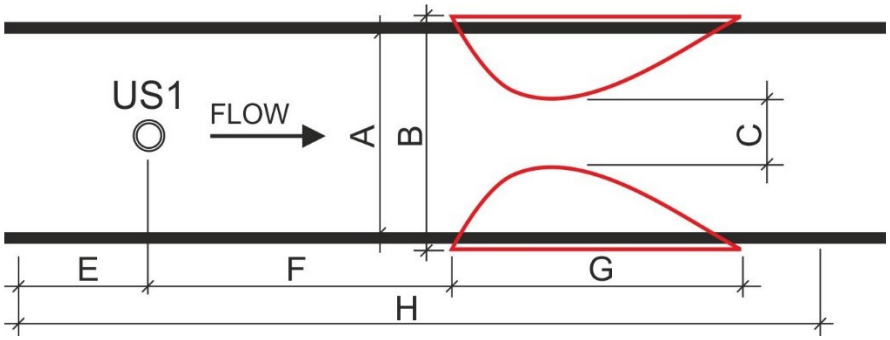
Use the following option 16 to 20 the coefficients A1, A2 of the consumption equation are automatically set according to the venturi size from MVŽ10 to MVŽ40. The number in the name of the measuring trough expresses its width at the narrowest point of the trough expressed in cm.

16 MZV10
17 MZV15
18 MZV20
19 MZV30
20 MZV40

Venturi consumption equation: **$Q=A1*h^{A2}$ [$m^3$ /s; m]**

Preset coefficients A1 and A2 are for an ultrasonic level sensor located in the centre of the flume in the direction of flow at a distance of three times the maximum possible level in the flume. The distance of the transducer from the throat should therefore be in the range of 1,5 m to 5 m.

***Venturi troughs:***




*Dimensions of a standardized venturi trough.*

***Dimensional table MVŽ10 - MVŽ40:***

| | MVŽ10 | MVŽ15 | MSY20 | MVŽ30 | MVŽ40 |
|---|---|---|---|---|---|
| **Qmax [l/s]** | 32 | 75 | 190 | 430 | 530 |
| **A [mm]** | 300 | 400 | 600 | 800 | 1000 |
| **B [mm]** | 410 | 510 | 700 | 900 | 1120 |
| **C [mm]** | 100 | 150 | 200 | 300 | 400 |
| **E [mm]** | 2000 | 2000 | 2000 | 2000 | 3600 |
| **F [mm]** | 1000 | 1000 | 1600 | 1600 | 2200 |
| **G [mm]** | 900 | 1080 | 1605 | 1935 | 3755 |
| **H [mm]** | 5300 | 5300 | 7800 | 8100 | 11000 |
| **A1 [-]** | 0,23034 | 0,32319 | 0,42165 | 0,61394 | 0,75986 |
| **A2 [-]** | 1,61639 | 1,58694 | 1,56049 | 1,54407 | 1,54739 |

***Legend to figure and table***

**US1** Ultrasonic level sensor entering the ACH: Level channel
**Qmax** Maximum measurable flow [l/s]
**A, B** Inflow channel width and construction width of the venturi [mm]
**F** Recommended distance of the ultrasonic probe in front of the trough [mm]
**E** Minimum reassuring length of the channel in front of the measuring point [mm]
**H** Celk minimum required channel length for the placement of MVŽxx [mm]
**A1,A2** Preset coefficients of the consumption equation [-]



## GAUGE SPILLWAYS WITH TRIANGULAR CROSS-SECTION

The oval triangular gauge overflows are often used in practice because of their simplicity and low cost. They are usually made of stainless steel sheet and their edge should be no wider than 1-2 mm to clearly define the point of separation of the overflow beam.

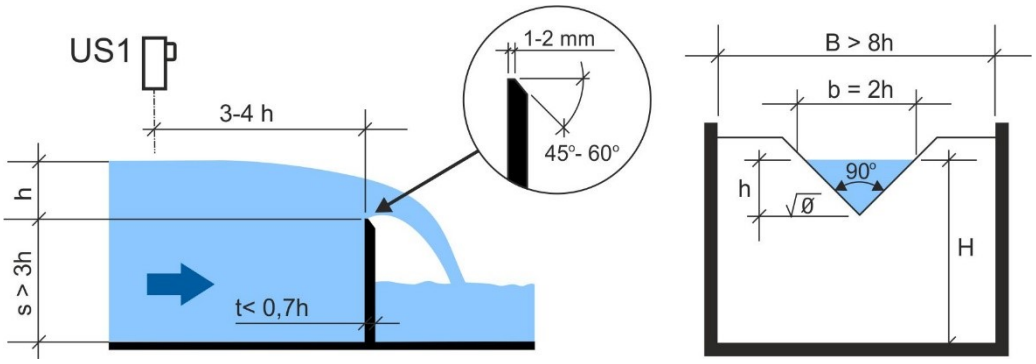
Overflows of this type are mainly used on sites with a large range of flows. The flow area increases quadratically with linearly increasing overflow height. The spillway is therefore highly sensitive to the correct adjustment of the measured level. The error in the setting is reflected in the calculation of the flow rate with a power of n = 2.5. When measuring the overflow head accurately, the triangular overflow is one of the most accurate flow meters.

Using the following up option, the coefficients A1, A2 of the consumption equation are automatically set according to the type of the gauge overflow from MTP90° to MTP30°. The number in the name of the measuring trough expresses the angle of the isosceles triangle.

21 MTP 90°
22 MTP 60°
23 MTP 45°
24 MTP 30°
25 Thomson 90°

Calculation equation of the specific triangular overflow: $\mathbf{Q=A1*h^{A2}}$ [$m^3$ /s; m]
The consumption equation is valid assuming: 0.05 < h < 0.55 m; S > 3h; B > 8h

***Thomson overflow:***




Overflows with an angle of less than 90° are used for accurate measurement of smaller flows.

| | MTP90 | MTP60 | MTP45 | MTP30 | MTP20 |
|---|---|---|---|---|---|
| **Qmax [l/s]** | 240 | 139 | 100 | 65 | 42,6 |
| **Angle α** | 90° | 60° | 45° | 30° | 20° |
| **A1 [-]** | 1,3310 | 0,7701 | 0,5533 | 0,3585 | 0,2363 |
| **A2 [-]** | 2,47 | 2,47 | 2,47 | 2,47 | 2,47 |

***Legend to figure and table:***

| | |
|---|---|
| **US1** | Ultrasonic level sensor entering the ACH: Level channel |
| **Qmax** | Maximum instantaneous flow for H = 0.5 m [l/s] |
| **H** | Measured level height from the top of the triangle [mm] |
| **A1,A2** | Preset coefficients of the consumption equation [-] |

***Any vertex angle:***

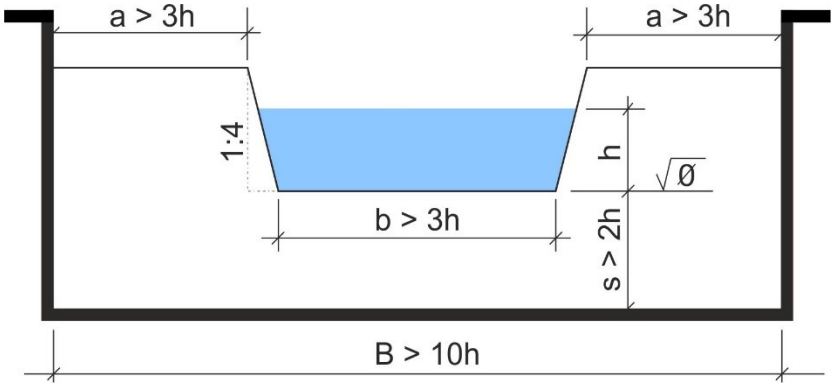
Consumptive equations for a triangular overflow with arbitrary vertex angle α ranging from 20° to 120° (according to Grave):

$$\mathbf{Q= 1.331 * (tg\ \alpha/2)^{0.996} * h^{2.47}}\quad [m^3/s; m]$$



## TRAPEZOIDAL AND COMPOUND SPECIFIC OVERLAYS

Among the frequently used pointed spillways in monitoring open flows in smaller streams and tributaries is the trapezoidal Cipoletti gauge spillway with 1:4 side walls.

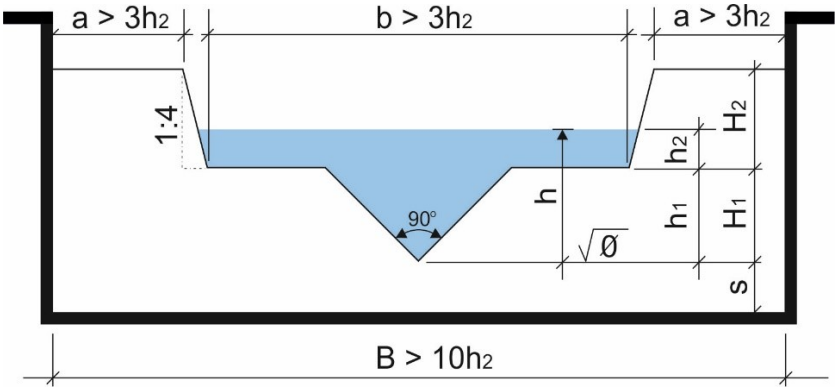



Consumption equation of the specific Cipoletti overflow: **$Q = 1.86*b*h^{1.5}$** [$m^3/s$; m]

The consumption equation is valid assuming: 0.05 < h < 0.55 m; S > 3h; B > 3h

### *Composite Cipoletti and Thomson specific overflow*

For measuring flow rates over a wider range, a composite Cipoletti overflow together with a Thomson triangular overflow is suitable. The Thomson spillway is used to measure smaller and medium flows, while the downstream Cipoletti spillway can accommodate the exceptional flow generated by a larger storm event.




Consumption equation of the composite gauge overflow:

**$Q = 1.3331*(h \text{ to } H_1)^{2.47} + 1.86*b*(h-H_1)^{1.5}$** [$m^3$ /s; m]

### *Flow meter setting for composite overflow*

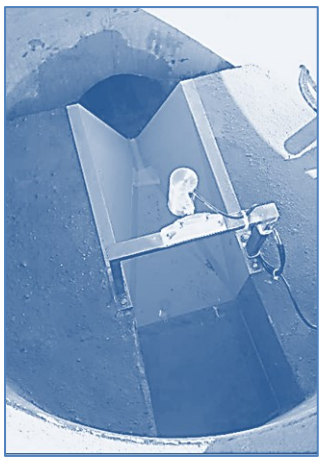
**Example 22.**

*Set Flow Meter #3 to measure the flow through the composite gauge overflow from the previous illustration. The level will be measured at ACH1.*

***Important parameters:***

***Flowmeter settings 3:***

- ***Flowmeter mode:*** *Weir*
- ***Level channel:*** *1 (ACH1)*
- ***Correction channel:*** *0 (not measured)*
- ***Computation Type:*** *Custom 1+2*
- ***H1:*** *$H_1$ (height of Thoms. overflow)*
- ***A1:*** *1,3546*
- ***A2:*** *2,4852*
- ***A4:*** *1,86*
- ***A5:*** *1,5*

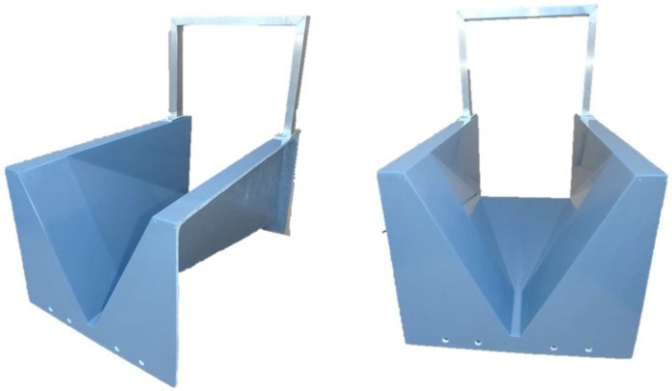


## BUILT-IN MEASURING TROUGH Z-PVK-1

The Ž-PVK-1 trough is designed for measuring the flow rates and flow volumes of raw surface water, seepage, precipitation and waste water. Due to its construction and material it is also suitable for measuring water from chemical industry. The advantages of using this measuring trough include in particular:

- small loss of gradient
- Flow measurement possible even with significant downstream flooding
- no or very little sedimentation in front of the measuring object
- self-cleaning capability
- large range of measured flow rates
- easy maintenance and long service life

The Z-PVK-1 metering trough consists of an inlet section with a rectangular cross-section with a width of 0.275 m and a structural height of 0.250 m. The rectangular cross-section transitions smoothly into the trapezoidal cross-section of the throat via planar surfaces. The length of the neck is 0,100 m. The neck is 0,015 m wide at the bottom. The bottom of the trough is horizontal.



***Mechanical design***

The measuring trough is made of fibreglass and high-quality polyester UV-stable resin with a thickness of approx. 3-4 mm. The inner surface is smooth - glossy grey. The mechanical design of the trough ensures sufficient resistance to wear, weathering and degradation by sunlight.

***Location of the ultrasonic level sensor***

The trough design includes a mounting bracket for the installation of the US1200 ultrasonic level sensor, which will thus be fixed in the longitudinal plane of symmetry of the trough and at an upstream distance of 0.325 m from the beginning of the trough neck. The height of the gauge trough is relative to the bottom level at the profile of the beginning of the neck.

***Consumption equation***

The calculation equation of the construction trough Ž-PVK-1 has the form:

**Q = 1.3476 - (Ha + 0.019)2.8796** [m3.s-1; m]

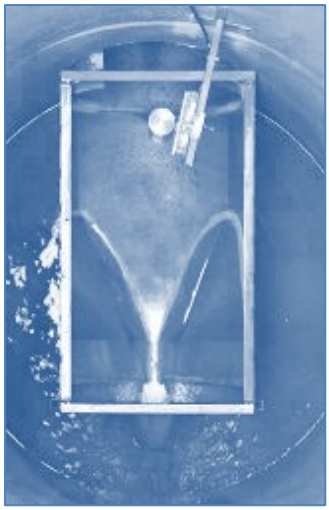
and is valid in the range of 0.03 m to 0.25 m which corresponds to 0.23 l/s to 31.2 l/s.

***Influence of the water level***

The onset of the influence of the bottom water level on the flow through the flume occurs at the critical ratio Hb/Ha = 0.60. This ratio should not be exceeded over the entire range of the gauge curve. The influence on the flow at ratios higher than 0,70 exceeds 5 %.

***Weight and dimensions***

Trough weight: 4.0 kg
Dimensions: Length: 0.550 m; width: 0.345 m; height: 0.285 m



**DIMENSIONAL BUILT-IN TROUGHS FR, FRP AND MZK**

type of trough is designed for free-floating systems with a circular profile in the bottom section or for pipe outlets in the free-floating section. The gutter is easily installed in existing sewer manholes and at the outlet of circular pipes.

Using the following up option, the coefficients A1, A2 and A3 of the consumption equation are automatically set according to the type of trough.

26 FR

27 FRP

The calculation equation of the construction trough has the form:

$$Q=A1*(h+A3)^{A2} \quad [m^3/s; m]$$

## 2-4 Coefficients

Setting the values of the individual coefficients of the consumption equations.
Parameters A1 to A9 are used to specify the coefficients of the Q-h curve. Those parameters that do not make sense for the given calculation are ignored.
Parameters H1 and H2 are used to specify the fracture levels for calculating complex shapes of the Q-h curve. They are entered in metres.

1 H min

Minimum level in [m] for flow calculation.

The parameter H min determines the minimum level in the profile from which the calculation will be performed. If the level is less than this value, the flow value is zero.

2 A1
3 A2
4 A3
5 H1
6 A4
7 A5
8 A6
9 H2
10 A7
11 A8
12 A9

H1, H2 = max. level in [m] of the first, second stage of the combined trough.
A1 to A9 = freely adjustable dimensionless coefficients of the consumption equation.

13 C1 [-]

Parameter C1 is used to correct the flow in case of imperfect overflow. It is entered as the ratio of the lower to the upper level, from which the empirical relationship for correction in imperfect overflow according to ISO 9826 starts to apply. The usual value is 0.5 to 0.8.

14 C2 [-]

Parameters C2 are used to correct the flow during imperfect overflow and are entered as the ratio of the lower to the upper level from which the empirical relationship for correction during imperfect overflow ceases to apply. The value shall be less than C1, usually by 5 to 10 %.

If the ratio of the lower and upper levels is higher than the set value, the flow rate calculation is not possible and a measurement error is signalled.

15 C3 [m]

The C3 parameter is used to correct the flow rate in case of imperfect overflow and is entered as the width of the flume neck in metres. If **C3 = 0**, the flowmeter does not correct the flow according to the empirical relationship, but sets it to zero flow when the flooding ratio exceeds **C1**. The flow measurement resumes when the flow rate drops below the flood ratio **C2**.

## 3-5-3 Area - Velocity




The Area-Rate mode of the flowmeter calculates the instantaneous flow rate as a multiple of the cross-sectional velocity and the cross-sectional area. The cross-sectional area is calculated based on the upper level height (H) using the selected calculation method or the level-area table.

### 3-1 Level channel

Set the number of the analog channel that measures the level in the gauge profile. The level channel can be measured in any unit of measure and the flowmeter module automatically converts the measured value to meters.

### 3-2 Speed channel

Set the number of the analog channel that measures the water velocity in the gauge profile. Similarly to the level channel, the velocity channel can be set to any unit of measure for velocity and the flowmeter module will automatically convert the measured value to m/s.

#### CROSS-SECTIONAL VELOCITY MEASUREMENT CHANNEL

Set only when calculating the flow rate from the flow velocity

The measured variable is set to Velocity, the measurement method is set according to the probe type and connection method. Units and Number of decimal places as required.

It is possible to set the Zero Band parameter, which suppresses the level measurement below its value. The correction equation parameters A0, A1 and A2 can be used to correct the measured velocity value. The Probe Settings menu can be used to automatically calculate the A0 and A1 coefficients. Otherwise, A0 = 0.0 A1 = 1.0 and A2 = 0.0.

### 3-3 Profile shape

#### 1 Table

Table parameters can only be entered using the Most4 program.

#### 2 Circle

Calculation of the area in the shape of a circular segment with height H. The diameter of the circular profile is entered in the Dimensions submenu as the 1st dimension.

#### 3 Rectangle

Rectangle: calculation of the area in the shape of a rectangle with height H. The width of the rectangular profile is entered in the following submenu Dimensions as a parameter 1st dimension.

### 3-4 Dimensions

#### 1 H min

The parameter H min determines the minimum level in the profile from which the calculation will be performed. If the level is less than this value, the flow value is zero.

#### 2 H sediment

The sediment parameter H determines the height of the sediment in the profile. The cross-sectional area is reduced by the sediment area

#### 3 1st dimension

#### 4 2nd dimension

#### 5 3rd dimension

#### 6 4th dimension

Parameter 1st dimension to 4th dimension are entered in meters and specify the dimensions of a circular or rectangular profile.




# 3-6 Calibration

*Probe Calibration* menu for initial setup of level probes and periodic calibration of connected electrochemical or optical probes and sensors.

A special function of the *Probe Calibration* menu is the "*Flowmeter Verification*" option, which is used to verify the correct function and settings of the selected flowmeter.

After selecting the *Probe Calibration* menu, the unit first displays an overview of all set analogue channels, including the measurement method and units of measurement used.

The first step is to select the desired analog channel for calibration, level setting or flowmeter verification, and then in the submenu 3-6-1 Select Calibration (p. 181), select the type of probe to be used from the list offered.

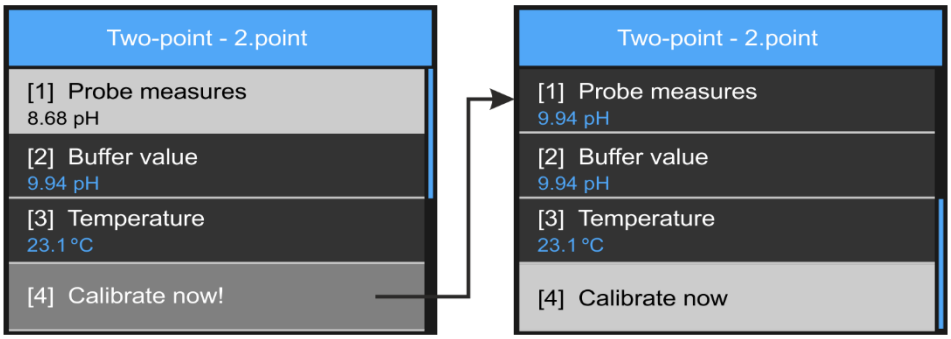
## SINGLE-POINT AND TWO-POINT CALIBRATION



The calibration of the connected probe can be single-point or two-point.

In **single point calibration**, the probe is placed in a calibration buffer or left in place and the actual value of the measurand is measured with another instrument.

In the second step, the buffer value or the desired measurement value of the analog channel being set is entered.




In the third step, after pressing the *Calibrate now! button,* the new additive or steepness coefficient of the correction equation is automatically calculated. Depending on the type of calibrated probe, this corrected coefficient is either written into the calibration unit (parameters A0-additive or A1-multiplicative) or sent via RS485 bus to smart probes like PH485, ISE485, ESKO12, ESK11, ESV11, ...

The new coefficients remain stored in the memory of the probe or unit until the next calibration, even if the power supply is removed from the instrument. The following descriptions of each calibration procedure will indicate which type of write of corrected coefficients the procedure uses.

***Two-point calibration***

**A two-point calibration** is basically a twice repeated single-point calibration at two different points of the measurand - usually in two different buffers, where the new corrected coefficients of the correction equation are stored only after the second calibration is completed by pressing the Calibrate Now button!

In contrast to the single-point calibration, the two-point calibration always resets both coefficients of the correction equation A0 and A1 (offset and steepness).

## CALIBRATION AND RECALIBRATION

***Recalibration and new sensor***

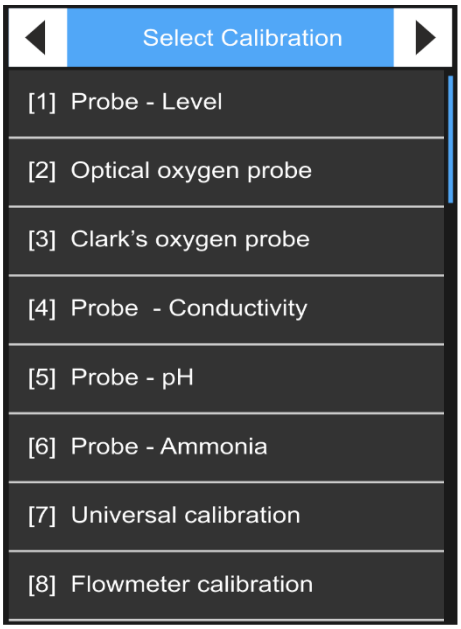
At the beginning of the calibration menu for electrochemical sensors there is a choice between recalibration and calibration of a new sensor. New sensor means the initial calibration of a new sensor or electrode, while recalibration is a repeated calibration performed at more or less regular intervals as needed during the aging of the sensor.

***Steepness tracking***

At the end of the calibration, the calculated value of the steepness calibration constant is stored in the memory as a reference value against which the newly calculated calibration constant will be gradually compared during the recalibrations. This ratio is displayed on the display of the calibration unit as a percentage change in steepness at the end of each recalibration and can alert the user to the end of life of the measuring electrode or sensor.

## 3-6-1 Select Calibration

Menu for selecting the desired sensor type to calibrate. Depending on the specification of the selected analog channel and the type of measuring unit, some options may be inactive. The sensor type to be calibrated is included in the title of each menu item.




### 1 Probe - Level

Adjust the measured level to the desired value using the additive coefficient A0 in unit H7. This calibration procedure can be used for all strain gauge, ultrasonic, float or radar level sensors (TSH22, TSH27, TSH37, LMP307, LMK809, US1200, US3200, VEGAPULS Cx, PILOTREK, ...).

### 2 Optical oxygen probe

Calibration of the optical dissolved oxygen sensor (ESKO12, S423/C/OP).

### 3 Calrk´s oxygen probe

Calibration of dissolved oxygen sensor with Clark sensor (ESK11).

### 4 Probe - Conductivity

Calibrating the ESV11 conductivity sensor.

### 5 Probe - pH

Calibration of the pH electrode (PH485, ESP11).

### 6 Probe - Ammonia

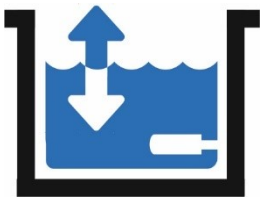
Calibration of the Ammonium ISE485 sensor

### 7 Universal calibration

Setting of any measured variable to the desired value using the unit coefficients A0 and A1.

### 8 Flowmeter calibration

Function to check the correct setting of the selected flowmeter. The function does not make any changes to the set parameters, it is only used to display the measured level, instantaneous flow rate and leaked volume for the selected time interval.





## 1-1 Probe - Level

Submenu to set the measured level to the desired value. After calibration, the additive parameter *Coefficient A0* in the calibration unit is set. The new calibration coefficient is not written to the connected sensor. The calibration of the level probe is thus actually a shift of the measured zero level.

### 1 Instant level

Display of the current measured level

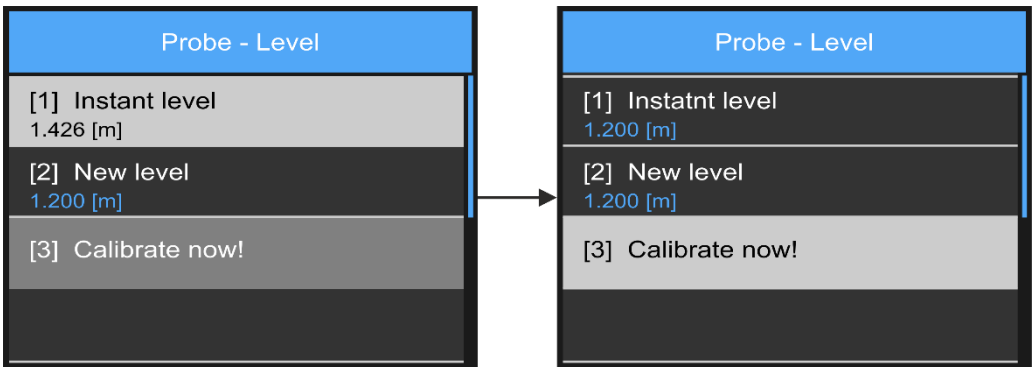
### 2 New level

Enter the desired level value to be measured. The new level value must be entered in the set units of measure for the channel.

### 3 Calibrate now !

When this option is selected, the additive coefficient of the analog channel being set is automatically recalculated so that the current level equals the desired new level value.

Calibration is performed only by shifting the measured value to the desired value using the *Coefficient A0* parameter of the H3, H7 or Q2 unit. The new calibration coefficient is not written to the connected level sensor.




*Calibration of the level probe to the desired value of 1,200 m.*

### USAGE:

The "Level Probe" calibration can be used not only for submersible strain gauge level sensors but also for radar or ultrasonic probes that sense the measured level from above by reflecting the transmitted pulse from the measured level. Similarly, the level measured by the PSH30 float level gauge can be levelled to the desired value using this function.

| Some selected level sensors | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
| Strain gauge sensor LMK809 | Ultrasonic transducer SPA590 | PSH30 float sensor | Radar sensor C11 | Ultrasonic transducer US1200 |

## 1-2 Optical oxygen probe

The ESKO12 and S423/C/OPT optical dissolved oxygen sensors are automatically calibrated by a self-programming procedure running inside the sensor, and thus do not require periodic calibration by the user.

After 1 to 2 years of operation, and whenever the exhausted CAP423 head is replaced with a head with a new phosphor, it is advisable to recalibrate the entire sensor.

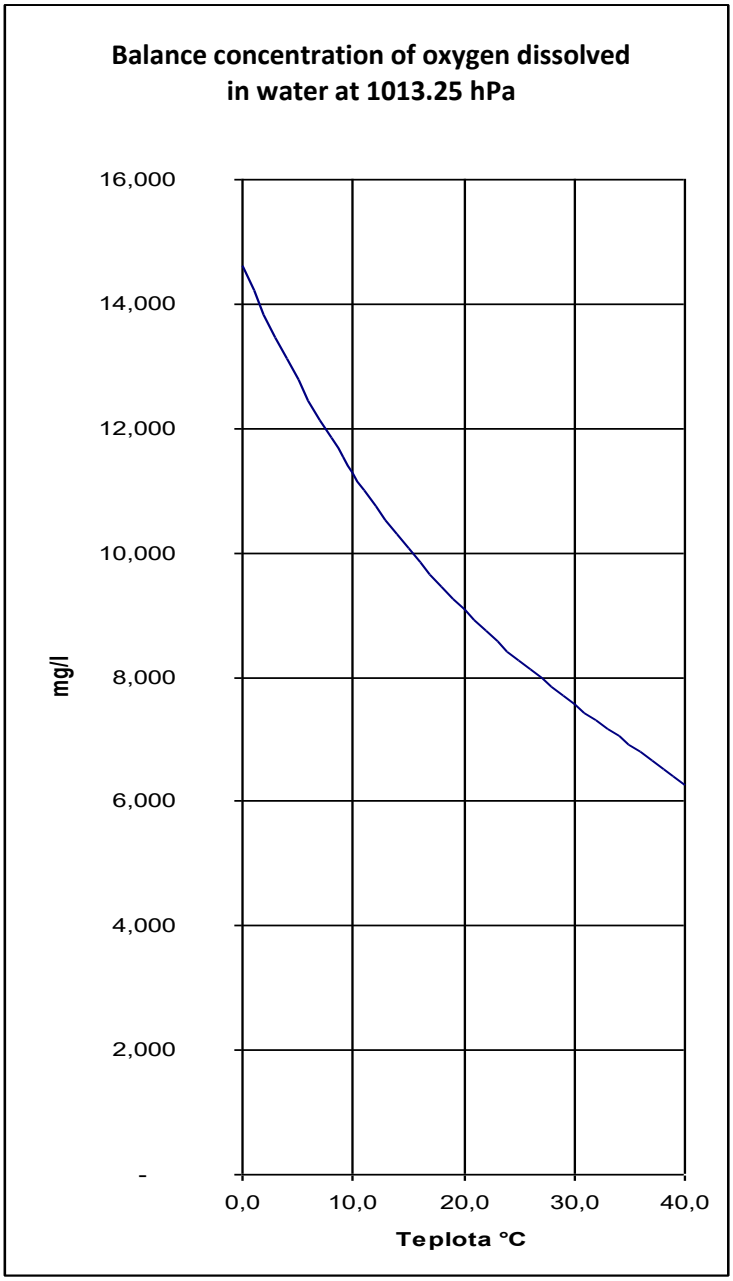
### CALIBRATION AT 100% SATURATION

Calibration can be performed in oxygen saturated water or in air saturated with water vapour. Due to the higher thermal conductivity of water, it is better to calibrate in water because the temperature of the sensor will settle more quickly to the temperature of the calibration medium. Both methods are equivalent in terms of the accuracy of the calibration performed.

For reference, the following table shows the maximum dissolved oxygen in water as a function of the temperature of the water. It is clear from the table that the most oxygen can be found in water at 0 ºC.

***Relationship between water temperature and maximum dissolved oxygen***

| Temperature | Dissolved oxygen |
|---|---|
| °C | mg/l |
| 0,0 | 14,624 |
| 1,0 | 14,225 |
| 2,0 | 13,841 |
| 3,0 | 13,472 |
| 4,0 | 13,118 |
| 5,0 | 12,779 |
| 6,0 | 12,453 |
| 7,0 | 12,141 |
| 8,0 | 11,841 |
| 9,0 | 11,554 |
| 10,0 | 11,279 |
| 11,0 | 11,016 |
| 12,0 | 10,763 |
| 13,0 | 10,521 |
| 14,0 | 10,289 |
| 15,0 | 10,067 |
| 16,0 | 9,854 |
| 17,0 | 9,650 |
| 18,0 | 9,454 |
| 19,0 | 9,265 |
| 20,0 | 9,084 |
| 21,0 | 8,909 |
| 22,0 | 8,741 |
| 23,0 | 8,579 |
| 24,0 | 8,422 |
| 25,0 | 8,270 |
| 26,0 | 8,123 |
| 27,0 | 7,979 |
| 28,0 | 7,839 |
| 29,0 | 7,702 |
| 30,0 | 7,567 |
| 31,0 | 7,435 |
| 32,0 | 7,304 |
| 33,0 | 7,175 |
| 34,0 | 7,046 |
| 35,0 | 6,917 |





The equilibrium concentration values given in the table are valid for an atmospheric pressure of 1013.25 hPa and with a change in air pressure there is a proportional change in the values of dissolved oxygen in 100% saturated water.

If the dissolved oxygen value measurement becomes stable so that the displayed value does not change any more in the interval of 5-10 minutes, calibration of the measured value can be performed using the connected H3, H7 unit.

## CALIBRATION TO THE DESIRED VALUE

Quick and convenient calibration can also be performed by setting the correct dissolved oxygen concentration value measured by another calibrated oximeter. The setting and calibration procedure depends on the type of control or display unit connected. The reference (desired) dissolved oxygen value must not be less than 1 mg/l.

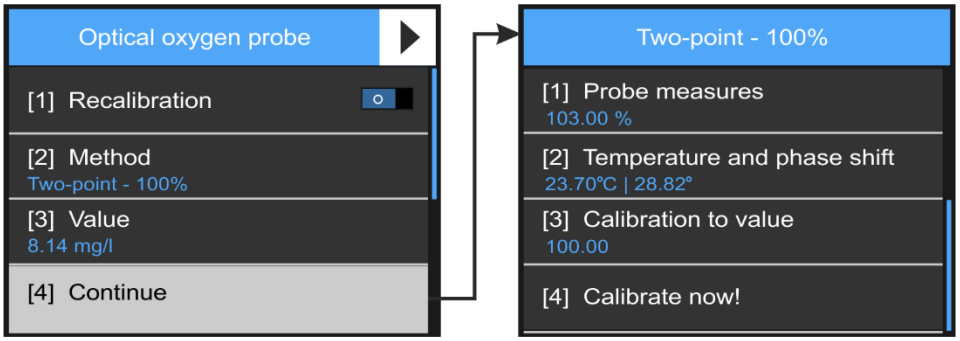
## STORING CALIBRATION CONSTANTS IN THE SENSOR

The sensor communicates with the connected unit H3, H7 over the RS485 bus under the MODBUS RTU protocol, over which it transmits the measured values to the unit. The unit communicates with the sensor during calibration over the same bus. At the end of the calibration, new calibration constants are stored directly in the sensor memory.

## CALIBRATION PROCEDURE



1. Gently clean the sensor head of dirt and deposits (when cleaning the phosphor target, use only a soft brush and cloth to avoid mechanical damage to the phosphor layer). See the sensor manual for more information.
2. Select the analog channel to be calibrated.
3. Enter submenu 1-2 Optical oxygen probe.




### 1 Recalibration [0/1]

### 2 Method

Turning off recalibration allows a full factory calibration of the probe at two points including temperature calibration or RESET of the probe calibration parameters (see previous figure). Turning recalibration on allows for a single point calibration to the setpoint or to 100% saturation per the equilibrium equation.

### 3 Value

Specify the reference value of dissolved oxygen in water (or temperature) to which the probe should be set.

### 4 Continue

Display of the measured value and the desired reference value. Wait for the measured value to settle.

### 5 Calibrate now!

Automatic calculation of new calibration coefficients so that the measured value matches the reference value and subsequent storage of the calibration coefficients in the memory of the calibrated probe.

## 1-3 Clark's oxygen probe

The ESK11 Dissolved Oxygen Sensor with Clark OC254 sensor requires periodic calibration at a frequency of 1 week to 3 months depending on the operating conditions of the sensor.

### SENSOR OC254

The OC254 sensor is a Clark-type oxygen sensor, consisting of a polarized (working) electrode in the shape of a platinum target on the sensor face and a non-polarized argent chloride electrode (anode). The working electrode is covered with a gas permeable Teflon film which separates the electrode system from other ions and adsorptive impurities in the solution to be measured. A polarisation voltage is applied between the two electrodes. Oxygen molecules depolarise the working electrode, increasing the electric current between the electrodes. The magnitude of the current is directly proportional to the partial pressure of oxygen and, in the usual measured solutions, also - by inference - to the concentration of dissolved oxygen.

The sensor is watertight screwed through a coaxial connector into the ESK11 sensor.

### SINGLE POINT CALIBRATION

The OC254 type oxygen sensor is calibrated by a single point calibration, in which the calculated or specified value of the calibration solution is compared with the measured value. After the measured value has stabilized, the user commands the automatic calculation of calibration constants to match the new measured value to the calibration solution and these new constants are automatically stored in the ESK11 sensor memory.

***The equilibrium equation***

Calibration is most often performed according to the so-called equilibrium equation. This determines the maximum amount of oxygen soluble in water for a given temperature. During the calibration, the calibration unit repeatedly calculates this maximum possible oxygen concentration from the measured temperature and recalculates the calibration constant at the end of the calibration so that the measured value is equal to the calculated dissolved oxygen value for the water temperature just measured.

***Calibration to a known value***

The calibration procedure of the M4016 allows calibration not only to the equilibrium equation but also to a known dissolved oxygen value. This can be pre-measured with another precision instrument and the measured value can then be entered as the value of the calibration solution.

The method of calibration to the desired value or to oxygen saturated water is similar to the calibration of the ESKO12 dissolved oxygen optical sensor described in the previous chapter.

### IMPORTANT CALIBRATION RULES

***ESK11 sensor with OC254 sensor:***



An alternative, but in practice the most common solution, is calibration to air oxygen. In this procedure, it is important to observe three rules that can greatly affect the accuracy of the calibration achieved:

- The first rule of thumb is to place the sensor's measuring diaphragm in a high huthat has a foam soaked in potable water (or is itself filled about a quarter full of water) and must be tempered to ambient (air) temperature for at least 15 minutes. An alternative solution is to place the sensor just above the water surface, where a consistently high humidity is also ensured. At the same time, it is advisable to shade the calibrated sensor and the temperature sensor from sunlight (the simplest solution is to place a wet cloth over the probe cover during the calibration period).
- The second rule of successful calibration is to tilt the probe from the vertical axis at an angle of 25° to 45° to prevent a droplet of dripping water from forming on the sensor membrane. The actual action of the sensor in making the measurement would deplete the dissolved oxygen from this droplet of water and such a calibration would result in a very inaccurate value of the calibration constant.
- The third rule relates to a sufficiently long time between removing the probe from the water and the command to calibrate, because the temperature of the temper-

ature sensor located in the stainless steel tube must be equalized with the temperature of the air, as well as waiting for the temperature of the membrane and the whole body of the oxygen sensor to equalize with the temperature of the ambient air. The evaporation of water results in significant cooling of the temperature sensor and membrane and it is therefore important to maintain high humidity during calibration. The time between pulling the probe and the end of calibration should be no less than 15 minutes.

## PREPARING A NEW SENSOR FOR CALIBRATION



The OC254 oxygen sensor is delivered filled and before first use it only needs to be screwed into the sensor body with the side wrench No.19. The tightening must be sensitive so that the lower o-ring on the sensor fits tightly on the sensor and does not break the plastic sensor body.

To check that the sensor is properly tightened into the sensor body, it is advisable to perform this assembly with the sensor connected to the unit on which the calibration procedure is running. This is because the second line of the calibration menu shows the sensor current in nanoamps. When the sensor is tightened, the displayed current value jumps from a low value (0-1 nA) to a current in the range of 10 to 100 nA (the exact value depends on the sensor design and the temperature and humidity).

## PREPARING AN OLDER SENSOR FOR CALIBRATION

***Cleaning the sensor***

Before any recalibration of an older sensor, it is first necessary to remove the sensor from the measuring point and clean the sensor of accumulated dirt. Rough cleaning of the working diaphragm must be avoided. After spraying the sensor with pressure water, it is advisable to wash off the last dirt from the diaphragm by rinsing it in clean water.

***Greater pollution***

The following cleaning solutions can be used to remove accumulated dirt:

- **Grease contamination** - detergents can be used. The use of organic solvents should be avoided.
- **Contamination by calcium deposits** and metal hydroxides - 10% hydrochloric acid
- **Sulphur contamination** - a mixture of 10% hydrochloric acid saturated solution of thiourea.
- **Protein contamination** - a mixture of 10% hydrochloric acid and saturated pepsin solution.

## OXYGEN SENSOR MAINTENANCE

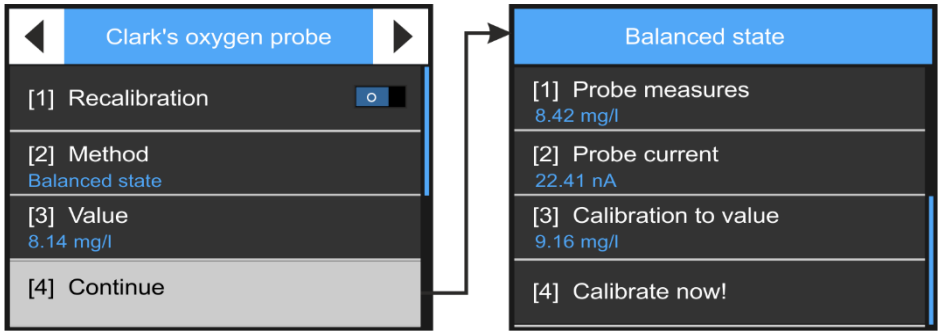
***Replacing the membrane***

The membrane of the OC254 oxygen sensor should be replaced once a year. Replacement should also be carried out earlier if the membrane is heavily clogged or mechanically damaged. The replacement diaphragm is supplied with the screw carrier as a single unit. It is advisable to order the electrolyte together with the replacement diaphragm. When replacing the diaphragm, proceed as follows:

1. The sensor is turned working part up, the carrier with the membrane is unscrewed and the used electrolyte is poured out of the sensor.
2. After repeated rinsing of the sensor with distilled water, a new electrolyte is filled to the edge of the sump, the axis of which passes through the glass part of the sensor.
3. The membrane carrier is then screwed on (it is threaded on and the membrane is tightened by turning until the cap is bent under the pressure of the glass shaft inside the sensor).
4. Finally, the sensor is turned membrane down and ready for calibration.

## CALIBRATION PROCEDURE

1. Gently clean the sensor head of dirt and deposits (when cleaning the membrane, use only a soft brush and cloth to avoid mechanical damage to the measuring membrane). Please refer to the sensor manual for more information.
2. Selecting the analog channel to be calibrated
3. Enter submenu 1-3 Clark's oxygen probe.




### 1 Recalibration [0/1]

Turning recalibration on or off only affects the calculation of the probe sensor's informative aging coefficient and not the actual calibration. When recalibration is turned off, the sensor coefficient is set to 100%, which corresponds to the current flowing through the sensor at steady state and 100% oxygen saturation of the water.

### 2 Method

Selection of a reference value between the steady state, i.e. 100 % oxygen saturation of the water, and a one-point calibration to a value specified in mg/l by another meter. The probe calibration coefficients can also be reset in this submenu.

### 3 Value

Specify the reference dissolved oxygen value to which the probe should be calibrated.

With the previous selection "Equilibrium state", the value is set automatically by calculating from the equilibrium equation, which determines the maximum possible amount of dissolved oxygen in the bubbled water for the temperature measured by the probe.

### 4 Continue

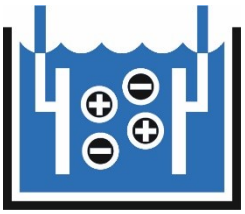
Calibration menu. The first line "Probe measuring" displays the measured dissolved oxygen value in mg/l. Before the actual calibration, it is necessary to wait for this measured value to stabilize (usually 10-20 min).

