
LHT65N-E5 -- LoRaWAN Temperature_Humidity & Illuminance Sensor User Manual

last modified by Xiaoling

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1. Introduction

1.1 What is LHT65N-E5 Temperature,Humidity&Illuminance Sensor

The Dragino **LHT65N-E5 Temperature, Humidity & Illuminance sensor** is a Long Range LoRaWAN Sensor. It includes a **built-in Temperature & Humidity sensor** and has an **external Illuminance sensor**.

The LHT65N-E5 allows users to send data and reach extremely long ranges. It provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption. It targets professional wireless sensor network applications such as irrigation systems, smart metering, smart cities, building automation, and so on.

LHT65N-E5 has a **built-in 2400mAh non-chargeable battery** which can be used for more than 10 years*.

LHT65N-E5 is fully compatible with **LoRaWAN v1.0.3 Class A protocol**, it can work with a standard LoRaWAN gateway.

* The actual battery life depends on how often to send data, please see battery analyzer chapter.

1.2 Features

- LoRaWAN v1.0.3 Class A protocol
- Frequency Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915
- AT Commands to change parameters
- Remote configure parameters via LoRaWAN Downlink
- Firmware upgradeable via program port
- Built-in 2400mAh battery for up to 10 years of use.
- Built-in Temperature & Humidity sensor
- External Illuminance Sensor
- Tri-color LED to indicate working status
- Datalog feature to save sensor data when no LoRaWAN network

1.3 Specification

Built-in Temperature Sensor:

- Resolution: 0.01 °C
- Accuracy Tolerance : Typ ±0.3 °C
- Long Term Drift: < 0.02 °C/yr
- Operating Range: -40 ~ 85 °C

Built-in Humidity Sensor:

- Resolution: 0.04 %RH
- Accuracy Tolerance : Typ ±3 %RH
- Long Term Drift: < 0.25 RH/yr
- Operating Range: 0 ~ 96 %RH

External Illuminace Sensor:

- Base on BH1750 Illumination Sensor
- Cable Length : 50cm
- Resolution: 1 lx
- Range: 0-65535 lx
- Operating Range: -40 °C ~ 85 °C

2. Connect LHT65N-E5 to IoT Server

2.1 How does LHT65N-E5 work?

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LHT65N-E5 is configured as LoRaWAN OTAA Class A sensor by default. Each LHT65N-E5 is shipped with a worldwide unique set of OTAA keys. To use LHT65N-E5 in a LoRaWAN network, first, we need to put the OTAA keys in LoRaWAN Network Server and then activate LHT65N-E5.

If LHT65N-E5 is within the coverage of this LoRaWAN network. LHT65N-E5 can join the LoRaWAN network automatically. After successfully joining, LHT65N-E5 will start to measure environment temperature, humidity & illumination, and start to transmit sensor data to the LoRaWAN server. The default period for each uplink is 20 minutes.

2.2 How to Activate LHT65N-E5?

The LHT65N-E5 has two working modes:

- **Deep Sleep Mode:** LHT65N-E5 doesn't have any LoRaWAN activation. This mode is used for storage and shipping to save battery life.
- **Working Mode:** In this mode, LHT65N-E5 works as LoRaWAN Sensor mode to Join LoRaWAN network and send out the sensor data to the server. Between each sampling/tx/rx periodically, LHT65N-E5 will be in STOP mode (IDLE mode), in STOP mode, LHT65N-E5 has the same power consumption as Deep Sleep mode.

The LHT65N-E5 is set in deep sleep mode by default; The ACT button on the front is to switch to different modes:



Behavior on ACT	Function	Action
Pressing ACT between 1s < time < 3s	Test uplink status	If LHT65N-E5 is already Joined to the LoRaWAN network, LHT65N-E5 will send an uplink packet, if LHT65N-E5 has external sensor connected, Blue led will blink once. If LHT65N-E5 has not external sensor, Red led will blink once.
Pressing ACT for more than 3s	Active Device	Green led will fast blink 5 times, LHT65N-E5 will enter working mode and start to JOIN LoRaWAN network. Green led will solidly turn on for 5 seconds after join in network.

Fast press ACT 5 times.

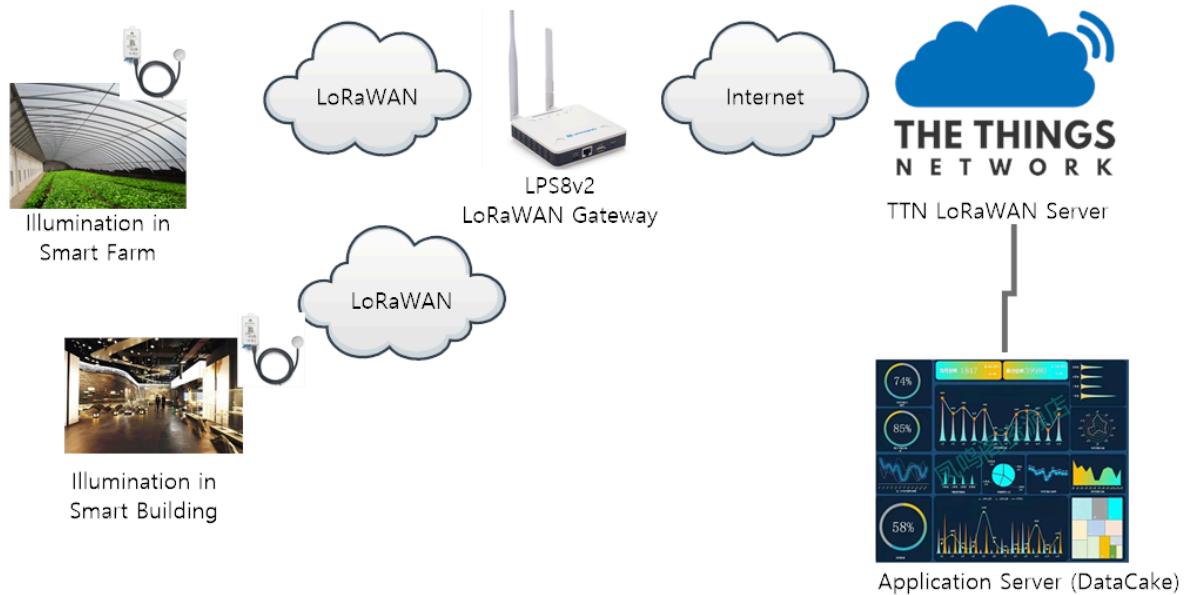
Deactivate Device

Red led will solid on for 5 seconds. Means LHT65N-E5 is in Deep Sleep Mode.

2.3 Example to join LoRaWAN network

This section shows an example of how to join the TTN V3 LoRaWAN IoT server. Use with other LoRaWAN IoT servers is of a similar procedure.

LHT65N-E in a LoRaWAN Network



Assume the LPS8v2 is already set to connect to [TTN V3 network](#), So it provides network coverage for LHT65N-E5. Next we need to add the LHT65N-E5 device in TTN V3:

2.3.1 Step 1: Create Device n TTN

Create a device in TTN V3 with the OTAA keys from LHT65N-E5.

Each LHT65N-E5 is shipped with a sticker with its device EUI, APP Key and APP EUI as below:



User can enter these keys in the LoRaWAN Server portal. Below is TTN V3 screenshot:

Add APP EUI in the application.

The screenshot shows the 'Add application' page of The Things Stack Community Edition. The top navigation bar includes 'Overview', 'Applications' (which is highlighted), 'Gateways', and 'Orgs'. The main form fields are: 'Owner*' (davidhuang), 'Application ID*' (my-new-application), 'Application name' (My new application), and 'Description' (Description for my new application). Below the form is a note: 'Optional application description; can also be used to save notes about the application'. At the bottom is a blue 'Create application' button.

The screenshot shows the CCC LoRaWAN dashboard. At the top, there are icons for LoRaWAN, CCC, and IP: 123. Below that, it says "4 End devices", "2 Collaborators", "2 API keys", and "Created 95 days ago". The main area has sections for "General information" (Application ID: 123, Created at: Feb 2, 2021 11:12:30, Last updated at: Apr 30, 2021 11:00:33) and "Live data" (a list of recent events). A red arrow points from the "Add end device" button to the "Register end device" section below.

Register end device

[From The LoRaWAN Device Repository](#) [Manually](#)

1. Select the end device

Brand*: Dragino Technology Co.,... **Model***: Type to search...

Cannot find your exact end device?

2. Enter registration data

Please choose an end device first to

[Register end device](#)

A red arrow points to the "Model*" dropdown menu, which lists various end device models: LBT1, LDDS20, LDDS75, LDS01, LGT92, LHT65, LSE01, and LSN50-V2. The LHT65 option is highlighted with a red arrow pointing to it.

Note: LHT65N-E5 use same payload decoder as LHT65.

