Manual for LoRaWAN AG Tilt Angle Sensor - WSLRW-AG | FW 2

THIS IS **OBSOLETE** MANUAL

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This manual is applied to the following products

Item code	HW Version	Firmware Version	Remarks
WSLRW-AG-...	1	2	

Information Changes in this version v.s previous version

Item	Changes	Changed by	Changed Date	Approved by	Approved Date
2	Improve accuracy and resolution on FW 2	P.N.Diep	07-09-2022	N.V.Loc	07-09-2022
1	Initial version FW 1	P.N.Diep	01-06-2022	N.V.Loc	02-06-2022

To use this product, please refer step by step to the below instructions.

1. Quick Guide

> *Reading time: 10 minutes*
> *Finish this part so you can understand and put the sensor in operation with the default configuration from the factory.*

1.1 What is the LoRaWAN AG Tilt Sensor and its principle of operation?

WSLRW-AG is a LoRaWAN Tilt Sensor that can measure 3 tilt angles X, Y, and Z of any object such as a Tower, Building, Tree, Electricity Tower, Telecom Tower, Bridges... The Tilt sensor utilizes the combination of an advanced Accelerometer and Gyro meter to deliver high accuracy and stable measurement of the Tilt angle of 03 axis X, Y, and Z. With Ultra-low Power design and smart firmware allows the sensor can last up to 10 years with 02 x AA-type battery (depends on configuration). The sensor will transmit data in kilo-meters distance to the LoRaWAN gateway, any brand on the market.

Please refer to **this link** for the AG Tilt Sensor's principle operation.

1.1.1 What are the typical applications of this sensor?

Please refer to **this link** for typical applications.

1.1.2 When does the device send uplink messages?

The device will send uplink messages in the following cases:

- **Case 1:** After power-up in the 60s, the device will send the first message called START_UP. The payload will tell the user the HW version, FW version, and current configuration of the device;
- **Case 2:** Then, in every interval time (pre-configured), for example, 10 minutes, it will send the message called CYCLIC_DATA. The payload will tell the user the following data like measured values, battery level, alarm status...

> To change the cycle of data sending, you can change the value of the parameter: CYCLIC_DATA_PERIOD (default is 600 seconds).

- **Case 3:** During commissioning, testing, or calibration sensor, the user can force the device to send the uplink message to get the data immediately. This message is called FORCE_DATA. The payload will provide data like raw measured value, scaled measured values, battery level, alarm status... It can be forced by applying the magnet key on the reed switch in 1s;
- **Case 4**: If users want to change the configuration immediately, they don't need to wait until the next cyclic data sending message, instead they can force the device to send a special uplink message so that the device can get the new downlink message. This uplink message is named PARAMETERS_UPDATE. It can be forced by applying the magnet key in more than 5s.

1.1.3 The important configuration parameters

The sensor was pre-configured at the factory with default values for configuration parameters that meet most use cases. However, depending on the specific use case, the customer can adjust those parameters. Please refer to **section 3.2** for more details.

1.1.4 What kind of battery is used for this sensor?

The sensor is powered by 2 x AA 1.5V batteries for many years of operation. We recommend using Energizer L91 battery which is very popular and high performance. This battery has a capacity of up to 3500mAh with a working temperature range from -40 to +60 oC. The instruction for installing the batteries is in **this link**.

For Battery life estimation, please refer to this link.

1.2 What's in the package?

> **The package includes:**
> 01 x Main device
> 01 x Magnet key
> 01 x Wall mounting bracket and screws

1.3 Quick Test for LoRaWAN Sensor

With the default configuration, the device can be connected quickly to the Network Server by the following steps.

Step 1: Prepare the values of communication settings:

Frequency zone	Most of the sensor was configured the frequency zone to suit customer application before delivery
DevEUI	Get the DevEUI on the product nameplate
AppEUI	Default value: 010203040506070809
AppKey	Default value: 0102030405060708090A0B0C0D0E0F10
Activation Mode	OTAA with local join server
Network Mode	Public
LoraWAN Protocol version	1.0.3
Class	A

> **Note:** If the above settings do not match your network server/application, please refer to**section 3.2 Sensor configuration** to change the settings

Step 2: Register the device on the LoRaWAN network server.

