SENSE NODE PLUS USER MANUAL

Multiple Sensor Device

Abstract

LoRaWAN Sense Node Plus is a rechargeable device that reads temperature, relative humidity, CO2, ambient light, and atmospheric pressure and sends collected data over the LoRaWAN network.

UM0003
Document Code

Contents

1. Document overview

1.1. Introduction

This document and the contents hereof are considered proprietary and confidential information of PTS Technologies Pte Ltd. Disclosure to unauthorized individuals or dissemination, publication or copying is prohibited without the prior written consent of PTS Technologies Pte Ltd.

1.2. Version History

Version	Date	Description
1.0	14-02-2020	Initial release

1.3. Purpose

The purpose of this document is to guide users on how to use and deploy PTS Sense Node Plus devices.

1.4. Scope

This document will mainly focus on Sense Node Plus and its implementation as an environmental sensing device.

1.5. Definitions, Acronyms, and Abbreviation

Term	Description
LoRaWAN™	a MAC protocol for high capacity, long-range star network that the LoRa Alliance is standardizing for Low Power Wide Area Networks (LPWAN).
LoRa® Gateway	Designed to be used in long-range star network architectures and are utilized in a LoRaWAN™ system. Also known as LoRa® Concentrator.
TRH Sensor	Temperature and Relative Humidity sensing component integrated into the LoRaWAN Sense Node.
OTAA	Over-the-Air activation method.
DevEUI	Device EUI is the unique ID of the LoRaWAN sense node.
AppEUI	Application EUI is the unique ID of the Application server.
AppKey	The AppKey is the encryption key between the source of the message (behind the DevEUI) and the destination of the message (behind the AppEUI).

2. Product Description

2.1. General Description

The PTS Sense Node Plus is a device that measures temperature, relative humidity, CO_2 concentration, Ambient Light, & Atmospheric Pressure and transmits the data to a Gateway through LoRaWAN Communication Protocol. This device can be paired with an existing LoRaWAN network.

The device transmits the collected data measured from on-board sensors at a fixed interval. This device will greatly help the users that need to remotely monitor the environmental conditions of their poultry sheds or farms.

2.2. System Operation

The entire system is composed of the following:

Hardware:

1. Sense Node Plus – collects sensor measurements and transmits the data to the gateway periodically.
2. Gateway – receives the data from Sense Node Plus devices. This gateway can receive data from any LoRaWAN enabled device.

Software:

1. Network Server – authenticates data received by the gateway. If data is addressed to Network Server, data is processed and will be forwarded to Application Server.
2. Application Server – decrypts the data from Network Server.
3. Web Dashboard – a visual representation of the data decrypted by the Application Server.
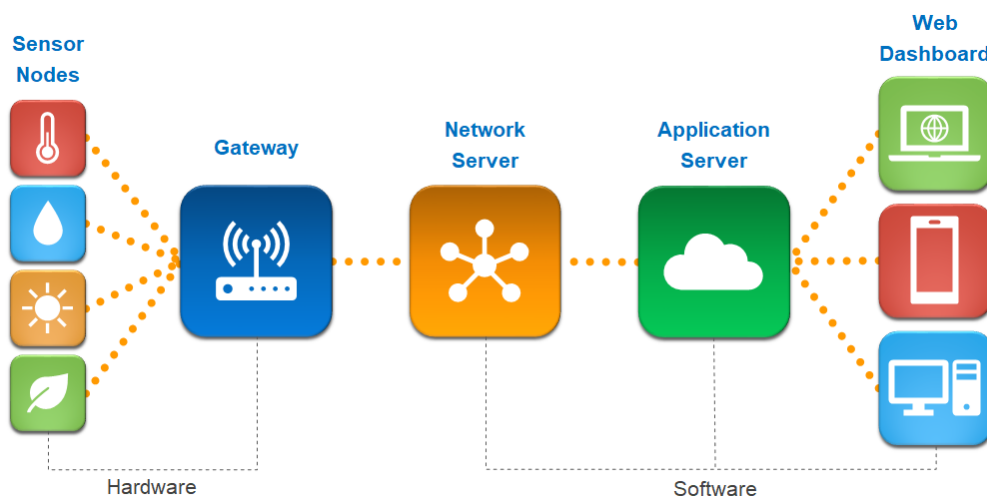

Figure 1. LoRaWAN™ System

2.3. Enclosure

Ambient Light Sensor

Power ON Button

Power OFF Button
Press this button together with the Power ON button to turn OFF the device.

