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1. Introduction

1.1 What is Temperature & Humidity Sensor

The Dragino S31-CB and S31B-CB are **NB-IoT/LTE-M Temperature and Humidity Sensor** for Internet of Things solution. It is used to measure the surrounding **environment temperature and relative air humidity precisely**, and then upload to IoT server via NB-IoT or CAT-M1 network.

The temperature & humidity sensor used in S31x-CB is SHT31, which is fully calibrated, linearized, and temperature compensated digital output from Sensirion, it provides a strong reliability and long-term stability. The SHT31 is fixed in a **waterproof anti-condensation casing** for long term use.

S31x-CB supports different uplink methods include **MQTT, MQTTs, TCP, UDP or CoAP** for different application requirement. and Support Uplinks to various IoT Servers.

S31x-CB is powered by **8500mAh Li-SOCI2 battery**, It is designed for long term use up to several years. (Real-world battery life depends on the use environment, update period and uplink method. Please check related Power Analyze report).

*make sure you have NB-IoT or CAT-M1 coverage locally.

1.2 Features

- For -NB Bands: B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/B19/B20/B25/B28/B66/B70/B85
- For -CB Bands: B1/B2/B3/B4/B5/B8/B12/B13//B18/B19/B20/B25/B28/B66/B71/B85
- CAT-M1 / LTE-M Bands: B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B26/B27/B28/B66/B85
- Ultra-low power consumption
- External 3 meters SHT31 probe (For S31-CB)
- Measure range -40°C ~ 80°C
- Temperature & Humidity alarm
- Multiply Sampling and one uplink
- Uplink via MQTT, MQTTs, TCP, UDP or CoAP
- GNSS for Location Report
- Support Bluetooth v5.1 remote configure and update firmware
- Uplink on periodically
- Downlink to change configure
- 8500mAh Li/SOC12 Battery (S31x-CB)
- Solar panel + 3000mAh Li-ion battery (S31x-CS)
- Nano SIM card slot for NB-IoT SIM

1.3 Specification

Common DC Characteristics:

- Supply Voltage: 2.6v ~ 3.6v
- Operating Temperature: -40 ~ 85°C

Temperature Sensor:

- Range: -40 to + 80°C
- Accuracy: ± 0.2 @ 0-90 °C
- Resolution: 0.1°C
- Long Term Shift: <0.03 °C/yr

Humidity Sensor:

- Range: 0 ~ 99.9% RH
- Accuracy: $\pm 2\%$ RH (0 ~ 100%RH)
- Resolution: 0.01% RH
- Long Term Shift: <0.25 %RH/yr

NB-IoT Spec:

NB-IoT Module: BG95-NGFF

Support Bands:

- B1 @H-FDD: 2100MHz
- B2 @H-FDD: 1900MHz
- B3 @H-FDD: 1800MHz
- B4 @H-FDD: 2100MHz
- B5 @H-FDD: 860MHz
- B8 @H-FDD: 900MHz
- B12 @H-FDD: 720MHz
- B13 @H-FDD: 740MHz
- B17 @H-FDD: 730MHz
- B18 @H-FDD: 870MHz
- B19 @H-FDD: 870MHz
- B20 @H-FDD: 790MHz
- B25 @H-FDD: 1900MHz

- B28 @H-FDD: 750MHz
- B66 @H-FDD: 2000MHz
- B70 @H-FDD: 2000MHz
- B85 @H-FDD: 700MHz

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:

- STOP Mode: 14uA @ 3.3v
- Max transmit power: 350mA@3.3v

1.4 Applications

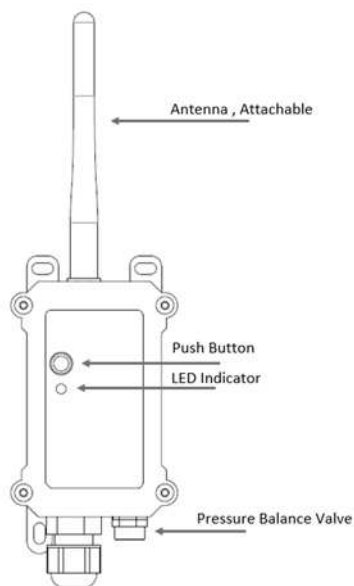
- Smart Buildings & Home Automation
- Logistics and Supply Chain Management
- Smart Metering
- Smart Agriculture
- Smart Cities
- Smart Factory

1.5 Sleep mode and working mode

Deep Sleep Mode: Sensor doesn't have any NB-IoT/CAT-M1 activate. This mode is used for storage and shipping to save battery life.

Working Mode: In this mode, Sensor will work as NB-IoT Sensor to Join NB-IoT 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.

1.6 Button & LEDs



Behavior on ACT	Function	Action
Pressing ACT between 1s < time < 3s	Send an uplink	If sensor has already attached to NB-IoT/CAT-M1 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 attach NB-IoT/CAT-M1 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 attach NB-IoT/CAT-M1 network or not.
Fast press ACT 5 times.	Deactivate Device	Red led will solid on for 5 seconds. Means device is in Deep Sleep Mode.

Note: When the device is executing a program, the buttons may become invalid. It is best to press the buttons after the device has completed the program execution.

1.7 BLE connection

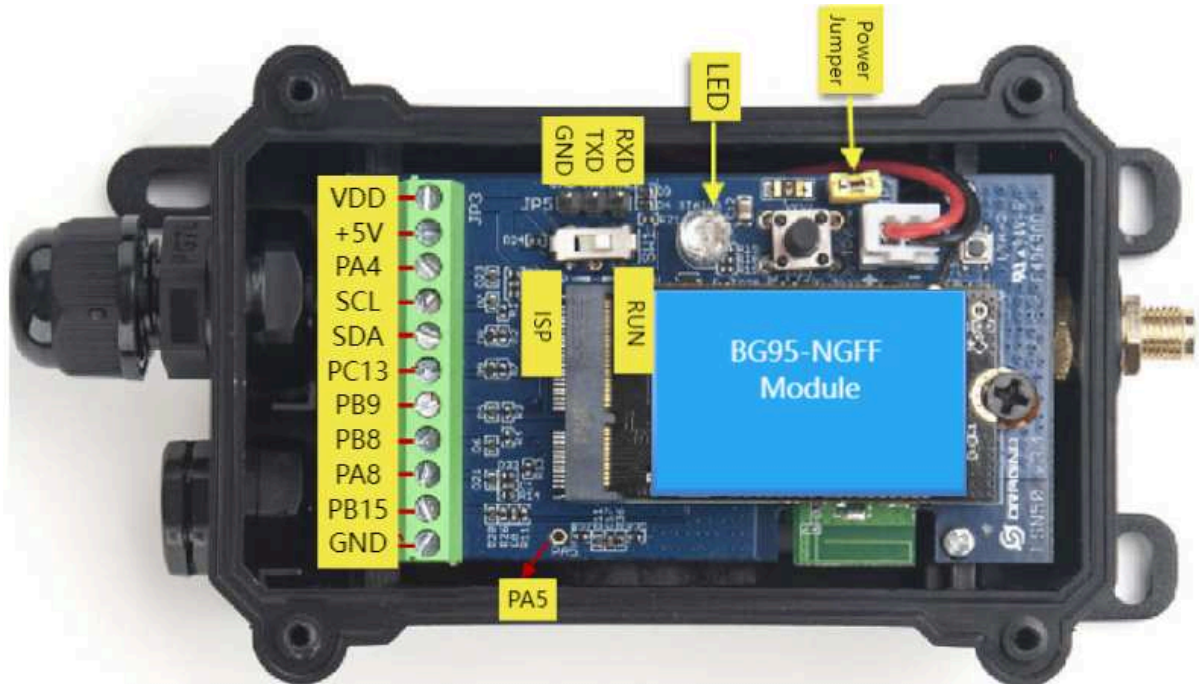
S31x-CB support BLE remote configure and firmware update.

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.

1.8 Pin Definitions , Switch & SIM Direction



1.8.1 Jumper JP2

Power on Device when put this jumper.

Power off device when take out this jumper

1.8.2 BOOT MODE / SW1

1) **ISP**: upgrade mode, device won't have any signal in this mode. but ready for upgrade firmware. LED won't work. Firmware won't run.

2) **Flash**: work mode, device starts to work and send out console output for further debug

1.8.3 Reset Button

Press to reboot the device.

1.8.4 SIM Card Direction

See this link. [How to insert SIM Card.](#)

1.9 Hardware Variant

Model	Photo	Probe Info
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S31-CB		1 x SHT31 Probe Cable Length : 3 meters
S31B-CB		1 x SHT31 Probe Installed in device.

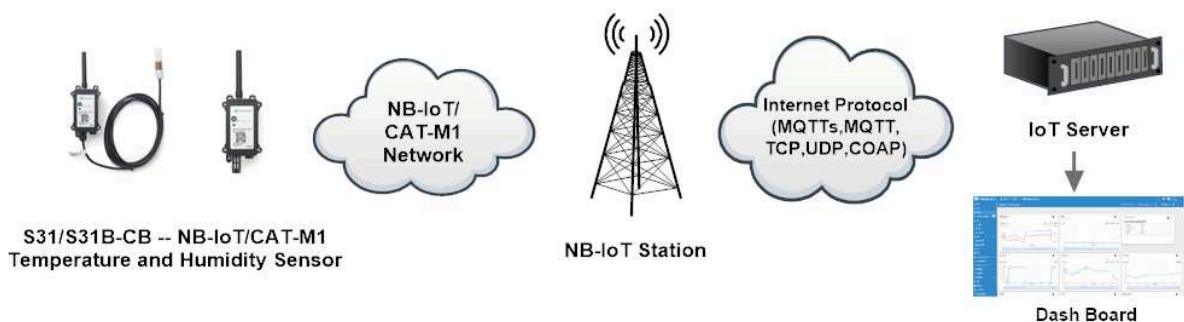
2. Use S31x-CB to communicate with IoT Server

2.1 Send data to IoT server via NB-IoT/CAT-M1 network

The S31x-CB is equipped with a NB-IoT module, the pre-loaded firmware in S31x-CB 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 S31x-CB.

