M4016-G (-L, -A, -P)

User guide version 1.06   *12/2006*

Registration and controlling unit, Telemetric station, Flow meter, …

FIEDLER-MÁGR

ELEKTRONIKA PRO EKOLOGII

Version M4016

Modular registration units M4016 are available in many versions differing on numbers of inputs and outputs, PC communication, performance, supply and on software.

M4016-☐☐-☐☐-☐

Code	- Connection board (M4016-■☐-☐☐-☐)
L	„smal**L**" connection board LPD (4x DAV, 2x PV, RS485, 1x relay)
G	„di**G**ital" connect. board DPD (6xDAV, 2xDV, 2xAV, 8xPV, RS485, 2x relay)
A	„**A**nalogue" connect. board APD (15x AV, 2x DAV, 2xPV)
P	„**P**ulse" connect. board PPD (4x PV, 2x AV)
K	Communication of parallel connection of boards DPD + APD

Code	- Communication (M4016-☐■-☐☐-☐)
1	RS232, connector CANNON 9DB
2	RS232, inbuilt GSM module (DATA + SMS)
3	RS232, inbuilt GSM module (DATA + GPRS + SMS)
4	Converter RS232/Ethernet (TCP/IP), RJ45

Code	- Mechanical variants (M4016-☐☐-■☐-☐)
0	Standard variant, 3 cable penetrations
K	Portable variant, a holder, 3 connectors IP67 on the side
V	Inbuilt variant (without an outside box)
P	Variant on the panel (without an outside box)

Code	- Supply (M4016-☐☐-☐■-☐)
0	Replaceable accumulator 12V / 7,2Ah
1	DC/DC converter 16-30V / 13,8 V + accumulator 12V
2	Power supply 230 V / 13,8V–1A + accumulator 12V
3	13.8-20V DC (preparing for solar panel)+ aku.12V
4	Replaceable accumulator 6V / 12Ah

M4016-M (Minimax)	Data logger with special SW for seeking of water leakage
M4016-RV (Regulator)	Controlling units of membrane governing valves, data logger
M4016-H2	Analogue and binary inputs, SMS system, without data logging
M4016-PFT (Irrigations)	The units for controlling two irrigational valve of rainfall tanks
M4016-ZV (Watering)	Controlling units of watering system

1. Specification of telemetric unit M4016

The self-contained unit M4016 contains a universal data logger, a telemetric unit with inbuilt GSM module, a programmable controlling automaton and while combined with ultrasonic or pressure level sensors also it contains a multiple flow meter.

1.1. Examples of using

- Measuring immediate and accrued flow in open profile containers
- Monitoring and controlling technological mechanisms
- Measuring and collection of data in water and power supply engineering, gas manufacture, etc.
- Basic component of stream gauge stations and warning system in GSM net
- Telecounting of connected water meters through GPRS
- A field data logger for monitoring of environment
- Measuring of levels and flows in sewerage nets
- Weather stations with long distance data transmissions and warning SMS system
- Universal measuring unit for scientific and research workstations
- Compensation of cable lines confirmed with SMS communication
- Supervision and controlling of technology via Ethernet

1.2. Basic specification

Recording channel   The user has at disposal 16 dynamically eligible recording channels for measuring and archiving of flows, levels, pressures and many other values.

Up to 40 binary channels can monitor running and faults of pumps, intrusion of entity or generally states of contacts.

Inputs   Recording channels do not have fixed attached inputs. The inputs can be analogue, pulse, frequency, digital or binary and their numbers are different under the connected board types.

During channel parameters setting the chosen input is attached.

Outputs   Standard connected board DPD contains only two relays. The unit M4016 allows to control up to 14 relays through limit, time or logical conditions. The relays are situated in external switching units SP06 connected through concentrator RS485 or signal DCL.

Data memory   Measured signals values in particular inputs are converted to required measure units and stored in adjustable minute intervals to data memory. The capacity of memory is 2MB and

takes in even 400.000 values included dates and time of its origination. Data memory also records remarkable events – SMS receiving or sending, mistakes, supply failures, etc.

Data archive   Average values, measured for whole archive interval, are stored in the regular interval to unit memory in the normal mode with permanent switched on sensor power supply. In economic mode the result of only one measuring from end of archive interval is stored. In economic mode the central unit   detaches sensor and probe supply clips from accumulator and switch itself to mode lowered power consumption.

GSM communica-   Units M4016-x2 and M4016-x3 with inbuilt GSM module, can take over measured values
tion   through GSM/GPRS communication to server (only in M4016-x3) or through dialled data calling the dispatching workstations. The units can also send warning or informative SMS and receive inquiry or controlling SMS. Through data communication it is possible to change parameter setting. Special running mode allows confirmed and index SMS communication among several units, which is used for example to recharge reservoirs from far water- pumping stations.

Parameter setting   Parameter setting of record channels and all other parameters settings included setting of conditions for automatic sending warning SMS are done with connected PC program MOST. Most of the basic parameters can be also set with controlling unit keyboard.

Power supply   Low power consumption allows long time power supply of whole device with inbuilt charging accumulator. The accumulator is possible to charge right in a device with connected external power supply or with solar panel.

Economic mode of   If the unit shall be installed outdoor without possibility of supply accumulator charging, the
running   economic running mode can be set. The unit measures and tests input signals shortly in intervals settings by users. The economic mode can be set also for inbuilt GSM module.

1.3. Software

Calculation   ▪   Displaying and storing of measured values in setting measure units

▪   Calculation of immediate and accrued flow from water level based on setting parameters of applied measure profile container Parshall's or Ventury's channels, measure overflows). 14 equations for the most often applied profile containers have been set in the units.

▪   Flow calculation for combined Parshall's channels (double and triple combinations).

▪   Flow correction during back water in discharge of Parshall's channel (signals of two connected ultrasonic sensors are used for calculation).

▪   Flow calculation from worksheet setting dependence of level to flow.

▪   Calculations of immediate and accrued flows from pulses of REED and OPTO sensors.

▪   Sum and differential functions of two channels (sum and difference of measured values). Calculation of sliding sum, sliding average and trends in any channel).

▪   For every setting channel separately nonlinear output signals can be revised with polynomial function of order 2.

Statistical calcula-   ▪   Finding up to 5 daily minimums or maximums included times of archive dates at
tions   every day and in every recording channel.

▪   Calculations of daily average values in channels which record flows and calculations of daily total flows from values stored in data memory.

▪   Operating hours with minute resolution in every binary channel.

Alarms   ▪   Separate limit alarm for every measure channel

▪   Separate gradient alarm for every measure channel.

▪   During alarm time in channel the different frequency of data records can be set from it is set during normal state.

Communication   ▪   All data transfers through RS232 and data transfers in GSM net (parameters and also measured values) are transmitted via FINET protocol (binary protocol with fixed frame). Data packet transfers through GSM/GPRS and communication in Ethernet net process via TCP/IP protocol.

- Basic program product, which provides maintenance and creates parametric and data files, is program MOST. Program MOSTNET-SERVER and program MOSTVIEW are designed for communication via net Ethernet or GSM and for dispatching workstations.

- The units allows automatic regular sending of measured data included archive values via GPRS net to Internet to set IP address (to the server with installed program MOSTNET-SERVER).

- Different operating mode is transmission of measured values through mobile phones or house phones with program MOST. Automatic calling from the unit to dispatching workstation at determinate time is convenient to set in the units supplied only with accumulators. Inbuilt GSM modem can be switched off before and after data transmission.

- Phone list for 16 addressees, grouping in 3 groups is possible, adjustable authorization of particular phone numbers for inquiries and controlling.

- Warning system based on 32 user adjustable and 8 default SMS messages.

- Activation of SMS sending or data contact establishment (included GPRS), either achievement of limit value in measured channel, after activation of limit or gradient alarm, regularly in time, during fault of a sensor, during low accumulator voltage, after switching-on of binary input, during decrease of prepaid credit or on demand of SMS from authorized number

- Adjustable delay and hysteresis of limit SMS

- 25 inquiry and command codes for creation of inquiry or controlling SMS

- Automatic insertion of channel immediate value in SMS text

- Program controlled switching-on of modem at determine time and for determine time (interval can be set in hours or weeks)

- Time setting for sending of daily SMS. Time and day setting for sending of weekly SMS.

- Controlling of one controlled unit M4016 from up to 4 controlling units through indexed and confirmed each other SMS

- Postponed sending of unimportant SMS off the night hours.

- Automatic switching between winter and summer time

Outputs
- Parameters for controlling of 14 real and 6 virtual relays (limit switching-on under values, function of wiper-speed switch, time switching-on, switching-on under combined logic condition and actual state of binary channels). Above mentioned switching-on conditions can be combined in one output with virtual relays. Automatic switching between winter and summer time is possible to set for time controlling (like for SMS sending).

- Parameters for controlling up to 16 external modules DAV420 with galvanized separated active analogue output 4-20 mA.

Security
- Separate access codes for output controlling and for changes of parameters

- Operating hours with minute resolution, which record time of device switching on and off. Times of errors in sensors measuring are registered separately under particular measuring channels.

- Diary of events, which is involved in data memory, records special events (switching on of selected inputs, power failure, restoration of supply, incoming and outgoing SMS, error signal in connected sensors, etc.)

2. Operating of the registration unit M4016 with a keyboard

Unit M4016 control program allows to run several actions together. While a user controls the unit, the measuring, storing of data, etc. can be made.

Keyboard   With the keys of the membrane keyboard it is possible to call up immediate, statistical and stored values, set any of the parameters and read required information about the unit. A short sound signal indicates the valid connection after pressing a key.

Úsporný režim   During standby mode the unit display is turned off. The display is activated after pressing of any key.
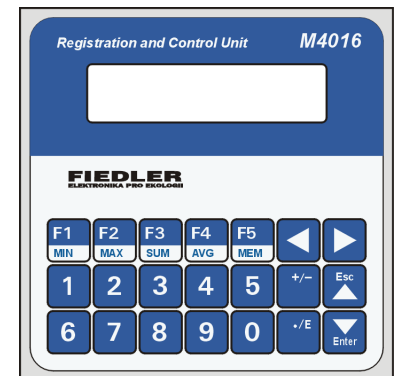
Tab. 1: Keyboard description

Key	Description
0 - 9	▪ Immediate choice of a channel ▪ Immediate choice of submenu ▪ Setting of parameter numeric value
◄ , ►	▪ Sequence choice of a channel ▪ Sequence choice of submenu ▪ Movement of cursor while setting ▪ Deleting of a figure while setting
F1 Minima - F5 Archív	▪ Calling up statistical and stored values ▪ Calling up helping functions
+/−	▪ Change of parameter signs ▪ More display contrast
Enter ▼	▪ Input to submenu ▪ Confirmation of parameter setting
Esc ▲	▪ Output from submenu to menu ▪ Cancellation of parameter setting
•/E	▪ Decimal point of parameters ▪ Switching-over to set an exponent ▪ Less display contrast

2.1. View of software services

The software services available to users can be divided into 6 basic groups, the first three groups are used exclusively for displaying of immediate, statistical and stored values of monitored features, the other three groups for reading of information about the unit, setting of parameters and temporary output setting.

Chart 2: Software services of unit M4016

Software services	chap.	side
Cyclic displaying of immediate values to chosen channels	2.2	10
Displaying of channel statistical values	2.3	11
Displaying of channel stored values	2.3.3	12
Information menu (device checking)	2.5	14
Setting menu (setting and change of parameters)	2.7	19
Manual control (relay status change, output 4-20 mA, modem)	2.6	17

Structure of basic operation services

M4016 - CONTROL STRUCTURE

Forced display of setting channels

C 1-16: Label Value [unit]

1 — 9
◄ ►

▼

F1 — F4   F5

Statistical computing above current channel (Min, Max, Sum, Average)

Display of stored data of current channel from memory

▲   ▲   ▲

>Main menu< 1. Information ►   >Main menu< 2. Settings ►   >Main menu< 3. Man.Control ►

◄   ◄   ◄
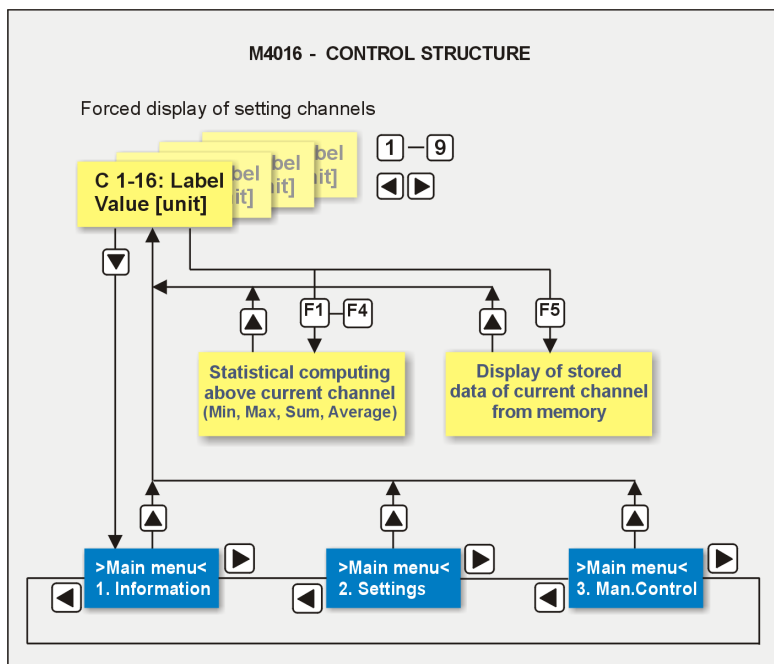
2.2. Cyclic displaying of immediate values to chosen channels

The basic operating mode of the unit is cyclic displaying.
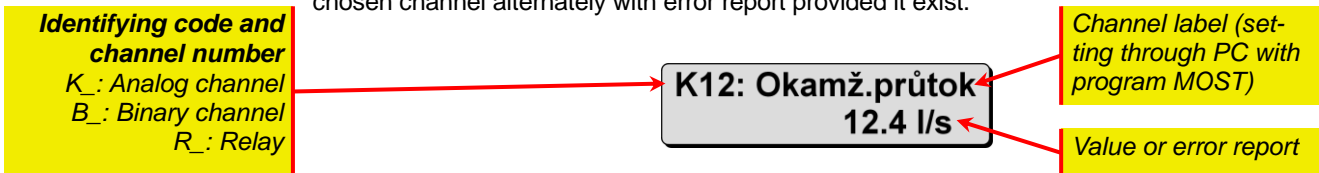
Cyclic displaying   Immediate values of channels, total sums of flow volume, error reports and operating hours of binary channels are cyclically showed on the unit display. To cyclic displaying it is possible to add immediate status of chosen relay and current outputs 4-20 mA..

Displaying time of a data is set with parameter *Period of display change* (see window in chap. 4.2). If the period is set to 0, the cyclic displaying is switched off and the display shows last chosen channel alternately with error report provided it exist.

Identifying code and channel number
K_: Analog channel
B_: Binary channel
R_: Relay

K12: Okamž.průtok
12.4 l/s

Channel label (setting through PC with program MOST)

Value or error report

Basic displaying of a channel in cyclic displaying mode

Return into cyclic displaying   From other operational mode (for example informative mode), the user can return into cyclic displaying mode if a key [Zpět] is pressed repeatedly. How many times shall it be pressed depends on the level of submerging into the mode. Five minutes after last key is pressed in different mode, the unit automatically returns into the cyclic displaying.

Channel number   It is the ordinal number of the recording channel. Repeated pressing of key ◄ and ► will activate displaying of the immediate value of any chosen channel.

Direct channel selection   Quick displaying of required channel is possible with pressing of keys [0] up to [9]. The numbers of channels above 9 is made with using the same keys. For example the channel number 10 is chosen with the aid of keys 1 and 0, which are pressed in second's sequence. There is view of codes for channel displaying, relay status and analogue outputs 4-20 mA in the chart below.

Chart 3: Codes for showing of channels, relays and analogue outputs on the display.

Channels group	Sign of group	Displaying code
Analogue channels	K	1 – 16
Binary channels	B	101 – 140
Relay status	R	201 – 220
Analogue output status	K	301 – 316

Actual channel   It is the channel just being displayed; the statistical and stored values are taken from this channel.

2.3. Displaying of statistical values

Statistical values involve measured maximum, minimum, average values and total or partial sums of flowing volumes (for balance values as flow, rainfall).Statistical calculation is made above a actual chosen channel.

2.3.1. Local daily minimum and maximum values

For displaying of channel minimum values the key ⬚F1⬚ is used and the key ⬚F2⬚ for maximum values. After pressing the keys **today's values** are shown, after repeated pressing keys **yesterday's values** are displayed and after another pressing there is possibility to enter data and time (beginning of day) and parameter *Daily step* and confirm with key ⬚Vstup⬚. After that the information is found in memory.

Displaying statistical values
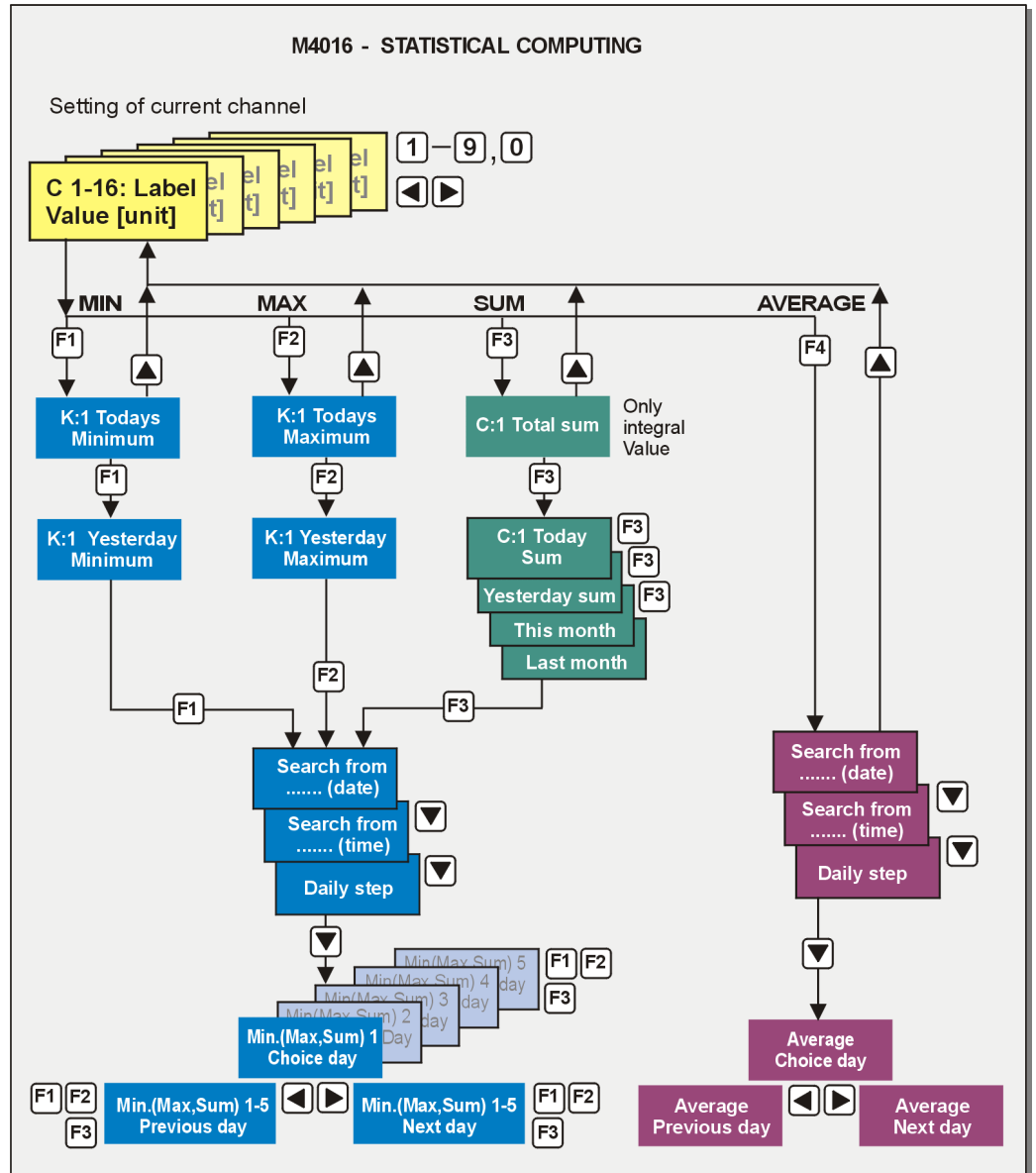
Chart 1: Structure of displaying statistical values

Daily step

The parameter indicates, if statistical values are found day by day (Daily step = 1), or for example week by week (Daily step = 7).The parameter value is offered the same as it was entered during last setting. The unit keeps new set parameter for next command.

