STELA-3

user manual version 2.01

Small telemetry station for general use

FIEDLER
ELEKTRONIKA PRO EKOLOGII

CONTENTS:

1 Using STELA-3 stations

STELA telemetry stations of the 3rd generation have a very long operating time without changing the power supply batteries and high mechanical resistance. They are therefore suitable for measurements in underground sewage networks, in transfer shafts, in water tanks and wherever it is not possible to connect the station to an external power supply.

The telemetry station meets the high requirements for battery-powered devices, mainly due to its unique design. The station has a very low current consumption and is powered by 2 to 4 lithium batteries. The total installed capacity of the batteries in the station can therefore reach more than 50 Ah. At the same time, the batteries have very low self-discharge and can therefore power the telemetry station with connected sensors and transducers for more than 10 years, with daily transmission of measured data to the database server via the built-in GSM/GPRS modem.

The STELA-3 telemetry stations can thus be used to create large monitoring networks, independent of external supply voltage, and can also be combined into a single system with the more sophisticated H7, M4016, or the small Hydro Loggers H1 and H40.

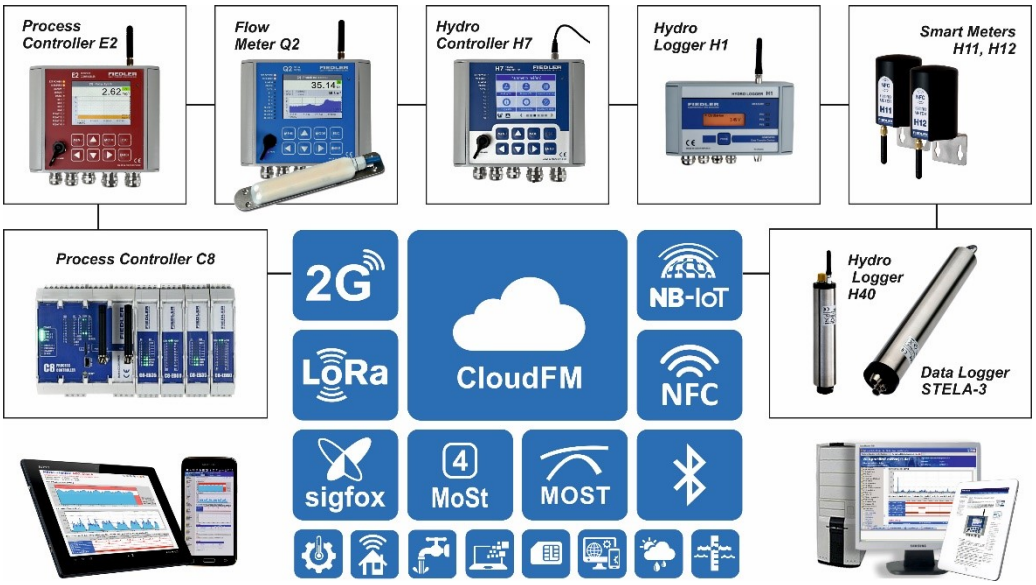
TYPICAL APPLICATIONS OF THE STELA-3 TELEMETRY STATION

- **Basic element of the monitoring network for places without external power supply**
- **Measuring flows in sewer manholes and open streams**
- **Measurement of flow rates and levels in the water supply system, CS and water meter shafts**
- **Local warning system element for rainfall measurements with simultaneous warning of torrential and prolonged rainfall**
- **Environmental monitoring**
- **Measuring levels in sewer networks**
- **Measuring levels in open river profiles**

1.1. Automatic data collection via GPRS network

The STELA telemetry station is equipped with a GSM/GPRS data module for automatic transfer of measured data from the device to the database on the server.

Automatic data collection system



ACTIVE STATIONS SYSTEM

FIEDLER telemetry stations are characterized by long battery life and very low operating costs with regular data transmission to the server. This has been achieved by a system of active stations and a 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.
- The system can receive data from multiple stations simultaneously.
- The GSM/GPRS modem in the station is switched on only for the time necessary for data transfer from the station to the server - saving power of the power battery.
- If an extraordinary event occurs at the measurement location, the station can immediately transmit this information to the server - the usual delay of cyclical calling of stations by the server is eliminated.
- 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 of the system.

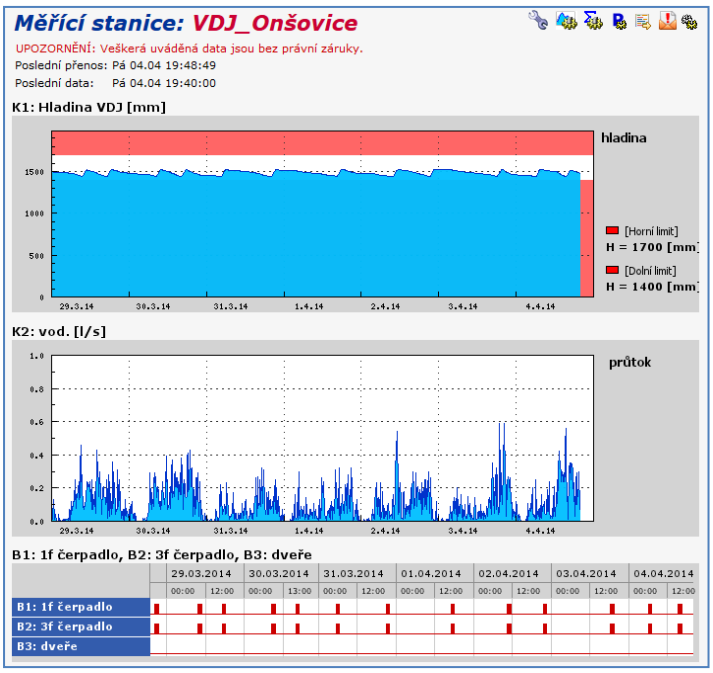
DATA SERVER SERVICES

The data server is accessible via a standard web browser. 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 another ftp server
- printing of graphs and monthly reports including statistical summaries
- creating virtual stations that can contain differently averaged, summed or otherwise adjusted data from different real 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, ...).

PARAMETERIZATION OF THE STATION REMOTELY

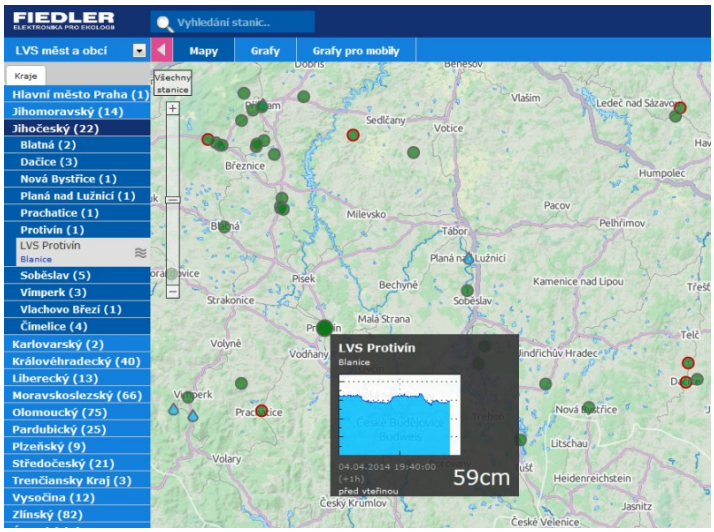
A special server service allows you to change the settings of the station parameters remotely over the Internet and GSM/GPRS network via the MOST program. All previous and current parameter files are stored in the server database, including the date and time of their change and the login name of the specific user who made the parameter change.



All these services are available to the station user for a low annual fee, which is incomparable to the investment in the equipment of 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.

MAP VISUALIZATION

In some applications, it may be advantageous to display the location of the station and its current status on a map base. The status can be both information about the station's trouble-free operation and the measured values of the selected channel.



An example is the freely accessible server www.hladiny.cz, which displays measured data from hundreds of stations installed on rivers and streams across the country.

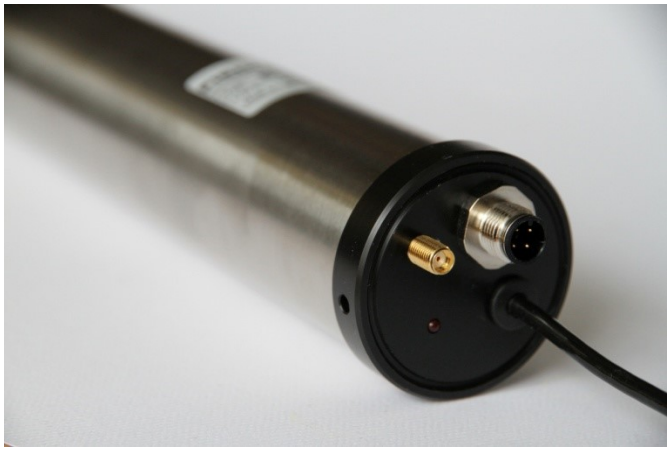
Incorporation of the station into the system is performed by the server administrator at the request of its owner.

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 the delivery of the station. These borrowed SIM cards have a low monthly fee, including 1 MB of free data/month. 1 MB of data is in the vast majority sufficient for the normal operation of the station.

2 Basic description

Recording channels The STELA-3 station allows you to set up to 8 recording channels K1 - K8 for measuring selected physical quantities and 8 binary channels B1 - B8 for recording states on binary inputs.



Control channels In addition to the recording and binary channels, the station contains 7 control channels K9 - K15 for recording the battery supply voltage, remaining battery capacity expressed in %, current drawn by the connected sensors during measurement, temperature and humidity inside the instrument.

Data memory The data memory can hold up to 400,000 values including date and time of acquisition. The capacity of the data memory is sufficient for several years of data recording in normal operation. When the memory is full, the oldest stored values are gradually overwritten. The data memory also records extraordinary events - receipt or sending of SMS, occurrence of an input error, data transfer to the server, etc.

Economical operating mode The STELA-3 station operates in a power saving mode, in which the instrument is hibernated most of the time and only wakes up and performs measurements at the set archiving interval. During the measurement period, power is supplied to the connected sensors and transducers. The magnitude of the supply voltage is adjustable from 6 to 17 VDC.

GSM communication The STELA-3 telemetry station transmits the measured values via GSM/GPRS communication to a database server. In addition, the station can send warning or informative SMS and receive query or control SMS. Parameter settings can also be changed and FW upgrades can be performed via GSM/GPRS data communication.

Parameter settings All STELA station parameters are set via the MOST program. Parameters can be changed from a PC (laptop) via cable connection or remotely via web browser and data server.

Power The instrument is powered by 2 to 4 D-size lithium battery cells, which allow the instrument to operate for many years while transmitting the measured data to the server via GSM/GPRS network on a daily basis. When the batteries are exhausted, indicated by the remaining capacity on the K13 control channel dropping to zero, the user can replace them himself in the field. Unlike the H1, H7 or M4016 stations, the STELA-3 station is not designed for external power supply connection.

2.1. Overview of program procedures and functions

The following overview briefly summarizes the program procedures and functions contained in the STELA-3 station FW, which are fully available to the station users during its parameterization and setup. Most of these functions will be described in detail in the "Setup" chapter.

Calculation functions

- Calculation and storage of the measured quantity in set units of measurement
- Sliding sum over a configurable time interval over the selected channel (flow or rainfall) to trigger an SMS alarm message
- Calculation of instantaneous flow rate and leaked volume for commonly used gauge troughs and gauge overflows (Parshall or Venturi troughs, Thomson overflow, ...) There are 14 equations preset in the station for frequently used profiles.
- Calculation of instantaneous flow rate and leaked volume from water meter pulses (REED and OPTO sensors)
- Flow calculation for composite Parshall troughs (double and triple combinations)
- Calculation of the flow rate from the tabulated level/flow relationship
- Sum and difference functions over two channels (sum and difference of measured variables), Calculation of moving average and trend over any channel
- The nonlinear output signals can be corrected by a 2nd order polynomial separately for each of the set channels.
- Calculation of the remaining capacity of the power battery based on continuous measurement of the current drawn from the battery

Statistical calculations

- For channels recording flow or rainfall, both daily and monthly total flow is calculated.
- Motor hours with resolution to minutes for each binary channel

Alarms

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

Communication

- Data transfers are performed under the FINET protocol (binary protocol with fixed frame) or Modbus RTU, HART. Data packet transmissions over GSM/GPRS network are performed under TCP/IP protocol.
- Regular sending of archived values via GPRS network to the Internet to the set IP address (to the server with the MOSTNET-SERVER program installed)
- Phonebook for 10 recipients, up to 3 groups possible
- Alert system based on 14 user configurable SMS messages
- Activation of sending SMS or transferring data to the server via GPRS network periodically in time or after reaching the limit value on the measuring channel, after activation of limit or gradient alarm, in case of sensor fault, low battery voltage, after activation of binary input or on request by SMS
- Adjustable delay and hysteresis for SMS warning limits
- 25 query and command codes for creating a query or control SMS
- Automatic insertion of the instantaneous value of the measuring channel into the SMS text
- Setting the time for sending daily SMS and day for weekly SMS
- Automatic switching between daylight saving time and standard time, automatic time comparison with the server
- Automatic archiving of the current parameter file on the server after each parameter change

Operational diary

- The event log contained in the data memory records extraordinary events (activation of selected inputs, incoming and outgoing SMS, occurrence of error signals at connected sensors, successful and unsuccessful data transmission to the server, etc.).

2.2. Mechanical design

The STELA-3 telemetry station is available in two basic versions, which differ in the way the sensors and transducers are connected to the station inputs:

- connection of sensors and transducers via K2 connector
- connection of sensors and transducers via terminal block in the junction box

The connector connection has the advantage of quick installation of mobile measuring sets in the field, while the connection of sensors and probes via the installation box allows greater versatility in the number and types of sensors to be connected and is more suitable for fixed installations inside buildings.

Robust housing

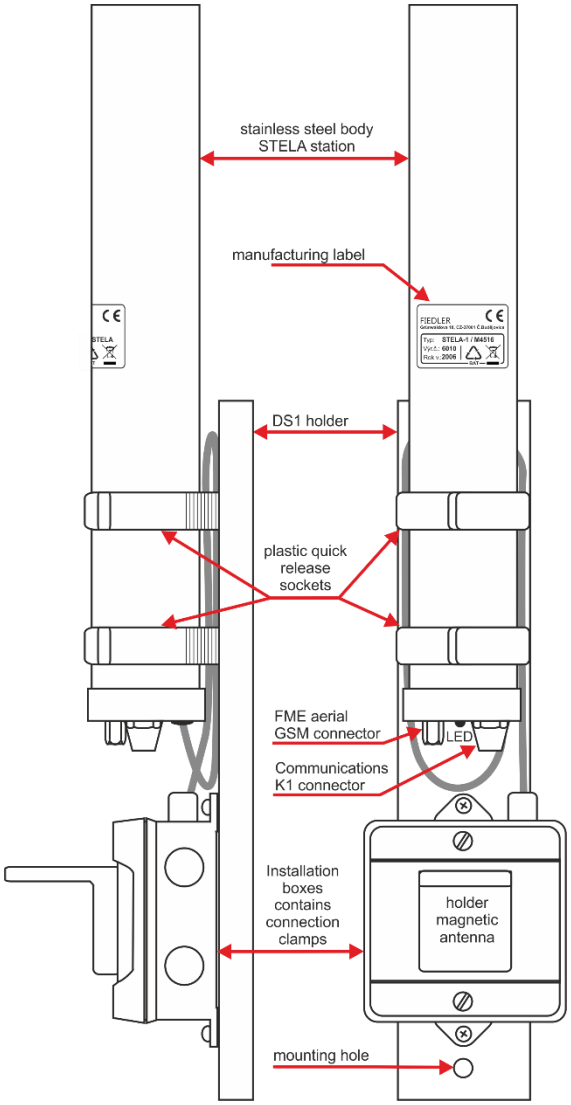
The STELA station is housed in a cylindrical semi-closed stainless steel housing with a diameter of 50 mm, which is finished with a plastic cap on the free side. It contains a communication connector K1, SMA connector for GSM antenna connection and a short signal cable with connected connector K2 or installation box with clamps. The communication connector K1 is covered with a removable cover against moisture and dirt.

The robust housing protects the power batteries and electronic circuits from external interference and adverse climatic conditions and is resistant to intentional and accidental mechanical damage.

DS1 mounting bracket

The STELA telemetry station can be ordered with the DS1 stainless steel holder, which includes two plastic quick-release sleeves. The holder also includes a mounting box with connection clamps, a detailed description of which will be given in the chapter "Installation".

The DS1 bracket has two mounting holes that are used to firmly attach the bracket to a wall, ceiling or other mechanical structure.



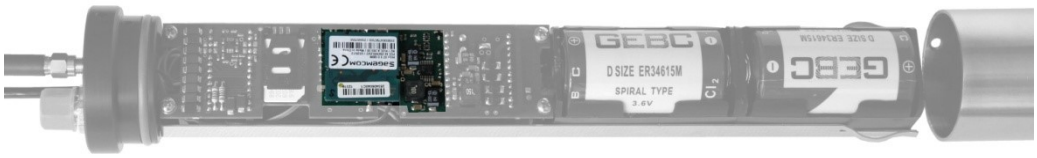
2.3. Communication

Parameter setting in the station and transmission of measured data can be done either by cable from a connected PC (laptop) or remotely via a server and GSM network.

GSM/GPRS COMMUNICATION MODULE

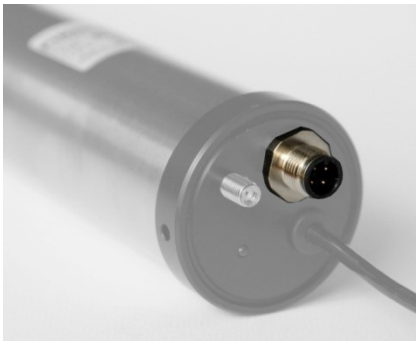
The STELA-3 telemetry station contains a GSM/GPRS communication module, which usually mediates all data transmissions between the station and the user. Therefore, it is usually not necessary to connect to the station from a PC (laptop).

Measured data stored in the station is automatically transferred via GPRS network to the database on the server at the specified time. Conversely, a parameter file is transferred from the server to the station if any changes to the station parameters are needed. The parameter file is transferred at the end of the data session and only if the user has changed at least one of the parameters and placed the new parameter file on the server. The MOST program is used to manage the parameter file.



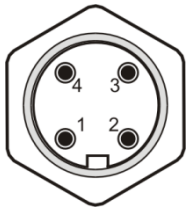
CONNECTING A PC (LAPTOP) TO THE STELA STATION

Transfer of measured data from the STELA station to a connected PC or setting of parameters in the STELA station can also be done from a PC (notebook) connected to the station with a 2 m long KP232/M12 communication cable.



On the PC side, the cable is connected via a 9-pin connector to the RS232 port. If the PC or laptop is not equipped with an RS232 connector, it is necessary to add a USB/RS232 converter (a suitable type of converter can be ordered with the station).

On the side of the STELA unit, the K1 connector type M12 is used for cable communication.

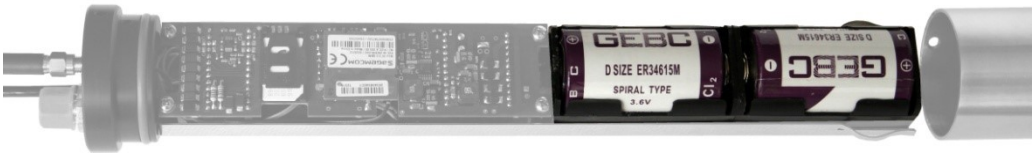


PIN	1	2	3	4
Signal	TxD	NC	GND	RxD

Connecting the pins of communication connector K1

2.4. Power supply system

The STELA telemetry station is supplied with batteries. Because the operating time of the device is extremely long when the parameters are set correctly, there is no need to change the batteries for the first few years of operation.



Station STELA-3A The STELA-3A (basic version) is powered by 2 lithium D batteries with a voltage of 3.6 V and a total capacity of 26 Ah. The self-discharge rate of these batteries is only about 1-2% of the capacity per year and they can be easily replaced when they are exhausted - they are located in a slide-out holder behind the electronic part of the station.

Stanic STELA-3B The STELA-3B 4-battery station is used where sensors and probes requiring higher current consumption or higher supply voltage are connected to and powered from the station.

A typical example of such a sensor can be a standard ultrasonic level sensor with a 4 - 20 mA output, which is also powered via a communication link. The usual time required to obtain the first measurement ranges from 30 to 60 s and the power supply for the sensor and the STELA station itself must be switched on for this entire time.

The exceptions in ultrasonic transducers are the US1200, US3200 and US4200 types, which have the first measurement within 2 s after the power supply voltage is switched on.

Integrated voltage converter In contrast to previous versions of STELA stations, there is no longer a need to select the type of station according to the required supply voltage of the connected probes and sensors, because the two- and four-battery version of the STELA-3 station already includes a user-programmable voltage converter as standard, which generates the required supply voltage for the connected sensors from parallel-connected 3.6 V batteries.

