NSPH01-NB-IoT Soil pH Sensor User Manual

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on 2022/10/25 16:46

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1. Introduction

1.1 What is NSPH01 Soil pH Sensor

The Dragino NSPH01 is a **NB-IoT soil pH sensor** for IoT of Agriculture. It is designed to measure the soil pH and soil temperature, so to send to the platform to analyze the soil acid or alkali level. The probe is IP68 waterproof.

NSPH01 probe is made by Solid AgCl reference electrode and Pure metal pH sensitive electrode. It can detect soil's **pH** with high accuracy and stable value. The NSPH01 probe can be buried into soil for long time use.

NarrowBand-Internet of Things (NB-IoT) is a standards-based low power wide area (LPWA) technology developed to enable a wide range of new IoT devices and services. NB-IoT significantly improves the power consumption of user devices, system capacity and spectrum efficiency, especially in deep coverage.

NSPH01 supports different uplink methods include **TCP,MQTT,UDP and CoAP** for different application requirement.

NSPH01 is powered by **8500mAh Li-SOCl2 battery**, It is designed for long term use up to 5 years. (Actually Battery life depends on the use environment, update period & uplink method)

To use NSPH01, user needs to check if there is NB-IoT coverage in the installation area and with the bands NSPH01 supports. If the local operator supports it, user needs to get a **NB-IoT SIM card** from local operator and install NSPH01 to get NB-IoT network connection.

NSPH01 in a NB-IOT Network
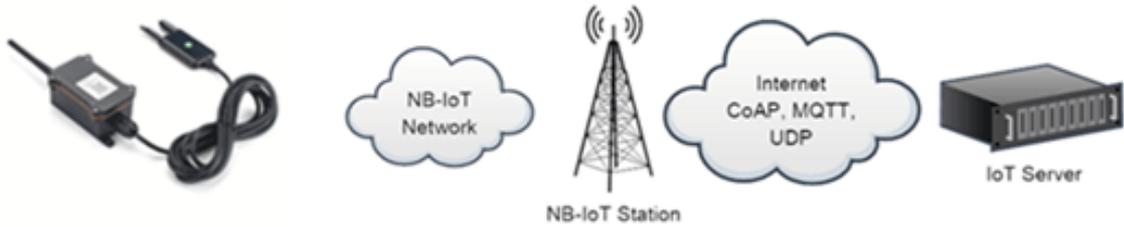
NSPH01 NB-IOT

PH Sensor

1.2 Features

- NB-IoT Bands: B1/B3/B8/B5/B20/B28 @H-FDD
- Monitor soil pH with temperature compensation.
- Monitor soil temperature
- pH and Temperature alarm function
- Monitor Battery Level
- Support pH calibration by end user
- Uplink on periodically
- Downlink to change configure
- IP66 Waterproof Enclosure
- IP68 rate for the Sensor Probe
- Ultra-Low Power consumption
- AT Commands to change parameters
- Micro SIM card slot
- 8500mAh Battery for long term use

1.3 Specification

Common DC Characteristics:

- Supply Voltage: 2.1v ~ 3.6v
- Operating Temperature: -40 ~ 85°C

NB-IoT Spec:

- - B1 @H-FDD: 2100MHz
- - B3 @H-FDD: 1800MHz
- - B8 @H-FDD: 900MHz
- - B5 @H-FDD: 850MHz
- - B20 @H-FDD: 800MHz
- - B28 @H-FDD: 700MHz

1.4 Probe Specification

Soil pH:

- Range: 3 ~ 10 pH
- Resolution: 0.01 pH
- Accuracy: ±2% under (0~50 ℃, Accuracy will poor under 0 due to frozen)
- Temperature Compensation Range: 0 ~ 50℃
- IP68 Protection
- Length: 3.5 meters

Soil Temperature:

- Range -40℃～85℃
- Resolution: 0.1℃
- Accuracy: <±0.5℃(-10℃～40℃)，<±0.8℃ (others)
- IP68 Protection
- Length: 3.5 meters

1.5 Applications

- Smart Agriculture

1.6 Pin mapping and power on
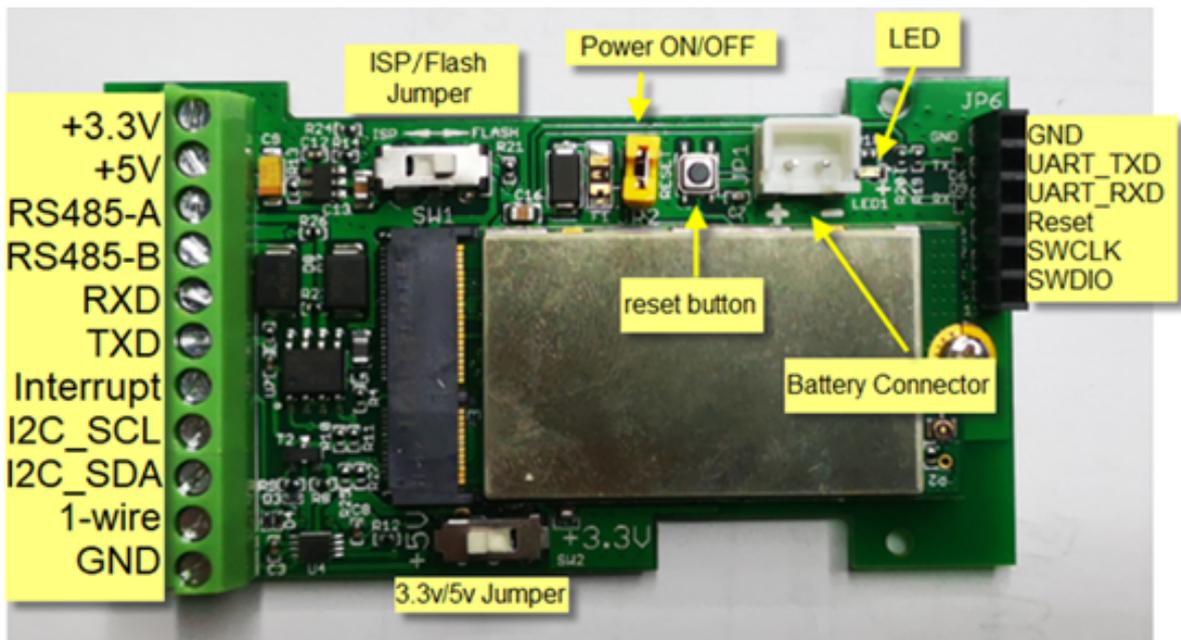
2. Use NSPH01 to communicate with IoT Server

2.1 How it works

The NSPH01 is equipped with a NB-IoT module, the pre-loaded firmware in NSPH01 will get environment data from sensors and send the value to local NB-IoT network via the NB-IoT module. The NB-IoT network will forward this value to IoT server via the protocol defined by NSPH01.