Displaying local ex-tremes

After setting of last parameter an extreme local daily maximum (minimum) value is shown on the display as well as data and time of it.The user can call up other five extreme values with repeated touch of key ⬚F1⬚ or ⬚F2⬚. In the upper line of the display data and time are shown alternately with a channel number, indication of maximum or minimum and an ordinal number of extreme value (from 2 to 5).

Data evaluation from preceding or following days

Data about maximum (minimum) values from preceding (following) days are gained with pressing of the key ◀ (▶). How many days back or forward the user goes with pressing key ◀ (▶) the parameter *Daily step* determines. After pressing the key ◀ (▶) first local extreme value is shown. Other extreme values (from 2 to 5) are called up with repeated pressing of key F1 (F2).
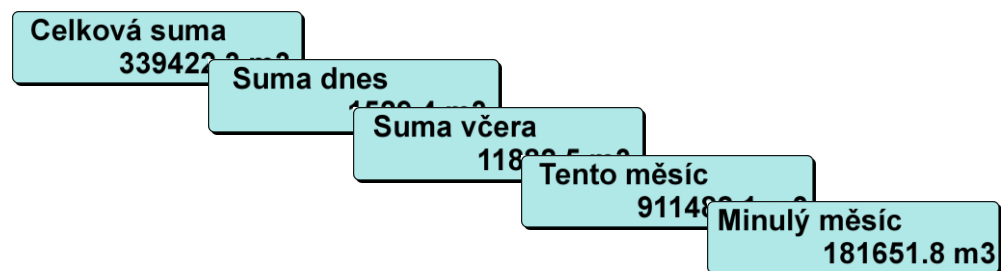
2.3.2. Summary values

Summary values are displayed only for balance values.

TOTAL SUM

The total sum of actual channel is displayed with pressing of key F3. The total sum means amount from last initialization of total values and usually it is the sum from device installation.

Celková suma
  339422.? m?

Suma dnes
  15??.? m?

Suma včera
  118??.? m?

Tento měsíc
  91148?.? m?

Minulý měsíc
  181651.8 m3

DAILY SUMS

With repeated pressing of key F3 it is possible to display today's daily sums. With other pressings of the same key the sum of preceding day, sum from beginning of current month to the date or the sum of last ended month are shown gradually.   Another pressing of key F3 allows entering data and time and *Daily step*. If the key ◀ (▶) is pressed during displaying of daily summary value, the display shows the sum of the day, which goes before (after) selected day by number of days setting in parameter *Daily step.*

Average value of the actual channel is also calculated within one selected day. The average value is called up with pressing of key F4, setting of data and beginning of selected day and the parameter *Daily step*. The parameter *Daily step* is used the same way as with above mentioned statistical values.

2.3.3. Initialization of statistical values

The user can initialize (reset) statistical summary values in menu: **Settings –> Initialization –> Total values.**

2.4. Displaying stored values

There is possibility to call up on the display immediate measured values, which are gradually fetched from unit memory. Statistical values (minimums, maximums, averages, sums of balance values) are continuously calculated from displayed values.

2.4.1. Recalling of stored values

After selection of a channel number the user can recall stored summary values with pressing of key [F5]. When date and time is entered the record from that time or next record after that time is displayed. Following records are recalled by hand or automatically.

Browsing of stored data is possible with keys as follows:

Chart. 4: Keys for archive browsing

➢ Manual switching to following or preceding value

➢ Start or stop of quick archive value displaying

➢ Statistical value recalling (minimum, maximum, sum, average) for displaying period

➢ Archive browsing termination

Displaying of archive values
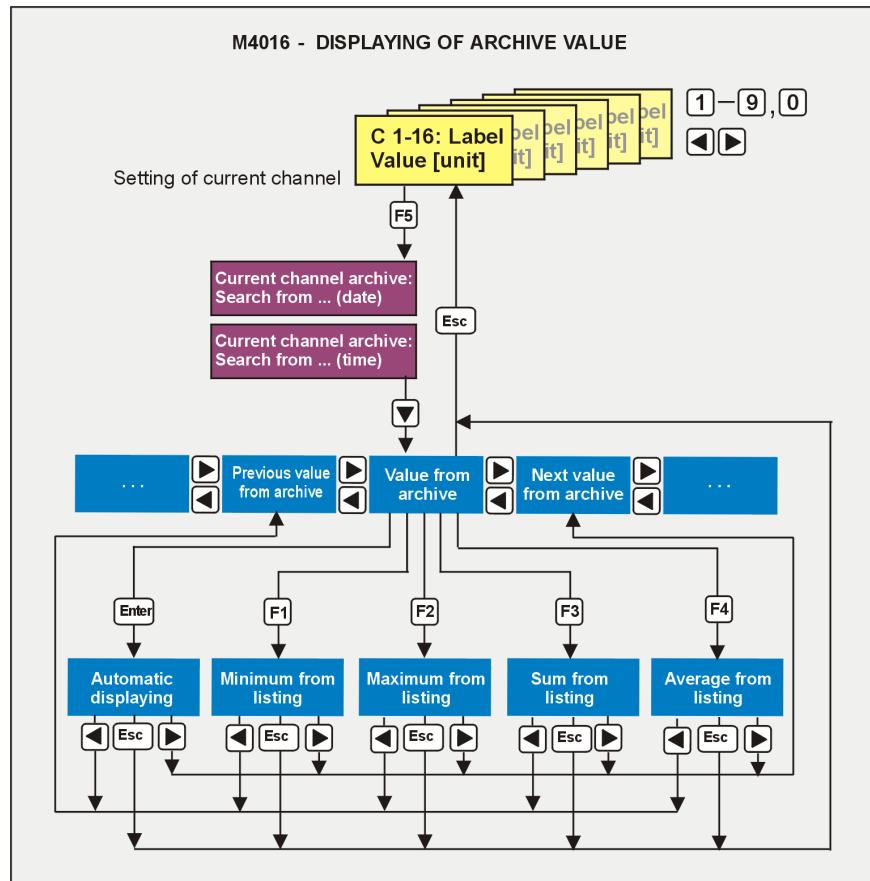
Picture 2: Service structure for recalling of archive values

Statistical values of displayed data

Pressing of keys from [F1] to [F4] whenever the user can display calculated values (Minimum, Maximum, Sum and Average) for displayed period of time. If the values are displayed automatically, it is necessary at first to set the displaying with key [Vstup]. After checking the values it is possible to continue displaying of archive values with key [Vstup] again.

Signalling of archive searches

While archive values are shown on the unit display **an asterisk is blinking** in the left part of the bottom line.

2.5. Main menu INFORMATION

It is the first menu after pressing the key Vstup *in basic mode. Another pressing* Vstup *allows input to menu. Browsing in menu can display various data as free memory capacity, parameter values, device production data etc.*

Browsing through information menu cannot change any of the unit parameters nor stored data.

Information menu controlling
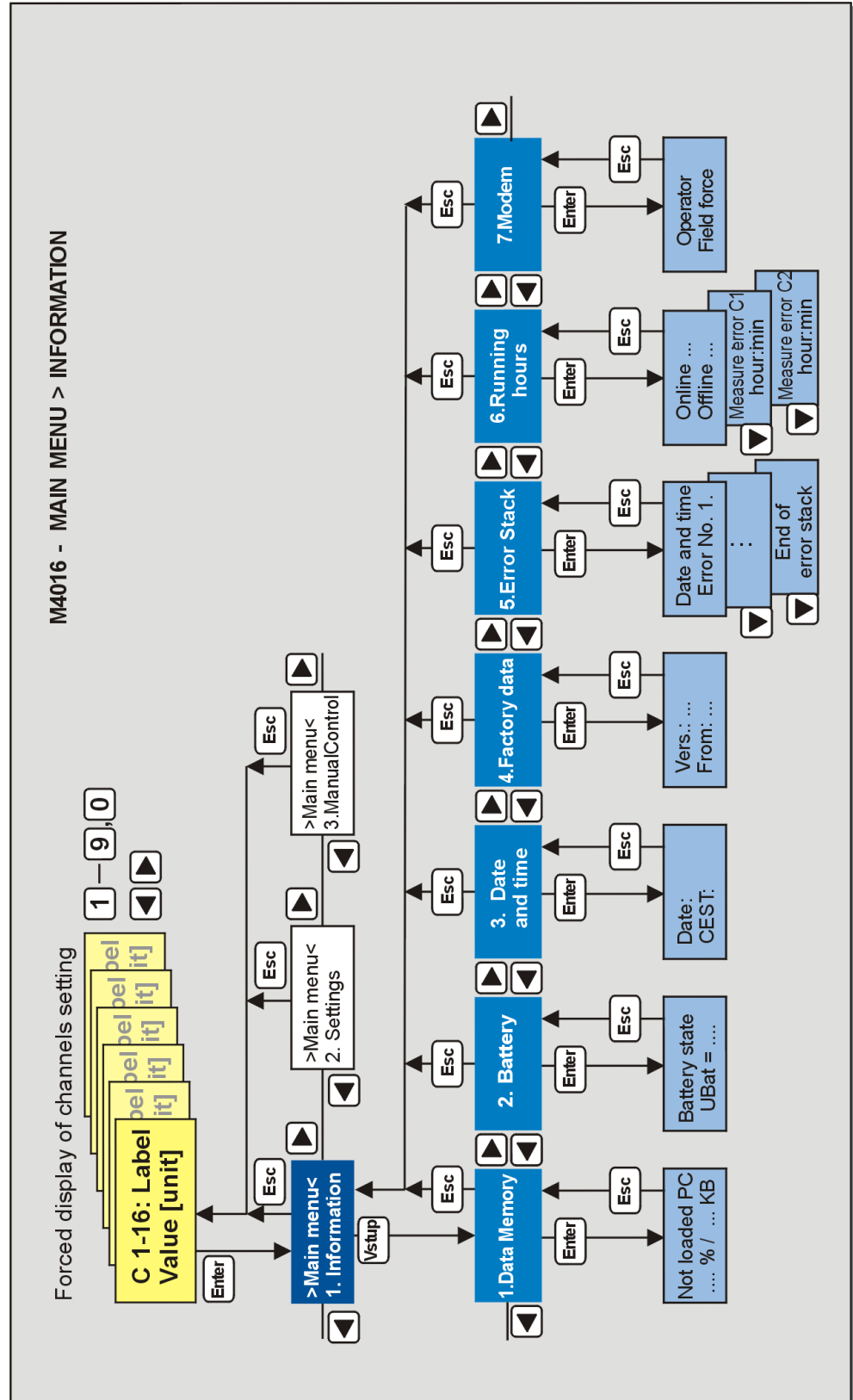
2.5.1. Data memory

Nepřečteno do PC
12% z 2032 kB

Submenu "Data memory" informs the user about total data memory capacity and percentage using of memory. Using of memory or memory saturation means data volume, which have not been transferred to PC with respect to total memory capacity.

Internal memory

Archive values are stored in cyclic mode. The oldest data are continuously deleted with new data. Immediately after data transfer to PC drive the "Not loaded PC" is 0%.

The oldest archive data are lost, if it is not transferred to PC and memory is full. The unit memory is always full of the latest data.

2.5.2. Accumulator

Extern nap. OK
UAku=12.75V

This menu item shows accumulator voltage and informs about connecting of external power supply of the unit.

If external power supply is interrupted the label **Power off** is shown in upper line. The same time warning sign is cyclically displayed.

2.5.3. Date and time

This submenu is applied to checking of system data and unit time. Date and time are changed in menu **Setting➔Parameters➔Date and time** only.

Throughout the year data are stored continuously by winter time, but they are displayed by winter or summer time.

2.5.4. Factory data

Verze:MCPU 1.01
Ze dne 28/08/03

Selecting of **Factory data** the user can find out the device type, firmware version and date of its creating.

2.5.5. Error stack

The Error stack is used for record of unit errors, so-called "System errors". An error codes are stored in the Error stack together with dates and time, when the errors took place. It is especially important for supplier service actions.

Max. 15 System errors are recorded in the Error stack. Repeated pressing key `Vstup` allows displaying continuously the System errors. End of displaying is signalized with message **"End of error stack".**

Chart 5: List of "System errors"

Name of mistake	Reason of mistake	Elimination of mistake
Low voltage AKU	Dead accumulator in a portable unit	Replacement of accumulator
Extern. feeder	Supply failure, source of voltage breakdown	Source of voltage replacement
Communication modem	Unavoidable error of communication with modem	-
WatchDog reset	Unavoidable error of the recording unit	-
Disconnected probes	Unexpired interruption of communication with probe	Checking of probe
Lith. Batteries	Battery of type CR2032 will be need to change	Replacement of battery
Production setting	Error parameters records to/from EEPROM	Checking of parameters

2.5.6. Operating hours – error of a connected sensor

```
Provoz      Vypnuto
  1685:44       5:07
```

Operating hours give information how long the unit has operated since beginning of installation and how much time from operating time it was switched off. That time is stated in hours and minutes.

The user can display information about error time of connected sensors to setting channels with every other press of the key ⌷Vstup⌷. Total displaying time must be multiple of archive interval of a channel. An error time counter is incremented at the end of archive interval only in case the error is running without interrupt for whole archive period.

```
Chyba měření K1
          12:20
```

Sensors errors of probes (ultrasonic probes USX000, electrochemical sensors M2001-E) are signalized with error codes, other sensors with outputs of analogue 4-20 mA currents loops usually signalize errors with current outside that bounds (usually 0 mA, 3,5mA or 23,5 mA).

2.5.7. Modem

GSM modem status is displayed with messages as follows:

```
Stav GSM modemu
Přihlašuje se ...
```

The message means, that the modem tries to log in operator network. When it is not successful in fixed period, it switches off modem power supply for short time and in a while the modem tries to log in again.

Possible reasons of unsuccessful logging in below:

- ▪ SIM card does not have unblocked security. Remove the SIM card from the unit and unblock it in a mobile phone (after unblock it is not needed to enter PIN code).
- ▪ An antenna is not connected to the unit or chosen operator field is low.

```
Stav GSM modemu
T-Mobile - CZ, 28
```

The message means, the unit has been logged in. It says an operator name and field strength, which can be from 1 to 31. Field strength is needed at least 10 for data transfer, for SMS it can be 5.

This message is good to call up during instalment of an antenna. It can find the right location of it.

```
Stav GSM modemu
Vypnutý
```

GSM modem is switched off. It can be caused with parameters setting (the modem shall be switched on only when messages are sent or in advance determined hours for limiting time) or it can be caused with voltage drop of accumulator or supply failure (and simultaneously during permission of modem switching off in this cases).

In this case the modem can be switched on with a menu command for a short term:

Manual control -> Modem on –> Power on X minutes

2.6. Menu MANUAL CONTROL

It is used for manual setting of control of some unit parts. The setting is done only with device keyboard.

The "Manual Control" is opened, when the also possible through a PASSWORD (**Setting➔Parameters➔Passwords),** see picture no. 16. It prevents from changes of output values, which are important for running surrounding devices, depended on the M4016 unit.
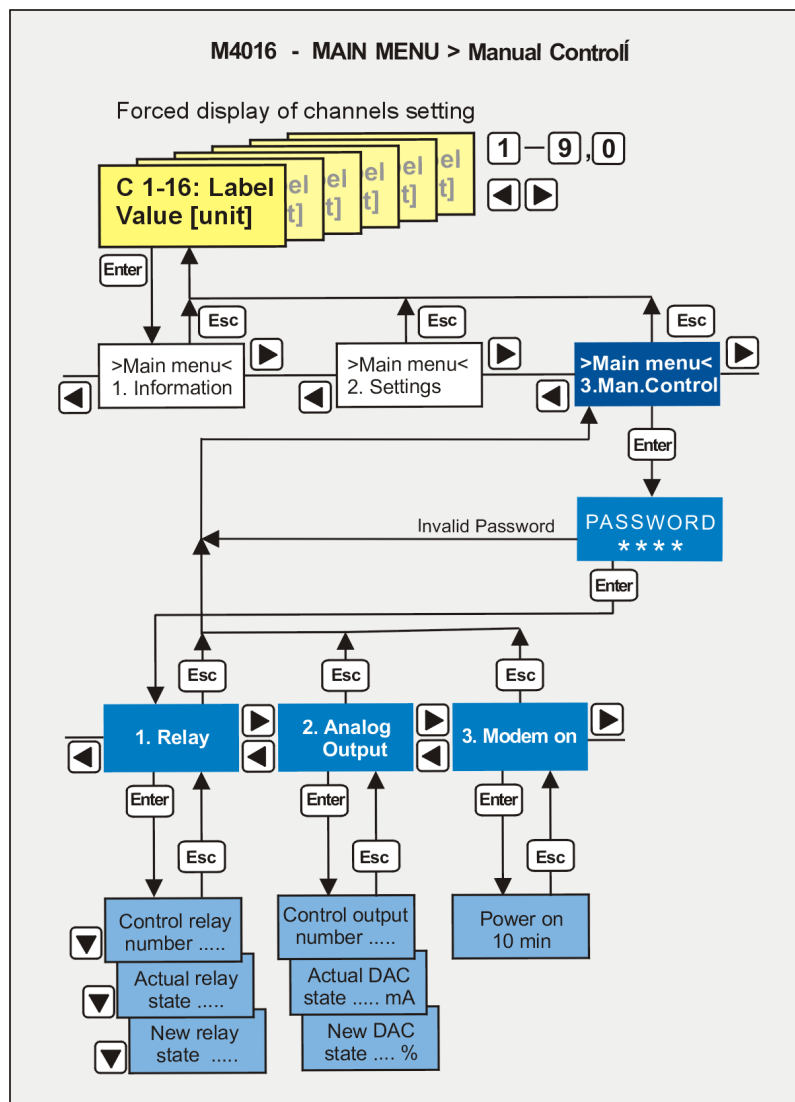
Picture no. 3: Structure of "Manual control"

2.6.1. Relay

The submenu controls relays connected to M4016 unit. All relays can be energized to manual mode. The manual mode is preferred for automatic control and lasts to its deactivation.

Activation and deactivation of the manual mode is set with keyboard, controlling SMS message or data communication (record to a register of binary outputs). The manual control is signalized with message on the unit display (Rn – manually switch on, Rn – manually switch off).

RELAY SELECTION

The user keeps at disposal 20 relays, two ones on digital connecting board DPD (Limit, Sampler), up to 12 relays in two SP06 relay units and 6 helping virtual relays. Any relay of them is possible to control manually with the unit.

When the user comes in the Relay submenu with key ⟦Vstup⟧ he is asked to choose the relay number (1-20).

ACTUAL RELAY STATE

The unit informs about relay state as follows:

0	**Switched off**
1	**Switched on**
0	**Switched off manu-ally**
1	**Switched on manu-ally**

NEW RELAY STATE

After repeated press of key ⟦Vstup⟧ the user is asked to enter new relay state. There are 3 possibilities, see below:

1	**Switch off**	The user should switch off.
2	**Switch on**	The user should switch on.
3	**Automatically**	The unit controls a relay automatically.

2.6.2. Analogue output

With the choice the user can set any current value (from 4 to 20 mA) of MAV420 module output. Current value is set percentage (0% = 4mA, 100% = 20 mA). On the display output current value is shown in mA and percentage and there is also displayed actual output state (Manual control).

2.6.3. Switching on of the modem

It is concerned manual switching on of switched off modem in time, when modem activation was not set. The modem is possible to switch on for 10 minutes. It is convenient during GSM communication test in outdoor M4016 units, which use GSM transfers only for limited time (time control of GSM modem switching on).

2.7. Main menu SETTING

Parameter setting of M4016 unit can be done with a device keyboard as well as with a connected PC with help of program MOST2.0. In this chapter the parameters setting through keyboard will be described.

