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Instruction for use

021502/07/06

Datalogger DLx-Radiation

with optional Sensor-Interface 9.1755.01.013

V3.01

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CONTENTS

FIGURES:

1 CONSTRUCTION OF THE DATALOGGER

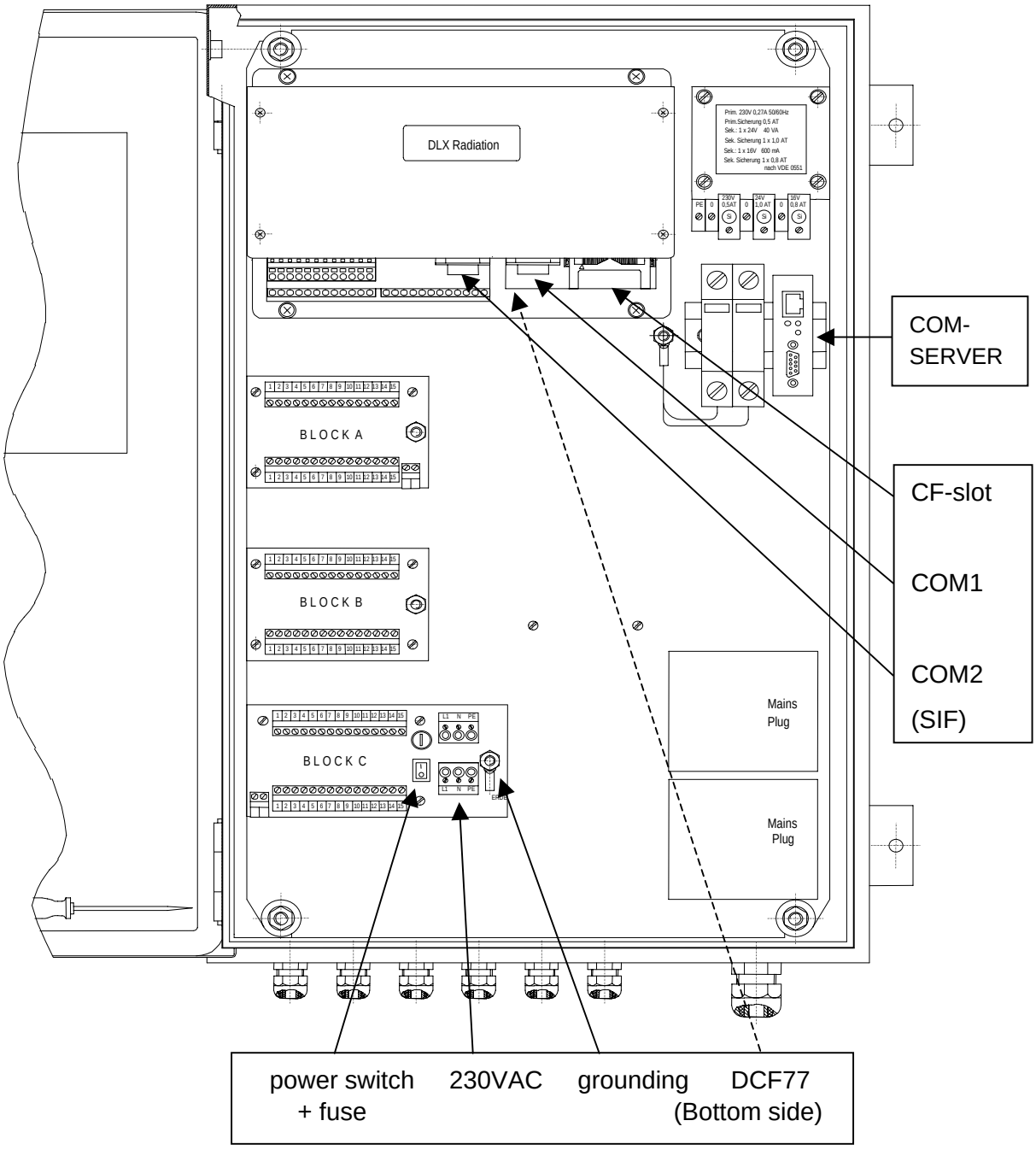


Figure 1: Connections

The datalogger DLx-Radiation is a complete measurement system serving for the acquisition and storing of 13 meteorological parameters (temperature, radiation). Optional measuring of 4 parameters can be done by connecting the so-called Sensor-Interface (SIF, 9.3099.00.001) to the serial interface COM2.The instrument is operated by 230VAC power supply. An additional accumulator serves for bridging in case of power failure.

In order to protect the accumulator against discharging the measurement of the sensors is interrupted in case the voltage is below 10,5 V (thus the current consumption is minimized). Then, the voltage is measured every 5 minutes; when it is higher than 11,0 V the normal measuring routine is continued.

The housing can be locked, is impermeable to jet-water (IP65), and is a very stable construction. For shielding against electromagnetic fields the housing is made of stainless steel. In addition, operation is guaranteed for temperatures ranging from – 30 °C to 70 °C.

The instrument can be easily operated either by means of three keys or via serial interface COM1. The three keys are referred to in the following as"<Δ>", "<∇>"on, and "<ENTER>" (see `Figure 2`). A two-line, alphanumeric liquid crystal display (LCD) serves as indicating instrument.

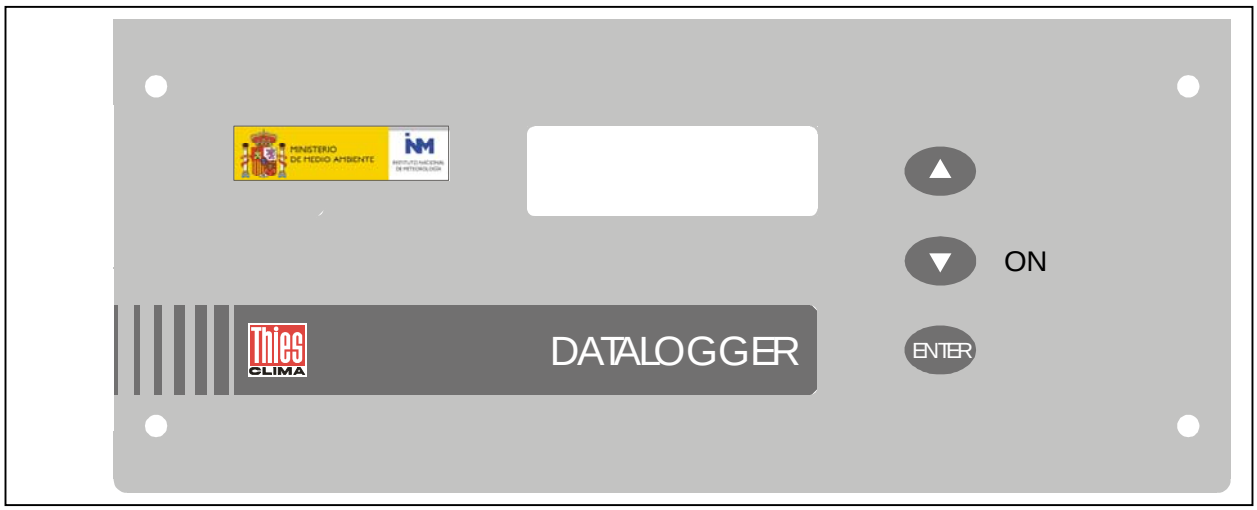


Figure 2: Front view

The scanning of the measuring values is selectable in the range from 1 second to 1 minute, and is controlled through the so-called „**T**rue **S**olar **T**ime“ (abbreviated in the following as “TST”) or the Coordinated Universal Time (“UTC”). The TST-time is depending on the position of the datalogger (degree of longitude), and the day of the year.

For each sensor the scanning, and further processing can be switched on or off separately. The optional sensors connected to the Sensor-Interface are processed if the datalogger receives a telegram over the serial interface COM2.

The measuring values are stored in a memory (CMOS-RAM) with a storing rate of 1 minute (selectable up to 1 hour). This memory is organized as ring memory with a capacity of 1MB. If the capacity of the ring memory is exhausted, the next step is to overwrite the oldest record. The reading-out of the data can be carried out via the serial interface COM1, or via a compact-flash-card.

The contents of the data memory, and the clock-operation are buffered for several hours by means of an integrated energy storage in case of disconnected accumulator. That means, that the stored measuring values, and the time of day are being secured for some time without additional power supply, as well.

There is a so-called switch output available for the supply of an optional GSM-modem; by means of this contact output the modem can be supplied at up to 6 selectable times (local).

It is possible to synchronize the internal time (UTC-time, „Universal Time Coordinated“) automatically by means of a separately connectable DCF77-receiver module.

For checking the sensors or the measuring inputs the datalogger can be turned into the maintenance-mode. While this mode is active the measuring values of the sensor cannot get into the memory. I.e. values detected during the maintenance-mode are displayed usually as raw values, however, are not taken into consideration for the calculation of mean- or extreme values.

1.1 MOUNTING

The datalogger is designed for wall-mounting.

In order to carry out an EMC-compatible installation the cable screen (excepted the supply cable, which is normally not shielded) is to be connected to the contact spring of the screwed cable gland (Figure 3) For wiring plan ref. to chapter 7 WIRING PLAN.

1. With the Standard Contacting (see Figure 3-1**)**

- Strip back the outer sheath and screen (shielding)
- Make a round cut in the outer sheath approx. 15 mm along but do not remove the sheath
- Guide the cable through the cable gland
- Pull off the outer sheath
- Pull back the cable until the connection is made between the cable screen and contact spring
- Turn shut… and it is ready for use!

2. With thin Wires without an Inner Sheath (see Figure 3-2**)**

- Strip back the outer sheath
- Pull back the screen braid approx. 15-20mm over the outer sheath
- Insert the cables into the cable gland until the contact is made between the cable screen and contact spring
- Turn shut ….and it is ready for use!

3. When Routing the Cable Screen to another Connection (see Figure 3-3**)**

- Expose the screen braid approx. 10 mm
- Guide the cable through the cable gland until the connection is made between the cable screen and contact spring
- Turn shut…and it is ready for use!