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2. Enter registration data

Frequency plan ⓘ *

The frequency plan used by the end device

AppEUI ⓘ *

The AppEUI uniquely identifies the owner of the end device. If no AppEUI is provided by the device manufacturer (usually for development), it can be filled with zeros.

DevEUI ⓘ *

The DevEUI is the unique identifier for this end device

AppKey ⓘ *

Input APP EUI, APP KEY and DEV EUI:

2. Enter registration data

Frequency plan *

Europe 863-870 MHz (SF12 for RX2)

The frequency plan used by the end device

AppEUI *

----- ee

The AppEUI uniquely identifies the owner of the end device. If no AppEUI is provided by the device manufacturer (usually for dev

DevEUI *

The DevEUI is the unique identifier for this end device

AppKey *

The root key to derive session keys to secure communication between the end device and the application

End device ID *

my-new-device

After registration

2.3.2 Step 2: Activate LHT65N-E5 by pressing the ACT button for more than 5 seconds.

Use ACT button to activate LHT65N-E5 and it will auto-join to the TTN V3 network. After join success, it will start to upload sensor data to TTN V3 and user can see in the panel.

		Last seen 3 seconds ago	↑ 573	↓ 34		Created 8 days ago		
		Overview	Live data	Messaging	Location	Payload formatters	Claiming	General settings
▼	Time	Type	Data preview					
▼	↑ 10:09:42	Forward data message to Application	DevAddr: 26 0B B5 9A	MAC payload: 79 41 62 C5 18 2A B9 99 5A E2 A7	FPort: 2	SNR: -6.2	RSSI: -126	Bandwidth: 125000
●	↑ 10:09:42	Store upstream data message	DevAddr: 26 0B B5 9A					
↑	10:09:42	Forward uplink data message		Temperature Sensor, Hum_SHT: 56.1, TempC_DS: 327.67, TempC_SHT: 38.28	: CB F4 0B D4 02 31 01 7F FF 7F FF	FPort: 2	SNR: -6.2	RSSI: -126
↑	10:09:42	Receive uplink data message	DevAddr: 26 0B B5 9A					
↑	10:09:42	Successfully processed data message	DevAddr: 26 0B B5 9A	FCnt: 573	FPort: 2	MAC payload: 79 41 62 C5 18 2A B9 99 5A E2 A7	Bandwidth: 125000	SNR: -6.2 RSSI: -126 Raw payl
↑	10:09:42	Drop data message						
↑	10:09:42	Receive data message	DevAddr: 26 0B B5 9A	FCnt: 573	FPort: 2	MAC payload: 79 41 62 C5 18 2A B9 99 5A E2 A7	Bandwidth: 125000	SNR: 7.6 RSSI: -46 Raw payl

2.4 Uplink Payload (Fport=2)

The uplink payload includes totally 11 bytes. Uplink packets use FPORT=2 and **every 20 minutes** send one uplink by default.

After each uplink, the **BLUE LED** will blink once.

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Size(bytes)	2	2	2	1	4
Value	BAT	Built-In Temperature	Built-in Humidity	Ext #	Ext value

- The First 6 bytes: has fix meanings for every LHT65N-E5.
- The 7th byte (EXT #): defines the external sensor model. It can be 0x05 or 0x09 for LHT65N-E5
- The 8th ~ 9th byte: Illuminance. Range: 0-65535 lx.
- The 10th ~ 11th byte: Reserve, always 0xFFFF

2.4.1 Decoder in TTN V3

When the uplink payload arrives TTNNv3, it shows HEX format and not friendly to read. We can add LHT65N-E5 decoder in TTNNv3 for friendly reading.

Below is the position to put the decoder and LHT65N-E5 decoder can be download from here: <https://github.com/dragino/dragino-end-node-decoder>

The screenshot shows the TTN V3 web interface with the sidebar open. The main navigation bar includes Overview, Live data, Messaging, Location, Payload formatters (which is highlighted with a red box), Claiming, and General settings. Below this, there are tabs for Uplink and Downlink. The Uplink tab is active. A note says: "These payload formatters are executed on uplink messages from this end device and take precedence over application level payload formatters." Under "Formatter type", the "Javascript" option is selected (indicated by a red box). The "Formatter parameter" section contains the following code:

```

1 function decodeUplink(input) {
2   return {
3     data: [
4       bytes: input.bytes
5     ],
6     warnings: [],
7     errors: []
8   };
9 }

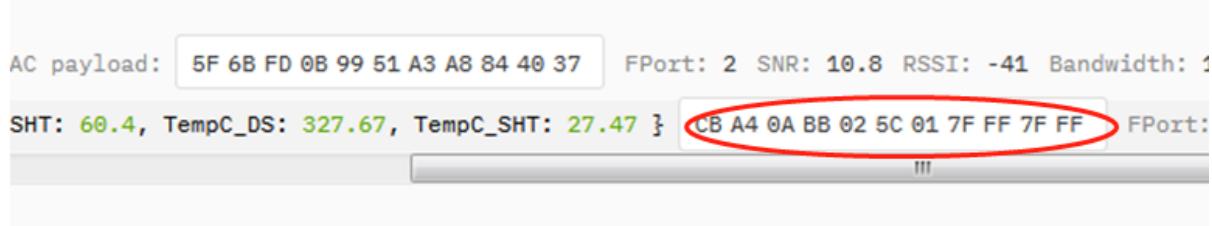
```

At the bottom right is a "Save changes" button.

2.4.2 BAT-Battery Info

These two bytes of BAT include the battery state and the actually voltage

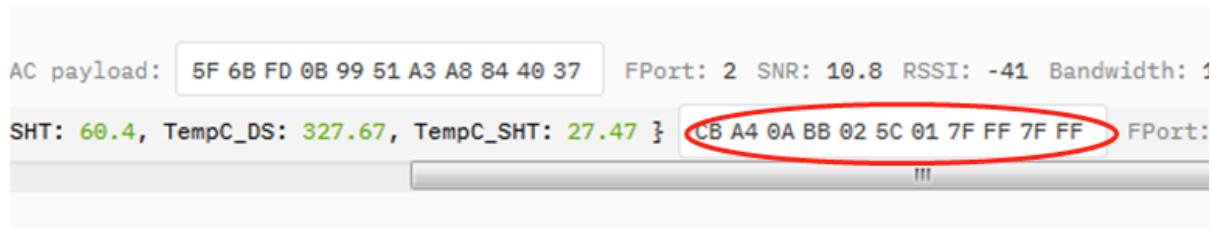
Bit(bit)	[15:14]	[13:0]
Value	BAT Status 00(b): Ultra Low (BAT <= 2.50v) 01(b): Low (2.50v <=BAT <= 2.55v) 10(b): OK (2.55v <= BAT <=2.65v) 11(b): Good (BAT >= 2.65v)	Actually BAT voltage



Check the battery voltage for LHT65N-E5.

- BAT status=(0xcbba4>>14)&0xFF=11(B), very good
- Battery Voltage =0xCBFB6&0x3FFF=0xBA4=2980mV

2.4.3 Built-in Temperature

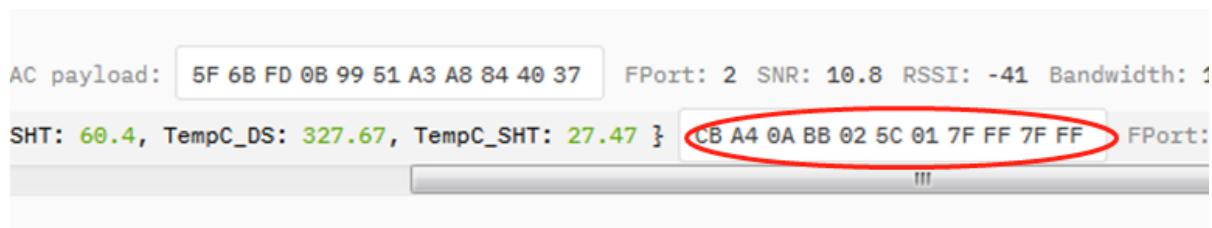


- Temperature: 0x0ABB/100=27.47°C



- Temperature: (0xF5C6-65536)/100=-26.18°C

2.4.4 Built-in Humidity



- Humidity: 0x025C/10=60.4%

2.4.5 Ext value

2.4.5.1 Ext=0x05, Illuminance Sensor

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The screenshot shows the TTN V3 Live data interface. It displays a downlink schedule and an uplink message. The uplink message details: Hum_SHT: 66.9, ILL_Ix: 94, TempC_SHT: 19.61, Work_mode: "Illumination Sensor". The payload bytes are CB C9 07 A9 02 9D 05 00 .. followed by CBC907A9029D05005E7FFF.