Parameters setting with program MOST2.0 will be explained in chap. 3.
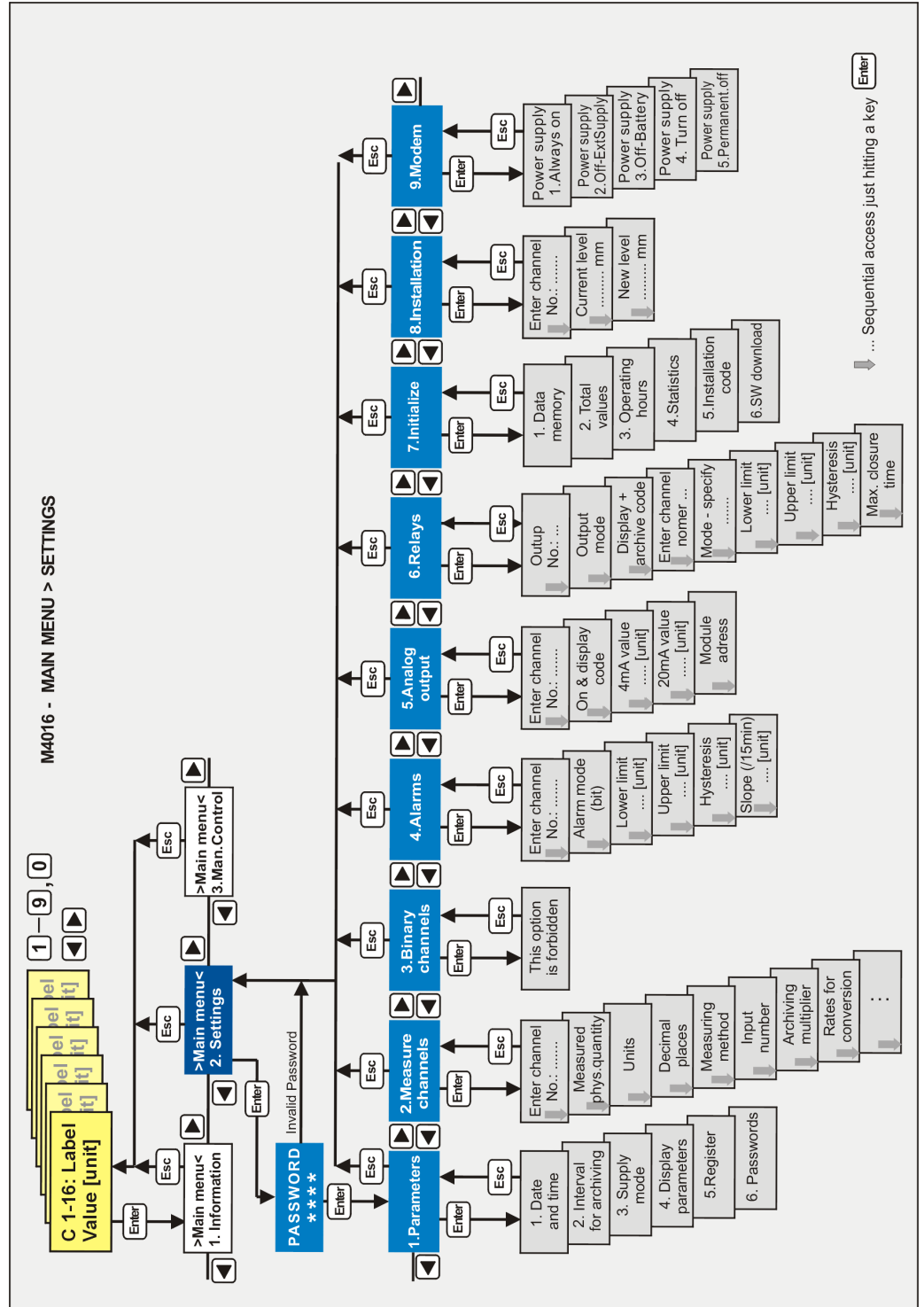
Picture no. 4: Structure of SETTINGS menu

The SETTINGS menu is opened after press of keys [Vstup], [2], [Vstup] in basic displaying mode. The above picture describes SETTINGS menu structure including keys for submenu movements. The access to submenu can be allowed only with PASSWORD. It can prevent from error overwriting of parameters.

3. Parameter setting with program MOST

The parameter adjustment of station M4016 is the best possible with connected PC through program MOST. The station can be connected to PC directly with a cable by means of an interface RS-232 (from USB port through a converter, which can be ordered along with an unit), or a connection is made remotely via a net of GSM.

3.1. Program MOST

MOST (**MO**nitoring **ST**ation) is universal communication, evaluation an adjustment program common to all devices produced by group of FIEDLER-MÁGR.

Permanent UPGRADE and DEMO version
In case you have bought a licence number you can get a current program version on www.fiedler-magr.cz. Without licence number the program works as DEMO version and does not communicate with devices.

Volume 2 of the manual
A detailed program description is shown in volume 2 of the manual. A station user, who would like to use large possibilities of its software, should get some information about controlling over the program before going on.

About MOST

MOST2.3 version
Communication and evaluation software
for monitoring unit MS16

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S.N. ELEKO

[OK]

Program MOST is not a standard part of the current delivery of the M4016 station.

3.1.1. Basic rules

Basic rules of MOST program controlling:

- At first a PC and the unit must be connected physically. After that a software connection is needed to ensure through a menu in the "Communication" icon or the "COM" icon or the "Telephone" icon.

- At the beginning of work the parameters should be unloaded from the connected device (if you do not work with default parameters).

- The new parameters must be saved in the device after a parameter adjustment. It is possible trough a menu in the „Communication" icon or to use this icon.

- As well the adjusted parameters are recommended to save in a file on the PC drive.

3.1.2. Connection

Cable connection
A suitable sort of a connecting cable (so-called Nulmodem) is part of MOST program delivery.

Connection trough modem
A parameter adjustment and data unloading are possible to do remotely through GSM modem building in a station. A window called „Parameters of communication through modem" shows typical parameter values, which are setting automatically during installation of MOST program.

Parameters of communication through modem

Initialization command (AT) :

AT+CBST=75,0,1

Dial
Max. time for connection:
60 s

Number of repeating:
5

Pause between Dialing:
30 s

Communication PC - unit
Max. time for answer:
2500 ms

Number of repeating:
5

Pause between messages:
25 byte

[OK]   [Port]   [Cancel]
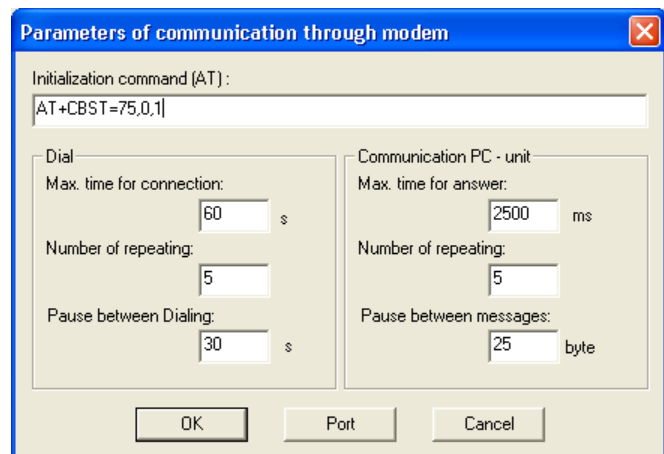
Program MOST needs to have an authorization for this way of connection (an active phone icon). It is authorized if there is entered a licence number during a program installation.

3.2. General parameters

General parameters adjust characteristics of data memory and activity memory and determine of station behaviour and a station adjustment during a normal running.

The unit shows the device label at the beginning of SMS and to a data file.

If the password value is different from 0, the access is blocked.

Multiples are possible for various channels.

Starting day time for daily flow calculation and for a change of daily regulator curves

Filing of SMS including a text, a phone number, and a date.

The periodic display of a setting channel. Zero value breaks up a cycling.

Time period for switch off of a backlight is counted from last press of any key. The backlight is permanent switched on if the value is zero.

The unit can be slept. Sensors are not supplied with power. One measuring cycle only is made (at the end of an archiving period).

A protection against concentrated moisture (inside heating).

Main parameters - Sewage-Krumlov.prm

General | Channels A | Channels B | Relay | Analog | GSM | SMS

Device label
Sewage_example

ID number   1234

Parameter change password: *

Manual control password: *

Archivation
Base archivation interval   30   minutes
Day begins at 0 hour 0 minutes

☑ Sent messages
☑ Received messages
☑ Error and exceptional states

Communication speed and protocol

Network address   1

RS232   19200 ▼ Baud FINET ▼   Server
RS485 - sensor 19200 ▼ Baud FINET ▼
Output   2400 ▼ Baud FINET_SO on RS485 ▼   ..details

Time zone
☑ Automatic daylight saving time switching

Displaying
Period of display change   2   s
LCD backlight time   30   s
Permanent when external power ☑

Power supply
Power saving Never ▼
Analog meas. delay after power on 0.2 s
Test external power supply ☑
Analog in.power Unap ▼
Heating OFF ▼

OK   Storno   Použít   Nápověda

3.2.1. Identification

Device label The Device label can have maximum 16 ASCII figures, which described the device. It is used for visual check of an opened parametric file and a connected device. It is shown at the beginning of a data file and in a head of data table.

Identification number The value of this parameter has the same meaning like The Device label. The Identification number and concerned data are saved into the data file and determine uniquely an origin of the data. Therefore we recommend setting a different identification number for each unit. The parameter value can be chosen from interval of 1 - 65535. A server administrator quotes the parameter value in case using GPRS data transmission to an internet server.

Parameter change password Password value can be from 0 to 9999. The Zero switches off checking and allows unlimited parameter transcription. It is important to remember a password because nonzero parameter does not allow other changes of parameters without correct password.

Manual control password This parameter provides access to a menu for station control. It is possible through keyboard to turn on or turn off a relay, to control output current value (with connected MAV420 module). In case the unit works in power saving mode with turning off modem there is also possibility for short time to turn on GSM modem.

3.2.2. Data archive

Base archiving interval This parameter can be from 1 minute to 1440 minutes (1 day).

The interval quotes minute period, in which the unit saves average measured values of channels to its data memory.

Note: If the average is not required it is necessary to set a power saving mode of the unit. The measuring needs to be processed only at the end of archiving interval and this measured value is saved to the memory.

The particular channels can have to adjust their own archiving intervals, which are multiples of basic archiving intervals.

The station M4016 automatically determines time of the first record independently on setting archiving interval. For example if the archiving interval is 10 minutes and the station starts to measure at the 13th minute of hour, the first record will be at 20th minute and

then regularly after every other 10 minutes. The station does not record at 23th , 33th , 43th minutes.

Sent messages   When The Sent messages are ticked off information about sent SMS messages is stored in data memory (time of sending, a message text, a receiver's phone).

Note: Information about events is automatically fetched together with reading out data memory and stores in file with ending of *.dte. A file name with * is identical to the name of file with measured data.

Received messages   It is similar the Sent messages. When the Received messages are ticked off time of receiving SMS messages, messages text, sender's identification are stored.

Error and exceptional states   When the Error and exceptional states is ticked off exceptional states are stored in memory with events. The exceptional states can be a disconnection from supply or from a measuring sensor or a error smart probe signal.

3.2.3. Time zone

When the Automatic daylight saving time switching is ticked off after time change the unit modifies automatically its activity (controlling a relay, sending SMS messages) with accordance to that change. For example it will send SMS messages still on Monday at 8:00 for whole year. Data will be stored to unit memory according to winter time independently on time zone selection because of a time sequence of measuring values.

3.2.4. Displaying

Period of display change   The *Period of display change* in seconds quotes a period of displaying one measuring channel. A zero value turns off cyclic display of measuring channels and there is the last measured value of channel on the display.

LCD backlight time   When a fixed station and an external power supply are used *LCD backlight time* should be 0. In that case the backlight is permanent switching on. Backlight warm of 2W (approx. 0,15A * 13V = 2W) prevents moisture condensation in the unit and it is not necessary permanent to turn on internal heating (see 4.2.5. Power supply). On the other hand an accumulator is unloaded soon. That is why the backlight cannot be switched on with using the accumulator without charging.

Permanent when external power   The *Permanent when external power* can help with the unloaded accumulator. When this option is ticked you can set 0 in LCD backlight time because when there is external power failure, the backlight is automatically switched off.

Contrast LCD a brightness of backlight   Using a keyboard you can find in menu through **2.Setting -> 1.Parameters -> 4.Display paremeters** following parameters: Intensive light and LCD contrast. The both parameters are quoted as percentage of maximum possible value. Kontrast displeje is possible to set in basic displaying mode. Long pressing +/- (more contrast) and . /E (less contrast).

3.2.5. Power supply

The parameters, which influence unit power consumption, adjust conditions for automatic switching off of GSM modem and set a control unit economical mode. In that saving mode measuring is realised only before data archive.

Power saving   *The Power saving controls* a central telemeter unit activity, in period between times of data archive. When the saving mode is turned off (option "Never") the unit permanent measures setting channels inputs and in archive time it counts average of values, which were measured in archive period. When the saving mode is turn on a microprocessor and whole unit is working in a special mode of small power consumption (60 uA). The unit sleeping is interrupted only at regular measuring time of input signals, at the time of pulse receiving or at the time of setting input changes. The measuring time depends on setting data interval. After measuring and storing information about inputs the unit sleeps again.

Current unit power consumption without GSM modem and without connected sensors is about 10 mA.

Text external power supply   The *Text external power supply* allows the unit to control a presence of power supply voltage and according to setting economical mode to turn on or turn off GSM modem power supplying or to convert from permanent measuring to the saving mode.

When the *Text external power supply* is ticked the station is normally supplied with a network voltage source (or with another steady voltage source) therefore every power failure is logged up to a error recorder and to an event diary. After an interruption of external power supply a warning SMS message is sent from SMS messages list. That is why in case using of only   solder supply or accumulator supply external power supply testing is better to turn off.

Power supply AV With this option you choose power supply way of connected sensors. The voltage Unap means an accumulator voltage, +17V is an output voltage of a built-in step up DC/DC converter. If connected measuring sensors do not need this higher power voltage, we recommend the *Power supply AV* was turned off because of inconsiderable the DC/DC converter power consumption.

Heating Heating resistor 100 R in the unit M4016 can be supplied from external power source. The resistor consumes 1,9W during normal external voltage 13,8V DC. It is enough to increase the inside temperature by approx. 5°C above the outside temperature and to prevent moisture condensation in the unit.

3.2.6. Communication speed and protocols

The station M4016 has 3 types of interface for data transfer:

RS-232 **Serial interface for PC with MOST programme**

Connection through RS232 works with transfer protocol FINET.

Transfer speed 19200 Bd is by default set in all devices of company Fiedle-Magr and is automatically also set after MOST programme installation.

RS-485 **Serial interface used for connection measuring sensors and probes** (ultrasonic level probes or electrochemical probes for measuring of pH and dissolved oxygen). Communication through this interface (terminals from 21 to 24 on the connection board DPD) runs over FINET protocol.

Output (DCL and RS-485 FIENT_SO) If the M4016 station shall be connected to another controlling system and M4016 will pass measuring data to this system, it will be better to program in controlling system processing of data only, which is received from unidirectional FINET_SO(send only) protocol.

It is not suitable to program the complete FINET protocol, which needs two-way communication.

The item menu contents an output protocol setting and setting of transfer speed for DCL or for DCL and RS485 together (DCL is abbreviation for **D**igital **C**urrent **L**oop and it is digital data output to 0/20 mA current loop – 20 and 26 terminals on DPD board).

FINET_SO normally sends actual setting channels values and balance values.

SP06 relay switching units, MAV420 analogue output modules and external display for displaying measured values are possible to connect to DCL.

DCL is unidirectional and do not able to receive data. The station sends data in regular intervals determined according to number of measuring station channels. One sending cycle always comes after all setting inputs are measured. A sending data format is controlled by FINET_SO protocol (**S**end **O**nly). A number of sending messages repeating is allowed to set in *…details.*

A default value, which indicates speed of DCL protocol sending,   is 2400 Bd and we do not recommend changing it. The speed of sending is fixed with SP06 relay units.

Network address M4016 *The Network address* is set 1 by default and it is not necessary to change it with the exception a network of units connected through RS232/RS485 converters to one controlling system (PC with MOST programme).

SMS communication among devices The other exception of network address setting is *SMS communication among devices* in case, which more controlling units is connected to one controlled unit.   Network addresses of the controlling units should be set to extend of 1-4.

3.3. Analogue channels setting

Analogue channels are basic of a data logger. Analogue, frequency, pulse and other signals are measured, converted to a physical value and stored in specific units. Free channels are possible to use for calculations (sum, difference and special functions) or to use them for storing data from SMS communication of devices. Each channel can have to set own archive interval and limiting values of alarms.

After press a right mouse button over chosen channel you can copy its parameters, enter or delete

Setting –step 1: Choose any free channel.

Step 2: Choose the Measured quantity.

Step 3: Choose the Measuring method.

Alarm activation can evoke sending of SMS message or converting of a basic archive interval to an excess interval

After exceeding of measured value above top limit or after falling below lower limit a limit alarm comes.

The channel Label will be shown on the unit display and in SMS messages (hooks, accents and others marks above letters are not automatically quoted).

Input on the connected board may not correspond to a channel number

Other important parameters depended on measured value and on measuring method method methodmeth-

Above limit interval takes down in detail interesting behaviours.

The Hysteresis prevents often alarm turning on and turning off.

The slope alarm is activated during increasing and falling above setting speed.

3.3.1. Setting procedure and basic parameters

Channel In a controlling unit every measured value is in one channel, which parameters and memory room are at the disposal of only that measured value.

A M4016 station user can set as many as 16 analogue channels.

Do not confuse a channel and an input. A signal incoming to an input is possible to be processed and archived with more channels. For example: We can measure a water level in an open flow either with an ultrasonic probe (the connection through RS-485) or with a pressure sensor (the connection through 4-20 mA). One station channel can watch a water level and the other can count an actual flow and record it.

Choice of channel sequence number is the first setting step.

Measured quantity The second step must be the choice of measured quantity from a list because that choice influences a list of units of measure and a list of measuring methods.

Measuring method A type of output sensor signal should be chosen in the measuring method list. Options are a current range, a frequency range and 3 digital protocol formats using by sensors of MS16 monitoring system. Abbreviations CL020/ASCII.U or ../ASCII.S mean a data transfer through the 0/20 mA current loop and through the DCL protocol (explained in a manual of ultrasonic probes).

"Channel via SMS" belongs among special measuring methods, which are used only in M4016 stations equipped with GSM modem. The setting is used for archive of values measured by distant M4016 station.

The measuring method called „**Computing function"** helps to watch counted running sums or running averages for setting time period in an individual channel. According to the

counted values a warning SMS message can be sent. An archive of that helping channel is usually turned off and it saves data memory.

Units   For some values (for example pressure or flow) there is a large list of units, in which the value can be measured, archived and displayed. There is only one type of units in the list with other values as pH or temperature.

Number of dec.   Maximum possible extension, which measured value can take, is 65535 for integral numbers and it decreases decade with increasing number of decimal places. Maximum possible extension of bipolar values (for example temperature or voltage) takes half quantity of it. It results from 16 bit archive of measured actual values.

Label   Twelve figures long label of setting channel will be shown on a display and be transferred with data in SMS message format. It will be transferred with data to PC during loading of archive data.

Input   The input number on the using connected board. According to in advance chosen measuring method the MOST program submits only the inputs, which allow the chosen measuring method.

With option of the **485/FINET measuring method** the field for enter of the input number is not active and the user is asked to set the parameters as follows:

RS485 Adr.   It is regarding the network address of the measuring probe. The producer sets default 1. The probe address is used after connecting more devices to one RS-485 interface.

RS485 channel   It is regarding the sequence number of probe inside channel. A detailed description of inside channels is given in service instructions, which are enclosed to every probe.

The following chart quotes a probe inside channel summary (setting during choice of measuring method through 485/FINET):

RS485 channel	Ultrasonic probe of type USX000	ESX11 electrochemical probe
1	Distance, water level	pH, oxygen, conductivity, redox
2	Flow, volume	Water temperature
3	Air temperature	-
4	Water temperature	-

3.3.2. Alarms

The unit allows to set limiting and slope alarm parameters for every channel. For example: After channel activation it is possible more often to record measured values (as well as at other channels), to send warning SMS messages or to operate a setting relay.

Limit alarms   Setting limits determine range, in which measured value can move. After limits overrun by *Hysteresis* value the limit alarm is set. The alarm is turned off after moving measured value to determined range at least by *Hysteresis value*

Slope alarms   The gradient alarm is set after quick increasing or falling of measured value by set value per 15 minutes' fixed time.

3.3.3. Display on LCD

You can suspend from cyclic displaying the channels, which are not important for operating. You can also suspend a total sum (from start of installation to a date) of the balance values (flow, rainfall, pulses). The „DCL output" button is used for determining the values and the total sums, which shall be sent on the external display through DCL output.

3.3.4. Archive

Every channel of M4016 station can have the different *Archiving interval* set as multiple of *Basic archiving interval*. You can that way save station data memory and time of data transfer to PC.

When that parameter is zero, the determine channel is completely suspended from the archive.

NUMBER OF MEASURING SETTING

When the unit is permanent active (saving mode is not active), it measures one value for approx. 0,5 seconds. According to using channels it is possible to deduce total number of measuring in one archiving interval. An arithmetic average of all measuring in the determine channel is stored at the end of the archiving interval.

The *Archiving interval* and option of the *Saving mode* can help you to decrease number of samples for average counting or store a result of one measuring processed at the end of the interval before storing.

Examples of parameter setting follow:

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

    Basic archiving interval = 30 minutes

    Archiving interval = 30

    Saving mode = „Always"

Example B: Storing of average value counted in every 30th minute for whole archiving interval

    Basic archiving interval = 30 minutes

    Archiving interval = 30

    Saving mode = „Never" (or „During low AKU voltage", „During supply failure").

Number of measuring for average counting is determined by number of using station channels. When there is more using channels, measuring of a determined channel will be processed less often.