USUAL OPERATING TIME

The system of active stations and a passive server allows the GSM module to be permanently switched off and only switched on when the station requests to transfer measured data to the server or to send a warning SMS. This concept also allows the station to operate for many years without changing the power supply batteries. In a practical test, it was tested that the STELA-3B station with 4 battery cells connected in parallel is able to carry out up to 10,000 data sessions to the server (or send the same number of warning SMS) without changing the batteries.

In addition to the power required for data transmissions to the server, the power supply battery must also cover the power consumption of the probes and sensors connected to the station. With a typical archiving interval of 10 - 15 minutes, one REED flow sensor and one pressure sensor, the STELA station can thus operate for more than 10 years without battery replacement while transmitting data to the Internet on a daily basis.

In applications such as measuring long-term level fluctuations in a borehole or monitoring flow with REED sensors without simultaneous analogue signal measurement, the operating time is even longer. When OPTO sensors are used in water meters, the operating time is reduced due to the inherent current consumption of these permanently powered speed sensors.

Replacing dead batteries The current drawn from the batteries is continuously integrated in the station and the energy drawn is continuously subtracted from the initial capacity of the power batteries. The remaining battery capacity is archived on the user-accessible control channel K13. The time record of the declining battery capacity can in many cases explain the often mysterious rapid discharge of batteries - for example, inappropriate parameter settings, a fault in the connected sensor, cable damage, etc.

When the batteries are exhausted and the remaining battery capacity drops to zero, the user can replace the batteries himself in the field. The detailed procedure for replacing the power supply batteries is given in the chapter "Service".

Notice *The STELA-3 station is not designed for external power supply connection.*

3 Installation

The installation of the telemetry assembly can be divided into its mechanical placement, including the connection of sensors and transducers, finding the optimal location of the GSM antenna and inserting the SIM card, and setting the control parameters. The detailed description and setting of the individual parameters is covered in Chapter 4.

3.1. Mechanical location of telemetry assembly

Depending on the intended installation method, the STELA assembly is either supplied separately, with only two plastic quick-release sleeves, or a simple DS1 stainless steel bracket can be added.

DS1 holder The universal stainless steel bracket has 2 plastic clamps for mounting the station body and includes an installation box with clamps for connecting external sensors and sensors. The DS1 bracket is simply attached with two dowels to the wall or ceiling of the building and once the sensors and GSM antenna are connected, the mechanical installation is complete.

Protection against moisture If possible, it is advisable to install the station in a location free of permanently condensing moisture. If this cannot be avoided, then extra care must be taken when connecting the connectors - to tighten them (they have a built-in O-ring). It is also advisable to treat the GSM antenna connector with silicone petroleum jelly or insulating self-adhesive or self-vulcanizing tape to seal any leaks.

Temperature influences The telemetry assembly should not be installed in locations where the temperature is consistently above 40 °C, as this increases the self-discharge of the power supply batteries, resulting in a shorter battery life. Conversely, low temperatures below -20 °C reduce the usable capacity of the batteries.

3.2. To insert SIM cards y

The station manufacturer has long been lending its own SIM cards to its products for a low monthly fee, which includes 1 MB of free data/month. The STELA station can therefore be delivered with an already inserted SIM card. The operating costs of the borrowed SIM card are invoiced to the user of the station together with the data hosting for database rental and server services.

To insert a SIM card

When inserting or replacing your own SIM card, please note the following:

PIN unblocking

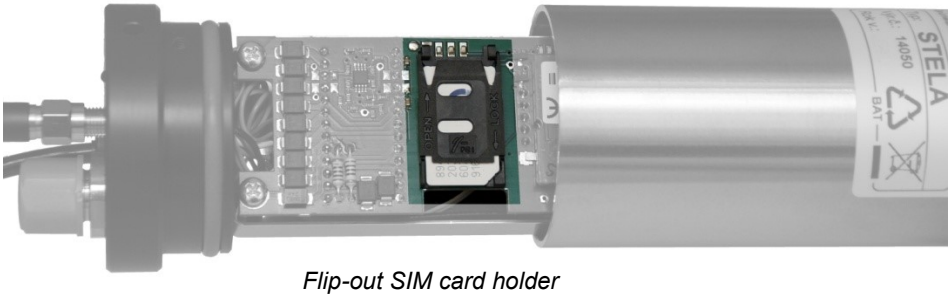
The SIM card must be unblocked before it is inserted into the station and the PIN code must be requested after switching on. Unblocking can be done on any mobile phone - security function.

GSM module power off

When inserting and removing the SIM card, the GSM module must be switched off from the power supply. This can be achieved, for example, by setting the GSM modem permanently off in the station parameters. It is not recommended to switch off the modem power by removing the power batteries, as this may affect some previously set variables (real time of the station, total leaked volumes, ...).

To access the SIM card holder

The SIM card is inserted into a flip-up holder located on the PCB next to the GSM module inside the station. This PCB is mechanically connected to the plastic cap of the cylindrical housing of the station. The cap is fitted with a sealing O-ring and is not only inserted into the cylindrical outer housing of the station, but is also secured with an M4 screw against rotation and sliding.

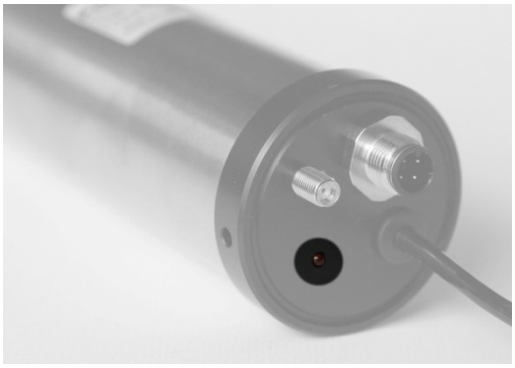


Flip-out SIM card holder

When opening the station, the M4 locking screw is first turned out and then the plastic cap with the PCB is pulled out of the stainless steel casing of the station. The two opposite holes on the sides of the plastic cap are for fixing the cap if the stainless steel casing of the station cannot be easily removed.

3.3. Signaling of the GSM modem operating status

The plastic cap of the STELA station contains, in addition to the GSM connector, the communication connector and the connecting cable, a signaling red LED. By the speed of flashing of this LED, the device indicates the current status of the GSM module.



Tab. 1: Signalling red LED.

Red LED

The state of the worm. LEDs	Meaning of signalling
The LED is not lit	GSM modem is switched off - normal idle state.
Flicker 1 Hz	The GSM modem logs into the network.
Short flash once every 5 sec.	The GSM modem is logged into the network, no data transfer is taking place.
Fast flashing 2 Hz	Receiving or sending an SMS message
Fast flashing 5 Hz.	Data transfer via GPRS data network

Before data transfer from the station to the server or before sending SMS from the station, the modem of the station must be logged into the GSM network. If the GSM signal is strong enough at the location of the station antenna, the station will be logged into the network after about 20 seconds from switching on the GSM module (slow flashing of the LED).

Data transmission to the server can take from a few seconds to 5-10 minutes, depending on the amount of data transmitted and the quality of the GSM field. During the ongoing data session, the signaling LED flashes at an increased frequency of 2 Hz.

Forced switching on of the modem during installation of the station can be triggered from a PC (notebook) connected by cable under the MOST program. The procedure is described in the following text.

3.4. Antenna and its location

Reliable GPRS and SMS communication requires a GSM field strength of at least 8 on a scale of 0 to 31 at the antenna location. With lower signal strengths, it may happen that some GPRS data sessions do not take place at the set time, but only on other days with better conditions for GSM signal propagation.

Above-ground objects

When installing the station, it is therefore important to take care of the appropriate location of the supplied magnetic GSM antenna with respect to the GSM field strength. In most above-ground buildings, the location of the antenna is not critical and it can be mounted vertically almost anywhere on a suitable elevated location.

The simplest method of finding a suitable location for the antenna using a scale on a mobile phone gives only approximate results. Remember to use the SIM of the same operator that the telemetry set-up will be using. This method can be used wherever the GSM field strength is sufficient and no special requirements are placed on the location of the GSM antenna.

AGSM-9dB-SMA

Metal enclosed objects

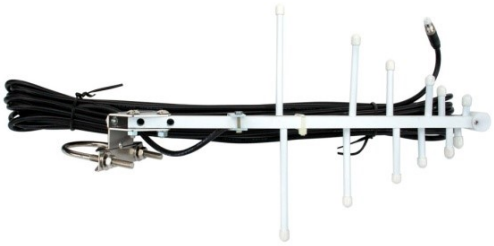
When installing the station outdoors, it is often the case that the station is placed in a metal enclosure, in the head of a borehole or otherwise shielded from the external GSM field. In this case, it is advantageous to use a special hemispherical antenna that is placed on the outer surface of the metal casing. This special type of antenna can be ordered together with the station from its manufacturer under the designation AGSM-3db/P-SMA. The antenna shall be fixed in a 12 mm diameter hole and secured against theft from below with an overmolding nut.

AGSM-3dB/P-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, is it necessary to proceed to external antenna placement. A suitable solution may be, for example, a plastic tube (protector) with a cap that contains the supplied rod antenna. The positioning of the protector above the ground should take into account the height of the snow cover at the installation site.

More powerful GSM antennas



Directional antenna AGSM-12dB-SMA

In locations with very weak GSM signal, the supplied magnetic antenna with 6 dB gain can usually be replaced by a larger omnidirectional magnetic antenna with 9 dB gain or a small directional antenna with 12 dB gain (the long directional antenna requires precise antenna pointing and homogeneity of the electromagnetic field and its use has not been proven in practice). Beware of the usual vertical polarization in GSM networks when installing a directional antenna! A small directional antenna 60 cm long can be ordered together with its bracket from the manufacturer of the telemetry assembly.

GSM extension cable

Finding the optimal antenna location often requires experimentation, sometimes with SIM cards from other operators. A coaxial extension cable can also help, which can be ordered with the set or as an option. The length of this extension cable can range from 2 to 10 m.

Extension coaxial cable PK-GSM-5M-SMA

TREATMENT OF THE GSM ANTENNA CONNECTOR AGAINST MOISTURE PENETRATION

The used GSM antenna connector is watertight when screwed together and the mutually bonded dielectric prevents the penetration of air moisture to the central antenna conductor.

However, when installing the station in a humid environment, we recommend treating this connector joint with a suitable insulating tape or applying a thin layer of silicone petroleum jelly to the antenna connector before connecting it to the station.

GSM FIELD STRENGTH DETECTION USING MOST

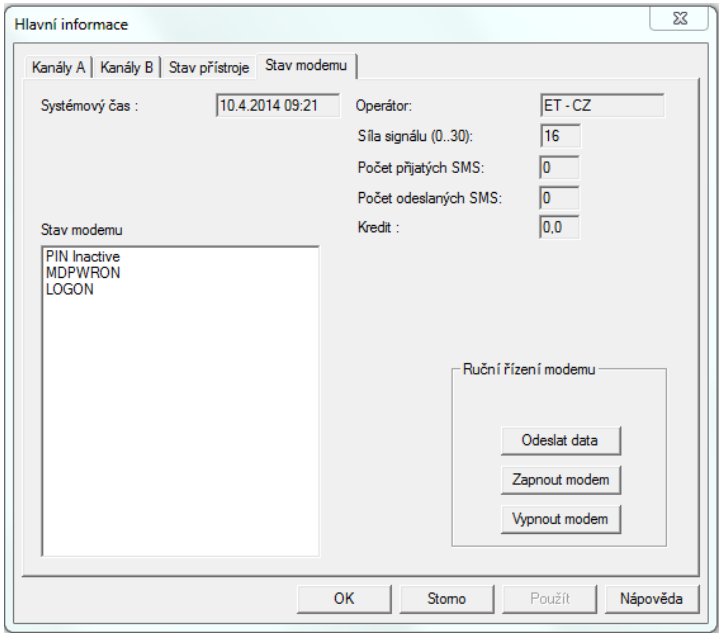
When installing the station, it is advisable to place its antenna in the place with the highest GSM field strength. The modem in the station converts the current measured field strength into a number on a scale from 0 to 30 (the higher the number, the better the location for the antenna).

Although the STELA station does not include a display or any buttons, the optimal antenna location can be found using a laptop connected to the station with a cable.

When looking for the optimal location of the GSM antenna, proceed as follows:

- Connect a PC or laptop with the MOST software installed to the STELA station using the KP232/M12 cable.
- Start the MOST program and use the COM icon to establish communication with the station.
- In the main menu select *"Info" -> "Current values"* and then in the "Main information" window select the "Modem status" tab. This procedure will display the following information window on your monitor:

"Modem Status" information window



- The "Operator", "Signal strength" and "Modem status" fields will not be filled in until you instruct the station to log into the GSM network by pressing the "Switch modem on" button.

LED status indication

- During login, the signal LED will flash at a frequency of approximately 1 Hz. After the device has logged into the network, the regular flashing of the LED will change to short light pulses with a period of about 5 s and the GSM operator code and signal strength will appear in the "Modem status" information window. For reliable transmissions it is advisable to find a location for the antenna such that the field strength is 8 or more.
- After installing the antenna in the optimal location and after completing the overall parameterization of the station according to chapter 4, you can use the "Send data" button to transfer the current settings (valid parameter file) and the last measured values to the database on the server.
- **Finally, don't forget to log off the device from the GSM network by pressing the "Turn off modem" button.**

Remark:

If the STELA telemetry station is located in a place with a weak GSM field, it will be forced to repeat some data calls, it will be difficult to log into the network and the result will be a reduction in the above mentioned operation time. Therefore, when installing the GSM antenna, always try to ensure its optimal location (see chapter: Installation).

3.5. Connecting sensors and transducers

RECORDING CHANNELS

The STELA telemetry station can record up to 8 measured physical quantities in its data memory. Each measured quantity occupies one recording channel K1 to K8. Unoccupied recording channels are not allocated and thus do not occupy space in the data memory (so-called dynamic channel occupation).

Recording channel settings

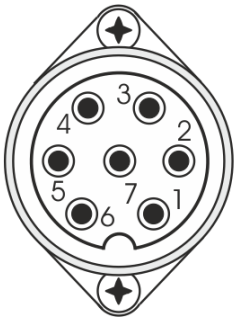
Any recording channel, if it is to be active, must first be set up. Setup is done via the MOST program from a PC connected by cable, or remotely via a web browser and special data server services. During setup, one input is assigned to each recording channel. In special cases, multiple recording channels can have one common input.

When setting up the recording channel, in addition to the input, the type of measurand, measurement method, units of measurement, number of decimal places and other necessary parameters are selected. The setting of recording channels is covered in detail in chapter 4. Parameter settings.

3.5.1. Inputs

The STELA-3 telemetry station is available in two basic variants, which differ in the way the sensors and measuring probes are connected to the station inputs:

- Connection of sensors via 7-pin K2 connector with IP67 protection.
- Connection of sensors via terminal block in IP66-protected junction box.



1 ... Supply voltage Unap
2 ... Analog input AV1
3 ... Pulse input PV1
4 ... Uopto supply voltage
5 ... RS485-B
6 ... RS485-A
7 ... GND

Connection of K2 connector sleeves

Connecting the terminals in the junction box

CONNECTION OF SENSORS VIA K2 CONNECTOR

The K2 connector is connected to the STELA station by a short cable. The connector connection limits the number of sensors that can be connected to the STELA and requires the addition of a similar connector to the sensor cable. On the other hand, the connector connection makes installation and possible servicing easier and faster where only 1 external sensor is connected to the station.

Connector expander

A larger number of sensors equipped with connectors can be connected to one station via a connector expander, which can be ordered from the station manufacturer. The expander contains 2 to 5 parallel connected K2 connectors.

CONNECTION OF SENSORS VIA THE TERMINAL BLOCK IN THE JUNCTION BOX

This variant allows you to use almost all inputs offered by the STELA station to connect sensors and sensors. The connection box with terminals is mounted on a single stainless steel bracket together with the STELA station, to which it is connected by a short cable.

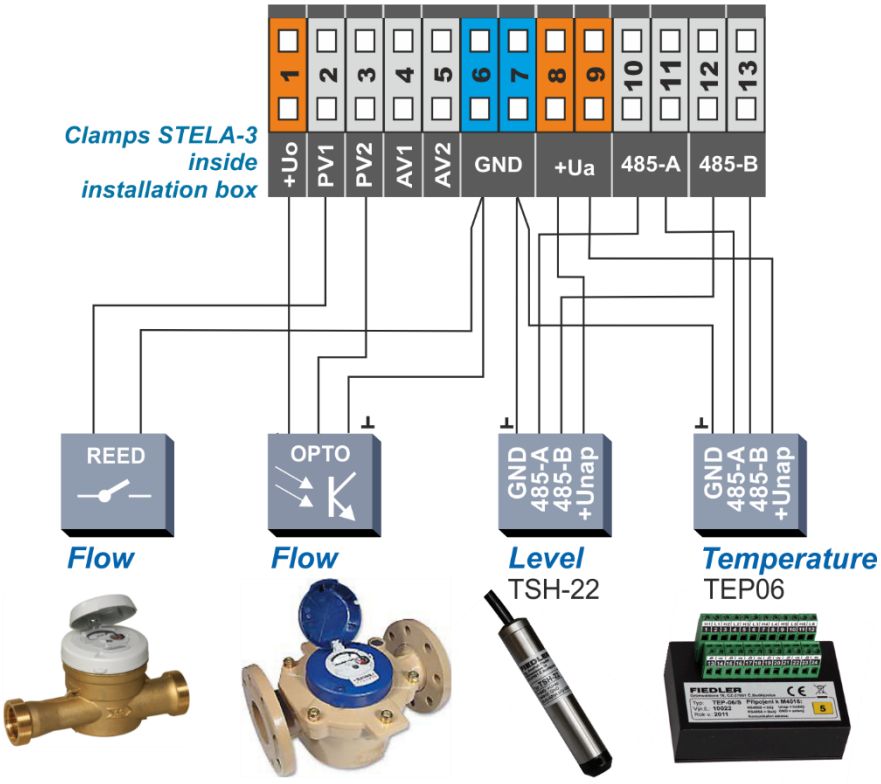
Larger junction box

If the number of cable glands of a small connection box (max. 3 glands for connecting sensors) is a limiting factor for connecting more sensors to one telemetry station, then a station with a larger connection box (up to 6 cable glands) can be ordered from the manufacturer.

Connection box with clamps is part of the DS1 holder

Terminal block wiring

The following figure shows the connection of the individual terminals in the junction box. Some terminals are duplicated for easier connection of multiple sensors and probes to one power supply or RS485 bus.



Connecting terminals in the connection box of the STELA-3 station

Standard input wiring

Enter	Type of input	K2 connector	Clamp no.
PV1	pulse-binary input	3	2
PV2	pulse-binary input	-	3
AV1	0(4)-20 mA input	2	4
AV2	0(4)-20 mA input	-	5
RS485-A	RS485-A	6	10, 11
RS485-B	RS485-B	5	12, 13
+Unap	power supply 6 to 18 VDC	1	8, 9
+Uopto	3.6 V power supply (permanent)	4	1
GND	ground terminal (-power supply)	7	6, 7

Special design of inputs

In special cases, the STELA station can be supplied with a different input connection. The station can have two additional analog inputs AV3, AV4 or two additional pulse-binary inputs PV3, PV4 and one serial communication line SDI-12.

Instead of 4 - 20 mA current inputs, the STELA-3 can also be supplied with 0-2 V voltage inputs and programmable gain from 20 mV to 2.5 V.

Inputs not used in the standard STELA-3 station design:
(can be added after prior agreement with the station manufacturer):

Signal	Signal name	K2 connector	Staples
PV3	pulse-binary input	-	-
PV4	pulse-binary input	-	-
AV3	0(4)-20 mA input	-	-
AV4	0(4)-20 mA input	-	-
SDI-12	SDI-12 (1200 Bd)	-	-

Surge protection of inputs

All inputs are protected against overvoltage by an effective semiconductor barrier that eliminates induced interference pulses up to 600 W.

3.5.2. Power supply for connected sensors and transducers

Power terminal +Unap

In addition to the inputs, the K2 connector also contains station terminals for powering connected probes and sensors. On the terminal marked +Unap (connector K2-pin 1, terminals 8, 9 in the installation box) the supply voltage is present only during the measurement of signals from the connected sensors. The measurement interval is an adjustable parameter ranging from 1 min to 24 h.

Another adjustable parameter of the unit allows you to switch on this power supply in advance of the actual measurement, so that the connected sensors have time to start up and correctly set the size of the output signal in proportion to the physical quantity being monitored.

The supply voltage is user adjustable from 6 to 18 V and its optimal setting depends on the type of sensors to be connected. A lower voltage setting saves the life of the power supply battery.

When connecting multiple sensors to one telemetry station, it is necessary to connect several power wires to this one power terminal. For this reason, the +Unap power terminal in the installation box is doubled (terminals 7, 8) as well as the GND ground terminal (negative pole of the supply voltage - terminals 6,7).

Power clamp +Uopto

Some sensors require a continuous uninterrupted power supply. Examples include OPTO sensors used for flow measurement with propeller water meters. The Uopto terminal (terminal 1 in the installation box, pin 4 in the K2 connector) is designed to supply power to such sensors, where the 3.6 V battery voltage can be permanently present. This voltage must be permanently switched on when parameterizing the instrument.