The diagram below shows the working flow in default firmware of NSPH01:

```
                              power on
                         LED lihgts for one second

                                  │
                                  ▼

                            Device Initialization

                                  │
                                  ▼

                          Start to join the network

                                  │
                                  ▼

                          Whether to access the
   Enable stop mode  ◀── N   network within one minute?
                                  │
        │                         │ Y
        ▼                         ▼

    TDC timeout              LED lights for three second

        │                         │
        ▼                         ▼

    Exit stop mode            Enable 5V power

                                  │
                                  ▼

                            Data acquisition

                                  │
                                  ▼

                            Get sensor data

                                  │
                                  ▼

                            Disable 5V power

                                  │
                                  ▼

                            Send package
                            LED lights for 500 ms

                                  │
                                  ▼

                            Enable stop mode

                                  │
                                  ▼

                          TDC timeout/Interrupt
                                trigger

                                  │
                                  ▼

                            Exit stop mode
```

2.2 Configure the NSPH01

2.2.1 Test Requirement

To use NSPH01 in the field, make sure meet below requirements:

- Your local operator has already distributed a NB-IoT Network there.
- The local NB-IoT network used the band that NSPH01 supports.
- Your operator is able to distribute the data received in their NB-IoT network to your IoT server.

Below figure shows our testing structure. Here we have NB-IoT network coverage by China Mobile, the band they use is B8. The NSPH01 will use **CoAP(120.24.4.116:5683)** or raw **UDP(120.24.4.116:5601)** or **MQTT(120.24.4.116:1883)**or **TCP(120.24.4.116:5600)**protocol to send data to the test server.

2.2.2 Insert SIM card

User need to take out the NB-IoT module and insert the SIM card like below. (Pay attention to the direction)

2.2.3 Connect USB – TTL to NSPH01 to configure it

   User need to configure NSPH01 via serial port to set the **Server Address** / **Uplink Topic** to define where and how-to uplink packets. NSPH01 support AT Commands, user can use a USB to TTL adapter to connect to NSPH01 and use AT Commands to configure it, as below.

   Connection:

   USB TTL GND <----> GND

   USB TTL TXD <----> UART_RXD

   USB TTL RXD <----> UART_TXD

   In the PC, use below serial tool settings:

   - Baud: **9600**
   - Data bits: **8**
   - Stop bits: **1**
   - Parity: **None**
   - Flow Control: **None**

   Make sure the switch is in FLASH position, then power on device by connecting the jumper on NSPH01. NSPH01 will output system info once power on as below, we can enter the **password: 12345678** to access AT Command input.

2.2.4 Use CoAP protocol to uplink data

Use below commands:

- **AT+PRO=1**   // Set to use CoAP protocol to uplink
- **AT+SERVADDR=120.24.4.116,5683**   // to set CoAP server address and port
- **AT+URI=5,11,"mqtt",11,"coap",12,"0",15,"c=text1",23,"0"**   // Set COAP resource path

For parameter description, please refer to AT command set

```
NB-IoT Stack : D-BC95-003
Protocol in Used: COAP
[241]reboot error:POR/PDR!
NSPH01 NB-IOT  PH Sensor
Image Version: v1.0.0

NB-IoT Stack : D-BC95-003
Protocol in Used: COAP
[10099]NBIOT has responded.
[11431]Echo mode turned off successfully.
[13377]Model information:BC95-GV.
[14715]The IMEI number is:867787050213317.
[16063]The IMSI number is:460080049309796.
Currently set frequency band:1,3,5,8,20,28
[19759]Set automatic network access successfully.
[21114]Signal Strength:24
[26148]PSM mode configured
[27480]DNS configuration is successful
[28523]No DNS resolution required
[29561]*****Upload start:0*****
[29596]remaining battery =3222 mv
[36145]PH1:6.67

[36166]temp:26.60

[37707]Create a CoAP Context
[48249]Successfully deleted CoAP context
[49294]Send complete
[50318]*****End of upload*****
```

After configure the server address and **reset the device (via AT+ATZ)**, NSPH01 will start to uplink sensor values to CoAP server.
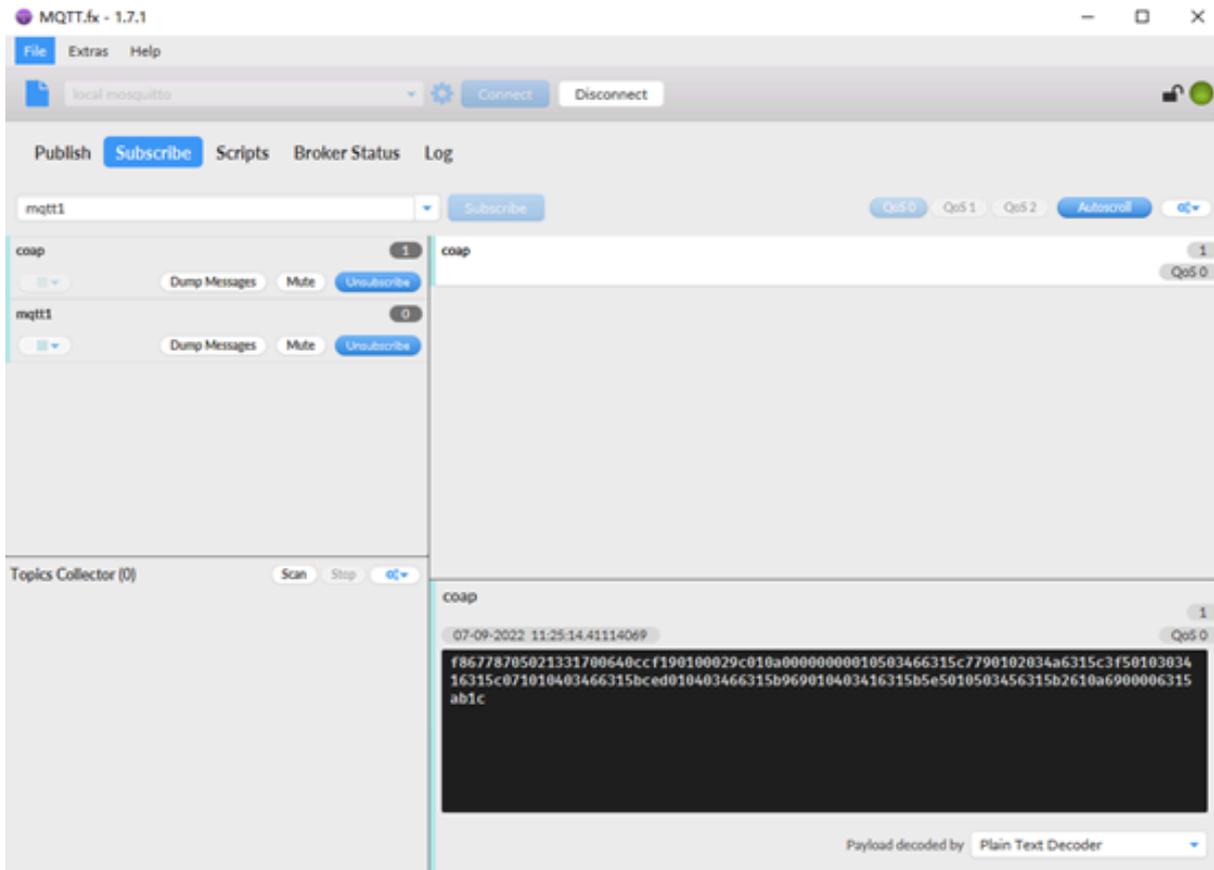
2.2.5 Use UDP protocol to uplink data(Default protocol)

