



LTC2 LoRaWAN Temperature Transmitter User Manual

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1. Introduction

1.1 What is LTC2 LoRaWAN Temperature Transmitter

The Dragino LTC2 Industrial LoRaWAN Temperature Transmitter is designed to monitor temperature for different environment. It supports to read **PT100 probe** and convert the value to temperature and uplink to IoT server via LoRaWAN protocol.

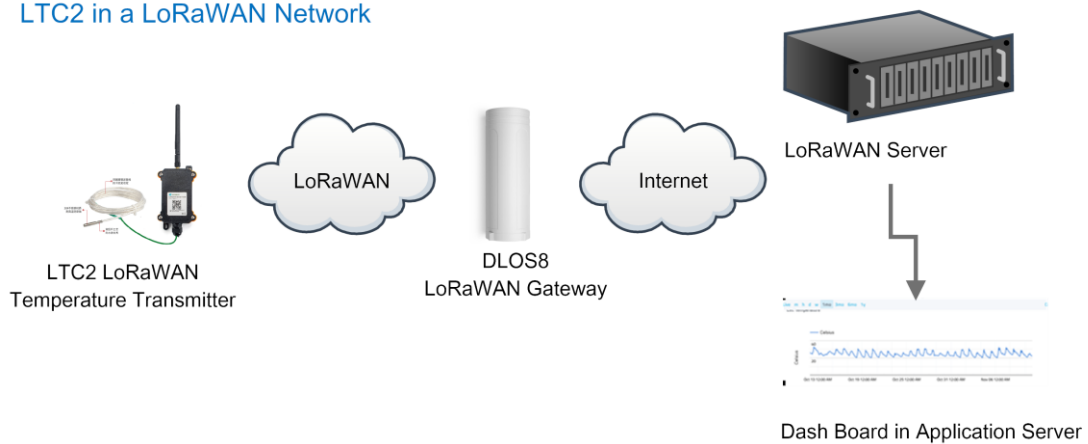
LTC2 supports **Datalog feature**. User can retrieve the sensor value via LoRaWAN downlink command.

LTC2 is powered by **8500mA Li-SOCI2 battery** for long time measurement. The battery can run 2~10 years depends on the network environment and working mode.

Each LTC2 has **two internal 24-bit ADC interfaces** and are calibrated on 12 set resistors to make sure the accuracy measurement on wide range.

LTC2 is LoRaWAN v1.0.3 compatible. Each LTC2 is pre-load with a set of unique keys for LoRaWAN registration, register these keys to local LoRaWAN server and it will auto connect after power on.

LTC2 in a LoRaWAN Network



1.2 Features

- ✓ LoRaWAN v1.0.3 Class A
- ✓ max: 2 x monitor temperature channels
- ✓ Support 3 -wire PT-100
- ✓ 8500mAh Li-SOCI2 Battery
- ✓ Firmware upgrade via console
- ✓ Wall Mountable
- ✓ Configurable via LoRa or UART

- ✓ Datalog and retrieve via LoRaWAN
- ✓ Use pre-load PT100 probe or 3rd PT100 probe
- ✓ Factory calibration for different resistance range
- ✓ Support accuracy measure of resistance and upload
- ✓ Battery Monitoring and upload

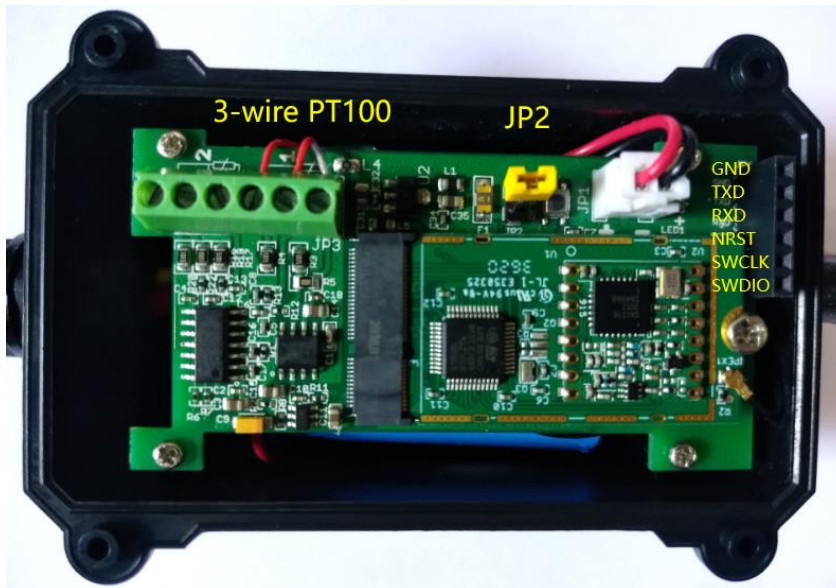
1.3 Applications

- ✓ Logistics and Supply Chain Management
- ✓ Food management
- ✓ Cold chains solution
- ✓ Industrial Monitoring and Control

1.4 Hardware Change log

LTC2 v1.0: Release.

1.5 Pin Definitions and Switch



1.5.1 Jumper JP2 (Power ON)

Put a jumper on JP2 will power on the LTC2.

1.5.2 LED

The LED will flash in below case.

- 1) Send an uplink packet

1.5.3 PT100 Interfaces

There are two independent channels to connect 2 x PT100 probes.




Each channel has 3-wire connection for 3-wire PT100 probes.