Battery Status LED

Activity Status LED

CO2 Sensor
TRH Sensor
Pressure Sensor

Micro USB Port
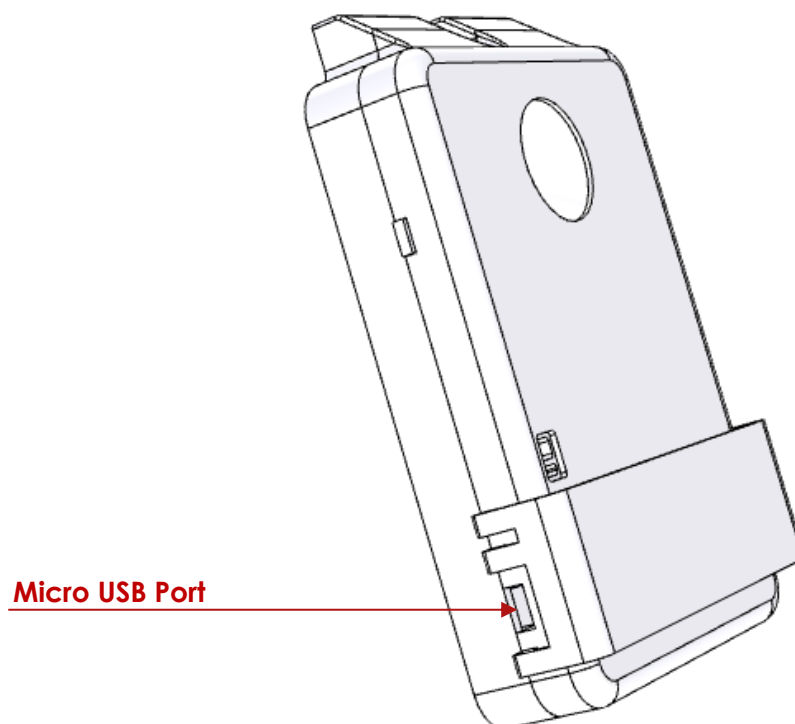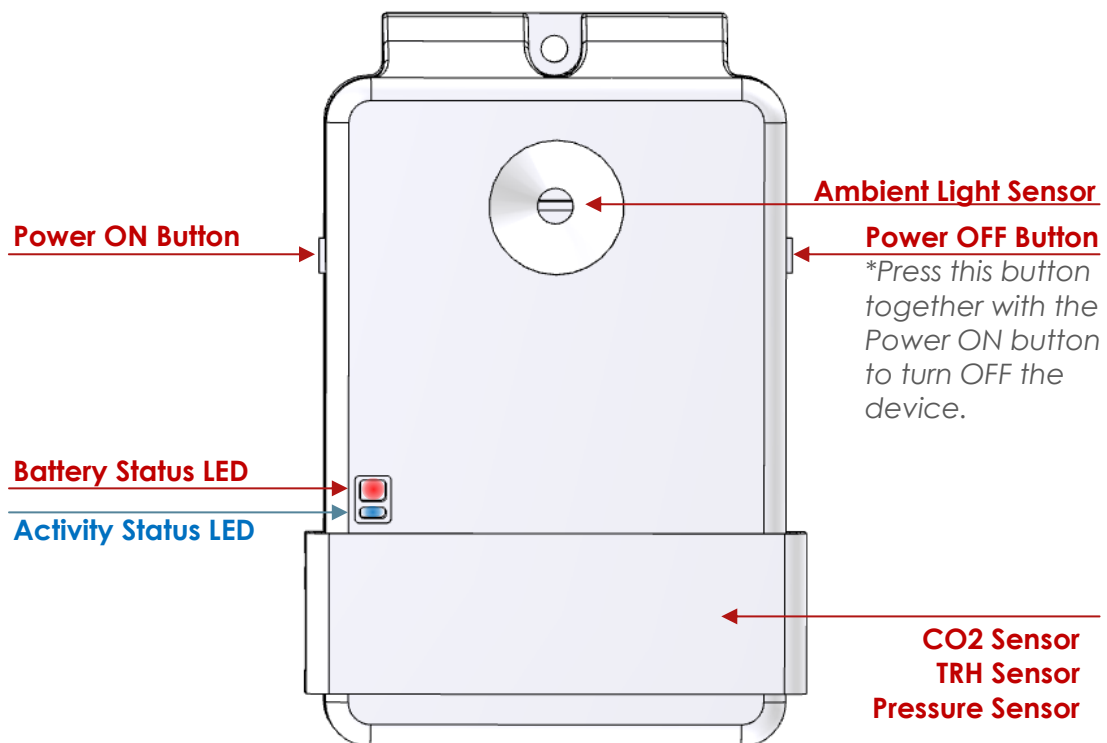
2.4. Technical Specifications

