SL711 Water Level Sensor User Manual

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1. General Information

SL711 is low power water level sensor with built in LoRa module, low power cunsumption, long range, high volume Li-battery, can be widely adopted in water level monitorning situations.

Sensor Type	Model
Water level sensor	SL711CN, SL711EU,SL711US,SL711AS, SL711AU etc

Note
CN: Based on LoRaWAN CN470，Frequency：470~510 MHz
EU: Based on LoRaWAN EU868，Frequency：863~870 MHz
US: Based on LoRaWAN US915，Frequency：902~928 MHz
AS: Based on LoRaWAN AS923，Frequency：920~925 MHz

1.1.Features

- 1.The maximum transmission power is 22dbm, the transmission distance is long, and the open space can reach 3-5 km.
- 2.Built in 19ah high-capacity lithium sub battery, with a service life of more than 5 years.
- 3.The new generation of water level transmitter adopted, high precision, high reliability and low power consumption.
- 4.Wireless configuration for LoRa parameters
- 5.Open communication protocol and access to the third-party Lora gateway with simple configuration.
- 6.Industrial design, working temperature range -40 ℃ ~+85 ℃.

- 7.IP67 waterproof design, suitable for harsh industrial environment.

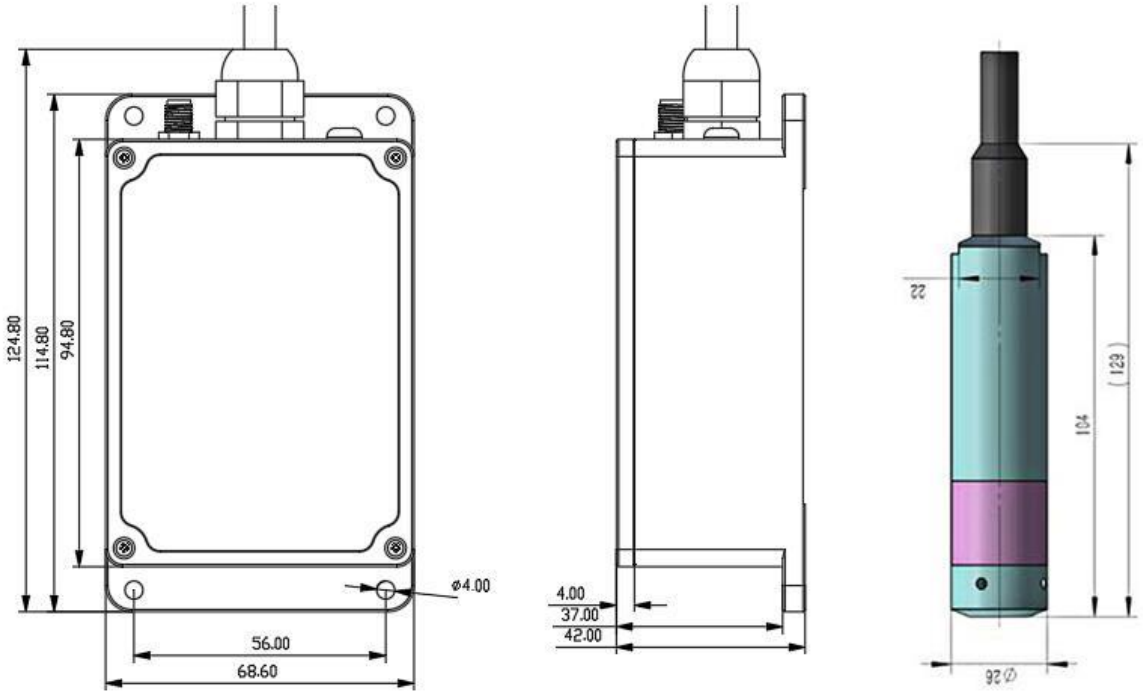
1.2.Specifications

Parameters	Features
CPU	STM32L151
Wireless	LoRa（SX1268/SX1262）
Encription	AES128
Power	Built-in Li battery（Non-rechargable）
Battery	19000 mAh
Life span	5 Years(Data collecting every 10 seconds， Data uploading every mins@SF9）
Level Range	0~5M
Temp Range	-40℃~125℃
Precesion	±0.25 %FS
Response time	10 Seconds（Configurable, e,g Data collecting time）
Communication	Half-duplex
Data rate	300bps ~ 62.5 kbps
Working temp	-40℃~80℃
Power	Max 22dBm

Parameters	Features
Sensitivity	-140 dBm
Antenna	SMA
Frequency	SX1268: CN470 SX1262: EU868 / US915 / AS923

1.3.Product Details

Picture



Size

2. User Instruction

Before turn on, please make sure you connect with LoRa antenna, and battery is well installed. If the battery is empty, please change the same type Li-battery.

2.1.Turn on/off

The equipment adopts waterproof keys for easy deployment.
By default, the system will automatically enter the configured wait mode after startup, and the timeout is 60 seconds. If the sensor receives a wireless signal within 60 seconds, the wait time is automatically reset. If there is no wireless data for 60 seconds, it will automatically enter the normal operation mode. In this way, it is convenient for the equipment to carry out factory production test and parameter wireless configuration.

