



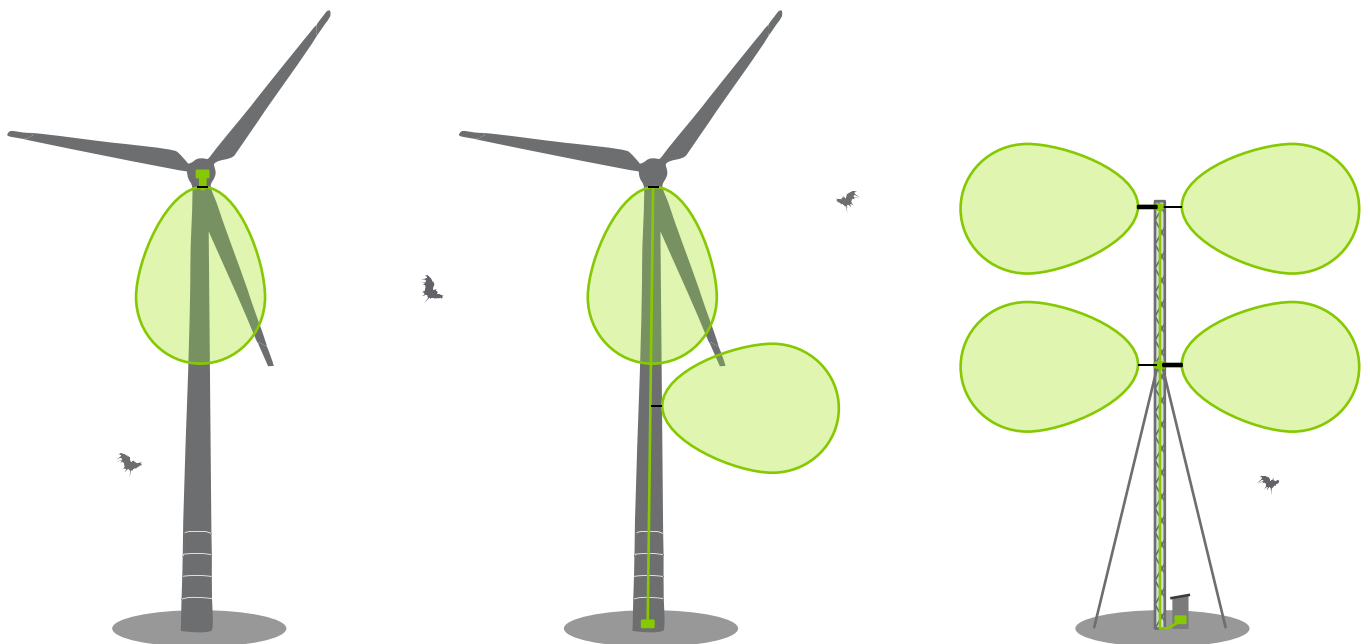
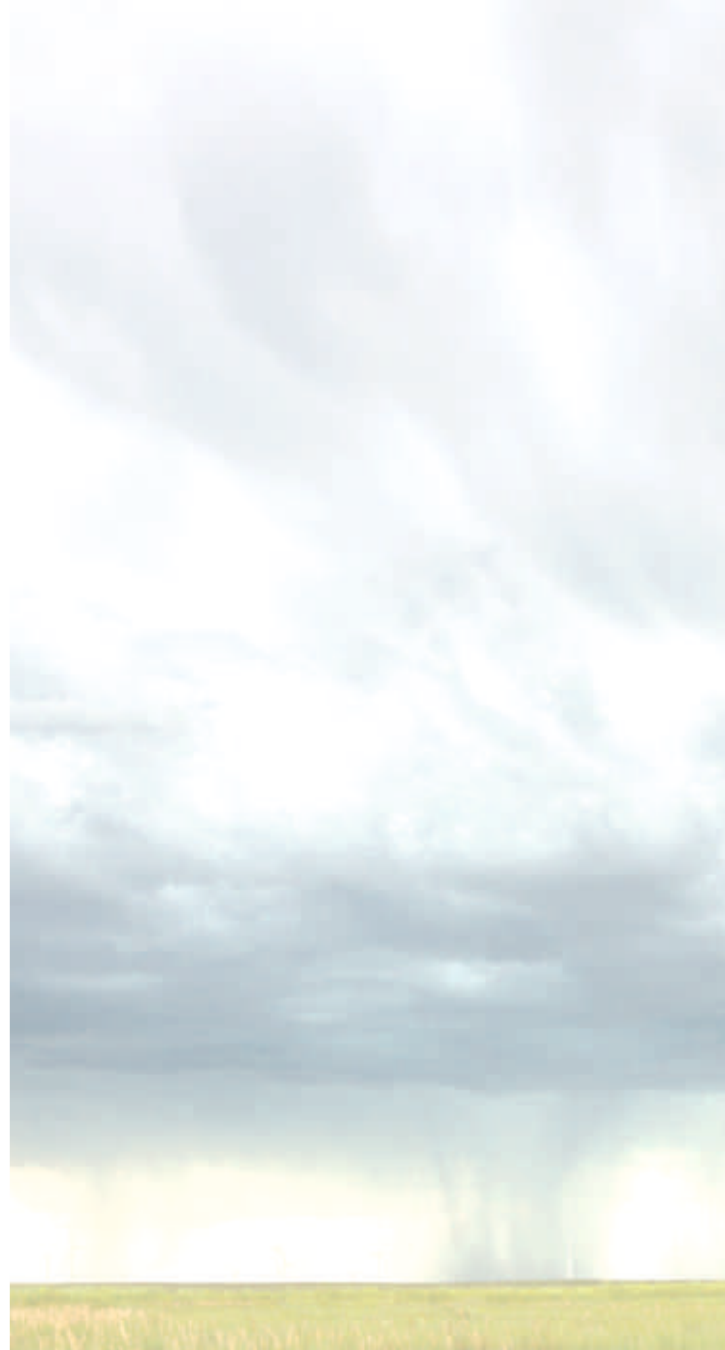
Acquisition of Meteorological Data with the BATmode System