Input the above settings on your device registration page of the network server.

> **Note:** Different network server software will have different device registration processes. Please refer to the manual of the network server software used for more details.

Please visit **this link** to get the instructions for adding the LoRaWAN sensors to some common network servers such as Actility, TTN...

Step 3: Install the batteries to the device

Refer to **this link** for details.

After installing the battery in 60 seconds, the first data packet will be sent to the LoRaWAN gateway. After receiving the first data packet, the time of another packet depends on the value of the parameter: **cycle_send_data**. Additionally, you can use a Magnet Key to force the device to send data instantly.

Step 4: Decode the payload of receiving package

Please refer to section **1.4 Uplink Payload and Data Decoding** for details of decoding the receiving packet.

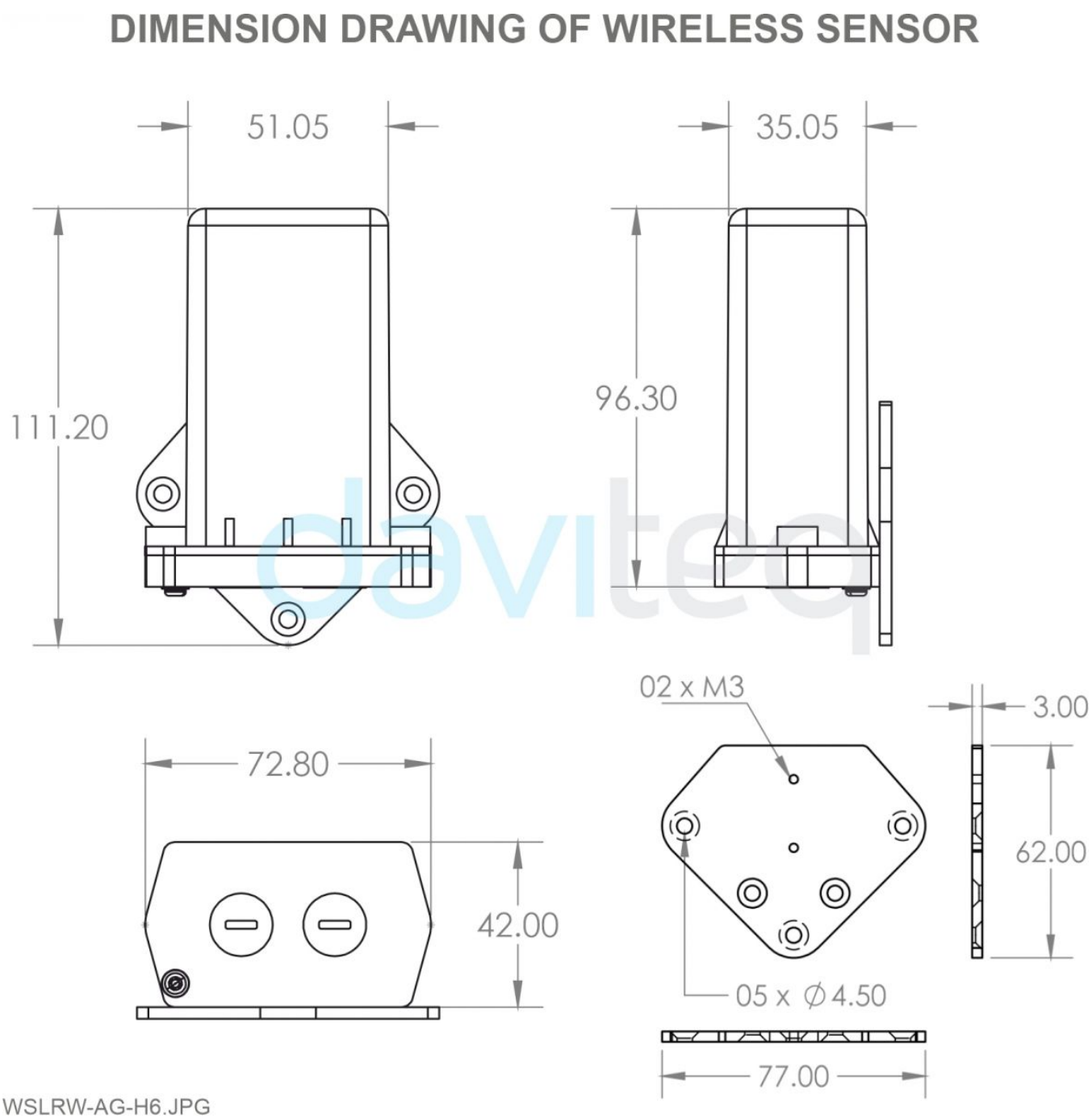
1.4 Uplink Payload and Data Decoding

For the Uplink Payload structure, please refer to**this link**.

