# Willow Sensors Industrial Outdoor Anemometer Sensor User Manual

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## Overview

Outdoor Anemometer sensor (wind sensor) based on BiPOM's WillowBee LoRaWAN module. Uses STM32WL processor based on Semtech SX1262.

**Sensor Accessories**

The sensor consists of 2 parts: The main LoRaWAN sensor module and the external anemometer:


Accessories

**Specifications**

**LoRaWAN Features:**

- Built-in LoRaWAN 1.0.4 Stack
- Ultra-Low Power
- Suitable for battery operation
- User-programmable
- Configurable power output
- Maximum output power: 22 dBm
- Frequency Bands:
- US915/AS915/AU915/EU868/CN779/EU433/KR920/IN865/RU86
- (Supported but not officially certified in all regions)
- 64 KB of RAM and 256 KB of Flash available for user applications

**Anemometer Sensor Features:**

- 868/915 MHz LoRaWAN protocol
- Up to 15 km communications distance
- Up to 10 years of battery life
- Low power consumption; sleep current 2 µA
- Test Range: 0.5 m/s to 50 m/s
- Minimum wind speed measured: 0.2 m/s
- Resolution: 0.1 m/s
- Accuracy: 1 m/s in worst case
- Max Wind Speed: 70 m/s

## Power Consumption

- Sleep mode power consumption: 2 µA
- Data transmission power consumption: 120 mA

## Storage and Operation Temperature

- -40 °C, + 85°C

## Applications

- Farm
- Industry
- Skyscraper
- Weather Stations
- Factory
- Ports
- Warehouse
- Greenhouse
- Energy Monitoring

## Operating Modes

The sensor has two modes: Deep Sleep Mode and Run Mode.

### Deep Sleep Mode

In Deep Sleep mode, the sensor does not have any LoRaWAN activity. This mode is used for storage and shipping to save battery life.