The "Probe Current" reading tells you the state of the Clark sensor membrane. A current value of less than 5 nA usually indicates clogging of the measuring membrane by deposited impurities or aging of the membrane and a requirement for replacement. A probe current greater than 40 nA may be caused by impurities in the coaxial connector of the sensor or a rupture of the measuring membrane.

"Calibrate to value" displays the set (single point calibration) or calculated (steady state) dissolved oxygen reference value set in the previous item of this menu.

### 5 Calibrate now!

Automatic calculation of new calibration coefficients so that the measured value matches the reference value and subsequent storage of the calibration coefficients in the memory of the calibrated probe.



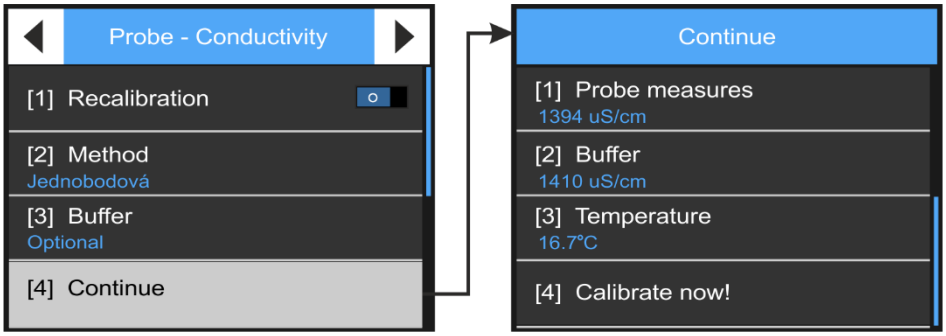
## 1-4 Probe - Conductivity

The ESV11 probe is designed to measure the conductivity and temperature of water in open surface streams or groundwater in boreholes and wells. For this reason, the individual measurement channels of the probe contain not only temperature-compensated (K2) and uncompensated (K4) conductivity, but also non-linear temperature-compensated conductivity on channel K3 according to ČSN EN 27888. After calibration of the sensor, any change in the measured conductivity value will be reflected in all measurement channels.



### CALIBRATION PROCEDURE

1. Cleaning the electrodes of dirt and deposits.
2. Selecting the analog channel to be calibrated
3. Enter the submenu: Conductivity Probe




### 1 Recalibration [0/1]

Enabling the Recalibration parameter is used for an older electrode or recalibration of a new electrode. At the end of each calibration, an aging coefficient is always calculated, the value of which, in percentage, represents the decrease in the steepness of the signal gain of the electrode compared to the new electrode (= 100%).

Disabling the Recalibration parameter causes this coefficient to be set to 100%.

### 2 Method

Choice of calibration types.

### 3 Buffer

Choice of preset buffers with defined conductivity or choice for setting an optional buffer (setting to a value measured by another conductivity meter).

### 4 Specify optional pH buffer

Set the value of the buffer used in units of uS/cm.

### 5 Continue

Button to call up the custom calibration screen.

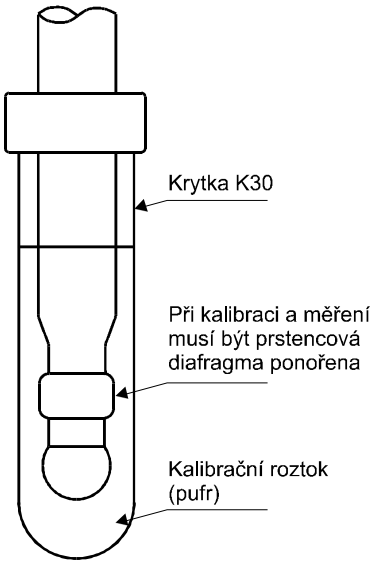
The individual lines of this calibration menu display the current measured conductivity value, the reference desired conductivity value and the temperature of the reference solution.

Before calling up the calibration with the button "Calibrate now ! " button, it is necessary to wait for the measured value to stabilize. After the calibration is called up, the new calibration coefficients are automatically calculated so that the measured value matches the reference conductivity value and the calibration coefficients are then stored in the memory of the calibrated probe.

## 1-5 Probe pH




The combined pH electrode type HC253 used in the PH485 probes and ESP11 sensors is calibrated by a one-point or two-point calibration, in which the specified value of the calibration solution (buffer) is compared with the measured value. After the measured value has stabilized, an automatic calculation of the calibration constants is performed at the user's command so that the new measured value matches the calibration solution.




***Single-point and two-point calibration***

In single-point calibration only the additive calibration constant is calculated, in two-point calibration the multiplicative calibration constant is also determined. The new calibration constants are automatically stored in the sensor for further calculations of the correct pH value.

The most commonly used two-point calibration requires sequential placement of the electrode in the selected buffers. Between buffer changes, it is important to rinse the electrode first with potable water and then with distilled water. For two-point calibration, it is common to use a buffer with a pH value closer to neutral 7 as the first calibration solution.

***Temperature correction of buffers***

The pH value of the normalised buffers depends on their temperature. In order to avoid having to look up the buffer value for a given temperature from the tables, the temperature dependencies of all common buffers are already stored in the M4016 calibration unit and the temperature-corrected buffer value is already displayed in the calibration window of the unit when the appropriate buffer is selected. The temperature is continuously measured by a built-in temperature sensor located either in the stainless steel tube next to the electrode (ESP11) or directly in the pH electrode body (PH485).



### PROBE PH485

The PH485 probe combines a combined high-precision and stable pH electrode type HC253 with partial self-cleaning capability and long lifetime with measuring and communication electronics into one compact unit. The probe has digital data output via RS485 bus under both FINET and MODBUS RTU protocols and can therefore be directly connected to the H3, H7 unit. The calibration coefficients are stored in the probe.

### ESP11 SENSOR

Unlike the PH485 probe, the ESP11 allows the pH electrode itself to be replaced at the end of its life. The actual measuring electronics are located separately from the probe at the top of the sensor. The ESP11 also communicates with the H3, H7 unit via the RS485 bus, so there is no significant difference between the two types of probe in terms of electrical connection or electrode calibration.

### ELECTRODE HC253C

***Electrode HC253C***



The front-mounted combined pH electrode type HC253C is part of the ESP11 sensor and is also included in the PH485 probe in a modified mechanical design. The electrode combines a glass pH electrode with a reinforced membrane and an argent chloride reference electrode, separated from the measured solution by a ring diaphragm. The electrode is designed for continuous operational pH measurement and control and can be used from the purest waters to polluted sewage and wastewater. The electrode has a self-cleaning effect.

### PREPARING A NEW ELECTRODE FOR CALIBRATION AND MEASUREMENT

the electrode is supplied filled with the reference electrolyte. After removal of the protective part, it shall be immersed for at least 15 minutes in distilled water, which may be acidified with a few drops of hydrochloric acid, or in a storage solution. After this time, the electrode is ready for calibration and measurement.

## PREPARING THE ELECTRODE TO BE USED FOR RECALIBRATION

First, the probe or sensor must be removed from the measuring point and the electrode cleaned of accumulated dirt. After spraying the electrode with pressurised water, it is advisable to wash off the last impurities from the electrode by rinsing it in distilled water.

***Greater pollution*** The following cleaning solutions can be used to remove accumulated dirt:

- Grease contamination - detergents or organic solvents (preferably acetone if effective) or e.g. diethyl ether can be used, in which the electrode including the diaphragm is soaked for about 30 minutes and then for about 1 hour in a KCL solution of 0.5 mol/l or in distilled water.
- Calcium deposits and metal hydroxides - 10% hydrochloric acid
- Sulphur - a mixture of 10% hydrochloric acid saturated solution of thiourea.
- Proteins - a mixture of 10% hydrochloric acid and saturated pepsin solution.
- Indeterminate diaphragm contamination/impermeability - degreasing using the above procedures and briefly dipping the electrode into the chromosulfur mixture.

**After using the cleaning solution, the electrode should be soaked in 3M KCL solution or at least distilled water for at least 3 hours.**

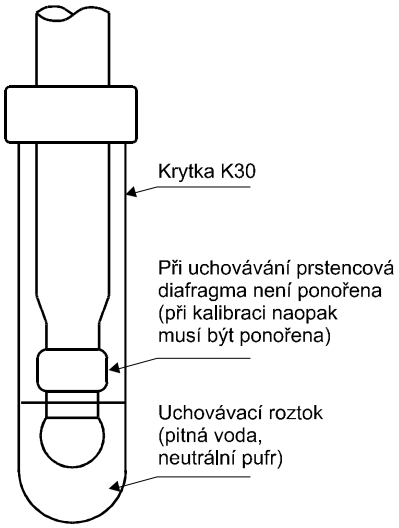
## REPLACING THE ELECTRODE IN THE ESP11 SENSOR

The built-in coaxial connector in the electrode head together with the watertight screw connection greatly simplifies the possible replacement of the electrode at the end of its life. Replacement is carried out after removal of the protective basket. The electrode is screwed into the sensor (probe) using a No.19 side wrench. The tightening must be sensitive so that the lower o-ring on the sensor fits tightly onto the sensor without overtightening the thread.

## REMOVING ANY INSTABILITY

The instability of the electrode is most often caused by contamination, which can be removed by the above procedures. After prolonged dry storage and when the KCL layer on the flask has been removed, the electrode should be soaked in potable water for at least 15 minutes to stabilize the electrode asymmetry. In certain cases, instability may be caused by an air bubble remaining inside the flask. The bubble should be moved over the flask by vaulting.

Short-term instability can also be induced by keeping the electrode in distilled water while the diaphragm is immersed. In this case, the instability can be removed by soaking the entire electrode including the diaphragm in a solution with a higher ionic strength (drinking water, dilute neutral buffer). Finally, the electrode is allowed to settle briefly in neutral buffer.




## SOAKED ELECTRODE STORAGE

If it is necessary to interrupt the measurement for some time, it is necessary to keep the electrode inserted in a K30 cap filled with ordinary drinking water. The cap is sealed and this ensures that the storage solution does not dry out.

An important prerequisite for optimal electrode function is that the ring diaphragm is not wetted when the electrode is held, unlike in the case of measurements, where the diaphragm must be submerged.

***Important notice*** **Apart from light cleaning, any manipulation of the ring diaphragm of the pH electrode should be avoided.**

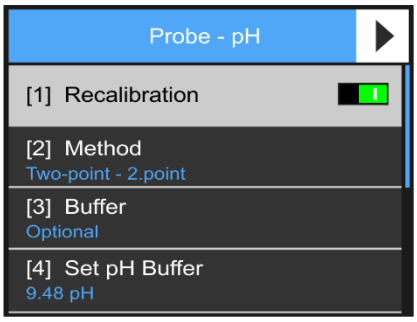
## PROCEDURE FOR CALIBRATING THE PH ELECTRODE

1. Gentle cleaning of the electrode from dirt and deposits. See the sensor manual for more information.
2. Selecting the analog channel to be calibrated
3. Enter submenu 1-5 Probe pH.

### 1 Recalibration [0/1]

Enabling the Recalibration parameter is used for an older electrode or recalibration of a new electrode. At the end of each calibration, an aging coefficient is always calculated, the value of which, in percentage, represents the decrease in the steepness of the signal gain of the electrode compared to the new electrode (= 100%).

Disabling the Recalibration parameter causes this coefficient to be set to 100%.




### 2 Method

Choice of calibration types:

[1] Single point

Calculation of the additive parameter A0 (measured value shift)

[2] Two-point - 1.point

[3] Two-point - 2.point

Calculation of additive A0 and multiparameter A1 parameter

[4] Coefficient reset

Setting the calibration parameters A0=0 and A1=1

### 3 Buffer

Setting the buffer value

[1] Optional
[2] 4.00 pH
[3] 6.86 pH
[4] 9.18 pH
[5] 10.00 pH

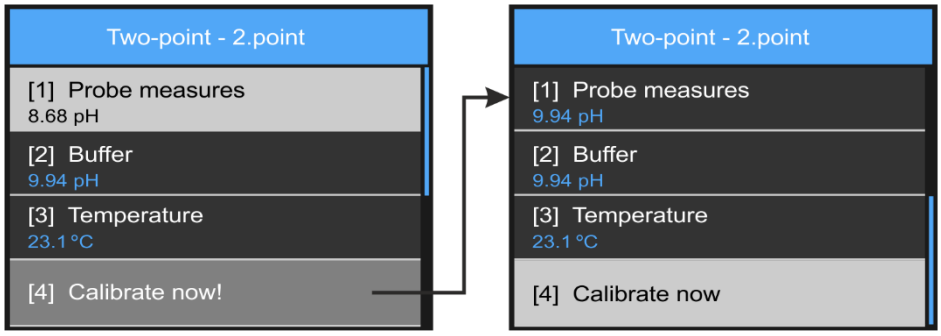
Choice of preset buffers or Optional buffer

### 4 Set pH buffer

Set the value of the buffer used in pH units. Instead of buffer, the pH value of the calibration solution or measurement medium measured by another pH meter can also be entered.

### 5 Continue

Button to call up the calibration screen:




After the measured value has been stabilized (line [1] Probe measures:") press the button "Calibrate now!" This calculates the calibration coefficients A0, A1 and stores them immediately in the memory of the connected PH485 probe (ESP11).

## 1-6 Probe Ammonia

## 1-7 Universal calibration



Submenu for setting any measured variable to the desired value. After calibration, a new additive parameter *Coefficient A0* or multiplicative parameter *Coefficient A1* is calculated and stored in the memory of the unit H3, H7. The calibration thus actually represents a shift or change in the gain of the measurand.

The new calibration coefficient is not written to the connected sensor, so that the value of any measured channel can be calibrated in this way, regardless of the type of measurement method.

### ADDITIVE OR STEEPNESS CALIBRATION

After selecting the channel with the calibrated measurand, it is necessary to determine which type of calibration will be required:

- **Additive calibration**
- **Steep calibration**

***Additive calibration*** After Additive Calibration, only the changed A0 coefficient is stored in the unit's memory and the A1 coefficient remains unchanged. Similarly, during Steep Calibration, only the A1 coefficient is changed.If it is necessary to set both coefficients to their default form (A0=0, A1=1), then select the Reset Coefficients option.

***Steep calibration*** If both A1 and A0 coefficients are required, then the calibration must be performed twice - once with the Additive setting of A0 and a second time with the Steepest setting of A1.



### CALIBRATION PROCEDURE

After selecting the calibration type, a screen will appear:

#### 1 Current value

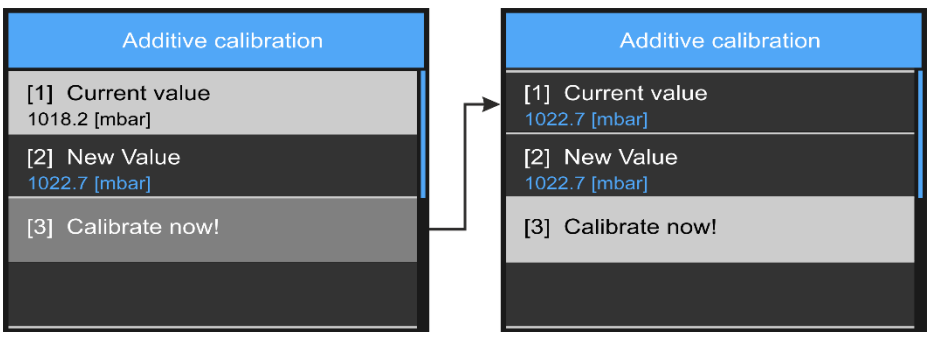
Display of the current measured value

#### 2 New value

Enter the desired value of the measurand to be measured. The new value must be entered in the set units of measure for the channel.

#### 3 Calibrate now

When this option is selected, the additive coefficient of the analog channel being set is automatically recalculated so that the current measured value equals the desired new value of the measured variable. The calibration is performed only by shifting the measured value to the desired value using the *Coefficient A0* parameter of the H3, H7 unit. The new calibration coefficient is not written to the connected measurand sensor.




*Calibration flow of the channel measuring atmospheric air pressure to the desired value*

## 1-8 Flowmeter calibration

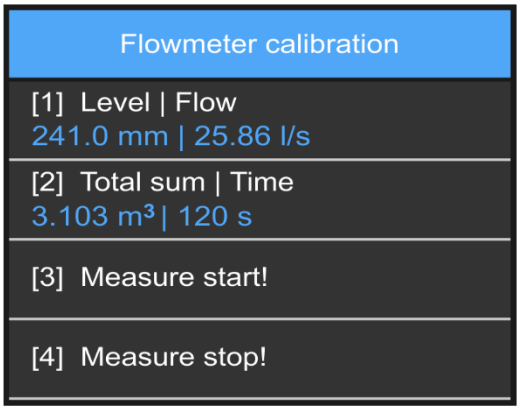


Overview screen for quick and easy verification of the correct function of the selected flowmeter of the Q2 unit. This procedure does not set or change any unit parameters, nor does it affect the total flow volumes of the set flow meters.

*The Flow Meter Verification* option is only active when the analog control channel with the associated flow meter is selected.

In addition to displaying the measured level and instantaneous flow rate, this menu also allows you to start and stop the cumulative leaked volume reading function after the desired time interval and thus verify the functionality of the correctly set integration of the total leaked volume of the flow meter being monitored.

The actual leaked volume counter in the Q2 unit is not affected by this verification procedure.




### 1 Level | Flow

Information bar for displaying the measured level and the corresponding instantaneous flow rate in blue font in the lower half of the information bar. The units of measurement and the number of decimal places are taken from the instrument's controlled flow meter settings.

The units of measure for the displayed level and instantaneous flow rate, including the number of decimal places, are taken from the analog channel settings (3-1-8 Counter, p. 128

If the function of an inductive or ultrasonic flowmeter without a level sensor is verified, the displayed level value will be permanently =0.

### 2 Total sum | Time

Information line for displaying the leaked volume of the selected flowmeter from the moment the verification measurement is started with the "Start measurement ! ". Along with the leaked volume, the integration time in sec from the start of the cumulative flow measurement is continuously displayed.

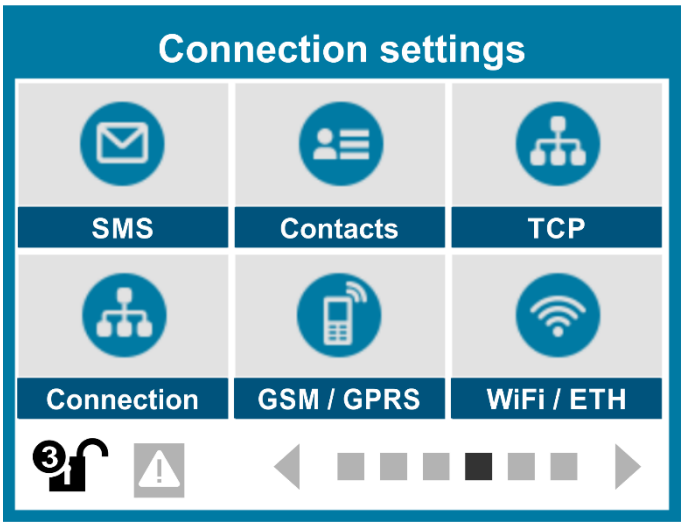
The units of flow volume, including the number of decimal places displayed, are taken from the settings of the flow meter being verified (3-1-8 Counter, p. 128).

### 3 Measure start!

Button to reset the leaked volume and integration time and to start a new control measurement.

### 4 Measure stop!

Button to stop the control measurement.




## 11.5. Parameters of communications

The Communications Parameters screen provides access to the settings for six groups of communication parameters for the unit. These are structured so that one group can always contain parameters focused on one common area: SMS settings, contact directory creation, communication port settings, GSM or WiFi/Ethernet communication module settings, etc. One of the following chapters is dedicated to each group.

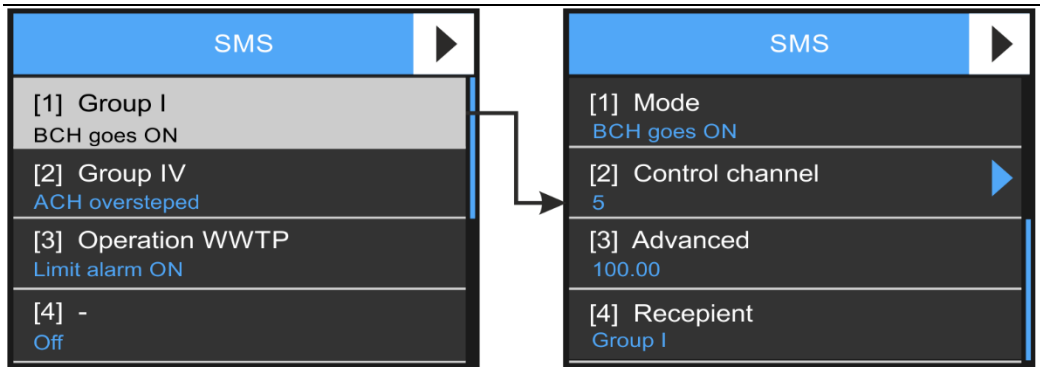



### 4-1 SMS [1..48]

The choice for theto set the parameters of up to 48 different warning and informative SMS that the unit can automatically send to selected recipients from the Contacts list after the activation conditions are met.

All individual parameters related to SMS messages are accessible after selecting the serial number of the selected SMS. The following picture in the first window shows the first four SMS messages out of the total of 48 messages that can be set by the user. The window opens after pressing the SMS button on the device screen.

***View individual SMS from list 1 to 48***




From the previous left window, you can see that the 1st, 2nd and 3rd SMS are set in the device. SMS 4 has not yet been set. After pressing the line with the serial number of the SMS, the right window of the previous figure opens, through which the individual parameters of the SMS message to be set can be accessed. A detailed description of the individual SMS parameters is given in the following chapter 4-1-1 on the following page.

***Command and query SMS***

In addition to SMS sent from the station to a given addressee, or even to a whole group of addressees, the SMS chapter also includes a description of commands sent by the user of from his mobile phone (or other opposite station) to the station - the so-called query and command SMS.

## 4-1-1 Outgoing SMS

Outgoing SMS are prepared in the unit parameters and sent automatically after the set activation condition is met. These are mostly informative and warning SMS. However, the outgoing SMS can also be a control SMS for another station using the FMD protocol.

### 1-1 Mode

Setting conditions for SMS activation.



#### 1 Off

SMS deactivation. The previously set parameters remain stored in the device memory and the SMS can be quickly re-enabled at any later time.

#### 2 BCH goes ON

SMS activation by switching the control binary channel.

#### 3 BCH goes OFF

SMS activation by disabling the control binary channel.

#### 4 ACH oversteped

SMS activation after the measured value of the analogue control channel exceeds the limit value.

#### 5 ACH dropped

SMS activation after the measured value of the control analogue channel is below the limit value.

#### 6 Counter oversteped

SMS activation after the counter size of the measured variable of the control analog channel exceeds the limit value.

#### 7 ACH error

Activation of SMS after detection of a measurement error of the analogue control channel.

#### 8 Limit alarm ON.

Activation of SMS at the beginning of the limit alarm of the analogue control channel.

#### 9 Limit alarm OFF

SMS activation at the end of the limit alarm of the analogue control channel.

#### 10 Gradient alarm ON

Activation of SMS at the beginning of a steep alarm of the analogue control channel.

#### 11 Gradient alarm OFF

Activation of SMS at the end of the steep alarm of the analogue control channel.

### 1-2 Control channel

Setting the binary or analog control channel number.

### 1-3 Advanced



Binary parameters for setting properties of sent SMS.

#### 1 Disable ident. insert [0/1]

Enable/Prohibit inserting the station name in the SMS text.

[1]=don't insert Analog label, [0]=insert Analog label

#### 2 Disable time insert [0/1]

Enable/command to insert the real time in the SMS text at the moment of sending

[1]=do not store real time, [0]=store real time

#### 3 Wait for ext. pwr to send [0/1]

Enable/Disable to send SMS only when external power is present.

[1]=do not send in case of external power failure, [0]=send even in case of external power failure.

#### 4 Wait for GSM to send [0/1]

Enable/Disable to send SMS only when the GSM module is switched on

[1]=do not send when GSM module is switched off, [0]=send SMS at any time (GSM module is switched on for the time needed to send GSM)

### 1-4 Recipient



SMS recipient settings. The individual recipients and their grouping is done in the sub-menu 4-2-1 "Contact".

1 Group I
2 Group II
3 Group III
4 Group IV
5 Group V
6 Group VI
7 Group VII
8 Group VIII

Setting the group of recipients to whom the SMS will be sent after its activation.

#### 9 SMS loopback

This option sends an SMS to the unit itself. It can thus send itself the command contained in the SMS based on the monitored event. For example, when data is sent to the server, when an alarm is exceeded, when a binary input is triggered, when the external power supply fails, etc.

#### 10 A selection of 48 contact phone numbers

Select one of the preset contacts.

### 1-5 Delay [HH:MM:SS]



The length of time that an activation condition on the control channel must be met continuously for the SMS to be sent. The usual size of this parameter in the order of tens of seconds can eliminate short-term overruns of trigger conditions on the control channel.

### 1-6 Limit

Set the analog channel limit value for the options 4 "ACH", 5 "ACH" or 6 "Counter over" from the option 1-1 "Mode". The Limit parameter is set in Control Channel units of measure.

### 1-7 Hysteresis

Setting the hysteresis value that can suppress repeated SMS sending when the measured variable moves close to the set limit value. The Hysteresis parameter is set in Control Channel units.

In mode 4 "ACH", SMS will be sent after the trigger condition is activated and after the parameter expires 1-5 "Delay [HH:MM:SS]". The next SMS will be sent after the measured value drops by the size of the Hysteresis parameter and after the Limit value is exceeded again. Similarly, the hysteresis parameter is applied in the 5 "ACH".

### 1-8 Text SMS



Any user configurable text up to 79 characters long. Before the text, the device can insert the device name and the time of sending the SMS depending on the parameter settings 1-3 "".

You can also enter the current analog channel value into the SMS text using the "#" character followed by a "V" or "v" (Value) and the ACH channel number.

***Strings to insert into SMS text:***

| | |
|---|---|
| **#VX** | The character string can be anywhere in the specified text and will be replaced by the current value of analog channel X including units at the time of sending the SMS |
| **#vX** | Extension of the previous option by the analogue X channel Analog label |

## 1-9 Action



A list of options that allow you to set SMS parameters more efficiently by moving or copying them. The first step is to fill in the parameter Destination SMS and then the selected action (Move SMS, Copy SMS or Production settings (delete)) can be performed.

### 1 Default settings !

This option initializes all SMS parameters and the SMS becomes inactive (turns off). Note that the SMS is initialized immediately after selecting this option without further queries.

### 2 Move SMS !

The option transfers all settings of the current SMS to the position of the destination SMS given by the parameter 4 "Target SMS". The original SMS becomes inactive (switches off).

### 3 Copy SMS !

The option transfers all settings of the current SMS to the position of the destination SMS given by the parameter 4 "Target SMS". The original SMS will be retained.

### 4 Target SMS

The sequence number of the destination SMS to move or copy the parameters of the current SMS.

***Sending a warning SMS when the measured value drops below the limit***

**Example 23.**

*Set a warning SMS to be sent to all contacts in group II when the dissolved oxygen value on channel ACH8 drops below 0.5 mg/l with a hysteresis of 0.2 mg/l.*

**Set up SMS:**

- ***Mode:*** *ACH dropped*
- ***Control channel:*** *8*
- ***Recipient:*** *Group II*
- ***Limit:*** *0.5*
- ***Hysteresis:*** *0.2*
- ***Text message:*** *oxygen concentration has dropped to #V8*

*For example, the received SMS will look like the following (the current value of channel 8 at the time of sending the SMS will be added to the text):*

***Oxygen concentration has dropped to 0.49 mg/l***

***Regular sending of informative SMS***

**Example 24.**

*Set up a periodic "morning" SMS to report the current flow on the ACH3 channel and the total volume flowed the previous day. The SMS will include information about the GSM signal quality. The SMS will be sent only on weekdays at 7:20 a.m. to all contacts assigned to Group I.*

**Set BCH1:**

- ***Mode:*** *Output - virtual (Switching BCH1 at 7:20 activates sending SMS)*
- ***Function:*** *Switching timer*
- ***Active days:*** *Mon,Tue,Wed,Wed,Sat,Sat,Sat,Sat*
- ***1. Function:*** *Switch On* ***1. Time:*** *07:20:00*
- ***2. Function:*** *Switch Off* ***2. Time:*** *07:25:00*

**Set up SMS:**

- ***Mode:*** *BCH goes On*
- ***Control channel:*** *1 (BCH1)*
- ***Recipient:*** *Group I*
- ***SMS text:*** *exec,ach3,ldsum3,q*

*Recipients receive SMS with the following text:* ***ach3=39.4l/s,4.870m3,q1=67***

## 4-1-2 Inquiry SMS



The SMS query can be used to remotely find out the current measured values, counter statuses and some other variables. The query SMS is sent to the station phone number in the form Password1,command1,command2 etc.

**Query SMS format:** password1,command,command2,...

The password is case sensitive. The command ignores case. The separator for passwords and commands is the comma ',' and the space character ' '.

The station replies to the recipient with an SMS message composed according to the type and number of query commands. The non-existent command is copied into the response. This can be used to supplement the response from the station with its own text.

Parameter **Password1** is set in the menu 4-5 GSM / GPRS.

**List of selected commands for query SMS:**

| | |
|---|---|
| **IDT** | Unit identification data (Name tag, ID) |
| **ACHX** | Status of analogue channel X<br>*Example answer without error: ach11=152 mm, answer with error: ach11=E10* |
| **BCHX** | Binary channel status X |
| **ISUMX** | Status of the total analog channel counter X |
| **DSUMX** | Status of the daily counter of the analogue channel X |
| **MSUMX** | Status of the monthly X channel counter |
| **LDSUMX** | Daily status of the X channel counter for the previous day |
| **LMSUMX** | The status of the monthly X channel counter for the previous month |
| **GPS** | Reading the GPS coordinates detected by the modem |
| **Q** | Field strength in the range of 0 to 100% |

## 4-1-3 Abbreviated query SMS

The user has the option of using MOST4, CloudFM or the parameter 1-21 Response to INFO/STATUS on p. 220, store a query string consisting of selected SMS query commands (see previous table) in the unit parameters. At the beginning of this command string, the EXEC command should be inserted first.

Subsequently, a one-word command INFO or STATUS in a separate SMS can be used at any time to call up the station's response, which will be composed of answers to the stored query command string. The INFO or STATUS command is case insensitive and is sent to the station without a password.

**Format of the shortened query SMS:** info

**List of commands for shortened SMS query:**

| | |
|---|---|
| **INFO** or **STATUS** | The unit generates a response in the format predefined in the parameters, the command is sent to the polled station without a password. There is no difference between INFO and STATUS commands (introduced for backward compatibility with M4016 and H1 units) |

| | |
|---|---|
| **EXEC** | The command at the beginning of the command string to follow the query commands, separated by a comma, is interpreted in the SMS text by its numeric value. |

## 4-1-4 Command and control SMS



The user can remotely control some of the device's functions using a command SMS. The command SMS must contain **Password2** and one or more commands separated by a comma. The command SMS can combine the query commands listed in the previous chapter with the commands in this chapter.

**Command SMS format:** password2,command1,command2 etc.

The password is case sensitive. The command ignores case. The separator for passwords and commands is the comma ',' and the space character ' '.

Parameter **Password2** is set in the menu 4-5 GSM / GPRS, param. 1-19 SMS Password 2 (p.220).

The station responds to the recipient with an SMS message based on the type and number of commands. A non-existent command is copied into the reply. This can be used to supplement the response from the station with its own text.
If the command SMS does not contain the command "To" (No Acknowledgment=do not reply), the station replies to the recipient with an SMS message composed according to the type and number of control commands.

**List of commands for command SMS:**

| | |
|---|---|
| **NA** | No Acknowledgment. |
| **#VX** | Command command, which will be interpreted in the SMS text by the numeric current value of the analog channel X |
| **DIALX** or **TCPX** | Sending data to the server using TCP profile X. Without a number, it sends to the first TCP. New, previously untransmitted data will be sent to the server and possibly also parameters if they have been changed on the server or unit side. |
| **ACHX=V** | Set analog channel X to manual mode to V.<br>Similarly to the SMS text, the current value of another analog channel can be stored in the analog channel X to be set using the "#" character.<br>*Example: the command ach5=#V2 stores the current value from the ACH2 channel of the control unit into the ACH5 channel of the controlled unit.* |
| **ACHX=A** | Setting analog channel X to automatic measurement mode |
| **BCHX=V** | Set binary channel X to manual mode to V (1 or 0) |
| **BCHX=A** | Setting binary channel x to automatic measurement mode |
| **BCHX =VTC** | Set the X binary channel to manual mode to V (1 or 0) for a period of C (in minutes). After the C time has elapsed, the binary X channel is switched back to automatic control.<br>*Example: **BCHT=1T20 (**switching bin. channel number 2 to log 1 for 20 min)* |
| **ISUMX=V** | Setting the total analog channel X counter to V |
| **SMRST** | Delete all SMS on the SIM card |
| **MEMRST** | Deleting data memory |
| **CNTRSTX** | Reset all analog channel X counters |
| **TCPX** | Sending data to the server using TCP profile X (1-primary or 2-second) |
| **SYSRST** | Restart the program |
| **WPTX=V** | Setting the value of the Set point parameter X to the value V |
| **EZSx** | 1-Blocking EZS, 0-Blocking the first EZS in the BCH sequence (Security function) |

***Example:*** *The unit responds to the command **SMS: PASSWORD,TCP1,ACH2** by SMS: **TPC1=ok, ach2=1082 mm**.*

***Relay control via SMS***

**Example 25.**

*Set up the binary channels of the unit so that the internal RELE1 can be switched on or off remotely via SMS to control the pump operation. The unit has already set the input binary channel BCH5 to monitor the pump fault (BCH5=1).*

**Set BCH1:** ***Input BCH for receiving a control command:***

- ***Mode:*** *Input - Remote*
- ***Binary label:*** *remote switching*
- ***Function:*** *Binary input*
- ***Input/Output:*** *1*

**Set BCH2:** ***Output BCH for relay control:***

- ***Mode:*** *Output-Local (relay)*
- ***Binary label:*** *Pump running*
- ***Function:*** *Logic function*
- ***Logic function in prefix:*** *& B1!B5 (BCH1=1 and absence of fault BCH5=0)*
- ***Output function:*** *direct*

***RELE1 control via SMS:***

**The command to switch on:** PASSWORD,bch1=1

**Variant SMS:** PASSWORD,bch=1,bch5,ach1
*The response to the variant SMS will include the current pump fault status (BCH5) and the current value of the analogue channel ACH1.*

**The command to disengage:** PASSWORD,bch1=0

***Sending a warning SMS in case of external power failure***

**Example 26.**

*Set up a warning SMS to be sent to all contacts in Group III in the event of a failure of the unit's external power supply and its restoration. The power failure SMS will only be sent if the power failure is longer than 5 min, and the power restoration SMS will only be sent 1 min after the external power is restored.*

**Basic settings:** ***Power supply - External power supply:***

- ***Enable Measurement:*** *On (external supply voltage measurement)*
- ***Alert while pwr under:*** *11.5 (voltage in volts)*
- ***Delay alert for:*** *00:05:00 (flag setting after delay)*
- ***Hold on alert:*** *00:01:00 (dropping the flag after the delay)*

**Set BCH31:**

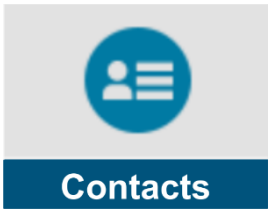
- ***Binary label:*** *ext. power failure (auxiliary binary channel)*
- ***Mode:*** *Input - diagnostic bits*
- ***Function:*** *Binary input*
- ***Input/Output:*** *22 (serial number of status bit for ext. power supply error)*

**Set SMS: (power failure)**

- ***Mode:*** *BCH goes ON*
- ***Control channel:*** *31*
- ***Recipient:*** *Group III*
- ***SMS text:*** *Power failure 5 min ago*

**Set SMS: (power recovery)**

- ***Mode:*** *BCH goes OFF*
- ***Control channel:*** *31*
- ***Recipient:*** *Group III*
- ***SMS text:*** *Power restoration*




# 4-2 Contact [1..32]

Set up to 32 recipient names including their phone numbers or email addresses. In addition, each recipient can have rights set for controlling the device via query and control SMS.

## 4-2-1 Contact

Select one of up to 32 contact persons for setting or editing.

### 1-1 Mode

Enable/Disable the edited contact.



#### 1 Disabled

The set contact will be inactive. The name, phone number and rights will remain set in the device's memory and the contact can be easily reactivated at any time in the future.

#### 2 Phone

The edited contact will be active.

#### 3 Inactive

The contact is stored in the unit's memory, but sending SMS to this Inactive contact is blocked. This mode is suitable for parameter preparation during station recovery when it is not desirable to send warning SMS.

#### 4 ID

Setting the ID number of another "opposite" station to which the unit can send commands via web server instead of SMS.

#### 5 IP

Setting the IP address of another "opposite" station to which the unit can send commands via web server instead of SMS.

#### 6 Email

E-mail address for sending an alert message. The warning message is not sent directly from the station but virtually via CloudFM.

### 1-2 Name

Contact name up to 15 characters long.

### 1-3 Number / e-mail



Phone number or email address of the contact person up to 29 characters long. The number can be entered with or without the country prefix (+420). Spaces are not allowed.

This parameter can also contain the identification number of the opposite station in the form IDxxx. This setting is used when two stations are communicating with each other via the server. An example may be a setup of stations at a water tank and a water treatment plant, where the water tank is filled from the water treatment plant based on the currently transmitted value of the water level in the water treatment plant.

If the SMS with the level information is to be sent to a contact with a completed ID, instead of sending an SMS, the station sends the requested level information via GPRS communication to the server, where it is stored and subsequently forwarded to the target station as soon as the target station logs on to the server.

## 1-4 Advanced

Binary switches for setting the right to control the device using query and control SMS.



### 1 Accept queries [0/1]

Enabling this parameter allows the set contact to receive information about the device status by means of SMS queries.

### 2 Accept commands [0/1]

Enabling the parameter authorizes the set contact to control the device using control SMS.



## 1-5 Group Membership

In this option, you can assign the set contact to membership in selected groups I. to VIII. for easier sending of selected SMS to more contacts.

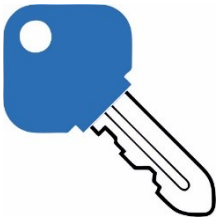
## 1-6 Competency

An option that assigns permissions to a given user to log the user on to the station

### 1 Maintenance

### 2 Administrator

### 3 Service



## 1-7 Password change!

Option to change the password of the selected contact person




# 4-3 TCP

Set parameters for controlled transmission of measured data to up to two servers on the Internet. The second server can be, for example, a backup database operated by another provider or a SCADA system for local visualization of measured data.

If there are two communication modules in the unit (GSM module on slot 0 and WiFi module on slot 2), then it is also necessary to set the TCP communication for each module. Both modules can use FCSP protocol and can also communicate with the same server.

## 4-3-1 Primary data server

Setting the parameters of the primary data server.

### 1-1 Protocol

Select the type of communication protocol used.



#### 1 Off

Communication with the server will be disabled.

#### 2 FMD

Older version of the communication protocol for the GSM module.

#### 3 FMDv2

The usual communication protocol setting for the GSM module. If there is also a radio or WiFi module operating under FCSP protocol in the communication slot of the unit, then it is advisable to set the FCSP protocol for the GSM module as well.

#### 4 FCSP

Communication protocol suitable for realtime communication. Usual communication protocol settings for WiFi module.

#### 5 FCSPv2

Communication protocol suitable for realtime communication. Usual communication protocol settings for WiFi module or Ethernet module.

FCSPv2 protocol supports live data in dashboards on cloudFM. When you click on a specific screen on CloudFM, a connection is made directly to the station and the current values are read directly into the chart at 5 sec intervals outside the storing interval. This option is therefore suitable for online status monitoring and remote SCADA screens.

**Default settings:** default.4envi.com

### 1-2 Select APN

Entering the type of the communication module and its position - the location of the module on the internal slots of the unit marked EXTER.-0 to EXTER.-2. The GSM communication module can be placed only in the EXTER.-0 slot.

#### 1 Primary GSM

Selection of the primary APN for the GSM module located in slot 0

#### 2 Secondary GSM

Selection of the primary APN for the GSM module located in slot 0

#### 3 Primary to Ext1

#### 4 Secondary to Ext1 *)

#### 5 Primary to Ext2

Selecting the APN for the WiFi module located in slot 2

#### 6 Secondary to Ext2 *)

*) This option is not available in the current unit software.

**Default setting:** primary GSM

### 1-3 URL

Setting the primary server URL up to 25 characters long.

**Default settings:** default.4envi.com

## 1-4 Port

Setting the server communication port.

## 1-5 Date of first transfer [YYYY/MM/DD]

Setting the date for the start of transferring the measured data to the server.

If you do not want to temporarily block data transmission, set the current or historical date.

**Default setting:** 2015/01/01

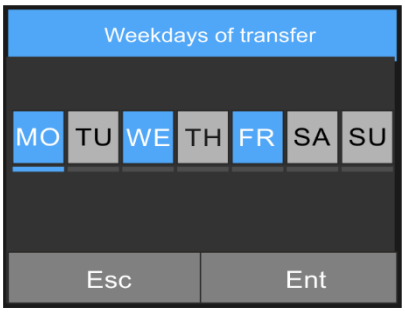
## 1-6 Time of first transfer [HH:MM:SS]

Set the time for periodically sending data to the server. The next data upload will follow after this time at intervals given by the parameters 1-8 "Regular interval" Or 1-9 "Exceptional interval".

When installing multiple devices with one operator, it is advisable to set a different First Send Time parameter for each device with a difference of tens of seconds so that the devices log on to the server sequentially and not all at once. Sequential data collection will reduce the time required for data transfer and thus extend the life of the power supply battery/accumulator.

**Default setting:** 2015/01/01

## 1-7 Weekdays of transfer



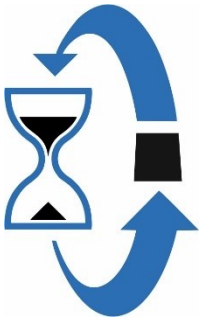

This option is particularly important for battery-powered instruments, where it can significantly extend the operating time of the instrument without replacing the power battery/accumulator.

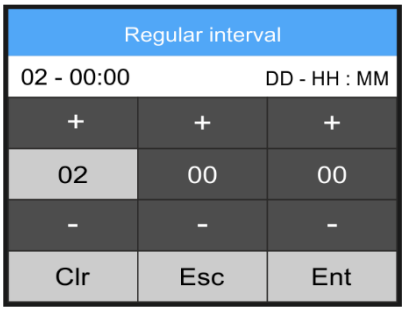
By selecting a limited number of active days per week, not only can the total weekly time required to log the instrument to the network be reduced, but also the time required to transfer the measured data can be reduced by eliminating the daily transfer of communication protocol overhead.

You can deactivate the days when data should not be transferred to the server from the list of days offered.

**Default setting: MO – TU – WE – TH – FR – SA – SU**

## 1-8 Regular interval [DD-HH:MM]



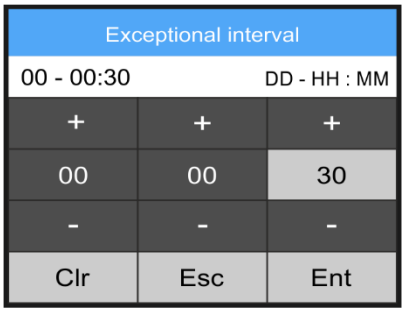



The regular time interval for setting the frequency of data transfers to the server in the normal operating state of the instrument.

