

# *MONITORING, DATALOGGING AND CONTROL SYSTEM MS2, MS3, MS4*

## **INSTRUCTION MANUAL**

*ANDMETE JÄLGIMISE, SALVESTAMISE JA KONTROLLIMISE  
SEADMED MS2, MS3, MS4*

**Käsitsemisjuhised inglise keeles**



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## **1. INTRODUCTION**

One-channel to sixteen-channel datalogger is designed for autonomous monitoring of electrical and non-electrical values into its internal electronic memory. Also binary, counter and serial RS485 inputs are available. Any time during recording it is possible to transfer data from datalogger to any IBM PC compatible computer for analyzing and printing out. Also on-line viewing of actual values from all channels is enabled on the PC screen, independently on data logging. Input signals are connected to removable Wago terminals (with the exception thermocouple inputs). Datalogger is supplied from an external AC/DC adapter.

### **The MS2 datalogger**

for simpler applications - no display, no alarms, only storing function. Displaying of the actual input values is possible on a PC screen by means of the PC software. There are 4 LEDs on the front panel for indicating power and the memory occupation in three levels.

### **The MS3 datalogger with display and alarms**

- in addition to the MS2 model MS3 is equipped with the dual line alphanumeric LCD and the alarms. The LCD enables displaying actual values from input channels, device configuration and status. Two comparing levels for each input are user adjustable. Crossing of the levels is acoustically and optically indicated (appropriate LED on the front panel is ON).

### **The monitoring and control system MS4 with alarms**

- all functions as MS3 plus installed output board with 16 relays with switching-over contacts for controlling of external devices. It is possible to assign any number of relays to any alarms from any inputs. Assigning of relays is performed by the PC software. Output signals from relays and the power are connected to internal terminals via cable glands.

## **2. TECHNICAL DESCRIPTION**

### **2.1. System design**

Datalogger is designed as autonomous system, which works completely only with applied power voltage (note 1). The heart of the device circuitry is a single chip microprocessor, high capacity memory SRAM, real time clock and 16 bit AD sigma-delta converter. In addition datalogger contains peripheral circuitry, as galvanic isolated interface RS232/RS485, audio indication output, pulse source 5V, I/O output port for display and 16 positions equipped with single row connectors for input modules connection. Those parts are implemented on the motherboard. Dataloggers MS3 and MS4 have a display board with keyboard, datalogger MS4 has a board of 16 relay outputs.

Note 1: *Datalogger does not work if power voltage is not applied. All data are internally backed-up against loss. Inputs CTU and CTK work even when power of datalogger is switched off.*

### **2.2. Technical parameters of datalogger**

#### **2.2.1. Power**

Datalogger is powered from 230 V, 50 Hz by means of an AC/DC adapter, which is included in delivery.

Protection from dangerous contact from power side in accordance with EN 33 2000-4-41:  
class II., double isolation

Protection: cut-out fuse on motherboard: F2A

Output connector of AC/DC adapter is plugged in connector marked **AC/DC adapter**  
on upper side of datalogger.

Power connector: four pole MIC334 on the upper panel

Note 2: *Datalogger MS2 and MS3 works with power voltage at the range of 9..30V dc.  
Datalogger MS4 works with voltage approximately 24 V dc. Detailed information on  
power voltage and current consumption is specified in [appendix 1](#).*

### 2.2.2. Display and keyboard of dataloggers MS3 and MS4

Display is dual line 2x16 characters, LCD illuminated, keyboard has four push buttons.  
Below keyboard 2x16 LED diodes are located for optical indication of alarms and 4 LED  
diodes for indication of power voltage and memory occupation.

### 2.2.3. Output relay board of datalogger MS4

Board contains 16 relays with switching over contacts, which are available on self-clamping  
Wago terminals located on the board. Each relay is connected to 3 terminals.

Maximum applicable voltage: 250 V AC (125 V DC) when respecting points in *Not allowed  
manipulations*.

Maximum current through contact: 6A

Maximum switching power: 720 VA

Mechanical life of relay contact: 10<sup>7</sup> cycles

Material of contact: Ag Cd O

Resistance of closed contact: 50 mΩ

### 2.2.4. The ALARM OUT output.

Parameters of activated output: voltage approximately 4.8 V DC, max. load 50 mA

Parameters of non-activated output: 0 V DC

Connection: connector CINCH, central contact – positive pole (older models - JACK 3.5''  
mono)

Length of interconnection cable: max. 100 m, only indoor use

This output is designed especially for connection of external audio indication or telephone  
voice dialer.

### 2.2.5. Input signals

Input signals (with the exception of thermocouples) are connected by means of a 32 pin  
removable terminal block. Part with connected wires is possible to remove from  
datalogger.

Max. cross-section of wire in terminal block: 2.5 mm<sup>2</sup>

Thermocouple inputs are equipped with subminiature thermocouple female connectors.

### 2.2.6. Communication interface

Each datalogger is equipped with serial interface RS232:

Communication: Rx/D, Tx/D, GND, switchable confirmation signal RTS/CTS

Galvanic isolation: electric strength 500 V DC, no safety function

Connection: male Canon 9 connector located on the upper side of the case

Maximum length of communication cable: 10 m, only indoor use

Dataloggers MS3 and MS4 are in addition equipped with interface RS485:

Input impedance: approximately 7 kΩ

Connection: two female connectors Canon 9 located on the upper side of the case, both connectors are connected in parallel

Maximum cable length: 1200 m – indoor use

This interface is galvanic connected with interface RS232 and from other circuitry is galvanic isolated identically as RS232

Selectable communication speed: datalogger can communicate by speed 1200 Bd, 9600 Bd, 19200 Bd, 57600 Bd, 115200 Bd.

**2.2.7. Real time clock:** contains actual data of seconds, minutes, hours, days, months and years.

Circuitry works even if datalogger power is switched off.

Accuracy: maximum error 255 ppm  $\pm$  5 ppm/year at temperature 23°C  $\pm$  10 °C.

**2.2.8. Date and time back-up:** is done by internal Lithium battery. Battery is applied only if device is switched off. Battery life: 10 years from the date of production

### 2.2.9. Electromagnetic compatibility

Device is tested in accordance with standards EN 50081-1 and 50082-1 for living, office and light industry rooms.

Result of tests:

- EN 55022 mod. A1, A2: class A
- EN 61000-3-2+A12+cor. 1-1998
- EN 61000-3-3+cor. 1-1998
- EN 61000-4-2: class A
- EN 61000-4-3: class B (measuring error outside of tolerance)
- EN 61000-4-4: class B (measuring error outside of tolerance)
- EN 61000-4-5: class A
- EN 61000-4-6: class B (measuring error outside of tolerance)
- EN 61000-4-11: class B (measuring error outside of tolerance)

*Warning: Datalogger is a class A product. In indoor use product can cause radio interference. In such case can be required for the user to take suitable steps.*

### 2.2.10. Operating condition

Outer effects in accordance with EN 33-2000-3: normal rooms with this specification:

AA5,AC1,AE1,AM1,AN1,BA4,BE1,CB1

Operating temperature: (0..50) °C

Settling time: 15 minutes after datalogger switching on

**2.2.11. Storing conditions:** storing temperature -10 to +70 °C at humidity 5 to 95 %RH

### 2.2.12. Mechanical parameters

Dimensions of case: datalogger MS2 and MS3: case LUCA (220 x 180 x 90) mm

datalogger MS4: case LUCA (250 x 320 x 110) mm

datalogger with thermocouple inputs are built in case of size as MS4

Weight: datalogger MS2, MS3: approximately 800 g

datalogger MS4: approximately 2kg

Wall mounting: by means of 4 wall holders

Protection: IP20

Optional accessory:

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

connection: connector CINCH on the case

### 2.2.13. Not allowed manipulation and warning

Do not operate the datalogger with possible human touch of terminal block in case of measuring dangerous voltage. Galvanic isolation does work as protection from injury from electric current. Isolation distances on input terminal block and between input modules E3 and D3 (0..400) V in certain cases do not match safe distances in accordance with EN 61010-1. In those cases the adjacent positions of input channels should be empty. Maximum applicable voltage on relay board is 250 V (only MS4 loggers).

## 2.3. Technical parameters of the inputs

The parameters of each input module are strictly defined by input circuitry. The PC software enables in User calibration to assign measured values different values by means of two-point linear transformation. Then it is necessary data of accuracy recalculate in proper way.

Inputs are designed as replaceable modules, containing circuitry protection, circuitry for conversion of levels and a memory with calibration and configuration constants. Galvanic isolated inputs are isolated using optically isolated operational amplifier (i.e., those inputs could have slightly worse linearity than non-isolated inputs). Response time to unit step of input signal is negligible referring to shortest sampling interval (1 s). The exception is in case of ac inputs.

Ac inputs have time constant  $t_{90}$  upwards from 0 to  $\frac{3}{4}$  range approximately 2 s and vice versa (i.e. from  $\frac{3}{4}$  range to 0) approximately 10 s. Ac inputs contain a RMS/DC converter designed for measurement of signals with sinus waveform. Measurement error increases with different waveform. The additional error depends on the ratio of peak to effective value. For ratio 1.41 (sinus waveform) is additional error zero, for ratio 1.0 (symmetric rectangle waveform) additional error is 11%, for ratio 1.73 (triangle waveform) is additional error approximately -4%. All ac inputs are calibrated in frequency 50 Hz.

Temperature of cold end is compensated in thermocouple inputs (with the exception of thermocouple type B). Temperature is sensed at the point where thermocouple wire is connected to copper layer on the board. The temperature value is recalculated to thermoelectric voltage and is added to thermoelectric voltage measured by the thermocouple. Result is recalculated to back to temperature, which is the real temperature value. All dataloggers with thermocouple inputs are designed as custom devices with special connectors.

Counter input contains its own processor unit registering pulses even if datalogger power is switched off. Record is performed similarly as in analog inputs, i.e. by writing counter state to data memory at the moment of logging interval. Data from counter are possible to display in absolute form or as recalculated (multiplied by real constant k). Record is also possible to display in relative form as increments for the time between subsequent logging intervals.

Input RS contain its own processor unit and serves for reading data from intelligent transducers in protocol ADVANTECH. Only one RS input can be present in datalogger. All channels from the position of RS module up to channel 16 are automatically directed to input serial link RS485. That is why positions for input modules higher channels should stay vacant.

Binary inputs (S, SG, S1) are designed for record of time of an event. This input has its own independent mode of logging. Date, time and state of input are stored immediately after the change of input signal.

### 2.3.1. Input A0

Range: (4.. 20) mA dc with dc source for two-wire connection

Accuracy: 0.1 % from range ( $\pm 0.02$  mA)

Limitation of short circuit current between terminals: approximately 25 mA

Voltage between terminals for power transducer: output voltage power adapter - 3V

See wiring in [appendix 3](#).

