LoRaWAN Analog Sensor User Manual

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1. Introduction

1.1 What is LoRaWAN Pressure Sensor

The Dragino PS-LB series sensors are **LoRaWAN Pressure Sensor** for Internet of Things solution. PS-LB can measure Air, Water pressure and liquid level and upload the sensor data via wireless to LoRaWAN IoT server.

The PS-LB series sensors include **Thread Installation Type** and **Immersion Type**, it supports different pressure range which can be used for different measurement requirement.

The LoRa wireless technology used in PS-LB allows device to send data and reach extremely long ranges at low data-rates. It provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption.

PS-LB supports BLE configure and wireless OTA update which make user easy to use.

PS-LB is powered by **8500mAh Li-SOCI2 battery**, it is designed for long term use up to 5 years.

Each PS-LB is pre-load with a set of unique keys for LoRaWAN registrations, register these keys to local LoRaWAN server and it will auto connect after power on.

1.2 Features

- LoRaWAN 1.0.3 Class A
- Ultra-low power consumption
- Measure air / gas or water pressure
- Different pressure range available
- Thread Installation Type or Immersion Type
- Monitor Battery Level
- Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865
- Support Bluetooth v5.1 and LoRaWAN remote configure
- Support wireless OTA update firmware
- Uplink on periodically
- Downlink to change configure
- 8500mAh Battery for long term use
- Controllable 3.3v,5v and 12v output to power external sensor

1.3 Specification

Micro Controller:

- MCU: 48Mhz ARM
- Flash: 256KB
- RAM: 64KB

Common DC Characteristics:

- Supply Voltage: 2.5v ~ 3.6v
- Operating Temperature: -40 ~ 85°C

LoRa Spec:

- Frequency Range, Band 1 (HF): 862 ~ 1020 Mhz,Band 2 (LF): 410 ~ 528 Mhz
- Max +22 dBm constant RF output vs.
- RX sensitivity: down to -139 dBm.
- Excellent blocking immunity

Current Input Measuring :

- Range: 0 ~ 20mA
- Accuracy: 0.02mA
- Resolution: 0.001mA

Voltage Input Measuring:

- Range: 0 ~ 30v
- Accuracy: 0.02v
- Resolution: 0.001v

Battery:

- Li/SOCI2 un-chargeable battery
- Capacity: 8500mAh
- Self-Discharge: <1% / Year @ 25°C
- Max continuously current: 130mA
- Max boost current: 2A, 1 second

Power Consumption

- Sleep Mode: 5uA @ 3.3v
- LoRa Transmit Mode: 125mA @ 20dBm, 82mA @ 14dBm

1.4 Probe Types

1.4.1 Thread Installation Type

- Hersman Pressure Transmitter
- Measuring Range: -0.1 ~ 0 ~ 60MPa, see order info.
- Accuracy: 0.2% F.S
- Long-Term Stability: 0.2% F.S ±0.05%
- Overload 200% F.S
- Zero Temperature Drift: 0.03% FS/℃(≤100Kpa), 0.02%FS/℃（＞100Kpa)
- FS Temperature Drift: 0.003% FS/℃(≤100Kpa), 0.002%FS/℃（＞100Kpa)
- Storage temperature: -30℃~80℃
- Operating temperature: -20℃~60℃
- Connector Type: Various Types, see order info

1.4.2 Immersion Type

- Immersion Type, Probe IP Level: IP68
- Measuring Range: Measure range can be customized, up to 100m.
- Accuracy: 0.2% F.S
- Long-Term Stability: ±0.2% F.S / Year
- Storage temperature: -30℃~80℃
- Operating temperature: 0℃~50℃
- Material: 316 stainless steels

1.5 Probe Dimension

1.6 Application and Installation

1.6.1 Thread Installation Type

Application:

- Hydraulic Pressure
- Petrochemical Industry
- Health and Medical
- Food & Beverage Processing

- Auto-controlling house
- Constant Pressure Water Supply
- Liquid Pressure measuring

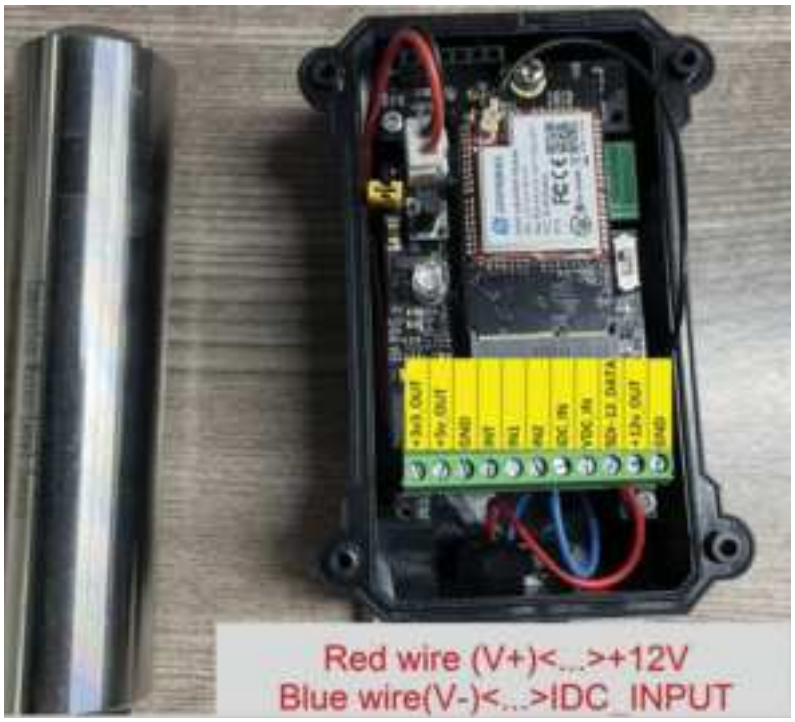
Order the suitable thread size and install to measure the air / liquid pressure

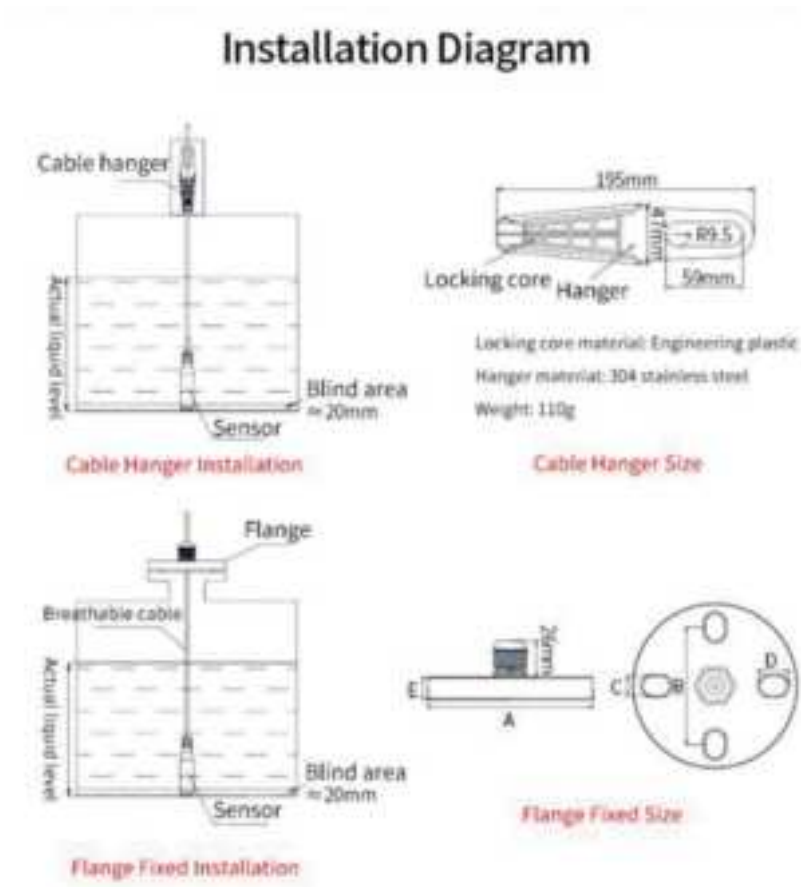
1.6.2 Immersion Type

Application:

Liquid & Water Pressure / Level detect.