Permanently powered sensors must not overload the battery in the station and therefore their current consumption should not exceed 200 µA. For example, OPTO sensors of the VLP-8 to VLP-11 type are suitable and draw an average supply current of only 80 µA from the Uo terminal.

3.5.3. Pulse inputs PV1-PV2

In the basic version, the STELA station has two pulse-binary inputs PV1 and PV2. The inputs can be used for reading pulses from water meters and as status inputs monitoring pump runs and faults, etc. The type of input (pulse or binary) is determined by the parameters when setting up the station.

Activation of input

Both pulse inputs are activated by their connection to the GND ground terminal, and therefore the connected sensors must have either a common open collector or a potential-free contact (relay contact) at the output. In the quiescent inactive state, the voltage at the pulse input is 3.3 V. When the input is switched on, the input circuit draws a current of 30 µA from the battery supply. The minimum required pulse length is 10 mS.

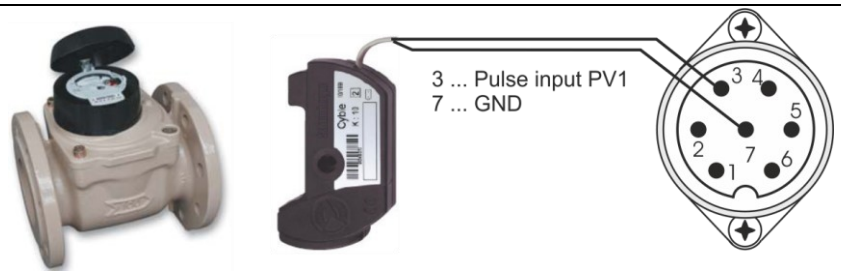
Calculation of instantaneous flow rate

From the pulse weight (a parameter expressed as the number of litres per pulse) and the frequency of pulse occurrence, STELA continuously calculates the instantaneous flow rate. If the instantaneous flow rate exceeds the set limit, a warning SMS message can be sent.

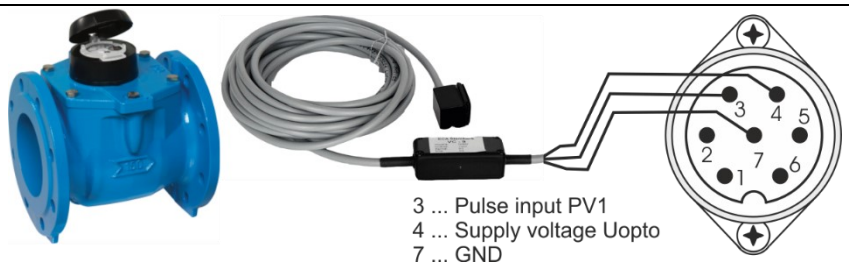
Calculation of the leaked volume

From the pulse weight and the total number of pulses per archiving interval, the STELA station calculates the leaked volume. The leaked volume per archiving interval is recorded in a separate channel.

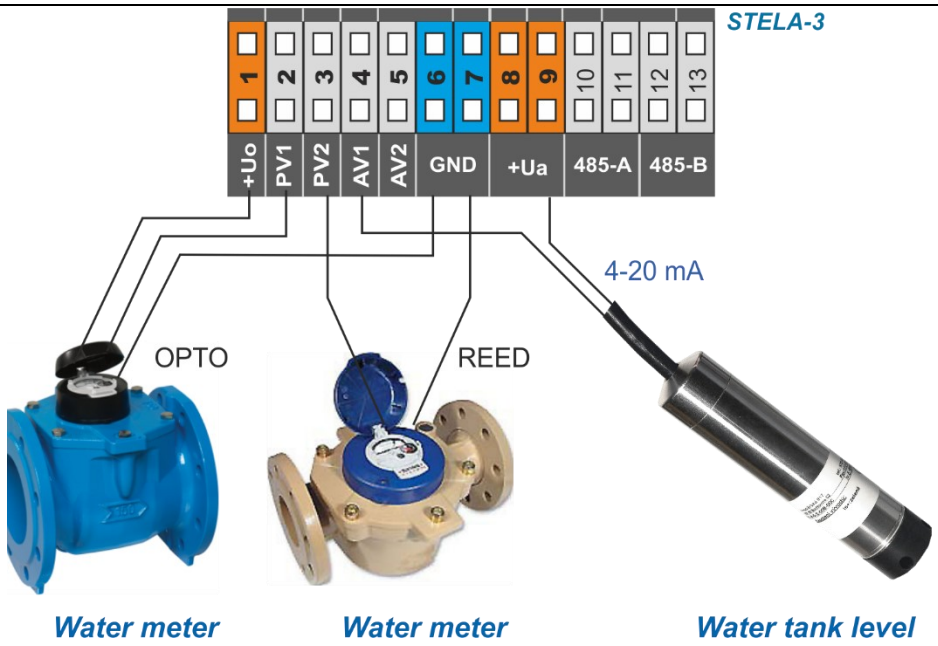
Connecting a water meter with CYBLE sensor to the K2 connector



Connection of water meter with OPTO sensor to connector K2



Connection of water meters and level gauges via connection box terminals



3.5.4. Analog inputs AV1- AV2

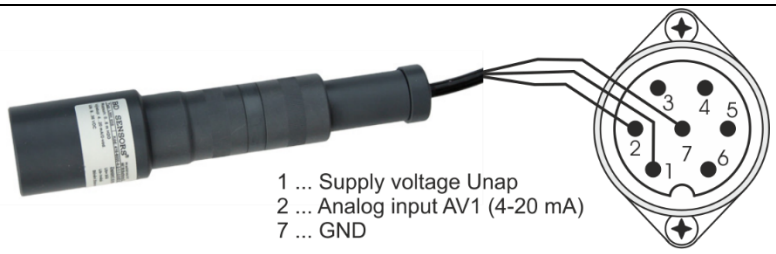
Inputs AV1 and AV2 are used to connect sensors and transducers with output signals of 4 - 20 mA, 0 - 20 mA, 1 - 5 mA, 0 - 5 mA and 0 - 1 mA.

The voltage drop across the AV input can be as low as 2 V at 20 mA. This drop should be increased by the minimum supply voltage of the connected sensor declared by its manufacturer on the +Unap power terminal. Conversely, an unnecessarily high +Unap supply voltage will excessively deplete the capacity of the power supply battery.

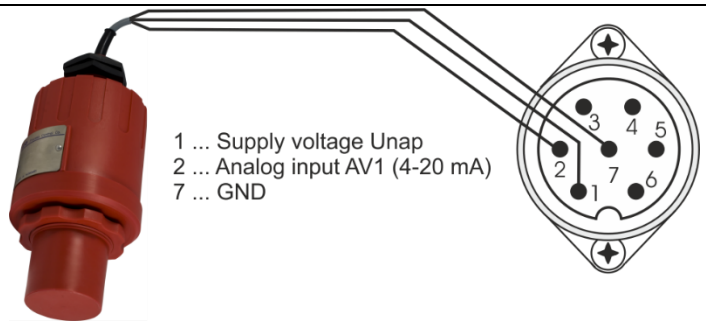
The analogue signals fed to the AV1 and AV2 inputs are measured by a precision transducer with a digital filter that suppresses interference voltages induced in the input cable and performs automatic self-calibration of the measuring ranges.

Measurement sensors can be connected to the AV inputs in both two-wire (terminals: +Unap, AV) and three-wire (terminals: +Unap, AV, GND).

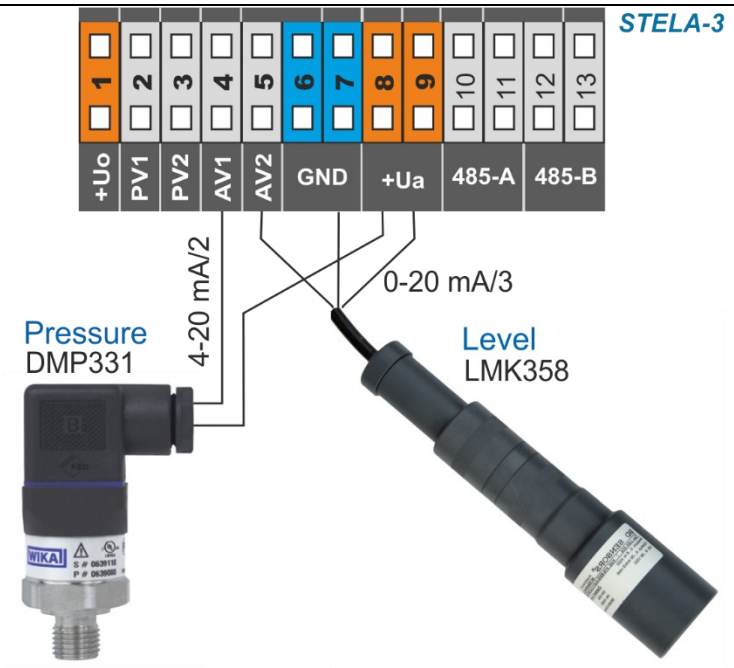
Connecting the LMP858 pressure level sensor with 4-20 mA output to the K2 connector



Connecting the SPA-370-4 ultrasonic level sensor to the K2 connector



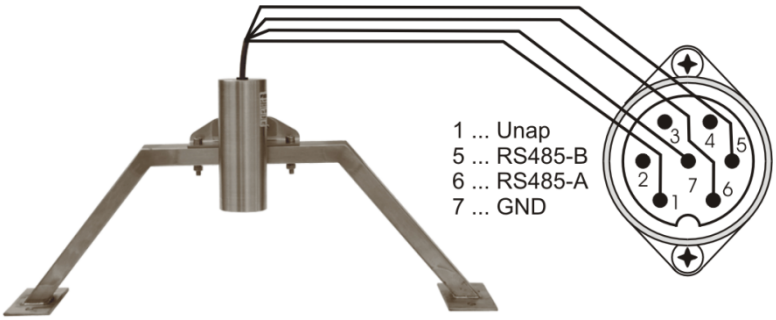
Connection of sensors via connection box terminals



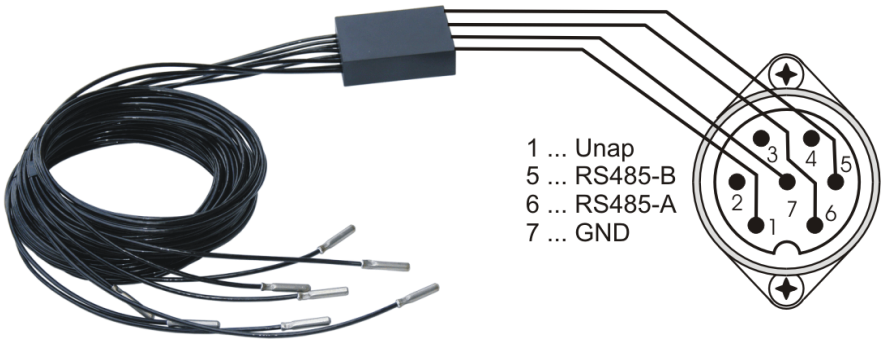
3.5.5. RS485 serial line

The STELA station contains RS485 communication bus terminals for connection of selected sensors and measuring transmitters that communicate under FINET, HART or Modbus RTU protocols. Such devices can be, for example, ultrasonic or immersion level sensors US1200 and TSH22, water conductivity sensors ESV11 and many other sensors and transducers listed in the table on page 28.

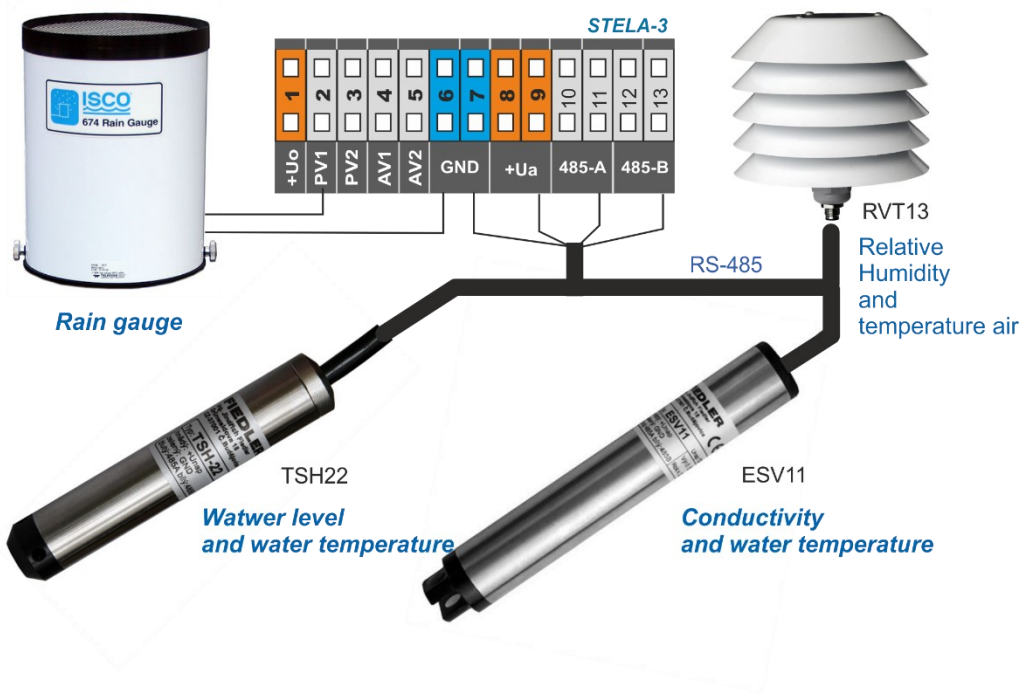
Connecting the ultrasonic level sensor US1200 to the K2 connector



TEP06 transmitter connection



Connection of sensors via connection box terminals



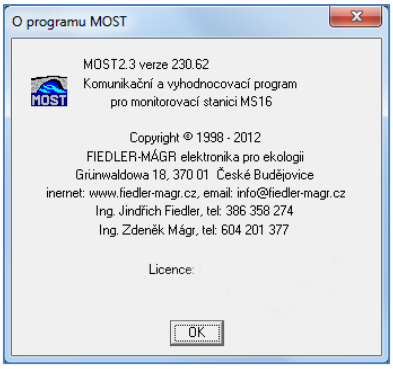
4 Parameter settings

All user-accessible parameters of the STELA station can be read from the instrument and stored in a parameter file with the *.PRM extension. The user can modify this parameter file, archive it and write the changed parameters back to the instrument. The MOST program is designed for working with the parametric file.

Parameter setting can be done from the PC directly via RS-232 interface cable (from USB port via converter, which can be ordered together with the station), or it is possible to set parameters remotely from the server via GSM/GPRS network.

4.1. MOST programme

MOST is a universal communication, setup and evaluation program common to all FIEDLER instruments.



A detailed description of the program is given in a separate manual. The user who will use this program only for working with parameters will be satisfied with the description of individual parameter windows described in detail in the rest of this user manual.

You can get the latest version of the program on the manufacturer's website.

The MOST program is not included in the standard delivery of the telemetry set.

4.1.1. Basic rules for working with parameters

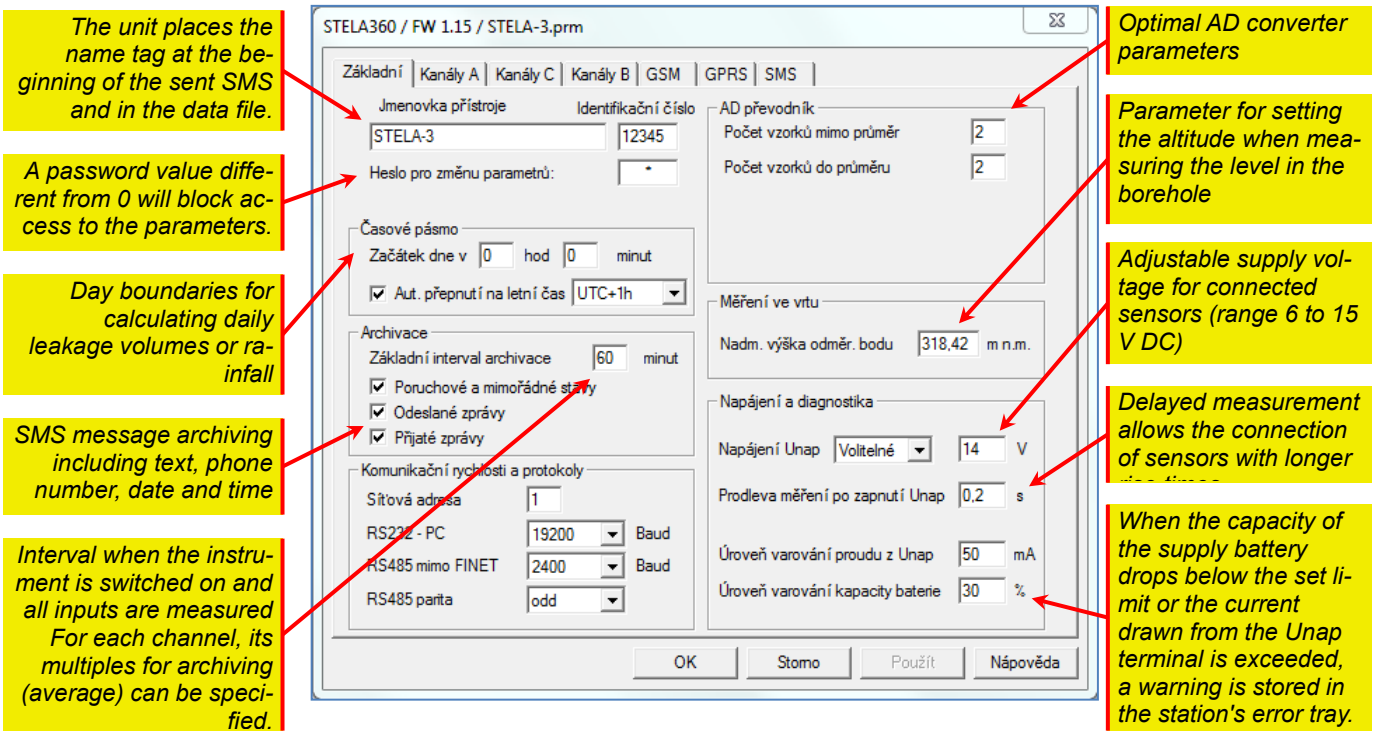
After physically **linking** the PC to the STELA station (via cable or dial-up connection via modems), the **connection** must first be made. For this purpose, either the menu in the "Communication" menu or the "COM" or "Telephone" icons are used. Both the linking and the connection are not necessary if you use the server service for setting or changing parameters.

At the beginning of working with parameters, it is advisable to first read the parameters from the connected device. You can also load the parameters from the database on the server (if you have the appropriate permissions), where they are automatically saved after each change, or from a backup file on the PC.

After setting the parameters, the new parameters must be saved in the instrument. This can be done from the "communication" menu or by using the icon. When using a server, simply save the new parameter file to the server and the station will download the file at the next data communication. You can start the data communication immediately by sending an SMS message in the form: HESLO, dial0 to the station's phone number (this requires that the modem of the STELA station is switched on at the time of sending the SMS).

4.2. Basic parameters

A group of basic parameters for setting station identification, measurement frequency, supply voltage control, data archiving and station communication with sensors



4.2.1. Identification

Instrument nameplate

The basic parameters include the instrument nameplate, which can store a maximum of 17 ASCII characters characterizing the instrument. The name tag is preferably used to visually check the affiliation of the opened parameter file to the connected instrument and can be seen at the beginning of the *.dta data file, inserted into sent SMS and serves as a station identifier on the server.

Note: the "Device Name" parameter is automatically transferred to the station name on the server. Therefore, if you need to rename a station on the server, just change the name tag in the parameters and the next time the station has a data session with the server, the name of the station on the server will automatically change.

Identification number

The value of this parameter serves as a station identifier on the server and is assigned by the server administrator. The *identification number* is stored together with the data in one data file and thus uniquely identifies the origin of the measured data. The parameter can take values in the range 1-65535.

Password to change parameters

Setting this parameter to a non-zero integer prevents further parameter changes without knowing the password. The password value can take values from zero to 9999. A value of zero disables the control and allows unlimited overwriting of the instrument parameters.

4.2.2. Time zone

Summer time

By checking the "*Automatic daylight saving time*" option, you allow the station to automatically adjust its internal functions during the time change, such as the regular sending of SMS messages. This way, an informative SMS message will be sent automatically at a fixed time throughout the year - for example, every Monday at 8:00 am.

The data will always be recorded in the station's memory according to standard time, regardless of the parameter selection. This is so that the time sequence of the measured values is not disturbed.

Start of the day

The setting of this parameter affects the calculation of daily leakage volumes, daily precipitation, etc. The parameter is used for example when loading data in an organization using shift operation, where the calculation needs to start with the start of a new shift (e.g. at 6:00).

