Instructions for Use

021714/08/13

Weather Station Compact WSC11

4.9056.00.00x

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Instructions for use

These instructions for use describe all application and adjustment options for the device.

These detailed instructions allow users to modify the factory settings to their needs via the serial interface of the Weather Station Compact WSC11.

Scope of supply

1 Weather Station Compact WSC11
1 copy of the instructions for uses

For assisting the parameter settings and/or special configurations there is our cost-free Device Utility Tool art.-no. 9.1700.81.000 available for you for download.

Please send a short e-mail to info@thiesclima.com, keyword "Utility Tool WSC 11" in the subject heading, as well as your sender information and our order number / invoice number.
We will then let you have your log-in for the download.

1 Device version

Designation	Order No.	Output terminal	Data format	Operating voltage
WEATHER STATION COMPACT WSC11	4.9056.00.000	1 x RS485	Data in ASCII format (command interpreter: THIES)	18...30 V DC 18...28 V AC
WETTERSTATION COMPACT WSC11	4.9056.00.001	1 x RS485	Data in binary format (command interpreter: MODBUS RTU)	18...30 V DC 18...28 V AC

2 Application

The WEATHER STATION COMPACT WSC11 is designed for use in building services automation systems (e.g. shade protection control). The WSC11 features the following measured variables:

- wind speed
- wind direction
- 4 x brightness (north / east / south / west)
- twilight
- global irradiance
- precipitation
- air temperature
- absolute air pressure
- relative air pressure
- time / date
- geostationary data (local altitude, longitude and latitude)
- position of the sun (elevation / azimuth)
- relative air humidity
- absolute humidity
- dew-point temperature
- inside temperature of housing

The interface to the device is digital and consists of an RS485 interface in half-duplex mode. Together with ID-based communications the interface allows the Weather Station to be operated in a bus. Two data protocols are available:

- ASCII (THIES- format)
- Binary (MODBUS RTU)

3 Structure / Mode of operation

Wind speed / wind direction:

Wind measurement is based on the hot wire principle. The underside of the housing is equipped with a heated cylindrical sensor. A PID controller adjusts the temperature of the cylinder to a temperature that is constantly increased in relation to the environment. The supplied heat energy is a measure of wind speed.

The metal cylinder contains four temperature-measuring resistors. These resistors are thermally coupled with the cylinder and positioned according to the 4 points of the compass. When an incident flow affects the cylinder as a function of the wind direction, this is accompanied by a temperature gradient which is registered by the measuring resistors. The relationships between the 4 temperature values are used to calculate the wind direction.

In case the wind direction cannot be determined because the wind velocity is 0 m/s, the value is set to 0. Wind from the north is displayed with 360°.

Brightness:

The brightness measurement is carried out via 4 Silicium photo sensors, which are aligned to the 4 cardinal directions in the mean elevation angle (40°).

Twilight:

Twilight means the light diffusion in the atmosphere, which arises with the smooth transition between day and night before the beginning or after the end of day.
i.e., the solar disc is not visible.
The twilight is direction-independent.
It is calculated from the sum of the 4 measuring values of the direction-independent brightness sensors.
A change to the mean value from the 4 brightness values is possible by command.

Global irradiance:

A silicon PIN photodiode is used to measure global irradiance. The sensor is positioned horizontally and registers the diurnal values of the solar irradiation intensity.

Precipitation:

The detection of precipitation is based on conductivity measurement, i.e. the conductivity of the sensor surface varies when wet. The sensor is installed in the housing cover. An integrated heating system adjusts the sensor area to an overtemperature in relation to the ambient temperature. This over temperature (approx. 2K) prevents bedewing of the sensor surface. The thermal output is increased with precipitation. This accelerates drying of the sensor, allowing the time at which precipitation ended to be identified more accurately.

Air temperature:

A PT1000 measuring resistor is used to measure the air temperature. The sensor is mounted on a flexible printed board and positioned in the lower section of the housing.

Air pressure:

Absolute air pressure is measured with a piezoresistive MEMS sensor.

To make a meaningful comparison between air pressure values simultaneously measured at different locations, they need to be converted to a common datum (height above sea level). The calculation is referred to the height above sea level (QNH) according to the international altitude formula (DIN ISO2533).

$$p(h) = p_b(1 + \frac{\beta}{T_b} \cdot h)^{-\frac{g_n}{\beta \cdot R}}$$

P_h = air pressure at local altitude
P_b = air pressure at height above sea level
β = -0065K/m
g_n = 9.80665m/s^2
R = 287.05287m^2/K/s^2
T_b = 288.15K

The station height, required for the calculation, can be entered manually by the **Command SH**, or can be determined automatically by GPS.
If you want to achieve an accuracy of 0.1hPa, referred to sea level, the local altitude (altitude of the baro transmitter) must be given up to an accuracy of 0.8 m.

Time / date and geostationary data:

The Weather Station has a GPS receiver with a built-in RTC. This allows it to receive the position of the Weather Station (degree of longitude/latitude, local altitude) time (UTC) and date. The GPS receiver does not need alignment.
The built-in RTC (Real Time Clock) is buffered with a backup capacitor and retains its data without a voltage supply for a period of minimum 3 days.

Position of the sun (elevation / azimuth):

On the basis of the GPS data the current sun position is calculated every second.

Humidity measurement:

A built-in hygro-thermosensor is used to measure humidity levels. The sensor has a small air exchange volume thanks to its compact design and responds to changes in humidity in seconds.

A software module uses the relative humidity and air temperature to calculate absolute humidity and the dew-point temperature.

Inside temperature of housing:

A silicon temperature sensor measures the temperature inside the housing.

GPS-Receiver:

The weather station has a GPS receiver with integrated RTC (Real Time Clock) for receiving the position of the weather station, and time + date (UTC).
An alignment of the GPS receiver is not necessary.
The integrated RTC is buffered for a period of 3 days.
General information:
After activation of the WSC11 the first satellite data are available after approx. 2.5 min.

When receiving the signals from one satellite:	time with an accuracy of < 1 µs.
When receiving the signals from three satellites:	position with an accuracy of < 20 m
When receiving the signals from four satellites:	altitude, referred to the WGS84-ellipsoid, with an accuracy < 30 m

4 Installation of COMPACT WSC11 Weather Station

> **Please note:**
>
> **The working position of the COMPACT WSC11 Weather Station is horizontal (plug connection underneath).**
> **During installation, de-installation, transport or maintenance of the COMPACT WSC11 Weather Station make sure that no water gets into the device and connector.**

4.1 Selection of installation site

An exposed position should be selected for this site. Measurement properties should not be influenced by light reflections, cast shadows or the device being positioned in the lee of the wind. Protection against lightning and overvoltages should also be provided by the customer.

4.2 Mechanical installation

The intended installation of the Weather Station WSC11 requires the use of a pipe socket / pipe with an **outside diameter of ≤25 mm**. The **inside diameter must be ≥19 mm** to admit the connector and cable.

Tool:

  Hexagon socket wrenchSW2 mm
  (socket wrench)

Procedure:

1. Push cable/plug connection through the bore hole of the mast, tube, bracket etc.
2. Put WSC11 on mast, tube.
3. Align WSC11 to "north". (**Procedure see chapter 4.2.1**).
4. Secure WSC11 by the M4-hexagon socket screw.