Parameters	Value
Frequency Band	868 MHz (Europe)
Electrical Rating	Charging: 5V ⎓ 500mA
Operating Temperature Range	5°C to 40°C
Temperature Accuracy	±0.3°C (typical)
Relative Humidity Operating Range	20% to 80% RH (recommended)*
Relative Humidity Accuracy	±2% (typical)
CO_2 Measurement Range and Accuracy	400 to 10,000 ppm
Ambient Light Measurement Range	0.01 to 83,000 Lux
Absolute Pressure Range	260 to 1,260 hPa
Transmission Interval	15 minutes
Enclosure Protection Rating	T.B.D.
Communication Range	T.B.D.
Battery Operating Time	40 days (Full charge)

Long-term exposure to conditions outside the recommended range, especially at high humidity, may temporarily offset the RH signal.

3. Product Operation

3.1. Standby Mode

When the device is shipped, it will be on Sleep Mode. The power consumption in this mode will be minimal. At sleep mode, the device will not be measuring and transmitting sensor data.

It is recommended to store the device in Standby Mode to prolong the battery lifespan.

3.2. Active Mode

Before using the device, it should be switched to Active Mode first. Activate the device by pressing the button on the left side of the enclosure. During active mode, the device will be measuring and transmitting the sensor data periodically.

There is an LED indicator in the device to show the following status:

Status	LED Blinking Pattern
Device Activated	Blue LED toggles 5x
Join Request Procedure Success	Blue LED toggles 5x at a faster rate
Data Transmission	Blue LED toggles 1x every transmission

3.3. Device Reset

If a problem occurs (e.g. No data received from the device), the device can be reset by turning OFF the device and then turning it ON again.

To turn OFF the device, press the buttons on both sides of the enclosure at the same time for 3 seconds. The Blue LED will blink 3 times at a very fast interval indicating that the device is deactivated and will return to Standby Mode.

To turn ON the device, press the button on the left side of the enclosure. This will set the device back to Active Mode.

4. Payload

4.1. Payload Decoding

The payload contains the following data from the sensors and battery percentage onboard the device:

1. Temperature (°C)
2. Relative Humidity (%RH)
3. CO2 concentration (ppm)
4. Ambient Light (lux)
5. Atmospheric Pressure (hPa)
6. Battery State-of-Charge (%)

The payload is encoded into hexadecimal format. The data length is 11 bytes. Each byte of the payload contains the following data:

1st & 2nd bytes → Temperature

3rd & 4th bytes → Relative Humidity

5th & 6th bytes → CO2 Concentration

7th & 8th bytes → Ambient Light

9th & 10th bytes → Atmospheric Pressure

11th byte → Battery State-of-Charge

Below is an example of a payload decoder.

```
function Decoder(payload) {
 var decoded = {};
 // Decode bytes to integer
 var temperatureInt = (payload [0] << 8) | payload [1];
 var humidityInt = (payload [2] << 8) | payload [3];
 var co2Concentration = ( payload [4] << 8 | payload [5]);
 var lux = (payload [6] << 8 | payload [7] );
 var pressure = (payload [8] << 8 | payload [9]);
 var battPercent = payload [10];

 // Convert integer to float
 decoded.temperature = temperatureInt / 100;   // Temperature in °C
 decoded.humidity = humidityInt / 10;   // Humidity in %
 decoded.co2 = co2Concentration;   // Co2Concentration in ppm
 decoded.lightIntensity = lux; //LightIntensity in Lux
 decoded.pressure = pressure; //Pressure in hPa
 decoded.battPercent = battPercent; //Battery Capcaity in %

 return decoded;
 }
```

In the example above, if payload = 0A 86 01 AE 03 68 01 00 03 F0 59, decoded value will be:

- "temperature": 26.94,
- "humidity": 43,
- "co2": 872,
- "lightIntensity": 256,
- "pressure": 1008,
- "battPercent": 89

5. Deployment Procedure

When requesting for Sense Node Plus device only (no gateway and network server), the user/client should already have an existing LoRaWAN System in their site.

The device is set to OTAA (Over-the-Air Activation) mode and it has pre-defined Device EUI (DevEUI), Application EUI (AppEUI), and Application Key (AppKey).

NOTE: If the client requests for the sensor device only, it is assumed that they know how to add/register the device to their own Network Server.

5.1. Check the Device Information

PTS will provide a document that contains the following information:

1. PTS Device Serial Number
2. DevEUI
3. AppEUI
4. AppKey

5.2. Register the Device to the Network Server

Add/register the device into the network server using the keys provided in section 5.1. Use Over-the-Air Activation in registering the device.

Example:

Activation Method	OTAA
Device EUI	34 31 37 32 66 36 6F 0E
Application EUI	70 B3 D5 7E D0 00 BF 3C
App Key	DF 93 F6 39 E4 80 C4 04 50 D1 D5 43 7F 14 1C 52

5.3.   Activate the Device

The device is shipped in Standby Mode to conserve battery power.

Activation is done by pressing the button on the left side of the device. Please refer to section 2.3.

Upon activation, LED will blink 5 times to indicate device activation.

The LED will blink again 5 times at a faster rate to indicate that the Join Request Procedure is done, and the device is ready to transmit measurement data.

NOTE: *When the Join Request Procedure is done, it will be connected to the Network Server through shared keys. Modifying the device registration in the Network Server will cause the device to be disconnected from the network because the shared keys will be void. Reset the device as instructed in section 5.5.*

Sometimes the Join Request Procedure fails. When this happens, the user has 2 options:

1. Wait for the device to automatically re-try the Join Request Procedure after 3 minutes.
2. Reset the device as described in section 5.5.

5.4.   Check if the Device is Transmitting

Here are the recommended ways to check if the device is transmitting:

1. Check in the Network Server if the payload is received from the device.
2. Check your dashboard if the temperature data is posted.

5.5.   Reset the Device (optional)

If the join procedure failed or no data is received from the device, the first option is to reset it.

To reset the device, hold both buttons on the side of the enclosure at the same time for 3 seconds. The LED will blink 3 times to indicate that the device is deactivated. This means the device is in standby mode.