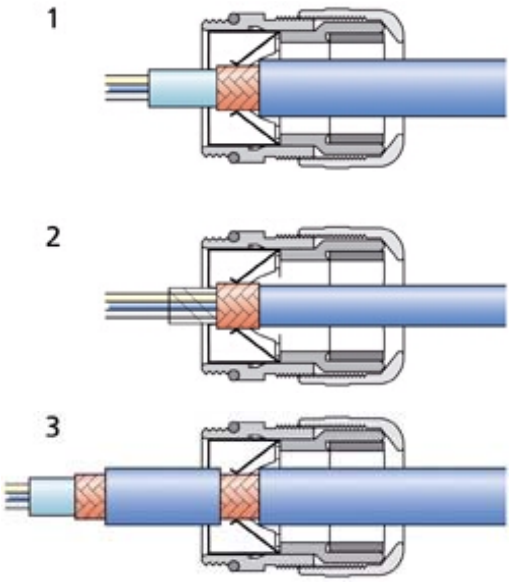


Figure 3: Screen cable connection to the cable gland

Accumulator:

The accumulator is to be connected always. It is absolutely necessary to pay attention to the specified polarity (**red** -> **+** ,**black** -> **-**)!
When replacing the accumulator with active power supply please take care that the red cable has no contact with any part of the housing (danger of short-circuit).
A replacing or loading is necessary at the latest when the indicated accumulator voltage decreases below 9.0V. However, a discharge of the accumulator below 11,0 V should be avoided, as no considerable capacity is available any more. With operation below 10,5 V the life time of the accumulator is reduced considerably! The new accumulator should be newly charged before mounting, because, possibly, it might not have its maximum capacity due to self-discharge (approx. 3 % per month). The stored data are being secured during the replacement. Before disconnecting the accumulator, the data should be secured.
Without accumulator no measurements are being carried out.
In case the accumulator is not connected, a buffer-condenser supplies the data memory and the clock for some hours.

Remark: During the installation please take care that all connections are voltage-free, and that people and/or instruments are not endangered!

Mains Connection:

When the 230V-power supply cable is installed, and connected, a red LED lights at the datalogger between clamps 1 and 2 for the function control of the charging connection. In case the LED does not light, the fuses of 230 V, and 16 V should be checked.

DCF-Active Antenna (9.1760.00.000):

Generally, please take care that the position of the antenna is optimal. It should be aligned horizontally to, and across the direction of the transmitter (situated near Frankfurt/M., N 50° 01', E 09° 00'). The antenna should have a minimum distance of 1m from sources of interference such as power lines, and a 20cm-distance from metal obstacles. For other information on the alignment of the antenna ref. to chap.2.2.5

2 OPERATION

When the accumulator is connected, the datalogger starts automatically with the so-called Bootloader (uploads new Firmware), and re-initializes itself. The Bootloader waits 50 seconds and start the actual Firmware automatically. After the first activation, time and date should be controlled.

2.1 DISPLAY OPTIONS

The display is switched on through the button <∇> (press half a second at the most). The display deactivates itself automatically, if – for 3 minutes – no button was pressed or no signal was sent or received via the serial interface. After the unit has been switched on the station name appears on the display.
The character "*" as first character signifies for the user that it is possible to edit this value or to get more information (ref. chapter 2.2). By pressing the <∇>-button you reach the next indicated value, and get back respectively through button <∆>.
„M“ as first character with the sensor measuring values shows the maintenance operation.

Remark:

The display can be read off up to a minimum temperature of –20°C . For technology reasons, the time until the value appears on the display, is rather long with low temperatures (approx. 10 seconds at –20 °C!).

SEQUENCE OF DISPLAY VALUES:

- Station name
- Degree of longitude
- Date and time (UTC)
- Time (TST, „True Solar Time“)
- DCF77 receiving control
- DCF77 synchronisation
- Switch output-timer
- Status des A/D-converter
- Status EEPROM
- Sensor configuration
- Measuring rate / storing rate
- Measuring Time / Unit Radiation
- Voltage of the accumulator
- Status of power supply
- Baudrate COM1 / CF-Card
- Baudrate COM2
- Mode

- Radiation/Sensor constants [*]:
    1. Global radiation CM21
    2. Diffuse radiation CM21
    3. Direct radiation CH1
    4. UVA radiation
    5. IR radiation CG4
    6. PAR radiation PAR-Lite
    7. UVB radiation

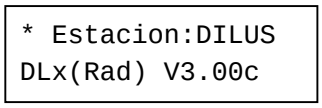
- Sensor measuring values :
    1. Global radiation (Kipp & Zonen CM21)
    2. Temperature (Pt100)
    3. Diffuse radiation (Kipp & Zonen CM21)
    4. Temperature (Pt100)
    5. Direct radiation (Kipp & Zonen CH1)
    6. Temperature (Pt100)
    7. UVA radiation (Yankee)
    8. Temperature (thermistor 44011)
    9. Temperature infrared sensor CG4 (Pt100)
    10. IR radiation (Kipp & Zonen CG4)
    11. PAR radiation (Kipp & Zonen PAR-Lite)
    12. UVB radiation (Yankee)
    13. Temperature (thermistor 44011)
    14. Option SIF: IR radiation 1 (Kipp & Zonen CG4)
    15. Option SIF: Temperature infrared sensor 1 CG4 (Pt100)
    16. Option SIF: IR radiation 2 (Kipp & Zonen CG4)
    17. Option SIF: Temperature infrared sensor 2 CG4 (Pt100)

- Voltage measurement radiation inputs:
    1. Voltage Global voltage CM21
    2. Voltage diffuse voltage CM21
    3. Voltage direct voltage CH1
    4. Voltage UVA voltage
    5. Voltage IR voltage CG4
    6. Voltage PAR voltage PAR-Lite
    7. Voltage UVB voltage
    8. Option SIF: Voltage IR radiation 1 (Kipp & Zonen CG4)
    9. Option SIF: Voltage IR radiation 2 (Kipp & Zonen CG4)

- Data output

[*] The Sensor constants of the two CG4-Radiation-Sensors connected to the Sensor-Interface SIF can be set and read only via the serial interface (see command “SI” , ch. *5.2 FORMAT OF THE COMMANDS (COM1)*)

STATION NAME:

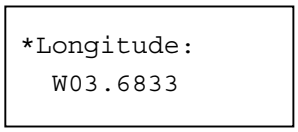


The station name serves to distinguish the data from several stations. The name (here: "DILUS") can comprise up to 5 characters. On the readout, this name is output along with the data via the serial interface. The instrument type(„DLx(Rad)“) and the software version („V3.00a“)are mentioned in the second line.

Language:

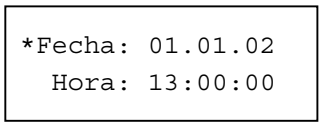
When changing the station name (ref. section *2.2.1 STATION NAME*) the second line turns to the language selection for the display output („language :German“ or „Lengua. : Espanol“); selecting between both modes is possible, then.

DEGREE OF LONGITUDE:



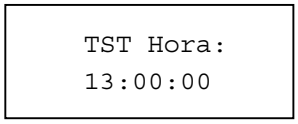
Output of the adjusted decimal longitude of the station (W: West, E: East).
Here: West 3.6833° (Longitude Madrid)

DATE / TIME:



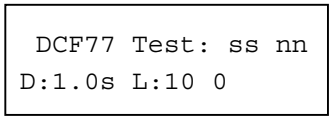
Display of date and time of the logger (UTC).

TST-TIME:

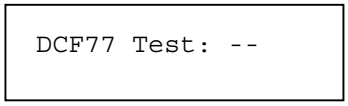


Output of the „**T**rue **S**olar **T**ime“ („TST“).

DCF77 RECEIVING CONTROL:



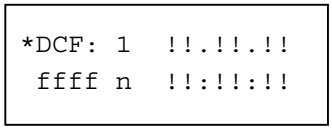
DCF-antenna on



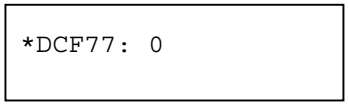
DCF-antenna off

For more information ref. to chapter 2.2.5.

DCF77 SYNCHRONISATION



DCF-antenna on



DCF-antenna off

For more information ref. to chapter *2.2.6 DCF77 SYNCHRONIZATION*

SWITCH OUTPUT TIMER:

*PROG-Timer: X programar	X= 1,2,3,4,5,6	*PROG-Timer: desactivar

Display of the programmed timers for the connection of a consumer load (for ex. GSM-Modem, s.a. chapt. 2.2.4 SWITCH OUTPUT TIMER).

A/D-Converter State (for service purposes only):

```
A/D: OK
```

State:

OK	(A/D converter in order)
Err	(A/D converter defect)

STATE EEPROM:

```
 Estado EEPROM
Usuario:OK DL:OK
```

State of the EEPROM memory (parameter memory for user-settings and balancing values).
In case, “OK” is not displayed here, the instrument might be defect.

SENSOR CONFIGURATION:

```
*Config.Sensor.:
xxxxx xxxxx xxxS
```

X = 0 Sensor switched off **S** = + Sensor-Interface SIF OK
X = 1 Sensor switched on **S** = - No Sensor-Interface detected

Sensor 1...13

Display of the configured measuring channel („1“→ switched on) and the state of the Sensor-Interface SIF (communication is working or not). Measuring channels which are not configured („0“→ switched off) are marked by bars (for ex. „---.-“) in the display and in the output via the serial interface (applies only for sensors connected directly to the datalogger).
The first digit (from the left side) means the 1. measuring value of the sensor (temperature global) the last one means sensor 13 (wind direction).

For more information to change the sensor configuration ref. to chapter *2.2.3 SENSOR CONFIGURATION*

***MEASURING RATE / STORING RATE**:*

```
*Meas.Cyc. 1 sec
 Memory C. 1 min
```

The display shows the set measuring rate (line 1) and the storing rate (line 2).

Setting options **measuring rate**:

1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 seconds (applies only for sensors connected directly to the datalogger)

Setting options **storing rate**:

1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 und 60 minutes

MEASURING TIME / UNIT RADIATION

```
*Meas.Time : TST
 Unit Radiat.: V
```

The display shows the set measuring time (line 1) and the unit of the radiation values for storing (line 2).