> *Attention:*
>
> ***The hexagon socket screw is to be tightened by 0.6 Nm.***
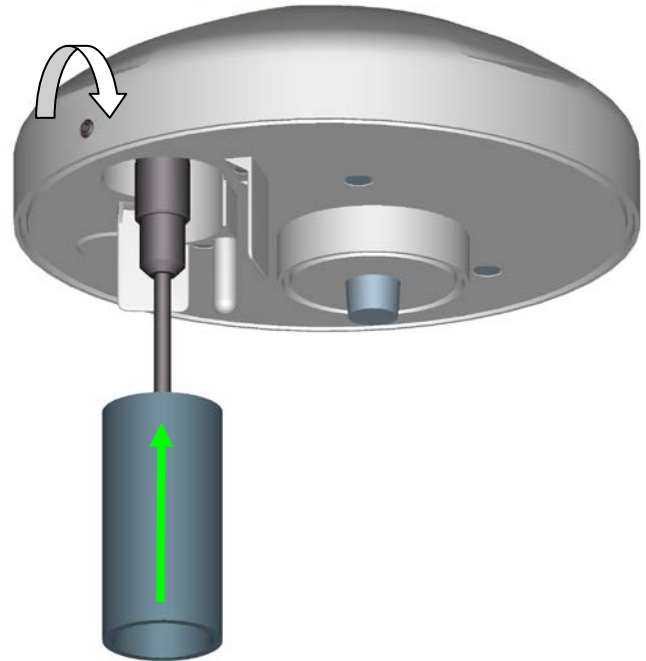
When using the **mounting angel article no. 509276** (see chap. accessories) the **guide angles must be removed**, see fig.

The mounting angle is not included in delivery.
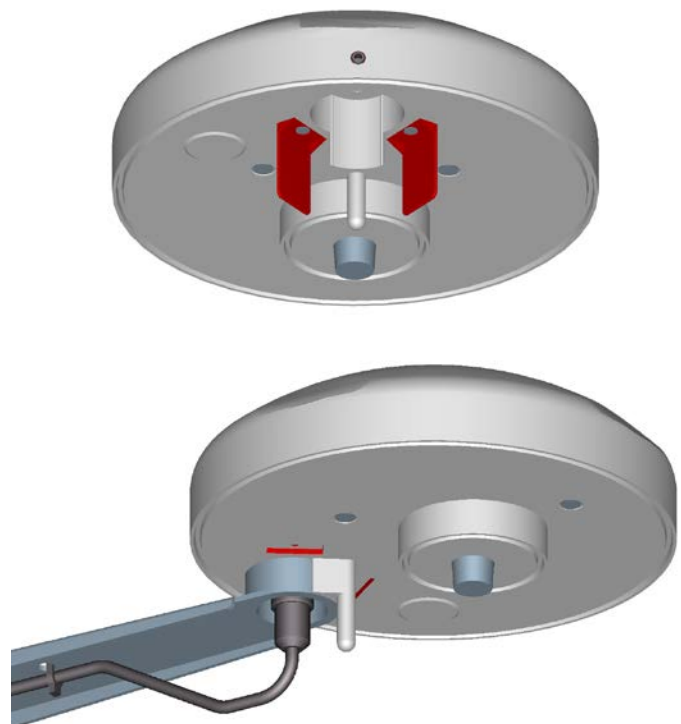
Remark: Tube and mounting angle are not included in delivery.

4.2.1 Alignment to north

For the exact determination of wind- and brightness direction the WEATHER STATION COMPACT WSC11 must be mounted in **north alignment** (geographic north).

The hexagon socket screw **serves as north marking (N)**

Tool:

> Hexagon socket wrenchSW2 mm (socket wrench)

Procedure:

1. Detect a prominent object in the surrounding area (tree, building etc.) in north direction by means of a compass.

2. Via the north marking (N) and an imaginary north-south axis the weather station is to be located on the prominent object.

3. Align weather station.
   The north marking must indicate to the geographic north.

4. In case of match the weather station is to be secured by an M4-hexagon socket screw.
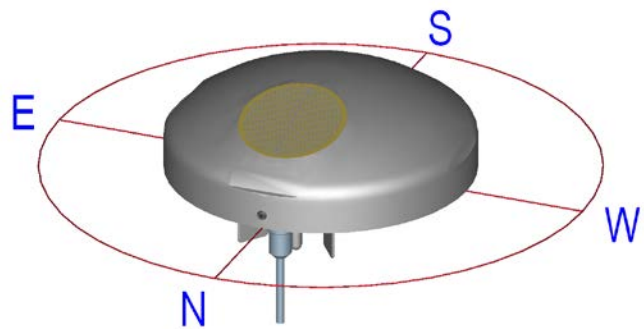
Attention:

> *The hexagon socket screw is to be tightened by 0.6 Nm.*

Remark:

With the north alignment by means of a compass, the local variation (deviation in direction of a compass needle from the true north direction) by interfering magnetic fields, and magnetic field influences by hardware and electric cable are to be considered.

4.3 Electrical installation

The COMPACT WSC11 Weather Station is equipped with a 5-pin plug for electrical connection. A cable socket (mating connector) is included in the scope of supply.

4.3.1 Cable, cable preparation, connector installation

The cable to be used for connection should have the following properties:
5 cores, core cross-section max. 0.25 mm², cable diameter max. 5.0 mm, resistant to ultraviolet rays, overall shielding.

Note:

A prepared connecting cable is available for the COMPACT WSC11 Weather Station as an optional accessory.

Cable socket, type: Binder, series 711

Trägerhalbschale-Oberteil (grau)
carrier sleeve part 1 (grey)

Gewindering Dose
connection ring female connector

Druckschraube
pressing screw

Buchseneinsatz
female insert

Trägerhalbschale-Unterteil (schwarz)
carrier sleeve part 2 (black)
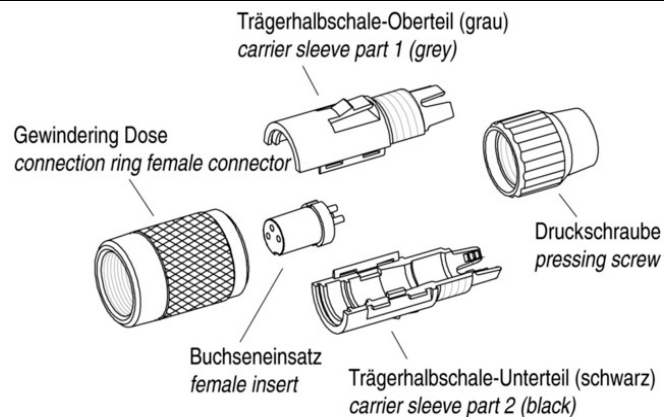
Achtung: max. Drehmoment des Gewinderinges im Flanschsteckverbinder: 50c
Attention: *max. torque of ring nut in socket connector: 50cNm (manual adjustme*

4.3.2 Diagram of connections
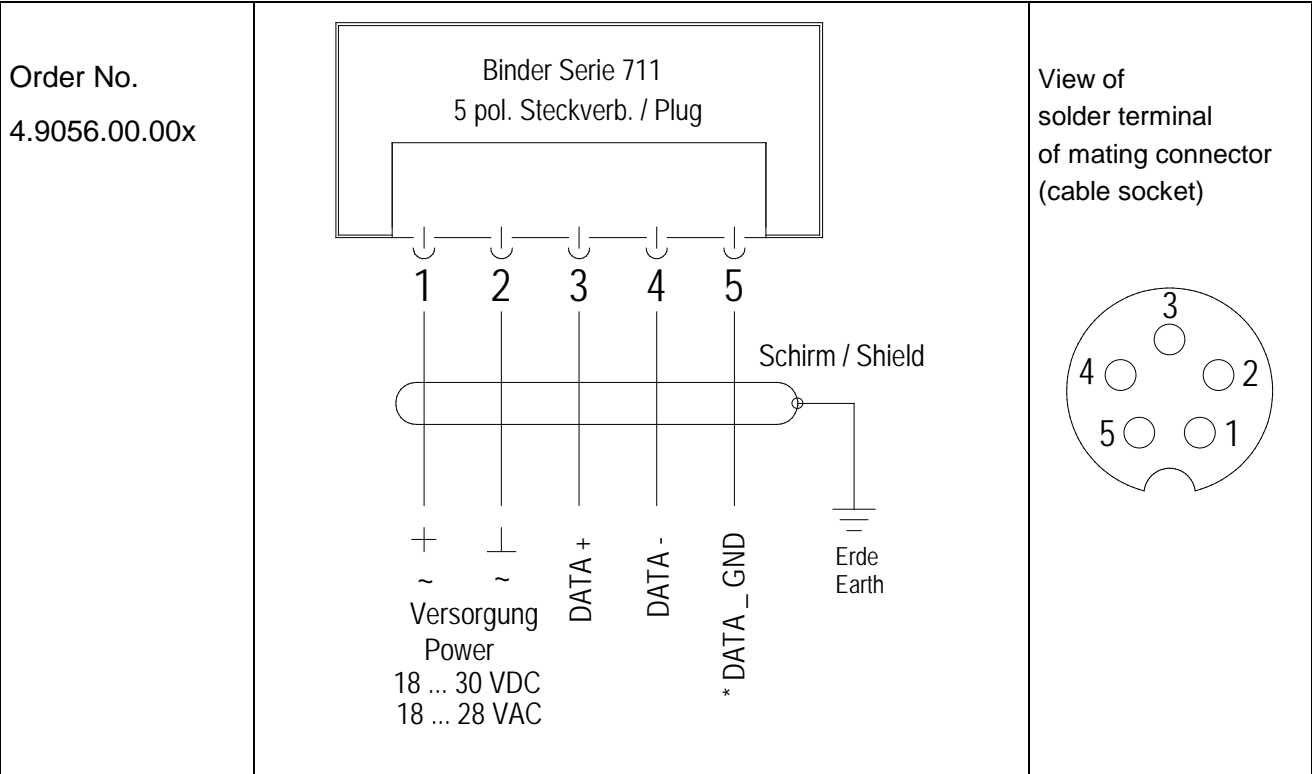
Order No. 4.9056.00.00x	**Binder Serie 711** **5 pol. Steckverb. / Plug** Pins: 1 2 3 4 5 Schirm / Shield 1: + ~ 2: ⊥ ~ 3: DATA + 4: DATA - 5: * DATA_GND Versorgung Power 18 ... 30 VDC / 18 ... 28 VAC Erde Earth