### 2.3.2. Input A1 and input A1G - current dc input

Range: (4.. 20) mA dc, accuracy: 0.1 % from range ( $\pm 0.02$  mA)

Overloading: 100 % (current  $\pm 40$  mA max.), input resistance: approximately 14  $\Omega$

Galvanic isolation (only A1G): isolation strength 500 V, not tested as safety isolation

### 2.3.3. Input B0 and input B0G - current dc input

Range: (0.. 20) mA dc, accuracy: 0.1 % from range ( $\pm 0.02$  mA)

Overloading: 100 % (current  $\pm 40$  mA max.), input resistance: approximately 14  $\Omega$

Galvanic isolation (only B0G): isolation strength 500 V, not tested as safety isolation

### 2.3.4. Input B1 and input B1G - current dc input

Range: (0.. 1) A dc, accuracy: 0.1 % from range ( $\pm 1$  mA)

Overloading: current  $\pm 5$  A max., input resistance: approximately 0.04  $\Omega$

Galvanic isolation (only B1G): isolation strength 500 V, not tested as safety isolation

### 2.3.5. Input B2 and input B2G - current dc input

Range: (0.. 5) A dc, accuracy: 0.1 % from range ( $\pm 5$  mA)

Overloading: 10% (current  $\pm 5.5$  A max.), input resistance: approximately 0.04  $\Omega$

Galvanic isolation (only B2G): isolation strength 500 V, not tested as safety isolation

### 2.3.6. Input C0 - current ac input

Range: (0.. 20) mA ac, 50 Hz, accuracy: 1 % from range ( $\pm 0.2$  mA)

Overloading: 100% (current 40 mA max.), input resistance: approximately 14  $\Omega$

Galvanic isolation: strength 500 V, not tested as safety isolation

### 2.3.7. Input C1 - current ac input

Range: (0.. 1) A ac, 50 Hz, accuracy: 1 % from range ( $\pm 10$  mA)

Overloading: current 5 A max., input resistance: approximately 0.04  $\Omega$

Galvanic isolation: strength 500 V, not tested as safety isolation

### 2.3.8. Input C2 - current ac input

Range: (0.. 5) A ac, 50 Hz, accuracy: 1 % from range ( $\pm 50$  mA)

Overloading: current 5.5 A, input resistance: approximately 0.04  $\Omega$

Galvanic isolation: strength 500 V, not tested as safety isolation

### 2.3.9. Input D0 and input D0G - voltage dc input

Range: (0.. 100) mV dc, accuracy: 0.1 % from range ( $\pm 0.1$  mV)

Overloading: voltage  $\pm 5$  V max., input resistance:  $>10$  M $\Omega$

Galvanic isolation (only D0G): isolation strength 500 V, not tested as safety isolation

### 2.3.10. Input D1 and input D1G - voltage dc input

Range: (0.. 1) V dc, accuracy: 0.1 % from range ( $\pm 1$  mV)

Input D1: overloading: voltage  $\pm 5$  V max., input resistance:  $>10$  M $\Omega$

Input D1G: overloading:  $\pm 10$  V max., input resistance:  $>400$  k $\Omega$

Galvanic isolation (only D1G): isolation strength 500 V, not tested as safety isolation

### 2.3.11. Input D2 and input D2G - voltage dc input

Range: (0.. 10) V dc, accuracy: 0.1 % from range ( $\pm 10$  mV)

Overloading: voltage  $\pm 50$  V max., input resistance:  $>1$  M $\Omega$

Galvanic isolation (only D2G): isolation strength 500 V, not tested as safety isolation

### 2.3.12. Input D3 and input D3G - voltage dc input

Range: (0.. 400) V dc, accuracy: 0.1 % from range ( $\pm 400$  mV)

Overloading: voltage  $\pm 440$  V max., input resistance:  $>900$  k $\Omega$

Galvanic isolation (only D3G): isolation strength 500 V, not tested as safety isolation

### 2.3.13. Input E0 - voltage ac input

Range: (0.. 100) mV ac, 50 Hz, accuracy: 1 % from range ( $\pm 1$  mV)

Overloading: voltage 5 V max., input resistance:  $>10$  M $\Omega$

Galvanic isolation: strength 500 V, not tested as safety isolation

### 2.3.14. Input E1 - voltage ac input

Range: (0.. 1) V ac, 50 Hz, accuracy: 1 % from range ( $\pm 10$  mV)

Overloading: voltage 5 V max., input resistance:  $>10$  M $\Omega$

Galvanic isolation: strength 500 V, not tested as safety isolation

### 2.3.15. Input E2 - voltage ac input

Range: (0.. 10) V ac, 50 Hz, accuracy: 1 % from range ( $\pm 100$  mV)

Overloading: voltage 50 V max., input resistance:  $>1$  M $\Omega$

Galvanic isolation: strength 500 V, not tested as safety isolation

### 2.3.16. Input E3 - voltage ac input

Range: (0.. 400) V ac, 50 Hz, accuracy: 1 % from range ( $\pm 4$  V)

Overloading: voltage 440 V max., input resistance:  $>800$  k $\Omega$

Galvanic isolation: strength 500 V, not tested as safety isolation

### 2.3.17. Input F and input FG – two-wire measuring resistance

Range: 100 $\Omega$ .. 1 M $\Omega$ , user specified, accuracy: 0.1 % from range

Max. applicable voltage to the input: 5 V max.

Permanent current through resistor (approximately):  $I = 1.25/\text{range}$  [A,  $\Omega$ ]

Galvanic isolation (only FG): isolation strength 500 V, not tested as safety isolation

### 2.3.18. Input J and input JG – two-wire measurement of RTD Nickel temperature sensor

Type of sensor: Nickel 1000/ 6180 ppm, range: (-50 .. 250)  $^{\circ}\text{C}$

Accuracy (without probes):  $\pm 0.3$   $^{\circ}\text{C}$  at range (-50..100)  $^{\circ}\text{C}$ ,

$\pm 0.5$  % from value at range (100 .. 250)  $^{\circ}\text{C}$

Max. applicable voltage to the input:  $\pm 5$  V max.

Permanent current through sensor: approximately 0.25 mA (in accordance with temperature)

Galvanic isolation (only JG): isolation strength 500 V, not tested as safety isolation



### 2.3.19. Input K and input KG – two-wire measurement of RTD Platinum temperature sensor Pt100

Type of sensor: Pt100 0.385  $\Omega/^\circ\text{C}$ , range: (-140 .. 600)  $^\circ\text{C}$

Accuracy (without probes):  $\pm 0.3$   $^\circ\text{C}$  at range (-140..100)  $^\circ\text{C}$ ,  
 $\pm 0.5$  % from value at range (100 .. 600)  $^\circ\text{C}$

Max. applicable voltage to the input:  $\pm 5$  V max.

Permanent current through sensor: approximately 2 mA (in accordance with temperature)

Galvanic isolation (only KG): isolation strength 500 V, not tested as safety isolation

### 2.3.20. Input K1 and input K1G – two-wire measurement of RTD Platinum temperature sensor Pt1000

Type of sensor: Pt1000 3.85  $\Omega/^\circ\text{C}$ , range: (-140 .. 600)  $^\circ\text{C}$

Accuracy (without probes):  $\pm 0.3$   $^\circ\text{C}$  at range (-140..100)  $^\circ\text{C}$ ,  
 $\pm 0.5$  % from value at range (100 .. 600)  $^\circ\text{C}$

Max. applicable voltage to the input:  $\pm 5$  V max.

Permanent current through sensor: approximately 0.2 mA (in accordance with temperature)

Galvanic isolation (only K1G): isolation strength 500 V, not tested as safety isolation

### 2.3.21. Input N and input NG - measuring of temperature of thermocouple type K (NiCr-Ni)

Type of sensor: thermocouple type "K", range: (-70..1300)  $^\circ\text{C}$

Accuracy (without probes):  $\pm (0.3$  % from measured value + 1  $^\circ\text{C})$

Max. applicable voltage to the input:  $\pm 5$  V max.

Galvanic isolation (only NG): isolation strength 500 V, not tested as safety isolation

### 2.3.22. Input O and input OG - temperature measurement of thermocouple type J (Fe-Co)

Type of sensor: thermocouple type "J", range: (-200..750)  $^\circ\text{C}$

Accuracy (without probes):  $\pm (0.3$  % from measured value + 1  $^\circ\text{C})$

Max. applicable voltage to the input:  $\pm 5$  V max.

Galvanic isolation (only OG): isolation strength 500 V, not tested as safety isolation

### 2.3.23. Input P and input PG - temperature measurement of thermocouple type S (Pt10%Rh-Pt)

Type of sensor: thermocouple type "S", range: (0..1700)  $^\circ\text{C}$

Accuracy (without probes):  $\pm (0.3$  % z measured value + 1  $^\circ\text{C})$

Max. applicable voltage to the input:  $\pm 5$  V max.

Galvanic isolation (only PG): isolation strength 500 V, not tested as safety isolation

### 2.3.24. Input Q and input QG - temperature measurement of thermocouple type B (Pt30%Rh-Pt)

Type of sensor: thermocouple type "B", range: (100..1800)  $^\circ\text{C}$

Accuracy (without probes):  $\pm (0.3$  % z measured value + 1  $^\circ\text{C})$  v range (300..1800)  $^\circ\text{C}$

No cold end temperature compensation is performed.

Max. applicable voltage to the input:  $\pm 5$  V max.

Galvanic isolation (only QG): isolation strength 500 V, not tested as safety isolation

### 2.3.25. Input S and input SG - binary input for potential-less contact

Function of the input: to store time, when change of contact state occurred

Maximum resistance closed contact: 1000  $\Omega$

Minimum duration of the state for storing: 200 ms

Galvanic isolation (only SG): isolation strength 500 V, not tested as safety isolation

### 2.3.26. Input S1 - binary input for voltage level, galvanic isolated

Function of the input: to store time, when change of contact state occurred

Minimum voltage for state "closed": 3 V DC

Maximum voltage applicable to the input: 30 V DC

Input current in the state "closed": (1..9) mA .. in accordance with applied input voltage

Minimum duration of state for storing: 200 ms

Galvanic isolation : isolation strength 500 V, not tested as safety isolation

### 2.3.27. Input CTU - galvanic isolated counter for voltage signal

Function of the input: counting of pulses (gas meters, electrometers ..). Input is equipped with programmable filter of short changes (ringing)

Counter capacity: 31 bits, is activated with falling edge of input signal

Minimum voltage for state "H": 3 V DC

Maximum voltage applicable to the input: 24 V DC

Input current in "H" state: approximately 7 mA

Maximum measuring frequency: 5 kHz (filter switched off)

Minimum duration of input pulse: 30  $\mu$ s (filter switched off)

Minimum duration of input level (filter switched on): 200 ms

Galvanic isolation : isolation strength 500 V, not tested as safety isolation

Module works independently to datalogger power. It contains its own micro controller and supply battery. Battery works only when datalogger is switched off. If module is implemented in system and datalogger is switched off, the battery life is 6 months at minimum.

### 2.3.28. Input CTK - galvanic non-isolated counter for potential-less contact

Function of the input: counting of pulses (gas meters, electrometers..) from a contact or "open collector". Input is equipped with programmable filter of short changes (ringing)

Counter capacity: 31 bits, is activated with leading edge of input signal

Maximum resistance of contact for state "H": 10 k  $\Omega$

Minimum resistance of contact for state "L": 250 k  $\Omega$

Maximum measuring frequency: 5 kHz (filter switched off)

Minimum duration of input pulse: 30  $\mu$ s if filter is switched off

Minimum duration of input level (filter is switched on): 200 ms

Module works independently to datalogger power. It contains its own micro controller and supply battery. Battery works only when datalogger is switched off. If module is implemented in system and datalogger is switched off, the battery life is 6 months at minimum.

### 2.3.29. Input RS - galvanic isolated input for transducer with serial output RS485

Function of the input: input is designed for reading data from devices communicating in protocol ADVANTECH.

Input link: RS485, designed for indoor leads of maximum length of 1200 m.

Input impedance (reception): approximately 12 k  $\Omega$

Communication speed: (1200, 2400, 4800, 9600, 19200) Bd

Addresses of input device: 1 to 16 (decimal)

Format of input data: Engineering units

CRC: should be always switched on

Protocol : #AA cr (single input device) or #AA n cr (multi input device, n .. number of input 0..7)

Function of the module: Module can communicate with 1 to 16 devices (or measured points). Maximum number of measured points depends on the module position module in datalogger.

Module sends command for reading data from the first transducer and waits for the response. Maximum waiting time is enable to set to approximately 500 ms. After that time communication error message is send and reading of next channel continues. If device responses in specified time, response is evaluated and reading of next channel continues too.

Galvanic isolation : isolation strength 500 V, not tested as safety isolation

Note: detailed *specification and the way of module configuration* is described in [appendix 3](#).

### **3. FUNCTION OF DATALOGGER**

#### **3.1. Measuring mode of datalogger**

In usual operation datalogger is in measuring mode. It means, input signals connected to input channels, which are switched on by PC program, are consequently connected to sigma-delta AD converter and after settling converted to digital form. Converter range is 16 bits, short-term stability is approximately  $\pm 5$  LSB (in accordance with type of input etc.). After switching on the datalogger measuring cycle is automatically initialized. It is only possible to switch on/off input channels. Data from AD converter is mathematically modified to floating point format (it is available in reading the Display item in user program). Measured values is possible to recalculate in User calibration and assign different values (linear transformation). Dataloggers MS3 and MS4 display measured values on the datalogger LCD.

#### **3.2. Alarm evaluation function of dataloggers MS3 and MS4**

In each measuring cycle evaluation of set alarms is performed. This is valid for all analog inputs, binary inputs S, S1, SG, RS. It is not possible to set alarms if inputs CTU and CTK. For each input channel is possible to set two alarm levels. For each level it is possible to set direction of activity (upwards, downwards), hysteresis (to avoid possible un-stabilities near limit level), activation of audio indication (internal, external or both) and alarm delay time (i.e. duration of measured value is out of set limits, till alarm is activated – filter of false alarms). Each alarm has its own signal LED diode, which indicates the activation (alarm I. yellow, alarm II. red). Datalogger MS4 has 16 output relays and it is possible to assign any number of relays to any alarms.