Setting options **measuring time:**

TST, UTC

Setting options **unit radiation** for the storing of data:

V, W

V: Voltage W: W/m² (mol/m² for PAR-radiation)

VOLTAGE OF THE ACCUMULATOR:

```
Acumulador:  OK
  12.5 V
```

OK : voltage >11.5 V
!!! voltage 10.6 ... 11.5 V
Low : voltage <10.5 V loading/replacing of the accumulator !
Display of the measured voltage of the accumulator.

Remark:

Analogue measurements at a recorded voltage of below 9V are not accurate! A discharge of the accumulator below 10,5 V should be avoided, as, firstly, no considerable capacity is available any more, and secondly the life time of the accumulator is reduced considerably ! Please replace or charge the accumulator, if "!!!" is displayed. In order to protect the accumulator against further discharge the query of the sensors is interrupted at a voltage of 10.5 V; thus the current consumption is minimized . Then, the voltage is checked every 5 minutes; when it is higher than 11,0 V the normal measuring routine is continued (ref. chap.3).

Status of Power Supply :

```
Tension AC:
     1
```

Display of the state of power supply (1: mains voltage available, 0: no mains voltage).

BAUD RATE (COM1) / CF Card:

```
*Vel.baudios 1:
    9600 Bd 8N1
```

No CF-Card in the slot

Display of baud rate.
Setting options:
300 Bd, 600 Bd, 1200 Bd, 2400 Bd,
4800 Bd, 9600 Bd, 19200 Bd, 38400 Bd,
57600Bd, 115200 Bd

8 data bits, no (none) parity,
1 stop bit

```
SanDisk SDCFB-32
 30.6MB  30934KB
```

CF-Card in the slot of the datalogger

Output of producer name (SanDisk), model (SDCFB32),
the total capacity (unformatted) („30.6MB“),
and the free memory („30934KB“) of the used CF-card.

Remark: indication of the free memory is valid only if there are no directory on the card!

BAUD RATE (COM2)

```
 Vel.baudios 2 :
9600 Bd 8N1
```

Display of the serial interface COM2 (connection to the Sensor-Interface SIF). Setting options are the same like COM1 (see above).

Remark:

To avoid data loss the baudrate of COM2 may be not higher than COM1.

OPERATION MODE:

```
*Modo:
 Normal
```

Display of the selected mode:
„Normal“: normal mode
„Mantenimiento“: Maintenance mode (Measuring values are not stored in the memory)

Remark:

The maintenance mode is stopped automatically when the display is switched off!

SENSOR CONSTANTS:

FOR SENSOR 1: RADIATION CONSTANT PYRANOMETER CM21

```
*Const.Global:
15.0000 uV/W
```

Display of the set radiation constant of the sensor "Pyranometer CM21“. The value to be adjusted is given in the test certificate of the sensor.

Setting range: 4.0000 ... 20.9999 µV/Wm^{-2}

FOR SENSOR 3: RADIATION CONSTANT PYRANOMETER CM21

```
*Const.Diffus:
 15.0000 uV/W
```

Display of the set radiation constant of the sensor "Pyranometer CM21“. The value to be adjusted is given in the test certificate of the sensor.

Setting range: 4.0000 ... 20.9999 µV/Wm^{-2}

FOR SENSOR 5: RADIATION CONSTANT PYRHELIOMETER CH1

```
*Const.Direct:
 11.0000 uV/W
```

Display of the set radiation constant of the sensor "Pyrheliometer CH1“. The value to be adjusted is given in the test certificate of the sensor.

Setting range: 4.0000 ... 20.9999 µV/Wm^{-2}

FOR SENSOR 7: RADIATION CONSTANT PYRANOMETER UVA

```
*Const. UVA:
 28.0400 W/V
```

Display of the set radiation constant of the UVA sensor. The value to be adjusted is given in the test certificate of the sensor.

Setting range: 10.0000 ... 39.9999 Wm^{-2}/V

FOR SENSOR 10: RADIATION CONSTANT PYRGEOMETER CG4

```
*Const. IR:
 11.0000 uV/W
```

Display of the set radiation constant of the sensor “Pyrgeometer CG4”. The value to be adjusted is given in the test certificate of the sensor.

Setting range: 6.0000 ... 16.9999 µV/Wm^{-2}

FOR SENSOR 11: RADIATION CONSTANT PAR-LITE

```
*Const. PAR:
  5.0000 uV/mol
```

Display of the set radiation constant of the PAR sensor “PAR-Lite”. The value to be adjusted is given in the test certificate of the sensor.

Setting range: 3.0000 ... 6.9999 µV/µmol*m^{-2}

FOR SENSOR 12: RADIATION CONSTANT PYRANOMETER UVB

```
*Const. UVB:
  2.0000 W/V
```

Display of the set radiation constant of the UVB sensor. The value to be adjusted is given in the test certificate of the sensor.

Setting range: 0.0000 ... 3.9999 Wm^{-2}/V

SENSOR MEASURING VALUES:

For display, all measuring values are detected, and updated every second.
General error message (exceeding of measuring range or sensor not connected) is the output of „???.?“.
If a sensor is not configured (switched off) „---.-„ is output (applies only for sensors connected directly to the datalogger).
„M“ as first character with the sensor measuring values shows the maintenance operation.

SENSOR 1 Global Radiation CM21:

```
 Global radiac.:
    NNNN W/sm
```

Display of the instantaneously measured global radiation.
Measuring range: 0 ... >1428 W/m^2
Resolution : 1 W/m^2

SENSOR 2 Temperature:

```
 Temperatura Gl:
    NNN.N °C
```

Display of the instantaneously measured temperature (global radiation sensor).
Measuring range: -30 ... 70 °C
Resolution: 0.1 °C

SENSOR 3 Diffuse Radiation CM21:

```
Global radiac.:
   NNNN W/sm
```

Display of the instantaneously measured diffuse radiation.
Measuring range: 0 ... >1428 W/m^2
Resolution : 1 W/m^2

SENSOR 4 Temperature:

```
Temperatura Df:
   NNN.N °C
```

Display of the instantaneously measured temperature (diffuse radiation sensor).
Measuring range: -30 ... 70 °C
Resolution : 0.1 °C

SENSOR 5 Direct Radiation CH1:

```
Direct radiac.:
   NNNN W/sm
```

Display of the instantaneously measured diffuse radiation.
Measuring range: 0 ... >1428 W/m^2
Resolution: 1 W/m^2

SENSOR 6 Temperature:

```
Temperatura Dt:
   NNN.N °C
```

Display of the instantaneously measured temperature (direct radiation sensor).
Measuring range: -30 ... 70 °C
Resolution: 0.1 °C

SENSOR 7 UVA Radiation:

```
UVA radiacion:
   NNN.N W/sm
```

Display of the instantaneously measured UVA radiation.
Measuring range: 0 ... 140 W/m^2 (with sensor constant 28 W/V)
Resolution: 0.1 W/m^2 (with sensor constant 28 W/V)

SENSOR 8 Temperature:

```
TemperaturaUVA:
   NNN.N °C
```

Display of the instantaneously measured temperature (UVA radiation sensor).
Measuring range: -30 ... 70 °C
Resolution: 0.1 °C

SENSOR 9 Temperature CG4:

```
Temperatura IR:
   NNN.N °C
```

Display of the instantaneously measured temperature (direct radiation sensor).
Measuring range: -30 ... 70 °C
Resolution: 0.1 °C

SENSOR 10 IR-Radiation CG4:

```
IR radiacion:
   NNN.N W/sm
```

Display of the instantaneously measured IR radiation. The sensor temperature (sensor 9) is taken into consideration for the own radiation acc. to the sensor manufacturer.
Measuring range: <-235 ... >235 W/m^2 (sensor temperature 0°K)
Resolution: < 0.1 W/m^2

SENSOR 11 PAR Radiation:

```
PAR radiacion:
   NNNN umol
```

Display of the instantaneously measured PAR radiation.
Measuring range: 0 ... >4285 µmol * m^{-2}
Resolution: <1.5 µmol * m^{-2}

SENSOR 12 UVB Radiation:

```
UVB radiacion:
   NNNN mW/sm
```

Display of the instantaneously measured UVB radiation.
Measuring range: 0 ... 9999 mW/m^2 (with sensor constant 2 W/V)
Resolution: 2.5 mW/m^2 (with sensor constant 2 W/V)

SENSOR 13 Temperature:

```
TemperaturaUVB:
   NNN.N °C
```

Display of the instantaneously measured temperature (UVB radiation sensor).
Measuring range: -30 ... 70 °C
Resolution: 0.1 °C

SENSOR 14 SIF IR-Radiation 1 CG4:

```
SIF IR rad. 1:
  NNNN.N W/sm
```

Display of the instantaneously measured IR radiation 1 of the optional Sensor-Interface SIF. The sensor temperature (sensor 15) is taken into consideration for the own radiation acc. to the sensor manufacturer.
Measuring range: see manual SIF
Resolution: see manual SIF

SENSOR 15 SIF Temperature 1:

```
SIF Temp.IR 1:
   NNNN.N °C
```

Display of the instantaneously measured temperature 1 of the optional Sensor-Interface SIF (IR radiation sensor 1).
Measuring range: see manual SIF
Resolution: see manual SIF

SENSOR 16 SIF IR-Radiation 2 CG4:

```
SIF IR rad. 2:
  NNNN.N W/sm
```

Display of the instantaneously measured IR radiation 2 of the optional Sensor-Interface SIF. The sensor temperature (sensor 17) is taken into consideration for the own radiation acc. to the sensor manufacturer.
Measuring range: see manual SIF
Resolution: see manual SIF

SENSOR 17 SIF Temperature 2:

```
SIF Temp.IR 2:
   NNNN.N °C
```

Display of the instantaneously measured temperature 2 of the optional Sensor-Interface SIF (IR radiation sensor 2).
Measuring range: see manual SIF
Resolution: see manual SIF

VOLTAGE MEASUREMENT RADIATION INPUTS:

VOLTAGE 1 Global Radiation CM21:

```
Global radiac.:
   NNNNN uV
```

Display of the instantaneously measured voltage of the global radiation sensor.
Measuring range: 0 ... 30000 µV
Resolution : <3 µV