View of solder terminal of mating connector (cable socket)

* With long transmission paths connection to the GND of data acquisition may reduce their susceptibility to interference.

Important:

There should not be any electrical connection between power_GND and DATA_GND.

4.3.3 Connection using cable 509279 / 509445 (optional accessory)

PIN	Core colour	Function
1	WHITE	+ power 18...30 V DC / 18...28 V AC
2	BROWN	- power 18...30 V DC / 18...28 V AC
3	BLACK	DATA +
4	BLUE	DATA -
5	GREY	* DATA _ GND

* With long transmission paths connection to the GND of data acquisition may reduce their susceptibility to interference.

Important:

There should not be any electrical connection between power_GND and DATA_GND.

5 Maintenance

As the device does not have any moving parts, i.e. is not subject to wear during operation, only minimal servicing is required.
Depending on the location the instrument might pollute. The cleaning should be carried out by means of water and a soft cloth. Aggressive cleaning agents must not be used.

> **Please note:**
> *During storage, installation, de-installation, transport or maintenance of the COMPACT WSC11 Weather Station make sure that no water gets into the device or connector.*

6 Interface

The interface to the Weather Station consists of a RS485 link (half-duplex mode), with the following data format:

- 9600 baud (the baud rate can be selected with the **Command BR**)

- 8 data bits

- no parity

- 1 stop bit

- Data in ASCII format (command interpreter: THIES)

- Data in binary format (command interpreter: MODBUS RTU)

The behavior (configuration) of the Weather Station can be changed using the available commands (see **Commands and description**). For the command interpreter Thies-type the query of the measuring values is carried out by the **Command TR** or resp. by the **Command TT**.

When the Weather Station starts up, the character string "Weather Station", software version, hardware version and serial number is output:

Weather Station
v03.04
508990 v11-11
12030123

6.1 Command interpreter THIES

The Weather Station is equipped with a command interpreter of THIES-type, which can be used to change the behaviour of the device. This allows you for example to adjust the averaging periods for wind speed and wind direction. Commands basically have the following structure:

- <id><command><CR>   (no parameter: used to interrogate the selected parameter)
- <id><command><parameter><CR>   (with parameter: used to set a new parameter)

id: identification number ("00" to "99")
command: command encompassing 2 characters (see list of commands)
parameter: parameter value with between 1 to 10 positions (decimal value in ASCII format)
<CR>:   carriage return (13_{dec}; 0x0D)

The 'id' identification number allows several devices to be operated together in a bus system. Every device is assigned its own 'id' (see **Command ID**), and automatic telegram output is switched off (see **Command TT**).

A transmitted command is acknowledged with an echo telegram. The echo telegram starts with a "!" followed by the id, command and value selected. It ends with the characters "carriage return" and "new line".

Commands can be transmitted with or without a parameter. If no parameter is specified, the set value will be output.

Example: 00BR<CR>
                      !00BR00005<CR>

If a command is transmitted with a parameter, the parameter is verified. If it is valid, it will be saved and specified in the echo telegram. If the parameter is invalid, it will be disregarded and the set value output in the echo telegram.

Examples:

00BR00005<CR>	transmission command
!00BR00005<CR>	echo telegram (parameter valid and password OK)
00BR00004<CR>	transmission command
!00BR00005<CR>	echo telegram (parameter valid but key incorrect)

> **Note:**
>
> **The values measured by the sensor can be queried with the command TR.**
> **In this case the Weather Station does not respond with the echo telegram, but with the requested data telegram!**

To avoid any unintentional change in parameters, some commands (see list of commands) are protected with a password. This password must be transmitted before the actual command.

Example: Change baud rate

00KY234<CR>	Release commands of user level
00BR4<CR>	Set baud rate to 4800
!00BR00004<CR>	Baud rate set to 4800

The Weather Station supports 3 different password levels.

- user level (password: "234")
- calibration data level
- administrator level

> **Please note:**
>
> **Password-protected commands are released as long as one of the following conditions is satisfied:**
> **- the supply voltage is switched**
> **- command 00KY0<CR> is transmitted**
> **- no new command is transmitted for min. 120s.**

6.1.1 Data telegrams

Data output takes place in response to a request with the command TR. You can chose between the following telegrams:

- measured value telegram (parameter=1)
- sensor data telegram (parameter=2)

Calculation of the checksum, the composition of the status word and the control characters/separators used in the telegrams are described below.

Control characters:

CR – Carriage return (13$_{dec}$; 0x0D)
LF – Line feed (10$_{dec}$; 0x0A)
STX – Start of text (2$_{dec}$; 0x02)
ETX – End of text (3$_{dec}$; 0x03)

Separators:

The semicolon ';' is used as the separator between the individual measured values in the string.
The checksum separator is the multiplication sign '*'.

Checksum:

The checksum is the XOR link of all characters between <STX> and the byte <*>.
The asterisk acts as the separator from the checksum and is no longer included in the checksum.

Status:

The Weather Station includes a status word (16-bit), which supplies information about the status of the Weather Station. The measured values undergo a plausibility check and are shown in the status word.

Bit number	Function	Description
Bit 0	Precipitation sensor	=1, bedewing protection active
Bit 1	Precipitation sensor	=1, drying phase of sensor surface
Bit 2	GPS data	=1, no valid RMC telegram received
Bit 3	RTC data from GPS receiver	=1, time from GPS receiver invalid
Bit 4	ADC values	=1, values from analog-digital-converter invalid
Bit 5	Air pressure	=1, measured value from air pressure sensor invalid
Bit 6	Brightness north	=1, measured value from brightness sensor north invalid
Bit 7	Brightness east	=1, measured value from brightness sensor east invalid
Bit 8	Brightness south	=1, measured value from brightness sensor south invalid
Bit 9	Brightness west	=1, measured value from brightness sensor west invalid
Bit 10	Twilight	=1, measured value for twilight invalid
Bit 11	Global irradiance	=1, measured value from global irradiance sensor invalid
Bit 12	Air temperature	=1, measured value from air temperature sensor invalid
Bit 13	Precipitation	=1, measured value from precipitation sensor invalid
Bit 14	Wind speed	=1, measured value from wind speed sensor invalid
Bit 15	Wind direction	=1, if measured value from wind direction sensor is invalid.

Table 1 : Status word

6.1.1.1 Measured value telegram

The Weather Station responds to the command "00TR1\r" with the measured value telegram. The telegram structure is given in the following table.