This feature is supported since firmware version v1.0.1

- **AT+PRO=2**   // Set to use UDP protocol to uplink
- **AT+SERVADDR=120.24.4.116,5601**   //   to set UDP server address and port
- **AT+CFM=1**   //   If the server does not respond, this command is unnecessar
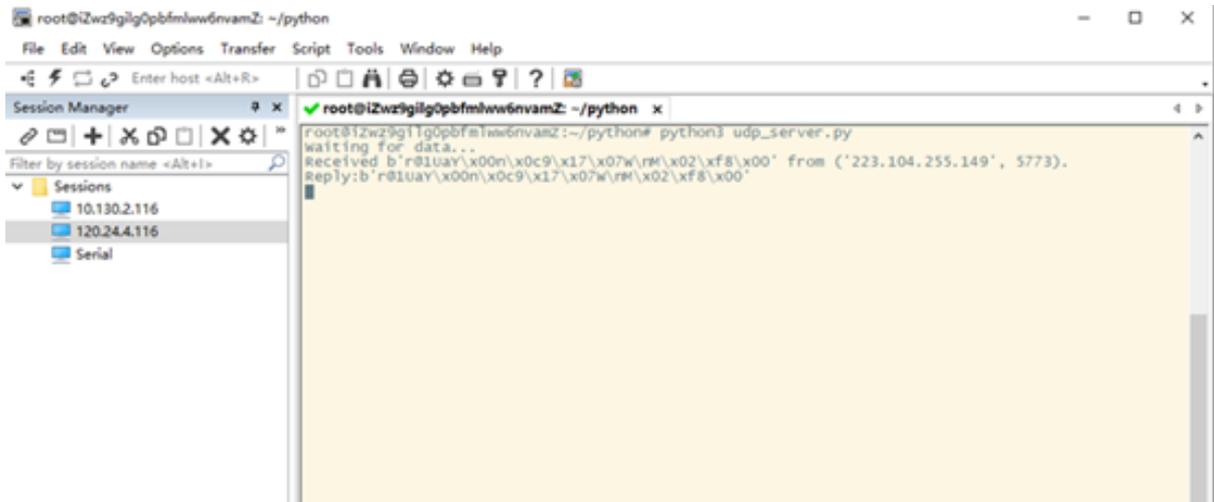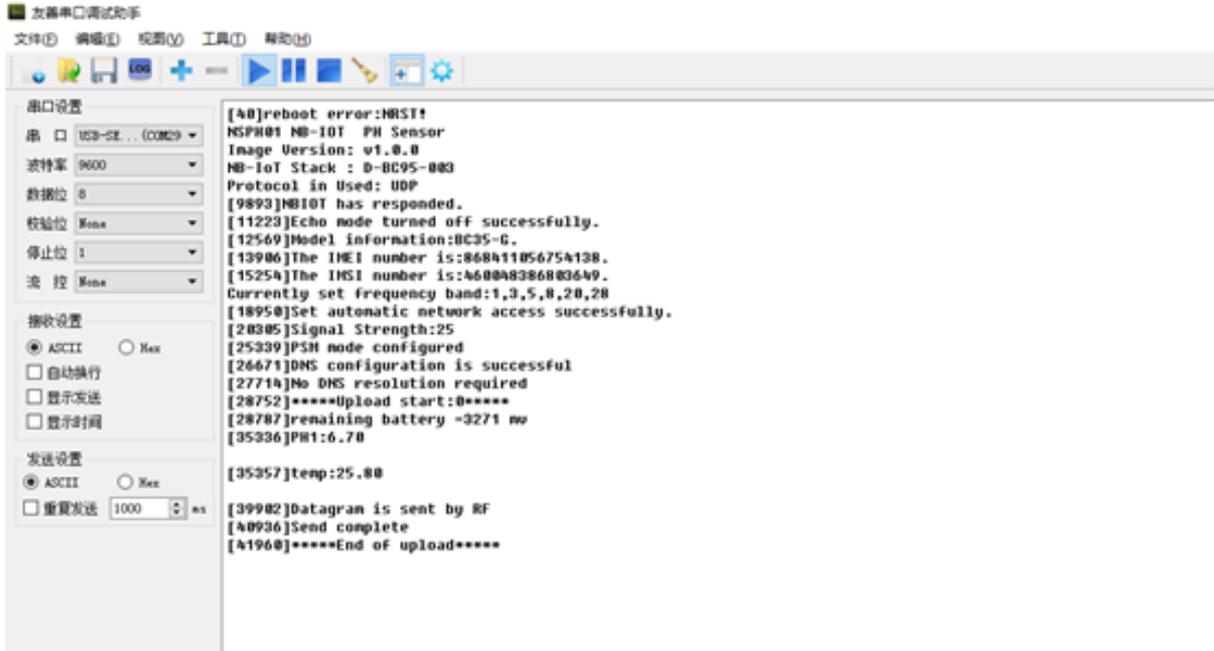
2.2.6 Use MQTT protocol to uplink data

This feature is supported since firmware version v110

- **AT+PRO=3**   // Set to use MQTT protocol to uplink
- **AT+SERVADDR=120.24.4.116,1883**   // Set MQTT server address and port
- **AT+CLIENT=CLIENT**   // Set up the CLIENT of MQTT