1.5.4 Reset Button

Press this button will reboot the LTC2

1.6 Probe Variant

LTC2 provide default probe version. See below for the variant:

Model	Photo	Description
LTC2-SI		<p>Standard IP68 Probe Version</p> <ul style="list-style-type: none"> ➤ LTC2 with 1 x Standard IP68 PT100 probe. ➤ Installation: Insert ➤ Cable Length : 2m ➤ PT100 Class : Class A ➤ Probe Dimension: 4*30mm ➤ Measure Range: -50 ~ 200 °C ➤ Suitable Environment: General environment
LTC2-LT		<p>Low Temperature Version</p> <ul style="list-style-type: none"> ➤ LTC2 with 1 x Low Temperature PT100 probe. ➤ Installation: Insert ➤ Cable Length : 2m ➤ PT100 Class : Class A ➤ Probe Dimension: 4*30mm ➤ Measure Range: -196 ~ 150 °C ➤ Suitable Environment: Low temperature measurement, such as COVID vaccine transport
LTC2-FS		<p>Food Safety Version</p> <ul style="list-style-type: none"> ➤ LTC2 with 1 x Food Safety PT100 probe. ➤ Installation: Insert ➤ Cable Length : 2m ➤ PT100 Class : Class A ➤ Probe Dimension: 4*150mm ➤ Measure Range: -50 ~ 200 °C ➤ Suitable Environment: Food temperature measurement

LTC2-FT		<p>Flat Type Version</p> <ul style="list-style-type: none"> ➤ LTC2 with 1 x Flat Type PT100 probe. ➤ Installation: Attached ➤ Cable Length : 2m ➤ PT100 Class : Class A ➤ Probe Dimension: 8*25mm ➤ Measure Range: -50 ~ 200 °C ➤ Suitable Environment: Attached to the measure point.
LTC2-HT		<p>High Temperature Version</p> <ul style="list-style-type: none"> ➤ LTC2 with 1 x high temperature PT100 probe. ➤ Installation: Insert ➤ Cable Length : 3m ➤ PT100 Class : Class A ➤ Probe Dimension: 4*30mm ➤ Measure Range: -70 ~ 550 °C <p>Suitable Environment: High Temperature</p>
LTC2-NA		<p>No Probe version:</p> <ul style="list-style-type: none"> ➤ User can connect to their own PT100 Probe ➤ Grand Hole: M12 ➤ Suitable Environment: <p>Connect to customized probe</p>

2. How to use LTC2?

2.1 Connect to PT100 sensors

LTC2 has different probe option provided for ordering, if user has LTC2 with probe, just skip this step. If user want to connect to a 3rd party PT100 probe, please see [CONNECT A 3rd PARTY PT100 probe](#).

2.2 How it works?

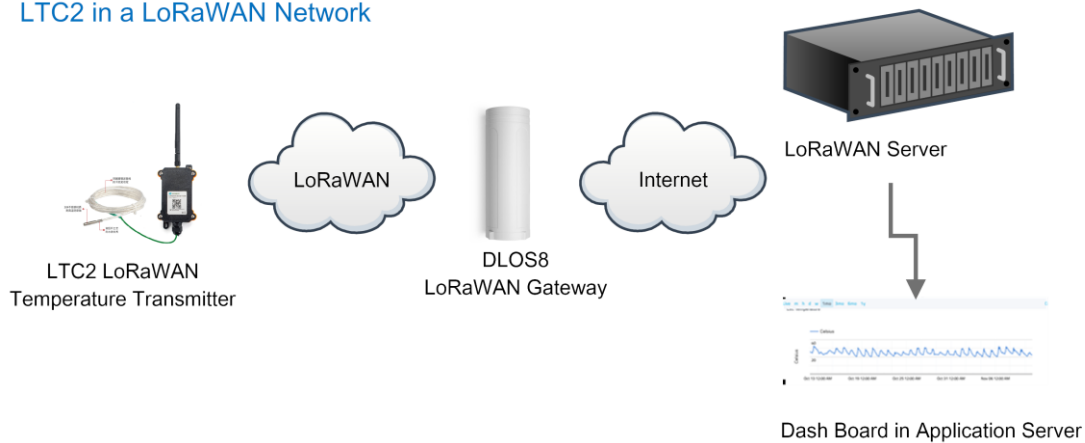
The LTC2 is working in LoRaWAN OTAA Class A mode. Each LTC2 is shipped with a worldwide unique set of OTAA and ABP keys. User needs to input the OTAA or ABP keys in the LoRaWAN network server so to register. LTC2 will join the LoRaWAN network and start to transmit data. The default period for each uplink is **20 minutes**.

On each uplink, LTC2 will check its two ADC Interfaces and get the temperature from the sensor and send out to server.

2.3 Quick guide to connect to LoRaWAN server (OTAA)

Here is an example for how to join the [TTN v3 LoRaWAN Server](#). Below is the network structure, in this demo we use [DLOS8](#) as LoRaWAN gateway.

