MONITORING, DATA LOGGING AND CONTROL SYSTEM MS2+, MS3+, MS4+

INSTRUCTION MANUAL
Basic Part

comet SYSTEM s.r.o.

CONTENT: **page**

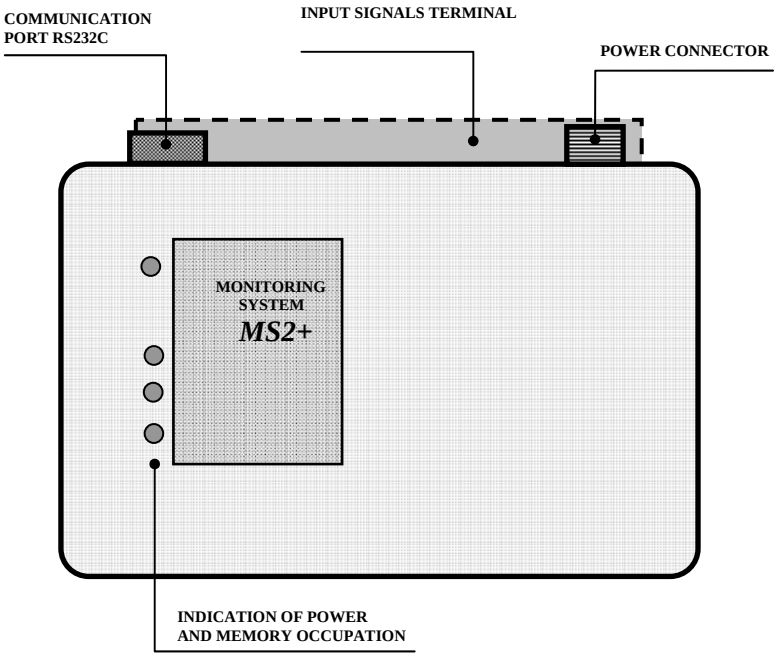
Note: Appendixes to Manual are available in electronic format.

INTRODUCTION

Data loggers are designed for applications, where it is necessary to achieve time characteristic of up to 16 relatively slow signals (changes >1s). Basic version of this family is data logger MS2+. In addition data loggers MS3+ have display with simple keyboard and the possibility of evaluation of alarm states. Most complex are data loggers MS4+ with 16 output relays enabling to control external devices in dependence on alarm states. Recorded data evaluation and data logger configuration are performed by means of the connection to personal computer.

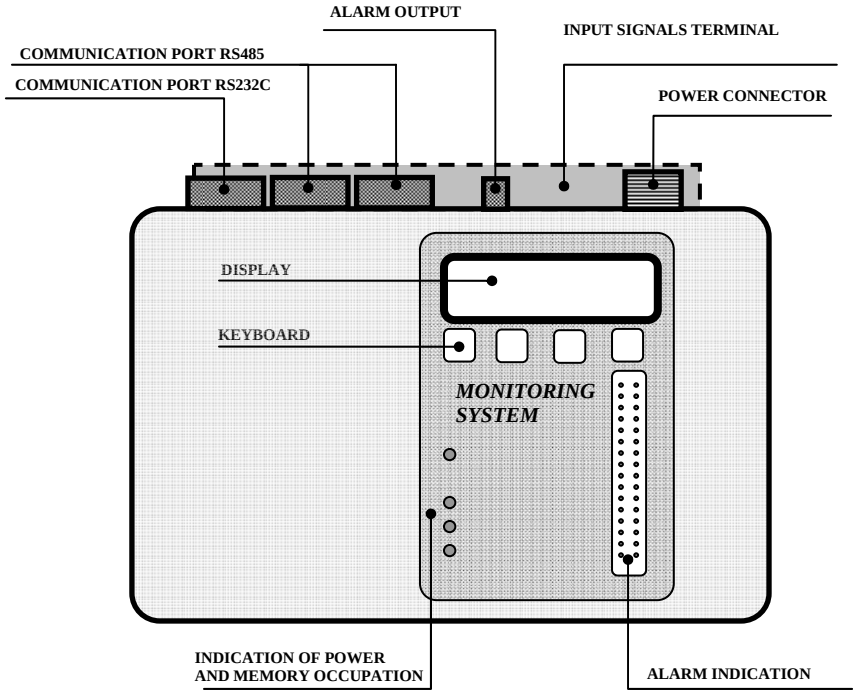
Warning: Data logger is powered from ac/dc adapter, which is connected to electric power mains. Additionally in some cases dangerous voltage is connected to input terminals. It is necessary to mind Not allowed manipulation and warning

Data logger MS2+:



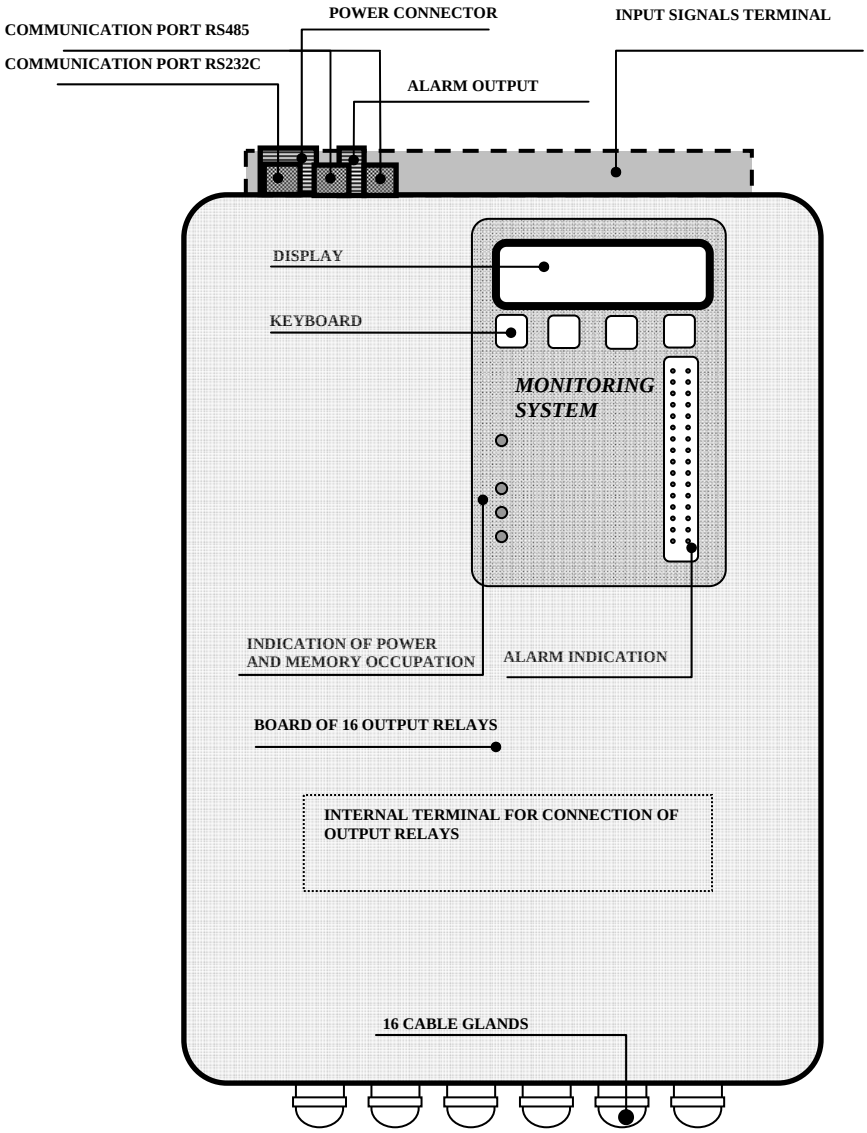
- possibility of installing of 1 to 16 different input modules to match the application requirements
- communication interface RS232C
- input for connection of power adapter
- backed-up real time clock (RTC) and data memory (SRAM) by internal battery

Data logger MS3+:



- possibility of installing of 1 to 16 different input modules to match the application requirements
- communication interface RS232C and RS485
- evaluation of alarm (limit) states
- optical indication of alarm states on front panel of data logger (two LEDs for each channel)
- internal audio indication of alarm states
- output ALARM OUT enabling to connect external alarm indication or telephone dialer
- illuminated LCD display of 2x16 characters on front panel of data logger
- four buttons keyboard on front panel of data logger
- input for connection of ac/dc power adapter
- backed-up real time clock (RTC) and data memory (SRAM) by internal battery

Data logger MS4+:



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- four buttons keyboard on front panel of data logger
- input for connection of ac/dc power adapter
- backed-up real time clock (RTC) and data memory (SRAM) by internal battery
- 16 output relays for external devices control

Installation of data logger

- selection of suitable location of data logger (generally is recommended to locate data logger to the wall as near as possible to measured points with respecting ambient environment)
- installation of probes and connection of cables (input channels, connection to the computer, power and other accessory)
- checking of correct connection

Detailed instructions for installation of data logger are specified in the chapter RULES FOR INSTALLATION AND CONNECTION OF DATA LOGGER.

2.2. Basic data logger activation

After data logger is mounted and checked, and connect data logger to the power. Check basic function (at least two LED diodes must shine with MS2+, check the function of display and the keyboard with MS3+, MS4+). If connection to computer via RS232 link is used, read data logger configuration (icon **i**).

- data logger is installed , connected to computer, correctness of connection is checked
- connect logger to power and check function (almost two LEDs must shine on MS2+, on MS3+, MS4+ check display and keyboard functions)
- install PC program on your PC (see part PROGRAM FOR DATA LOGGER)
- if logger is connected to the computer via RS232 link, read logger configuration (icon **i**). In case logger is supposed to communicate in different way, it is recommended to verify first the functions in basic connection via RS232 and then set logger to communication interface to be used finally.

Program enables to work simultaneously with several loggers that are connected to the computer in different ways.

2.3. Setting of data logger

- logger is connected and communication works
- read configuration of data logger (icon **i**)
- set Name of data logger, Date and time in data logger (if differs from reality)
- set parameters of communication interface of data logger (ATTENTION – if data logger is connected in different way than by means of interface RS232, it is possible, other communication parameters will be necessary to reconfigure too)
- enter names of each measured point and modify the display of the values in accordance with your requirements (recalculations, decimal point position etc.)
- switch ON and set logging function for each channel in accordance with your requirements:
  - use Continuous record with fixed interval and select suitable logging interval for channels, where continuous record is required.
  - if record only in several cases (e.g. in activated alarms) is required, use Conditional record, which will be active only during specified Condition is valid. Then select suitable logging interval.
  - if there is a need to know only a value and time in appearance of defined event, use Sampled record
  - each typ of record is possible to limit for a time interval (absolutely from... to... and/or daily from... to)
  - all three types of record functions are possible to combine
  - for records dependent on appearance of defined conditions it is possible to enter logic function to start the record
  - record in several (maximum four) defined daily times
- if needed set alarm functions (only for MS3+, MS4+)

  - to activate alarm it is necessary to define condition first, when alarm is created and ended (in dependence on value and/or time)
  - assign actions to be performed to the defined condition (light up of LED on data logger panel, activation of output ALARM OUT, activation of audio indication, sending of SMS, for MS4+ also switching ON of selected relays)
  - action can be assigned not only to one condition, but also to combination up to four conditions created at different channels. It is entered as logical expression
  - at one channel maximum 4 conditions and 2 different actions can be defined; if more alarms are needed for one channel, it is possible in case other channels do not use alarms
  - output ALARM-OUT is mostly used to distant signal of selected alarm states (e.g. by means of external audio unit or telephone dialer). Active alarm can be disabled by personnel (from keyboard of data logger or from the PC – in both cases password can be required), simultaneously it is possible to record alarm activation/deactivation (including information on way of disabling)
- if it is needed to mark record parts during record with own notes, it is enabled by Processes. Those texts must be known before and stored in data logger. From keyboard of data logger is possible to select from the list. Together with measured value text of selected process is recorded. Sixteen predefined processes in data logger are enabled.
- if all configuration of data logger is necessary to modify (e.g. different sensors are connected etc.), without any PC it is possible to select one of predefined configuration Profiles by means of the logger keyboard
- if secured data transfer and access to data logger and program functions is required use password and access rights system

Detailed description of configuration of data logger is in part DESCRIPTION OF SETTING AND MODES OF DATA LOGGER.

2.4. Ordinary work with data logger

- downloading of recorded data and viewing, archiving and printing/exporting of recorded data from data logger or a file on disk
- watching on-line measured values in Display mode - enables to view simultaneously all connected data loggers

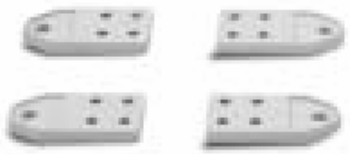
Instructions for regular data logger check are in part RECOMMENDATION FOR OPERATION AND MAINTENANCE.

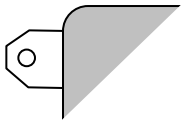
RULES FOR INSTALLATION and CONNECTION OF DATA LOGGER

Mechanical installation of data logger

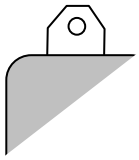
Location of data logger must comply with operating conditions and not allowed manipulations. Working position of data logger: standard position is with input terminals upward. Included is a set of four consoles with screws for installation on the wall. Screw consoles to corners of data logger and then entire data logger to vertical flat non-inflammable surface.

Fixing consoles for installation of data logger on the wall:





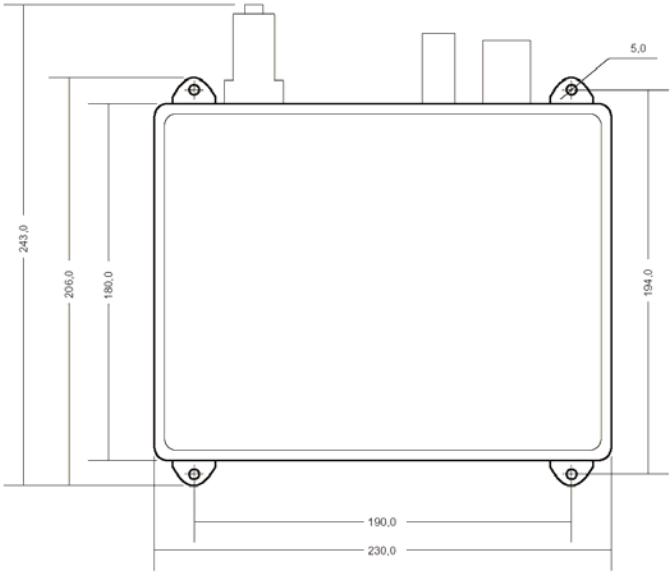
or:

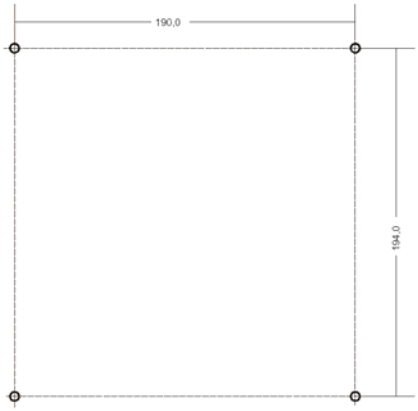


Drilling holes to the wall: for data logger in smaller case hole centers are at corners of rectangular 190x194 mm, for data logger in larger case it is rectangular with dimensions 210x337 mm.

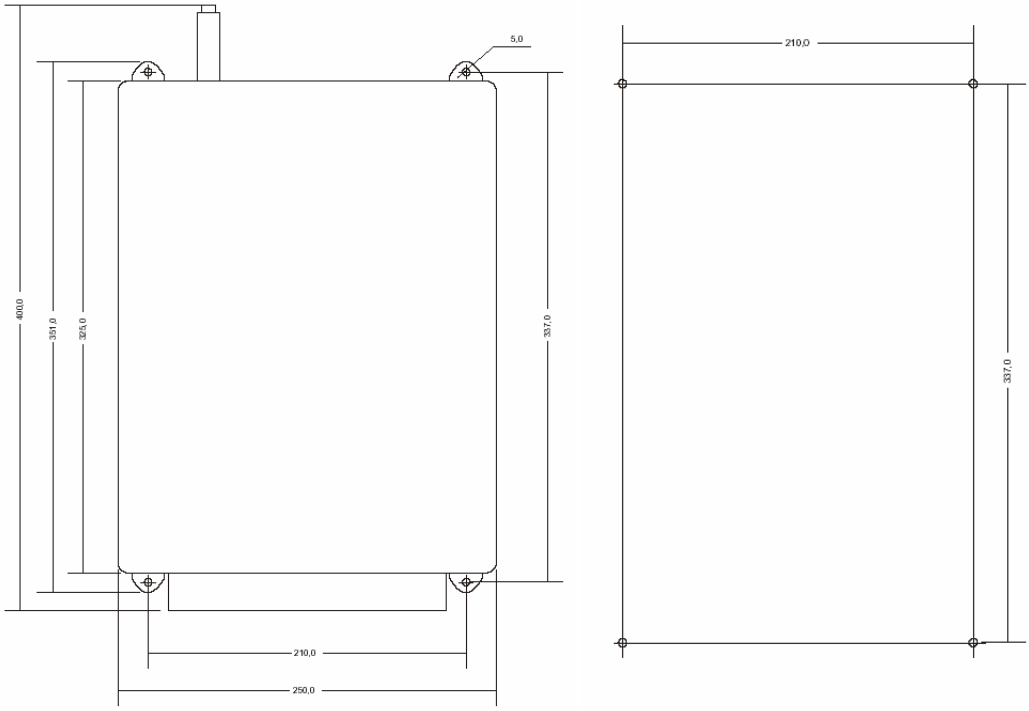
Mechanical drawings:

a) data loggers in smaller case (MS2+, MS3+)

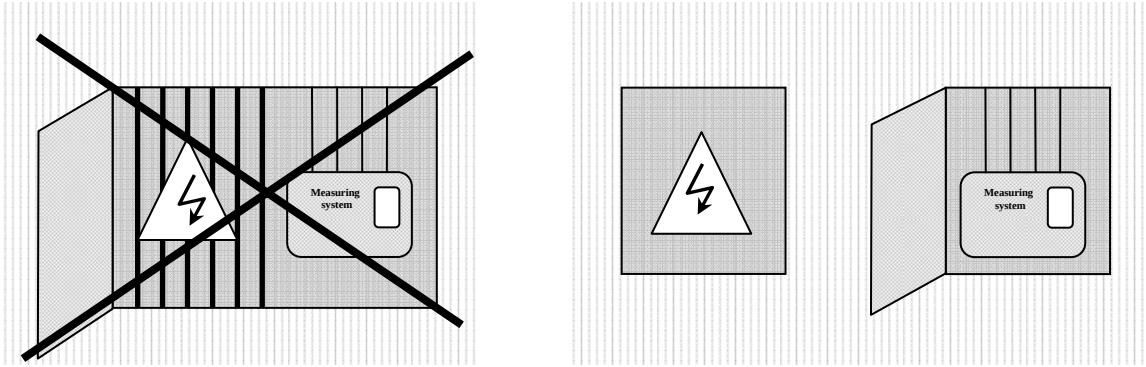




b) data loggers in larger case (MS4+ and data loggers with thermocouple inputs)



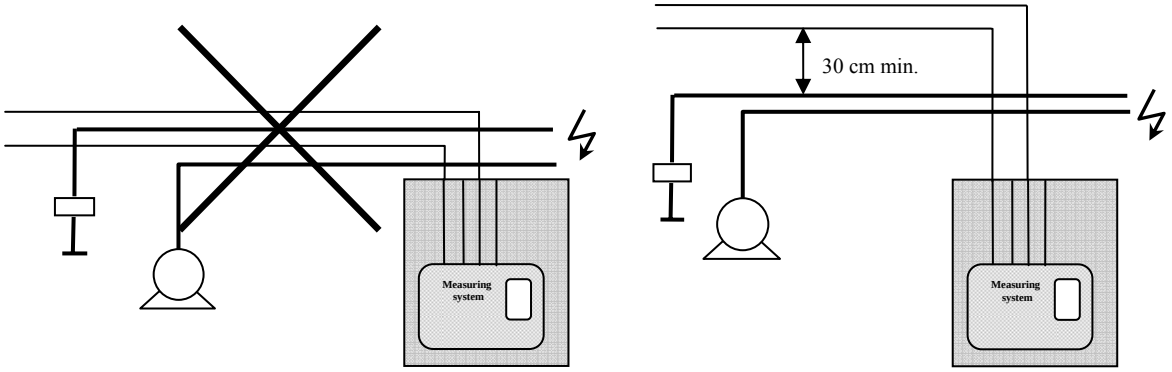
If dangerous voltage is present at input terminals it is necessary to ensure additional protection. The best way is to install logger to separate larger box. Data logger must not be installed directly to power switchboards or near to switchboards. Also it is not allowed to install data logger to power contactors, motors, frequency converters and other sources of strong interference.



General rules for leading of cables

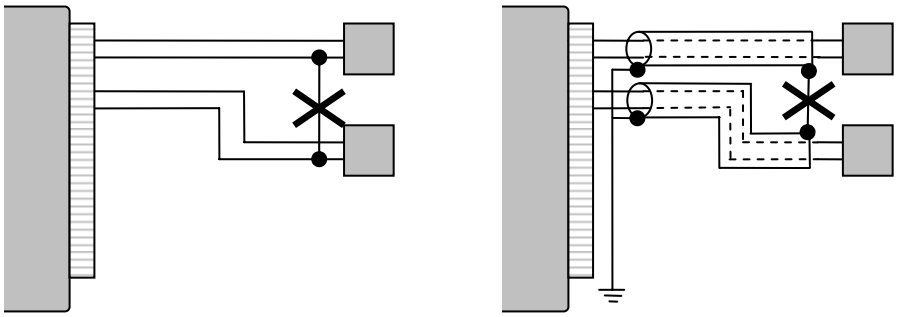
Leading cables requires special attention to avoid electromagnetic interference to cables. Special attention requires also location of transducers and probes. It is not allowed to install them near to sources of strong interference.

Mind not to lead cables in parallel with electric power distribution. Safe distance depends on the magnitude of interference field in most adverse case (especially in transient modes). If in doubt as large as possible distance is recommended.

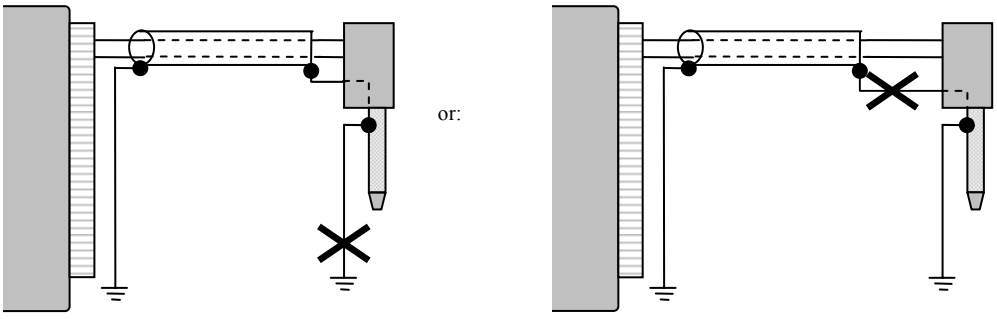


All cables connected to data logger must be led in indoor rooms (data logger is not equipped with protection against atmospheric electricity). Mind not to connect leads to other circuitry, if application itself allows. Parameters of used cables depend on signal characteristic and external conditions, cabling will be exposed to. Do all light current installation by shielded cable. For stationary light current installations shielded cables n pairs x 0.5 mm^2 are recommended.
In connection cables mind the following rules:

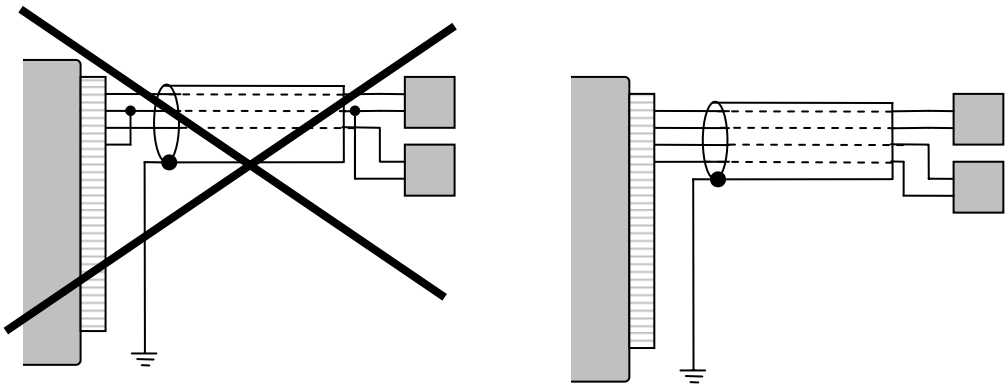
1. It is necessary to avoid all ground loops. It concerns both measuring circuits and shielding cables.