The Immersion Type pressure sensor is shipped with the probe and device separately. When user got the device, below is the wiring to for connect the probe to the device.


Red wire (V+)<...>+12V
Blue wire(V-)<...>IDC_INPUT

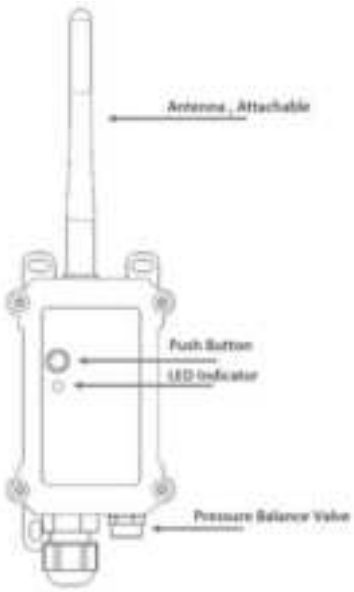

Installation Diagram
Cable hanger
Actual liquid level
Blind area
≈ 20mm
Sensor
Cable Hanger Installation
195mm
17mm
R9.5
59mm
Locking core
Hanger
Locking core material: Engineering plastic
Hanger material: 304 stainless steel
Weight: 110g
Cable Hanger Size
Flange
Breathable cable
Actual liquid level
Blind area
≈ 20mm
Sensor
Flange Fixed Installation
Flange Fixed Size

1.7 Sleep mode and working mode

Deep Sleep Mode: Sensor doesn't have any LoRaWAN activate. This mode is used for storage and shipping to save battery life.

Working Mode: In this mode, Sensor will work as LoRaWAN Sensor to Join LoRaWAN network and send out sensor data to server. Between each sampling/tx/rx periodically, sensor will be in IDLE mode), in IDLE mode, sensor has the same power consumption as Deep Sleep mode.

1.8 Button & LEDs



Behavior on ACT	Function	Action
Pressing ACT between 1s < time < 3s	Send an uplink	If sensor is already Joined to LoRaWAN network, sensor will send an uplink packet, **blue led** will blink once. Meanwhile, BLE module will be active and user can connect via BLE to configure device.
Pressing ACT for more than 3s	Active Device	**Green led** will fast blink 5 times, device will enter **OTA mode** for 3 seconds. And then start to JOIN LoRaWAN network. **Green led** will solidly turn on for 5 seconds after joined in network. Once sensor is active, BLE module will be active and user can connect via BLE to configure device, no matter if device join or not join LoRaWAN network.
Fast press ACT 5 times.	Deactivate Device	**Red led** will solid on for 5 seconds. Means PS-LB-NA is in Deep Sleep Mode.

1.9 Pin Mapping

1.10 BLE connection

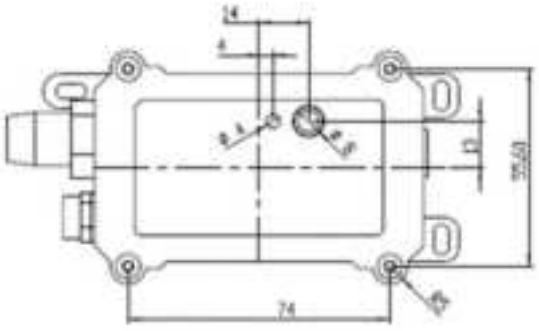
PS-LB support BLE remote configure.

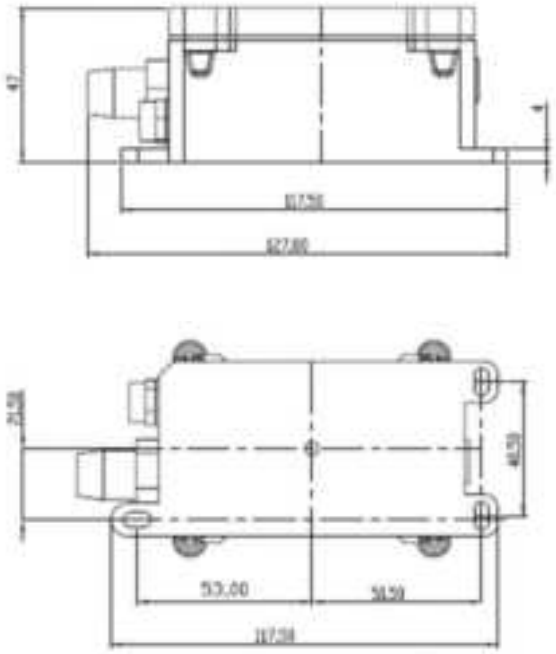
BLE can be used to configure the parameter of sensor or see the console output from sensor. BLE will be only activate on below case:

- Press button to send an uplink
- Press button to active device.
- Device Power on or reset.

If there is no activity connection on BLE in 60 seconds, sensor will shut down BLE module to enter low power mode.

1.11 Mechanical





2. Configure PS-LB to connect to LoRaWAN network

2.1 How it works

The PS-LB is configured as **LoRaWAN OTAA Class A** mode by default. It has OTAA keys to join LoRaWAN network. To connect a local LoRaWAN network, you need to input the OTAA keys in the LoRaWAN IoT server and activate the PS-LB. It will automatically join the network via OTAA and start to send the sensor value. The default uplink interval is 20 minutes.

2.2 Quick guide to connect to LoRaWAN server (OTAA)

Following is an example for how to join the TTN v3 LoRaWAN Network. Below is the network structure; we use the LPS8v2 as a LoRaWAN gateway in this example.