LTC2 in a LoRaWAN Network

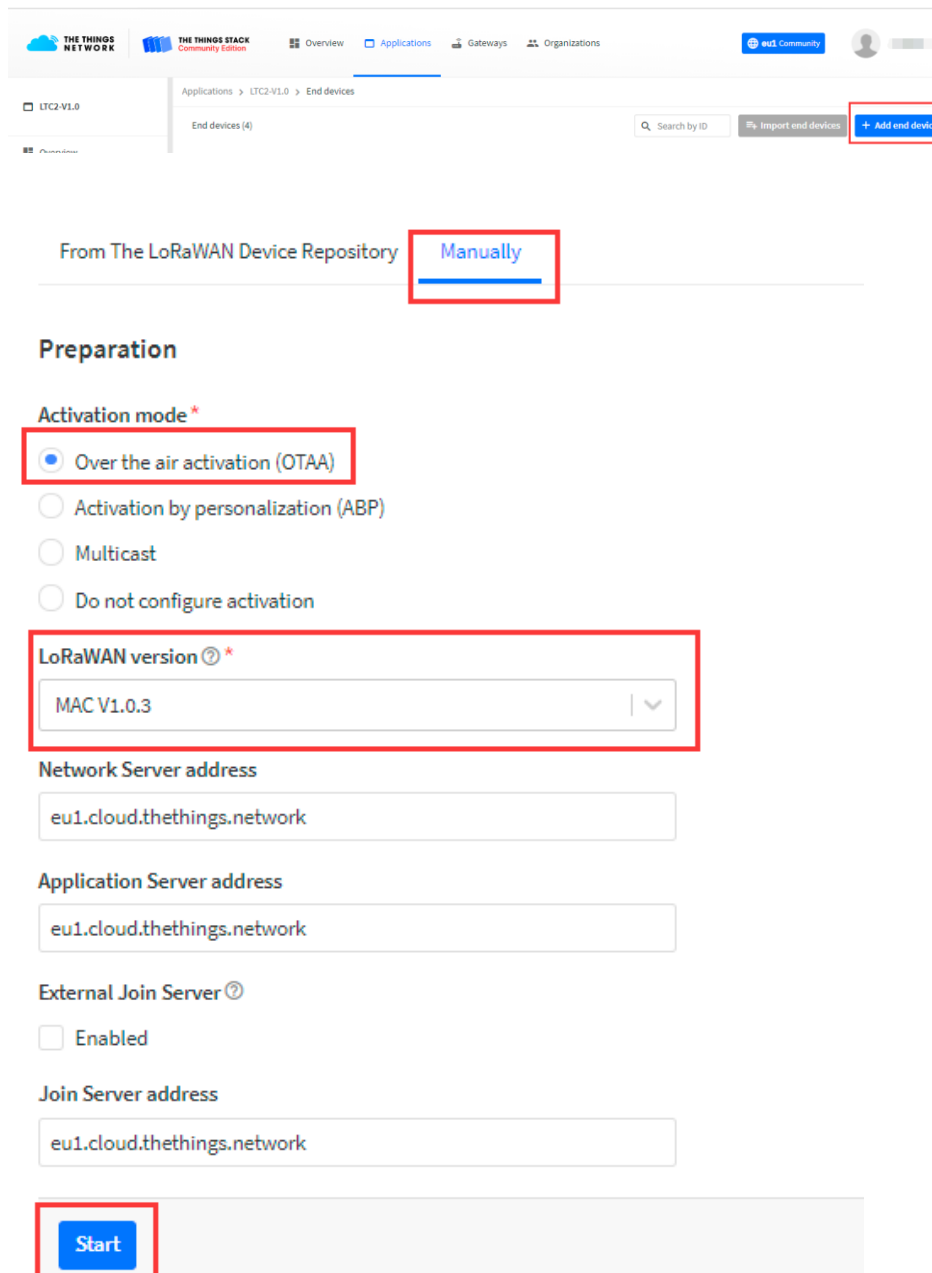


The DLOS8 is already set to connect to [TTN](#) . Rest we need to is register the LTC2 to TTN v3:

2.3.1 Step 1: Create a device in TTN with the OTAA keys from LTC2.

Below is TTN screen shot:

- Create Application first.
- Manually Add a LoRaWAN End Device device. Choose **OTAA** and **MAC v1.0.3**



Input the OTAA keys for LTC2.

Each LTC2 is shipped with a sticker with the default device EUI as below:



➤ Input these keys to device portal.

From The LoRaWAN Device Repository [Manually](#)

1 Basic settings ————— **2 Network layer settings** ————— **3 Join settings**
End device ID's, Name and Description Frequency plan, regional parameters, end device class and session keys. Root keys, NetID and kek labels.

End device ID *
my-new-device

AppEUI *
.....00

DevEUI *
.....

End device name
My new end device

End device description
Description for my new end device

Optional end device description; can also be used to save notes about the end device

[Network layer settings >](#)

➤ Choose the Frequency band for this end node.

From The LoRaWAN Device Repository [Manually](#)

1 Basic settings ————— **2 Network layer settings** ————— **3 Join settings**
End device ID's, Name and Description Frequency plan, regional parameters, end device class and session keys. Root keys, NetID and kek labels.

Frequency plan *
Europe 863-870 MHz (SF9 for RX2 - recommended)

LoRaWAN version *
MAC V1.0.3

Regional Parameters version *
PHY V1.0.3 REV A

LoRaWAN class capabilities

Supports class B

Supports class C

Advanced settings ▾

[< Basic settings](#) [Join settings >](#)

➤ Input APP Key in this page as well.

Applications > LTC2-V1.0 > End devices > Register manually > Join settings

Register end device

From The LoRaWAN Device Repository **Manually**

- 1 Basic settings
End device ID's, Name and Description
- 2 Network layer settings
Frequency plan, regional parameters, end device class and session keys.
- 3 **Join settings**
Root keys, NetID and kek labels.

Root keys

AppKey *

Advanced settings ▾

< Network layer settings **Add end device**

Add payload formatter So TTNv3 knows how to parse the LTC2 upload value.