4.2.3. Archiving

Basic archiving interval This parameter can be set from 1 minute to 1440 minutes (1 day) and determines the frequency with which the instrument will wake up and measure the set measurement channels. Typical current consumption of a switched on station without a GSM modem on with one 4 - 20 mA sensor is around 30 mA. Between measurements, the microprocessor and with it the whole station is put into a very low power consumption mode (20 uA).

Individual measurement channels can have their own "*Archiving Interval"* set differently, which must be a multiple of this basic recording interval. The average of as many measurements as the basic archiving interval fits within the archiving interval of the recording channel is then stored in memory.

The STELA-3 automatically sets the time of the first recording so that, regardless of the set archiving interval, the recording occurs at the full hour. If, for example, the "Archiving Interval" is set to 10 minutes and the station starts measuring at the 13th minute of the current hour, the first memory entry will take place at the 30th minute and regularly every 10 minutes thereafter. Thus, the station will not store data at the 23rd, 33rd, 43rd, etc. minute.

Fault and emergency conditions The name of this option implies its meaning. Checking it allows to store extraordinary and unexpected conditions in the event memory, which can be, for example, disconnection of the measuring sensor, error signal of the intelligent probe, etc.

Sent messages Checking this option allows you to store information about sent SMS messages in the data memory. In addition to the sending time, the text of the sent message and the recipient's phone number are also recorded.

Note: *The event memory is automatically loaded along with the reading of the data memory and its contents are stored in a file with the *.dte extension. The file name under the asterisk is the same as the measured data file name. When using the server for data acquisition, the event table is displayed last in the "GRAPH" section.*

Messages received Similar to the previous choice. The checkbox enables storing the exact time of SMS messages receipt into the event memory, including their text and the sender's identification (his/her phone number).

4.2.4. Power and diagnostics

Power supply Unap The STELA-3 is powered by a 3.6 V lithium battery. This voltage would be insufficient to power most of the probes and sensors in use, so the device includes a step-up DC/DC converter that produces a voltage of the desired magnitude from 6 V to 18 V at its output.

The "*Power Unap*" parameter allows you to set the optimal supply voltage according to the type of connected sensor. Setting the supply voltage too high leads to a shortened lifetime of the power supply battery. The optimum supply voltage size is 1 - 2 V higher than the minimum permissible supply voltage of the measuring sensor used (see table on page 19).

If several sensors with different minimum Unap voltage requirements are connected to the station, it is necessary to set the voltage according to the highest required value.

Measurement delay after switching on Unap Some sensors provide a valid measured value only after a certain period of time after the supply voltage is switched on. Examples include some ultrasonic or radar level sensors connected via a two-wire 4 - 20 mA signal. The typical rise time of these sensors ranges from 20 to 50 s, and although their use in conjunction with a STELA station is not optimal, they are often connected to these stations (river level monitoring).

The parameter value is adjustable from 0 to 125 s with a resolution of 0.5 s.

External Power Testing This parameter must remain unchecked for the STELA station. Checking this option assumes that the station is powered from the mains (or other voltage source) during normal operation, and therefore any power failure is recorded in the error log and event log.

4.2.5. Communication speeds and protocols

RS-232 **Serial interface for connection of STELA station to PC with MOST program**

The RS232 connection uses the FINET transfer protocol of the MOST program. The baud rate must be set to 19200 Bd.

4.3. Analog channel settings

Analog channels form the basic structure of the recording part of the STELA-3 station. Analog or pulse signals are measured, converted to the measured physical quantity and stored in memory in the selected units of measurement. Free channels can also be occupied by a value calculated from the values on the occupied channels (sum, difference and special functions). Each channel can have its own archiving interval and alarm limits.

By pressing the right mouse button over the selected channel, you can copy, paste or delete its parameters.

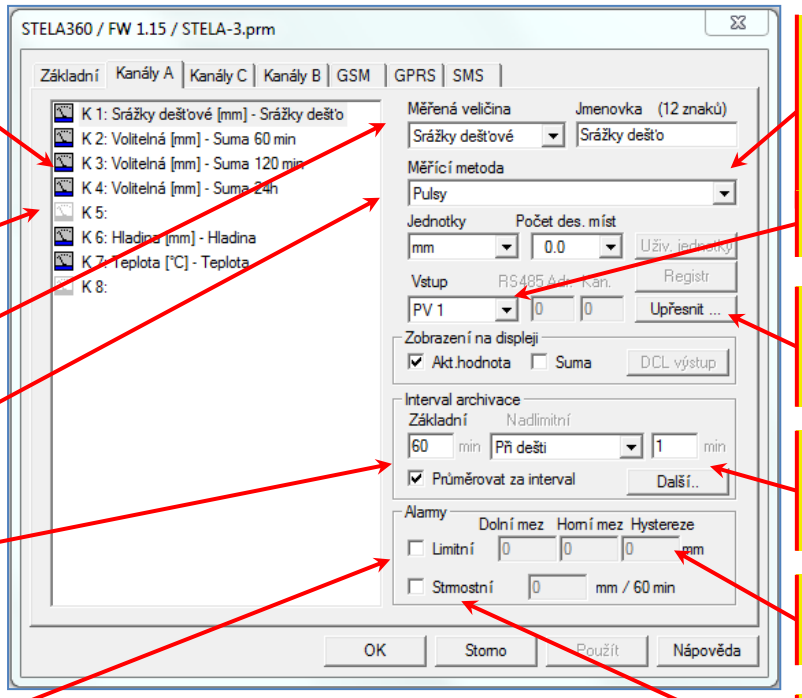
***Step 1 Setup**: select any free channel*

***Step 2:** Select the measured quantity*

***Step 3:** Select the measurement method*

Activation of alarms can trigger the sending of an SMS or change the basic archiving interval to an overlimit

A limit alarm occurs when the measured value exceeds the upper limit or falls below the lower limit.



The channel name will be displayed on the unit display and in the SMS (diacritics are automatically suppressed before sending the

The input does not have to match the

Other important parameters dependent on the measurand and the measurement met-

The overlimit interval will help to record interesting waveforms in detail.

Hysteresis prevents frequent switching on and off of the alarm.

The steepest alarm is activated on both rise and fall above the set speed.

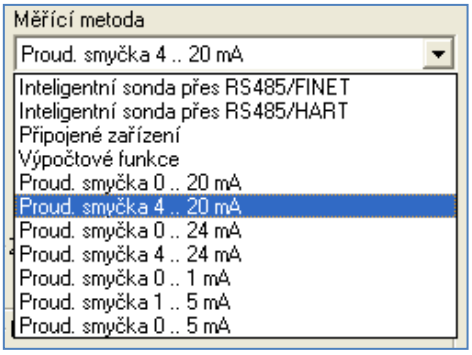
4.3.1. Setup procedure and basic parameters

Channel Each measurand occupies one channel in the station, whose parameters and memory space are fully available to this one measurand only. The user has the possibility to set a total of 8 analogue channels.

Do not confuse the channel with the input. A signal fed to one input can be processed and archived on multiple channels. Selecting the channel serial number is the first step in the setup.

Measured variable The selection of the measurand from the offered list must be the second step, because the list of offered measurement units and measurement methods depends on the selected measurand.

Measuring method In the list of measurement methods, you need to select the appropriate signal type of the connected probe. For example, when measuring the level in a VDJ with a submersible pressure transducer with a standard current output, select the method "**Current. Loop 4 - 20 mA**". When measuring flow with a propeller water meter using an OPTO or REED sensor, select the "**Pulse**" measurement method.



The measurement method called "**Calculation Functions**" has an important place in STELA-3. With its help, it is easy to monitor on a separate channel the continuously calculated moving sum or moving average for a configurable time interval and then activate the sending of a warning SMS according to this calculated value. It is usual that the archiving of this auxiliary channel is suppressed (see below). Other methods in the "Calculation functions" menu include, for example, the sum or difference of two channels.

RS485 Very often, measuring probes and sensors are connected to the telemetry station via the RS485 serial communication interface. With this method of communication between the station and the sensor, it is necessary to set the communication address of the sensor and the number of the internal measurement channel for the desired physical quantity (see overview table on the following page) in addition to the appropriate measurement method.

The measuring method "**Intelligent probe via RS485/HART**" is set for probes from BD Sensors s.r.o. , equipped with RS485 interface.

The measurement method "**Intelligent probe via RS485/FINET**" is set for FIEDLER probes and sensors equipped with RS485 interface.

Units Some quantities, such as pressure or flow, have a rich list of units in which the desired quantity can be measured, archived and displayed. Other quantities, such as rainfall or battery voltage, offer only one type of unit.

Number of decimal places An important parameter for determining the resolution of each monitored variable is the number of decimal places with which the measured variables are to be archived in the selected units of measurement. A higher number of decimal places is at the expense of the allowed range. An inappropriate choice of the number of decimal places may cause the maximum range to be exceeded, resulting in 'clipping' of out-of-range values.

The maximum possible magnitude that the measurand can take is 65535 for integers and it decreases decade by decade as the number of decimal places increases. Bipolar quantities such as temperature or voltage have half this maximum possible value. This "limitation" results from the 16-bit archiving of measured instantaneous values.

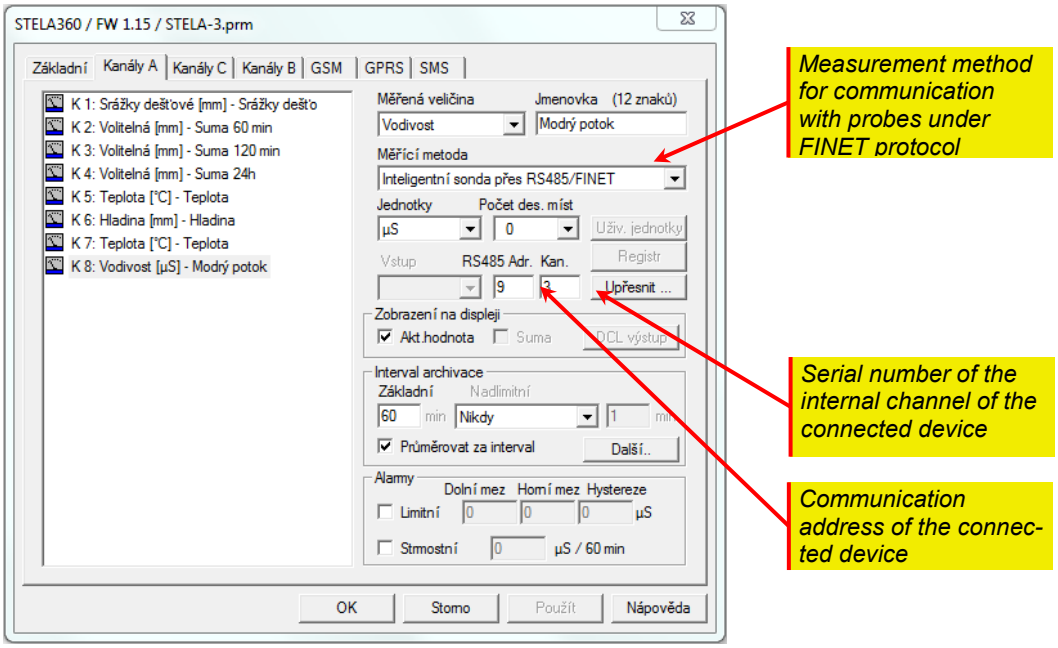
The relationship between the number of decimal places and the allowable range of the monitored variable can be seen in the following table.

Tab. 2: Maximum range of archived values

Number of dec	Resolution	Max. range of unipolar quantity	Max. range of bipolar quantity
0	1	0 ... 65535	-32767 to +32767
1	0,1	0,0 .. 6553,5	-3276.7 to +3276.7
2	0,01	0,00 .. 655,35	-327.67 to +327.67
3	0,001	0,000 .. 65,535	-32.767 to +32.767

Access This parameter determines which terminals (which input) will be used to connect the sensor. As mentioned, the STELA-3 station has two pulse inputs PV1 and PV2 and two current analog inputs AV1 and AV2.

RS485-address and channel setting If you select one of the measurement methods using the RS485 serial bus, MOST will require the "**Address**" and "**Channel" parameters to** be set instead of the "Input" parameter.



Addresses and measurement channels of sensors withRS485 output

Type Sensors	Address	Unap [V]	FINET	Modbus	Channel	Measured quantity	Resolu-tion	Units
METEO weather sig-nal converter	1	12	✓	✓	K1	Wind speed	0,01	m/s
					K2	Wind direction	10	°
					K3	Maximum wind *	0,01	m/s
					K4	Relative humidity - sensor 1	0,01	%
					K5	Air temperature - sensor 1	0,01	°C
					K6	Relative humidity - sensor 2	0,01	%
					K7	Air temperature - sensor 2	0,01	°C
					K8	Global radiation - sensor 1	0,1	W/m^2
					K9	Integrated radiation - sensor 1*	1	W/m^2
					K10	Global radiation - sensor 2	0,1	W/m^2
					K11	Integrated radiation - 2* sensor	1	W/m^2
TEP01	11	6	✓		K1	Air temperature, Pt100-A sensor	0,001	°C
TEP101	11	6	✓		K1	Water temperature, Pt100-A sensor	0,001	°C
TEP06	4	6	✓		K1-K6	Temp. on channel K, Pt100-A sensors	0,001	°C
PTZ04 transmitter for soil strain gauges	15	6	✓		K1-K4	Tensometric soil suction pressure	0,01	kPa
					K5-K8	Soil temperature	0,1	°C
					K9	Atmospheric air pressure	0,1	mbar
					K10	Air temperature	0,1	°C
US1200 **US4200**	5	12	✓		K1	Level (1200 mm from probe = 0)	1	mm
					K2	Air temperature	0,1	°C
ESP11 pH meter	6	12	✓		K1	Water temperature	0,1	°C
					K2	pH	0,01	pH
ESR11 redox meter	7	12	✓		K1	Water temperature	0,1	°C
					K2	Redox potential	0,1	mV
ESK11 oximeter	8	12	✓		K1	Water temperature	0,1	°C
					K2	Dissolved oxygen	0,01	mg/l
S423/C/OPT opt.oximeter	10	12		✓	K1	Water temperature [°C]	0,1	°C
					K2	Dissolved oxygen	0,01	mg/l
ESV11 conductivity sensor	9	8	✓		K1	Water temperature	0,1	°C
					K2	Conductivity linearly temp. comp.	1	µS/cm^2
					K3	Conductivity of non-linear comp. EN27888	1	µS/cm^2
					K4	Conductivity without temp. comp.	1	µS/cm^2
ATM01 **ATM11** Atmospheric pressure sen-sor departs.	10	6	✓		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
RVT01 **RVT11** **RVT13**	11	6	✓		K1	Relative humidity	0,1	%
					K2	Air temperature SHT (RVT01,RVT11)	0,1	°C
					K3	Pt100 air temperature (RVT11, RT13)	0,01	°C
TSH22 pressure le-vel sensor	14	6	✓		K1	Level	1	mm
					K2	Water temperature	0,1	°C
					K5	Level only at t> 0°C (from WF 1.05)	1	mm
PSH30 float hunger sensor.	15	6	✓		K1	Level	1	mm
					K3	Air temperature	0,1	°C

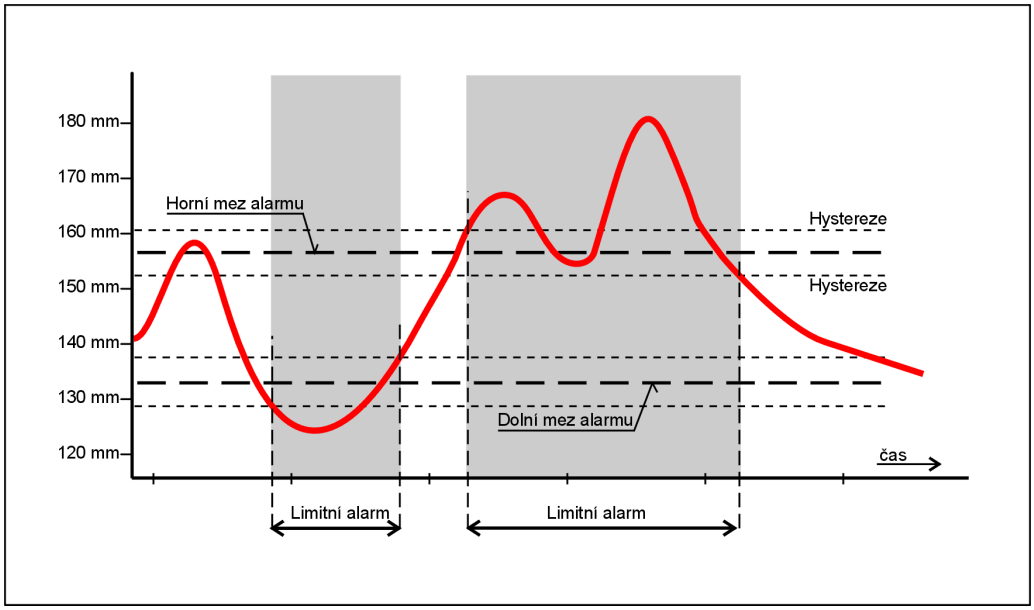
Type Sensors	Address	Unap [V]	FINET	Modbus	Channel	Measured variable	Resolu-tion	Units
RT-03 heating con-troller for rain gauge SR03/V	16	6	✓		K1	Temp. of the lower section gauge	0,1	°C
					K2	Surface temp.of the upper section	0,1	°C
					K3	Reserve – temp. of external temp.	0,1	°C
					K4	External power supply voltage size	0,1	V

**channels are functional only when the transmitter is powered continuously*

Unap ... the required minimum supply voltage of the sensor.

ALARMS

The STELA-3 allows you to set the limit and steep alarm parameters for each channel. After activating the alarm, it is possible, for example, to record measured values more frequently (even on other channels) and send warning SMS or change the interval for sending data to the server.



Limit alarms and their parameters

Limit alarm 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 only be switched off again after the instantaneous value has returned to the permissible range narrowed on both sides by the value of the *Hysteresis* parameter. These relationships are illustrated in the previous figure.

To remember: A value within the limits is OK, an alarm occurs when the limits are exceeded by a hysteresis.

Steep alarm The steep alarm requires the input of a single parameter. This parameter is called the *Steepness Limit* and its value indicates the maximum allowable change in the monitored variable over the archiving interval. If this parameter is exceeded, either by an increase or decrease in the monitored variable, in a time less than or equal to the set archiving interval, a *Steep Alarm* will be activated on the channel.

4.3.2. Archiving

Each recording channel of the instrument has its own **Archiving Interval**, adjustable in multiples of the **Basic Archiving Interval** (it is located in the 1st tab of the parameters "Basic parameters" and is usually set to 10 min). Less important quantities can therefore be recorded at a longer interval (e.g. 1 h) and thus save both the data memory of the STELA-3 station and the time required for transferring the measured data to the server.

Note: Because the Archiving Intervals are stored in the instrument parameters as multiples of the Base Archiving Interval, a change to this Base Interval will be reflected in all Archiving Intervals for each recording channel.

Archiving suppression

A zero value of the "Archiving interval" parameter will exclude the set channel from archiving. This can be preferably used for those channels that are to be used only for activating SMS alerts.

SETTING THE NUMBER OF MEASUREMENTS

The number of samples from which the final value for archiving will be calculated using the weighted average method can be set by combining the *Basic Archiving Interval* and the *Archiving Interval* for each recording channel.

Averaged value storage

The STELA-3 station performs one measurement on all set channels at the interval specified by the *Basic archiving interval* parameter. If this parameter is the same as the Archiving Interval of the measuring channel, this one measured value is stored in memory at the end of the archiving interval. However, if the *Basic Archiving Interval* is set to e.g. 10 min and the *Archiving Interval of* the measuring channel to 30 min, the average value calculated from 3 measured samples is stored in the memory of the instrument every 30th minute.

The parameter settings can be seen from the following examples of settings:

Example A: Storing the current value measured at the end of every 30th minute

Basic archiving interval = 30 min

Archiving interval = 30 min

Example B: Store the average value of 6 measurements every 60th minute.

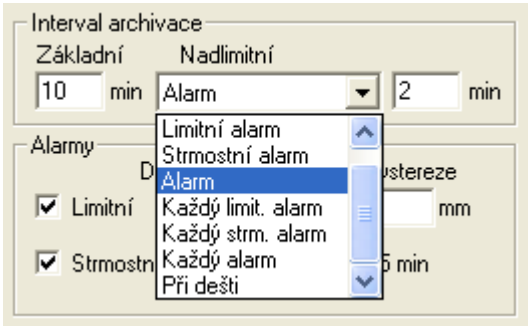
Basic archiving interval = 10 min

Archiving interval = 60 min

Note: Reducing the "Basic Archiving Interval" parameter below 10 minutes results in a faster discharge of the power supply battery, so set this parameter value judiciously. This note becomes less important when using an external power supply.

OVERLIMIT ARCHIVING INTERVAL

The figure shows the triggering conditions for the over-limit archiving interval. Setting it allows you to record in detail the progress of the incident on the measurement channel.



