



Willow Sensors Outdoor Tilt Sensor User Manual

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Overview

The user manual explains the features of the WS-O-8-AE-TS-1 LoRaWAN Outdoor Ultrasonic Distance sensor. WS-O-8-AE-TS-1 uses the popular STM32WL55 Cortex-M4 microcontroller of STMicroelectronics. This microcontroller combines a computer unit and a LoRaWAN radio on a single chip. WS-O-8-AE-TS-1 is fully backed by a 3-year warranty, technical support, and application assistance by BiPOM Electronics, Inc.



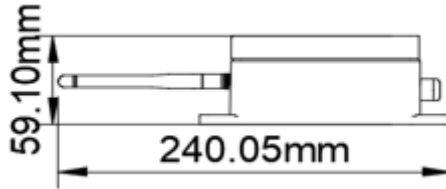
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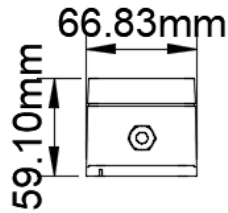


Sensor Features

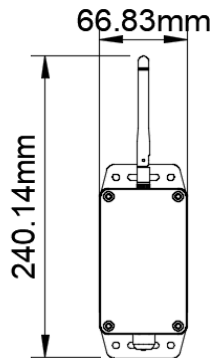
Dimensions



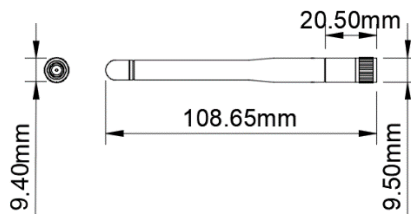
Side view with antenna



Front View without antenna



Top View



Antenna Dimensions



Sensor Accessories

The sensor consists of 3 parts: External Antenna, Magnet and Main LoRaWAN Sensor Module:





Specifications

LoRaWAN

- 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

Outdoor Tilt Sensor

- User-selectable resolution
 - Fixed 10-bit resolution
 - Full resolution, where resolution increases with g range, up to 13-bit resolution at ± 16 g
- Extended industrial temperature range: -55°C to $+105^{\circ}\text{C}$



Operating Modes

The sensor has two different modes as Deep Sleep Mode and Working Mode.

Idle Mode

In idle mode, the sensor does not have any measurement and LoRaWAN activity. This mode is used to increase battery life.

Working Mode

In this mode, the sensor operates as a LoRaWAN end node and sends out the sensor data to a LoRaWAN server. Between each measurement and transmitting period, the sensor will be in the idle mode.