The payload for TTN can be found at below link:

https://www.dragino.com/downloads/downloads/LoRa_End_Node/LTC2/Decoder/

Applications > LTC2-V1.0 > Payload formatters > Uplink

Default uplink payload formatter

You can use the "Payload formatter" tab of individual end devices to test uplink payload formatters and to define individual payload formatter settings per end device.

Setup

Formatter type*
Javascript

Formatter parameter*

```
1 function Decoder(bytes, port) {
2
3   var poll_message_status=(bytes[2]&0x40)>>6;
4
5   var decode = {};
6
7   decode.Ext= bytes[2]&0x0F;
8   decode.BatV= ((bytes[0]<<8 | bytes[1]) & 0x3FFF)/1000;
9
10  if(decode.Ext==0x01)
11  {
12    decode.Temp_Channel1=parseFloat(((bytes[3]<<24>>16 | bytes[4])/100).toFixed(2));
13    decode.Temp_Channel2=parseFloat(((bytes[5]<<24>>16 | bytes[6])/100).toFixed(2));
14  }
15  else if(decode.Ext==0x02)
```

2.3.2 Step 2: Power on LTC2

LTC2 is power off when ship from factory.
Put a Jumper on JP2 to power on the device.



After power on, LTC2 will auto join to TTN network via the LoRaWAN coverage by DLOS8. After join success, LTC2 will start to update message to IoT server.

Below is an example uplink message which shows the LTC2 is sending Join Request to TTNv3.

Time	Type	Data preview
09:56:21	Receive join-request	JoinEUI: [redacted] DevEUI: [redacted] Bandwidth: 125000 SNR: 9.8 RSSI: -42 Raw payload: [redacted]
09:56:21	Receive join-request	JoinEUI: [redacted] DevEUI: [redacted] Bandwidth: 125000 SNR: 3.2 RSSI: -115 Raw payload: [redacted]
09:56:21	Drop join-request	Uplink is a duplicate
09:56:21	Receive join-request	JoinEUI: [redacted] DevEUI: [redacted] Bandwidth: 125000 SNR: -2.5 RSSI: -122 Raw payload: [redacted]
09:56:21	Drop join-request	Uplink is a duplicate
09:56:21	Receive join-request	JoinEUI: [redacted] DevEUI: [redacted] Bandwidth: 125000 SNR: -4.5 RSSI: -124 Raw payload: [redacted]
09:56:21	Receive join-request	JoinEUI: [redacted] DevEUI: [redacted] Bandwidth: 125000 SNR: 4 RSSI: -115 Raw payload: [redacted]
09:56:21	Join-request to cluster-loc...	DevAddr: [redacted] JoinEUI: [redacted] DevEUI: [redacted] Session key ID: [redacted]
09:56:21	Accept join-request	DevAddr: [redacted]
09:56:21	Drop join-request	Uplink is a duplicate
09:56:21	Drop join-request	Uplink is a duplicate
09:56:21	Send join-request to cluster...	DevAddr: [redacted] JoinEUI: [redacted] DevEUI: [redacted] Selected MAC version: MAC_V1_0_3
09:56:21	Drop join-request	Uplink is a duplicate
09:56:21	Receive join-request	JoinEUI: [redacted] DevEUI: [redacted] Bandwidth: 125000 SNR: 5.2 RSSI: -112 Raw payload: [redacted]
09:56:21	Receive join-request	JoinEUI: [redacted] DevEUI: [redacted] Bandwidth: 125000 SNR: 1.5 RSSI: -117 Raw payload: [redacted]

After join successful, LTC2 will send uplink message with the sensor value.

Time	Type	Data preview
09:56:28	Link ADR request enqueued	DevAddr: [redacted]
09:56:28	Successfully scheduled data	DevAddr: [redacted]
09:56:28	Schedule data downlink for t	DevAddr: [redacted] Rx1 Delay: 5
09:56:28	Forward data message to Appl	DevAddr: [redacted] MAC payload: 9E D6 E2 ED 6C 1D 66 A7 2D 60 0D FPort: 2 SNR: 4.2 RSSI: -112 Bandwidth: 125000
09:56:28	Forward uplink data message	DevAddr: [redacted] Payload: { BatV: 3.692, Ext: 1, Systemstamp: 1611878406, Temp_Channel1: 25.94, Temp_Channel2: -327.67 } 0E
09:56:28	Receive uplink data message	DevAddr: [redacted]
09:56:28	Successfully processed data	DevAddr: [redacted] FPort: 2 MAC payload: 9E D6 E2 ED 6C 1D 66 A7 2D 60 0D Bandwidth: 125000 SNR: 4.2 RSSI: -112 Raw payload: [redacted]
09:56:28	Drop data message	Uplink is a duplicate
09:56:28	Receive data message	DevAddr: [redacted] FPort: 2 MAC payload: 9E D6 E2 ED 6C 1D 66 A7 2D 60 0D Bandwidth: 125000 SNR: -2 RSSI: -122 Raw payload: [redacted]

Above value shows Channel1 detect 25.94 degree. There is no PT100 connected on Channel 2, so it shows -327.67.