Below shows the network structure:

S31/S31B-CB in a NB-IoT/CAT-M1 Network



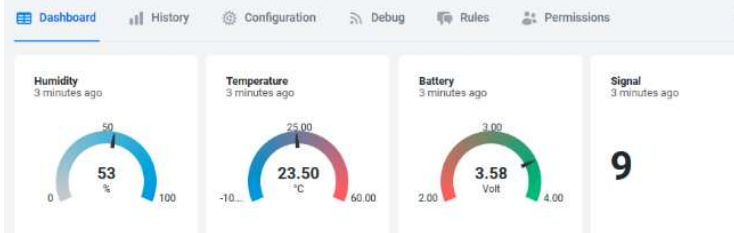
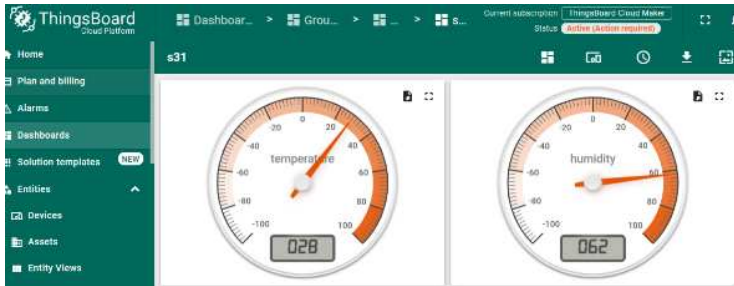
There are two version: **-GE** and **-1T** version of S31x-CB.

GE Version: This version doesn't include SIM card or point to any IoT server. User needs to use AT Commands to configure below two steps to set S31x-CB send data to IoT server.

- Install NB-IoT SIM card and configure APN. See instruction of [Attach Network](#).

- Set up sensor to point to IoT Server. See instruction of [Configure to Connect Different Servers](#).

Below shows result of different server as a glance.

Servers	Dash Board	Comments
Node-Red		
DataCake		Raw Payload. Need Developer to design Dash Board Raw Payload. Need Developer to design Dash Board
Tago.IO General UDP General MQTT ThingSpeak		
ThingsBoard		

1T Version: This version has 1NCE SIM card pre-installed and configure to send value to ThingsEye. User Just need to select the sensor type in ThingsEyeand Activate S31x-CB and user will be able to see data in ThingsEye. See here for [ThingsEye Config Instruction](#).

2.2 Payload Types

To meet different server requirement, S31x-CB supports different payload type.

Includes:

- [General JSON format payload](#). (Type=5)
- [HEX format Payload](#). (Type=0)
- [ThingSpeak Format](#). (Type=1)
- [ThingsBoard Format](#). (Type=3)

User can specify the payload type when choose the connection protocol. Example:

```
AT+PRO=1,0      // Use COAP Connection & hex Payload
AT+PRO=1,5      // Use COAP Connection & Json Payload
AT+PRO=2,0      // Use UDP Connection & hex Payload
AT+PRO=2,5      // Use UDP Connection & Json Payload
AT+PRO=3,0      // Use MQTT Connection & hex Payload
AT+PRO=3,5      // Use MQTT Connection & Json Payload
AT+PRO=4,0      // Use TCP Connection & hex Payload
AT+PRO=4,5      // Use TCP Connection & Json Payload
```

Since firmware V1.0.4, [count mode](#) has been added to S31x-CB, so payload adds count.

Since firmware V1.1.0, [IMSI](#) has been added to payload.

The following describes the latest payload.

Note: The default is AT+GPS=0 // The GPS function is not enabled. Therefore, the GPS collection time in the following example payload does not follow the system time, and the latitude and longitude are 0.

2.2.1 General Json Format(Type=5)

This is the General Json Format. As below:

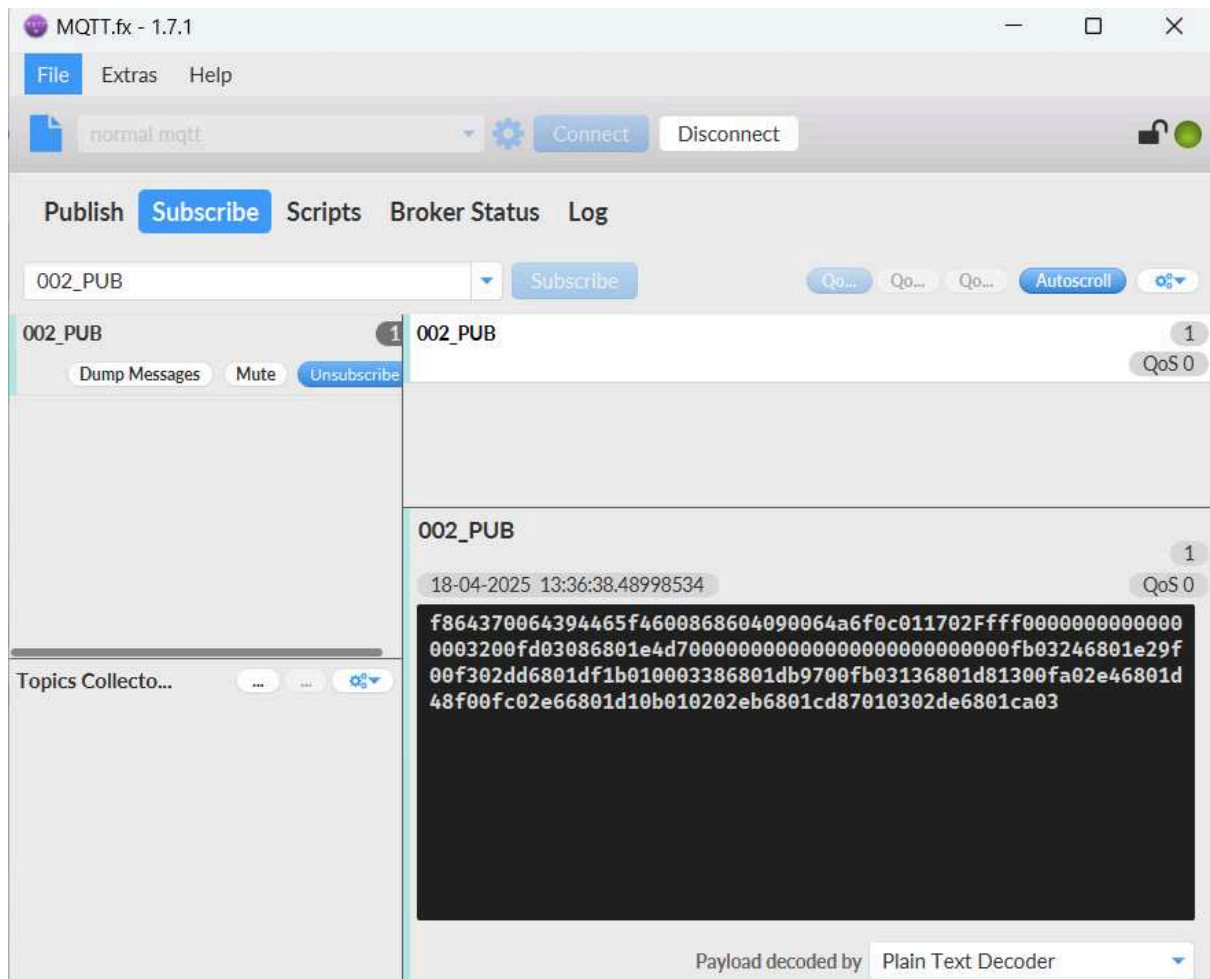
```
{"IMEI":"868508065628110","IMSI":"460240210507481","Model":"S31x-
CB","temperature":25.6,"humidity":52.5,"interrupt":0,"interrupt_level":0,"count":0,"battery":3.48,"signal":21,"time":"2024/1
03:24:54","latitude":0.000000,"longitude":0.000000,"gps_time":"1970-01-01T00:00:00Z","1":
[24.2,52.5,"2024-12-02T05:34:19Z"],"2":[24.1,52.5,"2024-12-02T05:19:19Z"],"3":
[24.1,52.6,"2024-12-02T05:04:19Z"],"4":[24.2,52.8,"2024-12-02T04:49:19Z"],"5":
[24.3,52.0,"2024-12-02T04:34:19Z"],"6":[24.2,51.6,"2024-12-02T04:19:19Z"],"7":
[24.5,50.2,"2024-12-02T03:39:02Z"],"8":[24.3,50.1,"2024-12-02T03:24:02Z"]}
```

Notice, from above payload:

- Temperature, Humidity, Interrupt, Interrupt_level, Count, Battery, Signal, latitude, longitude & GPS time are the value at uplink time.
- Json entry 1 ~ 8 are the last 1 ~ 8 sampling data as specify by **AT+CLOCKLOG=1,65535,15,8** Command. Each entry includes (from left to right): Temperature, Humidity, Sampling time.

Example:

HEX Format for S31B-CB(AT+CLOCKLOG=1,65535,15,8)										4a6f	0c01	17	02	Ffff	00	00	00	0000	00000032	00fd	0308	6801e4d7	00000000	00000000	00000000
f864370064394465 f+IMEI 8 Bytes				f460086860409006 f+MSI 8 Bytes				Version	BAT	Signal	Mod	DS18B20	PA4_level	Interrupt	interrupt_level	adc	count	Temp	Hum	Timestamp	latitude	longitude	gps_timestamp		
																37 Bytes									
00fb	0324	6801e29f	Timestamp (last 1st)	00f302dd6801df1b	010003386801db97												00fb03136801d813								
tem	hum	Timestamp	8 Bytes	last 2nd data	8 Bytes				last 3rd data				8 Bytes				last 4th data				8 Bytes				
00fa02e46801d48f	last 5th data			00fc02de6801d10b	last 6th data			010202eb6801cd87								010302de6801ca03									
8 Bytes				8 Bytes				last 7th data				8 Bytes				last 8th data				8 Bytes					



Device ID(f+IMEI): f864370064394465 =864370064394465

SIM Card ID(f+IMSI): f460086860409006 =460086860409006

Version:

These bytes include the hardware and software version.

Higher byte: Specify Sensor Model: 0x4a for S31B-CB & S31-CB

Lower byte: Specify the software version: 0x6f=111, means firmware version 1.1.1

BAT (Battery Info):

Ex1: 0x0c01 = 3073mV

Signal Strength:

NB-IoT Network signal Strength.

Ex1: 0x17 = 23

0 -113dBm or less

1 -111dBm

2...30 -109dBm... -53dBm

31 -51dBm or greater

99 Not known or not detectable

DS18B20_Temperature:

Example: 0x00de(H)= 222(D) =22.2 °C

Note: If the DS18B20 sensor is not connected, the hex payload is **0xFFFF** and Serial port print: **-409.5 °C**.

PA4_level:

Level of PA4 pin. (0: Low level 1: High level)

Interrupt:

This data field shows if this packet is generated by interrupt or not.

Example:

If byte[0]&0x01=0x00 : Normal uplink packet.

If byte[0]&0x01=0x01 : Interrupt Uplink Packet.

Interrupt_level:

This byte shows whether the interrupt is triggered by a high or low level.