Note: Please select the right Payload document to suit the FW version of the sensor

1.5 Sensor Installation

1.5.1 Dimension drawings



WSLRW-AG-H6.JPG

1.5.2 Battery Installation

Please follow the instructions in **this link**.

1.5.3 Sensor calibration and configuration

The LoRaWAN AG Tilt sensor is pre-calibrated at the factory. There is no need to re-calibrate it at the field.

1.5.4 Sensor mounting on wall or pole

Please follow **this link**.

2. Maintenance

2.1 Troubleshooting

- **Problems with LoRaWAN communication** like not receiving the packets...please refer to **this link** to troubleshoot the device.
- **Problems with the sensor functions** like not measuring or inaccurate measuring....please refer to **this link** to troubleshoot the sensor part.

2.2 Sensor maintenance

2.2.1 Maintenance of Wireless transmitter

Maintenance works	Yes/No	Descriptions
Consumable parts replacement	Yes	The battery is the only part need to check the lifetime to replace. Check the battery status on the back-end system.
Cleaning device	No	
Re-calibration / Re-validation	No	No calibration is required for the wireless transmitter.

2.2.2 Maintenance of the AG Tilt sensor

Please refer to **this link**.

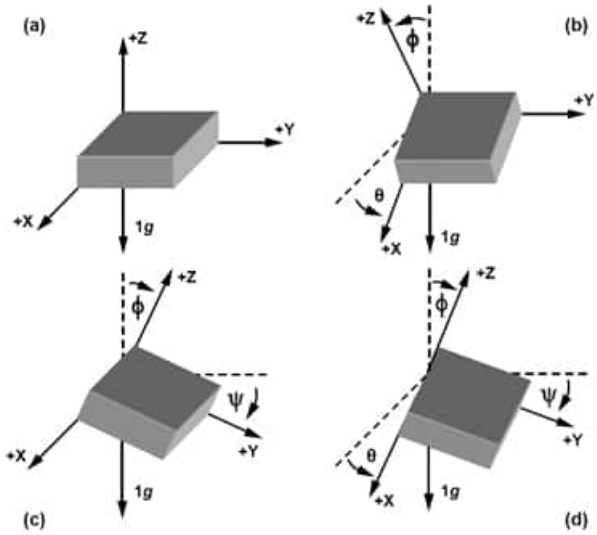
3. Advanced Guide

3.1 Operating principle of LoRaWAN AG Tilt Sensor

3.1.1 Operating principle of the complete device

The Daviteq LoRaWAN AG Tilt Sensor comprises 02 parts linked internally:

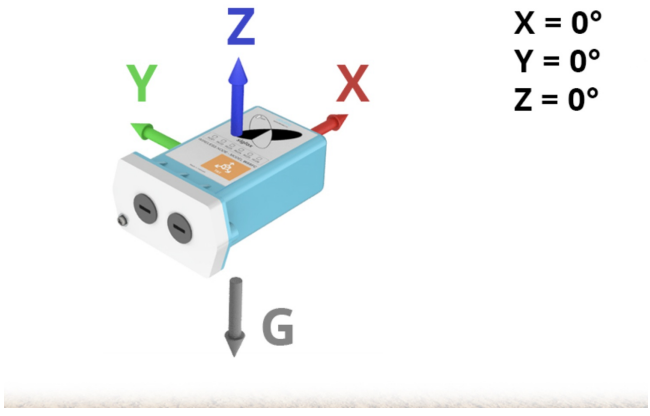
- The Daviteq LoRaWAN wireless transmitter;
- The Daviteq AG tilt sensor;