2.4 Uplink Payload

2.4.1 Payload Analyze

Below is the uplink payload which shows

Size (bytes)	2	1	2	2	4
Value	BAT	Status & EXT	Channel 1 data	Channel 2 data	Unix TimeStamp

✓ **BAT:** Ex1: 0x0E3C ⇒ 3644 (mV) = 3.644 V

✓ **Status & EXT:**

Bits	7	6	5	4	[3:0]
Status & Ext	Not Defined	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 time ok, 0: N/A. After time SYNC request is send, device will set this bit to 0 until got the time stamp from application server.
- **Unix Time Request:** 1: Request server downlink Unix time, 0 : N/A. In this mode, LTC2 will set this bit to 1 every 10 day to request a time SYNC. (AT+SYNCMOD to set this)
- **EXT:** The decode method for Channel 1 data and Channel 2 data
 - ✧ 0b(0001): Upload PT100 temperature, with 2 decimals, range: -327.67 ~ 327.67 °C
 - ✧ 0b(0010): Upload PT100 temperature, with 1 decimals, range: -3276.7 ~ 3276.7 °C
 - ✧ 0b(0011): Upload Resistance instead of Temperature, range: -327.67~ 327.67 ohm

✓ **Channel1 data and Channel 2 data**

Example Payload on channel 1 or channel 2	Sensor Value when EXT=0b(0001)	Sensor Value when EXT=0b(0010)	Sensor Value when EXT=0b(0011)

0x1422	$0x1422/100 = 51.54^{\circ}\text{C}$	$0x1422/10 = 515.4^{\circ}\text{C}$	$0x1422/100 = 51.54 \Omega$
0xEC2D	$(0xEC2D-65536)/100 = -50.75^{\circ}\text{C}$	$(0xEC2D-65536)/10 = -507.5^{\circ}\text{C}$	$0xEC2D/100 = 604.61 \Omega$

✓ **Unix TimeStamp**

Refer to Datalog feature.

Example Uplink Payload:

Uplink payload example 1:0CE9011422EC2D6073E83B

- Bat voltage:0x0CE9 =3305mV
- Ext=0x01
- Channel1 temp=0x1422/100=51.54 °C
- Channel2 temp=(0xEC2D-65536)/100=-50.75 °C
- System timestamp=0x6073E83B= 1618208827(UTC)

Uplink payload example 2:0CED020203FE056073E697

- Bat voltage:0x0CED =3309mV
- Ext=0x02
- Channel1 temp=0x0203/10=515.4 °C
- Channel2 temp=(0xFE05-65536)/10=-507.5 °C
- System timestamp=0x6073E697=1618208407(UTC)

Uplink payload example 3 :0CE9032EDE1F406073E967

- Bat voltage:0x0CE9 =3305mV
- Ext=0x03
- Channel1 res=0x2EDE/100=119.98 ohm
- Channel2 res=0x1F40/100=80.00 ohm
- System timestamp=0x6073E967= 1618209127(UTC)

2.5 Datalog Feature

LTC2 will auto get the time from LoRaWAN server during Join, and each uplink will then include a timestamp. When user want to retrieve sensor value, user can send a poll command from the IoT platform to ask sensor to send value in the required time slot.

LoRaWAN server must be v1.0.3 or higher, if LoRaWAN server doesn't support this time request, user can manually set the timestamp.

2.5.1 Unix TimeStamp

LTC2 uses Unix TimeStamp format base 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 screenshot shows two web interfaces. On the left, EpochConverter displays the current Unix epoch time as 1611889418. A red arrow points from this value to the Code Beautify 'Decimal to Hex Converter' on the right. In Code Beautify, the decimal number 1611889405 is entered, and the resulting hex representation is 60137afd.

So, we can use AT+TIMESTAMP=1611889405 or downlink 3060137afd00 to set current time 2021 – Jan -- 29 Friday 03:03:25

2.5.2 Set Device Time

There are two ways to set device’s time:

1. Through LoRaWAN MAC Command (Default settings)

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

Once LTC2 Joined LoRaWAN network, it will send the MAC command (DeviceTimeReq) and server will reply with (DeviceTimeAns) to send the current time to LTC2. If LTC2 fails to get the time from server, LTC2 will use the internal time and wait for next time request (AT+SYNCTDC to set 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 and loriot support but TTN 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 v2 if SYNCMOD=1.

2. Manually Set Time

User need to set SYNCMOD=0 to manual time, otherwise the user set time will be overwrite by the time set by server.

2.5.3 Poll sensor value

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

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

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

For example, downlink command `31 60A06E90 60A07CA0 0A`

Is to check 2021/5/16 01:00:00 to 2021/5/16 02:00:00's data

Uplink Internal =10s, means LTC2 will send one packet every 10s. range 5~255s.

2.5.4 Datalog Uplink payload

When server sener a datalog polling to LTC2, LTC2 will reply with one or more uplink messages as reply. Each uplink message includes multiply data entries value. Each entry has the same payload format as [normal uplink payload](#).

Note:

- 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 LTC2 has below data inside Flash:

Flash Addr	Unix Time	Ext	BAT voltage	Value
8021630	system= 2021/5/16 01:17:44	1	3684	Temp1=28.89 Temp2=-327.67
8021640	system= 2021/5/16 01:37:44	1	3681	Temp1=28.79 Temp2=-327.67
8021650	system= 2021/5/16 01:57:44	1	3681	Temp1=28.67 Temp2=-327.67
8021660	system= 2021/5/16 02:17:44	1	3684	Temp1=28.60 Temp2=-327.67
8021670	system= 2021/5/16 02:37:44	1	3684	Temp1=28.56 Temp2=-327.67
8021680	system= 2021/5/16 02:57:44	1	3684	Temp1=28.52 Temp2=-327.67
8021690	system= 2021/5/16 03:17:44	1	3684	Temp1=28.51 Temp2=-327.67
80216A0	system= 2021/5/16 03:37:44	1	3684	Temp1=28.50 Temp2=-327.67
80216B0	system= 2021/5/16 03:57:44	1	3684	Temp1=28.46 Temp2=-327.67

If user send below downlink command:

```
3160A06E9060A098C00A
```

Where : Start time: 60A06E90 = time 21/5/16 01:00:00

Stop time: 60A098C0 = time 21/5/16 04:00:00

LTC2 will uplink this payload.