VOLTAGE 2 Diffuse Radiation CM21:

```
Diffus radiac.:
   NNNNN uV
```

Display of the instantaneously measured voltage des diffuse radiation sensor.
Measuring range: 0 ... 30000 µV
Resolution : <3 µV

VOLTAGE 3 Direct Radiation CH1:

```
Direct radiac.:
   NNNNN uV
```

Display of the instantaneously measured voltage of the direct radiation sensors.
Measuring range: 0 ... 30000 µV
Resolution: <3 µV

VOLTAGE 4 UVA Radiation:

```
UVA radiacion:
    NNNN mV
```

Display of the instantaneously measured voltage of the UVA radiation sensor.
Measuring range: 0 ... 5000 mV
Resolution: 1 mV

VOLTAGE 5 IR Radiation CG4:

```
IR radiacion :
  NNNNN uV
```

Display of the instantaneously measured voltage of the IR radiation sensor.
Measuring range: -4000 ... 4000 µV
Resolution: <2 µV

VOLTAGE 6 PAR Radiation:

```
PAR radiacion:
    NNNN uV
```

Display of the instantaneously measured voltage of the PAR radiation sensor.
Measuring range: 0 ... 30000 µV
Resolution : <3 µV

VOLTAGE 7 UVB Radiation:

```
UVB radiacion:
    NNNN mV
```

Display of the instantaneously measured voltage of the UVB radiation sensor.
Measuring range: 0 ... 5000 mV
Resolution: 1 mV

VOLTAGE 8 SIF IR Radiation 1 CG4:

```
SIF IR rad. 1:
  NNNNN uV
```

Display of the instantaneously measured voltage of the IR radiation 1 sensor of the optional Sensor-Interface SIF.
Measuring range: see manual SIF
Resolution: see manual SIF

VOLTAGE 9 SIF IR Radiation 2 CG4:

```
SIF IR rad. 2:
  NNNNN uV
```

Display of the instantaneously measured voltage of the IR radiation 2 sensor of the optional Sensor-Interface SIF.
Measuring range: see manual SIF
Resolution: see manual SIF

DATA OUTPUT:

```
 Data Output
      ?
```

Starting the data output (ref. chap.5)
If there is no CF-card in the slot, the output is is carried out automatically via the serial interface COM1.

2.2 CHANGING PARAMETERS

All display values which are output with a "*" to top left can be changed.

In order to be able to edit the displayed value, first simply press the <ENTER>-key and then the <∇>-key. The value to be changed is then indicated by the flashing cursor. Now you can release both keys. With the <Δ> key the value can be raised, or decreased with the. <∇> key. If the set value is o.k., simply press the <ENTER>-key again in order to leave the edit mode or to proceed to the next changeable value.

2.2.1 STATION NAME

Station name identifies the measuring station. If several data loggers are in use, then each logger should be given a different name. All letters and digits can be set as well as the underlining "_" and the space key. When the station name is changed in the second line the output language is displayed, and can be selected between „Deutsch“ and „Espanol“ through the arrow key.

2.2.2 DATE

If an invalid date is entered (for example.: 31.4.00), it is corrected automatically.

2.2.3 SENSOR CONFIGURATION

For changing the sensor configuration, it is necessary – after pressing the <ENTER>- and <∇> -key at the same time – to proceed as follows:
The second line is cancelled, and an interrogation mark is output. Afterwards, press the <∇>- and <Δ> -key at the same time for 10 seconds. The „countdown“ is shown on the display. After the „countdown“ has finished you can change the values as usual.

2.2.4 SWITCH OUTPUT TIMER

The timer activates up to 6 daily time slots for an externally connected GSM-modem.
By setting small time slots (for ex. 5 min) the average current consumption of the modem per day (operating current approx. 200 mA) can be kept down.
During a data transmission via a timer-controlled modem, the remaining power-on-time is fixed on 5 min, thus a re-logging-in in case of a failure is guaranteed within this period.
In the edit mode all timers can be set in turn .
Selectable are the daily starting time, and the minimum power-on-period.

```
  TIMER X:HH:MM
ACTIVADO: NN min
```

X = 1,2,3,4,5,6

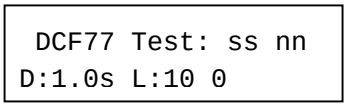
„HH:MM“ indicates the starting time of the respective timer slot in the format hour:min.

The power-on-period is selectable in minute-increments from 5 to 31. When the power-on-time is set to 0, the respective timer is deactivated.

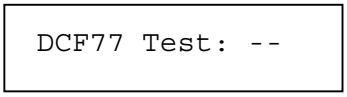
Remark:

The timers are activated even if the discharge-protection for the accumulator is active (voltage
< 10.5V).

2.2.5 DCF77 RECEIVING CONTROL



DCF-antenna on



DCF-antenna off

This display serves for controlling and setting of the DCF77-antennna.

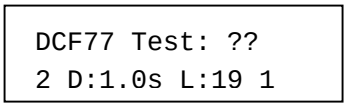
„ss“: indicates the seconds (0-60, with overflow „??“), after the minute mark has been identified

„nn“: cycle counter (0-99) of the received second marks.

„D:D.Ds“: time difference of the second marks in seconds (ideal: 1.0s, except for the second 60 (minute mark): 2.0s)

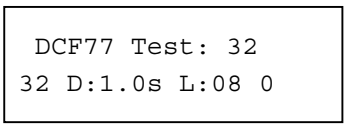
„L:NN B“: length of the second marks in 10ms(NN).
B indicates the binary decoding (L= 6..13[10ms] -> „0“, L= 16...23[10ms] -> „1“, other lengths are output with “?”)

After this output has been activated, the following values appear for example:



The minute mark has not yet been identified („??“). The 2. second mark received has a length of 190 (19*10)ms.
The length of the second mark (optimal: L=10 resp. L=20, the length is shorter with weak reception) is well suited for the optimal alignment of the antenna.

After the minute mark has been recognized (D:2.0s und L: 7...13[10ms]) „ss“ is output and is raised every second up to a maximum of 60. When the reception is correct, “ss” and “nn” run almost synchronously. A difference of more than 1 means, that error pulses or not enough pulses have been received; thus a decoding of the DCF77 time information is impossible.



Remark:

If the reception is very weak in the daytime, the antenna should be aligned at night (broader reach). Never try to align the antenna during sunrise or sunset (position of transmitter and receiver)!
Possibly, there are several alignments (neither horizontal!) allowing a reception (reflections).
The transmitter can be inactive for several hours (thunderstorm close to the sender).

2.2.6 DCF77 SYNCHRONIZATION

```
*DCF: 1  !!.!!.!!
 ffff n  !!:!!:!!
```

DCF-antenna on

```
*DCF77: 0
```

DCF-antenna off

This display serves for switching on and off the DCF-antenna, indicates the last time of synchronization and the manual start of synchronization.

When the DCF-antenna is active, it tries to receive a time telegram at night from 01:30 h (max. 10 minutes) because of the better reception. This time telegram is sent during standard time as CET (“Central European Time”, CET=UTC+1h), and during daylight saving time as CEST (“Central European Summer Time”, CEST=UTC+2h). This time telegram is converted in UTC, and the internal clock is synchronized.

In the edit mode the antenna can be activated and deactivated.

```
*DCF: 1
30.04.02 03:33 s
```

s = 0 CET/standard time

s = 1 CEST/daylight saving time

With active DCF-antenna, and sufficient reception, when you wait approx. 2 minutes or longer, the DCF time telegram is displayed, and the internal clock is synchronized (provided that no error occurs).

Example: Reception of a time telegram (year not yet received)

```
*DCF: 1  30.04.!!
 ffff n  09:06:52
```

ffff = Error display in the hexadecimal (0 means “no error”)

n = 0...9 display of the received second pulses

When the minute mark has been received, the seconds are set to zero

Second 28: reception minute

Second 35: reception hour

Second 41: reception day

Second 49: reception month

Second 57: reception year

3 MEASURING VALUE ACQUISITION

For reasons of current consumption the display, and other control parts are switched off in case that for 3 minutes no button has been pressed, or no data communication has been proceeded.
When the display is on (display mode) all configured channels are scanned every second.
In the pure measuring mode (display off) the configured measuring channels are measured, depending on the set measuring rate (1 second to 1 minute) .
The following figures will make clear the process of the measuring value acquisition:

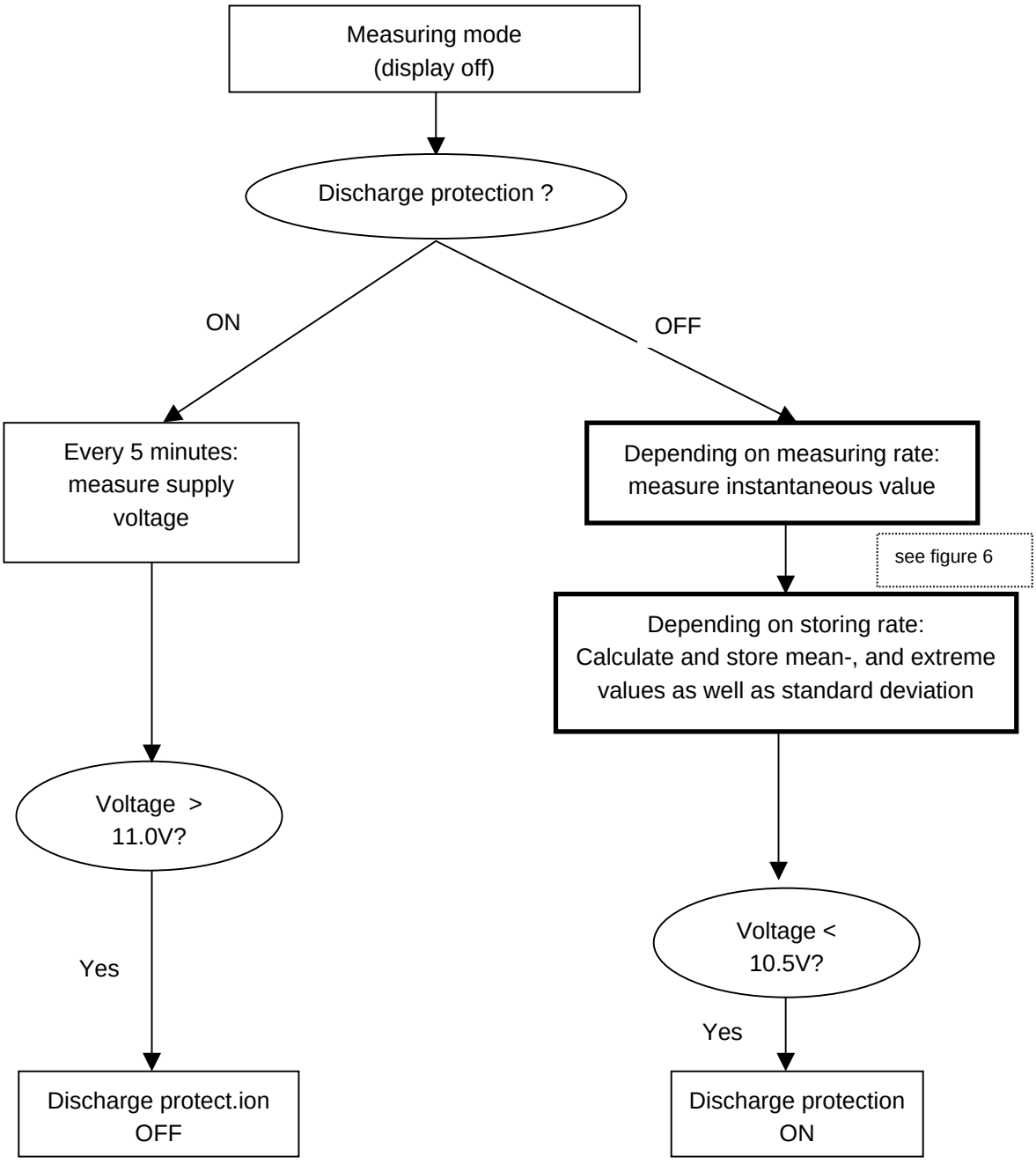


Figure 4: Flow diagram in the measuring mode (display off)

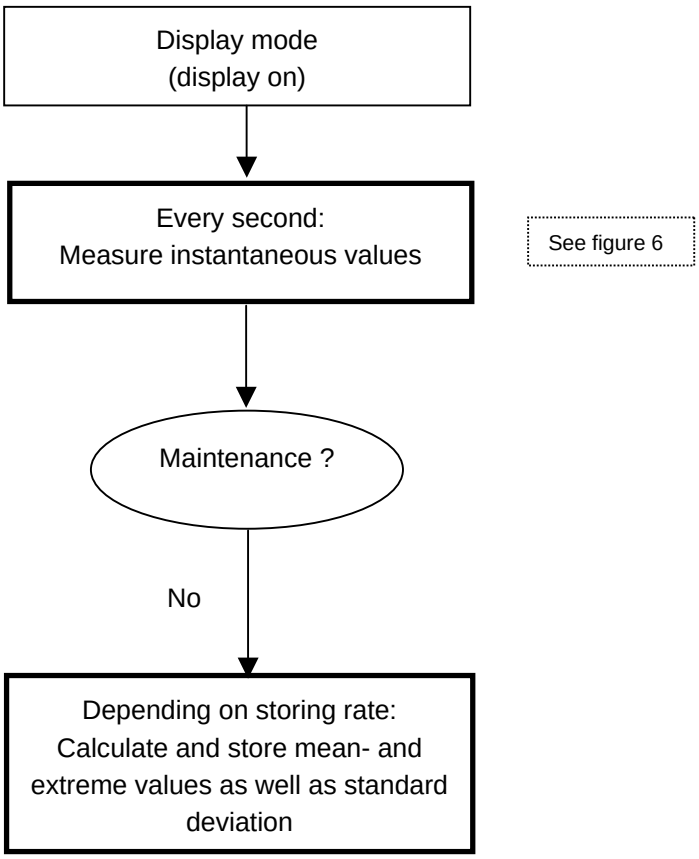


Figure 5: Flow diagram in the display mode (display on)

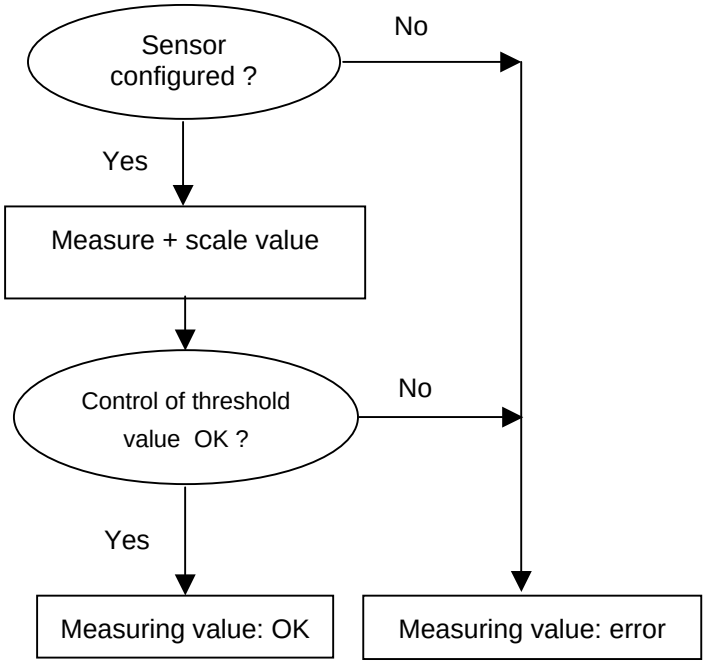


Figure 6: Flow diagram detect raw data (is run for each sensor directly connected to datalogger)

4 CALCULATIONS

4.1 MEANVALUE

The mean value is calculated from the measured instantaneous values x_i acc. to the formula mentioned below:

n: number of measurements

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

4.2 STANDARD DEVIATION

The standard deviation is calculated according to the following formula:

$$s = \sqrt{\frac{1}{n-1}\left(\sum_{i=1}^{n} x_i^2 - n * (\bar{x})^2\right)}$$

4.3 TRUE SOLAR TIME

The true solar time „TST“ is depending on the degree of longitude of the datalogger and day of the year:

TST = Time_UTC – 4min/degree * L_e + E_t

Time_UTC :	time of DLx(UTC)
L_e:	longitude [degree] [west:positive east:negative]
E_t:	correction peak position of the sun [min]

$$E_t = (0,000075 + 0,001868\cos\Gamma - 0,032077\sin\Gamma - 0,014615\cos 2\Gamma - 0,04089\sin 2\Gamma)(229,18)$$

$$\Gamma = \frac{2\pi(d_n - 1)}{365}$$

d_n: day of the year

5 DATA OUTPUT

On principle, there are two interfaces existing at the datalogger for the data output:

- serial (V.24 / RS232) (COM1)
- CF-Card (memory card CompactFlash)

With the serial interface (COM1) it is possible to query the data of the datalogger via a cable or modem from another computer.
The serial data output can be carried out manually or by remote-control.
For the reading out of data you can use a usual terminal program (for ex. “Terminal” of WINDOWS).
The serially transmitted data are output as ASCII-files (clear text). Thus, you are in a position, to see your data records with word processors, as well, to process them and to print them out. Herewith, you are also in a position to follow up your data via the ASCII-interface with standard-software such as spread sheet, data bases etc.

The data written on the CF-card are saved as binary TDF-file (“Thies Data File”), and can be converted through a respective software. We recommend to format the CF-Card with the highest possible cluster size (FAT16) to get the maximum output speed.

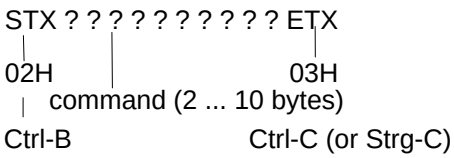
5.1 CONNECTING CABLE OF THE SERIAL INTERFACE (COM1)

The serial interface COM1 is designed as “three-wire”-connection. The transmission line (TxD) and the receiving line (RxD) are to be crossed in the cable.

PC/TERMINAL	DLx
Sub-D25 (25 pins)	Sub- D9
TxD 2 ———	2
RxD 3 ———	3
Ground 7 ———	5
Sub-D9	
RxD 2	2
TxD 3	3
Ground 5 ———	5

5.2 FORMAT OF THE COMMANDS (COM1)

The commands are existing of 4 up to 12 bytes:



LIST OF THE COMMANDS:

"HH"	Help: indicates the list of entering commands
“PD“	Turn DLx into “powerdown” (display off, Measuring-Mode)
“RS”	Reset of the DLx. Start of Bootloader
„CC“<10..19>	Set baud rate COM1 10:300Bd 15:9600Bd 19:115200Bd
“TT”<0,1>	Setting of measuring time 0:UTC 1:TST
“UR”<0,1>	Setting of unit radiation 0:Watt 1:Volt
„MT“<1,2,3,4,5,6,10,12,15, 20,30,60>	Set measuring rate in seconds
„ST“<1,2,3,4,5,6,10,12,15, 20,30,60>	Set storing rate in minutes
„SM“	Output of the stored measuring values
„GM“	Total measuring value memory: Reasonable only, when the logger has re-initialized itself, in order to save data which have not been overwritten
"tm"<DdMoYy>	Stored data of one day (TST or UTC) (Description parameter see the following line)
„dm“<DdMoYyHhMi>	Output stored data from a specific date (TST or UTC, depends on actual setting): Dd:day, Mo:month, Yy:year w/o century, Hh:hour, Mi:minute Example: STX“dm0103041200“ETX Data from 1.03.2004 12:00 (TST or UTC) are required.
"EP"	Output of EEPROM-data (parameter memory) for service purposes
"LL"	Logger status: Output station name, longitude, date and time (UTC/TST), state of the AD-transducer, sensor configuration, voltage of the accumulator, state of power supply, radiation constants, EEPROM-status, operation mode, contact output-Timer, last DCF-synchronisation time and appropriate logger time
"MM"	Instant. meas. values: output with sensor description (multiline)
"mm"	Instant. meas. values: output as single-line data record (sequence as in the display output)
"DD"	Output Logger-date
"DT"<1..31>	Entering day: Setting of day for the logger-clock