Temperature, Precipitation, Wind Data, Humidity



The BATmode System

As a highly specialized acoustic bat detector, the BATmode system provides a calibrated determination of bat activity using one or more ultrasonic microphones. Since this activity can strongly correlate with the prevailing meteorological conditions, the BATmode 2S+ also allows to record a wide range of environmental parameters. Consequently, you can not only perform a more detailed investigation of the temporal bat activity distribution, but also recognize weather-related relationships and consider them in your studies.





To acquire meteorological data, we primarily utilize sensors from ThiesClima. Since these sensors are extremely precise and robust, also leading wind turbine manufacturers use anemometers and precipitation sensors of ThiesClima to control their turbines. In addition, these sensors are often used for site surveys in wind energy exploration as well as meteorological measurements by German environmental ministries and the German Weather Service.



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Integrated Temperature Sensor

The BATmode 2S+ system already has an integrated temperature sensor in the antenna disc as standard. By this, the installation of the antenna disc into the nacelle housing of the wind turbine enables the recording of the ambient temperature with an accuracy of typically $\pm 1^{\circ}\text{C}$. Data is transmitted analogously to the BATmode and logged automatically when acoustic bat monitoring is active.

Due to the given installation location of the antenna disc in the bottom of the nacelle, a falsification of the recorded temperature data cannot be excluded due to increased temperatures inside the nacelle. If your investigations require a highly accurate temperature measurement, please use the BATmode with the Laser Precipitation Sensor and the optional 'Hygro-Thermo-transmitter' (see page 10).



Antenna Disc

Just as is usual in wind turbine control systems, the meteorological measurement data is averaged over 10-minute time intervals and stored with a corresponding time stamp every full tenth minute. This allows to correlate data captured by the wind turbine control system (e.g. wind speed) directly with data collected by the BATmode system.



Infrared Precipitation Sensor

In addition to the temperature sensor integrated in the antenna disc, the BATmode 2S+ system can optionally be equipped with an Infrared Precipitation Sensor from ThiesClima (5.4103.20.041). This sensor provides an intensity-dependent analog signal and thus allows the determination of precipitation intensities. The sensor is equipped with an integrated heating unit to protect it from snowing and freezing.

The infrared precipitation sensor is mounted on a mast on top of the nacelle. The mast mount and a 230V AC power supply unit are included in the scope of delivery. Due to the exposed installation location, the system can be equipped with surge protection modules to protect against lightning strikes.

