DATALOGGER
MeteoLOG TDL 14

Instruction for use: 9.1740.xx.xxx
Software-Version: as of 3.12 **11/2005**

Table of Contents

1. Construction of the Data Logger

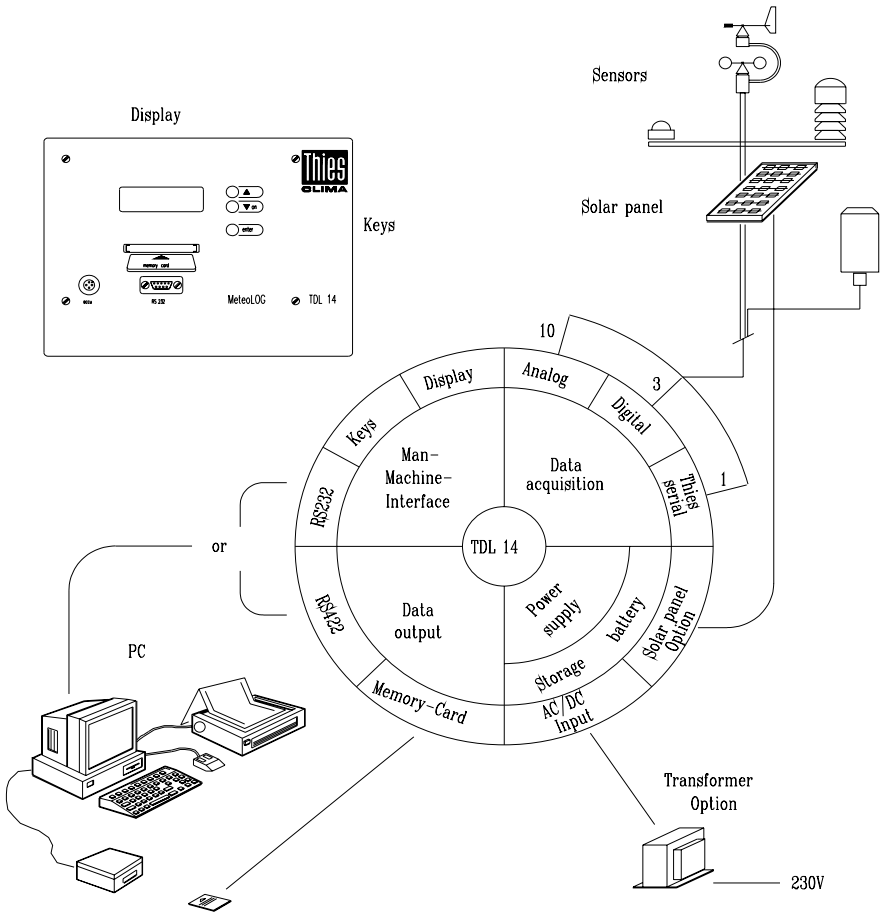
The MeteoLOG TDL 14 data logger is a complete measurement system to detect and store meteorological data. The instrument is battery-operated, thus allowing it to be set up acc. to model and sensor equipment at site without any mains supply for some hours or even days. The exchangeable storage battery is situated in the data logger case. The case, which can be locked, is water-tight (IP65) and very sturdy. The case is made of stainless steel to protect the instrument from electro-magnetic fields. Furthermore, operation in a temperature range from -30° to 50°C is guaranteed.

The instrument is easy to operate, either with the three keys or over the serial interface. The three keys are indicated by "<Δ>", "<∇> on" and "<enter>" in the following. The instrument has a two-line, alphanumeric display.

Numerous inputs are available for the connection of measured data transmitters (sensors). A maximum of 10 analog and 4 digital sensors can be connected. The measured values are saved time-controlled in a CMOS-RAM which has been secured against loss of data. This memory is organized as a ring memory and can save 256 KB. The data can be read out either over a serial interface (V.24/RS232-C or RS422) or over a memory card (option). The TDL14 with COM2 allows an additional output of the instantaneous data every second. The COM2 is not possible with the TDL14 with ultrasonic connection.

An integrated lithium battery buffers the contents of the data memory and the clock operation when no other power supply is available. This means that the saved values and the time are not lost even when there is no additional power supply.

Functional Arrangement of the Data Logger:



1.1 Models available

The data logger is available in different models geared to the requirements of the respective application:

Order-No.:9.1740.XX.XXX	Datalogger TDL 14
.X0	Power supply: 14...24 V AC/ 17...33 V AC/ integrated 12 V storage battery
.X1	Power supply: an additional integrated power transformer (230 V)
.X2	Power supply: an additional integrated power transformer (115 V)
.X3	Power supply: solar charge regulator
.X4	Power supply: solar charge regulator/ power transformer (230 V)
.1X	Standard
.2X	Calculation of the humidity from: Temperature 1 = Dry temperature of humidity 1 Temperature 2 = Wet temperature of humidity 1 Temperature 3 = Dry temperature of humidity 2 Temperature 4 = Wet temperature of humidity 2
.XX0	RS232 (COM1) (optionally: memory card interface)
.XX1	RS422 (COM1) (optionally: memory card interface)
.0XX	Wind speed transmitter compact/standard and gsm (optional)
.01X	COM2 and wind speed transmitter compact / standard
.50X	Wind transmitter Ultrasonic Anemometer (4.3800.00.640/641)

1.2 Mounting

The data logger is designed to be mounted to a vertical wall. Four screws of 8 mm diameter are required for this. There are special mounting sets available in the following diameters: 48, 60, 80, 90, 102 and 132 mm for installation on a mast.

The transmitter cables are lead through the appropriate cable screwing to the connecting terminals. For details, please refer to the connecting diagram.
In order to carry out an EMC-compatible installation the cable screen/shielding is to be connected to the contact spring of the cable gland, depending on the model.

Proceedure:

1. With the Standard Contacting

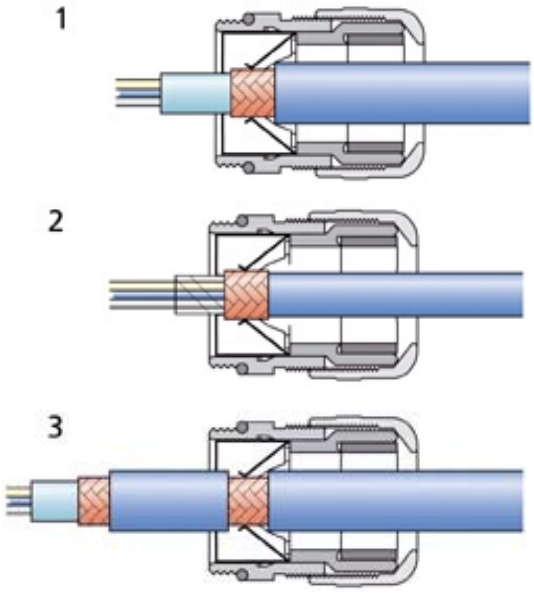
- Strip back the outer sheath and screen (shielding)
- Make a round cut in the outer sheath approx. 15 mm along but do not remove the sheath
- Guide the cable through the cable gland
- Pull off the outer sheath
- Pull back the cable until the connection is made between the cable screen and contact spring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

2. With thin Wires without an Inner Sheath

- 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 fig. 9-3)

- 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!