- **AT+UNAME=UNAME**   // Set the username of MQTT
- **AT+PWD=PWD**   // Set the password of MQTT
- **AT+PUBTOPIC=NSE01_PUB**   // Set the sending topic of MQTT
- **AT+SUBTOPIC=NSE01_SUB**   // Set the subscription topic of MQTT

```
OK

OK

[37]reboot error:Software!
NSPH01 NB-IOT  PH Sensor
Image Version: v1.0.0
NB-IoT Stack : D-BC95-003
Protocol in Used: MQTT
[9895]NBIOT has responded.
[11225]Echo mode turned off successfully.
[13171]Model information:BC95-GV.
[14509]The IMEI number is:867787050213317.
[15857]The IMSI number is:460080049309796.
Currently set frequency band:1,3,5,8,20,28
[19553]Set automatic network access successfully.
[20908]Signal Strength:25
[25942]PSM mode configured
[27274]DNS configuration is successful
[28317]No DNS resolution required
[29355]*****Upload start:0*****
[29390]remaining battery =3279 mw
[35939]PH1:6.68

[35960]temp:26.60
[40704]Opened the MQTT client network successfully
[44262]Successfully connected to the server
[48813]Upload data successfully
[52351]Subscribe to topic successfully
[56898]Close the port successfully
[57937]Send complete
[58961]*****End of upload*****
```
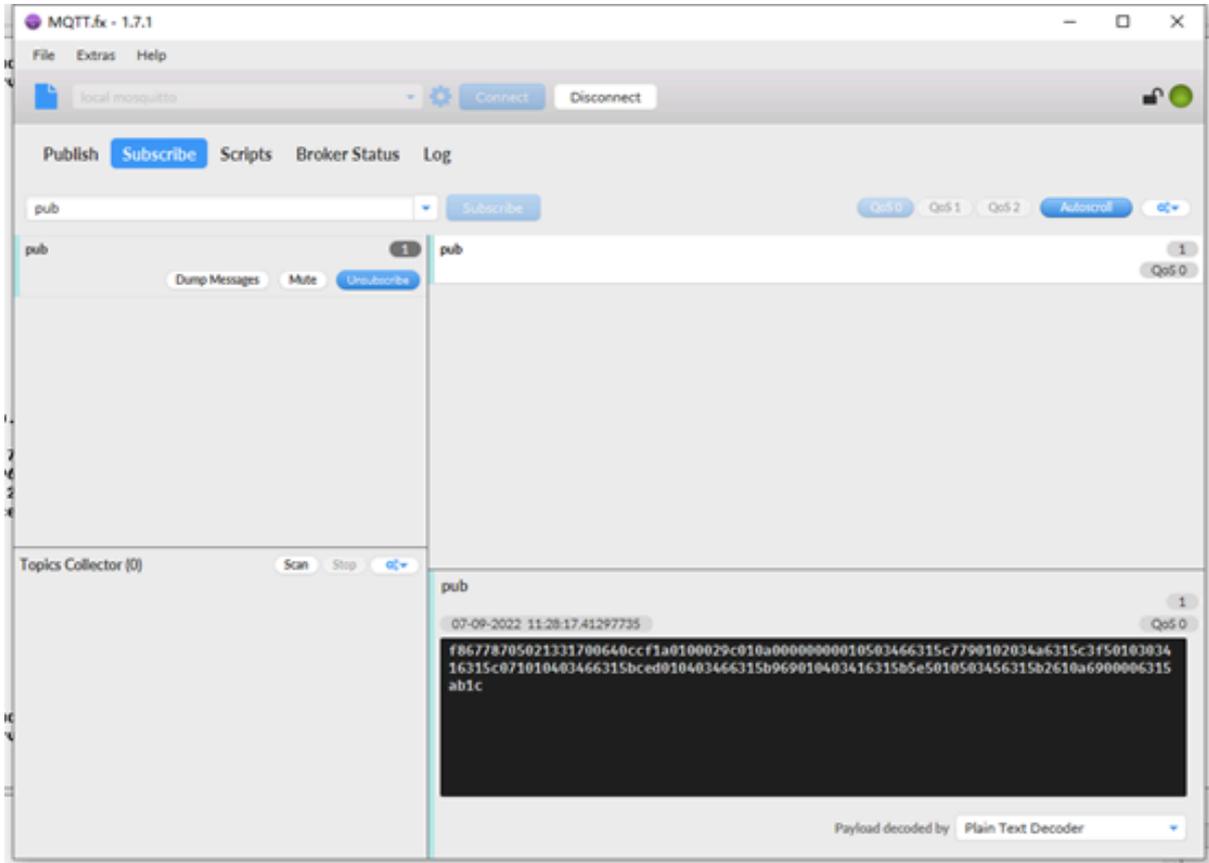
MQTT protocol has a much higher power consumption compare vs UDP / CoAP protocol. Please check the power analyze document and adjust the uplink period to a suitable interval.

2.2.7 Use TCP protocol to uplink data

This feature is supported since firmware version v110

- **AT+PRO=4**   // Set to use TCP protocol to uplink
- **AT+SERVADDR=120.24.4.116,5600**   // to set TCP server address and port
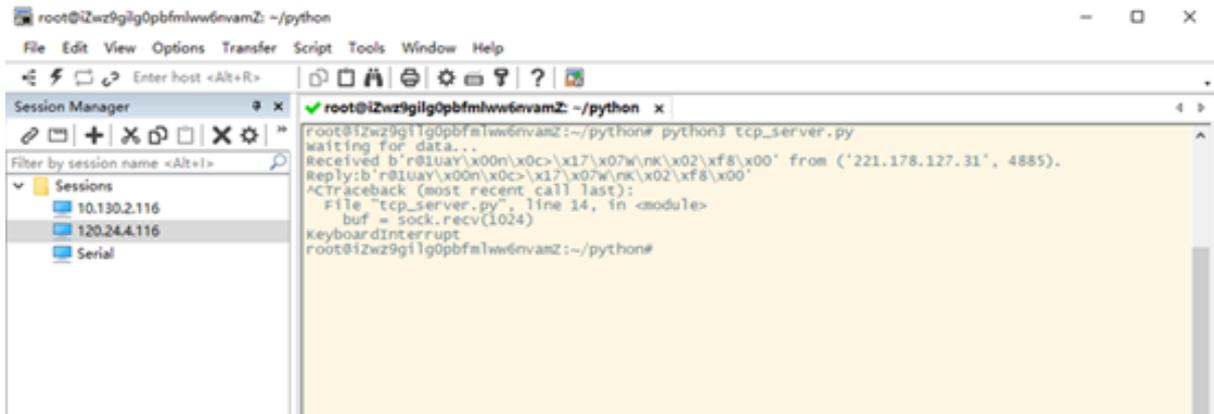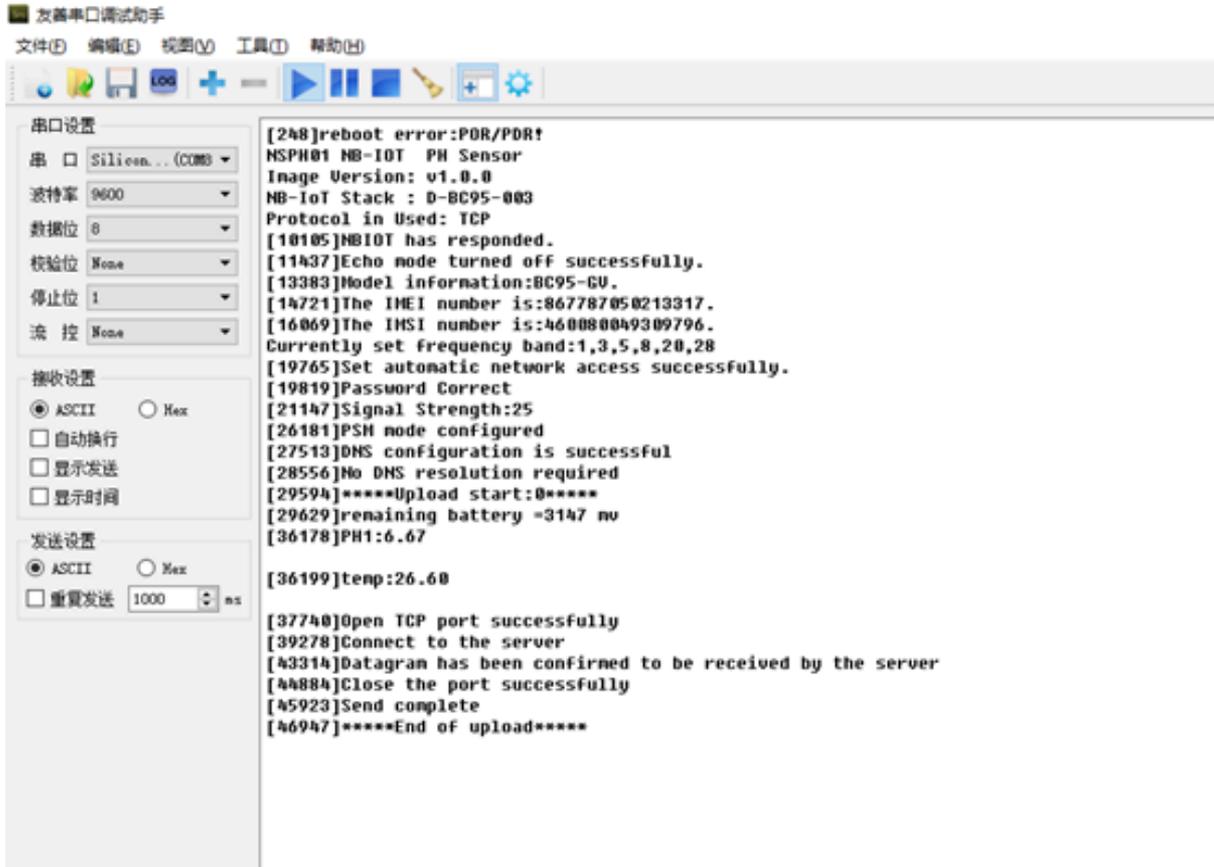
2.2.8 Change Update Interval

Users can use the below command to change the **uplink interval**.