The overlimit interval (2 minutes in the example in the picture) can be triggered not only by activating an alarm on the channel itself (in the picture), but also by an alarm on another set channel (conditions "Every ..."), or by the start of rain and then, for example, to record minute-by-minute rainfall, and thus actually capture the intensity of rainfall during one rain.

Suppressing the recording of unimportant data

Appropriate setting of the archiving parameters allows, for example, to suppress the recording of uninteresting low values of the measured variable and to store only values that exceed the set limit.

Example 1: When measuring temperature, only store values greater than 30 ºC.

Basic archiving interval = 10 minutes (in the basic parameters window)
Archiving interval = 0 (in the channel window)
Limit alarm set (Lower limit = 0, Upper limit = 28, Hysteresis = 2)
Over limit trigger condition: limit alarm
Archiving interval overlimit value = 2 minutes

Example 2: When measuring the level, record detailed values greater than 160 mm .

Basic archiving interval = 1 min (in the basic parameters window)
Archiving interval = 5 min (in the channel window)
Limit alarm set (Lower limit = 0, Upper limit = 155, Hysteresis = 5)
Over limit trigger condition: limit alarm
Archiving interval overlimit value = 1 min

The overlimit interval is specified in minutes and cannot be greater than the value of the base Archiving Interval.

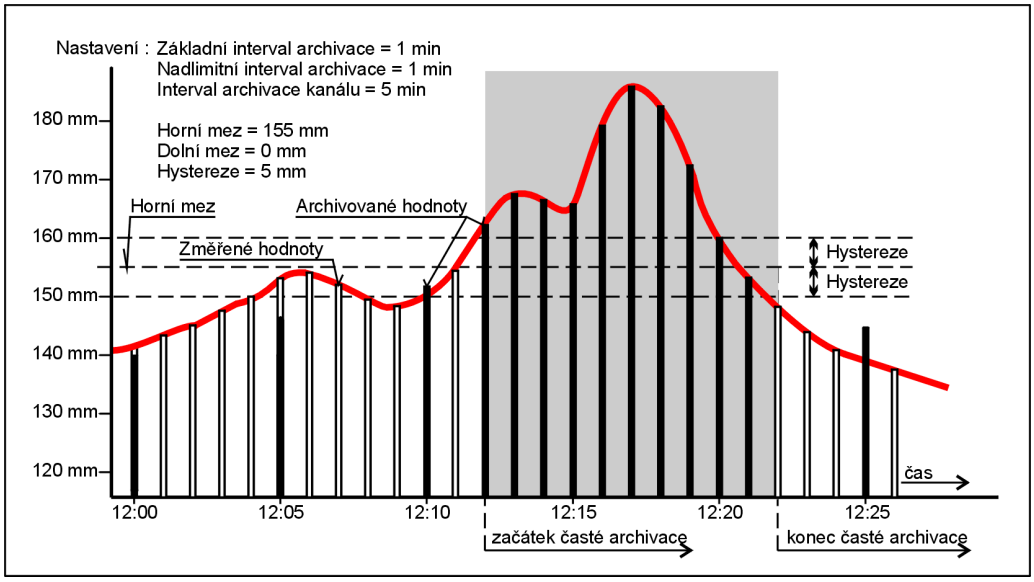


Fig. 1Detailed record of the measurand using the Over-Limit Archiving Interval.

Note: The trigger condition for going to the "Over Limit Interval" archiving of a given channel can be a Limit or Gradient alarm on the channel itself, or a Limit or Gradient alarm on any other channel. A special trigger condition for the "Over Limit Interval" may also be the start of rain (first flip of the boat rain gauge).

4.3.3. Advanced parameters

An important step in setting up a recording channel is to call up a window with advanced parameters. The shape of this window and the type of parameters it contains depends on the selected measurand. For example, there is a different window for setting the flow measurement in an open profile and another, much simpler window for measuring temperature.

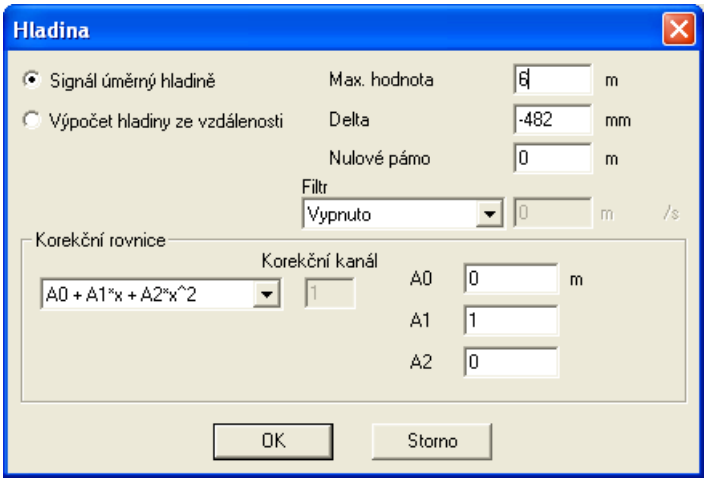
The setting of the refinement parameters for some measured variables will be explained by examples.

EXAMPLE 1.: MEASURING THE LEVEL

Most commonly, the level is measured with a pressure dipping probe or an ultrasonic probe placed above the maximum level.

Output signals The output signal of the probes is either a 4 - 20 mA current output (0 - 20 mA, 1 - 5 mA) or an RS485 serial interface. Depending on the type of output signal, select the "Measurement method" parameter and set the Input number or address for RS485 communication.

After pressing the "Advanced" button, a window opens with parameters that define the measuring range, zero offset and possible correction coefficients for calculating the level.



Signal proportional to level Use the first option "Signal proportional to level" for most probes. You only need to set the level vs. distance calculation for older US1000 ultrasonic probes, which sent the distance of the level from the probe instead of the level.

Max. value This parameter is set for probes with current output, where the parameter value corresponds to the maximum possible measuring range of the probe. Therefore, for a pressure probe with a measuring range of 0 to 6 m of water column (corresponding to an output current of 4 to 20 mA), set the parameter Max. value = 6 m.

The Max. value parameter is not set for ultrasonic probes type US1200, which send the already measured level directly in mm.

Delta This parameter can be used to scroll the zero level value. The additive coefficient A_0 of the correction equation has the same meaning.

Zero band The value of the parameter determines in set units the insensitivity band in which the signal will be artificially zeroed. In this way, various signal noises in the vicinity of the zero value are filtered out.

Correction equation Finally, the measured value can be adjusted by a 2nd order polynomial. This option is retained for all measured quantities except flow and volume, where the individual parameters A_0 to A_2 take on different meanings.

Filter parameters

Blackout on The value of this parameter determines the maximum possible change of the measured quantity in one second. A small value actually means a large dimming of the signal and vice versa. A zero parameter disables signal damping.

Error when changing o If the measured value changes by the set limit value, the measured value will not be stored in the memory, but the corresponding error code will be stored.

EXAMPLE 2: FLOW CALCULATION

The setup window for flow measurement is similar to the one described in the previous chapter, so only new parameters or parameters that have a different meaning will be described here.

Signal proportional to flow rate

This option must be selected, for example, when processing a signal from an inductive flowmeter. The parameter "Max. value" must correspond to the maximum range of the flowmeter.

When measuring flow in open channels with a built-in gauge profile, the known relationship between the level in the gauge profile and the instantaneous flow is used.

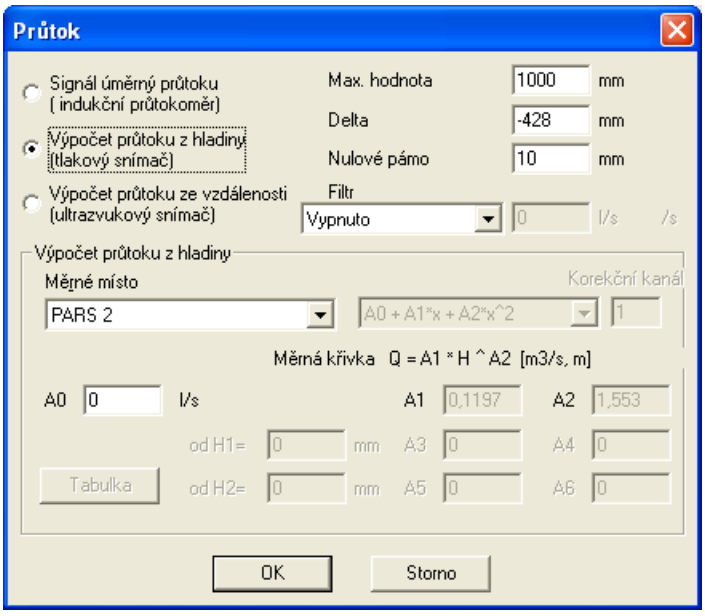
Calculation of the flow rate from the surface

Pressure probes and most ultrasonic probes have an output signal proportional to the level, so the "Calculate flow from level" option must be selected for measurement, not only for pressure submersible level transducers, but also when installing a US1200 ultrasonic transducer or when installing a MICROFLEX ultrasonic probe.

In contrast to the level measurement described in the previous window, the Delta parameter can no longer be replaced by the additive coefficient A0, as this is entered in the set flow rate units, whereas the Delta parameter is always intended for zero level offset.

Measuring point

The list of measuring points shows the 14 most frequently occurring profiles for measuring instantaneous flow in an open channel with predefined coefficients of the consumption equation (basic series of Parshall and Venturi flumes, Thomson overflow, composite double and triple Parshall flumes).



This menu is supplemented by the possibility of custom setting of the coefficients of the consumption equation A0 to A2 (optional profile) and the tabular input of the dependence between level and flow rate.

The consumption equation is most often of the form :

Flow = A_1 * Level^{A2} [m^3 /s, m]

If necessary, it can be supplemented with the additive coefficient A_0 . In the case of more complex composite gutters, additional auxiliary coefficients A3 to A6 and the heights of the built-in gutters H1 and H2 are added to the above coefficients (see figure on this page).

Table

There can be two tables (for two different measuring channels) and they are used to record the tabular relationship between the level height [mm] and the value of instantaneous flow [l/s]. Table 1 has 30 rows and Table 2 has 20 rows.

Only integers in the range from 0 to 65535 can be written to the tables. If the flow rate with a resolution of e.g. 2 decimal places is to be stored in the table, then the flow rate 100 times greater without the decimal point is entered in the individual rows of the table and the value 0.01 is set in the multiplicative coefficient A1 of the correction equation. This will retroactively reduce the calculated flow back 100 times to the correct value.

The first row of the table should always start with zero values.

EXAMPLE 3: RAINFALL MEASUREMENT - WARNING SYSTEM

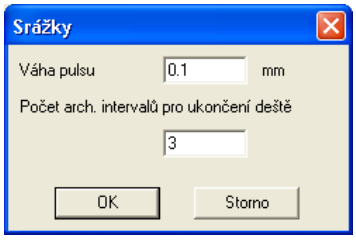
The STELA station programmatically supports the connection of a rain gauge (e.g. SR02 or SR03 rain gauges). The rain gauge can be connected to the pulse input PV1 or PV2.

When setting the parameters of the channel recording the collisions (or even another channel reading the occasionally arriving pulses), the user has a choice between two recording options - to record the number of pulses in the archiving interval or the time of each pulse. The choice of variant is made by selecting the measurement method (Pulses or Pulse Time). It is also possible to record the pulse times on one channel and the number of pulses per archiving interval (usually 1 minute) on the other channel. In this case, however, it is necessary to connect in parallel the two pulse inputs to which the rain gauge is connected and to allocate one of the inputs set in the channel parameter window to each method.

Option to record each pulse

The exact flip time of the rain gauge measuring cell with a resolution of seconds is recorded on the channel with the measurement method set to "Pulse Time". The MOST program can read data from a recording channel set in this way and save it in a table and in a data file.

Fixed interval variant



The second, more common variant records at the end of the archiving interval the amount of measured rainfall in mm that fell during this interval (the calculation of rainfall in mm is done automatically in the station as a multiple of the number of pulses and the weight of one pulse in mm). As the intensity of the rain is also of interest, the unit automatically switches to a compressed recording with minute data storage after the first pulse and this continues until the rain stops (a set number of minute intervals without pulse terminates the rain).

When setting up this method of recording rainfall, select the measurement method "Pulses" and change the trigger condition for the overlimit archiving interval from "Never" to "When it rains". Set the overlimit interval to 1 minute. Then set the parameter "Pulse weight" in the advanced menu according to the type of rain gauge used.

The parameter "Pulse weight" depends on the type of connected rain gauge. A well set up SR02 rain gauge with a collection area of 200 cm^2 has a pulse weight calibrated by the manufacturer to 0.2 mm/pulse, SR01 and SR03 rain gauges have a pulse weight of half that, i.e. 0.1 mm/pulse, and are therefore more suitable for accurate measurements of even very low rainfall totals.

Note: *Any boat rain gauge can be individually calibrated - to determine its actual pulse weight - and set to the station. The calibration can be done in various ways, the simplest method is to drip a pre-measured amount of water through the rain gauge, for example through a small hole in a plastic bottle (remembering the second air hole) and then calculate the pulse weight from the measured number of pulses, the volume of water and the area of the rain gauge.*

Pulse weight [mm/pulse] =10 * water volume [ml] / (number of pulses * precipitationarea [cm^2]).

Example: *750 ml of water flowed through the SR03 rain gauge with a 500 cm area^2 and the unit read 147 pulses. After being inserted into the sample:*

*Weight pulse = 10 * 750 / (147 * 500) = 0.102 mm/pulse*

Number of archiving intervals for rain termination

The long name of this parameter describes its meaning. If no pulse occurs during the set number of truncated archiving intervals, the rain will be declared complete. The end of the rain must be set to determine the start of the next rain and to allow the unit to return to the base archiving interval. From the start of each rain (first pulse), STELA automatically calculates the amount of rainfall in mm into a sum called "SS" and if the preset limit is reached, the station can send a warning SMS.

More warning SMS

Sending a warning message regarding rainfall (but also, for example, the number of pulses of the propeller flow meters) can also occur when other reasons are reached:

1. *The precipitation size in the current archiving interval exceeds the set limit [mm].*
2. *The running total of rainfall continuously calculated for the last X minutes exceeds the set level [mm].*

EXAMPLE 4: CALCULATING THE FLOW RATE FROM THE PULSES FROM THE WATER METER

In practice, the flow rate is very often measured with propeller flow meters equipped with speed sensors. 2 such sensors can be connected to the STELA station.

REED and OPTO speed sensors

A REED or OPTO type sensor with an open collector can be connected to the pulse inputs PV1 or PV2.

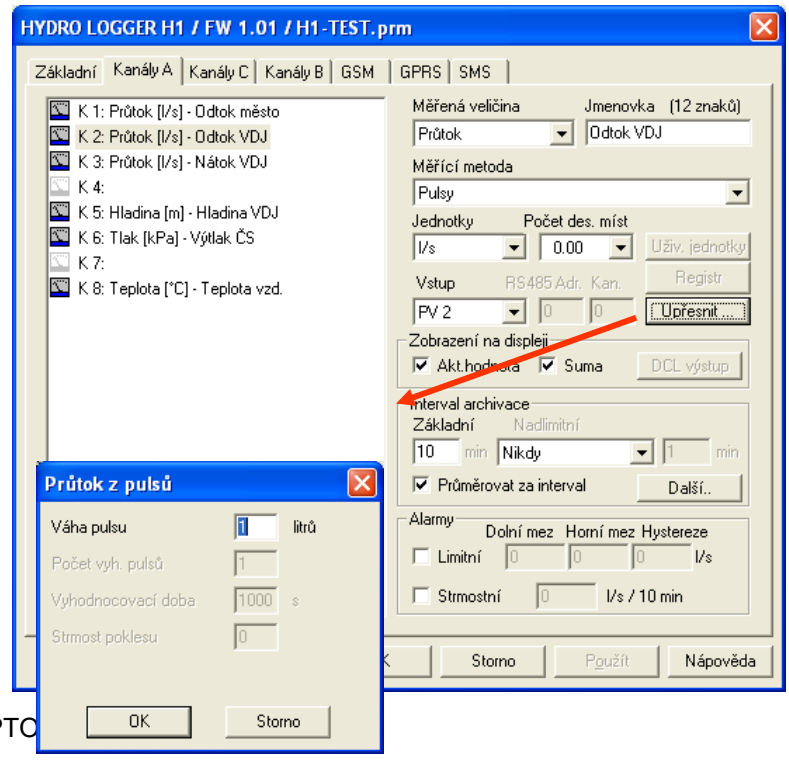
For OPTO sensors it is necessary to ensure that the output has an open collector or potential-free contact - all PV inputs of the station are activated by connecting the input to ground (GND).

Calculation of instantaneous flow rate

The STELA station can continuously calculate the instantaneous flow rate from the frequency of pulses and their weight in litres and send the value, for example, regularly in the form of an informative SMS message. However, only the number of pulses per archiving interval multiplied by their weight is always stored in the unit's memory under the set channel, because the calculation of the instantaneous flow rate is burdened with a certain error due to the calculation of the flow rate from irregularly arriving pulses. To optimize this calculation for different sensor types and a wide range of measured flow rates, the following parameters need to be set.

Settings

First select the free channel, then the measured quantity (flow), the measuring method (pulses) and the units of measurement (l/s). The number of decimal places is selectable, as is the channel name. As an example, the parameter side window can be used.



After selecting refine, MOST prompts you to enter another parameter:

Pulse weight

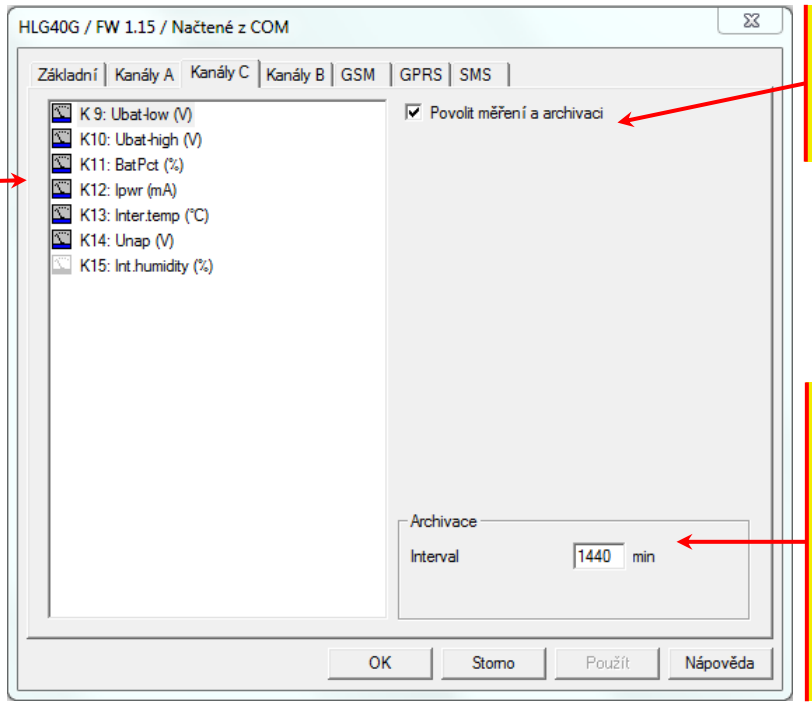
The value of one pulse in liters. Typical pulse value for REED sensors is 100 l (10 l) and for OPTO (2 l, 4 l, 10 l).

4.4. Control channels

The STELA-3 station contains 7 control channels K9 to K15, which monitor the operating parameters of the instrument such as the capacity of the power battery, temperature and humidity inside the instrument, the size of the external supply voltage or the current consumption of the connected sensors and probes.

Fixed preset control channels. Any control channel can be switched off or enable for measurement and archiving.

To select a channel, click the left mouse button above the channel.



Check this option to enable measurement and archiving of the selected control C-channel.

The archiving interval is common for all control C-channels. Do not set the value of this parameter to a shorter interval than 60 min to avoid unnecessarily increasing the amount of data transmitted and archived.

The user has the option to enable/disable the selected control channel and set a common archiving interval. Usually this interval is set to a value higher than 60 min (most often 1440 min - 1x per day), so that the volume of transmitted and archived data does not increase excessively.