Example C: Storing of average value, counted from five measuring (stored in every 30th minute)

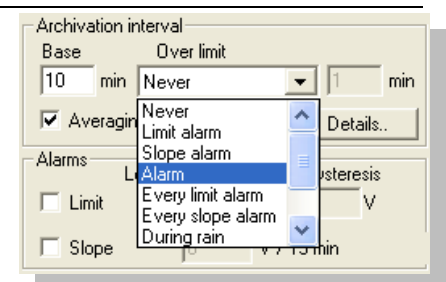   Basic archiving interval = 6 minutes

    Archiving interval = 30

    Saving mode = „Always".

OVER-LIMIT ARCHIVING INTERVAL

Starting conditions for over-limit archiving interval are quoted in the chart below. Its setting allows to record in detail for example course of flood surges in the river or progress of pollu

tion (set according to channel measured pH).

Above-limit interval (there is 2 minutes in the chart) can be started not only by activating of the alarm in the own channel (see the chart) but also an alarm in another set channel („Every …" conditions) or at the beginning of rain. After that it can record minute rainfall and in that way it can show intensity of rain in the course of one rainfall.

Suppressed record of unimportant data Setting of archive parameters allows for example to suppress record of unimportant low values and store only values, which passed across adjusted limit.

Example: While measuring of water level to store only values above 200

    Basic archiving interval = 10 minutes (in a basic parameter window)

    Archiving interval = 0 (in a channel window)

    Limit alarm is set (lower limit = 0, upper limit = 195, Hysteresis = 5)

    Over-limit starting condition: Limit alarm

    Value of over-limit archiving interval = 2 minutes

3.3.5. Parameters for specifying

Important step in setting of recording channel is inciting of a window with specifying parameters.

The shape of the window and parameters type, which the window contains, depends on a chosen measured value. The window for setting of flow measuring in an open profile is different from the window for temperature measuring. The window for temperature measuring is much simpler.

The setting of specifying parameters for some measured values is explained below:

EXAMPLE 1.: MEASURING OF WATER LEVEL

Signal proportional to water level or level calculation from distance
Such setting depends on way of level water measuring. The ultrasonic probes made in past (SX000) emitted digital signals proportional to distance of water level from the probe. Therefore lower range needed to be quoted from that the receiving value was deducted so that water level could be measured (distance and level are inverse against each other). New types of probes with ASCII.U protocols allow setting output signals proportional to distance and water level.

Also diving pressure probes for measuring of water levels emit signals proportional to water levels above probes and therefore the window with specifying parameters was completed with possibility to choose a type of input signal proportion.

The above chart shows typical setting of specifying parameters during measuring of water level with ultrasonic probe, which emits distance of the probe from water level.

Lower range
The *Lower range* is a specific parameter for ultrasonic probes and its value often corresponds to maximum measured range of probe.

Delta
The *Delta* helps you to move zero value of water level. The additive coefficient A_0 of a correction equation is the same.

Zero zone
Value of the *Zero zone* quotes zone of insensibility, in which the signal will be reset. That way you can filter round signal disturbance.

Strmost poklesu

3.4. Setting of binary channels (binary inputs)

Forty binary channels are established for record of runs or error state of pumps and other binary information. Resolution during storage of state change is 1 second and 1 minute for operating time.

After press a right mouse button over chosen channel you can copy its parameters, enter or delete

You can choose here:
1) Own input at the connecting board
2) External input in JDV16 units
3) Relay state (from

Parameters for communication with JDV16 through RS-485

The channel Label will be shown on the unit display and in SMS messages (hooks, accents and others marks above letters are not automatically quoted).

On the display you can change ON to OFF with operating input

Display of successively counted time of switch-on with resolution of minutes

Not setting with inputs, which often change their state

Label The *Label* has the same meaning as in case using analogue channels, it means that the Label is shown on the display, in the SMS message and transferred with measured values to PC for processing.

Mode With the *Mode* you choose binary input source. The source can be the M4016 unit, which contains to 8 binary inputs on the DPD board or it can be first or second JDV16 module of binary inputs (the module is connected with RS-485). The special input "device" can be also SMS message sent from another M4016 station.

Negation The binary input is not normally active (there is shown OFF on the display). When the input is connected to an earthing terminal (with a relay contact, with an open collector), it is activated (displayed ON). In some cases it is suitable to change the order of OFF and ON. For example while using of a break contact of fault signalling relay to display an active failure with ON.

You can tick the *Negation* field for above mentioned change.

Display on LCD Ticking of the first option includes a channel in cyclic displaying in basic mode of the M4016 unit. The *Operating hour's* option shows channel state (ON/OFF) and total time (in minutes) of switch-on channel from station installation to a date. For example if a binary channel is set to watch a pump running, according to operating time you can find out whole pump wastage or compare runs of pumps.

Save time of channel state change Ticked option allows storing all state changes of station binary channels. Switch-on or switch-off contact, current protection failure of a machine, failure of a building security and other reasons leading to state changes of some binary inputs will be recorded to the station data memory immediately after the events, including data and time (with an accuracy of seconds).

The parameter of *Basic archiving interval* is not used for binary channels.

3.5. Relay setting (binary outputs)

M4016 unit can control two own relays in the board PDP (R1 and R2) and other 12 relays (R3-R14) in two SP06 switching units by means of RS485 or DCL communication. There are at disposal other 6 helping relays (virtual relays R15-R20), which of outputs can be engaged as inputs of real relays for creating of logical and time functions.

Setting step 1:
choose a setting relay from the list

Setting step 3:
Choose a controlling channel from the offer of setting channels – for LIMIT and ALARM modes

Setting step 4:
According to selected mode set numeric parameter values: limits for LIMIT and ALARM, times for time relays

The function inverts switch-on condition.

Setting step 2:
Choose a run mode for the chosen relay (Limit, Alarm, a sampler, a timer, and a logical condition)

Insertion of relay state (0/1) in cyclic displaying

It allows saving of switch-on and switch-off time of relay in data memory, with an accuracy of seconds (used for a sampling mode).

The suitable chosen function prevents from damage of connected machines and permanent switching-on pumps, etc.

Working relay mode — All 20 relays are equivalent. According to the next chart every relay can be set for one of working modes. You can control together several relays with one channel.

LIMIT MODE

It is a basic mode, in which the relay is controlled in accordance with limit value of a control channel. The parameters are shown in above window.

Control channel — In menu you can find a list of setting analogue channels.

Operating of relay — When monitored value is raised above the *Upper bound* increased by *Hysteresis* or when it is decreased *to* the *Lower bound* reduced by *Hysteresis,* particular relays are operated*.*

Switch-off relay — On the contrary the operating relay is switched off, if the value is decreased below the *Upper bound* reduced by *Hysteresis* or if it is raised to level of the *Lower bound* increased by *Hysteresis* .

Switches when out — The two above items (*Operating of relay* and *Switch-off relay*) describe the situation, which happens, when the option *Switch when out* is ticked.

The relay will be switched on between bounds (inverse function), when the option is not ticked.

Examples of setting — In the above window there is shown the setting of relay no. 1 parameters, from which follows:

The relay will be operating when flow is higher than 250 l/s and it will be switched off when flow falls to 150 l/s.

Typical applying — Keeping water level in a reservoir or a tank with one filling pump

Example: The pump shall turn off with level high of 5 meters and turn on after falling of level to 1 m: Lower bound = 0 m;   Upper bound = 3 m;   Hysteresis = 2 m;
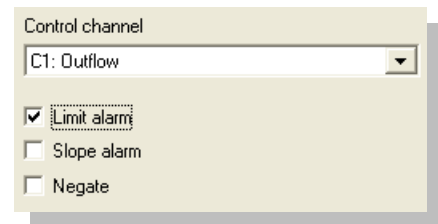
  "Switches when out" option is not ticked.
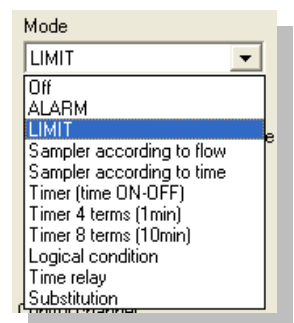
ALARM MODE

ALARM mode is similar to LIMIT mode. Bound values are set in the window of analogue channel in part of Alarms. It is useful, that the set relay can be operated also after activation of the slope alarm.
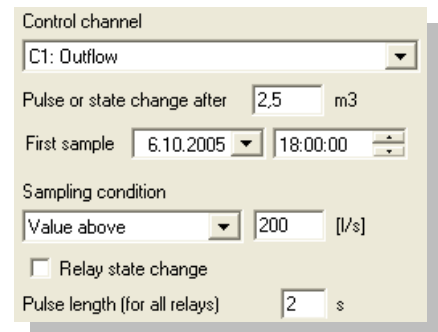
In *Control channel* menu you can choose one of the active channels or activate a relay during active Alarm in any set channel with option "all channels"

SAMPLER MODE ACCORDING TO FLOW – PULSE OUTPUT

The Sampler mode is used to controlling of a sampler so that takings would be done proportionally according to flowing water volume. The set relay can be used for information transfer about flowing water volume to a superior system (for example a pulse after each 1 m^3).

After you chose the mode you can find parameters in a right low part of setting RELE window (see the next chart).

Control channel It should contain balance sum values (flow, rainfall, pulses).

First sample This time condition is used especially in controlling sampler. For example the device can be set during a day, but the sampling itself will start from entered time and date. It enables to synchronize several devices gradually installed on one river or start night sampling of wastewater, which is drain from industrial enterprises.

Sampling condition The sampling can be conditioned by reaching limit value of controlled channel. If values are lower or higher than the set value, the device will not make samples.

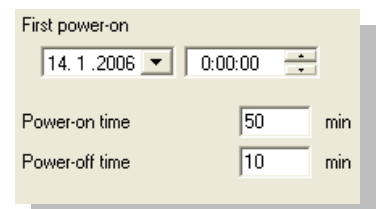**SAMPLER MODE ACCORDING TO TIME**

Sampler according to time is analogical to previous mode. The parameters are similar. The difference is that controlling channel can be a flow as well as whichever analogue channel. And the sampling isn't proportional to the flow, but periodic (according to minute intervals, which can be set).

Not only delayed starts of sampling, but also limiting conditions for sampling remain unmodified.

Application: The sampler starts than the limit value of pH is reached or periodic starts of pressure water using for cleaning electrochemical sensor (pH, oxygen, etc.).

TIMER MODE (TIME ON/ OFF)

This mode allows you to set selected relay for periodic cycling with fixed on/off time. It is possible to set constituent periods to much longer intervals than you can see in the picture beside this text (daily or monthly cycling). The maximal value of one interval is 65535 minutes and it equals to 57 more than days.

TIMER MODE – FIXED TIME

There are two timer modes with fixed time of turning on available. The first of them includes 2 On and 2 Off times, which have minute tolerance of setting. The second from timer modes includes 4 On and 4 Off times with 10 minute tolerance of setting (study the picture).

You can swap On time for Off time in the header.

LOGICAL CONDITION MODE

Binary members This mode allows you to control relay according to current state in selected binary channels (Bn) and binary outputs (Rn). The station M4016 can operate with 40 binary channels (B1 to B40) and 20 binary outputs (relay R1 to R20).

Logical condition The controlling condition for switching relay can contain maximally 8 members Bn and Rn, which must be connected with operators AND, OR or NON. When the term is evaluating, AND enjoy priority over OR. Negative operator NON can be written before every member and it is also possible to make negative the whole logical term. But an evaluating program of the station doesn't support brackets. So if need to use brackets, you are forced to rewrite logical term in agreement with example below:

B1 AND (B2 OR B3) = B1 AND B2 OR B1 AND B3

or you can use The De Morgan rule in complicated cases:

(B1 OR B2) AND (B3 OR B4) =

**NON(NON(B1) AND NON(B2) OR NON(B3) AND (NON(B4))**.

In the second case negation of the whole term will be made by ticking "Negation whole condition".

Writing of Logical condition In the logical condition equation for logical operators and operations, which are made by MOST2.0, you can use these symbols:

Symbol	Description of symbol
Bn	Number of binary channel n (n = 1 to 40)
Rn	Number of binary output = relay n (n = 1 to 20)
~	Negation (NON)
&	Conjunction (AND)
|	Disjunction (OR)

Simultaneous check of writing During your writing of logical condition into the special window the program MOST2.0 will particularly lead you. The information gradually displayed below the equation textbox will notice you to invalid operators, unknown logical functions, reaching the limit of operators etc.

Example of writing logical condition
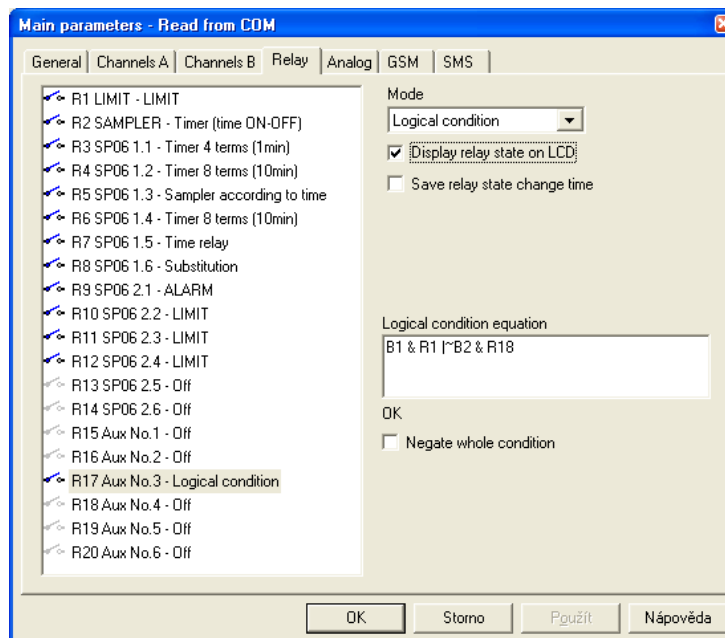
The logical condition **B1 & ~R1 | ~B2 & R18** will be satisfy, if the binary channel B1 is set to one and relay R1 is not switched on at the same time or if channel B2 is not set to 1 and virtual relay R18 is switched on at the same time.

While you writing a logical condition, don't forget that you can use binary channels and relays as operators and not directly pulse-binary inputs on the connection board. Before using of input in logical condition you always must set first binary channel for monitoring relevant input.

Application of auxiliary R15 - R20 In case of longer and complicated logical condition it is possible to use auxiliary virtual relays or unused relays R1 to R14 for gradually creation of logical term, where outputs of one relay,   controlled by short and transparent logical term, are entering control logical condition another relay as logical member Rn. Individual virtual relays can "substitute" brackets in complicated logical terms.

TIME RELAY MODE

This mode allows you to control selected relay by output of another relay in three different time functions: 1. Delayed switch on (Late ON), 2. Delayed switch off (Late OFF), 3. Mono-stabile circuit (MKO), 4. FLIP-FLOP

Control channel You can choose control channel from whole list of relays R1 to R20. But it is self-evident that it makes sense to choose only active relays and it doesn't matter if it is a real relay or auxiliary relay R15-R20.
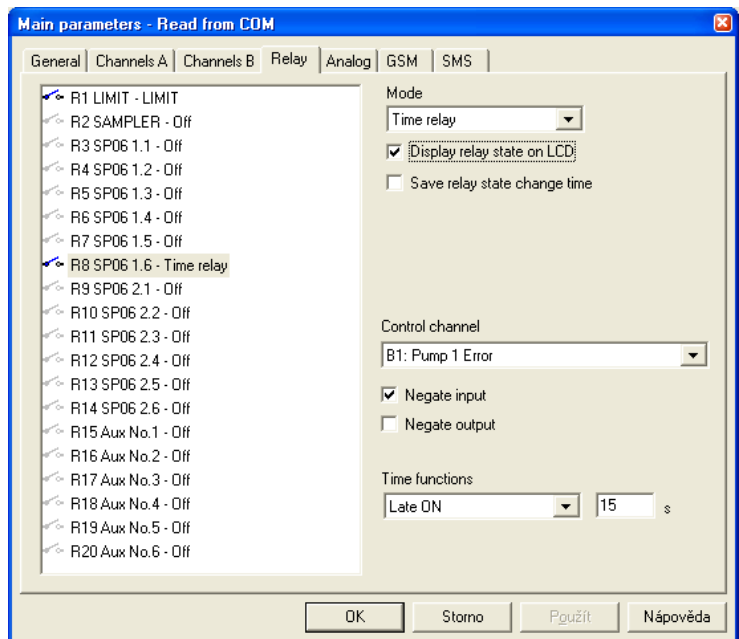
Negation of input The relay in time relay mode is activated by relay of control channel. If you tick selection "Negate input", the time relay will be activated by switching off control relay.

Negation of output If you need to invert output of time relay, just tick selection "Negate output".

Delayed switch on This time function delays command for switching on the relay for set value in seconds (picture above: relay R8 will switch on in 10 s from switching off relay R1). The time delay can be set in range 0 - 65535 s. The relay is switching off dawns in the same time as a change of control channel relay.

Delayed switch off This function is similar to the previous one. The set relay switches on immediately and switches off with variable delay based on control channel relay.

MKO The time relay will be switched on(off) for the duration of variable parameter (1-65535 s) from last switching on(off) of control channel relay. If control channel relay switches faster than is the set value of parameter, the control channel relay will stay permanently switched on(off). Words in brackets are valid, while the negation of output or input is active.

The time function MKO should be more understandable from the next picture.
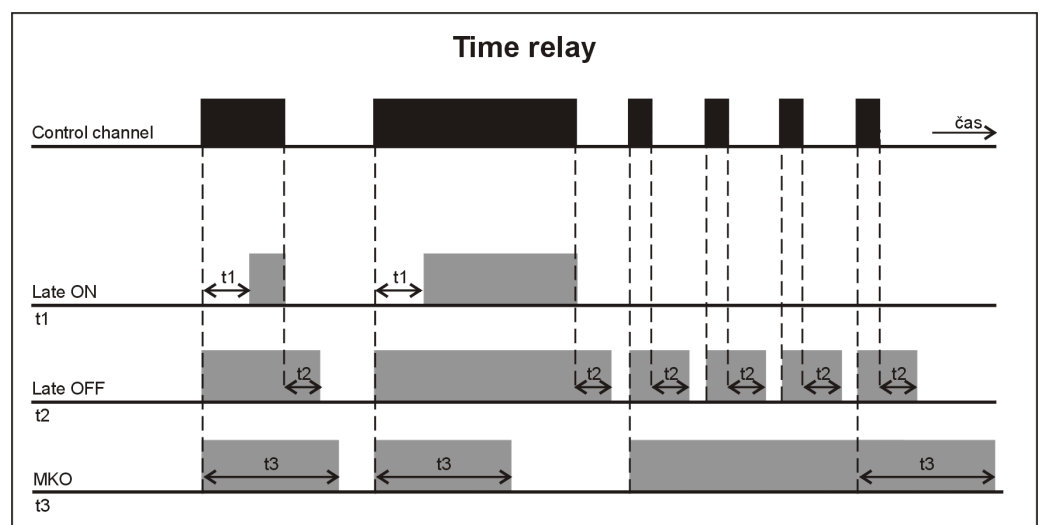
SUBSTITUTION MODE

This mode is useful to control two or more pumps or blowers. The idea is that the pumps are periodically changing themselves in operating. If any failure of pump engine occurred, another pump from one group will take over its function (this is an explanation of why is called the substitution mode).

Example:
pumping device

Typical example of controlling two pumps with substitution is shown in the picture below.
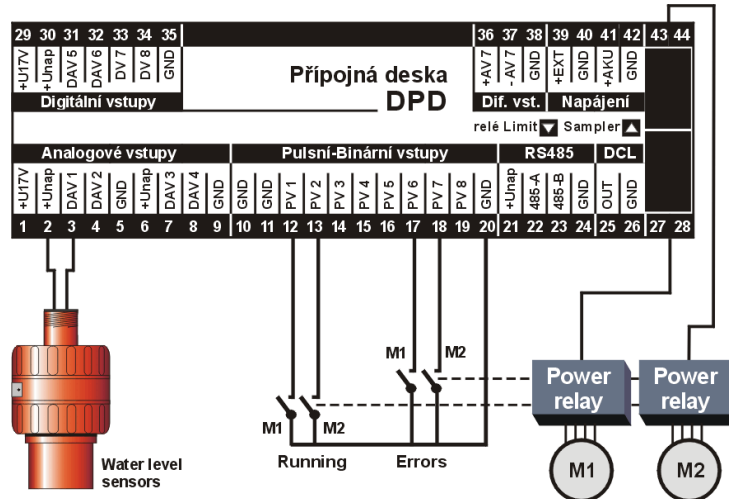
Ultrasonic sensor continuously measures height of water level in a tank and by set limits the station M4016 uses relay R1 (Limit) and R2 (Sampler) for regulating pumps M1 and M2. Normally pumps can change after each of pumping or in periodic intervals, for example daily.

Inputs for monitor
of operating

The signals of operating individual pumps are connected to inputs PV1 and PV2 in order to monitor the operating time. The number of operating hours and minutes of individual pumps is indicated on the station's display. The display also shows you a state of relevant binary channel (ON/OFF).