Time	Type	Data preview
↑ 11:07:43	Forward data message to Appl...	DevAddr: 26 0B AB 87 MAC payload: A9 B2 69 81 BE 9A 72 56 85 6C 9F BE AD 66 9E 35 8E 0E 0C DF 1E B7 5E 2C A0 96 F9 99 8E 03 92 F7 09 A4 F7 69 81
↑ 11:07:43	Forward uplink data message	DevAddr: 26 0B AB 87 Payload: { } 0E 64 41 0B 49 80 01 60 A0 72 88 0E 61 41 0B 3F 80 01 60 A0 77 68 0E 61 41 0B 33 80 01 60 A0 7C 18 0E 64 41 0B
↑ 11:07:43	Receive uplink data message	DevAddr: 26 0B AB 87
↑ 11:07:43	Successfully processed data ...	DevAddr: 26 0B AB 87 FCnt: 5 FPort: 2 MAC payload: A9 B2 69 81 BE 9A 72 56 85 6C 9F BE AD 66 9E 35 8E 0E 0C DF 1E B7 5E 2C A0 96 F9 99 8E 03 92 F7 09 A4 F7 69 81

0E64410B49800160A072B80E61410B3F800160A077680E61410B33800160A07C180E64410B2C800160A080C80E64410B28800160A085780E64410B24800160A08A280E64410B23800160A08ED80E64410B22800160A093880E64410B1E800160A09838

Where the first 11 bytes is for the first entry:

0E64410B49800160A072B8

Bat voltage:0x0E64 =3684mV

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

Channel1 temp=0x0B49/100=28.89 °C

Channel2 temp=0x8001/100=-327.67 °C

System timestamp=0x60A072B8= 1621127864(UTC)

2.6 Alarm Mode

LTC2 can monito the temperature in every CTTEMP time, when the temperature exceed the limit , it will uplink the sensor value immediately.

Detail commands see:

[Enable Alarm Mode.](#)

[Config Alarm Sampling Time.](#)

[Set Alarm Threshold](#)

3. Configure LTC2 via AT Command or LoRaWAN Downlink

Use can configure LTC2 via AT Command or LoRaWAN Downlink.

- AT Command Connection: See [FAQ](#).
- LoRaWAN Downlink instruction for different platforms:
http://wiki.dragino.com/index.php?title=Main_Page#Use_Note_for_Server

There are two kinds of commands to configure LTC2, they are:

- **General Commands.**

These commands are to configure:

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

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

http://wiki.dragino.com/index.php?title=End_Device_Downlink_Command

- **Commands special design for LTC2**

These commands only valid for LTC2, as below:

3.1 Set Transmit Interval Time

Feature: Change LoRaWAN End Node Transmit Interval.

AT Command: AT+TDC

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

Downlink Command: 0x01

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

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

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

3.2 Enable PT100 channels

Feature: Enable PT100 channels. Default only Enable Channel 1

AT Command: AT+ENPTCHNUM

Command Example	Function	Response
AT+ENPTCHNUM=?	Get current ENPTCHNUM settings	1 OK
AT+ ENPTCHNUM =1	Enable channel 1	
AT+ ENPTCHNUM =2	Enable channel 1 and 2	

Downlink Command: 0xA1

Total bytes: 2 bytes

Example:

- ✧ 0xA101: same as AT+ENPTCHNUM =1
- ✧ 0xA102: same as AT+ENPTCHNUM =2

3.3 Set External Sensor Mode

Feature: Change External Sensor Mode.

AT Command: AT+EXT

Command Example	Function	Response
AT+EXT=?	Get current EXT settings	1 OK
AT+EXT=1	Set EXT to 0b(0001)	
AT+EXT=2	Set EXT to 0b(0010)	
AT+EXT=3	Set EXT to 0b(0011)	

Downlink Command: 0xA2

Total bytes: 2 bytes

Example:

- ✧ 0xA201: same as AT+EXT=1

3.4 Quit AT Command

Feature: Quit AT Command mode, so user need to input password again before use AT Commands.

AT Command: AT+DISAT

Command Example	Function	Response
AT+DISAT	Quit AT Commands mode	OK

Downlink Command:

No downlink command for this feature.

3.5 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

3.6 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

3.7 Set Time Sync Interval

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

AT Command:

Command Example	Function
AT+SYNCTDC=0x0A	Set SYNCTDC to 10 (0x0A), so the sync time is 10 days.

Downlink Command:

0x29 0A // Same as AT+SYNCTDC=0x0A

3.8 Retrieve data

Feature: Retrieval data for specify time slot.

AT Command: No AT Command, only valid for downlink command.

Downlink Command:

[See Poll Sensor Value.](#)

3.9 Enable Alarm mode

Feature: Enable Alarm Mode.