2. Operation

The data logger starts automatically as soon as the storage battery is connected. The data logger is reinitialised during this process. Once the instrument has been switched on, first the clock and the date (see section 2.2.2) and then the measurement cycle (see section 2.2.3) should be set. Furthermore note the sensor settings and the language (see section 2.2.5).
The data logger has two data ring memories with a capacity of 256 KB. The ring memories can record data continuously i.e. when one of the ring memories is full, then the oldest data record is overwritten. The data ring memories can be read out over the serial interface or over a memory-card (option) (see section 2.3).

2.1 Standards Displays

Switch the display on with key <∇> (just press briefly). The data logger switches off automatically when no key has been activated over a period of 30 seconds or when no character was either transmitted or received over the serial interface. After the display has been switched on, the station name appears. Where "* " appears as the first character, this indicates that the user can change this value (see 2.2). The next display value is reached by pressing the <∇> key. You can return to the preceding value with the <Δ> key.

2.1.1 Sequence of Display Values:

- station name
- date and time
- gsm-timer [1)]
- status of the A/D converter
- channel configuration
- storage battery voltage
- baud rate COM1/memory card (option)
- Baud rate COM2 [2)]
- telegram COM2 [2)]
- measurement cycle /memory cycle
- extreme values cycle
- transmitter constants: radiation CM 3/CM 6B
- station elevation
- sensor measured values:
  1. wind speed
  2. wind direction
  3. temperature 1
  4. special input 3/ rel. humidity
  5. special input 5/ air pressure
  6. radiation
  7, precipitation
  8. leaf moistening / virtual temp. [3)]
  9. special input 4/ tensiometer
  10. temperature 2
  11. temperature 3
  12. reference/(optionally: temperature 4, rf. Page 11)
  13. special input 1
  14. special input 2
- data output

[1)] only Datalogger: 9.1740.XX.00X
[2)] only Datalogger: 9.1740.XX.01X
[3)] only Datalogger: 9.1740.XX.50X

STATION NAME:

```
* THIES_CLIMA
TDL14  V3.12 X
```

X = 0...9

The station name allows the user to differentiate between the data of several stations. The name (here: „THIES CLIMA“) can be up to 11 characters long. For read-out, this name appears on the memory card [1)] respectively it is output with the data over the serial interface. In the second line you find the instrument model („TDL 14“), the software version („V 3.12 “) and the software variation („0“ ... „9“). The software variation differentiates between the two opto-electronic wind speed transmitter models (sensor 1) and the air transmitter (sensor 5)

Variation	Order no:	Wind speed transmitter		Air transmitter
0	(9.1740.1x.0xx)	Compact	(z.B. 4.3519.xx.xxx)	PTB 100A
1	“	Compact	(z.B. 4.3519.xx.xxx)	PTB 100B
2	“	Standard	(z.B. 4.3303.xx.xxx)	PTB 100A
3	“	Standard	(z.B. 4.3303.xx.xxx)	PTB 100B
4	“	Reed	(z.B. 4.3515.30.xxx)	PTB 100A
5	“	Reed	(z.B. 4.3515.30.xxx)	PTB 100B
6	(9.1740.1x.50x)	Ultrasonic	(4.3800.00.640/641)	PTB 100A
7	“	Ultrasonic	(4.3800.00.640/641)	PTB 100B
8	(9.1740.1x.0xx)	First Class	(z.B. 4.3350.00.x00)	PTB 100A
9	“	First Class	(z.B. 4.3350.00.x00)	PTB 100B

LANGUAGE:

When changing the station name (see section 2.2) in the second line appears the language selection („Sprache:Deutsch“ or. „Lang. : English“), and then you can choose between these two modes.

DATE / TIME:

```
*date: 01.01.05
 time: 12:00:00
```

Display of logger date and time.

GSM-TIMER: [1)]

```
*PROG-Timer: X
 programmed
```

X = 1,2,3

Display of programmed GSM-timer

STATUS OF A/D CONVERTER:

```
    A/D: OK
 0  0  512  1023
```

- OK (A/D converter is functioning properly) / Err (A/D converter defective)
- Self-test of the A/D converter, Setpoint: 1021 ±2
- Self-test of the A/D converter, Setpoint: 512 ±12
- Current measured offset, Setpoint: 0 - 3
- Offset, with which all other measurements will be corrected (is measured at the time when the instrument is switched on).

[1)] only Datalogger: 9.1740.XX.00X

CHANNEL CONFIGURATION:

```
*Channel config:
xxxxx xxxxx xxxx
```

X = 0 sensor not reporting
X = 1 sensor reporting

Sensor 1...14

Displays the configured measurement channels („1"→ reporting). Non-configured measurement channels („0"→ not reporting) are indicated on the display and on the serial online commands by dashes („-„). These channels are stored with the general error identification („?").
The first number to the left stands for sensor 1 (wind speed), the last for sensor 14.

Please note: *To Change the channel configuration see chapter 2.2.7 on page 16.*

STORAGE BATTERY VOLTAGE

```
Accumulator: OK
    12.5 V
```

OK : Voltage >11.5 V
!!!: Voltage 10.6 ... 11.5 V
Low: voltage <10.5V Charge/ change batteries recommended!

Displays the measured voltage of the storage battery. The actual storage battery voltage is higher (approx. 0.2 V). Analog measurements become imprecise below a measured voltage of 8.5 V.

Please Note*:*
The storage battery should not be discharged below 10.5 V because, first of all, there is no appreciable capacity available anymore and, secondly, because the operating life of the battery will be considerably shortened. Please change or charge the storage battery while „!!!" still appears on the display.

BAUD RATE (COM1) / memory card [1)]

```
* Baudrate 1:
  9600 Bd 7E1
```

No memory card in the holder

Displays the baud rate:
Settings:
300 Bd, 600 Bd, 1200 Bd, 2400 Bd,
4800 Bd, 9600 Bd
7 data bits (even) parity
1 stop bit or
8 data bits, no (none) parity,
1 stop bit.
(default: 9600Bd 7E1)

```
Memory Card
     3,0 V  OK
```

OK : Voltage > 2,7V
!!! : Voltage 2,6...2,7V
Low : Voltage <2,6V

memory card in the holder of the data logger

Displays the voltage of the memory card battery: The measurement is limited to 3.0 V, i.e. higher voltages are not displayed. We recommend that you change the battery when "!!!" appears on the display.
The function of the „MC“ is not guaranteed below 2,6 V

Please note:
On the beginning of operation the baud rate COM1 must be adjusted to the respective receiving instrument. This COM-Port is designed to communicate with “Mevis” and so on.

BAUD RATE COM2 [2)]

```
* Baudrate 2:
   9600 Bd 7E1
```

(default: 9600Bd 7E1)

Display of baud rate and parity for COM2.
300 Bd, 600 Bd, 1 200 Bd, 2 400 Bd
8 data bits, no parity, 1 stop bit (8N1) or 7 data bits, even parity, 1 Stop bit (7E1)

Please note:
On the beginning of operation the baud rate COM2 must be adjusted to the respective receiving instrument.
The COM2 is only designed to outputs the Online-Telegrams, which can be used by “Meteo-Online” (for ex.).