#### **3.3. Datalogging mode**

##### **3.3.1. Logging interval**

Datalogger stores measured values from all active channels to its internal memory in user selectable interval. The following intervals are available: 1s, 2s, 5s, 10s, 15s, 30s, 1min, 2min, 5min, 10min, 15min, 30min, 1h, 2h, 3h, 4h, 6h, 8h, 12h, 24h. The interval is common for all analog and counter channels. Storing is performed always in whole number multiples of above intervals. E.g. *if datalogger 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.* Logging interval is common for all analog (including CTU, CTK, RS) inputs. No input channel is enabled to be switched off only for storing. Once channel is off no measuring and no alarm evaluation is performed with it.

Note: *Datalogger measure one channel after another. Measurement of one channel takes approximately 100 ms. It means if all 16 channels are active, the total measurement time is 1.6 s. Measured values are stored at internal buffer and at logging interval all buffer together is stored to data memory. This is important with shortest logging intervals.*

### 3.3.2. Capacity of data memory

The maximum time available till memory is full depends on memory capacity, type and number of activated channels and on set logging interval. Also on number of stored events from inputs S, SG and S1. Generally, in 128 kB memory is available approximately 120 000 bytes and in 512 kB it is approximately 480 000 bytes. Record of one measurement from counter input (CTU, CTK) occupies 4 bytes, record of event from binary input occupies 9 bytes and record from other inputs occupies 2 bytes. When specifying time of fulfilling memory, we have to know how many bytes of memory occupies one measurement on all activated channels and this we multiply with set logging interval. With dataloggers with activated binary inputs S, SG, S1 recording events, we have to calculate predicted number of events.

*Datalogger with no activated binary inputs has the following approximate time for filling the memory:*

$$t_{max} = 60\,000 * I / (A + 2 * C) \quad \text{for memory 128 kB}$$

$$t_{max} = 240\,000 * I / (A + 2 * C) \quad \text{for memory 512 kB,}$$

where  $A$  is number of activated analog channels (including those, connected to RS input, if any)

$C$  is number of activated counter channels (CTU, CTK – if any)

$I$  is logging interval (1s to 24 h)

### 3.3.3. Cyclic and noncyclic logging mode

Datalogger has two logging modes. If noncyclic mode is selected, after filling memory logging ends (datalogger still measures and evaluates alarms). In case of selected cyclic mode, datalogger after filling memory continues in logging and oldest data are rewritten by newest. In both cases datalogger indicates full memory.

### 3.3.4. Maximum number of digits left and right from decimal point

Storing of measured values is performed in compressed form and the number of digits is limited. Datalogger enables to set such number of digits, if the following condition is matched: if we ignore decimal point in maximum measured value (after user calibration), then result number should be lower than 32 767.

Example: we have an input A0 with recalculation 4mA to  $-30^{\circ}\text{C}$  and 20 mA to  $+80^{\circ}\text{C}$ . If we want to set two digits right from decimal point, the following must be matched  $80\,00 < 32\,768$ . It is matched, then it is possible to set two digits right from decimal point.

## 3.4. Control and indication elements of datalogger

### 3.4.1. Power indication and memory occupation indication

Indication LED diodes are located on the case lid. Green LED marked Power indicates presence of internal power voltage +5V. Red LED marked 100% indicates state of data memory occupation to 100%, yellow LED marked 75% indicates state of data memory over 75%, green LED marked Data indicates state of data memory below 75%. If datalogger operation is correct always two LED diodes shine (Power and one of memory occupation LEDs). Filling memory to 100% is possible to indicate by an internal audio beeper as well.

### 3.4.2. Display and keyboard of dataloggers MS3 and MS4

Display is dual line controllable by means of the keyboard located below. Keyboard has four buttons: MENU, ▲, ▼, ENTER. After connection of datalogger to power first self test of some internal voltages is performed. If all voltages are correct, datalogger starts the basic display mode.

### 3.4.2.1. The basic display mode

On the basic display upper line there is the user specified description of the first activated channel. On the lower line actual measured value is displayed with physical unit or the state of input channel. By ▲,▼ keys is possible to view all activated channels. Error messages can occur instead of measured value. Counter inputs CTU and CTK "measure" always all counter state. This number (max. 7ffffffh is possible to recalculate by multiplying constant k. If k=1, counter state is displayed directly, in other case recalculated state with floating decimal point is displayed. Binary inputs have user specified description on the lower display line, which differs for logic 0 and 1 input levels.

### 3.4.2.2. Functions available from menu on the datalogger MS3 and MS4 display

Enter information and setting menu by pressing MENU key. Keys ▲,▼ enable to view menu item one by one. Press MENU key again to get back to basic display. Items available from menu:

- A) Name (identification) of datalogger – on the upper line is displayed datalogger type and user defined name of datalogger (eight characters). This name is possible to enter from the PC program. Only characters allowed for name of directory (folder) in the computer can be used. On the lower line serial number of datalogger is displayed.
- B) Datalogger address in RS485 network – relevant only, when more dataloggers in network RS485 exist. After pressing ENTER key it is possible to select required address at range of 1 to 31 by means of ▲,▼ keys. Store the value by pressing ENTER key.  
*Note: This setting is enabled only, if the RS232 communication cable is plugged in datalogger, which activates signal CTS, to avoid undesirable change of datalogger setting in RS485 system. Only plugging of cable RS232 in the datalogger connector is sufficient, other side of the cable can stay unplugged – cable has connected RTS-CTS signals.*
- C) Information on actual date in datalogger
- D) Information on actual time in datalogger
- E) Communication speed between datalogger and computer – datalogger can communicate with speed 1200 Bd, 9600 Bd, 19200 Bd, 57600 Bd, 115200 Bd. Pressing ENTER key enables to select desired communication speed by ▲,▼ keys. Store the value by pressing ENTER key. For this setting is valid the same as in note to part B) Datalogger address in RS485 network
- F) Information on logging interval
- G) Information on logging mode – cyclic/noncyclic
- H) Information on data memory size (128/512 kB) and the percentage of its occupation (%)
- I) Information on selftest of internal voltages – for service purpose. First value is of datalogger power voltage, second of -5V (can be at range of -2 V to -6V and third is the state of back-up battery (2.5V to 3.2 V).

### 3.4.2.3. Error messages in basic datalogger display

Following messages can occur in analog input channels :

- A) Error 01 ... input value is below lower limit of range  
*In input A0 the cause can be open current loop, in dc inputs the cause can be reversal of poles on input terminals, in resistance temperature probes the cause can be the short circuit. This message appears, if result value of AD converter is 0.*
- B) Error 02 ... input value is above upper limit of range  
*In input A0 the cause can be the short circuit of current loop, in dc inputs the cause can be overloading, in resistance temperature probes the cause can be broken probe (open circuit). This message appears, if result value of AD converter is 65535.*

- C) Error 03, Error 04 ... writing of user calibration from user program was not successful. It is necessary to repeat writing. If message of recalculation error occurs, check if stored data is correct and if needed reduce number of digits right from decimal point or change the recalculation (see paragraph 3.3.4 Maximum number of digits left and right from decimal point).

In counter inputs CTU and CTK following states can occur:

- A) Error 01 ... internal communication error between datalogger and input module
- B) Error 02 ... error message of counter module. It can indicate module's low battery voltage or data loss due interference. It is recommended to try transfer data from datalogger to the computer, then reset counter by means of user program.
- C) Error D ... input works, value is not possible to display (only with recalculation constant not equal 1).

In channels operated by input RS following states can occur:

- A) Error 01 ... input device sent string >-0000, which means, device is in lower limitation
- B) Error 02 ... input device sent string >+9999, which means, device is in upper limitation
- C) Error 03 ... input device did not response in set time, try to increase waiting time, check the line and its polarity
- D) Error 04 ... CRC error, check if input device sends CRC
- E) Error 05 ... received not valid string
- F) Error 06 ... received number is outside of datalogger range
- G) Error 08 a Error 09 ... internal datalogger error, check all settings

#### 3.4.2.4. Selftest error after datalogger connection to power

If "self test error" message appears on the display upper line after connection of datalogger to power, then some of internal voltages is out of specified limits. If lower line displays symbol **Ucc**, power voltage is too low. Ac/dc adapter cab be damaged or the problem is in datalogger connection. For diagnosing remove terminal block with input signals, disconnect audio indication unit, communication connector and if needed try another ac/dc adapter. In case lower line displays symbol **-5V**, internal negative source is outside of range. Try to eliminate over-voltage on inputs by disconnection of input terminal block. The last possible symbol on the lower line is **bat**. This message appears, if internal back-up battery is low. Battery is necessary to replace by authorized person. Leave self test error message by pressing ENTER key. *Find particular values of voltages in menu (see [3.4.2.2.](#)).*

#### 3.4.3. Audio indication

Datalogger contains internal audio beeper and independent output alarm signal designed for external audio indication or telephone voice dialer. All selections for audio indication are selectable by means of the PC software.

- A) Indication of logging moment – at the moment of logging to memory internal audio beeper shortly beeps. Interval between beeps corresponds to set logging interval.
- B) Indication of filling the memory – after memory occupation to 100% internal audio beeper signals permanently.
- C) Internal alarm indication – only dataloggers MS3 and MS4 – after alarm activation internal audio beeper signals permanently.
- D) External alarm indication – only dataloggers MS3 and MS4 – after alarm activation, voltage on the output ALARM OUT appears.

Notice: Internal and external alarm indication is possible to deactivate by pressing ENTER key on datalogger (if display is in basic mode – in menu it is not enabled). After pressing ENTER

indication is muted. If new alarm occurs (e.g. measured value on the same channel gets back to limits and then exceeds the limits again), audio indication is activated again.

## **4. MOUNTING AND CONNECTION OF DATALOGGER**

### **4.1. Mechanical datalogger location**

Location of datalogger should be in accordance with operating conditions and not allowed manipulations. Operating position of datalogger is with input terminal block towards up. Four wall brackets with screws for wall mounting are included in delivery. Tighten the wall brackets to the case corners and entire datalogger install to vertical flat wall. If dangerous voltages are measured, additional protection of input terminal block is necessary by locating datalogger to a large safety case. Datalogger is not allowed to install in power switchboard. Approximately 0.5m distance from power switchboards is necessary. Also it is not possible to install datalogger near power contactors, motors, frequency converters and other sources of interference.

### **4.2. General principles for wire leads**

Attention should be paid to wire leads and their paths to prevent electromagnetic interference to wires. Also attention should be paid to location of transducers and probes. It is not possible to locate transducers and probes near sources of interference. All wire leads connected to datalogger should be led in internal room (datalogger does not contain protection against atmospheric electricity). Avoid leading the wires in parallel with power lines. Safe distance depends on the intensity of interference field (especially in transient processes), recommended distance is approximately 0.5 m. Avoid also wire connection with other circuitry. Use shielded cable for all signal installation. Recommended is shielded cable SYKIFY n pairs x 0.5. In installation of cables keep the following rules:

1. Avoid ground loops. It concerns both measurement circuits and cables shielding.
2. Do not connect cable shield on the end device side, if the device does not have a terminal for shielding. Shielding should not be connected to metal parts of the device nor other devices (*Hazard of creation of undesirable current loops – do not connect!*). Do not also connect shielding directly to measuring signals. See [appendix 4](#).
3. In case from end device other long shielded cable leads, then connect shielding mutually.
4. On the datalogger side should be a ground terminal connected by strong wire to grounded parts of building or to protection circuit. Connect shielding of all cables leading to datalogger to this terminal. The grounding point of datalogger is located on the housing of power connector – recommended especially in installation with electromagnetic interference hazard.
5. Do not connect shielding of RS232 cable (interface is designed for communication to short distance) to common point, see appendix 5 – cable wiring.

### **4.3. Connection of input signals**

Required parameters of applied wires depends on input type, on outer operating condition and the type of installation. For low current cabling use multi-wire cable SYKIFY n x 0.5, resistance temperature transducer connect with shielded two-wire cable. It is essential to use for each channel separate wire pair (do not create „common wire“ for more channels). Connect input signals to self-clamping WAGO terminals, located on 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 datalogger by pulling it up from the connector.*

There are no common wires for connection of channels with current loop powered from datalogger (inputs A0). All devices inserted to the current loop (panel indicators, measuring computer cards etc.), should be galvanic isolated. In case, it is not possible, use galvanic isolated inputs A1G and external source to power current loops. Wiring of module A0 input circuitry including connection to two-wire transducer is in [appendix 2](#).