2.2.Indicator

The device contains a dual color (red and green) LED indicator.
Red: Indicates that the key is pressed.
Green: Indicates the sending instruction or the configuration mode.

2.2.1. Wireless Configuration Indicator

When turn on the device, sensor is on congifuration mode, led light is green.

2.2.2. Sending indicator

When the device send data, led light change from green to turn off, that means data has been send successfully.

2.3. Wireless Configuration Mode

When turn on the device, sensor is on configuration mode, led light is green for 60 seconds.
You can use LoRa Dongle for wireless configuration, here below you can find the instruction:
http://doc.rejeee.com/web/#/32?page_id=449

2.4.Antenna

The equipment antenna interface adopts standard SMA, with the specification of external thread and internal hole. When installing, pay attention to avoid metal and strong interference equipment. If the installation environment is poor, it is recommended to use a sucker antenna with feeder for installation.

2.5.Data Uploading

When turn on the device, the sensor send data immediatly
When the data is exceeding the caliation data, the sensor send data immediatly.
Sensor heart beacon, sending data periodically

3. Data Configuration

You can use USB dongle for data configuration, and here is the instruction SensorTool
The configutation mainly include two parts:
Sensor parameter: Data sending peroid, data collecting peroid, calibration
LoRa parameter: like SF, RX/TX Freq etc.

3.1.Data check peroid

The default check peroid is 10 seconds and minimum is 1 seconds, max peroid is 65553 seconds. The shorter peroid, the more sensitive the response, otherwise, the power consumption will increase.

3.2.Data uploading peroid

The default data uploading peroid is 600 seconds(e.g 10 mins, which means sensor heart beacon), For example, in a constant liquid level environment, that is, data is reported every 10 minutes, and this parameter can be adjusted according to the actual situation.

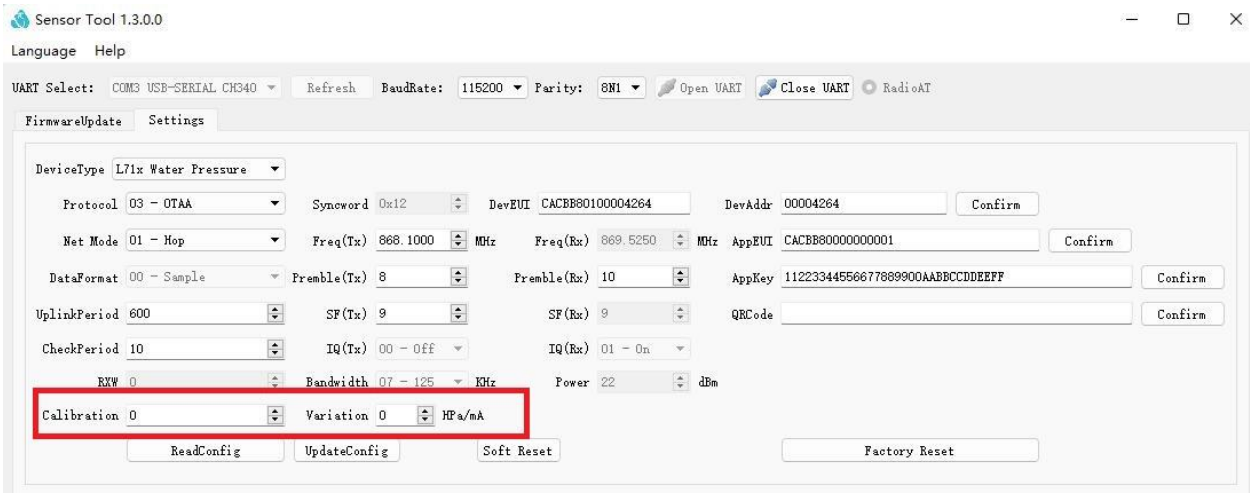
3.3.Calibration

The default calibration is 0.
For special customized projects, when reporting the data pressure value, the user can modify the calibration value as required. Negative values are supported, unit is Pa