The regular interval can be set from 1 minute to 31 days. The usual setting for this parameter is 1 hour to 1 day. Transmitting data more frequently than once per hour increases the cost of transmissions, shortens the life of the instrument's power battery, and puts a strain on the receiving server.

**Default setting:** 01 - 00:00

## 1-9 Exceptional interval [DD-HH:MM]




An exceptional time interval for setting the frequency of data transfers to the server for the duration of the event.

The Emergency Interval is usually set for a shorter period of time than the Basic Interval and is applied for the duration of the emergency (setting of one of the limit or steepness alarms), when it provides more frequent data transfers to the server than during normal

operation of the station. When the emergency event ends (alarm disconnection), an automatic transition back to the Basic interval of data sessions to the server occurs.

**Default setting:** 02 - 00:00

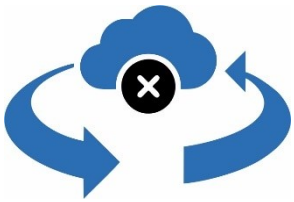
### 1-10 Commands read interval [HH:MM:SS]

Time parameter for setting the frequency of reading control commands from the server. Usually the value of this parameter is set in units to tens of minutes.

A typical example of the use of this parameter is the server-controlled "Pumping station - Water tank" setup, in which the controlled station installed in the pumping station asks the server whether it should start pumping water into the water tank.

**Default setting:** 00:00:00

### 1-11 Retry attempts



Parameter that determines the number of attempts when the measured data is unsuccessfully transmitted to the server or when control commands are unsuccessfully retrieved from the server. Before the next attempt of the data session, the time delay given by the parameter 1-12 "Interval between ".

The parameter can take values from 0 to 255.

**Default setting:** 2

### 1-12 Interval between attempts [HH:MM:SS]

The time delay between repeated attempts to transfer data to the server or retrieve commands from the server.

**Default setting:** 00:00:30

### 1-13 Max. connection time [HH:MM:SS]



The parameter value sets the maximum allowed time for the duration of one data session between the station and the server. This parameter prevents an erroneous persistent data connection and may also limit the size of the data transferred if the device parameters are set inappropriately.

For FCSP (or UDP) protocol this parameter is not relevant.

**Default setting:** 00:01:30

### 1-14 Refresh time [HH:MM:SS]

Parameter for setting the interval in sec for sending data during a permanent connection under FCSPv2 protocol.

**Default setting:** 12:00:00

## 4-3-2 Secondary data server



The Secondary Data Server parameters have the same structure and composition as the Primary Data Server parameters, and follow the instructions above to set them.

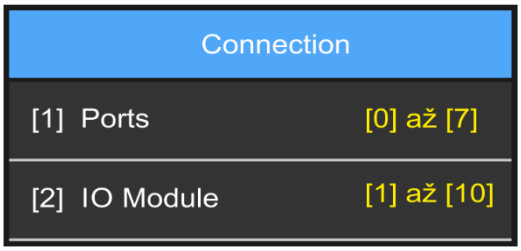
**Default setting:** Off




# 4-4 Connection

*The Connection* menu offers only 2 options:

- ***Ports*** for setup physical layer parameters of 4 communication ports Port-0 to Port3 -including the selection of their communication protocols.
- ***IO Modules*** for parameterization of up to 10 software IO Modules through which the H7 unit can communicate serially with external I/O modules.




## 4-4-1 Ports

The port settings determine, among other things, under which protocol and at what baud rate the communication will take place over the serial buses of the H7 unit, i.e. over RS485-I or RS485-II lines.

The first four ports have factory preset parameters so that they can be directly used for controlling data communication with connected sensors under FINET and MODBUS_RTU protocols.

The basic parameterization of the ports and their fixed assignment to the above mentioned serial buses is set from the factory.

***Basic port assignment to RS485***

| Port | Assigned bus | Communication Protocol | Variant protocol |
|---|---|---|---|
| **0** | RS485-I | FINET | - |
| **1** | RS485-II | MODBUS_RTU | - |
| **2** | RS485-I | MODBUS_RTU | MODBUS_RTU_SLAVE |
| **3** | RS485-II | MODBUS_RTU | - |

*The Ports* menu of the H7 unit contains 4 more ports Port-4 to Port-7, which are not used in the current FW version.



**RESTRICTIONS FOR MODBUS_SLAVE MODE**

The previous table shows that if the unit is to operate as a slave station and transfer data to the higher-level system on demand under the MODBUS_RTU_SLAVE protocol, then it is necessary to use the RS485-I serial line and Port-2 for this communication. No other devices and measuring probes that require master communication from the unit for control and data acquisition can be connected to this line. When selecting this operating mode, the parameters must be set according to Example 27. on p. 209.

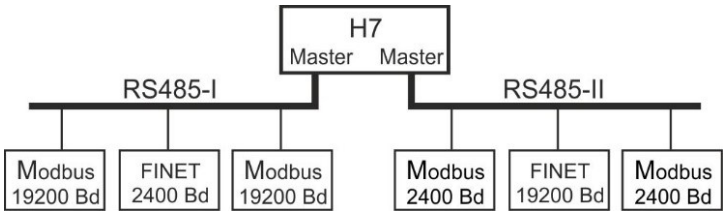
Another limitation that can be seen from the table is the fact that only devices with the same communication parameters (baud rate, parity, stop bits, Handshaking,...) can work on one RS485 serial link under one communication protocol.

If e.g. 2 devices with different communication speed working under the same communication protocol are to be connected to one unit, then it is necessary to connect each of the devices to a different RS485 serial line and change the settings of the respective Port parameters.

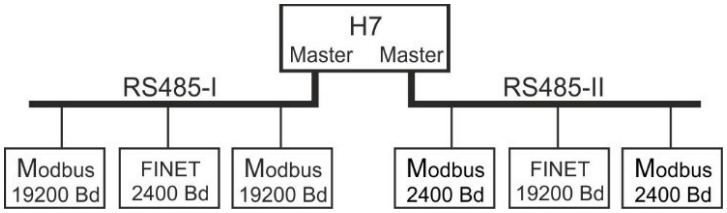
On the other hand, it is possible to connect devices operating under both FINET and MODBUS_RTU communication protocols to one RS485 line. The control unit automatically sets the appropriate port for communication with the sensor or I/O module according to the selected measurement method (parameter 3-1-5 "Measurement method") of the analogue channel. In this case, however, we recommend using different baud rates for the communication protocols. The following overview briefly summarizes the above limitations:

## CORRECT AND INCORRECT USE OF RS485-I AND RS485-II BUSES

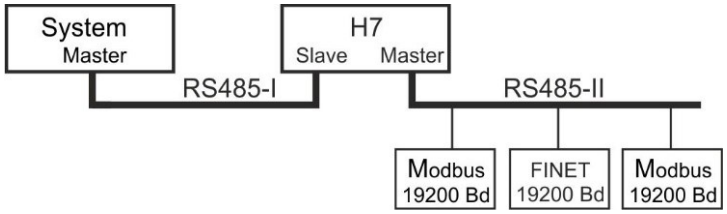
***Correctly connected sensors:***



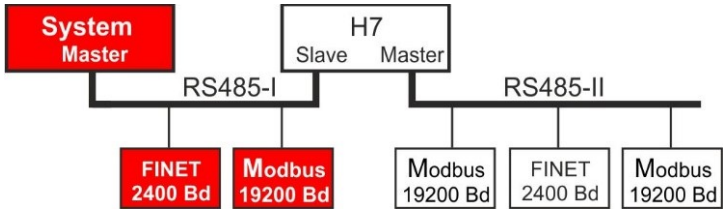

***RS485-II branch baud rate conflict:***




***Correctly connected master system via RS485-I:***




***Faulty sensors connected to the RS485-I Slave line:***



## 1-1 Port 0 (RS485-I, FINET, 19200, none, 1 stop bit, none, 111, 80 ms, 3x)



The following overview describes the parameter settings for Port-0.The settings of the remaining ports Port-1 to Port-3 have the same structure and composition of parameters as Port-0 described below. Ports Port-4 to Port-7 are not used in the current FW version.

**The preset port parameters are listed in parentheses in the title of this chapter.**

### 1 Mode

- OFF
- **FINET**
- MODBUS_RTU
- MODBUS_RTU_SLAVE

### 2 Baudrate

- 1200 Bd2400 Bd
- 9600 Bd
- **19200 Bd**
- 38400 Bd
- 57600 Bd
- 115200 Bd

### 3 Parity

- **None**
- Odd
- Even

### 4 Stop bits

- **1 stop bit**
- 2 stop bits

### 5 Handshaking

- **None**
- CTS/RTS

### 6 Address-P

Setting the communication address Port. The communication address of the port can range from 0 to 65535, with the limiting factor being the communication protocol used. The FINET protocol allows setting the address in the range of 1 to 255, the MODBUS_RTU protocol allows setting the communication address in the range of 1 to 65535.

**Default setting:** 111



### 7 Timeout

A configurable parameter in ms that determines the length of the wait time for the addressed device to respond. Typical parameter value = 50 to 250 ms.

**Default setting:** 80 ms

### 8 Retries

Parameter for setting the number of communication retries if no data transfer occurs.

**Default setting:** 3x

### 9 No data timeout [sec]

Setting the time for which the unit in master mode should wait for the response of the polled probe over the RS485 bus. A higher value of this parameter slows down

the measurement loop and increases the total measurement time in case one or more probes are faulty or disconnected.

**Default setting: 5 sec**

***Note*** The choice of RS485-I or RS485-II serial bus is not configurable and is fixed by the selection of the *Port* parameter according to the previous table on p. 208.

### 1-2 Port 1 (RS485-II, Modbus RTU, 19200, none, 1 stop bit, none, 111, 80 ms, 3x)

The Port 1 parameters have the same structure as the Port 0 parameters above.

### 1-3 Port 2 (RS485-I, Modbus RTU, 19200, none, 1 stop bit, none, 0, 80 ms, 3x)

The Port 2 parameters have the same structure as the Port 0 parameters above.

### 1-4 Port 3 (RS485-II, Modbus RTU, 9600, none, 1 stop bit, none, 0, 80 ms, 3x)

The Port 3 parameters have the same structure as the Port 0 parameters above.

***Modbus RTU Slave*** From the table on p. 206 shows that only Port 2 can operate in Modbus RTU Slave mode. When selecting this operating mode, the parameters must be set according to Example 27 on p. 209.

***Register map*** A map of the registers of the Modbus RTU Slave working mode is given in the appendix on page 2. 280.

### 1-5 Port4 (Off)

### 1-6 Port5 (Off)

### 1-7 Port6 (Off)

### 1-8 Port7 (Off)

Port-4 to Port-5 parameters are not used in the current version of the instrument software.

***Setting H7 to MODBUS RTU SLAVE mode***

**Example 27.** *Set the H7 unit to operate in MODBUS_RTU_SLAVE mode with 9600 Bd, 1 Stop bit, no parity, communication address: 111.*

***Set:*** ***Communication parameters -> Connection:***

- ***Ports:*** *Port-2*
- ***Mode:*** *MODBUS_RTU_SLAVE*
- ***Baudrate:*** *9600 Bd*
- ***Parity:*** *None*
- ***Stop bits:*** *1*
- ***Handshaking:*** *None*
- ***Address-P:*** *111*

*Note: MODBUS_RTU_SLAVE mode can only be set to RS485-I (Port-2). If this mode is active, no sensor or external module can be connected to the RS485-I line (DV2).*

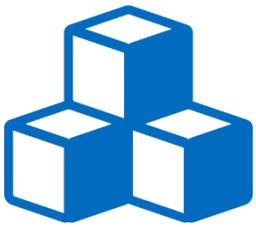
***Setting Port-3 to MODBUS RTU MASTER mode***

**Example 28.** *Set the H7 unit to operate in MODBUS_RTU_MASTER mode with a Baudrate of 19200 Bd, 1 Stop bit, no parity, communication address: 10.*

***Set:*** ***Communication parameters -> Connection:***

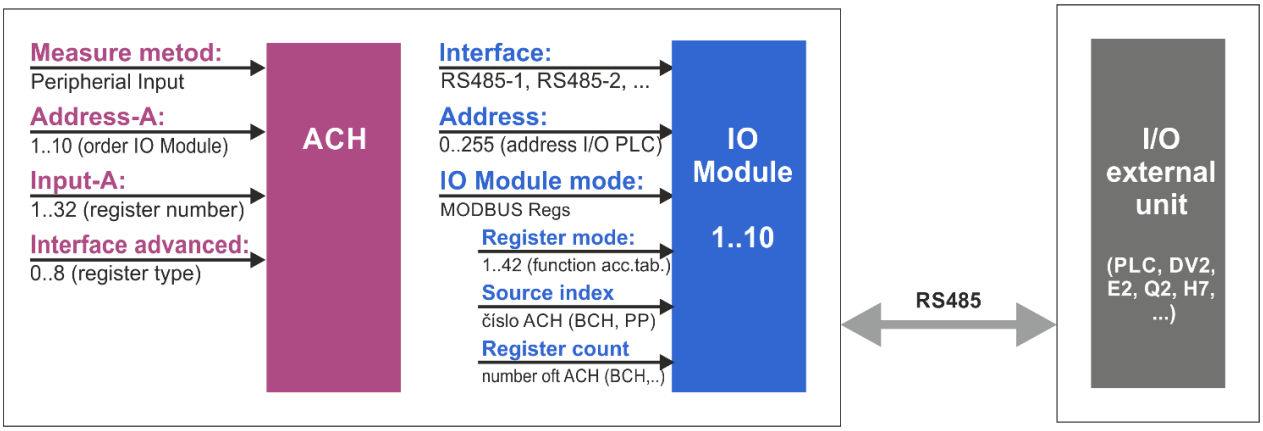
- ***Ports:*** *Port-3*
- ***Mode:*** *MODBUS_RTU*
- ***Baudrate:*** *19200 Bd*
- ***Parity:*** *None*
- ***Stop bits:*** *1*
- ***Handshaking:*** *None*
- ***Address-P:*** *10*

## 4-4-2 IO Module



A user configurable group of parameters for configuring up to 10 software IO Modules through which it is possible to communicate with physical IO units and devices (PLC, DV2, DV3, other H7 unit, E2 or Q2, ...) connected to the serial buses of the H7 unit under a communication protocol (usually MODBUS RTU or FINET for DV2).

Each of the ten IO Modules also includes a buffer for storing data read over the serial bus from a physical external I/O module or data ready to be written to a physical I/O module. The buffer can store the contents of up to 32 float registers, which can be read into the ACH channel using the 9-4 Input-A (pg. 129).



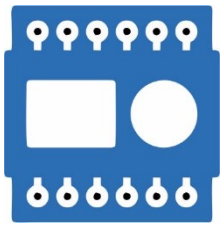

*Example of selected parameters for setting ACH using the Peripheral input method.*

***Measuring method*** The measurement method that works with IO Modules is called "Peripheral input" and its description including an example is given in chap. 16-Measurement method: Peripheral input on p. 251.

***IO Module address*** The selection of one of the ten IO Modules is done by setting the parameter 9-3 Address -A (pg. 129) for reading/writing the analog ACH channels or by setting the parameter 3-2-3 Address -B (pg. 146) for reading/writing binary BCH channels, to a value of 1 to 10.

### 2-1 IO module mode

Setting the IO Module type (**Default setting:** Off).



#### 1 Off

IO Module is disabled. To further parameterize the selected software IO Module, you need to set one of the following options 2-DV2 to 5-MODBUS Regs.

#### 2 DV2

Set up IO Module for communication with external I/O module DV2. This option provides the selection of the required communication protocol for the DV2 (FINET, 19200 Bd, no parity, 1 Stop bit) and allocates buffer units to read up to 16 binary inputs and control 6 binary outputs (relays) of the DV module.

As the H7 unit contains a total of 10 software IO Modules, up to 10 external DV2 modules can therefore theoretically be connected to it.

#### 3 DV3

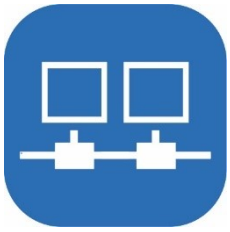
Set up IO Module for communication with external I/O module DV3. Unlike the DV2 module, the DV3 module has a smaller number of binary inputs (6) and outputs (3). The other facts mentioned in the previous option 2-DV2 remain unchanged.

#### 4 MB Coils

#### 5 MB Regs

Setting the IO Module to communicate under MODBUS RTU protocol. This issue is discussed in more detail in the following chapter 2-7 MODBUS Registers on p. 212, including an overview table of MODBUS registers.

## 2-2 Interface



Setting the type of serial communication line between the unit and the external I/O module. The selection of the appropriate type of communication line depends on the communication interface of the connected I/O module (most often it is an RS485 line).

1 Off
2 RS485 1
3 RS485 2
4 SDI-12
5 Radio 1
6 DCL_RX
7 INT_UART_1
8 INT_UART_2
9 EXT_UART_1
10 EXT_UART_2
11 EXT_UART_3
12 EXT_UART_4

**Default setting:** Off

### AUTOMATIC PORT SELECTION

For the most commonly used RS485 bus, based on the selected communication link (RS485-1 or RS485-2) and the measurement method (which contains a fixed communication protocol), the H7 unit will automatically select the appropriate communication port according to the table on page 5. 206.

## 2-3 Address

Setting the communication address of the physical slave device (PLC, E2, Q2, external I/O module). The address of the external I/O module can take values in the range 0 to 255. The standard addresses of external I/O modules are listed in the description of these devices in chapter *9. Expansion I/O modules* on p. 72.

**Default setting:** 0

## 2-4 Module DV2

This option is enabled only when selecting DV2 in the submenu 2-1 IO module mode.



### 1 Reading interval DV2

The DV2 read interval is set in sec with hundredths resolution and its size determines the frequency of reading or writing data from/to the external DV2 module compared to the frequency of measuring other analog channels. Communication with the DV2 module is always interleaved with the measurement of at least one other analog channel (if set).

The Q2 unit communicates with the DV2 module only if the set interval has elapsed since the last communication. If it has not yet, the next analogue channel is measured and then tested again to see if it can communicate with the DV2 (whether the DV2 Read Interval has elapsed).

The DV2 reading interval can be zero - then each communication with the DV module is interleaved with the measurement of only one other analog channel.

Since the communication protocol (FINET, 19200 Bd, no parity, 1 Stop bit) and the number of input/output binary channels are fixed in the Q2 unit, there is no need to set any further user-defined parameters for the communication of the unit with this I/O external module.

## 2-5 Module DV3

This option is enabled only when selecting DV3 in the submenu 2-1 IO module mode.

### 1 Reading interval DV3

The DV3 reading interval is set in the same way as the DV2 reading interval in sec and has the same meaning as the above described parameter (frequency of communication with the DV3 module).

## 2-6 MODBUS Coil



Menu for setting addresses and numbers of input and output coils. This option is enabled only when selecting the MB Coils in the submenu 2-1 IO module mode (pg. 210).

### 1 MBCoils Interval

Communication frequency - if multiple commands/channels are set at the same time, the read/write is performed sequentially at this interval.

### 2 Number of input coils

Parameter adjustable from 0 to 64

### 3 Input coil address

Address of the first coil read. For example, when reading the state of binary channels of BCH from another unit H3, H7, Q2, E2, the address of the required first read BCH is set according to the register map (for BCH[1] the parameter *Input coil address* = 1000).

The parameter is adjustable from 0 to 65535

### 4 Number of output coils

Parameter adjustable from 0 to 64

### 5 Output coil address

Parameter adjustable from 0 to 65535

## 2-7 MODBUS Registers



Menu for setting advanced parameters of the IO Module for MODBUS RTU communication. This option is enabled only when selecting the MB Regs in the submenu 2-1 IO module mode on p. 210.

### 1 MBRegs Interval [s]

Communication frequency - if multiple commands/channels are set at the same time, the read/write is performed sequentially at this interval.

### 2 Register mode

Parameter adjustable from 0 to 255 according to the table on the following page. The register mode is the core parameter located in the first column of this table. Values of this parameter 1 and 2 are for reading a group of data as UINT16. Parameter values from 16 to 20 inclusive define the write types of a single register. Values of this parameter greater than 30 are for writing to multiple registers at once.

### 3 Source index

The number of the ACH analog channel, BCH binary channel or SP operating parameter to be written. If the register mode is set to write multiple registers at once, then the Data Source Index represents the number of the ACH, BCH, or SP to be written first.

### 4 Registers count

The number of registers written in the mode working with multiple registers at the same time.

### 5 Address 1

The number of the register or coil where it will be recorded

### 6 Address 2

Parameter adjustable from 0 to 65535, not used in the current version of FW.

### 7 Data 1

Parameter adjustable from 0 to 65535, not used in the current version of FW.

### 8 Data 2

Parameter adjustable from 0 to 65535, not used in the current version of FW.

**Overview table of commands for reading and writing from/to MODBUS registers. A map of the H7 unit registers is in the appendix on p. 287.**

**Commands to read a group of registers:**

| Register mode | Source index | Registers count | Write/read format | Modbus FC | Command Description |
|---|---|---|---|---|---|
| **1** | has no meaning | number of reads UINT16 | UINT16 | 0x04 | **reading** a series of data as INPUT regs, format UINT16 (Address1: number of the first reg. with UINT16) |
| **2** | has no meaning | number of reads UINT16 | UINT16 | 0x03 | **reading of** data series as HOLDING regs, format UINT16 (Address1: number of the first register with UINT16) |
| **Commands for setting (writing) one AO register:** | | | | | |
| **16** | ACH number | 1 | UINT16 | 0x06 | writing the analog channel **value** as UINT16 (Address1: number of the register to be written to) |
| **17** | ACH number | 1 | UINT16 | 0x06 | writing the analog channel **error flag** as UINT16 |
| **21** | PP number | 1 | UINT16 | 0x06 | writing the **Set point parameter** as UINT16 |
| **22** | ACH number | 4 | DOUBLE | 0x10 | writing the analog channel **counter** as DOUBLE |
| **23** | ACH number | 2 | UINT32 | 0x10 | writing the analog channel **counter** as UINT32 |
| **Commands for setting (writing) one COIL:** | | | | | |
| **18** | BCH number | 1 | COIL | 0x05 | writing the binary channel **value** as COIL (Address1: the COIL number to which it will be written) |
| **19** | BCH number | 1 | COIL | 0x05 | writing the bin. channel **error flag** as COIL |
| **20** | BCH number | 1 | COIL | 0x05 | writing the **flag of manual control** of BCH as COIL |
| **Commands for setting (writing) multiple registers:** | | | | | |
| **32** | the ACH number whose value will be written first | number of written ACH channels | UINT16 | 0x10 | writing analog channel **values** as UINT16 (Address1: address of the first register to be written to) |
| **33** | ACH number, ... | number of ACH | UINT16 | 0x10 | writing **error codes of** analogue channels as UINT16 |
| **34** | BCH number, ... | number of BCH | COIL | 0x0F | writing binary channel **values** as COIL |
| **35** | BCH number, ... | number of BCH | COIL | 0x0F | write binary channel **error flags** as COIL |
| **36** | BCH number, ... | number of BCH | COIL | 0x0F | writing of **manual** binary channel **control flags** as COIL |
| **37** | the SP number whose value will be written first | number of en-rolled SPs | UINT16 | 0x10 | writing **Set point parameters** as UINT16 (Address1: address of the first register to be written to) |
| **38** | ACH number, ... | number of ACH | FLOAT | 0x10 | writing analog channel **values** as FLOAT |
| **39** | PP number, ... | number of SP | FLOAT | 0x10 | writing **Set point parameters** as FLOAT |
| **40** | BCH number, ... | number of BCH | WORD | 0x10 | writing binary channel **values** as WORD (Address1: address of the first register for writing the first 16 BCH states) |
| **41** | ACH number whose integer counter will be written first | number of counters to be written | DOUBLE | 0x10 | writing total **counters** as DOUBLE (Address1: address of the first register to be written to) |
| **42** | ACH number whose integer counter will be written first | number of counters to be written | UINT32 | 0x10 | writing of total **counters** as UINT32 (Address1: address of the first register to be written to) |

***Reading and writing binary states from/to the external DV2 module***

**Example 29.**



*Set the parameters for standard communication with the DV2 module, which has address 2 set and is connected to the RS485-II bus. The Q2 unit communicates with the DV2 module using the FINET protocol (19200 Bd, no parity, 1 Stop bit).*

*Binary channel **BCH5** will record a pump fault on input 12 of module DV2.*
*Binary channel **BCH6** will switch relay 1 of module DV2 twice a day for 30 min.*

***Setting the communication parameters with DV2:***
*Connections > Ports:*

- ***Port-0:** (RS485-I, FINET, 19200, none, 1 stop bit, none, 111, 80 ms, 3x)*

**3.IO Module settings:**

*Connections > IO Modules: (3rd IO Module selected from 1 to 10)*

- ***IO module mode:** DV2*
- ***Interface:** RS485-I*
- ***Address:** 2 (communication address of the physical module DV2)*
- ***Reading interval DV2:** 0.5 (sec)*

**Setting BCH5:**
**(Input 12 of DV2 module)**

- ***Binary label:** Pump failure*
- ***Mode:** Input - IO module*
- ***Address-B:** 3 (serial number of the IO Module set to DV2 mode)*
- ***Input/Output:** 12 (DV2 binary input)*

**Setting BCH6:**
**(relay1 output)**

- ***Binary label:** Pulses on RELE-1*
- ***Mode:** Output - IO Module*
- ***Address-B:** 3 (serial number of the IO Module set to DV2 mode)*
- ***Input/Output:** 1 (RELE1 on physical module DV2)*
- ***Function**: Up time/Down time*
- ***> Up time:** 1800 (1800 sec = 0:30)*
- ***> Down Time:** 41400 (11:30)*
- ***> Initial time:** 00:00:00*

***Setting the IO Module as MODBUS Regs for writing the SP group***

**Example 30.**

*TB9 evaporator control board (slave) will be connected to the H7 (master) unit via RS485-I bus. The operating parameters SP1 to SP8 are to be written from the H7 unit to the holding registers of the TB9 control board from address 4500 as UINT16.*

***Setting of communication parameters with TB9 over RS485-I:***
*Connections > Ports:*

- ***Port-0:** (RS485-I, FINET, 19200, none, 1 stop bit, none, 111, 80 ms, 3x)*

**IO Module settings:**

*Connections > IO Modules: (2nd IO Module selected from 1 to 10)*

- ***IO module mode:** MODBUS Regs*
- ***Interface:** RS485-I*
- ***Address:** 98 (default communication address of TB9 board)*
- *MB Reg. **> MBRegs Interval:** 60 (in sec, interval for writing SP values to TB9)*
- *MB Reg. **> Register mode:** 37 (writing SP as UINT16 - see previous table)*
- *MB Reg. **> Source index:** 1 (PP number whose value will be written first)*
- *MB Reg. **> Registers count:** 8 (number of SPs to be written)*
- *MB Reg. **> Address 1:** 4500 (address of the first holding register of the TB9 board)*

**Example 31.**

***Setting the IO Module as MODBUS Regs for writing BCH states***

*Set the IO Module to write the states of the binary channel group BCH21 to BCH24 via RS485-I bus to the TB9 evaporator control board. The equivalent register within TB9 is of type COIL starting at address 1000.*

***Setting of communication parameters with TB9 over RS485-I:***

*Connections > Ports:*

- ***Port-0:*** *(RS485-I, FINET, 19200, none, 1 stop bit, none, 111, 80 ms, 3x)*

**IO Module settings:**

*Connections > IO Modules: (6th IO Module selected from 1 to 10)*

- ***IO module mode:*** *MODBUS Regs*
- ***Interface:*** *RS485-I*
- ***Address:*** *98 (default communication address of TB9)*
- *Modbus Reg.* ***> MBRegs Interval:*** *2 (in sec, interval for writing BCH states to TB9)*
- *Modbus Reg.* ***> Register mode:*** *34 (write BCH states as COIL - see table )*
- *Modbus Reg.* ***> Source index:*** *21 (BCH number whose value will be written first)*
- *Modbus Reg.* ***> Registers count:*** *4 (number of BCH channels to be written)*
- *Modbus Reg.* ***> Address 1:*** *1000 (first COIL address)*

**Example 32.**

***Reading and writing ACH and BCH values between H7 (master) and Q2 (slave)***

*Set the MODBUS RTU communication parameters between H7 and Q2 units to read/write analog and binary channels as specified in the following table:*




| ***Unit H7 (master)*** | | ***Unit Q2 (slave)*** |
|---|---|---|
| *ACH7 AKU voltage [V]* | ← | *battery [V]* |
| *ACH8 flow rate [l/s]* | ← | *ACH3 flow [l/s]* |
| *ACH9 total counter [$m^3$ ]* | ← | *ACH3 total counter [$m^3$ ]* |
| *ACH10 level [mm]* | → | *ACH6 level [m]* |
| *BCH15 running M1* | ← | *BCH3 run M1* |
| *BCH16 M1 malfunction* | ← | *BCH18 M1 malfunction* |
| *BCH22 manual control ON* | → | *BCH10 manual control ON* |

This example, using only IO Modules, requires setting up a total of 4 IO Modules (3x MODBUS Regs. and 1x MODBUS Coil):

- MB Regs: reading voltage (from ACH16) and instantaneous flow in l/s (from ACH3)
- MB Regs: reading counter $m^3$ (from ACH3)
- MB Regs: write level (to ACH6)
- MB Coil: read Run M1 (from BCH3); read Failure M1 (from BCH18); write Manual control (to BCH10)

**Note**

For such and similar tasks, it seems more appropriate in some cases to use measurement methods for setting analog ACH channels:

- RS485 / MODBUS probe (setting ACH10; see Example 51, p. 247)
- RS485 / MODBUS output (writing to ACH10 from Q2; Example 68. pg. 262)

**Port settings:**

*Connections > Ports:*

- ***H7: Port-3:*** *(RS485-II, MODBUS_RTU, 19200, none, 1 stop bit, address 100)*
- ***Q2: Port-2:*** *(RS485-I, MODBUS_RTU_SLAVE, 19200, none, 1 stop bit, address 25)*

## READING ACH

**H7-setting of IO Module[1] for reading voltage from ACH16 and instantaneous flow from ACH3**

*Connections > IO Modules: (1st IO Module selected from 1 to 10)*

- ***IO module mode:*** *MODBUS Regs*
- ***Interface:*** *RS485-II*
- ***Address:*** *25 (communication address Q2)*
- *MB Registers* ***> MBRegs Interval:*** *5 (sec, Q2 read interval)*
- *MB Registers* ***> Register mode:*** *1 (read data block of INPUT type as UINT16)*
- *MB Registers* ***> Source index:*** *(meaningless)*
- *MB Registers* ***> Registers count:*** *14 (number of read values from ACH3 to ACH16)*
- *MB Registers* ***> Address 1:*** *1004 (addr. of the first INPUT reg.Q2 as UINT16)*

**H7-setting ACH7: (AKU voltage)**

- ***Measured quantity:*** *Voltage* ***Analog label:*** *Voltage AKU*
- ***Measurement method: Peripheral input***
- *Inputs* ***> Interface:*** *off (communication is controlled by the 1st IO Module)*
- *Inputs* ***> Interface advanced:*** *0 (type of read register, INPUT register as UINT16)*
- *Inputs* ***> Address-A:*** *1 (serial number of the set IO Module of the H7 unit)*
- *Inputs* ***> Input-A:*** *14 (number of the read register, i.e. the ACH16 values of the Q2)*

**H7-setting ACH8: (instantaneous flow)**

- ***Measured quantity:*** *flow rate* ***Analog label:*** *instantaneous flow from Q2*
- ***Measurement method: Peripheral input***
- *Inputs* ***> Interface:*** *off (communication is controlled by the 1st IO Module)*
- *Inputs* ***> Interface advanced:*** *0 (type of read register, INPUT register as UINT16)*
- *Inputs* ***> Address-A:*** *1 (serial number of the set IO Module of the H7 unit)*
- *Inputs* ***> Input-A:*** *1 (number of the read register, i.e. the ACH3 values of the Q2)*
- ***Counter:*** *off*

## READING Counters

**H7-setting of IO Module[2]for reading the total counter from ACH3**

*Connections > IO Modules: (2nd IO Module selected from 1 to 10)*

- ***IO module mode:*** *MODBUS Regs*
- ***Interface:*** *RS485-II*
- ***Address:*** *25 (communication address of unit Q2)*
- *MB Registers* ***> MBRegs Interval:*** *60 (sec; Q2 read interval)*
- *MB Registers* ***> Register mode:*** *1 (read data block of INPUT type as UINT16)*
- *MB Registers* ***> Source index:*** *(meaningless)*
- *MB Registers* ***> Registers count:*** *2 (number of read values)*
- *MB Registers* ***> Address 1:*** *5004 (address of the first INPUT reg. Q2 as UINT32)*

*Note: The E2 unit does not allow to read data in UINT32 format and therefore the total counter of the ACH3 channel will be read by two registers as UINT16 in the resulting UINT32 format.*

**H7-setting ACH9: (instantaneous flow)**

- ***Measured quantity:*** *flow rate*
- ***Analog label:*** *Total flow from Q2*
- ***Measurement method: Peripheral input***
- *Inputs* ***> Interface:*** *off (communication is controlled by the 2nd IO Module)*
- *Inputs* ***> Interface advanced:*** *7 (*reading INPUT reister as INT32/UINT32; FC = 0x04; *see chap. 16. Measurement method: Peripheral input on p. 251)*
- *Inputs* ***> Address-A:*** *2 (serial number of the set IO Module of the H7 unit)*
- *Inputs* ***> Input-A:*** *1 (number of the first register read)*
- ***Input-B:*** *0* ***Input-C:*** *0*
- ***Counter:*** *on* ***Units:*** *m3*
- ***Floating points:*** *1* ***Bipolar:*** *off*

*Note: The instantaneous flow rate ACH[8] and the total flow volume [ACH9] can be merged into one common ACH channel, if required, using the measurement method: Other channel (see Example 51.* Reading current and accumulated flow value from Q2 (slave) to H7 (master) *on page 247.*

## WRITE to ACH

**H7-setting of the IO Module[3]for writing the level from ACH10 in H7 to ACH6 in Q2:**

*Connections > IO Modules: (3rd IO Module selected from 1 to 10)*

- ***IO module mode:*** *MB Regs* ***Interface:*** *RS485-II*
- ***Address:*** *25 (communication address Q2)*
- *MB Registers* ***> MBRegs Interval:*** *5 (sec, Q2 read interval)*
- *MB Registers* ***> Register mode:*** *16 (write ACH value as UINT16)*
- *MB Registers* ***> Source index:*** *10 (analog channel number ACH10)*
- *MB Registers* ***> Registers count:*** *1 (number of read values)*
- *MB Registers* ***> Address 1: 1010*** *(destination address for writing the value to the ACH6 channel in the Q2 unit as UINT16 - see Q2 unit register map)*

**Q2-setting ACH6: (level)**

- ***Quantity:*** *level*
- ***Analog label:*** *Level from H7*
- ***Units:*** *same as for ACH10 in H7*
- ***Floating points:*** *same as for ACH10 in H7*
- ***Measurement method: Remote input***
- ***Address-A:*** *0* ***Input-A:*** *0*
- ***Input-B:*** *0* ***Input-C****: 0*
- ***Signal Amplification:*** *1* ***Offset Delta:*** *0*

*Note: Other than the IO Module settings, no auxiliary ACH channel settings are required on the H7 unit. Data transfer to the connected module in slave mode (Q2 unit in the example) is controlled by the IO Module with the frequency set by the Read Interval regs parameter.*

## READING and RECORDING BCH

**H7-Setting the IO Module[4]for reading and writing BCH**

*Connections > IO Modules: (4th IO Module selected from 1 to 10)*

- ***IO module mode:*** *MODBUS Coil* ***Interface:*** *RS485-II*
- ***Address:*** *25 (communication address Q2)*
- *Modbus Coil* ***> MBCoils Interval:*** *5 (sec)*
- *Modbus Coil* ***> Number of input Coils:*** *18 (read BCH1 to BCH18 at the same time)*
- *Modbus Coil* ***> Input Coils address:*** *1000 (BCH1 status register address in Q2)*
- *Modbus Coil* ***> Number of output Coils:*** *1 (write only one BCH)*
- *Modbus Coil* ***> Output Coils address:*** *1009 (BCH10 status register address in Q2)*

**H7-setting BCH15: (reading 3 from IO Module)**

- ***Binary label BCH:*** *Chod M1*
- ***Mode:*** *Input - IO module*
- ***Address-B:*** *4 (serial number of the set IO Module)*
- ***Input/Output:*** *3 (3rd Coil IO Module with BCH3 status)*

**H7-setting BCH16: (reading 18 from IO Module)**

- ***Binary label:*** *M1 failure*
- ***Mode:*** *Input - IO module*
- ***Address-B:*** *4 (serial number of the set IO Module)*
- ***Input/Output:*** *18 (18th last Coil IO Module with status BCH18)*

**Existing channel BCH22: (Manual control ON)**

- ***Binary label:*** *Manual control ON (state controlled by the PIN5 input of the connection board)*
- ***Mode:*** *Input-local*
- ***Address-B: (****not relevant)*
- ***Input/Output:*** *5 (serial number of the local input on the H7 connection board)*
- ***Function:*** *binary* ***input***

**H7-setting of auxiliary BCH23: (entry in BCH10)**

- ***BCH Binary label:*** *copy of BCH22 by Q2*
- ***Mode:*** *Output-IO Module*
- ***Address-B:*** *4 (serial number of the set IO Module)*
- ***Input/Output:*** *1 (writes to the first Coil of address 1009 = value of BCH10 in Q2)*
- ***Functions > Logical function in prefix:*** *B22 (= copy of BH22****)***

GSM / GPRS

# 4-5 GSM / GPRS

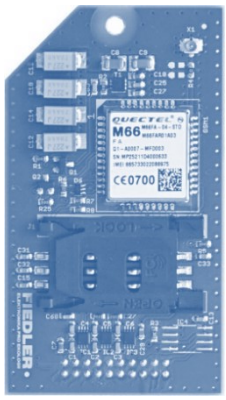
Setting parameters for controlling the operation of the GSM communication module.

## 1-1 Power mode

Selection of the power supply mode of the GSM communication module.




The permanently switched on GSM module in Continuous Operation mode ensures virtually instantaneous reception of control and command SMS. On the other hand, however, it places a significant load on the power supply by its continuous consumption. Therefore, the continuous operation is usually set only for stations equipped with an external power supply. Receiving control or query SMS from the operator is only performed in power saving mode when the modem is switched on.




### 1 Always on

The power supply of the GSM module is permanently switched on until the power supply voltage is depleted. During the entire period of Continuous Operation, the GSM module is permanently on and the device can respond immediately to incoming control or query SMS.

### 2 Saving while no ext. power

The power supply of the GSM module is switched on for the duration of the external power supply. For the duration of the external power failure, the GSM module is switched off in a controlled manner. The GSM module will be switched on for a short period of time only when a request is made to perform a data session from the station to the server according to the current time interval for sending data or when a request is made to send a warning SMS.

### 3 Saving ehile low power

The GSM module power supply is permanently switched on until the battery supply voltage drops below the set warning level (parameter 11.3.2-27-2 Alert while pwr under [V] ).

Then the GSM module will be switched on for a short time only when a data session from the station to the server is requested or when a warning SMS is sent.

### 4 Saving based on BCH

The power supply of the GSM module is permanently switched on for the time of disconnection of the control binary channel. Switching off the binary channel activates the power saving mode of the GSM module.

In the power saving mode, the GSM module will be switched on for a short time only when a data session from the station to the server is requested or when a warning SMS is sent.

### 5 Always saving

The GSM module will be permanently operated in power saving mode, where it will be switched on for a short time only when a data session from the station to the server is requested or when a warning SMS is sent.

**Default setting:** Always on

## 1-2 Controlled input

Setting the binary channel number for controlling the 4th option of the GSM module Power Mode. **Default setting:** Disable

## 1-3 Delayed power-on [HH:MM:SS]

Setting the time in the GSM module's power saving mode for which the GSM module will remain on after the last data session to the server or after the last SMS is sent. While the modem is switched on, the unit can be remotely "communicated" with using command or query SMS.

**Default setting: 00:01:00**

### 1-4 Incoming SMS [0/1]

Prohibit/Permit to receive incoming command or control SMS.

**Default setting:** on (receiving incoming SMS enabled)



### 1-5 Outgoing SMS [0/1]

Prohibition/Permission to send warning or informative SMS.

The number of SMS sent during one day can be limited by setting the parameter 1-16 Max. SMS per day (pg. 220).

**Default setting:** on (sending outgoing SMS enabled)

### 1-6 GPRS roaming [0/1]

Banning/enabling data roaming.

**Default setting:** on



### 1-7 SIM PIN

Parameter for entering the PIN of the SIM card inserted into the device. The modem of the communication module verifies whether the inserted SIM requires a PIN and if it does (the PIN has not been permanently disabled, for example in a mobile phone), it tries to unlock the SIM using the PIN entered by this parameter.

If SIM unblocking fails, the information and invalid PIN will be stored in the error code log in the station and the communication module modem will be inoperative.

The four-digit PIN entered is hidden on the unit's display under the characters ####.

### 1-8 SMS coast

Setting the price per SMS sent.

### 1-9 Currency

Set the currency for calculating the amount called.

1 CZK 2 EUR 3 USD

### 1-10 Balance limit

Setting the size of the credit in the selected currency, after which you will be banned from sending SMS or transferring data to the server. The credit size can be set from 0 to 255.

### 1-11 Forward unknown SMS [0/1]

Setting this parameter activates the function for automatic forwarding of those incoming SMS that do not meet the requirements for control or informative SMS (do not contain Password, do not contain understandable commands or commands).

**Default setting:** off

### 1-12 Forward recipient

Select the recipient of the forwarded SMS from the preset contacts.

### 1-13 APN 1 (primary)

Setting the primary APN. The Name and Password parameters are set only in special cases if they are required by the ISP. In other cases, these two parameters can remain unset.



#### 1 APN

LIMIT: 25 characters. Frequent value of this parameter = internet

**Default setting:** internet

#### 2 Name

LIMIT: 20 characters

#### 3 Password:

LIMIT: 8 characters

### 1-14 APN 2 (secondary)

Setting the secondary APN.

1 APN

LIMIT: 25 characters

**Default setting:** internet.t-mobile.cz

2 Name

LIMIT: 20 characters

3 Password:

LIMIT: 8 characters



### 1-15 Max. connection time [HH:MM]

Setting the maximum time for the dial-up connection, after which the data connection of the GSM module with the calling modem will be terminated. The parameter acts as a safety against a possible data call error. The validity of this parameter determines the type of GSM communication module used (whether or not it supports data calling).

**Default setting: 01:00:00**

### 1-16 Max. SMS per day

Set the maximum number of SMS sent during the current day. The parameter acts as a safety against possible failure of the unit to cycle when sending SMS.

**Default setting: 50**



### 1-17 Max. responses per day

Set the maximum number of replies to SMS queries during the current day. The parameter acts as a safety against possible unit locking error when sending SMS.

**Default setting: 200**

### 1-18 SMS Password 1

Password settings for sending SMS query.

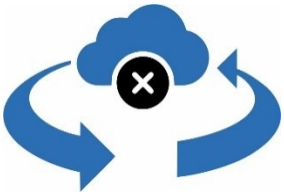
Password 1 can contain up to 15 characters.