Ex1: 0x00 Interrupt triggered by falling edge (low level)

Ex2: 0x01 Interrupt triggered by rising edge (high level)

Count:

When using count mode, PB15 will accumulate counts each time it is triggered.

Example: 0x00000064(H)= 100(D), So the count value is 100.

Use the **AT+CFGMOD** command to set the working mode to count mode.

Use **AT+EXT** to set the count value.

Temperature:

If payload is: 0105H: (0105 & 8000 == 0), temp = 0105H /10 = 26.1 degree

If payload is: FF3FH : (FF3F & 8000 == 1) , temp = (FF3FH - 65536)/10 = -19.3 degrees.

(FF3F & 8000: Judge whether the highest bit is 1, when the highest bit is 1, it is negative)

Humidity:

Read:0295(H)=661(D) Value: 661 / 10=66.1, So 66.1%

TimeStamp & GPS Timestamp

Unit TimeStamp Example: 666A909F(H) = 1718259871(D)

Put the decimal value into this link(<https://www.epochconverter.com/>) to get the time.

Latitude:

Example: 0x015a7886(H)=22706310(D)=22.706150

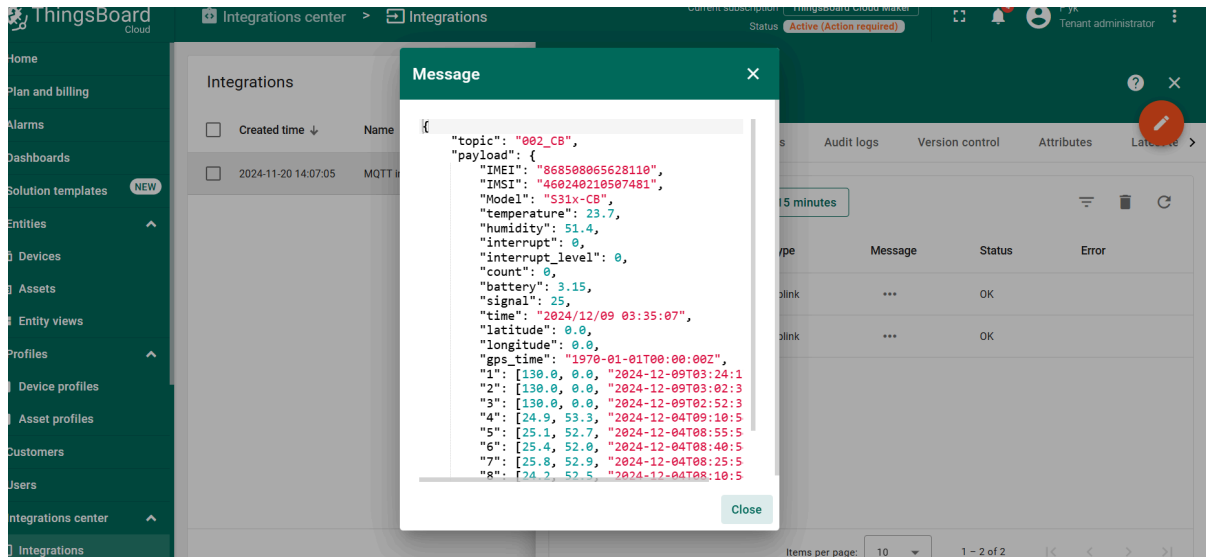
Longitude:

Example: 0x06cf341e(H)=114242590(D)=114.242830

2.2.3 ThingsBoard Payload(Type=3)

Type3 payload special design for ThingsBoard, it will also configure other default server to ThingsBoard.

```
{
  "topic": "002_CB",
  "payload": {
    "IMEI": "868508065628110",
    "IMSI": "460240210507481",
    "Model": "S31x-CB",
    "temperature": 23.7,
    "humidity": 51.4,
    "interrupt": 0,
    "interrupt_level": 0,
    "count": 0,
    "battery": 3.15,
    "signal": 25,
    "time": "2024/12/09 03:35:07",
    "latitude": 0.0,
    "longitude": 0.0,
    "gps_time": "1970-01-01T00:00:00Z",
    "1": [130.0, 0.0, "2024-12-09T03:24:17Z"],
    "2": [130.0, 0.0, "2024-12-09T03:02:32Z"],
    "3": [130.0, 0.0, "2024-12-09T02:52:32Z"],
    "4": [24.9, 53.3, "2024-12-04T09:10:54Z"],
    "5": [25.1, 52.7, "2024-12-04T08:55:54Z"],
    "6": [25.4, 52.0, "2024-12-04T08:40:54Z"],
    "7": [25.8, 52.9, "2024-12-04T08:25:54Z"],
    "8": [24.2, 52.5, "2024-12-04T08:10:54Z"]
  }
}
```



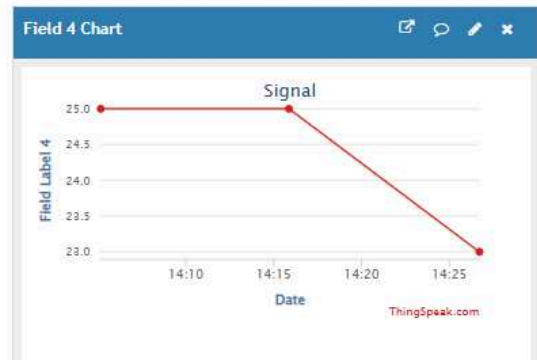
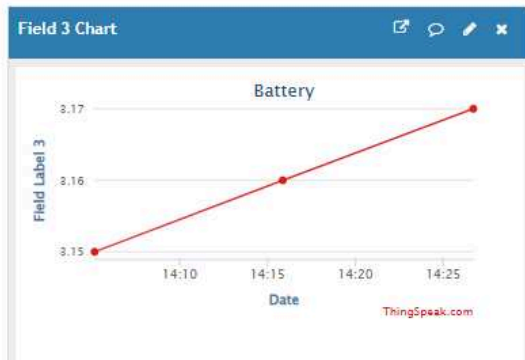
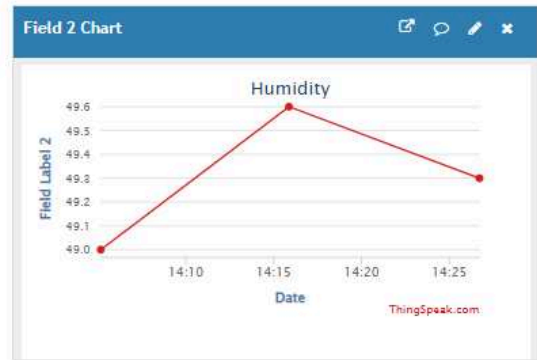
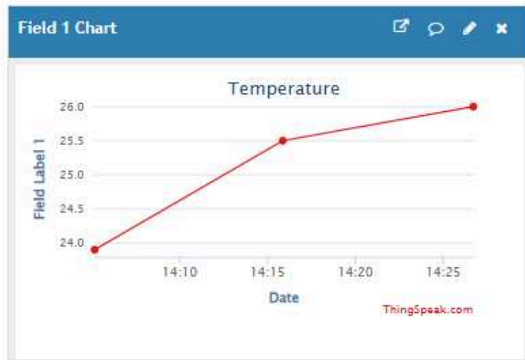
2.2.4 ThingSpeak Payload(Type=1)

This payload meets ThingSpeak platform requirement. It includes only four fields. Form 1~6 are:

Temperature, Humidity, Battery, Signal, Latitude & Longitude. This payload type only valid for ThingSpeak Platform.

As below:

field1=Tem&field2=Hum&field3=BatV&field4=Singal&field5=latitude&field6=longitude



3. Configure S31x-CB

3.1 Configure Methods

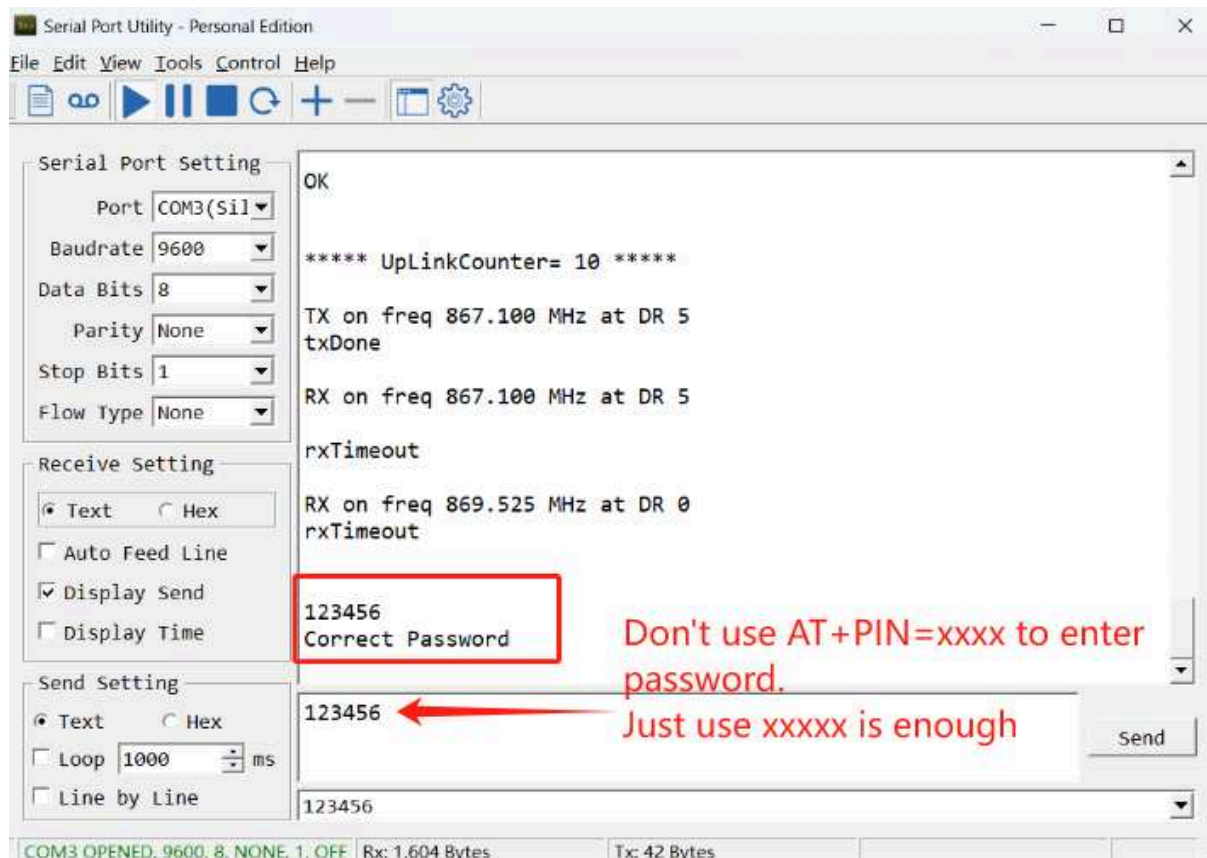
S31x-CB supports below configure method:

- AT Command via Bluetooth Connection (**Recommended**): [BLE Configure Instruction](#).
- AT Command via UART Connection : See [UART Connection](#).