2. Do not connect shielding cables at side of end devices as long as those devices have no terminal for shielding. Shielding should not be connected to outer metal parts of this device nor other devices (*Possibility of creation of undesirable current loops - in those cases do not connect!).* Also shielding connection directly to measured signals is not allowed.

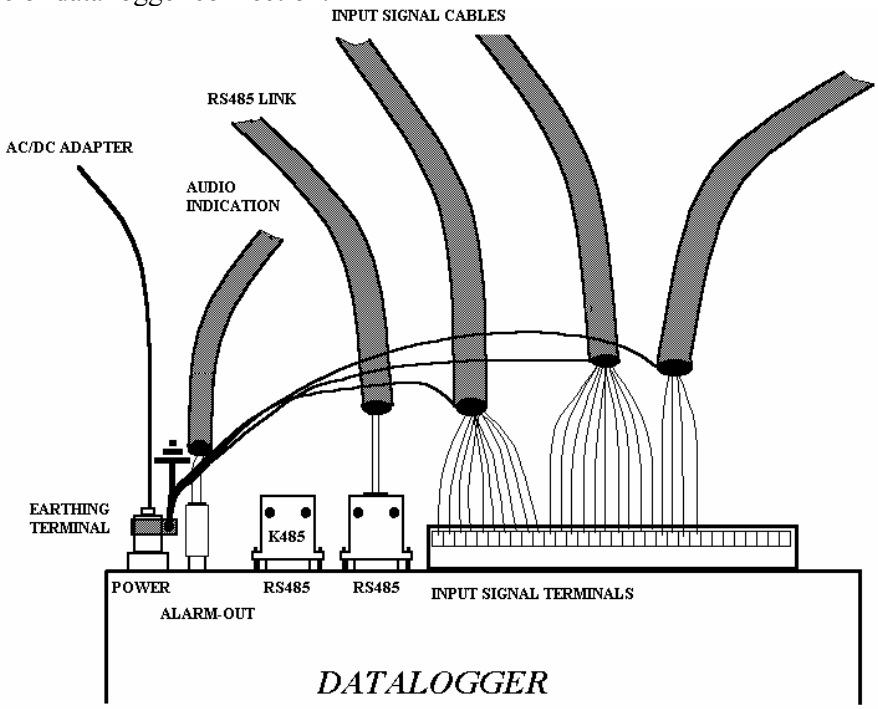


3. On principle use separate lead pair for each channel (do not create „common lead“ for several channels):



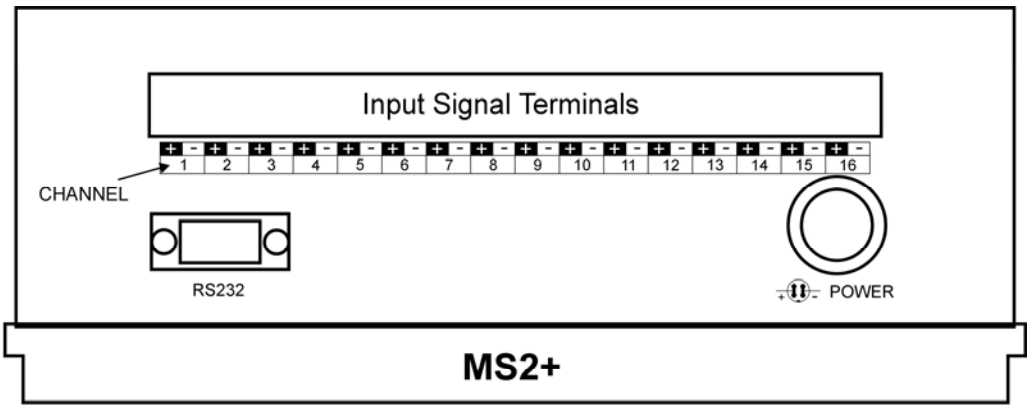
4. Ground terminal should be connected by strong lead to building construction or to protection circuit at data logger side. Connect shielding of all cables coming to data logger to this terminal. The point for earthing data logger is located at the shield of power connector – recommend especially in installations with s risk of electromagnetic interference. **Do not connect** cable of communication interface RS232 and RS485 to earthing terminal.

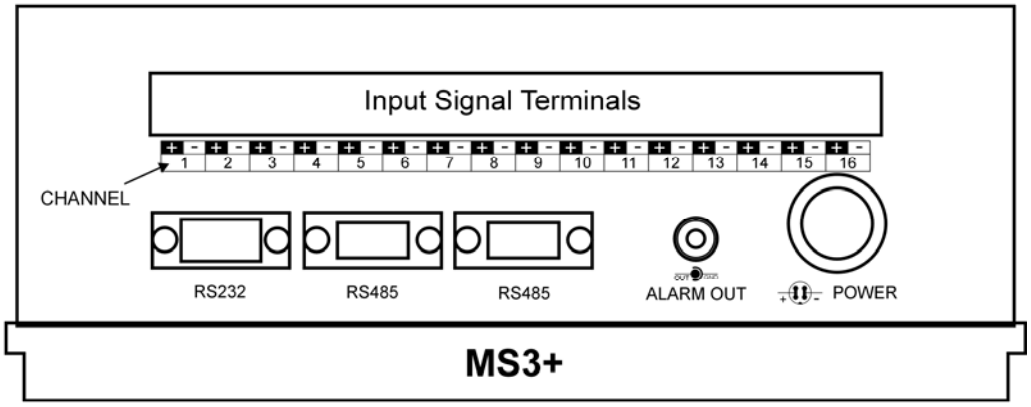
Example of data logger connection:

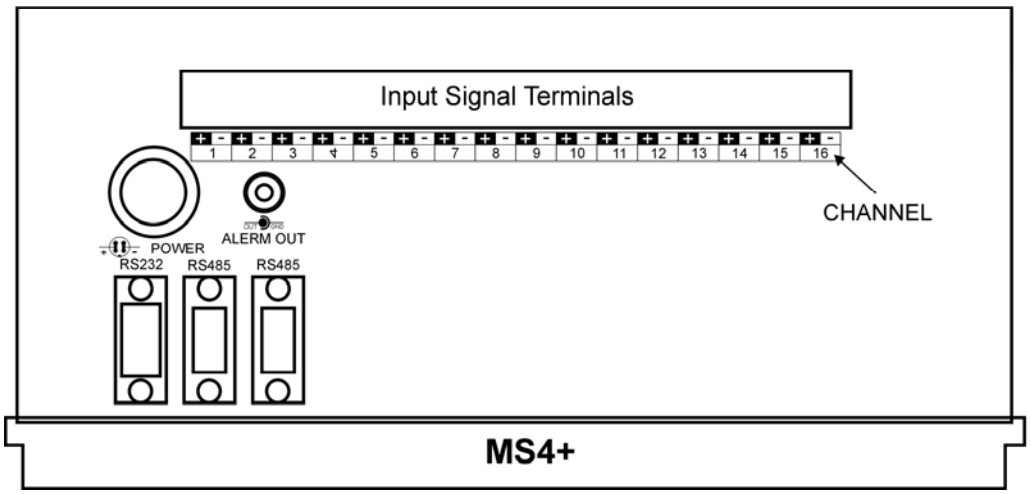


5. **Do not connect** shielding for RS232 cable (interface is designed for short distance communication) to common point, see appendix 4– cable wiring. Also d**o not connect** shielding for RS485 cable to earthing terminal.

Connection elements for input signals, power and communication interface







Connection of input channels

Terminal for input channels

Connect input signals to self-locking WAGO terminal, located at the upper side of the case. Insert flat-bladed screwdriver to rectangle terminal hole and push screwdriver towards away from you - contact is released. Connect wire to released terminal (circular hole behind the rectangular one) and close the terminal by removing the screwdriver. Input terminal + (IN) is always the left terminal of the pair, the right of the pair is the –(IN) terminal. Connect input signal positive pole of the dc signals to +IN terminal.

Notice: The entire input terminal block is possible to remove from data logger by pulling it up from the connector.

Connection of transducers with current output powered by current loop

In case of connection of channels with current loop powered from data logger (inputs A0) it is possible to insert other devices (panel meters, measuring computer cards, etc.) to current loop. In this case it is necessary to consider, if undesirable current coupling will not cause measurement inaccuracy. All inserted devices must be galvanic isolated from other circuits. In case, it is not possible to ensure this, use galvanic isolated inputs A1G and power loops from external source. Connection of input part of the module A0 including connection to two-wire probes is described in appendix 2.

Connection of thermocouple probes

For connection of thermocouples use appropriate extension cable. Continuity of material of thermocouple wire should be kept along the line up to data logger connector. Extension (compensation) cable for thermocouples type S (PtRh-Pt) is used from different materials (due cost reasons).

Marking of subminiature thermocouple connectors and wires manufactured by OMEGA (in accordance with US standard):

Type of thermocouple	Connector color	+ wire color	- wire color
K (NiCr-Ni)	Yellow	Yellow	Red
J (Fe-Co)	Black	White	Red
S (Pt10%Rh-Pt)	Green	Black	Red
B (Pt30%Rh-Pt)	White	Black	Red
T (Cu-CuNi)	Blue	Blue	Red

If there are more thermocouple inputs in data logger not galvanic isolated, avoid thermocouples to be mutually connected. If hazard of current leakage exists (mostly between thermocouple welded point and surrounding metal framework), thermocouple probes with galvanic isolated weld from outer probe shield or galvanic isolated input modules should be used. In other case high measuring errors can appear. It is recommended to use shielded thermocouple cables for longer distance (depending on possible interference sources).

Connection of temperature resistance transducers

For connection of temperature resistance transducers with medium impedance (Nickel 1000, Pt1000) use shielded two-wire cable (do not connect shielding to any pole of input terminals, but the earthing terminal). Metal head and shank of transducer should not be galvanic connected to measuring chip itself (nor cable shielding – hazard of undesirable coupling through metal frames etc.). For connection resistance transducers with low impedance Pt100 it is necessary to use wire with sufficient cross section due to measurement accuracy (sensitivity of Pt100 is approximately 0.385 Ohms/°C). Measurement error due cable resistance or manufacturing sensor tolerance is possible to correct by means of the PC program.

In Appendix 6 additional errors caused by leads resistance are specified.

Connection of transducers with ADVANTECH ADAM protocol to RS input

For connection of RS485 link for input module RS use e.g. shielded cable 2x2x0.5 mm^2, where one pair use for power of transducers and second pair for link RS485. Network of transducers is recommended to power from separate source (no from ac/dc adapter, which powers data logger itself). Generally: link RS485 is designed for communication up to 1200 m (in internal room, data logger does not have protection against atmospheric electricity), use for cabling twisted two-wire of nominal impedance 100 Ohms , loop resistance maximum 240 Ohms , maximum 98 Ohms /km, maximum capacity 65 pF/m, cross talk between pairs –40 dB/150 kHz. Cable is in one line, i.e. no „tree“ or „star“. Cable ends with termination resistor.

Wire marking of other manufacturers: „+“ corresponds to „A“, „-“ corresponds to „B“. Mutually connect cable shielding, do not connect with transducers.
Note: for short distance is possible to use other network topology. Termination resistor equals to parallel combination of input resistance of all devices connected to the link.
Generally value of 120 Ohms *is recommended in literature. This could decrease network parameters, because of lower voltage levels and immunity against interference. Other literature recommends termination resistor up to 1 k*Ohms*. Termination resistor is possible to leave in short lines.*

Connection of ALARM OUT output (MS3+, MS4+)

The output is designed for connection of devices indicating alarm state. Most frequently external audio indication unit or telephone dialer is applied.

External audio indication unit is designed especially for wall mounting. Recommended shielded cable 2x0.5 mm^2, maximum length of 100m. Connect ALARM OUT output on data logger with audio unit with proper polarity. Negative pole of connector CINCH is the outer terminal. Select item ALARM OUT signalization in menu Configuration-Settings-Profile settings. At the same time it is necessary to have activated ALARM OUT signalization of all required alarms. If indication controls external devices, it is recommended to set suitable delay of desired alarms to prevent false indication.

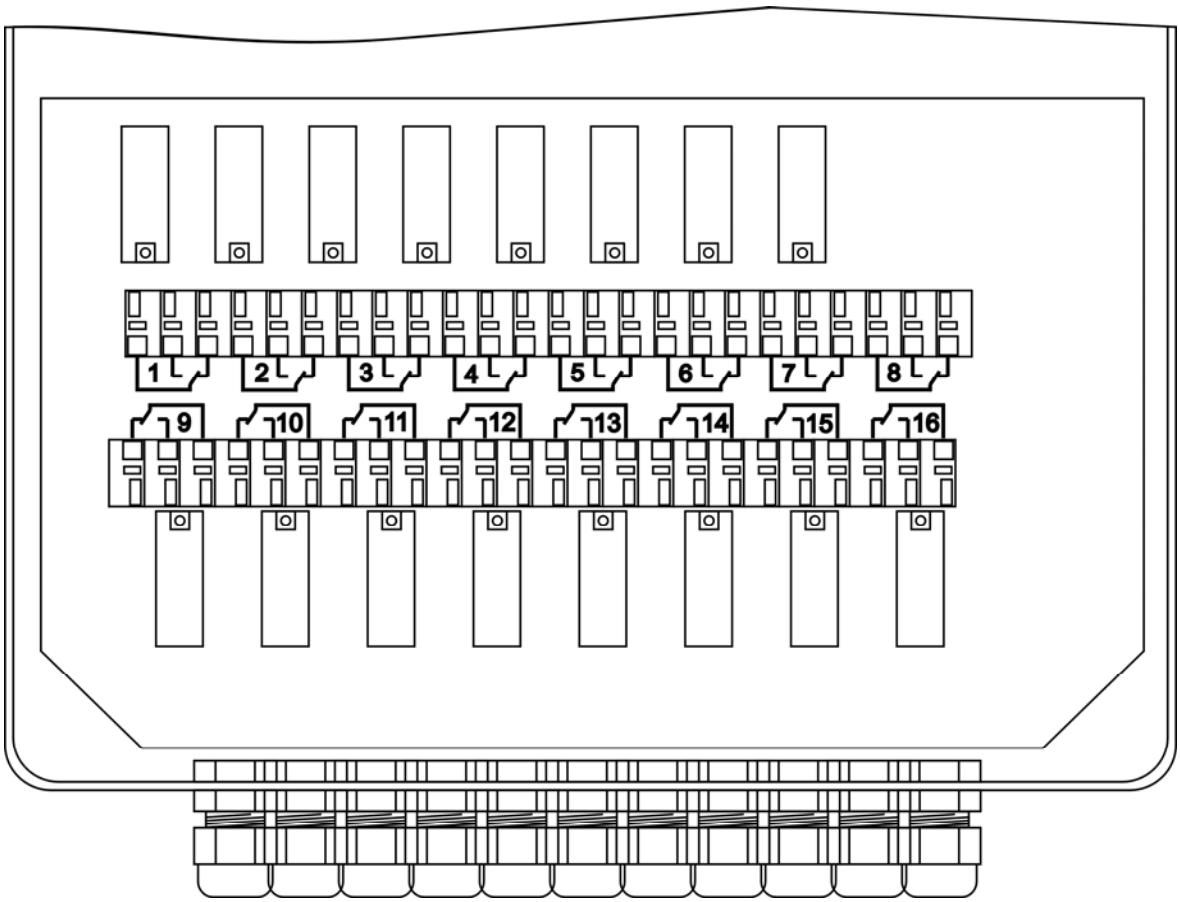
In case of alarm telephone dialer dials specified telephone number and announces voice message. Follow the rules from the manual of the telephone dialer in installation. Connection: connect 12V output of ac/dc adapter to terminal marked +12V and GND. ALARM OUT output of data logger connect in correct polarity to terminal IN1+ and IN1-. Plug the ac/dc adapter in mains. In dialer configuration first select user mode, then store phone number (or numbers) and record voice message. Then it is recommended to set delay of transmitting after activation at least 10 seconds (*Function 4 1)*. After completing of all settings connect dialer to phone line and check the function.

Note: *This data logger output enables to connect other devices, e.g. relay (it is necessary to use parallel diode to the coil) or telephone voice dialer. It is necessary to respect the maximum consumption. Data logger output is not protected against permanent short circuit.*

Connection of output relays of data logger MS4+

Data logger MS4+ contains 16 output relays with switching over contacts designed for external device control (see relay parameters and Not allowed manipulations). It is possible to assign any number of relays to any alarm. Relay terminals are accessible after opening the lid (it is absolutely necessary to disconnect data logger from power before). Remove lid after releasing six screws. The lid is connected with case by a flat cable, maximum care should be taken, to cable or data logger damage. It is recommended to disconnect flat cable from the lid to release lid totally. Relays are marked with numbers 1 to 16. Each relay is connected to three terminals. Relay contacts are switching over. The interconnection cables should first go through glands at the case wall. Tighten properly the glands to prevent disconnection of cables from terminals. Insert the screwdriver to the slot at terminal upper part and slightly lift to open the terminal. Now connect the wire-tinned end to the square hole below the slot and release the screwdriver to connect wire perfectly. All connecting of wires should be done with maximum care to prevent contact with live parts of the system (real time clock and some parts work even the power is switched off).

After all output signals and mains plug are connected it is possible to plug in the flat cable connector into the male connector at the lid, close the case and tighten the six screws. Plug in the connector carefully with the respect of the proper orientation.



Connection of data logger to the computer

Procedure:

- *in accordance with the following examples connect each device. If other accessories are needed (converters etc.), then recommended types are always specified, correct function is verified with. Different accessory is possible to use, but no problem installation (including cabling) and reliability is not guaranteed.*
- *if needed , install drivers of accessories (modem, USB....)*
- *define Communication device, data logger is connected to in software menu Setting of communication*
- *assign data loggers connected to each communication device in the same menu item*

Selection of communication speed

It is necessary to adjust suitable communication speed for correct and fast communication of the computer with data logger. It can be done always from the PC program or from the keyboard of data loggers MS3+ and MS4+. If communication speed is too high with respecting the communication path quality, then frequent repeating of communication is required and communication time is longer.

Connection of communication link RS232

Features:

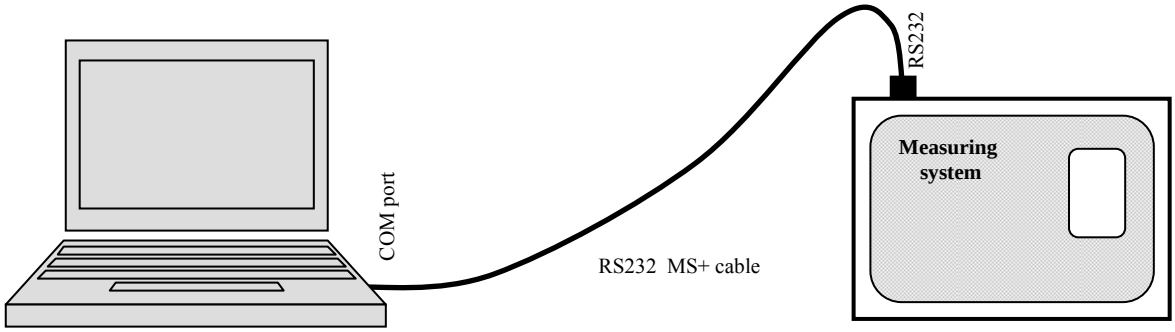
- *simplest way of data logger connection to the computer*
- *only for short distance between data logger and master device (PC, converter Ethernet RS232..) – up to 10 meters*
- *no connector of another interface (RS485) nor termination resistance K485 should be connected to data logger*
- *suitable cable is shielded two-wire*

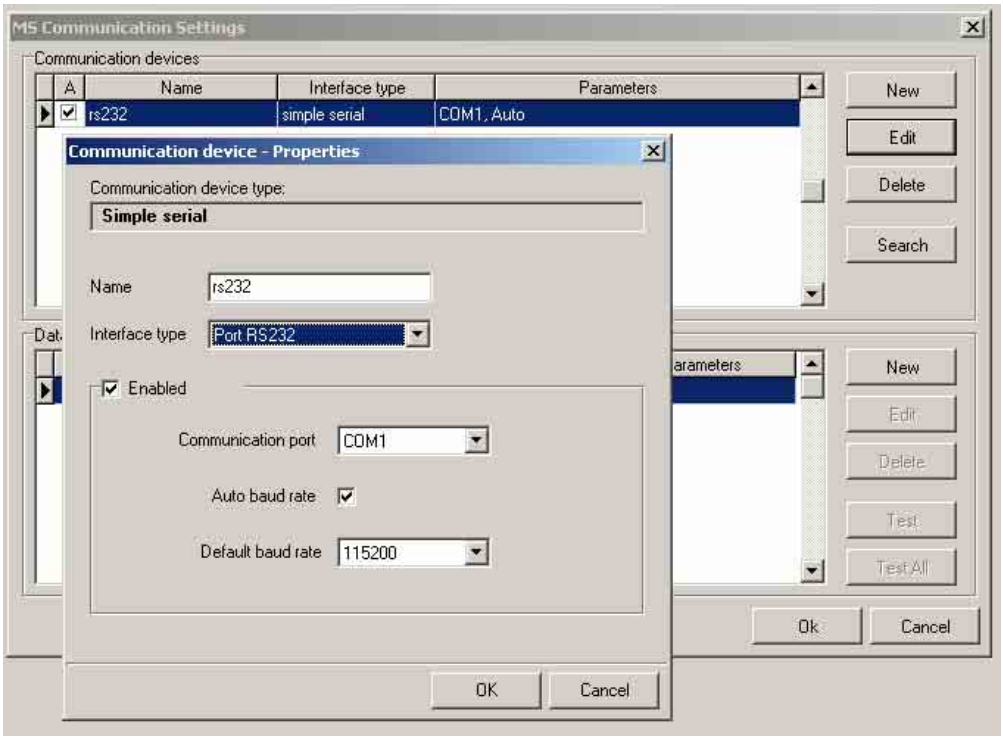
Typical connections:

a) connection by means of standard communication cable RS232 (accessory of data logger, wiring diagram of the communication cable - see Appendix 4, part D4.1).