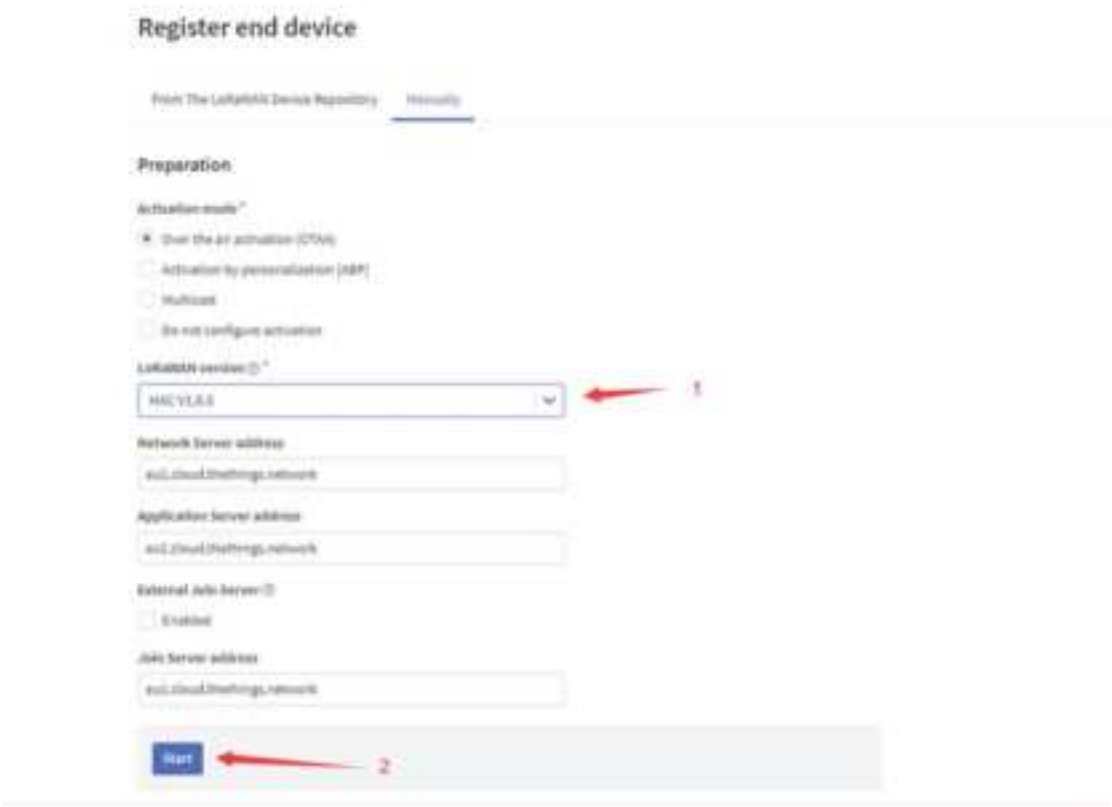
The LPS8V2 is already set to connected to TTN network , so what we need to now is configure the TTN server.

Step 1: Create a device in TTN with the OTAA keys from PS-LB.

Each PS-LB is shipped with a sticker with the default device EUI as below:

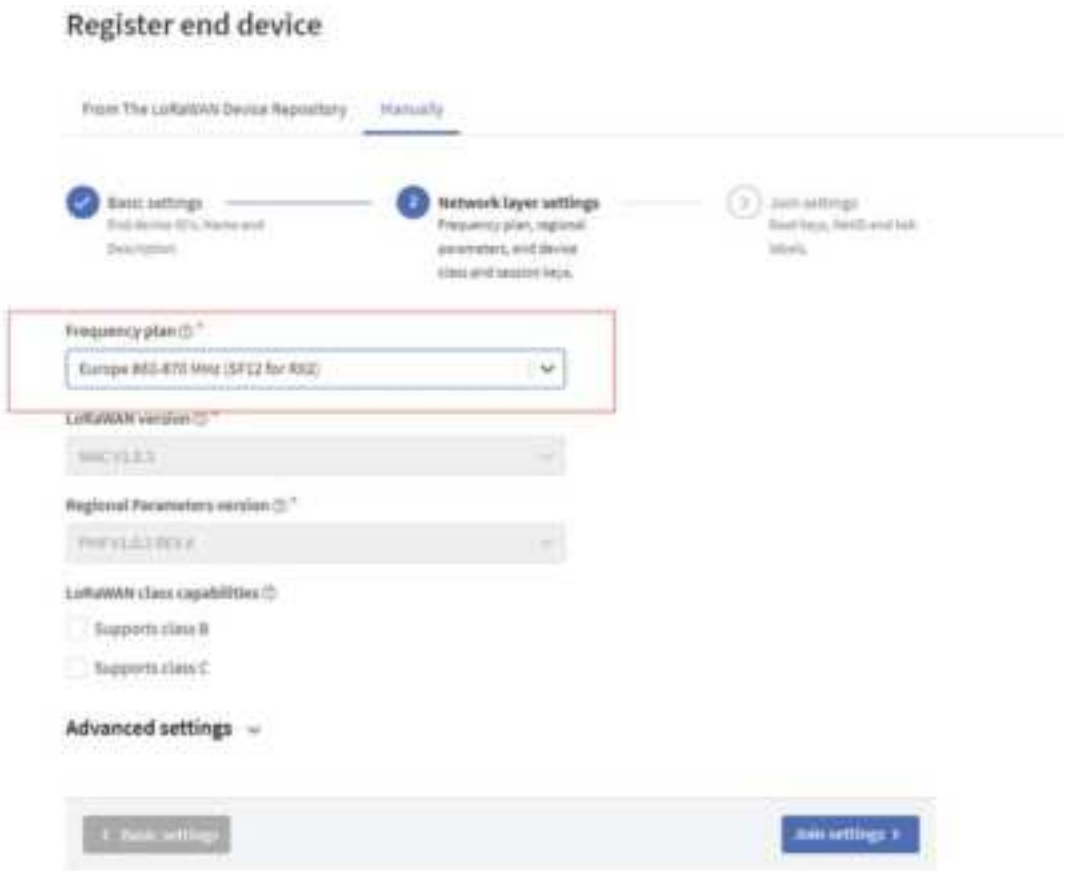
You can enter this key in the LoRaWAN Server portal. Below is TTN screen shot:

Register the device



Add APP EUI and DEV EUI

Add APP EUI in the application


Register end device
From The LoRaWAN Device Repository
Manually
Basic settings
Network layer settings
Frequency plan
Europe 863-870 MHz (SF12 for RX2)
LoRaWAN version
Regional Parameters version
LoRaWAN class capabilities
Supports class B
Supports class C
Advanced settings
Join settings

Add APP KEY

Register end device
From The LoRaWAN Device Repository
Manually
Basic settings
Network layer settings
Join settings
Root keys
AppKey
BD 72 1D AC F3 CC AB 67 72 BD 7A F5 4D DF 38 B8
Advanced settings

Step 2: Activate on PS-LB

Press the button for 5 seconds to activate the PS-LB.

Green led will fast blink 5 times, device will enter **OTA mode** for 3 seconds. And then start to JOIN LoRaWAN network. **Green led** will solidly turn on for 5 seconds after joined in network.

After join success, it will start to upload messages to TTN and you can see the messages in the panel.

2.3 Uplink Payload

2.3.1 Device Status, FPORT=5

Include device configure status. Once PS-LB Joined the network, it will uplink this message to the server.

Users can also use the downlink command(0x26 01) to ask PS-LB to resend this uplink.

Device Status (FPORT=5)					
Size (bytes)	**1**	**2**	**1**	**1**	**2**
Value	Sensor Model	Firmware Version	Frequency Band	Sub-band	BAT

Example parse in TTNv3

Sensor Model: For PS-LB, this value is 0x16

Firmware Version: 0x0100, Means: v1.0.0 version

Frequency Band:

*0x01: EU868

*0x02: US915

*0x03: IN865

*0x04: AU915

*0x05: KZ865

*0x06: RU864

*0x07: AS923

*0x08: AS923-1

*0x09: AS923-2

*0x0a: AS923-3

*0x0b: CN470

*0x0c: EU433

*0x0d: KR920

*0x0e: MA869

Sub-Band:

AU915 and US915:value 0x00 ~ 0x08

CN470: value 0x0B ~ 0x0C

Other Bands: Always 0x00

Battery Info:

Check the battery voltage.