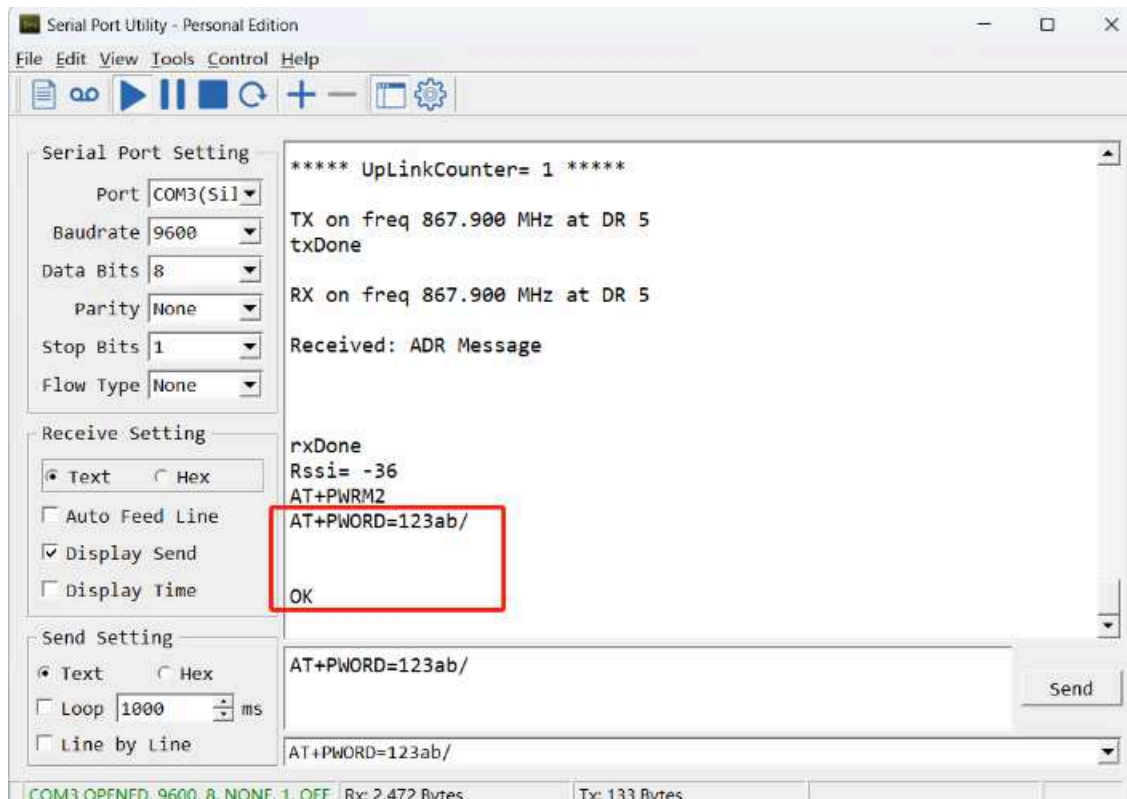
3.2 Serial Access Password

After the Bluetooth or UART connection is successful, use the Serial Access Password to enter the AT command window.

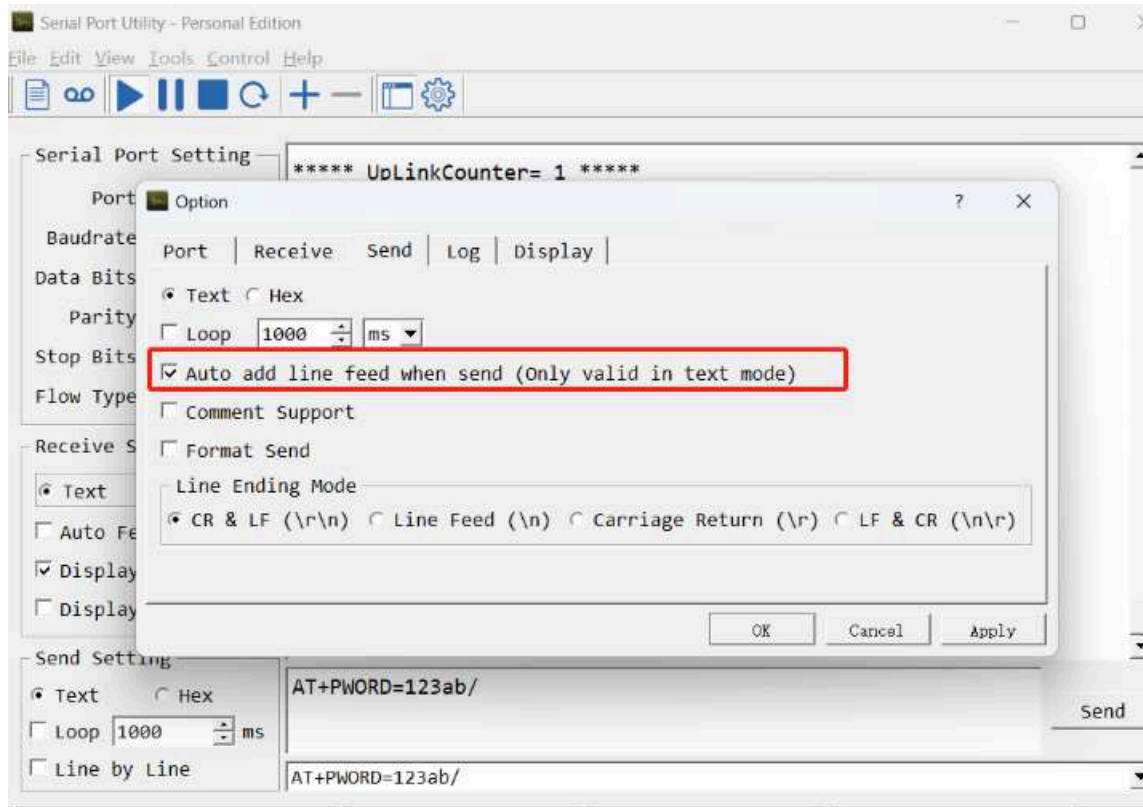
The label on the box of the node will print the initial password: AT+PIN=xxxxxx, and directly use the six-digit password to access the AT instruction window.



If you need to change the password, use **AT+PWORD=xxxxxx** (6 characters), -CB nodes only support lowercase letters.



Note: After entering the command, you need to add a line break, and you can also set automatic line breaks in the Bluetooth tool or UART connection tool.



3.3 AT Commands Set

AT+<CMD>? : Help on <CMD>
 AT+<CMD> : Run <CMD>
 AT+<CMD>=<value> : Set the value
 AT+<CMD>=? : Get the value

General Commands

AT+MODEL : Get module information
 AT+CFGMOD : Working mode selection
 AT+DEUI : Get or set the Device ID
 AT+CFG : Print all settings
 AT+SERVADDR: Get or Set the Server address
 AT+TDC : Get or set the application data transmission interval in s
 AT+INTMOD : Get or Set the trigger interrupt mode (0:input,1:falling or rising,2:falling,3:rising)
 AT+APN : Get or set the APN
 AT+5VT : Get or Set extend the time of 5V power
 AT+PRO : Get or Set usage agreement (1:COAP,2:UDP,3:MQTT,4:TCP)
 AT+RXDL : Get or Set the receiving time

AT+EXT : Get or Set Count value

AT+SHTEMP: Get or Set alarm of shtemp

AT+SHHUM: Get or Set alarm of shthum

AT+GETSENSORVALUE : Returns the current sensor measurement

AT+DNSCFG : Get or Set DNS Server

AT+CSQTIME : Get or Set the time to join the network

AT+GDNS : Get or Set the DNS

AT+SLEEP : Get or Set the sleep mode

AT+IPTYPE : Set the IPv4 or IPv6

AT+QSW : Power on and power off BG95 module

AT+CLOCKLOG: Get or set SHT record time

AT+QBAND: Get or set Frequency Band

AT+IOTMOD: Configure Network Category to be Searched for under LTE RAT

AT+DOWNTE: Get or set the conversion between the standard version and 1T version downlinks

MQTT Management

AT+CLIENT : Get or Set the MQTT clientID

AT+UNAME : Get or Set the MQTT Username

AT+PWD : Get or Set the MQTT password

AT+PUBTOPIC: Get or set MQTT publishing topic

AT+SUBTOPIC: Get or set MQTT subscription topic

AT+MQOS : Set the QoS level of MQTT

AT+TLSMOD : Get or Set the TLS mode

COAP Management

AT+URI1: Get or set CoAP option 1

AT+URI2: Get or set CoAP option 2

AT+URI3: Get or set CoAP option 3

AT+URI4: Get or set CoAP option 4

AT+URI5: Get or set CoAP option 5

AT+URI6: Get or set CoAP option 6

AT+URI7: Get or set CoAP option 7

AT+URI8: Get or set CoAP option 8

GPS

AT+GNSST : Extend the time to turn on GNSS

AT+GPS : Turn off and on GPS

AT+GTDC : Get or set GPS positioning interval in units of h

Information

AT+FDR1 : Reset parameters to factory default values except for passwords

AT+FDR : Reset Parameters to Factory Default

AT+PWORD : Get or set the System password

AT+LDATA : Get the last upload data

AT+CDP : Read or Clear cached data

AT+PDTA: Print the sector data from start page to stop page

AT+PLDTA: Print the last few sets of data

AT+CLRDTA: Clear the storage, record position back to 1st

AT+GETLOG : Print serial port logs

ATZ : Trig a reset of the MCU

3.4 Test Uplink and Change Update Interval

By default, Sensor will send uplinks **every 2 hours**.

User can use below commands to change the uplink interval.

AT Command: AT+TDC

Example: AT+TDC=7200 // Set Update Interval to 7200 seconds

Downlink Commands: 0x01

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

Example: 12 hours= 43200 seconds 43200(D)=0xA8C0(H)

Downlink Payload **01 00 A8 C0** // AT+TDC=43200, Set Update Interval to 12 hours.

Note: User can also push the button for more than 1 second to activate an uplink.