- **AT+TDC=7200**   // Set Update Interval to 7200s (2 hour)

NOTE: By default, the device will send an uplink message every 2 hours. Each Uplink Include 8 set of records in this 2 hour (15 minute interval / record).

2.3 Uplink Payload

In this mode, uplink payload includes 87 bytes in total by default.

Each time the device uploads a data package, 8 sets of recorded data will be attached. Up to 32 sets of recorded data can be uploaded.

Size(bytes)	8	2	2	1	1	1	2	2	4	2	2	4
Value	Device ID	Ver	BAT	Signal Strength	MOD	Interrupt	Soil PH	Soil Temperature	Time stamp	Soil Temperature	Soil PH	Time stamp .....

If we use the MQTT client to subscribe to this MQTT topic, we can see the following information when the NSPH01 uplink data.
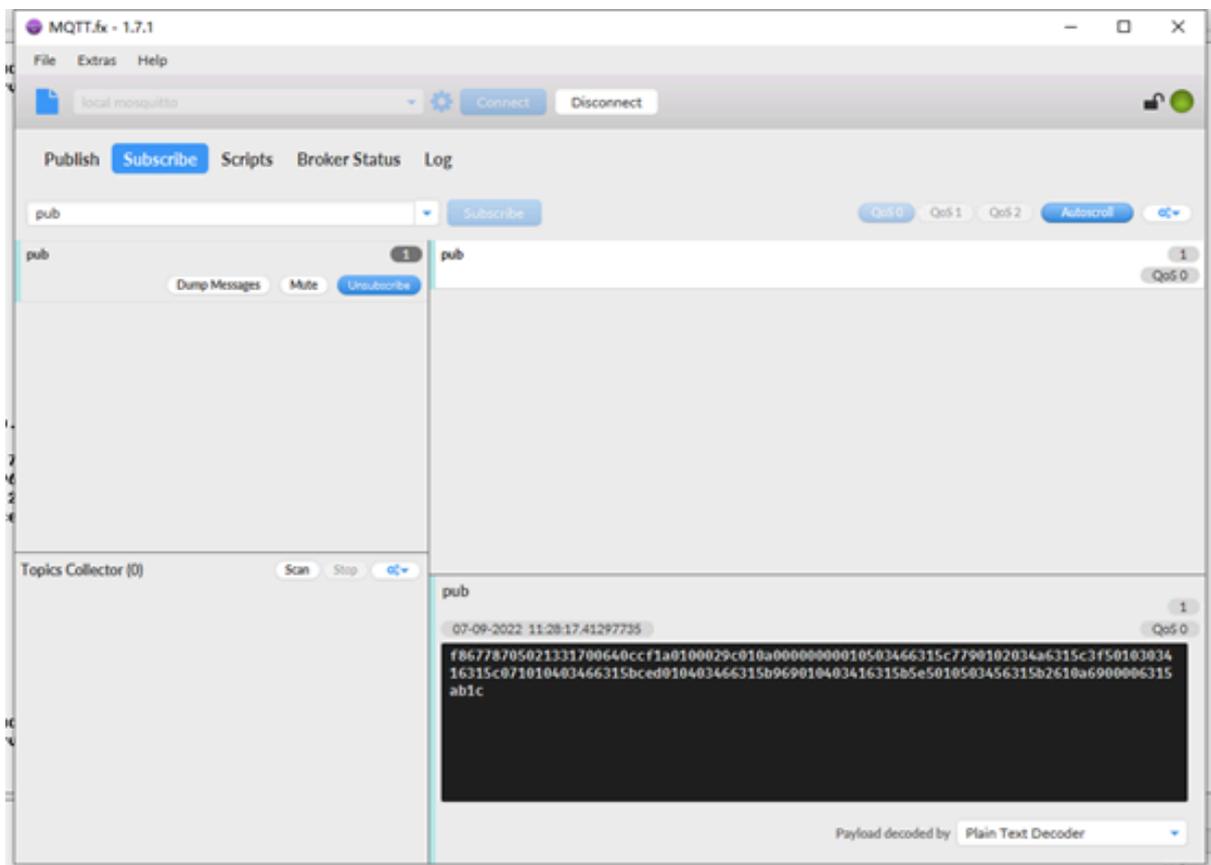
The payload is ASCII string, representative same HEX:

0x f868411056754138 0064 0c78 17 01 00 0225
010b 6315537b 010b0226631550fb 010e022663154d77 01110225631549f1 011502246315466b
01190223631542e5 011d022163153f62 011e022163153bde 011e022163153859

where:

- **Device ID:** 0xf868411056754138 = f868411056754138
- **Version:** 0x0064=100=1.0.0
- **BAT:** 0x0c78 = 3192 mV = 3.192V
- **Singal:** 0x17 = 23
- **Mod:** 0x01 = 1
- **Interrupt:** 0x00= 0
- **Soil PH:** 0x0225= 549 = 5.49
- **Soil Temperature:** 0x010b =267=26.7 °C
- **Time stamp :** 0x6315537b =1662342011 (Unix Epoch Time)
- **Soil Temperature,Soil PH,Time stamp :** 010b0226631550fb
- **8 sets of recorded data:** Temperature,Soil PH,Time stamp : 010e022663154d77,.......

2.4 Payload Explanation and Sensor Interface

2.4.1 Device ID

By default, the Device ID equal to the last 15 bits of IMEI.

User can use **AT+DEUI** to set Device ID

Example:

AT+DEUI=868411056754138

The Device ID is stored in a none-erase area, Upgrade the firmware or run AT+FDR won't erase Device ID.

2.4.2 Version Info

Specify the software version: 0x64=100, means firmware version 1.00.

For example: 0x00 64 : this device is NSPH01 with firmware version 1.0.0.

2.4.3 Battery Info

Check the battery voltage for NSPH01.

Ex1: 0x0B45 = 2885mV

Ex2: 0x0B49 = 2889mV

2.4.4 Signal Strength

NB-IoT Network signal Strength.

Ex1: 0x1d = 29

0	-113dBm or less
1	-111dBm
2...30	-109dBm... -53dBm
31	-51dBm or greater
99	Not known or not detectable

2.4.5 Soil PH

Get the PH content of the soil. The value range of the register is 300-1000(Decimal), divide this value by 100 to get the percentage of PH in the soil.