Use:

- *Computer is located near data logger (up to 10m)*
- *Computer has available serial COM port*

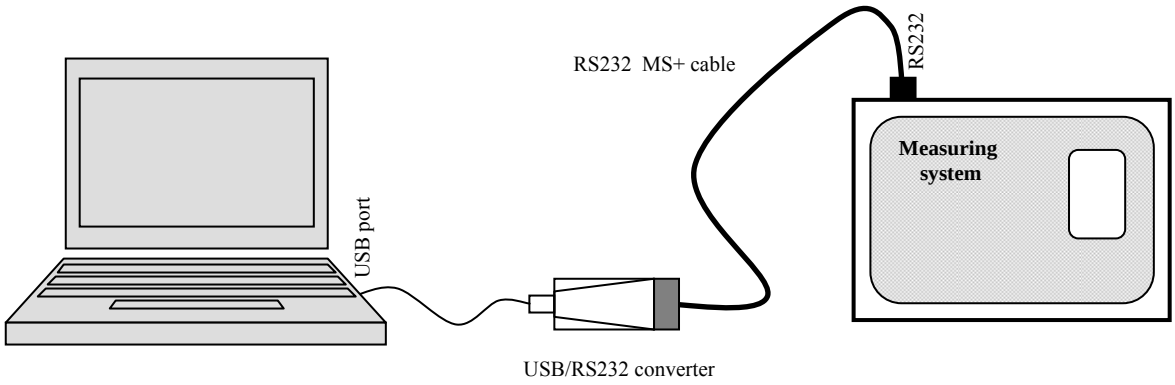


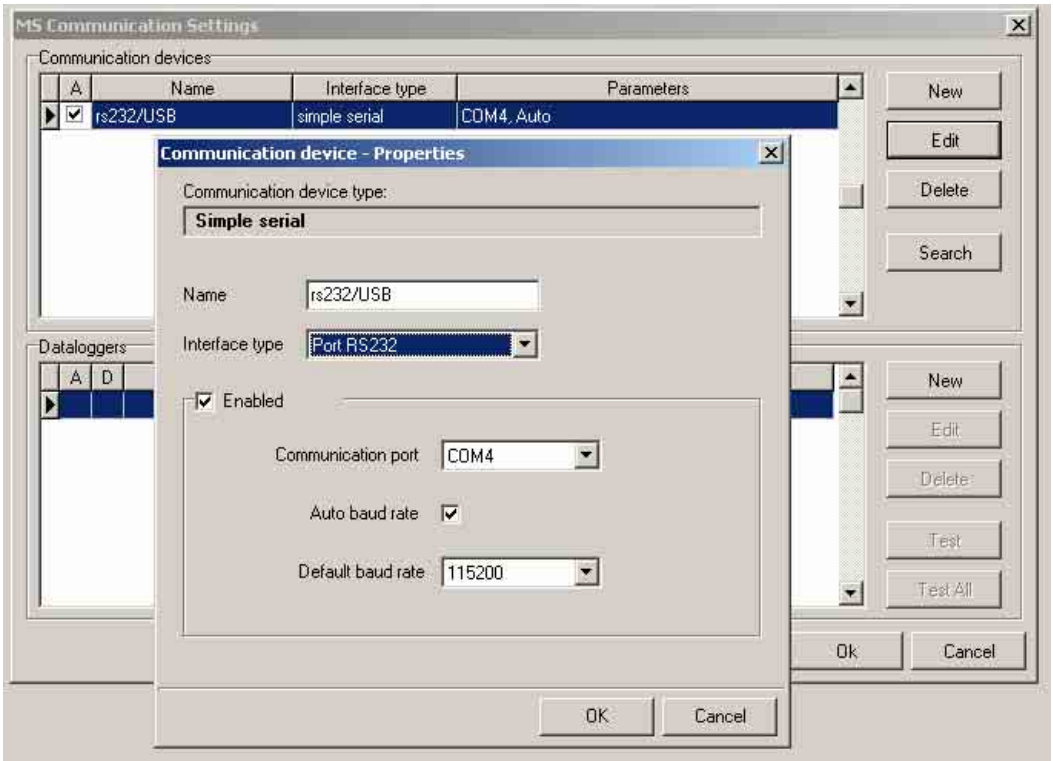


b) connection by means of USB interface

Use:

- *Computer is located near data logger*
- *Computer has no serial COM port available, only USB interface*
- *if data logger has built-in USB interface connect it to the computer, if not, use converter USB/RS232 (FTDI US232 Converter Cable, ASIX UCAB232) and standard cable RS232 from data logger accessory (see figure)*
- *Before setting of communication in MS2,3,4+ software it is necessary to connect converter to the computer and install virtual port driver COM – see Appendix 10*

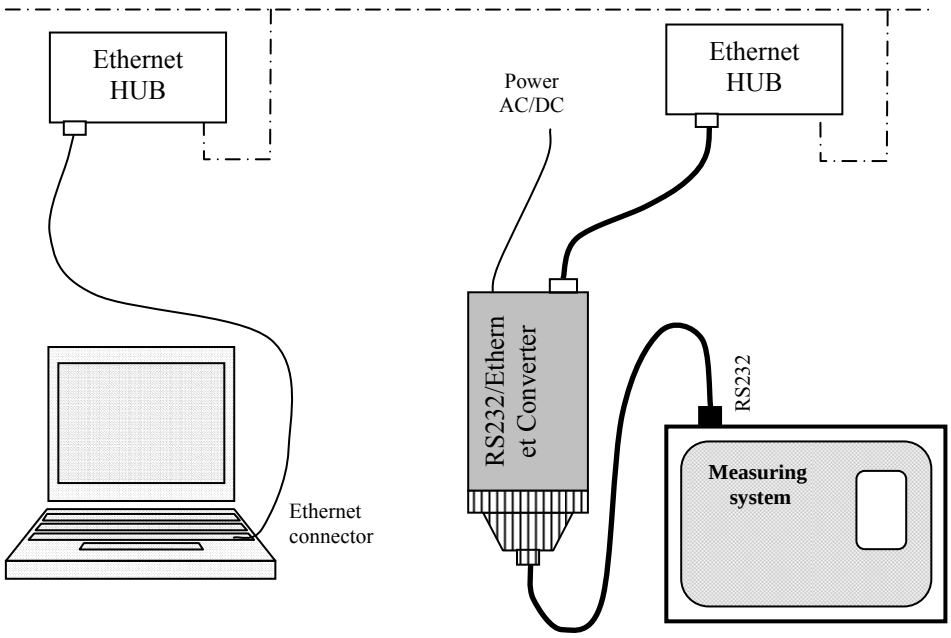


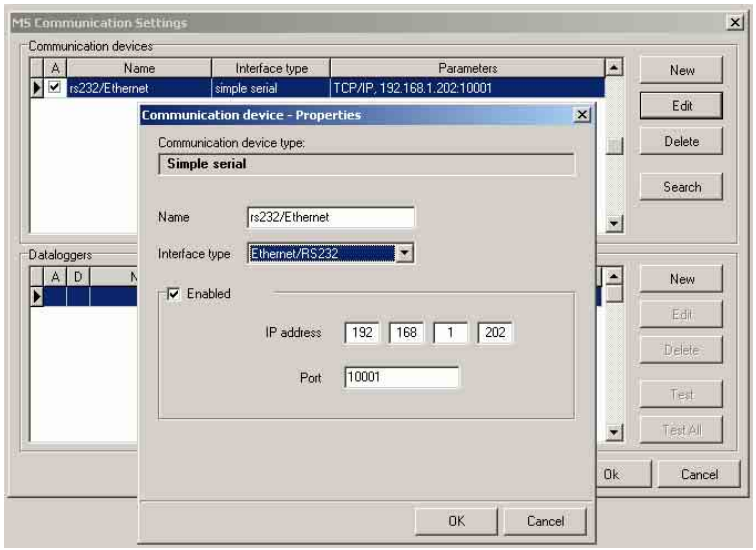


c) connection to Ethernet network

Use:

- *Computer is not located near data logger, but connected to network, possibility of access from several computers, possibility of access via Internet*
- *There is an Ethernet network connection near data logger*
- *if data logger is equipped with Ethernet interface, connect it to computer network, follow instructions in accordance with Appendix 9 during adjustment.*
- *if data logger is not equipped with Ethernet interface, use converter RS232/Ethernet (Lantronix UDS-100, wiring diagram of cable is specified in Appendix 4, part D4.2- see figure), during adjustment follow instructions in accordance with Appendix 9*
- *ATTENTION – communication speed adjusted in menu on data logger must be identical as speed adjusted in configuration of Ethernet interface. If changed (in data logger or from the PC in configuration of data logger), there must be changed also in adjustment of Ethernet interface (by means of e.g. Internet Explorer)*





Completion of adjustment in connection of data logger by means of RS232 link

Connect data logger to power after definition of Communication device, select line with defined communication device by mouse and select search of data (Search). Program searches all available communication speeds and display found data loggers in lower part of the window (Dataloggers). Finally confirm window Adjustment of communication (OK).

Connection of communication link RS485

Features:

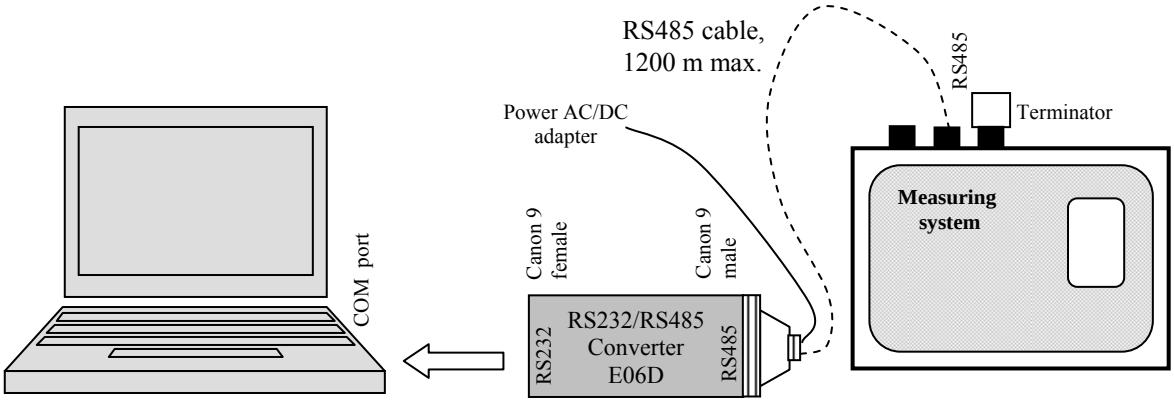
- *available only with data loggers MS3+ and MS4+*
- *suitable for communication with one or several data loggers connected to one link RS485 for longer distances (up to 1200 m – only in indoor rooms)*
- *necessary port RS485 in the computer or converter to other interface (RS232/RS485, Ethernet/RS485 ...), ATTENTION – converter must be powered by ac/dc adapter, without power communication does not work*
- *recommended cable – shielded twisted two-wire, e.g. cable SYKFY n x 0.5, detailed wiring diagram - see Appendix 4, part D4.4*
- *termination resistor K485 (Terminator) – in case of communications problems try to leave it out - see Appendix 4.*
- *no connector can be inserted to other interfaces of data logger (RS232)*
- *data logger must not be set to communication RS232-modem (enabled to change from keyboard in data logger menu)*
- *if using more data loggers connected to one network RS485, then all data loggers must be set to the same communication speed and each data logger must have its own address (no data loggers with the same address must be present in the network). This adjustment is possible to change from the PC SW or directly from keyboard of data logger MS3+ and MS4+.*

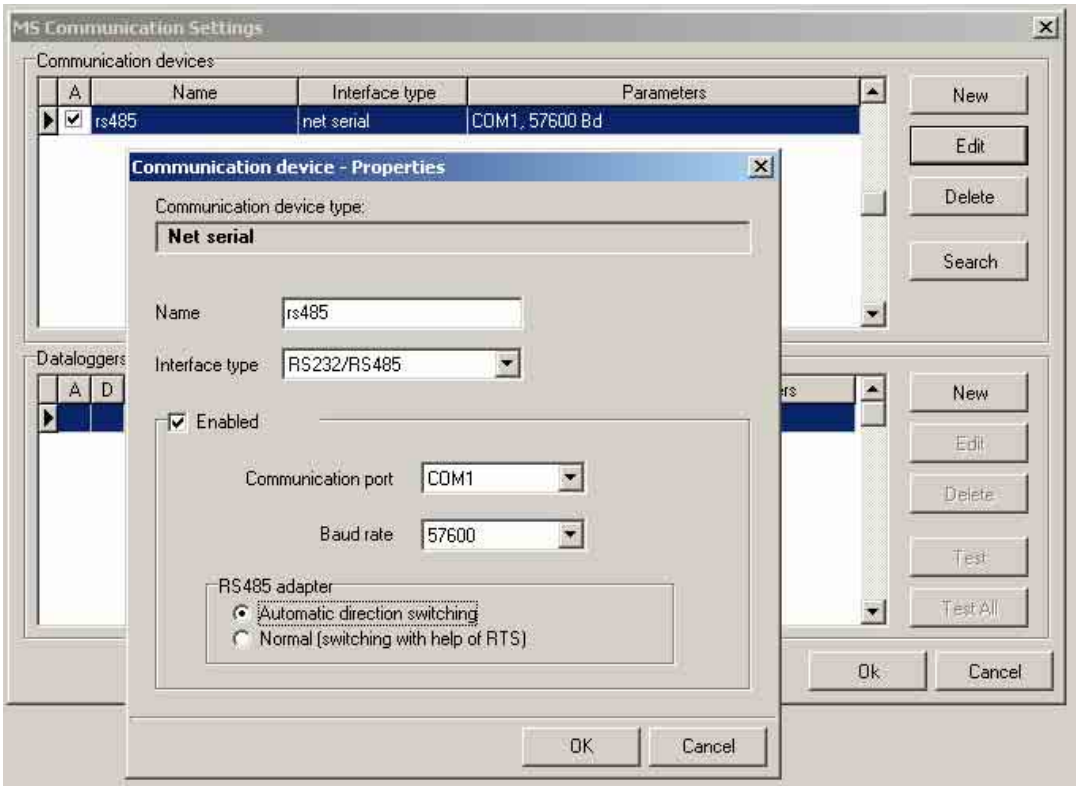
Typical examples of connection of one data logger with the computer by means of interface RS485:

a) by means of converter RS232/RS485 with automatic direction switch (e.g. E06D, AUT485), connect converter to COM port of the computer directly or by means of the Canon25-male /Canon9-female, see wiring diagram of cable RS485 in Appendix 4, part D4.4

Use:

- *Computer is located up to 1200m from data logger*

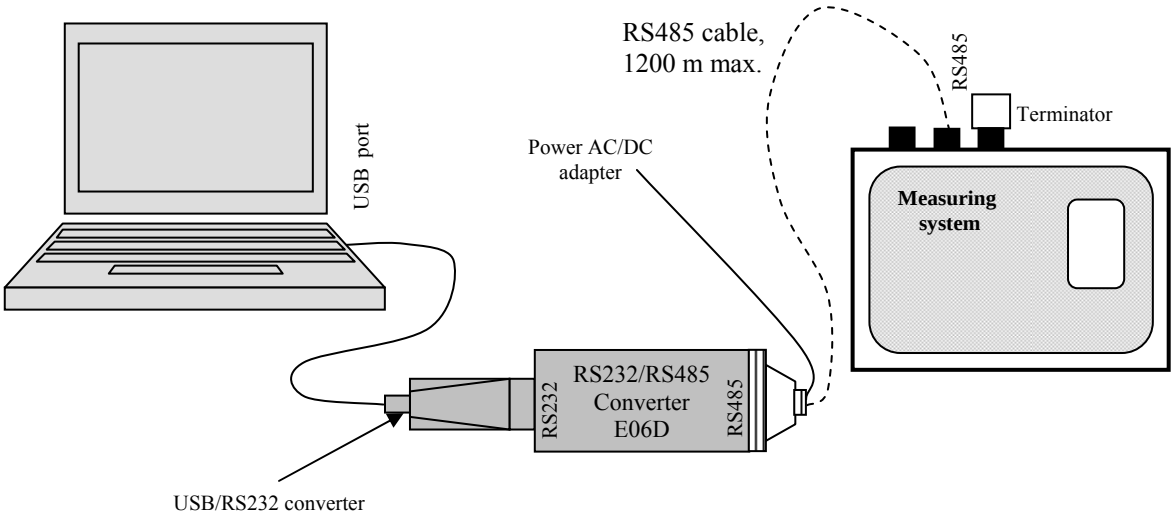




b) by means of converter RS232/RS485 s automatic direction switch(E06D, AUT485), PC does not have a COM port, only USB interface - use converter USB/RS232 (FTDI US232 Converter Cable, ASIX UCAB232), see wiring diagram of cable RS485 in Appendix 4, part D4.4

Use:

- *Computer is located up to 1200m from data logger*
- *Before adjustment of communication in SW MS2,3,4+ it is necessary to connect converter to the computer and install driver of virtual COM port (see Appendix 10). Other adjustment is then identical as in previous case*



Communication of more data loggers in network RS485:

Except of the above adjustments it is necessary to assign address to each data logger and write it to data logger list in PC program. Simplest solution is to set addresses of data loggers at theirs displays, where all addresses must differ from 1 to 255. All data loggers must be set to the same communication speed. Check finally the connection of RS485 link (frequent error is e.g. mix up of both signals). Wiring diagram of output circuitry and connection example is in Appendix 4, part D4.3. and D4.4.

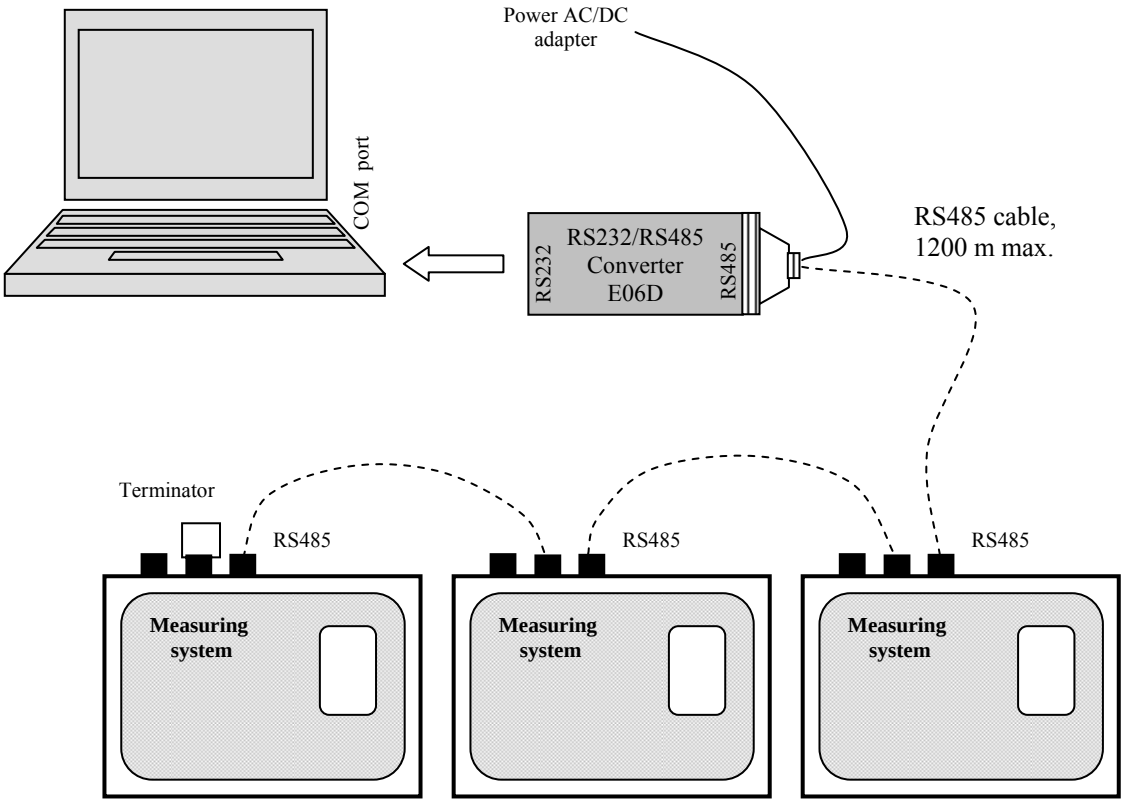
Typical examples of connection of several data loggers to the computer by means of interface RS485

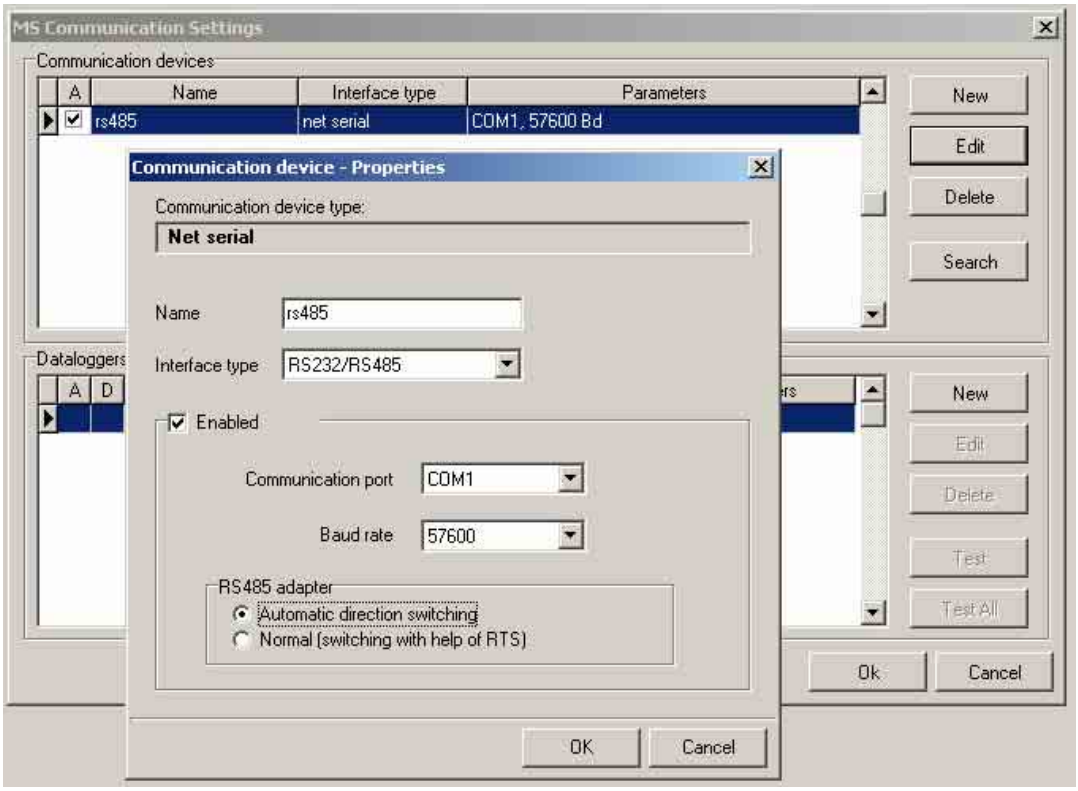
a) by means of converter RS232/RS485 with automatic direction switch (E06D, AUT485), connect converter to COM port of the computer directly or by means of adapter Canon25-male /Canon9-female

Use:

- *Computer is located up to 1200m from data logger, data loggers can be far from each other*

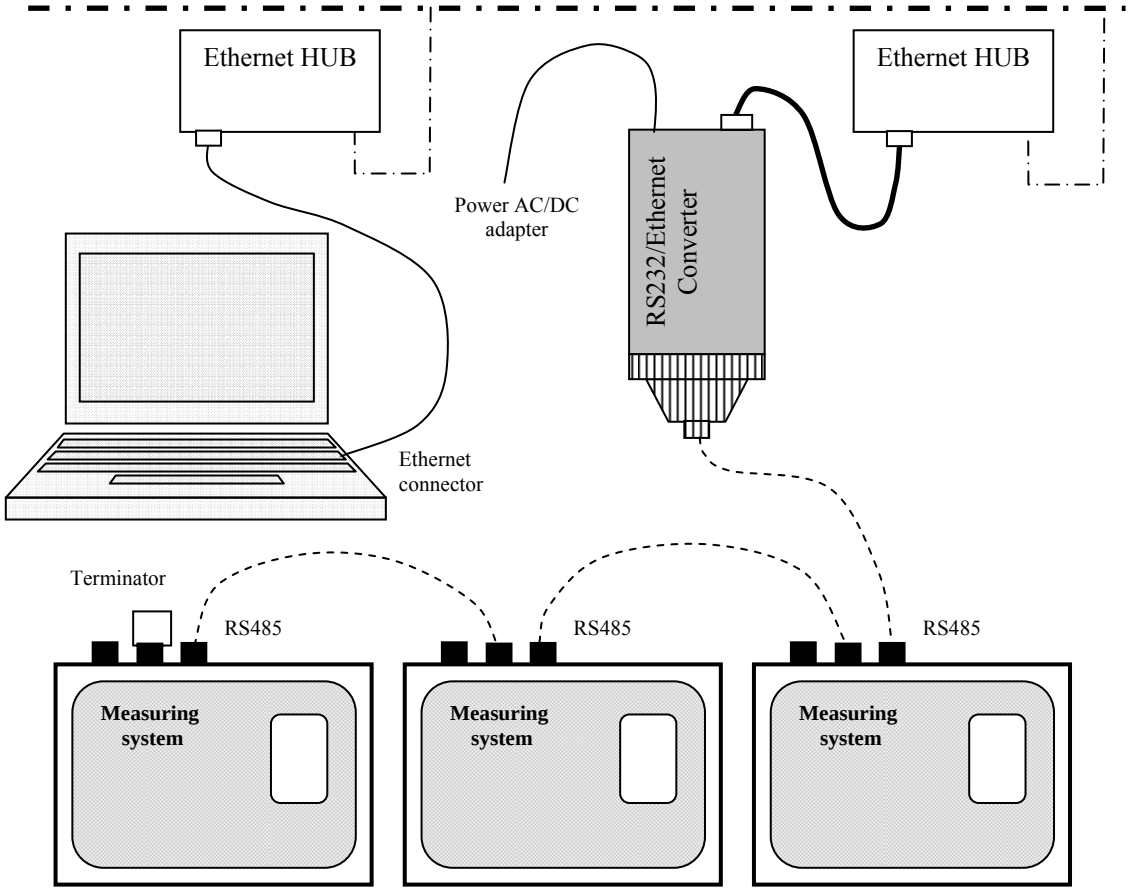
If computer has only USB interface, then insert an extra converter USB/RS232 between USB port and converter RS232/RS485 analogically as in previous case. Before adjustment of communication in SW MS2,3,4+ it is necessary to connect converter to the computer and install driver of virtual COM port. Wiring diagram is in Appendix 4, part D4.4.