- Illumination=0x005E=94 lux

The last 2 bytes of data are meaningless

The screenshot shows the TTN V3 Live data interface. It displays a forward uplink message and a successfully processed data message. The forward uplink message details: Hum_SHT: 62.2, ILL_Ix: "NULL", TempC_SHT: 19.18, Work_mode: "Illumination Sensor". The payload bytes are CB C7 07 7E 02 6E 05 FF .. followed by CBC7077E026E05FFFF7FFF.

- When the sensor is not connected or not connected properly, will show "NULL"

The last 2 bytes of data are meaningless

2.4.5.2 Ext=0x85, E5 sensor with Unix Timestamp

Timestamp mode is designed for LHT65N-E5 with E3 probe, it will send the uplink payload with Unix timestamp. With the limitation of 11 bytes (max distance of AU915/US915/AS923 band), the time stamp mode will be lack of BAT voltage field, instead, it shows the battery status. The payload is as below:

Size(bytes)	2	2	2	1	4
Value	External temperature	Built-In Temperature	BAT Status & Illumination	Status & Ext	Unix Time Stamp

- Battery status & Built-in Humidity**

Bit(bit)	[15:14]	[13:0]
Value	BAT Status 00(b): Ultra Low (BAT <= 2.50v) 01(b): Low (2.50v <=BAT <= 2.55v) 10(b): OK (2.55v <= BAT <=2.65v) 11(b): Good (BAT >= 2.65v)	Illumination

- Status & Ext Byte**

Bits	7	6	5	4	[3:0]
Status&Ext	None-ACK Flag	Poll Message FLAG	Sync time OK	Unix Time Request	Ext: 0b(1001)

- Poll Message Flag:** 1: This message is a poll message reply, 0: means this is a normal uplink.
- Sync time OK:** 1: Set timeok, 0: N/A. After time SYNC request is sent, LHT65N-E5 will set this bit to 0 until got the time stamp from the application server.
- Unix Time Request:** 1: Request server downlink Unix time, 0 : N/A. In this mode, LHT65N-E5 will set this bit to 1 every 10 days to request a time SYNC. (AT+SYNCMOD to set this)

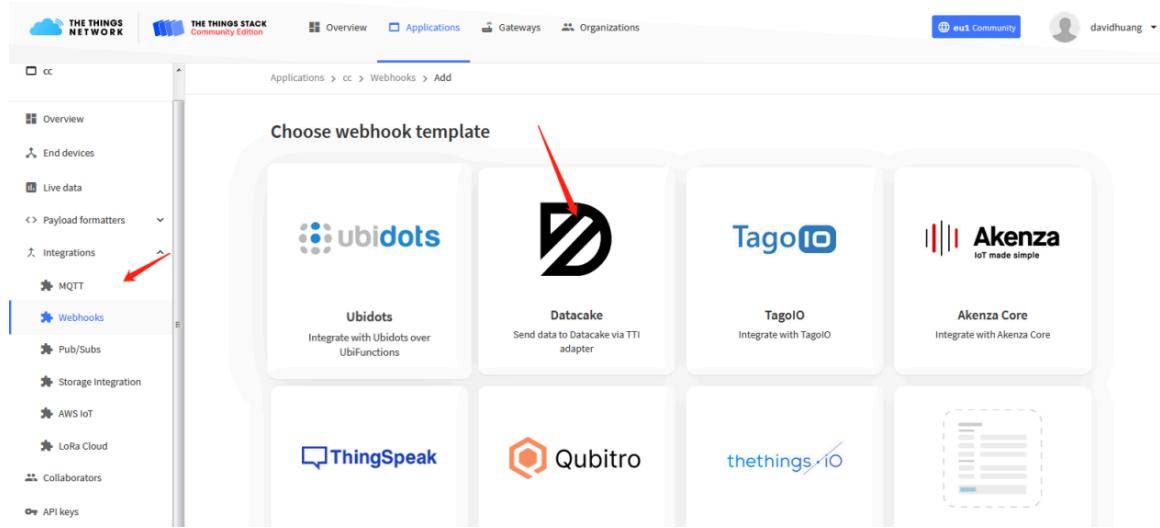
2.5 Show data on Datacake

Datacake IoT platform provides a human-friendly interface to show the sensor data, once we have sensor data in TTN V3, we can use Datacake to connect to TTN V3 and see the data in Datacake. Below are the steps:

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

Step 2: Configure your Application to forward data to Datacake you will need to add integration. Go to TTN V3 Console --> Applications --> Integrations --> Add Integrations.

Add Datacake:



Select default key as Access Key:

Add custom webhook

Template information



Datacake

Send data to Datacake via TTI adapter

[About Datacake](#) | [Documentation](#)

Template settings

Webhook ID*

my-new-datacake-webhook

Token*

Datacake API Token

Create datacake webhook

In Datacake console (<https://datacake.co/>) , add LHT65 device.

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Device Template

Datacake supports LoRaWAN devices from different manufacturers out of the box without complex configuration and setup.

The screenshot shows a search interface for Datacake's Device Template. The search bar at the top has 'Search' and a magnifying glass icon on the left, and 'Dragino' on the right. Below the search bar is a list of device templates:

- Dragino LGT92** Dragino
- Dragino LHT52** Dragino
Temperature and Humidity
- Dragino LHT65** Dragino
Temperature & Humidity sensor
- Dragino LHT65N** Dragino
New Version of LHT65(N) temperature & humidity
- Dragino LLDS12** Dragino
Template for the awesome Dragino LiDAR Distance Sensor LLDS12.

At the bottom of the list, it says "Showing 6 to 10 of 19 results" with "Previous" and "Next" buttons.

The screenshot shows the Datacake dashboard for the 'lht65n' device. At the top, it displays the serial number (1231234234234320) and last update (Wed Dec 14 2022 17:11:59 GMT+0800). Below the header are navigation tabs: Dashboard (selected), History, Downlinks, Configuration, Debug, Rules, and Permissions. On the far right is a toggle switch.

The main area features three circular gauges: Temperature (21.43 °C), Humidity (56.8 %RH), and Temperature Probe (0.00 °C). To the right of these gauges is a section titled "Sensor" containing the following data:

External sensor	0.00
No data	
Battery Voltage	3.02 V
Battery Status	3

2.6 Datalog Feature

Datalog Feature is to ensure IoT Server can get all sampling data from Sensor even if the LoRaWAN network is down. For each sampling, LHT65N-E5 will store the reading for future retrieving purposes. There are two ways for IoT servers to get datalog from LHT65N-E5.

2.6.1 Ways to get datalog via LoRaWAN

There are two methods:

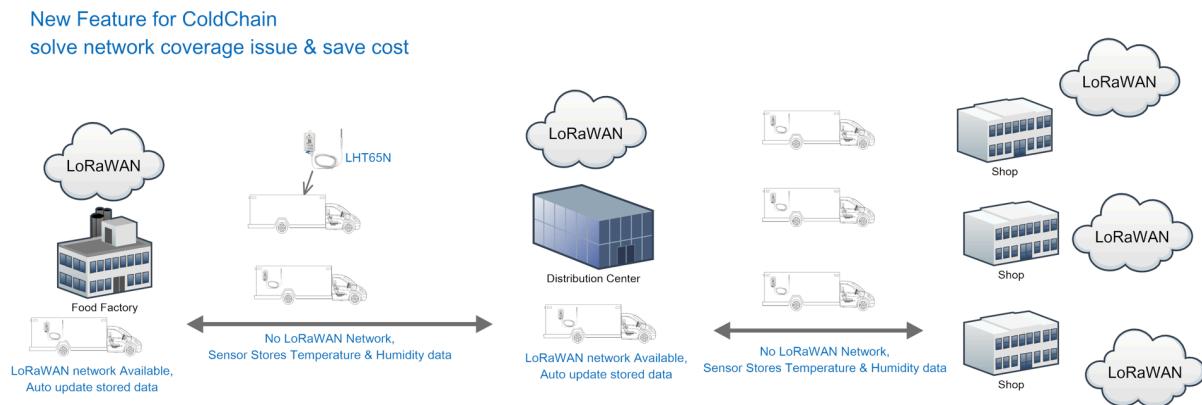
Method 1: IoT Server sends a downlink LoRaWAN command to [poll the value](#) for specified time range.

Method 2: Set PNACKMD=1, LHT65N-E5 will wait for ACK for every uplink, when there is no LoRaWAN network, LHT65N-E5 will mark these records with non-ack messages and store the sensor data, and it will send all messages (10s interval) after the network recovery.

Note for method 2:

- a) LHT65N-E5 will do an ACK check for data records sending to make sure every data arrive server.
- b) LHT65N-E5 will send data in **CONFIRMED Mode** when PNACKMD=1, but LHT65N-E5 won't re-transmit the packet if it doesn't get ACK, it will just mark it as a NONE-ACK message. In a future uplink if LHT65N-E5 gets a ACK, LHT65N-E5 will consider there is a network connection and resend all NONE-ACK Message.