### 1-19 SMS Password 2

Password settings for sending control and command SMS.

Password 2 can contain up to 15 characters.

In justified cases, both Passwords can be set the same.



### 1-20 Logon time

This parameter specifies the number of attempts to log the H7 unit's communication modem into the GSM network. After the preset number of attempts is exhausted, the modem is reset. The interval between login attempts lasts approximately 1 sec.

**Default setting: 30**

### 1-21 Response to INFO/STATUS



Here you can create a command string that the unit uses to create an SMS in response to an abbreviated query SMS in the form INFO or STATUS. See 4-1-3 Abbreviated query SMS on p. 198.

**Default setting:** V1,V2,V3,Q

***Remark:*** *The H7 unit automatically detects the presence of the GSM communication module and adds it to the parameters. Apart from selecting the desired power mode and setting the HESLA for SMS reception, it is not recommended to change the production parameters for GSM communication by the user.*




# 4-6 WiFi / ETH

Setting parameters for controlling the operation of the WiFi module or Ethernet communication module.

Before setting the WiFi communication parameters, it is necessary to have a WiFi communication module with a connected antenna in slot 2 of the unit.

To connect the unit to an existing WiFi network, just set the parameters:

1-4 DHCP modeDynamic

1-10 Network SSID, i.e. the name of the network

1-13 Securw key, i.e. the network password

Most of the other parameters are for when the unit is to create its own WiFi network.

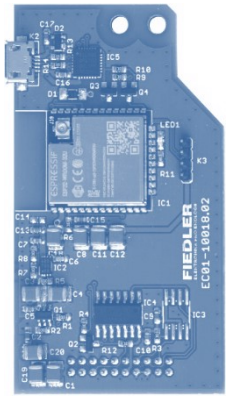
The status of the WiFi module can be monitored on the display of the unit in the section "Manual control -> WiFi status".




## 1-1 Power mode

Selecting the power supply mode of the communication module.

The permanently switched on communication module in the Continuous Operation mode ensures virtually instantaneous reception of control commands. On the other hand, however, it places a significant load on the power supply by its continuous consumption. Therefore, the continuous operation is usually set only for stations equipped with an external power supply.

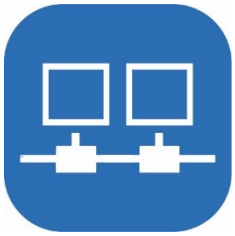


### 1 Always on

The power supply of the communication module is permanently switched on until the power supply voltage is depleted. During the entire period of Continuous Operation, the communication module is permanently on and the device can respond immediately to incoming commands.

### 2 Saving while no ext. power

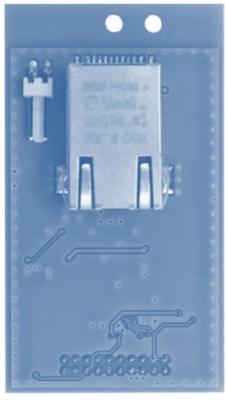
The power supply of the communication module is switched on for the duration of the external supply voltage. For the duration of the external power supply failure, the communication module will be switched off in a controlled manner and will only be switched on briefly when a data session is requested from the station to the server according to the current time interval for sending data.



### 3 Saving while low power

The power supply of the communication module is permanently switched on until the supply voltage falls below the set warning level (parameter level (parameter 11.3.2-27-2 Alert while pwr under [V] ).

Then the communication module will be switched on for a short time only when a data session from the station to the server is requested.



### 4 Saving based on BCH

The power supply of the communication module is permanently switched on for the duration of switching off the control binary channel. Switching off the binary channel activates the power saving mode of the communication module.

In the power saving mode, the communication module will be switched on for a short time only when a data session from the station to the server is requested.

### 5 Always saving

The communication module will be permanently operated in power saving mode, where it will be switched on for a short time only when a data session from the station to the server is required.

**Default setting:** Always on



## 1-2 Power controll BCH [BCH]

Set the binary channel number for controlling the 4th option of the Communication Module Power Mode.

**Default setting:** Disable

## 1-3 Power delay [HH:MM:SS]

Setting the time in the economical operating mode of the communication module for which the module remains on even after a data session to the server is executed.

**Default setting:** 00:00:00

## 1-4 DHCP mode

DHCP protocol selection.

Protocol for automatic configuration of not only newly connected devices to the network (Dynamic Host Configuration Protocol). The choice of mode depends on the configuration of the local network to which the unit is connected, i.e. if the network does not provide network settings (dynamic DHCP), manual configuration must be selected (static DHCP mode)

### 1 Off

### 2 Dynamic

The most common choice of DHCP mode. The necessary parameters are assigned by the parent network element (Parameters 1-5 to 1-9 will be set automatically).

### 3 Static

In this option of the DHCP mode it is necessary to enter all network parameters manually in the unit settings, i.e. the parameter ""communication""Gateway", "Network mask" and possibly also "DNS server".

**Default setting: Off**

## 1-5 IP address

LIMIT: 16 characters

The communication IP address for the unit must be unique throughout the network and from the same subnet as the default gateway address.

## 1-6 Gateway

LIMIT: 16 characters

The IP address of the default gateway is the IP address through which the unit can communicate with other networks, i.e. the Internet and the cloud.

## 1-7 Net mask

LIMIT: 16 characters

Defines the size of the subnet in which the unit is located.

## 1-8 Primary DNS

LIMIT: 16 characters

The IP address of the primary DNS server to be used by the unit on the network. The DNS server serves as a service for resolving FQDN names (e.g. www.google.com) to an IP address (e.g. 8.8.8.8).

## 1-9 Secondary DNS

LIMIT: 16 characters

IP address of the backup/second DNS server.

In Dynamic DHCP mode, the above parameters will be set automatically.

## 1-10 Network SSID

LIMIT: 32 characters

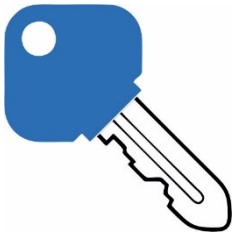
Setting a WiFi network name

## 1-11 WiFi channel

LIMIT: 0 - number of bin. channels

Applies when using the Wifi module in server mode. Defines the number of the radio channel on which to create the WiFi network.

## 1-12 Secure mode



Setting the security protocol used when communicating over WiFi networks. It is recommended to use only WPA2 security. Other security methods such as these are outdated/obsolete, easily cracked and cannot be considered secure. It is strictly not recommended to use them in a production environment and they are only offered in the unit settings for backward compatibility.

1 None
2 WPA2
3 WPA
4 WEP

**Default setting: none**

## 1-13 Securw key

LIMIT: 64 characters

Entering a WiFi network access password

***Setting up communication with the server via Ethernet***

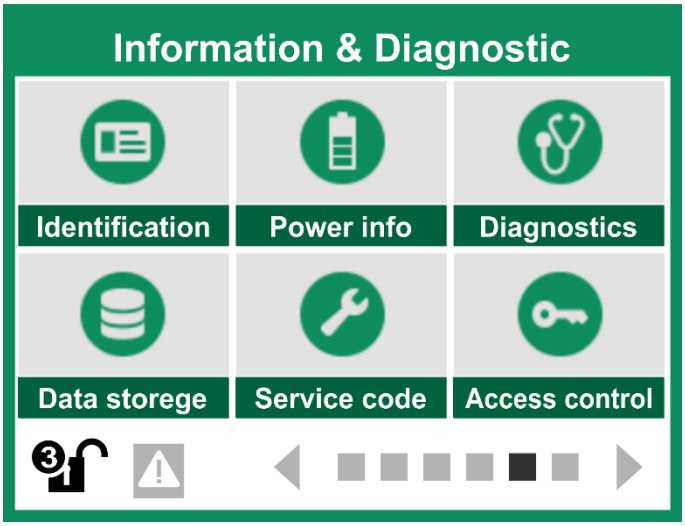
**Example 33.**

*Set up communication with the server using the connected Ethernet module located in SLOT-2.*

**Set:**

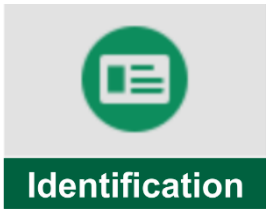
- ***APN selection:*** *primary Ext2 (slot selection 2 - see chap. 4-3* TCP *2. 203)*
- ***DHCP mode:*** *dynamic (parameters such as IP address, Gateway, Netmask and DNS address will be set automatically*

*The parameters "Power mode", "Control bin channel" and "Power delay" can take values according to the operation requirements and power supply method of the H7 unit. If the unit includes a GSM communication module in slot 0, these parameters are usually set identically for both communication modules.*




## 11.6. Information and diagnostics

This green 5th group of main menu items displays production information, current status and current instrument settings. The meaning of each item in this menu is clear from its name.




### 5-1 Identification

Displays the manufacturing versions of the SW and HW device and the used connection board, the values of the set basic identification parameters and the date of initial installation of the device.

This menu only displays the required data without the possibility of changing or resetting it.

1 Station type
H7 (H3, E2, Q2)

2 Hardware version
HW unit version / plug-in board type.

3 Software version
DISP: x. x.xx x | CPU: x.xx.xx x

4 Modem type
xxx | -|-

5 Serial number
8-digit serial number of the instrument

6 Device label
User-set device nameplate

7 Station ID
Device identification number (unique up to 10 digits)

8 Installed
YYYY/MM/DD (start of counter content measurements and calculations)




# 5-2 Power info

Display of the current measured magnitude of supply voltages and currents, display of the status of supply branches for connected probes and sensors.

1 Ext. power supply
The size of the external supply voltage.

2 Ext. battery
Battery voltage magnitude and current drawn/delivered to/from the battery.

3 Internal battery
Current capacity of the Li-Ion rechargeable battery in % and current drawn/supplied.

4 Unap1 power
Display the magnitude of the supply voltage of the 1st branch and the current drawn by the connected sensors.

5 Unap2 power
Display the magnitude of the 2nd branch supply voltage and the current drawn by the connected sensors.

6 Uopto power
Display the magnitude of voltage and current drawn from the UOPTO terminal.




# 5-3 Diagnostics

View the status of many error trays and error messages displayed on the diagnostic screen. The total number of communication errors for each serial interface is shown in detail in the overview.

1-1 Error messages
Overview of error messages. Clicking this option displays a diagnostic screen containing a list of error messages.

1 Error messages count
After pressing, a list of error messages will open

2 Reset !
Resetting diagnostic screen error messages

1-2 Communications diagnostics

1 Errors comm total:

2 Errors comm RS485:
1 – Errors comm RS485 all:
2 – Errors comm RS485-I:
3 – Errors comm RS485-II:

3 Errors comm MODBUS:

4 Errors comm FINET:

5 Errors comm SDI-12:

6 Errors comm DCL:

7 Errors comm MBUS:

8 Errors comm HART:

9 Errors comm Terminal board:

10 Reset comm diagnostics

11 Factory diagnostics




## 5-4 Data storage

1 Total available

The size of the total data memory of the unit in kB.

2 Free available

Display the size of the remaining data memory capacity for storing measured data.

3 Storage erased

The date the data memory was last cleared.

4 Up time

Display the total operating time of the unit.

5 Up time with errors

Display the total time of operation of the unit with the detected error.

6 Down time

Display the total time of the unit shutdown. No measurements have been taken during this time.

7 Installed

Display the date and time of installation of the unit. Start of counter content measurements and calculations.

8 Flow times

The total operating time of the first flowmeter and the total operating time of the first to fourth flowmeter with detected error.

1 – Up time flow 1

2 – Error time flow 1

3 – Up time flow 2

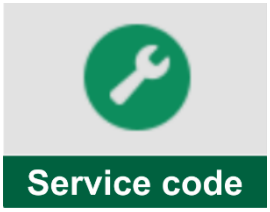
4 – Error time flow 2

5 – Up time flow 3

6 – Error time flow 3

7 – Up time flow 4

8 – Error time flow 4

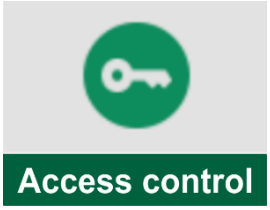



## 5-5 Service code

This menu is used during installation of the unit to quickly set the required parameters and has no application or authorization for user operation of the unit. The menu is only accessible to users with permission 3 and above.

1 Edit command

2 Send command !




# 5-6 Access control

The unit has a four-level authorisation system. The lowest level, zero, is indicated by a locked lock icon in the lower left of the display and prevents any changes to the unit's parameter settings.

Permission levels 1 to 3 allow parameter changes and are therefore password protected.

The whole issue regarding access rights is described in detail in chapter 10.1.1 Access permissions on p. 83.

## 1-1 Password change

The password is entered as an integer of 1 to 15 digits. The value 0 is also a valid password of one character. To disable a password, completely delete all characters in the password entry screen.

The following options are used to set passwords for each access level. Passwords can be set in order from the highest permission to the lowest. Thus, it is not possible to enter the password for Service (level 1) without first entering the password for Administration (level 2).

Two or all 3 passwords can be the same - then the device "unlocks" to a higher permission level when the password is entered.

### 1 Maintenance

Authorisation level

View current measured values and operating parameters.

### 2 Administrator

Authorisation level

Viewing the current measured values and operating parameters, changing instrument parameters except for calibration of analogue channels.

### 3 Vendor

Authorisation level

Change and set parameters and control all functions of the device without limitations.

## 1-2 Auto logout [0/1]

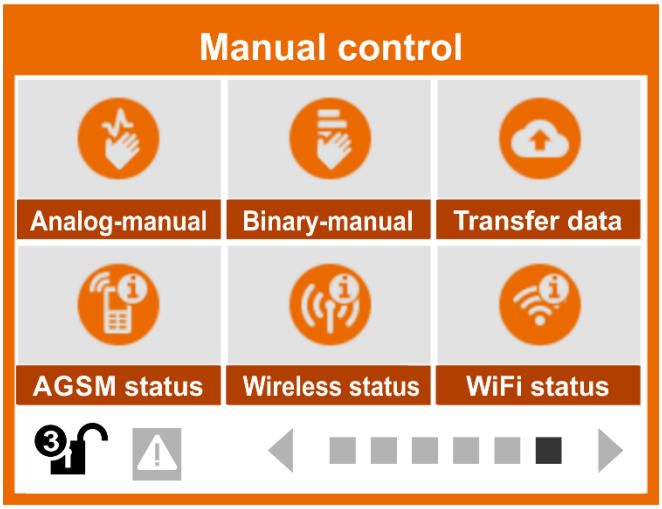
The "Auto Logout" binary parameter is used to enable automatic locking of the device after a preset time has elapsed since the last touch of the keypad or display.

**Default setting: off**

## 1-3 Login timeout [HH:MM:SS]

Time parameter for the Automatic Logout (Lockout) function of the device. After the set time has elapsed since the last key press or touch of the display, the device will automatically lock.

**Default setting: 00:05:00**




## 11.7. Manual control

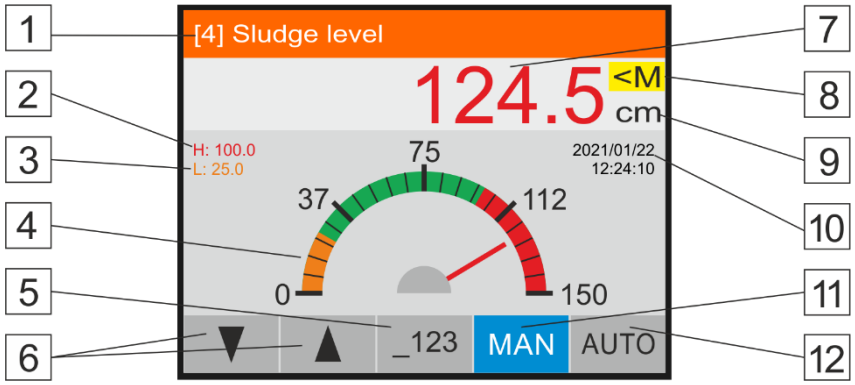
The last orange window of the main menu allows you to force the analog or binary channel to the desired value. Manual control commands can also be entered by remote access.

Access to the manual control can be conditioned by knowing the password and thus preventing changes to output values important for the operation of surrounding devices.

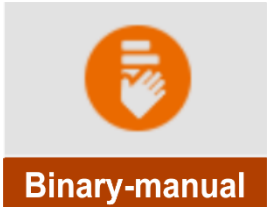



## 6-1 Analog-manual

The "Analog-Manual" menu is used to manually set the value of the selected analog ACH channel. After pressing the button of this menu, the desired ACH channel must first be selected from the displayed list of set analog channels.




| | |
|---|---|
| 1 | Sequence number and Namesake of the selected ACH for manual control |
| 2 | Set value of upper limit alarm, also red marked scale |
| 3 | Set value of the lower limit alarm, also orange marked scale |
| 4 | Scale with manual display of the measured (AUTO) or desired (MAN) value |
| 5 | Button to call up a numeric entry of the desired ACH value |
| 6 | Buttons for decrementing/incrementing the desired ACH value |
| 7 | Measured or set ACH value according to the status of the MAN and AUTO butt. |
| 8 | Mark indicating manually entered ACH channel value ( M =manual, A =automatic, E =error in AUTO mode) |
| 9 | Units of measure of the ACH channel being set |
| 10 | Current date and time of the unit |
| 11 | Button to enable manual control of the ACH value (blue = on) |
| 12 | Button to disable manual control and switch to automatic mode (measurement) |




# 6-2 Binary-manual

This option displays an overview of all the binary channels set in the instrument, including information about setting them to automatic or manual control. At the same time, individual binary channels can be switched between automatic and manual control using this screen, including forcing the desired value (0/1) in manual control mode.

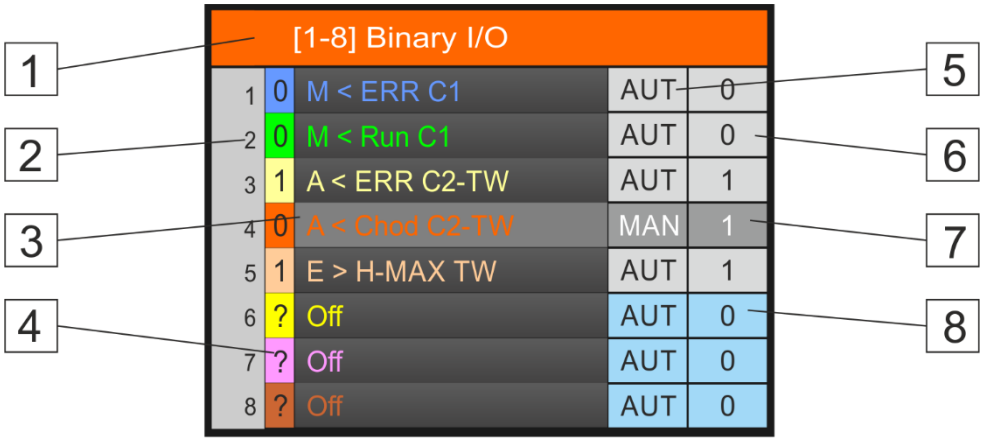
After pressing the "Binary-Manual" button and selecting one of the offered binary channels, the unit automatically switches to a table showing the binary value of the selected channel and up to 7 other adjacent channels.

The selected binary channel has a light gray coloring of the Binary label [3]. Selecting another binary channel can be done by using the UP and DOWN arrows or by pressing either of the two right columns of the screen [5], [6].

***Colour coding of BCH*** The color coding of the individual binary channels is the same for the channel settings in the "Binning-Manual" mode, as well as for the display of the current and archived values of the binary channels. Thus, the binary channels in manual control mode have a yellow colouring of the button [5] including the Binary label and the instantaneous value indicator, the binary channels in automatic control mode are coloured green and the binary channels in fault mode are marked in red.

***AUT / MAN*** The buttons in the table column to the right of the Binary label [5] can either be labeled AUT (automatically set BCH state) or MAN (manually/manually set BCH state). To change the flag, click the screen button [6], [7] or use the ENTER knob.

***0 / 1*** Changing the state of a manually controlled binary channel can be done by pressing the button in the right column of the unit [6] for the selected binary channel or by using the RIGHT (sets 1) and LEFT (sets 0) arrows.




| | |
|---|---|
| **1** | Sequence numbers of the eight displayed binary input/output channels. |
| **2** | The current value of the binary channel. |
| **3** | Gray shaded BCH selected for manual output adjustment; select binary channel using UP, DOWN or screen buttons [5], [6]. |
| **4** | Unconfigured BCH channel (addition to the BCH channel display eight) |
| **5** | Button for switching between automatic (AUT) and manual (MAN) binary output setting. Manually controlled binary channels have these buttons in yellow. |
| **6** | Button to change the 0/1 status of the selected channel in manual mode. State change is also performed using the LEFT (0) and RIGHT (1) knobs. |
| **7** | The dark colored button indicates a request to switch on (1) the BCH channel and the light gray color indicates a request to switch off (0) the binary channel in manual control mode. |
| **8** | Inactive buttons of unset channels (addition to display eight). |
| **MODE** | A longer press of the MODE button will switch to the display of the current BCH values. |




# 6-3 Transfer data

Menu with command button for manual forced sending of data to the server outside the regular communication interval with the server. The menu item "Sending status" displays the status of data sending, i.e. whether the data is being sent and whether it has been sent. The instrument also displays the total amount of data already sent and received in kB. When the "Send data" button is clicked, the data is sent to the server.

## 1-1 Sending status

Notification in which working mode the process of sending data to the server is currently in and possibly also downloading instructions, parameters or FW from the server. The "Off" notification is displayed at rest.

## 1-2 Sent data

## 1-3 Received data

Overview of data sent and received in kB within the current data session with the server.

## 1-4 Send data!

Command button to start the process of transferring the measured data to the server via the communication module located in slot 0 (GSM/GPRS).

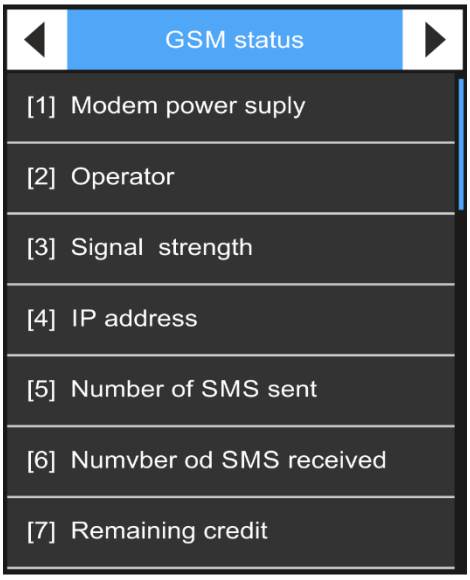
## 1-5 Send data -2 !

Command button to start the process of transferring the measured data to the server via the communication module located in slot 2 (WiFi or Ethernet).




# 6-4 GSM status

Display of the current GSM modem status: modem power ON/OFF, operator name, signal strength, remaining credit and number of sent and received SMS.




This information menu is usually launched when the GSM antenna is installed and the modem is switched on as described in the previous chapter 6-3 Transfer data. The signal strength information can be important in terms of selecting the optimal antenna location.

## 1-1 Modem power supply

Information about the current power status of the modem. If the current modem power status is off, this may not be an error. The off state may be caused by parameter settings (the modem should be switched on only when sending data at predetermined times for a certain period of time), or by a drop in the voltage of the power supply battery, or by an external power failure (while allowing the modem to switch off in these cases).

## 1-2 Operator

Information with the name of the operator to which the station has subscribed to the network.

## 1-3 Signal strength

Information about the field strength at the GSM antenna location. The higher the number, the better the conditions for data communication between the station and the server.

The minimum signal strength for GPRS communication is usually 25% and 15% for receiving and sending SMS.

## 1-4 IP address

The current IP address of the communication module. [FW-CPU:1.18.39; FW-DISP: 4.1.23]

## 1-5 Number of SMS sent

## 1-6 Number of SMS received

Total number of SMS sent and received within one current day.

## 1-7 Remaining credit

The value of the remaining credit when using prepaid SIM cards.



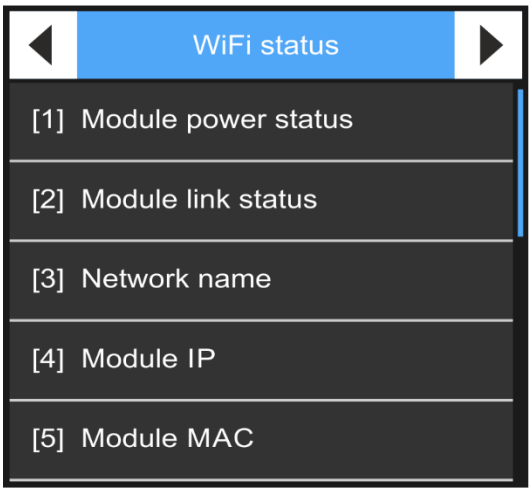

# 6-5 Wireless status

The Radio Status option is not supported in the current version of the unit software.




# 6-6 WiFi status

Only an information menu showing the current status of the communication WiFi or Ethernet module including information on setting some important parameters.




## 1-1 Module power status

Information about the current power status of the modem. If the current modem power status is off, this may not be an error. The off state may be caused by parameter settings (the modem should be switched on only when sending data at predetermined times for a certain period of time), or by a drop in the voltage of the power supply battery, or by an external power failure (while allowing the modem to switch off in these cases).

## 1-2 Module link status

Information about Connecting/Disconnecting the unit.

## 1-3 Network name

Display of the network name set in the parameters of the WiFi communication module.

## 1-4 Module IP

Display a static IP address from the set parameters or display an automatically assigned IP address using DCHP.

## 1-5 Module MAC

Displaying the MAC address of the communication module in the parameters.

# Measurement methods in examples

## Current measurement

Measuring physical quantities with current output sensors

### 1. Measurement method: Current 4..20 mA, 0..20 mA, 1..5 mA, ...

Measurement methods for measuring the current flowing into the AIN input of the connection board. Depending on the range of current to be measured, the appropriate measurement method is selected.

The current inputs AIN1 to AIN6 contain precision and temperature stable 100 R measuring resistors connected to the ground terminal AGND before the ADC. If the AIN7 and AIN8 inputs on the TA4 connection board are also to be used for current measurement, then such precision resistors must be connected externally between the AIN7, AIN8 and AGND terminals.

***Analog ground AGND***

Active current signals supplied from a source outside the Q2 unit are connected to terminals AIN and AGND.

***Important parameters***

**Measurement method:**

| | |
|---|---|
| Current 0...20 mA | Current 1...5 mA |
| Current 4...20 mA | Current 0...5 mA |
| Current 0...24 mA | Current 0...1 mA |

**Input-A:** 1 to 6 for inputs AIN1 to AIN6

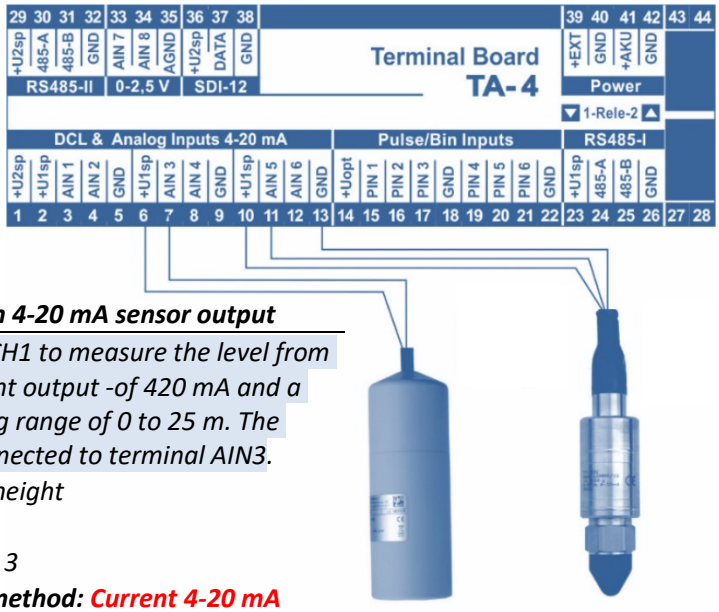
**Measured quantity:**

Current: the result corresponds directly to the value from the AD converter

Other variables: the result must be adjusted using the Signal amplification and Offset parameters.

**Amplification:** range of the measurand in units of measurement

**Offset Delta:** Possible offset in units of measurement




***Level measurement with 4-20 mA sensor output***

**Example 34.**

*Set analogue channel ACH1 to measure the level from a probe that has a current output -of 420 mA and a corresponding measuring range of 0 to 25 m. The probe output will be connected to terminal AIN3.*

***Set ACH1:***

- ***Quantity:*** *level height*
- ***Units:*** *m*
- ***Floating points:*** *3*
- ***Measurement method:*** ***Current 4-20 mA***
- ***Input-A:*** *3 (AIN3)*
- ***Signal amplification:*** *25 (measuring range 0 to 25 m)*
- ***Offset Delta:*** *0 (zero offset)*




# Voltage measurement

Measuring physical quantities with voltage output sensors

## 2. Measurement method: Voltage

Measurement methods for measuring the voltage at the two inputs AIN7 and AIN8 of a suitable connection board. The measurement method is selected according to the voltage range to be measured. The unipolar voltage applied to inputs AIN7 to AIN8 is always measured against the common ground terminal AGND. Differential bipolar voltages shall be measured only between inputs AIN7 and AIN8, and the voltage against the AGND ground terminal at each of these two inputs shall range from 0 V to max 4 V.

*Note: Inputs AIN1 to AIN6 contain internal 100R measuring resistors connected between the inputs and the AGND ground terminal and therefore cannot be used for voltage measurements.*

***Important parameters***

**Measurement method:**

**Unipolar voltage:**

| | |
|---|---|
| Voltage 0...2,5 V | Voltage 0...80 mV |
| Voltage 0...1,25 V | Voltage 0...40 mV |
| Voltage 0...600 mV | Voltage 0...20 mV |
| Voltage 0...300 mV | Voltage 0...1 V |
| Voltage 0...150 mV | Voltage 0...2 V |

**Bipolar voltage:**

| | |
|---|---|
| Voltage -2,50 V...+2.50 V | Voltage -150 mV...+150 mV |
| Voltage -1,25 V...+1.25 V | Voltage -80 mV...+80 mV |
| Voltage -600 mV...+600 mV | Voltage -40 mV...+40 mV |
| Voltage -300 mV...+300 mV | Voltage -20 mV...+20 mV |

**Input-A:**

**1 to 8** for unipolar voltages to AGND on inputs AIN1 to AIN8 (standard inputs AIN1 to AIN6 are connected via sensing resistor 100R to GND).

**101 to 108** for bipolar voltages at inputs AIN7(+) - AIN8(-) on the terminal boards.

**Quantity:**

Voltage: the result corresponds directly to the value from the ADC
Other variables: the result must be adjusted using the *Signal amplification* and *Offset Delta* parameters.

**Signal Amplification:** quantity range in units of measurement / probe output voltage range

**Offset Delta:** Possible offset in units of measurement

***Temperature measurement using a sensor with 0-2 V voltage output***

**Example 35.**

*Set the ACH7 analog channel to measure temperature from a sensor that has an output voltage range of 0.0 to 2.0 V and a corresponding measurement range of -20 to +60 °C. The sensor output voltage will be connected to terminals AIN8 and AGND.*

***ACH7 settings:***

- ***Quantity:*** *Temperature*
- ***Units:*** *°C*
- ***Floating points:*** *2*
- ***Measurement method:*** ***Voltage 0 .. 2,5 V***
- ***Input-A:*** *8*
- ***Signal amplification:*** *40 (=80°C/2V ratio where 80°C is the max-min measurement range: 60°C-(-20°C))*
- ***Offset Delta:*** *-20 (20°C offset)*

# Voltage measurement

Measuring the battery supply voltage

## 3. Measurement method: Battery voltage

The magnitude of the battery supply voltage has its own separate measurement method, and the setting of the important parameters can be seen from the following example.

***Measuring the voltage of the power supply battery:***

**Example 36.**

*Set the analog channel ACH8 to measure the voltage of the power battery.*

**ACH8 settings:**




- ***Quantity:*** *Voltage*
- ***Analog label:*** *Voltage AKU*
- ***Units:*** *V*
- ***Floating points:*** *1*
- ***Measurement method:*** ***Battery voltage***
- ***Input-A:*** *1*
- ***Signal Amplification:*** *1*
- ***Offset Delta:*** *0*



# Flow in open profile

Measuring the flow in the riser using the Flowmeter method

## 4. Measurement method: Flowmeter

Unit H7 contains 4 independent SW blocks Flowmeter [1] to Flowmeter [4].

Flowmeter parameters and settings are described in chap. 3-5 Flow Meters on p.169.

***Flowmeter setting for PARS P3; probe with 4-20 mA output; pulse output***

**Example 37.**

*Set the parameters of the flowmeter and the necessary analog channels in the H7 unit to measure the instantaneous flow and the flow volume through the Parshall trough P3. The level upstream of the flume will be measured by a US1200 ultrasonic level sensor connected upstream of the DCL output and will be accessed on channel ACH1, the calculated instantaneous flow on channel ACH2.*

*The instantaneous flow rate will be transmitted to the master system via a 4-20 mA current output in the range 0 to 30 l/s (ACH5) and the flow volume via RELE1 as 2 sec long pulses with a weight of 0.1 $m^3$ (BCH1).*

**Setting ACH1: (Level)**

- ***Quantity:*** *level*
- ***Units:*** *mm*
- ***Measuring method: the*** *DCL ASCII-U probe*
- ***Units:*** *l/s*
- ***Floating points:*** *2*

**Setting ACH2: (Flow)**

- ***Measured quantity:*** *flow*
- ***Units:*** *l/s*
- ***Measurement method:*** ***Flowmeter***
- ***Counter:*** *Enable*
- ***Counter units****: $m^3$* ***Counter decimal places****: 0.000*
- ***Input-A:*** *1 (1st flow meter of 4)*

**Setting ACH5: (4-20 mA output)**

- ***Quantity:*** *Optional*
- ***Units:*** *%*
- ***Measurement method:*** *Current output 4-20 mA*
- ***Interface advanced:*** *1 (IOUT1 output number)*
- ***Input-A:*** *2 (analog control channel number)*
- ***Signal amplification:*** *30 (max analog channel range in l/s for 20 mA)*

**Setting BCH1: (output RELE1)**

- ***Mode:*** *Output - Local (relay)*
- ***Input/Output:*** *1 (RELE 1)*
- ***Function:*** *Sampler based on count.*
- ***Control channel:*** *2 (ACH2)*
- ***Upper limit:*** *999999 (high flow number that cannot be exceeded in practice)*
- ***Lower limit:*** *0*
- ***Pulse interval samp.:*** *0.1 (in counter units, i.e. in $m^3$ )*
- ***Pulse length:*** *2*

**Flowmeter Settings:**

- ***Flowmeters:*** *1 (1st flowmeter of 4)*
- ***Flowmeter mode:*** *Weir*
- ***Level channel: 1***
- ***Computation type:*** *PARS P3*

# Pulse counter

Measurement of instantaneous flow, leaked volume, energy and precipitation

## 5. Measuring method: Pulse counter

This measuring method is designed for measuring flow or volume by pulses.

It is possible to specify one common channel for both flow and leaked volume measurement or two separate channels - one for instantaneous flow without sum and the other for leaked volume registration with counter. The analogue channel setting for both instantaneous flow and leaked volume is limited by the maximum number of analogue channels with counter (the H7 unit has 64 counters on the first 64 analogue channels).

***Important parameters***

**Measured quantity:**

**Flow rate** for instantaneous flow with or without sum. Instantaneous flow is calculated from the pulse weight and the pulse rate per 10 sec.

**Volume** for the leaked volume counter with sum.

**Rainfall** for recording rainfall totals (sums).



**Measurement method:** Pulse counter

**Input-A:**

the number of the pulse PIN input on the connection board in the range 1 to 8. One input can be used for multiple channels.

**Input-B**

number of the pulse PIN input for direction control (reverse flow). Allowed parameter range 1 to 8. When the input is on, it is added on the channel with **Reverse** on. When the input is open, it is added on the channel with **Reverse** disabled.

***Note: Valid until FW 1.17.49*** *: The physical input for direction selection is the input following the input specified in the Input Number parameter. When the input is unlatched, it is read on the channel with* ***Reverse*** *on. When the input is open, it is read on a channel with Reverse disabled.* ***From FW 1.17.50*** *see. Input-B.*

**Units of measurement:**

The units of instantaneous flow and volume required are arbitrary. In the case of measuring the flow volume with a counter, the channel and counter units must be set to the same units. Usually the instantaneous flow rate is set in l/s and the leaked volume in $m^3$.



**Floating points:**

In the case of measuring the leaked volume with a counter, it is necessary to set the channel and counter units to the same Floating points.

**Signal amplification:**

The volume per pulse is entered in counter units (pulse weight).

**Signal->Reversion:**

For pulse direction sensors with directional resolution, the channel is set to measure the forward direction with the Reversion parameter turned off and the Reversion parameter is turned on for the reverse direction.

**Zero zone:**



For the correct function of calculating the instantaneous flow rate from the time between pulses and from the weight of one pulse, it is necessary to enter the minimum registered flow rate value in the selected flow rate units. The lower the value entered, the longer it takes to evaluate the instantaneous flow rate. A higher value speeds up the response of the current flow value, but there may be skipping between zero flow and the flow value corresponding to the value between the last two pulses.

**Aggregation before storing:**

The measurement method requires setting the Last measurement option.



## METHOD FOR CALCULATING INSTANTANEOUS FLOW RATE

- the evaluation interval of the instantaneous flow rate is 10 seconds in case of continuous power supply mode or the measurement interval in case of power saving mode.
- the pulse frequency per evaluation interval is calculated
- if this frequency is greater than or equal to 2 Hz, the resulting flow rate is determined as the pulse frequency per evaluation interval * pulse weight
- if the pulse frequency is less than 2 Hz, the time since the last pulse is detected.
- if this time is longer than the time between pulses corresponding to the specified Zero band, the instantaneous flow is zero. * Otherwise, the instantaneous flow is calculated from the difference of the times between the last two pulses.

***Measurement of instantaneous flow and volume from water meter pulses***

**Example 38.**

*Set ACH5 to measure instantaneous flow and leaked volume from the connected water meter to the PIN4 input, pulse weight 1 litre.*

**ACH5 settings:** *(Flowmeter)*

- ***Measured quantity**: flow* ***Units**: l/s*
- ***Floating points**: 2* ***Measuring method**: Pulse counter*
- ***Input-A**: 4* ***Signal amplification**: 1 (pulse weight = 1 l/pulse)*
- ***Zero band**: 0.05* ***Counter**: Enable*
- ***Counter units**: $m^3$* ***Counter decimal places**: 0.000*
- ***Aggregation before storing**: Last Value*

***Electrical energy measurement using pulse input***

**Example 39.**

*Set CH12 to measure the electricity consumed by pulses from the meter connected to the AIN5 input, pulse weight 0.01 kWh/pulse.*

**Setting ACH12:** *(Meter)*

- ***Measured quantity**: energy* ***Units**: kWh*
- ***Floating points**: 0.00* ***Measuring method**: Pulse counter*
- ***Input-A**: 5 (pulse meter output connected to input AIN5 and GND)*
- ***Signal amplification**: 0.01 (pulse weight)* ***Zero band**: 0*
- ***Counter**: enable* ***Counter Units**: kWh*
- ***Counter decimal places**: 0.00*
- ***Aggregation before storing:** Last value*

***Setting the rain gauge parameters***

**Example 40.**

*Rainfall measurements from an articulated rain gauge with a pulse weight of 0.1 mm connected to the PIN2 input. If it does not rain, then archive once per hour. If it rains, switch to minute rainfall recording only at the channel with the rain gauge and record minute rainfall for 15 minutes after the last pulse (since the rain stopped). Detection of active rainfall will be set on the binary channel BCH5, which will decide if more frequent storing is needed.*

**Setting ACH1:** *(Rain gauge)*



- ***Quantity:** rainfall* ***Units:** mm*
- ***Floating points:** 1* ***Measuring method:** pulse counter*
- ***Input-A:** 2 (pulse input PIN2)* ***Signal amplification:** 0.1*
- ***Counter:** enable* ***Counter Units:** mm*
- ***Counter decimal places:** 1* ***Regular storing:** Regular interval*
- ***Regular storing interval:** 60 min* ***Exceptional storing:** Bin. trigger*
- ***Exceptional storing Interval**: 1 min*
- ***Trigger channel for storing:** 5 (BCH5)*

**Setting BCH5:** *(rain detection)*

- ***Mode**: Input - Local* ***Input:** 2 (PIN2 pulse input)*
- ***Storing:** on* ***Function:** Binary input*
- ***Delayed Off:** 900 (900 sec = 15 minutes)*

# PID Controller

Calculation and setting of PID controller parameters

## 6. Measurement method: Controller Example 20. on page. 168

# Calculations from data of other ACHs

Copying, gating and mathematical operations between ACH channels

## 7. Measurement method: Custom channel

Calculation of the current value of an analog channel based on the current values of two other analog channels.

***Important parameters***

**Measurement method:** Custom channel

**Input-A:** Number 1. Analog channel for calculation.

**Input-B:** Number 2. Analog channel for calculation.

**Input-C:** Number 3. Analog channel number or binary channel number for controlled switching between two analog channels.

**Interface:** set to off.

**Interface advanced: the** parameter value specifies the calculation method:

**1** ... **Copy of** channel ACH[Input-A] including error codes. [FW1.17.20]

**2** ... **Absolute value of** channel ACH[Input-A] including error codes. [FW1.17.20]

**3** ... **Integration of** the ACH[Input-A] value over time. The value of the input channel is multiplied by the time in seconds and the gain. The result is stored in the counter increment. If the input channel is in error, nothing is added. [FW1.17.40]

**4** ... **Virtual output in %**, conversion of ACH value to 0-100% according to Signal amplification and Offset parameters. This is a support function for various control algorithms. [FW1.18.13]

- **Input-A:** ACH number that controls the virtual analog channel
- **Signal amplificat.:** value for 100% analog output in control channel units
- **Offset Delta:** Offset of analog output zero in control channel units
- **Reversion:** When set, the analog output is inversely proportional to the value of the control channel

**5 ... Change of** ACH[Input-A] **counter value** in time. The value of the total input channel counter is compared to the previous value at one minute intervals. The difference in counter status is then multiplied by the gain due to unit conversion. When an input channel error occurs, the error is copied. The status of the total counter is also copied. [FW1.18.10]

**6 ... Conversion of level to pumped/unpumped volume** according to pump switched on and tank area. [FW1.18.22]

**Important parameters:**

- **Input-A:** ACH channel number with level in meters
- **Input-B:** BCH channel number indicating pump operation
- **Reinforcement:** tank area in m2
- **Interface Advanced:** 6
- **Bipolar:** 1 - Draining, 0 - Pumping
- **Zero band: the** minimum level change to count

**7 ... A rounded copy of the ACH**[Input-A] **channel** including the error code. [FW1.18.50]
Rounding is performed according to the value of the Amplification parameter. The following table shows the resulting values of this function in two examples:

| Access-A | Gain: 0.1 | Amplifica-tion: 1 | Amplifica-tion: 5 | Amplifica-tion: 10 |
|---|---|---|---|---|
| **278,056** | 278,100 | 278,000 | 280,000 | 280,000 |
| **-1364,252** | -1364,300 | -1364,000 | -1365,000 | -1360,000 |

**11** ... **Sum of the** instantaneous values of two channels ACH[Input-A] + ACH[Input-B]. If one or both input channels indicate a measurement error, the calculation is performed with the last valid value or zero (depending on the error parameter set to zero of the source channel). [FW1.17.0]

**12** ... **Difference of** instantaneous values of two channels ACH[Input-A] - ACH[Input-B]. If one or both input channels indicate a measurement error, the calculation is performed with the last valid value or zero (depending on the error parameter set to zero of the source channel). [FW1.17.0]

**13** ... **The average of** the instantaneous values of the two channels ACH[Input-A] and ACH[Input-B]. If one input channel indicates a measurement error, the result is equal to the value of the input channel that has no error. In the case of an error on both channels, a calculation error (15) is signalled. [FW1.17.0]

**14** ... **Ratio of** instantaneous values of two channels ACH[Input-A] / ACH[Input-B]. If one of the input channels measures with an error or the value of the channel ACH[Input2] is zero, a calculation error is signaled (15). [FW1.17.13]

**15 ... Sum of 3 channels.** Similar to 11 [FW1.17.41].

**21** ... **Switches the value of** two channels ACH[Input-A] and ACH[Input-B]. If BCH[Input-C] is in OFF mode, it copies ACH[Input-A], if BCH[Input-C] is in ON mode it copies ACH[Input-B]. The copying is done including the error code.