Ex1: 0x0B45 = 2885mV

Ex2: 0x0B49 = 2889mV

2.3.2 Sensor value, FPORT=2

Uplink payload includes in total 9 bytes.

Size(bytes)	2	2	2	2	1
Value	BAT	Probe Model	0 ~ 20mA value	0 ~ 30v value	IN1 &IN2 Interrupt flag

2.3.3 Battery Info

Check the battery voltage for PS-LB.

Ex1: 0x0B45 = 2885mV

Ex2: 0x0B49 = 2889mV

2.3.4 Probe Model

PS-LB has different kind of probe, 4~20mA represent the full scale of the measuring range. So a 12mA output means different meaning for different probe.

For example.

Part Number	Probe Used	4~20mA scale	Example: 12mA meaning
PS-LB-I3	immersion type with 3 meters cable	0~3 meters	1.5 meters pure water
PS-LB-I5	immersion type with 5 meters cable	0~5 meters	2.5 meters pure water

PS-LB-T20-B	T20 threaded probe	0~1MPa	0.5MPa air / gas or water pressure

The probe model field provides the convenient for server to identical how it should parse the 4~20mA sensor value and get the correct value.

2.3.5 0~20mA value (IDC_IN)

The output value from **Pressure Probe**, use together with Probe Model to get the pressure value or water level.

Example:

27AE(H) = 10158 (D)/1000 = 10.158mA.

Instead of pressure probe, User can also connect a general 4~20mA in this port to support different types of 4~20mA sensors. below is the connection example:

2.3.6 0~30V value (pin VDC_IN)

Measure the voltage value. The range is 0 to 30V.

Example:

138E(H) = 5006(D)/1000= 5.006V

2.3.7 IN1&IN2&INT pin

IN1 and IN2 are used as digital input pins.

Example:

09 (H): (0x09&0x08)>>3=1 IN1 pin is high level.

09 (H): (0x09&0x04)>>2=0 IN2 pin is low level.

This data field shows if this packet is generated by **Interrupt Pin** or not. Click here for the hardware and software set up. Note: The Internet Pin is a separate pin in the screw terminal.

Example:

09 (H): (0x09&0x02)>>1=1 The level of the interrupt pin.

09 (H): 0x09&0x01=1 0x00: Normal uplink packet.

0x01: Interrupt Uplink Packet.

2.3.8 Sensor value, FPORT=7

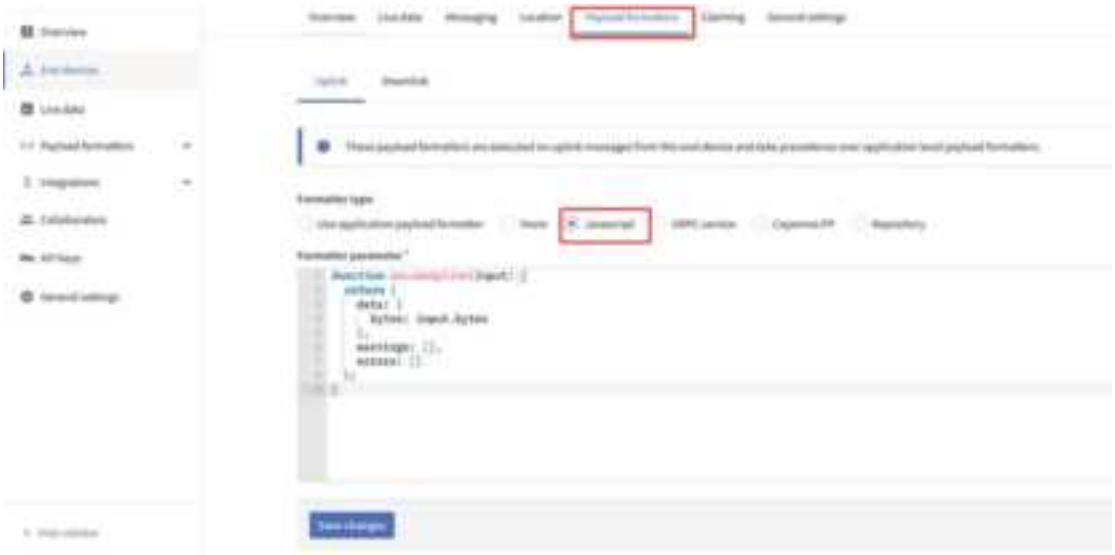
Size(bytes)	2	n
Value	BAT	Voltage value, each 2 bytes is a set of voltage values.

Multiple sets of data collected are displayed in this `form`:

[voltage value1], [voltage value2], [voltage value3],...[voltage value n/2]

2.3.9 Decode payload in The Things Network

While using TTN network, you can add the payload format to decode the payload.



PS-LB TTN Payload Decoder: https://github.com/dragino/dragino-end-node-decoder

2.4 Uplink Interval

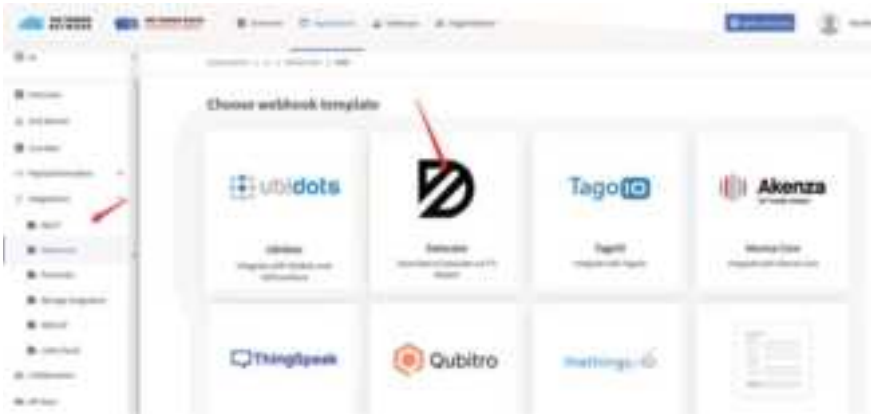
The PS-LB by default uplink the sensor data every 20 minutes. User can change this interval by AT Command or LoRaWAN Downlink Command. See this link: http://wiki.dragino.com/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/#H4.1ChangeUplinkInterval