	Response: entered day, logger date
"DM"<1..12>	Entering month: setting of month for the logger-clock Response: entered month, logger date
"DJ"<0..99>	Entering year: setting of year for logger-clock Response: entered year, logger date
"ZZ"	output logger-time
"ZH"<0..23>	Entering hour: entering of hour for the logger-clock(UTC) Response: entered hour, logger-time
"ZM" <0..59>	Entering minute: entering of minute for the logger-clock(UTC). The second is set to zero. Response: entered minute, logger-time
„ZS“ <0..59>	Entering second: setting of second for the logger-clock. Response: entered second, logger time
"XX"	Output of the station name, instrument type, and software-version.
„XXn“<AAAAA>	Entering station name
„LK“<W,E><NN.NNNN>	Enter longitude in degree decimal west (W) or east (E).
„SK“<1..7>’ ’<NN.NNNN>	Enter radiation constants 1 to 7 (sequence like display output)
“KK“<01..13>’ ’<0,1>	Entering sensor configuration of a sensor (ref. also chap.2.1) <01..13> sensor number <0,1> 0 -> switch off 1 -> switch on Ex..: STX “KK02_1“ETX (switch on sensor 2)
“FF“	Output of all switch-output timers
“FS“<1..6><HH><MM><LL>	Setting of a switch output-timer: <1..6> timer number, <HH> starting hour, <MM> starting minute, <LL> power-on time in minutes Ex.: STX“FS2083005“ETX (timer 2, start at 08:30 h, time: 5 minutes)
“SI” <??????????>	Transparent Gateway / Bridge command to COM2 (Sensor-Interface SIF). The command <??????????> (up to 10 signs) is send to COM2 and the answer is given back. Example: STX “SI**SK1:10.123**” ETX -> The constant 1 is set to 10.123 (command to SIF marked in bold) Note: see manual of SIF for commands or send STX “SIHH” ETX to get help.
CR LF"?"CR LF	Response in case of unknown command or erroneous parameter

ADDITIONAL CHARACTERS AND THEIR MEANING:

STX (02H)	Start of command
ETX (03H)	End of command
EOT (04H)	End of memory output by the commands: "SM", "GM", "tm", "dm"
XON (011H)	Software-Handshake (continue output)
XOFF (013H)	Software-Handshake (stop output; max. 3 minutes, otherwise the logger turns itself off!)

5.3 SERIAL DATAFORMAT

The data are output in one line with variable telegram length. Separator is the semicolon. Lines are concluded with "CR LF". All values are output with a leading zero. Decimal separator is the point. Erroneous values are marked by one or several "?".
Sensors, which are not selected, are not output (identifiable via P1 to P13, characters 56 to 68 ,applies only for sensors connected directly to the datalogger).

Only if a Sensor-Interface SIF is connected to the serial port COM2 of the datalogger the additional values are given out.

Depending on the setting of “Unit Radiation” exist two output formats (separation is sign number 76/77:

“11” for Watt and “99” for Voltage).

Remark

The stamp of date and time (TST or UTC) refers to the end of the measurement.

5.3.1 Watt-Data line (W)

Sign Number	Len	Abbreviation	Explanation	Sensor
1	5	IIIII	Station name (alphanumeric)	
6	1	";"		
7	8	Dpp.pppp	Longitude (D: W/E [west/east] pp.pppp[degree]) (Example: "W01.3415")	
15	1	";"		
16	8	dd-mm-aa	Datestamp (UTC-Time/Time of Datalogger) “day-month-year”	
24	1	";"		
25	3	ddd	Day of year / Julian Day (1-366)	
28	1	";"		
29	8	hh:mm:ss	Timestamp (UTC-Time/Time of Datalogger) “hour:minute:second”	
37	1	";"		
38	8	dd-mm-aa	Datestamp (True Solar Time) “day-month-year”	
46	1	";"		
47	8	hh:mm:ss	Timestamp (True Solar Time) “hour:minute:second”	
55	1	";"		
56	1	P1	Sensor selected (1) or not (0): Global radiation (CM21)	Value: 1 or 0
57	1	P2	Sensor selected (1) or not (0): Temperature (Pt100)	
58	1	P3	Sensor selected (1) or not (0): Diffuse radiation (CM21)	
59	1	P4	Sensor selected (1) or not (0): Temperature (Pt100)	
60	1	P5	Sensor selected (1) or not (0): Direct radiation (CH1)	
61	1	P6	Sensor selected (1) or not (0): Temperature (Pt100)	
62	1	P7	Sensor selected (1) or not (0): UV-A radiation (UVA-1)	
63	1	P8	Sensor selected (1) or not (0): Temperature (Thermistor)	
64	1	P9	Sensor selected (1) or not (0): Temperature CG4 Housing (Pt100)	
65	1	P10	Sensor selected (1) or not (0): Infrared radiation (CG4)	
66	1	P11	Sensor selected (1) or not (0):Photosynthetically active radiation (PAR-Lite)	
67	1	P12	Sensor selected (1) or not (0): UV-B radiation (UVB-1)	
68	1	P13	Sensor selected (1) or not (0): Temperature (Thermistor)	
69	1	";"		
70	2	“ss”	Measuring cycle [sec] : 1/2/3/4/5/6/10/12/15/20/30/60 seconds	
72	1	";"		
73	2	“mm”	Memory cycle [min] : 1/2/3/4/5/6/10/12/15/20/30/60 minutes	

75	1	";"		
76	2	“11”	Identifier for Radiation W/m² Output	
78	1	“;”		
79	4	"rrrr"	Mean value radiation [W/m²]	Global radiation
83	1	";"		P1=1
84	4	"rrrr"	Minimum value radiation [W/m²]	
88	1	";"		
89	4	"rrrr"	Maximum value radiation [W/m²]	
93	1	";"		
97	4	"rrrr"	Standard deviation radiation [W/m²]	
98	1	";"		
99	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
104	1	";"		P2=1
105	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
110	1	";"		
111	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
116	1	";"		
117	4	"rrrr"	Mean value radiation [W/m²]	Diffuse radiation
121	1	";"		P3=1
122	4	"rrrr"	Minimum value radiation [W/m²]	
126	1	";"		
127	4	"rrrr"	Maximum value radiation [W/m²]	
131	1	";"		
132	4	"rrrr"	Standard deviation radiation [W/m²]	
136	1	";"		
137	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
142	1	";"		P4=1
143	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
148	1	";"		
149	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
154	1	";"		
155	4	"rrrr"	Mean value radiation [W/m²]	Direct radiation
159	1	";"		P5=1
160	4	"rrrr"	Minimum value radiation [W/m²]	
164	1	";"		
165	4	"rrrr"	Maximum value radiation [W/m²]	

169	1	";"		
170	4	"rrrr"	Standard deviation radiation [W/m²]	
174	1	";"		
175	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
180	1	";"		P6=1
181	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
186	1	";"		
187	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
192	1	";"		
193	5	"rrr.r"	Mean value radiation [W/m²]	UV-A radiation
198	1	";"		P7=1
199	5	"rrr.r"	Minimum value radiation [W/m²]	
204	1	";"		
205	5	"rrr.r"	Maximum value radiation [W/m²]	
210	1	";"		
211	5	"rrr.r"	Standard deviation radiation [W/m²]	
216	1	";"		
217	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
222	1	";"		P8=1
223	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
228	1	";"		
229	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
234	1	";"		
235	5	"+tt.t"/"-tt.t"	Mean value temperature CG4 [°C]	Temperature CG4
240	1	";"		P9=1
241	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
246	1	";"		
247	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
252	1	";"		
253	6	"+rrr.r"/"-rrr.r"	Mean value radiation [W/m²]	Infrared radiation
259	1	";"		P10=1
260	6	"+rrr.r"/"-rrr.r"	Minimum value radiation [W/m²]	
266	1	";"		
267	6	"+rrr.r"/"-rrr.r"	Maximum value radiation [W/m²]	
273	1	";"		
274	5	"rrr.r"/"rrr.r"	Standard deviation radiation [W/m²]	

279	1	";"		
280	4	"rrrr"	mean value radiation [mol/m²]	PAR radiation
284	1	";"		P11=1
285	4	"rrrr"	Minimum value radiation [mol/m²]	
289	1	";"		
290	4	"rrrr"	Maximum value radiation [mol/m²]	
294	1	";"		
295	4	"rrrr"	Standard deviation radiation [mol/m²]	
299	1	";"		
300	4	"rrrr"	Mean value radiation [mW/m²]	UV-B radiation
304	1	";"		P12=1
305	4	"rrrr"	Minimum value radiation [mW/m²]	
309	1	";"		
310	4	"rrrr"	Maximum value radiation [mW/m²]	
314	1	";"		
315	4	"rrrr"	Standard deviation radiation [mW/m²]	
319	1	";"		
320	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
325	1	";"		P13=1
326	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
331	1	";"		
332	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
337	1	";"		
338	1	“P”	Mains Power Status yes/no (1/0)	Mains (1/0)
339	1	";"		
340	4	“bb.m”	Minimal battery voltage [V]	Battery
344	1	";"		
345	6	"+rrr.r"/"-rrr.r"	Mean value radiation [W/m²]	Infrared radiation
351	1	";"		CG4 Sensor 1
352	6	"+rrr.r"/"-rrr.r"	Minimum value radiation [W/m²]	Sensor-Interface
358	1	";"		
359	6	"+rrr.r"/"-rrr.r"	Maximum value radiation [W/m²]	
365	1	";"		
366	5	"rrr.r"/"rrr.r"	Standard deviation radiation [W/m²]	
371	1	";"		
372	5	"+tt.t"/"-tt.t"	Mean value temperature CG4 [°C]	Temperature CG4

377	1	";"		Sensor 1
378	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	Sensor- Interface
383	1	";"		
384	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
389	1	";"		
390	6	"+rrr.r"/"-rrr.r"	Mean value radiation [W/m²]	Infrared radiation
396	1	";"		CG4 Sensor 2
397	6	"+rrr.r"/"-rrr.r"	Minimum value radiation [W/m²]	Sensor-Interface
403	1	";"		
404	6	"+rrr.r"/"-rrr.r"	Maximum value radiation [W/m²]	
410	1	";"		
411	5	"rrr.r"/"rrr.r"	Standard deviation radiation [W/m²]	
416	1	";"		
417	5	"+tt.t"/"-tt.t"	Mean value temperature CG4 [°C]	Temperature CG4
422	1	";"		Sensor 2
423	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	Sensor-Interface
428	1	";"		
429	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
434	1	";"		
435	1	CR		
436	1	LF		