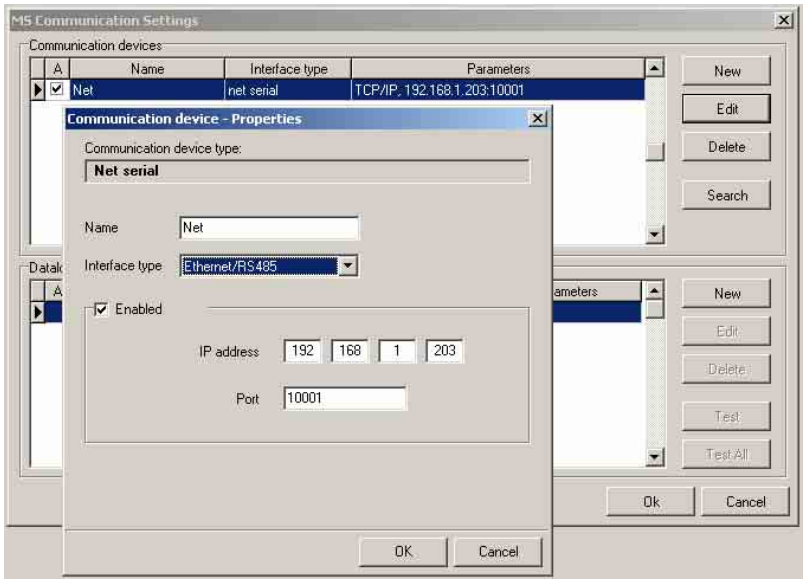

Power AC/DC
adapter
COM port
RS232/RS485
Converter
E06D
RS232
RS485
RS485 cable,
1200 m max.
Terminator
RS485
RS485
RS485
Measuring
system
Measuring
system
Measuring
system


MS Communication Settings
Communication devices
A
Name
Interface type
Parameters
rs485
net serial
COM1, 57600 Bd
New
Edit
Delete
Search
Communication device - Properties
Communication device type:
Net serial
Name
rs485
Interface type
RS232/RS485
Enabled
Communication port
COM1
Baud rate
57600
RS485 adapter
Automatic direction switching
Normal (switching with help of RTS)
OK
Cancel
Dataloggers
A
D
New
Edit
Delete
Test
Test All
Ok
Cancel

b) by means of converter Ethernet/RS485 (see cable wiring diagram in Appendix 4, part D4.5)
Use:

- *Computer is located up to 1200m from data logger (in indoor rooms)*
- *Computer is connected to Ethernet network*
- *Ethernet connection is available in the location, where data loggers are installed*
- *possibility of very distant access via internet*
- *Before adjustment of communication in SW MS2,3,4+ it is necessary to connect converter to power, then follow instructions in Appendix 9.*





Completion of adjustment in connection of data logger by means of link RS485

Connect data logger to power after definition of Communication device, select line with defined communication device by mouse and select search of data (Search). Program searches all available addresses and display found data loggers in lower part of the window (Dataloggers). Finally confirm window Adjustment of communication (OK).

ATTENTION: contrary to interface RS232, when all communication speeds are searched, in this case only speed entered in definition of communication interface is searched. It is necessary adjustment of speed is identical for all data loggers!

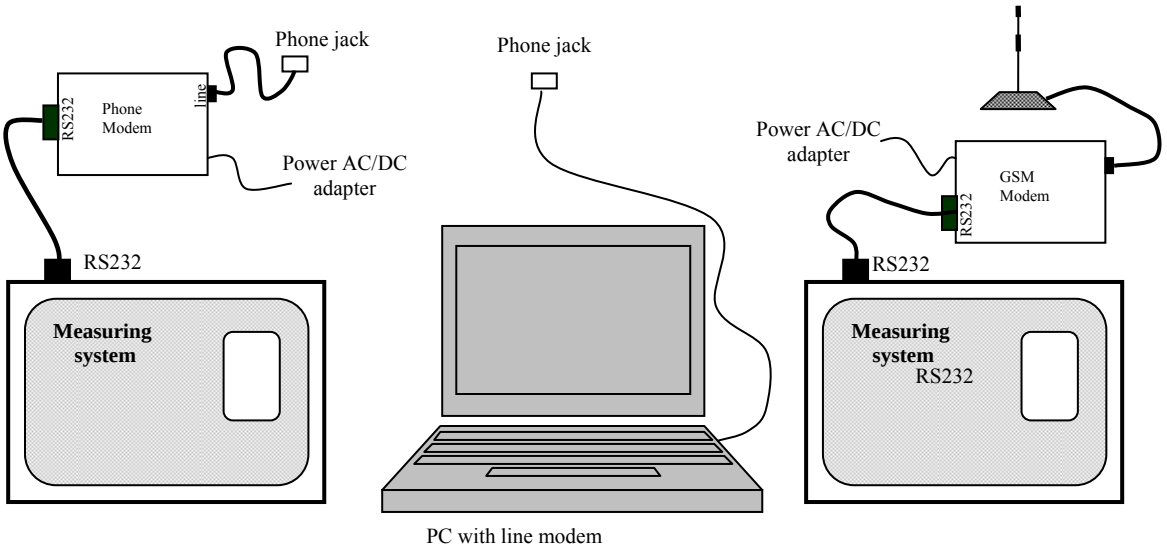
Connection of data logger via modem

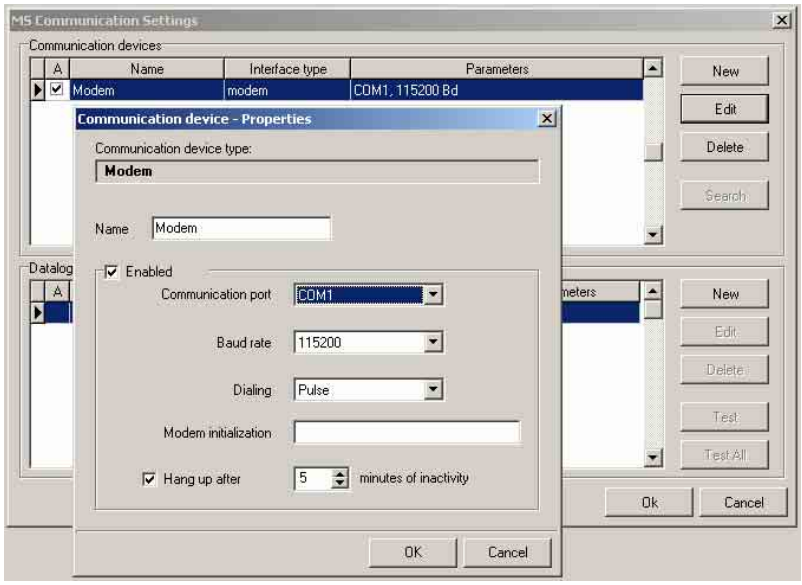
Use:

- *Computer is very far from data logger*
- *In location of data logger and the computer a vacant telephone link or GSM operator coverage is available*
- *work with SMS messages is required*

Features:

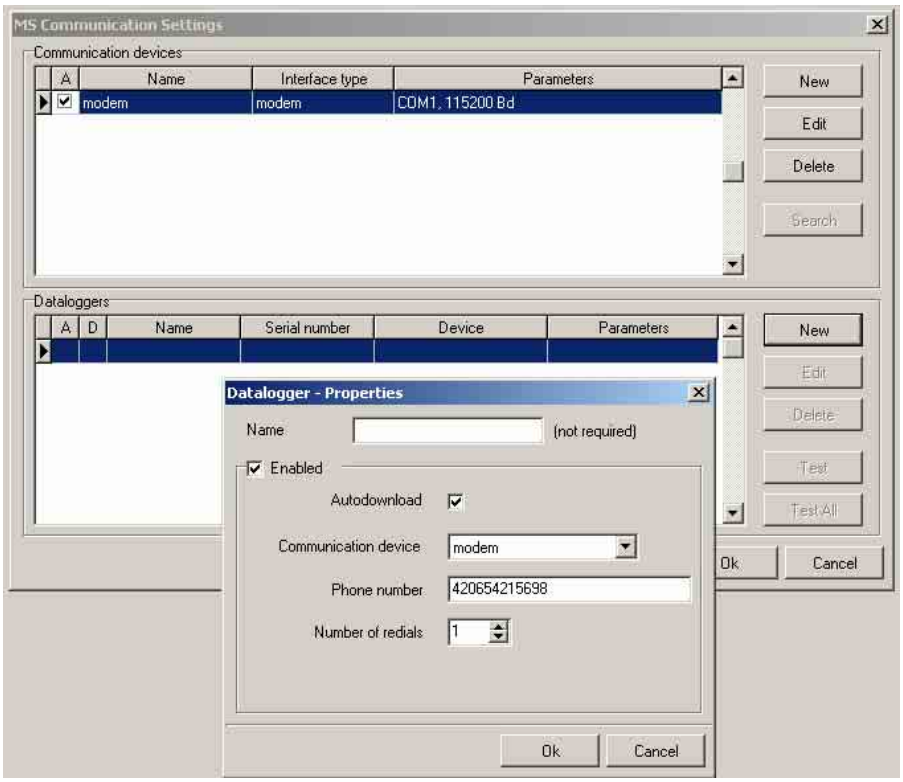
- *computer contains an internal modem or external modem is connected to the telephone link or GSM modem is connected*
- *modem drivers are installed in the computer*
- *first connect data logger via basic interface RS232 to the computer, read its configuration, set communication to RS232-modem, select corresponding modem type (for land line resp. GSM modem). AT initiation command is created, which data logger will write to the modem always after switching ON the power. If in problems set modem manually (see Appendix 5)*
- *external modem is connected to data logger via RS232 (ba means of cable delivered with modem !)*
- *connect modem to power and after about 10 s connect data logger to power (this way first configuration of modem by data logger is performed)*





Completion of adjustment in connection of data logger by means of modem

Connect data logger to power after definition of Communication device, select line with defined communication device by mouse. Select New from bottom part of the screen and enter telephone number of modem data logger is connected to. Then perform Test of connection:

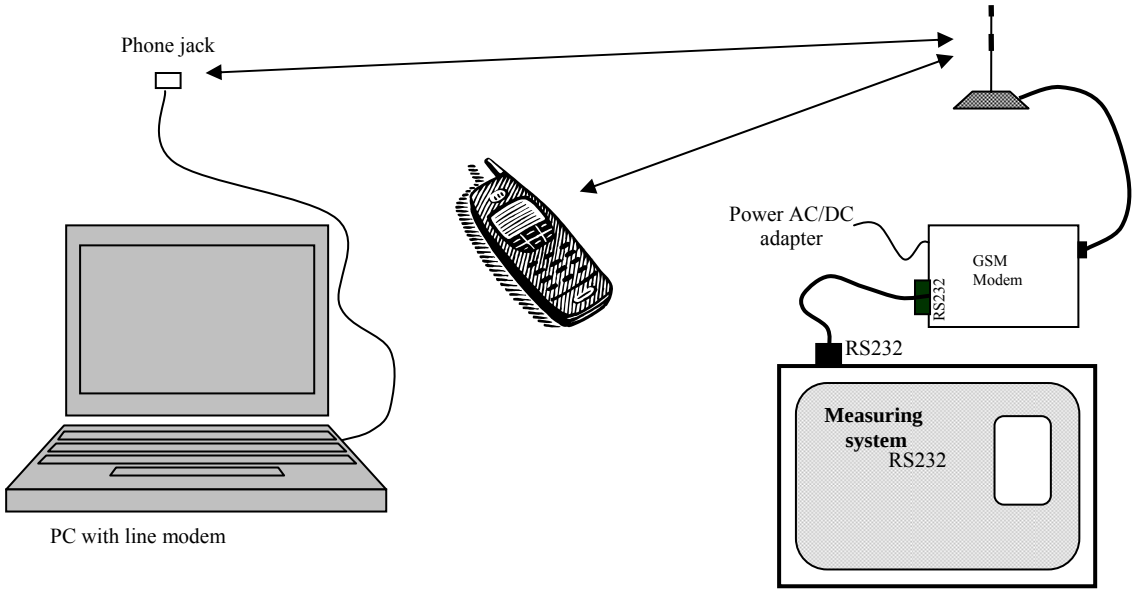


Connection of data logger with SMS support
The below functions are tested with GSM modem Wavecom WMOD2 and M1306B. Detailed setting of SMS transfer parameters is performed by means of the PC SW in service mode.

a) Data logger is connected to GSM modem. This channel is used both for data communication and transfer of SMS messages.

Features:

- *computer is very far from data logger, communication between PC and data logger is via GSM network*
- *if data communication between data logger and PC runs (download of record, configuration, Display mode), sending SMS from data logger waits for the end of this transfer and cancel of data connection*
- *not suitable for creation of permanent data connection (e.g. Display mode permanently running)*
- *connection cable between data logger and modem – use cable delivered with modem!*



b) Data logger is connected to GSM modem via optional serial interface - there is a special SMS module installed in data logger. Other data communication is performed via main serial channel (RS232, RS485, USB, Ethernet interface).

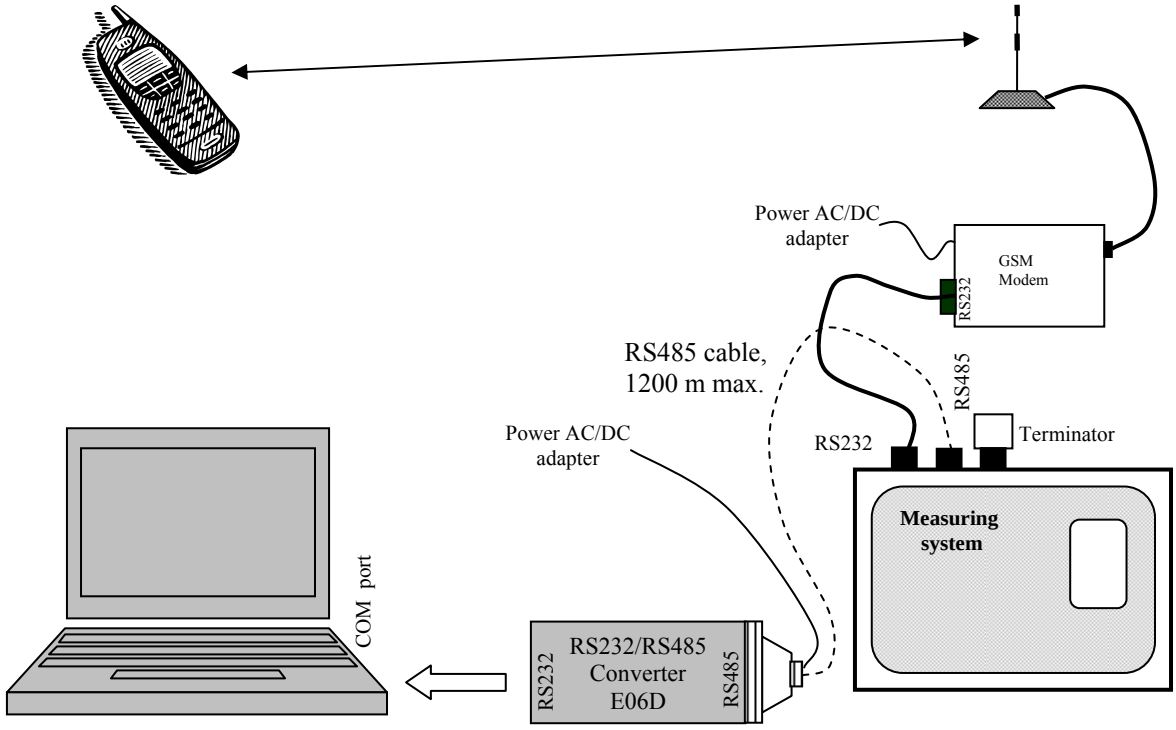
Features:

- *reception and sending of SMS messages does not depend on data transfer between PC and data logger (e.g. data download, Display mode running etc.)*
- *this way is suitable if SMS function is required and at the same time data logger is connected to the PC other way than via GSM modem*
- *optional SMS interface is designed only for connection to GSM modem for sending SMS and no other data transfer is possible.*

c) Data logger is connected to GSM modem via RS232 interface and communication with the PC runs via RS485 interface

Features:

- *this way is suitable if there is no permanent communication between data logger and the PC, SMS function and occasional distant GSM communication is required. Typical application - data is transferred time from time to the local PC during working hours. After the end of the shift local PC is switched OFF, data logger can send and receive SMS and distant communication with a PC is enabled if required.*
- *if data communication proceeds between data logger and PC (download of record, configuration, Display mode), sending SMS from data logger waits for ending of this transfer and canceling of data connection*
- *not suitable for creation of permanent data connection (e.g. Display mode permanently running)*
- *in case, request for communication with the PC appears in time, when communication with modem runs, data logger does not response to the computer, SW reports error of communication. Repeat the action – in second attempt communication would be free and data transfer with no problem (SMS communication is stopped during existing data transfers)*
- *ATTENTION – in this case data logger must be set on interface <u>RS232/RS485, not to RS232-modem</u>!*
- *connection cable between data logger and modem – use cable delivered with modem!*



The way of work with several data loggers connected to the computer in different ways

If more data loggers are connected to the computer, then after hardware connection define each communication device, that are added consequently to upper part of window Adjustment of communication (assign a name to each device). At next step assign communication device to one or more data loggers in accordance with theirs physical connection. This way data logger list is created, displayed always before the start of communication with data logger.

Connection of data logger to power

Data logger is powered from delivered ac/dc adapter. First connect connector of ac/dc adapter to data logger then ac/dc adapter to power mains. Earth permanently installed data logger via power connector as specified above. If powered from another source it is necessary to use dc voltage corresponding with technical parameters of data logger and respect data logger consumption (see Appendix 1). In some applications uninterrupted record is required during mains failure. In this case it is necessary to use similar UPS as for the computer. UPS is suitable to use also in cases when extreme fluctuation and interference in power mains is present.

PC PROGRAM FOR DATA LOGGER

Program characteristic

Basic version of program enables to use all data logger functions. After purchasing the licence and receiving registration key, program allows optional functions.
Operation system: Windows 98 and newer

Hardware:

- minimum configuration: processor Pentium 166, 32 MB RAM, Windows 98
- recommended configuration: processor Pentium 700 and higher, 128 MB RAM

In case, we already use data logger of MSx+ family and have purchased the new MSx+ logger, use always newer software for all data loggers (install newer version). Newest SW version SW is always available to download from manufacturer internet pages.

Installation of program

Insert disk with programs for Comet instruments to the CD unit and run program setup.exe. Installation wizard starts to help the installation. Run installed program in menu Start-Program files-Comet-MSPlus (if you did not change the location during installation).

Functions of program basic version

A) reading of recorded data from data logger, its saving to computer disk and display in table format with different display options including actual configuration display, data was recorded with.
Note: *Values are saved on disk files in binary format, which is unique for data logger and not compatible with standard formats. In case, value in table is not available or is not correct, error message is displayed – see Appendix 7.*

B) print and export of recorded data - it is possible to select time area and specify measured channels for print-out or export. In print mode preview of the measurement protocol is displayed first, which is ready to print out.

C) Configuration of data logger – this setting is described in part 3. In changing data logger configuration the following approaches are possible:

1. data logger is used stationary and there is no need to change configuration often – in this case first downloading of data to the computer is recommended then changing the configuration of data logger. Before its saving confirm query for clearing all recorded data.
2. during record change of data logger setting is required, but no recorded data erasure is required (e.g. record continuity or saving to one file is required). In this case no confirmation of data erasure is recommended before saving of configuration to data logger. Then in data logger will be recorded data with both original and new configuration. It is enabled to perform at least 6 (and 20 at maximum) such configuration changes without data erasure (accordingly to memory consumption of each change). Then it is necessary to erase recorded data.
3. user performs with data logger different measurements, each measurement requires different setting of data logger. In this case it is possible to define at least 6 (20 at maximum) different configuration profiles, to store them to data logger and select from them from keyboard of data logger.

Warning: *Change of time setting in data logger causes necessity to erase recorded data from data logger. User is warned before to enable him to download data to the computer.*

D) Data memory erasure - after confirmation of this selection logger data memory is cleared. States of counters in counter modules are not effected. Memory is erased also (after confirmation by the user) in configuration changes of data logger and after record is transferred to disk, if erasure was required.

E) Reset of counter inputs and memory erasure - after choosing this selection counters in counter modules (CTU, CTK) are reset and entire data memory erasure follows.

F) Communication settings – here creation of communication devices list is enabled. Also assignment of each data logger connected by different interface to the computer is enabled as well as functionality test of performed setting.

G) Display - on-line viewing of actual values on the computer screen, refresh interval is possible to set in section File-Options, bookmark Display.

User program – optional version

Optional program version for Windows contains all functions of basic version and additionally graphic work with measured data, possibility of automatic data download, color alarm distinction in table and graph, program protection by password system etc. Program control and menus corresponds to basic version.

Register program in Menu *Help-About program-Licence* to enable optional functions. Enter your company or organization name to the line Company, your registration key to the line Key. Key is specified on the Licence card. Warning – using of optional program version is allowed only with valid licence purchased.

Optional program version support administration of clients and password system – see Appendix 11.

DESCRIPTION OF SETTINGS AND MODES OF DATA LOGGER

Data logger setting is performed from personal computer by means of the software. If other communication interface than RS232 is used, it is recommended to perform first setting of data logger connected via simplified RS232 interface by means of the included cable. It is supposed for the following, that data logger communicates with the computer. If not first it is necessary to find error (see part *Solving of possible problems)*. The below description corresponds with menu item ***Data logger setting***. In case of using optional functions enabling to store several different configuration profiles, first select desired configuration profile of data logger.

There are three parts in data logger setting:

- *Common Setting*, containing settings of entire data logger

- *Profile Setting*, where setting are defined common for certain data logger configuration and for all channels
- bookmarks for *Input Channels*, containing setting of input channels one by one.

Common settings

Name of data logger: each data logger must have user defined name, which is a chain of maximum 16 characters without diacritics. Folder with this name is created in computer for storing downloaded files with recorded data. MS3+, MS4+ loggers display the name of data logger on the LCD display after switching ON and the name is available in data logger *Menu*. Name of data logger is used for identification in PC SW. Usually user enters location of data logger or description of recorded objects.

Serial number: chain of 8 digits, first two digits specify the year of production

Type : MS2+, MS3+, MS4+

Data memory is 2 MB. Maximum time till memory is fulfilled depends on number of active channels, their types and on set logging interval. Maximum of 480 000 measured values or 240 000 separate samples or events from binary inputs is possible to store. In practice the number will be slightly lower.

Date and time in datalogger – datalogger has its own real time clock backed-up by internal battery, which is its source of timing.

Erasing of all recorded data is required by the software after changing of set time in data logger.

Processes: Process is the name of object monitored by data logger. User can select for each channel from preset process names by means of the logger keyboard. This enables to distinguish in record what process was monitored in what time.

Example: in smoke-box are processed different products during one shift and it is required to know, which product was smoked in what time.

The method of work with processes:

- enter all processes (e.g. products) to be used to the *Process label list* in configuration of data logger. Maximum is 16 processes. Each process name consists of maximum 16 characters.
- select for each channel processes to be used (all-some-none). This selection makes easy process selection itself (product name), when only relevant processes are offered with each channel
- at the start of each process (e.g. inserting of one product type to smoke-box) select desired input channel by the logger keyboard and press ENTER key for several seconds. Name of first process is displayed. Select preset name for that product by means of arrow keys. Press ENTER again to activate this process in data logger.
- when above process is finished and new process is required (e.g. different product type is inserted to smoke-box), activate new process in similar way or select blank process (*No process name*).
- after recorded data download each time segments will be described by process names activated in that time on that channel
- press ENTER on the logger keyboard shortly to display actual process

Process names are not enabled with binary channels (S,SG,S1) and with data loggers MS2+ (no keyboard and display).

Profile: data logger enables to realize some more complex measurements. Some field applications require easy change of configuration without connected computer. First store desired configuration profiles to data logger to select easily from. Maximum is 20 configuration profiles, minimum is 6 (depending on differences between profiles). Each configuration profile has its name defined by the user.

Profile management – enables user to work with several predefined data logger configurations and change them.

Enable profile change from data logger keyboard – dataloggers MS3+ and MS4+ enables to select configuration profiles from keyboard of data logger without the need of the computer.

Data logger communication interface

- RS232, RS485 (basic interface) - used for connection of data logger to computer for short distance. Most frequent connection.
- modem – RS232 with activated flow control RTS/CTS, used for communication with modem.

In case communication interface is set to RS232-modem, then communication link RS485 does not work!
In case of communication with computer via RS232 no connector for communication with computer via RS485 should be inserted to data logger and vice versa!

The change of setting can be done from PC program or with data loggers MS3+ and MS4+ also from the keyboard of data logger.