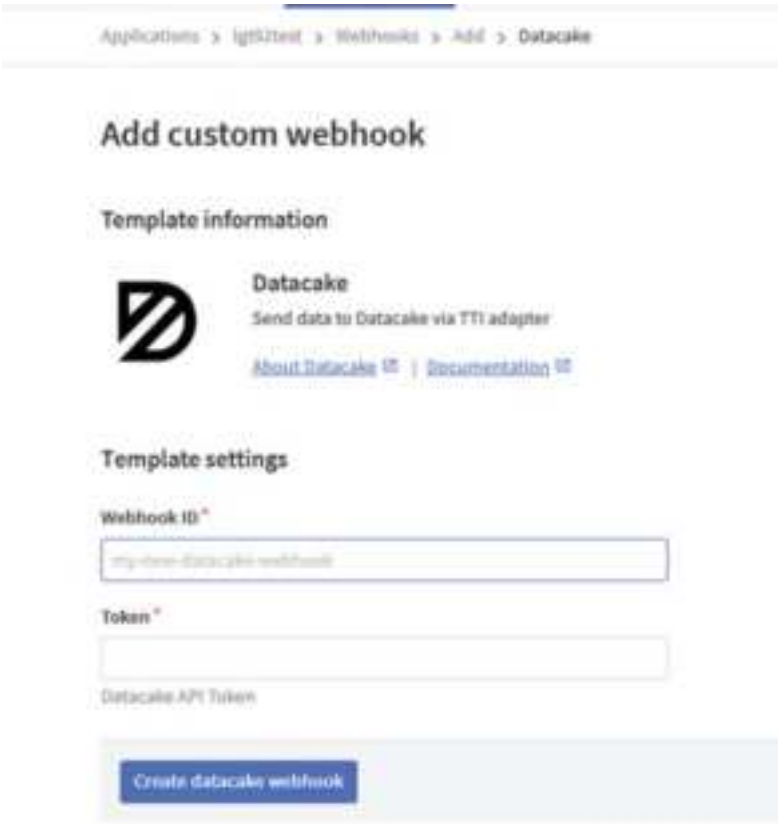
2.5 Show Data in DataCake IoT Server

DATACAKE provides a human friendly interface to show the sensor data, once we have data in TTN, we can use DATACAKE to connect to TTN and see the data in DATACAKE. Below are the steps:

Step 1: Be sure that your device is programmed and properly connected to the network at this time.

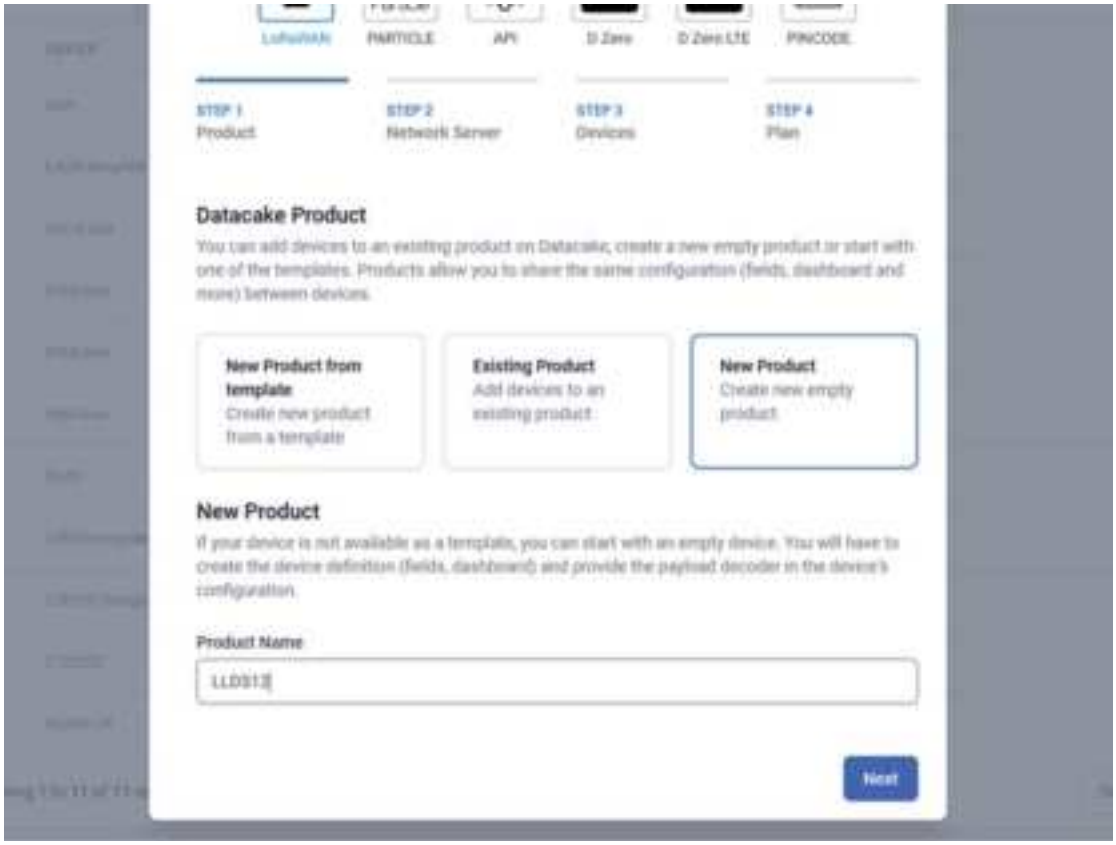
Step 2: To configure the Application to forward data to DATACAKE you will need to add integration. To add the DATACAKE integration, perform the following steps:

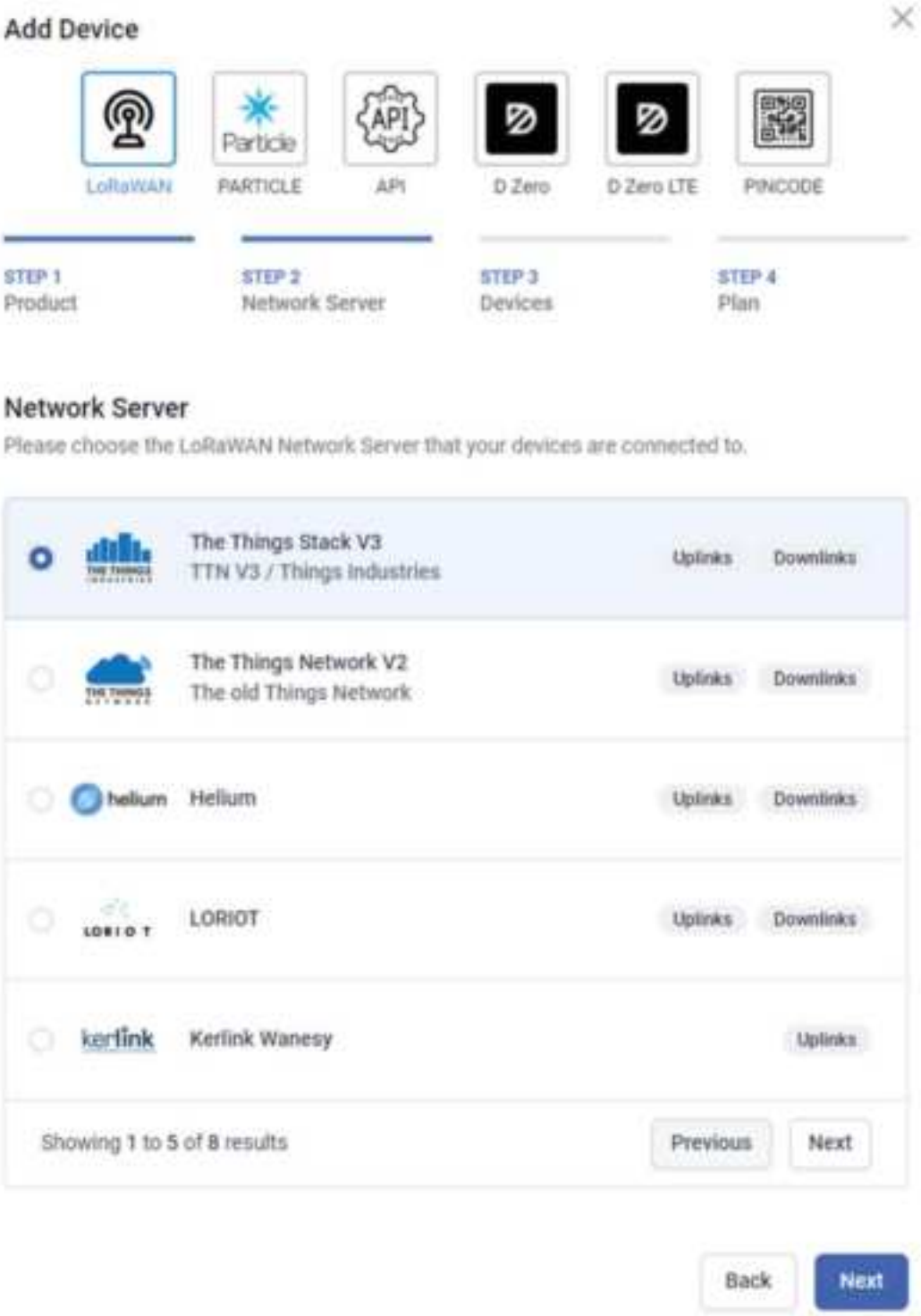


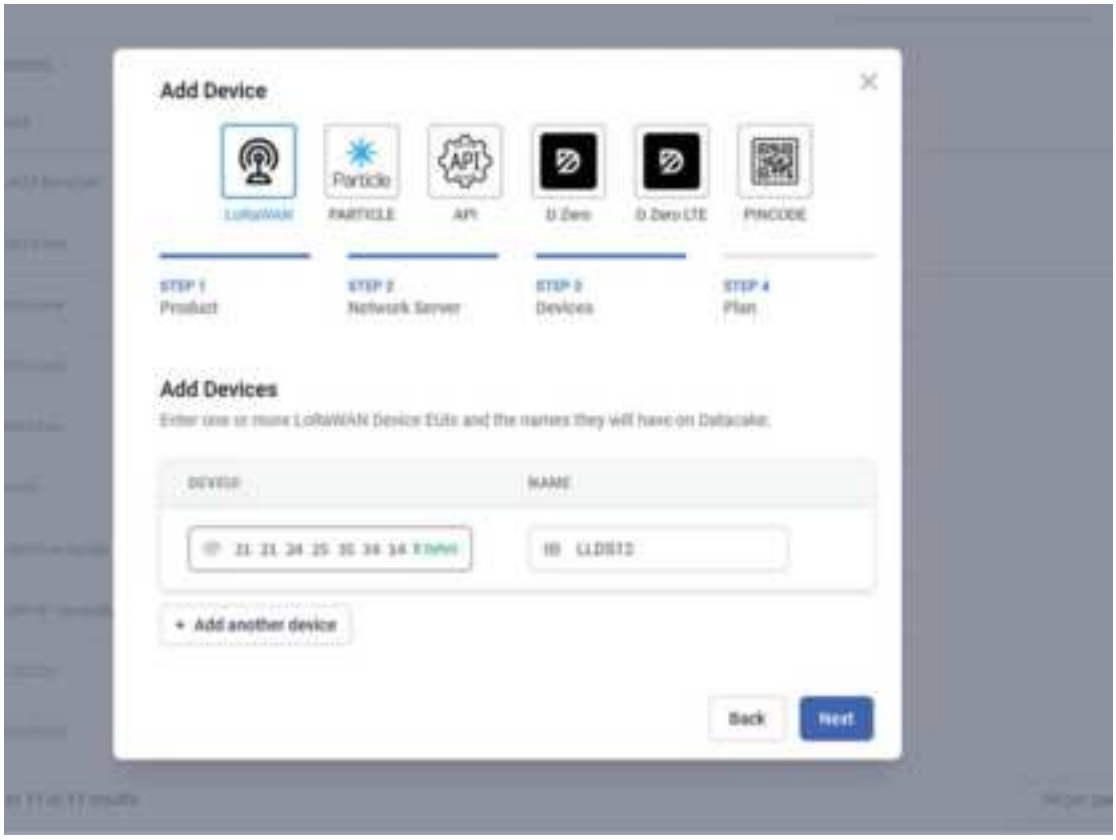


Step 3: Create an account or log in Datacake.

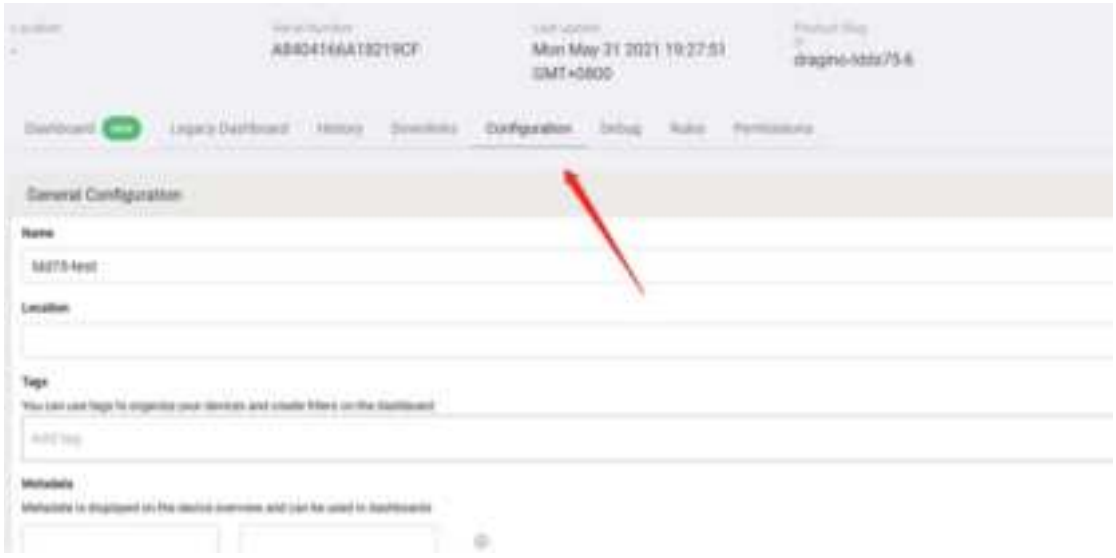
Step 4: Create PS-LB product.


LoRaWAN
PARTICLE
API
D Zero
D Zero LTE
PINCODE
STEP 1
Product
STEP 2
Network Server
STEP 3
Devices
STEP 4
Plan
Datacake Product
You can add devices to an existing product on Datacake, create a new empty product or start with one of the templates. Products allow you to share the same configuration (fields, dashboard and more) between devices.
New Product from template
Create new product from a template
Existing Product
Add devices to an existing product
New Product
Create new empty product
New Product
If your device is not available as a template, you can start with an empty device. You will have to create the device definition (fields, dashboard) and provide the payload decoder in the device's configuration.
Product Name
LLDS12
Next