Sensor Activation

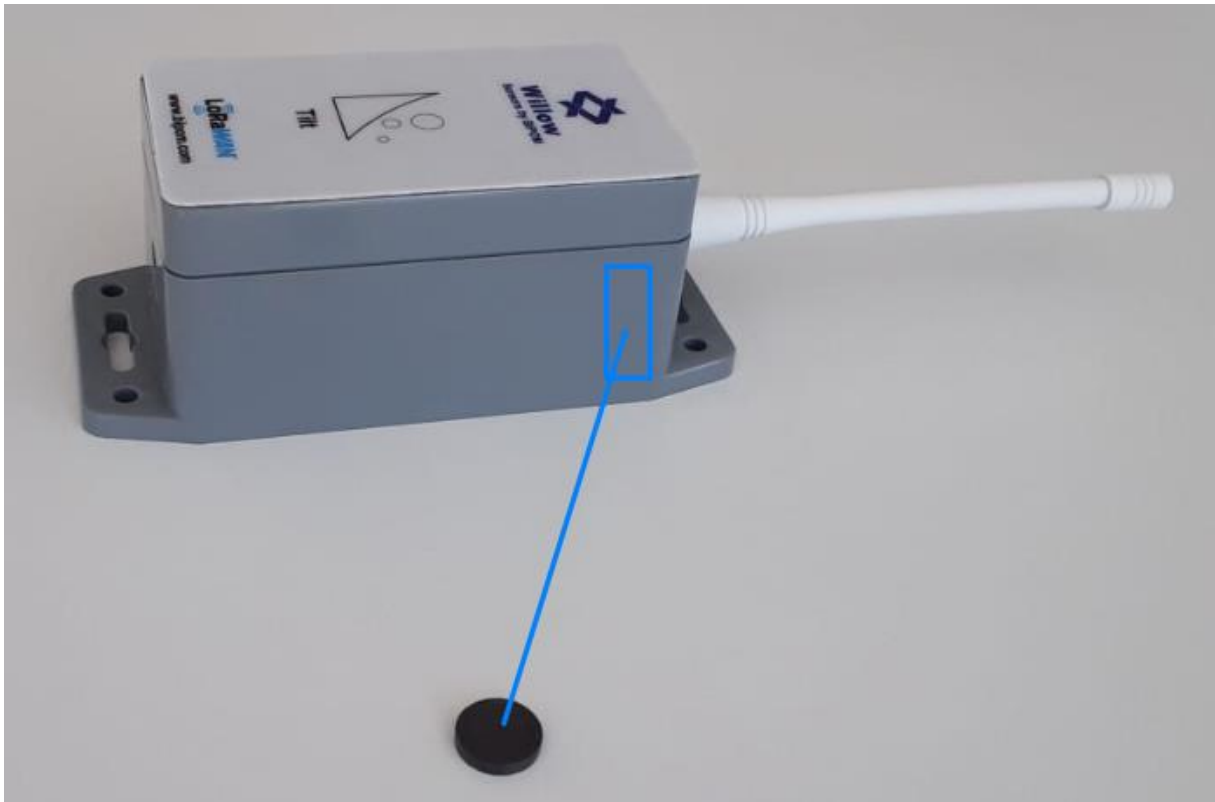
The sensor does not send any LoRaWAN packets after shipping. The user need to wake up the sensor with a magnet. Then, the sensor starts sending LoRaWAN join-request for 3 times until it joins to the LoRaWAN network. If the sensor cannot join to the LoRaWAN network after 3 attempts, the sensor will switch to Deep Sleep mode to save battery. The user should use magnet again to activate sensor once again.

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, due to security issues.

Note: Use magnet again to deactivate sensor manually.

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





Payload (Uplink Message) Structure

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Battery Level	Internal Temp LSB	Internal Temp MSB	AccX LSB	AccX MSB	AccY LSB	AccY MSB	AccZ LSB	AccZ MSB

Uplink message consists of 8 bytes which are indicates Battery Level, MCU Temperature, Acceleration X, Acceleration Y, and Acceleration Z, respectively.

- Battery Level (1 byte / 8-bit)
- Internal (MCU) Temperature in Celsius (2 byte / 16-bit)
- AccX in g (2 byte / 16-bit)
- AccY in g (2 byte / 16-bit)
- AccZ in g (2 byte / 16-bit)

Example Payload:

0x64 0x0023 0xFFFF1 0x0374 0x001E

Battery Level: 0x64 equals to 100 in decimal which indicates 100%

Internal Temperature: 0x0023 equals to 35 in decimal which indicates 35 Celsius

AccX: 0xFFFF1 equals to 65521 in decimal which is parsed on LuvitRED and results for -0.015 g

AccY: 0x0374 equals to 884 in decimal which is parsed on LuvitRED and results for 0.884 g

AccZ: 0x001E equals to 30 in decimal which is parsed on LuvitRED and results for 0.003 g



Downlink Message Structure

The sensor supports downlink messages to perform software reset and to set data transmission interval. The sensor can receive downlink messages only after the sensor sends an uplink message to the LoRaWAN server.

Software Reset Downlink Command

By sending below command one can perform software reset.

Port	Payload
0x0A	0x11

Setting Data Transmission Interval

User can change data transmission interval with the following command to related port address.

Payload indicates time interval in millisecond.

Port	Payload
0x08	0x012C *

* Example payload, means 300 seconds)



Battery Life

Data Rate	Payload Size (Byte)	Interval (minute)	Battery life (25 °C)
DR_0 (SF-10 EU868)	5 Byte	1 minutes	1.5 Year
DR_0 (SF-12 EU868)	5 Byte	5 minutes	5 Years
DR_0 (SF-12 EU868)	5 Byte	10 minutes	10 Years