List of control C-channels

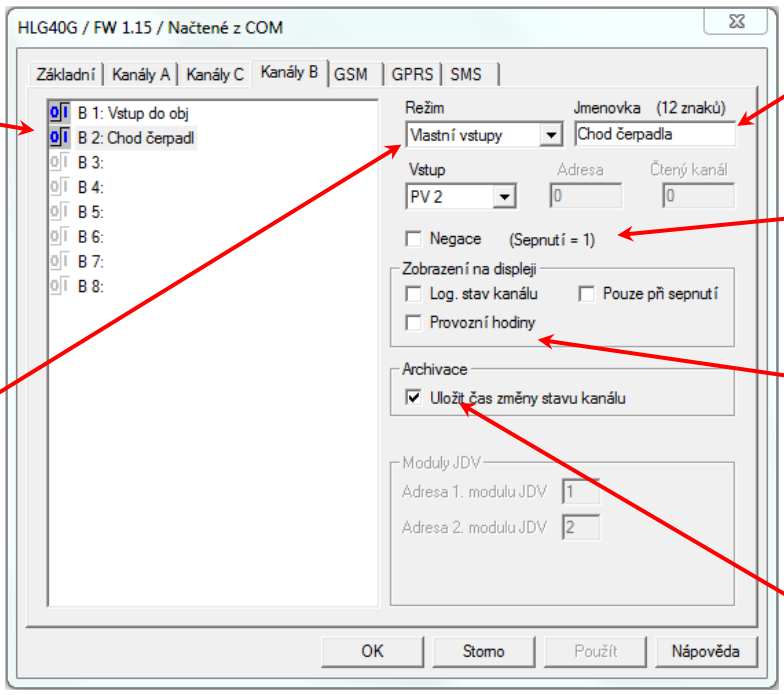
Channel	Measured quantity
K9. Ubat-low [V]	Voltage loaded on the lithium battery supply (I= 100 mA). Measurements are taken at 24 h intervals or at the end of each data session to the server.
K10. Ubat-high [V]	Unloaded lithium battery supply voltage (I = 5 mA). Measurements are taken at 24 h intervals or after each data session to the server.
K11. BatPct [%]	Capacity of the power supply battery calculated by sequential integration of the current drawn from the battery
K12. Ipwr [mA]	The amount of current drawn from the Unap power terminal. Analog sensors with 4 - 20 mA output or probes communicating via RS485 serial interface are connected to this terminal. The power supply to external sensors and probes is only momentary for the duration of the measurement of the monitored quantities.
K13. Inter.temp [°C]	Temperature inside the device
K14. Unap [V]	Unap terminal voltage size The size of this supply voltage is user adjustable from 6 to 15 V DC.
K15. Int.humidity [%]	Relative humidity inside the instrument An increase above 80% indicates a leak in the instrument and can lead to damage to the electronic circuitry in the long term. An RH sensor is not standard with the instrument.

The most important for the user is the K11 control channel, which shows the remaining capacity of the power battery. The other control channels are mainly important for servicing and self-diagnosis of the correct function and optimum setting of the instrument.

4.5. Binary channel settings

The STELA station has the ability to record the status of its binary inputs in eight binary channels B1 to B8. As standard, the STELA-3 station is equipped with two binary inputs PV1 and PV2, therefore binary channels B3 to B8 are not used. Both switching on and off of a potential-free contact or open-collector output of a connected sensor can be recorded.

The change of state of the binary channel is stored in the memory with a resolution of 1s.



By pressing the right mouse button over the selected channel, you can copy, paste or delete its parameters.

You have a choice of options:

***Own inputs** (PV1 and PV2)*

*Binary channel states of the connected device **read from the device***

The channel name will be displayed in the SMS (diacritics are automatically suppressed before sending the SMS).

You can change the stored variable from ON to OFF when the input is switched on.

The operating hours (switch-on time) with resolution to minutes are transferred to the database on the server.

This option sets the date and time to be stored in the instrument's memory whenever the binary value of the input changes. Do not set for channels that

Channel nameplate The parameter has the same meaning as for analogue channels, i.e. it appears in the text of the SMS message and is transferred together with the measured values to the PC and the server for further processing.

Mode This parameter specifies the type of binary input. The STELA station parameters distinguish between "Custom inputs" and "Read from instrument" inputs.

Custom inputs The "Custom Inputs" mode allows you to select a binary input in the following "Input" parameter to which the monitored signal is connected (monitoring of the building entrance, float switch status, motor operation, pump fault, etc.). The STELA-3 has 2 binary inputs PV1 and PV2 as standard, which are connected to the terminals in the connection box.

Read from the device Intelligent measuring probes connected to the STELA-3 station via RS485 serial interface can transmit not only instantaneous states of the measured quantity (level, flow, leaked volume, etc.) but also binary fault and status values to the instrument. This status information is usually stored in the connected probe on the channels corresponding to the value of the parameter "Read channel". Therefore, in "Read from instrument" mode, the corresponding internal channel (parameter "Read channel") must always be set in addition to the communication address of the connected probe (parameter "Address").

Negation The binary input is inactive in the normal state. When the input is connected to a ground terminal (relay contact, open collector), the input is activated and a logic one is recorded in memory along with the time and date of the switching. When the pulse ends and the input returns to its normal state, a logic zero is stored in memory. In some cases, it may be 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" check box is available.

Save channel state change time This option must be enabled if state changes on binary channels are to be recorded in the data memory. Disconnecting or disconnecting a contact, breaking the security of the object and other reasons leading to a change in the state of one of the binary inputs will be recorded in the station memory immediately after the event occurs, including the date and time with a resolution of seconds. The *Basic Archiving Interval* parameter does not apply to binary channels.

4.6. GSM parameters

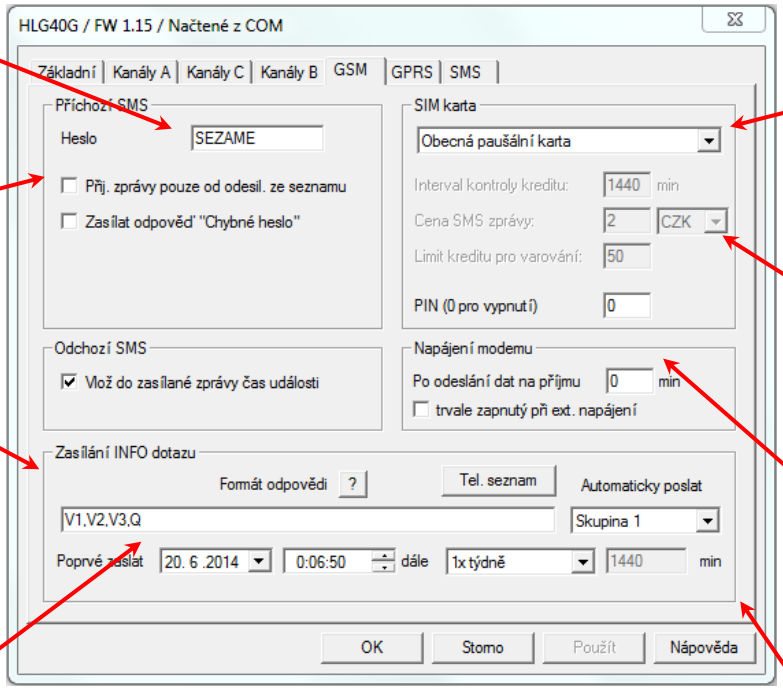
This tab contains parameters related to SMS communication, including access to SMS phonebook settings.

Password for query SMS (made from query codes)

Check if you want the communicator to reply only to users listed in the phone book.

A command line according to which the unit composes an SMS message and sends it to the number from which the INFO request was sent. Do not set more than 6 - 8 commands as the SMS length is limited

You can set the time and day of the week you wish to receive informative SMS.



Depending on the SIM card you are using, select the operator and card type from the list. This option is used to periodically check the credit amount of the prepaid SIM card

Advanced credit check parameters

After sending the data to the server, the GSM module of the device can remain logged in for a short period of time in case of a data call or in case of receiving and sending SMS messages.

Access to a user-modifiable phone book

SIM card type

Recently, the formerly widely used prepaid credit SIM cards have taken a back seat and the use of flat-rate SIM cards, which usually include a certain amount of free data, has become more widespread.

For this reason, and also because the information about the remaining credit on the prepaid SIM provided by the operator often changed in the form and structure of the informative SMS, the device's FW stopped supporting the automatic calculation of the remaining credit on the prepaid SIM card. Therefore, if the user selects an option other than "General flat rate card" in the device parameters for the SIM card type, the calculated remaining credit will most likely not correspond to the reality.

The other GSM communication parameters can be left in the basic settings except for the command line for setting the content of the periodic or informative SMS. This command line should be set according to the actual channel occupancy and the requirements of the station operator. The list of codes used in the command line is given in the table on page 41.

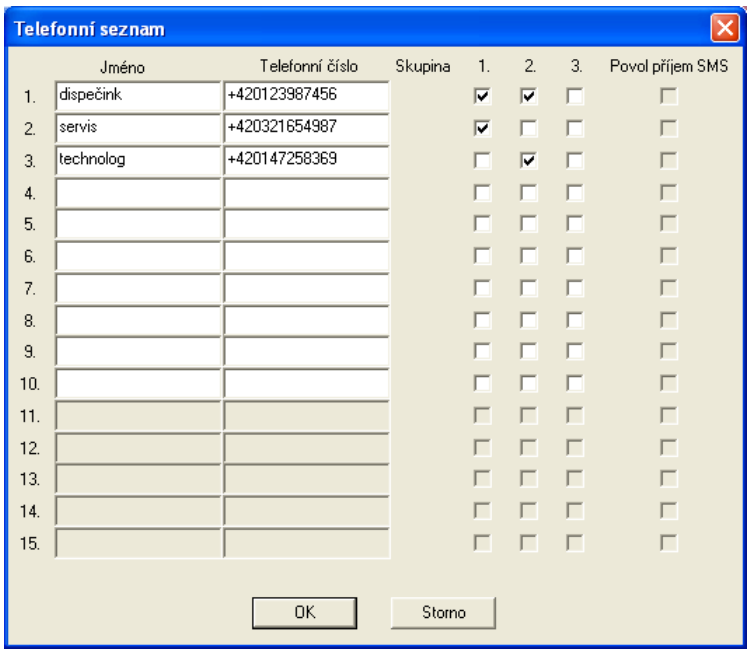
Note: Stela-3 will also respond to incoming SMS containing individual codes separated by commas after the password.

The importance of other parameters will be explained in the chapter "SMS communication".

4.7. SMS communication

4.7.1. List of authorised persons

The basic settings of the GSM parameters include the creation of a list of persons to whose mobile phones warning or informative messages should be sent. The window with the phone list opens after pressing the "**Phone list**" button in the "GSM" parameters tab.



Group You can direct the sending of a specific message to a group of people, who will be sent the message sequentially according to the order in the list. You can create up to 3 groups of people in the list.

4.8. SMS distribution

This chapter will describe the setting parameters and SMS types that can be divided into basic categories:

SMS sent from the station	SMS received at the station
Informative SMS	**Inquiry SMS**
Warning SMS	
Control SMS	**Control SMS**

Informative and query SMS messages have a common group of codes that determine the content of the information transmitted from the device to its operator or, conversely, the command to compose an informative SMS on the device side and send it to the interviewer.

The sent control SMS can directly control the relay in the addressed opposite station. A received control SMS, on the other hand, causes the specified command to be executed. Warning SMS messages are dealt with in a separate chapter 4.9. on p. 43.

4.8.1. Informative SMS

In this text, we will refer to informative SMS as those messages that will be automatically sent from the communicator to a group of persons or an individual on request or at a regular time, independently of the actual value of the measured variable (as opposed to warning SMS, which are activated by reaching a set limit, a fault, an alarm, etc.).

INFORMATIVE SMS SENT REGULARLY

To activate the regular sending of informative SMS messages, select the recipient in the parameters window called "Automatically send". This drop-down parameter will offer all preset recipients from the phonebook, including groups.

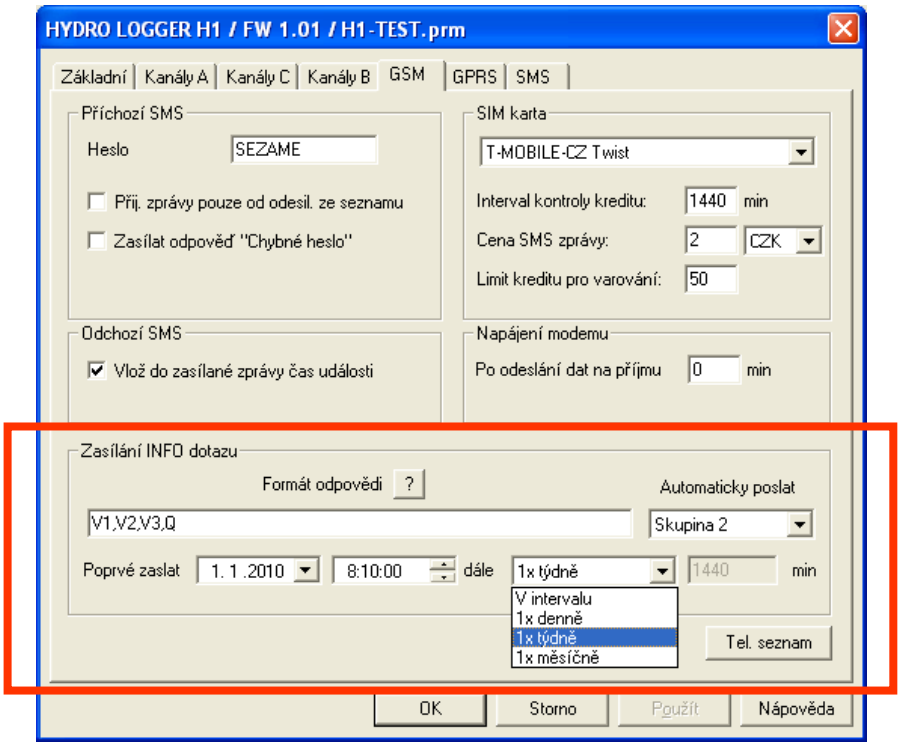
Regular sending

In the "First time send" setting window on the "GSM" tab, the time when the informative SMS message is to be sent is set. The "further" parameter determines the frequency of the message to be sent. It is possible to set monthly, weekly, daily sending or to specify any interval adjustable in minutes. In case of weekly and monthly sending, it is necessary to set the day of the week (month) when the sending should be done regularly.

From the point of view of power saving of the power battery it is advantageous to set the same time for GPRS communication and for regular sending of informative SMS, because in this way only one login of the STELA-3 station to the GSM network takes place.

Creating an informative SMS

The content of the informative SMS is determined by the sequence of codes on the control line. The meaning of the individual codes and their overview is on the next page. The individual codes are separated by a comma, no spaces, no comma or full stop at the end:



4.8.2. Inquiry SMS

The second large group of informative messages consists of replies to incoming SMS inquiry messages. Depending on what query codes the query SMS contains (see list on the next page), the station will compose the text of the reply and send it to the interviewer immediately. The same rules apply for the composition of the query SMS as for the informative SMS.

Warning:

Inquiry SMS are received only after the device is logged into the GSM network, and therefore the response to the inquiry SMS may be significantly delayed. For the STELA-3 station, it is assumed that the modem is switched on and data is sent to the server at an interval of once a day.

Password:

To prevent unauthorized persons from making queries, a password must be included at the beginning of the query SMS. This password is accessible to the user in the "GSM" tab.

INFO query

A specific query SMS consists of a short message containing only one word "INFO". This can be written in lower case and must not be preceded by a PASSWORD. The device responds to the received INFO query with a message composed according to the codes contained in the control line.

LIST OF QUERY AND CONTROL CODES

The STELA-3 station does not distinguish between upper and lower case

Inquiry code Control command

COMMANDS (Query codes can be separated by comma in one SMS query)

Bk	Current value of the binary channel *k* (1..8)
MHk	Binary channel motor hours *k* (1..8)
Vk	Current channel value *k* (1.. 8)
Sik	Sum from channel installation *to* (1.. 8)
SDk	Sum from the beginning of the day channel *to* (1.. 8)
SMk	Sum from the beginning of the month of the channel *to* (1.. 8)
SLk	Sum for the last completed day of the channel *to* (1.. 8)
SKk	Amount for the last completed month of the channel *to* (1.. 8)
SS	Sum of rainfall since the start of the rain (only for the first rainfall channel)
LVk	Last stored channel value *k* (1-8)
Every	Minimum value of today's channel *k* (1.. 8)
Xk	Maximum value of today's channel *k* (1.. 8)
Ilk	Minimum value of the previous day's channel *k* (1.. 8)
XLk	Maximum value of the previous day's channel *k* (1.. 8)
PO	Total number of messages sent
PP	Total number of messages received
Q	GSM signal intensity in the range 0..31
KR	Remaining prepaid card credit amount
NA	*(No Answer)* Do not reply to receive a control SMS

** A different password can be set for control commands from the password for obtaining information from the unit.*

EXAMPLE OF QUERY SMS

Inquiry *SMS*

PASSWORD,V3,SD3,V4,U

PASSWORD ... access code
V3 ... query for the current value of the 3rd channel (flow rate)
V2 ... query for the current value of the 2nd channel (level)
SD3 ... query for daily sum (leaked amount) on channel 3
U ... query for the battery voltage magnitude

Answer: (Informative SMS)

NAME, V1=51.12 l/s, SD3=4255.8 m3, V2=1259 mm, U=12.62 V

NAME ... station name tag (configurable parameter)

Time of dispatch The station name can be followed by the date and the current time of the unit as information about the time of transmission of the message from the unit to the operator's network. In this case it is necessary to have the option "Insert event time in the sent message" checked in the "GSM" parameters page.

4.8.3. Special characters inserted in SMS text

When setting the parameters of SMS messages from the MOST program, it is possible to place special characters in the text of the warning SMS, which the control processor either transforms into another character string or does not send the SMS and instead performs an "alarm data sending to the server".

Special characters in SMS text

#V	**The current** value, including the units of measure , is inserted into the text of the sent SMS.
#G	The station performs an "Alarm data upload to the server". Based on the emergency data sent, for example, warning or informative emails can be sent from the server. The setting of the emails is described in the manual "Web browser control".

4.8.4. Control SMS incoming

The STELA-3 station does not contain any relays, therefore, unlike the M4016-G3 unit, the number of control SMS is severely limited. In fact, it is only a command to immediately send the measured data to a server on the Internet.

This command is usually used to immediately rebuild parameters according to a new parameter file on the server.

HESLO,DIAL0	After receiving this command, the measured data is immediately transferred to the server via the GPRS network and, if necessary, a new parameter file is downloaded from the server to the device (no waiting for a regular data session).

Security The stations have built-in two-level security against misuse of control commands by an unauthorized person.

Password: The first level of protection consists in the presence of a HESLA, which must be used to start every command message. The password can be any sequence of up to 12 characters, separated from subsequent commands by a comma.

Security Another configurable condition for executing the command is that the phone number from which the control message was received is present in the list of stations with SMS reception enabled (if the option "Receive messages only from senders in the list" is set in the basic GSM parameters window). **In this case, the phone number must also be listed with the country identification, i.e. for the Czech Republic with the prefix +420.**

Response suppression The station responds to command SMS messages with a confirmation SMS message that the command has been received and is understandable. If this confirmation SMS is not to be sent, the special command NA (No Answer) must be included anywhere in the text of the control SMS.

EXAMPLE CONTROL SMS

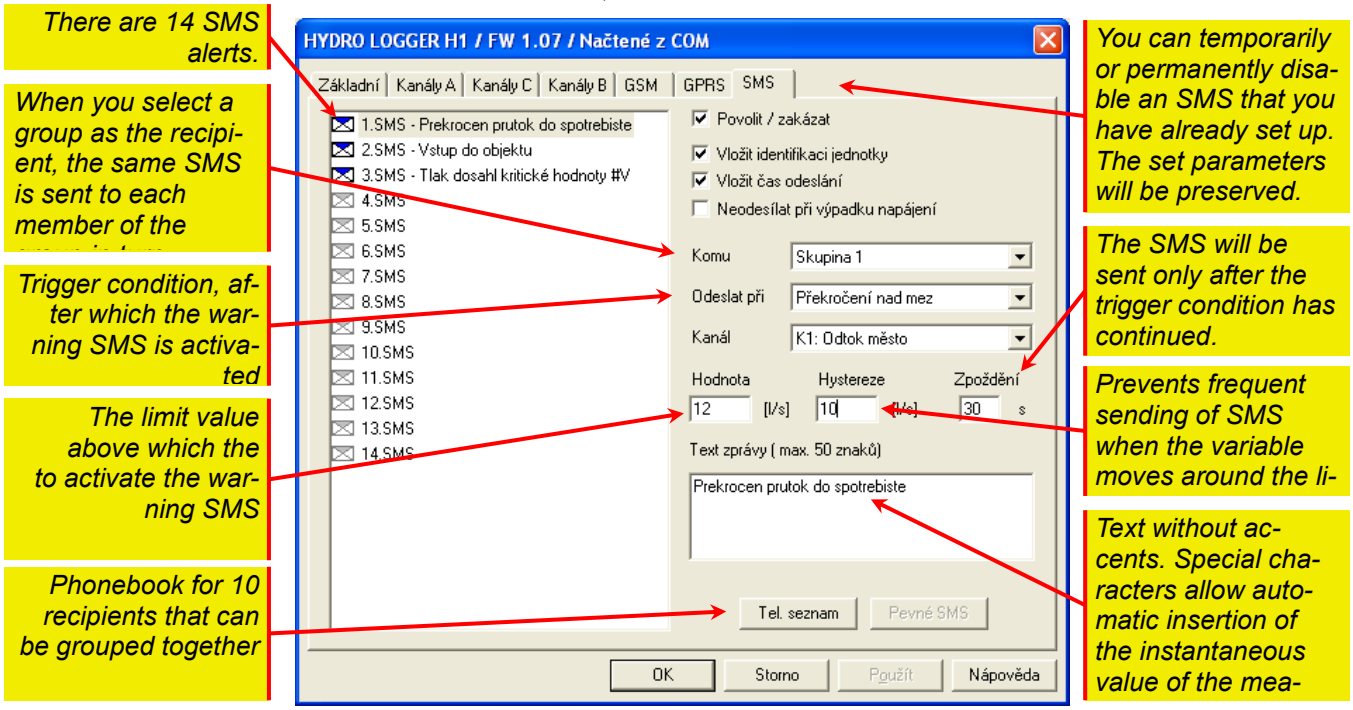
Control SMS:

HESLO,DIAL0

PASSWORD ... access code (enter the actual password set on the device)
DIAL0 .. . the procedure for immediate sending of data to the server is activated

4.9. Warning and control SMS

Automatic sending of a preset warning or control SMS can be triggered not only by exceeding the preset limit value on the measuring channel, but also by a change in the state of the binary channel, an error in the measuring signal, activation or deactivation of an alarm on the channel, etc.