For connection of thermocouples use appropriate extension cable. Continuity of material of thermocouple wire should be kept along the line up to datalogger 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

If there are more thermocouple inputs in datalogger 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).

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 – see paragraph 4.2). 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  $0.385 \Omega/^{\circ}\text{C}$ ). Measurement errors due cable resistance or manufacturing sensor tolerance is possible to correct by means of [User calibration](#) in PC program.

For connection of RS485 link for input module RS use e.g. cable SYKFY 2x2x0.5, 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 datalogger itself). Generally: link RS485 is designed for communication up to 1200 m (in internal room, datalogger does not have protection against atmospheric electricity), use for cabling twisted two-wire of nominal impedance  $100 \Omega$ , loop resistance maximum  $240 \Omega$ , max.  $98 \Omega/\text{km}$ , maximum capacity  $65 \text{ pF/m}$ , cross talk between pairs  $-40 \text{ dB}/150 \text{ kHz}$ . 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  $\Omega$  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 $\Omega$ . Termination resistor is possible to leave in short lines.

#### 4.4. Connection of external audio indication unit (MS3, MS4)

External audio indication unit is designed especially for wall mounting. Recommended cable is SKY, maximum length of 100m. Connect ALARM OUT output on datalogger with audio unit with proper polarity. Negative pole of connector CINCH is the outer terminal. Select item External alarm indication in menu Configuration-Audio indication. At the same time it is necessary to have activated Audio indication of all required alarms. If indication controls external devices, it is recommended to set suitable delay of desired alarms to prevent false indication.

Note: This datalogger 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. Datalogger output is not protected against permanent short circuit.

#### 4.5. Connection of output relays of datalogger MS4

Datalogger 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 datalogger 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 datalogger 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, where always the middle from the three terminals is connected to common contact. 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.

#### 4.6. Connection of communication link RS232

Datalogger uses simple or full communication with computer through RS232 serial link. In case datalogger is configured for communication RS232 or RS485, then communication uses wires RxD and TxD referred to GND. In case we select RS232-modem communication, additionally CTS signal is tested for interruption of data transmitting to TxD. Signal RTS of datalogger is active permanently.

Included null-modem cable (see [appendix 5](#) for schematic diagram) is for communication with computer via simple RS232 link (cable connects signals RTS-CTS on datalogger side). Suitable cable is shielded two-wire of 10 meters maximum length. Full communication is used only in communication with a modem.

Note: *If using supplied communication cable RS232 for simple communication and in PC program is set Mode of connection to computer through RS232 (see [part 5.1.5.7 paragraph C](#)), communication should be found always, independently on set communication interface of datalogger or its address or its communication speed.*

For correct and fast communication with the computer is necessary to select suitable communication speed. This is enabled anytime from the PC program or in dataloggers MS3, MS4 from the keyboard (see [part 3.4.2.2. paragraph E](#)). Communication speed of 19200 Bd is set from the manufacturer. This speed is reliable in most applications. If needed to use the highest speed, it is useful to compare data transfer duration with this speed and the speed lower. If the communication speed with respecting transmitting condition is too high, frequent transfer repeating occurs and its duration can be longer than if using lower speed. When using communication through RS232, no connector for communication RS485 should be plugged in datalogger.

Note: *If too high communication speed is selected and datalogger is not able to communicate, then in dataloggers MS3, MS4 decrease the speed from logger keyboard (Attention – it is necessary to connect the communication cable). With MS2 datalogger please do the following steps:*

1. *disconnect communication cable at logger MS2 side, leave PC program in the computer*
2. *disconnect datalogger power and wait 10 seconds*
3. *connect datalogger to power*
4. *run user program*
5. *plug in connector of communication cable to datalogger (other side is connected to the computer)*
6. *Select Configuration – Setting of Communication from the menu and decrease communication speed*

*The above steps are important with MS2 datalogger, because after switching on the power with disconnected communication cable, communication speed of 1200 Bd is set automatically.*

Notice: The PC program supports only communication ports COM1 and COM2.

## 4.7. Connection of communication link RS485

### 4.7.1. Connection at datalogger side and cabling

Dataloggers MS3, MS4 contain the RS485 communication interface. This interface is design for datalogger connection with computer for longer distance (from 10m, to 1200 m maximum, at indoor rooms) or for network of several dataloggers on one communication link. For suitable cable and termination resistor please see paragraph [4.3.](#) for input module RS. Datalogger is equipped with a pair of Canon 9 – female connectors marked RS485. Both connectors are connected in parallel for easy connection of other dataloggers. At pin 1 is + (A) and at pin 9 is – (B) interface RS485 (shielding is possible to connect to pin 5 – it is connected only to adjacent connector). When communication with computer via RS485 is run, no connector for RS232 communication should be connected to datalogger. If datalogger is configured to RS232-modem interface, then communication via RS485 does not work. In this case connect computer with datalogger by RS232 cable and by means of program set this configuration (see [5.1.5.7. part B](#)). Included accessory is K485 connector with 100  $\Omega$  resistor, which enables the link termination (considering facts specifying in part [4.3.](#)). For communication speed setting please see part [4.6.](#) When changing the speed from logger keyboard, it is necessary to plug in RS232 cable (see [3.4.2.2. part B](#)).

Note: *Selection RS232-modem is not preset from manufacturer if datalogger was not configured together with a modem. I.e. new dataloggers are not necessary to configure with above procedure.*

Wiring is available in [Appendix 6](#).

#### 4.7.2. Connection at computer side

For connection of RS485 link to computer an external RS485/RS232 converter with automatic direction switching, type AUT485 5kV is recommended. Converter is powered from included ac/dc adapter 6V DC. Plug this converter to serial computer port COM1/COM2. Connect link from logger to RS485 side with the proper polarity (pins 1 and 2) and interconnect mutually pins 10 and 11. Output of the DC adapter 230V/6V DC should be plugged in converter and adapter itself plugged in mains.

#### 4.7.3. Communication of several dataloggers in RS485 network

In addition to above settings (4.7.1-2 ) a datalogger address is necessary to assign and write it to the list of dataloggers in user program. The simplest solution is setting of loggers' addresses on the display. Each address should be from the range of 1 to 31 (see [3.4.2.2. part B](#)). The adjusted speed of all dataloggers should be identical. Then check connection of RS485 link, run PC program and perform following steps:

1. Select communication via RS485 from program – see part [5.1.5.7. paragraph C](#).
2. Create list of dataloggers by searching – see part [5.1.5.7. paragraph F](#).
3. Each communication with datalogger then starts with selection of desired datalogger from displayed list of dataloggers.

#### 4.8. Connection of datalogger to telephone line via modem

Datalogger enables communication with computer by means of a modem via telephone line. It is necessary to have an external modem at datalogger side and external or internal modem at computer side (including drivers installed). First select proper communication interface of datalogger - RS232-modem, which is done with direct interconnection of computer and datalogger via RS232 interface (see [part 5.1.5.7. B](#)). External modem should be configured to the same communication speed as datalogger, should “pickup the phone” and should have deactivated DTR-DSR loop. Connect the modem with datalogger by a cable, which is the part of the modem (!), connect telephone line and power of the modem. Run user program at computer side and set communication parameters – see [part 5.1.5.7 E](#) Detailed description of steps for external modem ASKEY is specified in [Appendix 7](#).

Note: *Datalogger does not support GSM modems (datalogger does not enable to enter PIN after switched on the power).*

#### 4.9. Connection of phone dialer TD101 to output ALARM OUT.

After alarm activation phone dialer dials specified phone number and plays voice message. Follow instructions of manufacturer of phone dialer in installation. Connection: connect 12V output of ac/dc adapter to terminal marked +12V and GND. ALARM OUT output of datalogger 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.

#### 4.10. Connection of datalogger to power

Datalogger is powered from included ac/dc adapter. First connect connector of adapter to datalogger then plug adapter to mains. In stationary installation ground datalogger (from power connector) - see [Appendix 4](#).

If using power from other supply it is necessary to take into account parameters power input and consumption of datalogger (see [Appendix 1](#)). Some applications require continuous operation even mains power fails. In this use back-up UPS similar as for computers. UPS is also needed if mains is extremely interfered and fluctuating.

## **5. THE PC PROGRAM**

### **5.1. Program for Windows – free included (lite) version**

#### **5.1.1. Program characteristic**

Free program for Windows is designed for computers working under system Windows 95 and later. It enables to use all functions of datalogger.

Limitations: - it does not support graphic processing of data

- it does not support automatic data transfer to computer disk in set intervals
- it does not support program protection with password system

#### **5.1.2. Installation of program**

Insert diskette to diskette drive with program for MS Windows- basic version, disk 1 and run program setup.exe. Installation wizard starts to help with entire installation. Run installed program from selection Start-Programs-Comet-MS\_234.

#### **5.1.3. Menu File**

Menu File contains following selections:

- A) From disk – reading of record file from computer disk.
- B) From datalogger – data transfer from datalogger to computer and its display. After choosing this selection, name of datalogger is read in (see [part 3.4.2.2. A](#)), and name and path of file is offered to create on disk. You are asked, if you want to erase data in datalogger after the transfer to computer. If you use default values, then folder on disk is created (if it does not exist) with name identical with the name of datalogger and new file is created and opened for viewing.  
Note: *Data in files are stored on disk in binary format, which is unique for datalogger and it is not compatible with standard formats. Size of binary file is 140 kB maximum (for data memory of 128 kB) and 530 kB (for data memory of 512 kB).*
- C) Print – selection is active only in data viewing mode. Choose this selection to open a window, where time zone (marked as the beginning and end of print) and to specify measured channels to print (values are preset to entire record length and to all channels). After confirmation Protocol of measurement appears, which is possible to print.
- D) Export – of measured values to format \*.dbf. Choose this selection to open a window, where time zone (marked as the beginning and end of export) and to specify measured channels to export (values are preset to entire record length and to all channels). After confirmation a window opens to enter name and path of file to store (type of file is dbf). Default is the same name and path as the source (msr) file. If the record contains both analog and binary channels, first export of analog followed by binary channels is performed. Selection is active only in data viewing mode.
- E) Setting of the printer – standard printer window from Windows.
- F) End – program end.
- G) List of several files opened before.

#### **5.1.4. Viewing of stored data**

After transferring data from datalogger to the computer or after reading of a stored file from disk, table of recorded values is displayed on the screen. In case record contains both analog and binary channels, two tables are displayed. Tables are possible to view in standard way. Click right mouse button on the table to roll down context menu, which contains following items:

- A) Logging parameters – set logging parameters are displayed, i.e. name and serial number of datalogger, sampling interval, alarm setting of each channels, name and path to data file on computer disk.
- B) Logging interruptions – list of time intervals, where logging was not performed (e.g. due to switched off power of datalogger etc.). Time interval is always described by time of first missing logging and time of first logging after datalogger operation.
- C) Export – see [part 5.1.3. D.](#)
- D) Synchronizing of tables – this selection is active only in case, record from both analog and binary channels exist. If you move in one of tables, other table automatically moves in the same time range.
- E) Statistic data – window with statistic data of analog channels appears, i.e. minimum and maximum value, average value, standard deviation and number of valid measurements for each channel. All values from the beginning to the end of record.

Note: If an *measurement error occurs* (see [part 3.4.2.3](#)), *measured value is replaced by hyphens*.

## 5.1.5. Menu - Configuration

### 5.1.5.1. Information on datalogger

Choose this selection to read configuration data from datalogger and display a window with following data: serial number, name (identification) of datalogger, total memory capacity with percentage ( %) of its occupation, logging interval, logging mode (cyclic-noncyclic), communication port of computer datalogger is connected to (COM1/COM2), communication speed, actual date and time in datalogger, names of all datalogger channels and information which channels are activated for measurement. Press the Setting Button to enter directly the window Setting of logging parameters (see below).