**22** ... **Switches the value** (with preference for the non-error channel) of two channels ACH[Input-A] and ACH[Input-B] in the same way as the previous option 21, except that if it measures one of the input channels with an error, the state of the switching input is ignored and the result copies the value of the non-error input channel. [FW1.17.11]

**23 ... Lower value.** Copy of the channel ACH[Input-A] or ACH[Input-B] with the lower value. [FW1.17.49]

**24 ... Higher value.** A copy of the ACH[Input-A] or ACH[Input-B] channel with the higher value. [FW1.17.49]

**25 ... Merging the current value of ACH[Input-A] and the total counter from ACH[Input-B]** into one channel. An example would be to merge the instantaneous 4-20 mA flow on ACH1 and the total sum recorded as a pulse input on ACH5 into one channel on ACH2. A similar example is the MODBUS flow and sum readout, which must be handled using two channels. These two channels can be reunified by this function and only one unified channel can be archived. [FW1.18.40]

**31 ... Dew point** from the instantaneous value of ACH[Input-A] and the instantaneous humidity of ACH[Input-B]. [FW1.18.29]

**32 ... Sensible temperature** from instantaneous value ACH[Input-A], instantaneous humidity ACH[Input-B] and wind speed ACH [Input-C]. [FW1.18.29]

**33 ... Conversion to physical units. This** function converts the measured value of the analog channel (4-20 mA) to physical units according to the conversion equation and coefficients from the calibration sheet of the specific probe/sensor. The conversion coefficients need to be stored in the SP Set point parameter group according to the type of the selected conversion equation (so far only polynomial equations). [FW1.18.47]

- **Input-A: the** ACH number we want to convert
- Input-B: (reserve)
- **Input-C:** number 1.PP of the group with conversion coefficients, meanings of SP in the group:
- **1. SP in group:** type of conversion equation (1.PP=0 ... Ax^3 + Bx^2 + C*x + D)
- **2. SP:** absolute (0) / incremental (1) measurement relative to the refer. value
- **3. SP:** conversion coefficient A (in the form -x.xxxxE-xx) according to the probe calibration sheet
- **4. SP:** conversion factor B (in the form -x.xxxxE-xx) according to the probe calibration sheet
- **5. SP:** conversion coefficient C (in the form -x.xxxxE-xx) according to the probe calibration sheet
- **6. SP:** conversion coefficient D (in the form -x.xxxxE-xx) according to the probe calibration sheet
- **7. SP:** reference value for incremental measurement

***Blower control by lower value from two ACH channels***

**Example 41.**

*Channels AH1 and ACH2 measure the instantaneous dissolved oxygen at two points in the activation tank. Set ACH3, which will be used to control the blowers, to record the lower of the two measurements.*

**ACH3 settings:** *(lower value of 2)*

- ***Quantity**: dissolved oxygen*
- ***Units**: mg/l*
- ***Floating points**: 0.00*
- ***Measurement method**: Custom channel*
- ***Interface advanced:** 23 (function selection lower value)*
- ***Input-A:** 1 (ACH1)* ***Input-B:** 2 (ACH2)*

***Monitoring the pumped volume from the change in level***

**Example 42.**

It is required to measure the pumped volume into a 2x3 m tank. The current level value is set to ACH[1], the pump switch-on state to BCH[31].

**ACH2 settings:** *(Volume)*

- ***Measured quantity**: volume*
- ***Units**: m3*
- ***Floating points**: 0.00*
- ***Measurement method**: Custom channel*
- ***Interface advanced:** 6 (level to volume conversion with BCH on)*
- ***Input-A:** 1 (ACH1)* ***Input-B:** 2 (BCH31)*
- ***Signal amplification [m2]:** 6 (2 m x 3 m = 6 m2)*
- ***Zero band:** 0.03 (noise suppression around small level changes)*
- ***Counter:** Enable* ***Counter units:** m3*
- ***Counter decimal places:** 0.00*

***Flow and volume within one ACH***

**Example 43.**

Requirement to merge into one ACH channel **the current** ACH **flow rate**[6] and the **leaked** ACH **volume**[7]. The values of both channels are read from the connected PLC - see Example 50 on pg. 246.

**ACH1 settings:** *(Instantaneous flow and leaked volume)*

- ***Measured quantity**: flow rate*
- ***Units**: l/s*
- ***Floating points**: 0.00*
- ***Measurement method**: Custom channel*
- ***Interface accuracy:** 25*
- ***Input-A:** 6 (ACH6)* ***Input-B:** 7 (ACH7)*
- ***Counter:** enable* ***Counter units:** m3*
- ***Counter decimal places:** 0.00*

# Calculations from archived data

Calculation of the ACH value based on data from other channels

## 8. Measurement method: Custom functions

Calculation of the current channel value based on archived source channel data. The calculation value scans the archived source channel data backwards for the specified interval and searches for valid measurements (error code = 0). It then statistically evaluates these values. The beginning and end of the data search interval is rounded down to whole minutes.

***Important parameters***

**Measurement method:** Calculation functions
**Input-A:** number of the analog channel from whose archived data the calculation is performed.
**Signal amplification:** indicates the duration of the evaluation interval in minutes.
**Interface:** set to off.
**Interface advanced: the** parameter value specifies the calculation method:

- **1** .. moving sum of the archived data for the specified interval. If the source channel has a counter enabled, the incremental values of the source channel are added.
- **2** .. moving average of archived data for the specified interval
- **3** .. minimum archived value for the specified interval
- **4** .. maximum archived value for the specified interval
- **5** .. oldest archived value for the specified interval
- **6** .. the latest archived value for the specified interval
- **7** .. difference of the latest and oldest archived values for the specified interval
- **8** .. difference of current and oldest archived values for the specified interval
- **9** .. difference of current and latest archived values for the specified interval
- **10**..prediction of new value in current time + Offset in minutes [FW:1.18.53]

***Sending a warning SMS when the set rainfall exceeds the set rainfall***

**Example 44.**

*Set a warning SMS to be sent to all contacts in group II if the rainfall measured on channel ACH7 exceeds 50 mm in the last 120 min. The rain gauge is set on channel ACH1.*

***Setting ACH7: (rainfall total)***

- ***Analog label:*** *precipitation total 120 min.*
- ***Quantity:*** *rainfall*
- ***Units:*** *mm*
- ***Floating points:*** *0,00*
- ***Measurement method:*** *Custom functions*
- ***Input-A:*** *1 (ACH number for the calculation of the running total)*
- ***Signal Amplification:*** *120 (set the calculation time in min)*
- ***Interface Advanced:*** *1 (Sliding Sum function selection)*
- ***Regular storing:*** *global interval*

***Set SMS: (warning)***

- ***Mode:*** *ACH upper limit*
- ***Control channel:*** *7*
- ***Recepient:*** *Group II*
- ***Limit:*** *50 (condition for sending warning SMS is exceeding 50 mm on ACH7)*
- ***Hysteresis:*** *5 (next SMS sent after the ACH7 value drops below 45 mm and reaches 50 mm again)*
- ***Text message:*** *warning - more than 50 mm of rain in 120 min*

*Alternatively, you can also create an SMS text using #V: In the last 120 min #V7 rainfall. The recipient then receives a text message: for the last 120 min ACH7=50.1 mm of precipitation.*

# Autodiagnostics H3, H7

Measurement of supply voltages, currents, temp. and other

## 9. Measuring method: Internal sensors

***Usage:*** This measurement method is used to **measure the internal sensors of the** instrument's operating conditions. The measured quantity is determined by the value of the parameter **Input-A** (left column of the table):

| | |
|---|---|
| **1** | UNAP1 power supply branch voltage [V] |
| **2** | Current drawn from UNAP1 [mA] |
| **3** | UNAP2 power supply branch voltage [V] |
| **4** | Current drawn from UNAP2 [mA] |
| **5** | UNAP3 power supply branch voltage [V] |
| **6** | Current drawn from UNAP3 [mA] |
| **7** | U-OPTO supply branch voltage [V] |
| **8** | Current drawn from U-OPTO [mA] |
| **9** | External power supply voltage [V] |
| **10** | External Pb battery voltage [V] |
| **11** | Current from/to external Pb battery [mA] |
| **12** | Percentage of charge of internal LI battery [%] |
| **13** | Remaining capacity of internal LI battery [mAh] |
| **14** | Current from(-)/to(+) internal LI battery [mA] |
| **15** | Temperature on the circuit board inside the unit [°C] |
| **16** | Relative humidity on the circuit board [%] |
| **17** | Internal LI battery capacity [%] |
| **18** | Temperature of the BQ chip used for controlled charging of the LI backup battery [°C] |
| **19** | Precise IPD plate temperature [°C] |
| **20** | Internal LI battery voltage [V] |
| **21** | Full capacity of internal LI battery [mAh] |
| **22** | Complete analog loop time [sec] |
| **23** | Priority analog loop time [sec] |

***Using the measurement method "Internal sensors"***

**Example 45.**

*Setting the ACH25 to measure relative humidity with an internal sensor located on the circuit board inside the unit.*

***Setting ACH25:***
***(humidity in the unit)***

- ***Quantity:*** *humidity*
- ***Units:*** *%*
- ***Floating points:*** *0.0*
- ***Measuring method:*** ***Internal sensors***
- ***Input-A:*** *16*

RS485

# Data acquisition via RS485 - FINET

Reading data from probes under FINET protocol

## 10. Measuring method: probe RS485 / FINET

Reading data from probes connected to the RS485 bus under the FINET protocol.

***Important parameters***

**Measuring method:** probe RS485 / FINET

**Interface:** RS485-I or RS485-II depending on the actual probe connection

**Address-A:** address of the connected probe

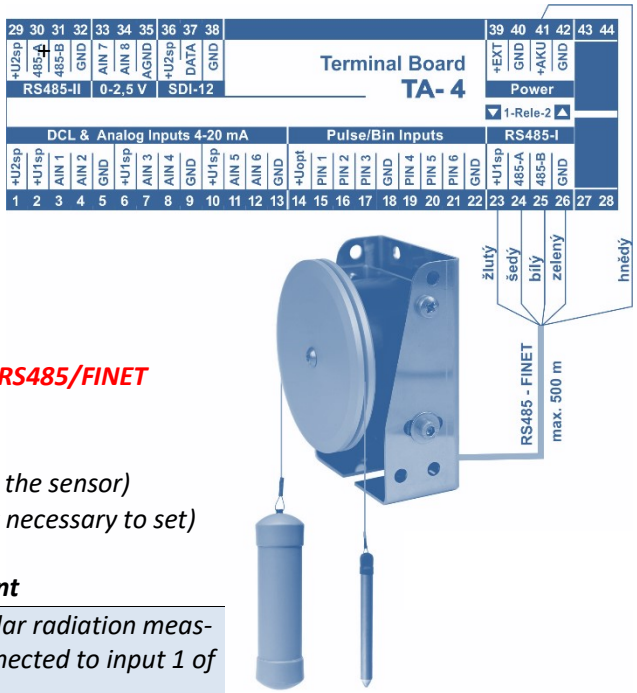
**Input-A:** probe measurement channel number

The FINET communication protocol automatically takes over parameter settings from Port 0 or Port 1 depending on which RS485 bus the device is connected to.

***Level measurement with PSH sensor 30***

**Example 46.**

*Set the ACH10 to measure the level using a PSH-30 float sensor connected to the RS485-I bus.*




***Setting ACH10: (level)***

- ***Analog label:*** *level*
- ***Quantity:*** *level*
- ***Units:*** *mm*
- ***Floating points:*** *0*
- ***Measuring method:*** ***Probe RS485/FINET***
- ***Interface:*** *RS485-I*
- ***Address-A:*** *15*
- ***Input-A:*** *1 (channel 1 inside the sensor)*
- ***Signal Amplification:*** *x (not necessary to set)*

***CMP3 global radiation measurement***

**Example 47.**

*Set ACH11 to measure the global solar radiation measured by the CMP3 pyranometer connected to input 1 of the TEP06/P external module.*



***Setting ACH11: (global radiation)***

- ***Analog label:*** *pyranometer*
- ***Quantity:*** *solar radiation*
- ***Units:*** *W/m²*
- ***Floating points:*** *0.000*
- ***Measuring method:*** ***probe RS485/FINET*** *(TEP06/P communication protocol)*
- ***Interface:*** *RS485-I (selection depending on which RS485 bus the TEP06/P is connected to)*
- ***Address-A:*** *4 (communication address of TEP06/P module)*
- ***Input-A:*** *1 (channel 1 inside TEP06/P)*
- ***Signal amplification:*** *x (does not need to be set, only applies to analog signals)*
- ***Coefficient A1:*** *set to 1000 µV / pyranometer calibration coefficient [µV/W] *)*
- ***Processing->Correction function:*** *A0+A1*X+A2*X^2 (default setting)*

**) The value measured by TEP06/P is in mV. The calibration coefficient is from the manufacturer Kipp&Zonen and is recorded in the calibration sheet supplied with the CMP3 pyranometer. E.g. 25,69 µV/(W/m2). The conversion equation is Radiation [W/m2]= UTEP06[mV] / 0.02569[mV/(W/m² )] = $U_{TEP06}$ [mV] * (1/0.02569[mV/(W/m² )] = $U_{TEP06}$ [mV] * 38.926*. So the A1 coefficient is 38.925.

# Data acquisition via RS485 - Modbus RTU

Reading data from probes under MODBUS RTU protocol

## 11. Measuring method: probe RS485/MODBUS

Setting the unit to read data from probes connected to the RS485 bus under the MODBUS_RTU protocol. The Modbus RTU communication protocol automatically takes parameter settings from Port 2 or Port 3 depending on which RS485 bus the device is connected to.

***Important parameters***

**Measuring method:** probe RS485 / MODBUS **Address-A:** address of the connected probe

**Interface:** RS485-I or RS485-II depending on the actual probe connection

**Interface advanced:** the type of register to be read according to the following overview

0 - reading the **INPUT** register as UINT16/INT16 (FC = 0x04)
1 - reading the **HOLDING** register as UINT16/INT16 (FC = 0x03)
2 - reading **INPUT** register as Big Endian FLOAT (FC = 0x04)
3 - reading the **HOLDING** register as Big Endian FLOAT(FC = 0x03)
4 - reading 1 to 16 **COILS** (FC = 0x01)
5 - reading **INPUT** register as DOUBLE-BE (FC = 0x04)
6 - reading the **HOLDING** register as DOUBLE-BE (FC = 0x03)
7 - reading **INPUT** reister as INT32/UINT32 (FC = 0x04)
8 - reading the HOLDING register as INT32/UINT32 (FC = 0x03)

For FC=0x01, the parameter **Input-B** is the number of COIL reads 1-16 (out of range of config. error).

**The REVESE** parameter throws the WORD at FLOAT/DOUBLE/U/INT16

**Input-A:** probe register number **Input-B:** number of Coil reads in series, max 16

**Amplification:** amplification of the transmitted value **Offset Delta:** Offset of the transmitted value from the probe

***Reading the remote counter:***

The Modbus read value is compared to the total counter value on the unit channel and if different, the total counter state is set to the Modbus RTU read value.

***Reading data from WS103 sensor under MODBUS RTU protocol***

**Example 48.**

*Set channels ACH30 and ACH31 to measure the averaged wind speed and maximum wind gusts using the WS103 sensor connected to the RS485-II interface.*

***Setting ACH30:***
***(average wind speed)***



- ***Analog label:*** *wind speed - average* ***Quantity:*** *Speed*
- ***Units:*** *m/s* ***Floating points:*** *0.00*
- ***Measuring method:*** ***probe RS485 / MODBUS***
- ***Interface:*** *RS485-II*
- ***Interface Advanced:*** *0* ***Address-A: 8***
- ***Input-A:*** *1 (internal channel of WS103 sensor measuring average wind speed)*
- ***Signal amplification:*** *0.01*
- ***Regular storing:*** *global interval*

***Setting ACH31:***
***(wind gusts)***

- ***Analog label:*** *wind speed-gusts* ***Quantity:*** *Speed*
- ***Units:*** *m/s* ***Floating points:*** *0.00*
- ***Measuring method:*** ***probe RS485 / MODBUS***
- ***Interface:*** *RS485-II* ***Interface Advanced:*** *0*
- ***Address-A: 8***
- ***Input-A: 3*** *(inner channel of WS103 sensor measuring wind gusts)*
- ***Signal amplification:*** *0.01* ***Regular storing:*** *global interval*

***Reading data from TSH37 sensor under MODBUS RTU protocol***

## Example 49.

*Set channels ACH6 and ACH7 to measure level and temperature with the TSH37 sensor connected to the RS485-II interface.*

The TSH 37 probe communicates at 9600 Bd with even parity and therefore requires a port setting other than the default.

**Port settings for MODBUS and TSH37**

- ***Mode: MODBUS_RTU***
- ***Baudrate: 9600***
- ***Parity: even***
- ***Stop bits: 1 Stop***

**ACH6 setting:** *(level from TSH37)*



- ***Analog label:*** *level* ***Quantity:*** *level height*
- ***Units:*** *cm* ***Floating points:*** *0.1*
- ***Measuring method:*** ***probe RS485 / MODBUS***
- ***Interface:*** *RS485-II*
- ***Interface Advanced:*** *2*
- ***Address-A: 1***
- ***Input-A: 8***
- ***Signal amplification: 100*** *(m to cm)*

**Setting ACH7:** *(temperature from TSH37)*

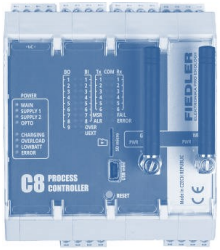
- ***Analog label:*** *water temperature* ***Quantity:*** *Temperature*
- ***Units:*** *°C* ***Floating points:*** *0.0*
- ***Measuring method:*** ***probe RS485 / MODBUS***
- ***Interface:*** *RS485-II*
- ***Interface Advanced:*** *2*
- ***Address-A: 1***
- ***Input-A: 18***
- ***Signal Amplification:*** *1*

***Reading the current and accumulated value from the connected PLC***

## Example 50.

*Set channels ACH6 and ACH7 to measure flow and leakage volume from a PLC connected to RS485-I. The flow register address is 1012 of type WORD(UINI16), the volume register address is only 1013 of type DWORD(UNIT32), the PLC address is 1*

**Setting ACH6:** *(Instantaneous Flow from PLC)*



- ***Namesake:*** *flow rate* ***Measured value:*** *instantaneous flow rate*
- ***Units:*** *l/s* ***Floating points:*** *0.02*
- ***Measuring method:*** ***probe RS485 / MODBUS***
- ***Interface:*** *RS485-I*
- ***Interface advanced:*** *0 (UINT16 as Input)*
- ***Address-A: 1***
- ***Input-A: 1012***
- ***Signal amplification: 0.****1*

**Setting ACH7:** *(leaked volume from PLC)*

- ***Analog label:*** *cumulative flow* ***Measured quantity:*** *volume*
- ***Units:*** *$m^3$* ***Floating points:*** *0*
- ***Measuring method:*** ***probe RS485 / MODBUS***
- ***Interface:*** *RS485-I*
- ***Interface advanced:*** *7 (DWORD as Input)*
- ***Address-A:*** *1*
- ***Input-A:*** *1013*
- ***Signal Amplification:*** *1*
- ***Counter:*** *on*
- ***Counter units:*** *$m^3$* ***Floating points:*** *0*
- ***Display ACH->Display sum:*** *Totalsum*
- ***Display ACH->Presentation mode:*** *Chart+overview or Counter overview*

## Example 51.



***Reading current and accumulated flow value from Q2 (slave) to H7 (master)***

*Set the H7 unit channels to read instantaneous and cumulative flow from the Q2 unit. The instantaneous flow is set on channel ACH3 including the counter in unit Q2 and the request is to set unit H7 to copy this channel to channel ACH10 in unit H7.*

*In the RS485/MODBUS probe measurement method, it is not possible to set the reading of the current value of the instantaneous flow rate and the counter at the same time. The solution is to create two auxiliary channels ACH8 (instantaneous flow) and ACH9 (counter status), which are then merged into ACH10.*

*The Q2 unit must be set to MODBUS_RTU_SLAVE mode:*

- ***Ports:*** *Port-2* ***Mode:*** *MODBUS_RTU_SLAVE*
- ***Baudrate:*** *19200 Bd* ***Parity:*** *None*
- ***Stop bits:*** *1* ***Handshaking:*** *None*
- ***Address-P:*** *99*

**H7-Setting ACH8:**
**(instantaneous flow from Q2)**

*Analog label, units can be set according to requirements, storing can be switched off, instantaneous flow values will be merged and archived in ACH10.*

- ***Quantity:*** *flow* ***Analog label:*** *PARS3 inflow*
- ***Units:*** *l/s* ***Floating point****: 2*
- ***Bipolar:*** *off* ***Counter:*** *off*
- ***Measuring method:*** ***probe RS485 / MODBUS***
- ***Input-A:*** *3004 (FLOAT ACH3 register number - see register map in the appendix)*
- ***Input-B:*** *0* ***Input-C****: 0*
- ***Signal Amplification:*** *1* ***Offset Delta:*** *0*
- ***Address-A:*** *99 (set communication address in Q2 unit)*
- ***Interface advanced:*** *2 (read INPUT register as Big Endian FLOAT)*
- ***Regular Storing:*** *off*

**H7-Setting ACH9:**
**(counter from Q2)**

*Analog label, units, … can be set according to requirements, storing can be disabled, values of the total counter state will be merged and archived in ACH10.*

- ***Measured quantity:*** *volume* ***Analog label:*** *PARS3 inflow volume*
- ***Units:*** *m3* ***Floating points:*** *1*
- ***Bipolar:*** *off* ***Counter:*** *on*
- ***Counter units: m3*** ***Number of counters: 1***
- ***Measuring method:*** ***probe RS485 / MODBUS***
- ***Input-A:*** *15004 (number of the read register UINT32 of the total counter ACH3 - see register map in the attachment)*
- ***Input-B****: 0* ***Input-C:*** *0*
- ***Amplification:*** *1* ***Offset Delta:*** *0*
- ***Address-A:*** *99 (set communication address in unit Q2)*
- ***Interface advanced:*** *7 (reading INPUT register UINT32)*
- ***Regular Storing:*** *off*

**H7-Setting ACH10:**
**(merger of ACH8+ACH9)**

- ***Measured quantity:*** *flow rate* ***Analog label:*** *flow rate*
- ***Units:*** *l/s* ***Floating point****: 2*
- ***Bipolar:*** *off* ***Counter:*** *on*
- ***Counter units:*** *m3* ***Number of counter positions:*** *1*
- ***Measurement method:*** *Custom channel* ***Input-C:*** *off*
- ***Interface advanced:*** *25 (merge current value of ACH[Input-A] + total counter from ACH[Input-B])*
- ***Input-A:*** *8 (channel ACH8 with instantaneous flow in l/s)*
- ***Input-B****: 9 (channel ACH9 with counter in $m^3$ )*
- ***Amplification:*** *1* ***Offset Delta:*** *0*
- ***Regular Storing:*** *Global interval*

SDI-12

# Data acquisition via RS485 / HART

Reading data from sensors and probes under HART protocol

## 12. Measuring method: RS485 / HART probe

The HART communication protocol is often used in strain gauges and other level sensors. A typical example is the submersible probe from BD Sensors s.r.o.

***Important parameters***



**Measuring method:** probe RS485 / HART

**Address-A:** 32 bit address of the connected probe. For BD Sensors probes, this is the serial number of the probe. If Address-A = 0, probe address autodetection is used. In this case, however, only one probe with this protocol can be connected per RS485 bus.

**Interface:** RS485-I or RS485-II depending on the actual probe connection

**Interface advanced:** determines the communication Baudrate of the probe:

- 0 ... communication Baudrate 2400 Bd (even parity, 1 Stop bit)
- 1 ... communication rate 1200 Bd (even parity, 1 Stop bit)

**Input-A:** order of the read value in the probe response (usually 1)

**Input-B:** manufacturer code. For BD Sensor it is 185 (0xB9). If set to 0, the default value of 185 is used.

**Input-C:** probe type. For BD Sensor LMP it is 126 (0x7E). If set to 0, the default value of 126 is used.

***Note for FW up to 1.18.43***

- The current implementation of this measurement method multiplies the first read value (**Input-A=1**) by 1000, i.e. it is a **fixed conversion of mm to m**.
- Signal amplification and Offset parameters are not functional. Any correction of the read value must therefore be done via the **A1** and **A0** coefficients.

***Note for FW from 1.18.44***

- The fixed multiplication factor of 1000 is removed and the **Signal amplification** and **Offset** parameters are included in the signal adjustment**.**

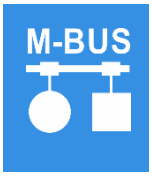
***Connection of LMP307i/HART level probe with RS485 output***

***Example 52.***

*The LMP307i probe with the HART protocol set up will be connected to the RS485-I interface and the level is to be measured on channel 1. The settings in the example above are valid for units with FW1.18.44 and higher.*

***Setting ACH1: (level height)***

- ***Quantity:*** *level height*
- ***Units:*** *m*
- ***Floating points:*** *0.0*
- ***Measuring method:*** ***probe RS485/HART***
- ***Interface:*** *RS485-I*
- ***Interface Advanced: 0***
- ***Address-A:*** *0*
- ***Input-A:*** *1*
- ***Signal Amplification: 1***
- ***Offset Delta: 0***
- ***Regular storing: Global interval***




# Data acquisition via M-BUS

Reading water meters, electricity meters and other meters via M-BUS

## 13. Measuring method: MBUS

The unit allows communication over the M-Bus bus only via an external RS485/M-Bus physical layer converter at a communication Baudrate of 2400 Bd/8E1.

### BASIC MEASUREMENT CHANNEL SETTINGS

**Measurement method:** bus M-Bus
**Address-A:** address of the meter on the bus (primary or secondary)
**Input-A:** order of the read value in the telegram
**Interface:** RS485-I or RS485-II according to the actual connection of the RS485/M-Bus converter
**Amplification:** multiplying factor for conversion of units of measurement

***Slave address on the M-Bus line***

1. Own primary address in the range 0.. 250. With multiple meters on the bus, it is necessary to set a unique address for each.
2. Bulk address 254 - for a single meter on the bus with unknown address
3. Secondary address of the meter in the form of an 8-digit ID number - the ID number usually corresponds to the serial number of the meter

***Reading the remote counter:***

The read value on the M-Bus is compared with the total counter value on the unit channel and if different, the total counter state is set to the value read via the M-Bus.

### READING THE REMOTE COUNTER IN DETAIL (WATER METER STATUS)

- Enable counter
- Set the desired counter units and Floating points
- Necessary parameters (**Input-A** and **Signal amplification**) can be found from the meter documentation or by connecting to the software for displaying the M-Bus telegram (free software for reading the meter data and finding the readable values can be found e.g. at https://www-m-bus.de/software.html
- Automatic mapping of telegram elements according to the selected variable is not supported
- Set the daily and monthly counter as needed
- The state of the total counter cannot be set to a value other than that read from the meter, and any offset must be resolved directly at the meter.

### CALCULATION OF INSTANTANEOUS FLOW RATE FROM CHANGE IN WATER METER STATUS

- Set one ACH to read the water meter status with the appropriate units and counter set.
- Set the following channel as Virtual channel with the parameter Interface refine=5 (change of the ACH[Input1] counter value in time).
- The instantaneous flow channel does not need to have a counter enabled. However, it must be set on a channel that allows the counter setting (for H7: 1.. 64) because it uses it internally.
- The Instantaneous Flow Channel Gain parameter must be set to the correct unit conversion. For example, if the counter is in m3 and the instantaneous flow is in l/s, the Amplification parameter must be set to 1000.

RS485

# Data acquisition via RS485/CHEMITEC

Reading data from the optical dissolved oxygen sensor ESKO12

## 14. Measuring method: Probe RS485/ CHEMITEC

Measuring method designed for communication with the optical dissolved oxygen sensor ESKO12 (S485) via RS485 bus under MODBUS_RTU protocol.

The Modbus RTU communication protocol automatically takes over parameter settings from Port 2 or Port 3 depending on which RS485 bus the device is connected to.

***Important parameters***

**Measuring method:** probe RS485 / CHEMITEC

**Address-A:** address of the connected ESKO12 probe. The factory setting of ESKO12 is address 10.



**Interface:** RS485-I or RS485-II depending on the actual probe connection. The probe requires the parameters of the selected port to be set to 9600 Bd Baudrate, no parity and 1 Stop bit.

The Interface advanced parameter has no meaning.

**Input-A: the** order of the read value from the probe response:

1. Temperature [°C]
2. Dissolved oxygen concentration [mg/l]
3. Dissolved oxygen concentration [%]

***Example***

Example for writing a value to a selected ACH channel in a connected Q2 (slave) unit using the method **Probe RS485/CHEMITEC** is Example 68.: Write the current dissolved oxygen value from H7 (master) to Q2 (slave) on pg. 262.

RS485

# Data acquisition via RS485 / PONSEL

Reading data from the Ponsel optical turbidity sensor

## 15. Measuring method: Probe RS485/ PONSEL

Measuring method designed for communication with optical turbidity sensor ESKZ11 over RS485 bus under MODBUS_RTU protocol.

The Modbus RTU communication protocol automatically takes over parameter settings from Port 2 or Port 3 depending on which RS485 bus the device is connected to.

***Important parameters***

**Measuring method:** probe RS485 / PONSEL

**Address-A:** address of the connected ESKZ11 sensor. The factory setting of the sensor is address 40.



**Interface:** RS485-I or RS485-II depending on the actual probe connection. The probe requires the parameters of the selected port to be set to 9600 Bd communication speed, no parity and 1 Stop bit.

The Interface advanced parameter has no meaning.

**Input-A: the** order of the read value from the probe response:

42. Temperature [°C]
43. 1. monitored turbidity parameter [NTU]
44. 2. monitored turbidity parameter [FNU]
45. 3. monitored turbidity parameter [mg/l]

***!!! Note !!! :***

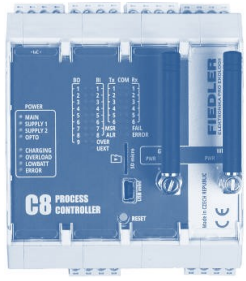
PONSEL can also be connected via SDI-12 bus. In both cases, however, it is necessary to limit the supply voltage of the sensor to a **maximum of 12 V DC**.

RS485

# Data acquisition via RS485/Periphery

Reading data from the connected IO module over RS485

## 16. Measurement method: Peripheral input



Using this universal measuring method, the required block of data can be read from the connected periphery (PLC, other H7 unit, Q2, E2, ...) within one communication under the MODBUS_RTU protocol, which is then stored in the buffer of one of the ten software IO Modules of the H7 unit.
The method requires the correct configuration of the selected IO Module in Modbus register mode (chap. 2-1 IO module mode on p. 210).
Each Software IO Module contains up to 32 float register values that can be read into analog ACH or binary BCH channels, counters or SP operating parameters.

***Important parameters***

**Measurement method:** Peripheral input

**IO Module:** setting the parameters of the selected IO Module (2-1 IO module mode, p. 210).

**Address-A:** serial number [1 to 10] of the IO Module through which communication with the external I/O module will take place.

**Input-A**: read register number 1... 32 of the selected periphery

**Input-B: the** read register number 1... 32 of the selected periphery with the status register stored as an error code.

**Interface:** set to Off

**Interface advanced:** the type of register to be read according to the following overview

0 - reading the **INPUT** register as UINT16/INT16 (FC = 0x04)
1 - reading the **HOLDING** register as UINT16/INT16 (FC = 0x03)
2 - reading **INPUT** register as Big Endian FLOAT (FC = 0x04)
3 - reading the **HOLDING** register as Big Endian FLOAT(FC = 0x03)
4 - reading 1 to 16 **COILS** (FC = 0x01)
5 - reading **INPUT** register as DOUBLE-BE (FC = 0x04)
6 - reading the **HOLDING** register as DOUBLE-BE (FC = 0x03)
7 - reading **INPUT** reister as INT32/UINT32 (FC = 0x04)
8 - reading the HOLDING register as INT32/UINT32 (FC = 0x03)

***MODBUS_RTU communication settings for reading ACH channel group***

**Example 53.**

*TB9 vapour meter control board will be connected to the H7 unit via RS485-I bus. The analogue channels ACH1 to ACH17 of the H7 unit are to be filled with the actual values measured by the TB9 control board. These are stored in the INPUT type registers of the TB9 board with starting address 1000 in UINT16 format.*

***Setting of communication parameters with TB9 over RS485-I:***
*Connections > Ports:*

- ***Port-0:*** *(RS485-I, MODBUS_RTU, 19200, none, 1 stop bit, none, 111, 80 ms, 3x)*

***IO Module settings:***

*Connections > IO Modules: (2nd IO Module selected from 1 to 10)*

- ***IO module mode:*** *MODBUS Register*
- ***Interface:*** *RS485-I*
- ***Address:*** *98 (default communication address of TB9 board)*
- *Modbus Reg.* ***>MBRegs Interval:*** *2 (in sec, interval for reading values from TB9)*
- *Modbus Reg.* ***> Register mode: 1*** *(read data block of INPUT type as UINT16)*
- *Modbus Reg.* ***> Source index:*** *1 (meaningless)*
- *Modbus Reg.* ***> Registers count:*** *17 (number of read values)*
- *Modbus Reg.* ***> Address 1:*** *1000 (address of the first INPUT reg. of the TB9 board)*

**ACH1 settings**

*Analog label, measurand, Floating points, display, storing, etc. according to requirements*

- ***Measurement method:*** ***Peripheral input***
- ***Address-A*** *2 (serial number of the set IO Module - see above)*
- ***Input-A:*** *1 (number of the read register - i.e. ACH channel number)*
- ***Interface advance:*** *0 (INPUT register as UINT16)*

**to**

**ACH17 settings**

- ***Measurement method:*** ***Peripheral input***
- ***Address-A:*** *2 (serial number of the set IO Module - see above)*
- ***Input-A:*** *17 (read register number - i.e. ACH channel number)*
- ***Interface advance:*** *0 (INPUT register as UINT16)*

**Another example**

Another example for writing a value to a selected ACH channel in a connected Q2 (slave) using the **Peripheral Input** method is given in Example 32 Reading and writing ACH and BCH values between H7 (master) and Q2 (slave)on p. 215.

# Data acquisition via SDI-12

Read data from probes connected via SDI-12 interface

## 17. Measuring method: Probe SDI-12

SDI-12 probes require a 12V supply voltage. This value must be set as the output voltage of UNAP1 or UNAP2.

For faster reading of data from the connected probes over SDI-12 it is advisable to set in the unit those analogue channels that will be occupied by measured values from one probe (address) read by one command (Interface advanced). The unit will then communicate with the probe only when reading the first channel and the other values for the Custom channels in sequence will be read from the SDI-12 buffer.

***Important parameters:***

**Measuring method:** probe SDI-12

**Input-A: the** order of the read value from the probe response (1.. n), or the new address in case of an address change command.

**Address-A:** address of the connected probe. By setting the parameter Address-A = 0, only a single probe on the bus can be addressed, regardless of its actual address.



**Interface advanced:** read command type according to SDI-12 specification

0: Start Measurement Command (aM!)
1: Additional Measurement Command (aM1!)
:
9: Additional Measurement Command (aM9!)
10: Concurrent Measurement Command (aC!)
11: Additional Concurrent Measurement Command (aC1!)
:
19: Additional Concurrent Measurement Command (aC9!)
100: Continuous Measurement Command (aR0!)
:
109: Continuous Measurement Command (aR9!)
255: Change Address Command (aAb!)

***Reading data from the CS650 soil moisture sensor using the SDI-12 protocol***

**Example 54.**

*Set channels ACH40 and ACH41 to measure soil moisture and temperature using the CS650 probe connected to SDI-12 bus address 21.*

***Setting ACH40:*** *(volumetric soil moisture)*

- ***Quantity:*** *humidity*
- ***Units:*** *%*
- ***Floating points:*** *0.00*
- ***Measuring method:*** ***probe SDI-12***
- ***Address-A:*** *21 (set communication address of the CS650 probe)*
- ***Interface Advanced: 0***
- ***Input-A:*** *1 (reading the first position from the CS650 probe)*

***Setting ACH41:*** *(soil temperature)*

- ***Quantity:*** *Temperature*
- ***Measuring method:*** *probe SDI-12*
- ***Address-A:*** *21*
- ***Interface Advanced:*** *0*
- ***Input-A:*** *3 (reading the 3rd position from the CS650 probe)*

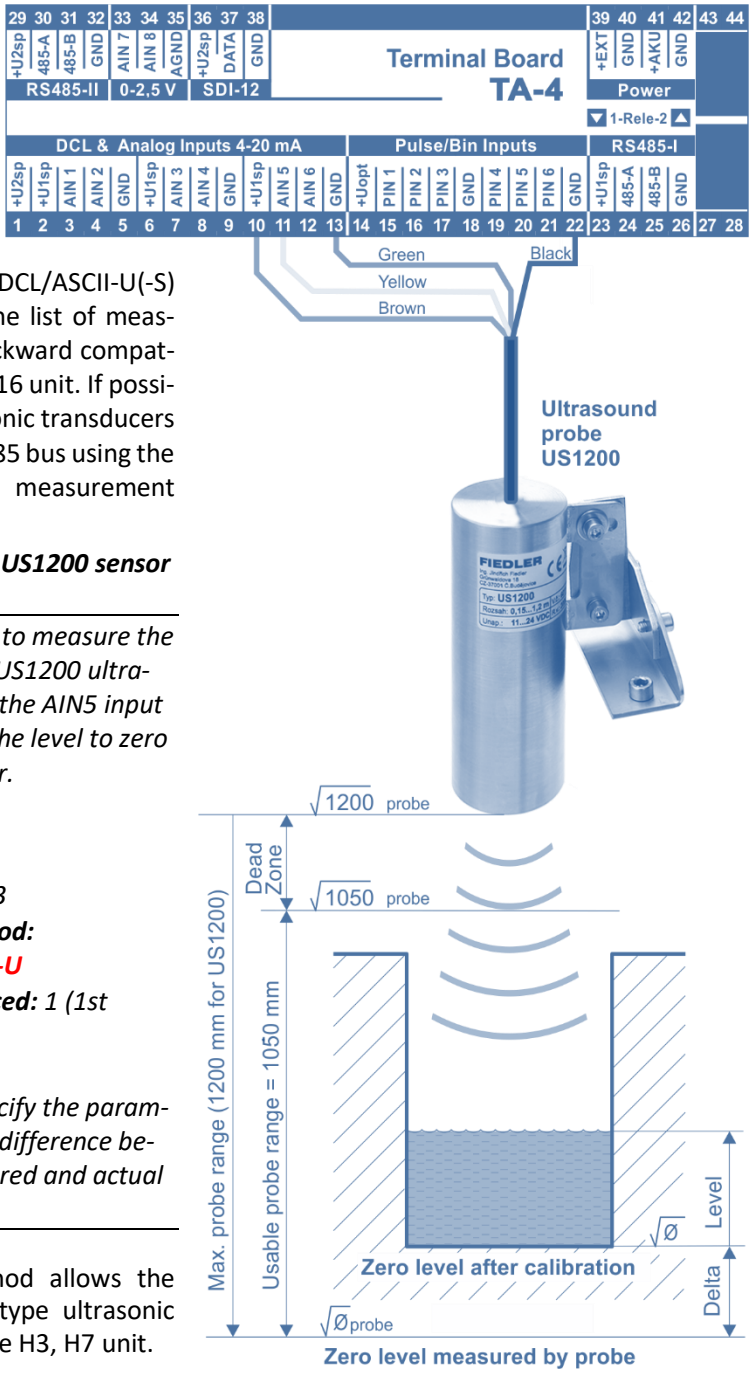
# Data acquisition via DCL

Reading data from USx200 probes connected via DCL interface

## 18. Measuring method: Probe DCL /ASCII-U, ../ASCII-S

Measuring method for 3-wire connection of ultrasonic probes type US1200 to US4200. The surface height (K1) and air temperature (K2) are transmitted from the probe over a 0/20 mA digital current loop (DCL) over a distance of up to 300 m at 1200 Bd. The DCL current loop connects to the AIN inputs of the connection board.

The probes send a numerical value of the water level, where the zero level is at a distance of 1200 mm from the bottom edge of the probe.




Measurement methods DCL/ASCII-U(-S) probes are included in the list of measurement methods for backward compatibility with the older M4016 unit. If possible, connect these ultrasonic transducers to the H7 unit via the RS485 bus using the "Probe RS485 / FINET" measurement method.

***Level measurement with US1200 sensor after DCL***

**Example 55.**

*Set the analogue channel to measure the level in the sump using a US1200 ultrasonic probe connected to the AIN5 input via the DCL loop and set the level to zero using the Delta parameter.*

**Set:**

- ***Quantity:*** *level*
- ***Units:*** *m*
- ***Floating points:*** *3*
- ***Measuring method:*** ***Probe DCL/ASCII-U***
- ***Interface Advanced:*** *1 (1st probe channel)*
- ***Input-A:*** *5 (AIN5)*
- ***Offset Delta:*** *specify the parameter value as the difference between the measured and actual level.*

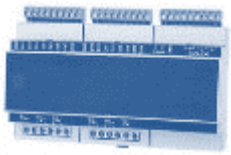
***onda DCL/ASCII-S*** This measurement method allows the connection of an older type ultrasonic level sensor US3000 to the H3, H7 unit.

The US3000 sensor sends the distance of the obstacle-water level from the bottom edge of the probe along the current loop instead of the level (the distance decreases as the level rises).

RS485

# Binary I/O modules

Read and write binary signals from/to DV2 or DV3 modules



## 19. Reading Binary Signals

Setting the binary input channels of the Q2 unit to read the binary input states from the external I/O modules DV2 or DV3. The Q2 unit communicates with the DV2 module using the FINET protocol (19200 Bd, no parity, 1 Stop bit).