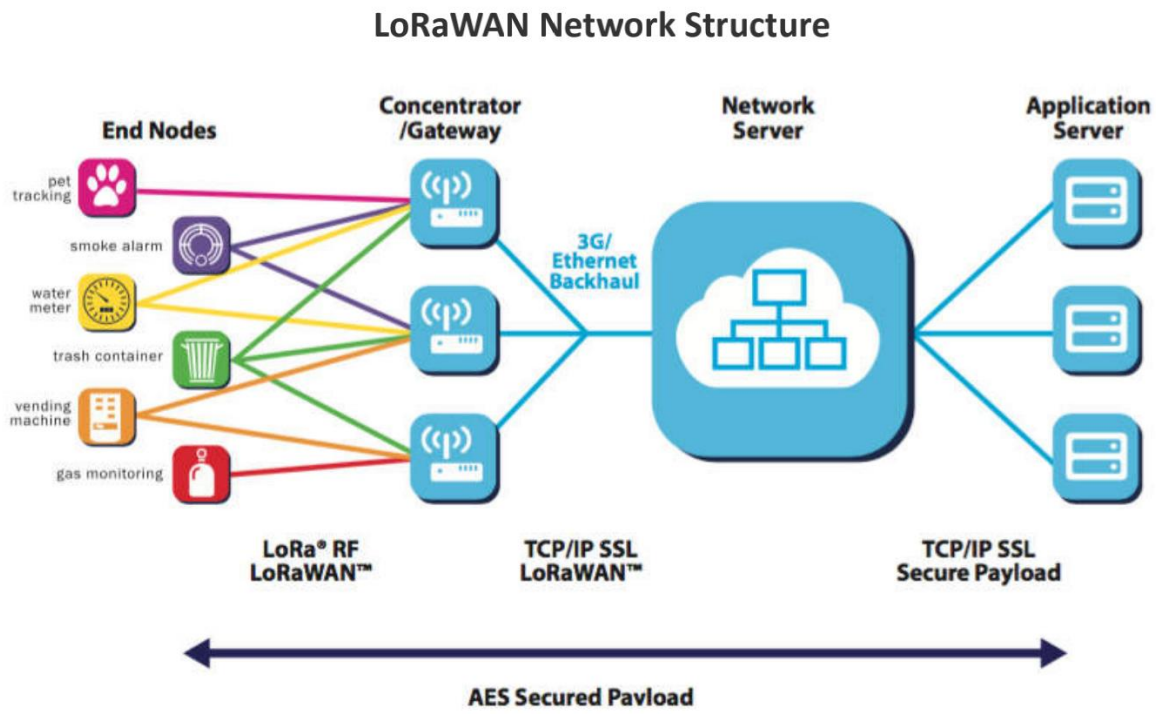
3.4. Viriation

The purpose of design variation is to support the equipment to report on a periodic basis, and to judge the variation according to the sampling period. When the sampling data and the last sent data exceed the change amount, it is reported immediately without waiting for the reporting cycle time. In order to support rapid response to the measured object.
The internal default minimum change of liquid level equipment is designed as 1mA. If the system default change is not configured (i.e. 0), the internal logic judgment is based on 1mA as the change.

See as below:

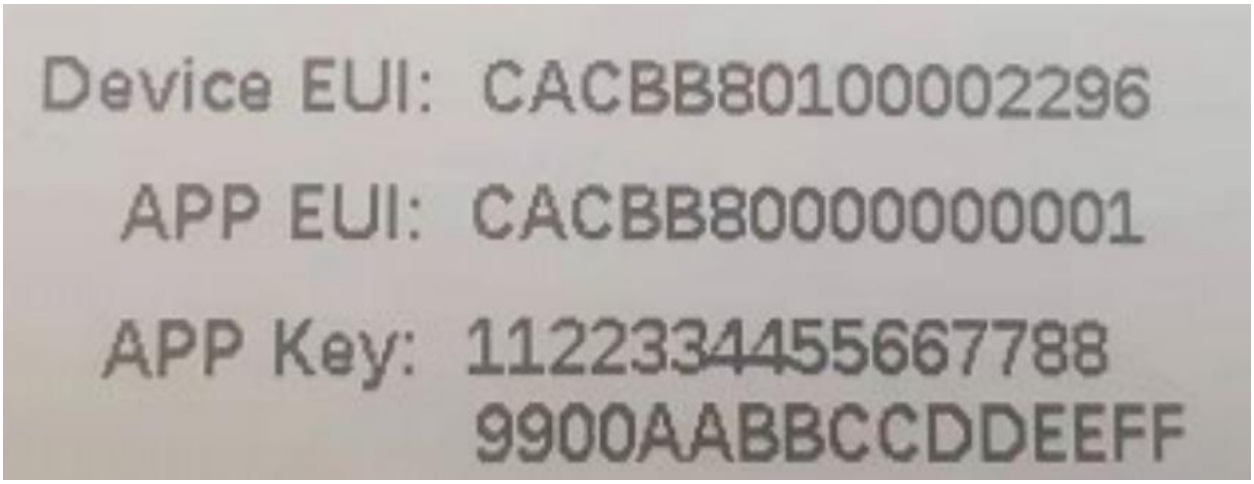


3.5. Connect to LoRaWAN Network



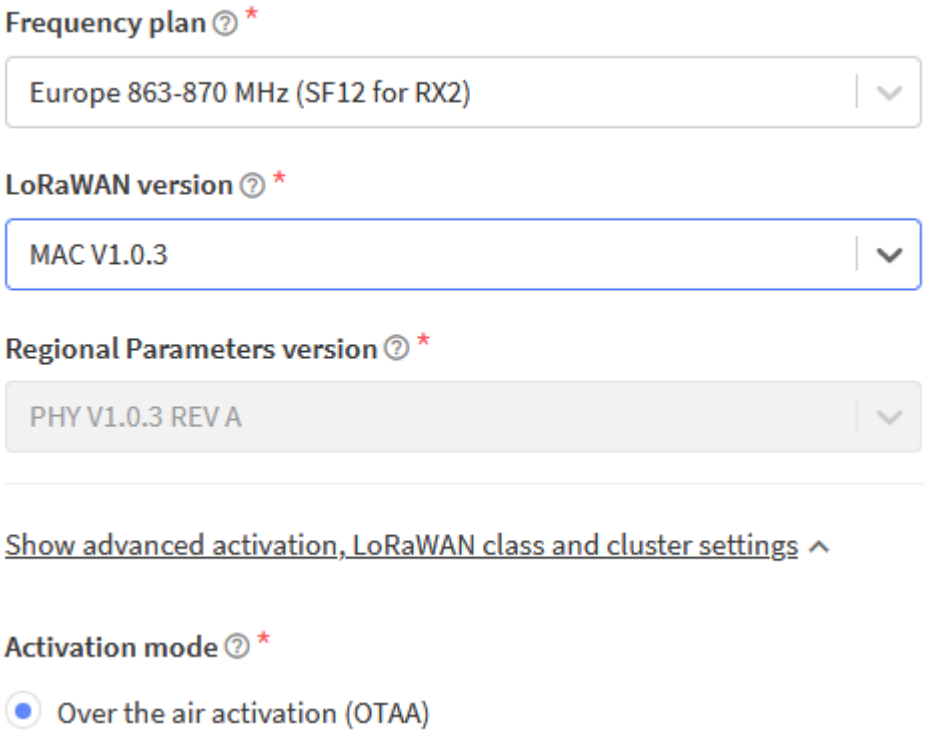
SL711 water level sensor is based on standard LoRaWAN Class A/C, so you can connect to any LoRaWAN network through OTAA or ABP.

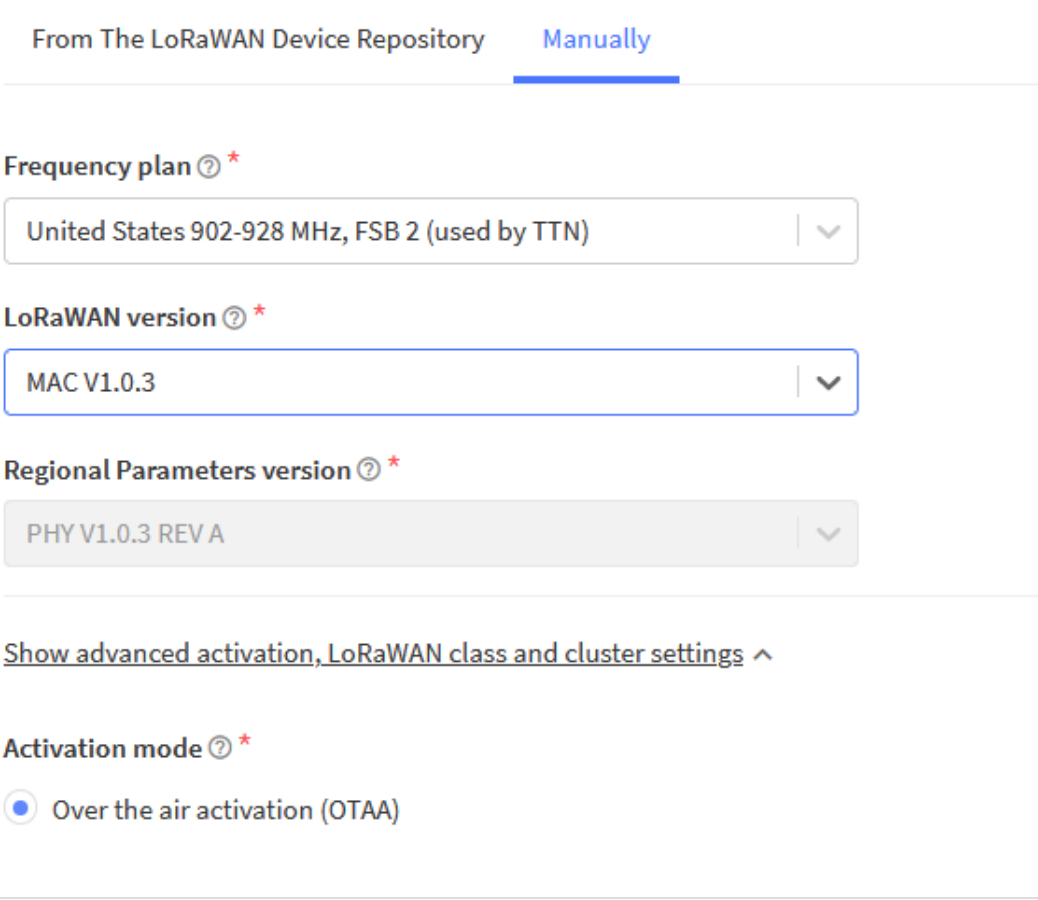
On the package of device, you can find information as below, with this information, you can connect to any LoRaWAN server.