Baudrate – for reliable and fast communication between computer and data logger it is necessary to set suitable communication speed. It can be done from PC program or with data loggers MS3+ and MS4+ also from the keyboard of data logger.

RS485 network address – is relevant, in case of communication with several data loggers connected to one interface RS485. Address of data logger can be from 1 to 255. Address change can be done from PC program or with data loggers MS3+ and MS4+ also from the keyboard of data logger.

ATTENTION – in case of communication with data loggers via interface RS485 it is necessary not to use identical address for two different data loggers. All data loggers connected to one link RS485 must have the same Baud rate.

Support of SMS – if data logger is connected to modem supporting SMS functions following actions are enabled:

- response to incoming SMS queries, when following cases are possible:

a) **Info** – if SMS is sent to modem with this text (both capital/lower-case letters are allowed), SMS response is received containing basic information on data logger (type, name, memory occupation, channel names, measured values and alarm states). This SMS can consist of up to four partial SMS messages depending on configuration of data logger. One long SMS can be displayed on mobile telephones with support of long SMS.

b) **Alarm** - if SMS is sent to modem with this text (both capital/lower-case letters are allowed), SMS response is received containing basic information on data logger (type, name) and channel numbers in active alarm states.

c) **Ch1** - if SMS is sent to modem with this text (both capital/lower-case letters are allowed), SMS response is received containing basic information on data logger (type, name), channel 1 name, actual measured value and alarm state at channel 1. For other channels enter corresponding number (e.g. Ch11 for channel 11).

- sending of SMS with alarm report - in case alarm at one of input channels appears, data logger can activate modem and send SMS message. Up to four telephone numbers are enabled to enter to common parameters for each profile. It is possible to select for each alarm at each channel to which telephone number SMS message will be sent. If alarm state of measured value appears, data logger sends SMS in above format **Alarm.** If critical state in data logger appears, one SMS is sent with specification of data logger type, name and names of critical states (error of configuration, measurement, selftest or memory occupation limit).
  ATTENTION – always set corresponding time delay (minimum of 1 minute is recommended) and non-zero hysteresis for sending SMS. It will prevent possible frequent sending of SMS in states close to alarms.

More detailed information on support of SMS messages are in *Appendix 8*.

ATTENTION: considering reliability of GSM network early and reliable reception of SMS messages cannot be guaranteed.

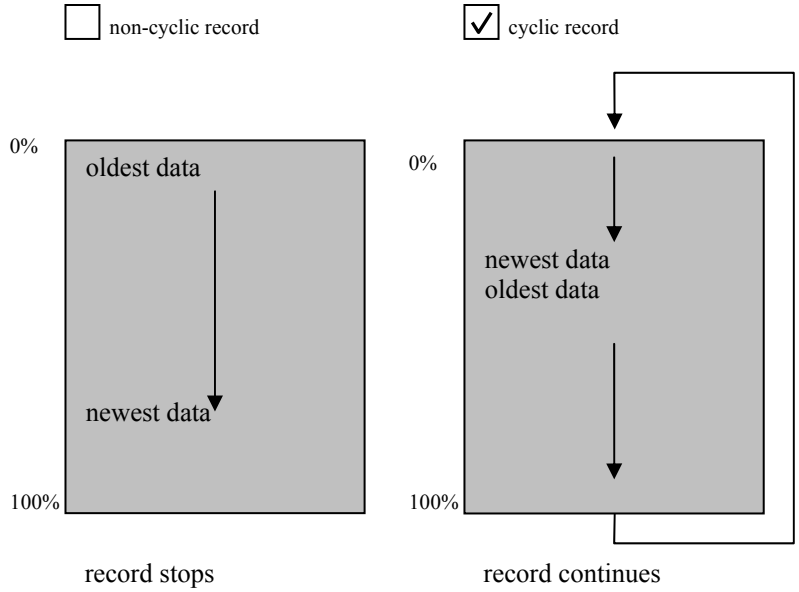
Communication secured by password – data logger enables to protect transferred data at low communication level by ciphering by means of 8 character safety chain. Enter and confirm the chain after enabling this function.

If password protection is applied, it is necessary to remember the password! No communication is possible without the password!

Alarm signalization – audio indication and ALARM OUT output activation can be deactivated by the personnel, if it is enabled. Optionally it can be done from the logger keyboard by simple pressing of ENTER key in basic display mode (display of actual values), not in data logger menu or in selection of processes. Other way is by special menu item of data logger (if it is required from personnel to perform more complicated operation). Also request for PIN entering directly on data logger is enabled. New activation of audio indication can be caused e.g. by new alarm appearance. In case alarm, which activated audio indication is manually deactivated and then appears again, audio indication is activated again. Deactivation of audio indication also covers the internal audio indication and ALAM OUT output for connection of external audio indication.

Setting of parameters for profiles (Profile Settings)

Cyclic record - if no cyclic record is selected, then record stops after filling the memory (data logger continues to measure and evaluate the alarms). In case cyclic record is selected, data logger continues in record by overwriting oldest data by newest after filling the memory. In both cases fulfilling of memory is indicated.



Alternative record times – data logger can also record in several selected daily times apart from selected regular logging interval. Maximum of four alternative times are allowed for entire logger. For more information see setting of input channels.

Language – language localization of fixed messages on data logger display, no concern language localization of PC program

Internal acoustic alarm signalization – data loggers MS3+ and MS4+ with alarm function enable globally switch ON/OFF internal audio signalization. It is necessary to switch ON globally the audio signalization and at the same time to switch it ON for each alarm of each input channel, where audio signalization is required.

ALARM OUT signalization – function is similar to internal audio indication, i.e. can be switch ON/OFF globally. It is necessary to switch ON globally the ALARM OUT and at the same time to switch it ON for each alarm of each input channel, where ALARM OUT activation is required.

Record of the ALARM OUT state changes – it is possible to record activity of this output, including the way, how activity was finished (returning inside of set limits or deactivation by the user)

Full memory acoustic signalization – if data memory is fulfilled (100%), internal audio indication starts to sound. The signal is deactivated after memory erasure or can be deactivated from the data logger keyboard by the user.

Critical states actions – optionally defined action can be perform by data logger, if some of critical states appears: error measurement at an input channel, error in configuration of data logger, reaching of programmed data memory occupation and selftest error. If this state lasts for set time without interruption, it is possible to activate internal audio signalization, ALARM OUT output or activate selected relay with MS4+.

Adjustment of SMS – up to four telephone numbers are enabled to enter, to which SMS will be sent in selected actions. International number format is supported 00<country code> <telephone number> resp. +<country code> <telephone number> , e.g. +420 604... or 00420 604 ...

Setting of input channels – Identity & Calculations

Input channels are equipped with selected input modules. Modules should be properly installed in proper position and activated by the software.

Type and range of input module – there are four basic groups of input modules:

- analog input modules and module for frequency measurement
- binary input modules (S,S1 and SG) – only two-state evaluation (ON-OFF)
- counter input modules (CTU, CTK) – these modules work independently to power voltage of data logger, theirs output is binary value of 31 bits counter, user calibrate-able
- RS input module for monitoring of serial signal with ADVANTECH ADAM protocol. No other modules can be installed in higher positions than RS module.

These values cannot be edited by the user.

Channel name: - user selectable name of measured point. Length of name is 16 characters. This name is used in list of measured values and on the display of data logger (with MS3+, MS4+).

Physical unit (no concern with binary inputs) – user selectable chain of 6 characters, designed to define physical unit of measured quantities. It is used in list of measured values and on the display of data logger (with MS3+, MS4+).

ON/OFF state description of binary inputs – user selectable chains of 16 characters, describing state „closed“ (input S,SG) respectively „no voltage“ (input S1) and state „opened“ (input S,SG) respectively „with voltage“ (input S1).

Number of decimal places (not for binary inputs) - data logger enables to set maximum 5 digits right from decimal point. Measurement and record are performed in floating decimal point corresponding with 4 byte single format. If value exceeds length of display, data logger automatically decreases number of digits behind decimal point. If it is not possible to display value with zero digits behind decimal point, error display appears.

Recalculation of measured value (not for binary inputs) - measured value can be recalculated by means of two-point linear transformation to the desired value. Initial state is 1:1 and full range points are applied or value 0-0, 1-1. Arbitrary values can be used, exept for identical input values – disabled.

Example: Example: To data logger with the current input 4 - 20 mA is connected temperature transducer with current output giving in temperature -30°C output current 4 mA and in temperature +60°C current 20 mA. To the table is needed to enter following values:

Measured value 4.000 [mA] corresponds to value of -30.0 [°C].
Measured value 20.000 [mA] corresponds to value of +60.0 [°C].

If measurement correction (e.g. RTD temperature sensor) is performed, it is necessary to set "no recalculation" for finding of original measured values or to calculate needed values manually.

Processes (not for binary inputs) – it is enabled to select for each input several names from 16 predefined process names, which will be offered to select for each channel. See Common Settings for more information.
Show increments (only CTU, CTK inputs) – with counter inputs always absolute, respectively recalculated absolute counter value is displayed. It is enabled to display in the table only increments between subsequent measurements accordingly to adjusted logging interval.
Bouncing Filter (only CTU, CTK inputs) – designed to eliminate signal overshoots during change of logic level of input signal. Filter parameters are specified in input module description.
Connected device adress, Maximum wait time, Multichannel device, Multichannel device channel number, Baud rate – setting of RS input, more details are in Appendix 3.

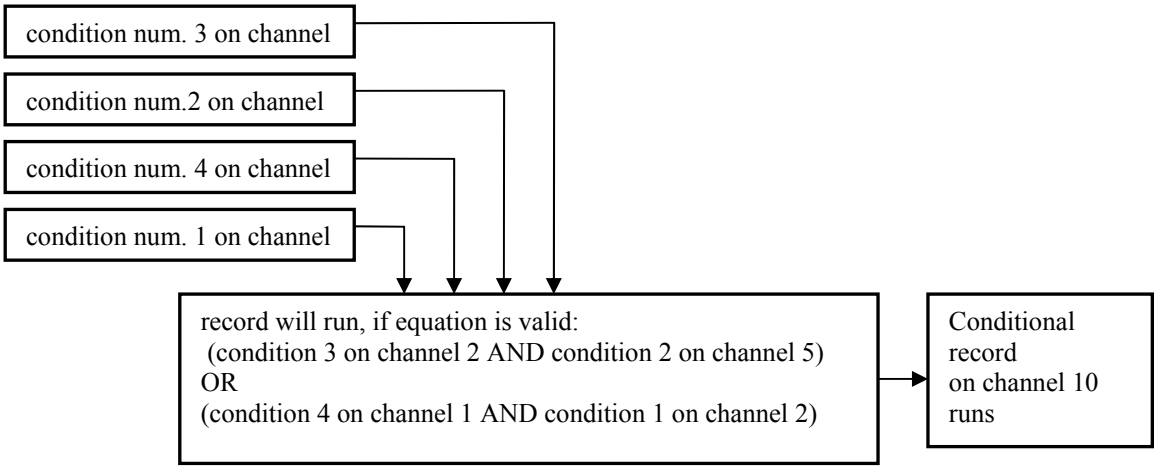
Setting of measurement and record on input channels
Each input channel can be activated for measurement and alarm evaluation and for data record.
Data logger enables several different mutually independent data record:
A) for analog input channels, counters, RS input and measurement frequency:

a) **continuous record** – record runs independently to measured value. Data is recorded with adjusted *logging interval,* which is individually adjustable for each input channel independently to other channels. It is possible to limit time for the record by entering record start (date and time) and record end (date and time). It is also possible to limit record only to one selected part of the day (daily from... daily to...).
Example.:

Date and time	Channel num. 1: T[°C]
1.1.2004 08:00:00	23,8
1.1.2004 08:30:00	24,5
1.1.2004 09:00:00	26,8
1.1.2004 09:30:00	33,2
1.1.2004 10:00:00	37,5
1.1.2004 10:30:00	42,3
1.1.2004 11:00:00	45,1
1.1.2004 11:30:00	45,2
1.1.2004 12:00:00	44,1
1.1.2004 12:30:00	40,1
1.1.2004 13:00:00	35,2
1.1.2004 13:30:00	30,1

b) **conditional record -** record run is dependent on measured value. Data is recorded similarly as in previous case with adjusted C*onditional Recording Interval*, which is individually adjustable for each input channel independently to other channels. Contrary to continuous record, conditional record is active only, if *Condition* is valid on the channel or generally valid logic *Combination of conditions* on different channels of data logger. It is possible to limit time for the record by entering record start (date and time) and record end (date and time). It is also possible to limit record only to one selected part of the day (daily from... daily to...).

Example of conditional record if logic combination of conditions is applied:



Example of list of measured values (condition for record – temperature is higher than 40°C) :

Date and time	Channel num. 10: T[°C]
1.1.2004 10:55:00	40,1
1.1.2004 11:00:00	41,3
1.1.2004 11:05:00	40,2
1.1.2004 11:30:00	40,3
1.1.2004 11:35:00	42,5
1.1.2004 11:40:00	40,1

Continuous and conditional record is used e.g. when monitoring of device is required. In case of its proper function longer logging interval is sufficient, but in case of failure more detailed record is required.
Example.:

Date and time	Channel num. 1: T[°C]	
1.1.2004 08:00:00	23,8	continuous
1.1.2004 08:30:00	24,5	continuous
1.1.2004 09:00:00	26,8	continuous
1.1.2004 09:30:00	33,2	continuous
1.1.2004 10:00:00	37,5	continuous
1.1.2004 10:30:00	39,3	continuous
1.1.2004 10:55:00	40,1	conditional
1.1.2004 11:00:00	41,3	continuous +conditional
1.1.2004 11:05:00	40,2	conditional
1.1.2004 11:30:00	40,3	continuous +conditional
1.1.2004 11:35:00	42,5	conditional
1.1.2004 11:40:00	40,1	conditional
1.1.2004 12:00:00	34,1	continuous
1.1.2004 12:30:00	30,1	continuous
1.1.2004 13:00:00	25,2	continuous
1.1.2004 13:30:00	20,1	continuous

c) **sampled record** – there is no constant logging interval with this record. Measured value and time is stored with defined event. This event is also represented by creation/end of *Condition* on the channel or logic *Combination of conditions* on different input channels of data logger. It is possible to

limit time for the record by entering record start (date and time) and record end (date and time). It is also possible to limit record only to one selected part of the day (daily from... daily to...). This record can be combined with previous types of record.

Example:

Date and time	Channel num. 1: T[°C]
1.1.2004 08:01:11	23,8
1.1.2004 08:40:23	24,5
1.1.2004 09:05:07	26,8
1.1.2004 09:12:44	33,2
1.1.2004 10:08:09	37,5
1.1.2004 10:32:48	42,3

B) **record of binary channels** is analogical to sampled record, but every change on binary inputs is recorded. Value is replaced by text description, corresponding with user setting.

5.4.1 Recording interval

Recording interval is individually adjustable for each record type (continuous, conditional) and for each channel. Following intervals are available: 1s, 2s, 5s, 10s, 15s, 30s, 1min, 2min, 5min, 10min, 15min, 30min, 1h, 2h, 3h, 4h, 6h, 8h, 12h, 24h. Storing is performed always in whole number multiples of above intervals. E.g. *if data logger is switched on at 5:05 and the interval is set to 1 hour, first data are stored at 6:00, next at 7:00 etc.* Additionally to above logging intervals record is enabled also in alternative daily time. Maximum of four alternative logging times can be defined for entire data logger. For each channel is possible to select from them.

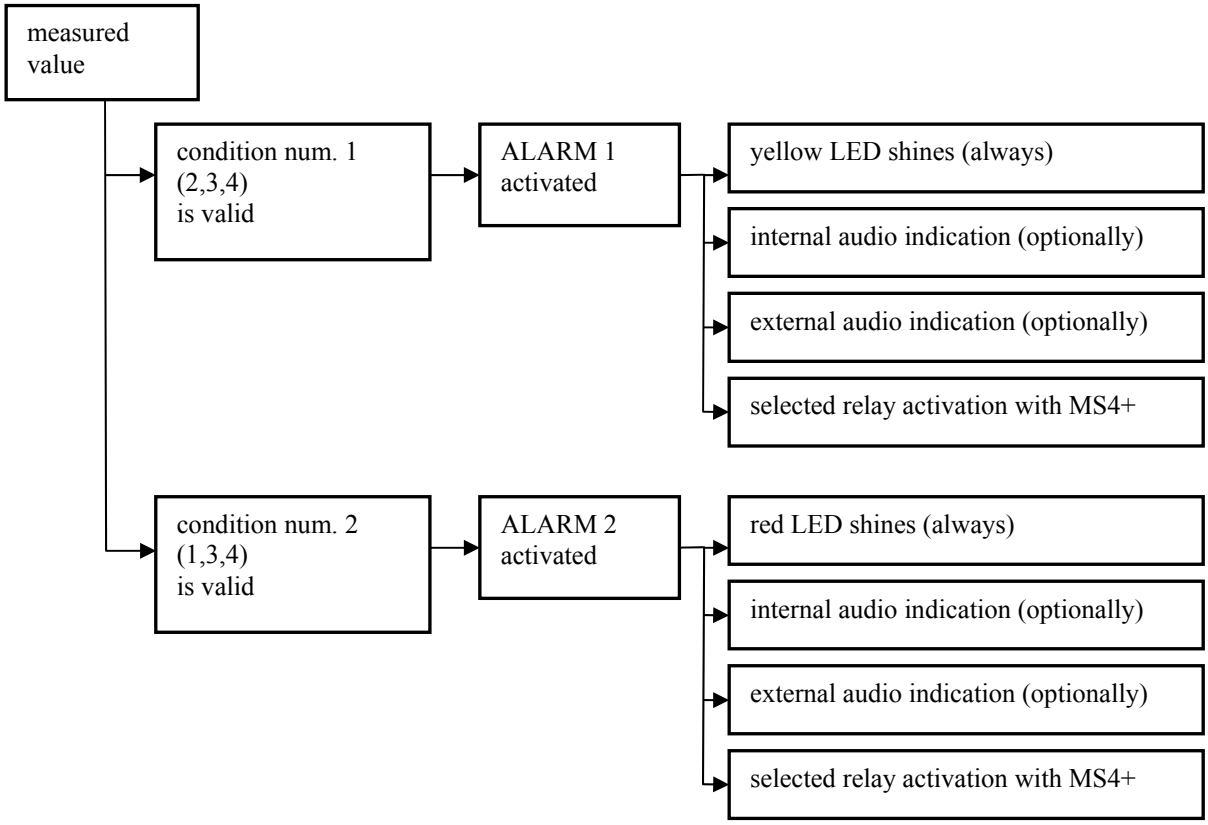
Note: *Data logger measure one channel after another. Measurement of one channel takes approximately 130 ms. It means if all 16 channels are active, the total measurement time is about 2s. This is important with shortest logging intervals.*

Alarms and indication with data loggers MS3+ and MS4+

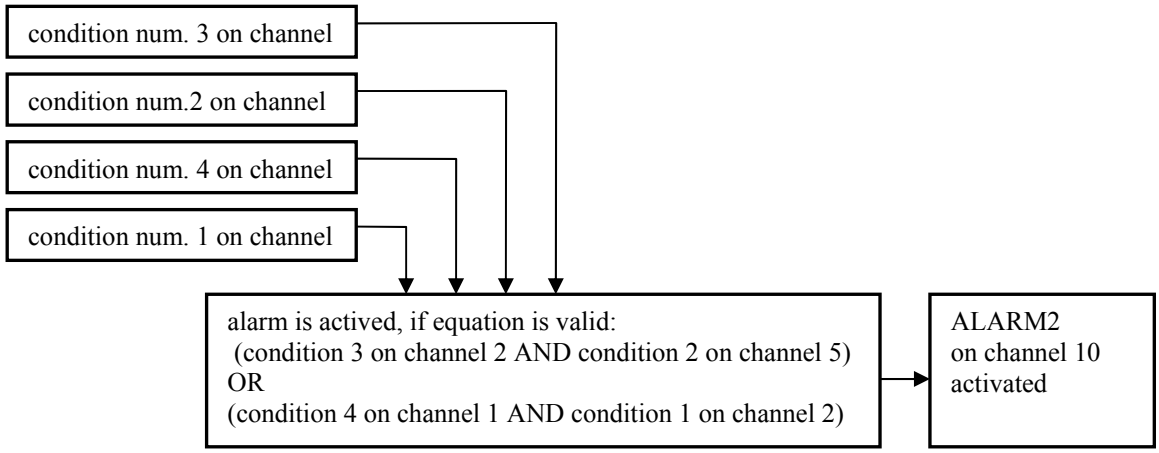
Data loggers MS3+ and MS4+ enable to evaluate user defined limit states, indicate them optically, acoustically, by ALARM OUT output activation or by selected relay activation (with MS4+). Two independent alarms are enabled for each channel with assigned required action.

Alarm creates, if *Condition* on the channel is valid (i.e. measured value exceeded/dropped adjusted limit or binary module reports selected state). In case of more complex requirements for alarm evaluation, alarm can be activated dependently on validity of logic equation. Logic equation can contain up to four conditions from different active channels.

Illustration of possibility of alarm state creation:

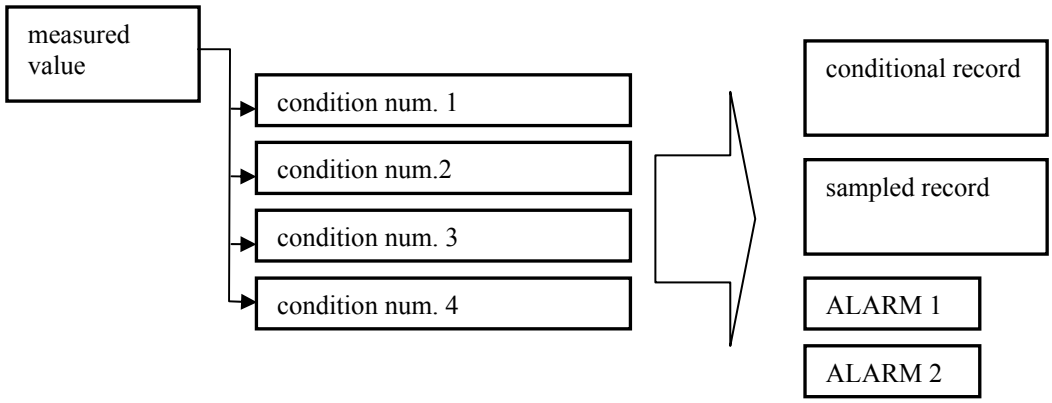


Example of alarm creation when applying logic combination of conditions:



Evaluation of validity of conditions on input channels

Condition - defines certain state of measured value (exceeding of adjusted limit upward/downward, certain state of binary input) on the input channel. Condition has two states: valid-invalid. Up to four independent conditions can be defined on one channel. Creation of alarm states depends on condition states. Conditional and sampled record is controlled by conditions:



Each of four conditions can be activated for evaluation. The following parameters can be set for all input types except binary inputs:

☐ Condition n

Start of validity: • value greater than • value less than **Cn** for the duration **t**on [s]

End of validity: ☐value returns back with hysteresis **Hn** • AND • OR ☐ expires **t**off [s]

In case of input error (measured value is not available):
- condition remains invalid
- condition becomes active after delay set above
- condition becomes active immediately

Used symbols:

Cn ... limit condition

ton ... duration (delay) in seconds. If set to zero, then condition is valid immediately after exceeding value Limit. If higher than zero, then condition becomes valid only, if measured value in this entire time matched specified condition

Hn... hysteresis serves to avoid instability, if measured value is close to the limit. In case, condition is valid (by exceeding or dropping of measured value against the Limit), then Limit is internally shifted - measured value must be of hysteresis closer to the state of invalid condition to deactivate.

toff... duration of condition validity

In the following text examples of setting and function description of different setting of conditions are listed. To simplify, only in first part example is shown with condition, which starts to be valid, if measured value drops below Limit. In other cases behavior is analogical, i.e. characteristics will be mirror-inverted refer to horizontal axis.

With binary inputs setting is analogical, values Limit and Hyst has no meaning:

☐ Condition n

Start of validity: • L state occurs • H state occurs for the duration of **t**on [s]

End of validity: ☐ input state changes to other than above • AND • OR ☐ expires **t**off [s]

In case of input error (measured value is not available):
- condition remains invalid
- condition becomes active after delay set above
- condition becomes active immediately

Function of conditions with binary inputs is analogical to lower described conditions with other inputs. User also can select the action of condition in case, value or state are not known for some reasons.