Position	Length	Example	Description
1	1	<STX>	Start of text characters (0x02)
2	3	WSC	Designates theWSC11 Weather Station
5	1	;	Semicolon
6	2	##	Identification number of Weather Station
8	1	;	Semicolon
9	19	dd.mm.yyyy hh:mm:ss	Date and time separated with a blank character dd: day, mm: month, yyyy: year, hh: hour, mm: minute, ss: second
28	1	;	Semicolon
29	6	######	Specifies time format: UTC CEST CET UTC+xh
35	1	;	Semicolon
36	5	###.#	Brightness north (kLux)
41	1	;	Semicolon
42	5	###.#	Brightness east (kLux)
47	1	;	Semicolon
48	5	###.#	Brightness south (kLux)
53	1	;	Semicolon
54	5	###.#	Brightness west (kLux)
59	1	;	Semicolon
60	3	###	Twilight (Lux)
63	1	;	Semicolon
64	4	####	Global irradiance (W/m2)
68	1	;	Semicolon
69	5	###.#	Air temperature (°C)
74	1	;	Semicolon
75	1	#	Precipitation status (0: no precipitation, 1: precipitation)
76	1	;	Semicolon
77	4	##.#	Average[1] wind speed (m/s)
81	1	;	Semicolon
82	3	###	Average[1] wind direction (°)
85	1	;	Semicolon
86	6	####.#	Absolute air pressure (hPa)
92	1	;	Semicolon
93	6	####.#	Relative air pressure (hPa), referred to height above sea level
99	1	;	Semicolon
100	5	###.#	Inside temperature of housing (°C)
105	1	;	Semicolon
106	5	###.#	Relative humidity (% r.h.)
111	1	;	Semicolon
112	6	###.##	Absolute humidity (g/m³)
118	1	;	Semicolon
119	5	###.#	Dew-point temperature (°C)
124	1	;	Semicolon

Position	Length	Example	Description
125	11	####.######	Degree of longitude (°) (GPS position) Positive sign for longitude in eastern direction. Negative sign for longitude in western direction.
135	1	;	Semicolon
136	1	##.######	Degree of latitude (°) (GPS position)
137	10	###.######	Latitude (°) (GPS position) Positive sign for latitude in northern direction. Negative sign for latitude in southern direction.
147	1	;	Semicolon
148	5	###.#	Position of the sun, elevation or resp. elevation angle (°) On sunrise and sunset elevation equals 0°. Between these distinctive points (i.e. intraday) the elevation takes positive values.
153	1	;	Semicolon
154	5	###.#	Position of the sun, azimuth or resp. geographic direction (°) The azimuth is counted positively from the north to the south. 0° = north ; 180° = south
159	1	;	Semicolon
160	4	####	16-bit sensor status in hexadecimal format (0000 – FFFF)
164	1	*	Asterisk as separator for checksum
165	2	##	8-bit checksum in hexadecimal format (00 – FF). The checksum is calculated from the exclusive OR link of all characters after STX to the character before "*".
167	1	<ETX>	End of text characters (0x03)
168	1	<CR>	Carriage return (0x0D)
169	1	<LF>	Line feed (0x0A)

Table 2 : Measured value telegram

[1] : The averaging interval is selected with the **Command AI**.

Measured values

The measured values are 1-second average values, with the exception of wind speed and wind direction.

If the specified measuring range is exceeded (see **Technical data**), the measured value is limited to the maximum (terminal value of measuring range) and the relevant bit set in the status (see **Table 1 : Status word**).

6.1.1.2 Sensor data telegram

The Weather Station responds to the command "00TR2\r" with the sensor data telegram. The telegram structure is given in the following table.

Position	Length	Example	Description
1	1	<STX> 0x02	Start of text characters
2	10	##########	Serial number
12	1	;	Semicolon
13	5	##-##	HW version (e.g. 06-11)
18	1	;	Semicolon
19	5	##.##	SW version (e.g. 01.00)
24	1	;	Semicolon

25	6	####.#	Height of Weather Station referred to height above sea level in metres, derived from the GPS data (Geoid Model)
31	1	*	Asterisk as separator for the checksum
32	2	##	8-bit checksum in hexadecimal format (00 – FF). The checksum is calculated from the exclusive OR link of all characters after STX to the character before "*".
34	1	<ETX> 0x03	End of text characters
35	1	<CR> 0x0D	Carriage return
36	1	<LF> 0x0A	Line feed

Table 3 : Sensor data telegram

6.2 Command interpreter MODBUS RTU

Once the command interpreter is selected the transmitted bytes are interpreted according to the MODBUS specification (http://www.modbus.org/). Here, the weather station WSC11 is representing a MODBUS Slave.

The data transmission is carried out in packages, so-called frames, of maximum 256 bytes. Each package contains a 16bit CRC checksum (initial value: 0xffff).

Slave-Address	Function code	Data	CRC	
1 byte	1 byte	0...252 byte(s)	2 bytes	
			CRC low-byte	CRC high-byte

Table 4 : MODBUS Frame

The following MODBUS functions are supported:

- 0x04 (Read Input Register)
- 0x03 (Read Holding Registers)
- 0x06 (Write Single Register)
- 0x10 (Write Multiple Registers)

The weather station WSC11 supports a write access for the slave-address 0 ("Broadcast").

All received MODBUS request are checked for validity before carrying out. In error case the weather station responds with one of the following exceptions (➔MODBUS Exception Responses).

Code	Name	Signification
0x01	ILLEGAL FUNCTION	The function code in the request is not allowed for the register address.
0x02	ILLEGAL DATA ADDRESS	The register address in the request is not valid.
0x03	ILLEGAL DATA VALUE	The stated data in the request are not allowed.

Table 5: MODBUS Exceptions

6.2.1 Measuring values (Input Register)

All measuring values of the weather station WSC11 consume 32Bit, i.e. 2 MODBUS register addresses. The following table shows the allocation of measuring value to register address, while the measuring values are sorted as follows:

- by measuring value type (30001 to 34999)

- in unbroken sequence (35001 to 39999)

Register address	Parameter Name	Unit	Multiplicator	Explanation	Data type
30001	Wind speed	m/s	10	value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
30003	Mean value Wind speed	m/s	10	value / 10 (1 decimal place, e.g.. 101=10.1m/s)	U32
30201	Wind direction	°	10	value/ 10 (1 decimal place, e.g. 1010=101.0°)	U32
30203	Mean value Wind direction	°	10	value / 10 (1 decimal place, e.g. 1010=101.0°)	U32
30401	Air temperature	°C	10	value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
30403	Interior temperature of housing	°C	10	value / 10 (1 decimal place, e.g. 355=35.5°C)	S32
30601	relative humidity	%r.h.	10	value/ 10 (1 decimal place, e.g. 355=35.5°r.F.)	U32
30603	absolute humidity	g/m³	100	value / 100 (2 decimal places, e.g. 923=9.23g/m^3)	U32
30605	Dew point temperature	°C	10	value / 10 (1 decimal place, e.g. 115=11.5°C)	S32
30801	Absolute air pressure	hPa	100	value / 100 (2 decimal places, e.g. 105000=1050.00hPa)	U32
30803	Relative air pressure relating to NHN	hPa	100	value / 100 (2 decimal places, e.g. 105000=1050.00hPa)	U32
31001	Global radiation	W/m²	10	value / 10 (1 decimal place, e.g 10000=1000.0W/m^2)	S32