The sensor detects precipitation optoelectronically by means of an infrared light barrier over a measuring area of approx. 25 cm². Measurement range is from 0 - 10 mm/min, whereby a particle size > 0.2 mm is assumed. Due to this measurement principle recorded data may show a relatively large measurement error. However, since this sensor is also often used for wind turbine control systems, the measuring accuracy is sufficient for many investigations developing bat-friendly operation algorithms of wind turbines. If you require higher measurement accuracies, please use the Laser Precipitation Sensor (see page 8).



Power Supply Unit and Surge Protection Module

Supply Voltage: 24 V DC $\pm 15\%$

Current: ca. 90 mA

Heating Unit: max. 1 A

Operating Temperature: -30 ... +60 °C

Protection Class: IP65

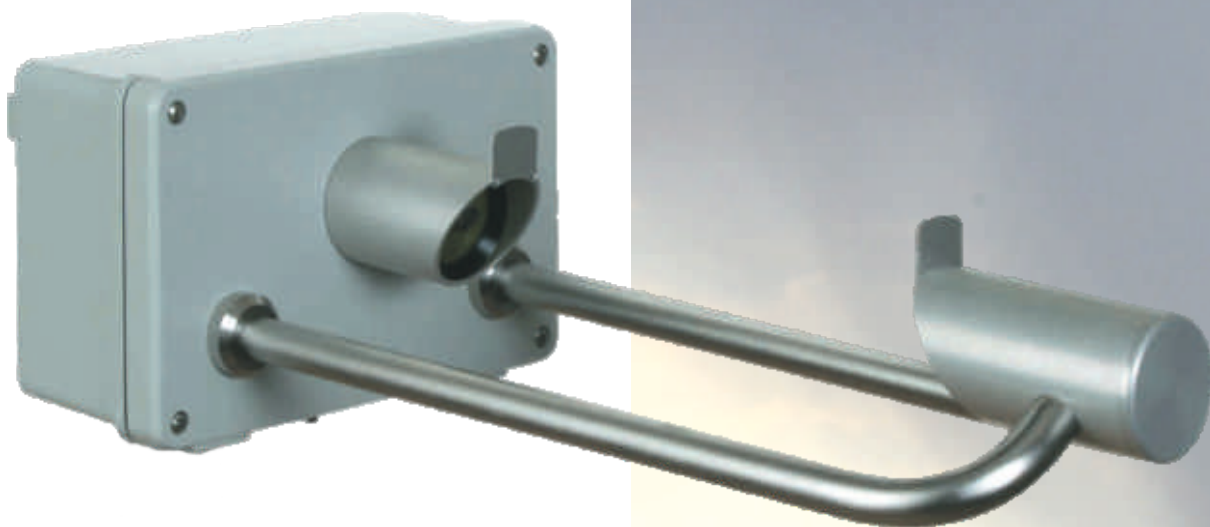
Dimensions: 130 x 140 x 40 mm

Weight: 0,4 kg

Laser Precipitation Sensor

The ThiesClima Laser Precipitation Sensor (5.4110.00.x00) is used to acquire highly accurate precipitation data with the BATmode system. It precisely determines the type, intensity and spectrum of precipitation and makes this available via an RS485 interface. All optical components are equipped with an integrated heating unit to prevent snowing and freezing.

Just like the Infrared Precipitation Sensor, the Laser Precipitation Sensor is also mounted on a mast on top of the nacelle. The mast mount is included in the scope of delivery. Supply voltage versions with 24V DC or 230/115V AC are available. Due to the exposed installation site, the system can be equipped with surge protection modules to protect against lightning strikes.





ThiesClima

To detect precipitation, the sensor generates a parallel light band by means of a laser-optical radiation source. If a precipitation particle falls through this light band (measuring area 45.6 cm²), the signal on the receiver is attenuated and corresponding measurement data can be derived.

The sensor detects particles from 0.16 to 8 mm in size and with a drop speed of 0.2 to 20 m/s. Thus, it is possible to determine precipitation intensities from 0.005 to 250 mm/h and to distinguish between drizzle, rain, hail, snow, snow drizzle and sleet.

The precipitation intensity is averaged and stored by the BATmode system in the known 10 minute intervals. All other measurement data generated by the sensor is stored in a configurable log file.

The sensor can be equipped with an optional Wind Protection Element in order to reliably detect precise precipitation intensities even at high wind speeds.