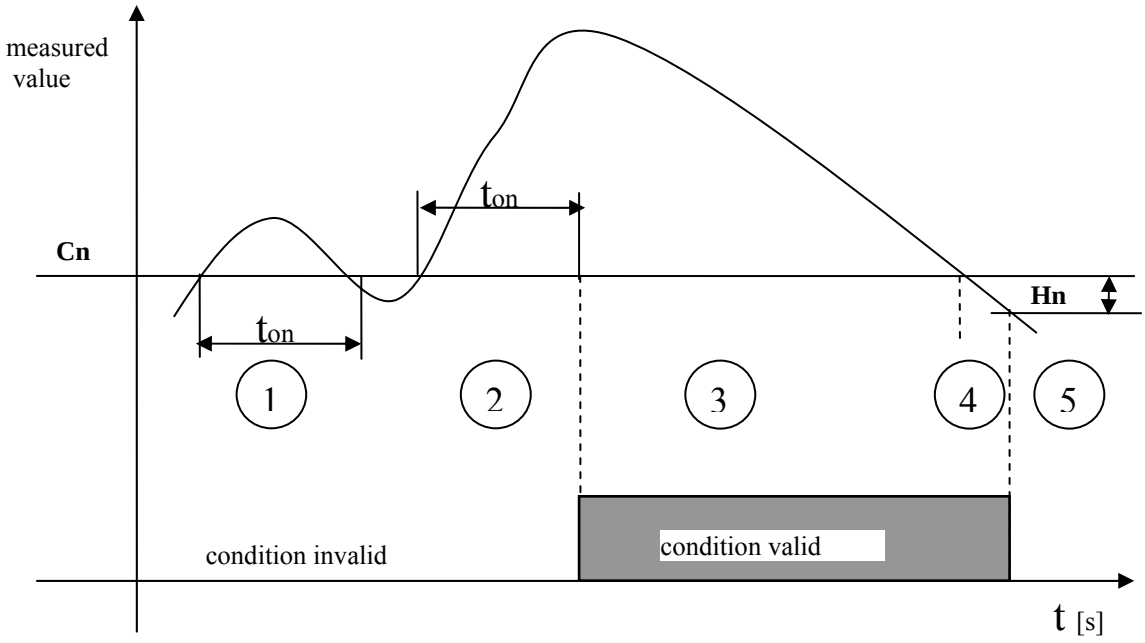
Condition in exceeding of limit with hysteresis

☑ Condition n

Start of validity: • value greater than **Cn** for the duration **t**on [s]

End of validity: ☑value returns back with hysteresis **Hn** • AND • OR ☐ expires **t**off [s]

In case of input error (measured value is not available): • condition remains invalid



Function description:

Area 1... measured value exceeded limit **Cn**, but was not over this limit for all duration ton, condition invalid.
Area 2 ... measured value exceeded limit **Cn** and was over this limit for all duration ton. After duration ton condition became valid.
Area 3 ... measured value is still over limit **Cn**, condition is valid.
Area 4 ... measured value dropped already below limit **Cn**, but non-zero hysteresis **Hn** is defined, for end of condition validity measured value must drop of hysteresis.
Area 5 ... measured value dropped below limit (**Cn**-**Hn**), condition is invalid.

Notes:

1. if power of data logger is switched OFF in area 2, after switching ON again measured value is still over limit **Cn** and duration ton is not finished, data logger continues in testing, as if there was no power interruption.
2. if power of data logger is switched OFF in area 2, after switching ON again measured value is still over limit **Cn** and duration ton is already finished, condition is immediately activated.
3. if power of data logger is switched OFF in area 2, after switching ON again measured value is not over limit **Cn,** testing of duration ton stops (similarly as in area 1).
4. if power of data logger is switched OFF in areas 3 or 4, after switching ON measured value is over the limit (**Cn** - **Hn**), condition stays valid. If measured value is not over the limit, condition is immediately deactivated.

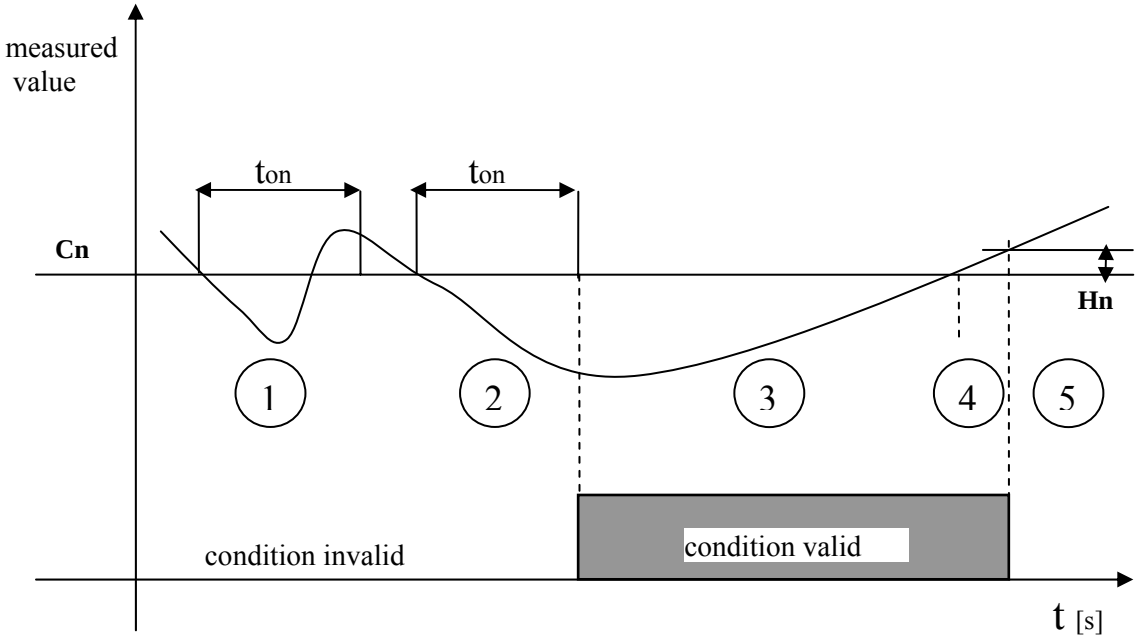
Condition in drop below limit with hysteresis

☑ Condition n

Start of validity: • value less than **Cn** for the duration **t**on [s]

End of validity: ☑value returns back with hysteresis **Hn** • AND • OR ☐ duration expires **t**off [s]

In case of input error (measured value is not available): • condition remains invalid



Function description: is analogical as in previous case.

Condition in exceeding the limit with defined validity duration

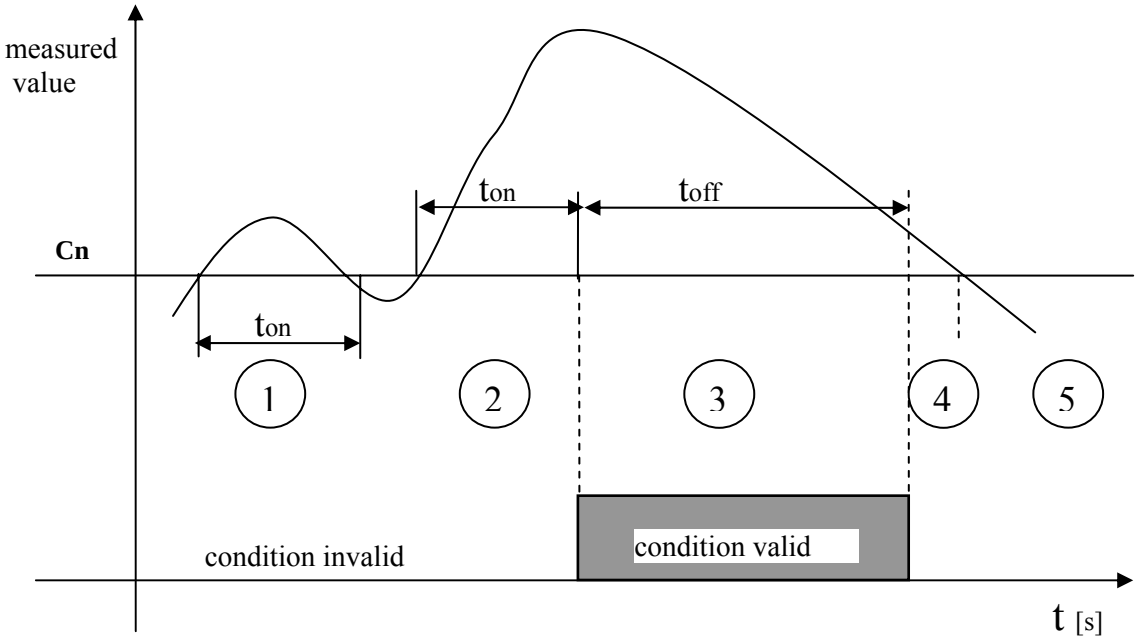
If value exceeds the limit **Cn** with duration ton, condition becomes valid. Its duration is specified by fixed time toff. During validity of condition does not matter, if measured value is over or below limit **Cn**. When duration toff is finished, condition becomes invalid. If measured value is still over limit **Cn**, condition will be valid no more. Measured value must first drop below this limit first to set condition valid again.

☑ Condition n

Start of validity: • value greater than | **Cn** | for the duration | **t**on | [s]

End of validity: ☐value returns back with hysteresis | **Hn** | • AND • OR | ☑duration expires | **t**off | [s]

In case of input error (measured value is not available): • condition remains invalid



Function description:

Area 1... measured value exceeded limit **Cn**, but was not over this limit with duration ton, condition invalid.

Area 2 ... measured value exceeded limit **Cn** and was over this limit with duration ton. After finishing duration ton condition became valid.

Area 3 ... measured value is still over limit **Cn**, time toff is not finished yet, condition is valid.

Area 4 ... measured value is still over limit **Cn**, time toff is finished already, condition is invalid. If measured value will not drop below limit **Cn**, then in this area condition cannot be valid any more.

Area 5 ... measured value dropped below limit **Cn**, condition is invalid, after exceeding limit again and finishing duration ton condition can become valid again.

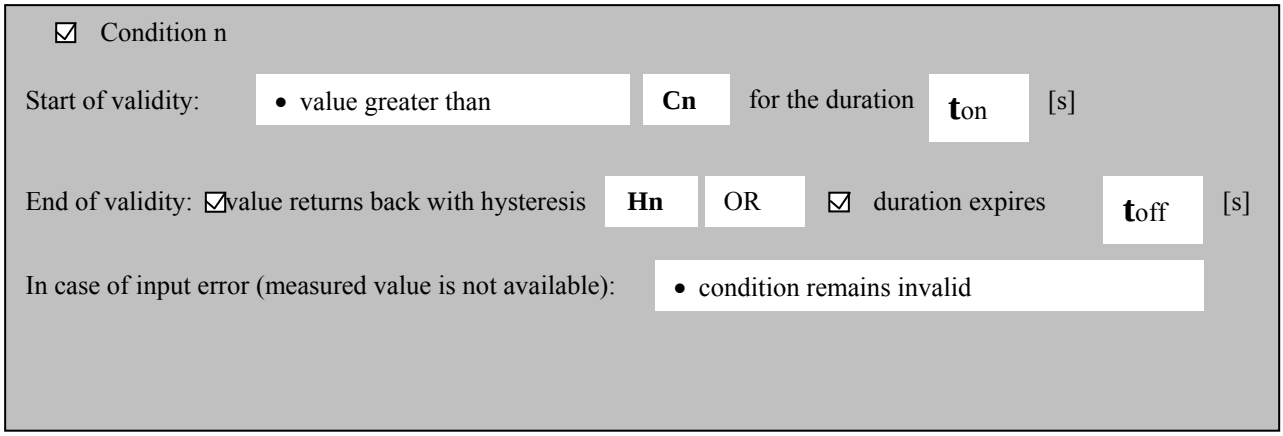
Notes:

1. if power of data logger is switched OFF in area 2, after switching ON again measured value is still over limit **Cn** and duration ton is not finished, data logger continues in testing, as if there was no power interruption.
2. if power of data logger is switched OFF in area 2, after switching ON again measured value is still over limit **Cn** and duration ton is already finished, condition is immediately activated.

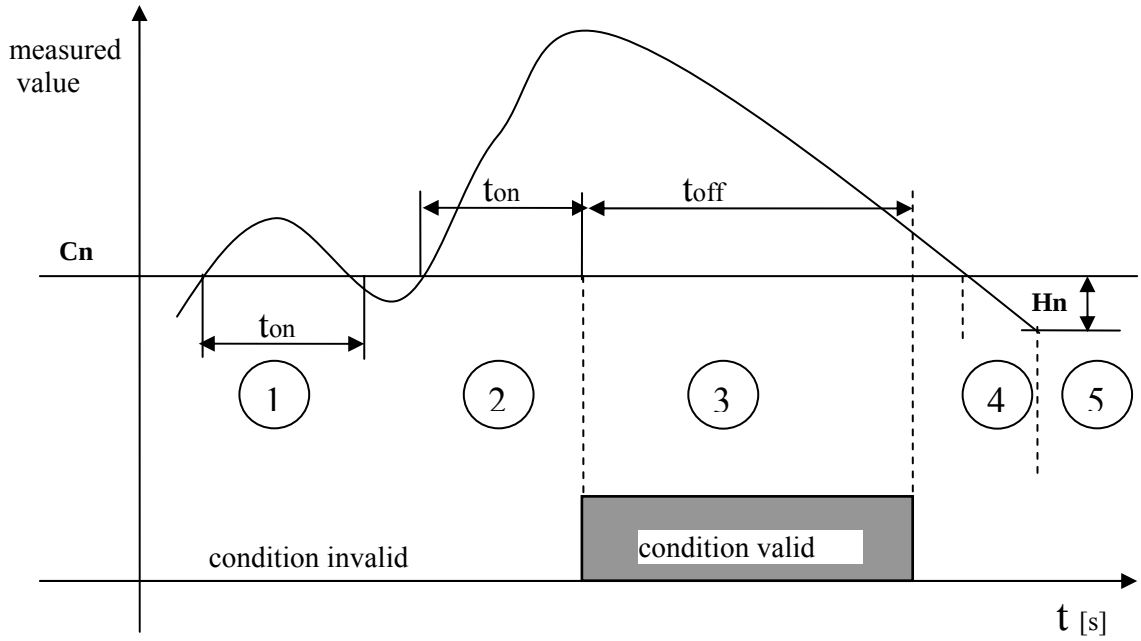
3. if power of data logger is switched OFF in area 2, after switching ON again measured value is not over limit **Cn,** testing of duration ton stops (similarly as in area 1).
4. if power of data logger is switched OFF in area 3, data logger evaluates if time toff has come from condition creation and results condition becomes to be valid or invalid.

Condition with limit exceeding with hysteresis or with defined validity duration

If value exceeds limit **Cn** with duration ton, condition becomes valid. If measured value drops below limit **Cn** reduced of hysteresis, condition immediately becomes invalid. But if fixed time toff from its validity creation expires, condition becomes invalid no matter what measured value is. If condition was finished by expiration of fixed duration toff, then measured value must return inside of limits, where condition can not be matched and then after matching of state „start of validity" condition becomes valid.



Example, when validity of condition was finished by expiration of duration **toff:**



Function description:

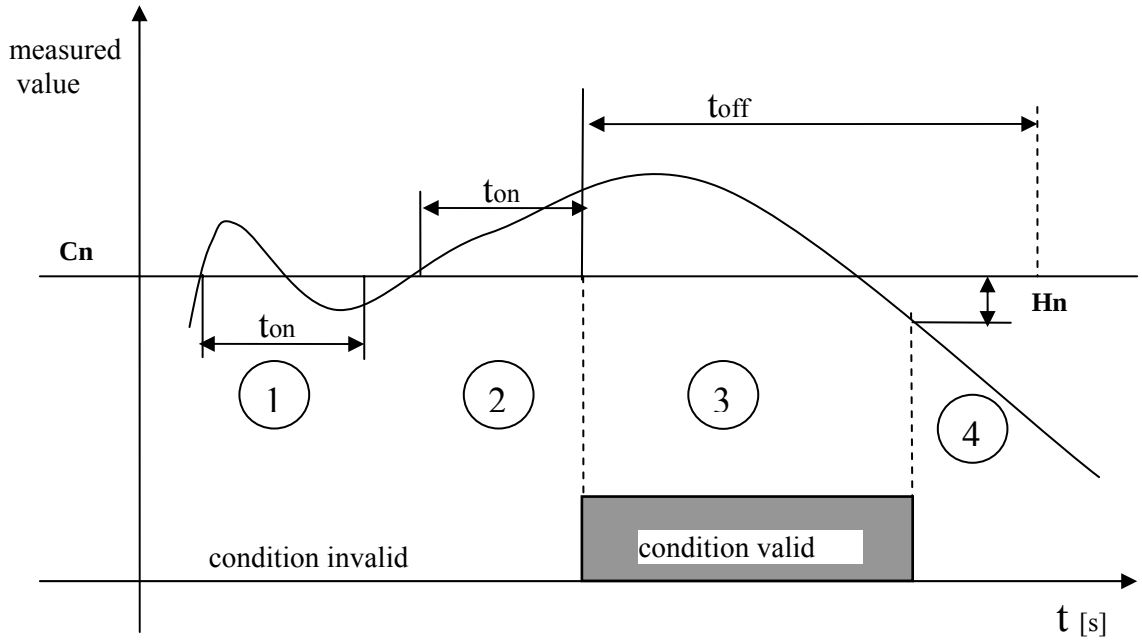
Area 1... measured value exceeded limit **Cn**, but was not over this limit for entire time ton, condition invalid

Area 2 ... measured value exceeded limit **Cn** and was over this limit for entire time ton. After expiration of duration ton condition became valid.

Area 3 ... measured value is still over limit **Cn**, time toff did not expired already, condition is valid.

Area 4 ... measured value is still over limit (**Cn**-**Hn**), time toff expired already, condition is invalid. If measured value does not drop below limit (**Cn**–**Hn**), then in this area condition can not be valid.
Area 5 ... measured value dropped below limit (**Cn**-**Hn**), condition is invalid.
After exceeding limit again, after expiration of time ton condition can become valid again.

Example, when validity of condition is finished by drop of measured value:



Function description:
Area 1... measured value exceeded limit **Cn**, but was not over this limit during entire time ton, condition invalid.
Area 2 ... measured value exceeded limit **Cn** and was over this limit for entire time ton. After expiration of time ton condition became valid.
Area 3 ... measured value is still over limit (**Cn**-**Hn**), time toff did not expired yet, condition is valid.
Area 4 ... measured value dropped below limit (**Cn**-**Hn**), time toff did not expired already, condition is invalid.

After switching OFF the power analogical notes are valid as in previous cases.

Condition with exceeding the limit with hysteresis and simultaneously with defined validity duration

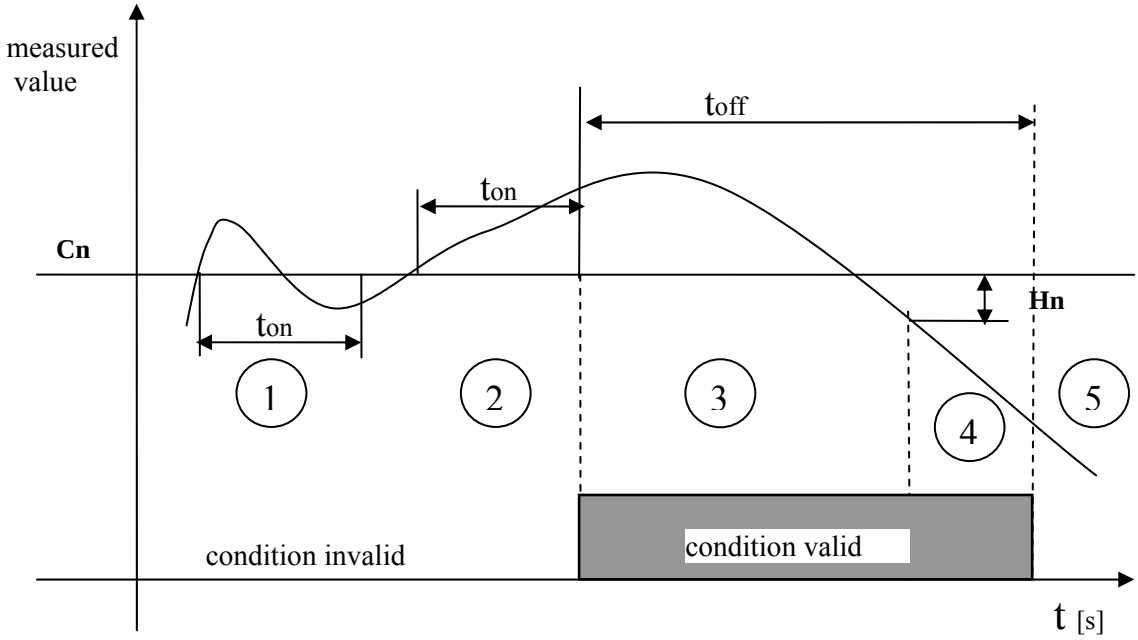
If value exceeds limit **Cn** with duration ton, condition becomes valid. Condition becomes invalid, if measured value drops below limit (**Cn-Hn**), but duration toff must be finished before.

☑ Condition n

Start of validity: • value greater than **Cn** for the duration **t**on [s]

End of validity: ☑value returns back with hysteresis **Hn** AND ☑ duration expires **t**off [s]

In case of input error (measured value is not available): • condition remains invalid



Function description:

Area 1... measured value exceeded limit **Cn**, but was not over this limit for entire time ton, condition invalid

Area 2 ... measured value exceeded limit **Cn** and was over this limit for entire time ton. After expiration of ton condition became valid.

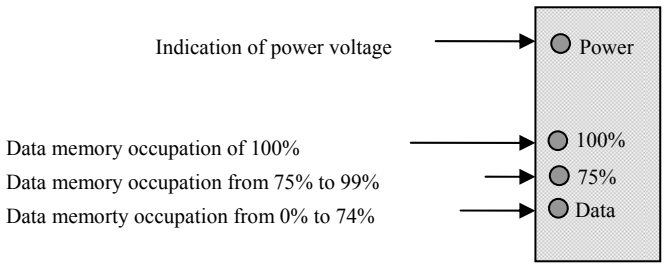
Area 3 ... measured value is still over limit (**Cn-Hn**), time toff did not expired yet, condition is valid.

Area 4 ... measured value dropped below limit (**Cn-Hn**), time toff did not expired yet, condition is still valid

Area 5 ... measured value dropped below limit (**Cn-Hn**), time toff expired already, condition is invalid, after exceeding measured value over limit **Cn,** condition can be valid again

Controls and indications of data logger

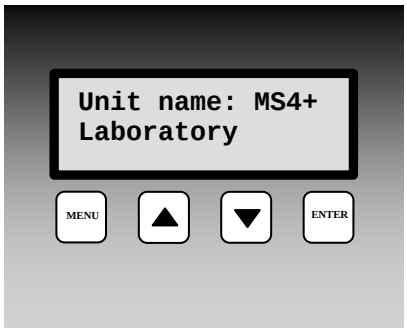
Indication of power and memory occupation



Indication is realized optically by LED diodes located on lid of case. In correct function of data logger always two LED diodes should shine (Power and one indicating memory occupation). After filling of memory to 100%, data logger can be set to indicate the state also by internal audio beeper.

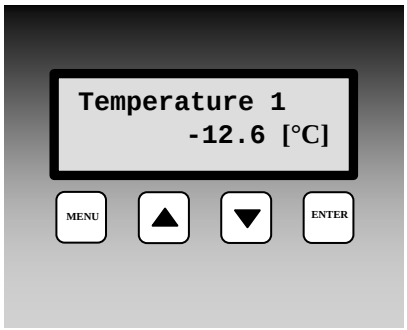
Display and keyboard of data loggers MS3+ and MS4+

Dual-line display can be controlled by four-button keyboard located below (buttons MENU,▲,▼,ENTER). After connection of data logger to power selftest is performed first of several internal voltages. If all is correct, data logger goes to basic display mode.



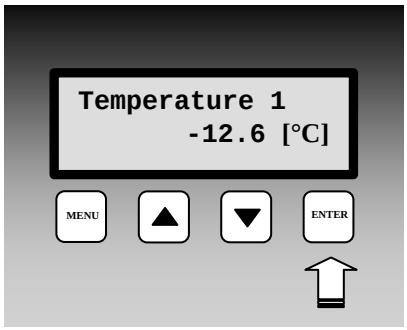
Display after connection of power to data logger. For several seconds data logger type and name is displayed. Then data logger evaluates selftest of internal voltages. If correct, display goes to basic display. If selftest is not correct, data logger reports Selftest Error with indication of voltage, which is not correct (power voltage or internal battery or source of negative voltage). Failure is necessary to be repaired. Press ENTER key to confirm error message and data logger goes to basic display mode.