### 5.1.5.2. Setting of logging parameters

Choose this selection to read configuration data from datalogger and display a window to modify following parameters:

- A) logging interval – see [part 3.3.1.](#)
- B) mode of logging - cyclic/noncyclic – see [part 3.3.3.](#)
- C) channels enable/disable – if an input channel is disabled, then it does not work in any mode. If it is enabled, then logging and alarming is in operation.
- D) Setting of date and time in datalogger – click on button Date and time to open a window with system time and date of computer. This is possible to write to datalogger.
- E) Name (identification) of datalogger – maximum length is 8 characters and only valid characters are those for folder (directory) names in computer, because logged data are stored to disk to folder with this name. It also appears on datalogger LCD display (see [part 3.4.2.2. A](#)), in record file, protocol etc.

Notice: *Any modification of those parameters causes the need to erase data stored in datalogger. Before writing modified parameters to datalogger you are noticed to this need. You can of course cancel the writing to transfer data first.*

### 5.1.5.3. Setting of input channels

Choose this selection to read configuration data from datalogger and display a window with information on each input channel in datalogger. In the upper part of window there are buttons with horizontal arrows to move between channels. Structure of pages differs referring to type of input:

- A) analog inputs and channels served by the RS input

**Channel name and decimal point position** - here it is possible to enter channel name (16 characters length), physical unit (6 characters length) and the decimal point position. (maximum number of digits right from decimal point is limited – see part [3.3.4.](#), if incorrect format is entered, program returns recalculation error). Dataloggers MS3, MS44 displays those messages on the LCD display – see part [3.4.2.1.](#)

**Alarm I** and **Alarm II**. (only MS3, MS44) – here it is possible to set alarm limits, hysteresis, audio indication, direction and delay of alarms. Every alarm is possible to set individually. Direction of alarm means, if alarm is activated when limit is overloaded or under loaded. **Hysteresis** avoids instability, if measured value varies tightly near the limit. If alarm is activated (by increasing or decreasing of measured value over alarm limit), then alarm limit is internally corrected of hysteresis value towards non-alarm state, i.e. measured value must bring near to non-alarm state of hysteresis value to deactivate the alarm.

*Example: alarm is set to overloading temperature of 100 °C and hysteresis is set to 1 °C. If temperature increases over 100 °C, alarm is activated. Temperature has to drop below 99 °C to deactivate the alarm.*

**Delay of alarm** is designed for preventing of short or false alarms (see part 4.4. and 4.9.). In case state for alarm reporting occurs, datalogger waits for time of delay and tests if the input is still in alarm state. If the input is in alarm state all time of delay, alarm is activated after delay. Alarm deactivation is instant (with no delay) after measured value gets back to set limits.

**Audio indication** – for each alarm it is possible to switch on/switch off its audio indication. In addition it is necessary to enable internal or external audio indication of alarms (see part [5.1.5.6.](#) , resp. [3.4.3.](#) ).

Note: *Alarm of analog inputs is not possible to switch off directly, deactivation is enabled by setting limits to full-scale values of input module range.*

**Assignment of output relays** (only datalogger MS4) – to each alarm is possible to assign any number of output relays, which close after alarm activation. One relay can be assigned to several alarms at the same time. Relay closes, if at least one of the alarms is active. Mutual interconnection of relay contacts enables controlling in different alarm combinations.

**User calibration** - datalogger enables to recalculate measured value to different value, which is then displayed on datalogger LCD and in computer (recalculation is only linear). This feature is applied most often with e.g. 4-20 mA output transducers or when precise correction of an input is needed. In user calibration two values measured by datalogger and corresponding required values are entered to datalogger. Measured value means value indicated in certain point, required output value means value to be displayed, to be in data table and on the print-out from a printer and in exported file.

*Example: To datalogger 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].*

Note 1: *For maximum accuracy of measurement is useful when the two calibration points are as far as possible from each other. Full-scale points of the measuring range are the optimum.*

Note 2: *The decimal point position for entering of constants for desired values is limited (see part 3.3.4 – desired value has to match the equation even if there are no digits right from decimal point position. The maximum number is 32767).*

Note 3: *If there is no need to correct measured value by user constants follow this procedure: measured value A corresponds value A, measured value B corresponds value B, where A is lower value of full scale range and B is upper value of full scale range of the input module.*

Note 4: *If correction of measurement is needed (e.g. temperature probe), it is necessary for finding measured values to have constants in „no recalculation“ state (see Note 3 above).*

#### B) binary inputs (S, SG, S1)

Name – here it is possible to enter channel name. Maximum name length is 16 characters, specification of state, when input logic signal is at level 0 and 1 (2 x 16 characters). Dataloggers MS3, MS44 display this information on the LCD – see part [3.4.2.1](#).

Alarm I. and Alarm II. – here it is possible to enable alarm reporting and specify, if alarm is active in logic level 0 or logic level 1 on the module input, audio indication and alarm delay. Each alarm is also possible to disable. For audio indication, delay and relay assignment the same rules are valid as for analog inputs.

#### C) counter inputs (CTU, CTK)

Name and decimal point position – here it is possible to enter name of channel with maximum length of 16 characters, physical unit in length of 6 characters and the decimal point position. Dataloggers MS3, MS4 display this information on the LCD – see part [3.4.2.1](#).

Recalculation, filter, and mode – here it is possible to enter recalculation constant (real number) to multiply the number of pulses with. This result is then displayed on the datalogger LCD and in the record. If constant 1 is entered no recalculation is performed and direct counter state is displayed. Recalculation gives reading of measured quantity, e.g. electric current consumption from counted pulses. Filter serves for elimination of undesirable pulse ringing (see part [2.3.27-28](#)). It is also possible to choose absolute counter state (recalculated or not) or counter increments during logging interval.

Note: *If logging of increments is chosen, it is not possible to display absolute counter state in existing file on disk.*

Notice: *Modification of channel setting causes in most case the need to erase logged data in datalogger. Before writing modified parameters to datalogger you are noticed to this need. You can of course cancel the writing to transfer data first.*

#### 5.1.5.4. Erasing data memory of datalogger

Chose this selection and confirm to erase the memory with logged data. Counter states in counter modules are not affected. Memory is erased also after configuration changes of datalogger (if confirmed by the user) and after data transfer to disk, if required by the user.

#### 5.1.5.5. Reset of counter inputs and erasing of memory

Chose this selection to reset counters in counter modules (CTU, CTK) and erase all data memory in datalogger.

### 5.1.5.6. Setting of audio indication

Chose this selection to open a window for all global settings of audio indication, described in part [3.4.3.](#)

### 5.1.5.7. Setting of communication

#### A) Communication speed

Chose this selection to read actual state, saved in datalogger. Selection of different communication speed is enabled and after saving in datalogger new speed is set (see part [2.2.6.](#), [4.6 a 4.7.](#)).

#### B) Setting of datalogger interface

This selection is for setting of communication interface of **datalogger**. First connect datalogger with computer by cable RS232 (*Use included with interconnected loop RTS-CTS, because in this case datalogger always communicates with the computer. If you use cable without interconnected RTS-CTS and datalogger is set to communication RS232-modem, then no communication is enabled. Similarly if you are connected by means of interface RS485 and datalogger is set to RS232-modem, then communication does not work, too*). Then program searches for datalogger, finds out its serial number, name and address for network operation. Confirm to enter a window to set following selections:

- a) RS232 – classic communication for RS232, signal CTS is not tested, its state is indifferent.
- b) RS485 – setting of datalogger is the same as in above paragraph a). In addition it is possible to enter address of datalogger.
- c) RS232-modem – full RS232 communication, datalogger tests in transmitting signal CTS to short term data flow interruption. This selection is necessary to specify in datalogger communication with modem. In this case the link RS485 does not work.

#### C) Connection to computer

This selection enables to set **program** for communication through specified interface.

A window is displayed containing the following items:

- a) RS232 – after choosing this selection program uses universal address (0), when each datalogger communicates independently on entered address. In this setting more than one dataloggers cannot work in RS485 network. If communication is not found, program search for communication ports COM1, COM2 in all speeds consequently.
- b) RS485 – after choosing this selection program uses particular datalogger address (not universal) from the list of connected dataloggers, communication speed and port, which is specified Communication adapter RS485 item of menu (see below). If datalogger of desired address in specified communication speed is not found on specified communication port, no search for communication is performed and communication error is reported.
- c) RS232-modem – before choosing this selection is supposed, datalogger is configured together with external modem and all connections are done (see part [4.8.](#) and [Appendix 7](#)). This selection causes program is referred to modem (internal/external) and if request for communication with datalogger occurs, user is asked to confirm dialing of required number by the modem (if telephone connection is not established yet). After dialing connection is established and communication with datalogger performs similarly as through local



communication port. Parameters of modem and number to dial are specified in Setting of modem (see below).

#### D) Communication adapter RS485

In communication in RS485 network no searching for dataloggers is performed, but it is necessary to specify, to which computer port (COM1/COM2) are dataloggers connected and what is the communication speed of datalogger. In addition item Type of adapter is present to select either automatic direction switching or normal (switching of direction by means of RTS).

*Note: If we the Normal item (switching of direction by means of RTS), then transfer direction is switching directly by the computer. Some configuration of computer can cause problems with communication through RS485 link due to indirect access of software to ports. It can cause undesirable delay in switching direction of communication. Therefore – if the converter RS232/RS485 is connected properly – is recommended to use automatic mode (it concerns converter AUT485. Detailed description is in part [4.7.2.](#) ).*

#### E) Setting of modem

In case datalogger communicates by means of a modem, specification of following data is necessary:

- a) number to dial – enter entire phone number of link datalogger is connected to
- b) frequency/pulse dialing – frequency dialing is recommended.
- c) Serial port - it is possible to select serial port for connection of external modem or serial port for mapping of internal modem in computer (COM1-COM4)
- d) Speed – select communication speed between computer and modem. Newer modems support speed of 115 200 Bd.

*Note: In communication by means of modems 3 different values of communication speed can appear:*

1. datalogger- external modem speed – stored in datalogger
2. modem-modem speed on phone line
3. computer- modem speed

- e) Special modem setting – it is possible to enter AT command, here ATX3.
- f) Hang up after .... minutes of no activity – if connection with datalogger through modems is established, link is through until it is not hung up manually. Here entering of duration is enabled to hang up automatically if no communication occurred during specified time interval.

#### F) List of connected dataloggers

List of dataloggers connected to RS485 link is specified here. If several dataloggers (configured to interface RS485) are connected to RS485 serial link, each has different address and identical communication speed and program is set to RS485 communication, then after selection Search, a window Communication adapter RS485 appears (see part [Communication adapter RS485](#)). Then entire address space is monitored (only on port and speed specified in Communication adapter RS485) and all found dataloggers are listed.

*Note: Address of datalogger is possible to enter manually by clicking on existing line in the list. Confirm the message informing, that direct editing of address was entered. If the line is empty, enter address of datalogger to cell Address RS485. If adding of another datalogger is needed, press the Insert key, which creates a new line. Enter address of datalogger in above described way. Then press the Test button to read*

*data from datalogger of such address. If removing of a datalogger from the list is needed, click once on its name by the mouse to highlight and then click on the Remove button.*

## 5.1.6. Menu Display

### 5.1.6.1. Display

This selection enables to display actual measured values from datalogger. After reading parameters a window with all existing channels appears with actually measured values and physical units. Measured values are cyclically read from datalogger. Refreshing interval is approximately 1 to 3 seconds in accordance with configuration of datalogger.

### 5.1.6.2. Self test

This selection is designed for service and its readings are identical with self test on datalogger LCD (see part [3.4.2.2.1](#)).

## 5.2. Program for Windows – optional version

Optional version of program for Windows is installed in similar way as the basic free version. It contains all functions as the basic version with the addition of graphic display and printing of logged data, of automatic data transfer feature, of color distinction of alarms in table and graph, system protection by passwords etc. Program control and the menu correspond with the basic version. Program has its own manual.