5.3.2 Voltage-Data line (V)

Sign Number	Len	Abbreviation	Explanation	Sensor
1	5	IIIII	Station name (alphanumeric)	
6	1	";"		
7	8	Dpp.pppp	Longitude (D: W/E [west/east] pp.pppp[degree]) (Example: "W01.3415")	
15	1	";"		
16	8	dd-mm-aa	Datestamp (UTC-Time/Time of Datalogger) “day-month-year”	
24	1	";"		
25	3	ddd	Day of year / Julian Day (1-366)	
28	1	";"		
29	8	hh:mm:ss	Timestamp (UTC-Time/Time of Datalogger) “hour:minute:second”	
37	1	";"		
38	8	dd-mm-aa	Datestamp (True Solar Time) “day-month-year”	
46	1	";"		
47	8	hh:mm:ss	Timestamp (True Solar Time) “hour:minute:second”	
55	1	";"		
56	1	P1	Sensor selected (1) or not (0): Global radiation (CM21)	Value: 1 or 0
57	1	P2	Sensor selected (1) or not (0): Temperature (Pt100)	
58	1	P3	Sensor selected (1) or not (0): Diffuse radiation (CM21)	
59	1	P4	Sensor selected (1) or not (0): Temperature (Pt100)	
60	1	P5	Sensor selected (1) or not (0): Direct radiation (CH1)	
61	1	P6	Sensor selected (1) or not (0): Temperature (Pt100)	
62	1	P7	Sensor selected (1) or not (0): UV-A radiation (UVA-1)	
63	1	P8	Sensor selected (1) or not (0): Temperature (Thermistor)	
64	1	P9	Sensor selected (1) or not (0): Temperature CG4 Housing (Pt100)	
65	1	P10	Sensor selected (1) or not (0): Infrared radiation (CG4)	
66	1	P11	Sensor selected (1) or not (0):Photosynthetically active radiation (PAR-Lite)	
67	1	P12	Sensor selected (1) or not (0): UV-B radiation (UVB-1)	
68	1	P13	Sensor selected (1) or not (0): Temperature (Thermistor)	
69	1	";"		
70	2	“ss”	Measuring cycle [sec] : 1/2/3/4/5/6/10/12/15/20/30/60 seconds	
72	1	";"		

73	2	“mm”	Memory cycle [min] : 1/2/3/4/5/6/10/12/15/20/30/60 minutes	
75	1	";"		
76	2	“99”	Identifier for Radiation Voltage Output	
78	1	“;”		
79	5	"rrrrr"	Mean value radiation [µV]	Global radiation
84	1	";"		P1=1
85	5	"rrrrr"	Minimum value radiation [µV]	
90	1	";"		
91	5	"rrrrr"	Maximum value radiation [µV]	
96	1	";"		
97	5	"rrrrr"	Standard deviation radiation [µV]	
102	1	";"		
103	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
108	1	";"		P2=1
109	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
114	1	";"		
115	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
120	1	";"		
121	5	"rrrrr"	Mean value radiation [µV]	Diffuse radiation
126	1	";"		P3=1
127	5	"rrrrr"	Minimum value radiation [µV]	
132	1	";"		
133	5	"rrrrr"	Maximum value radiation [µV]	
138	1	";"		
139	5	"rrrrr"	Standard deviation radiation [µV]	
144	1	";"		
145	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
150	1	";"		P4=1
151	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
156	1	";"		
157	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
162	1	";"		

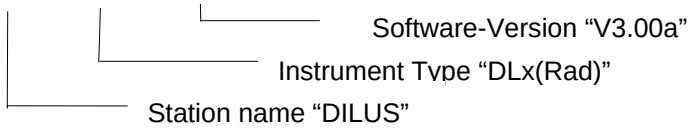
163	5	"rrrrr"	Mean value radiation [µV]	Direct radiation
168	1	";"		P5=1
169	5	"rrrrr"	Minimum value radiation [µV]	
174	1	";"		
175	5	"rrrrr"	Maximum value radiation [µV]	
180	1	";"		
181	5	"rrrrr"	Standard deviation radiation [µV]	
186	1	";"		
187	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
192	1	";"		P6=1
193	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
198	1	";"		
199	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
204	1	";"		
205	4	"rrrr"	Mean value radiation [mV]	UV-A radiation
209	1	";"		P7=1
210	4	"rrrr"	Minimum value radiation [mV]	
214	1	";"		
215	4	"rrrr"	Maximum value radiation [mV]	
219	1	";"		
220	4	"rrrr"	Standard deviation radiation [mV]	
224	1	";"		
225	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
230	1	";"		P8=1
231	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
236	1	";"		
237	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
242	1	";"		
243	5	"+tt.t"/"-tt.t"	Mean value temperature CG4 [°C]	Temperature CG4
248	1	";"		P9=1
249	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
254	1	";"		
255	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
260	1	";"		

261	5	"+rrrr"/"-rrrr"	Mean value radiation [µV]	Infrared radiation
266	1	";"		P10=1
267	5	"+rrrr"/"-rrrr"	Minimum value radiation [µV]	
272	1	";"		
273	5	"+rrrr"/"-rrrr"	Maximum value radiation [µV]	
278	1	";"		
279	4	"rrrr"	Standard deviation radiation [µV]	
283	1	";"		
284	5	"rrrrr"	mean value radiation [µV]	PAR radiation
289	1	";"		P11=1
290	5	"rrrrr"	Minimum value radiation [µV]	
295	1	";"		
296	5	"rrrrr"	Maximum value radiation [µV]	
301	1	";"		
302	5	"rrrrr"	Standard deviation radiation [µV]	
307	1	";"		
308	4	"rrrr"	Mean value radiation [mV]	UV-B radiation
312	1	";"		P12=1
313	4	"rrrr"	Minimum value radiation [mV]	
317	1	";"		
318	4	"rrrr"	Maximum value radiation [mV]	
322	1	";"		
323	4	"rrrr"	Standard deviation radiation [mV]	
327	1	";"		
328	5	"+tt.t"/"-tt.t"	Mean value temperature [°C]	Temperature
333	1	";"		P13=1
334	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	
339	1	";"		
340	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
345	1	";"		
346	1	“P”	Mains Power Status yes/no (1/0)	Mains (1/0)
347	1	";"		
348	4	“bb.m”	Minimal battery voltage [V]	Battery
352	1	";"		Infrared radiation
353	5	"+rrrr"/"-rrrr"	Mean value radiation [µV]	CG4 Sensor 1

358	1	";"		Sensor-Interface
359	5	"+rrrr"/"-rrrr"	Minimum value radiation [µV]	
364	1	";"		
365	5	"+rrrr"/"-rrrr"	Maximum value radiation [µV]	
370	1	";"		
371	4	"rrrr"	Standard deviation radiation [µV]	
375	1	";"		
376	5	"+tt.t"/"-tt.t"	Mean value temperature CG4 [°C]	Temperature CG4
381	1	";"		Sensor 1
382	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	Sensor-Interface
387	1	";"		
388	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
393	1	";"		
394	5	"+rrrr"/"-rrrr"	Mean value radiation [µV]	Infrared radiation
399	1	";"		CG4 Sensor 2
400	5	"+rrrr"/"-rrrr"	Minimum value radiation [µV]	Sensor-Interface
405	1	";"		
406	5	"+rrrr"/"-rrrr"	Maximum value radiation [µV]	
411	1	";"		
412	4	"rrrr"	Standard deviation radiation [µV]	
416	1	";"		
417	5	"+tt.t"/"-tt.t"	Mean value temperature CG4 [°C]	Temperature CG4
422	1	";"		Sensor 2
423	5	"+tt.t"/"-tt.t"	Minimum value temperature [°C]	Sensor-Interface
428	1	";"		
429	5	"+tt.t"/"-tt.t"	Maximum value temperature [°C]	
434	1	";"		
435	1	CR		
436	1	LF		

5.3.3 End line

END OF LINE: END OF DATA Estacion:DILUS DLx(RAD) V3.00a“



6 TECHNICAL DATA

Housing	:	stainless steel
Protection class	:	IP 65

Power supply:

-Battery	:	12V 7Ah (lead acid gel cell), voltage is monitored
-Buffer-condensator	:	Goldcap-capacitor (0.22F), buffering data memory and real time clock for several hours
-external	:	230V AC 0.27A, monitoring status of mains(On/Off), overvoltage protection (DEHNGuard 275, 40 kA 8/20µs)
-Switched Output	:	12V 300mA (e.g. for supplying a GSM-Modem)

Power consumption	:	approx. 17 mA (Display active without Sensors)

Temperature range	:	-30...+70°C
Temperature Display	:	-20...+60°C (for reading)
Temperature COM-Server:		0…60°C
Storage Temperature	:	-40...+85°C
Humidity	:	up to 100% RH, non-condensing

Analog Measurement (applies not for Sensor-Interface SIF measurement):

-A/D-Converter	:	24 Bit Resolution		
-Accuracy 30mV	:	± (1LSB + 0.1% full scale)	= ± (3µV + 20µV)	= ± 23µV (-20...70°C)
-Accuracy –4...4mV	:	± (1LSB + 0.1% full scale)	= ± (1µV + 8µV)	= ± 9µV (-20...70°C)
-Accuracy 5V	:	± (1LSB + 0.1% full scale)	= ± (1mV + 5mV)	= ± 6mV (-20...70°C)
-Accuracy Pt100	:	± 0.2°C (-30...70°C)		
-Accuracy Thermistor	:	± 0.8°C (0...70°C)		
-Overvoltage protection	:	Varistor (2.5 kA 8/20µs, all inputs) and Suppressor-diode (120A 8/20µs, Inputs: Pt100, Thermistor, 5V)		

-Channel	:	13	
		4 Temperature Pt100	(-30...70°C)
		2 Temperature Thermistor YSI type 44011	(-30...70°C)
		2 Voltage for Yankee UVA or UVB-Sensor	(0...5V)
		4 Voltage for K&Z CM21 or CH1 or PAR-lite	(0...30mV)
		1 Voltage for K&Z CG4	(-4...4mV)

-Optional Additional Channels Sensor-Interface SIF 9.3099.00.001: 4

2 Voltage for K&Z CG4

2 Temperature Pt100

-Input resistance (applies not for SIF measurement):

0…30mV	100kΩ
-4…4mV	100kΩ
0…5V	93kΩ

-Factory calibration mV-Input series resistance (applies not for SIF measurement) :

CM21,CH1	68Ω
PAR-Lite	240Ω
CG4	120Ω

Sensor calibration constants for the radiation sensors connected directly to the datalogger can be modified in the display or serial command.