Inputs for failure

The inputs PV6 and PV7 are using for monitoring failures of pumps. The system allows you to find out, how long is a pump out of order (operating time) and when a failure begins and ends (recording of binary channels). You can also let the system send you warning SMS messages, when a failure appears or at the end of the failure.

Substitution group

If you have substitution mode active, the station M4016 manages to swap automatically functionless pump for another pump from their group. After removing failure the station will fluently get back to periodic changing of pumps. The number of pumps in one group is limited to a number of unused binary channels (of a relay). One single station M4016 can control up to 4 separated groups A, B, C and D.

Parameters modification

Parameters modification of relay in substitution mode is possible to execute only in program MOST. The window in the picture below responds to connection of two pumps in one group by previous example.

Group of relays

At the beginning we pick out singular relays, which may create one substitution group. And then set the same group name of each relay by using "Substitution group" box. According to picture below we picked out relays R1 and R2. Afterwards we chose group name A.

Limit
(switching on)

This function determines the logical condition for control the substitution relay, which is being set at the moment. From a list of relays select a relay in limit mode, which is controlled by current measured height of water level or by quantity of dissolved oxygen (for blowers) etc. To this purpose you can use one of auxiliary relays R15 to R20 in advantage.

If you want to engage in switching control by float-gauge or by other binary condition, you can find some information on the next page.

The same setting of function above (Limit) carry out also for remaining relays in the group.

Change

This function determines the changing condition for relay in one group. The changing can be done after each pumping or periodically timed.

Change after time If you need to set periodic changing by time, you should choose one of unused relays (auxiliary relay R15 - R20 best) as a timer (time On/Off) first. This mode allows you to enter the time of first switch-on and even complete period of switching. For example, we attempt to set daily switching, so we should set 1 minute as time of switching-on and 1439 minutes as time of switching-off. Afterwards we choose in box "Change" the relay R17, because it was set as timer (time On/Off), see the picture next to this text.

Changing after pumping Changing after each pumping is possible to choose analogous to previous time changing. But you will use relay R15 expect relay R17, because R15 is in Limit mode. The switching will turn up at the same time as a change of this condition from 0 to 1.

Combination of changing condition The program MOST allows you to compose complicated changing condition, which contents limit and time relays even states of binary channels. So you can easier define manual control transition between periodic changing after each finished pumping and periodic timed changing, if another logical or limit condition is satisfied etc.

Failure This option is intended for choosing a relay or a binary channel, which is set for monitoring failures. In other words, you should choose a setting binary channel or other relay, which prevents (in level 1) to switch-on here setting substitution relay. See the picture above: Binary channel B4 is monitoring failure of engine M2.

Next relay in changing The meaning of this option is evident from the name. Enter number of binary channel input (relay). If an impulse for changing or a failure occurs, this input will be the next one working after the input, which you are setting now. The next input (relay) must be from the same group, for completeness.

Change after limit This option is useful, when relays periodic time changing is active. If it is set, the changing will not run till the correct pumping ends (condition of switching on is 0).

Delay of changing The time in seconds you will enter to this option determinates how long will the system wait till it switches on next relay after switching off a relay from the same group. The maximal value is 250 seconds. This parameter ensures a fluently working termination of a pump or blower before another one in order starts working (if you use periodic time changing without waiting on condition terminating = "Change after limit" is not active).

Example: **Setting of switching condition at control with two floating switches**

Often used control of several pumps in one tank is based on two floating switches. The top float will be connected to pulse input and we will assign it binary channel B5, for example. The bottom float will be connected to pulse input and we will assign it binary channel B6, for example. The switching condition of the relay R1 (it was R15-LIMIT in our previous example) is changed on this logical condition:

      B5 & B6 || B6 & R1 (likewise for relay R2: B5 & B6 || B6 & R2)

Relay R1 might be switched on, if both of the floats B5 and B6 are switched on (a tank is full) or if relay R1 and the bottom float is switched on. So once switched on relay from fully tank is holding out itself for the tank is completely empty, then it switches off B6.
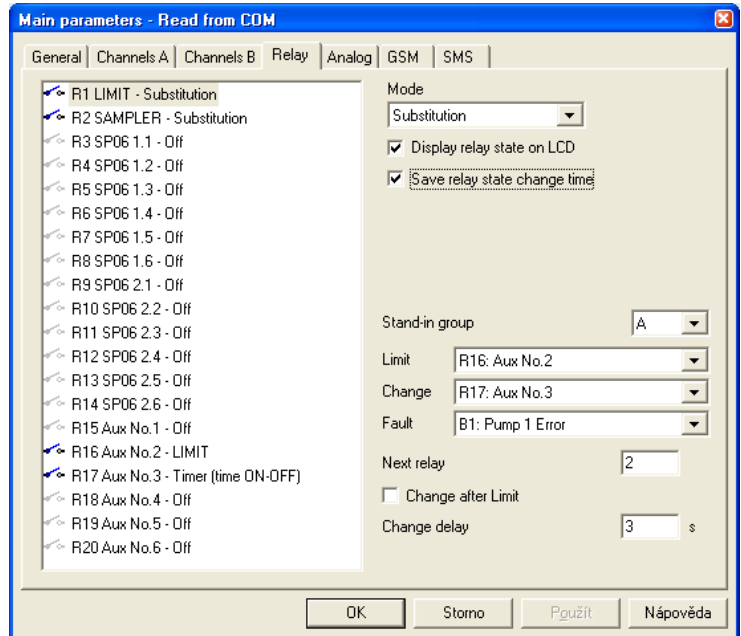
3.6. Setting of 4-20 mA output current loop

The external modules DAV420/DIN are connected to RS485. Through them you can assign to each binary channel one or more 4-20 mA galvanic-separable active current loop outputs.

Step 1 of setting: Select control binary channel for an analogical output from the list.

Notice: M4016 allows mathematic functions over channels. So you can send sum or difference of used channels, their moving sum, polynomial correction, etc. on unused channel. Then this unused channel can serve as a control channel for an analogical output.

Step 2 of setting: Enable sending of control commands for DAV420/DIN module

Set the limit values of control channel.

This option allows the station to add information about present value of output current in the loop to the cyclic displaying.

Address of concrete DAV420/DIN module in the RS485 network (The modules have individual signification by switches)

Main parameters - Read from COM

General | Channels A | Channels B | Relay | Analog | GSM | SMS

- C 1: Level [mm] - Level test
- C 2: Rainfall [mm] - Flow
- C 3: Channel not set
- C 4: Channel not set
- C 5: Voltage [V] - Power
- C 6: Channel not set
- C 7: Channel not set
- C 8: Channel not set
- C 9: Channel not set
- C10: Channel not set
- C11: Channel not set
- C12: Channel not set
- C13: Channel not set
- C14: Channel not set
- C15: Channel not set
- C16: Channel not set

☑ Enable analog output

Min. value for 4mA   0   [mm]
Max. value for 20 mA   200   [mm]

☑ Display state on LCD

Module address   1

[OK]   [Storno]   [Použít]   [Nápověda]

None of connection boards of the station M4016 have terminal with 4-20mA current output, but after all you can control up to 16 this signals from one station. These signals are usually used for control frequency converters or for sending information about a measured value into a superior system.

MAV420/DIN MODULE

Each of MAV420/DIN modules includes one 4-20 mA active galvanic-separate current output, one switch for module address setting (under the red transparent panel) and one RS485 serial interface. This interface mediates connections to the station M4016.

Module power supply You should find the power supply for the module on the connection board from terminals 21 (+Unap) and 24 (GND) via one cable, which also includes data conductors A and B. If you connected a lot of modules to the station M4016, it impends that the total consumption will negatively affect the system (the influence of galvanic-separate current loop and the factual consumption of control microprocessor can cause that the total consumption with increase up to 50 mA). In this case is better to connect all modules to independent external power supply 12V / 1A. More information about MAV420/DIN modules see page **Chyba! Záložka není definována.**.

3.7. Parameters of GSM communication

If the hardware of the station M4016 includes built-in GSM module, MOST2.0 can recognize it itself and during setting parameters will offer you also GSM communication parameters. These are divided into two groups. In the first ... is general settings of GSM parameters and informative SMS messages. The second ... provides setting of warning SMS messages and a phonebook.

Modem can be permanently on or for purpose of saving energy can be active only for predefined

Confirmed parameters and indexed SMS of communication (tank – pump station)

If the station receives query INFO, it compiles SMS from this command line for an answer and sends the SMS back to this phone number. Don't use more than 6-8 commands per line, because of SMS length (160 chars).

Set the time and day of the week, when you wish to receive information SMS.

Password for query SMS (built from codes for query)

Password for command SMS. Password can be the same. Command SMS must begin by password.

This feature avoids unauthorized accesses and queries

Help for query and command codes

Command line support daily or monthly sums, maximums, minimums, etc. Caution: character limit is 160 per SMS.

Calling parameters for setting periodic calls from the station

The general parameters of GSM communication needn't be changing expect access passwords, updating of the pre-paid card (special button) and two command lines for compiling of periodic and informative SMSes. You should write these command lines by actual used channels and by your demands. For study the list of available codes for the command line see page 39.

Notice: The station M4016 will answer also at any inbox SMS, which includes correct password at the beginning and then the direct codes separated by commas.

MODEM POWER AND BATTERY SUPPLY

The mode of control consumption allows you to run the station and the GSM module only from one own accumulator without attendance of external power or battery supply, but it causes some limitations. To have a long period between accumulator changes (month and more) we recommend you to have switched off the GSM module for most of time and switch it on if only it might send a SMS or in fixed time. If the modem is active, you can make connection with it and download measured data or modify setting parameters.

Frequency of switching This feature provides setting period of the modem network logging. If the frequency value is more than 1x per day, the day will be divided into several even intervals so that the first switching on runs in a defined hour and minute.

Power supply If you make use of power supply, you should set "Permanently ON" mode. More information about current consumption of the GSM modem and also about the individual modes of power and battery supplies was mentioned in chapter **Chyba! Nenalezen zdroj odkazů.** on page **Chyba! Záložka není definována.**.

3.8. SMS communication

The automatic sending of preset alarm or informative text messages in mobile phones of defined people circle makes from the telemetric station M4016 very useful machine, which exceeds mere monitoring of technology, data-loggers or simple control unit. This fact is more raising by ability of receiving query or control SMS messages. They allow sending required current compiled information or control relays in the connection switching unit SP06.

Delivering SMS The disadvantage of SMS communication can be delay between sending and receiving of SMS messages. Fortunately time out is hardly ever exceeded 30 seconds. Otherwise there are some critical situations added to this. The GSM networks are being overloaded during Christmas holydays, when people send congratulation messages, and during similar occasions such as exhibitions, etc. Then expect delays up to a few minutes.

3.8.1. List of authorized persons

The creating of the list of authorized person is a part of basic SMS parameters. The filled phone numbers will receive warning and informative messages. The dialog with phone book will appear after clicking on "Phone book" button in "SMS" parameters.

Group The concrete message sending is possible to direct on to specific group of persons. The message will be sending to them gradually according to the number of their row in the list. The program supports creating up to 3 groups of persons.

Authorizing If you tick the feature „Receive SMS from", the station will accept control and query SMSes from the selected person.

3.9. SMS dividing

This chapter will explain and descript the parameters of setting and types of SMS. The types of SMS are divided into two basic categories:

Tab. 6: SMS messages dividing

SMS sending from the station	SMS receiving in the station
Informative SMS	Query SMS
Warning SMS	Control SMS
Limit	
Fixed	

Informative, query even control SMS messages have the same group of codes. These codes define a content of transmitting information from the unit to the user's station or define a command, which might be executed in the unit. For more information about warning messages see chapter 0.

3.9.1. Informative SMS

The informative SMS messages are used for automatic sending information on demand or in periodic time from the station to one person or groups of persons. It's important that the sending is not dependent on the factual value of measured quantity unlike warning messages. Because the warning messages are activated by reaching set value, failure, alarm, low money-credit, etc.

PERIODIC SENDING OF INFORMATIVE SMS

Periodic sending Set the time you want to send an informative SMS in the "First send" box and then choose the frequency of sending SMS in "next" box. You can choose between monthly, weekly, daily sending or you can set a random interval settable in minutes. If you chose the option weekly or monthly, don't forget to enter a day in the week (month) in the "First send" feature, when the sending might be executed.

Query codes The content of the informative SMS is defined by a sequence of codes written in the command line „Sent message". The meaning of individual codes and their overview is on the next page. The individual codes are being separated by commas, spaces are not allowed and at the end of the code sequence can be neither comma nor dot (see the next picture):

SENDING SMS ON DEMAND

The second big group of informative messages makes answers to received query SMS messages. The station compiles an answer from query codes (see their list on the next page) and sends it back to an enquirer. For compiling of query SMSes is binding the same rules as for informative messages.

Password At the beginning of every query SMS must be a password to avoid unauthorized modification of parameters by third person. This password can be changed in "GSM".

We recommend you to save often used query SMSes to the memory in your mobile phone. Then you can load them easily and send in case of need.

3.9.2. List of query and control codes

M4016 is not CaSe-SeNsItIvE.

■ Query code   ■ Control command

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

B*k*	Actual value of binary channel *k* (1..40).
MH*k*	Operating time of binary channel *k* (1..40).
V*k*	Actual value of channel *k* (1..16).
Si*k*	Sum since installation of channel *k* (1..16).
SD*k*	Sum since morning of channel *k* (1..16).
SM*k*	Sum since the first day in this month of channel *k* (1..16).
SL*k*	Sum of last whole measured day of channel *k* (1..16).
SK*k*	Sum of last whole measured month of channel *k* (1..16).
SS	Sum of rainfall since the beginning of rain (only for first rainfall channel).
LV*k*	Last saved value of channel *k* (1-16.)
I*k*	Today minimal value of channel *k* (1..16).
X*k*	Today maximal value of channel *k* (1..16).
II*k*	Previous day minimal value of channel *k* (1..16).
XL*k*	Previous day maximal value of channel *k* (1..16).
U	Actual accumulator voltage.
PE	Number of errors in the error stack.
PO	Total sent messages.
PP	Total received messages.
Q	Intensity of GSM signal in range 0..31.
KR	Remaining credit of pre-paid card.
DIAL*n*	The station starts calling to n. item in the phone book.
R*r*	Display state of relay *r* (1..20).
RZ*r* *	Manual switching-on of relay *r* (1..20).
RV*r* *	Manual switching-off of relay *r* (1..20).
RT*x**	Time interval in range x = 0..1090 minutes for manual control of relay.
RA*r* *	Return to automatic control of relay *r* (1..20).
NA	Suppression of the station's answer to the control SMS (No Answer)

   * The control commands can have different password from password for acquiring information.

INFO query The specific query SMS is a short message including only one word "INFO" (it's not case sensitive). But this message has exception, it mustn't include password. The answer of the station to this "INFO" query is compiled from the codes including in the command line "Reply to INFO query". The query SMS "INFO" is often used by workers needing immediately know present value of some quantities and together with they aren't informed enough about creating any query messages. Hence the control command line should be written in respect to these workers and otherwise use pre-prepared, specifically compiled query SMS for normal working.

EXAMPLE

Query SMS

> **PASSWRD,V3,SD3,V4,U**

PASSWRD	… access code
V3	… query for value channel 3 (flow)
V2	… query for actual value channel 2 (water level)
SD3	… query for daily sum (flow volume) channel 3
U	… query for accumulator voltage

Answer: (Informative SMS)

> **NAME, V1=51,12 l/s, SD3=4255.8 m3, V2=1259 mm, U=12.62 V**

NAME … name of station (settable parameter).

Sending time You can add time and date of the station to a message. It will indicate you, when a message was delivered to mobile operator. This time and date will be inserted behind the name of the station. You make active the sending time function by ticking "Insert time of event into message" in the "GSM" parameters.

3.9.3. Special symbols inserting into SMS text

When you are setting the parameters of warning SMS messages in program MOST, it allows you to insert special symbols. The processor will transform them into another string or not send the SMS and instead of sending, it will call "alarm notice" on a preset phone number (more information see **Chyba! Nenalezen zdroj odkazů.**).

Special symbols in SMS text

#V	**Actual** value including unit of measure will be inserted into sending SMS text.
#D	Station will make „Alarm notice" on a preset phone number from the phone book.
#X	Station will send forwarding SMS in the system of interdevice communication.

3.9.4. Control SMS

The control SMS includes commands for the station outputs control (relays on individual connection boards DPD or MPD and relays in external units SP06). Every control SMS must begin with *Password* following by commands sequence. One message can be combination of control even query commands. All commands must be separated by commas without spaces, at the end of SMS is not necessary to have comma.

Commands authorization The stations M4016 have built-in two-level protection against commands disusing by unauzthorized person.

Password The first degree of protection is based on PASSWORD existence, which every command SMS must begin. The password can be a random sequence of maximum 12 characters, separated from other commands by a comma. This password for control can be different from password for demanding information through the informative SMSes (see "GSM" parameter). This divides an authorized person, who can fully operate with the station, from the other users normally using only the informative SMSes.

Security The next settable condition for commands executing is for phone numbers. Because the phone number must be filled in the list of accessible numbers and must have checked "Re-

ceive SMS from" (if the item "Accept messages only from sender in list" in the GSM parameters main dialog is checked). **Caution: In this case, the telephone number must be filled in the list in full version, it means with identification of the country, for example the Czech Republic has prefix +420.**

Commands priority If you correctly set the right station parameters, the station can autonomously control single relays by momentary state of measured values on its relevant ports. But this automatic mode can be switched off by the switch-on command for relays (RZr) or by the switch-off command for relays (RVr) till the station receives the return command RAr (return to automatic mode). The selected relay will be permanently switched-on/off according to last received command, independent from the control output state.

The incoming command in the control SMS is preferred to autonomous regulation of the station.

Switching on/off If you insert command RTx before a switching on/off control command, it will cause that the
for a time selected relay will be switched on/off just for a time. The relay returns to autonomous mode after elapsing of time (it's not necessary to send RAr command any more).

Answer suppres- The station answers to all control SMS messages by confirmation SMS message. This
sion message includes information about accepting and comprehensibility of the command (The answer can be the relay actual state or a brief notice "OK"). If you don't want to receive that confirmation SMS, you must insert anywhere into the SMS the special command NA (No Answer).

EXAMPLE

Control SMS:

PASSWORD,RZ1,RV6,RT120,RZ2,RV7,RT5,RZ3,RA4,RT0,RZ5,NA

PASSWORD	… access code
RZ1	… switch on the relay 1 for unlimited period
RV6	… switch off the relay 6 for unlimited period
RT120	… set timer for 120 minute
RZ2	… switch on the relay 2 for 120 minute, then autonomy mode
RV7	… switch off the relay 7 for 120 minute, then autonomy mode
RT5	… set timer for 5 minute
RZ3	… switch on the relay 3 for 5 minute, then autonomy mode
RA4	… return the relay 4 to autonomy mode
RT0	… switch off timer
RZ5	… switch on the relay 5 for unlimited period
NA	… the unit will not answer to this command SMS

Note: autonomy mode means controlling relay by initially factory set mode (Alarm, Limit, Pulse output, wiper-speed switch, …).

Warning SMS

The automatic sending of preset SMS can be caused by a limit value reaching, a binary channel state or a control relay change, failure in a measured signal, activation or deactivation of alarm, etc.

Up to 32 SMSes are available.

Next 8 SMS messages with fixed defined text: failure or restoration of external supply, low accumulator voltage, decreasing of credit under set limit, …)

The phonebook for 16 addressees, who can be sorted into groups.

Before set SMS is possible to temporarily or permanently disabled. Set parameters are being saved.

Every member of selected group will receive the same SMS.

SMS will be sent after continuance of a starting condition

Avoids to repeated sending of SMS, when the value is moving near limits.

Text without diacritic symbols. Special symbols allow you automatic inserting of actual value of measuring quantity.

Main parameters - Read from COM

General | Channels A | Channels B | Relay | Analog | GSM | SMS

SMS no. 1 - Pressure more then 280 kPa
SMS no. 2 - Pressure more then 450 kPa
SMS no. 3 - Water level get at 3500 mm
SMS no. 4
SMS no. 5
SMS no. 6
SMS no. 7
SMS no. 8
SMS no. 9
SMS no. 10
SMS no. 11
SMS no. 12
SMS no. 13
SMS no. 14
SMS no. 15
SMS no. 16
SMS no. 17
SMS no. 18
SMS no. 19
SMS no. 20

☑ Permit / forbide
☑ Insert unit identification
☑ Insert time
☐ Don't send at power outage

Recipie   [2nd group ▼]
Send when [Increase over upper boundary ▼]
Channel   [C1: Level test ▼]

Value   Hysteresis   Delay
[3500] [mm] [300] [mm]   [30] s

Message text (max. 50 characters)
Water level get at 3500 mm

[Phone book] [Fixed SMS]

[OK] [Storno] [Použít] [Nápověda]

Starting condition The station M4016 continuously evaluates actual measuring values in analogical, binary channels and control relays states. Then the system is sending a relevant preset SMS to selected mobile phones in case the set limit value is reached, after binary channels outputs switching on/off, after relays states change, etc.