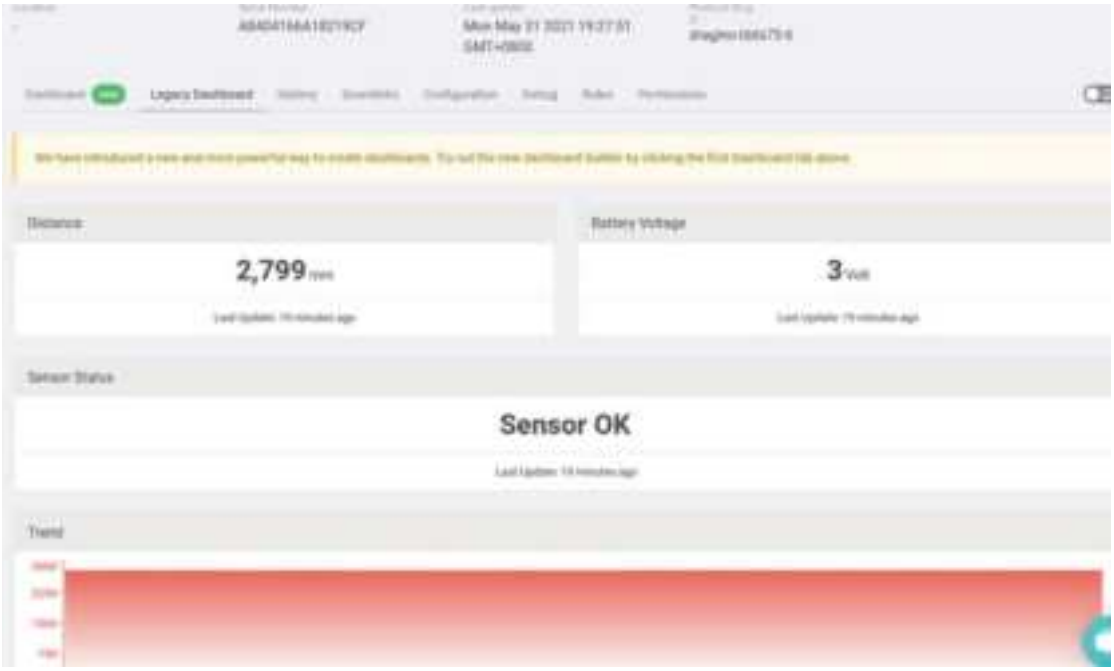

Add Device
LoRaWAN
PARTICLE
API
D Zero
D Zero LTE
PINCODE
STEP 1
Product
STEP 2
Network Server
STEP 3
Devices
STEP 4
Plan
Network Server
Please choose the LoRaWAN Network Server that your devices are connected to.
The Things Stack V3
TTN V3 / Things Industries
Uplinks
Downlinks
The Things Network V2
The old Things Network
Uplinks
Downlinks
helium
Helium
Uplinks
Downlinks
LORIOT
Uplinks
Downlinks
kerlink
Kerlink Wanesy
Uplinks
Showing 1 to 5 of 8 results
Previous
Next
Back
Next



Step 5: add payload decode



After added, the sensor data arrive TTN, it will also arrive and show in Datacake.



2.6 Frequency Plans

The PS-LB uses OTAA mode and below frequency plans by default. If user want to use it with different frequency plan, please refer the AT command sets.

http://wiki.dragino.com/xwiki/bin/view/Main/End%20Device%20Frequency%20Band/

2.7 Firmware Change Log

Firmware download link:

https://www.dropbox.com/sh/gf1gllloczbzz19h/AABbuYI4WY6VdAmpXo6o1V2Ka?dl=0

3. Configure PS-LB

3.1 Configure Methods

PS-LB-NA supports below configure method:

- AT Command via Bluetooth Connection (**Recommand Way**): BLE Configure Instruction.
- AT Command via UART Connection : See FAQ.
- LoRaWAN Downlink. Instruction for different platforms: See IoT LoRaWAN Server section.

3.2 General Commands

These commands are to configure:

- General system settings like: uplink interval.
- LoRaWAN protocol & radio related command.

They are same for all Dragino Devices which support DLWS-005 LoRaWAN Stack. These commands can be found on the wiki:

http://wiki.dragino.com/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/

3.3 Commands special design for PS-LB

These commands only valid for PS-LB, as below:

3.3.1 Set Transmit Interval Time

Feature: Change LoRaWAN End Node Transmit Interval.

AT Command: AT+TDC

Command Example	Function	Response
AT+TDC=?	Show current transmit Interval	30000 OK the interval is 30000ms = 30s
AT+TDC=60000	Set Transmit Interval	OK Set transmit interval to 60000ms = 60 seconds

Downlink Command: 0x01

Format: Command Code (0x01) followed by 3 bytes time value.

If the downlink payload=0100003C, it means set the END Node's Transmit Interval to 0x00003C=60(S), while type code is 01.

- Example 1: Downlink Payload: 0100001E // Set Transmit Interval (TDC) = 30 seconds
- Example 2: Downlink Payload: 0100003C // Set Transmit Interval (TDC) = 60 seconds

3.3.2 Set Interrupt Mode

Feature, Set Interrupt mode for GPIO_EXIT.

AT Command: AT+INTMOD

Command Example	Function	Response

AT+INTMOD=?	Show current interrupt mode	0 OK the mode is 0 =Disable Interrupt
AT+INTMOD=2	Set Transmit Interval 0. (Disable Interrupt), 1. (Trigger by rising and falling edge) 2. (Trigger by falling edge) 3. (Trigger by rising edge)	OK

Downlink Command: 0x06

Format: Command Code (0x06) followed by 3 bytes.

This means that the interrupt mode of the end node is set to 0x000003=3 (rising edge trigger), and the type code is 06.

- Example 1: Downlink Payload: 06000000 // Turn off interrupt mode
- Example 2: Downlink Payload: 06000003 // Set the interrupt mode to rising edge trigger

3.3.3 Set the output time

Feature, Control the output 3V3 , 5V or 12V.

AT Command: AT+3V3T

Command Example	Function	Response
AT+3V3T=?	Show 3V3 open time.	0 OK
AT+3V3T=0	Normally open 3V3 power supply.	OK default setting
AT+3V3T=1000	Close after a delay of 1000 milliseconds.	OK
AT+3V3T=65535	Normally closed 3V3 power supply.	OK

AT Command: AT+5VT

Command Example	Function	Response
AT+5VT=?	Show 5V open time.	0 OK
AT+5VT=0	Normally closed 5V power supply.	OK default setting
AT+5VT=1000	Close after a delay of 1000 milliseconds.	OK
AT+5VT=65535	Normally open 5V power supply.	OK

AT Command: AT+12VT

Command Example	Function	Response
AT+12VT=?	Show 12V open time.	0 OK
AT+12VT=0	Normally closed 12V power supply.	OK
AT+12VT=500	Close after a delay of 500 milliseconds.	OK

Downlink Command: 0x07

Format: Command Code (0x07) followed by 3 bytes.

The first byte is which power, the second and third bytes are the time to turn on.

- Example 1: Downlink Payload: 070101F4 **--->** AT+3V3T=500

- Example 2: Downlink Payload: 0701FFFF **--->** AT+3V3T=65535
- Example 3: Downlink Payload: 070203E8 **--->** AT+5VT=1000
- Example 4: Downlink Payload: 07020000 **--->** AT+5VT=0
- Example 5: Downlink Payload: 070301F4 **--->** AT+12VT=500
- Example 6: Downlink Payload: 07030000 **--->** AT+12VT=0

3.3.4 Set the Probe Model

Users need to configure this parameter according to the type of external probe. In this way, the server can decode according to this value, and convert the current value output by the sensor into water depth or pressure value.

AT Command: AT +PROBE

AT+PROBE=aabb

When aa=00, it is the water depth mode, and the current is converted into the water depth value; bb is the probe at a depth of several meters.

When aa=01, it is the pressure mode, which converts the current into a pressure value;

bb represents which type of pressure sensor it is.