3.5 Set the receiving time

Feature: Extend the receiving time

AT Command: AT+RXDL

Example: AT+RXDL=1000 // Set the receiving time delay to 1000ms

Downlink Commands: 0x03

Format: Command Code (0x03) followed by 3 bytes.

Example: Downlink Payload: **03 00 03 E8** // AT+RXDL=1000

3.6 Reset

Feature: Trig a reset of the MCU.

AT Command: ATZ

Downlink Commands: 0x04FF

3.7 +5V

Feature: Set extend the time of 5V power.

AT Command: **AT+5VT**

Example: AT+5VT=2000 // Set extend the time of 5V power to 2000 ms

Downlink Commands: **0x05**

Format: Command Code (0x05) followed by 3 bytes.

Example: Downlink Payload: **05 00 07 D0** // AT+5VT=2000

3.8 Trigger an uplink by external interrupt

S31x-CB has an external trigger interrupt function. Users can use the PB15 pin to trigger the upload of data packets.

AT command:

- **AT+INTMOD** // Set the trigger interrupt mode
- **AT+INTMOD=0** // Disable Interrupt
- **AT+INTMOD=1** // Trigger by rising and falling edge
- **AT+INTMOD=2** // Trigger by falling edge
- **AT+INTMOD=3** // Trigger by rising edge

Downlink Commands: **0x06**

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

Example1: Downlink Payload: **06 00 00 01** // AT+INTMOD=1

Example2: Downlink Payload: **06 00 00 03** // AT+INTMOD=3

3.9 Set the QoS level

This command is used to set the QoS level of **MQTT**.

AT command:

- **AT+MQOS=xx** // 0~2

Downlink command: **0x07**

Format: Command Code (0x07) followed by 1 byte.

Ex1: Downlink payload: **0x0700** // AT+MQOS=0

Ex2: Downlink payload: **0x0701** // AT+MQOS=1

3.10 Clock logging

Sometimes when we deploy lots of end nodes in field. We want all sensors sample data at the same time, and upload these data together for analyze. In such case, we can use clock logging feature.

We can use this command to set the start time of data recording and the time interval to meet the requirements of the specific collection time of data.

AT command: **AT+CLOCKLOG=a,b,c,d**

a: 0: Disable Clock logging. **1:** Enable Clock Logging

b: Specify First sampling start second: range (**0 ~ 3599, 65535**) // **Note:** If parameter b is set to 65535, the log period starts after the node accesses the network and sends packets.

c: Specify the sampling interval: range (**0 ~ 255 minutes**)

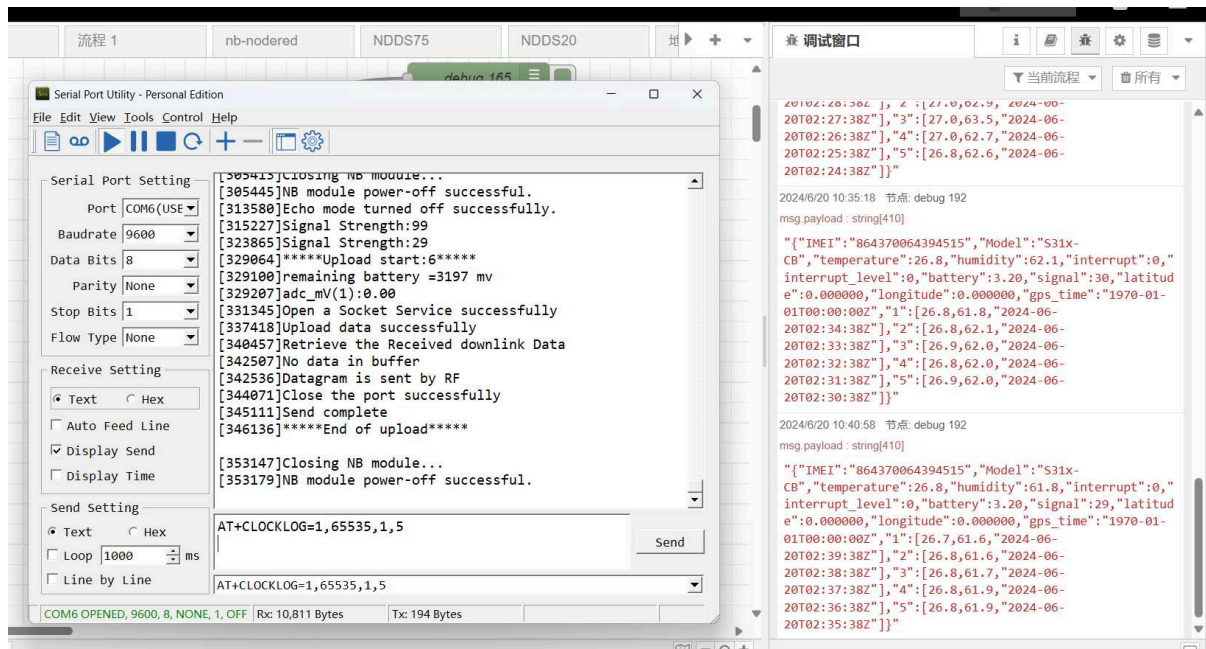
d: How many entries should be uplink on every TDC (**max 32**)

Note: To disable clock recording, set the following parameters: AT+CLOCKLOG=1,65535,0,0

Example:

AT+CLOCKLOG=1,65535,1,5

After the node sends the first packet, data is recorded to the memory at intervals of 1 minute. For each TDC uplink, the uplink load will include: battery information + the last 5 memory records (payload + timestamp).



Note: Users need to synchronize the server time before configuring this command. If the server time is not synchronized before this command is configured, the command takes effect only after the node is reset.

Downlink command: 0x08

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

- **Example 1:** Downlink Payload: **08 01 FFFF 0F 08** // Set SHT record time: AT +CLOCKLOG=1,65535,15,8
- **Example 2:** Downlink Payload: **08 01 04B0 0F 08** // Set SHT record time: AT +CLOCKLOG=1,1200,15,8

Note: When entering the downlink payload, there must be no Spaces between bytes.

3.11 Set the TLS mode

Refer to this link ([MQTT Connection to send data to Tago.io](#)) to use the TLS mode.

AT Command: AT+TLSMOD

Example 1: AT+TLSMOD=0,0 // Disable TLS Mode.

Example 2: AT+TLSMOD=1,0 // No authentication

AT+TLSMOD=1,1 // Perform server authentication

AT+TLSMOD=1,2 // Perform server and client authentication if requested by the remote server

Downlink command: 0x09

Format: Command Code (0x09) followed by 2 bytes.

Example1: Downlink Payload: **09 00 00** // AT+TLSMOD=0,0

Example2: Downlink Payload: **09 01 02** // AT+TLSMOD=1,2

3.12 Set GNSS open time

Extend the time to turn on GNSS. The automatic GPS location time is extended when the node is activated.

AT Command: AT+GNSST

Example: AT+GNSST=30 // Set the GPS positioning time to 30 seconds

Downlink command: 0x10

Format: Command Code (0x10) followed by 2 bytes.

Example: Downlink Payload: **10 00 1E** // AT+GNSST=30

3.13 Turn on/off GPS

AT Command: AT+GPS

Ex1: AT+GPS=0 // Turn off GPS

Ex2: AT+GPS=1 // Turn on GPS

Downlink command: 0x11

Format: Command Code (0x11) followed by 1 byte.

Example: Downlink Payload: **11 01** // AT+GPS=1

3.14 Set GPS positioning interval

Feature: Set GPS positioning interval (unit: hour).

When GPS is enabled, the node automatically locates and uplinks each time it passes **GTDC time** after activation.

AT Command: AT+GTDC

Example: AT+GTDC=24 // Set the GPS positioning interval to 24h.

Downlink command: 0x12

Format: Command Code (0x12) followed by 3 bytes.

Example: 24 hours: 24(D)=0x18(H)

Downlink Payload: **12 00 00 18** // AT+GTDC=24

3.15 Set the search network time

Feature: Get or Set the time to join the network(unit: minutes).

AT Command: AT+CSQTIME

Example: AT+CSQTIME=10 // Set the search time to 10 minutes.

Downlink command: 0x13

Format: Command Code (0x13) followed by 1 byte.

Example: Downlink Payload: **13 0A** // AT+CSQTIME=10

3.16 Humidity and Temperature alarm function

On each sampling define by AT+CLOCKLOG=1,65535,**15**,8 (default 15 minutes), when the value exceed the range, it will trigger an Alarm and immediately sends a uplink.

AT Command:

AT+ SHTEMP=min,max

SHTTEMP must be -40 to 125.

Example: AT+ SHTEMP=20,30 // Alarm when temperature lower than 20 or higher than 30

AT+ SHHUM=min,max

Example: AT+ SHHUM=50,80 // Alarm when humidity lower than 50 or higher than 80.

Downlink Commands: 0x0A

Format: Command Code (0x0A) followed by 4 bytes.

The first and second bytes following the function code are the minimum and maximum value of **SHTEMP**, and the third and fourth bytes are the minimum and maximum value of **SHHUM**.

- **Example 1:** Downlink Payload: **0A 14 1E 32 50** // AT+ SHTEMP=20,30 & AT+ SHHUM=50,80
- **Example 2:** Downlink Payload: **0A 00 00 00 00** // disable temperature and humidity alarm.

For **negative payload temperature**, calculate it as follows: **65536+ temperature = FFaa**, the value is **aa**.

- **Example:** -40°C : 65536+(-40)=65496(D)=FFD8(H), Therefore, select a numerical representation of D8 as -40 °C for the downlink payload.

Notice:

- To disable Alarm, user can set min and max to same value , such as **AT+SHTEMP=0,0 and AT+SHHUM=50,50**
- If user only want to send only min or max, user can set the alarm to a value that device won't reach. For example: **AT+SHTEMP=-40,0**(Alarm above 0 degrees Celsius).

3.17 Set the IPv4 or IPv6

This command is used to set IP version.

AT command:

- **AT+IPTYPE=1** // IPv4
- **AT+IPTYPE=2** // IPv6

3.18 Configure Network Category to be Searched for under LTE RAT.

AT command: AT+IOTMOD=xx

- xx:**
- 0: eMTC
 - 1: NB-IoT
 - 2: eMTC and NB-IoT

3.19 Factory data reset

Two different restore factory Settings configurations.

AT command:

- **AT+FDR** // Reset Parameters to Factory Default.
- **AT+FDR1** // Reset parameters to factory default values **except for passwords**.

3.20 Set CoAP option

Feature: Set CoAP option, follow this link to set up the CoaP protocol.