***Reading the binary state from the input of the external module DV2***

**Example 56.**

*Set BCH47 to signal the controlled process to switch to manual mode. The auxiliary contact of the switch is connected to binary input 14 of the DV2 external module with network address 2.*

***Setting the communication parameters with DV2:***
*Connections > Ports:*

- ***Port-0:*** *(RS485-I, FINET, 19200, none, 1 stop bit, none, 111, 80 ms, 3x)*

**Settings [5] IO Module**

*Connections > IO Modules: (5th IO Module selected from 1 to 10)*

- ***IO module mode:*** *DV2*
- ***Interface:*** *RS485-I*
- ***Address:*** *2 (communication address of the physical module DV2)*
- ***Reading interval DV2:*** *0.5 (sec)*

**Setting BCH47: (Input 14 of DV2)**

- ***Mode:*** *Input - IO module*
- ***Binary label:*** *manual mode enabled*
- ***Address-A:*** *5 (IO Module serial number)*
- ***Input/Output:*** *14 (DV2 binary input)*



## 20. Binary Signals Writing

*Setting the output binary channels of the Q2 unit to control the binary outputs of the external DV2 or DV3 I/O modules*

***Controlled pumping of water into the VDJ using the external module DV2***

**Example 57.**

*Set the BCH30 so that its output controls via RELE2 the external module DV2 with address 2 the pump M1 for pumping raw water to the water tank. The pump should switch on at a level of 2 m and switch off when it reaches 2.4 m. The level is measured by a dip probe on channel ACH1.*

*The pump fault is monitored by binary channel BCH2 (fault = on) and the "Automatic / Manual" switch by channel BCH4 (Automatic = on). In fault or manual mode, pump start-up must be inhibited regardless of the level.*

***Setting parameters for communication with DV2:*** *4-4-2 IO Module on page 210 or previous ref.*

**Set BCH29: (auxiliary channel)**

- ***Mode:*** *Output-Virtual* ***Function:*** *Limit Output Type 2*
- ***Channel reference:*** *1 (ACH1 = level measurement in m)*
- ***Switching On limit:*** *2.0* ***Switching Off limit:*** *2.4*

**Set BCH30: (relay2 output)**

- ***Mode:*** *Output-IO Module* ***Input/Output:*** *2 (RELE2 on physical module DV2)*
- ***Address-B:*** *5 (serial number of the IO Module - see IO Module in the prev. annex)*
- ***Function:*** *Logic function*
- ***Logic function in prefix:*** *&&B29B4!B2 (pump running & automatic & no fault)*
- ***Output function:*** *Direct*

RS485

# Analog input modules

Reading values measured by external modules AIM600, AIM615



## 21. Reading measured values from AIM600, AIM615 modules

The external modules type AIM600 or AIM615 are used for measuring 4-20 mA (0-20 mA) analog signals and their conversion to RS485 under FINET protocol. Each module has 6 current inputs which it converts to 6 analogue channels K1 to K6 in the range 0... 100% (corresponding to the 4-20 mA range).

**Address-A**: the address of the connected module in the range 60 to 75.

**Input-A:** measurement channel numbers 1 to 6 correspond to inputs IN1 to IN6 of the AIM.

**Interface:** set according to the physical connection of the module (RS485-I or RS485-II)

**Signal amplification:** adjusts the range of the sensor connected to the AIM module

**Offset Delta:** offset of the measured value in units of the ACH channel being set

***Reading the analogue pressure value from the AIM600 external module***

**Example 58.**

*Set ACH8 to measure pressure from a sensor connected to input AI6 of the AIM600 module, which is set to address 60, communicates at 19200 Bd under FINET protocol and is connected to RS485-I. The pressure sensor has a 4-20 mA output and a corresponding measurement range of 0 to 6 MPa.*

**ACH8 setting: (pressure from AIM600)**

- ***Quantity:*** *Pressure*
- ***Units:*** *MPa*
- ***Floating points****: 0.00*
- ***Measuring method: probe RS485 / FINET***
- ***Address-A:*** *60*
- ***Input-A****: 6 (AIM module input number)*
- ***Signal amplification:*** *6 (20 mA module transmits 100% = 1)*
- ***Offset Delta:*** *0*
- ***Regular storing:*** *global interval*

***Reading the analogue level value from the external module AIM615***

**Example 59.**

*Set ACH1 to measure the level from a sensor with a range of 0... 2 m water column, which is connected to the AI4 input of the AIM615 module with address 60 on the RS485-I bus.*

**Setting ACH1: (level from AIM600)**

- ***Quantity:*** *level height*
- ***Units:*** *mm*
- ***Floating points****: 0*
- ***Measuring method: probe RS485 / FINET***
- ***Address-A:*** *60*
- ***Input-A****: 4 (AIM module input number)*
- ***Signal amplification:*** *2000 (module for 20 mA transmits 100% = 1)*
- ***Offset Delta:*** *0*
- ***Regular storing:*** *global interval*

RS485

# Analog output modules

Writing data to current output modules MAV421, MAV422

## 22. Measurement method: Output RS485/MAV

***Important parameters***



**Measuring variable:** Optional

**Units:** % (The *channel set for the analog output function measures in percent of the specified range. Any conversion to current for display, for example, must be done in a copy of this channel using the coefficients A0 and A1)*

**Input-A**: Number of the analog channel that controls the analog output.

**Signal amplification**: Indicates 100% of the analog output. Specified in control channel units.

**Offset**: Specifies the zero offset of the analog output. It is specified in units of the control channel.

**Signal->Reversion:** If this binary parameter is set, the analog output will be inversely proportional to the value of the control channel.

**Outputs on external module MAV421 or MAV422:**

The parameter **Measurement method** must be set to RS485/MAV output.

**The Interface** parameter is set according to the module connection to RS485-I or RS485-II.

**The Interface advanced** parameter specifies the serial number of the output on the module (1 or 2).

**The Address-A** parameter specifies the address of the MAV42x module. It is in the range 121 to 136 according to the DIP switch setting on the module.

***4-20 mA current output control of the MAV422 external module***

**Example 60.**

*Set analog channel ACH17 to control the 2nd current output of the MAV422 module so that the 4-20 mA output is controlled by the temperature from input ACH10 in the range -40°C to +60°C (-40°C = 4 mA, +60°C =20 mA). The communication address of the MAV module has been set to 121.*

***Setting ACH17: (4-20 mA output)***

- ***Analog label:*** *control MAV422*
- ***Quantity:*** *Optional*
- ***Units:*** *%*
- ***Floating points:*** *0.00*
- ***Measurement method:*** ***Output RS485/MAV***
- ***Address-A:*** *121*
- ***Interface:*** *RS485-I (or RS485-II depending on the physical connection of the module)*
- ***Interface advanced:*** *2 (MAV422 module current output number)*
- ***Input-A:*** *10 (analog temperature Channel reference ACH10)*
- ***Signal amplification:*** *100 (range setting for 100% in control channel units, i.e. in this case max-min=60°C-(-40°C)=100°C )*
- ***Offset Delta:*** *-40 (parameter for range offset in control channel units)*
- ***Signal->Reversion:*** *Off (switching on will cause the current output to "reverse" = max. value will correspond to 4 mA output current and minimum value of 20 mA).*

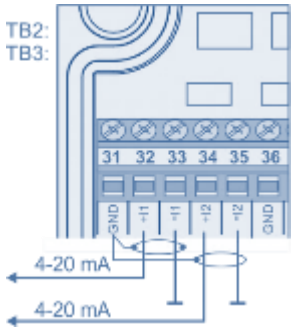
4-20

# 4-20 mA output

Control of current outputs of TB2 and TB3 boards

## 23. Measurement methods: Current output 4-20 mA; 0-20 mA

***Important parameters***




**Measuring variable:** Optional

**Units:** % (The *channel set for the analog output function measures in percent of the specified range. Any conversion to current for display, for example, must be done using the coefficients A0 and A1)*

**Input-A**: Number of the analog channel that controls the analog output.

**Signal amplification**: Indicates 100% of the analog output. Specified in Channel reference units.

**Offset Delta**: Specifies the zero offset of the analog output. It is specified in units of the Channel reference.

**Signal->Reversion:** If this binary parameter is set, the analog output will be inversely proportional to the value of the Channel reference.

**Outputs on the connection board TB2 and TB3:**

**The Measurement Method** parameter must be set according to the desired output range to (4-20mA Output, 0-20mA Output or 0-24mA Output)

**The Interface** parameter is not taken into account, it is set to Off.

**The Interface advanced** parameter specifies the number of the current output on the connection board (1 for +I1, 2 for +I2).

***4-20 mA level controlled output***

**Example 61.**

*Set the analog channel ACH3 to control the IOUT2 output on the TB3 connection board so that the 4-20 mA output is controlled by the level from ACH5 in the range 0 - 6 m (0 m=4 mA, 6 m=20 mA).*

***Setting ACH3: (4-20 mA output)***

- ***Quantity:*** *Optional*
- ***Units:*** *%*
- ***Floating points:*** *2*
- ***Measurement method:*** ***4-20 mA output***
- ***Interface advanced:*** *2 (current output number on the connection board)*
- ***Input-A:*** *5 (analog Channel reference ACH5)*
- ***Signal amplification:*** *6 (range setting for 100% in Channel reference units)*
- ***Offset Delta:*** *0 (parameter to offset the range in Channel reference units)*
- ***Signal->Reversion:*** *Off (switching on will cause the current output to "reverse" = max. value will correspond to 4 mA output current and minimum value of 20 mA).*

***4-20 mA temperature controlled output***

**Example 62.**

*Set analog channel ACH3 to control output IOUT2 on connection board TB3 so that the 4-20 mA output is controlled by the temperature from ACH5 in the range -50°C to +80°C (-50°C = 4 mA, +80°C = 20 mA).*

***The parameters except for Signal amplification and Offset will be identical to the previous example***

***Setting ACH3: (4-20 mA output)***

- ***Signal amplification:*** *130 (range setting for 100% in Channel reference units, max. - min heart rate = +80 - (-50 ) = 130)*
- ***Offset Delta:*** *50 (parameter to offset the range in Channel reference units)*




# Output RS485 / ModBus (master)

Data transfer to the higher system for RS485 from 0 to 100%

## 24. Measurement method: Output RS485 / MODBUS

Measuring method for writing the measured value to the connected controlled device.

The analog output channel with the measurement method set to "RS485 / MODBUS Output" measures in percent of the specified range, with 100% being the numeric value 65535. Thus, the value 0 to 65535 is written to the connected device via the RS485 bus using the MODBUS protocol and function 0x06 - WRITE_REGISTER.

***Important parameters***

**Measurement method:** RS485 / MODBUS output

**Units of measurement:** % (0 % = 0; 100 % = 65535)

**Address-A:** communication address of the device to be written to

**Interface:** RS485-I or RS485-II depending on the physical connection of the controlled device

**Interface advanced:** number of the channel to be written to

**Input-A:** register number for writing in the connected device

**Input-B:** analogue reference channel number (0 if **Input-C** is the reference bin. channel)

**Input-C:** binary channel reference number

**Signal amplification:** desired range in Channel reference units

**Offset Delta:** the required offset in units of the Channel reference. Most common application for bipolar measured quantities. *Example: Channel reference with a temperature range of -40°C to +80°C would have Offset=40, Signal amplification=120).*

***Signal->Reversion:*** *Enabling Reversion changes the direct proportion between the control ACH and output ACH to an inverse proportion (max. measured value of control ACH = 0% of output ACH and vice versa)*

***Writing the measured value to the connected device over MODBUS RTU***

***Example 63.***

*Set the ACH25 analog channel to transmit the pressure value to the connected PLC using MODBUS protocol over RS485-II. The PLC address is 5, the register to be written in the PLC has address 1200.*

*The pressure will be measured by a sensor with a current output of 4-20 mA connected to the AIN2 input of the Q2 unit in the range 0-15 Bar and will be displayed by the analogue channel ACH24.*

***ACH24 setting:*** ***(input - pressure measurement)***

- ***Analog label:*** *outlet pressure* ***Quantity:*** *Pressure*
- ***Units:*** *bar* ***Floating points:*** *0.000*
- ***Measurement method:*** *Current 4-20 mA* ***Input-A: 2*** *(AIN2)*
- ***Signal amplification:*** *15 (sensor measuring range 0 to 15 bar)*
- ***Offset Delta:*** *0 (zero offset)*

***ACH25:*** ***(MODBUS output)***

- ***Analog label:*** *pressure ACH24 to PLC* ***Measured quantity:*** *Optional*
- ***Units:*** *%* ***Floating points:*** *0.000*
- ***Measurement method:*** ***Output RS485/MODBUS***
- ***Interface:*** *RS485-II* ***Address-A:*** *5*
- ***Input-A:*** *1200 (register address for writing in PLC)*
- ***Input-B****: 24 (analog Channel reference)*
- ***Signal amplification:*** *0.000228885 (15 bar will correspond to 100%, i.e. the transmitted number 65535. Therefore, you need to set Sig. amplification = 15 / 65535)*
- ***Offset Delta:*** *0* ***Signal->Reversion:*** *Off*

***Another example***

Another example for writing a value to a selected ACH channel in a connected Q2 (slave) unit using the **Output RS485 / MODBUS** method is Example 51.: Reading current and accumulated flow value from Q2 (slave) to H7 (master) on p. 247.

# Run time or fault monitoring

Monitoring the total switch-on time of a binary channel

## 25. Measurement method: Binary channel

***Important parameters***

**Measured variable:** time / time

This measurement method is designed to monitor the switching time of the selected binary channel. This binary channel usually directly controls the switching of a pump, blower or generally any other technological element whose operation (switching on) time needs to be monitored. The motor hours are recorded by the analogue channel counter, which needs to be set up for this monitoring.

***ACH setting for pump motor hours monitoring***

**Example 64.**

*Set analogue channel ACH11 to monitor the motor hours of the pump, which is controlled by binary channel BCH28:*

***Setting ACH11: (pump motor hours)***

- ***Analog label:*** *Pump motor hours*
- ***Quantity:*** *Time/Period*
- ***Units:*** h (hours) ***Floating points:*** *0.00*
- ***Measurement method:*** ***Binary channel***
- ***Counter:*** *on*
- ***Counter units:*** *h* ***Floating points:*** *0.0*
- ***Input-A:*** *28 (binary channel control number)*
- ***Regular storing:*** *basic interval (different storing from other ACHs)*
- ***Regular storing interval:*** *12:00:00 (12 hour interval saves data memory)*
- ***Aggregation before storing:*** *Last Value*
- ***Display ACH->Display sum:*** *Total sum*
- ***Display ACH->Presentation mode:*** *Chart+overview or Counter overview*

***ACH settings for monitoring the failure time of the measuring probe***

**Example 65.**

*Set analogue channel ACH15 to monitor the total time that any of the sensors on channel ACH5 or ACH6 are faulty.*

***BCH10 settings: (auxiliary channel set in case of probe failure)***

- ***Mode:*** *Output - Virtual Probe failure*
- ***Input/Output:*** *0* ***Storing:*** *on*
- ***Global FAIL:*** *On* ***Function:*** *logic function*
- ***Logic function in pref:*** *|e5e6 (logic 1 when an error is detected on ACH5 or ACH6)*
- ***Output function:*** *Direct (BCH10 copies the state of the logic condition without further modification)*

***ACH15 settings: (failure motor hours)***

- ***Analog label:*** *probe failure time* ***Quantity:*** *time/day*
- ***Units:*** h (hours) ***Floating points:*** *0.00*
- ***Measurement method:*** ***Binary channel***
- ***Counter:*** *On*
- ***Counter units:*** *h* ***Floating points:*** *0.0*
- ***Input-A: 10*** *(binary channel control number)*
- ***Regular storing:*** *basic interval (different storing from other ACHs)*
- ***Regular storing interval:*** *12:00:00 (12 hour interval saves data memory)*
- ***Aggregation before storing:*** *Last Value*
- ***Display ACH->Display sum:*** *Total sum*
- ***Display ACH->Presentation mode:*** *Chart+overview or Counter overview*



# Remote Command

ACH setting by remote command before SMS or GPRS

## 26. Measurement method: Remote input

A measurement method for displaying and storing values from remote instruments. Values are written to the unit by SMS commands or in MODBUS_RTU_SLAVE mode.

***Important parameter***

**Interface refine:** (controls the counter calculation, which must be enabled)

**0** .... Integration of the counter in time from the current value.

**1** .... Both the current value and the total amount can be set. Increments are not calculated by integrating the current value but from the change in the total counter.

**2** .... The current value is calc. from the change in the total counter - not yet applied.

***Error 22*** An error occurs if a new value is not written for longer than the storing interval of the ACH.

***Transmission of level data from the WR to the WTP via SMS***

**Example 66.**

*Set the parameters of the unit in the water reservoir (WR) to transmit the ACH1 value (water level) every 15 min via SMS[1] to the ACH15 channel in the station installed in the water treatment plant (WTP).*

***Set BCH[30] in WR:*** ***The auxiliary channel controls the data transfer interval:***

- ***Analog label:*** *pulse every 15 min*
- ***Mode:*** *Output – virtual* ***Function:*** *Up time/Down time*
- ***Up time:*** *10* ***Down time:*** *890*

***Communic. Par. Contact [11] in WR:***

- ***Mode:*** *On*
- ***Name:*** *WTP Tel.*
- ***Number / email:*** *+420111222333 (tel. number of the station at the WTP)*

***Set SMS[1] in WR:***

- ***Mode:*** *BCH goes ON*
- ***Control channel:*** *30*
- ***Recipient:*** *select Contact [11] from the list*
- ***SMS text:*** *PASSWORD,ACH15=#V1*

***Set ACH[15] to WTP:***

- **Analog label:** Level WR **Quantity:** Level
- **Floating points:** 0.00 **Measuring method:** Remote input

***Transmission of level data from the VR to the WTP using a server and GPRS network***

**Example 67.**

*Set the parameters of the unit in the water reservoir (WR) to transmit the ACH1 (level) value to the server every 15 min via the GPRS network. Further, set the unit in the water treatment plant (WTP) to query the server every 5 min for the current level in the VR and fill the detected level with ACH15.*

***Set BCH[30]:*** ***See previous example***

***Communications Contact [12]:***

- ***Mode:*** *On* ***Contact name:*** *WTP-ID*
- ***Number/email:*** *ID777 (Station ID on the WTP = par. 2-1-2* Station ID *on pg. 103 )*

***Set SMS[1]:***

- ***Mode:*** *sealing BCH* ***Channel reference:*** *30*
- ***To send to:*** *select Contact [12] from the list*
- ***SMS text:*** *PASSWORD,ACH15=#V1*

***Set ACH[15] to WTP:***

- **Analog label: :** Level WR **Quantity:** Level
- **Floating points:** 0.00 **Measuring method:** Remote input

***Write the current dissolved oxygen value from H7 (master) to Q2 (slave)***

## Example 68.

UnitUnit *H7 on the ACH2 measures the current dissolved oxygen value. It is required to display this dissolved oxygen value on the display of unit Q2, which operates in MODBUS_RTU_SLAVE mode.*



***Adjustable channels:***

*ACH2 (H7) ..... dissolved oxygen measurement channel*
*ACH3 (H7) ..... dissolved oxygen output channel*
*ACH5 (Q2) ..... input channel for dissolved oxygen value*

*The Q2 unit must be set to MODBUS_RTU_SLAVE mode:*

- ***Ports:*** *Port-2* ***Mode:*** *MODBUS_RTU_SLAVE*
- ***Baudrate:*** *19200 Bd* ***Parity:*** *None*
- ***Stop bits:*** *1* ***Handshaking:*** *None*
- ***Address:*** *99*

### H7-Setting ACH2: (dissolved oxygen)

- ***Quantity:*** *dissolved oxygen* ***Analog label:*** *dissolved oxygen AKT1*
- ***Units:*** *mg/l* ***Floating point****: 2*
- ***Bipolar:*** *off* ***Counter:*** *off*
- ***Measuring method: Probe RS485 / CHEMITEC***
- ***Address-A:*** *10 (default address of ESKO12 CHEMITEC sensors)*
- ***Interface:*** *RS485-II* ***Interface Advanced: 0***
- ***Input-A:*** *2 (ESKO12 CHEMITEC read register number)*
- ***Input-B:*** *0* ***Input-C****: 0*
- ***Amplification:*** *1* ***Offset Delta:*** *0*
- ***Signal->Reversion:*** *off* ***Regular Storing:*** *Global interval*

### H7-Settings ACH3: (output channel)

*Measuring method Output RS485/MODBUS writes the value 0-65535 to the register according to the value of ref. ACH. Therefore, it is necessary to set the Signal amplification correctly on both sides of the communication.*

- ***Quantity:*** *Optional* ***Analog label:*** *Oxygen Output*
- ***Units:*** *%* ***Floating points****: 1*
- ***Bipolar:*** *off* ***Counter:*** *off*
- ***Measurement method: Output RS485 / MODBUSt***
- ***Address-A:*** *99 (set communication address in Q2 unit)*
- ***Interface:*** *RS485-I* ***Interface Advanced: 0***
- ***Input-A:*** *1008 (registry number for ACH5 entry - see registry map attached)*
- ***Input-B:*** *2 (reference channel ACH2 with dissolved oxygen)*
- ***Input-C****: 0*
- ***Signal amplification:*** *10 (10 mg/l ... 100%, i.e. output 65535)*
- ***Offset Delta:*** *0*
- ***Signal->Reversion:*** *off* ***Regular Storing:*** *Global interval*

### Q2-Setting ACH5 (display channel)

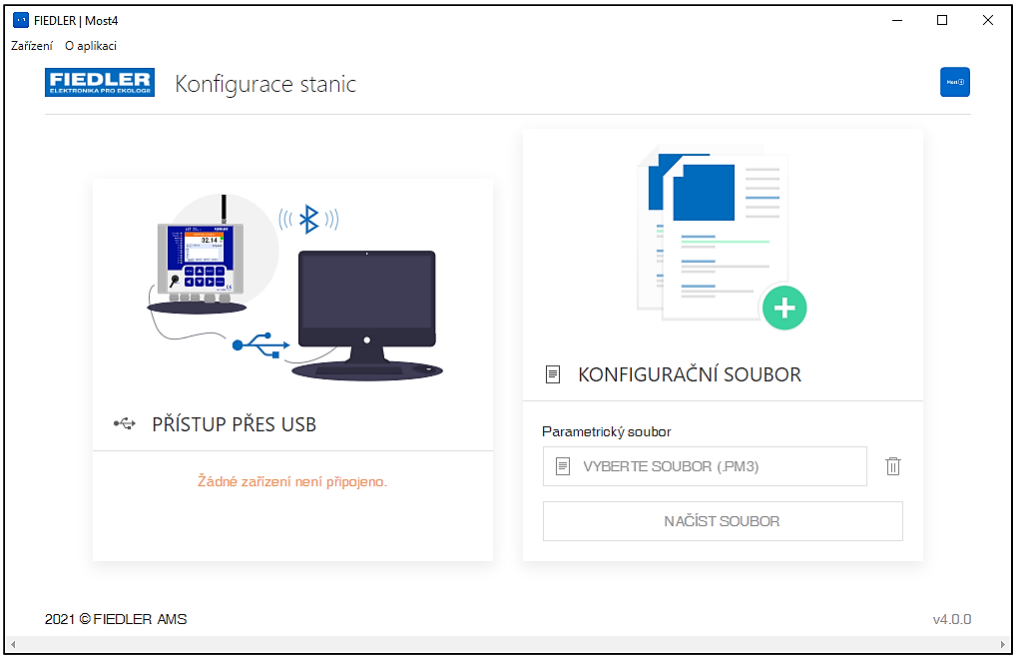
- ***Quantity:*** *dissolved oxygen* ***Analog label:*** *dis. oxygen from H7*
- ***Units:*** *mg/l* ***Floating point****: 2*
- ***Bipolar:*** *off* ***Counter:*** *off*
- ***Measurement method:*** **Remote input**
- ***Address-A:*** *0* ***Input-A:*** *0*
- ***Input-B:*** *0* ***Input-C****: 0*
- ***Signal amplification:*** *0.000152 (10mg/l / 65535, i.e. at 65535 10 mg/l will be displayed)*
- ***Offset Delta:*** *0*
- ***Signal->Reversion:*** *off* ***Regular Storing:*** *Global interval*

# 14 Software MOST 4

In addition to manually setting all parameters of the H7 unit, the configuration of the unit can be made clearer and faster with the MOST4 software tool.

## 13.1. Basic description

FIEDLER AMS offers the MOST4 program (MOnitorovací STanice) for data viewing and parameterization of its own units. This application can be used by owners and other authorized users of FIEDLER units. The application allows the configuration of all types of units of the new platform, including H3 and H7 stations.



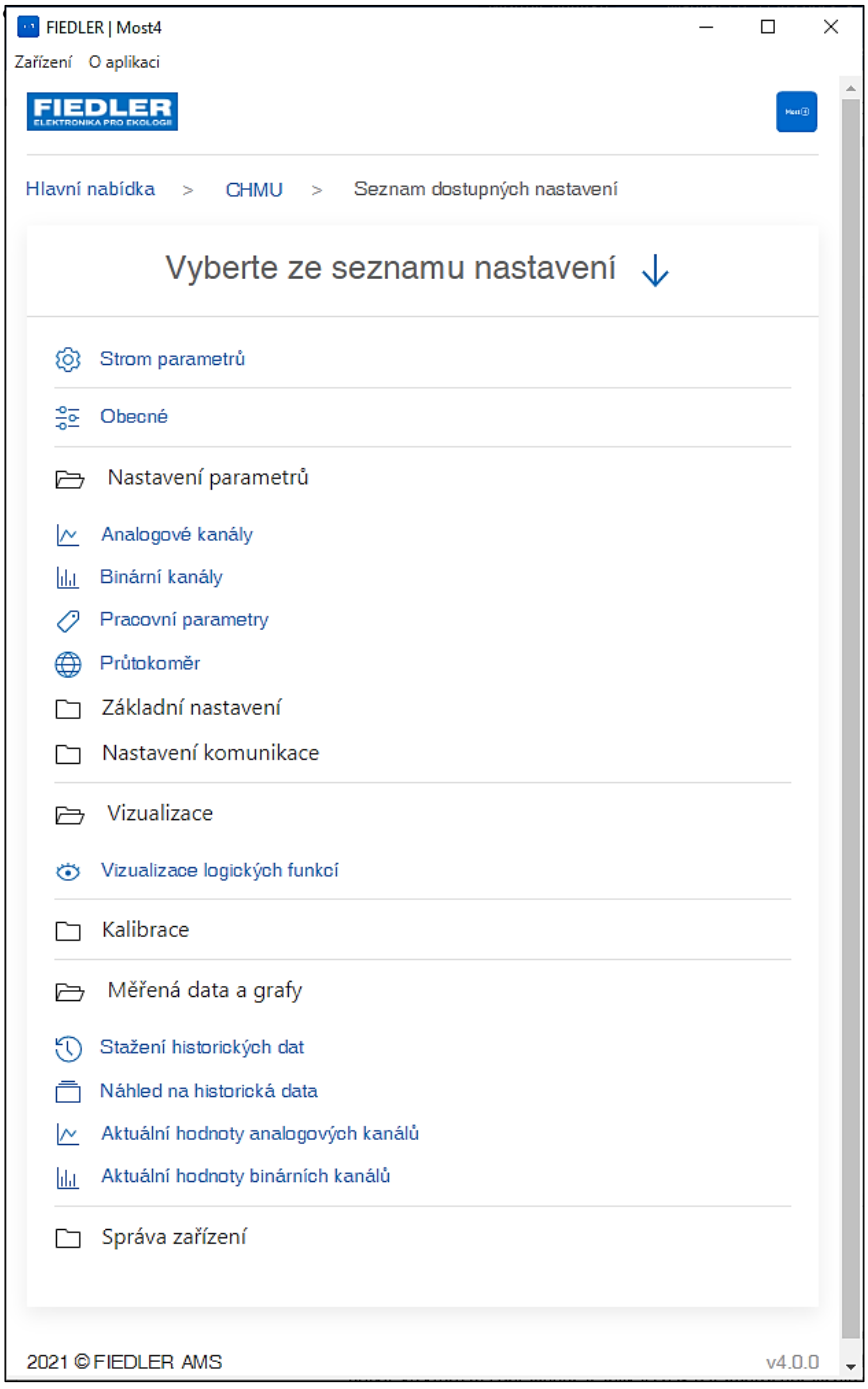

The application is primarily designed for use in a cloud environment, the user does not need to install any software, just open a web browser and log into the cloud. For FIEDLER devices installed in inaccessible locations, or for any other reason without available connectivity, a local offline version can be used, which installs on Windows or Linux as a traditional desktop application.

It is then possible to communicate with the unit locally, e.g. via USB cable, and perform direct parameterization of the units. The online version is implemented as a module on the CloudFM platform. The application also allows viewing the measured data in the form of visualization using charts and tables.

## THE MOST 4 APPLICATION ALLOWS, AMONG OTHER THINGS:

- Connection to a physical device via USB cable and Bluetooth
- Full parameterization of the connected device as well as creation and management of separate parametric pm3 files
- Work in multiple windows simultaneously
- Work with multiple connected stations simultaneously
- Monitor current analog and binary channel data
- Monitor the current log of events recorded by the station
- Download historical (measured) data from the station and then export it to a csv or dt3 data file
- Upgrade the software of the connected device
- Automatic download of Most4 updates from the server

***MOST4 application window with a list of possible settings and functions***

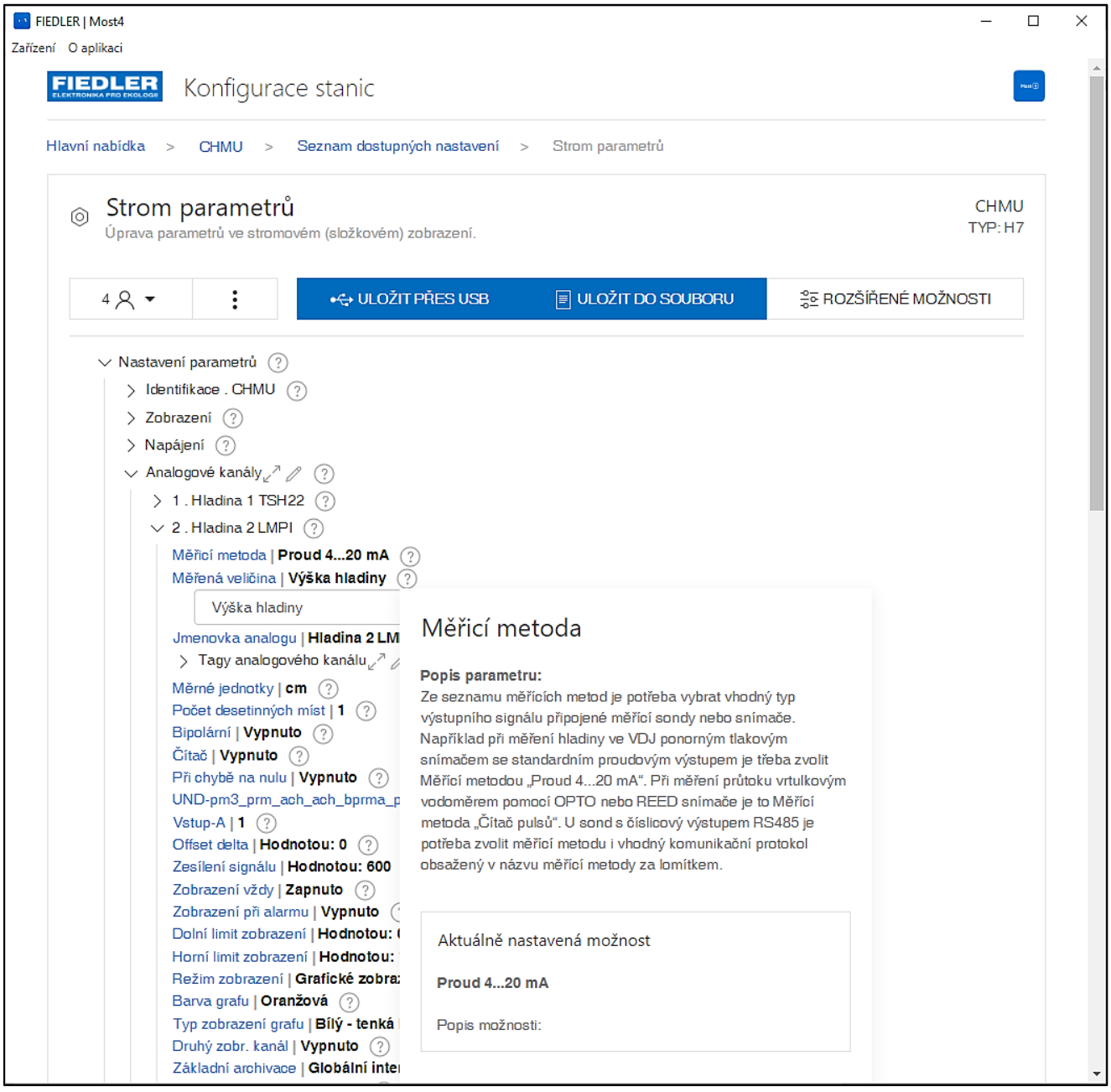


The user interface of the MOST4 application is designed to be used by both experienced experts and professionals, as well as by ordinary users without detailed knowledge of the structures of individual groups of instrument parameters.

The station parameter management environment can be displayed in two basic visualization modes according to the user's experience:

### 13.1.1. Tree structure mode

A mode suitable for experts and unlimited configuration. Parameters are displayed in a tree structure, clearly arranged in folders, similar to files on personal computer disks. The tree structure offers quick access to the available drive parameters. For complex H7 controllers, the tree structure can be extensive and complex.

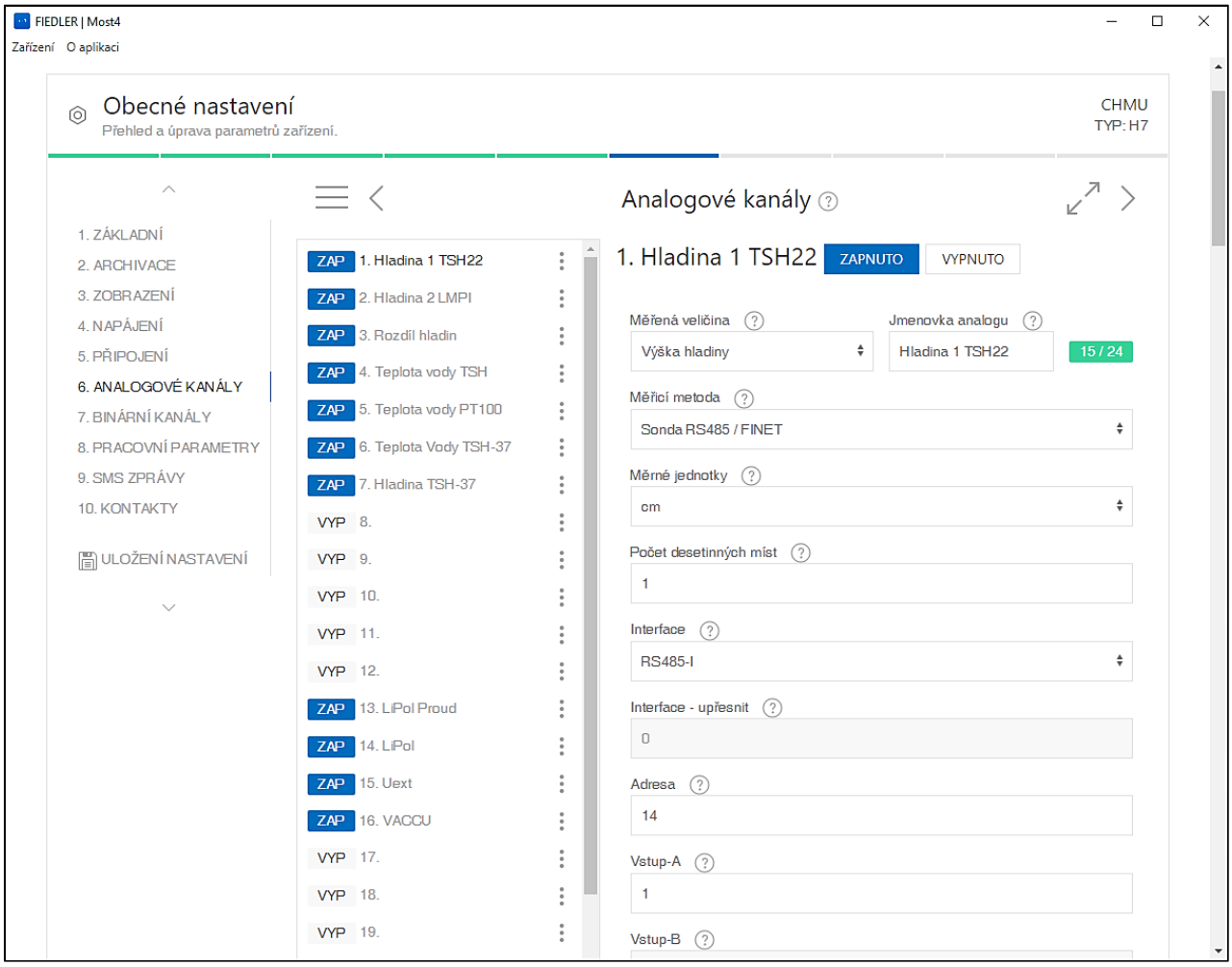


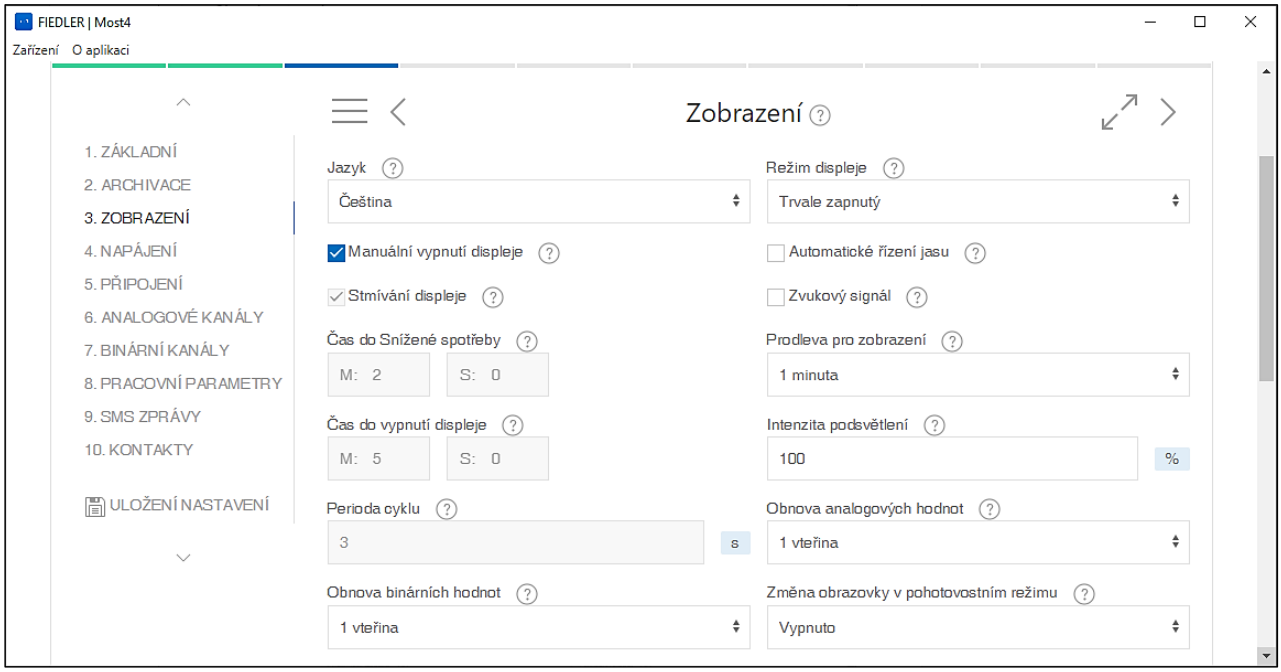

Parameters are set either by entering a numeric value or by selecting from a list and enabling/disabling the button for binary parameters.

***Help*** For each parameter you can open a help window that explains the meaning of the parameter

## 13.1.2. General setup mode

This mode is suitable for general users of H7 units without in-depth knowledge of the overall parametric structure of the instrument. The clear grouping of parameters into thematic groups and windows allows the complete setup of the instrument or making even minor changes to the settings simply and clearly.



## 13.2. Connection options

The application is cloud-connected and this synergy makes it easy to transfer configurations between any units of the same type. The user can easily retrieve the configuration and parameters from the unit they have permissions to, modify the parameters in the application as needed, and send them over a secure connection to the same or another station, whether it's next to them on their desk or hundreds of miles away.

**PARAMETERIZATION LOADING OPTIONS:**

- locally via USB communication cable or Bluetooth
- from the parameterization file from the disk
- remotely via cloud
- from another drive in the cloud

Connecting to the unit with a cable allows you to make immediate changes to the unit's settings. For remote units that are connected in power saving mode, i.e. they operate without connectivity most of the time and connect only once in a while, configuration changes will only take effect once the unit is connected to the cloud.

In addition to the standard work with the total image of the parameters of one station, it is also possible to work with only a subset of the parameters. Users have the possibility to make e.g. only partial changes to selected parameters, which can be backed up and applied later. Similarly, these partial changes can be applied to other stations without affecting the other parameters.

The MOST application also allows for device diagnostics and unit connectivity testing.

## 13.3. Bulk configuration

The CloudFM MOST4 web service provides full remote station configuration and more. Using remote access, you can perform bulk configurations of multiple devices at once. For example, if you need to change the send time of several stations, simply prepare a change file and then simply send it to the units in the user's list. Everything is done remotely online in a single CloudFM MOST4 environment, from where the user can manage all his devices, whether they are data loggers or simple company sensors.

## 13.4. How to get MOST4

The online version of CloudFM MOST4 is available to FIEDLER users via the CloudFM web portal. To access this portal, the user must first have an account on the cloud. After logging in, the user is shown the units to which he has been assigned access rights.

The offline version is available in the software download center on the manufacturer's website.

## 13.5. Compatibility with devices

The MOST software tool is available in two versions.

For older FIEDLER units, the MOST2 program is designed (units type M4016, M2001, H1, H2, H40, STELA and others).

For the new series of units with product designations H11, H7, H3, C8, Q2, E2, the MOST4 program is designed to be compatible with this new series of FIEDLER telemetry units and data loggers

The MOST4 program is not included in the standard delivery of the station.




# 15 Service and maintenance

Installed indoors in a dry, dust-free environment, the unit requires no regular maintenance or servicing other than occasional cleaning.

To increase the reliability of the operation of the device installed outdoors or in a humid indoor environment, we recommend checking the tightness of cable glands, the rubber seal of the cabinet including its treatment with a suitable silicone product and checking the power supply system at least once a year.

If the station is equipped with a maintenance-free gel battery, it is necessary to ensure that the power battery is recharged as often as possible, preferably permanently from a mains power supply. The maintenance-free gel battery should not be discharged too deeply for its life and capacity.

## CLEANING THE INSTRUMENT

Before cleaning the appliance, disconnect it safely from the mains power supply.

**!** **Before cleaning the instrument, make sure that the mains supply voltage is disconnected.**

When cleaning the appliance, use only a cloth soaked in lukewarm water to which a suitable detergent can be added. Heavily soiled parts can be cleaned with rubbing alcohol.
The use of acetone or any other similarly aggressive solvents and cleaners is not permitted for cleaning the unit.

## REPLACING THE MAINS FUSE

The supply voltage of the unit equipped with the connection plate TB3 is protected by fuse T1 / 400 mA.

**!** **Before replacing the fuse, make sure that the supply voltage is disconnected.**

Repeated replacement of the fuse indicates a serious technical fault and in this case it is necessary to order service intervention from the supplier of the device.