Activation by sum Concerning balance quantities (actual or cumulated flow, rainfall, number of pulse, …), activation of warning SMS can be also indicated by gradually accumulating. That accumulating is possible to limit by amount per defined period.

Warning SMS properties The warning messages are the basic and the most used type of SMS. The warning SMS properties are summarized in following points:
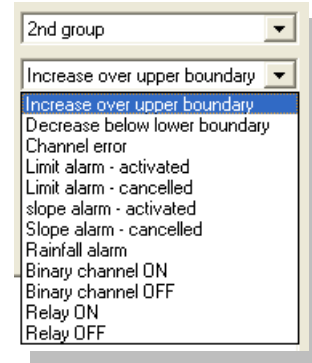
- The station supports setting of up to 32 different SMS texts.

- At the beginning of each warning SMS is possible to insert a name of station, which is sending that SMS, or actual station time, when the SMS was sent. The SMS own text follows after it.

- *Note: The time and name automatic inserting is necessary to be disabled, if you want to send messages to special numbers, for example to an operator, who is forwarding the delivered SMS to your e-mail.*

- The each of messages can have a own special receiver from the authorized person phonebook. The program also supports creating groups of receivers.

- The system supports setting time condition for sending SMSes. The SMS is sent if only activation condition is true for the time from that time condition. The activation condition is for example reaching limits (too high or low values), binary state change, measurement failure, alarm, …

- The repeated sending of warning SMSes is executed if only the actual value is returned to tolerable ranges with *Hysteresis* difference at least.

- The station supports inserting the actual measured value into the warning SMS text.

- It is not allowed to write to SMS more than 50 characters, because the rest is engaged by automatic inserted texts (name, time, actual value).

- The station supports sending up to 8 fixed (content) SMS. These messages are not editable and they inform you about failure and restoration of power and battery supply, accumulator voltage drops and about some of the next events.

- The time and text of each sent warning SMS can be saved to the event-diary-channel of the telemetric station. The event-box supports also saving of all others SMS (received, sent).

- If the warning SMS message is not delivered, the station repeats it n-times according to set repeating value. Although it is not delivered, the station saves the SMS to the event-diary-channel together with information about its unsuccessful sending.

PARAMETERS SETTING

The warning SMS automatic sending can be started by activation conditions listing in the picture next to this text. But if the SMS will be sent is also dependent on the delay parameter.

Delay This parameter is in seconds. A SMS is sent if only the activation condition takes as many seconds as that parameter has. Any short input returning to previous state will reset the time-counter and the time measuring will start from the beginning.

Activation conditions

2nd group

Increase over upper boundary
Increase over upper boundary
Decrease below lower boundary
Channel error
Limit alarm - activated
Limit alarm - cancelled
slope alarm - activated
Slope alarm - cancelled
Rainfall alarm
Binary channel ON
Binary channel OFF
Relay ON
Relay OFF

Tab. 7: Table of warning SMS activation conditions:

State	Description
Increase over upper boundary	The actual value in a control channel increased over value of parameter *Value*.
	Concerning balance quantities, SMS sending can be activated after reaching set number of accumulated pulses, rainfall or flow volume in current archiving interval over set *Value*. The accumulating amount is always reset at the beginning of new archiving interval (delay parameter must be set to zero). If the "Computing functions" is chosen from the list of measuring methods, it's possible to register the moving sum in an individual channel, sum or difference of two neighbouring channels and some other special computations.
	Then the computed channel value will compared with the limit value of set SMS. The computed values can be used just for a limit SMS activation and it isn't necessary to archived them in the station memory ("Archivation interval" = 0).
Decrease below lower boundary	The actual value in the selected channel decreased below value of parameter *Value*. The decreasing rules are the same as the increasing rules.
	For example: If that item might be used for signalization of gradually decreasing water level and the parameters setting is conducted at the time when water level is low, then it's necessary to count on sending all of the SMSes in time you turn on the station.
	Next meassages will be sent after real breaking of limits by hysteresis value and after following decrease to set limits.
Channel error	The existence of communication error with channel connected measuring probe or recognised failure in output signal of connected sensor (current signal out of range, value out of tolerable range, …)
Limit alarm – activated	Concerning the control channel, the limit alarm value reached the set boundary with the *hysteresis* difference. It means that it caused limit alarm activation.
Limit alarm – cancelled	The limit alarm was cancelled in the control channel (measuring value returned to its tolerable range).
Slope alarm – activated	The slope alarm value was reached in the control channel.
Slope alarm – cancelled	The slope alarm was cancelled in the control channel.
Rainfall alarm	This item reacts to the first selected channel, which was set to rainfall monitoring. The station M4016 is continuously computing the rainfall sum (called SS) and the warning SMS activation will be executed if the SS sum reached the *Value* parameter. The SS sum is reset by the first pulse of "new rainfall". So you can anytime asked about it by the command SMS (see the list of command codes on page 39). "The end of raining" is considered after the preset number of intervals

	elapsing without any pulse from a rain gauge (the number of intervals is settable in analogue channel settings).
Binary channel ON	The binary channel was switched on. If you want to choose a control channel, the list of used binary channels will be offered you.
Binary channel OFF	The binary channel was switched off.
Relay ON	The control relay was switched on. The program will offer you the list of relays R1 – R20 instead of control channel.
Relay OFF	The control relay was switched off.

Channel If you want to choose a control channel, the program MOST offers you the list of all used channels with their names (the last two activation conditions "switch on(off) relay" offer you an extra list of relays). One channel can activate more than one limit SMS.

Text The text length of one SMS is limited to 50 characters. The text can include hooks and commas (diacritic graphic symbols used by some languages), but the text will be converted not to be diacritic, because the most of mobile operators doesn't support these symbols. The rest of symbols in SMS is filled with the station name and time and date of sending.

Value This parameter is the activation limit for warning SMS. The value is being entered in the same unit of measure as works the control channel.

Hysteresis The parameter avoids to repeated sending of SMS, when the value is moving near limits. The repeated sending of warning SMSes is executed if only the actual value is returned to tolerable ranges with Hysteresis difference at least. In the deference of alarm parameters or relays, it is not necessary to increase over the limit plus hysteresis to activated warning SMS, but the station will send the SMS at the same time with reaching the limit value without any hysteresis.

3.9.5. Fixed SMS

The fixed SMS messages are part of warning SMS messages. The difference is that fixed SMS has a preset fixed content. You can see that the function of each SMS is comprehensible from its content. The receiver of each SMS can be also any person or group from the phonebook.

EXAMPLE A : THE RAINFALL WARNING SYSTEM

Connection: The toggling rain gauge connected to the DV1 input.

Task: Send warning SMS message, if rainfall is in 15 minutes bigger than 10 mm or in 6 hours bigger than 50 mm.

Parameters setting:

Channel K1 Measuring channel K1 must be set to recording of rainfall.
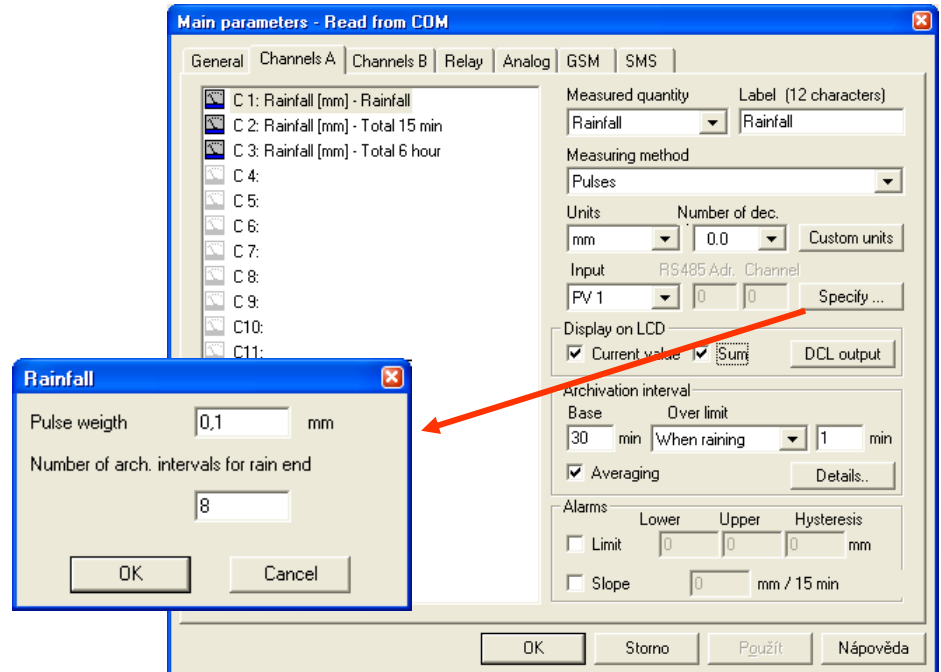
Channel K2 Measuring channel K2 must be set to auxiliary channel for moving sum computing without data archivation and without value showing on the display.
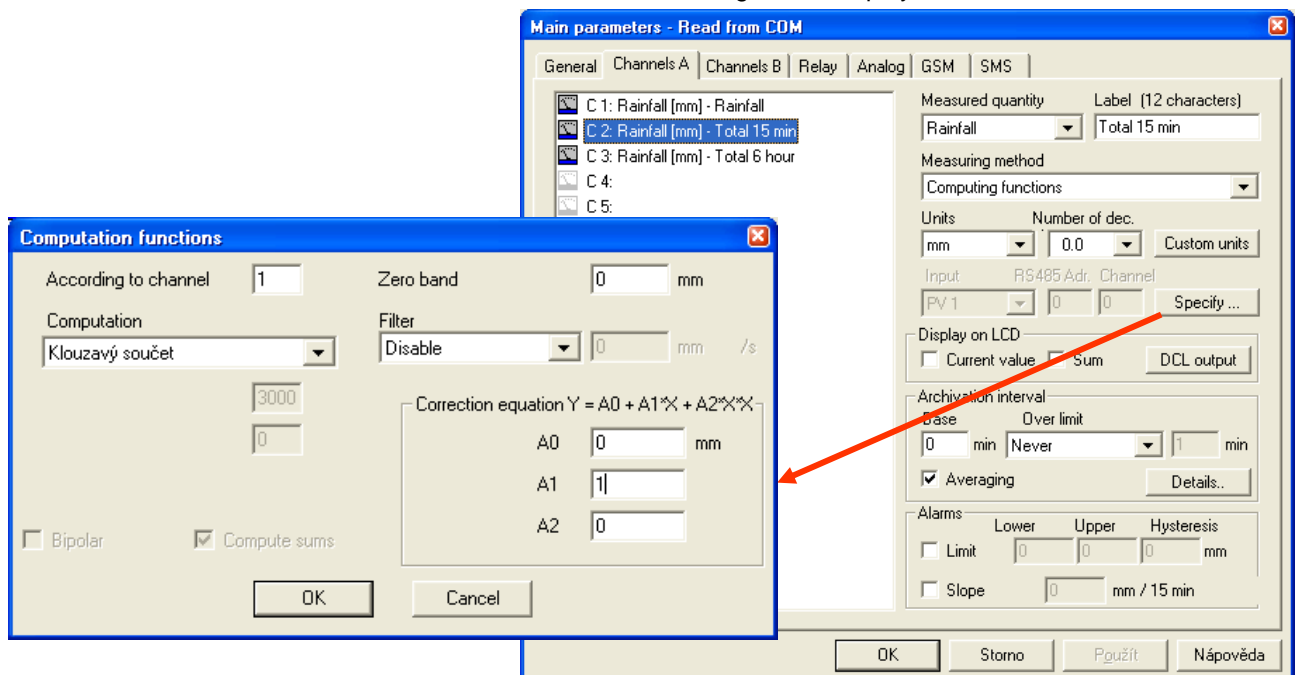
The channel K3 must be set for moving sum computing with 360 minutes of computing time.

The parameters of limit SMS set like this:

EXAMPLE B: WARNING SYSTEM FOR WATER CONSUMPTION MONITORING

Connection: Flow module with optical (OPTO) or with magnetic (READ) sensor is con-
nected to PV inputs of the M4016 station.

Task: Send a warning SMS message, if continuously measured water volume in
30 minutes is bigger than 20 m^3.
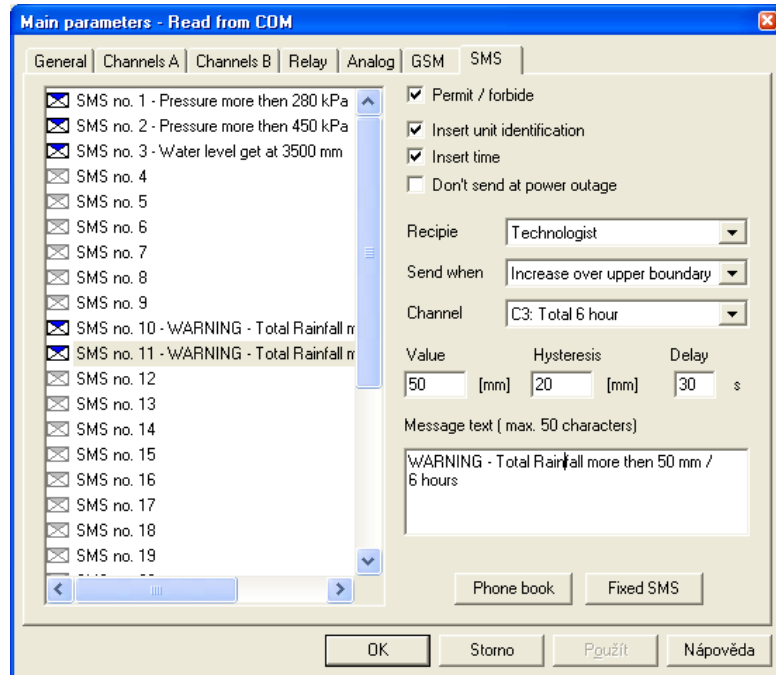
Parameters setting:

The setting procedure is similarly to previous example. The individual channel set to moving
sum monitoring; it means that you should choose "Flow" as a measured quantity and
"Computing functions" as a computing method. The control channel is the number of flow
recording channel and in specifying parameters, set moving sum with computing time 30
minutes. Finally, that set channel will activate a warning SMS message with the *Value* pa-
rameter set to 20.

3.10. Data sending via TCP/IP protocol (GPRS)

The transfer of measured and archive data from M4016 units to user's PC for another processing can be done in the several ways. The optimal way (user friendly, lower operating costs) is to use GPRS transfers in GSM net and store data to a internet or intranet server.

System of data collection
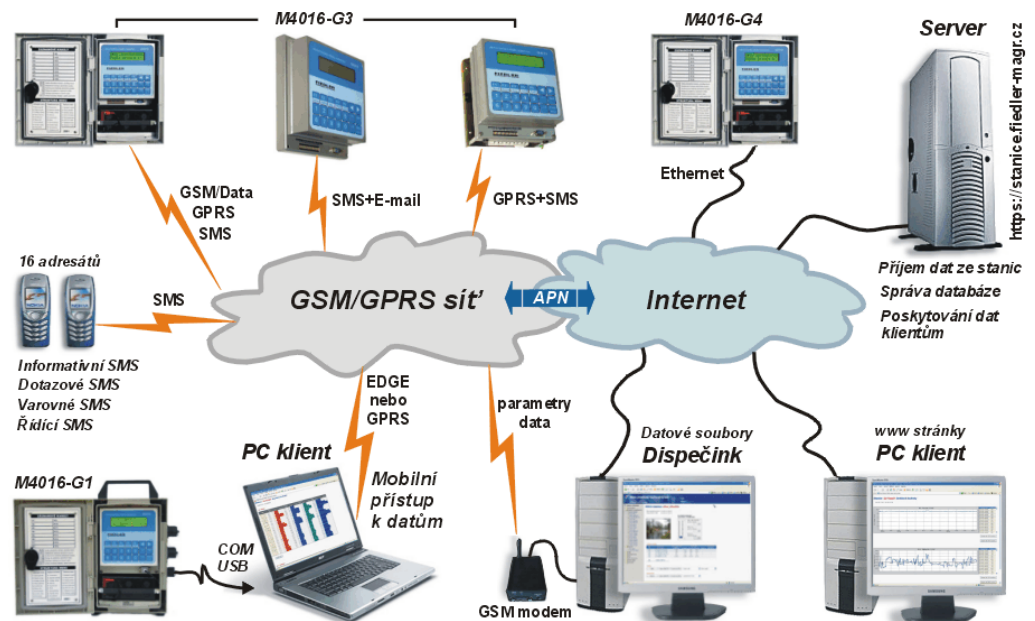
DESCRIPTION OF DATA COLLECTION SYSTEM

Autonomous activity of M4016 unit

M4016-G3 units with built-in GSM modem are programmed so, that after GPRS transfer activation the units works like autonomous clients and transmit data to a determined data server at determined time period or in extreme situation immediately. The units transmit data without request of the server.

Advantages

The current SIM cards without fixed IP addresses are used. In case the setting alarm states of channels turn up the data are transmitted immediately. The GSM/GPRS modem can be switched off between data transfers. That is why the units can work for several months or one year with full accumulator without its charging.

Disadvantages

On the other hand the units are unavailable at time between data transfers. It can be solved with sending of SMS command to the units, which initializes immediate data transfer or intervals of data transfers can be reduce (for example up to 15 minutes).

The unit allows setting longer data sending intervals for normal running and the short intervals for alarm states (limit or gradient alarms in measured channels).

Data server

Society FIEDLER-MÁGR have own data server with address https://stanice.fiedler-magr.cz, in which they hire data room for particular M4016 units. The authorize users use standard web browser for access to stored data and do not need to have another visualization program. The authorize user can look through charts and graphs of measured data and daily statistical values to particular channels. The values are quoted in monthly transparent charts.

Data of selected time period is possible to export from the server database to Excel or to a data file of the MOST program.

The data can be exported to established dispatcher programs according to arranged data format.