## **6. TROUBLE SHOOTING OF SOME PROBLEMS**

### 6.1. Problems with functionality of datalogger as an entire system

#### 6.1.1. Datalogger 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 datalogger first and then plug adapter in mains. disconnect all signals from datalogger (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 datalogger does not shine:

*Disconnected fuse in datalogger or internal source of +5V. Contact the supplier.*

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

*Program run in datalogger is stopped or datalogger 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 datalogger 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.*

Datalogger LEDs blink chaotically:

*Defective datalogger, extreme interference or input signals are not connected correctly.*

### 6.1.2. Self test errors

are described in part [3.4.2.4. Self test error after connection of datalogger to power](#)

### 6.2. Problems with measured readings

Readings of some inputs are not correct:

*Disconnect all inputs and connect always only one at a time and observe reading on datalogger. If all readings are correct, then check the cabling or input devices (incorrect wiring, undesirable loops).*

Datalogger does not recognize an input channel, even though input is present:

*Check if the input channel is activated in the PC program (see part [5.1.5.1.](#))*

Datalogger time from time irregularly indicates totally incorrect reading:

*Most probably the cause is electromagnetic interference. This effect is typical e.g. with current loop 4 to 20 mA with long leads near to strong interference sources. This effect can cause a short-term activation of alarm. It is necessary to check the cabling, optionally to lead cabling different route or decrease the interference level. Setting of suitable delay of alarm can help (see part [5.1.5.2.](#)). Defective transducer can cause similar behavior.*

Alarm indication of datalogger does not work:

*Check if alarm indication is enabled globally (see part [5.1.5.6](#) ) and for each alarm at the same time (see [5.1.5.2.](#) ). Other reason can be set alarm delay, wait for set delay time for checking alarm. Check furthermore the connection of external audio indication unit.*

Datalogger indicates Error 3 or Error 4 on an analog input:

*In setting channels too many digits right from decimal point were set. Value is too high to be processed by datalogger (see part [5.1.5.3.](#) and [3.3.4.](#) ).*

### 6.3. Problems in communication with computer

Datalogger does not communicate (through RS232 with included cable):

*It is necessary to decide if problem is in datalogger or in computer. Always use included cable RS232 (simple communication) for diagnosis. Most frequent problems can be: too high communication speed( 19200 Bd almost always works), device conflict (even though PC operational system did not recognize it), or e.g. port COM1 interruption is used by internal modem, which is on COM3 (the same is valid for COM2-COM4 pair), or network board is set to the same interruption as desired port COM.*

Datalogger communicates via RS232, but does not via RS485:

*Check cabling first, polarity of link, correct connection of converter RS232/RS485 including the jumper and connection of its power. If there are more dataloggers, let connected in network only one (others disconnect by disconnection of connector) and check communication. If communication works, the cause can be conflict of addresses, different communication speed set on dataloggers in network or short circuit on the link. If tests for communication are not successful set Adapter 485 to automatic switching of direction and check carefully all settings (see part [5.1.5.7.](#)*

*D) as well as settings in program ( [5.1.5.7. C](#) ). Optionally try another communication port.*

#### **6.4. Problems with program**

After program installation some of icons at upper screen part are not visible

*It is necessary to install Internet Explorer version 4.0 or later or run40comupd.exe file from folder Microsoft (on the installation CD or second diskette with program for Windows) to install newer version of system library of Windows (comctl32.dll). This trouble is not relevant with Windows 98 and later versions.*

### **7. RECOMMENDATION FOR OPERATION AND MAINTENANCE**

#### **7.1. Operation of datalogger in various applications**

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

Unsuitable and hazard applications: datalogger 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 datalogger could cause loss on property, it is recommended to amend system of independent indication device to monitor this state and avoid damages. This concerns especially control and indication outputs of dataloggers MS3, MS4. In critical applications it is suitable to power datalogger from backed-up sources (UPS) dimensioned to required operation without mains power. Furthermore critical can be datalogger connection to power itself. *It is not suitable to power both datalogger and critical device – e.g. freezing box – to one fuse. If fuse is disconnected, then neither datalogger 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 datalogger 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 datalogger 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 datalogger 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 datalogger, it is recommended not to erase data.

Alarm delay and hysteresis settings are very important. In MS4 datalogger it is also important to consider contacts state in case of mains failure (relays are in idle state).

#### **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 datalogger 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 performed inside of datalogger, 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. Evaluation of all problems from the last verification
3. Visual inspection of datalogger
4. Functional verification of datalogger (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 datalogger MS4 relay contacts lives
  - D) evaluate internal battery – third value in self test must be at least 2.6 V
5. 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.
6. Visual inspection of transducers for possible interference or water penetration.

Make a verification protocol.

### 7.4. Recommendation for service

Service of datalogger 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.*

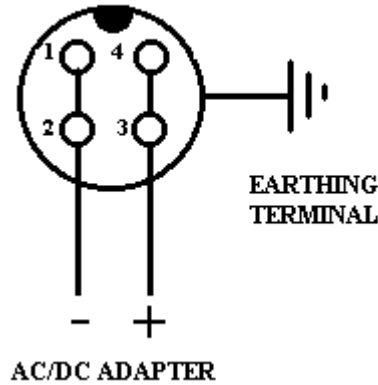
### 7.5. Placing out of operation after end of device life

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

**APPENDIX 1**

**Power input of datalogger**

**1. Wiring of power connector (view of datalogger from outside)**



**2. Power input parameters**

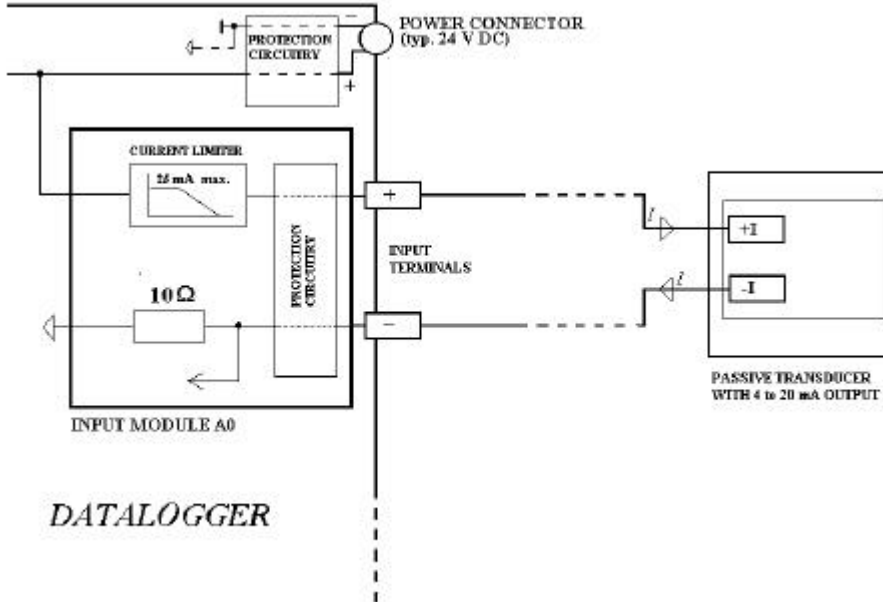
It is possible to power datalogger directly from dc voltage source to input for AC/DC adapter. Types MS2 and MS3 works with power voltage from 9 to 30V DC, MS4 with voltage 24 V DC. In case of not using included ac/dc adapter it is necessary to consider in selection of power voltage, if datalogger has implemented inputs A0. If there are A0 inputs, it is necessary to find out what power voltage requires the transmitter connected to this input and select datalogger power voltage approximately 3V higher then required from transmitter. Current consumption of datalogger depends on the type, input modules, operation mode and power voltage (pulse source). Negative pole of power connector is galvanic connected to internal GND of datalogger, therefore with inputs (if not galvanic isolated) and with external audio indication.

<i>Approximate current consumption of input for AC/DC adapter</i>			
	Power 9 V	Power 12V	Power 24V
MS2 without input modules	approx. 150 mA	approx. 120 mA	approx. 80 mA
MS3 without input modules, all LEDs shine	approx. 250 mA	approx. 200 mA	approx. 110 mA
Input module, galvanic insolated	< 3 mA	< 3 mA	< 3 mA
AC input module, galvanic isolated	approx. 50 mA	approx. 40 mA	approx. 20 mA
Input module A0, short circuited at input	approx. 33 mA	approx. 33 mA	approx. 33 mA
Relay board of MS4, relays closed	---	---	approx. 300 mA

**APPENDIX 2**

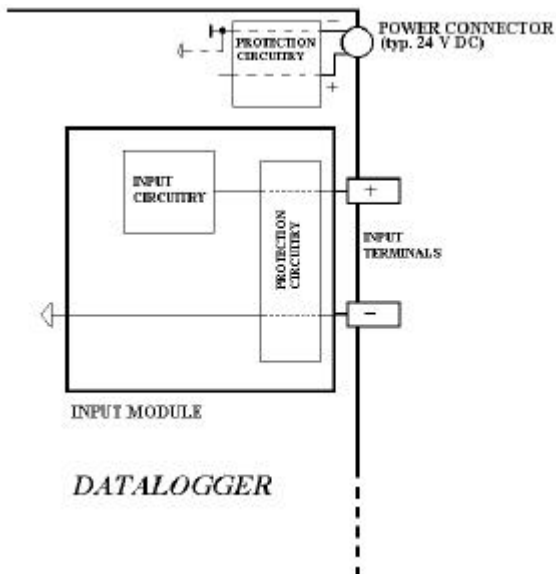
**Input circuitry of datalogger**

**1. Input for two-wire connection of passive transducer - type input A0:**

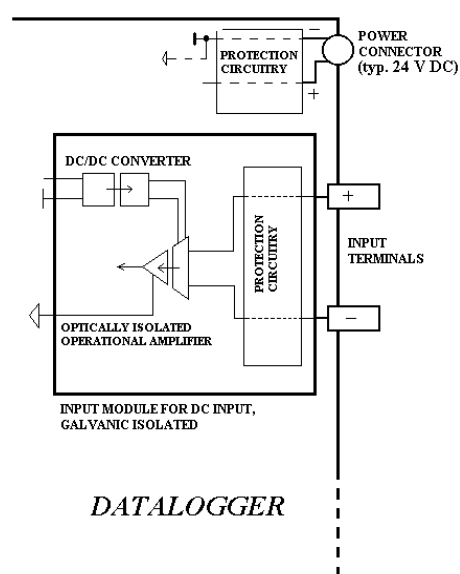


Note: As passive temperature transducers are applicable transducers Comet of range NS5xx, transducers NI-3080, NI-0150, NI-5030, relative humidity transducers of range HG421.xx and combined transducers temperature + RH of range NH421.xx.

**2. Dc inputs, inputs for temperature transducers and resistance measurement**

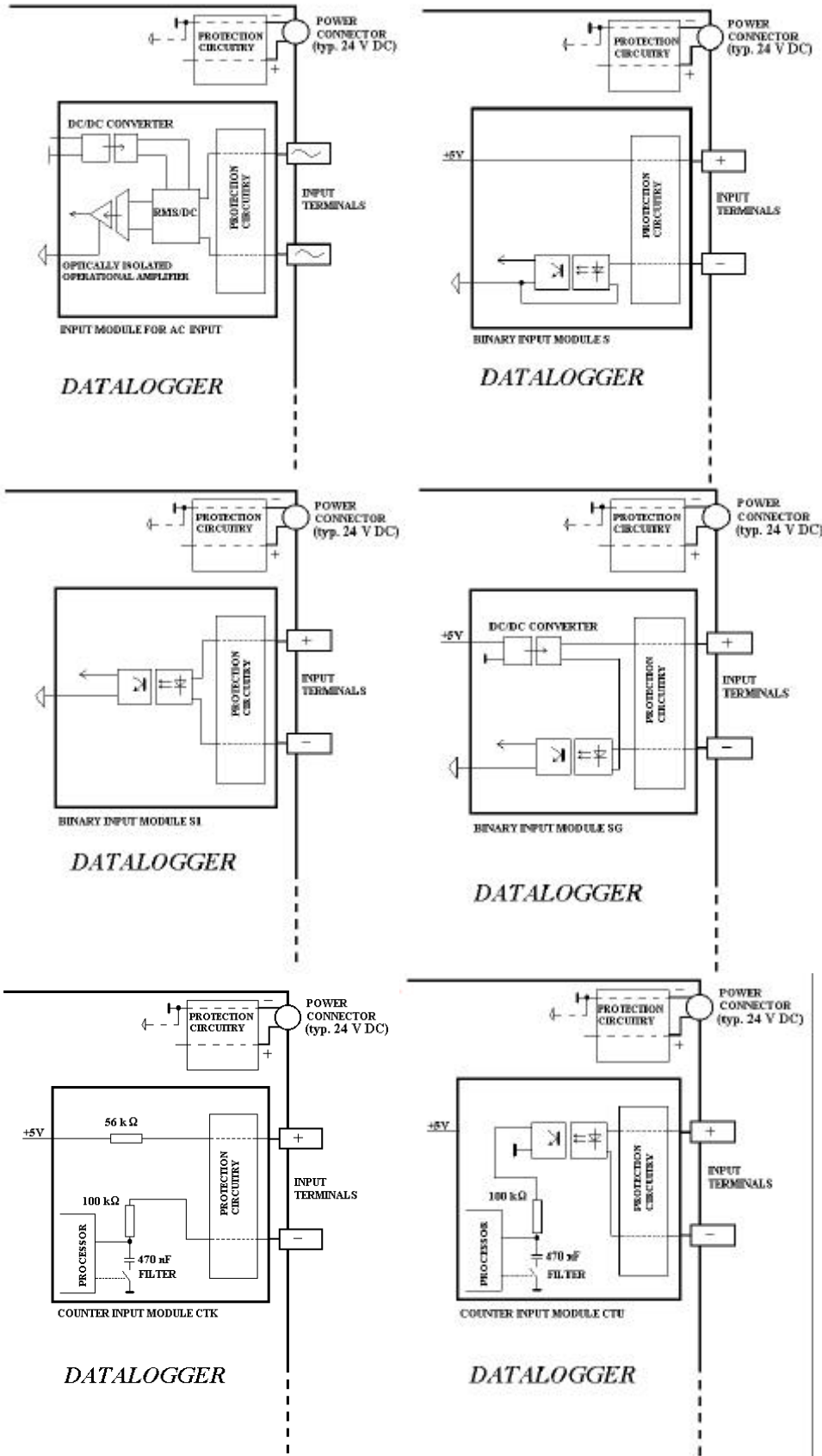


galvanic insolated input



galvanic isolated input

### 3. AC inputs, binary inputs and counter inputs





## APPENDIX 3

### Configuration of RS input

#### 1. Description

Input module is designed for reading values from serial link RS485, from device communicating in ADAM protocol of the Advantech company. It is design for up to 16 measured channels, the real number depends on particular position of this module in datalogger, which is always 16 channel at maximum.