31201	Brightness north	kLux	10	value / 10 (1 decimal place, e.g. 1200=120.0kLux)	U32
31203	Brightness east	kLux	10	value / 10 (1 decimal place, e.g. 1200=120.0kLux)	U32
31205	Brightness south	kLux	10	value / 10 (1 decimal place, e.g, 1200=120.0kLux)	U32
31207	Brightness west	kLux	10	value / 10 (1 decimal place, e.g. 1200=120.0kLux)	U32
31209	Twilight	Lux	1	value (no decimal place, e.g. 500=500Lux)	U32
31401	Precipitation status		1	value (no decimal place, (0=no precipitation, 1=precipitation)	U32
34601	Date		1	value (no decimal place, JJJJMMTT, e.g. 20121210=10.12.2012)	U32
34603	Time		1	value (no decimal place, HHMMSS, e.g. 121035=12:10:35)	U32
34605	Time format	h	1	value (no decimal place, offset to UTC in hours, e.g. 60=UTC+1h)	S32
34801	Longitude	°	1000000	value / 1000000 (6 decimal places, e.g.)	S32
34803	Latitude	°	1000000	value/ 1000000 (6 decimal places, e.g.)	S32
34805	Sun position Elevation	°	10	value / 10 (1 decimal place, e.g. 900=90.0°)	S32
34807	Sun position Azimuth	°	10	value / 10 (1 decimal place, e.g. 1800=180.0° / 0°=north, 180°=south)	S32
34809	Height above sea level	m	1	value (no decimal place, e.g. 240=240m above sea level)	U32
34811	Sensor status		1	value (no decimal place, bit coded, dep. of sensor)	U32
34813	Main loop cycles per 1s	1/s	1	Value (no decimal place, for ex. 2550=2550 1/s)	U32

34815	Operating time	s	1	Value (no decimal place, for ex. 255=255s)	U32
35001	Wind speed (30001)[1]	m/s	10	value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35003	Mean value Wind speed (30003)[1]	m/s	10	value / 10 (1 decimal place, e.g. 101=10.1m/s)	U32
35005	Wind direction (30201)[1]	°	10	value/ 10 (1 decimal place, e.g. 1010=101.0°)	U32
35007	Mean value wind direction (30203)[1]	°	10	value / 10 (1 decimal place, e.g. 1010=101.0°)	U32
35009	Air temperature (30401)[1]	°C	10	value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
35011	Interior temperature of housing (30403)[1]	°C	10	Value / 10 (1 decimal place, e.g. 355=35.5°C)	S32
35013	Dew point temperature (30605)[1]	°C	10	value/ 10 (1 decimal place, e.g. 115=11.5°C)	S32
35015	Rel. humidity (30601)[1]	%r.h.	10	value / 10 (1 decimal place, e.g. 355=35.5°r.h.)	U32
35017	Abs. humidity (30603)[1]	g/m^3	100	value / 100 (2 decimal places, e.g. 923=9.23g/m^3)	U32
35019	Absolute air pressure (30801)[1]	hPa	100	value / 100 (2 decimal places, e.g. 105000=1050.00hPa)	U32
35021	Rel. air pressure relating to sea level (30803)[1]	hPa	100	value / 100 (2 decimal places, e.g. 105000=1050.00hPa)	U32
35023	Global radiation (31001)[1]	W/m^2	10	value / 10 (1 decimal place, e.g. 10000=1000.0W/m^2)	S32
35025	Brightness north (31201)[1]	kLux	10	value / 10 (1 decimal place, e.g. 1200=120.0kLux)	U32
35027	Brightness east (31203)[1]	kLux	10	value / 10 (1 decimal place, e.g. 1200=120.0kLux)	U32
35029	Brightness south (31205)[1]	kLux	10	value / 10 (1 decimal place, e.g. 1200=120.0kLux)	U32
35031	Brightness west (31207)[1]	kLux	10	value / 10 (1 decimal place, e.g. 1200=120.0kLux)	U32

35033	Twilight (31209) [1]	Lux	1	value (no decimal place, e.g. 500=500Lux)	U32
35035	Precipitation status (31401) [1]		1	value (no decimal place, (0=no precipitation, 1=precipitation)	U32
35037	Date (34601) [1]		1	value (no decimal place, JJJJMMTT, e.g. 20121210=10.12.2012)	U32
35039	Time (34603) [1]		1	value (no decimal place, HHMMSS, e.g. 121035=12:10:35)	U32
35041	Time format (34605) [1]	h	1	value (no decimal place, Offset to UTC in hours, e.g. 60=UTC+1h)	S32
35043	Longitude (34801) [1]	°	1000000	value / 1000000 (6 decimal places, e.g.)	S32
35045	Latitude (34803) [1]	°	1000000	value / 1000000 (6 decimal place, e.g.)	S32
35047	Sun position Elevation (34805) [1]	°	10	value / 10 (1 decimal place, e.g. 900=90.0°)	S32
35049	Sun position Azimuth (34807) [1]	°	10	value / 10 (1 decimal place, e.g. 1800=180.0° / 0°=north, 180°=south)	S32
35051	Height above sea level (34809) [1]	m	1	Wert (no decimal place, e.g. 240=240m above sea level)	U32
35053	Sensor status (34811) [1]		1	value (no decimal place, bit coded, dep. of sensor)	U32
35055	Main loop cycles	1/s	1	value (no decimal place, number cycles per 1s)	U32
35057	SHT2x temperature	°C	10	value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
35059	NTC temperature	°C	10	value / 10 (1 decimal place, e.g. 255=25.5°C)	S32
35061	Operating time	s	1	Value (no decimal place, for ex. 24000=24000s since last reset)	U32

Table 6 : MODBUS Input Register

[1]: The numbers in parentheses describe the register addresses, which mean the same measuring value. Thus, the wind speed for ex. is situated at address 30001 and at address 35001.

6.2.2 Commands (Holding Register)

All commands of the weather station WSC11 consume 32Bit, i.e. 2 MODBUS register addresses, and are representing unsigned integral numbers. The following example shows the changing of the baud rate to 19200 baud.

1. Set password for the user level (KY=234)

Slave address	Function code	Starting address	Number Registers	Number byte(s)	Data	CRC	
0x01	0x10	0x9C 49	0x00 02	0x04	0x00 00 00 EA	0x4F 7C	
						CRC low-Byte	CRC high-Byte

2. Set command baud rate to 19200 baud (BR=6)

Slave address	Function code	Starting address	Number Registers	Number byte(s)	Data	CRC	
0x01	0x10	0x9C 45	0x00 02	0x04	0x00 00 00 06	0x4E A4	
						CRC low-Byte	CRC high-Byte

6.3 Commands and description

The following table lists the available commands and the associated passwords for read / write.

Command	MODBUS register address	Description	Password	
			Read[1]	Write[2]
Command AI	40069	Averaging interval for wind speed and wind direction	None	User
Command BR	40005	Select baud rate	None	User
Command CI	40013	Command interpreter	None	User
Command DC	40081	Mode of calculation for twilight	None	User
Command DO	40037	North correction of wind direction	None	User
Command FB	40001	Quick-start mode	None	User
Command ID	40003	Identification number resp. slave address	None	User
Command KY	40009	Set key / password	None	None
Command LC	40045	LED control	None	None
Command RS	40029	Reset	None	User
Command TR	-	Telegram output	None	None
Command SH	40071	Station height	None	User
Command TT	-	Automatic telegram output	None	None
Command TZ	40073	Time zone	None	User
Command SV	45005	SW-Version	None	--

Table 7 : List of commands

[1]: Command without parameter (used to read selected parameter)
[2]: Command with parameter (used to write a new parameter)

6.3.1 Command AI

<id>AI<parameter><CR>	Averaging interval for wind speed and wind direction
Access:	Read / write
Description:	The command AI is used to specify the averaging interval for the wind speed and wind direction in minutes. The averaging of the wind velocity is scalar, and the averaging of the wind direction vectorial.
	If the parameter is 0, the averaging is deactivated, and the mean values correspond to the instantaneous values. Here, the wind direction is reset (to 0°) during calm (< 0.6 m/s).
	Wind from the North is displayed with 360°.
Parameter description:	AI = 0 ➔ averaging disabled AI = 1 ➔ averaging interval = 1 minute
Value range:	0...10
Initial value:	10

6.3.2 Command BR

<id>BR<parameter><CR>   Select baud rate

Access: Read / write

Description: The command BR is used to select the required baud rate.

Parameter description:

Parameter	Description
12	1200 baud (8n1)
24	2400 baud (8n1)
48	4800 baud (8n1)
96	9600 baud (8n1)
192	19200 baud (8n1)
384	38400 baud (8n1)
576	57600 baud (8n1)
1152	115200 baud (8n1)

Value range: 12 / 24 / 48 / 96 / 192 / 384 / 576 / 1152

Initial value: 96

6.3.3 Command CI

<id>CI<parameter><CR>   selection of command interpreter

Access: read / write

Description: The requested command interpreter is set by command CL.