Telegram COM2 [2)]

```
*Telegramm COM2:
   NNNNNNNN
```

Display of output telegram at interface COM2.
The output interval of the telegrams is every second.

"Off"	no telegram
"Online"	online-output of all instantaneous values (command "mm" as with COM1, ref. to 2.3.1.2)
"Online 2"	like „online“ ,however with STX at the beginning of the telegram, and ETX at the end of the telegram
"Online ls"	like „online“, however output of the mean value of the last storage time.
"Wind-LED"	output of the instantaneous wind value for THIES wind display LED (4.322x.xx.xxx required baud rate 1200Bd7E1)
"Online + LED"	output of the telegrams online and LED as one telegram. This telegram is conceived only for the combination of digital display with parallel-connected LED-display. Please take care that the same baud rate and parity is set with all parallel-connected instruments!
"AMS sensor"	output telegram for the connection of a sensor electronics. (for ex.. AMS11 required baud rate 2400Bd7E1). Order of sensors like “online 2“, however without information on time and date.
"Test"	Test-output ("The quick brown fox jumps over the lazy dog").

[2)] only Datalogger: 9.1740.XX.X1X

MEASUREMENT CYCLE / MEMORY CYCLE:

```
*Meas.   cyc: 1 s
Memory  cyc: 10 min
```

Displays the measurement cycle and the memory cycle which has been set.
Settings measurement cycle: (only Data logger: 9.1740.xx.00x)
1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 seconds. All others have 1 second measurement cycle.
Settings memory cycle:
1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60 minutes (see section 2.2.4)

EXTREME VALUE CYCLE:

```
*Extreme  cycle:
    120 min
```

Displays the extreme value cycle.

Settings extreme value cycle:
1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60, 120, 180 and 240 minutes (see section 2.2.4)

TRANSMITTER CONSTANTS:

CONCERNING SENSOR 6: RADIATION CONSTANT PYRANOMETER CM3/ CM6B

```
*Pyr. CM3 Konst.
  15.0000 mV
```

Displays the radiation constant set on the "pyranometer CM3" or „CM6B“ sensor. The value to be set is stipulated in the sensor's test certificate.

Setting range: 9.0000...35.9999 mV/ 1000 Wm^{-2}

CONCERNING SENSOR 5: STATION ELEVATION:

```
* Station altitude:
    NNNN m
```

Inputting the station elevation is only of significance if an air pressure sensor has been connected to special input 5 (S4.5 = close, see 2.2.6).
Should you measure air pressure, then enter the station elevation here in order to obtain air pressure reduced to sea level (so-called "QFF").
When you enter station elevation 0 m, the sensor signal is output directly (air pressure at station elevation, so-called "QFE").
Elevations between 0 and 4000m can be set in consideration of the operation range from the air pressure sensor.

SENSOR MEASURED VALUES:

Please note the DIP switch setting on certain sensors (SW4, P15 see 2.2.6)

SENSOR 1 WIND VELOCITY

```
 Windvelocity:
  NN.N m/s
```

Outputs the mean wind speed per second (measured once a second).

Software Variation 0 or 1: (Compact-Wind transmitter)	Measuring range: 0,5...60 m/s resolution: 0,1 m/s
Software version 2 or 3: (Standard-Wind transmitter)	Measuring range: 0,3...52,9 m/s resolution: 0,1 m/s
Software version 4 or 5: (Sensor with Reed contact)	Measuring range: 0... 60,0 m/s resolution: 0,8 m/s
Software version 6 or 7: (Ultrasonic-Wind transmitter)	Measuring range: 0...60 m/s resolution: 0,1 m/s
Software Variation 8 or 9: (First-Class Wind transmitter)	Measuring range: 0,3...50 m/s resolution: 0,1 m/s

***Please Note**:*
The switches S4.1, S4.2 and S4.3 have no function when using an Ultrasonic wind transmitter.

SENSOR 2 WIND DIRECTION

Wind direction:
NNN °

Outputs the measured wind direction (continuous measurement). "???.?" appears if there has been a measurement error (for example, the sensor is not connected, the measuring range has been exceeded etc.).
Measuring range: 0...360°
Resolution: 1° (valid for a Ultrasonic wind direction transmitter)
≤ 3° (valid for a wind direction transmitter with 8 bits) (standard)
≤ 12° (valid for a wind direction transmitter with 5 bits) (compact)

SENSOR 3 TEMPERATURE 1

Temperature 1:
NNN.N °C

Outputs the instantaneous measured temperature (measurement once a second). "???.?" is output if there has been a measurement error (for example, the sensor is not connected, the measuring range has been exceeded)
Measuring range: -40...+60°C
Resolution: 0,1°C

SENSOR 4 SPECIAL INPUT 3/ REL. HUMIDITY

S4.4 = open

Input 3 0-1V:
NNN.N %

Outputs the measured input voltage in % (measurement once a second). For measurements above 102,2%, the ouput is limited to 102,3%.
Measuring range: 0...100% (corresponds to 0-1 V)
Resolution: 0,1 %

S4.4 = close

rel. humidity:
NNN.N %

Outputs the instantaneous measured relativ humidity (measurement once a second). ???.? appears if the measuring range has been exceeded or not reached.
Measuring range: 0,3...100%
Resolution: 0,1 %

SENSOR 5 SPECIAL INPUT 5/ AIR PRESSURE

S4.5 = open

Input 5 0-5V:
NNN.N %

Outputs the measured input voltage in % (measurement once a second). For measurements above 102,2%, the output is limited to 102,3%.
Measuring range: 0...100 % (corresponds to 0-5 V)
Resolution: 0,1 %

Please note: In order to keep a telegram length, that is independent from the DIP-switch, we added a leading blank space.

S4.5 = close

Air pressure:
NNN.N hPa

Outputs the instantaneous measured air pressure (measurement once a second). ???.? appears if the measuring range has been exceeded or not reached.
Version 0 an 1 (Transmitter PTB 100A)
Measuring range: 800...1060 hPa*
Resolution: ≤ 0,3 hPa
Version 2 and 3 (Transmitter PTB 100B)
Measuring range: 600...1060 hPa*
Resolution: ≤ 0,5 hPa
*The measuring range is relative to a station elevation of 0 m. The measuring range changes for other station elevations. (please also refer to TRANSMITTER CONSTANTS).

SENSOR 6 RADIATION

Radiation :
NNNN W/sm

Outputs the measured radiation (measurement once a second). The measured value depends on the radiation constant of the transmitter (for the setting, please see TRANSMITTER CONSTANTS).
Measuring range: 0...>1328 Wm^{-2}
Resolution: ≤ 5 Wm^{-2}

SENSOR 7 PRECIPITATION

Precipitation:
NNN.N mm

Outputs the amount of precipitation which has fallen during the current day.
(The sum of all precipitation since midnight, continuous measurement).
Measuring range: 0...99,9 mm
Resolution: 0,1 mm

SENSOR 8 PRECIPITATION (j/n) / VIRTUAL TEMPERATURE

Precipit. j/n:
N

Outputs the status of the event
(continuous measurement)
1 → input closed
0 → input open

virt. Temp.:
NNN.N °C

Outputs the instantaneous temperature values (measurement once a second). "???.?" indicates measurement errors (for example the sensor is not connected, the measuring range has been exceeded).
Measuring range: -40...+60°C
Resolution: 0,1°C

Please note: If an Ultrasonic wind sensor (version 5 or 6) is connected the virtual temperature is measured instead of the precipitation state of event.