Example: *If the RS module is located at channel 6. position, then link RS485 connected to channel 6. serves for channels 6 to 16. Physical positions of input modules for channels 7 to 16 must remain empty. On channels 1 to 5 any input modules can be applied (except for input RS, because only one RS input can be in datalogger).*

#### 2. Requirements for input device

Input device should support protocol ADVANTECH, valid range of addresses is 1 to 16 (1 to 10hex.), data format „Engineering units“ and check sum. Input device can be single-input or multi-input (up to 8 inputs). Communication speed should be at the range of 1200 Bd, 2400 Bd, 4800 Bd, 9600 Bd or 19200 Bd.

#### 3. Communication protocol

The RS module sends command for reading from input device. Command always contains check sum.

##### Syntax of command:

A) reading from single-input device

#AA (CRC) (cr) *e.g. #0184(cr), accordingly 23h,30h,31h,38h,34h,0Dh  
(CRC=23h+30h+31h=84h)*

where

AA .. address of device (01h..10h)

CRC .. check sum

this command is request for data from device at address 01h

use: single-channel device (e.g. 4011,4012,4013,4014D, Comet N485 etc.)

B) reading from multi-input device

#AA(M)(CRC)(cr) *e.g. #032B8 (cr) accordingly 23h,30h,33h,32h,42h,38h,0Dh  
this command is request for data from device at address 03h from  
channel 02h*

where

AA .. address of device (01h..0Fh)

M .. number of input of this device

use: poly-channel device (e.g. 4017, Comet NH485 etc.)

After sending command module is switched to reception and waits for response. Maximum duration for waiting is possible to set. After the waiting error is reported. Waiting duration for response is adjustable from approximately 28 to 500 ms (see below point 5).

Device response: Module RS supports response format corresponding with "Engineering units" protocol ADVANTECH:

>sxxxx.xxxx(CRC)(cr)

where

s ... sign

x ... digits, maximum number of digits left from decimal point is 11, right from decimal point is 6

(attention to maximum process able number in datalogger.. see below)

*Note: nor decimal point, nor the sign is required (number is considered as positive)*

*Example: >+3456.12345(CRC=66)(cr), accordingly*

*3ch,2bh,33h,34h,35h,36h,2eh,31h,32h,33h,34h,35h,66h.0dh*

*Examples of valid formats: >23(CRC)(cr)*  
*>-234.67(CRC)(cr)*  
*>+3389(CRC)(cr)*

*(CRC)... check sum is the sum of all transmitted bytes before the check sum, transmission is converted to ASCII code.*

*Example: >35 transmitted are following bytes: 23h, 33h, 35h*  
*CRC= 23h+33h+35h=8Bh*  
*therefore is sent >358B(cr) i.e. 23h,33h,35h,38h,42h,0Dh*  
*(cr) ... character 0Dh*

#### 4. Datalogging of data

Datalogger communicates with RS module in command-response mode. I.e. when measurement of particular channel is requested the command is passed to module and waits for its execution. Module converts received data to floating point format (single format). Datalogger consequently evaluates error messages and in case logging interval has come, measured data is stored.

Decimal point position: setting of decimal point position is user selectable. It is not dependent on the position of decimal point position in read device.

*Example: device responses >+12.52 a number of digits right from decimal point in datalogger is set to 3, 12.520 is displayed*

Notice: datalogger is able to process maximum number of 32767 without decimal point. Therefore in our example, if 3 digits right from decimal point are set, the highest recorded number is 32.767 (with the exception of Error 1,2 states) ! In case input device sends higher number, datalogger reports Error 8.

Error messages: error message are indicated on the datalogger LCD and in Display mode. In record there is no information on error type. For detailed specification see paragraph [3.4.2.3](#).

#### 5. Configuration of RS485 network of input devices

Variability of input devices requires to configure the network of input devices one device after another in accordance with individual requirements of devices. Therefore connect network directly to computer and configure it in proper program.

Requirements:- address of input device must be at range of 01h.. 10h (1..16).

- communication speed of 1200, 2400, 4800, **9600**, 19200 Bd
- format of data - "Engineering units"
- activated check sum

After completing the configuration connect the RS485 network to datalogger input (polarity of terminals matches the label).

*Note: It is recommended to work this way: connect first device, connect its jumper INIT and switch on the power. Set address from allowed range, communication speed, check sum and data*

format. Switch off the power, disconnect the INIT jumper, add another device, connect its INIT jumper, switch on the power, set suitable address etc.

## 6. Configuration of datalogger for the RS input

If e.g. the RS module is in position of channel 6, then channels 6 to 16 are reserved for the RS485 network. Datalogger is preset from the manufacturer, that channel number corresponds with the address of input device, i.e. in our example datalogger is able to read from addresses 06h to 10h, single-channel device in communication speed of 9600 Bd. It is possible to set different configuration by means of the PC program from user menu Setting of input channels. Channels controlled by the RS module have additional page Connected device. Following settings are possible:

**Device address (RS485):** enter input device address, which will be controlled by this channel of datalogger. Valid address is from 1 to 16 decimal.

**Multi-input device:** tick this field if connected device measures more quantities (at same address uses protocol syntax accordingly with 3B of this appendix).

**Number of input channel:** relevant only for multi-input device. Number is from 0 to 7 (multiplexer, sub-address) accordingly with 3B of this appendix.

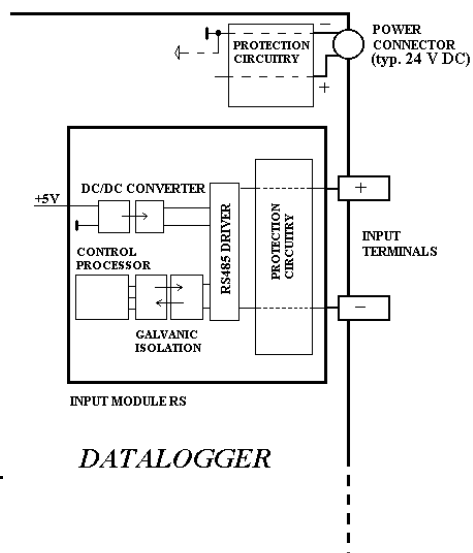
**Maximum waiting duration:** specifies the maximum time for datalogger to wait for response from input device. Error is reported after specified duration. Duration is possible to set up to 500ms. Too short duration can cause, device will not response in time, too long duration prolongs measurement in case transmitter does not response (it is switched off, removed etc). Considering compatibility with analog channels it is useful, device reliably responses to approximately 100 ms. In selection of logging interval 1 second consider, whether measured data can be actual.

**Communication speed:** enter speed through the RS485 link for RS input module. The speed should be identical for all devices connected to the RS485 network (its modification is transferred to all pages for setting of the RS input).

*Example: Dual channel temperature and relative humidity transducer NH485 (address is set to 2, speed 9600Bd) is connected to RS input at the position of datalogger channel 6. Requirement is to measure temperature on channel 8 and RH on channel 9. In PC program set address device 2 at channel 8, tick field Multi-channel and enter Number of input channel 0 (reading of temperature). Set communication speed to 9600Bd, maximum waiting duration to 200ms. On channel 9 set address device 2, tick field Multi-channel and enter Number of input channel 1 (reading of relative humidity, maximum waiting duration to 200ms). Save this configuration.*

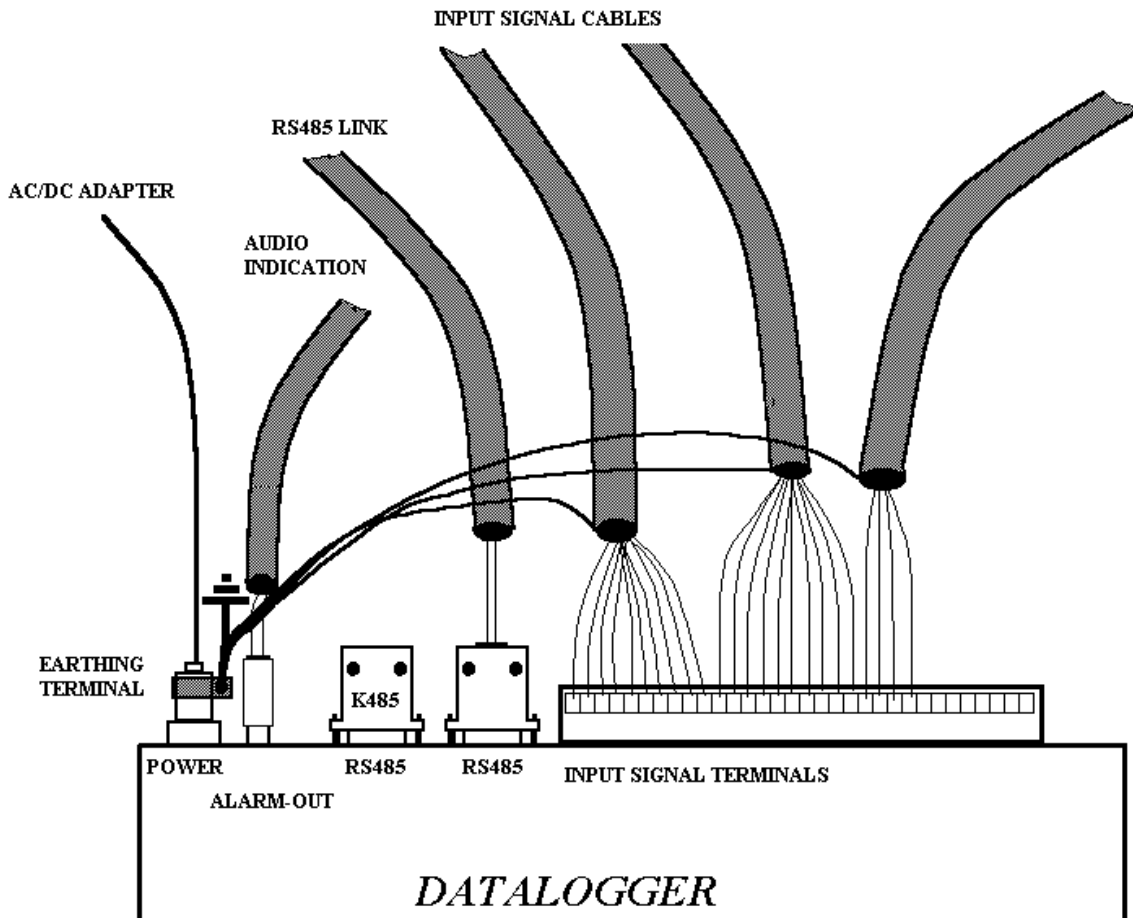
After configuration channels of module RS act identically as analog channels, therefore it is possible to enter description, decimal point position, user calibration, alarms etc.