> **Remark:**
> *If the identification number (ID) is > 98, it is set to 0 automatically with the change-over to the THIES interpreter!*

> **Remark:**
> *If the identification number (ID) equals 0, a change-over to the MODBUS-RTU-interpreter is not possible!*

Parameter description:

Parameter	Description
0	THIES
1	MODBUS RTU

Value range: 0 to 1

Initial value: 0

6.3.4 Command DC

<id>DC<parameter><CR>	Mode of calculation for twilight
Access:	read/ write
Description:	The mode of calculation for twilight is stated by command DC. The twilight is calculated from the 4 brightness values, depending on direction. Here, one can select between sum and mean value.
Parameter description:	0: Twilight corresponds to the sum of the 4 brightness values 1: Twilight corresponds to the mean value of the 4 brightness values
value rang:	0...1
Initial value:	0

6.3.5 Command DO

<id>DO<parameter><CR>	North correction of wind direction
Access:	Read / write
Description:	The command DO is used to specify an offset for the wind direction in °. This brings about correction to the north for the Weather Station.
Value range:	0…360
Initial value:	0

6.3.6 Command FB

<id>FB<parameter><CR>	Quick-start mode
Access:	Read / write
Description:	The command FB is used to select quick-start mode.
Parameter description:	0: quick-start mode disabled 1: quick-start mode enabled
Value range:	0...1
Initial value:	1

6.3.7 Command ID

<id>ID<parameter><CR>	Identification number
Access:	Read / write
Description:	This command is used to specify the identification number (THIES interpreter) resp. the slave address (MODBUS RTU Interpreter). A response telegram will only be transmitted if the 'id' in the command matches the one set in the Weather Station. An exception here is the generic 'id' that causes all weather stations to respond. Once the 'id' has been changed, the device will immediately respond with the new 'id'.

| Parameter description: | 99 | generic 'id' (THIES interpreter) |
| | 0 | Broadcast slave address (MODBUS RTU Interpreter) |

| Value range: | 0 to 99 (THIES interpreter) |
| | 1 to 247 (MODBUS RTU interpreter) |

| Initial value: | 0 (THIES Interpreter) |
| | 1 (MODBUS RTU Interpreter) |

6.3.8 Command KY

| <id>KY<parameter><CR> | Key/password |

| Access: | Read / write |

| Description: | Through of the command "KY" the value for the key (password) is set. For the change of parameters the required password must be used. |

| Parameter description: | 0 | no password |
| | 234 | password for user level |

| Value range: | 0 / 234 |
| Initial value: | 0 |

6.3.9 Command LC

| <id>LC<parameter><CR> | LED control |

| Access: | Read / write |

| Description: | The command LC is used to specify the mode for control of the blue LED. |

Parameter description:

Parameter	Description
0	LED (blue) indicates wind speed
1	LED (blue) is dark

Examples:

| LED dark blue: | "00LC1\r" |
| LED blue indicates wind speed: | "00LC0\r" |

| Value range: | 0 / 1 |
| Initial value: | 0 |

6.3.10 Command RS

<id>RS<parameter><CR>   Reset

Access: Read / write

Description: Through the command RS a reset of the microcontroller is carried out.
                         The cause for the last reset is output without stating a parameter.
                         Here, the output occurs in the form of strings (see the following table),
                         which are lined up in a row, separated by spaces.

String	Description
PORF	Power On Reset Flag
EXTRF	External Reset Flag
BORF	Brownout Reset Flag
WDRF	Watchdog Reset Flag
PDIRF	Programming/Debug Interface Reset Flag
SRF	Software Reset Flag
SDRF	Spike Detector Reset Flag

Parameter description: 1   Watchdog reset
                         2   Software reset

Value range: 1 / 2

Initial value: -

6.3.11 Command SH

<id>SH<parameter><CR>   Station height

Access: Read / write

Description: The command is used to select the altitude at the location where the
                         Weather Station is installed.
                         This value is used to calculate the relative air pressure.
                         Height is specified in metres.
                         If the set parameter is 3001, the relative air pressure with elevation is
                         calculated from the GPS data.

Parameter description: Height above NHN in metres

                         0...3000:   Station height in metres (the basis for calculation of the
                                      relative air pressure)
                         3001:   The parameter SH is disregarded (calculation of the
                                      relative air pressure is based on the height from the
                                      GPS data)

Value range: 0...3001

Initial value:	0

Remark: GPS determines ellipsoidal heights above the reference ellipsoid (==> World Geodetic System WGS84). From 36 m (in Western Pomerania) up to 50 m (in the Black Forest and in the Alps) the ellipsoidal heights in Germany are higher than the heavy-related heights (NN, HN, NHN).
That means, there are regional elevation errors, which can be avoided by manual entry.
Moreover, it must be considered that the GPS altitude values can be subject to a change of up to 30 m (referred to the WGS8 ellipsoid)

6.3.12 Command SV

<id>SV<CR>	SW-Version
Access:	Read
Description:	The software version can be read by means of command SV.
Parameter description:	-
Response telegram:	-
Value range:	-
Initial value:	-

6.3.13 Command TR

<id>TR<parameter><CR>	Telegram output
Access:	Read / write
Description:	This command initiates one-off transmission of a telegram. The parameter specifies the type of telegram.
Parameter description:	1 measured value telegram 2 sensor data telegram
Response telegram:	See section **6.1.1**
Value range:	1...2
Initial value:	-

6.3.14 Command TT

<id>TT<parameter><CR>	Automatic telegram output

Access: Read / write

Description: The command TT is used to select the automatic output of telegrams (interval = 1 second).

Automatic telegram output remains switched off for the first 10 seconds after start-up of the Weather Station. During this time the user has the opportunity of changing the parameter TT.

Parameter description:
0   automatic telegram output switched off
1   measured value telegram
2   sensor data telegram

Response telegram: See section **6.1.1**

Value range: 0...2

Initial value: 0

6.3.15 Command TZ

<id>TZ<parameter><CR>	Time zone

Access: Read / write

Description: The command TZ is used to change the output of date/time.

Parameter description::
0   UTC
23:   UTC-Zeit – 1 hours
24:   UTC-Zeit
25:   UTC-Zeit + 1 hours
48:   CEST or CET
      The change between summer- and winter time occurs independently.

TZ	Signification
0	UTC
1	UTC – 23 hours
...	...
24	UTC
...	-1
47	UTC + 23 hours
48	CEST or CET