Basic display mode



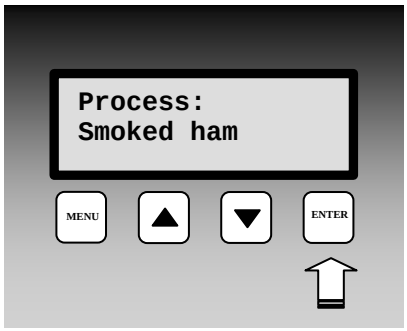
In basic display mode upper line shows users defined name of measured point (from the PC program) and lower line shows actual measured value with physical unit, respectively state of input channel. Use ▲,▼ keys to view all channels, activated for measurement and alarm evaluation. Error message can appear instead of measured value. With binary inputs lower display line shows user defined description of open/close state. In case, value is not available or it is incorrect, error message appears – see Appendix 7.

Deactivation of audio alarm and ALARM OUT output by pressing ENTER key



It is supposed: basic display of measured values is present. If this function is enabled, then short pressing of ENTER key deactivates audio indication and ALARM OUT output. In case, new alarm with audio indication requirement appears, audio indication is activated. Similarly, if alarm which activated audio indication is deactivated by data logger and alarm appears again, audio indication is activated.

Display of adjusted process

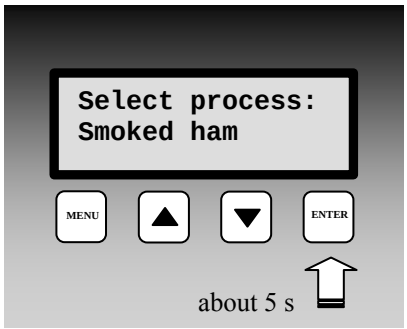


Assumptions:

1. basic display of measured values is present
2. selected input channel has enabled at least one of preset processes (otherwise display is not changed)

Press ENTER key to display adjusted process describing recorded data.

Selection of New process

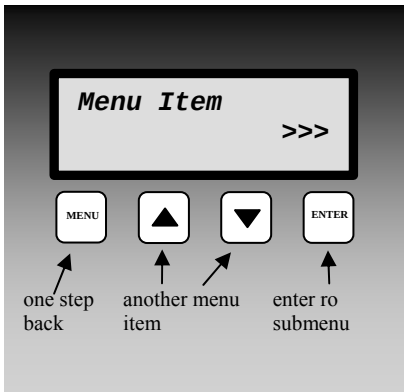


Assumptions:

1. basic display of measured values is present
2. selected input channel has enabled at least one of preset processes (otherwise process display mode is disabled)

Press ENTER key for about 5s to enter the selection from preset processes. Use ▲,▼ keys to select process names for each input channel. Use selection No Process not to use any process. Press ENTER key to activate selected process. If there is no need to change of process press MENU key, to return to basic display mode without saving process.

<u>Items and functions available from Menu of data logger</u>

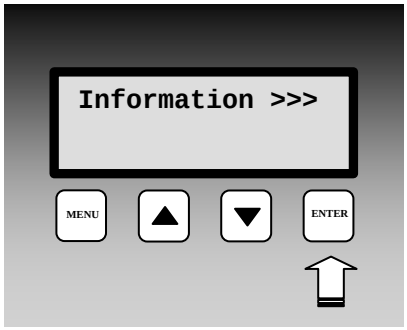


Press MENU key in basic display mode to enter the Menu of data logger. Use ▲,▼ keys to go through all Menu items. Press

MENU key to return to basic display mode.

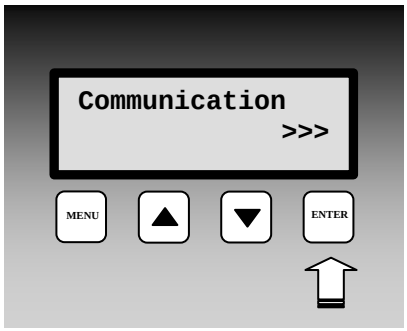
.

Menu item Information



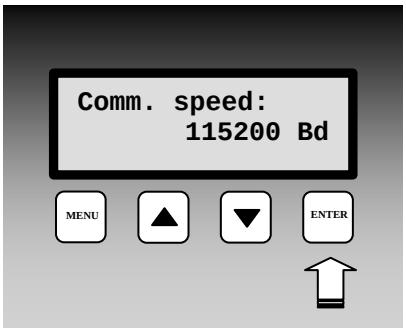
Menu item Information contains Sub-Menu. Press ENTER key to enter submenu and use ▲,▼ keys to move between menu items. Press MENU key to leave Sub-Menu.
Move in submenu **Information** to display one by one Type of data logger, Name of data logger, Serial number, Record mode (cyclic/noncyclic), Memory occupation, date and time in data logger, Language of fixed messages on display.

Menu item Communication



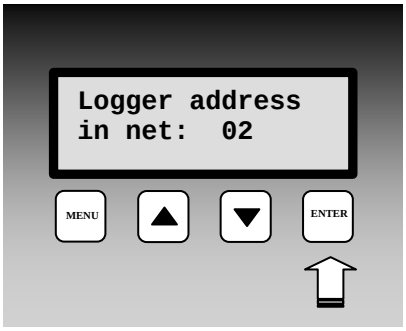
Submenu Communication – enables to display and change setting of Communication speed, Address of data logger in RS485 network and Communication interface of data logger for connection to personal computer.

Communication - setting of communication speed



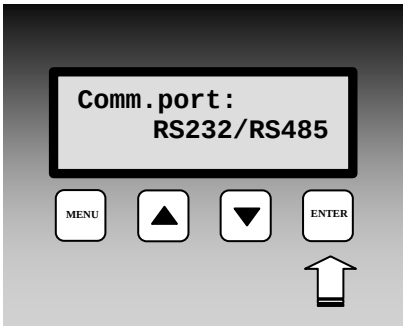
Actual communication speed between computer and data logger. The speed affects duration of data from download to computer. Press ENTER key to enter the mode of changing the communication speed. Select new speed by arrow keys and press ENTER key again to save to data logger. (Press MENU key to leave the mode without saving the change).

Communication - setting of data logger address in RS485 network



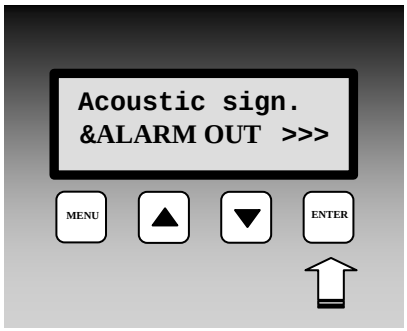
Actual address data logger in RS485 network. This address can range from 1 to 255 and is relevant, if there are several data loggers connected to one RS485 link. Press ENTER key to enter the mode of changing address of data logger. Select new address by arrow keys and press ENTER key again to save to data logger (Press MENU key to leave the mode without saving the change).

Communication – setting of communication interface of data logger



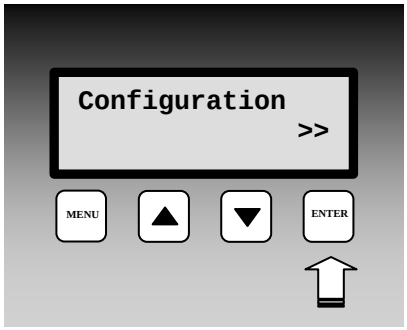
Actual setting of communication link. Can be either RS232/RS485 or RS232-modem (used to control flow of RTS/CTS, RS485 link does not work in this setting). Press ENTER key to enter the mode of changing the setting. Select desired setting by arrow keys and press ENTER key again to save to data logger (Press MENU key to leave the mode without saving the change).

Menu item Audio Indication



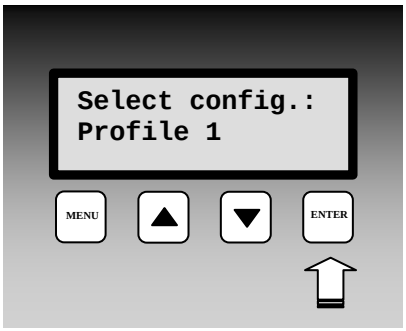
Submenu for switching OFF the audio indication. This item appears **only if user allowed in Common Settings** the selection **Confirm alarms by menu**. After entering the display shows actual state of audio indication and ALARM OUT output. If in active state, it is possible to deactivate by pressing ENTER key. New activation can be caused by New alarm appearance or by ending and new activation of alarm, which activated the action. In case, password protection function is activated in the PC program, it is necessary to enter password first (by means of arrow keys in the range of 1 to 9999) and to confirm.

Menu item Configuration



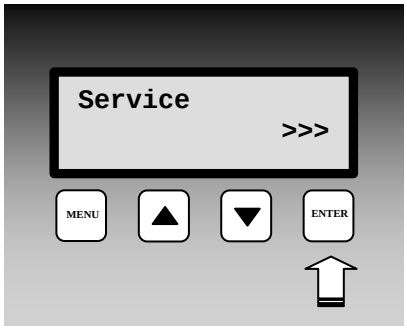
Submenu, where different preset configuration - profile of data logger is enabled to select. This menu item appears **only if user in Common Settings allowed Profile change from data logger keyboard.**

Configuration – selection of configuration profile



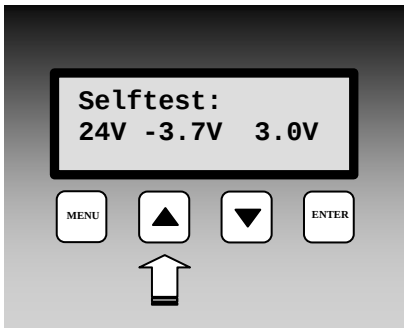
It is supposed user saved several configuration profiles to data logger and wants to change setting of data logger during operation. Then after entering the submenu Configuration it is possible by means of arrow keys to select one of those configuration profiles. Press ENTER key to set data logger to selected configuration profile. This action causes reset of all conditions, which appeared before.

Menu item Service



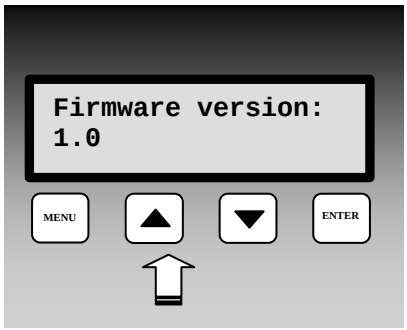
Submenu for displaying of values of several service parameters of data logger.

Service – display of internal voltage selftest

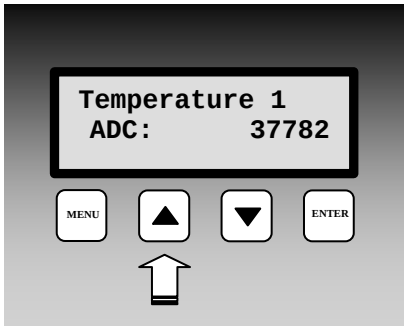


Selftest of internal voltages of data logger. First value indicates approximate power voltage (9 to 30 V, see Technical Parameters). Second value is voltage of negative source (-2V to -6V) and third value is voltage of internal back-up battery (2.6V to 3.3 V).

Service – display of firmware version

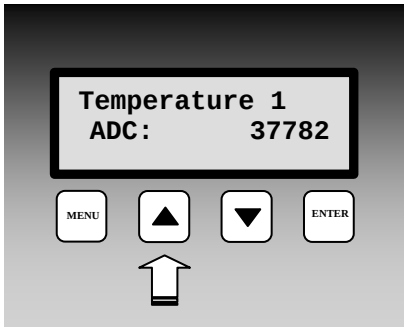


Service – display of temperature of thermocouple cold junction



This item is valid, if data logger has at least one input for measurement by thermocouple type J,K or S. If measurement circuitry of cold junction is not installed, error is reported. In newer data loggers state of some variables in SMS sending is displayed for service purpose at this item.

Service – display of A/D converter values for measured channels



Value read from A/D converter of analog inputs at the range of 0 to 65535. Limit value 0 indicates lower converter limitation (corresponds to Error1) and value 65535 (corresponds to Error 2) indicates upper limitation. Binary state of counter is indicated with counter inputs, state of input (ON/OFF) is indicated with binary inputs and „---“ is indicated with RS inputs.

TROUBLE SHOOTING OF SOME PROBLEMS

6.1. Problems with functionality of data logger as the entire system

6.1.1. Data logger seems to be out of proper operation

Power adapter is plugged, indication diode is not shining, mains voltage is correct:

Disconnected fuse in power adapter. Unscrew 4 screws in adapter corners and replace the fuse with the same type.

Fuse is disconnected after the power adapter is plugged in:

Problem can be caused in power connector – be careful to connect power connector to data logger first and then plug adapter in mains. disconnect all signals from data logger (careful – input terminal block is possible to remove as a complex). If a failure does not appear, problem is in cabling – e.g. incorrect connection of (undesired interconnection) of input wires (especially in input S). If failure keeps after wire disconnection, contact the supplier.

After connection of power adapter its indication diode shines, but power indication LED on data logger does not shine:

Disconnected fuse in data logger or internal source of +5V. Contact the supplier.

After connection of power voltage, power indication LEDs on ac/dc adapter and data logger shine, but no other indication LED does:

Program run in data logger is stopped or data logger is in service mode. Also low voltage of the ac/dc adapter can be the cause. Check the voltage on adapter output and replace it. If failure is still present contact the supplier.

After connection of power voltage, all indication LEDs shine and then data logger stops working, keyboard does not work:

Low power voltage caused processor stop, contact the supplier.

Display does not work:

Defective display, not connected cable connector or data logger is configured as MS2+.

Data logger LEDs blink chaotically:

Defective data logger, extreme interference or input signals are not connected correctly.

6.1.2. Self test errors

If selftest is not correct, data logger reports Seltest Error with specification of voltage which is not correct (power voltage, internal battery or negative voltage source). The failure must be repaired.

Problems with correct measurement

Data logger measures incorrectly at some inputs:

Disconnect all inputs and connect only one at a time and observe values on data logger. If values are correct, then search for the problem in cabling or in input devices (incorrect wiring, undesirable loops).

Typical values on display in open current loop (4 to 20) mA with inputs A0 and A1 for some selected input ranges:

Assigned values for current 4 to 20 mA in user calibration	measured value by data logger if current loop is open
-30 to 60	-52,5
-30 to 80	-57,5
-50 to 30	-70,0
0 to 150	-37,5
0 to 100	-25,0

Message Error2 in current loop indicates exceeding of 20 mA current, Error1 indicates opened loop.

Data logger works, as some input channel does not exist, although it is installed:

Check if input channel is switched ON or optionally if input module is installed.

Data logger time from time and totally irregulary indicates totally incorrect value:

Failure shows nonsensical value in record, on the display and short alarm activation. Most probably it is caused by electromagnetic interference. Effect is typical if correct rules for installation are not followed. It is necessary to check cabling, to change cable routing, to try to reduce interference etc. Most often this effect appears with current loops powered from A0 module, which are connected to transducers of resistance sensor to current, if resistance sensor shielding is not connected properly or shielding is perforated to ground of other devices. Adjust suitable alarm delay $\boldsymbol{t}_{ON}$ *(see setting conditions) in risky installations. Also faulty probe or transducer can cause such troubles.*

Audio alarm indication of data logger does not work:

Check if Audio alarm indication is switched ON. Also check if alarm delay $\boldsymbol{t}_{ON}$ *(see setting conditions) is adjusted and wait for this time. Check if alarm in audio indication is not deactivated by pressing ENTER key (try to active other alarm, to activate the audio indication). Also check the connection of external audio indication unit.*

Problems in communication with computer

Data logger does not communicate (via RS232 with delivered cable):

Try to find if problem is in data logger or in computer. Always use delivered cable RS232 (simplified communication). Most frequent problems can be: too high communication speed (19200 Bd would work always), device conflict, e.g. COM1 port interruption is used by internal modem, which is at COM3 port (same is valid for relation COM2-COM4), or network card is set to same interruption, as desired COM port (or other device). Also some resident programs can cause problems.

Data logger communicates via RS232, but does not communicate via RS485:

First check cabling, correct connection of link polarity, correction of connection of converter RS232/RS485 including jumper and connection of its power. If several data loggers are connected, let only one in the network (disconnect others by unplugging connector) and try communication. If correct, the cause can be address conflict, improper speed of communication or short circuit of the link. If using converter RS232/RS485 - type E06D or AUT485, always set communication device to selection S with automatic direction switching. *Communication could not work with each type of converter RS232/RS485. If user uses other type than recommended, problem can be in its dynamic parameters. Also try other communication port and recommended type of converter.*

RECOMMENDATION FOR OPERATION AND MAINTENANCE

7.1. Operation of data logger in various applications

Before application it is necessary to consider if data logger is suitable for required purpose, adjust optimal configuration and create instructions for its periodical metrological and functional verifications.

Unsuitable and hazard applications: data logger is not design for applications, where failure of operation could cause endanger of health or function of other device supporting life functions. In applications, where failure of data logger could cause loss on property, it is recommended to amend system of independent indication device to monitor this state and avoid damages. It concerns especially control and indication outputs of data loggers MS3, MS4. In critical applications it is suitable to power data logger from backed-up sources (UPS) dimensioned to required operation without mains power. Furthermore critical can be data logger connection to power itself. *It is not suitable to power both data logger and critical device – e.g. freezing box – to one fuse. If fuse is disconnected, then neither data logger nor monitored device is working.*

Location of temperature transducers: locate them to places with sufficient airflow and where most critical point is supposed (in accordance with application requirements). Transducer must be located sufficiently inside of measured room or be connected to, to avoid thermal influence of leading wires to measured temperature. *In monitoring of temperature in air-conditioned room, do not locate transducer to direct flow of air conditioning unit. E.g. at large chamber refrigerators can be temperature profile very inhomogeneous, deviations can reach up to 10 °C.*

Location of humidity transducers: in measuring of humidity in refrigeration boxes without additional humidity stabilization, strong changes of humidity can occur in switching on/off the refrigeration (up to tens of % RH) even though mean RH value is stable.
Optimum data logger operation: it depends on particular application. Important is the setting of logging and alarm parameters. It is necessary to take into account the memory capacity of data logger and frequency of data transfer to the computer. Select logging mode depending on preferable way of data management. If newest data are preferred select cyclic mode, if oldest data are preferred, select noncyclic mode. Further more consider if data will be erased from data logger after data transfer to the computer. In case data will be erased, then a long-term record is not stored in one file and it is not possible to identify eventual failures. In case memory is not erased, then data transfer duration to computer can be a problem. If there are problems with data logger, it is recommended not to erase data.
Alarm delay and hysteresis settings are very important. In MS4 data logger it is also important to consider contacts state in case of mains failure.

7.2. Recommendation for metrological verification

Metrological verification is performed in accordance with application requirements specified by the user. One year the manufacturer recommends periodical verification.
Notice: *accuracy of data logger input means accuracy of input itself without probes.*
In verification of thermocouple inputs it is necessary to take into account that cold end compensation is perform inside of data logger, where temperature is mostly slightly higher than ambient temperature on the outer connector. Best way is verification together with connected thermocouple.

7.3. Recommendation for periodical verification

Manufacturer recommends periodical verification of the system yearly. Interval and range of verification depends on the application. In stationary installations following verification is recommended:

1. Metrological verification
2. Regular overhaul in intervals accordingly to corresponding standards
3. Evaluation of all problems from the last verification
4. Visual inspection of data logger
5. Functional verification of data logger (functions used in application):
    A) verification of data transfer to computer
    B) verification of alarms – change input value to activate alarm and check on display and also in external audio indication (if used)
    C) evaluate in data logger MS4+ relay contacts lives
    D) evaluate internal battery – third value in self test must be at least 2.6 V
6. Verification of cabling – check the connection quality of cables, check visually entire cable length for damage and the route of cables for interference, especially whether some parallel power wires are not near.
7. Visual inspection of transducers for possible interference or water penetration.

Make a verification protocol.

7.4. Recommendation for service

Service of data logger is made at manufacturer or authorized partner. There is no service allowed without authorization from manufacturer. Unauthorized encroachment leads to loss of all warranty. *The most common damage due unauthorized manipulation with input modules is damage of the motherboard, when modules are connected in improper way.*

7.5. Placing out of operation after end of device life

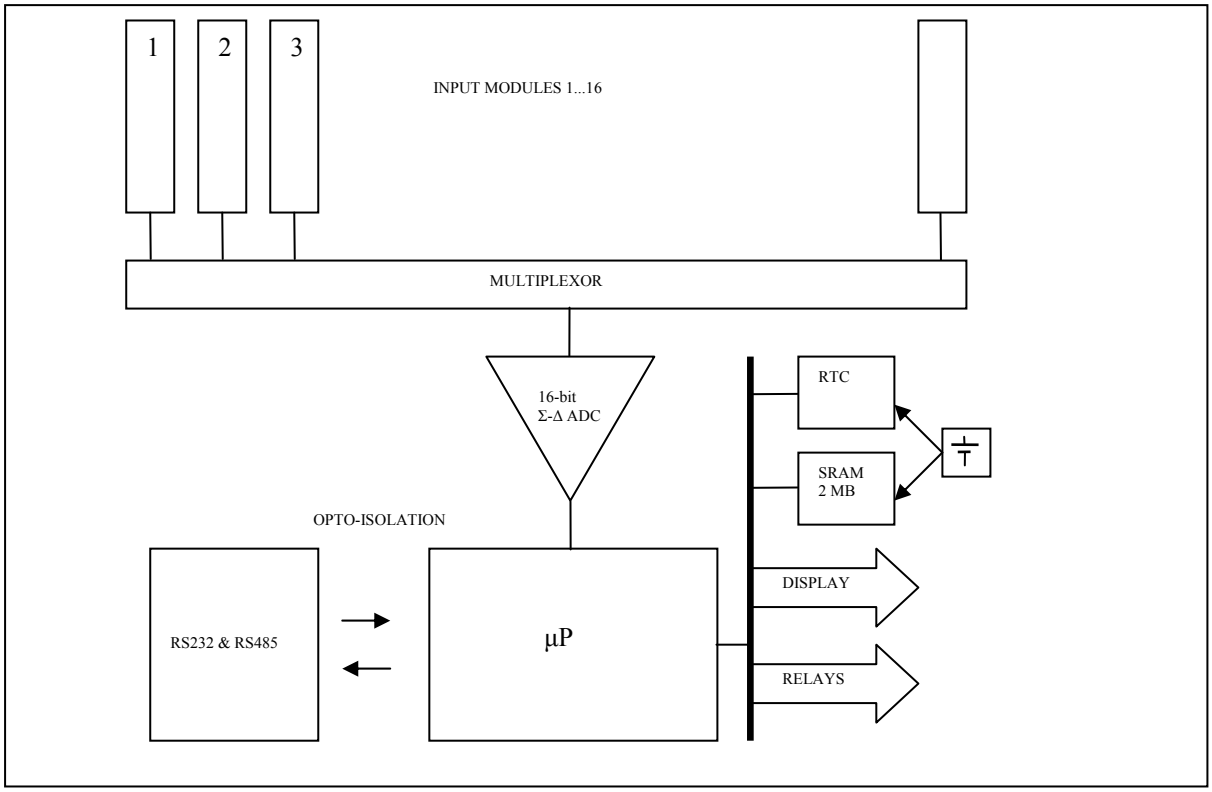
Disconnect the power cord and return data logger to the supplier or specialized company. Notice: *data logger contains back-up Lithium battery on motherboard and on each counter input module (CTU, CTK).*

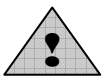
TECHNICAL DESCRIPTION AND PARAMETERS OF DATA LOGGER

Circuit concept of data logger

Data logger is designed as autonomous complex controlled by its own microprocessor, which fully works if power voltage is connected. If power voltage is not present, data logger does not work, but recorded data and internal time are saved. Exception is with counter inputs CTU and CTK, which internal counter works even in case of switched OFF power of data logger. Data logger is powered from external ac/dc adapter included in delivery.