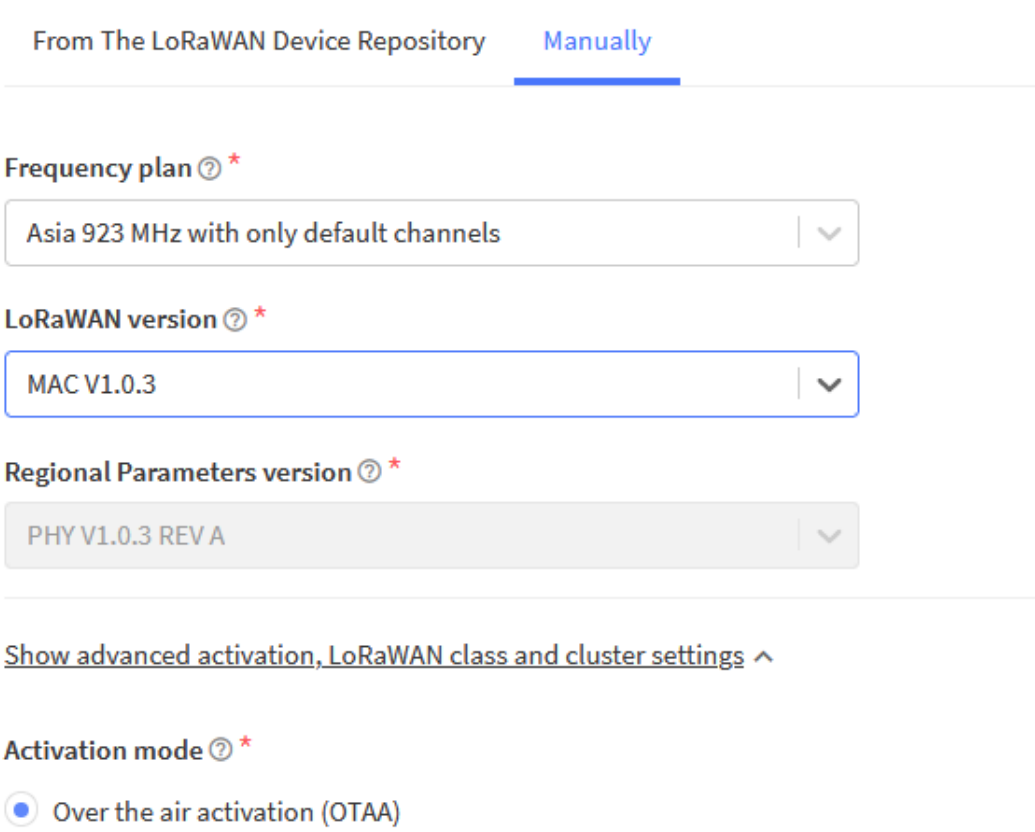


Here below take TTN as an example about how to connect the device to TTN server, please make sure to choose manually and the right frequency plan as below:

Sensor	LoRaWAN
SL711CN	From The LoRaWAN Device Repository / Manually Frequency plan * : China 470-510 MHz, FSB 11 LoRaWAN version * : MAC V1.0.3 Regional Parameters version * : PHY V1.0.3 REV A Show advanced activation, LoRaWAN class and cluster settings Activation mode * : Over the air activation (OTAA)