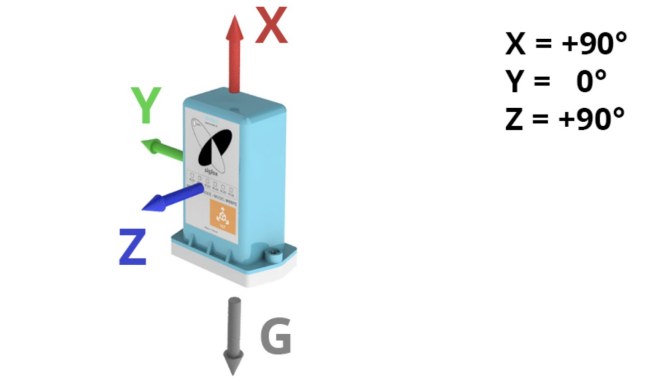
The AG Tilt sensor module measures the Acceleration of the 3-axis.

The LoRaWAN wireless transmitter is to read the measurement values from the AG sensor and performs the calculation to deliver the desired output values, then it sends data to the gateway in the following cases:

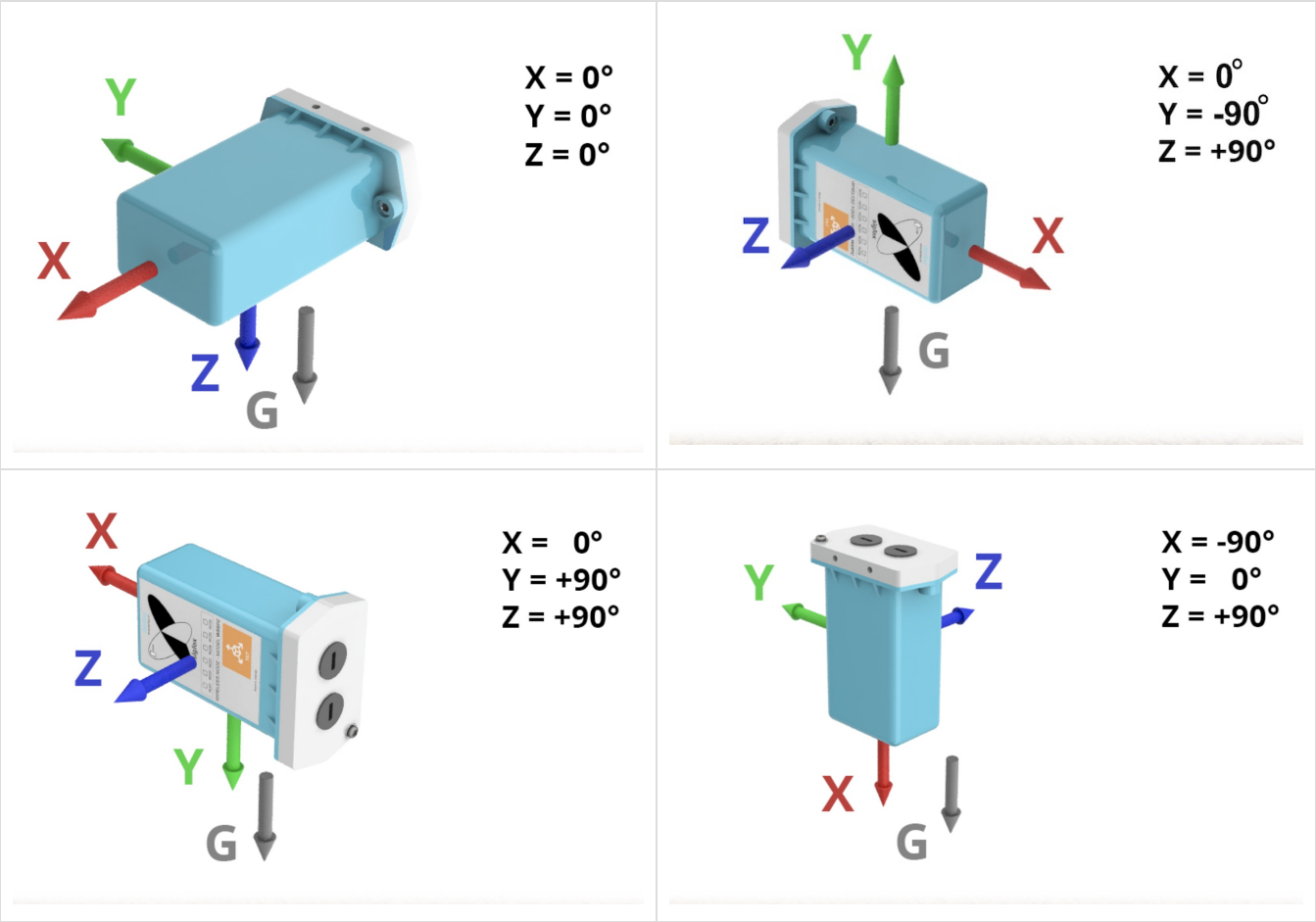
- Case 1: when the time of the Data sending cycle is reached.
- Case 2: when the device is forced to send data by a Magnet key.