For example, if the data you get from the register is **0x05 0xDC**, the PH content in the soil is

0229(H) = 549(D) /100 = 5.49.

2.4.6 Soil Temperature

Get the temperature in the soil. The value range of the register is -4000 - +800(Decimal), divide this value by 100 to get the temperature in the soil. For example, if the data you get from the register is **0x09 0xEC**, the temperature content in the soil is

Example:

If payload is 0105H: ((0x0105 & 0x8000)>>15 === 0),temp = 0105(H)/10 = 26.1 °C

If payload is FF7EH: ((FF7E & 0x8000)>>15 ===1),temp = (FF7E(H)-FFFF(H))/10 = -12.9 °C

2.4.7 Timestamp

Time stamp : 0x6315537b =1662342011

Convert Unix timestamp to time 2022-9-5 9:40:11.

2.4.8 Digital Interrupt

Digital Interrupt refers to pin **GPIO_EXTI**, and there are different trigger methods. When there is a trigger, the NSPH01 will send a packet to the server.

The command is:

AT+INTMOD=3   //(more info about INMOD please refer **AT Command Manual**)**.**

The lower four bits of this data field shows if this packet is generated by interrupt or not. Click here for the hardware and software set up.

Example:

0x(00): Normal uplink packet.

0x(01): Interrupt Uplink Packet.

2.4.9 +5V Output

NSPH01 will enable +5V output before all sampling and disable the +5v after all sampling.

The 5V output time can be controlled by AT Command.

AT+5VT=1000

Means set 5V valid time to have 1000ms. So the real 5V output will actually have 1000ms + sampling time for other sensors.

2.5 Downlink Payload

By default, NSPH01 prints the downlink payload to console port.

Downlink Control Type	FPort	Type Code	Downlink payload size(bytes)
TDC (Transmit Time Interval)	Any	01	4
RESET	Any	04	2
INTMOD	Any	06	4

Examples:

- **Set TDC**

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

Payload: 01 00 00 1E   TDC=30S

Payload: 01 00 00 3C   TDC=60S

- **Reset**

If payload = 0x04FF, it will reset the NSPH01

- **INTMOD**

Downlink Payload: 06000003, Set AT+INTMOD=3

2.6 LED Indicator

The NSPH01 has an internal LED which is to show the status of different state.

- When power on, NSPH01 will detect if sensor probe is connected, if probe detected, LED will blink four times. (no blinks in this step is no probe)
- Then the LED will be on for 1 second means device is boot normally.
- After NSPH01 join NB-IoT network. The LED will be ON for 3 seconds.
- For each uplink probe, LED will be on for 500ms.

2.7 Installation and Maintain

2.7.1 Before measurement

If the NSPH01 has more than 7 days not use or just clean the pH probe. User should put the probe inside pure water for more than 24 hours for activation. If no put in water, user need to put inside soil for more than 24 hours to ensure the measurement accuracy.

2.7.2 Measurement

Measurement the soil surface:

Choose the proper measuring position. Split the surface soil according to the measured deep.

Put pure water, or rainwater to make the soil of measurement point to moist mud. Remove rocks or hard things.

Slowly insert the probe to the measure point. Don't use large force which will break the probe. Make sure not shake when inserting.

Put soil over the probe after insert. And start to measure.

Measurement inside soil:

Dig a hole with diameter > 20CM.

Insert the probe inside, method like measure the surface.

2.7.3 Maintain Probe

1. pH probe electrode is fragile and no strong. User must avoid strong force or hitting it.
2. After long time use (3~ 6 months). The probe electrode needs to be clean; user can use high grade sandpaper to polish it or put in 5% hydrochloric acid for several minutes. After the metal probe looks like new, user can use pure water to wash it.
3. Probe reference electrode is also no strong, need to avoid strong force or hitting.
4. User should keep reference electrode wet while not use.
5. Avoid the probes to touch oily matter. Which will cause issue in accuracy.
6. The probe is IP68 can be put in water.

2.8 PH and Temperature alarm function

 # AT Command:

AT+ PHALARM=min,max

² When min=3, and max≠0, Alarm higher than max

² When min≠0, and max=0, Alarm lower than min

² When min≠0 and max≠0, Alarm higher than max or lower than min

Example:

AT+ PHALARM =5,8   // Alarm when PH lower than 5.

AT+ TEMPALARM=min,max

² When min=0, and max≠0, Alarm higher than max

² When min≠0, and max=0, Alarm lower than min

² When min≠0 and max≠0, Alarm higher than max or lower than min

Example:

AT+ TEMPALARM=20,30   // Alarm when temperature lower than 20.

2.9 Set the number of data to be uploaded and the recording time

 # AT Command:

- **AT+TR=900**   // The unit is seconds, and the default is to record data once every 900 seconds.(The minimum can be set to 180 seconds)
- **AT+NOUD=8**   //   The device uploads 8 sets of recorded data by default. Up to 32 sets of record data can be uploaded.

 The diagram below explains the relationship between TR, NOUD, and TDC more clearly**:**
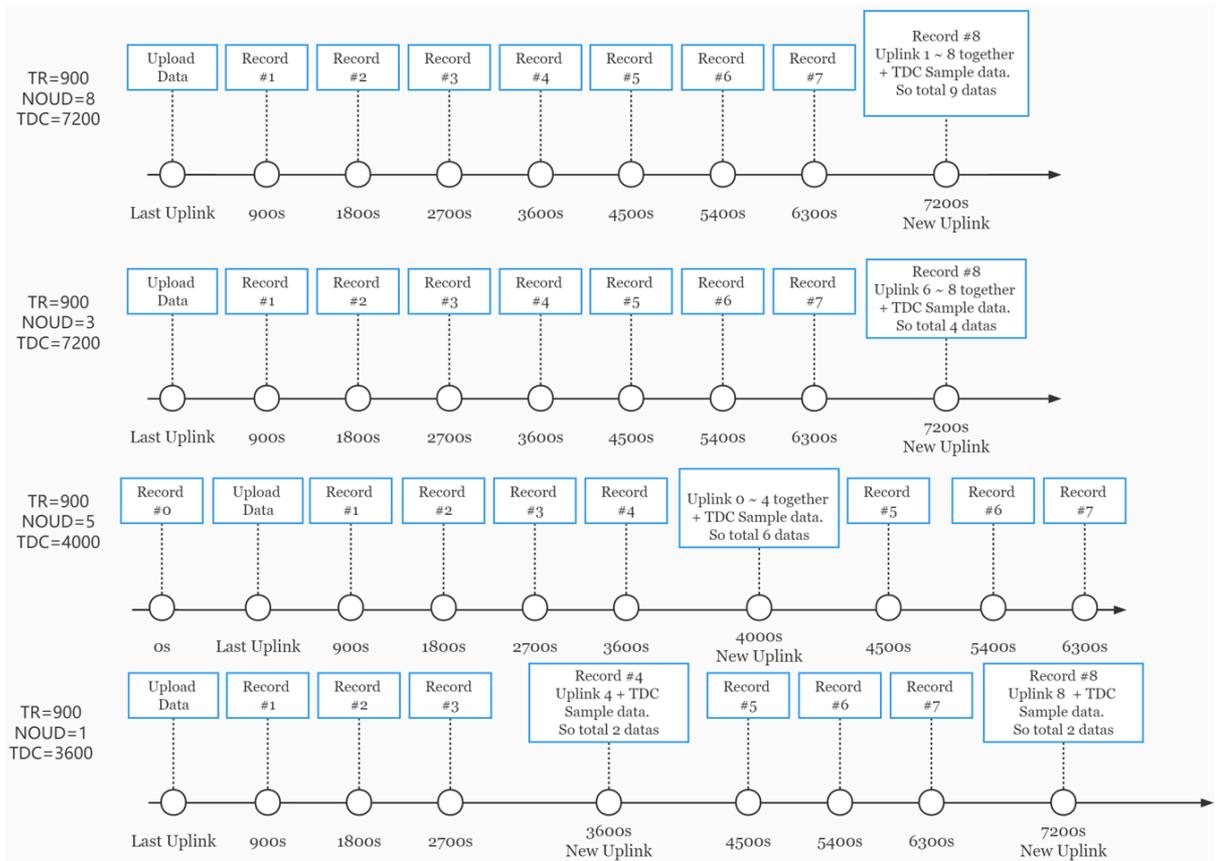
2.10 Read or Clear cached data