Below is the typical case for the auto-update datalog feature (Set PNACKMD=1)



2.6.2 UnixTimeStamp

LHT65N-E5 uses UnixTimeStamp format based on

Size (bytes)	4	1
DeviceTimeAns Payload	32-bit unsigned integer : Seconds since epoch*	8bits unsigned integer: fractional-second in $\frac{1}{2^8}$ second steps

Figure 10 : DeviceTimeAns payload format

User can get this time from link: <https://www.epochconverter.com/> :

Below is the converter example

The current Unix epoch time is 1611889405

Convert epoch to human-readable date and vice versa

1611889090 Timestamp to Human date [batch convert]

Supports Unix timestamps in seconds, milliseconds, microseconds and nanoseconds.

Assuming that this timestamp is in **seconds**:

GMT: 2021年1月29日星期五 02:58:10

Your time zone: 2021年1月29日星期五 10:58:10 GMT+08:00

Relative: 3 minutes ago

Mon Day Yr Hr Min Sec Human date to Time

Code Beautify

All Numbers Converter
Numbers to Words Converter
Decimal to Binary Converter
Decimal to Hex Converter
Decimal to Octal Converter
Binary to Decimal Converter
Binary to Hex Converter
Binary to Octal Converter
Binary to Text Converter
Text to Binary Converter
Hex to Decimal Converter
Hex to Binary Converter
Hex to Octal Converter
Octal to Decimal Converter

Decimal to Hex

Enter the Decimal number to decode Sample ⓘ

1611889405

Auto Convert File... ↴ ↵

The number in hex (base 16) representation:

60137afd

So, we can use AT+TIMESTAMP=1611889405 or downlink 3060137af00 to set the current time 2021 – Jan -- 29 Friday 03:03:25

2.6.3 Set Device Time

There are two ways to set device's time:

1. Through LoRaWAN MAC Command (Default settings)

User need to set SYNCMD=1 to enable sync time via MAC command.

Once LHT65N-E5 Joined LoRaWAN network, it will send the MAC command (DeviceTimeReq) and the server will reply with (DeviceTimeAns) to send the current time to LHT65N-E5. If LHT65N-E5 fails to get the time from the server, LHT65N-E5 will use the internal time and wait for next time request (AT+SYNCTDC to set the time request period, default is 10 days).

Note: LoRaWAN Server need to support LoRaWAN v1.0.3(MAC v1.0.3) or higher to support this MAC command feature, Chirpstack, TTN V3 v3 and loriot support but TTN V3 v2 doesn't support. If server doesn't support this command, it will through away uplink packet with this command, so user will lose the packet with time request for TTN V3 v2 if SYNCMD=1.

2. Manually Set Time

User needs to set SYNCMD=0 to manual time, otherwise, the user set time will be overwritten by the time set by the server.

2.6.4 Poll sensor value

User can poll sensor value based on timestamps from the server. Below is the downlink command.

1byte	4bytes	4bytes	1byte
31	Timestamp start	Timestamp end	Uplink Interval

Timestamp start and Timestamp end use UnixTimeStamp format as mentioned above. Devices will reply with all data log during this time period, use the uplink interval.

For example, downlink command **31 5FC5F350 5FC6 0160 05**

Is to check 2020/12/1 07:40:00 to 2020/12/1 08:40:00's data

Uplink Internal =5s, means LHT65N-E5 will send one packet every 5s. range 5~255s.

2.6.5 Datalog Uplink payload

The Datalog poll reply uplink will use below payload format.

Retrieval data payload:

Size(bytes)	2	2	2	1	4
Value	External sensor data	Built In Temperature	Built-in Humidity	Poll message flag & Ext	Unix Time Stamp

Poll message flag & Ext:

Bits	7	6	5	4	[3:0]
Status&Ext	None-ACK Flag	Poll Message FLAG	Sync time OK	Unix Time Request	Ext: 0b(1001)

No ACK Message: 1: This message means this payload is fromn Uplink Message which doesn't get ACK from the server before (for [PNACKMD=1](#) feature)

Poll Message Flag: 1: This message is a poll message reply.

- Poll Message Flag is set to 1.
- Each data entry is 11 bytes, to save airtime and battery, devices will send max bytes according to the current DR and Frequency bands.

For example, in US915 band, the max payload for different DR is:

- a) **DR0:** max is 11 bytes so one entry of data
- b) **DR1:** max is 53 bytes so devices will upload 4 entries of data (total 44 bytes)
- c) **DR2:** total payload includes 11 entries of data
- d) **DR3:** total payload includes 22 entries of data.

If devise doesn't have any data in the polling time. Device will uplink 11 bytes of 0

Example:

If LHT65N-E5 has below data inside Flash:

Flash Add	Unix Time	Ext	BAT voltage	Value
80196E0	21/1/19 04:27:03	1	3145	sht temp=22.00 sht hum=32.6 ds temp=327.67
80196F0	21/1/19 04:28:57	1	3145	sht temp=21.90 sht hum=33.1 ds temp=327.67

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8019600	21/1/19 04:30:30	1	3145	sht temp=21.81 sht hum=33.4 ds temp=327.67
8019610	21/1/19 04:40:30	1	3145	sht temp=21.65 sht hum=33.7 ds temp=327.67
8019620	21/1/19 04:50:30	1	3147	sht temp=21.55 sht hum=34.1 ds temp=327.67
8019630	21/1/19 04:00:30	1	3149	sht temp=21.50 sht hum=34.1 ds temp=327.67
8019640	21/1/19 04:10:30	1	3149	sht temp=21.43 sht hum=34.6 ds temp=327.67
8019650	21/1/19 04:20:30	1	3151	sht temp=21.35 sht hum=34.9 ds temp=327.67

If user sends below downlink command: **3160065F9760066DA705**

Where : Start time: 60065F97 = time 21/1/19 04:27:03

Stop time: 60066DA7= time 21/1/19 05:27:03

LHT65N-E5 will uplink this payload.

The screenshot shows a LoRaWAN uplink message with the following details:

- Uplink**: Indicated by a red arrow pointing to the "Payload" section.
- Payload**: Hexadecimal data: 7F FF 08 98 01 46 41 60 06 5F 97 7F FF 08 8E 01 4B 41 60 06 60 09 7F FF 08 85 01 4E 41 60 06 60 66 7F FF 08 75 01 51 41 60 06
- Fields**: No fields listed.
- Metadata** (highlighted in green):


```
{
        "time": "2021-01-20T01:57:27.690185935Z",
        "frequency": 904.5, // Frequency highlighted
        "modulation": "LORA",
        "data_rate": "SF7BW125", // Data rate highlighted
        "coding_rate": "4/5",
        "gateways": [
          {
            "gtw_id": "eui-a840411cf60415c",
            "timestamp": 3270993355,
            "time": "2021-01-20T01:57:27.544057Z",
            "channel": 3,
            "rss": -55,
            "snr": 10
          }
        ]
      }
```

7FFF089801464160065F97 7FFF 088E 014B 41 60066009

7FFF0885014E41600660667FFF0875015141600662BE7FFF086B015541600665167FFF08660155416006676E7FFF085F015A41

Where the first 11 bytes is for the first entry:

7FFF089801464160065F97

Ext sensor data=0x7FF/100=327.67

Temp=0x088E/100=22.00

Hum=0x014B/10=32.6

poll message flag & Ext=0x41,means reply data,Ext=1

Unix time is 0x60066009=1611030423s=21/1/19 04:27:03

2.7 Alarm Mode

when the device is in alarm mode, it checks the built-in sensor temperature for a short time. if the temperature exceeds the preconfigured range, it sends an uplink immediately.

Note: alarm mode adds a little power consumption, and we recommend extending the normal read time when this feature is enabled.

2.7.1 ALARM MODE

AT+WMOD=1: Enable/disable alarm mode. (0: Disabled, 1: Enabled Temperature Alarm for onboard temperature sensor)

AT+CITEMP=1: The interval between checking the alarm temperature. (In minutes)

AT+ARTEMP: Gets or sets the alarm range of the internal temperature sensor

AT+ARTEMP=? : Gets the alarm range of the internal temperature sensor

AT+ARTEMP=45,105: Set the internal temperature sensor alarm range from 45 to 105.