AT command: AT+URI1~AT+URI8

AT+URI1=11,"i" // "i" indicates that the endpoint supports observation mode. In -CB products, fixed setting AT+URI1=11,"i"

AT+URI2=11,"CoAP endpoint URI" // 11 is a fixed parameter.

Example: i/13a35fbe-9515-6e55-36e8-081fb6aacf86

AT+URI1=11,"i"

AT+URI2=11,"13a35fbe-9515-6e55-36e8-081fb6aacf86"

--> If multiple groups of CoAP endpoint urls:

AT+URI3=11,"i"

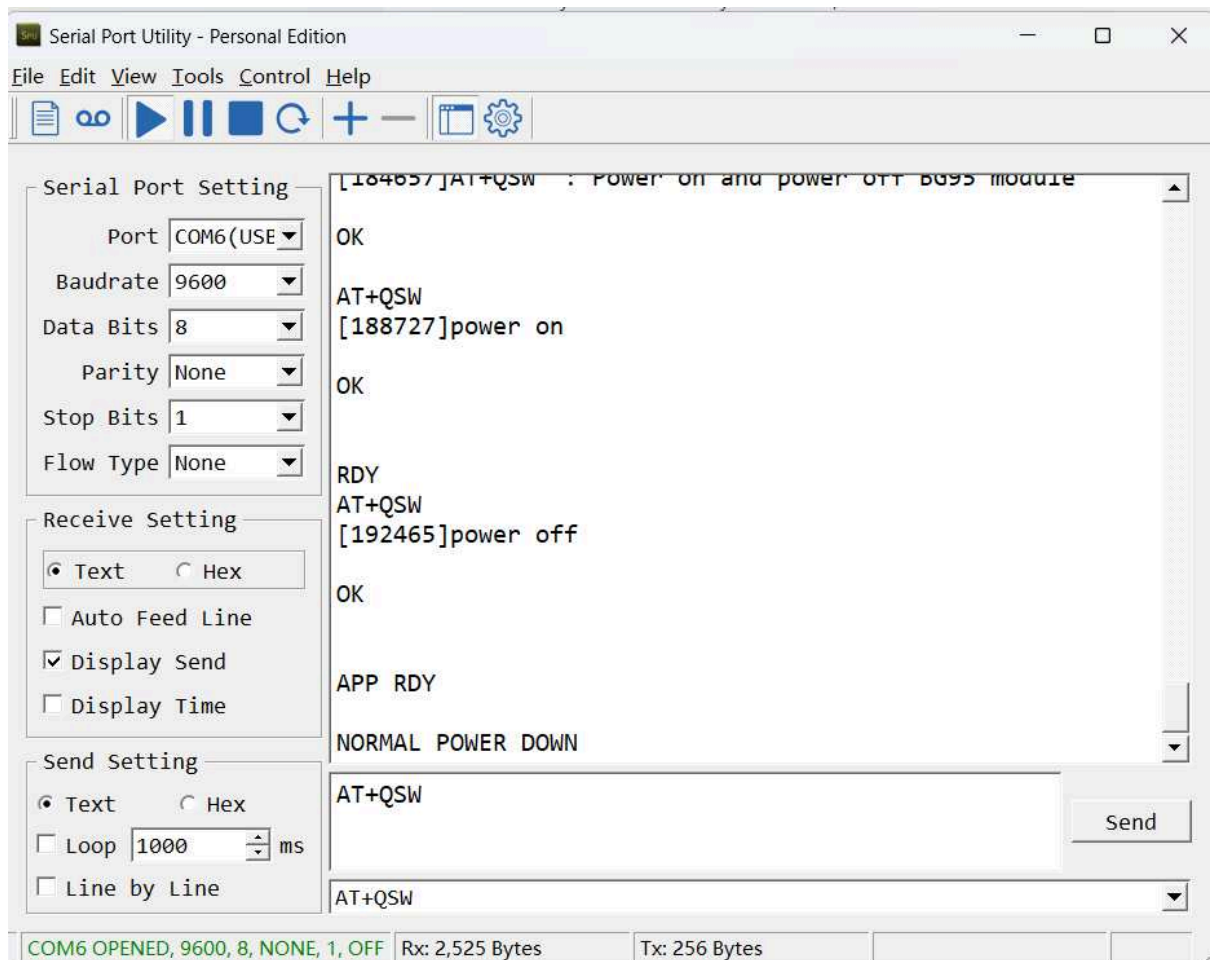
AT+URI4=11,"CoAP endpoint URI"

3.21 Power on / power off BG95 module

This command is used to power on and power off BG95 module.

- **AT command: AT+QSW**

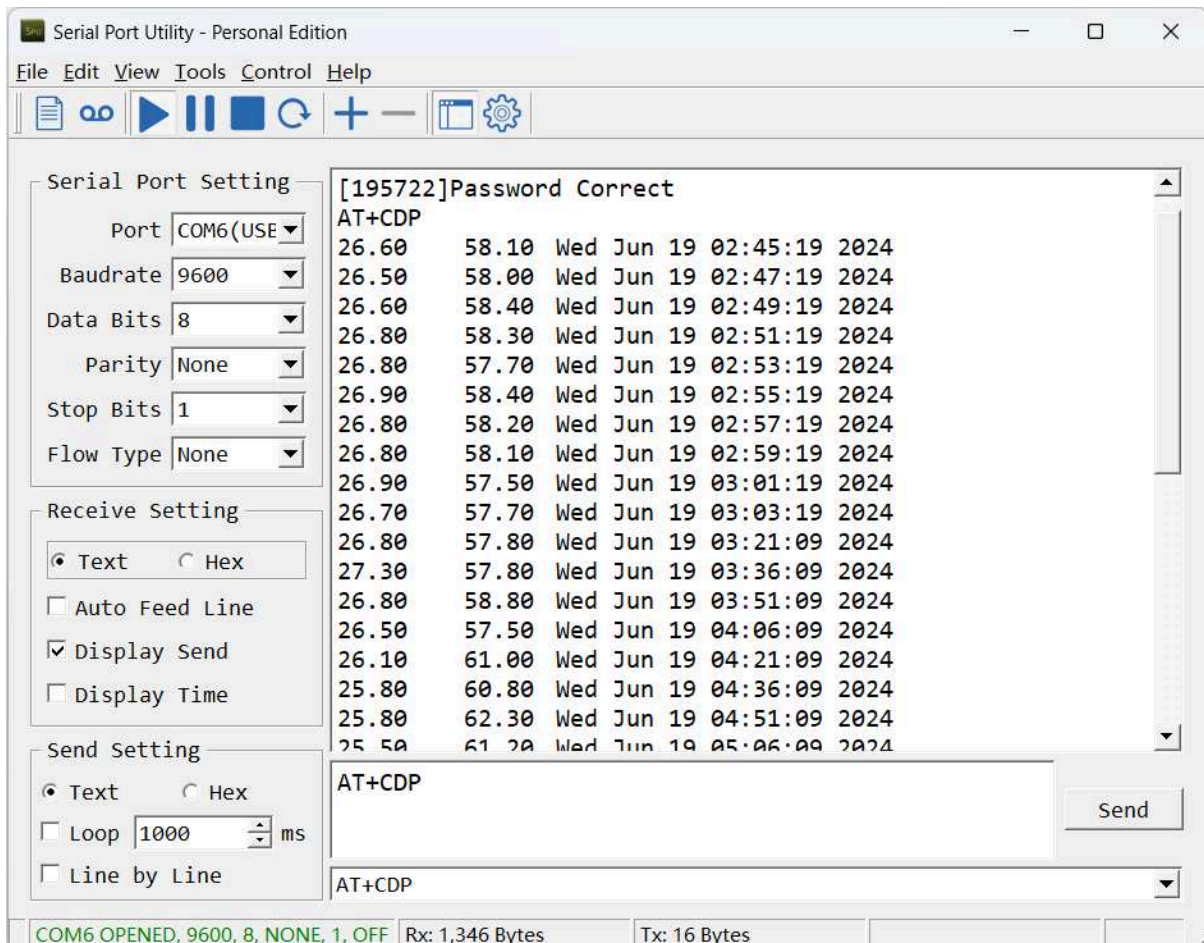
The module is powered on after the command is sent for the first time, and powered off after the command is sent again.



3.22 Example Query saved historical records

- **AT command:** `AT+CDP`

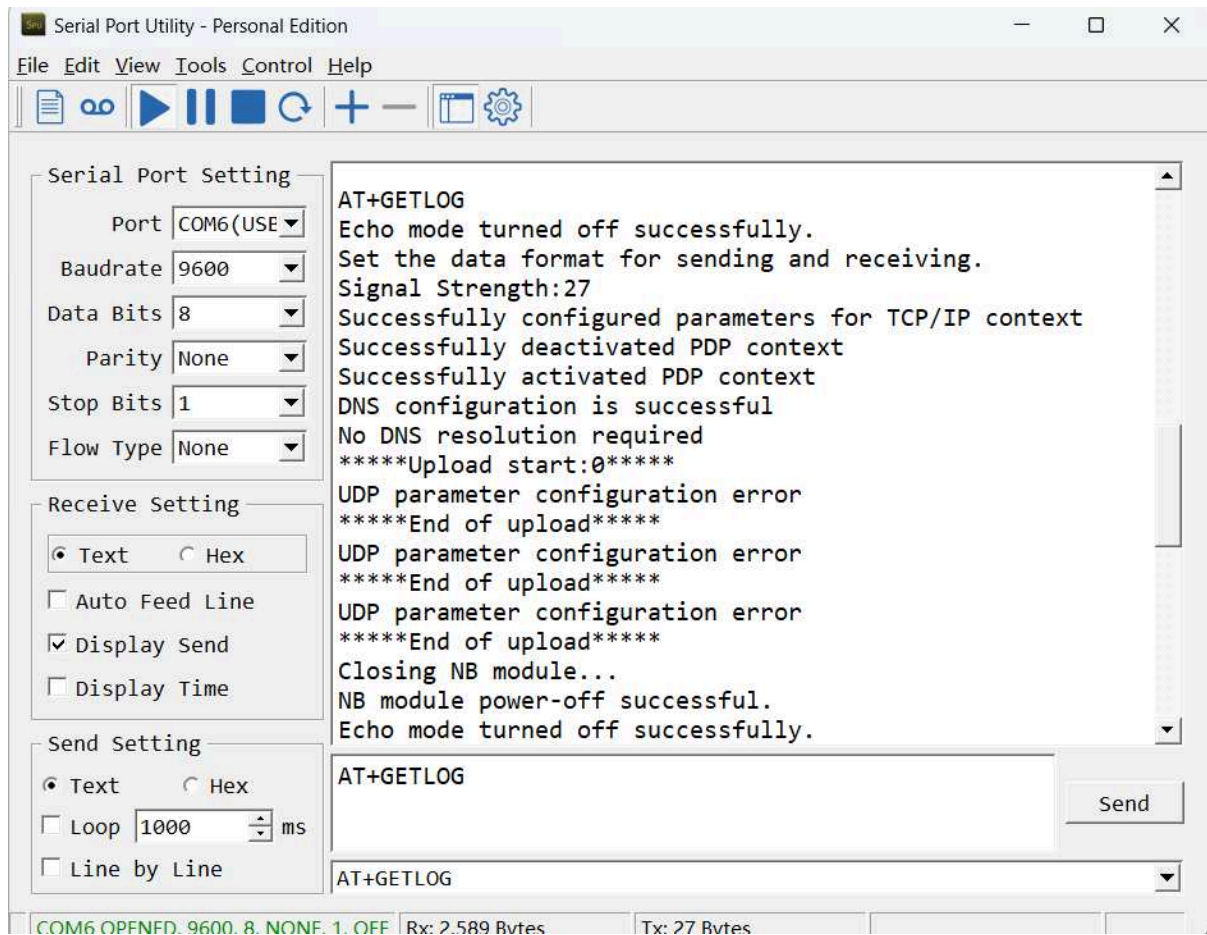
This command can be used to search the saved history, recording up to 32 groups of data, each group of historical data contains a maximum of 100 bytes.