## 7. Block diagram of RS module



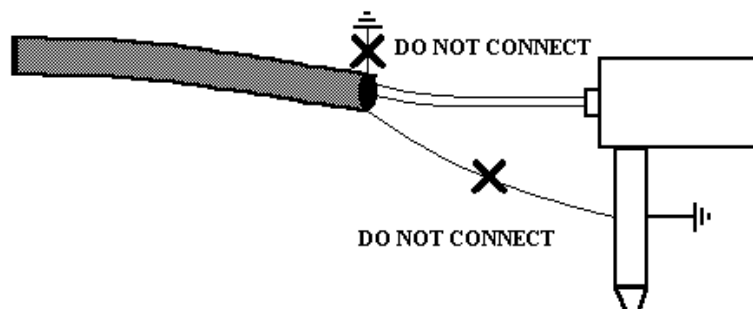
## APPENDIX 4

### Connection of shielding and earthing (recommendation)



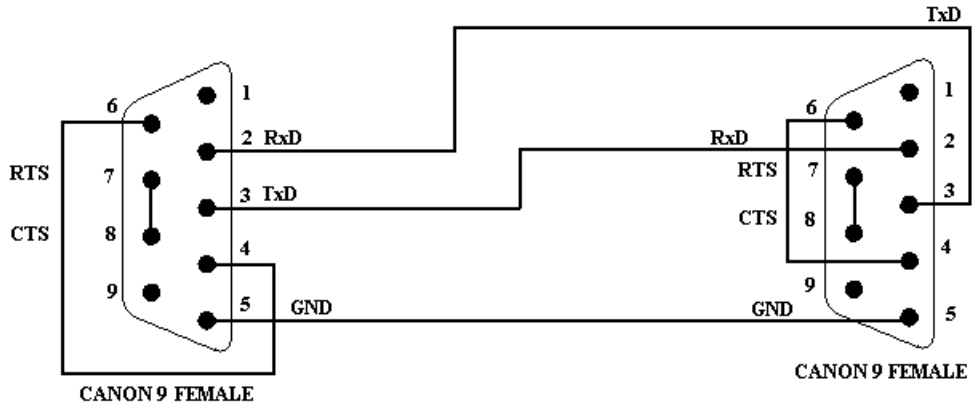
Above example is for stable installation, where there is hazard of electromagnetic disturbance, with RS485 link, audio indication and input signals 4 to 20 mA. K485 is termination resistor of the RS485 link. In communication via RS232 cable shielding should not be connected to earthing terminal, if it is used for connecting of GND of RS232 link.

Connection of opposite end of cables – avoid creation of ground loops:



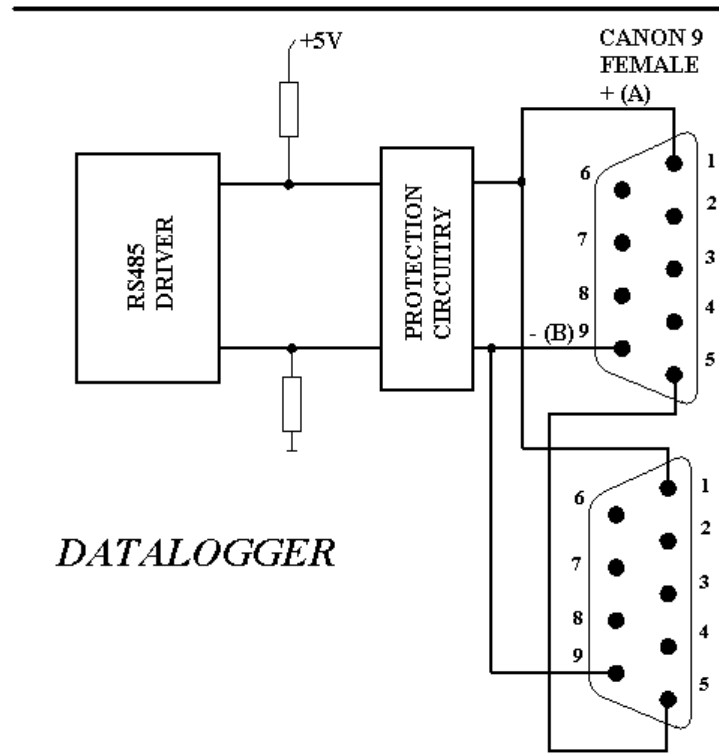
## APPENDIX 5

### Interconnection cable for RS232 serial interface



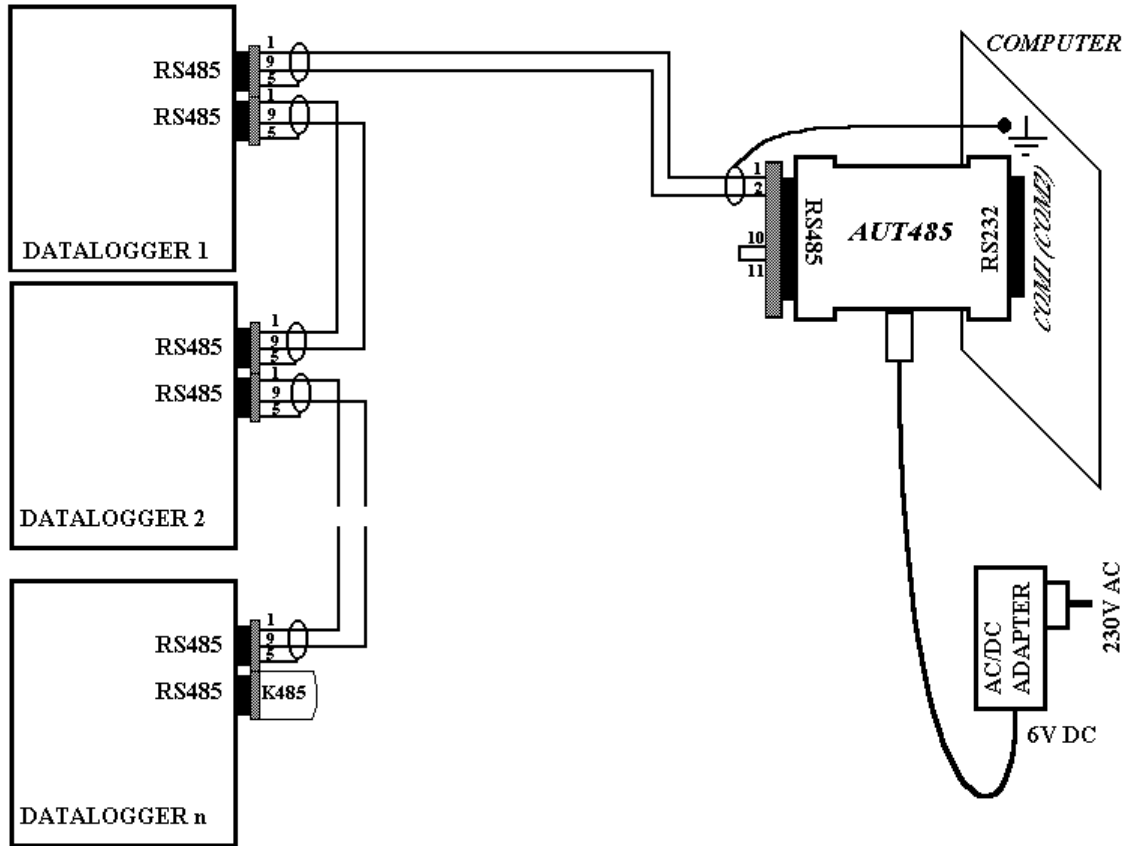
*This communication cable serves for direct connection between datalogger and the computer. In case computer is equipped with Canon 25 pins connector at communication port, use proper adapter (ordinary accessory of computers). This cable is not design for connection of datalogger with external modem.*

*Output circuitry of datalogger for interface RS485:*



## APPENDIX 6

### Connection of the RS485 link



*Connection cables are equipped with Canon 9 – male connectors at datalogger side. Shielding of cables are connected to pins 5 of these connectors (shielding should not be connected to circuitry of serial link nor local earthing terminal). Interconnection of pins 10 and 11 on the Canon 25-female connector corresponds with speed of 115200 Bd. In this configuration no problems in communication on lower speed occurs.*

## APPENDIX 7

### Configuration of datalogger with external modem

#### 1. Configuration of datalogger's communication interface

Connect datalogger via RS232 link to the computer (included cable), switch on and run user PC program. Select from menu *Configuration* item *Setting of communication* and select *Setting of datalogger interface*. After establishing of communication identification data of datalogger are read in. Confirm and enter the window for configuration of datalogger communication port. Choose here selection *RS232 - modem* and confirm. Furthermore check the communication speed of datalogger. 19200 Bd is recommended.

#### 2. Configuration of external modem at datalogger side

Connect modem with computer by a cable, which is the accessory of the modem, plug in the ac/dc adapter and switch on the modem. Run *HyperTerminal* program on your computer (it is located in *Accessory - Communication*). After its running a request of creation of new connection appears. Cancel this request. In menu *File - Parameters* choose in item *Connect by means of* selection *Directly to port COM1* (respectively COM2, if modem is connected to communication port COM2). Choose selection *Configuration* at the same window and set parameters *Number of bits per second* to 19200, *Number of data bits* to 8, *Parity*: no, *Stop-bits*: 1, *Flow control*: hardware. Confirm both windows to return to terminal. Here enter command **AT (cr)** (i.e. enter in upper case letters AT and press the Enter key). Modem must response: **OK**.

Now it is necessary to configure modem itself in the way modem after reception must "hung-up" (disconnect the call) and cancel the control of the DTR-DSR loop. This can be done as follows:

- a) **AT&Y0 cr** (selection of user template 0)
- b) **ATS0=1 cr** (modem „hang-up after the call“)
- c) **ATS23=060 cr** (communication speed 19200 Bd)
- d) **AT&D1 cr** (cancel of testing DTR-DSR loop)
- e) **AT&W0 cr** (saving of active configuration to profile 0)

Now modem is configured and can be switched off. Modem responds **OK** to each commands.

Notice: *Be careful not to send to modem AT command in other communication speed. It could cause modem reconfiguration.*

Note: *Above procedure is verified with external modem Microcom DeskPorte 56k Voice, ASKEY V 1456 VQE R-1 and ORIGO FM-56DT.*

#### 3. Configuration of modem at computer side

Connect modem (if external) to the computer by an accessory cable of modem and switch on

the power. Switch on the computer or restart it. In case modem is not installed, system Windows could run installation wizard.

#### 4. Function verification

Let modem connected to computer (if external) and connect phone line to its LINE input. Connect second modem configured in accordance with point 2 to datalogger to the RS232 connector RS232. Use cable, which is the accessory of modem(!). Connect second phone line to the LINE connector of this modem. Switch on modem and datalogger. Run user program for datalogger. In menu *Configuration – Setting of communication – Mode of connection to computer* select RS232-modem. Furthermore in menu *Configuration – Setting of communication – Setting of modem* check or edit each of the items: *Dialed number*: enter entire phone number of the link datalogger is connected to. In case the telephone exchange supports *Frequency dial*, then use it. Select desired computer port to item *Serial port* modem is connected to. In selection *Speed* choose maximum possible speed of communication between computer and modem (typically 115 200 Bd). Enter **ATX3** to *Special modem setting* item. Resting items serves for setting of automatic hung-up of the call. Try communication with datalogger, e.g. read information on datalogger. After entering this selection a message *Dial number ...?* appears. After confirmation communication between modems is established and required data from datalogger is read in.

#### 5. Trouble shooting

If communication via modems does not work and datalogger itself communicates with computer, first check the proper connections and settings. Pay attention to the cables, which should be the original ones to modems (included cable to datalogger serves only for direct connection between computer and datalogger. If all seems correct try to test communication between two computers. Modem, which was at datalogger side connect to computer 1 and run *HyperTerminal* identically as point 2. Connect modem originally connected to your computer to computer 2 (it supposed it is installed) and run *HyperTerminal* as well. Here establish new connection with phone number of link connected to first modem. By means of modem instruction manual try to create two-direction connection in speed of 19200 Bd. If it is successful note that for correct function with datalogger deactivated DTR-DSR loop is necessary. Save configuration to the modem.

#### 6. Connection of phone dialer

If a phone dialer is connected at the same time with modem, then connect its output link to the PHONE input in modem at datalogger side.