Response telegram: -

Value range: 0...48

Initial value: 0

7 LED signals

On the underside of the COMPACT WSC11 Weather Station there are 2 LEDs, which are externally visible through the housing.
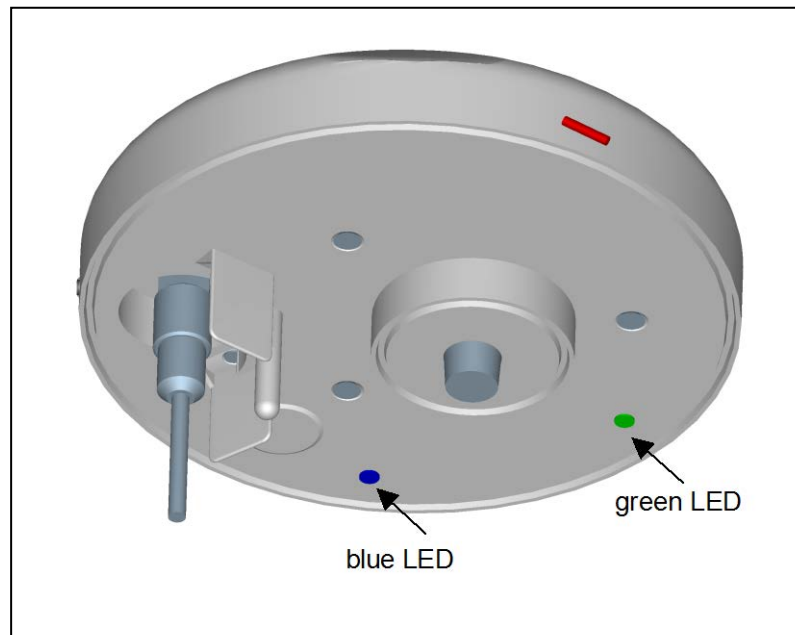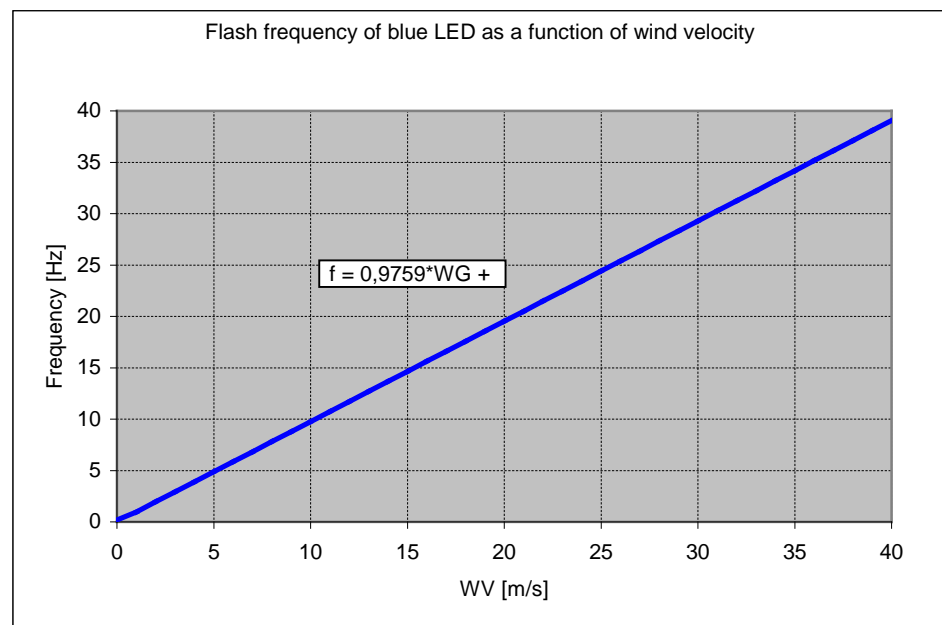

Figure 1: LEDs

If the Weather Station does not receive a command to query measured values for 3 seconds or longer, the green LED flashes at a frequency of 1Hz and signals its readiness for operation. If automatic telegram output is enabled (see **Command TT**), the green LED remains dark.

The flash frequency of the blue LED indicates the current wind speed (see **Command LC**). The correlation between the flash frequency and wind speed is shown in the following figure.

8 Technical data

Wind speed

	Type	Thermal anemometer
	Measuring range	0…40m/s
	Resolution	0.1 m/s
	Accuracy	to 10 m/s: ± 1 m/s (rms - mean over 360°) from 10 m/s: ± 5 % (rms - mean over 360°)

Wind direction

	Type	Thermal anemometer
	Measuring range	1 … 360°
	Resolution	1°
	Accuracy with laminar incident flow	± 10°

Brightness

	Type	Silicon sensor
(north, east, south, west)	Measuring range	0…150 kLux
	Resolution	0.1 kLux
	Accuracy	± 3% (± 4.5 kLux)
	Spectral range	475...650 nm

Twilight

	Type	Silicon sensor
	Measuring range	0…999 Lux
	Resolution	1 Lux
	Accuracy	± 10 Lux

Global irradiance

	Type	Silicon sensor
	Measuring range	0…1300W/m^2
	Resolution	1 W/m^2
	Accuracy	± 10% (± 130 W/m²)
	Spectral range	350...1100 nm

Precipitation

	Type	Guide value measurement, sensor area heated
	Measuring range	1 / 0 (precipitation yes/no)
	Thermal output, sensor dry, bedewing protection	0.1W
	Thermal output, sensor wet drying phase	1.1W

Temperature

	Type	PT1000
	Measuring range	-30 … +60°C
	Resolution	0.1 °C
	Accuracy with wind speed >2m/s	± 1 °C (-5°C…+25°C)

| Air pressure sensor		
	Type	Piezoresistive
	Measuring range	300…1100 hPa
	Resolution	0.01 hPa
	Accuracy	± 0.5 hPa at 20°C
	Long-term stability	± 0.1 hPa / year
Humidity sensor		
	Type	CMOS capacitive
Relative humidity		
	Measuring range	0…100% rel. humidity
	Resolution	0.1% rel. humidity
	Accuracy	± 10% rel. humidity at 20°C
Absolute humidity		
	measuring range	0...400 g/m^3
	Resolution	0.01 g/m^3
Dew-point temperature		
	Measuring range	-30...+60°C
	Resolution	0.1 °C
Inside temperature of housing		
	Type	Silicon sensor
	Measuring range	-30 … +60°C
	Resolution	0.1 °C
	Accuracy	± 2 °C
Digital interface		
	Type	RS485
	Mode	Half-duplex mode
	Baud rate	1200, 2400, 4800, **9600**, 19200, 38400, 57600, 115200
	Data format	- ASCII (command interpreter: THIES) - Binary (command interpreter: MODBUS RTU)
General		
Operating voltage		18...30 VDC, 18...28 VAC
	Power consumption	< 300mA at 24VDC
Ambient conditions	Temperature range	-30... +60 °C
	Humidity range	Non-condensing
GPS reception	GPS receiver with low power consumption, built-in RTC and antenna	
	Holding time of RTC (without voltage supply)	Approx. 3 days
Housing	Material	Polycarbonate
	Dimensions	See Dimension drawing
	Weight	0.22 kg
	Type of protection	IP64 in working position
	Type of connection	5-pin plug connector
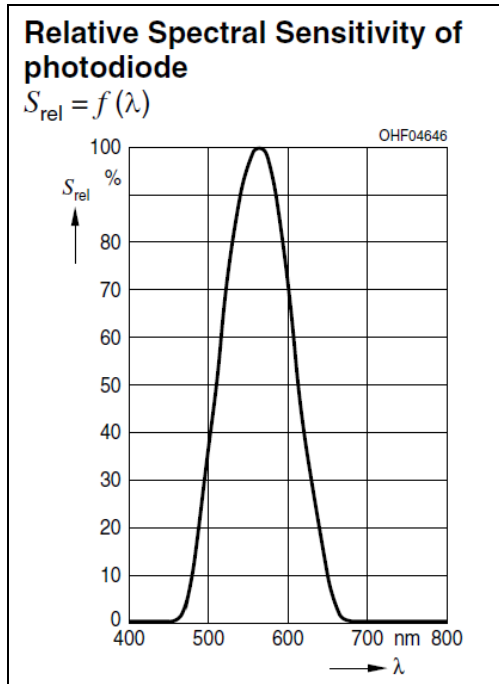
Figure 2: Spectrum of brightness sensors
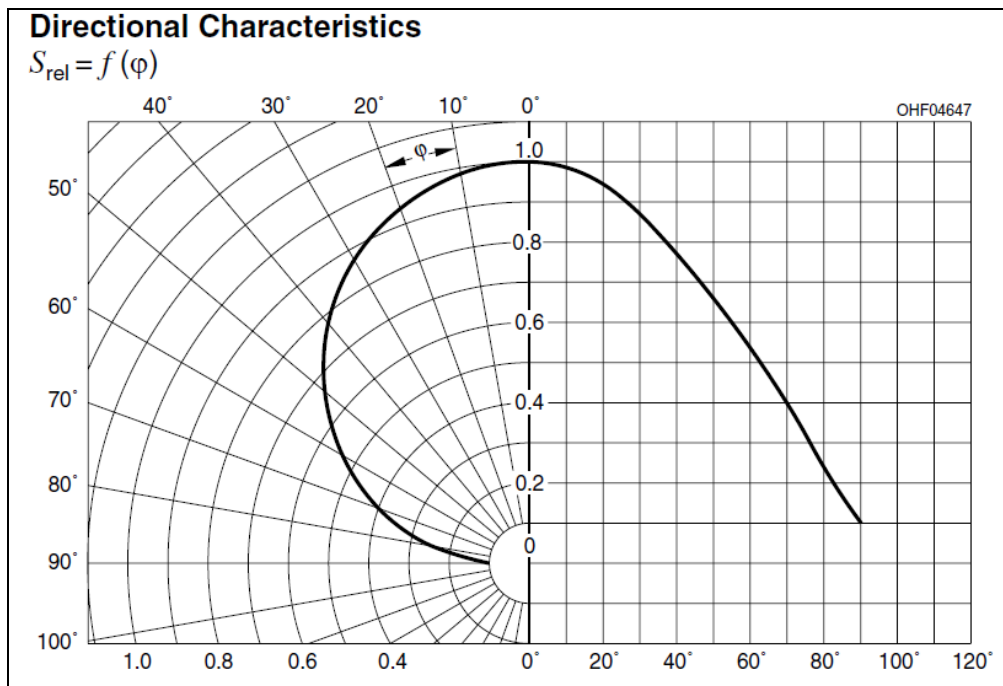(Source: data sheet for component SFH5711 / OSRAM)