Sensor	LoRaWAN
SL711EU	

Sensor	LoRaWAN
SL711US	

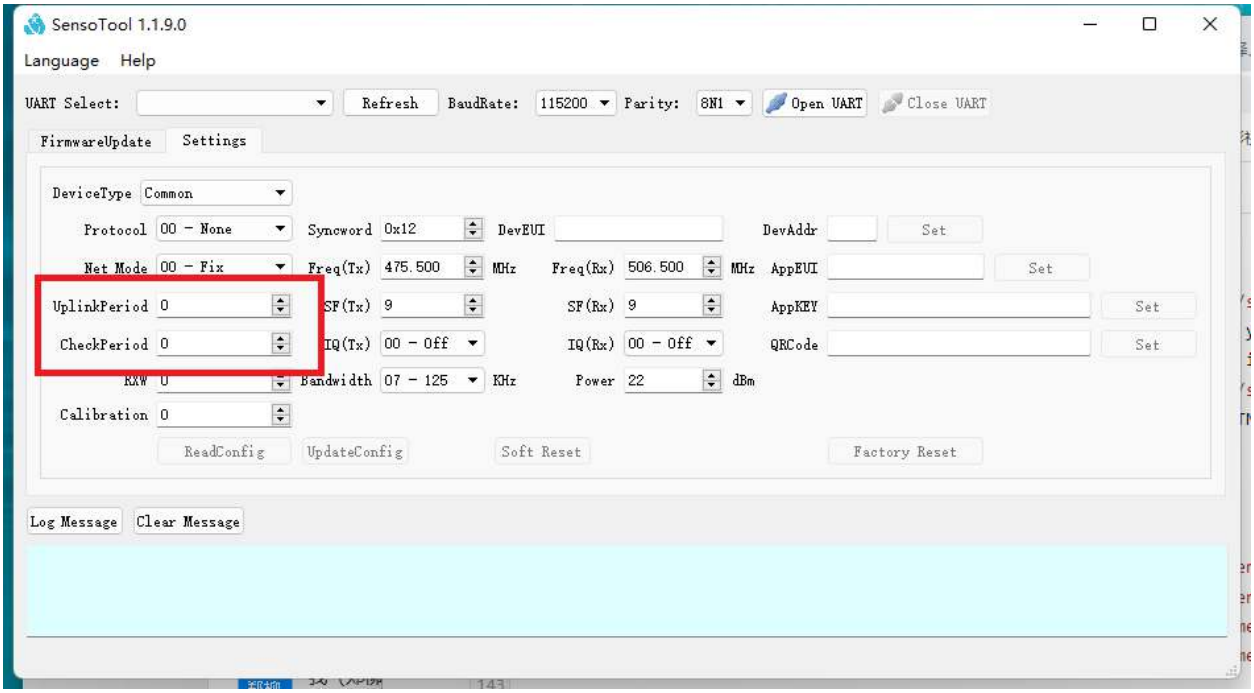
Sensor	LoRaWAN
SL711AS	

3.5.1 Data Configuration

Normally customer only needs to configure the following information under LoRaWAN:

- **Uplink Period**: Data uploading Period, that means sensor collect data and send to gateway

- **Check Period**：Data collecting period, that means sensor collect data but not upload



4.Wireless data format

The device support both LoRaWAN and non LoRaWAN.

4.1 SIP（00/01）— Non LoRaWAN

Header	DevAddr	FCtrl	SeqNo	Sensor Data1	...	Sensor DataN	CRC
1 bytes	4 bytes	1 bytes	2 bytes	data 1	...	data N	2 bytes
Head	Device ADDR	Control	Package No.	TLV(Refer to Type)	...	TLV(Refer to Type)	CRC16=Header至SensorDataN(即CRC之前的所有字节)

Sensor Data use TLV（Type+Length+Value),in order to save bandwidth and power consumption (i.e., save bytes), the length field is intentionally omitted for the basic types defined in this agreement document.

Example 03 00003DF9 00 0001 00 5F71 03 0190 FB06
e.g DevAddr is 0x00003DF9
00 5F71 device information
03 0190 sensor data(unit: 0.01mA) 0x0190 = 400 = 4mA
FB06 is CRC，refer to CRC Example

4.2 SIP（02/03）— LoRaWAN

<table>
<tr><td rowspan="3">MHDR</td><td rowspan="3">FHDR</td><td rowspan="3">FPort</td><td colspan="3">FRMPayload（SensorData）</td><td rowspan="3">MIC</td></tr>
<tr><td>Data 1</td><td>...</td><td>Data N</td></tr>
<tr><td>TLV(Refer to specific types of SensorData)</td><td></td><td>TLV(Refer to specific types of SensorData)</td></tr>
</table>

FPort：1
FRMPayload: sensor data(Massage body)

Refer to Rejeee sensor data。

4.3 Sensor Data Format

4.3.1 Device information（0x00）

Type	Value	Value	Value
1 Byte	3 bit	5bit	1 Byte
0x00	Version	Battery Level	Reserve

4.3.3. Sensor data（0x03）

Type 1 Byte	Value 2 Bytes	Note
0x03	ADC	2 Unsigned integer of byte, default ur mV

In order to unify the terminal firmware and adapt different range sensors, the liquid level equipment transmits and reports the actual sampling value (every 1mV is equivalent to the corresponding current value of 0.01mA)。