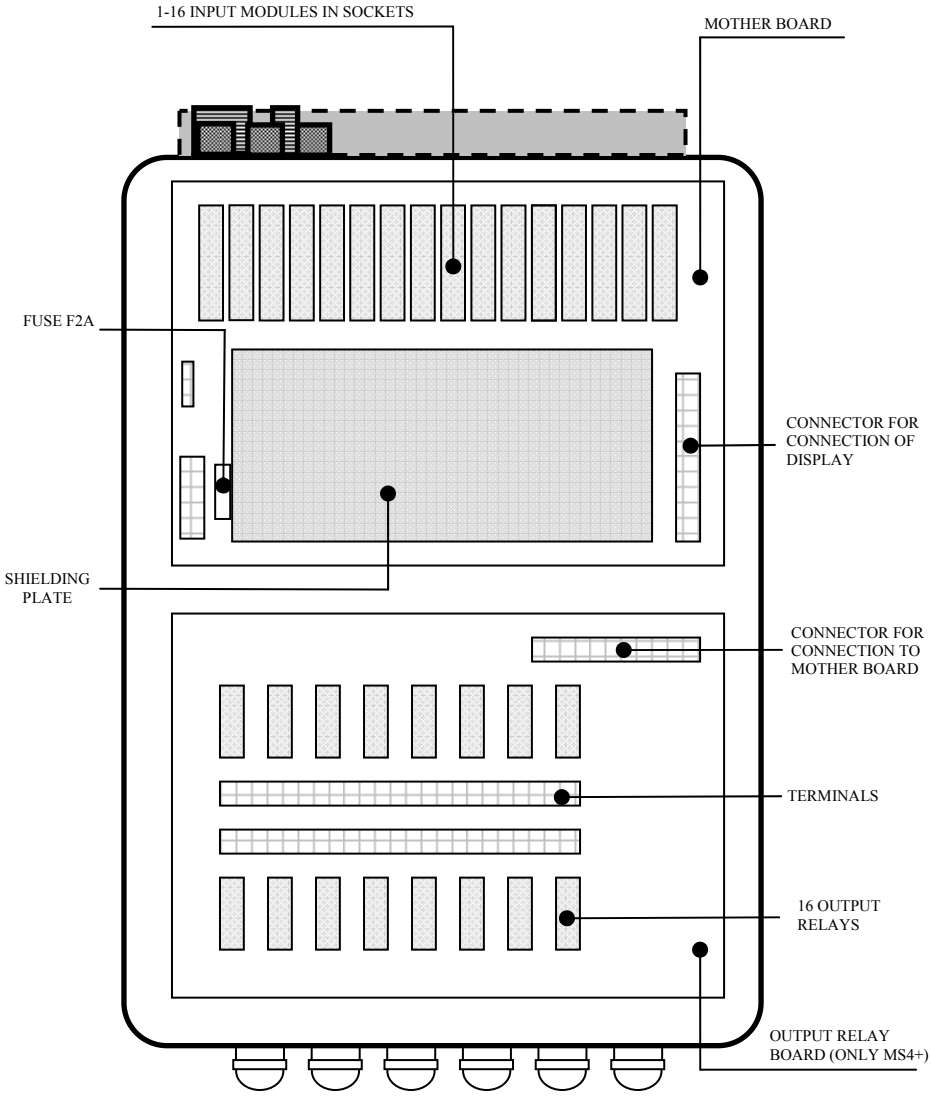
Circuit concept of data logger (simplified):





Each input module is replaceable with the exception of inputs for measurement thermocouples. Due to the possibility of data logger damage in incorrect manipulation with modules it is not allowed to manipulate with modules to unauthorized persons.

Mechanical description: data logger is built-in a LUCA system case. MS4+ models and all data loggers with inputs for measurement of thermocouples are built-in a larger case than standard MS2+ and MS3+ models.



Input signals are (with the exception of thermocouples) connected by means of 32 pin dual-part terminal. Upper part with connected cabling is possible to take out from data logger. Thermocouple inputs are connected by miniature thermocouple connectors. Communication interface RS232C and RS485 is connected by Canon connector, ALARM OUT output by means of the CINCH connector, output relay contacts are connected directly to terminal inside of the case by cables led via cable glands gland in case lower part.

Technical parameters of data logger

Not allowed manipulation and warning

Power adapter is a device connected to electric mains and if it is damaged including power cord there is danger of injury by electric current. It is not allowed to connect it to mains, if power cord is damaged or if its cover is damaged or removed. It is also not allowed to place it in humid and dangerous environment (e.g. bathroom etc.), at points exposed to direct sun radiation and other thermal sources, to prevent damage and deformation of the case. Data logger should not be operated with not protected terminals if dangerous voltage is connected. Galvanic isolation is not designed for protection from electric current injury. Isolation distances across input terminals and across input modules with inputs E3 and D3 (0..400) V do not comply in some cases the safety distances accordingly with EN 61010-1. In those cases adjacent input channels should

not be installed or it is necessary to apply additional isolation modules (e.g. measuring transformers).

Power

Data logger is powered from mains 230 V 50 Hz by means of the ac/dc adapter, which is included in delivery.

Power of data logger	
Power voltage:	mains 230 V 50 Hz
Maximum power:	25 W (1)
Power adapter:	ENCO NZ 21/25/1000, output 21V/1000mA
Protection from dangerous contact from power side:	EN 33 2000-4-41: class II., dual insulation
Protection:	tube fuse F2A on mother board
Power connector:	four-pole MIC334 on the panel
Input of AC/DC adapter:	MS2+, MS3+ ... 9... 30 V DC (2) MS4+... 24V DC (2)

Plug the output connector of ac/dc adapter to connector marked **AC/DC adapter o**n the logger upper side. Always first plug connector to data logger and then the power adapter to the mains.

(1)*Maximum input power with 16 inputs of type A0 with short-circuited inputs terminals. These input modules contain source for power of current loops of connected probes and are capable to supply approximately 25 mA/input. With power 24 V this additional power loss is approximately 10 W. More details see in appendix 1.*
(2)*More details on power voltage of data logger and its current consumption are specified in appendix 1.*

Output relay board of data logger MS4+

Board contains 16 mains relay with switching-over contacts, which are accessible at self-locking Wago terminals located on this board. Each relay is connected to 3 terminals.

Maximum voltage on the contact:	250 V AC
Maximum current through the contact:	8A
Maximum switching power:	2000 W
Mechanical life of relay contact:	3 x 10^7 cycles
Electric life of relay contact:	1 x 10^5 cycles
Material of contact:	Ag Cd O
Maximum wire cross section in terminal:	2,5 mm^2

Output ALARM OUT

This output is designed especially for connection of external audio indication or telephone dialer. The way of its activation is programmable in configuration of data logger.

Parameters of output in activation:	approximately 4.8 V DC, maximum 50 mA
Parameters of non-activated output:	0V, no load allowed
Connection:	connector CINCH, center – positive pole
Length of connection cable:	maximum 100 m, only in indoor environment

Note: It is possible to order galvanic isolated contact relay 24V/1A max instead of voltage output. Galvanic isolation is not designed as safety isolation in this case.

Communication interface

Each data logger is equipped with interface RS232C, data loggers MS3+ and MS4+ have in addition the interface RS485. Both communication interfaces are galvanic interconnected and are galvanic isolated from other data logger circuitry.

RS232C:	Applied signals:	RxD, TxD, GND RTS-CTS optionally from the program
	Galvanic isolation:	electric strength 500 V DC
	Connector:	Canon 9 male at upper side of case
	Maximum length of cable:	10 m, only in indoor rooms
RS485:	Input impedance:	approximately 7 kOhms
	Galvanic isolation:	electric strength 500 V DC
	Connectors:	2 x connector Canon 9 female on upper side of case, connectors are connected in parallel
	Maximum length of cable:	1200 m in indoor environment
USB	Compatibility:	USB1.1. and USB 2.0
	Connector:	USB type B from the side of the case
	Vendor ID:	0403
	Product ID:	6001
Ethernet	Compatibility:	10/100 MBit Ethernet
	Connector:	RJ45 from the side of the case

Galvanic isolation is not designed for safety protection from electric current injury!

way of transmission	
setting of communication	serial link, 1 start bit, 8 data bits, 1 stop bit, without parity
communication speed	1200 Bd, 9600 Bd, 19200 Bd, 57600 Bd, 115200 Bd

Optional serial interface for reception and sending SMS messages:

RS232/B	Applied signals:	RxD, TxD, GND RTS-CTS optionally from the program
	Galvanic isolation:	not galvanically isolated from internal logger circuitry
	Connector:	Canon 9 male at the top side of the case
	Maximum length of cable:	10 m, only in indoor environment
	Format of transferred data:	1 start bit, 8 data bits, 1 stop bit, no parity
	Communication speed:	1200 Bd, 9600 Bd, 19200 Bd, 57600 Bd, 115200 Bd

Circuit of real time clock:

Circuit contains actual value of seconds, minutes, hours, days, months and years. Circuit works even if data logger is switched OFF from power.

Time accuracy:	maximum 255 ppm ± 5 ppm/year in temperature 23°C ± 10 °C

Internal battery:

Serves to back-up recorded data and to power of real time clock (RTC) in case, data logger is not connected to power.

Type of battery:	Lithium 3V, VARTA CR ½ AA
Estimated life:	10 years from date of production of data logger

Electromagnetic compatibility

Device is tested accordingly with standards EN 50081-1 and 50082-1 for living environment and light industry.

radiation:	EN 55022 A1, A2: class A [1]
immunity:	EN 61000-3-2+A12+cor. 1-1998 [2]
	EN 61000-3-3+cor. 1-1998 [2]
	EN 61000-4-2: class A [2]
	EN 61000-4-3: class B [2]
	EN 61000-4-4: class B [2]
	EN 61000-4-5: class A [2]
	EN 61000-4-6: class B [2]
	EN 61000-4-11: class B [2]

[1] Warning: *data logger is a class A product. In indoor environment product can cause radio interference. In such case user can be obliged to apply proper precautions.*

[2] Class A in immunity test indicates the state, when device works in specified limits, class B indicates the state, when device during test went out from specified measuring limits, after the test device came back to the limits.

Operating conditions

Outere influence accordingly with EN 33-2000-3:	normal environment	
	Operating temperature:	(0..50) °C
	AC1	altitude up to 2000 m above sea level
	AE1	influence of other elements negligible
	AM1	influence of radiation negligible
	AN1	influence of sun radiation negligible
	BA4	qualification of persons – knowledgeable
	BE1	materials without fire danger in the object
Settling time after switching ON:	15 minutes	

Storing conditions:

Storing temperature:	-10 to +70 °C
Relative humidity:	5 to 95 %

Mechanical parameters:

Dimensions of the case:	(220 x 180 x 90) mm for MS2+, MS3+ (without thermocouples) (250 x 320 x 110) mm for MS4+ (a MS2+, MS3+ s thermocouples)
Weight:	approximately 800 g for MS2+, MS3+ approximately 2kg for MS4+
Protection:	IP20
Input terminals:	Removeable, maximum cross section of wires: 2.5 mm^2

Installation:	by means of 4 fixing consoles to flat vertical surface (wall)

Optional accessory:

External audio indication unit:	dimensions (110 x 65 x 40) mm connection: connector CINCH

Technical parameters of input modules

Input modules are designed as individual replaceable units plugged in sockets behind connection terminals of input channels. It is not possible to change modules for thermocouple measurement for other input module type. Manufacturer does not recommend to replace modules by unskilled personnel.

Each input module is adjusted to fixed maximum measuring range, where it works correctly in specified limits of accuracy. Input modules contain part of protection circuitry, circuitry for signal unification and memory with stored calibration and configuration constants. With galvanic isolated inputs optical isolation of the signal by analog operational amplifier is used. User is not able to modify configuration of input modules. If needed user can recalculate measured value to desired real value with physical unit by means of a special menu item Recalculations in the PC program.

Galvanic isolated inputs have isolation strength of 500 V. It is not tested as safety isolation, see Not allowed manipulations and warning.

Input modules for measurement of dc voltage and currents

These input modules are available in version without galvanic isolation or as galvanic isolated (with the exception of A0 input). Input with galvanic isolation is marked by additional letter G behind its type name.

Time response to step change of input signal is negligible referred to logging interval (1 s).

Input module type A0		
	Measured quantity:	dc current, with source for two-wire connection of transducers powered from current loop
	Range:	(4.. 20) mA
	Accuracy:	0.1 % from range (± 0.02 mA)
	Current in short circuit of input terminals:	limited to approximately 25 mA
	Voltage across open terminals:	output voltage of ac/dc adapter minus 3V, with 24V voltage it is approximately 21V
Input module type A1 and A1G		
	Measured quantity:	dc current
	Range:	(4.. 20) mA
	Accuracy:	0.1 % from range (± 0.02 mA)
	Input resistance:	approximately 14 Ohms
	Overload capacity:	100 % (current ± 40 mA maximum)
Input module type B0 and B0G		
	Measured quantity:	dc current
	Range:	(0.. 20) mA
	Accuracy:	0.1 % from range (± 0.02 mA)
	Input resistance:	approximately 14 Ohms
	Overload capacity:	100 % (current ± 40 mA maximum)
Input module type B1 and B1G		
	Measured quantity:	dc current

	Range:	(0.. 1) A
	Accuracy:	0.1 % from range (± 1 mA)
	Input resistance:	approximately 0.04 Ohms
	Overload capacity:	± 5 A maximum
Input module type B2 and B2G		
	Measured quantity:	dc current
	Range:	(0.. 5) A
	Accuracy:	0.1 % from range (± 5 mA)
	Input resistance:	approximately 0.04 Ohms
	Overload capacity:	10% (current ± 5.5 A maximum)

Input module type D0 and D0G		
	Measured quantity:	dc voltage
	Range:	(0.. 100) mV
	Accuracy:	0.1 % from range (± 0.1 mV)
	Input resistance:	>10 MOhms
	Overload capacity:	± 5 V maximum
Input module type D1 and D1G		
	Measured quantity:	dc voltage
	Range:	(0.. 1) V
	Accuracy:	0.1 % from range (± 1 mV)
	Input resistance:	>10 MOhms for input D1 >400 kOhms for input D1G
	Overload capacity:	± 5 V maximum for input D1 ± 10 V maximum for input D1G
Input module type D2 and D2G		
	Measured quantity:	dc voltage
	Range:	(0.. 10) V
	Accuracy:	0.1 % from range (± 10 mV)
	Input resistance:	>1 MOhms
	Overload capacity:	± 30 V maximum
Input module type D3 and D3G		
	Measured quantity:	dc voltage
	Range:	(0.. 400) V
	Accuracy:	0.1 % from range (± 400 mV)
	Input resistance:	>900 kOhms
	Overload capacity:	± 440 V maximum

Input modules for measurement of ac voltage and currents

These input modules are always galvanic isolated (without additional marking by G letter). These inputs contain converter RMS/DC, which is designed for measurement of sinus signals. Below specified measurement accuracies are valid for sinus signal of 50 Hz frequency.

General parameters of ac inputs		
non-sinus signal:	symmetrical rectangle 1:1 symmetrical triangle	additional error 11% additional error – 4%
time response t_{90}	step from 0 to $^3/_4$ range step from $^3/_4$ range to 0	approximately 2 s approximately 10 s

Input module type C0	
Measured quantity:	ac current
Range:	(0.. 20) mA
Accuracy:	1 % from range (± 0.2 mA)
Input resistance:	approximately 14Ohms
Overload capacity:	100% (current 40 mA maximum),
Input module type C1	
Measured quantity:	ac current
Range:	(0.. 1) A
Accuracy:	1 % from range (± 10 mA)
Input resistance:	approximately 0.04 Ohms
Overload capacity:	5 A maximum
Input module type C2	
Measured quantity:	ac current
Range:	(0.. 5) A
Accuracy:	1 % from range (± 50 mA)
Input resistance:	approximately 0.04 Ohms
Overload capacity:	5,5 A maximum
Input module type E0	
Measured quantity:	ac voltage
Range:	(0.. 100) mV
Accuracy:	1 % from range (± 1 mV)
Input resistance:	>10 MOhms
Overload capacity:	5 V maximum
Input module type E1	
Measured quantity:	ac voltage
Range:	(0.. 1) V
Accuracy:	1 % from range (± 10 mV)
Input resistance:	>10 MOhms
Overload capacity:	5 V maximum
Input module type E2	
Measured quantity:	ac voltage
Range:	(0.. 10) V
Accuracy:	1 % from range (± 100 mV)
Input resistance:	>1 MOhms
Overload capacity:	50 V maximum
Input module type E3	
Measured quantity:	ac voltage
Range:	(0.. 400) V
Accuracy:	1 % from range (± 4 V)
Input resistance:	>800 kOhms
Overload capacity:	440 V maximum

Input modules for measurement of resistance and resistance probes

These input modules are available in version without galvanic isolation or as galvanic isolated. Input with galvanic isolation is marked by additional letter G behind its type name.
Time response to step change of input signal is negligible referred to logging interval (1 s).
Modules are available for two-wire measurement. It is possible to compensate optional errors due to wire length in User Recalculation in the PC program.

Input module type F and FG		
	Measured quantity:	resistance
	Range:	0.. user defined range (from 100 Ohms to 1 MOhms)
	Accuracy:	0.1 % from range
	Measuring current:	approximately I = 1.25/range [A,Ohms]
	Maximum voltage at input:	± 5 V maximum
Input module type J and JG		
	Measured quantity:	temperature from RTD sensor Nickel 1000/ 6180 ppm
	Range:	(-50 .. 250) °C
	Accuracy (without probes):	±0.2 °C at range (-50..100) °C, ±0.2 % from value at range (100 .. 250) °C
	Measuring current:	approximately 0.25 mA (depending on temperature)
	Maximum voltage at the input:	± 5 V maximum
Input module type K and KG		
	Measured quantity:	temperature from RTD sensor Pt100/ 3850 ppm
	Range:	(-140 .. 600) °C
	Accuracy (without probes):	±0.2 °C at range (-140..100) °C, ±0.2 % from value at range (100 .. 600) °C
	Measuring current:	approximately 2 mA (depending on temperature)
	Maximum voltage at the input:	± 5 V maximum
Input module type K1 and K1G		
	Measured quantity:	temperature from RTD sensor Pt1000/ 3850 ppm
	Range:	(-140 .. 600) °C
	Accuracy (without probes):	±0.2 °C at range (-140..100) °C, ±0.2 % from value at range (100 .. 600) °C
	Measuring current:	approximately 0.2 mA (depending on temperature)
	Maximum voltage at the input:	± 5 V maximum

Input modules for measurement of temperature from thermocouple probes

Inputs for measurement of thermocouples (except for thermocouple type B) have compensation of cold junction inside of data logger. Temperature of the point where thermocouple wire is connected to copper layer is sensed. This temperature is converted to thermoelectric voltage and is added to thermoelectric voltage measured by thermocouple. Result is converted to temperature again, which is result measured temperature. All data logger with thermocouple inputs are designed as custom devices due to used special connectors and internal lead from corresponding thermocouple wire.

These input modules are available in versions without galvanic isolation or as galvanic isolated. Input with galvanic isolation is marked by additional letter G behind its type name.

Time response to step change of input signal is negligible referred to logging interval (1s).

Isolation strength of galvanic isolated inputs is only 100 V!

Input module type N and NG	
Measured quantity:	temperature measured by thermocouple type K (NiCr-Ni)
Range:	(-70..1300) °C
Accuracy (without probes):	± (0.3 % from measured value + 1 °C)
Cold junction:	compensated at temperature range (0..50) °C
Maximum voltage at the input:	± 5 V maximum
Input module type O and OG	
Measured quantity:	temperature measured by thermocouple type J (Fe-Co)
Range:	(-200..750) °C
Accuracy (without probes):	± (0.3 % from measured value + 1 °C)
Cold junction:	compensated at temperature range (0..50) °C
Maximum voltage at the input:	± 5 V maximum
Input module type P and PG	
Measured quantity:	temperature measured by thermocouple type S (Pt10%Rh-Pt)
Range:	(0..1700) °C
Accuracy (without probes):	± (0.3 % from measured value + 1 °C)
Cold junction:	compensated at temperature range (0..50) °C
Maximum voltage at the input:	± 5 V maximum
Input module type Q and QG	
Measured quantity:	temperature measured by thermocouple type B (Pt30%Rh-Pt)
Range:	(100..1800) °C
Accuracy (without probes):	± (0.3 % from measured value + 1 °C) at range (300..1800)°C
Cold junction:	not compensated
Maximum voltage at the input:	± 5 V maximum
Input module type T and TG	
Measured quantity:	temperature measured by thermocouple type T (Cu-CuNi)
Range:	(-200..400) °C
Accuracy (without probes):	± (0.3 % from measured value + 1 °C)
Cold junction:	compensated at temperature range (0..50) °C
Maximum voltage at the input:	± 5 V maximum

Input modules for pulse counting

Counter inputs are designed for counting of incoming pulses (gas meters, electrometers..). Modules contain own processor unit, which registers incoming pulses even if power is switched OFF (module has its own battery for power, if data logger is not switched ON). Record is performed similarly as with analog inputs, i.e. by writing counter value to data memory in adjusted logging interval. Value from counter can be displayed in absolute format or as recalculated, in record it is possible to display relative format as increments in logging intervals. Counter module contains switchable overshoot filter (fast changes) of input pulses.

Input module CTU - galvanic isolated counter for voltage signal	
Capacity of counter:	31 bits, activated by downward edge of input signal maximum value of counter: 2147483647
Input level:	state „L“: 0 to 0,8 V state „H“: 3 to 24 V maximum
Input current:	approximately 7 mA in state „H“
Input frequency:	0 to 5 Hz, length of pulse minimum 200 ms, if Filter is switched ON 0 to 5 kHz, length of pulse minimum 30 μs, if Filter is switched OFF
Galvanic isolated:	500 V, not designed for safety function
Battery life:	minimum 6 months, if data logger is switched OFF

Input module CTK - galvanic non-isolated counter for potential-less contact

Capacity of counter:	31 bits, activated by leading edge of input signal maximum value of counter: 2147483647
Input level:	state „L“: resistance of opened contact >250 k Ohms state „H“: resistance of closed contact < 10 k Ohms
Input frequency:	0 to 5 Hz, length pulse minimum 200 ms, if is Filter switched ON 0 to 5 kHz, length pulse minimum 30 µs, if is Filter switched OFF
Galvanic isolated:	module **is not** galvanic isolated from other circuitry of data logger
Battery life:	minimum 6 months, if data logger is switched OFF

Input modules for monitoring of binary event

Binary inputs serve for evaluation of two-state level input signals (contact closed/opened respectively voltage present/not present).

Input module S and SG - binary input for potential-less contact	
Input level:	state „L“: resistance of opened contact >100 k Ohms state „H“: resistance of closed contact < 1000 Ohms
Minimum length of input pulse:	200 ms
Galvanic isolated:	only with input module SG: 500 V, not designed for safety function
Input module S1 - binary input for voltage level, galvanic isolated	
Input level:	state „L“: 0 to 0,8 V state „H“: 3 to 30 V maximum
Input current:	(1..9) mA .. depending on applied input voltage ve state „H“
Minimum length of input pulse:	200 ms
Galvanic isolated:	500 V, not designed for safety function

Input modules for measurement of frequency

Module contains its own processor, procession of measured values is identical a with analog inputs.

Input module FU - galvanic isolated input for measurement of frequency voltage signal	
Range:	0 to 5 kHz, duration of input pulse minimum 30 µs
Resolution:	1 Hz
Accuracy:	± (0,2% from reading +1Hz)
Input level:	state „L“: 0 to 0,8 V state „H“: 3 to 24 V maximum
Input current:	approximately 7 mA in state „H“
Galvanic isolated:	500 V, not designed for safety function
Input module FK - galvanic non-isolated input for measurement of frequency of contact switching	
Range:	0 to 5 kHz, duration of input pulse minimum 30 µs
Resolution:	1 Hz
Accuracy:	± (0,2% from reading +1Hz)
Input level:	state „L“: resistance of opened contact >250 k Ohms state „H“: resistance of closed contact < 10 k Ohms

Input RS - galvanic isolated input for transducers with serial RS485 output

This input module contains its own processor unit and serves for reading from intelligent transducers, which support protocol of ADVANTECH format. Only one such input can be installed in data logger. All higher channels up to channel 16, which follow the position, where RS input is installed are automatically directed to input serial RS485 link. That is why, positions for higher channels must remain vacant.

Input communication interface:	RS485
Communication protocol:	compatible with ADVANTECH ADAM series 4000
Format data:	Engineering units, check sum switched ON, supported commands: #AA cr (single-input device) or #AAn cr (multi-input device, n .. number of input 0..7)
Address of input device:	must be from interval 1 to 16 (decimal)
Communication speed:	(1200, 2400, 4800, 9600, 19200) Bd
Impedance of input (reception):	approximately 12 k Ohms
Maximum length of cable:	1200 m at indoor rooms
Galvanic isolated:	500 V, not designed for safety function

This input can communicate with 1 to 16 devices (respectively measured points). Maximum number of measured points is defined by the position of module in data logger. Module sends command for reading of data from the first transducer, then waits for response. Maximum waiting duration is adjustable up to approximately 500 ms. After expiration of this duration communication error is reported and module continues with reading of the following channel. If device responses in adjusted time, the response is evaluated and module also continues with reading of the following channel.
Note: *more details and the procedure of setting of the module is described in* *Appendix 3*