Downlink Command: AAXXXXXXXXXXXXXX

Total bytes: 8 bytes

Example:AA0100010001003C

WMOD=01

CITEMP=0001

TEMPlow=0001

TEMPhigh=003C

2.8 LED Indicator

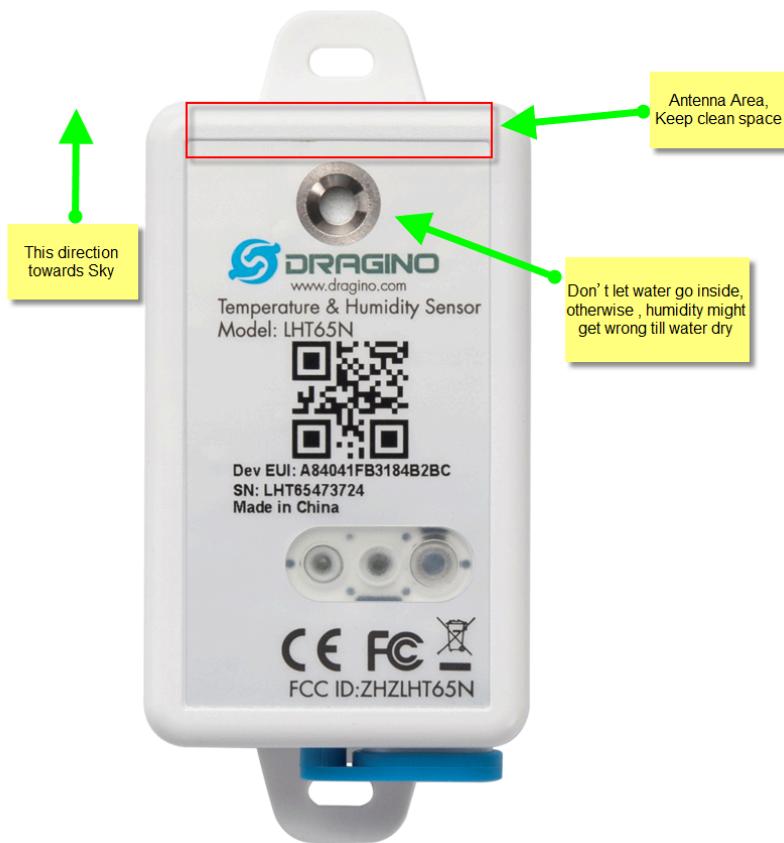
The LHT65 has a triple color LED which for easy showing different stage .

While user press ACT button, the LED will work as per LED status with ACT button.

In a normal working state:

- For each uplink, the BLUE LED or RED LED will blink once.
BLUE LED when external sensor is connected.
- RED LED when external sensor is not connected
- For each success downlink, the PURPLE LED will blink once

2.9 installation



3. Sensors and Accessories

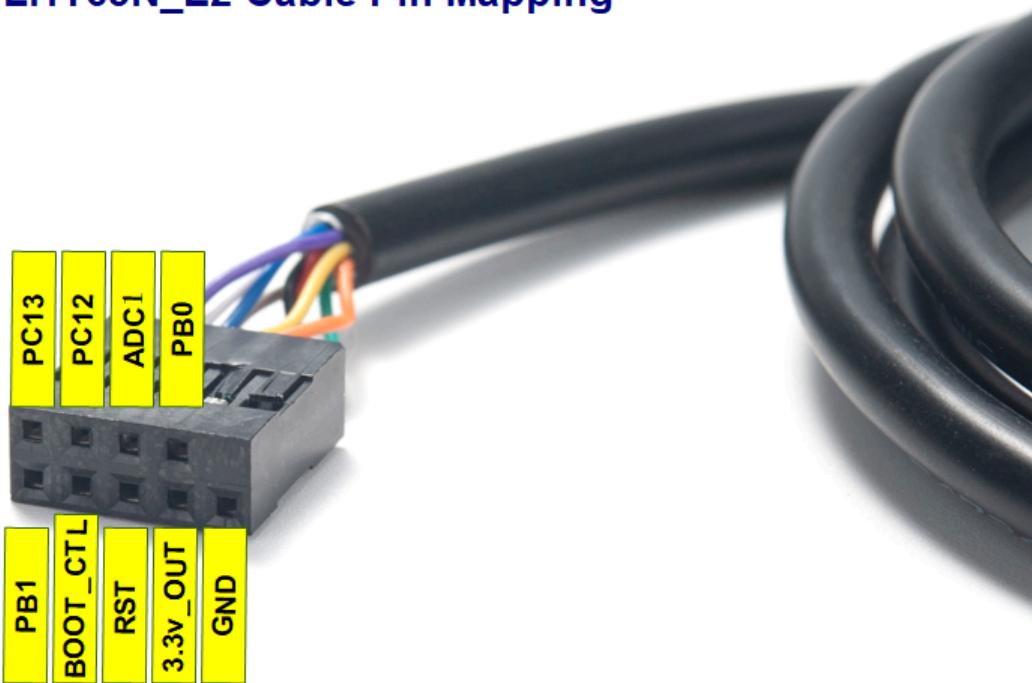
3.1 E2 Extension Cable



1m long breakout cable for LHT65N-E5. Features:

- Use for AT Command
- Update firmware for LHT65N-E5
- Exposed All pins from the LHT65N-E5 Type-C connector.

LHT65N_E2 Cable Pin Mapping



4. Configure LHT65N-E5 via AT command or LoRaWAN downlink

User can configure LHT65N-E5 via AT Command or LoRaWAN Downlink.

- AT Command Connection: See [FAQ](#).
- LoRaWAN Downlink instruction for different platforms: [IoT LoRaWAN Server](#)

There are two kinds of commands to configure LHT65N-E5, they are:

- **General Commands.**

These commands are to configure:

1. General system settings like: uplink interval.
2. LoRaWAN protocol & radio-related commands.

They are the same for all Dragino Devices which supports DLWS-005 LoRaWAN Stack(Note**). These commands can be found on the wiki: [End Device Downlink Command](#)

- **Commands special design for LHT65N-E5**

These commands are only valid for LHT65N-E5, as below:

4.1 Set Transmit Interval Time

Feature: Change LoRaWAN End Node Transmit Interval.

AT Command: AT+TDC

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

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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

4.2 Currently only supports E5

Feature: Set device password, max 9 digits

AT Command: AT+EXT

Command Example	Function	Response
AT+EXT=?	Get or Set external sensor model	5 OK
AT+EXT=5	Set external sensor mode to 5	

Downlink Command:0xA2

Total bytes: 2 bytes

Example:

- 0xA205: Set external sensor type to E5

4.3 Set to sleep mode

Feature: Set device to sleep mode

- **AT+Sleep=0** : Normal working mode, device will sleep and use lower power when there is no LoRa message
- **AT+Sleep=1** : Device is in deep sleep mode, no LoRa activation happen, used for storage or shipping.

AT Command: AT+SLEEP

Command Example	Function	Response
AT+SLEEP	Set to sleep mode	Clear all stored sensor data... OK

Downlink Command:

- There is no downlink command to set to Sleep mode.

4.4 Set system time

Feature: Set system time, unix format. [See here for format detail.](#)

AT Command:

Command Example	Function
AT+TIMESTAMP=1611104352	OK

Set System time to 2021-01-20 00:59:12

Downlink Command:

0x306007806000 // Set timestamp to 0x(6007806000),Same as AT+TIMESTAMP=1611104352

4.5 Set Time Sync Mode

Feature: Enable/Disable Sync system time via LoRaWAN MAC Command (DeviceTimeReq), LoRaWAN server must support v1.0.3 protocol to reply this command.

SYNCMOD is set to 1 by default. If user want to set a different time from LoRaWAN server, user need to set this to 0.

AT Command:

Command Example	Function
AT+SYNCMOD=1	Enable Sync system time via LoRaWAN MAC Command (DeviceTimeReq)

Downlink Command:

0x28 01 // Same As AT+SYNCMOD=1
0x28 00 // Same As AT+SYNCMOD=0

4.6 Set Time Sync Interval

Feature: Define System time sync interval. SYNCTDC default value: 10 days.

AT Command:

Command Example	Function
AT+SYNCTDC=0xA	Set SYNCTDC to 10 (0xA), so the sync time is 10 days.

Downlink Command:

0x29 0A // Same as AT+SYNCTDC=0xA

4.7 Get data

Feature: Get the current sensor data.

AT Command:

- AT+GETSENSORVALUE=0 // The serial port gets the reading of the current sensor
- AT+GETSENSORVALUE=1 // The serial port gets the current sensor reading and uploads it.

4.8 Print data entries base on page

Feature: Print the sector data from start page to stop page (max is 416 pages).