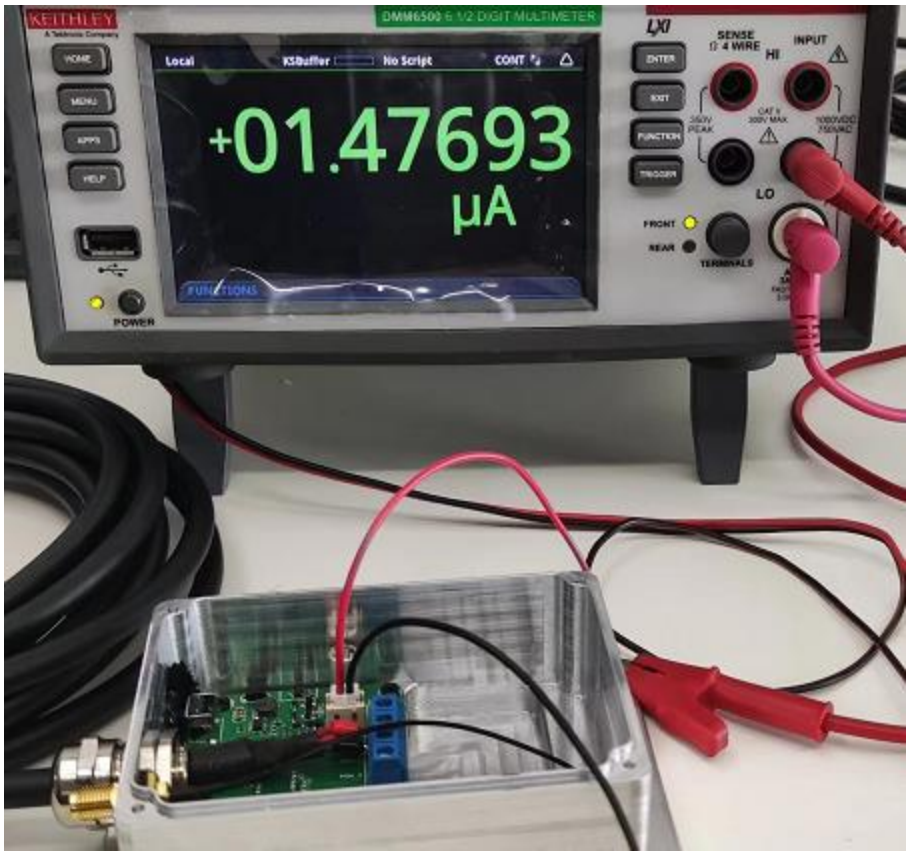
5.Feature test

		功耗/次数			
运行时间（天）	1				
采样周期LCP(秒)	10	8640	次		
上报周期LFT(秒)	600	144	次		
扩频因子SF	9				
发送时长	0.225	s			
采样时长	89	ms			
发送平均电流	140	mA			
采样电流	22	mA			
休眠平均电流	0.006	mA			
单次采样功耗	0.543888889	uAh			
单次发送功耗	8.75	uAh			
			占比	1年功耗	
采样功耗	4.6992	mAh	77.00%	1715.208	mAh
发送功耗	1.26	mAh	20.64%	459.9	mAh
休眠功耗	0.144	mAh	2.36%	52.56	mAh
预计总功耗	6.1032	mAh		2227.668	mAh

5.1.Standby power

pic: Standby current

5.2.Power while trun off

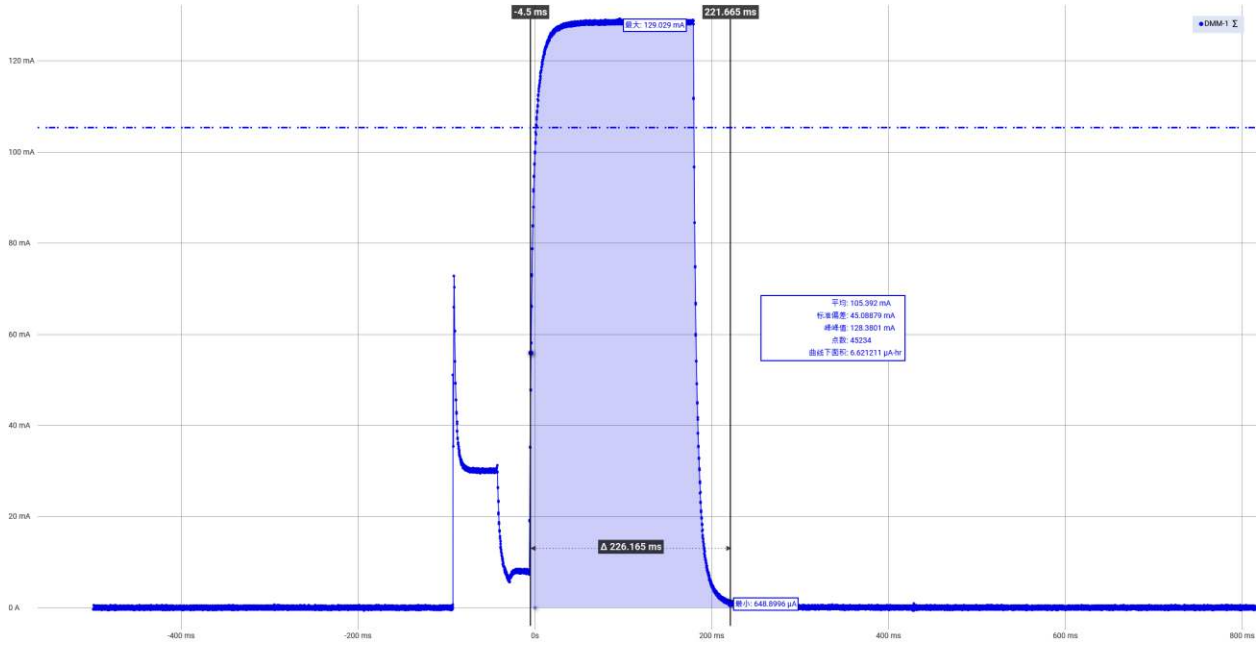


Pic: current while turn off

5.3.Single TX power

Example: Default SF9, Transmission action current power consumption, generally 140mA (depending on antenna matching, about 120~140mA). The test is performed in poor days.