(A->01,B->02,C->03,D->04,E->05,F->06,G->07,H->08,I->09,J->0A,K->0B,L->0C)

Command Example	Function	Response
AT +PROBE = ?	Get or Set the probe model.	0 OK
AT +PROBE =0003	Set water depth sensor mode, 3m type.	OK
AT +PROBE =000A	Set water depth sensor mode, 10m type.	OK
AT +PROBE =0101	Set pressure transmitters mode, first type(A).	OK
AT +PROBE =0000	Initial state, no settings.	OK

Downlink Command: 0x08

Format: Command Code (0x08) followed by 2 bytes.

- Example 1: Downlink Payload: 080003 **--->** AT+PROBE=0003
- Example 2: Downlink Payload: 080101 **--->** AT+PROBE=0101

3.3.5 Multiple collections are one uplink (Since firmware V1.1)

Added AT+STDC command to collect the voltage of VDC_INPUT multiple times and upload it at one time.

AT Command: AT +STDC

AT+STDC=aa,bb,bb

aa:
0: means disable this function and use TDC to send packets.
1: means enable this function, use the method of multiple acquisitions to send packets.
bb: Each collection interval (s), the value is 1~65535
cc: the number of collection times, the value is 1~120

Command Example	Function	Response
AT+STDC=?	Get the mode of multiple acquisitions and one uplink.	1,10,18 OK
AT+STDC=1,10,18	Set the mode of multiple acquisitions and one uplink, collect once every 10 seconds, and report after 18 times.	Attention:Take effect after ATZ OK

AT+STDC=0, 0,0	Use the TDC interval to send packets.(default)	Attention:Take effect after ATZ OK

Downlink Command: 0xAE

Format: Command Code (0x08) followed by 5 bytes.

- Example 1: Downlink Payload: AE 01 02 58 12 **--->** AT+STDC=1,600,18

4. Battery & Power Consumption

PS-LB-NA uses ER26500 + SPC1520 battery pack. See below link for detail information about the battery info and how to replace.

Battery Info & Power Consumption Analyze .

5. OTA firmware update

Please see this link for how to do OTA firmware update: http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20OTA%20Update%20for%20Sensors/

6. FAQ

6.1 How to use AT Command via UART to access device?

See: http://wiki.dragino.com/xwiki/bin/view/Main/UART%20Access%20for%20LoRa%20ST%20v4%20base%20model/#H1.LoRaSTv4baseHardware

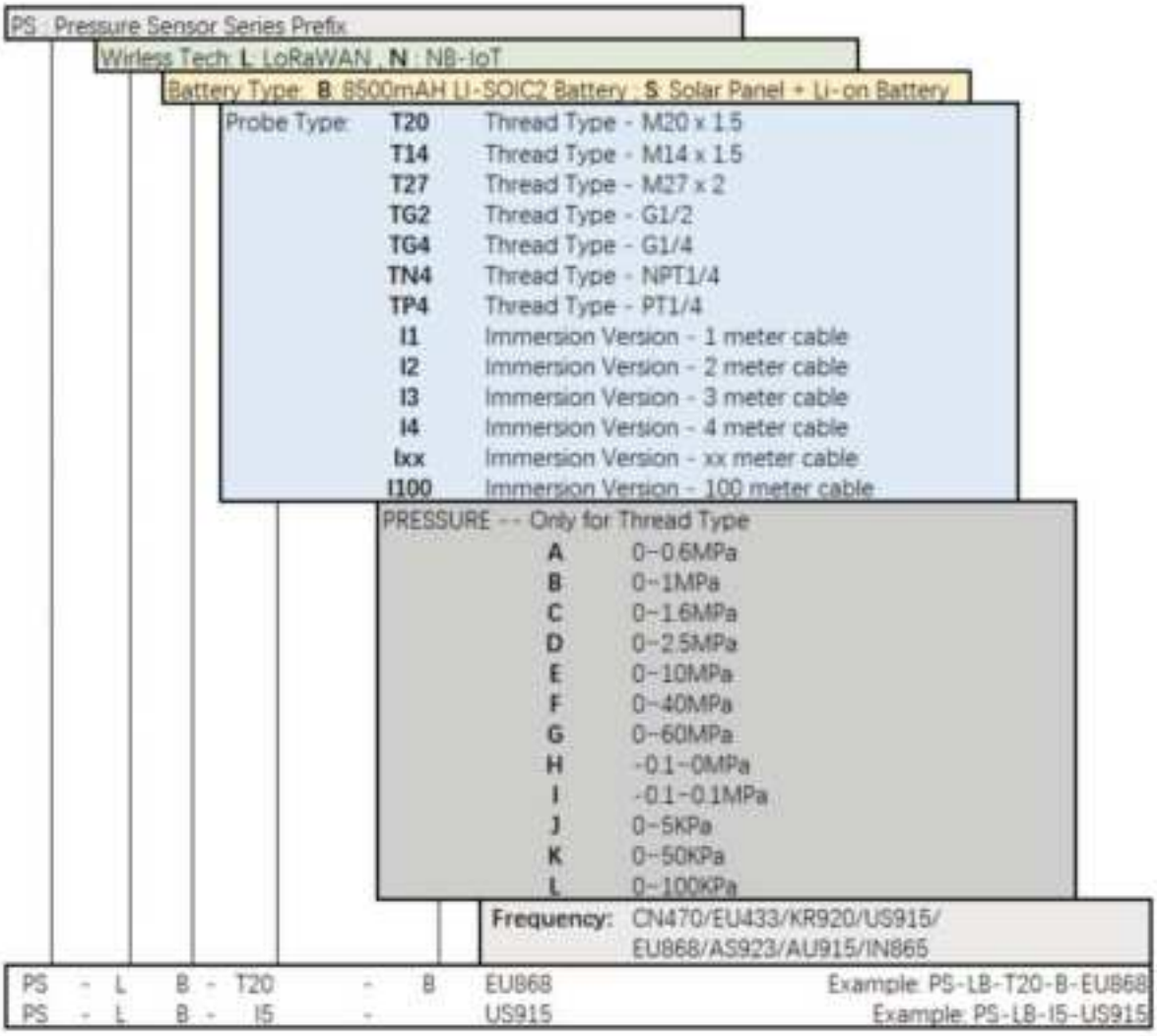
6.2 How to update firmware via UART port?

See: http://wiki.dragino.com/xwiki/bin/view/Main/UART%20Access%20for%20LoRa%20ST%20v4%20base%20model/#H1.LoRaSTv4baseHardware

6.3 How to change the LoRa Frequency Bands/Region?

You can follow the instructions for how to upgrade image.
When downloading the images, choose the required image file for download.

7. Order Info



8. Troubleshooting

8.1 Water Depth Always shows 0 in payload

If your device's IDC_intput_mA is normal, but your reading always shows 0, please refer to the following points:

1. Please set it to mod1
2. Please set the command AT+PROBE according to the model of your sensor
3. Check the connection status of the sensor

9. Packing Info

Package Includes:

- PS-LB LoRaWAN Pressure Sensor

Dimension and weight:

- Device Size: cm
- Device Weight: g
- Package Size / pcs : cm
- Weight / pcs : g

10. Support

- Support is provided Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different timezones we cannot offer live support. However, your questions will be answered as soon as possible in the before-mentioned schedule.
- Provide as much information as possible regarding your enquiry (product models, accurately describe your problem and steps to replicate it etc) and send a mail to Support@dragino.cc.

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.