3.23 Uplink log query

- **AT command:** AT+GETLOG

This command can be used to query upstream logs of data packets.



3.24 Print last few data entries

Feature: Print the last few data entries

AT command: AT+PLDTA

Command Example	4 bytes
AT+PLDTA=5	Stop Tx events when read sensor data
Print last 5 entries	1 24/9/20 23:31:37 temp=29.4 hum=70.4
	2 24/9/20 23:46:33 temp=29.4 hum=71.2
	3 24/9/21 00:01:33 temp=29.4 hum=71.0

```
4 24/9/21 00:16:47 temp=29.5 hum=71.3
5 24/9/21 00:31:33 temp=27.5 hum=68.0
Start Tx events
OK
```

Downlink Command:

No downlink commands for feature

3.25 Print data entries base on page

Feature: Print the sector data from start page to stop page.

AT command: **AT+PDTA**

Command Example	4 bytes
AT+PDTA=1,1 Print page 1 to 1	Stop Tx events when read sensor data 8028B00 24/9/20 10:31:33 temp=25.3 hum=60.0 8028B08 24/9/20 10:46:33 temp=25.3 hum=59.0 8028B10 24/9/20 11:01:33 temp=25.1 hum=59.3 8028B18 24/9/20 11:16:33 temp=25.0 hum=60.7 8028B20 24/9/20 11:31:33 temp=24.9 hum=61.4 8028B28 24/9/20 11:46:33 temp=24.7 hum=60.6 8028B30 24/9/20 12:01:33 temp=24.8 hum=60.8 8028B38 24/9/20 12:16:33 temp=24.6 hum=61.0 8028B40 24/9/20 12:31:33 temp=24.5 hum=60.8 8028B48 24/9/20 12:46:33 temp=24.6 hum=60.5 8028B50 24/9/20 13:01:33 temp=25.1 hum=60.5 8028B58 24/9/20 13:16:33 temp=26.4 hum=61.3 8028B60 24/9/20 13:31:33 temp=27.0 hum=61.9 8028B68 24/9/20 13:46:33 temp=27.4 hum=62.3 8028B70 24/9/20 14:01:33 temp=27.6 hum=62.6 8028B78 24/9/20 14:16:33 temp=27.8 hum=63.4 Start Tx events OK

Downlink Command:

No downlink commands for feature

3.26 Clear Flash Record

Feature: Clear flash storage for data log feature.

AT command: **AT+CLRTDA**

Command Example	Function	Response
-----------------	----------	----------

AT+CLRDTA	Clear date record	Stop Tx events,Please wait for the erase to complete Clear all stored sensor data... Start Tx events OK
-----------	-------------------	--

Downlink Command: 0x32

- Example: 0x32 00 // Same as AT+CLRDTA

3.27 Working mode selection(Since firmware V1.0.4)

Feature: Set interrupt mode or count mode (PB15 pin).

AT command: AT+CFGMOD

Command Example	Function
AT+CFGMOD=1	Interrupt mode (default mode)
AT+CFGMOD=2	count mode

Downlink Command: 0x02

- Downlink command: 02 01 // Equal to AT+CFGMOD=1
- Downlink command: 02 02 // Equal to AT+CFGMOD=2

3.28 Set Count value(Since firmware V1.0.4)

Feature: Set the count value of PB15.

AT command: AT+EXT

Command Example	Function	Response
AT+EXT=?	Show current count value.	0 (default) OK
AT+EXT=100	Set the count value to 100.	OK

Downlink Command: 0x0B

Format: Command Code (0x0B) followed by 4 bytes.

- Downlink command: 0B 00 00 00 00 // Set the count value to 0
- Downlink command: 0B 00 00 00 64 // Set the count value to 100

3.29 Set the downlink debugging mode(Since firmware v1.1.0)

Feature: Set the conversion between the standard version and 1T version downlinks.

AT command: AT+DOWNTE

Command Example	Function/Parameters	Response/Explanation
AT+DOWNTE=?	Get current Settings	0,0 (default) OK
AT+DOWNTE=a,b	a: Set the conversion between the downlink of the standard version and 1T version b: Enable/Disable downlink debugging	0: Set the downlink of the standard version. 1: Set the downlink of the 1T version(ThingsEye platform) 0: Disable downlink debugging mode.

1: Enable downlink debugging mode, users can see the original downlink reception.

Example:

- AT+DOWNTE=0,1 // Set to standard version downlink, and enable downlink debugging.
- AT+DOWNTE=1,1 // Set to 1T version downlink, and enable downlink debugging.

Downlink Command:

No downlink commands for feature

3.30 Domain name resolution settings(Since firmware v1.1.1)

Feature: Set static DNS resolution IP address.

AT command: AT+BKDNS

Command Example	Function/Parameters	Response/Explanation
AT+BKDNS=?	Get current Settings	1,0,NULL (default) OK
AT+BKDNS=a,b,c	a: Enable/Disable static DNS resolution.	0: Disable static DNS resolution
	b: Meaningless.	1: Enable static DNS resolution. The ip address will be saved after the domain name is resolved, if the next domain name resolution fails, the last saved ip address will be used.
	c: Set the IP address manually.	Set to 0 . The format is the same as AT+SERVADDR. If domain name resolution fails, this ip address will be used directly, if domain name resolution succeeds, parameter c will be updated to the successfully resolved IP address.

Example:

- AT+BKDNS=0,0,NULL //Disable static DNS resolution.
- AT+BKDNS=1,0,NULL // Enable static DNS resolution.
- AT+BKDNS=1,0,3.69.98.183,1883 //Enable static DNS resolution, if domain name resolution succeeds, the node uses the ip address successfully resolved and saves it to parameter c. If the domain name resolution fails, use the manually set ip address: 3.69.98.183 for communication.

Downlink Command:

No downlink commands for feature.

4. Battery & Power Consumption

S31x-CB use ER26500 + SPC1520 battery pack. See below link for detail information about the battery info and how to replace.

[Battery Info & Power Consumption Analyze](#) .

Please refer to the following instructions to ask the AI to let the AI intelligence help the user to calculate the battery life.

Ex1:

The S31x-CB using ER26500 + SPC1520 8500mAh battery packs.

1. CB version of AI questioning techniques:

Battery capacity is 8500mAh, self-discharge <2%/year
 Sleep current: 19.618uA
 Sampling current&Duration: 20mA. 10 seconds
 UDP Transmit/Receive Current & Duration: 58mA, 36 sec.
 MQTT protocol transmit current & duration: 63mA, 41 seconds
 TCP protocol transmit current & duration: 62mA, 41 seconds
 GSP positioning current & duration: 87.0756mA, 44.162 seconds
 Timed Acquisition Current & Duration: 8.78151mA, 0.125338s
 Acquisition every 120 minutes, launching once, GPS positioning once a day ,15 minutes timed acquisition once
 How many years can the battery be used in different transmission modes?

Here are the currents and durations for different transmission protocols for CB

Device (communication protocols)	sleep current	Sending and receiving current	Package acceptance time	Sampling power	Sampling time	GPS positioning current	GPS positioning time	Interrupt trigger current	Interrupt Trigger Time	Timed current collection	Timed acquisition time	Watchdog power	Watchdog time
S31-CB(UDP)	19.618uA	57.9943mA	35.664s	61.2125mA	9.335s	44.162s	87.0756mA		0	0 8.78151mA	125.338ms	0.795898mA	0.001s
S31-CB(TCP)	19.618uA	61.6228mA	40.673s	61.2125mA	9.335s	44.162s	87.0756mA		0	0 8.36641mA	125.338ms	0.795898mA	0.001s
devices: S31-CB(MQTT)	19.618uA	63.0371mA	40.591s	61.2125mA	9.335s	44.162s	87.0756mA		0	0 8.36641mA	125.428ms	0.795898mA	0.001s

Example:

Every 120 minutes to collect once, transmit once, GPS positioning once a day , 15 minutes timed collection once
 How many years can the battery be used in different transmission modes?