Simple calculation method: duration is about 0.2s, power consumption=140 * 0.2s=78uAh.

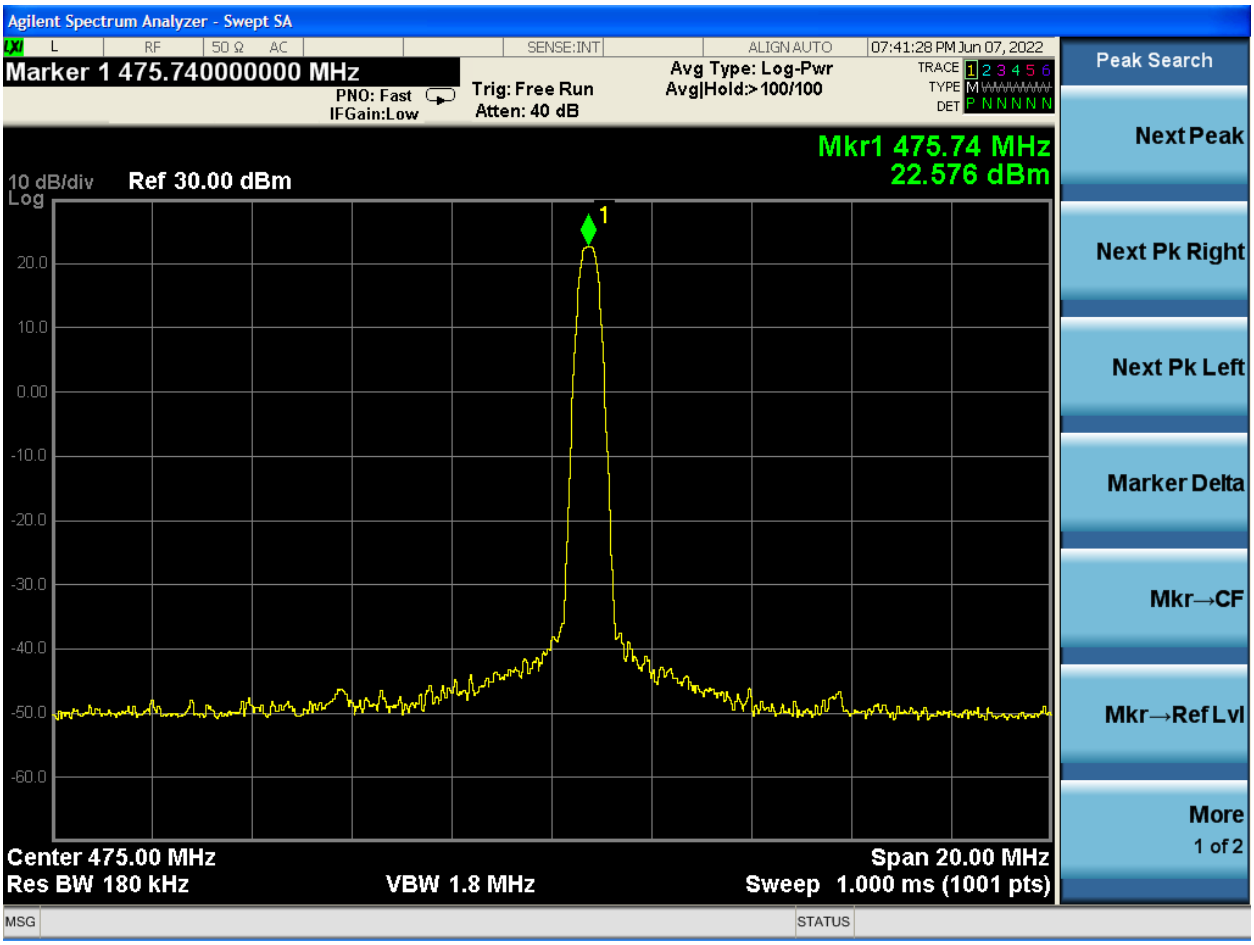


Pic: TX current（SF9）

5.4.Sensitivity test

扩频因子 SF	接收灵敏度 dBm，@BW=125K，470MHz
SF=7	-126
SF=8	-129
SF=9	-131
SF=10	-134
SF=11	-136
SF=12	-139

5.5.TX power test



Pic: Max TX power

6.CRC example

```
1. static uint16_t get_crc16(uint16_t inData, uint16_t outData) {
2. outData = (outData >> 8) | (outData << 8);
3. outData ^= inData;
4. outData ^= (outData & 0xff) >> 4;
5. outData ^= outData << 12;
6. outData ^= (outData & 0xff) << 5;
7. return outData;
8. }
9.
10. static uint16_t cal_crc16(const uint8_t *pData, const uint32_t len)
11. {
12. uint32_t i = 0;
13. uint16_t crc16 = 0xFFFF;
14. for (i = 0; i < len; i++) {
15. crc16 = get_crc16(*(pData++), crc16);
```

```
16. }
17. return crc16; }
```