Starting conditions

The STELA-3 continuously evaluates the current measured values on analogue and binary channels. If the value exceeds the set limit or if the binary input is switched on or off, it sends the appropriate, pre-prepared SMS to selected mobile phones.

Activation by sum

For integral variables (instantaneous or cumulative flow, rainfall, number of pulses, ...), the activation of the SMS warning can also be triggered by exceeding a pre-set limit value for a certain time.

Properties of warning messages

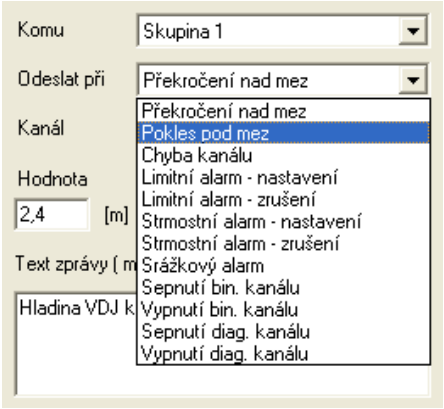
Warning messages are the basic and most frequently used type of SMS in the communicator. The features of warning SMS can be summarized in the following points:

- The user can set the text of up to fourteen different warning messages.
- At the beginning of each alert SMS it is possible to automatically insert the name of the device sending the message and the current time in the device at the time of sending the SMS. Only then is the actual text of the message followed.

  Note: in special cases, such as sending a message to a special operator number that forwards incoming messages to e-mail, it is necessary to disable the automatic insertion of the name tag and time.
- For each message, you can select the recipient from a list of authorised persons. You can also create a group of persons to whom the SMS will be sent in turn.
- The sending of the message can be conditioned by the time period for which the activation condition of the message must be fulfilled (overshoot, undershoot, binary state change, measurement error, alarm).
- Resending of the next warning message is activated only after the current value returns to the allowed area by at least the *Hysteresis* value and after the *Limit value* is exceeded again for the set Delay time.
- It is possible to insert the current measured value into the text of the warning SMS using the #V character pair. Not only the current measured value, but also the channel name and the set units of measure are transferred to the SMS text.
- The text length of one SMS must not exceed 50 characters (this limit does not include automatically inserted texts - *Name tag*, time, current value).

PARAMETERS SETTINGS

The adjacent image shows an expanded menu of activation conditions that can ultimately trigger an automatic SMS alert. However, the sending of the SMS still depends on the *Delay* parameter.



Delay This parameter is set in seconds and the activation condition must last as many seconds as the value of the parameter without interruption before sending the SMS. Even a short-term return of the input to the previous state resets the time counter and the time measurement starts from the beginning.

Activation conditions ***Alert SMS activation conditions table:***

Condition	Description
Exceeding the limit	The current value on the control channel has exceeded the size of the *Value* parameter. For the integral variable, the SMS can be activated when the number of pulses, rainfall or flow rate in the current archiving interval exceeds the set *Value*. At the beginning of a new archiving interval, the read quantities are always reset (set the delay parameter to zero). If the "Calculation functions" method is selected from the list of measurement methods, the moving sum, moving average, sum or difference of two adjacent channels and some other special calculations can be registered on a separate channel. The calculated channel value will then be compared with the limit value of the SMS being set. The calculated values can only be used to activate the limit SMS and do not need to be archived in memory.
Decline below the limit	The current value on the selected channel drops below the size of the *Value* parameter. The same rules apply for the drop as for the overshoot.
Channel error	Occurrence of a communication error with the measuring probe connected to the channel or a detectable fault in the output signal of the connected sensor (current signal out of range, quantity out of the permitted range, ...)
Limit alarm - settings	The limit alarm value on the control channel has been exceeded by the set *hysteresis* - i.e. the limit alarm has been activated.
Limit alarm - cancellation	The limit alarm (return of the measured value to normal limits) has been terminated on the control channel.
Steep Alarm - Settings	A steep alarm value has been exceeded on the control channel.
Steep alarm - cancellation	The steady alarm on the control channel has been terminated.
Precipitation alarm	This option applies only to the first channel, set to monitor rainfall. The STELA station continuously calculates the rainfall sum (called SS) when it rains, and a warning SMS is activated if the SS sum exceeds the value of the *Value* parameter.
Binary channel switching	The control binary channel has been switched. You will be presented with a list of occupied binary channels as the control channel.
Binary channel unlinking	The control binary channel has been disconnected.
Diagnostic channel disconnection	The set limit value on the control C-channel, i.e. the Iopto current (DG12) or the Unap current (DG11), has been exceeded. The limit value is set on the first "Basic" parameter tab in the "Power supply and diagnostics" section.
Diagnostic channel disconnection	The measured value of the diagnostic channel has fallen below the set limit value, i.e. low battery (DG4) or external supply voltage (DG6). The limit value is set on the first "Basic" parameter tab in the "Power supply and diagnostics" section.

Channel When selecting a control channel, MOST will list all occupied channels including their names. For the last two activation conditions, a list of diagnostic DG channels is offered. Multiple limit messages can be activated with one channel.

Text The text length of one SMS message is limited to 50 characters. The text may contain commas and semicolons, but these characters are converted to non-diacritical characters when creating the SMS message. The length of the text does not include the *station name* parameter, which is usually automatically inserted at the beginning of the message, or the text with the date and time of sending.

Value The value of this parameter is the threshold for activating the SMS warning message. The value is entered in the same units of measurement that the control channel works with.

Hysteresis This parameter prevents frequent sending of the same SMS when the measured value fluctuates around the limit value. The same SMS is sent only after the measured value returns to normal by at least the *Hysteresis* value and then exceeds the limit value again. Unlike alarm or relay parameters, it is not necessary to exceed the limit value by the Hysteresis to activate the SMS message, but the SMS is sent immediately after the limit value is exceeded.

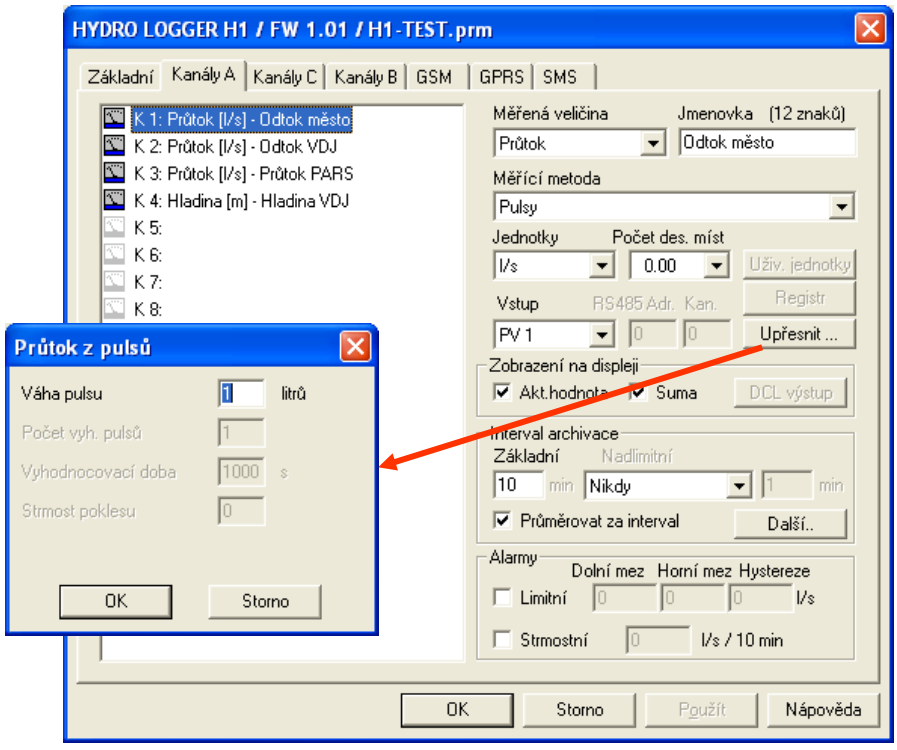
EXAMPLE A: WARNING SYSTEM FOR MONITORING EXCESSIVE WATER CONSUMPTION

Connection: the flowmeter with optical pulse sensor (OPTO or REED) is connected to the pulse input PV1.

Assignment: Send a warning text message if the amount of water continuously measured by the connected flow meter for the last 120 minutes is greater than 20 m^3 .

Parameter settings:

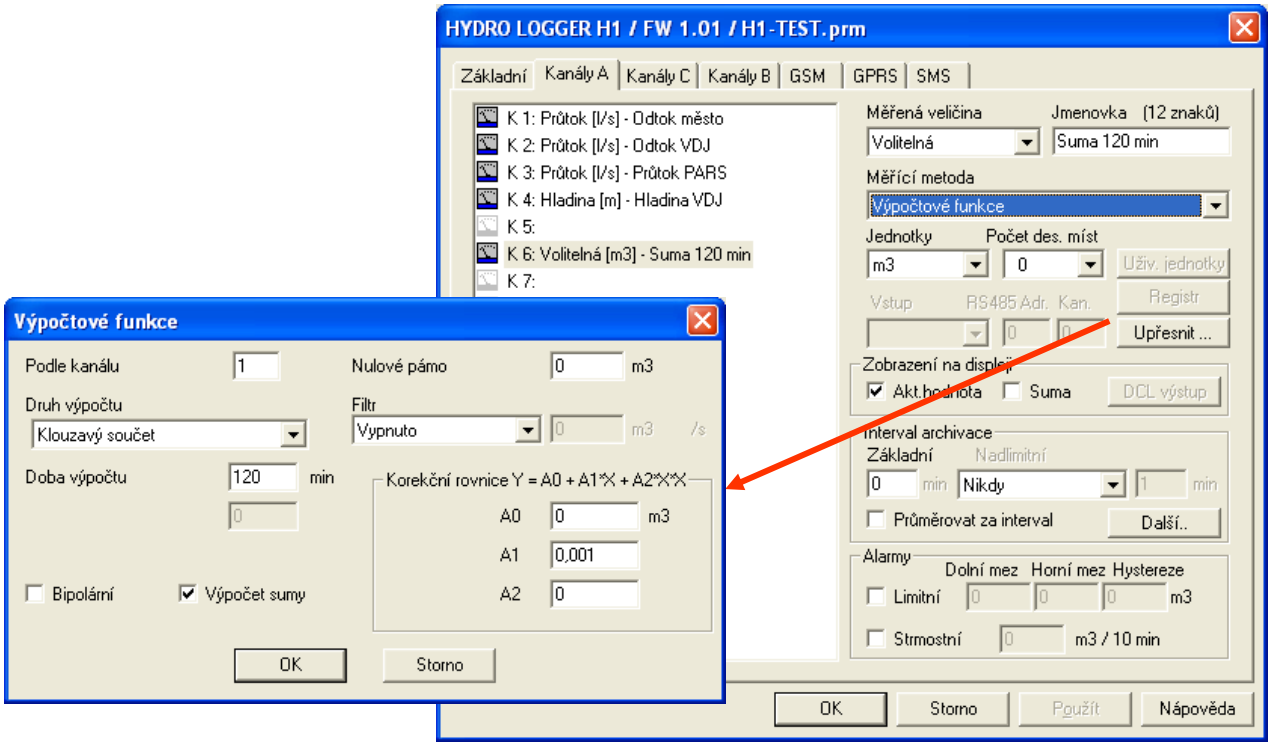
Measuring channel K1 Set measuring channel K1 to record the instantaneous flow value:



In the help window under the "Advanced" button, set the actual pulse weight (usually 1 l/pulse for OPTO type sensors and 10 l/pulse or 100 l/pulse for REED type sensors).

Channel for calculating the sum

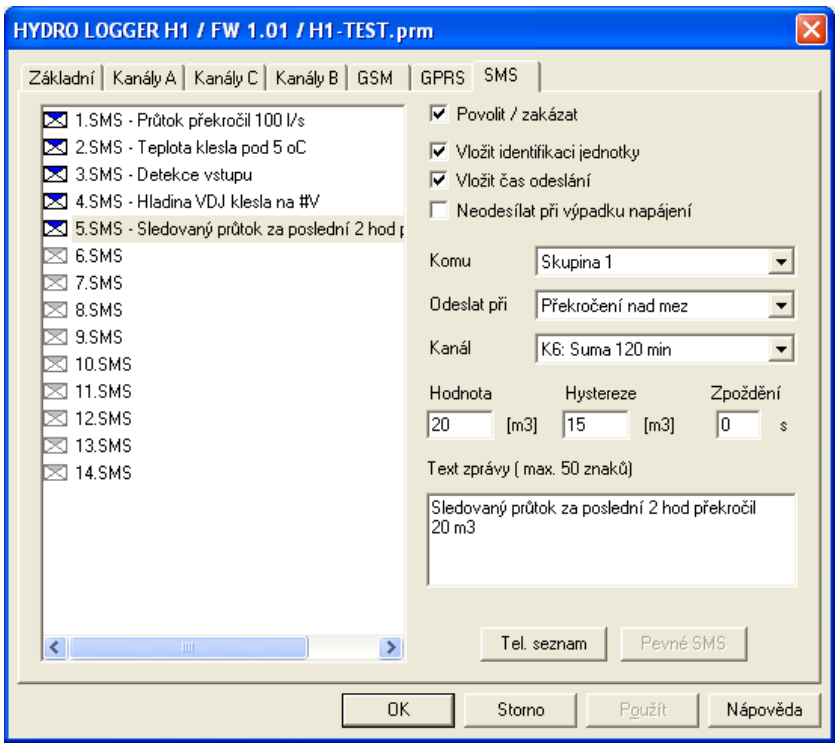
Set the free channel (e.g. K6) as an auxiliary channel for the calculation of **the running total** for 120 minutes without data archiving (parameter *Archiving interval* = 0).



The multiplicative coefficient A1 is set to 0.001 because the measuring channel K1 records the value of the instantaneous flow in litres and the sum channel K6 is set as specified in m^3 .

SMS alert settings

For example, set the SMS alert parameters as shown below:



Warning SMS No. 5 will be sent immediately (*Delay=0*) after the sum on channel K6 exceeds 20 m^3 . The same SMS will be sent again after the value on channel K6 falls below 5 m^3 (*Hysteresis* parameter = 15, i.e. 20 - 15 = 5 m^3) and the sum value on channel K6 subsequently rises back to 20 m^3 .

EXAMPLE B: EXCEEDING THE LEAKAGE VOLUME IN THE OPEN PROFILE

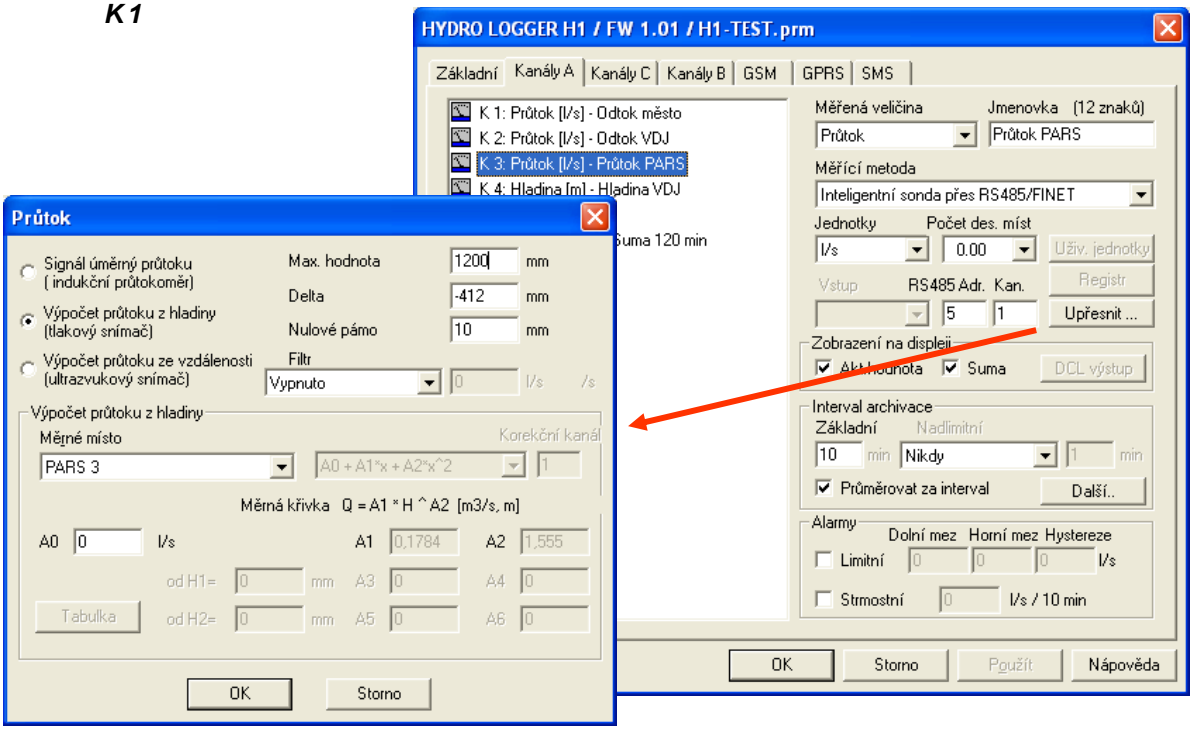
Connection: flow meter consisting of a measuring spillway (trough) and ultrasonic level sensor US1200 connected via RS485 serial interface

Assignment: Send a warning text message if the amount of water continuously measured by the connected flow meter for the last 12 hours is greater than 50m³.

Parameter settings:

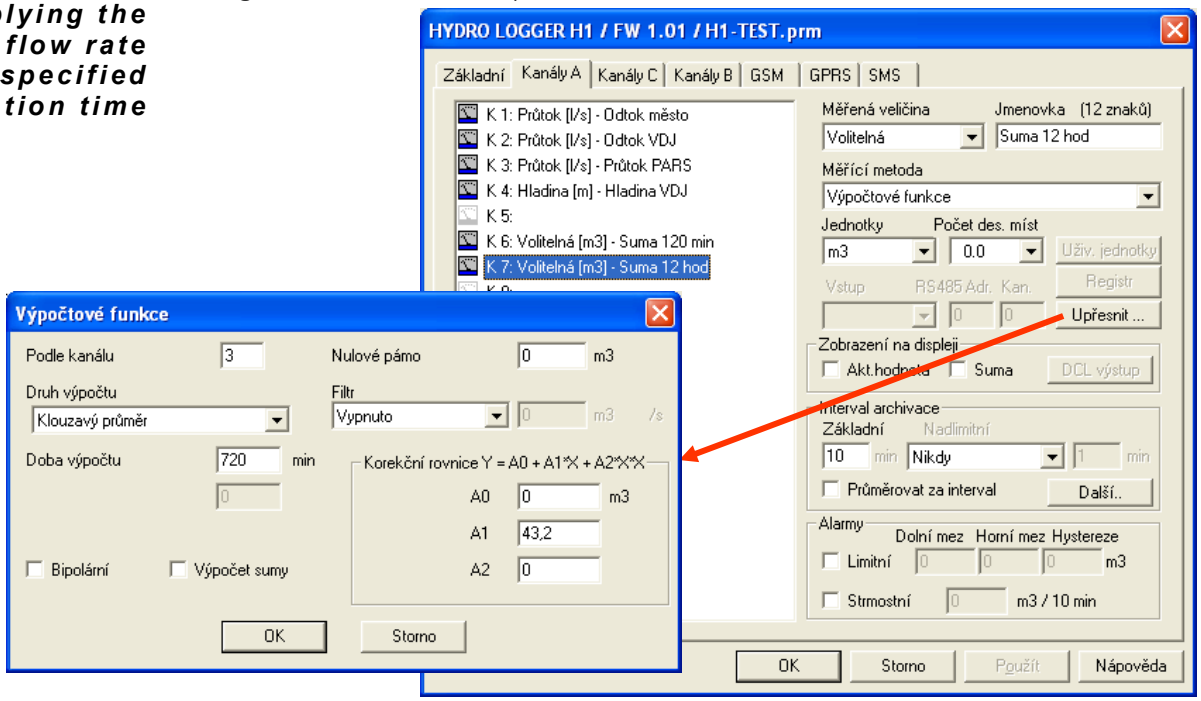
Measuring channel K1

Set measuring channel K5 to record the instantaneous flow value:



Channel to calculate the sum by multiplying the average flow rate and the specified calculation time

Set the free channel (e.g. K7) as an auxiliary channel for the calculation of the **moving average** over 720 min = 12 h).