Measuring rate	:	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 seconds (applies not for SIF measurement)
Memory rate	:	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 minutes
Calculation	:	-Mean values (Temperature channels) -Mean , minimum and maximum values and standard deviation (Radiation channels) -CG4-Channels: downward radiation (Temperature of sensor is considered)
Time base	:	Real time clock with leap year accuracy: ± 10ppm = ± 0,9s/ 24h (25°C) automatically time synchronisation with optional DCF77-Radioclock (Thies number: 9.1760.00.000)
Memory capacity	:	Flash: 64 KB (Software, Uploadable COM1 XModem-CRC) RAM: 1 MB (Data) EEPROM: 256 Bytes (Parameter)
Number data records	:	6541
Data output	:	
-Serial interface 1	:	RS232 (optional RS485 half- or full-duplex) Parameter: XON/XOFF-Handshake, 300...115200 Baud, 8 databits, no parity, 1 Stopbit
-Memory Card	:	Compact Flash, Type SanDisk SDCFB-32 (32MB) Formatted on PC with FAT16, compatible to Microsoft® Windows® and MS-DOS®
-Serial interface 2	:	RS232 (for connecting optional Sensor-Interface SIF 9.3099.00.001) Parameter: 300...115200 Baud, 8 databits, no parity, 1 stopbits
Operating	:	3 Keys and serial interface
LCD-Display	:	2 row with 16 character (alphanumeric)

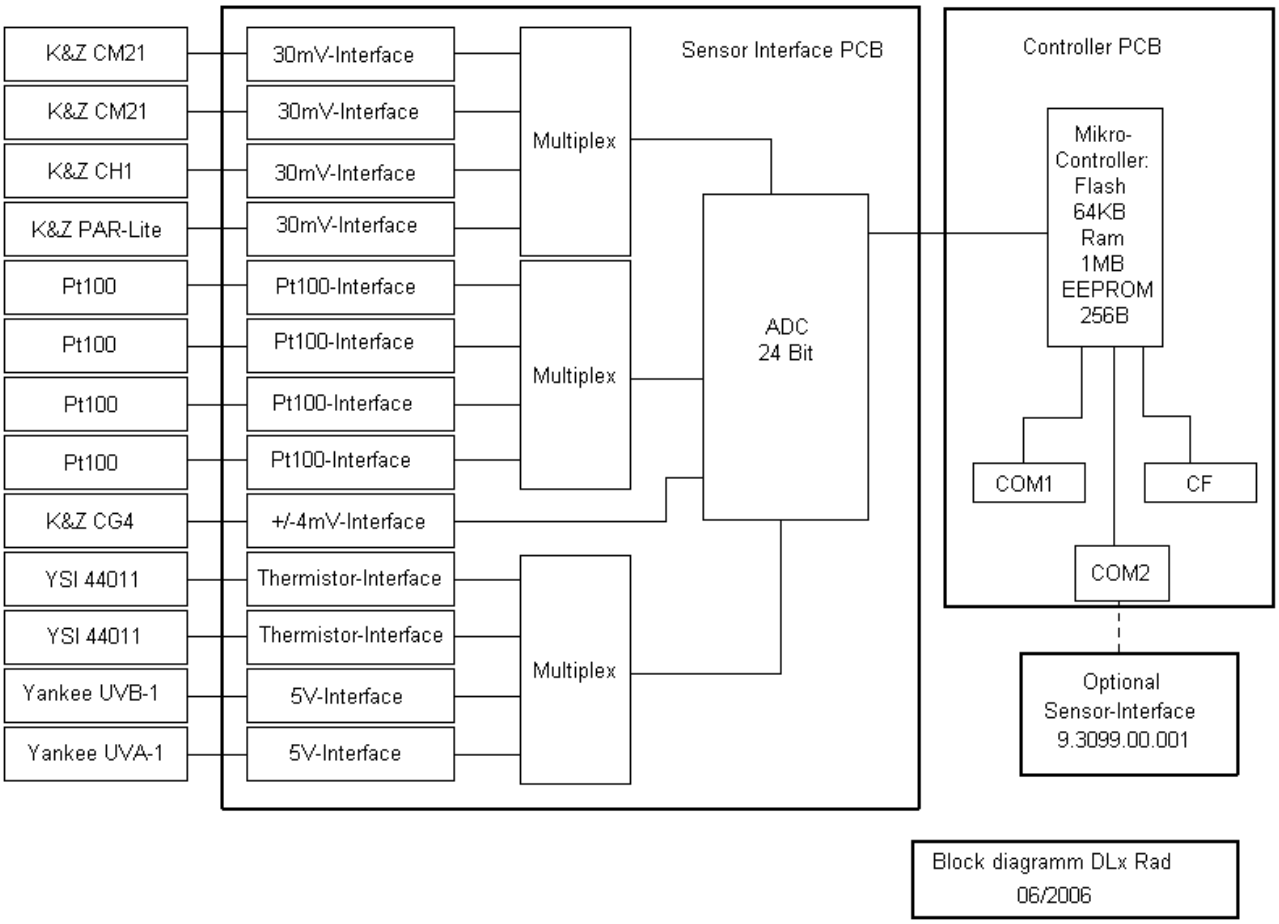
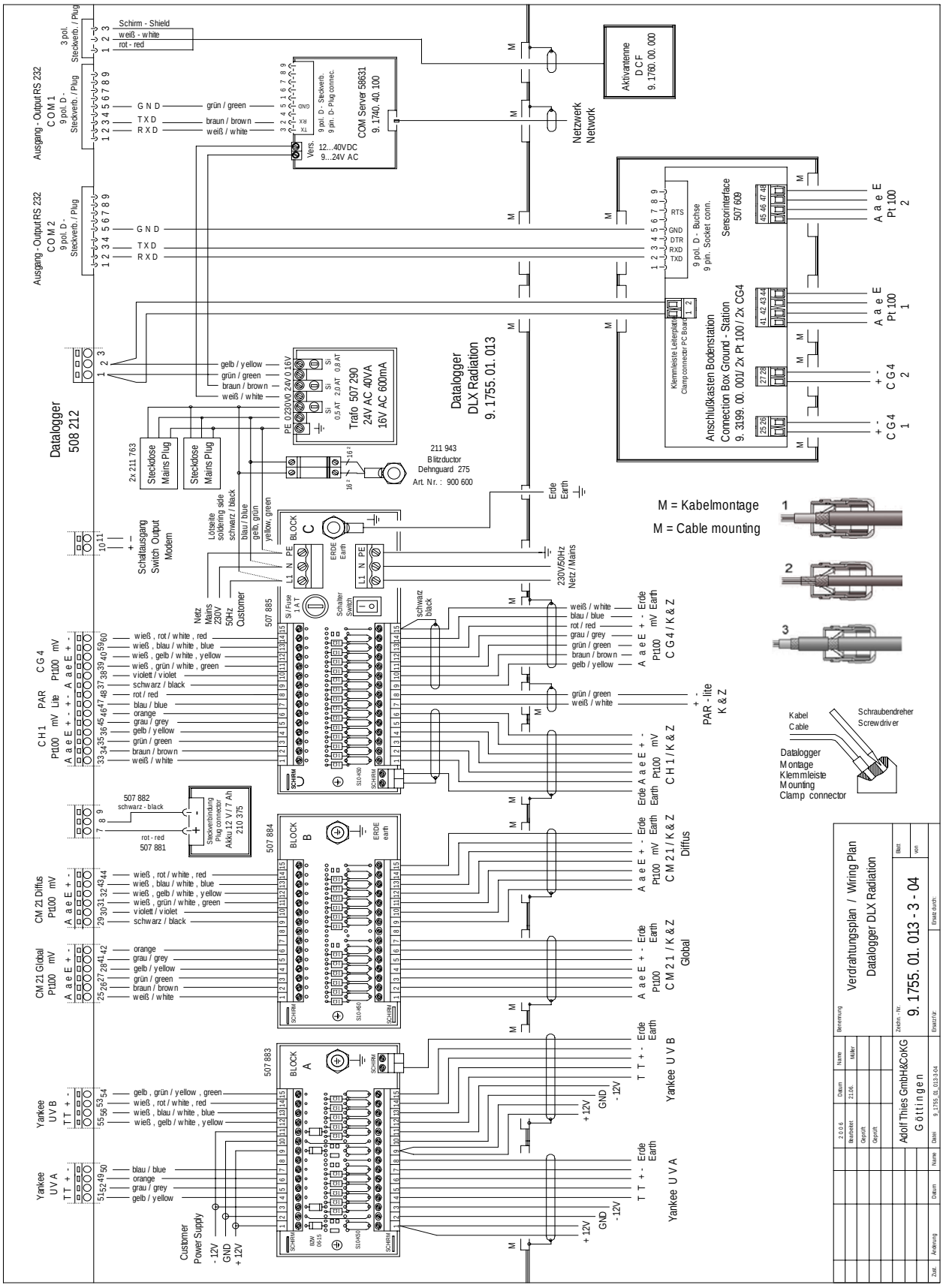


Figure 7: Block diagram DLx-Radiation

Additional Features

The above mentioned design is special developed to adapt Radiation sensors with his special characteristic. In comparison to standard mV inputs from other Datalogger systems , this design take care of the output resistance and the sensitive output of radiation sensors in special from K&Z .
The Amplification and Filtering of each mV-channel is separated to minimize the interferences with other signals. All components are designed and fine tuned to take care of this special characteristic. Each analogue circuit is optimised for this special task.
Further the design is optimised according the resolution and the accuracy of the a.m. sensors.

7 WIRING PLAN



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