X = 0°
Y = 0°
Z = 0°



X = +90°
Y = 0°
Z = +90°



3.1.2 Operating principle of AG Tilt sensor

To understand how the AG Tilt sensor work, please refer to**this link** for a complete understanding of this measuring technique.

3.1.3 Some important configuration parameters

Below are some important configuration parameters which affect the operation of the device.

- **measure_period | Default = 600s**
  This is the time period for the wireless transmitter to wake up and take the measurement from the sensor. The default value is 600s. Users can reduce this value, but smaller value, shorter battery life!
- **cyclic_data_period | Default = 600s**
  Interval time to send an uplink message regardless of any conditions

Those configuration parameters can be changed by downlink or offline tools. For more other configuration parameters, please refer to the next section.

3.2 Sensor Configuration

3.2.1 How to configure the LoRaWAN sensor?

Sensor configuration can be configured in 02 methods:

- **Method 1:** Configuring via Downlink message. Please find the instructions in**this link**, but please take note of the FW version of the Document.
- **Method 2:** Configuring via **offline cable**.

Note: THE SENSOR IS ONLY ACTIVE FOR OFFLINE CONFIGURATION IN THE FIRST 60 SINCE POWER UP BY BATTERY OR PLUGGING THE CONFIGURATION CABLE.

3.2.2 What parameters of the device are configured?

- Some parameters are read-only, and some are read and writeable.
- To read the parameters, use the off-line cable as above instruction.
- To write the parameters, use the off-line cable or downlink as above instructions.

Below tables are the lists of the parameters of the device.

Read-only Parameter Table

Modbus Register (Decimal)	Modbus Register (Hex)	Function Code	# of Registers	Description	Range	Default	Format	Property	Comment
0	0	3	5	device info			string	Read	Wireless Sensor LoRaWAN G4 Gas Sensor
5	5	3	4	firmware version		1.00ddmm	string	Read	ddmm = day / month
9	9	3	2	hardware version		1.10	string	Read	
11	B	3	4	lorawan protocol version		01.01.00	string	Read	LoRaWAN v1.0.3
15	F	3	6	application version		01.03.00.00	string	Read	application server v1.3.0.0
21	15	3	6	mac layer version		04.04.02.00	string	Read	mac layer v4.4.2.0
27	1B	3	4	deviceEUI			hex	Read	End Device's EUI number, used to register the product on the Network Server by OTAA

31	1F	3	4	Lora appEUI			hex	Read	Application server's EUI number is used to register the product on the Network Server by OTAA
35	23	3	8	Lora appKey			hex	Read	The number of keys used to create two security keys of the End Device, used to register the product on the Network Server by OTAA
43	2B	3	8	Lora nwkSkey			hex	Read	key number encrypts the communicatic command of the MAC layer of the End Device, which is used to register the product on the Network Server by ABP

51	33	3	8	Lora appSkey			hex	Read	End Device data encryption key number, used to register the product on the Network Server by ABP
59	3B	3	2	device address		0	uint32	Read	End Device address created by the Application server, used to register the product on the Network server by ABP
61	3D	3	2	network ID		0	uint32	Read	Network server ID number, used to register the product on the Network server by ABP
63	3F	3	2	join mode		OTAA	string	Read	OTAA: Over-the-Air activation, ABP: Activation by Personalizatic
65	41	3	4	network mode		PUBLIC	string	Read	PUBLIC, PRIVATE