The multiplicative coefficient A1 is set to 43.2 which is the value corresponding to the number of seconds in the monitored interval divided by one thousand (12 h x 3600 s = 43200 s).

SMS settings

Set the warning SMS in a similar way as described in example A on the previous page (parameter *Value* = 50 m³).

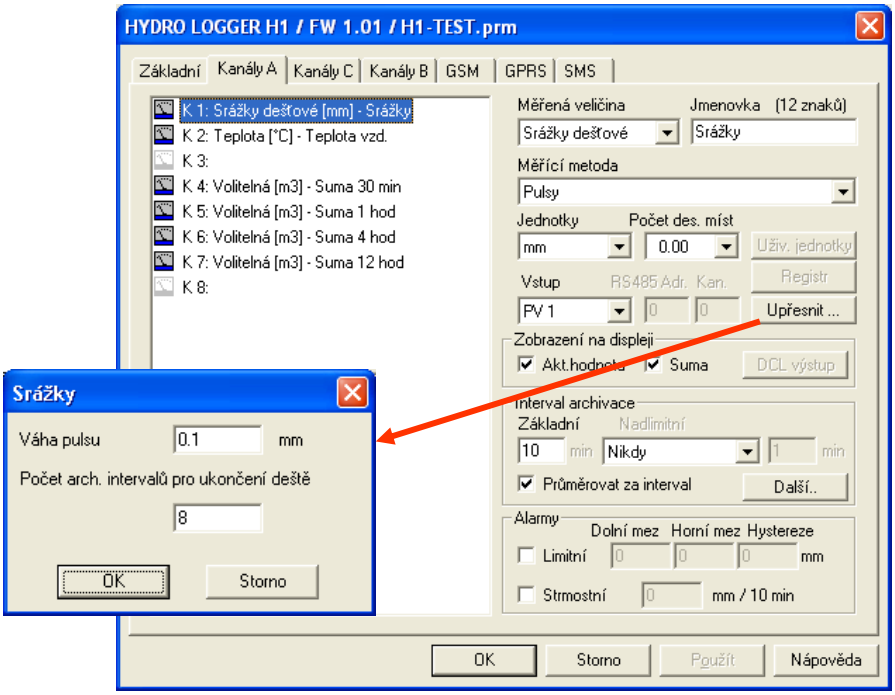
EXAMPLE C : RAINFALL WARNING SYSTEM

Connection: boat rain gauge connected to input PV1. Pulse weight 0.1 mm.

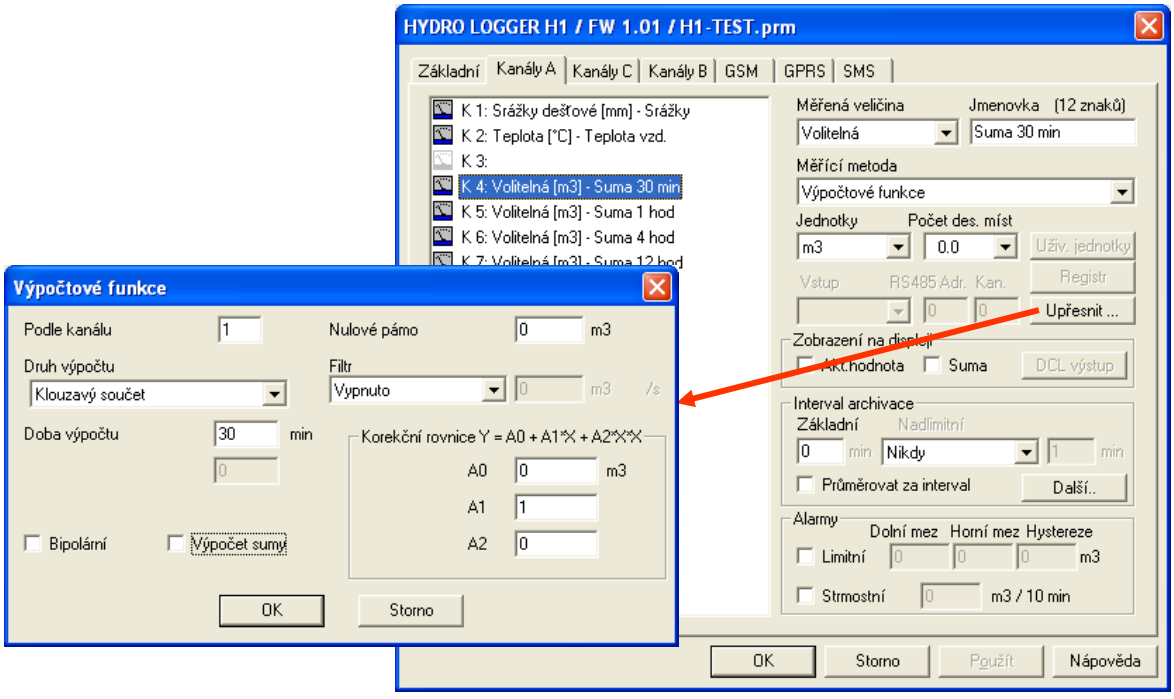
Assignment: Send a warning text message if the amount of rainfall falling within 30 minutes is greater than 40 mm or the amount of rainfall falling within 12 hours is greater than 100 mm.

Parameter settings:

Measuring channel K1 Set measurement channel K1 to record rainfall. Set the pulse weight according to the type of rain gauge connected, or adjust it after calibrating the rain gauge by dripping the exact amount of water by the ratio of the expected and actual pulses.



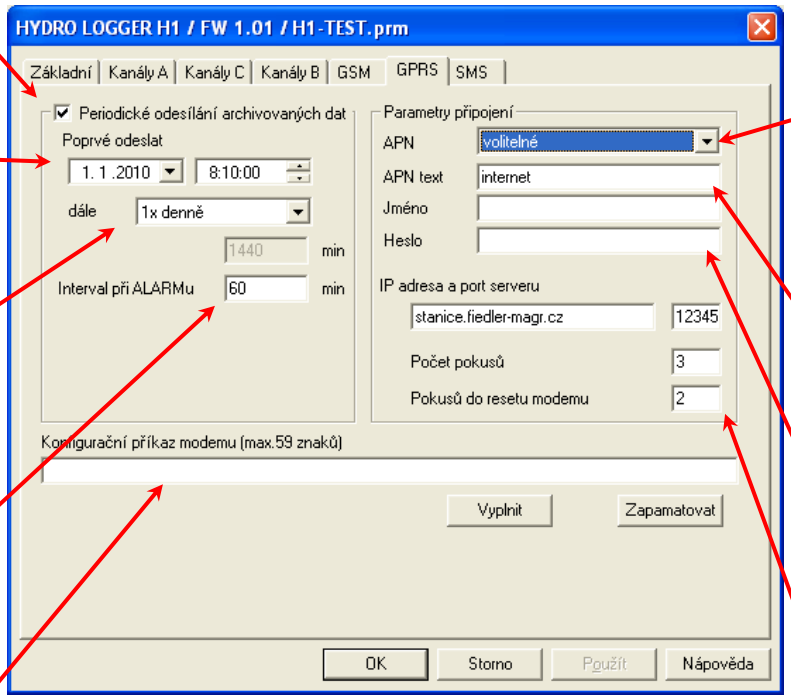
Channel for calculating the sum Set the K4 channel as an auxiliary channel to calculate the running total without archiving the data and without displaying the value on the display. Similarly, set the other free channels to calculate the sum for the desired time interval.



SMS settings Set the warning SMS in a similar way as in example A (parameter *Value* = 40 mm and for the next SMS *Value* = 100 mm).

4.10. Parameters for sending data under TCP/IP protocol

The "GPRS" tab contains the parameters needed to set up periodic sending of archived data via GSM/GPRS network to the designated server in the Internet.



Enabling GPRS data transfers

Setting the time for periodic sending of data to the server

Set the interval in days or hours for periodic data uploads

Setting the interval in minutes for sending data for the duration of an alarm condition on a measurement channel

Special command line for modem settings

List of preset APNs (Internet access points) of selected mobile operators

Box for setting your own APN for operators not listed

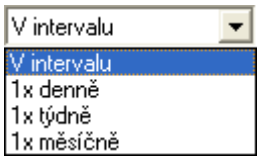
Name and password to access the private

Setting the server address, port and number of retries in case of failed data transfer to the server

Checking the "Periodic sending of archived data" option in the upper left corner of the window enables setting of individual parameters of this service. Uncheck this option to temporarily or permanently disable GPRS communication.

First time send Entering the date and time is used to set up regular data sending. Setting the date to a future day will enable sending from that day onwards. On the other hand, the "old" date in the settings does not matter, the first sending will be done at the nearest set hour and minute.

Further Under this option are the parameters for periodic data sending.



Alarm interval If an alarm condition occurs on any measurement channel (it does not matter whether it is a limit or a bridge condition), the communicator can send data to the server more frequently than in the normal "quiet" state. The value of the *Alarm Interval* parameter should not be less than 30 minutes. A shorter interval would put unnecessary load on the communicator battery and GSM/GPRS network, as well as on the server itself receiving data from multiple stations, and would also have a negative impact on the cost of data services.

Note

When only a few measured values are transmitted under the TCP/IP protocol, the protocol overhead itself makes up the vast majority of the information in the transmitted packet and the actual measured data occupies only a small part of the transmitted data volume. Therefore, as the sending interval shortens, the total transmitted data volume increases and thus the station's operating costs increase.

APN (Access Point Name) The Internet access point must be set according to the type of SIM card and operator used. The "optional" option also allows you to specify special APNs of private corporate networks or foreign operators.

Server IP address and port These parameters are set in the production and do not need to be changed. If the device will be operated in the customer's own system and the data will be transferred to the customer's own server, it is necessary to set the corresponding IP address and the port used.

5 Service and maintenance

The installed STELA telemetry station requires occasional checking of the condition of the cable connection of the measuring probes and the GSM antenna. Especially when installed in the field, the cable connections are stressed by weather and sunlight. Mechanical damage to the cables by various rodents often occurs. Suitable cable protectors and a well-designed station installation can ensure trouble-free operation of the station throughout its lifetime.

5.1. Firmware updates

The manufacturer of the STELA-3 telemetry station maintains updated firmware versions for most of its products on its server **www.fiedler. company** in the "Firmware and Utilities" partner zone. The partner zone is accessible to authorized users by logging in to the "Support" menu.

Firmware updates are performed from the menu of the MOST program, which must be licensed for service companies. A detailed description of how to update the firmware can be found on this website along with the individual firmware packages.

Follow these steps to update the firmware:

- Connect to the unit whose software you want to update with MOST.
- Read the current parameters from the connected telemetry station and save them as a parameter file as a backup of the current instrument settings. Similarly, back up archived measurement data.
- In MOST, select the "*Firmware*" option in the "*Manufacturing*" menu.
- Select the desired data file containing the firmware (*.hex) and load it into the PC by pressing the "Open" button.
- After the new firmware transfer is complete, the unit will automatically restart and MOST will display the message "Firmware update complete".

5.2. Replacing the power supply batteries

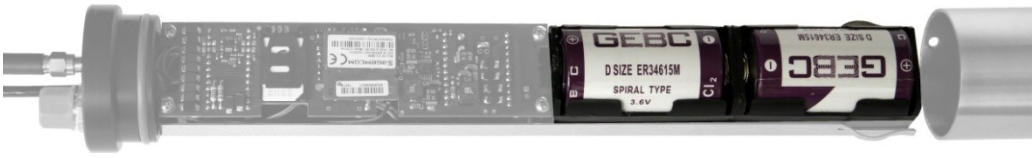
Control channel K11 displays the remaining capacity of the power batteries, expressed as a percentage. If this value falls below 15%, it is advisable to replace the batteries. The batteries can be changed by the user or by ordering a battery change from the station manufacturer.

Suitable battery types

Depending on the type, the telemetry station contains 2 (STELA-3A) or 4 (STELA-3B) lithium batteries 3.6 V/13 Ah size D. The batteries shall be of a spiral design to allow the higher current draws required for GSM/GPRS communication between the station and the server. Suitable batteries include, for example, LSH20 or ER34615M lithium cells. New replacement batteries can be ordered from the station manufacturer.

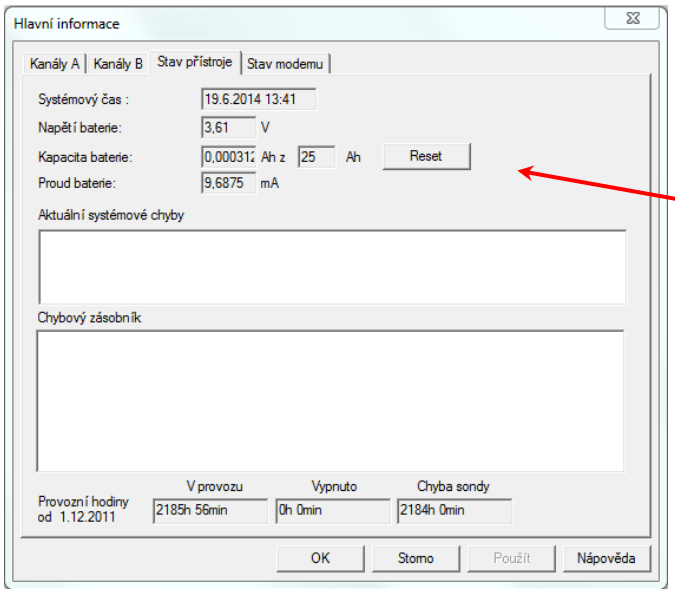
When replacing the batteries, proceed as follows:

- Unscrew the locking screw that secures the front panel in a fixed position in the station's stainless steel cylindrical housing and remove the station's stainless steel housing (see photo).



- Gradually replace worn-out batteries with new ones. Make sure that at least one battery is always inserted in the instrument holder (batteries are connected in parallel).
- Treat the O-ring around the perimeter of the front panel with silicone petroleum jelly to prevent airborne moisture from entering the station, and carefully replace the stainless steel cylindrical sleeve, securing it with the locking screw.
- Using the connected PC and the MOST program, RESET the capacity counter.

Setting the initial capacity after battery replacement



Button for zeroing counters of the energy consumed so far from the power batteries Press the button to set the control channel K11 to 100% after inserting new batteries.

After replacing the power supply batteries, you need to reset the power draw counter using the MOST program to set the initial capacity of the new batteries to 100%.

To reset the counter, press the *Reset* button in the "*Main Information"* window. This window is called up by selecting *Info -> Current values* from the main menu and selecting the *Instrument status* tab.

Notice

Used batteries can be returned to the station manufacturer. Improper disposal of used batteries could damage the environment.

Technical parameters

Parameters of recording channels

Number and distribution of channels	1 - 8 recording measurement channels with 16-bit resolution 0 - 8 binary channels with status and change time storage 7 control channels for recording voltage, currents, battery capacity consumption, temperature and humidity inside the instrument 1 text channel for storing events (1 record max. 220 B)
Storing data in memory	0 to 3 decimal places (0.000 to 65535; ±32767)
Channel nameplate	12 characters
List of measurement methods	number of pulses, pulse time data reading via RS-232 interface
Data memory capacity	2048 kB Flash type, 250,000 - 450,000 values including time
Main archiving interval	From 0 min to 1440 min, 1 min increments, each channel separately
Auxiliary interval arch.	From 0 min to 255 min, automatic interval switching
Motor hour counters	Counter with capacity 999 999 h : 59 min for each bin. channel
Alarms	Limit and gradient alarm for each recording channel
Other calculations over recording channels	The difference of two channels Sum of two channels Sliding sum, calculation in the interval 10 - 1440 minutes Moving average, calculated over the interval 10 - 1440 minutes Calculation of the trend, calculation in the interval 10 - 1440 minutes Value correction by a general second order polynomial

Software for flow monitoring

Calculation of instantaneous flow from pulses	Calculation of instantaneous flow from pulse weight and pulse frequency, max. number of connected water meters: 2
Calculation of the total leaked volume	Archiving separately by channels, calculation of daily flows
Capacity of flow counters	0 - 4,290,000,000 [m^3]

Inputs

Pulse Inputs PV1, PV2	min pulse width: 10 mS, max pulse frequency: 25 Hz Pulse counter capacity : 4.290.000.000
Binary Inputs PV1, PV2	H > 10 kΩ L < 1 kΩ, active level: L (max.I= 1 mA) Input quiescent state: H level 3.3 V (Ri=10 kΩ)
Analog Inputs AV1, AV2	Max. vs. range 0(4) - 20 mA, load res. 100 Ω, surge protection 18 V/ 600 W, ADC resolution 16 bits.

RS485 serial communication interface	Communication protocol FINET (HART, Modbus RTU), adjustable baud rate 1200 - 19600 Bd (default 19600)

Other parameters

Microprocessor	RISC type; 8 bits; supply voltage 2.8 V
Power	Lithium battery 3.6 V / 13 Ah (2 or 4 batteries)
Current consumption	Type. 6 mA, 30 uA at rest (active PV inputs, not switched)
Dimensions	Diameter 50 mm, length 340 mm STELA-3A (480 mm - 3B)
Weight	1100 g including batteries (1330 g STELA-3B)
Housing material	Robust stainless steel housing
Degree of coverage	IP67
Connectors	K1: Type M12, 4 poles, IP67;
Working temperature	-25° C ... +55° C (storage temperature -30° C ... +70° C)

GSM module

GSM module type	Hi-Lo , manufacturer: Sagem
GSM	Frequency band: 900/1800 MHz (EGSM/DCS) Sensitivity: -108 dB (typical value) Transmitting power: CLASS 4 (2W @ 900 MHz) CLASS 1 (1W @ 1800 MHz) CS Data: Asynchronous, max. transfer rate 9.6 kB/s
GPRS	Slots: Class 12 (4Rx / 4Tx, 5MAX)
SMS	Text SMS, 160 characters Number of configurable SMS: 14 alert, 8 fixed, 1 info Number of query codes for SMS: 19 Number of control codes: 1 Max. number of recipients in the list: 10 Support for credit SMS: periodic detection of current credit, sending alerts when it drops, forwarding operator SMS
Power	Internal controlled DC/DC converter: voltage. 1Tx/1Rx: max. 230 mA (peak 1.25 A), 1Rx: max. 105 mA, quiescent: < 5 mA, off: 10 uA type
Working temperature	-20°C to 60°C (storage temperature -40°C to 85°C)
SIM card	Access after removing the device from the case, flip-out holder
Antenna	SMA connector, magnetic dual 6 dB, 3 m cable

CE version

The instruments listed in this user manual comply with both the EMC directives 89/336/EU including their supplements and EN 61326-1:98 including its supplements.

Notice

The used lithium batteries can be returned by the manufacturer of the device - FIEDLER AMS s.r.o., Lipová 1789/9, 370 05 České Budějovice, which has a contract with the importer of batteries for the take-back of used batteries. Improper disposal of used batteries could damage the environment.

Disposal of equipment

The manufacturer has a contract for the take-back of this device with RETELA s. r. o. You can find an overview of collection points in your area at www.retela.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.

Warranty Card

Type : STELA-3 _____ Date of delivery to customer : _____

Serial number : _____ Date of commissioning : _____

.....
Manufacturer / Supplier - signature

The product was tested and set up correctly before being shipped from the company. Nevertheless, it may happen that during operation, defects may appear on the device that are undetectable when the product is tested by the manufacturer.

If any defect is caused by faulty material, workmanship or software, the product will be repaired or replaced free of charge if the claim is made within the warranty period, which is :

two years from the date of entry into service, but not more than two and a half years from the date of sale.

If the manufacturer is unable to repair or replace the product within the warranty period, it may provide a refund of the purchase price upon return of the product.

The manufacturer is not liable for defects caused by interference with the design of the device, damage to the device or improper connection. When installing and operating the device, it is necessary to observe all the instructions in the Technical Specifications, the related ČSN and safety rules.

All repairs during the warranty period are the sole responsibility of the manufacturer. For hygiene reasons, only clean and properly packaged products should be sent for repair.

Assurance of conformity

within the meaning of Act No.22/1997 Coll., on technical requirements for products

Producer: ***FIEDLER AMS s. r. o.***
represented by Ing. Jindřich Fiedler
Lipová 1789/9, 370 05 České Budějovice, Czech Republic
ID 03155501, Tel/Fax:. +420 386 358 274, E-mail: prodej@fiedler.company

Pursuant to§ 13 paragraph (5) of Act No.22/1997 Coll., on Technical Requirements for Products, we assure the distributor/customer that we have issued a "Declaration of Conformity" for the products manufactured/imported by us, which are covered by the aforementioned Act and the relevant government regulations.

In České Budějovice on 15. 04. 2014

Ing. Jindřich Fiedler
Managing Director

TXP0210317.00b
STELA-3-V201

Manufacturer:

FIEDLER AMS s.r.o.
Lipová 1789/9
307 05 České Budějovice

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