DATA DISPLAYING WITH THE WEB BROWSER

Splash screen of units

It is a basic entry page of the unit, in which can be displayed a photo and a basic four days' graph of a selected measured channel. Special M4016 units can also have own displaying (for example a controlling unit of a governing valve – the type M4016-RV).
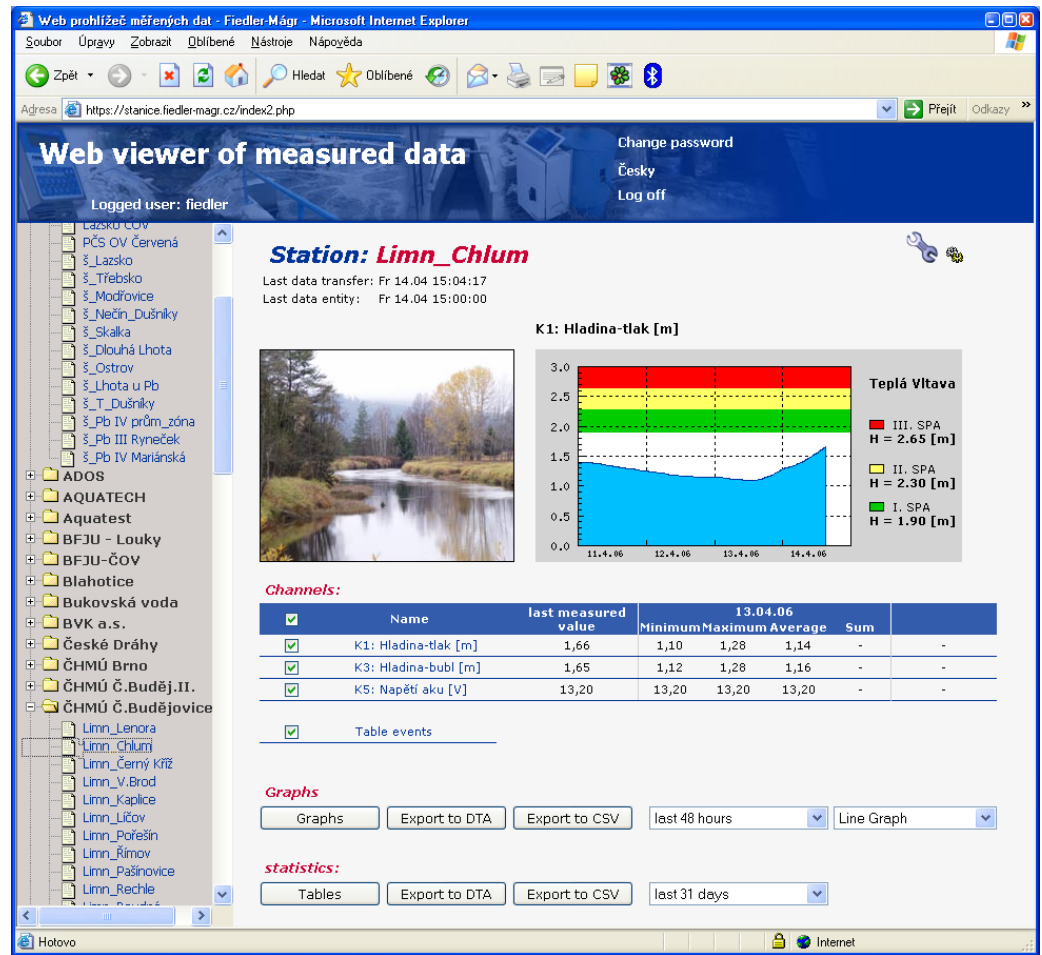
Window with graphs and charts   Type of the graph, displayed channels and time period are fixed till next access to the web side.
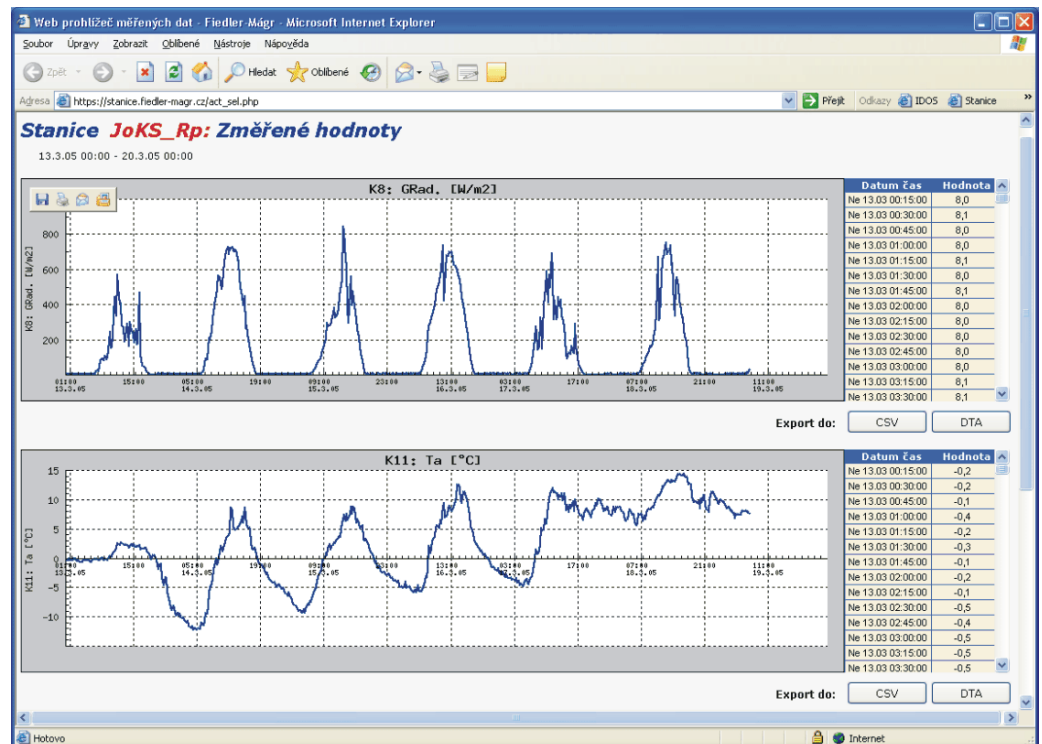
Monthly statistical charts   The statistical chart is used for quick demonstration of minimum, maximum and average measured values and daily flow volumes.
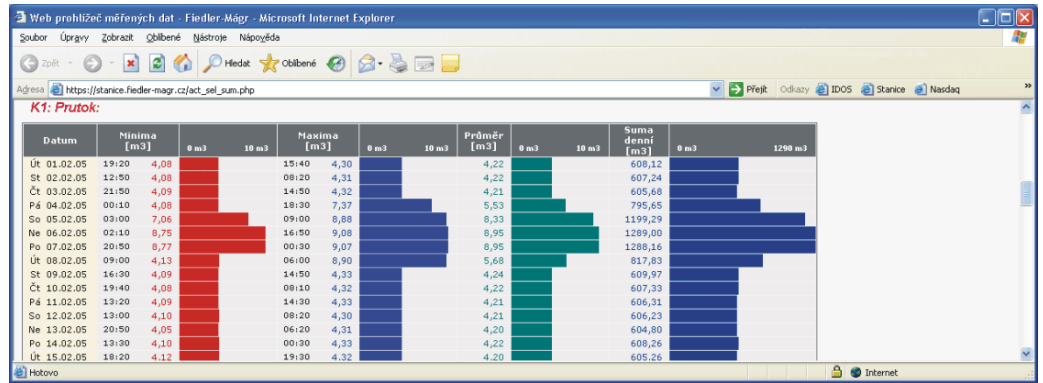
Chart of binary channels The chart of binary channels can be displayed at the end of analogue channels graphic display. Every line of chart represents some of channels change. There is time sign at the beginning of the line, which quotes time of change in seconds.

Charts of events The chart of events can be at the absolute end of graphic display, in which all important unit processes are recorded (settings or changes of parameters, power failures, sent or received SMS, error states of connected sensors, data sending to server, data calling, lost GSM signal, log in network and other events). The chart of events represents unit diary, which is registered in the units and also in the server.

**Data exports** There is also a button for data exports to files on each data page. The server can generate some data for other processing in the MOST program (DTA files) or in the Microsoft EXCEL program (CSV files).

DATA UTILIZATION FOR DISPATCHING PROGRAMS

Automatically created data files can be used for values or events transfers from server database to a dispatching program. The database does not need to be kept and upgraded with the same PC as the dispatching program, because data files can be transferred arbitrarily via internet.

MODIFICATION OF UNIT PARAMETERS THROUGH THE SERVER

After every parameter modification (during the next data sending from the unit) the changed parameter file is automatically transferred to the server. Authorized users can browse that parametric files, take out, change them and store to sending room. The unit takes over the changed parameters automatically during the next data transfer.

M4016 UNIT SETTING TO DATA SENDING VIA TCP/IP PROTOCOL

The button „Server" of main parameters opens the window for periodical archive data sending via GSM/GPRS net (M4016-G3).

Device label quotes an unit name, under which you can find the unit in the server

ID number assigned by a server administrator
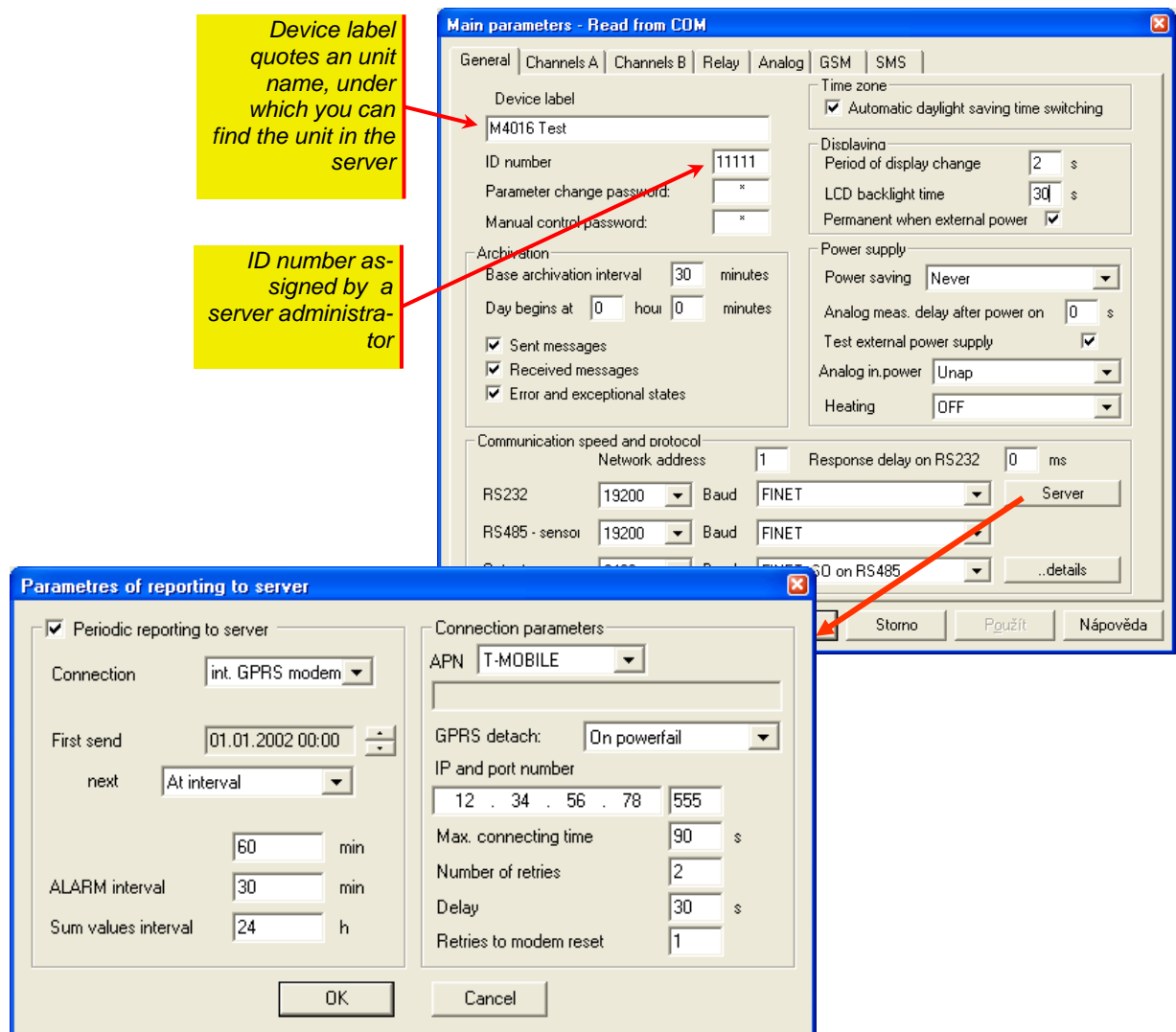
When you tick „Periodic reporting to server" in the left upper corner of the window, you can set particular parameters of the service.

Connection Choose the transfer type, which you wish to set. You can set internal GPRS modem (default setting) or data sending through an external modem connected to M4016 unit through COM port or you can choose „Ethernet", in case there is the unit with data converter RS232/Ethernet.

First send The field with date and time is used to set time of regular data sending. The data is transmitted of the set date. In the case of old set date, the data is sent at the next set minute and hour today.

Note: How to set time: click with the mouse over the set quantity (hour, minute) and then set requested value with an arrow placed on the right, next the window.

Next It is used to set regular data sending. When you choose „In interval", you need to set a minute interval size in the next field. Sending time is counted from time, which is set in „First send". For example the interval of 720 minutes with set time at 6:00 allows sending data every day at 6 a.m. and 6 p.m.

ALARM interval When the alarm is arisen in any measured channel (limit or slope alarm), the unit can send data to the server more often than in the normal status. It can be convenient for units powered only with accumulators, in which data sending frequency is usually set from 1 to 4 re-

ports daily. The users are interested in the data of alarm status; therefore the parameter should be used often. Typical examples of it are stream gauge stations. There is convenient to set an alarm condition and a warning SMS message.

Interval extent should not fall under 15 minutes. The shorter interval would burden both GSM/GPRS net and a server, which receives data from more units and in addition it would negatively affect costs of data services. During a transfer of only a few measured data via TCP/IP protocol the identification information about transferred data packet constitutes majority of transferred information and really measured data fills only small part of data volume. That is why the shorter sending interval is the more transferred data volume and unit operating costs are increased.

Sum value interval   Value of the parameter quotes, how often (from unit installation) operating hours of binary channels and status of total flow volumes shall be transferred to the server. They are separately registered in the M4016 unit for some channels (flows, rainfalls, pulses). In the units set for often data sending (on-line monitoring) it is not convenient to transmit above mentioned summary balance values with every transfer because of large transferred data volume.

Basic or alarm interval of outgoing data has priority before interval of outgoing sums. It means, when outgoing sums are set to 1 hour and at once the basic interval of outgoing is set for example 360 minutes, the data transmissions (included transferred sums) will be realized only every 6 hours.

If you do not need to transfer operating hours and flow volumes to the server, you can to set the parameter value to 0.

APN (Access Point Name)   The access point to internet is necessary to choose from submitted offer according to type of using SIM card and operator. Optional in the List Box allows setting a special APN of private company nets.

GPRS detach   Usual setting is Never. GPRS detach is used to cut power consumption of GSM modems in units powered with accumulators. Logged-up GSM modem with activated GRPS connection consumes by 20 % more power than modem with switched-off GPRS. If GSM modem shall be permanent switched on (receiving of data calling or SMS) and at once GPRS communication runs over long intervals of several hours, it is convenient (by reason of extension of running time with one full accumulator) so that GPRS net was logged off after every data transmission.

Selection of "On power failure" is possible to use in the units supplied with power net and with accumulator backup.

IP and port number   The setting is done according to actual location of data server and instruction of a server administrator. It is needed to contact the server administrator (mail to: magr@fiedler-magr.cz or phone no. +420 387 410 953 before setting of that parameters.

4. Technical specifications

Recordchannels parameters

Number of channels	0-16 analoque record channels with 16 bits resolutions 0-40 binaty channels 1 text channel
List of measurable features	Instant flow [l/s, hl/s, m3/s, l/h, hl/h, m3/h] Cumulated flow [m3] Water level [mm, m] Volume [l , hl, m3] Temperature [k, °C] Humidity [%] pH [pH] Redox, ISE [mV] Conductivity [mS/cm2] Dissolved oxygen [mg/l] Residual chlorine [mg/l] Pressure [Pa , hPa, kPa, Mpa, mm wc, mbar] Rainfall [mm] Cumulated Rainfall [mm] Current [uA, mA , A] Voltage [mV, V] Frequency [Hz , kHz, 1/min] Optional features [-] Time of pulse [-] Number of impulses [-]
Decimal points	0 až 3 (range from 0.000 to 65535; ±32767)
Name of channel	16 letters
List of measurement method	RS485 (FINET protocol) DCL (Digital Current Loop) 0/20 mA, ASCII-U protocol 0 – 1mA, 0(1) – 5 mA 0(4) – 20 mA , 0(4) – 24 mA 0 – 10 kHz 0 – 1 V; 0 – 2 V; 0 – 20 mV (40mV, 80mV, 150 mV, 0.3V, 0.6V, 1.25V, 2.5V) -20mV – +20 mV (40mV, 80mV, 150 mV, 0.3V, 0.6V, 1.25V) Sume of pulse, Time of pulse,
Capacity of data memory	2048 kB Flash type, 250.000 - 450.000 measured value
First storage interval	selectable from 1 min to 1 day
Second storage interval	selectable from 1 min to 255 min, activation by alarm
Operating hours	Counter 999 999 hour : 59 min for every binary channel

Speciál firmware M4016	**Computation of current flow rate from the water level in open cannel**	Parshall P1: $Q=0{,}0609 * H^{1{,}552}$ [m^3, m]
		P2: $Q=0{,}1197 * H^{1{,}553}$ [m^3, m]
		P3: $Q=0{,}1784 * H^{1{,}555}$ [m^3, m]
		P4: $Q=0{,}3539 * H^{1{,}558}$ [m^3, m]
		P5: $Q=0{,}5214 * H^{1{,}558}$ [m^3, m]
		P6: $Q=0{,}6746 * H^{1{,}556}$ [m^3, m]
		P7: $Q=1{,}0150 * H^{1{,}556}$ [m^3, m]
		P8: $Q=1{,}3680 * H^{1{,}564}$ [m^3, m]
		P9: $Q=2{,}0810 * H^{1{,}569}$ [m^3, m]
		Venturi 10: $Q=0{,}1986 * H^{1{,}541}$ [m^3, m]
		20: $Q=0{,}3248 * H^{1{,}543}$ [m^3, m]
		30: $Q=0{,}6133 * H^{1{,}544}$ [m^3, m]
		Thomson : $Q=1{,}3546 * H^{2{,}48515}$ [m^3, m]
		Adjustable profile: $Q=A_1 * H^{A2}$ [m^3, m]
		Composite Parshall: $Q=A_1*H^{A2} +A_3*(H-H1)^{A4}$ [m^3, m, m] $Q=A_1*H^{A2} +A_3*(H-H_1)^{A4} +A_5*(H-H_2)^{A6}$ [m^3, m, m, m]
		Empiric fill table: Tab. I: 30 line / Tab. II: 20 line
	Computation of current flow rate in pipe	Calculation from volume impulse and from time intervals between impulses, max time 10 impulse periods or 1 min.
	Computation of total volume	2.190 cells in separate data memory for 8-hours cumulated flow , automatic computation day ,month and year volume
	Capacity of one cell for total volume	0 – 4.290.000.000 [m3]
	Other optional computation	Difference of two channels Sum of two channels Correction of current flow rate in Parshall profile with high level in output (two ultrasonic level sensors needed) Gliding sum (for warning system) Correction by polynomial of the second order

Imputs

Analogue inputs DAV1–DAV6	Range : 0(4) –20 mA (Rz=100R), 0 – 2,5 V Resolution : 16 bits Accuracy : ±0.05% FS ±3 digit
Differential input AV1-AV15	Range : ±1,25VDC Selectable gain from ±20 mV to ±1,25V Resolution : 16 bit Accuracy : ±0.05% FS ±3 digit (2,5V)
Digital inputs DAV1-DAV8	DCL 2400 Bd or 0-25 kHz L < 0.5 mA, H >5 mA
Binari inputs PV1-PV8	H > 10 kOhm, L < 1kOhm, open collector
Pulse inputs PV1–PV8	min pulse width: 5 mS, max pulse frequency: 20 Hz H > 10 kOhm, L < 1kOhm, open collector Capacity of impulse counter : 4.290.000.000 impulses
Protections – all inputs	Suppressors 1500 W, 15VDC

External input module JDV2	H > 5 kΩ L < 300 R, open collector Communicatio: RS485
Přepěťová ochrana vstupů	Suppressors 600 W, 15 V DC

Interface

Outputs

RS232	CANNON DB9, 600 Bd – 19200 Bd, FINET protocol
RS485	600 Bd – 19200 Bd, FINET protocol
DCL Output	2400 Bd, current data loop 0/20 mA,
Relay ALARM and SAMPLER	Relay - max contact current 4A / 48 VDC Protection: suppressors 600 W
Module JDV2	6 x relay - max contact current 6 A / 250 AVC Protection: suppressors 600 W, 440 VDC
Analogue outputs 4-20 mA (external module MAV420)	Analogue fully programmable active output, Galvanically isolated, Resolution 16 bit, Nonlinearity = 0,05% , communication: RS485, max. 16 module U_{MAX} = 30 VDC, R_Z max = U_{MAX}-4/0.02

GSM/GPRS/SMS communication

GSM module	Type: Enabler-G Producer: Enfora
GSM	900/1800 MHz (EGSM/DCS) / -108 dB CLASS 4 (2W @ 900 MHz) CLASS 1 (1W @ 1800 MHz)
GPRS	Slot: Class 12 (4Rx / 4Tx, 5MAX)
SMS	Text SMS, 160 characters Number of SMS: 30 warning, 2 info Number of receiver: 16
Power	Internal DC/DC converter: 12 V DC / 3,8 V DC Power consumption: 1Tx/1Rx: 230 mA (max 1,25A) 1Rx: 105mA Sleep: < 5mA
Working temperature	-20°C … 60 °C (Storage temperature -40°C až 85 °C)

Parametry řídící jednotky

|	
Mikroprocesor	Type RISC-AVR; 8 bite; 3V3
Memory capacity of parameters	EEPROM 16 kB
Keyboard	21 keys, click efekt
Display	Back lightning LCD 2x16 chars, high of char 9 mm
Power supply voltage	Service-free accumulqator 12V/7,2 (9) Ah
Operating current	Typ. 100 uA (active only PV inputs) Typ. 30 mA: active inputs 4-20 mA Typ. 250 mA: backlight display on.
Dimension	320 mm x 215 mm x 170 mm
Weight	2,6 kg
Housing material	Glass fibre reinforced, self-extinguishing and halogen-free polyester.
Protection	IP66
Operating temperature	-25°C … +65°C
Storage temperature	-30°C … +75°C
Electrical connection	2 x Pg 13,5, 5 x Pg 11

The Supplement 1: Joining of intelligent sondes and sensors for M4016 through the module PREVOD

The external module PREVOD makes it possible to collect information from apparatuses equipped with the serial interface RS-232 or RS-485. It is possible to join 4 apparatuses to one module. The module program capacity in the chip allows to pre-set many different communication protocols. At the present the communications protocols are already prepared for:

- ISCO Sampler 6712
- SEBA Water-level Sensor
- a configuration of 1 – 4pcs. concurrently interconnected ISCO 2100 Flow Modules

Communication between the module PREVOD and the unit M4016 goes under the protocol FINET through the serial interface RS-485 which is in all terminal aces in the recording unit M4016 (no in the tablet APD). Communication speed is standard 19200Bd, 8, N, 1 like in other equipment (US1200, DV2, SP06).