AT Command:

- **AT+CDP**   // Read cached data

- **AT+CDP=0**   // Clear cached data

```
串口设置
串 口  Silicon...(COM8) ▼
波特率 9600              ▼
数据位 8                ▼
校验位 None             ▼
停止位 1                ▼
流 控  None             ▼

接收设置
◉ ASCII    ○ Hex
☐ 自动换行
☐ 显示发送
☐ 显示时间

发送设置
◉ ASCII    ○ Hex
☐ 重复发送 1000 ⬍ ms
```

```
[38401]COAP configuration failed
[39438]*****End of upload*****

[39474]Password Correct
27.20 5.30           Tue Sep  6 18:38:36 2022
27.20 5.30           Tue Sep  6 18:53:36 2022
27.30 5.30           Tue Sep  6 19:08:37 2022
27.30 5.30           Tue Sep  6 19:23:38 2022
27.40 5.30           Tue Sep  6 19:38:37 2022
27.40 5.30           Tue Sep  6 19:53:38 2022
27.50 5.30           Tue Sep  6 20:08:38 2022
27.50 5.30           Tue Sep  6 20:23:38 2022
27.50 5.30           Tue Sep  6 20:38:38 2022
27.60 5.30           Tue Sep  6 20:53:38 2022
27.60 5.30           Tue Sep  6 21:08:39 2022
27.60 5.30           Tue Sep  6 21:23:39 2022
27.70 5.30           Tue Sep  6 21:38:39 2022
27.70 5.30           Tue Sep  6 21:53:40 2022
27.70 5.30           Tue Sep  6 22:08:40 2022
27.70 5.30           Tue Sep  6 22:23:40 2022
27.80 5.30           Tue Sep  6 22:38:40 2022
27.80 5.30           Tue Sep  6 22:53:41 2022
27.80 5.30           Tue Sep  6 23:08:40 2022
27.80 5.30           Tue Sep  6 23:23:40 2022
27.90 5.30           Tue Sep  6 23:38:40 2022
27.90 5.30           Tue Sep  6 23:53:41 2022
27.80 5.30           Wed Sep  7 00:08:41 2022
27.80 5.31           Wed Sep  7 00:23:42 2022
27.60 5.31           Wed Sep  7 00:38:41 2022
27.30 5.32           Wed Sep  7 00:53:42 2022
26.80 5.33           Wed Sep  7 01:17:46 2022
26.60 5.34           Wed Sep  7 01:32:47 2022
26.40 5.33           Wed Sep  7 01:47:48 2022
26.20 5.34           Wed Sep  7 02:02:48 2022
26.00 5.34           Wed Sep  7 02:17:48 2022
25.80 5.34           Wed Sep  7 02:32:48 2022

OK

AT+CDP
```

2.11 Calibration

User can do calibration for the probe. It is limited to use below pH buffer solution to calibrate: 4.00, 6.86, 9.18. When calibration, user need to clean the electrode and put the probe in the pH buffer solution to wait the value stable (a new clean electrode might need max 24 hours to be stable).

After stable, user can use below command to calibrate.

pH buffer solution	AT Command to calibrate	Downlink Command	Read Cal Value
4.00	AT+PHCAL=4	0x13 04 Reply with Calibrate payload	AT+PHCAL=? Example 41,61,91
6.86	AT+PHCAL=6	0x13 06 Reply with Calibrate payload	AT+PHCAL=?
9.18	AT+PHCAL=9	0x13 09 Reply with Calibrate payload	AT+PHCAL=?
Factory Default	AT+PHCAL=15	0x13 15 Reply with Calibrate payload	AT+PHCAL=? Example 151

2.12 Firmware Change Log

Download URL & Firmware Change log: https://www.dropbox.com/sh/1tv07fro2pvjqj8/AAD-2wbfGfluTZfh38fQqdA_a?dl=0

Upgrade Instruction: Upgrade Firmware

2.13 Battery Analysis

2.13.1 Battery Type

The NSPH01 battery is a combination of an 8500mAh Li/SOCI2 Battery and a Super Capacitor. The battery is none-rechargeable battery type with a low discharge rate (<2% per year). This type of battery is commonly used in IoT devices such as water meter.

The battery is designed to last for several years depends on the actually use environment and update interval.

The battery-related documents as below:

- Battery Dimension
- Lithium-Thionyl Chloride Battery datasheet
- Lithium-ion Battery-Capacitor datasheet

2.13.2 Power consumption Analyze

Dragino battery powered product are all runs in Low Power mode. We have an update battery calculator which base on the measurement of the real device. User can use this calculator to check the battery life and calculate the battery life if want to use different transmit interval.

Instruction to use as below:

Step 1: Downlink the up-to-date DRAGINO_Battery_Life_Prediction_Table.xlsx from: https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/Battery_Analyze/

Step 2: Open it and choose

- Product Model
- Uplink Interval
- Working Mode

And the Life expectation in difference case will be shown on the right.
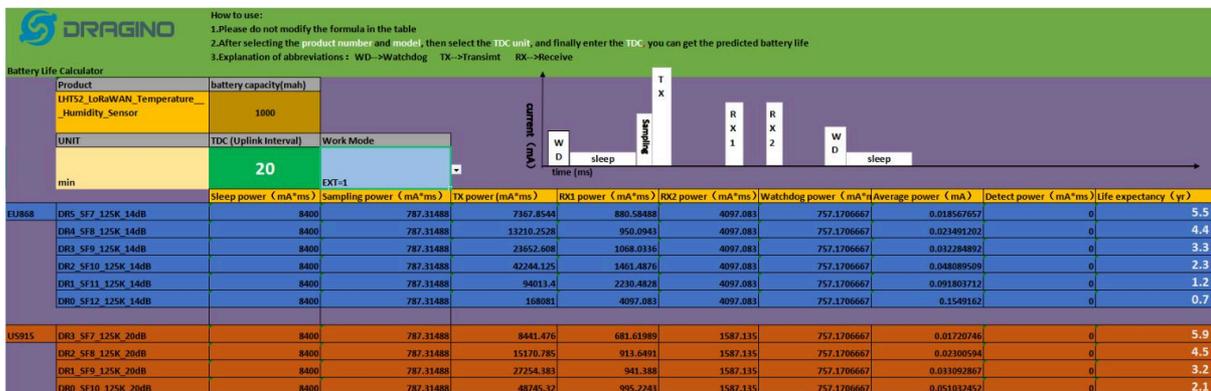
2.13.3 Battery Note

The Li-SICO battery is designed for small current / long period application. It is not good to use a high current, short period transmit method. The recommended minimum period for use of this battery is 5 minutes. If you use a shorter period time to transmit LoRa, then the battery life may be decreased.