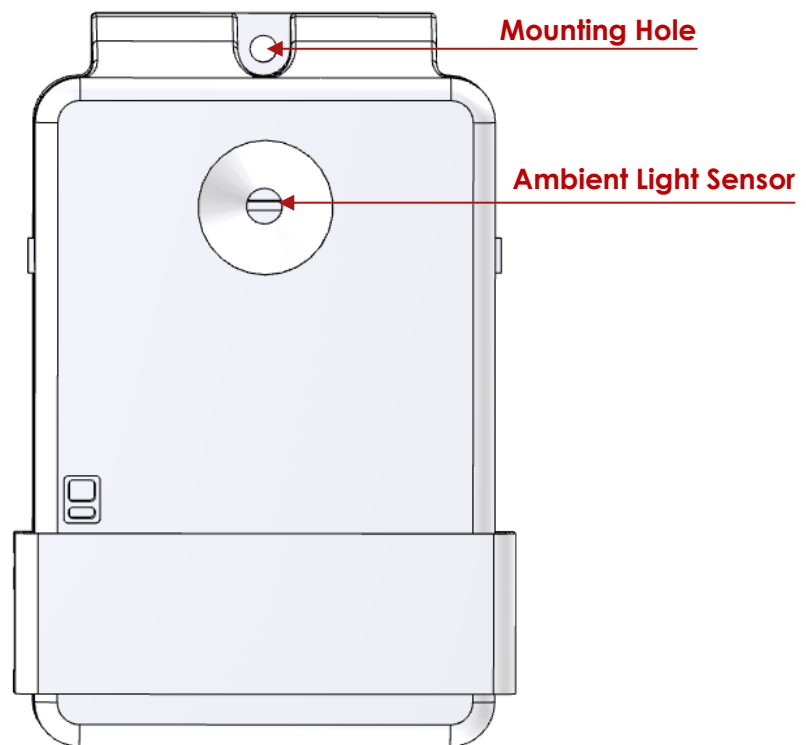Activate the device again by doing the activation procedure in section 5.3.

6. Installation

6.1. Environmental Conditions

The Sense Node Plus must be installed on the following conditions

a. Indoor Use.
b. Altitude up to 2000m.
c. Temperature 5ºC to 40ºC.
d. Pollution degree 2.
e. Not for wet location.

6.2. Mounting Instructions

The Sense Node Plus may be installed horizontally or vertically.

Secure the device by fastening it on the mounting hole.

The Ambient Light Sensor must be facing the Light Source without any obstructions.
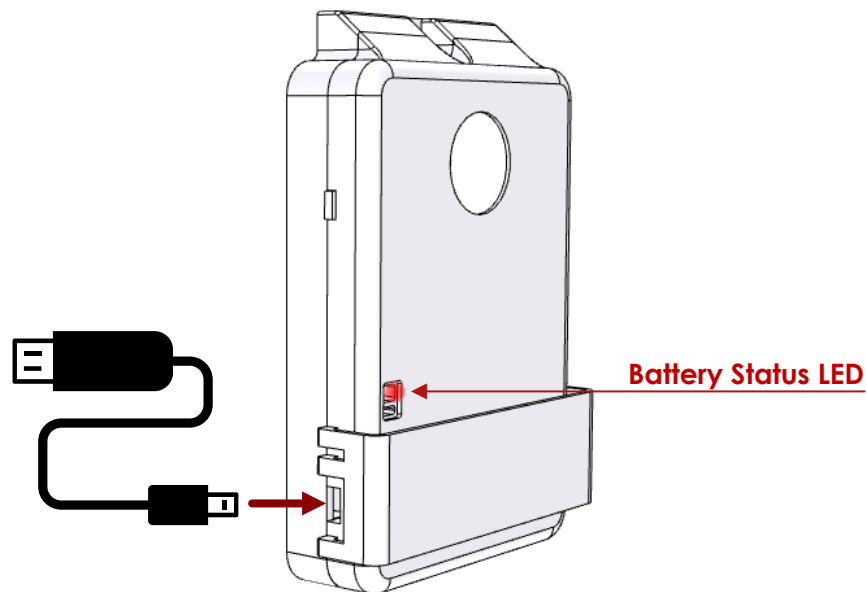
The device must be installed far from other antenna systems to avoid possible radio frequency interference.

The device must not be installed near a metal wall.

7. Battery

7.1. Charging the Device

Charge the device when the battery's state of charge is low. To charge, use a micro USB cable and a wall adapter. Charging from desktop or laptop is also applicable.

Battery Status LED

The color of the Battery Status LED will change according to the battery charge percentage.

LED Color	Battery Charge Percentage
☀ Red	0% to 30%
☀ Yellow	31% to 70%
☀ Green	71% to 99%
☀ OFF	100%

7.2. Storing the Device

When storing the device, it is advisable to turn off the device to preserve the battery life. The battery's shelf life is 3 years, but it is recommended to charge it every 6 months. The best storage temperature is 25°C.