Due to the high accuracy of the sensor, it is also used in the measuring network of the German Weather Service.

Intensity Measurement Error:

< 15% @ rain 0,5 ... 20 mm/h

< 30% @ snow (wind speed < 3m/s)

Accuracy of Precipitation Types:

drizzle > 97%, rain > 99%, hail > 95%, snow > 99%, snow drizzle > 60%

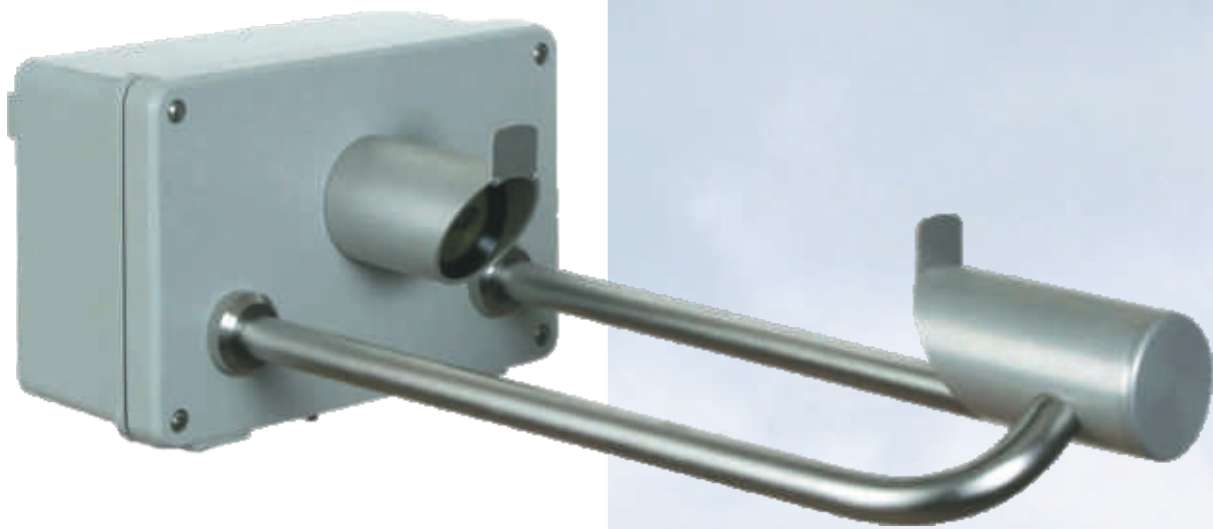
Power Supply: 24V DC / 115V AC / 230V AC

Operating Temperature: -40 ... +70 °C

Protection Class: IP65

Dimensions: 270 x 170 x 540 mm

Weight: 4,8 kg




Laser Precipitation Sensor with optional Measurement Channels

In addition to precipitation data, an extended version of the ThiesClima Laser Precipitation Sensor (5.4110.10.x00) can also be used with optional sensors to measure temperature, relative humidity, wind speed and wind direction with very high accuracy. The 'Hygro-Thermotransmitter' (1.1005.54.000), the 'Wind Direction Transmitter' (4.3129.00.000) as well as the 'Wind Transmitter' (4.3519.00.000) from ThiesClima are available sensors for this purpose.

The optional sensors are mounted with a threaded pin next to the Laser Precipitation Sensor on top of the nacelle of the wind turbine. Subsequently, the sensors are connected to Precipitation Sensor and it transmits acquired data digitally via RS485 to the BATmode.





While the temperature and the precipitation intensity are averaged and stored by the BATmode system in the known 10 minute intervals, all other measurement data is stored in a configurable log file.

Hygro-Thermotransmitter

Temperature Output: PT100

Measurement Range: -30 ... +70 °C

Accuracy: $\pm 0,1$ °C (PT100)

Wind Direction Transmitter

Measurement Range: 0 ... 360°

Resolution: 11,25 °

Accuracy: ± 5 °

Operating Temperature: -50 ... +70 °C

Protection class: IP55

Wind Transmitter Compact

Measurement Range: 0,5 ... 50 m/s

Resolution: $< 0,1$ m/s

Accuracy: $\pm 3\%$ or $\pm 0,5$ m/s

Operating Temperature: -40 ... +70 °C

Protection class: IP55



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