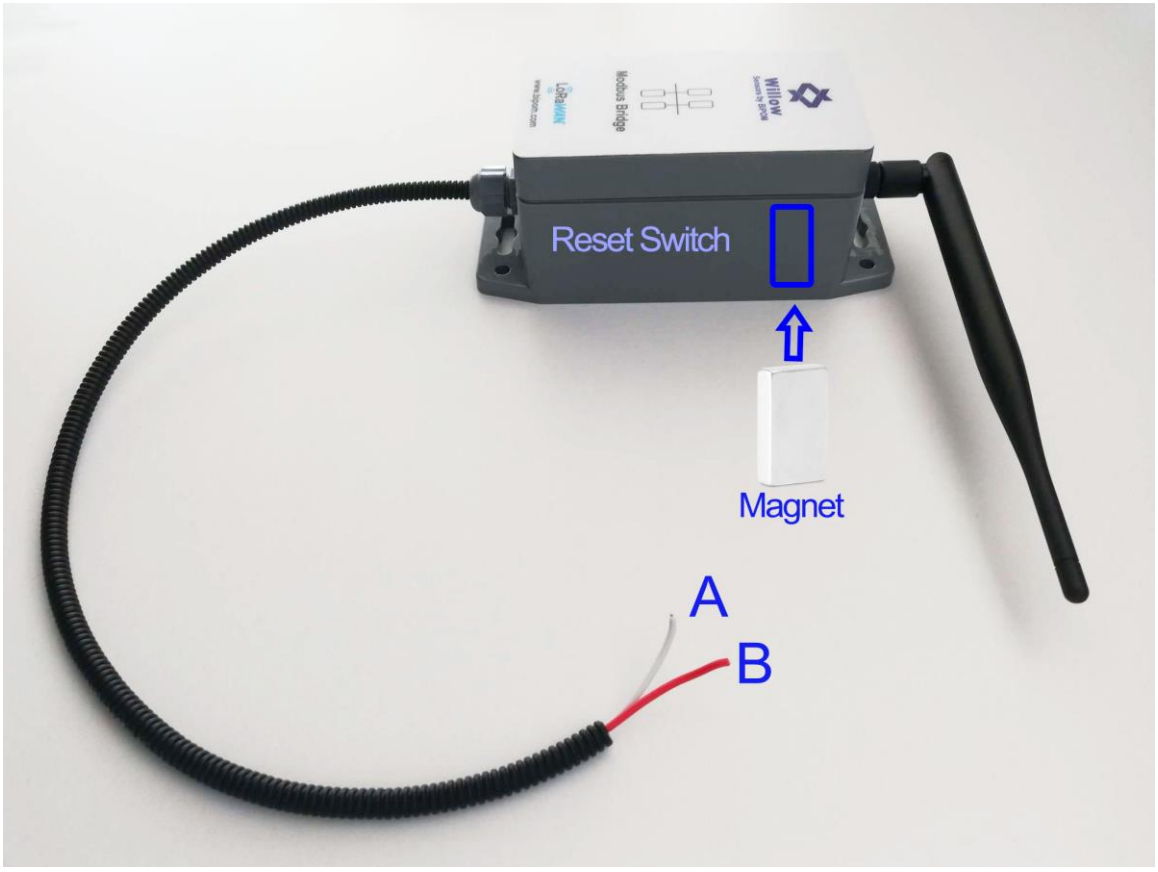
### Run Mode

In this mode, the sensor operates as a LoRaWAN sensor node to Join a LoRaWAN network and sends the sensor data to the LoRaWAN server. Between each periodic sensor activity, the sensor will be in STOP mode. In STOP mode, the sensor will consume the same current (2uA) as Deep Sleep Mode.

## Sensor Activation

The sensor does not send any LoRaWAN packets after shipping. The user first wakes up the sensor with a magnet. Then, the sensor starts sending LoRaWAN join-request until it joins the LoRaWAN network. If the sensor cannot join the LoRaWAN network for 16 minutes, the sensor will switch to Deep Sleep mode to save battery.

If the sensor fails to join the LoRaWAN network, touch the magnet to the highlighted blue area on the side of the sensor.




**Note:** There is no sign or text on the module to show reset switch position. This is for avoiding accidental reset by end users.

**Note:** Antenna should be plugged in before activating the module otherwise, the module can be damaged due to excessive radio frequency current.

### Activation Methods

The sensor supports both OTAA and ABP activation methods.

### OTAA Mode

The sensor requests OTAA join to the server after device wakes up and goes into the normal operation mode.

### ABP Mode:

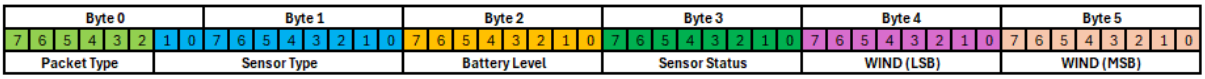
In ABP Mode, the sensor networks keys are hardcoded inside the sensor. In ABP mode, there is no join-request. The get the sensors with pre-programmed ABP, please contact BiPOM.

### Sensor Deactivation

The module can be deactivated only if the module has already joined a LoRaWAN network. The user first removes the sensor keys on the LoRaWAN network and then resets the module with the magnet.

## 1. Uplink Message Structure

The device starts sending uplink messages after joining the LoRaWAN network. The first uplink message is sent 5 minutes after joining the LoRaWAN network.




**Byte 0 (first 6 bits)** – Packet type.

**Byte 0 (last 2 bits) & Byte 1** – Sensor type.

**Byte 2** - Battery level (Between: 0 and 255)

0 – Battery Minimum Level
255 – Battery Maximum Level

**Byte 3** - Sensor Status

**Byte 4 (LSB) & Byte 5 (MSB)** – Wind (millimeters/s)

## 2. Downlink Message Structure

The sensor supports the downlink messages to set the Modbus parameters and the sensor states. The sensor can receive downlink messages only after the sensor sends an uplink message to the LoRaWAN server. Keep in mind that the payloads are little endian.

### 2.1. Data Interval Downlink

The following downlink message sets the sensor data interval time:

| Data Interval Downlink Message Structure | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fport | Payload | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0x08 | Byte 0 | | | | | | | | Byte 1 | | | | | | | | Byte 2 | | | | | | | | Byte 3 | | | | | | | |
| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | LSB - Data Interval (LSB) | | | | | | | | LSB - Data Interval (MSB) | | | | | | | | MSB - Data Interval (LSB) | | | | | | | | MSB - Data Interval (MSB) | | | | | | | |

Data interval between 60 seconds and 65535 seconds.

**Example Data**: 5-minute time interval

| Payload | | | |
|---|---|---|---|
| LSB - Data Interval (LSB) | LSB - Data Interval (MSB) | MSB - Data Interval (LSB) | MSB - Data Interval (MSB) |
| 0x2C | 0x01 | 0x00 | 0x00 |

**Hex Value:**

**0000012C**

5 minutes is 300 seconds and it is represented as 12C in hexadecimal format.

**Note:** The minimum data interval is 60 seconds. If the user sets data interval under 60 seconds, then, the sensor rejects the data interval that is set under 60 seconds.

## 2.2. Reboot Sensor Downlink

The following downlink message reboots the sensor. The sensor sends the join-request after the reboot by downlink.

| Reboot Sensor Downlink Message Structure | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| fport | Payload | | | | | | | |
| 0x0A | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | Byte 0 | | | | | | | |

**Value:**

**0x01 = Reboot sensor**