SENSOR 9 SPECIAL INPUT 4/ TENSIOMETER

S4.6 = open

Input 4 0-5V:
NNN.N %

Outputs the measured input voltage in % (measurement once a second). For measurements above 102,2%, the output is limited to 102,3%.
Measuring range: 0...100 % (match to 0…5V)
Resolution: 0,1 %

S4.6 = close

Tensiometer:
NNNNN mbar

Outputs the instantaneous soil saturation potential. (Measurement once a second).

Measuring range: -1000...0 mbar
Resolution: 1 mbar

SENSORS 10, 11, 12 TEMPERATURE 2, 3, 4

Temperature X:
NNN.N °C

X = 2,3,(4)

Outputs the instantaneous temperature values (measurement once a second). "???.?" indicates measurement errors (for example the sensor is not connected, the measuring range has been exceeded).
Measuring range: -40...+60°C
Resolution: 0,1°C

Please note: *Temperature 4 is used as reference. Thereby, it is guaranteed that the temperature inputs of the Logger remain linear in case it is used with extreme temperature ranges. However, for compatibility reasons the telegram output remain unchanged. The temperature channel 4 is handled like a logged-off channel. The temperature compensation is switched off by fading-in the channel (ref. to channel configuration chap. 2.2.7), and the value of the reference is output. (If necessary, sensor 12 can be re-utilized with omission of the temperature compensation).*

SENSORS 13, 14 SPECIAL INPUT 1, 2

S4.7 = open

S4.8 = open

Input x 10V/20 mA:
NNN.N %

x = 1,2

Outputs the measured input voltage (resp. current) in % (measurement once a second). For measurements above 102,2% the output is limited to 102,3%.
Measuring range: 0...100% (@0-10V / 0...20 mA)
Resolution: 0,1 %

S4.7 = close

S4.8 = close

Input x 4-20 mA:
NNN.N %

x = 1,2

Outputs the measured input voltage (resp. current) in % (measurement once a second). "???.?" appears when the measuring range has been exceeded.
Measuring range: 0...100% (@ 2-10 V / 4...20 mA)
Resolution: ≤ 0,2 %

Please note: *You can switch back and forth between current measurement and voltage measurement with the S5 DIP switch (see 2.2.5).*

DATA OUTPUT

```
Data output
     ?
```

Starts data output (see section 2.3).

2.2 CHANGING THE PARAMETERS

All display values which appear with a „*“ to the upper left can be changed.
These values are:

Station name, date, time, GSM-timer [1)], baud rate, measurement cycle , memory cycle, extreme value cycle, channel configuration, radiation constant and station elevation.

To edit the displayed value, simply press <ENTER> and the <∇> key. The value to be changed is indicated by the flashing cursor. Now release both keys. The value can be raised with the <∆> or lowered with the <∇> key. If the set value is satisfactory, then press the <ENTER> key to leave the editing mode or to select the next variable.

Please note: *To Change the channel configuration see chapter 2.2.7 on page 16.*

2.2.1 STATION NAME

The station name is used to identify the measuring site. If several data loggers are in use, each of them should be given a different name. All letters and numbers as well as the underlining "_" and the space bar can be used for the name.
With serial data output, all 11 characters of the station name are output. For output onto a memory-card [2)], the first seven characters are given.
When changing the station name the second line indicates the output language which can be selected through the arrow-key accordingly between “Deutsch “ or “English”.

2.2.2 DATE

If an invalid date is entered the computer automatically corrects it.

2.2.3 GSM-TIMER

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

X = 1,2,3

The GSM-Timer serves for activating a time window for a GSM-modem which is externally connected to a datalogger of the type 9.1740.xx.00x..
Through the setting of small time windows (<2 0 min) the medium current consumption of the modem (operating current approx. 200 mA) per day can be kept at a low level.(see also example rection 2.6.2).
During the data transmission via a timer controlled mode the remaining switch-on period is kept on 5 min., in order to guarantee a re-query within this period in case the data query was incorrect.

In the editing mode the 3 time windows for the GSM-modem can be set one after the other. If the online time is reset and confirmed through the <ENTER>-key, the current and the following timers are deactivated.

„HH:MM“ gives the starting time of the current time window in the format „std:min“.

The ONLINE-time is selectable in minute-intervals:

maximum online-time	:	60 min
minimum online-time	:	5 min
deactivate timer	:	0 min

Remark: *In case the accu voltage falls below 11 V, the GSM-modem is switched off in order to avoid a low-discharge of the accu!*

[1)] only Datalogger: 9.1740.XX.00X
[2)] optionally

2.2.4 MEASUREMENT CYCLE

The measurement cycle indicates the time intervals at which the analog and serial sensor values are measured by the data logger. The measurement cycle can be changed during operation without the preceding data being lost. The initial measurement interval set when the instrument is first switched on is 1 minute [1)] . All digital counting inputs (for example wind speed, precipitation) are continuously measured independent of the measured value set.

There are 23 different measurement intervals available:
seconds: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30
minutes: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60

Please note: *The measuring cycle of a datalogger with COM2 or ultrasonic wind transmitter is set permanently on 1 second.*

The **memory cycle** indicates time interval for storing the measuring values. For this, the measuring values are averaged, or accumulated.

The memory cycle is selectable in 12 steps.
Minutes : 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60

Example: meas. cycle 1 second
memory cycle 10 minutes

A mean value is calculated from 600 measuring values, and stored. The calculation of the mean value is carried out as arithmetic mean with „normal“ sensors. Exceptions are the wind direction (vectorial mean), and precipitation (formation of sums)..

Please note: *When changing the measurement cycle, the cycles of storing, and extreme values is corrected automatically to an integer multiple.*

The memory cycle influences the storing period of the mean values (ref. to section 2.7)

2.2.5 EXTREME VALUE CYCLE

The extreme value cycle gives the time point the extreme values are saved.

The extreme value cycle is selectable in 15 steps:
Minutes : 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60, 120, 180, 240

The extreme value cycle influences the extreme value memory period (see section 2.7.2).

[1)] only Datalogger: 9.1740.00x

2.2.6 DIP-SWITCH SENSOR SETTINGS

Below the front panel of the data logger there is an 8-pole (S4) and a 4-pole DIP switch (S5) to configure a number of sensor settings. You can only read in the switch setting of S4 after you have switched the instrument on. Readjusting the switch during measurement operation has no effect, i.e. you should adjust the switch during measurement operation (display off) and then switch the data logger on with the on-key. This makes the setting valid for the data logger.