AI will automatically help the user to calculate the average power consumption and battery life of the device for each packet sent, as shown below:

We need to calculate the **daily energy consumption** for each transmission protocol (UDP, MQTT, TCP) and account for battery self-discharge. Below is the step-by-step calculation:

Key Parameters

- **Battery capacity:** 8500 mAh
- **Self-discharge:** 2% per year (equivalent to ~0.4657 mAh/day)
- **Daily operations:**
 - Acquisition: 20 mA for 10 seconds → **every 120 minutes → 12 times/day.**
 - Protocol transmission: UDP/MQTT/TCP → **once every 120 minutes → 12 times/day.**
 - GPS positioning: 87.0756 mA for 44.162 seconds → **once/day.**
 - Timed acquisition: 8.78151 mA for 0.125338 seconds → **every 15 minutes → 96 times/day.**

Energy Consumption Formula

Total daily energy (mAh) =

(Sleep) + (Acquisition) + (Protocol) + (GPS) + (Timed Acquisition) + (Self-discharge)

Calculations for Each Protocol

1. UDP Protocol

- **Transmission:** 58 mA for 36 seconds → 0.58 mAh per transmission.
- **Daily energy breakdown:**
 - Sleep: $0.019618\text{ mA} \times 24\text{ h} = 0.4708\text{ mAh}$
 - Acquisition: $20\text{ mA} \times \frac{10}{3600}\text{ h} \times 12 = 0.6667\text{ mAh}$
 - UDP Transmission: $58\text{ mA} \times \frac{36}{3600}\text{ h} \times 12 = 6.96\text{ mAh}$
 - GPS: $87.0756\text{ mA} \times \frac{44.162}{3600}\text{ h} = 1.066\text{ mAh}$
 - Timed Acquisition: $8.78151\text{ mA} \times \frac{0.125338}{3600}\text{ h} \times 96 = 0.029\text{ mAh}$
 - Self-discharge: 0.4657 mAh
- **Total daily energy:**
 $0.4708 + 0.6667 + 6.96 + 1.066 + 0.029 + 0.4657 = 9.658\text{ mAh/day}$
- **Battery lifetime:**
 $\frac{8500}{9.658} \div 365 \approx 2.41\text{ years}$

2. MQTT Protocol

- **Transmission:** 63 mA for 41 seconds → 0.7175 mAh per transmission.
- **Daily energy breakdown:**
 - Sleep: 0.4708 mAh
 - Acquisition: 0.6667 mAh
 - MQTT Transmission: $63\text{ mA} \times \frac{41}{3600}\text{ h} \times 12 = 8.61\text{ mAh}$
 - GPS: 1.066 mAh
 - Timed Acquisition: 0.029 mAh
 - Self-discharge: 0.4657 mAh
- **Total daily energy:**
 $0.4708 + 0.6667 + 8.61 + 1.066 + 0.029 + 0.4657 = 11.308\text{ mAh/day}$
- **Battery lifetime:**
 $\frac{8500}{11.308} \div 365 \approx 2.06\text{ years}$

3. TCP Protocol

- **Transmission:** 62 mA for 41 seconds → 0.7056 mAh per transmission.
- **Daily energy breakdown:**
 - Sleep: 0.4708 mAh
 - Acquisition: 0.6667 mAh
 - TCP Transmission: $62\text{ mA} \times \frac{41}{3600}\text{ h} \times 12 = 8.47\text{ mAh}$
 - GPS: 1.066 mAh
 - Timed Acquisition: 0.029 mAh
 - Self-discharge: 0.4657 mAh
- **Total daily energy:**
 $0.4708 + 0.6667 + 8.47 + 1.066 + 0.029 + 0.4657 = 11.168\text{ mAh/day}$
- **Battery lifetime:**
 $\frac{8500}{11.168} \div 365 \approx 2.09\text{ years}$

Summary of Results

Protocol	Daily Energy (mAh)	Battery Lifetime
UDP	9.658	~2.41 years
MQTT	11.308	~2.06 years
TCP	11.168	~2.09 years

Notes

1. **Self-discharge** is included in calculations as a daily energy loss.
2. **Sleep current** dominates energy consumption (~50% of total usage).
3. **GPS positioning** contributes significantly to daily energy use (~11% for UDP).
4. Actual battery life may vary due to temperature, aging, and voltage cutoffs.

The S31x-CS uses a 3000mAh Li-Ion battery, please refer to the following instructions to ask the AI to let the AI intelligence help users calculate the battery life.

2.CS version of AI questioning techniques:

Battery capacity is 8500mAh, self-discharge <2%/year

Sleep current: 50.409uA

Sampling current&Duration: 20mA, 10 seconds

UDP Transmit/Receive Current & Duration: 58mA, 36 seconds.

MQTT protocol transmit current & duration: 63mA, 41 seconds

TCP protocol transmit current & duration: 62mA, 41 seconds

GSP positioning current & duration: 87.0756mA, 44.162 seconds

Timed Acquisition Current & Duration: 8.78151mA, 0.125338 seconds

Acquisition every 120 minutes, launching once, GPS positioning once a day ,15 minutes timed acquisition once

How many years can the battery be used in different transmission modes?

Here are the currents and durations for different transmission protocols for CS devices:

Device (communication protocols)	sleep current	Sending and receiving current	Package acceptance time	Sampling power	Sampling time	GPS positioning current	GPS positioning time	Interrupt trigger current	Interrupt Trigger Time	Timed current collection	Timed acquisition time	Watchdog power	Watchdog time
S31-CS(UDP)	50.409uA	57.9943mA	35.664s	61.2125mA	9.335s	44.162s	87.0756mA		0	0 8.36641mA	125.338ms	0.795898mA	0.001s
S31-CS(TCP)	50.409uA	61.6228mA	40.673s	61.2125mA	9.335s	44.162s	87.0756mA		0	0 8.36641mA	125.338ms	0.795898mA	0.001s
S31-CS(MQTT)	50.409uA	63.3527mA	43.175s	61.2125mA	9.335s	44.162s	87.0756mA		0	0 8.36641mA	125.338ms	0.795898mA	0.001s

Example:

Every 120 minutes to collect once, transmit once, GPS positioning once a day , 15 minutes timed collection once

How many years can the battery be used in different transmission modes?

AI will automatically help the user to calculate the average power consumption and battery life of the device for each packet sent, as shown below:

Key Parameters

- **Battery capacity:** 3000 mAh
- **Self-discharge:** 2% per year → **0.1644 mAh/day**
- **Sleep current:** 50.409 µA = **0.050409 mA**
- **Daily operations:**
 - **Acquisition:** 20 mA for 10 seconds → **12 times/day** (every 2 hours).
 - **Protocol transmission:** UDP/MQTT/TCP → **12 times/day** (every 2 hours).
 - **GPS positioning:** 87.0756 mA for 44.162 seconds → **1 time/day**.
 - **Timed acquisition:** 8.78151 mA for 0.125338 seconds → **96 times/day** (every 15 minutes)

Daily Energy Consumption Formula

Total (mAh/day) = Sleep + Acquisition + Protocol + GPS + Timed + Self-Discharge

Calculations for Each Protocol

1. UDP Protocol

- **Transmission:** 58 mA for 36 seconds → 0.58 mAh per transmission.
- **Daily energy:**
 - **Sleep:** 0.050409 mA × 24 h = 1.2098 mAh
 - **Acquisition:** 20 mA × $\frac{10}{3600}$ h × 12 = 0.6667 mAh
 - **UDP:** 58 mA × $\frac{36}{3600}$ h × 12 = 6.96 mAh
 - **GPS:** 87.0756 mA × $\frac{44.162}{3600}$ h = 1.066 mAh
 - **Timed:** 8.78151 mA × $\frac{0.125338}{3600}$ h × 96 = 0.029 mAh
 - **Self-discharge:** 0.1644 mAh
 - **Total:** 1.2098 + 0.6667 + 6.96 + 1.066 + 0.029 + 0.1644 = **10.096 mAh/day**
- **Battery Lifetime:**

$\frac{3000 \text{ mAh}}{10.096 \text{ mAh/day}} \div 365 \approx \mathbf{0.81 \text{ years}}$ (9.7 months)

2. MQTT Protocol

- **Transmission:** 63 mA for 41 seconds → 0.7175 mAh per transmission.
- **Daily energy:**
 - **Sleep:** 1.2098 mAh
 - **Acquisition:** 0.6667 mAh
 - **MQTT:** 63 mA × $\frac{41}{3600}$ h × 12 = 8.61 mAh
 - **GPS:** 1.066 mAh
 - **Timed:** 0.029 mAh
 - **Self-discharge:** 0.1644 mAh
 - **Total:** 1.2098 + 0.6667 + 8.61 + 1.066 + 0.029 + 0.1644 = **11.746 mAh/day**
- **Battery Lifetime:**

$\frac{3000}{11.746} \div 365 \approx \mathbf{0.70 \text{ years}}$ (8.4 months)

3. TCP Protocol

- **Transmission:** 62 mA for 41 seconds → 0.7056 mAh per transmission.
- **Daily energy:**
 - **Sleep:** 1.2098 mAh
 - **Acquisition:** 0.6667 mAh
 - **TCP:** 62 mA × $\frac{41}{3600}$ h × 12 = 8.47 mAh
 - **GPS:** 1.066 mAh
 - **Timed:** 0.029 mAh
 - **Self-discharge:** 0.1644 mAh
 - **Total:** 1.2098 + 0.6667 + 8.47 + 1.066 + 0.029 + 0.1644 = **11.606 mAh/day**
- **Battery Lifetime:**

$\frac{3000}{11.606} \div 365 \approx \mathbf{0.71 \text{ years}}$ (8.5 months)

Summary

Protocol	Daily Energy (mAh)	Battery Lifetime
UDP	10.096	0.81 years
MQTT	11.746	0.70 years
TCP	11.606	0.71 years

Key Observations

1. **Sleep Current Dominates:** Despite higher protocol/MQTT/TCP usage, sleep mode (1.21 mAh/day) contributes ~12% of total energy.
2. **Impact of Smaller Battery:** Compared to the previous 8500mAh battery, lifetimes are ~3× shorter due to reduced capacity and higher sleep current.
3. **Self-Discharge:** Minimal impact (0.1644 mAh/day) due to small battery size.

For extended lifetime, optimize sleep current or reduce transmission frequency.

5. Firmware update

User can change device firmware to::

- Update with new features.
- Fix bugs.

Firmware and changelog can be downloaded from : [Firmware download link](#)

Methods to Update Firmware:

- (Recommended way) OTA firmware update via BLE: [Instruction](#).
- Update through UART TTL interface : [Instruction](#).

6. FAQ

6.1 How can I access the BG95-NGFF AT Commands?

User can access to BG95-NGFF directly and send AT Commands.

[See BG95-NGFF AT Command set](#)

6.2 General Manual for -CB , -CS models

Users can follow the instructions in this [link](#) to see how to configure to connect to different servers.

7. Order Info

Part Number: [S31-CB-XX](#) / [S31B-CB-XX](#)

XX:

- **GE**: General version (Exclude SIM card)
- **1T**: with 1NCE* 10 years 500MB SIM card and Pre-configure to ThingsEye server

1NCE SIM Card NB-IoT network coverage: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Finland, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Latvia, Malta, Netherlands, Norway, Puerto Rico, Russia, Slovak , Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, USA, US Virgin Islands.

1NCE SIM Card LTE-M network coverage: Argentina, Austria, Australia, Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Ireland, Japan, Jersey, Korea, Republic of, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Puerto Rico, Romania, Spain, Sweden, Switzerland, Taiwan, USA, US Virgin Islands.

8. Packing Info

Package Includes:

- S31-CB or S31B-CB Temperature & Humidity Sensor x 1
- External antenna x 1

Dimension and weight:

- Device Size: 13.0 x 5 x 4.5 cm

- Device Weight: 150g
- Package Size / pcs : 14.0 x 8x 5 cm
- Weight / pcs : 180g



SE



NO

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