8. Maintenance
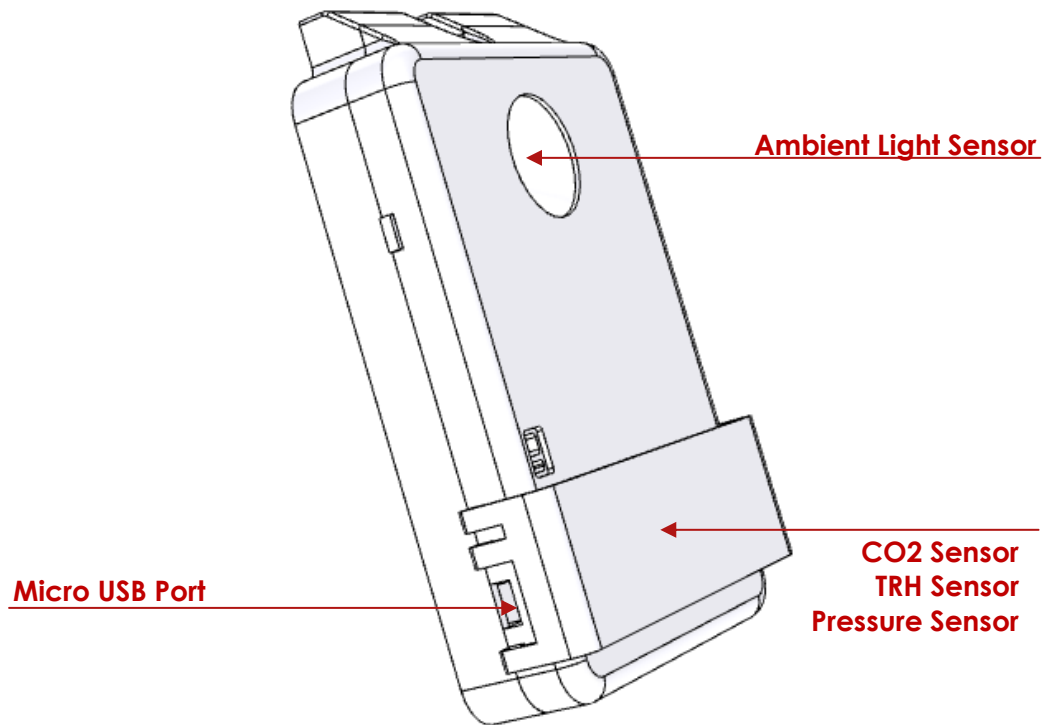
8.1. Cleaning the device

Cleaning the Enclosure
Use a damp cloth to remove the dirt on the enclosure.

Cleaning the Ambient Light Sensor
Use a damp cloth to wipe the dirt on the transparent cover.

Cleaning the CO2 Sensor, TRH Sensor and Pressure Sensor
Use a brush or damp cloth to remove the dirt on the surface of the Sensing Membrane.
Do not poke or press hard the Sensing membrane.

Cleaning the Micro USB port
If there are dust inside the Micro USB port, blow some air onto it or use a brush to remove the particles.

8.2. Repair of Device

Parts Repair

Repair of parts are done by the manufacturer. The device must be returned to the manufacturer for assessment.

Spoilt or bloated battery must be removed from the device and must be handled accordingly.

9. Manufacturer Contact

Name: PTS Technologies

Address: 2 Kaki Bukit Avenue 1, #04-05, 417938

Ph Number: +65 67494474

10. Compliance

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.

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

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.

FCC RF Radiation Exposure Statement

Caution: To maintain compliance with the FCC's RF exposure guidelines, place

the unit at least 20cm from nearby persons.

11.   Warranty

Warranty claims only be valid If the instruction in the manuals have been correctly followed.

The warranty may be rendered invalid if the product is incorrectly used and maintained.

12.   Warning

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

13.   Disposal

The symbol on the product shows that this product must not be treated as household waste. It must be taken to a collection point for recycling electrical and electronics equipment.

By ensuring correct disposal of the product, you will help to prevent negative consequences for the environment and health that around your society.