69	45	3	3	region code		AS923	string	Read	1: AS923, 2: KR920, 3: AU915, 4: US915, 5: EU868, 6: IN865, 7: RU864, 8: CN779, 9: CN470, 10: EU433
72	48	3	4	data rate		DR2:980	string	Read	DR0:250, DR1:440, DR2:980, DR3:1760, DR4:3125, DR5:5470
76	4C	3	3	bandwidth		BW125	string	Read	BW125, BW250, BW500
79	4F	3	2	spread factor		SF10	string	Read	SF12, SF11, SF10, SF9, SF8, SF7
81	51	3	4	activation of ADR		ADR OFF	string	Read	ADR ON, ADR OFF
85	55	3	1	class		A	string	Read	
103	67	3	1	sensor type	1-255		uint16	Read	1-254: sensor type, 255: no sensor

Read/Write Parameter Table

⚠ Note: Please check the column Property to identify which parameter requests a password for writing a new value. In this case, the user needs to input the password (190577) into the parameter name "password for setting" at address 268.

Modbus Register (Decimal)	Modbus Register (Hex)	Function Code	# of Registers	Description	Range	Default	Format	Property	Comment
256	100	3 / 16	1	Modbus address	1-247	1	uint16	R/W	Modbus address of the device

257	101	3 / 16	1	Modbus baudrate	0-1	0	uint16	R/W	0: 9600, 1: 19200
258	102	3 / 16	1	Modbus parity	0-2	0	uint16	R/W	0: none, 1: odd, 2: even
259	103	3 / 16	9	serial number			string	R/W (Password)	
268	10C	3 / 16	2	password for setting			uint32	R/W (Password)	password 190577
270	10E	3 / 16	4	Lora appEUI			hex	R/W (Password)	Application server's EUI number, used to register the product on the Network Server by OTAA
274	112	3 / 16	8	Lora appKey			hex	R/W (Password)	The number of keys used to create two security keys of the End Device, used to register the product on the Network server by OTAA
282	11A	3 / 16	8	Lora nwkSkey			hex	R/W (Password)	key number encrypts the communicatic command of the MAC layer of the End Device, which is used to register the product on the Network Server by ABP
290	122	3 / 16	8	Lora appSkey			hex	R/W (Password)	End Device data encryption key number, used to register the product on the Network Server by ABP
298	12A	3 / 16	2	device address			uint32	R/W (Password)	End Device address created by the Application server, used to register the product on the Network server by ABP
300	12C	3 / 16	2	network ID			uint32	R/W (Password)	Network server ID number, used to register the product on the Network server by ABP

302	12E	3 / 16	1	activation mode (join mode)	0-1	1	uint16	R/W (Password)	1: OTAA (Over-the-Air Activation), 0: ABP (Activation by Personalizatic
303	12F	3/16	1	downlink flag	0-1	1	unint16	R/W	1: Enable 0: Disable
304	130	3 / 16	1	application port	1-255	1	uint16	R/W (Password)	Port 224 is reserved for certification
305	131	3/16	1	network mode	0-1	1	uint16	R/W	1: Public, 0: Private
317	13D	3 / 16	1	region	1-7	1	uint16	Read/Write(Pa	1: AS923-1, 2: KR920, 3: AU915, 4: US915, 5: EU868, 6: IN865, 7: RU864, 8: AS923-2, 9: AS923-3, 10: AS923-1 Japan
318	13E	3 / 16	1	data rate		7	uint16	R/W (Password)	0: 250 bps, 1: 440 bps, 2: 980 bps, 3: 1760 bps, 4: 3125 bps, 5: 5470 bps
319	13F	3 / 16	1	tx power	2-20	16	uint16	R/W (Password)	tx power: 2,4,6,8,10,12,
320	140	3 / 16	1	adaptative data rate	0-1	0	uint16	R/W (Password)	Automatically adjust data rate, 0: disable, 1: enable
330	14A	3/16	4	current_confi			hex	R/W	current configuration code of the device

3.3 Calibration or commissioning for AG Tilt sensor

Please refer to **this link**.

4. Product specification

Please refer to the detailed specifications in **this link**.

5. Warranty and Support

For warranty terms and support procedures, please refer to **this link**.

6. References

Use-cases:

Case studies:

White-papers:

END.

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