THE DIAGRAM OF MODULE PREVOD INTEGRATION VERSION V1:
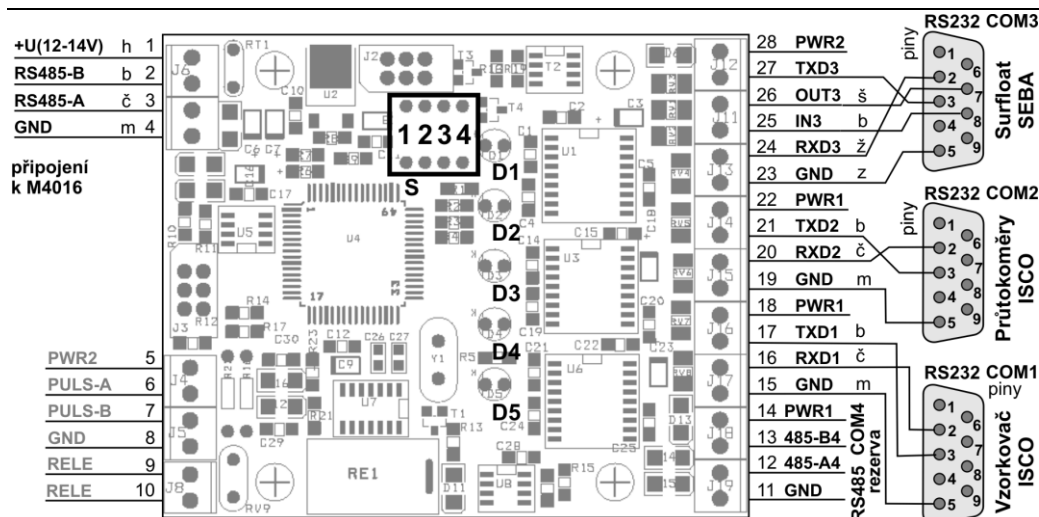
SOFTWARE SETTINGS

The module address

The module has 4 addresses in the serial interface RS485 that means that equipment joined to recording unit M4016 has its own address. The starting address is set in manufacture. It is 1 and is accordant with serial port COM1 which is reserved for ISCO sampler 6712(clips 15-18).

It is possible to connect YSI sonde with ISCO multi-parametric sampler 6712. As the reason of that, qualitative water parameters (measured by YSI sonde) can be counted through COM1.

Floated water-level sensor SEBA connected with serial port COM3 has the address 2 and clips 23-27.

Note: Multi-parametric YSI sondes can be connected with floated water-level sensor SEBA through serial port COM3 – address 3. YSI sondes have SDI-12 interface like M4016 made in 2004, so there is no reason to join them through the module PREVOD.

 Addresses 3 and 4 are reserved for serial port COM2 (clips 19-21). Four concurrently connected ISCO 2100 Series Flow Modules can be connected with the unit M4016 through addresses 3 and 4. Each flow module has 8 measured channels so the concurrent combination of 4 instruments with one serial interface R232 can contain as many as 32 measured channels. FINET protocol allows only 16 measured channels for addressing that is why addresses 3 and 4 were reserved for flow module configuration. More information is on our web sites in the application note APL-104

With the conversion of the starting address is automatically changed the rest of 3 ports (the starting address from +1 to +3). The starting address can be changed with the MOST software through a convertor RS232/RS485.

The setting of module PREVOD The reversing switch **S** designates from which ports the module will be gathering information. Switching on:

- the first switch S1 allows communication between module PREVOD and port COM1
- the second switch S2 allows communication with port COM3 (SEBA surfloat)
- switch S4 allows communication with COM2 (ISCO 2100 Series Flow Module)

In the reversing switch S switch on only ports which have joined functional corresponding equipment. In other way you would wait a long time for response from unattached equipment or from equipment without corresponding communication registry.

The frequency of communication The frequency of communication between module PREVOD and particular units COM1 – COM3 is adjustable parameter in the software MOST. The communication intervals are set in the manufacture. For communication through port COM1 (ISCO sampler 6712) it is 10sec. and through ports COM 2 (ISCO flow module) and COM3 (SEBA surfloat) the interval is 30sec.

Channels Joined equipment can measure and transfer as far as 16 physical values into the module PREVOD. Single values or stages hold individual channels on which is possible inquire from the joined recording unit M4016. Also is possible to inquire for the sensing heads US1200 ultra-sound channels or chemical sensing heads ESK11 channels.

In one address can be maximally 16 channels. Each channel is closely set by the type of equipment and is mentioned in the next chart.

Module PREVOD version V2channels

Switcher	S1	S4	S4	S2
Channel	COM1: ISCO sampler 6712 Basic address	COM2: ISCO flow modules Basic address +2	COM2: ISCO flow modules Basic address +3	COM3: SEBA surfloat Basic address +1
K1	**Water-level** (ISCO)	**Water-level** [m] (1st device 21xx)	**Water-level** [m] (3rd device 21xx)	**Water-level**
K2	**Flow rate** (ISCO)	**Speed** [m/s] (1st device 21xx)	**Speed** [m/s] (3rd device 21xx)	-
K3	**pH** (YSI sonde)	**Flow rate** [m3/s] (1st device 21xx)	**Flow rate** [m3/s] (3rd device 21xx)	-
K4	**ORP** (YSI sonde)	**Flow rate1** [m3/s] (1st device 21xx)	**Flow rate1** [m3/s] (3rd device 21xx)	-
K5	**Oxygen** (YSI sonde)	-	-	-
K6	**Temperature** (YSI sonde)	-	-	-
K7	**Temperature** (ISCO)	**Battery voltage**[V] (1st device 21xx)	**Battery voltage**[V] (3rd device 21xx)	-
K8	**Conductibility** (YSI sonde)	**Temperature** [˚C] (1st device 21xx)	**Temperature** [˚C] (3rd device 21xx)	-
K9	**Specific conductibility** (YSI sonde)	**Water-level** [m] (2nd device 21xx)	**Water-level** [m] (4th device 21xx)	-

K10	**Bottle number** from the last extraction	**Speed** [m/s] (2nd device 21xx)	**Speed** [m/s] (4th device 21xx)	-
K11	**Speed** (ISCO)	**Flow-rate** [m3/s] (2nd device 21xx)	**Flow-rate** [m3/s] (4th device 21xx)	-
K12	**Value 03D** (YSI sonde)	**Flow-rate1** [m3/s] (2nd device 21xx)	**Flow-rate1** [m3/s] (4th device 21xx)	-
K13	-	-	-	-
K14	-	-	-	-
K15	-	**Battery voltage**[V] (2nd device 21xx)	**Battery voltage**[V] (4th device 21xx)	-
K16	-	**Temperature** [˚C] (2nd device 21xx)	**Temperature** [˚C] (4th device 21xx)	-

Set-up M4016 When you set-up each channel in the recording unit M4016 choose option RS485-FINET then set-up the address and the channel in agreement with the previous tablet.

SIGNALIZATION OF INSTANT COMMUNICATION

Communication between the module PREVOD and joined devices is signalized by flashing of 5 LED-diode which are marked from D1to D5 (their meaning is explained in the next tab-let).

LED	Status signalling
D1	Communication with M4016 (fast blink = query from M4016 about some channel)
D2	Communication with COM4 (fast blink 60 ms = OK, long time blink 1s = error)
D3	Communication with COM3 (fast blink 60 ms = OK, long time blink 1s = error)
D4	Communication with COM2 (fast blink 60 ms = OK, long time blink 1s = error)
D5	Communication with COM1 (fast blink 60 ms = OK, long time blink 1s = error)

THE CONECTION OF ISCO 2100 SERIES FLOW MODULES

The connection of flow modules The convertor is connected to the configuration of 1-4 flow modules by a communication cable with connector CANNON-9 (a female connector) or straight by clips 19-21.

The convertor communicates with flow modules by protocol MODBUS (ASCII). The order of devices 21xx designates their type number (2110, 2150). If two devices have the same type number, a badge assigned by a user designates the order (see a documentation of flow modules).

When the convertor is switched on, it immediately starts to communicate with flow modules. Then the convertor finds out how many of flow modules has and starts their measuring.

Consequently the convertor waits for the end of measurement (maximally 60sec.). Then the convertor reads measured values and saves them in channels K1-16 according to the previous chart.

Flow modules charging ISCO flow meters are powered up by their own batteries or incoming cable of the unit M4016 accumulator. During a power supply from M4016 the white cable with a blue stripe is joined with + battery pole (permanent power supply) and the blue cable with a white stripe is joined with GND. The take-off of two flow modules is 3,5mA during a sleep mode and 50-250mA during a measurement.

Parameter „Dealy after switching on" During a sleep mode of M4016 () is necessary to set parameter value on 40sec. This period is needed for measuring in the flow module. Then unit M4016 waits another 30sec. until the measurement is finished (this stands for M4016 which has firmware 2.55 from August 2009). If there is an appearing error E22, it is necessary to heighten this parameter value.

CONECTION OF ISCO SAMPLER 6712

The converter is connected with ISCO sampler 6712 throughout the communication cable which is equipped with a connector CANNON-9 (a female connector). Otherwise, the converter can be straightly connected throughout the clips 15-18.

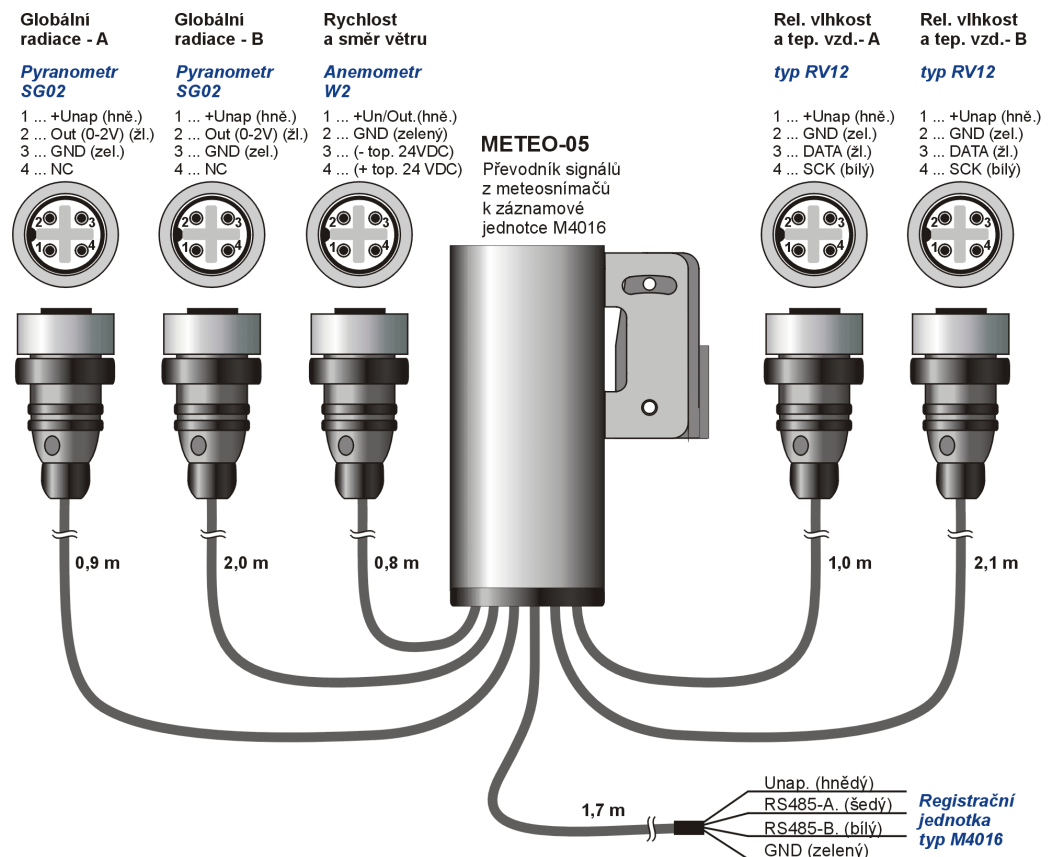If the qualitative parametric sonde YSI is connected with ISCO sampler 6712, measured values are accessible on channels K3-9 (according to the previous chart).

Error conditions can be controlled on unit M4016 binary inputs. These binary inputs are activated by bracing them against GND. ISCO sampler 6712 has current binary outputs that is why a suitable type of converter has to be placed between the sampler and unit M4016.

The Supplement2: Connection of meteorological sensors with M4016 throughout the converter METEO.

The external converter METEO convert signals from joined sensors of meteorological values (anemometer, pyranometer, relative air humidity sensors and air temperature) into serial communication for serial interface RS486 under the protocol FINET. The converter METEO is patchable to all units M4016 by one cable. Communication speed is standard 19200Bd, 8, N, 1 like in other equipment (US1200, DV2, SP06).

THE DIAGRAM OF THE CONVERTER CONFIGURATION:

Globální radiace - A

Pyranometr SG02

1 ... +Unap (hně.)
2 ... Out (0-2V) (žl.)
3 ... GND (zel.)
4 ... NC

Globální radiace - B

Pyranometr SG02

1 ... +Unap (hně.)
2 ... Out (0-2V) (žl.)
3 ... GND (zel.)
4 ... NC

Rychlost a směr větru

Anemometr W2

1 ... +Un/Out.(hně.)
2 ... GND (zelený)
3 ... (- top. 24VDC)
4 ... (+ top. 24 VDC)

METEO-05

Převodník signálů z meteosnímačů k záznamové jednotce M4016

Rel. vlhkost a tep. vzd.- A

typ RV12

1 ... +Unap (hně.)
2 ... GND (zel.)
3 ... DATA (žl.)
4 ... SCK (bílý)

Rel. vlhkost a tep. vzd.- B

typ RV12

1 ... +Unap (hně.)
2 ... GND (zel.)
3 ... DATA (žl.)
4 ... SCK (bílý)

0,9 m   2,0 m   0,8 m   1,0 m   2,1 m

1,7 m

Unap. (hnědý)
RS485-A. (šedý)
RS485-B. (bílý)
GND (zelený)

Registrační jednotka typ M4016

Kinds of sensors In the previous picture shows how is possible to configure the converter. There is combination of: 2 pyranometers SG002, 1 anemometer W2, relative air humidity sensors and air temperature RV12.

Measured values are saved in separated channels, which are possible to load with the protocol FINET and save into measuring channels in connected recording unit M4016.
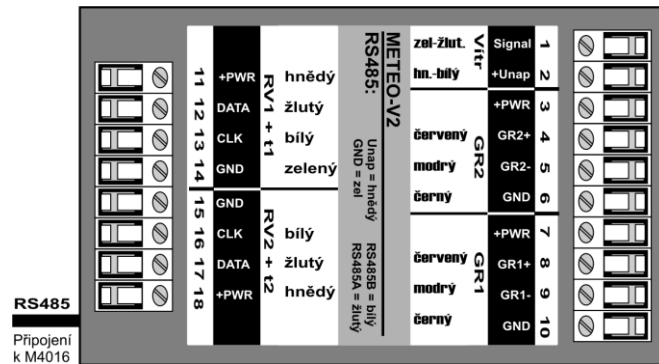
Built-in converter METEO

Built-in converter METEO makes it possible to easily and quickly change a connecting cable and the same converter.

METEO converter is usually placed inside unit M4016 above DPD connecting card. Cables go from sensors through cable bushings which are in the bottom side of unit M4016.

Connection of clips in built-in converter METEO:

THE PYRANOMETR SG002

The pyranometr SG002 has a voltage output 0-2V, to which matches measured global radiation 0-1200w/m^2. It is possible to join 2 pyranometrs with the converter METEO. The first of them measures incident radiation, the second measures reflected solar radiation. Then the recording unit M4016 counts the amount of radiation which has been absorbed by the Earth´s surface

THE ANEMOMETER W2

It is very mechanically resistant and accurate anemometer, which is specified for long-term running. For the winter time and places with frequent icing is good to use the heating version of the anemometer (tension for heater 24 VDC, 30W, heating regulated set on 5 ºC). The converter METEO provides power supply. The anemometer is joined to the converter only with two wires. The converter determines size and direction of wind according to size of electric current.

The calibration constant In the manufacture is each anemometer calibrated. The calibration constant is 1350Hz. If the sensor has another calibration constant, it is necessary to change multiplicative coefficient A_1 in the channel parameters in the recording unit M4016. For example if the anemometer has the calibration constant 1320Hz at 30m/sec, the coefficient must be $A_1 > 0$ it is figured out as a rate 1350/1310 so A_1 is 1,0305. For sensors with the calibration constant > 1350 the calibration coefficient is $A_1 < 1$.

Technical parameters

The range of measuring wind speed	0, 7 - 30m/s
The range of measuring wind direction	0 - 360º
Separation of measuring wind direction	10º
The weight of the sensor	175 g
Degree of protection	IP54

THE WET AND AIR TEMPERATURE SENSOR RV12

This sensor uses a recent semiconductor detector. The maximum distance between the sensor and the recording unit METEO should not be longer than 4 meters.

The detector is closely connected with a connector extension and is placed in a resistant plastic radiac cover, which is part of the sensor RV12. After 1–2 years is recommended to replace this sensor (it is possible to order it at company FIEDLER-MÁGR) to declare accurate of measuring.

Technical parameters

The detector marking	SHT-75-RV12
Accuracy of measuring relativity wet	±1, 8 % RV
Accuracy of measuring air temperature	±0, 3º C

THE CONVERTER METEO SETTING

The module address The converter METEO has the address 1 set in the manufacture. It is possible to change it in the software MOST through serial interface RS232/RS485. Another possibility how to change the address is switching on the reversing switch S4 on the converter´s printed circuit. This will set the address 2.

channels Measured and calculated values are saved into the converter´s channels. Then the recording unit M4016 read these values through the protocol FINET.

The time of transmission could be influenced by some of unattached or damaged sensors. For example disconnecting the relative wet sensor extends converted time to 2sec. Because of that do not keep working the converter with unattached or damaged sensors.

Converter METEO channels

Channel	Measured value	Resolution	Unit of measure
K1	Wind speed	0,01	meters per sec.
K2	Wind direction	10	º
K3	Full wind*	0,01	meters per sec.
K4	Relative air humidity – the sensor 1	0,01	%
K5	Air temperature – the sensor 1	0,01	ºC
K6	Relative air humidity – the sensor 2	0,01	%
K7	Air temperature – the sensor 2	0,01	ºC
K8	Global radiation – the sensor 1	0,1	W/m^2
K9	Integrated radiation – the sensor 1*	1	W/м^2
K10	Global radiation – the sensor 2	0,1	W/м^2
K11	Integrated radiation – the sensor 2*	1	W/м^2

*channels are functional only when the converter has full power supply

M4016 setting In the list of measuring method choose the option RS485-FINET than according to the next tablet set the address 1and the channel.
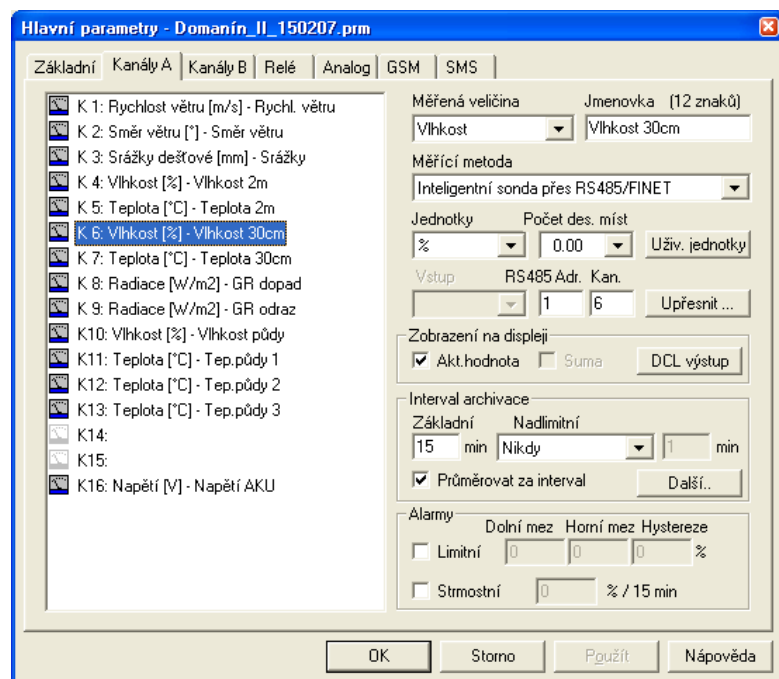
In this picture is example of the channel K6 setting for relative air humidity measuring with RV12 sensor.

Error:255 The converter METEO is in some cases delivered with a limited number of channels. It is possible to switch off first 3 channels for wind, relative air humidity and air temperature measuring. If the record unit M4016 makes enquiries though the converter´s channel is switched off, it gets answer the code ERROR 255.