AT Command: AT+PDTA

Command Example	Function
AT+PDTA=13 Print page 1 to 3	8019500 19/6/26 16:48 1 2992 sht temp=28.21 sht hum=71.5 ds temp=27.31 8019510 19/6/26 16:53 1 2994 sht temp=27.64 sht hum=69.3 ds temp=26.93 8019520 19/6/26 16:58 1 2996 sht temp=28.39 sht hum=72.0 ds temp=27.06 8019530 19/6/26 17:03 1 2996 sht temp=27.97 sht hum=70.4 ds temp=27.12 8019540 19/6/26 17:08 1 2996 sht temp=27.80 sht hum=72.9 ds temp=27.06 8019550 19/6/26 17:13 1 2998 sht temp=27.30 sht hum=72.4 ds temp=26.68

```
8019560 19/6/26 17:22 1 2992 sht temp=26.27 sht hum=62.3 ds temp=26.56  
8019570  
8019580  
8019590  
80195A0  
80195B0  
80195C0  
80195D0  
80195E0  
80195F0  
  
OK
```

Downlink Command:

No downlink commands for feature

4.9 Print last few data entries

Feature: Print the last few data entries

AT Command: AT+PLDTA

Command Example	Function
AT+PLDTA=5 Print last 5 entries	Stop Tx and RTP events when read sensor data 1 19/6/26 13:59 1 3005 sht temp=27.09 sht hum=79.5 ds temp=26.75 2 19/6/26 14:04 1 3007 sht temp=26.65 sht hum=74.8 ds temp=26.43 3 19/6/26 14:09 1 3007 sht temp=26.91 sht hum=77.9 ds temp=26.56 4 19/6/26 14:15 1 3007 sht temp=26.93 sht hum=76.7 ds temp=26.75 5 19/6/26 14:20 1 3007 sht temp=26.78 sht hum=76.6 ds temp=26.43 Start Tx and RTP events OK

Downlink Command:

No downlink commands for feature

4.10 Clear Flash Record

Feature: Clear flash storage for data log feature.

AT Command: AT+CLRDTA

Command Example	Function	Response
AT+CLRDTA	Clear date record	Clear all stored sensor data... OK

Downlink Command: 0xA3

- Example: 0xA301 // Same as AT+CLRDTA

4.11 Auto Send None-ACK messages

Feature: LHT65N-E5 will wait for ACK for each uplink, If LHT65N-E5 doesn't get ACK from the IoT server, it will consider the message doesn't arrive server and store it. LHT65N-E5 keeps sending messages in normal periodically. Once LHT65N-E5 gets ACK from a server, it will consider the network is ok and start to send the not-arrive message.

AT Command: AT+PNACKMD

The default factory setting is 0

Command Example	Function	Response
AT+PNACKMD=1	Poll None-ACK message	OK

Downlink Command: 0x34

- Example: 0x3401 // Same as AT+PNACKMD=1

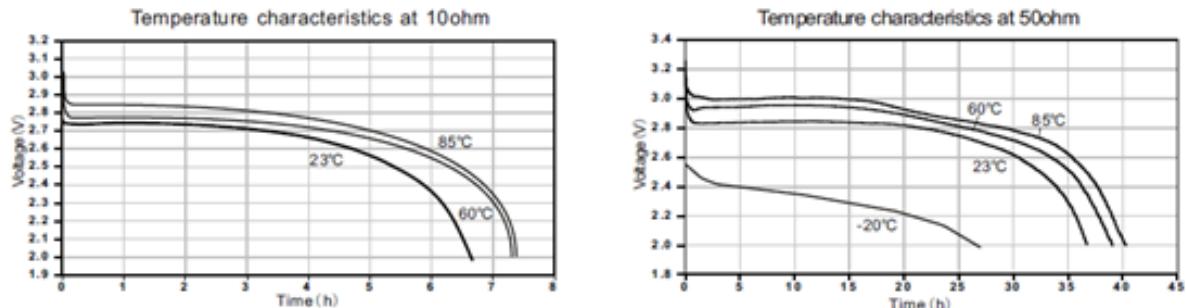
5. Battery & How to replace

5.1 Battery Type

LHT65N-E5 is equipped with a 2400mAH Li-MnO₂ (CR17505) battery . The battery is an un-rechargeable battery with low discharge rate targeting for up to 8~10 years use. This type of battery is commonly used in IoT devices for long-term running, such as water meters.

The discharge curve is not linear so can't simply use percentage to show the battery level. Below is the battery performance.

Performance



The minimum Working Voltage for the LHT65N-E5 is ~ 2.5v. When battery is lower than 2.6v, it is time to change the battery.

5.2 Replace Battery

LHT65N-E5 has two screws on the back, Unscrew them, and changing the battery inside is ok. The battery is a general CR17450 battery (3.0v). Any brand should be ok.



5.3 Battery Life Analyze

Dragino battery-powered products are all run in Low Power mode. User can check the guideline from this link to calculate the estimated battery life:

[https://www.dragino.com/downloads/downloads/LoRa_End_Node/Battery_Analyze/
DRAGINO_Battery_Life_Guide.pdf](https://www.dragino.com/downloads/downloads/LoRa_End_Node/Battery_Analyze/DRAGINO_Battery_Life_Guide.pdf)

A full detail test report for LHT65N-E5 on different frequency can be found at : [https://www.dropbox.com/sh/
r2i3lzsypavla/AAB1sZw3mdT0K7XjpHCITt13a?dl=0](https://www.dropbox.com/sh/r2i3lzsypavla/AAB1sZw3mdT0K7XjpHCITt13a?dl=0)

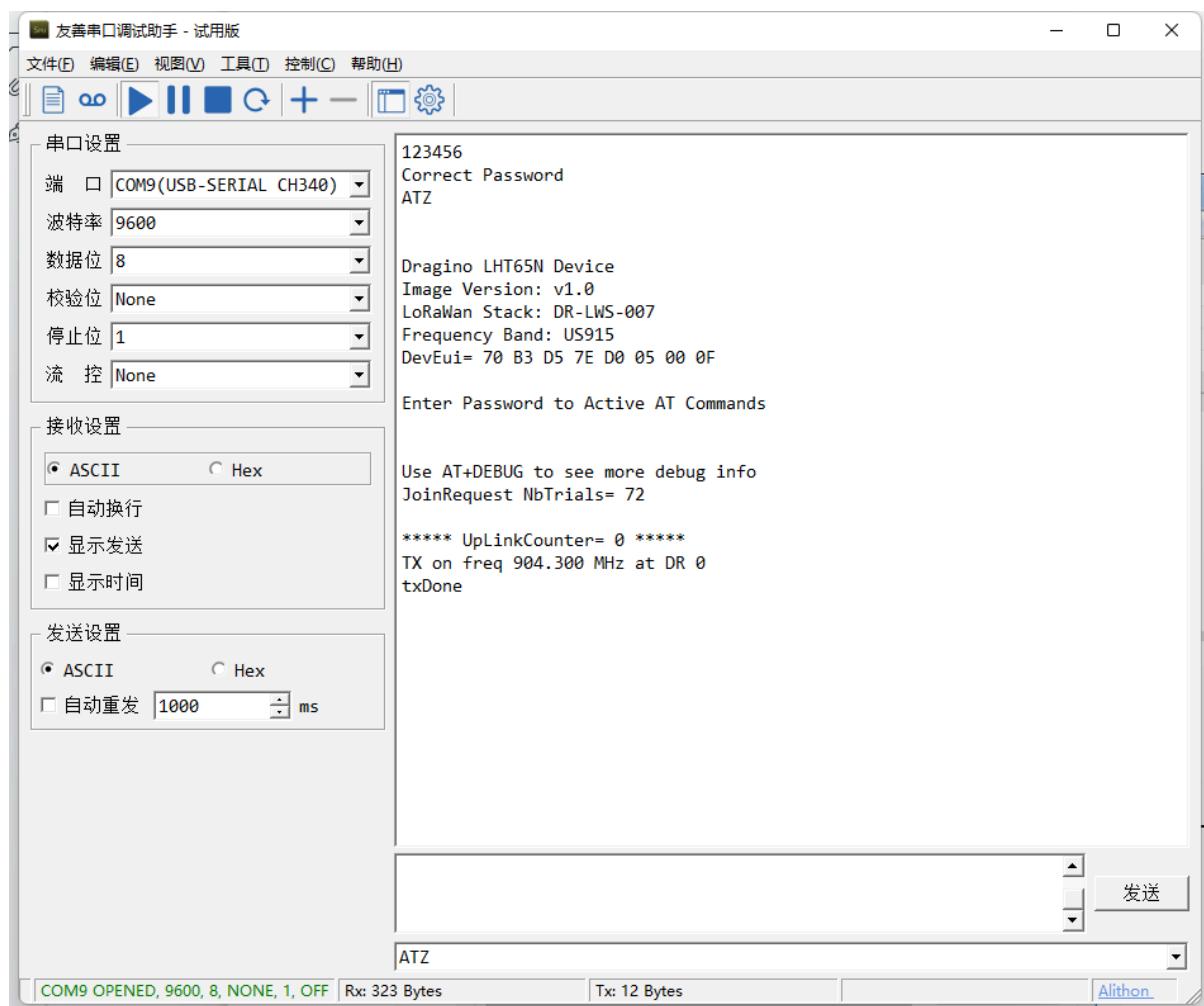
6. FAQ

6.1 How to use AT Command?

Refer this link for [UART Hardware Connection](#).