S 4.1	S 4.2	S4.3	wind speed transmitter	
open	open	open	Standard	4.33.0.22.007
close	open	open	Compact	4.3519.00.x00
close	open	close	First Class	4.3350.x0.000
open	close	close	Reed contact	4.3515.30.x00

S 4.4	special input 3 (sensor 4)
open	0-1 universal-input
close	rel. humidity (Thies)

S 4.5	special input 5 (sensor 5)
open	0-5 V universal-input
close	air pressure transmitter

S 4.6	special input 4 (sensor 9)
open	0-5 V universal-input
close	tensiometer (Thies)

S 4.7	S 5.1	S 5.2	special input 1 (sensor 13)
open	open		0-10 V universal-input
close	open		2-10 V universal-input
open	close		0-20 mA universal-input
close	close		4-20 mA universal-input

S 4.8	S 5.3	S 5.4	special input 2 (sensor 14)
open	open		0-10 V universal-input
close	open		2-10 V universal-input
open	close		0-20 mA universal-input
close	close		4-40 mA universal-input

DIP-switch S4

OFF (OPEN)

ON (CLOSE)

DIP-switch S5

OFF (OPEN)

ON (CLOSE)

2.2.7 CHANNEL CONFIGURATION

In order to be able to change the channel configuration, you must first simultaneously press the <ENTER> key and the <∇> key and then do the following:
The second line is deleted and a question mark appears. Now press the <∇> and the <Δ> keys simultaneously for 10 seconds. The countdown appears on the display. After the countdown is concluded, you can adjust the values as you usually do.

2.3 DATA OUTPUT

The Datalogger provides two possibilities to read out the data:

- serial (V.24 / RS232 9.1740.xx.xx0)
  (V.11 / RS422 9.1740.xx.xx1)
- memory card [1)]

An external computer can be connected with an appropriate cable to the serial interface of the Datalogger to access the stored data. The transmission of all mean values stored in the memory takes at least 15 minutes at 9600 baud. Data transmission to a memory card [1)] is considerably faster (less than 2 minutes) because the data are transferred in parallel.
All data are transferred in ASCII format (text). This means that any text editing program can be used to examine, edit, manipulate and print the data. Accordingly you are able to conduct further data analyses with standard software, such as table format programs, data banks, etc..

2.3.1 SERIAL DATA OUTPUT

For the output of data over the serial interface COM 1, make sure that the memory card[1)] is not in its holder[2)]. If you leave the memory card [1)] in its holder [2)], the data will be written on the memory card! [1)]
Serial data output can follow by pressing the key or via cable.
We recommend that you use our communications program "Mevis" to read out the data. Moreover, you can use a standard terminal program (for example "TeraTerm" or "Terminal" from Windows).

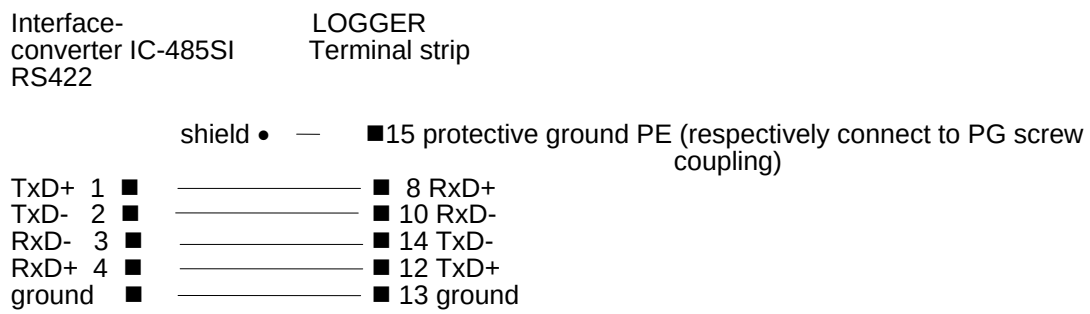
2.3.1.1 CONNECTING CABLE OF THE SERIAL INTERFACE

The serial interface (COM1) is a "three-wire" connection. The transmission line (TxD) and the receiving line (RxD) must be cross-connected in the cable.

RS232 / V.24 - Output: Order No.: 9.1740.xx.xx0

PC/TERMINAL Sub-D25 (25-pol)			LOGGER terminal strip		LOGGER RS232 Sub-D9
TxD	2	■———	9	RxD	2
RxD	3	■———	11	TxD	3
ground	7	■———	13	ground	5
Sub-D9					
RxD	2	■———	9	RxD	2
TxD	3	■———	11	TxD	3
ground	5	■———	13	ground	5

[1)] + [2)] optional

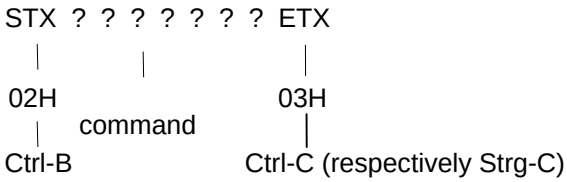


Please Note: *Shielded cable should be used. For line lengths exceeding 100 m, twisted wire in pairs should be used (RxD+/RXD-, TxD+/TxD-). The connection of the shield (pin 15) to protect the instrument from surges (for example lightning) is also important. The manufacturer is <u>not</u> responsible for damages resulting from surges.*

2.3.1.2 COMMAND FORMAT (COM1)

This section is only important for those who want to use their own communication program.

The commands consists of 4 to 9 bytes:



LIST OF COMMANDS:

"HH"	Help: shows the list of input commands
"SS"	mean value memory: output of saved mean values
"GS"	entire mean value memory: only useful if the logger has re-initialized itself in order to rescue data which has not yet been overwritten.
"ts" <T,Mo,J>	output one day's stored data (mean values)
"te" <T,Mo,J>	output one day's stored data (extreme values)
"ds" <T,Mo,J.H.Mi>	output stored data (mean values) from a certain timepoint on

"de" <T,Mo,J.H.Mi> output stored data (extreme values) from a certain timepoint on

T	:	Day in binary + 28	(29 ... 59)
Mo	:	Month in binary + 28	(29 ... 40)
J	:	Year in binary + 28	(28....127) (without
H	:	Hour in binary + 28	(28 ... 52) Century)
Mi	:	Minute in binary + 28	(28 ... 77)

Ex.: STX "ds" 29 31 32 40 28 ETX

1 3 04 12 0

Mean value data from 01.03.2004, 12.00 on are called up.
Characters have to enter without spaces!

"EE" extreme value memory: output of extreme values

“LS“ Last record from the mean value memory (see 'MM')

“ls“ <1..99> mean value records stored till now

“le“ <1..99> extreme value records stored till now.

"KK" <CH,STATUS> channel configuration CH: channel (1...14) STATUS(0/1)
for activating and de-activating each individual channel

"SK" <KONSTANTE> enter constant of radiation NN.NNNN

"SH" <0..4000> enter station height

"LL" logger status: Output logger date and time,
status of the A/D converter,
storage battery voltage,
measurement cycle,
memory cycle,
extreme value cycle
channel configuration
radiation constant
station elevation
GSM – timer [1)]

"MM" and "mm" instantaneous measured values:
Output all the values measured by the sensors.
The data are only valid three seconds after the
instrument has been switched on.

"MM" Output with sensor identification

"mm" Output as with the mean value data record however
with the addition of the second.