# Technical parameters

***Connection plate TB1:***

| | |
|---|---|
| Digital analog inputs | AIN1 to AIN4 |
| Pulse binary inputs | PIN1 to PIN4, switching against GND, R < 250 Ω |
| Serial communication lines | RS485-I, RS485-II |
| Sensor power supply terminals | UNAP1, 2: 6 to 24 VDC / 0.5 A (6.. 16 V to HW:406)<br>UOPTO: 12 V/0.5 A (3.7 V/0.05 A up to and including HW:409) |
| Surge protection of inputs | Suppressors 600 W, 15 VDC |
| Mechanical relays | RE1, RE2; 1x switching contact 230 VAC / 5 AC |
| Electronic relays | RE3, RE4; voltage 12 VDC / current max. 1 ADC |
| External power supply voltage | 14..28 VDC /max 2A (photovoltaic panel up to 28 VDC) |
| External battery | Gel maintenance-free 12 V / 7 to 100 Ah, aut. Re-chargeable |

***Connection plate TB2:***

| | |
|---|---|
| Digital analog inputs | AIN1 to AIN4 |
| Pulse binary inputs | PIN1 to PIN4, switching against GND, R < 250 Ω |
| Serial communication lines | RS485-I, RS485-II |
| Sensor power supply terminals | UNAP1, 2: 6 to 24 VDC / 0.5 A (6.. 16 V to HW:406)<br>UOPTO: 12 V/0.5 A (3.7 V/0.05 A up to and including HW:409) |
| Surge protection of inputs | Suppressors 600 W, 15 VDC |
| Mechanical relays | RE1, RE2; 1x switching contact 230 VAC / 5 AC |
| Electronic relays | RE3, RE4; voltage 12 VDC / current max. 1 ADC |
| Current output 4(0)-20 mA | Iout1, Iout2; galvanically isolated active output 4(0)-20 mA, Uod > 500 V DC |
| External power supply voltage | 14..28 VDC /max 2A (photovoltaic panel up to 28 VDC) |
| External battery | Gel maintenance-free 12 V / 7 to 100 Ah, aut. Re-chargeable |
| Internal Li-Ion battery | 3.7 V/ 2600 mAh |

***Connection plate TB3:***

| | |
|---|---|
| Digital analog inputs | AIN1 to AIN4 |
| Pulse binary inputs | PIN1 to PIN4, switching against GND, R < 250 Ω |
| Serial communication lines | RS485-I, RS485-II |
| Sensor power supply terminals | UNAP1, 2: 6 to 24 VDC / 0.5 A (6.. 16 V to HW:406)<br>UOPTO: 12 V/0.5 A (3.7 V/0.05 A up to and including HW:409) |
| Surge protection of inputs | Suppressors 600 W, 15 VDC |
| Mechanical relays | RE1, RE2; 1x switching contact 230 VAC / 5 AC |
| Electronic relays | RE3, RE4; voltage 12 VDC / current max. 1 ADC |

| | |
|---|---|
| **Current output 4(0)-20 mA** | Iout1, Iout2; galvanic isolated active output 4(0)-20 mA Uod > 500 V DC |
| **External power supply voltage** | 230 VAC / 50 Hz (100 - 240 VAC) |
| **External battery** | Gel. Maintenance-free 12 V / 7 to 100 Ah, 13.5 V re-chargeable |
| **Internal Li-Ion battery** | 3.7 V/ 2600 mAh |

### *Connection plates TA4, TA4E, TA5:*

| | |
|---|---|
| **Digital analog inputs** | AIN1 to AIN8 (AIN1 to AIN7 on TA5) |
| **Pulse binary inputs** | PIN1 to PIN6 (PIN1 to PIN8 on TA5)<br>switching against GND, R < 250 Ω |
| **Resistive inputs for Pt100** | TA4E only: 2x 4-wire Pt100 connection |
| **Serial communication lines** | RS485-I, RS485-II, (SDI-12 only TA4, TA4E) |
| **Sensor power supply terminals** | UNAP1, 2: 6 to 24 VDC / 0.5 A (6.. 16 V to HW:406)<br>UOPTO: 12 V/0.5 A (3.7 V/0.05 A up to and including HW:409) |
| **Surge protection of inputs** | Suppressors 600 W, 15 VDC |
| **Mechanical relays** | RE1, RE2; 1x switching contact 24 VDC / 5 ADC |
| **Electronic relays** | TA4E only: 1+1 |
| **Current output 4(0)-20 mA** | - |
| **External power supply voltage** | 13.7 VDC / 2 A |
| **External battery** | Gel maintenance-free 12 V / 7 to 100 Ah |

### *Control unit:*

| | |
|---|---|
| **Digital Analog Inputs AIN1 - AIN6** | 4-20 mA; 0-20 mA; 1-5 mA; 0-5 mA; DCL<br>Resolution: 19 bit, 24 bit converter<br>Measurement accuracy:± 0.02% FS± 3 digits<br>Max. input voltage drop: < 2.5 V<br>Reference: 0.02%, Tk: max. 10 ppm (type 3 ppm) |
| **Pulse Inputs PIN1 - PIN8** | Min pulse width: 2 mS, max pulse frequency: 30 Hz<br>Pulse counter capacity : 18 868 437 227 405 312 |
| **SDI-12** | 1x line for sensors (www.sdi12.org) |
| **Number of analogue channels. ACH** | H7: 96 ACH; H3: 32 ACH |
| **Max. archived ACH value** | 2^19 = ±524288 for 0 decimal places; ±524.288 for 0.000 |
| **Number of binary channels BCH** | H7: 208 BCH; H3: 32 BCH |
| **Number of PID controllers** | 3 fully parameterizable controllers |
| **Number of flow meters** | H7: 64 counters; H3: 32 counters |
| **Data memory capacity** | 6 MB (up to 1 million measured values) |
| **RTC backup** | Replaceable CR2032 battery (> 10 years of operation) |
| **Max. RTC error** | 15 sec / month |
| **Automatic RTC setting** | During GPRS communication with the server |

| | |
|---|---|
| **Keyboard** | 8 fingerboards, mechanical pressure response |
| **Display** | Touch, RGB, size 3,5", resolution 320x240 px |
| **Current consumption of the unit** | Type. 20mA; 150uA in power saving mode<br>Type. 300 mA when the display backlight is on |
| **Dimensions** | 130 x 160 x 85 mm |
| **Weight** | 1480 g without battery |
| **Control unit housing material** | Al die-cast, polycarbonate |
| **Degree of enclosure protection** | IP67 |
| **Working temperature** | -30° C ... +65° C (storage temperature -30° C ... +75° C) |

***GSM communication module***

| | |
|---|---|
| **GSM module** | Module type: M66<br>Module location: inside the metal casting - IP67 protection |
| **GSM** | Frequency band: 850/ 900/ 1800/ 1900 MHz<br>Sensitivity: -108 dB (typical value)<br>Transmission Power: Class 4 (2W @ 850/ 900 MHz)<br>Class 1(1W @ 1800/1900MHz)<br>CS Data: Asynchronous, max. transfer rate 85.6kbps |
| **GPRS** | Slots: Class 12 (4Rx / 4Tx, 5MAX) |
| **SIM card** | Standard size SIM, flip-out holder, access after removing the unit cover |

## CE version

The instruments listed in this user manual comply with the EMC directives 89/336/EU including their supplements, as well as EN 61326-1:98 including supplements.

## Notice

It is possible to hand back the used lead-acid accumulator and the lithium backup battery to their importer (FULGUR-BATTMAN s.r.o., Svitavská 39, 614 00 Brno) or to the manufacturer of the units (FIEDLER AMS s.r.o., Lipová 1789/9, 370 05 České Budějovice), who has concluded a contract with the importer on the take-back of used accumulators. Improper disposal of used accumulators and batteries could damage the environment.

## Disposal of equipment

The manufacturer has concluded a take-back contract with ASEKOL a.s. You can find a list of collection points in your area at www.asekol.cz.

**Installation according to this user manual may only be carried out by personnel at least competent according to § 5 of Decree 50/1978 Coll. or 51/1978 Coll.**

# Attachments

*A. LIST OF SELECTED ERROR CODES 273*

*B. LIST OF EXAMPLE SETTINGS 275*

*C. FREQUENTLY ASKED QUESTIONS AND PROBLEMS 277*

*D. STRUCTURE OF SELECTED PARAMETERS 280*

*E. MODBUS RTU - LINKS 286*

*F. MODBUS RTU SLAVE - REGISTER MAP 287*

# 16.1. List of selected error codes



***Error codes shown on the unit display***

| Code | Error description | Cause, removal |
|---|---|---|
| **0** | No mistake. | |
| **5** | Flow meter error | Zero flow BCH forcing |
| **6** | Flow meter error | Flooding coefficient > than 95% |
| **7** | Flow meter error | Erroneous input data for calculation (level measurement error) |
| **8** | Flow meter error | Flooding correction configuration error |
| **9** | Flow meter error | Flow calculation configuration error |
| **10** | The input signal from the sensor is missing. | Broken cable, damaged sensor, incorrect unit parameter settings |
| **11** | AD converter error | Service at the manufacturer |
| **12** | Frequency measurement overflow | Fix parameter settings |
| **13** | Underflow of the measurement result below the limit | Fix parameter settings |
| **14** | Overflow of the measurement result above the limit | Fix parameter settings |
| **15** | Other error in the calculation of the measured quantity | Insufficient number of samples for average, channel in error, division by zero, ... |
| **16** | Rinsing of electrodes in progress | Normal state |
| **17** | Invalid measurement due to GSM comm. | Normal state |
| **18** | Error in calculation of temperature correction for oxygen sensor | Recalibrate the sensor, or service it with the manufacturer |
| **19** | Sensor calibration in progress | Normal state |
| **20** | Checksum error when communicating with the probe over RTS485 | Shielded cable, eliminate interference |
| **21** | The sensor does not transmit or does not measure the desired quantity | Checking parameter settings |
| **22** | The sensor temporarily has no valid data | Extend the waiting time after power on |
| **23** | Exceeding the limits of the digital filter | Fix parameter settings |
| **24** | Wind direction measurement error due to zero wind speed (W2 type sensor). | Normal state |
| **25** | Current or voltage outside the range of the measuring method | Checking parameter settings |
| **26** | Sensor permanently lacks valid data | Sensor service at the manufacturer |
| **27** | Radio communication error between node and base | Antenna control, node power control |
| **28** | UART link error | Checking parameter settings |
| **29** | The requested configuration is not available | Out of range entry number |
| **30** | Measurements temporarily suspended | Normal state |
| **31** | Unknown measurement method. | Checking parameter settings |
| **32** | Measurement initialization - waiting for valid data | Normal state |
| **33** | Error ultrasound. sensors - no echo | Sensor service at the manufacturer |
| **34** | Error ultrasound. Sensors - deadband echo | Sensor check |
| **35** | Error ultrasound. sensors - echo at max. distance | Sensor service at the manufacturer |
| **36** | Error ultrasound. sensors - differential error | Surface ripples, foam, ... |

| | | |
|---|---|---|
| **37** | Ultrasonic temperature sensor error. Sensors | Sensor service at the manufacturer |
| **40** | ADC input signal over range | Signal control at terminals |
| **41** | ADC input signal below range | Signal control at terminals |
| **42** | Interruption of the supply to the Pt100 sensor | Sensor, cable check |
| **43** | Short circuit on the lead to the Pt100 sensor | Sensor, cable check |
| **46** | Output error (analog, relay) | No external power supply detected, wrong setting |
| **51** | RS485 communication is temporarily disabled | Normal state |
| **52** | Short or no response from a MODBUS RTU sensor | Broken cable, no power supply |
| **53** | Different request and response address of the sensor with MODBUS RTU protocol | Disrupted communication |
| **54** | General probe response error after MODBUS RTU | Communication OK, error in onda |
| **55** | Error CRC communication with probe over MODBUS RTU | Disrupted communication |
| **56** | Different query and response code over MODBUS RTU | Disrupted communication |
| **57** | Error of control reading of written sensor data with MODBUS_RTU protocol | Disrupted communication |
| **58** | Cannot open the port for sensors with MODBUS_RTU protocol. | Checking parameter settings |
| **59** | Receive buffer overflow of the sensor with MODBUS_RTU protocol. | Checking parameter settings, jammed communication |
| | | |
| **61** | Communication driver error - no response from slave device | Checking parameter settings, checking the data link |
| **62** | Communication driver error - Slave device response frame error | Disrupted communication |
| **63** | Communication driver error - overflow when receiving a response from a slave device | Disrupted communication |
| **64** | Communication driver error - the driver is used for another communication and cannot be used | Checking parameter settings |
| **65** | Communication driver error - incorrect parameters passed to the driver | Checking parameter settings |
| **66** | Communication driver error - other unspecified error | Checking parameter settings |
| | | |
| **80 - 100** | Errors read from another manufacturer's smart probe with an offset of 80 | Contact the probe supplier |
| | | |
| **254** | The channel is in manual control | Checking parameter settings |
| **255** | Unoccupied measurement channel | Checking parameter settings |

# 16.2. List of example settings

***List of examples of parameter settings that are listed in this user guide***




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| | | |
|---|---|---|
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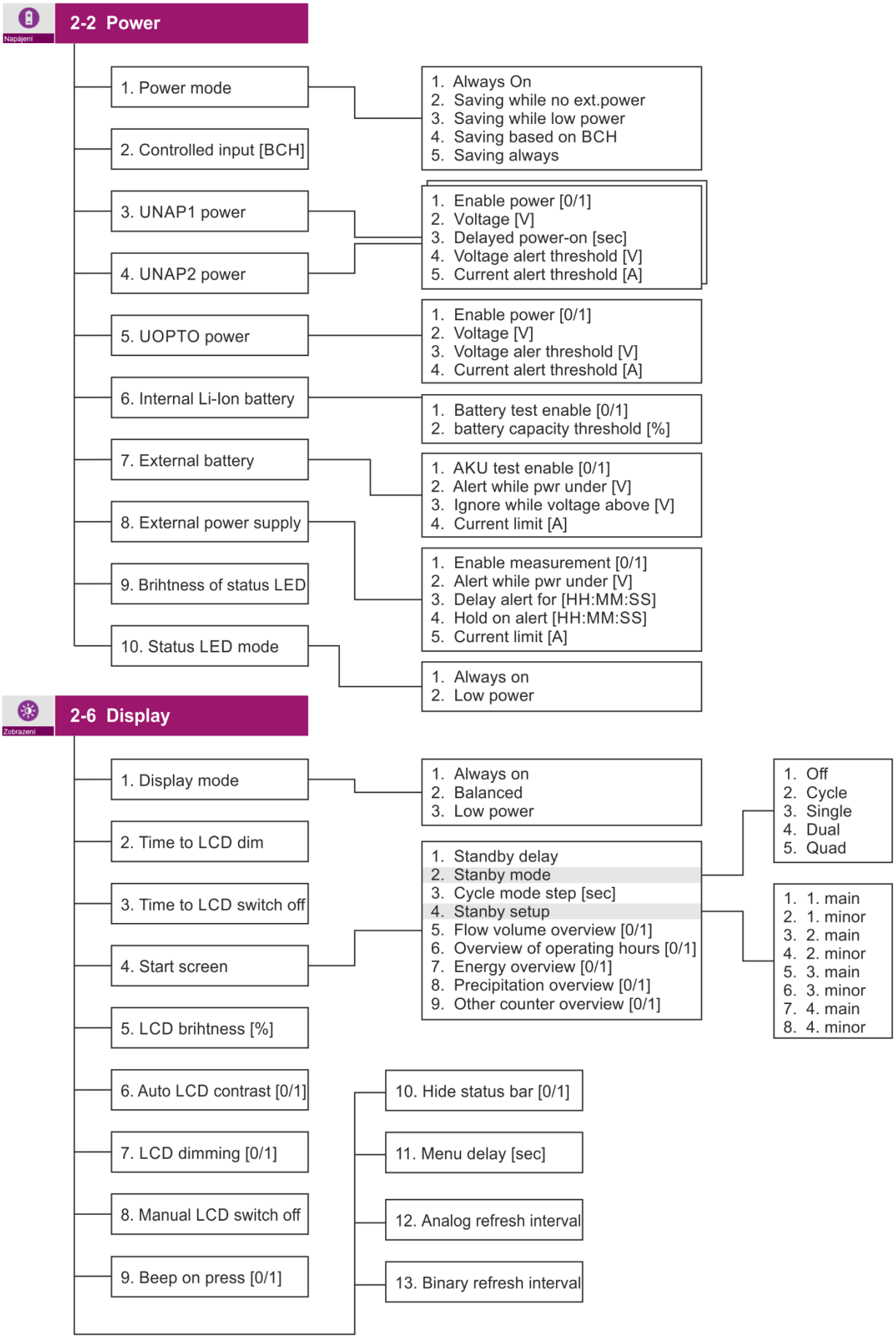
## 16.3. Frequently asked questions and problems

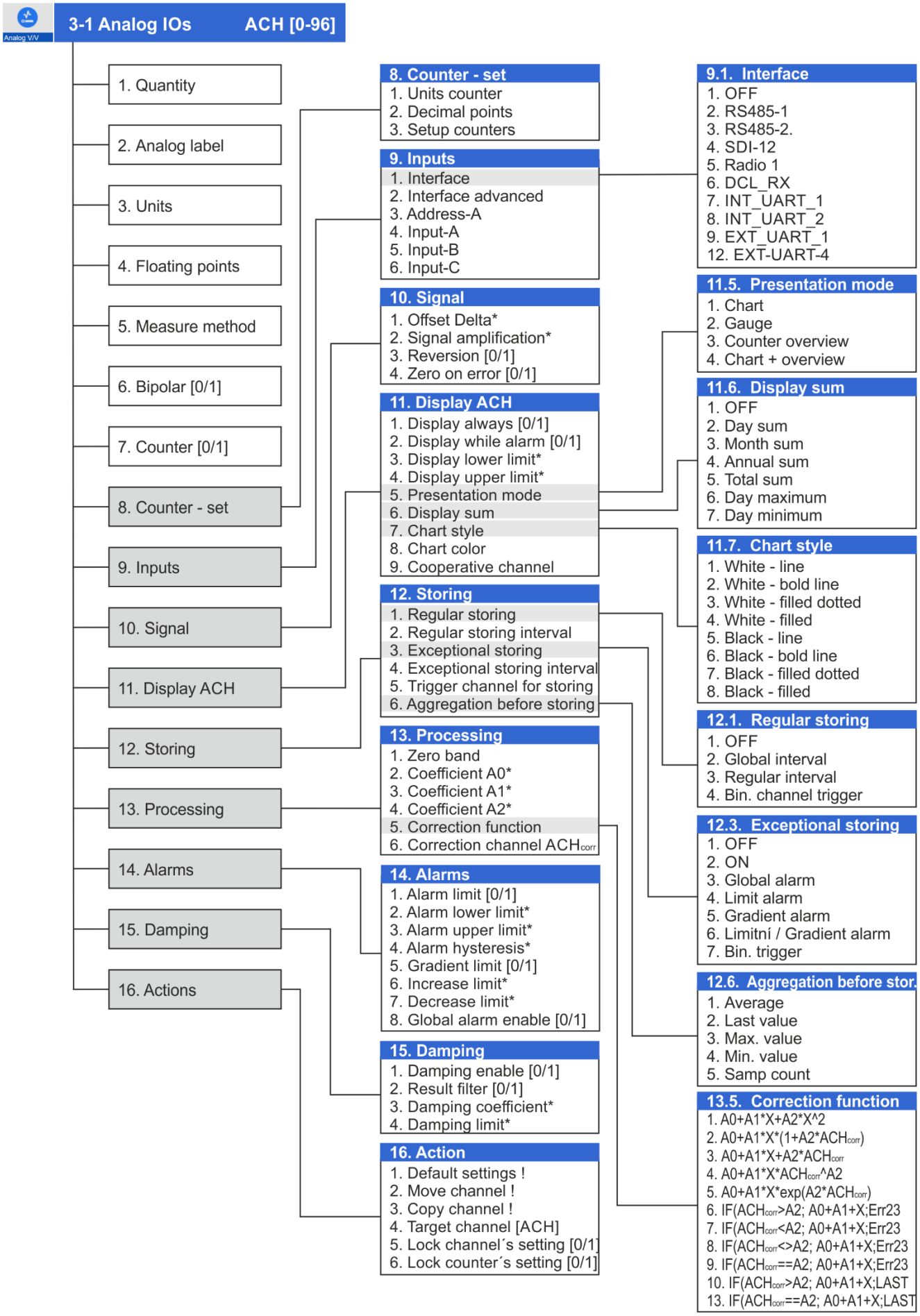
| Frequently asked questions and problems | Possible cause and its elimination |
|---|---|
| **Error - analog channel reports error 10: probe disconnected.** | Voltage/current measuring method. Check:<br>• connection of the probe to the terminals of the connection board<br>• Parameter Input A - number of the terminal where the probe is connected<br>• Probe supply voltage<br>FINET/MODBUS measurement method. Check<br>• Probe wiring - swapping RS485A+ and RS485B- wires<br>• Parameter Interface - selection of RS485-I or RS485-II bus according to the physical connection of the probe<br>• Communication parameters Address, Input, Interface advanced<br>• Parameters of the communication port - setting the Baudrate, parity...<br>• Probe power supply |
| **Error - ESKO12 probe reports error 10: probe disconnected** | 1. The ESKO12 probe has by default a different baud rate than the other probes, namely 9600 instead of the usual 19200 Bd. Check the Port setting for this 9600 Bd.<br>2. Probe wiring check:<br>red: +Unap, black: GND, yellow: RS485-A, green: RS485-B |
| **Error - conda reports error 81** | The probe does not have valid data until the "Maximum time to respond" parameter in the port parameters is closed. You can try to extend the usual value of 80 ms up to 5 sec, or reset the probe (disconnect it briefly from the power supply). You can determine the appropriate port to the probe according to the type of communication protocol and the RS485-I or -II bus used (p. 206). |
| **Error - unit in Mod bus SLAVE mode responds with an error** | Invalid register query, binary/analog number swap, etc. |
| **Error - probe reports checksum error 20** | 1. Poorly set communication parameters - Baudrate, parity<br>2. Two probes (devices) with the same address<br>3. Interference on the RS485 bus in parallel with the power line, reflections |
| **Error - probe reports error 46** | Current external power supply error of Li-Ion battery or Pb battery. The error message can be suppressed by turning off the UEXT or UAKU (UBat) measurement. |
| **The flow meter measures 0 at all times** | 1. The Hmin parameter of the flowmeter is too high and the level has not exceeded this limit. **Hmin** is always entered in **metres**.<br>2. The **Amplification** parameter is set to 0.<br>3. The parameter **Coefficient A1** is set to 0.<br>4. Poorly calibrated channel with input level to the flowmeter. Level shifts to a negative value so that the level is still 0. And therefore the flow rate is 0. |
| **The analog channel measures and displays the value correctly on the display, but the value 0 is archived in the historical data.** | Check that the analog channel has not accidentally turned on the counter. If the counter is enabled on the analog channel, then increments of the channel total are stored in the storing interval instead of the average, min or max value. In this combination of settings, only 0's will actually be stored in the unit's memory even if you see the correct value on the display. The counter only needs to be enabled for measurements where it requires some sort of sum to be archived, typically leaked volume, moto hours or rainfall. |
| **Power supply - UNAP1,2 voltage is higher than I have set** | The inverters are only of the StepUp type so that a minimum voltage is always guaranteed for the correct operation of the sensors even when the battery or power supply voltage drops.<br>If the unit is powered from the mains power supply and contains a connection board TB3 which has an output voltage behind the transformer of about 14V, |

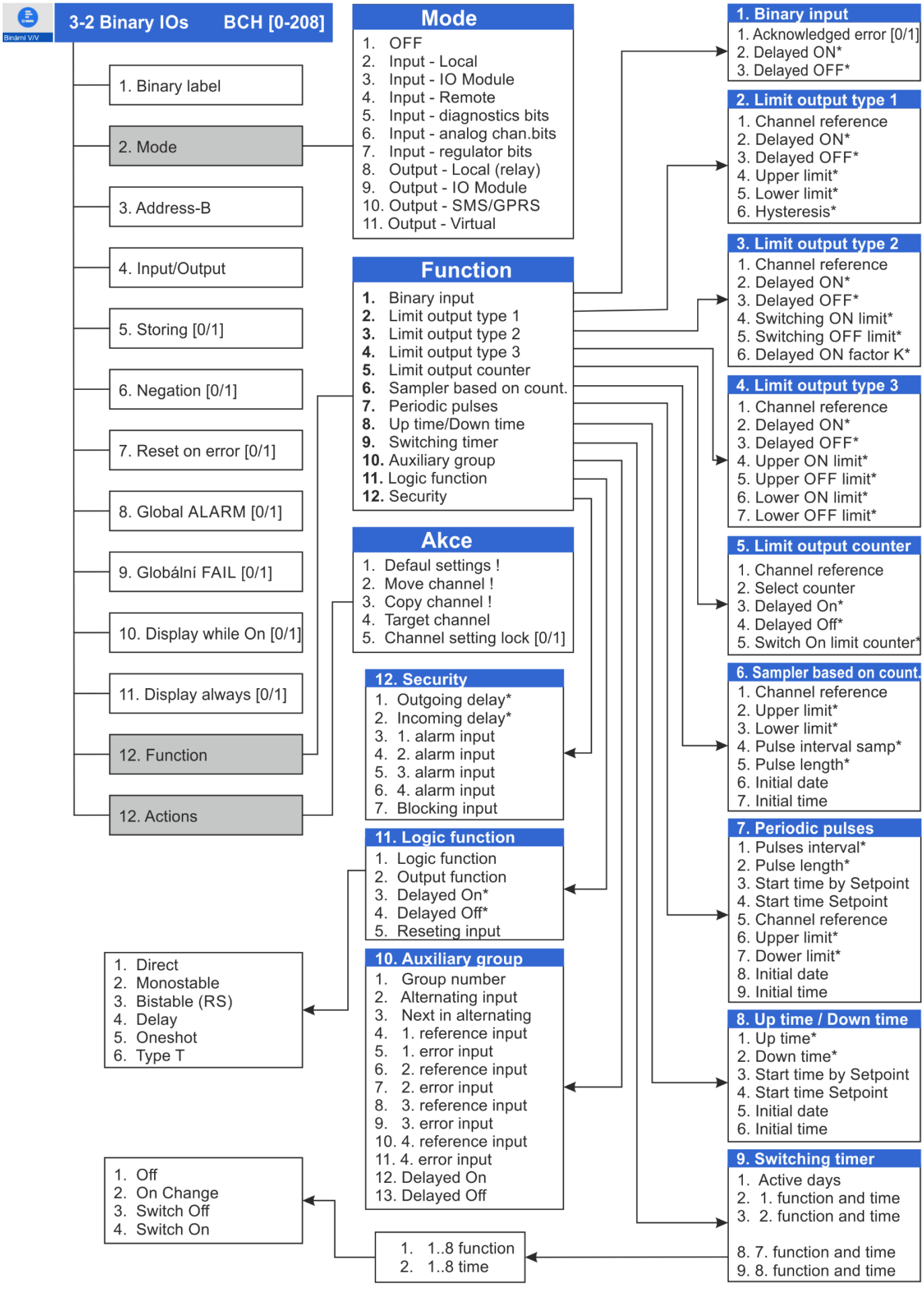
| | |
|---|---|
| | then the output of UNAP1,2 cannot reach a lower voltage than the voltage of the power supply.<br>A similar case can occur on the TB2 connection board where the unit can be powered<br>Voltage up to 24 V DC. |
| **Power supply - power supply error UNAP1,2** | 1. The maximum current draw set in the power section is exceeded<br>2. Voltage drop below the set limit set in the power supply section<br>3. Short circuit at the output |
| **Power - the display is constantly switching off/resetting** | Incorrect power saving mode setting, low battery.<br>Beware of setting the power saving mode and discharging one of the batteries. If the unit is set to any of the power saving modes or its conditions are met, and at the same time the Pb battery or Li-Ion battery is critically discharged, the unit will automatically switch to power saving mode (including turning off the display "under hands") to protect the battery. For example, when using a TB2, TB3 connection board and an unseated Li-Ion battery, this situation will occur over and over again. If the battery is not fitted intentionally, its measurement and detection can be overridden in the Power - Enable Battery Measurement section. A similar workaround can be used for Pb AKUs. |
| **READER - I can't see the channels in the SUM/hours overview** | 1. The overview screen must be set in the Display parameters<br>2. Display Mode must be set for the desired analog channel:<br>• Chart + summary of totals<br>• Summary of totals |
| **READER - I can't see the current level, flow rate and leaked volume on one screen** | For main channel with flow rate and total amount set as Secondary channel display channel number with level. The **secondary channel number must be from the same 16-tuple as the main channel being displayed.**<br>If the main channel with the sum is in first place. There must be a secondary channel in<br>range 2-16. If the main channel with sum is in position 20. The secondary channel must be in the range 17-32. The sum **channel** must always be the main channel and the level channel as a secondary channel. |
| **COUNTER - The counter displays the same value or a negative number** | The problem can typically occur with a remote counter. The sum value is read via<br>MODBUS/FINET/SDI12. During the parameterization of the unit was wrongly set<br>the format of the read data and a meaningless number was stored in the sum.<br>If the Bipolar parameter is not enabled, the sum value can only increase.<br>If we require the possibility that the total amount can decrease (water meter with backflow detection), the Bipolar parameter must be enabled.<br>In case you only managed to set up the communication incorrectly at the beginning, it is enough<br>Reset the total amount on the channel and the current valid amount will be loaded immediately<br>sum. |
| **READER - Where can I set/reset analog channel totals?** | All totals/counters can only be set with a maximum permission of 3 within the display operator. It is possible to set a counter (1) or reset all counters (2):<br>1. ACHSettings - specific channel and sum settings - Counter: settings<br>Setting counter values - fill in the required values here. Don't forget<br>at the very bottom click on **Write set values!**<br>2. Production settings - Delete **all** counters and **Reset totals!** |
| **READER - The total amount is not visible on the screen** | The counter display is not enabled in the display settings for the analog channel. |
| **COUNTER - 0 h is still displayed for moto hours** | The unit always displays the current measured value and possibly the counter in the field below the main value. In the case of the calculation of motor hours, the currently measured value has no telling value. The current value displays |

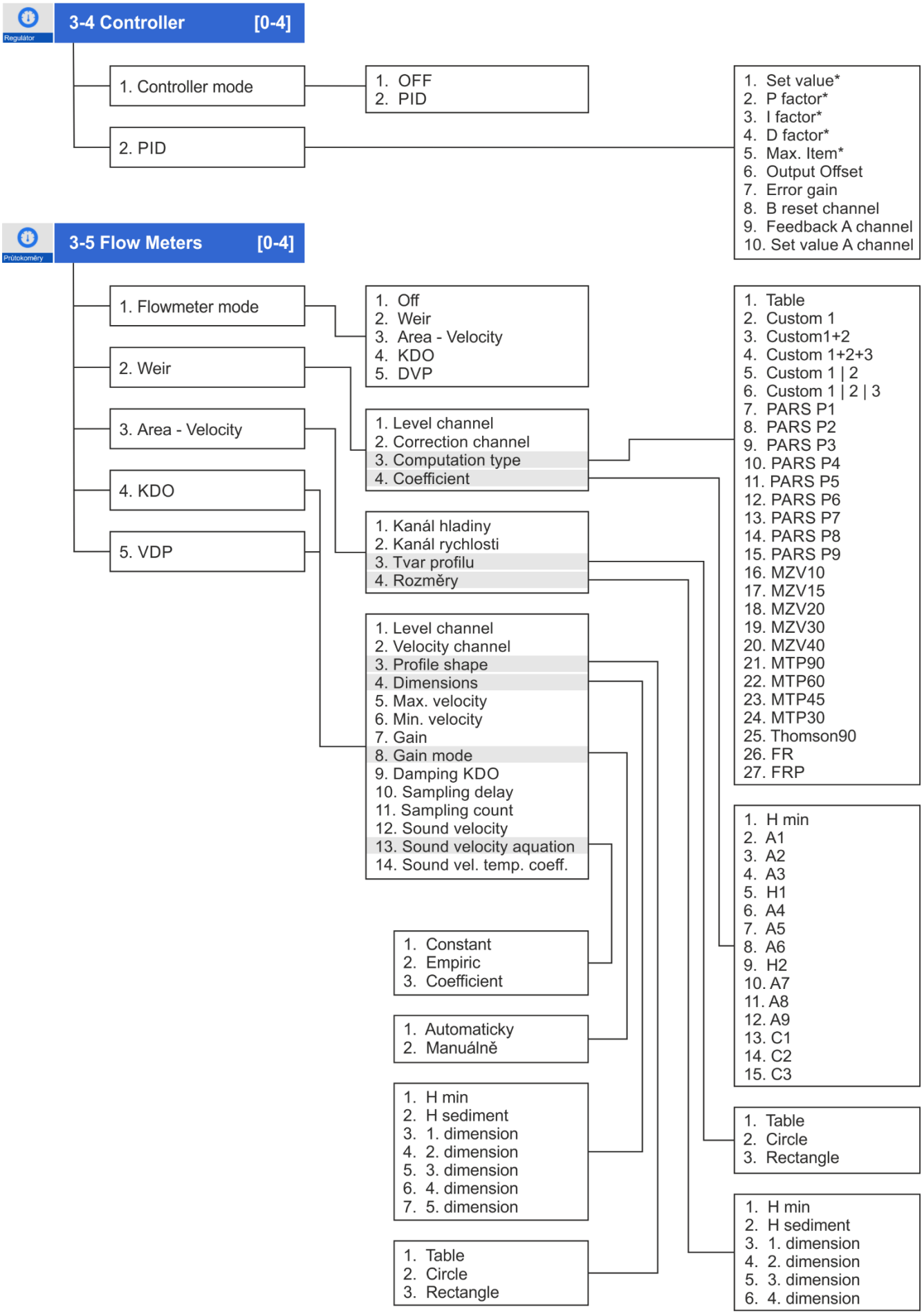
| | |
|---|---|
| | the sum of the current storing interval, typically 10 min. Therefore, when setting the channel units to hours and 0 decimal places, the display still shows 0.<br>We deliver set up: ACH display - Counter display - Total amount. |
| **SMS - "permition denied"** | After sending a query or command SMS, the user receives a "Permission denied" response. The cause may be a mistyped password. The SMS password is stored in the modem settings section: Password1 or Password2.<br>On new phones, it happens that the user accidentally types Enter, a space or another command character at the beginning and the password is then incorrectly evaluated. |
| **SMS - I get multiple SMS at the same time** | 1. SMS in ACH limit mode. We recommend checking the Hysteresis setting or increasing the SMS sending time delay.<br>2. SMS in BCH on/off mode. The problem may be similar. Check BCH settings. Limits, hysteresis, delays.<br>3. SMS in Alarm ACH mode. Again, the analog channel alarm itself will probably be set incorrectly. |
| **SMS - I didn't receive an SMS when the external power supply failed** | 1. Unset SMS or recipient - check SMS settings and number to send to<br>2. Erroneously set binary channel to monitor external power failure.<br>3. The outage was shorter than the power failure detection delay. The delay delay value can be set in the Power section<br>If you want to monitor short outages and send SMS only during longer outages, we recommend setting the delay to 0 s. Pull the outage into the binary channel settings and send SMS only with a delay. Or set up a second binary channel that is activated only with a delay and send SMS only when this second binary channel is activated. |
| **GSM - Low signal quality** | Check:<br>• Connecting an external antenna<br>• Pull the antenna through the cable gland and place it outside, looking for the optimal location with the highest measured GSM field strength (see Manual Control Mode - GSM Status)<br>• Test the signal with your phone<br>• Try the equipment in a place where there is certainly a good signal |
| **Display - The values on my display are showing red** | Check the alarm settings of the analog channel. The value turns red just when one of the set limits is exceeded. |
| **Where can I set the communication address of the external IO module (DV2, MAV422, ...)** | The address is set using the DIP SWITCH on the module board in binary code. For more information, see this manual in chap. 9 Expansion I/O modules on p. 72. |
| **When setting up channels for display, sometimes only the ACH number is displayed without the Analog label** | If the set channel is from the range of the currently loaded 16 tice channels, the Analog label is displayed properly. If it is outside the current 16 tice, only the number of the selected ACH is displayed. |

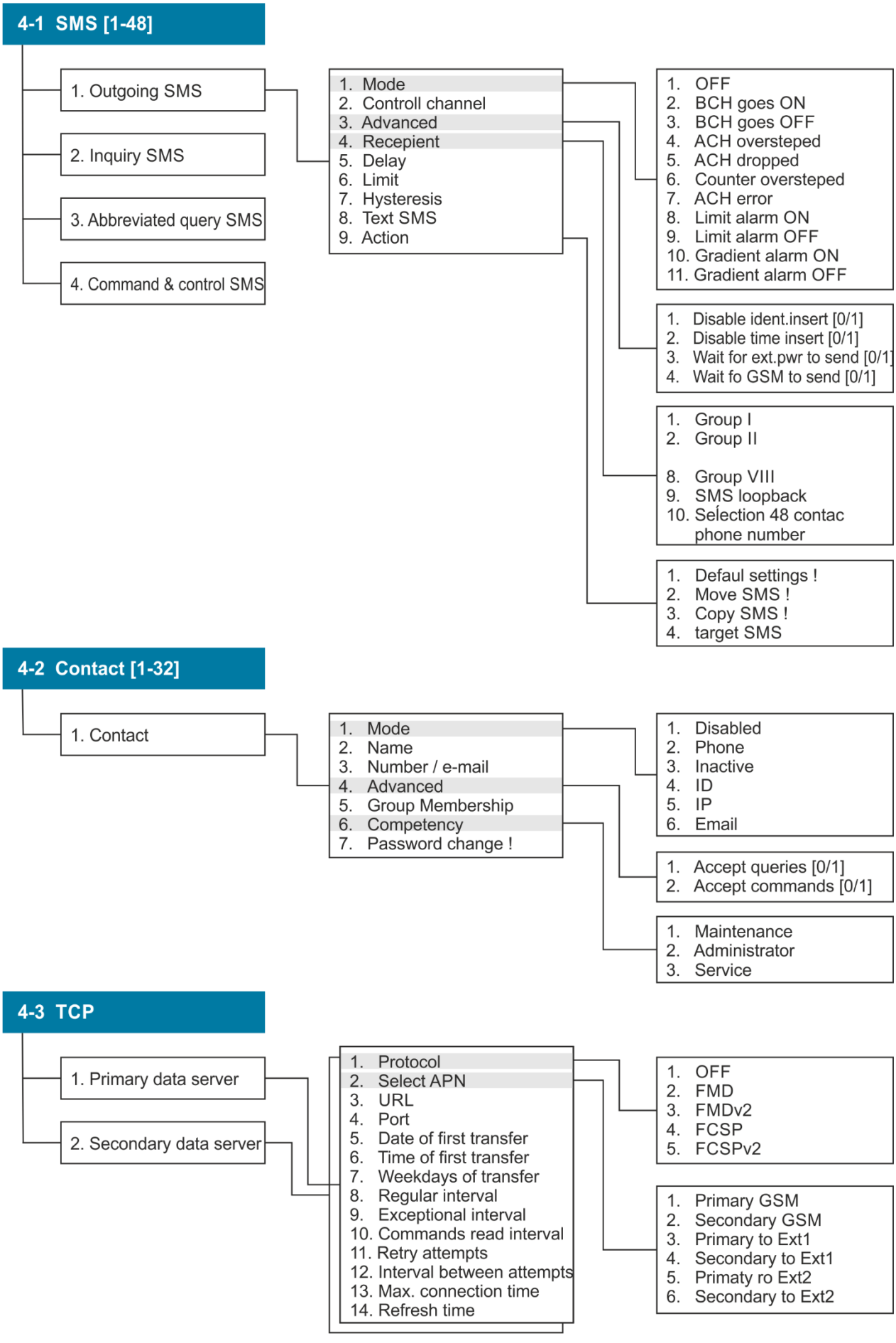
# 16.4. Structure of selected parameters



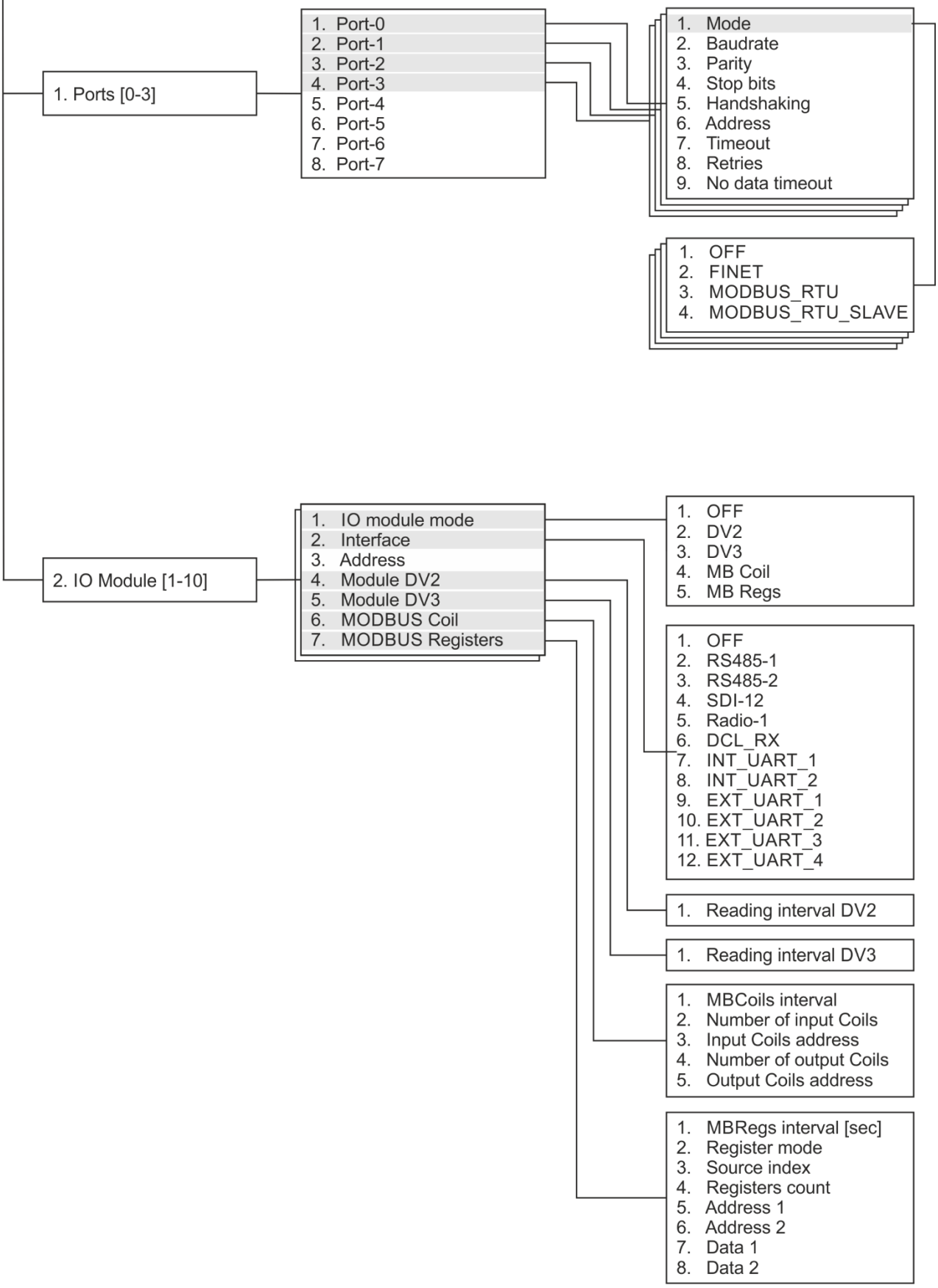

3-1 Analog IOs ACH [0-96]
1. Quantity
2. Analog label
3. Units
4. Floating points
5. Measure method
6. Bipolar [0/1]
7. Counter [0/1]
8. Counter - set
9. Inputs
10. Signal
11. Display ACH
12. Storing
13. Processing
14. Alarms
15. Damping
16. Actions
8. Counter - set
1. Units counter
2. Decimal points
3. Setup counters
9. Inputs
1. Interface
2. Interface advanced
3. Address-A
4. Input-A
5. Input-B
6. Input-C
10. Signal
1. Offset Delta*
2. Signal amplification*
3. Reversion [0/1]
4. Zero on error [0/1]
11. Display ACH
1. Display always [0/1]
2. Display while alarm [0/1]
3. Display lower limit*
4. Display upper limit*
5. Presentation mode
6. Display sum
7. Chart style
8. Chart color
9. Cooperative channel
12. Storing
1. Regular storing
2. Regular storing interval
3. Exceptional storing
4. Exceptional storing interval
5. Trigger channel for storing
6. Aggregation before storing
13. Processing
1. Zero band
2. Coefficient A0*
3. Coefficient A1*
4. Coefficient A2*
5. Correction function
6. Correction channel ACHcorr
14. Alarms
1. Alarm limit [0/1]
2. Alarm lower limit*
3. Alarm upper limit*
4. Alarm hysteresis*
5. Gradient limit [0/1]
6. Increase limit*
7. Decrease limit*
8. Global alarm enable [0/1]
15. Damping
1. Damping enable [0/1]
2. Result filter [0/1]
3. Damping coefficient*
4. Damping limit*
16. Action
1. Default settings !
2. Move channel !
3. Copy channel !
4. Target channel [ACH]
5. Lock channel´s setting [0/1]
6. Lock counter´s setting [0/1]
9.1. Interface
1. OFF
2. RS485-1
3. RS485-2.
4. SDI-12
5. Radio 1
6. DCL_RX
7. INT_UART_1
8. INT_UART_2
9. EXT_UART_1
12. EXT-UART-4
11.5. Presentation mode
1. Chart
2. Gauge
3. Counter overview
4. Chart + overview
11.6. Display sum
1. OFF
2. Day sum
3. Month sum
4. Annual sum
5. Total sum
6. Day maximum
7. Day minimum
11.7. Chart style
1. White - line
2. White - bold line
3. White - filled dotted
4. White - filled
5. Black - line
6. Black - bold line
7. Black - filled dotted
8. Black - filled
12.1. Regular storing
1. OFF
2. Global interval
3. Regular interval
4. Bin. channel trigger
12.3. Exceptional storing
1. OFF
2. ON
3. Global alarm
4. Limit alarm
5. Gradient alarm
6. Limitní / Gradient alarm
7. Bin. trigger
12.6. Aggregation before stor.
1. Average
2. Last value
3. Max. value
4. Min. value
5. Samp count
13.5. Correction function
1. A0+A1*X+A2*X^2
2. A0+A1*X*(1+A2*ACHcorr)
3. A0+A1*X+A2*ACHcorr
4. A0+A1*X*ACHcorr^A2
5. A0+A1*X*exp(A2*ACHcorr)
6. IF(ACHcorr>A2; A0+A1+X;Err23
7. IF(ACHcorr<A2; A0+A1+X;Err23
8. IF(ACHcorr<>A2; A0+A1+X;Err23
9. IF(ACHcorr==A2; A0+A1+X;Err23
10. IF(ACHcorr>A2; A0+A1+X;LAST
13. IF(ACHcorr==A2; A0+A1+X;LAST