In PC, User needs to set serial tool(such as [putty](#), SecureCRT) baud rate to **9600** to access to access serial console for LHT65N-E5. The AT commands are disable by default and need to enter password (default:**123456**) to active it. Timeout to input AT Command is 5 min, after 5-minute, user need to input password again. User can use AT+DISAT command to disable AT command before timeout.

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AT Command List is as below:

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

AT+<CMD> : Run <CMD>

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

AT+<CMD>=? : Get the value

AT+DEBUG: Set more info output

ATZ: Trig a reset of the MCU

**User Manual for LoRaWAN /NB -IoT End Nodes - LHT65N-E5 --
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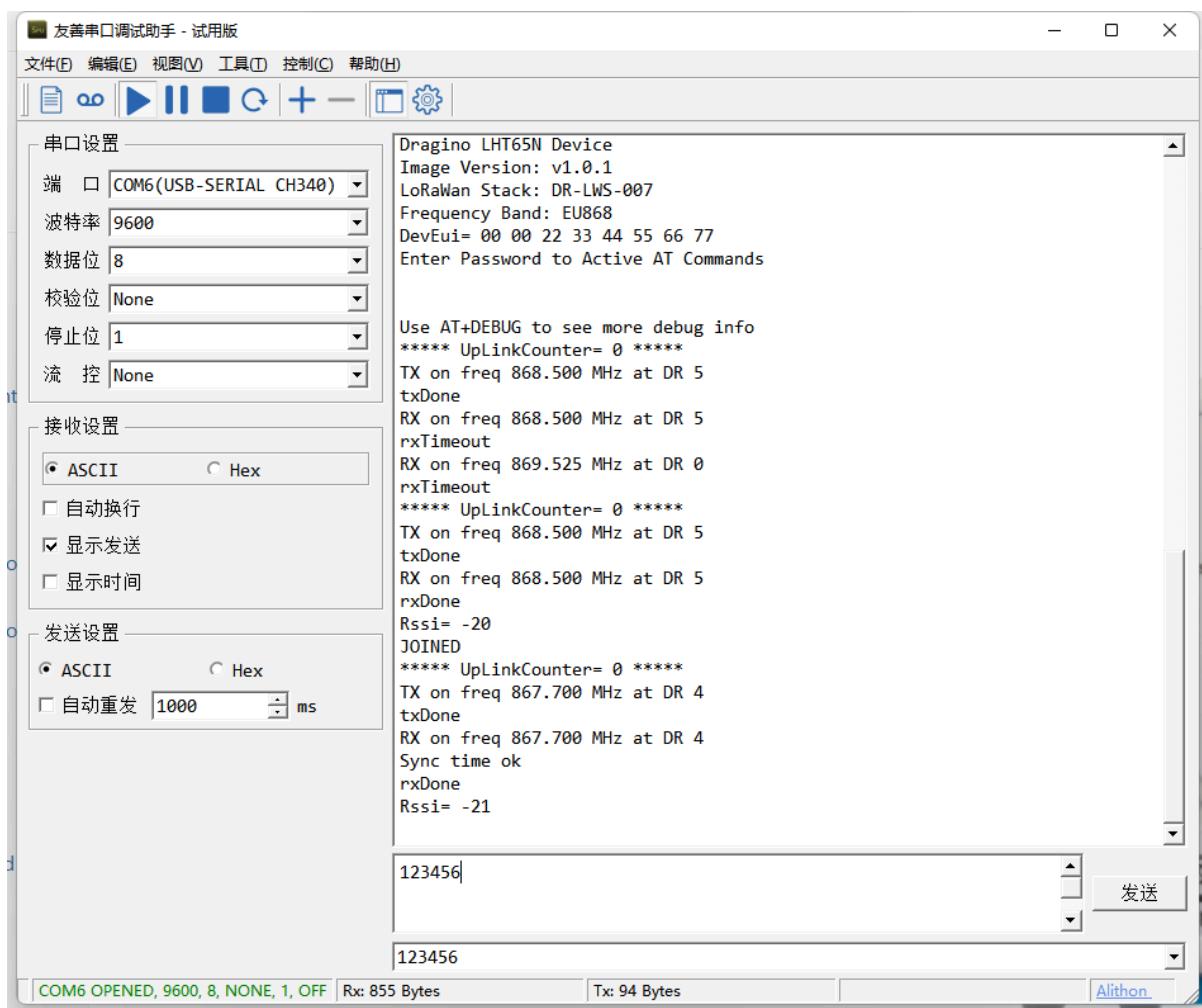
AT+FDR:	Reset Parameters to Factory Default, Keys Reserve
AT+DEUI:	Get or Set the Device EUI
AT+DADDR:	Get or Set the Device Address
AT+APPKEY:	Get or Set the Application Key
AT+NWKSKEY:	Get or Set the Network Session Key
AT+APPSKEY:	Get or Set the Application Session Key
AT+APPEUI:	Get or Set the Application EUI
AT+ADR:	Get or Set the Adaptive Data Rate setting. (0: off, 1: on)
AT+TXP:	Get or Set the Transmit Power (0-5, MAX:0, MIN:5, according to LoRaWAN Spec)
AT+DR:	Get or Set the Data Rate. (0-7 corresponding to DR_X)
AT+DCS:	Get or Set the ETSI Duty Cycle setting - 0=disable, 1=enable - Only for testing
AT+PNM:	Get or Set the public network mode. (0: off, 1: on)
AT+RX2FQ:	Get or Set the Rx2 window frequency
AT+RX2DR:	Get or Set the Rx2 window data rate (0-7 corresponding to DR_X)
AT+RX1DL:	Get or Set the delay between the end of the Tx and the Rx Window 1 in ms
AT+RX2DL:	Get or Set the delay between the end of the Tx and the Rx Window 2 in ms
AT+JN1DL:	Get or Set the Join Accept Delay between the end of the Tx and the Join Rx Window 1 in ms
AT+JN2DL:	Get or Set the Join Accept Delay between the end of the Tx and the Join Rx Window 2 in ms
AT+NJM:	Get or Set the Network Join Mode. (0: ABP, 1: OTAA)
AT+NWKID:	Get or Set the Network ID
AT+FCU:	Get or Set the Frame Counter Uplink
AT+FCD:	Get or Set the Frame Counter Downlink
AT+CLASS:	Get or Set the Device Class
AT+JOIN:	Join network
AT+NJS:	Get the join status
AT+SENDB:	Send hexadecimal data along with the application port
AT+SEND:	Send text data along with the application port
AT+RECVB:	Print last received data in binary format (with hexadecimal values)
AT+RECV:	Print last received data in raw format
AT+VER:	Get current image version and Frequency Band
AT+CFM:	Get or Set the confirmation mode (0-1)
AT+CFS:	Get confirmation status of the last AT+SEND (0-1)
AT+SNR:	Get the SNR of the last received packet
AT+RSSI:	Get the RSSI of the last received packet
AT+TDC:	Get or set the application data transmission interval in ms
AT+PORT:	Get or set the application port

AT+DISAT: Disable AT commands
AT+PWD: Set password, max 9 digits
AT+CHS: Get or Set Frequency (Unit: Hz) for Single Channel Mode
AT+CHE: Get or Set eight channels mode, Only for US915,AU915,CN470
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+SLEEP: Set sleep mode
AT+EXT: Get or Set external sensor model
AT+BAT: Get the current battery voltage in mV
AT+CFG: Print all configurations
AT+WMD: Get or Set Work Mode
AT+ARTEMP: Get or set the internal Temperature sensor alarm range
AT+CITEMP: Get or set the internal Temperature sensor collection interval in min
AT+SETCNT: Set the count at present
AT+RJTDC: Get or set the ReJoin data transmission interval in min
AT+RPL: Get or set response level
AT+TIMESTAMP: Get or Set UNIX timestamp in second
AT+LEAPSEC: Get or Set Leap Second
AT+SYNCFMOD: Get or Set time synchronization method
AT+SYNCTDC: Get or set time synchronization interval in day
AT+PID: Get or set the PID

6.2 Where to use AT commands and Downlink commands

AT commands:

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Downlink commands:

TTN:

User Manual for LoRaWAN /NB -IoT End Nodes - LHT65N-E5 -- LoRaWAN Temperature_Humidity & Illuminance Sensor User Manual

Applications > lht111 > End devices > eui-a84041ffff1234dd



eui-a84041ffff1234dd

ID: eui-a84041ffff1234dd

↑ 156 ↓ 156 • Last activity 13 days ago

Overview Live data **Messaging** Location Payload formatters General settings

Uplink

Downlink

Schedule downlink

Insert Mode

- Replace downlink queue
- Push to downlink queue (append)