"DD" logger date

"DT"<1..31> Enter day: setting the day of the logger
Response: entered day, logger date

[1)] only Datalogger: 9.1740.XX.00X

"DM" <1..12>	Enter month: setting the month of the logger Response: entered month, logger date
"DJ" <0..99>	Enter year: setting the year of the logger Response: entered year, logger date
"ZZ"	logger time
"ZH"<0..23>	Enter hour: setting the hour of the logger Response: entered hour, logger time
"ZM"<0..59>	Enter minute: setting the minute of the logger Response: entered minute, logger time
"XX"	Output of station name, instrument model and software version
CR LF"?" CR LF	Response to an unknown command respectively to an incorrect parameter.

ADDITIONAL CHARACTERS OF IMPORTANCE:

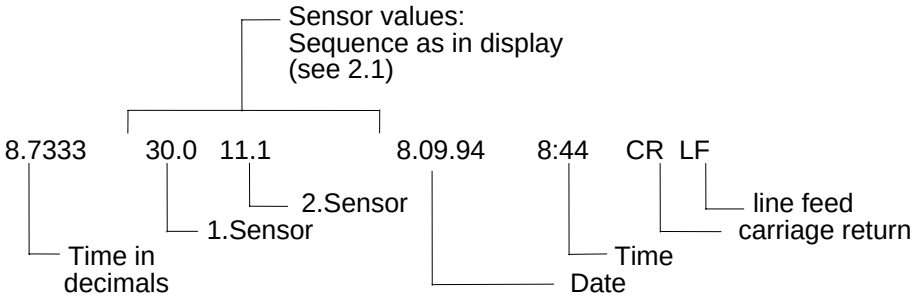
STX (02H)	start of a command
ETX (03H)	end of a command
EOT (04H)	Abort of memory output for the commands: "SS", "GS", "ts", "te", "ds", "de", "EE"
XON (011H)	software handshake (output continues)
XOFF (013H)	software handshake (stops output; 30 second maximum, otherwise the data logger switches off automatically!)

2.3.1.3 SERIAL DATA FORMAT

The data are delivered in tabular form with constant telegram length so that they can be processed by a tabular calculation program, for example. „EXCEL“.
Erroneous values are indicated by one or more "?" respectively "!". The data are output in tabular form. The separator character is at least one space (ASCII 32). Lines are concluded with "CR LF".

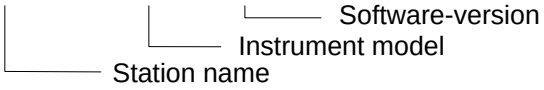
MEAN VALUES:

DATE LINE:



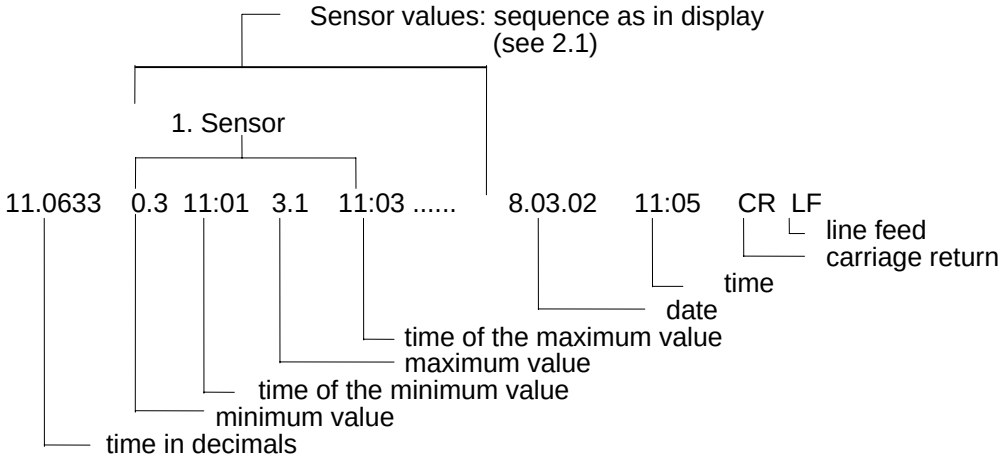
Remark: The date and time refer to the end of the measurement.

END LINE: "END OF DATA" "THIES CLIMA" "TDL 14 V3.12"



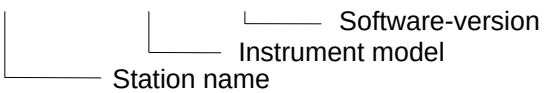
EXTREME VALUES:

DATA LINE:



Remark: Date and time refer to the end of measurement.

END LINE: "END OF DATA" "THIES CLIMA" "TDL 14 V3.12"



2.3.2 CONNECTING CABLE OF THE SERIAL INTERFACE (COM2) [1)]

The serial interface COM2 serves for the simple-transmission (transmission operation) of data.
A simultaneous connection to the RS232- or the RS422-output, as well, is possible.

RS232 – transmission:

PC/terminal SUB-D9 (9-pole)				Logger SUB_D9 (9-pole)
RXD	2	———	3	TXD
ground	5	———	5	ground

RS422 – transmission:

Interface converter RS422/RS232 9.1702.20.000 (DCE)			Logger 3-pole terminal strip
RXD-	———	2	TXD-
RXD+	———	1	TXD+
ground	———	3	ground

Please pay attention to the remarks in 2.3.1.1 concerning the cable with the RS422-transmission !

2.3.3 DATA OUTPUT OVER MEMORY-CARD [2)]

Output requires a memory card ("STARCARD" from ITT CANNON or compatible) with a memory capacity of at least 256 KBytes. The memory card should only be inserted into the holder of the data logger for read out.

SUGGESTIONS ABOUT USING THE MEMORY-CARD:
Battery-buffered static memories are used for data storage. Thus there must be a functioning battery in the memory card. The battery compartment is situated across from the contacts. To open the battery compartment, set the battery compartment lock to "UNLOCK" (use a tweezers or similar object). Now pull out the battery compartment. After returning the battery compartment to its original position, set the battery lock to "LOCK".

During transport and storage, make sure that the memory card is *always* in the anti-static cover!

[1)] only Datalogger: 9.1740.XX.01X
[2)] optional

The nominal operational life of the battery of the 256 KB memory card (type BS256F1-C) is 4 years, thus when the memory card is not used for a longer period of time, it is advisable to remove the battery.

1. Switch the data logger on with the <∇> key.

2. Insert the memory card into the data logger holder

3. Keep pressing the <∇> key until the words "data output" appear on the display. Continue to press the key (3 seconds) until the words "M-data" appear in the second line of the display.

4. Selecting the memory output: "M" stands for mean values and extreme values
   "E" stands for extreme values
   Mean values press <∇>
   Extreme values press <Δ>

   ***Please note**: Mean values and extreme values can be stored in succession on the memory card.*

5. Press <ENTER>: data output starts. Either "E" or "M" appears in the second line of the display, depending on what has been selected. In addition "MCard" and the number of data records output also appear.

6. Pressing the <ENTER> key interrupts transmission.

7. The end of the transmission is indicated in the display by ""end".

8. Remove the memory card from the holder.

9. Press <ENTER> to be able to operate the data logger "normally" again.

The memory card can be read out by a PC with a reading program and the corresponding reader (THIES accessories). The data format is set up in correspondence with the data lines in section 2.3.1.3. (The only difference: the data from the memory card always have only one space character as the separator.)