3-2 Binary IOs BCH [0-208]
1. Binary label
2. Mode
3. Address-B
4. Input/Output
5. Storing [0/1]
6. Negation [0/1]
7. Reset on error [0/1]
8. Global ALARM [0/1]
9. Globální FAIL [0/1]
10. Display while On [0/1]
11. Display always [0/1]
12. Function
12. Actions
Mode
1. OFF
2. Input - Local
3. Input - IO Module
4. Input - Remote
5. Input - diagnostics bits
6. Input - analog chan.bits
7. Input - regulator bits
8. Output - Local (relay)
9. Output - IO Module
10. Output - SMS/GPRS
11. Output - Virtual
Function
1. Binary input
2. Limit output type 1
3. Limit output type 2
4. Limit output type 3
5. Limit output counter
6. Sampler based on count.
7. Periodic pulses
8. Up time/Down time
9. Switching timer
10. Auxiliary group
11. Logic function
12. Security
Akce
1. Defaul settings !
2. Move channel !
3. Copy channel !
4. Target channel
5. Channel setting lock [0/1]
12. Security
1. Outgoing delay*
2. Incoming delay*
3. 1. alarm input
4. 2. alarm input
5. 3. alarm input
6. 4. alarm input
7. Blocking input
11. Logic function
1. Logic function
2. Output function
3. Delayed On*
4. Delayed Off*
5. Reseting input
10. Auxiliary group
1. Group number
2. Alternating input
3. Next in alternating
4. 1. reference input
5. 1. error input
6. 2. reference input
7. 2. error input
8. 3. reference input
9. 3. error input
10. 4. reference input
11. 4. error input
12. Delayed On
13. Delayed Off
1. Direct
2. Monostable
3. Bistable (RS)
4. Delay
5. Oneshot
6. Type T
1. Off
2. On Change
3. Switch Off
4. Switch On
1. 1..8 function
2. 1..8 time
1. Binary input
1. Acknowledged error [0/1]
2. Delayed ON*
3. Delayed OFF*
2. Limit output type 1
1. Channel reference
2. Delayed ON*
3. Delayed OFF*
4. Upper limit*
5. Lower limit*
6. Hysteresis*
3. Limit output type 2
1. Channel reference
2. Delayed ON*
3. Delayed OFF*
4. Switching ON limit*
5. Switching OFF limit*
6. Delayed ON factor K*
4. Limit output type 3
1. Channel reference
2. Delayed ON*
3. Delayed OFF*
4. Upper ON limit*
5. Upper OFF limit*
6. Lower ON limit*
7. Lower OFF limit*
5. Limit output counter
1. Channel reference
2. Select counter
3. Delayed On*
4. Delayed Off*
5. Switch On limit counter*
6. Sampler based on count.
1. Channel reference
2. Upper limit*
3. Lower limit*
4. Pulse interval samp*
5. Pulse length*
6. Initial date
7. Initial time
7. Periodic pulses
1. Pulses interval*
2. Pulse length*
3. Start time by Setpoint
4. Start time Setpoint
5. Channel reference
6. Upper limit*
7. Dower limit*
8. Initial date
9. Initial time
8. Up time / Down time
1. Up time*
2. Down time*
3. Start time by Setpoint
4. Start time Setpoint
5. Initial date
6. Initial time
9. Switching timer
1. Active days
2. 1. function and time
3. 2. function and time
8. 7. function and time
9. 8. function and time


Regulátor
3-4 Controller [0-4]
1. Controller mode
2. PID
1. OFF
2. PID
1. Set value*
2. P factor*
3. I factor*
4. D factor*
5. Max. Item*
6. Output Offset
7. Error gain
8. B reset channel
9. Feedback A channel
10. Set value A channel
Průtokoměry
3-5 Flow Meters [0-4]
1. Flowmeter mode
2. Weir
3. Area - Velocity
4. KDO
5. VDP
1. Off
2. Weir
3. Area - Velocity
4. KDO
5. DVP
1. Level channel
2. Correction channel
3. Computation type
4. Coefficient
1. Kanál hladiny
2. Kanál rychlosti
3. Tvar profilu
4. Rozměry
1. Level channel
2. Velocity channel
3. Profile shape
4. Dimensions
5. Max. velocity
6. Min. velocity
7. Gain
8. Gain mode
9. Damping KDO
10. Sampling delay
11. Sampling count
12. Sound velocity
13. Sound velocity aquation
14. Sound vel. temp. coeff.
1. Table
2. Custom 1
3. Custom1+2
4. Custom 1+2+3
5. Custom 1 | 2
6. Custom 1 | 2 | 3
7. PARS P1
8. PARS P2
9. PARS P3
10. PARS P4
11. PARS P5
12. PARS P6
13. PARS P7
14. PARS P8
15. PARS P9
16. MZV10
17. MZV15
18. MZV20
19. MZV30
20. MZV40
21. MTP90
22. MTP60
23. MTP45
24. MTP30
25. Thomson90
26. FR
27. FRP
1. H min
2. A1
3. A2
4. A3
5. H1
6. A4
7. A5
8. A6
9. H2
10. A7
11. A8
12. A9
13. C1
14. C2
15. C3
1. Constant
2. Empiric
3. Coefficient
1. Automaticky
2. Manuálně
1. H min
2. H sediment
3. 1. dimension
4. 2. dimension
5. 3. dimension
6. 4. dimension
7. 5. dimension
1. Table
2. Circle
3. Rectangle
1. Table
2. Circle
3. Rectangle
1. H min
2. H sediment
3. 1. dimension
4. 2. dimension
5. 3. dimension
6. 4. dimension


4-1 SMS [1-48]
1. Outgoing SMS
2. Inquiry SMS
3. Abbreviated query SMS
4. Command & control SMS
1. Mode
2. Controll channel
3. Advanced
4. Recepient
5. Delay
6. Limit
7. Hysteresis
8. Text SMS
9. Action
1. OFF
2. BCH goes ON
3. BCH goes OFF
4. ACH oversteped
5. ACH dropped
6. Counter oversteped
7. ACH error
8. Limit alarm ON
9. Limit alarm OFF
10. Gradient alarm ON
11. Gradient alarm OFF
1. Disable ident.insert [0/1]
2. Disable time insert [0/1]
3. Wait for ext.pwr to send [0/1]
4. Wait fo GSM to send [0/1]
1. Group I
2. Group II
8. Group VIII
9. SMS loopback
10. Selection 48 contac phone number
1. Defaul settings !
2. Move SMS !
3. Copy SMS !
4. target SMS
4-2 Contact [1-32]
1. Contact
1. Mode
2. Name
3. Number / e-mail
4. Advanced
5. Group Membership
6. Competency
7. Password change !
1. Disabled
2. Phone
3. Inactive
4. ID
5. IP
6. Email
1. Accept queries [0/1]
2. Accept commands [0/1]
1. Maintenance
2. Administrator
3. Service
4-3 TCP
1. Primary data server
2. Secondary data server
1. Protocol
2. Select APN
3. URL
4. Port
5. Date of first transfer
6. Time of first transfer
7. Weekdays of transfer
8. Regular interval
9. Exceptional interval
10. Commands read interval
11. Retry attempts
12. Interval between attempts
13. Max. connection time
14. Refresh time
1. OFF
2. FMD
3. FMDv2
4. FCSP
5. FCSPv2
1. Primary GSM
2. Secondary GSM
3. Primary to Ext1
4. Secondary to Ext1
5. Primaty ro Ext2
6. Secondary to Ext2

## 4-4 Connection



# 16.5. MODBUS RTU - links

### MODBUS RTU - RS485 BUS


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# 16.6. MODBUS RTU slave - register map H7 (H3)

***H7: 96 ACH; H3: 32 ACH***

| Analog channels ACH | Actual value | | Error | Manual |
|---|---|---|---|---|
| Entry: | FC=0x06 FC=0x10 | FC=0x10 | | Register Input Float FC=0x04 |
| Analog label / Read: Chan-nel | Register Input UINT16 FC=0x04 | Register Input Float FC=0x04 | Register Input UINT8 FC=0x04 | Coil FC=0x01 |
| 1. ACH | 1000 | 3000 | 1001 | 2100 |
| 2. ACH | 1002 | 3002 | 1003 | 2101 |
| 3. ACH | 1004 | 3004 | 1005 | 2102 |
| 4. ACH | 1006 | 3006 | 1007 | 2103 |
| 5. ACH | 1008 | 3008 | 1009 | 2104 |
| 6. ACH | 1010 | 3010 | 1011 | 2105 |
| 7. ACH | 1012 | 3012 | 1013 | 2106 |
| 8. ACH | 1014 | 3014 | 1015 | 2107 |
| 9. ACH | 1016 | 3016 | 1017 | 2108 |
| 10. ACH | 1018 | 3018 | 1019 | 2109 |
| 11. ACH | 1020 | 3020 | 1021 | 2110 |
| 12. ACH | 1022 | 3022 | 1023 | 2111 |
| 13. ACH | 1024 | 3024 | 1025 | 2112 |
| 14. ACH | 1026 | 3026 | 1027 | 2113 |
| 15. ACH | 1028 | 3028 | 1029 | 2114 |
| 16. ACH | 1030 | 3030 | 1031 | 2115 |
| 17. ACH | 1032 | 3032 | 1033 | 2116 |
| 18. ACH | 1034 | 3034 | 1035 | 2117 |
| 19. ACH | 1036 | 3036 | 1037 | 2118 |
| 20. ACH | 1038 | 3038 | 1039 | 2119 |
| 21. ACH | 1040 | 3040 | 1041 | 2120 |
| 22. ACH | 1042 | 3042 | 1043 | 2121 |
| 23. ACH | 1044 | 3044 | 1045 | 2122 |
| 24. ACH | 1046 | 3046 | 1047 | 2123 |
| 25. ACH | 1048 | 3048 | 1049 | 2124 |
| 26. ACH | 1050 | 3050 | 1051 | 2125 |
| 27. ACH | 1052 | 3052 | 1053 | 2126 |
| 28. ACH | 1054 | 3054 | 1055 | 2127 |
| 29. ACH | 1056 | 3056 | 1057 | 2128 |
| 30. ACH | 1058 | 3058 | 1059 | 2129 |
| 31. ACH | 1060 | 3060 | 1061 | 2130 |
| 32. ACH | 1062 | 3062 | 1063 | 2131 |
| 33. ACH | 1064 | 3064 | 1065 | 2132 |
| 34. ACH | 1066 | 3066 | 1067 | 2133 |
| 35. ACH | 1068 | 3068 | 1069 | 2134 |
| 36. ACH | 1070 | 3070 | 1071 | 2135 |
| 37. ACH | 1072 | 3072 | 1073 | 2136 |
| 38. ACH | 1074 | 3074 | 1075 | 2137 |
| 39. ACH | 1076 | 3076 | 1077 | 2138 |
| 40. ACH | 1078 | 3078 | 1079 | 2139 |
| 41. ACH | 1080 | 3080 | 1081 | 2140 |
| 42. ACH | 1082 | 3082 | 1083 | 2141 |

| | | | | |
|---|---|---|---|---|
| 43. ACH | 1084 | 3084 | 1085 | 2142 |
| 44. ACH | 1086 | 3086 | 1087 | 2143 |
| 45. ACH | 1088 | 3088 | 1089 | 2144 |
| 46. ACH | 1090 | 3090 | 1091 | 2145 |
| 47. ACH | 1092 | 3092 | 1093 | 2146 |
| 48. ACH | 1094 | 3094 | 1095 | 2147 |
| 49. ACH | 1096 | 3096 | 1097 | 2148 |
| 50. ACH | 1098 | 3098 | 1099 | 2149 |
| 51. ACH | 1100 | 3100 | 1101 | 2150 |
| 52. ACH | 1102 | 3102 | 1103 | 2151 |
| 53. ACH | 1104 | 3104 | 1105 | 2152 |
| 54. ACH | 1106 | 3106 | 1107 | 2153 |
| 55. ACH | 1108 | 3108 | 1109 | 2154 |
| 56. ACH | 1110 | 3110 | 1110 | 2155 |
| 57. ACH | 1112 | 3112 | 1113 | 2156 |
| 58. ACH | 1114 | 3114 | 1115 | 2157 |
| 59. ACH | 1116 | 3116 | 1117 | 2158 |
| 60. ACH | 1118 | 3118 | 1119 | 2159 |
| 61. ACH | 1120 | 3120 | 1121 | 2160 |
| 62. ACH | 1122 | 3122 | 1123 | 2161 |
| 63. ACH | 1124 | 3124 | 1125 | 2162 |
| 64. ACH | 1126 | 3126 | 1127 | 2163 |
| 65. ACH | 1128 | 3128 | 1129 | 2164 |
| 66. ACH | 1130 | 3130 | 1131 | 2165 |
| 67. ACH | 1132 | 3132 | 1133 | 2166 |
| 68. ACH | 1134 | 3134 | 1135 | 2167 |
| 69. ACH | 1136 | 3136 | 1137 | 2168 |
| 70. ACH | 1138 | 3138 | 1139 | 2169 |
| 71. ACH | 1140 | 3140 | 1141 | 2170 |
| 72. ACH | 1142 | 3142 | 1143 | 2171 |
| 73. ACH | 1144 | 3144 | 1145 | 2172 |
| 74. ACH | 1146 | 3146 | 1147 | 2173 |
| 75. ACH | 1148 | 3148 | 1149 | 2174 |
| 76. ACH | 1150 | 3150 | 1151 | 2175 |
| 77. ACH | 1152 | 3152 | 1153 | 2176 |
| 78. ACH | 1154 | 3154 | 1155 | 2177 |
| 79. ACH | 1156 | 3156 | 1157 | 2178 |
| 80. ACH | 1158 | 3158 | 1159 | 2179 |
| 81. ACH | 1160 | 3160 | 1161 | 2180 |
| 82. ACH | 1162 | 3162 | 1163 | 2181 |
| 83. ACH | 1164 | 3164 | 1165 | 2182 |
| 84. ACH | 1166 | 3166 | 1167 | 2183 |
| 85. ACH | 1168 | 3168 | 1169 | 2184 |
| 86. ACH | 1170 | 3170 | 1171 | 2185 |
| 87. ACH | 1172 | 3172 | 1173 | 2186 |
| 88. ACH | 1174 | 3174 | 1175 | 2187 |
| 89. ACH | 1176 | 3176 | 1177 | 2188 |
| 90. ACH | 1178 | 3178 | 1179 | 2189 |
| 91. ACH | 1180 | 3180 | 1181 | 2190 |
| 92. ACH | 1182 | 3182 | 1183 | 2191 |
| 93. ACH | 1184 | 3184 | 1185 | 2192 |
| 94. ACH | 1186 | 3186 | 1187 | 2193 |
| 95. ACH | 1188 | 3188 | 1189 | 2194 |
| 96. ACH | 1190 | 3190 | 1191 | 2195 |

***H7: the first 64 ACH with counter*** ***H3: the first 32 ACH with counter***

| Analog channel ACH with counter | Counter Total, Hours | | | Yearly | Monthly | Daily |
|---|---|---|---|---|---|---|
| Entry: | FC=0x10 | FC=0x10 | FC=0x10 | FC=0x10 | FC=0x10 | FC=0x10 |
| Read: | Register Input Float | Register Input Double | Register Input UINT32 | Register Input UINT32 | Register Input UINT32 | Register Input UINT32 |
| Analog label Chan-nel | FC=0x04 | FC=0x04 | FC=0x04 | FC=0x04 | FC=0x04 | FC=0x04 |
| 1. ACH | 13000 | 14000 | 5000 | 9000 | 8000 | 7000 |
| 2. ACH | 13002 | 14004 | 5002 | 9002 | 8002 | 7002 |
| 3. ACH | 13004 | 14008 | 5004 | 9004 | 8004 | 7004 |
| 4. ACH | 13006 | 14012 | 5006 | 9006 | 8006 | 7006 |
| 5. ACH | 13008 | 14016 | 5008 | 9008 | 8008 | 7008 |
| 6. ACH | 13010 | 14020 | 5010 | 9010 | 8010 | 7010 |
| 7. ACH | 13012 | 14024 | 5012 | 9012 | 8012 | 7012 |
| 8. ACH | 13014 | 14028 | 5014 | 9014 | 8014 | 7014 |
| 9. ACH | 13016 | 14032 | 5016 | 9016 | 8016 | 7016 |
| 10. ACH | 13018 | 14036 | 5018 | 9018 | 8018 | 7018 |
| 11. ACH | 13020 | 14040 | 5020 | 9020 | 8020 | 7020 |
| 12. ACH | 13022 | 14044 | 5022 | 9022 | 8022 | 7022 |
| 13. ACH | 13024 | 14048 | 5024 | 9024 | 8024 | 7024 |
| 14. ACH | 13026 | 14052 | 5026 | 9026 | 8026 | 7026 |
| 15. ACH | 13028 | 14056 | 5028 | 9028 | 8028 | 7028 |
| 16. ACH | 13030 | 14060 | 5030 | 9030 | 8030 | 7030 |
| 17. ACH | 13032 | 14064 | 5032 | 9032 | 8032 | 7032 |
| 18. ACH | 13034 | 14068 | 5034 | 9034 | 8034 | 7034 |
| 19. ACH | 13036 | 14072 | 5036 | 9036 | 8036 | 7036 |
| 20. ACH | 13038 | 14076 | 5038 | 9038 | 8038 | 7038 |
| 21. ACH | 13040 | 14080 | 5040 | 9040 | 8040 | 7040 |
| 22. ACH | 13042 | 14084 | 5042 | 9042 | 8042 | 7042 |
| 23. ACH | 13044 | 14088 | 5044 | 9044 | 8044 | 7044 |
| 24. ACH | 13046 | 14092 | 5046 | 9046 | 8046 | 7046 |
| 25. ACH | 13048 | 14096 | 5048 | 9048 | 8048 | 7048 |
| 26. ACH | 13050 | 14100 | 5050 | 9050 | 8050 | 7050 |
| 27. ACH | 13052 | 14104 | 5052 | 9052 | 8052 | 7052 |
| 28. ACH | 13054 | 14108 | 5054 | 9054 | 8054 | 7054 |
| 29. ACH | 13056 | 14112 | 5056 | 9056 | 8056 | 7056 |
| 30. ACH | 13058 | 14116 | 5058 | 9058 | 8058 | 7058 |
| 31. ACH | 13060 | 14120 | 5060 | 9060 | 8060 | 7060 |
| 32. ACH | 13062 | 14124 | 5062 | 9062 | 8062 | 7062 |
| 33. ACH | 13064 | 14128 | 5064 | 9064 | 8064 | 7064 |
| 34. ACH | 13066 | 14132 | 5066 | 9066 | 8066 | 7066 |
| 35. ACH | 13068 | 14136 | 5068 | 9068 | 8068 | 7068 |
| 36. ACH | 13070 | 14140 | 5070 | 9070 | 8070 | 7070 |
| 37. ACH | 13072 | 14144 | 5072 | 9072 | 8072 | 7072 |
| 38. ACH | 13074 | 14148 | 5074 | 9074 | 8074 | 7074 |
| 39. ACH | 13076 | 14152 | 5076 | 9076 | 8076 | 7076 |
| 40. ACH | 13078 | 14156 | 5078 | 9078 | 8078 | 7078 |
| 41. ACH | 13080 | 14160 | 5080 | 9080 | 8080 | 7080 |
| 42. ACH | 13082 | 14164 | 5082 | 9082 | 8082 | 7082 |
| 43. ACH | 13084 | 14168 | 5084 | 9084 | 8084 | 7084 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 44. ACH | 13086 | 14172 | 5086 | 9086 | 8086 | 7086 |
| 45. ACH | 13088 | 14176 | 5088 | 9088 | 8088 | 7088 |
| 46. ACH | 13090 | 14180 | 5090 | 9090 | 8090 | 7090 |
| 47. ACH | 13092 | 14184 | 5092 | 9092 | 8092 | 7092 |
| 48. ACH | 13094 | 14188 | 5094 | 9094 | 8094 | 7094 |
| 49. ACH | 13096 | 14192 | 5096 | 9096 | 8096 | 7096 |
| 50. ACH | 13098 | 14196 | 5098 | 9098 | 8098 | 7098 |
| 51. ACH | 13100 | 14200 | 5100 | 9100 | 8100 | 7100 |
| 52. ACH | 13102 | 14204 | 5102 | 9102 | 8102 | 7102 |
| 53. ACH | 13104 | 14208 | 5104 | 9104 | 8104 | 7104 |
| 54. ACH | 13106 | 14212 | 5106 | 9106 | 8106 | 7106 |
| 55. ACH | 13108 | 14216 | 5108 | 9108 | 8108 | 7108 |
| 56. ACH | 13110 | 14220 | 5110 | 9110 | 8110 | 7110 |
| 57. ACH | 13112 | 14224 | 5112 | 9112 | 8112 | 7112 |
| 58. ACH | 13114 | 14228 | 5114 | 9114 | 8114 | 7114 |
| 59. ACH | 13116 | 14232 | 5116 | 9116 | 8116 | 7116 |
| 60. ACH | 13118 | 14236 | 5118 | 9118 | 8118 | 7118 |
| 61. ACH | 13120 | 14240 | 5120 | 9120 | 8120 | 7120 |
| 62. ACH | 13122 | 14244 | 5122 | 9122 | 8122 | 7122 |
| 63. ACH | 13124 | 14248 | 5124 | 9124 | 8124 | 7124 |
| 64. ACH | 13126 | 14252 | 5126 | 9126 | 8126 | 7126 |

***Set point parameters SP [1] .. SP [48]:*** ***H7: 48 SP; H3:48 SP***

| **Set point SP par.** | **Actual value** | |
|---|---|---|
| **Entry:** | **FC=0x06 FC=0x16** | |
| **Read:** | **Regis-ter Holding Float FC=0x03** | **Register Holding Float or UINT32 FC=0x03** |
| 1. SP | 6000 | 4102 |
| 2. SP | 6002 | 4102 |
| 3. SP | 6004 | 4104 |
| 4. SP | 6006 | 4106 |
| 5. SP | 6008 | 4108 |
| 6. SP | 6010 | 4110 |
| 7. SP | 6012 | 4112 |
| 8. SP | 6014 | 4114 |
| 9. SP | 6016 | 4116 |
| 10. SP | 6018 | 4118 |
| 11. SP | 6020 | 4120 |
| 12. SP | 6022 | 4122 |
| 13. SP | 6024 | 4124 |
| 14. SP | 6026 | 4126 |
| 15. SP | 6028 | 4128 |
| 16. SP | 6030 | 4130 |

| **Set point SP par.** | **Actual value** | |
|---|---|---|
| **Entry:** | **FC=0x06 FC=0x16** | |
| **Read:** | **Register Holding Float FC=0x03** | **Register Holding Float or UINT32 FC=0x03** |
| 17. SP | 6032 | 4132 |
| 18. SP | 6034 | 4134 |
| 19. SP | 6036 | 4136 |
| 20. SP | 6038 | 4138 |
| 21. SP | 6040 | 4140 |
| 22. SP | 6042 | 4142 |
| 23. SP | 6044 | 4144 |
| 24. SP | 6046 | 4146 |
| 25. SP | 6048 | 4148 |
| 26. SP | 6050 | 4150 |
| 27. SP | 6052 | 4152 |
| 28. SP | 6054 | 4154 |
| 29. SP | 6056 | 4156 |
| 30. SP | 6058 | 4158 |
| 31. SP | 6060 | 4160 |
| 32. SP | 6062 | 4162 |

| **Set point SP par.** | **Actual value** | |
|---|---|---|
| **Entry:** | **FC=0x06 FC=0x16** | |
| **Read:** | **Register Holding Float FC=0x03** | **Register Holding Float or UINT32 FC=0x03** |
| 33. SP | 6064 | 4164 |
| 34. SP | 6066 | 4166 |
| 35. SP | 6068 | 4168 |
| 36. SP | 6070 | 4170 |
| 37. SP | 6072 | 4172 |
| 38. SP | 6074 | 4174 |
| 39. SP | 6076 | 4176 |
| 40. SP | 6078 | 4178 |
| 41. SP | 6080 | 4180 |
| 42. SP | 6082 | 4182 |
| 43. SP | 6084 | 4184 |
| 44. SP | 6086 | 4186 |
| 45. SP | 6088 | 4188 |
| 46. SP | 6090 | 4190 |
| 47. SP | 6092 | 4192 |
| 48. SP | 6094 | 4194 |

UINT32 and UINT16 possibility of both + control according to SP type (UINT32 for times, float for numbers)

***H7: 206 BCH; H3: 64 BCH***

***BCH [1] .. BCH [103]:***

| Binary channels BCH | State | Error | Manual |
|---|---|---|---|
| Entry: | FC=0x05 FC=0x15 | | |
| Read: Binary label Chan-nel | Coil FC=0x01 | | |
| 1. BCH | 1000 | 1400 | 1800 |
| 2. BCH | 1001 | 1401 | 1801 |
| 3. BCH | 1002 | 1402 | 1802 |
| 4. BCH | 1003 | 1403 | 1803 |
| 5. BCH | 1004 | 1404 | 1804 |
| 6. BCH | 1005 | 1405 | 1805 |
| 7. BCH | 1006 | 1406 | 1806 |
| 8. BCH | 1007 | 1407 | 1807 |
| 9. BCH | 1008 | 1408 | 1808 |
| 10. BCH | 1009 | 1409 | 1809 |
| 11. BCH | 1010 | 1410 | 1810 |
| 12. BCH | 1011 | 1411 | 1811 |
| 13. BCH | 1012 | 1412 | 1812 |
| 14. BCH | 1013 | 1413 | 1813 |
| 15. BCH | 1014 | 1414 | 1814 |
| 16. BCH | 1015 | 1415 | 1815 |
| 17. BCH | 1016 | 1416 | 1816 |
| 18. BCH | 1017 | 1417 | 1817 |
| 19. BCH | 1018 | 1418 | 1818 |
| 20. BCH | 1019 | 1419 | 1819 |
| 21. BCH | 1020 | 1420 | 1820 |
| 22. BCH | 1021 | 1421 | 1821 |
| 23. BCH | 1022 | 1422 | 1822 |
| 24. BCH | 1023 | 1423 | 1823 |
| 25. BCH | 1024 | 1424 | 1824 |
| 26. BCH | 1025 | 1425 | 1825 |
| 27. BCH | 1026 | 1426 | 1826 |
| 28. BCH | 1027 | 1427 | 1827 |
| 29. BCH | 1028 | 1428 | 1828 |
| 30. BCH | 1029 | 1429 | 1829 |
| 31. BCH | 1030 | 1430 | 1830 |
| 32. BCH | 1031 | 1431 | 1831 |
| 33. BCH | 1032 | 1432 | 1832 |
| 34. BCH | 1033 | 1433 | 1833 |
| 35. BCH | 1034 | 1434 | 1834 |
| 36. BCH | 1035 | 1435 | 1835 |
| 37. BCH | 1036 | 1436 | 1836 |
| 38. BCH | 1037 | 1437 | 1837 |
| 39. BCH | 1038 | 1438 | 1838 |
| 40. BCH | 1039 | 1439 | 1839 |
| 41. BCH | 1040 | 1440 | 1840 |
| 42. BCH | 1041 | 1441 | 1841 |
| 43. BCH | 1042 | 1442 | 1842 |
| 44. BCH | 1043 | 1443 | 1843 |

***BCH [104] .. BCH [206]:***

| Binary channels BCH | State | Error | Manual |
|---|---|---|---|
| Entry: | FC=0x05 FC=0x15 | | |
| Read: Binary label Channel | Coil FC=0x01 | | |
| 104. BCH | 1103 | 1503 | 1903 |
| 105. BCH | 1104 | 1504 | 1904 |
| 106. BCH | 1105 | 1505 | 1905 |
| 107. BCH | 1106 | 1506 | 1906 |
| 108. BCH | 1107 | 1507 | 1907 |
| 109. BCH | 1108 | 1508 | 1908 |
| 110. BCH | 1109 | 1509 | 1909 |
| 111. BCH | 1110 | 1510 | 1910 |
| 112. BCH | 1111 | 1511 | 1911 |
| 113. BCH | 1112 | 1512 | 1912 |
| 114. BCH | 1113 | 1513 | 1913 |
| 115. BCH | 1114 | 1514 | 1914 |
| 116. BCH | 1115 | 1515 | 1915 |
| 117. BCH | 1116 | 1516 | 1916 |
| 118. BCH | 1117 | 1517 | 1917 |
| 119. BCH | 1118 | 1518 | 1918 |
| 120. BCH | 1119 | 1519 | 1919 |
| 121. BCH | 1120 | 1520 | 1920 |
| 122. BCH | 1121 | 1521 | 1921 |
| 123. BCH | 1122 | 1522 | 1922 |
| 124. BCH | 1123 | 1523 | 1923 |
| 125. BCH | 1124 | 1524 | 1924 |
| 126. BCH | 1125 | 1525 | 1925 |
| 127. BCH | 1126 | 1526 | 1926 |
| 128. BCH | 1127 | 1527 | 1927 |
| 129. BCH | 1128 | 1528 | 1928 |
| 130. BCH | 1129 | 1529 | 1929 |
| 131. BCH | 1130 | 1530 | 1930 |
| 132. BCH | 1131 | 1531 | 1931 |
| 133. BCH | 1132 | 1532 | 1932 |
| 134. BCH | 1133 | 1533 | 1933 |
| 135. BCH | 1134 | 1534 | 1934 |
| 136. BCH | 1135 | 1535 | 1935 |
| 137. BCH | 1136 | 1536 | 1936 |
| 138. BCH | 1137 | 1537 | 1937 |
| 139. BCH | 1138 | 1538 | 1938 |
| 140. BCH | 1139 | 1539 | 1939 |
| 141. BCH | 1140 | 1540 | 1940 |
| 142. BCH | 1141 | 1541 | 1941 |
| 143. BCH | 1142 | 1542 | 1942 |
| 144. BCH | 1143 | 1543 | 1943 |
| 145. BCH | 1144 | 1544 | 1944 |
| 146. BCH | 1145 | 1545 | 1945 |
| 147. BCH | 1146 | 1546 | 1946 |

| | | | |
|---|---|---|---|
| 45. BCH | 1044 | 1444 | 1844 |
| 46. BCH | 1045 | 1445 | 1845 |
| 47. BCH | 1046 | 1446 | 1846 |
| 48. BCH | 1047 | 1447 | 1847 |
| 49. BCH | 1048 | 1448 | 1848 |
| 50. BCH | 1049 | 1449 | 1849 |
| 51. BCH | 1050 | 1450 | 1850 |
| 52. BCH | 1051 | 1451 | 1851 |
| 53. BCH | 1052 | 1452 | 1852 |
| 54. BCH | 1053 | 1453 | 1853 |
| 55. BCH | 1054 | 1454 | 1854 |
| 56. BCH | 1055 | 1455 | 1855 |
| 57. BCH | 1056 | 1456 | 1856 |
| 58. BCH | 1057 | 1457 | 1857 |
| 59. BCH | 1058 | 1458 | 1858 |
| 60. BCH | 1059 | 1459 | 1859 |
| 61. BCH | 1060 | 1460 | 1860 |
| 62. BCH | 1061 | 1461 | 1861 |
| 63. BCH | 1062 | 1462 | 1862 |
| 64. BCH | 1063 | 1463 | 1863 |
| 65. BCH | 1064 | 1464 | 1864 |
| 66. BCH | 1065 | 1465 | 1865 |
| 67. BCH | 1066 | 1466 | 1866 |
| 68. BCH | 1067 | 1467 | 1867 |
| 69. BCH | 1068 | 1468 | 1868 |
| 70. BCH | 1069 | 1469 | 1869 |
| 71. BCH | 1070 | 1470 | 1870 |
| 72. BCH | 1071 | 1471 | 1871 |
| 73. BCH | 1072 | 1472 | 1872 |
| 74. BCH | 1073 | 1473 | 1873 |
| 75. BCH | 1074 | 1474 | 1874 |
| 76. BCH | 1075 | 1475 | 1875 |
| 77. BCH | 1076 | 1476 | 1876 |
| 78. BCH | 1077 | 1477 | 1877 |
| 79. BCH | 1078 | 1478 | 1878 |
| 80. BCH | 1079 | 1479 | 1879 |
| 81. BCH | 1080 | 1480 | 1880 |
| 82. BCH | 1081 | 1481 | 1881 |
| 83. BCH | 1082 | 1482 | 1882 |
| 84. BCH | 1083 | 1483 | 1883 |
| 85. BCH | 1084 | 1484 | 1884 |
| 86. BCH | 1085 | 1485 | 1885 |
| 87. BCH | 1086 | 1486 | 1886 |
| 88. BCH | 1087 | 1487 | 1887 |
| 89. BCH | 1088 | 1488 | 1888 |
| 90. BCH | 1089 | 1489 | 1889 |
| 91. BCH | 1090 | 1490 | 1890 |
| 92. BCH | 1091 | 1491 | 1891 |
| 93. BCH | 1092 | 1492 | 1892 |
| 94. BCH | 1093 | 1493 | 1893 |
| 95. BCH | 1094 | 1494 | 1894 |
| 96. BCH | 1095 | 1495 | 1895 |
| 97. BCH | 1096 | 1496 | 1896 |
| 98. BCH | 1097 | 1497 | 1897 |

| | | | |
|---|---|---|---|
| 148. BCH | 1147 | 1547 | 1947 |
| 149. BCH | 1148 | 1548 | 1948 |
| 150. BCH | 1149 | 1549 | 1949 |
| 151. BCH | 1150 | 1550 | 1950 |
| 152. BCH | 1151 | 1551 | 1951 |
| 153. BCH | 1152 | 1552 | 1952 |
| 154. BCH | 1153 | 1553 | 1953 |
| 155. BCH | 1154 | 1554 | 1954 |
| 156. BCH | 1155 | 1555 | 1955 |
| 157. BCH | 1156 | 1556 | 1956 |
| 158. BCH | 1157 | 1557 | 1957 |
| 159. BCH | 1158 | 1558 | 1958 |
| 160. BCH | 1159 | 1559 | 1959 |
| 161. BCH | 1160 | 1560 | 1960 |
| 162. BCH | 1161 | 1561 | 1961 |
| 163. BCH | 1162 | 1562 | 1962 |
| 164. BCH | 1163 | 1563 | 1963 |
| 165. BCH | 1164 | 1564 | 1964 |
| 166. BCH | 1165 | 1565 | 1965 |
| 167. BCH | 1166 | 1566 | 1966 |
| 168. BCH | 1167 | 1567 | 1967 |
| 169. BCH | 1168 | 1568 | 1968 |
| 170. BCH | 1169 | 1569 | 1969 |
| 171. BCH | 1170 | 1570 | 1970 |
| 172. BCH | 1171 | 1571 | 1971 |
| 173. BCH | 1172 | 1572 | 1972 |
| 174. BCH | 1173 | 1573 | 1973 |
| 175. BCH | 1174 | 1574 | 1974 |
| 176. BCH | 1175 | 1575 | 1975 |
| 177. BCH | 1176 | 1576 | 1976 |
| 178. BCH | 1177 | 1577 | 1977 |
| 179. BCH | 1178 | 1578 | 1978 |
| 180. BCH | 1179 | 1579 | 1979 |
| 181. BCH | 1180 | 1580 | 1980 |
| 182. BCH | 1181 | 1581 | 1981 |
| 183. BCH | 1182 | 1582 | 1982 |
| 184. BCH | 1183 | 1583 | 1983 |
| 185. BCH | 1184 | 1584 | 1984 |
| 186. BCH | 1185 | 1585 | 1985 |
| 187. BCH | 1186 | 1586 | 1986 |
| 188. BCH | 1187 | 1587 | 1987 |
| 189. BCH | 1188 | 1588 | 1988 |
| 190. BCH | 1189 | 1589 | 1989 |
| 191. BCH | 1190 | 1590 | 1990 |
| 192. BCH | 1191 | 1591 | 1991 |
| 193. BCH | 1192 | 1592 | 1992 |
| 194. BCH | 1193 | 1593 | 1993 |
| 195. BCH | 1194 | 1594 | 1994 |
| 196. BCH | 1195 | 1595 | 1995 |
| 197. BCH | 1196 | 1596 | 1996 |
| 198. BCH | 1197 | 1597 | 1997 |
| 199. BCH | 1198 | 1598 | 1998 |
| 200. BCH | 1199 | 1599 | 1999 |
| 201. BCH | 1200 | 1600 | 2000 |

| | | | |
|---|---|---|---|
| 99. BCH | 1098 | 1498 | 1898 |
| 100. BCH | 1099 | 1499 | 1899 |
| 101. BCH | 1100 | 1500 | 1900 |
| 102. BCH | 1101 | 1501 | 1901 |
| 103. BCH | 1102 | 1502 | 1902 |

| | | | |
|---|---|---|---|
| 202. BCH | 1201 | 1601 | 2001 |
| 203. BCH | 1202 | 1602 | 2002 |
| 204. BCH | 1203 | 1603 | 2003 |
| 205. BCH | 1204 | 1604 | 2004 |
| 206. BCH | 1205 | 1605 | 2005 |

**Meaning of the "Interface advanced" parameter**

***BYTE (A.. least significant byte)***

| Reverse | Interface advanced | Typ | H | G | F | E | D | C | B | A |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | UNIT16 | A | B | | | | | | |
| ~~1~~ | ~~0~~ | ~~UNIT16~~ | ~~B~~ | ~~A~~ | | | | | | |
| 0 | 1 | UNIT16 | A | B | | | | | | |
| ~~1~~ | ~~1~~ | ~~UNIT16~~ | ~~B~~ | ~~A~~ | | | | | | |
| 0 | 2 | FLOAT | A | B | C | D | | | | |
| 0 | 3 | FLOAT | A | B | C | D | | | | |
| 1 | 2 | FLOAT | C | D | A | B | | | | |
| 1 | 3 | FLOAT | C | D | A | B | | | | |
| 0 | 4 | COIL | A | B | | | | | | |
| 1 | 4 | COIL | B | A | | | | | | |
| 0 | 5 | DOUBLE | A | B | C | D | E | F | G | H |
| 0 | 6 | DOUBLE | A | B | C | D | E | F | G | H |
| 1 | 5 | DOUBLE | G | H | E | F | C | D | A | B |
| 1 | 6 | DOUBLE | G | H | E | F | C | D | A | B |
| 0 | 7 | DWORD | A | B | C | D | | | | |
| 0 | 8 | DWORD | A | B | C | D | | | | |
| 1 | 7 | DWORD | C | D | A | B | | | | |
| 1 | 8 | DWORD | C | D | A | B | | | | |
| 0 | 201 | DOUBLE | E | F | C | D | G | H | A | B |
| 1 | 201 | DOUBLE | A | B | G | H | C | D | E | F |

**Meaning of the "Interface advanced" parameter**

| Reverse | Interface advanced | Typ | *WORD (A.. least significant byte)* D | C | B | A |
|---|---|---|---|---|---|---|
| 0 | 2 | FLOAT | B | A | | |
| 0 | 3 | FLOAT | B | A | | |
| 1 | 2 | FLOAT | A | B | | |
| 1 | 3 | FLOAT | A | B | | |
| 0 | 5 | DOUBLE | A | B | C | D |
| 0 | 6 | DOUBLE | A | B | C | D |
| 1 | 5 | DOUBLE | D | C | B | A |
| 1 | 6 | DOUBLE | D | C | B | A |
| 0 | 7 | DWORD | A | B | | |
| 0 | 8 | DWORD | A | B | | |
| 1 | 7 | DWORD | B | A | | |
| 1 | 8 | DWORD | B | S | | |
| 0 | 201 | DOUBLE | C | B | D | A |
| 1 | 201 | DOUBLE | A | D | B | C |

## CONVERT THE CURRENT ANALOG CHANNEL VALUE TO WORD REGISTER:

**WORD=ACT * $10^{PD}$**

**PD** ... Floating points **ACP** ... current value Float **WORD** ... value sent via Modbus

If the Bipolar parameter is enabled, the value range is -32768 to 32768 and the WORD is stored as INT16

If Bipolar is turned off, the range of values is 0 to 65535 and the WORD is stored as UINT16

*Example: on an analog channel the temperature is measured bipolarly to 2 decimal places, the current value is -12.36° C.*

*PD = 2; ACT= -12.36 WORD= -12.36 * $10^2$ = -1236*

*Bipolarity enabled, therefore WORD is saved as INT16: WORD=0xFB2C*

TXP0220418.118E

H3, H7

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