FPort*

1

Payload type

- Bytes
- JSON

Payload

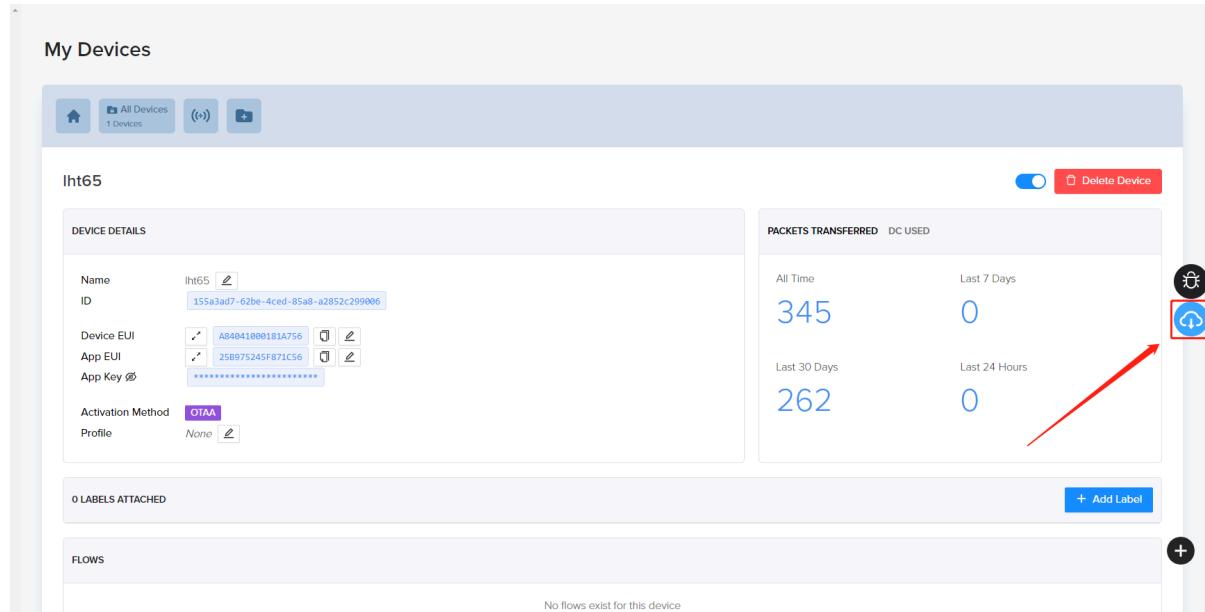
The desired payload bytes of the downlink message

Confirmed downlink

Schedule downlink

[Helium](#):

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Chirpstack: The downlink window will not be displayed until the network is accessed

The screenshot shows the Chirpstack application configuration screen for device 'wsc1'. The 'DETAILS' tab is active, displaying the following information:

Field	Value
Name	wsc1

A red arrow points to the 'Name' field with the text 'Mouse drop down'.

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Enqueue downlink payload

Port *

Please note that the fPort value must be > 0.

Confirmed downlink

BASE64 ENCODED JSON OBJECT

Base64 encoded string *

[ENQUEUE PAYLOAD](#)

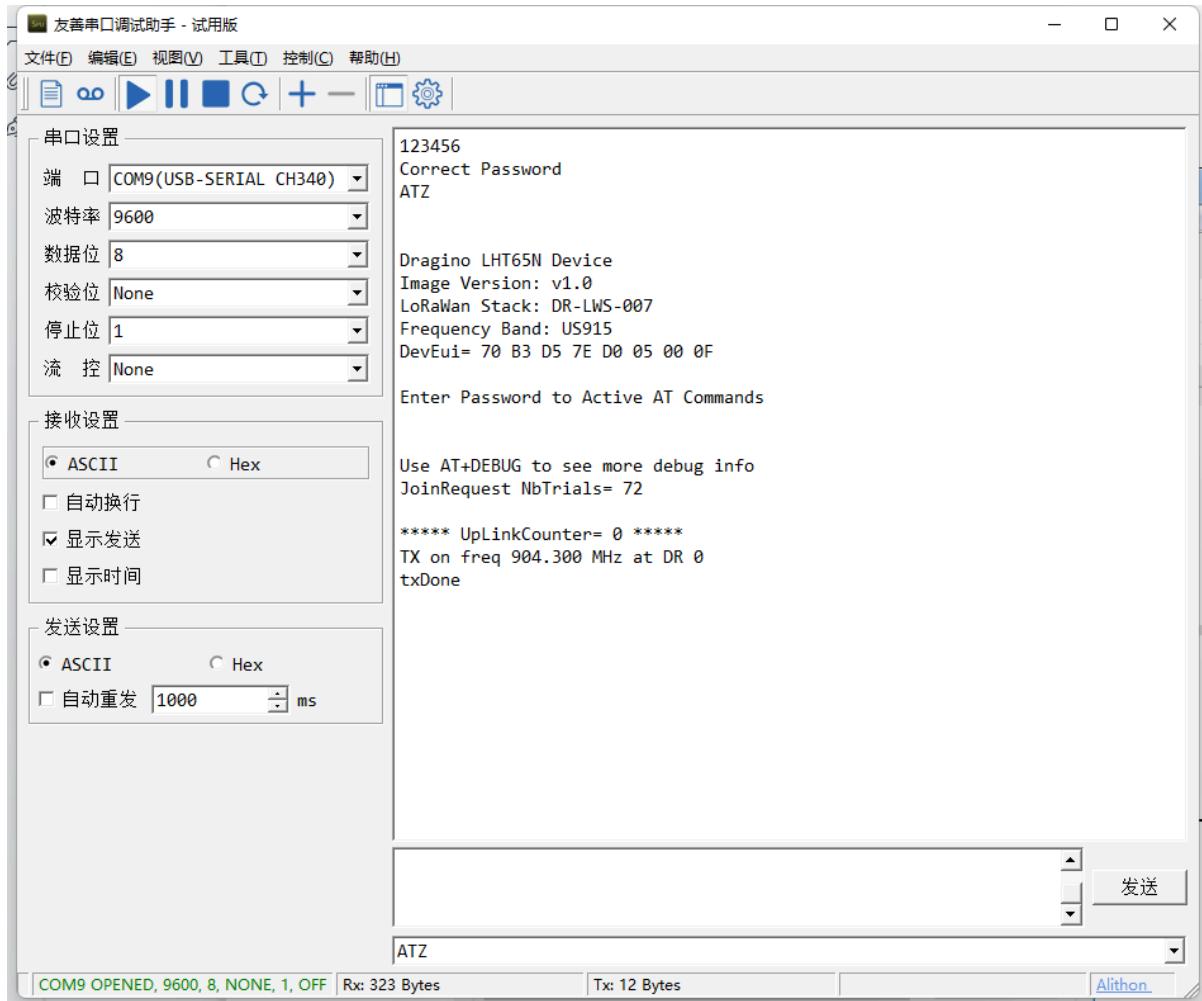
Aws:

The screenshot shows the AWS Device Farm interface. On the left, there's a navigation sidebar with various options like Test, Device Advisor, MQTT test client, manage, equipment, and more. The main area has four tabs: Device traffic, Configuration file, Downlink message queue, and Labels.

- Device traffic:** Shows a table with one row: DevEUI (a840411e96744159), RSSI (dBm) (-79), SNR (dB) (13.25), frequency (916800000), and Data rate (3).
- Configuration file:** Shows a table with one row: Device profiles (8287665f-9338-415c-ad8c-57f3f2d71ee2) and Service configuration file (fdb906f1-f524-4f14-ac20-2a22a17e0933).
- Downlink message queue:** An empty table with columns: The message ID, timestamp, FPort, and TransmitMode. It includes buttons for Clear the downlink queue, Delete, and Downlink messages are queued.
- Labels:** A table with columns: label and key. It shows a single entry: No labels. A note says: You don't have any tags attached to this resource.

6.3 How to change the uplink interval?

Please see this link: <http://wiki.dragino.com/xwiki/bin/view/Main/How%20to%20set%20the%20transmit%20time%20interval/>



6.4 How to upgrade firmware?

Please check [update instruction](#).

7. Order Info

Part Number: **LHT65N-E5-XX**

XX : The default frequency band

- **AS923**: LoRaWAN AS923 band
- **AU915**: LoRaWAN AU915 band
- **EU433**: LoRaWAN EU433 band
- **EU868**: LoRaWAN EU868 band
- **KR920**: LoRaWAN KR920 band
- **US915**: LoRaWAN US915 band
- **IN865**: LoRaWAN IN865 band
- **CN470**: LoRaWAN CN470 band

8. Packing Info

Package Includes:

- LHT65N-E5 Temperature/Humidity/Illuminance Sensor x 1

9. Reference material

- [Datasheet, photos, decoder, firmware](#)

10. FCC Warning

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;
- (2) this device must accept any interference received, including interference that may cause undesired operation.