2.4 CHANGING THE STORAGE BATTERY

The storage battery, at the latest, has to be replaced when the indicated storage battery voltage drops below 9.0V. However, the storage battery should not be discharged below 11.0 V as there is no appreciable capacity available anymore. The operational life of the storage battery is considerably reduced when operated below 10.5 V! The new storage battery should be "freshly" charged once more as, owing to self-discharge (approx. 3% per month), it may not have its maximum capacity. The stored data are retained during the exchange process. Before the storage battery is disconnected, the data should be secured. Without the storage battery,
no measurements are carried out. Before the storage battery is connected, press the <∇> ON key and hold it down. After the battery has been connected and the key released once again, the data logger starts. No power is drawn from the buffer battery when the storage battery is connected (or when there is an external power supply); i.e. during this time, only the self-discharge factor is of importance for the operational life. The buffer battery can only be replaced by the manufacturer. When no power is drawn, the operational life of the buffer battery is 10 years.

***Please Note:** During installation it is important to make sure that all terminals are switched voltage-free and that individuals and/or instruments are not endangered!*

2.5 EXTERNAL POWER SUPPLY

2.5.1 DATA LOGGER WITHOUT TRANSFORMER (9.1740.x0.xxx)

The input for external power supply can be used to charge the storage battery and to supply the data logger with current. The terminal is situated below the cover plate for the sensor connections (pin 1 and 2).

The power supply must supply a current of at least 500 mA. The voltage range for direct voltage is 17 to 33 V DC and for alternating current voltage 14 to 24 V AC. Above pin 3 of the terminal there is a red light-emitting diode (LED). This controls the external power supply (LED lights up). The storage battery must always be connected. To switch the data logger on, first connect the storage battery. Then the external power supply can be switched on. Switch-off takes place in reverse order.

2.5.2 DATA LOGGER WITH TRANSFORMER (9.1740.x1.xxx/ 9.1740.x2.xxx/ 9.1740.x4.xxx)

The AC mains voltage on the transformer generates two low-voltages to supply power to the sensor heaters (26 V AC) and to the data logger (16 V AC). We recommend a medium anti-surge 1 A-fuse (1 A mtr) to protect the mains voltage.

Please Note: *The connection of protective earth PE to the transformer is absolutely imperative for safety reasons!*

2.5.3 DATA LOGGER WITH SOLAR PANEL (9.1740.x3.xxx/ 9.1740.x4.xxx)

The solar panel is connected over pin 3 and pin 4 on the terminal strip. In the integrated charge regulator in the data logger, the charging voltage changes with the temperature. That is why the storage battery should always be in the data logger case.

Please Note: *The integrated regulator is designed for a solar panel with nominal data 12V/20W. The use of a different panel could destroy the electronics!*

General information of the solar panel:

Solar panels in use in the Northern Hemisphere should be aligned towards the South. For winter operation (with limited solar radiation) we recommend that you set an elevation angle adapted to the site (for Germany approx. 50°). Be careful that the arrangement of sensors or traverses above the panel does not cast shadows. Clean the surface of the solar panel as required (to remove snow, leaves etc.).

2.6 CURRENT CONSUMPTION

As already mentioned in section 2.2.3, the current usage depends on the selected time intervals of data acquisition. It is necessary to differentiate between second and minute intervals [1)] , because two different processor modes are employed. In addition one must differentiate between the active phases of operation.
A GSM-mode that is switched-on and accu-operated, increases the current consumption considerably (min. operating current approx. 50 mA, data transfer approx. 200 mA). Therefore, in case of pure accu-solar operation the GSM-online periods should be brief

In the following we show how to calculate the current consumption for both modes of operation. Note that these calculations assume that the sensors are only switched on up to the time of data acquisition. However, some sensors must be in operation continuously (e.g. wind velocity sensors). For these cases the additional current consumption must be added to the calculated values. Furthermore, these calculations are only approximations due to the variable performance and ageing of the electronic components and the storage battery. The exact time intervals at which the storage battery needs to be recharged can be determined only by practical experience. The capacity depends greatly on the temperature: For operation below 0° assume only half the capacity.
For the data logger in mains-independent operation (only storage battery and solar panel), we basically recommend that you only set the measurement cycle to greater than or equal to one minute.
Due to the high current consumption of the ultrasonic a power-supply-independent operation with ultrasonic as wind sensor is not possible without additional external accu, and solar panels of appropriate dimensions.

2.6.1 QUERY SECONDS

Power consumption is composed of a continuously flowing current I_{cont} and a current which only flows together for approx 0.6 s for measurement of the sensors.

I_{cont} = ca. 50 mA (RS232 / V.24)
= ca. 55 mA (RS422 connect with Interface Converter)

The measurement current consists of a permanent component I_{query} and a current I_{sensor} which is dependent on the connected sensors. The total current I_{mean} can be calculated as follows:

$$I_{mean} = I_{cont} + \frac{I_{query} + I_{sensor}}{\text{Measurement cycle [s]}} * 0.6s$$

EXAMPLE:

Measurement cycle	=	5 s, (RS 232-Interface)
I_{sensor}	=	30 mA
I_{query}	=	18 mA

$$I_{mean} = 50\ mA + \frac{18\ mA + 30\ mA}{5s} * 0.6s = \text{approx. } 56\ mA$$

[1)] only Datalogger: 9.1740.XX.00X

From mean power consumption I_{mean}, conclusions can be drawn about the operating life of the storage battery:

$$\text{Operating life} = \frac{\text{Capacity}}{\text{Current}}$$

EXAMPLE: Capacity 7 Ah

Current I_{mean} = 56 mA

$$\text{Operating life} = \frac{7\ \text{Ah}}{56\ \text{mA}} = 125\ \text{h (ca. 5 days)}$$

Remark: *The data logger 9.1740.xx.x1x (with COM2) operates only in a second's cycle and needs approx. 55 mA. Approx. 30 mA for sensors result in a theoretical life period of approx. 82 h.*

2.6.2 QUERY MINUTES [1)]

As with QUERY SECONDS, power consumption is composed of a continuously flowing current I_{cont} and a current which only flows together for about 1.6 s for sensor measurement.

The current I_{cont} is lower than comparable current in query seconds by a factor of 10. Thus, query minutes is preferable in storage battery operation.

I_{cont} = approx. 1 mA (RS232 / V.24)
= approx. 4 mA (RS422)

The measurement current, in turn, consists of a permanent component I_{query} and a current dependent on the connected sensors I_{sensor}.