Figure 3: Directional characteristics of brightness sensors
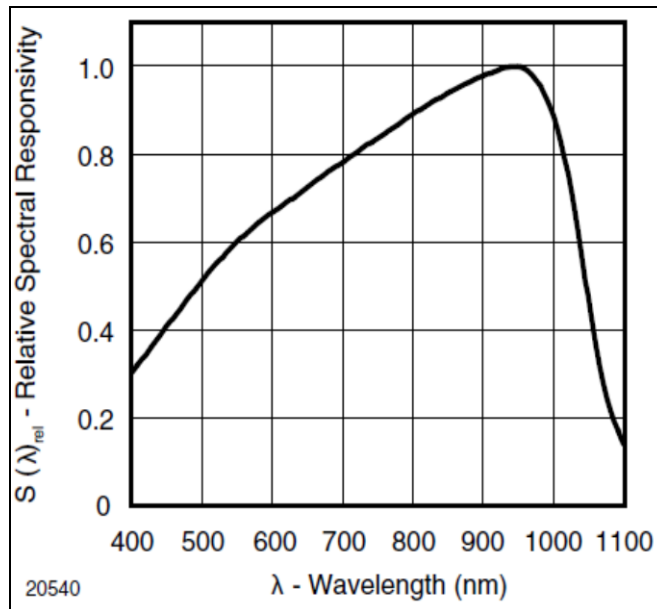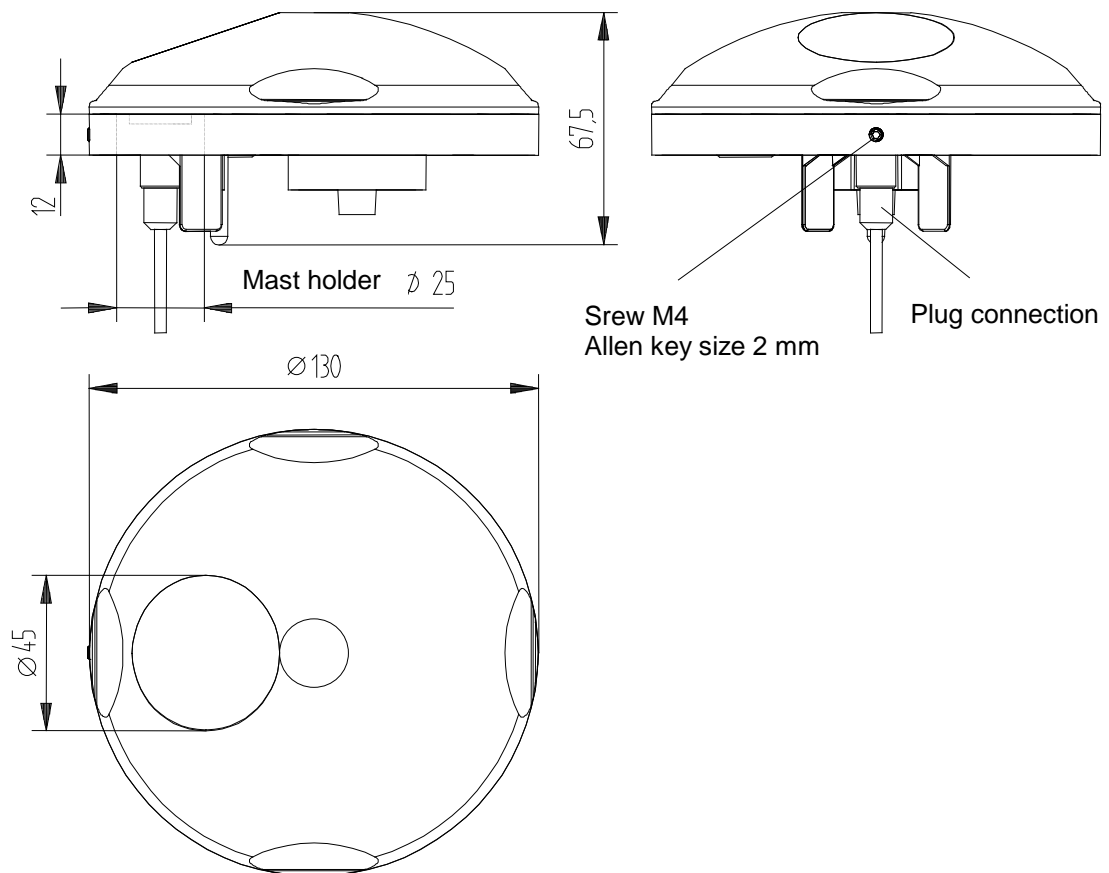(Source: data sheet for component SFH5711 / OSRAM)

Figure 4: Spectrum for global irradiance sensor
(Source: data sheet for component TEMD5080X01 / VISHAY)

9 Dimension drawing [in mm]

10 Accessories (optional)

Cable Prepared connecting cable for COMPACT WSC11 Weather Station. Features: Cable with cable socket on device side and open ends on reception side.	**Article No. 509279** **Article No. 509445**	Length: 5 m Length: 15 m
Device Utility Tool	Article No. 9.1700.81.000	Cost-free tool for parameter settings and/or special configurations. Please send a short e-mail to info@thiesclima.com, keyword "Utility Tool WSC 11" in the subject heading, as well as your sender information and our order number / invoice number. We will then let you have your log-in for the download.
Installation support Used for lateral attachment of COMPACT WSC11 Weather Station to a vertical surface.	**Article No. 509276**	Length: 320 mm Width: 60 mm Material: Stainless steel 1.4301

11 EC-Declaration of Conformity

Document-No.: **002002**   Month: 08   Year: 13

Manufacturer: **A D O L F   T H I E S   G m b H   &   C o.   K G**
Hauptstr. 76
D-37083 Göttingen
Tel.: (0551) 79001-0
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Description of Product: **Weatherstation Compact WSC11**

Article No.   **4.9056.00.000   4.9056.00.001**

specified technical data in the document: **021704/08/13**

The indicated products correspond to the essential requirement of the following European Directives and Regulations:

2004/108/EC   DIRECTIVE 2004/108/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 15 December 2004   on the approximation of the laws of the Member States relating to
electromagnetic compatibility and repealing Directive 89/336/EEC

2006/95/EC   DIRECTIVE 2006/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical
equipment designed for use within certain voltage limits

552/2004/EC   Regulation (EC) No 552/2004 of the European Parliament and the Council of 10 March 2004
on the interoperability of the European Air Traffic Management network (the interoperability
Regulation)

The indicated products comply with the regulations of the directives. This is proved by the compliance with the following standards:

Reference number	Specification
IEC 61000-6-2: 2005	Electromagnetic compatibility Immunity for industrial environment
IEC 61000-6-3: 2006	Electromagnetic compatibility Emission standard for residential, commercial and light industrial environments
IEC 61010-1: 2010	Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1: General requirements

Place: Göttingen   Date: 06.08.2013

Legally binding signature: issuer:

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