2.13.4 Replace the battery

The default battery pack of NSPH01 includes a ER26500 plus super capacitor. If user can't find this pack locally, they can find ER26500 or equivalence without the SPC1520 capacitor, which will also work in most case. The SPC can enlarge the battery life for high frequency use (update period below 5 minutes).

3. Access NB-IoT Module

Users can directly access the AT command set of the NB-IoT module.

The AT Command set can refer the BC35-G NB-IoT Module AT Command: https://www.dragino.com/downloads/index.php?dir=datasheet/other_vendors/BC35-G/
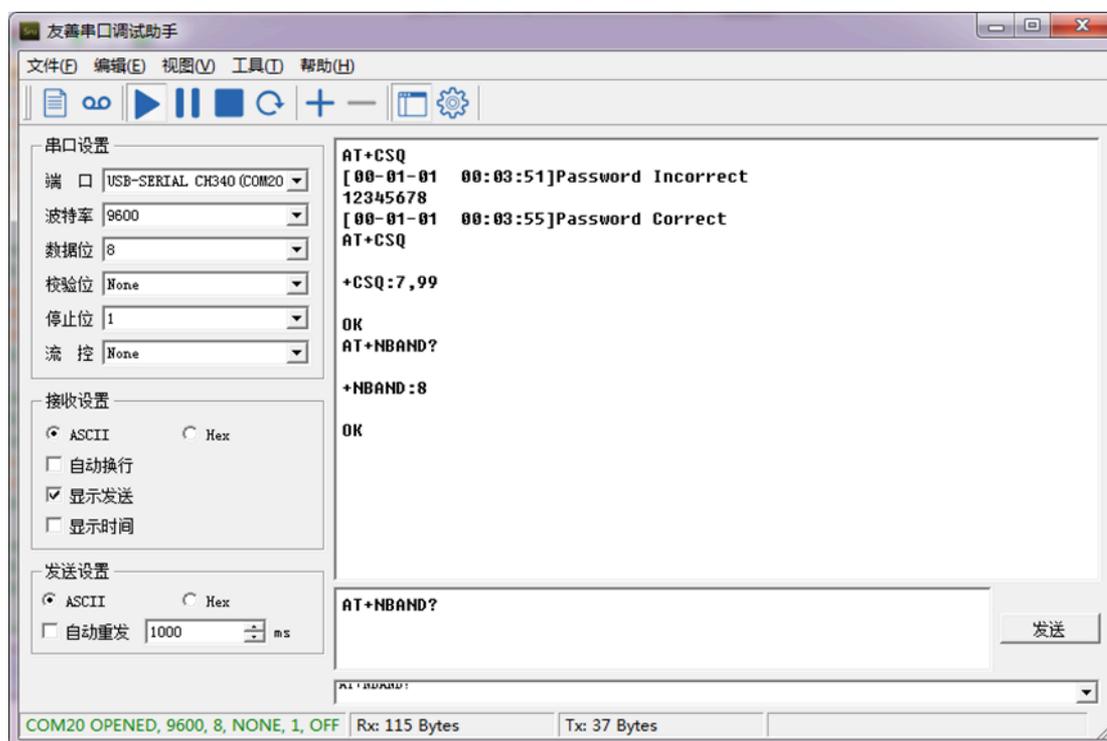
4. Using the AT Commands

4.1 Access AT Commands

See this link for detail: https://www.dropbox.com/sh/351dwor6joz8nwh/AADn1BQaAAxLF_QMyU8NkW47a?dl=0

AT+<CMD>?   : Help on <CMD>

```
AT+<CMD>              : Run <CMD>

AT+<CMD>=<value>      : Set the value

AT+<CMD>=?            : Get the value
```

General Commands

```
AT                    : Attention

AT?                   : Short Help

ATZ                   : MCU Reset

AT+TDC                : Application Data Transmission Interval

AT+CFG                : Print all configurations

AT+CFGMOD             : Working mode selection

AT+INTMOD             : Set the trigger interrupt mode

AT+5VT                : Set extend the time of 5V power

AT+PRO                : Choose agreement

AT+RXDL               : Extend the sending and receiving time

AT+SERVADDR           : Server Address

AT+TR     : Get or Set record time"

AT+APN          : Get or set the APN

AT+FBAND        : Get or Set whether to automatically modify the frequency band

AT+DNSCFG        : Get or Set DNS Server

AT+GETSENSORVALUE  : Returns the current sensor measurement

AT+NOUD     : Get or Set the number of data to be uploaded

AT+CDP     : Read or Clear cached data

AT+TEMPALARM     : Get or Set alarm of temp

AT+PHALARM    : Get or Set alarm of PH

AT+ PHCAL   : calibrate PH value
```

COAP Management

```
AT+URI        : Resource parameters
```

UDP Management

```
AT+CFM        : Upload confirmation mode (only valid for UDP)
```

MQTT Management

```
AT+CLIENT         : Get or Set MQTT client

AT+UNAME          : Get or Set MQTT Username

AT+PWD            : Get or Set MQTT password

AT+PUBTOPIC        : Get or Set MQTT publish topic
```

AT+SUBTOPIC   : Get or Set MQTT subscription topic

Information

AT+FDR   : Factory Data Reset

AT+PWORD   : Serial Access Password

5. FAQ

5.1 How to Upgrade Firmware

User can upgrade the firmware for 1) bug fix, 2) new feature release.

Please see this link for how to upgrade: http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20Upgrade%20Instruction%20for%20STM32%20base%20products/#H2.HardwareUpgradeMethodSupportList

Notice, NSPH01 and LSPH01 share the same mother board. They use the same connection and method to update.

5.2 Can I calibrate NSPH01 to different soil types?

NSPH01 is calibrated for saline-alkali soil and loamy soil. If users want to use it for other soil, they can calibrate the value in the IoT platform base on the value measured by saline-alkali soil and loamy soil. The formula can be found at this link.

6. Trouble Shooting

6.1 Connection problem when uploading firmware

Please see: http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20Upgrade%20Instruction%20for%20STM32%20base%20products/#H3.3Troubleshooting

6.2 AT Command input doesn't work

In the case if user can see the console output but can't type input to the device. Please check if you already include the **ENTER** while sending out the command. Some serial tool doesn't send **ENTER** while press the send key, user need to add ENTER in their string.

7. Order Info

Part Number**:** NSPH01

8. Packing Info

Package Includes:

- NSPH01 NB-IoT pH Sensor x 1
- External antenna x 1

Dimension and weight:

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

9. 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.com