I_{query} = 18 mA

The total current I_{mean} can be calculated as follows:

$$I_{mean} = I_{cont} + \frac{I_{query} + I_{sensor}}{\text{Measurement cycle [min]} * 60\text{s}} * 1.6\text{s} * \text{min}$$

EXAMPLE: Measurement cycle = 1 min RS232-Interface
I_{sensor} = 30 mA

$$I_{mean} = 1\ \text{mA} + \frac{18\ \text{mA} + 30\ \text{mA}}{1\ \text{min} * 60\text{s}} * 1.6\text{s} * \text{min} = 2.3\ \text{mA}$$

[1)] only Datalogger: 9.1740.XX.00X

For the operating life of the storage battery one calculates:

$$\text{Operating life} = \frac{\text{Capacity}}{\text{Current}}$$

EXAMPLE: Capacity 7 Ah
Current I_{mean} = 2.3 mA

$$\text{Operating life} = \frac{7\ \text{Ah}}{2.3\ \text{mA}} = 3043\ \text{h (126 days)}$$

In case a GSM-modem is connected to the accu, the total current increases and the operating life reduces as follows:

EXAMPLE: Online time: t_{online} = ½ h per day

$$I_{total} = I_{mean} + \frac{I_{GSM} * t_{online}}{24\ \text{h}} = 2.3\ \text{mA} + \frac{200\ \text{mA} * ½\ \text{h}}{24\ \text{h}} = 6.5\ \text{mA}$$

$$\text{Operating life} = \frac{\text{Capacity}}{I_{total}} = \frac{7\ \text{Ah}}{6.5\ \text{mA}} = 1076\ \text{h (approx. 44 days)}$$

2.7 MEMORY TIME PERIOD

The storage period is the period of time until the old data are overwritten. The data logger has two ring memories. The time period of the mean value memory depends on the memory cycle set. The time period of the extreme value memory depends on the extreme value cycle set.

Memory Cycle and Extreme value cycle	Mean Value Time Period (days)		Extreme Values Time Period (days)	
	Standard	16 values *)	Standard	16 Values *)
1	4,08	3,64	0,38	0,34
2	8,17	7,28	0,76	0,68
3	12,26	10,92	1,15	1,02
4	16,35	14,56	1,53	1,36
5	20,43	18,2	1,92	1,7
6	24,52	21,84	2,3	2,04
10	40,87	36,4	3,84	3.4
12	49,05	43,68	4,6	4,08
15	61,31	54,6	5,76	5,01
20	81,75	72,8	7,68	6,8
30	122,62	109,2	11,52	10,2
60	245,25	218,4	23,04	20,4
120	-	-	46,08	40,8
180	-	-	69,12	61,2
240	-	-	92,16	81,6

*) only Datalogger: 9.1740.2X.XXX

2.8 CHANGING THE FUSE

If nothing appears on the display after you have pressed the on-key, this could mean that the fuse (situated above pin 6) has blown. (condition: storage battery not discharged).
To check whether this is the case, open the slide lock (press down and rotate towards the left) and remove the fuse. Check the fuse with a measurement instrument to test the flow of current (a visual check usually does not suffice!).
If the fuse is defective: exchange it for one of a similar type (100 mAT). If the data logger still does not go on:
Disconnect all sensor and serial connecting lines. Check the fuse again. If the data logger now switches on, then connect the cable one by one to the sensors until the fuse blows again to pinpoint the defective sensor. Return the defective sensor to the manufacturer for testing.
If the data logger still does not switch on, return it to us for a check.

Please Note: *The blowing of a fuse as a result of a direct or indirect bolt of lightning is a normal protective function.*

3. TECHNICAL SPECIFICATIONS

Case	:	stainless steel, rustproof
Type of protection	:	IP 65
Power supply		
Internal storage battery	:	12V 7Ah (lead gel, fuse for power supply failure)
Buffer-battery	:	3.6V 0.75Ah (lithium)
External power supply	:	14...24V AC / 17...33 V DC
External mains	:	230 V AC (with optional transformer) (9.1740.x1.xxx/ 9.1740.x4.xxx) or 115 VAC (9.1740.x2.xxx)
External solar panel	:	12 V / 20 W (with optional solar-regulator) (9.1740.x3.xxx/ 9.1740.x4.xxx)
Current consumption	:	approx. 50 mA (9.1740.xx.x10, COM1: RS232)
(w/o sensors)	:	approx. 55 mA (9.1740.xx.x11, COM1: RS422)
Operating life		
Accumulator	:	nominal 3,5 days with COM2 (1 s meas.cycle and 20°C ambient temperature)
	:	nominal 4 months (1 min meas.cycle w/o GSM and w/o sensors)
Operating temperature	:	-30...+50°C
Storage temperature	:	-40...+70°C
Analogue meas. value		
A/D-converter	:	min. 10 bit (1024 steps)
Meas. accuracy	:	± 0,2% of the meas. range
Channels	:	10
		3x temperature Pt 100, (and optionally 1x temperature, if a temperature compensation is not necessary!)
		1x radiation transmitter CM3/CM6B
		1x 0-1V
		2x 0-5V
		2x 0-10V/ 0-20mA/ 2-10V/ 4-20mA
Digital meas. values		
Channels	:	4
		synchronous-serial (wind direction)
		16 bit counter (wind speed)
		8 bit counter (precipitation)
		8 bit counter + status (precipitation) or virtual temperature [1)]

[1)] Datalogger: 9.1740.XX.50X

Measurement cycle	:	1 s fix adjusted or 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 s, 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 min [1)]
Memory cycle		
Mean values	:	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 min
Extreme values	:	as mean values, 120, 180 and 240 minutes are additionally adjustable
Time base	:	real time clock with automatic leap year adjustment. powered by the buffer battery. (accuracy ± 10ppm = ± 0,9s/ 24h at 25°C)
Memory capacity		
Semiconductor memory	:	256 KB data contents are secured by the buffer battery.
Number of data records		
Mean values	:	5886 / 5246 [2)]
Extreme values	:	553 / 490 [2)]
Memory period	:	for ex. mean value cycle 5 min, extreme value cycle 60 min: mean values 20,4 days extreme values 23,0 days
Data output	:	Remote control query via the serial interface (COM1). Option: Memory-card interface for 256 KB-memory-cards („starcard“).
Serial		
Interface COM1	:	RS232 (V.24), transmission distance 15 m (9.1740.xx.xx0) RS422 (V.11), transmission distance 1000 m (9.1740.xx.xx1) Parameters: 300...9600 baud, 19200bd u. 57600bd 7 data bits, even parity, 1 stop bit (7E1) or 8 data bits, no parity, 1 stop bit (8N1) basic setting: 9600bd 7E1, XON/XOFF-Handshake
Serial		
Interface COM2 [3)]	:	interface for online output, output cycles min. 1 second 2 output telegrams RS232 and RS422- output Parameter: 300 ... 9600 Baud 8 data bits, no parity, 1 stop bit (8N1) or 7 data bits, even parity, 1 stop bit (7E1)
Operation	:	3 keys on the instrument. remote control operation via serial interface (COM1).
LCD-Display		2 lines à 16 characters
Input resistance		
Sensor inputs	:	special input 3 0...1 V R = 20 kΩ special input 4/ 5 0...5 V R = 50 kΩ special input 1/ 2 0...10 V R = 100 kΩ 0...20 mA R = 250 Ω

[1)] Datalogger: 9.1740.XX.00X
[2)] Datalogger: 9.1740.2X.XXX
[3)] Datalogger: 9.1740.XX.01X

4. APPENDIX

4.1 Connecting Diagrams acc. to Instruments

see enclosed circuit diagrams

ADOLF THIES GmbH & Co. KG
Hauptstraße 76 37083 Göttingen Germany
P.O. Box 3536 + 3541 37025 Göttingen
Phone ++551 79001-0 Fax ++551 79001-65
www.thiesclima.com info@thiesclima.com