AT Command:

Total bytes: 2

Example:

0xA500:AT+WMOD=0(default)

0xA501:AT+WMOD=1(alarm mode)

Downlink Command:

[See Poll Sensor Value.](#)

3.10 Alarm check time

Feature: The time interval to check sensor value for Alarm.

AT Command:

AT+CITEMP:

Total bytes: 3

Example:

0xA60001:AT+CITEMP=1(default)

Set collection interval in 1min,only in alarm mode

Downlink Command:

[See Poll Sensor Value.](#)

3.11 Set Alarm Threshold

Feature: Set Alarm Threshold.

AT Command:

Total bytes: 9 Unit: °C

Example:

A7FF380320FF380320

AT+ARTEMP=-200,800,-200,800

A7000A0064000A0065

AT+ARTEMP=10,100,10,101

Channel 1 operating temp:10~100

Channel 2 operating temp:10~101

Downlink Command:

[See Poll Sensor Value.](#)

3.12 Set Calibrate Value

Feature: Set Calibrate value for PT100 cable. Detail of use of this command please see [connect to a customized PT100 Probe.](#)

AT Command:

Total bytes: 5

Example:

AT+RCABLE=296,300

Channel 1 rcable=0x0128/1000=0.296R

Channel 2 rcable=0x012C/1000=0.300R

Downlink Command:

0xA80128012C → Same as AT+RCABLE=296,300

3.13 Poll Calibrate Value

Feature: Poll Calibrate value. LTC2 will reply with this command send an uplink to server.

AT Command: No AT Command.

Downlink Command:

Example:A901

End nodes will send racable config to server

Like uplink payload: 010128012C

3.14 Print data entries base on page.

Feature: Print the sector data from start page to stop page (max is 400 pages).

AT Command: AT+PDTA

Command Example	Response
AT+PDTA=259,260 Print page 259 to 260	Stop Tx events when read sensor data 8021600 systime= 2021/5/16 00:17:44 1 3684 Temp1=28.71 Temp2=-327.67 8021610 systime= 2021/5/16 00:37:44 1 3685 Temp1=28.78 Temp2=-327.67 8021620 systime= 2021/5/16 00:57:44 1 3684 Temp1=28.83 Temp2=-327.67 8021630 systime= 2021/5/16 01:17:44 1 3684 Temp1=28.89 Temp2=-327.67 8021640 systime= 2021/5/16 01:37:44 1 3681 Temp1=28.79 Temp2=-327.67 8021650 systime= 2021/5/16 01:57:44 1 3681 Temp1=28.67 Temp2=-327.67 8021660 systime= 2021/5/16 02:17:44 1 3684 Temp1=28.60 Temp2=-327.67 8021670 systime= 2021/5/16 02:37:44 1 3684 Temp1=28.56 Temp2=-327.67 8021680 systime= 2021/5/16 02:57:44 1 3684 Temp1=28.52 Temp2=-327.67 8021690 systime= 2021/5/16 03:17:44 1 3684 Temp1=28.51 Temp2=-327.67 80216A0 systime= 2021/5/16 03:37:44 1 3684 Temp1=28.50 Temp2=-327.67 80216B0 systime= 2021/5/16 03:57:44 1 3684 Temp1=28.46 Temp2=-327.67 80216C0 systime= 2021/5/16 04:17:44 1 3684 Temp1=28.40 Temp2=-327.67 80216D0 systime= 2021/5/16 04:37:44 1 3683 Temp1=28.37

	<pre>Temp2=-327.67 80216E0 systime= 2021/5/16 04:57:44 1 3684 Temp1=28.36 Temp2=-327.67 80216F0 systime= 2021/5/16 05:17:44 1 3685 Temp1=28.32 Temp2=-327.67 Start Tx events OK</pre>
--	---

Downlink Command:

No downlink commands for feature

3.15 Print last few data entries.

Feature: Print the last few data entries

AT Command: AT+PLDTA

Command Example	Response
<pre>AT+PLDTA=5 Print last 5 entries</pre>	<pre>Stop Tx events when read sensor data 1 systime= 2021/5/17 03:12:37 1 3681 Temp1=26.01 Temp2=-327.67 2 systime= 2021/5/17 03:17:37 1 3682 Temp1=26.02 Temp2=-327.67 3 systime= 2021/5/17 03:22:37 1 3687 Temp1=25.94 Temp2=-327.67 4 systime= 2021/5/17 03:27:37 1 3684 Temp1=25.95 Temp2=-327.67 5 systime= 2021/5/17 03:32:37 1 3684 Temp1=26.20 Temp2=-327.67 Start Tx events OK</pre>

Downlink Command:

No downlink commands for feature

3.16 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

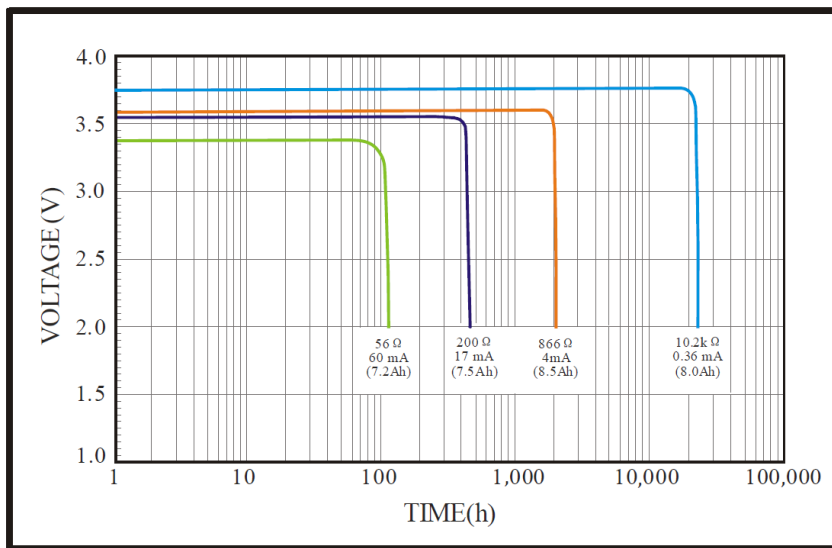
4. Battery & How to replace

4.1 Battery Type

LTC2 is equipped with a [8500mAH ER26500 Li-SOCI2 battery](#). The battery is un-rechargeable battery with low discharge rate targeting for 8~10 years use. This type of battery is commonly used in IoT target for long term running, such as water meter.

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

1. Typical discharge profile at +20 °C (Typical value)



Minimum Working Voltage for the LTC2:

✓ LTC2: 3.0v ~ 3.6v

4.2 Replace Battery

Any battery with 3.6v can be a replacement. We recommend to use Li-SOCI2 Battery. And make sure the positive and negative pins match.

4.3 Power Consumption Analyze

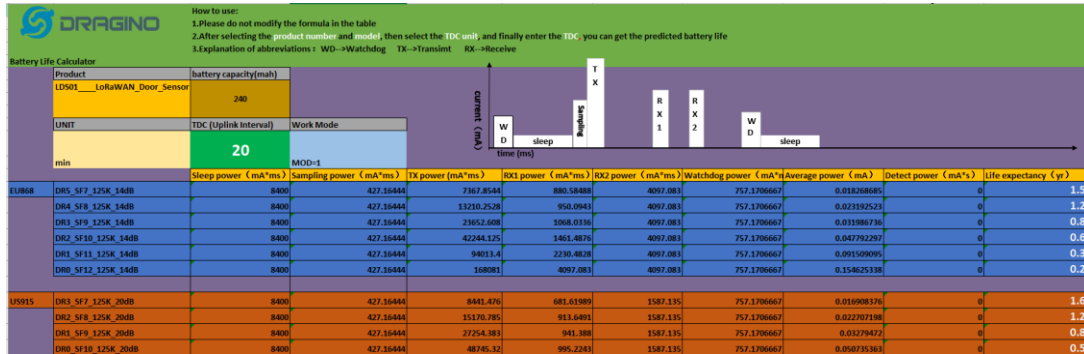
Dragino Battery powered product are all runs in Low Power mode. We have an update battery calculator which base on the measurement of the real device. User can use this calculator to check the battery life and calculate the battery life if want to use different transmit interval.

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.



5. Firmware Change Log and Upload Firmware

User can use ST-Link v2 to upgrade firmware into LTC2 for bug fix or new features. The hardware connection for upgrade firmware is as below:

Connection:

- ✓ ST-LINK v2 GND <--> LTC2 GND
- ✓ ST-LINK v2 RESET <--> LTC2 NRST
- ✓ ST-LINK v2 SWCLK <--> LTC2 SWCLK
- ✓ ST-LINK v2 SWDIO <--> LTC2 SWDIO
- ✓ LTC2 power must be on.

Firmware Location and Change Log:

http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LTC2/Firmware/

6. FAQ

6.1 How to use AT Command to configure LTC2

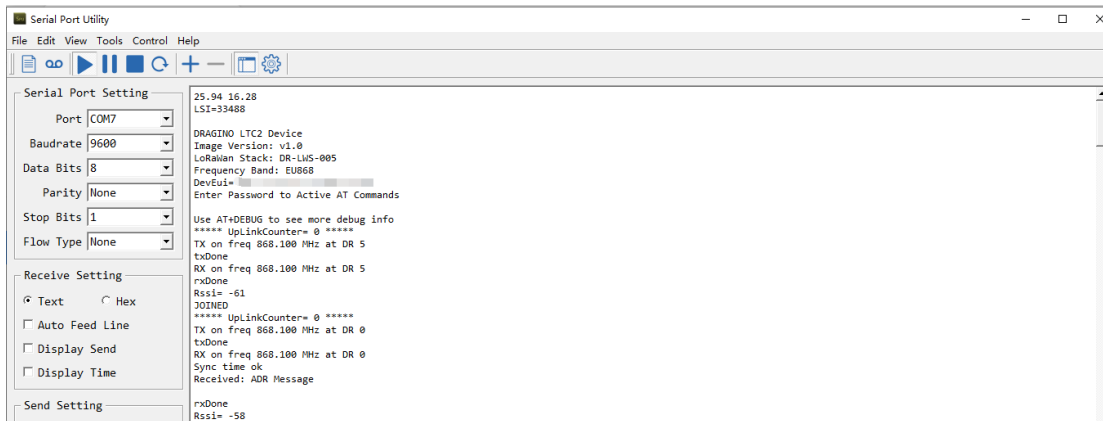
LTC2 supports AT Command set. User can use a USB to TTL adapter plus the Program Cable to connect to LTC2 for using AT command, as below.

Connection:

- ✓ USB to TTL GND <--> LTC2 GND
- ✓ USB to TTL RXD <--> LTC2 TXD
- ✓ USB to TTL TXD <--> LTC2 RXD

In PC, User needs to set **serial tool**(such as [putty](#), SecureCRT) baud rate to **9600** to access to access serial console for LTC2. 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.

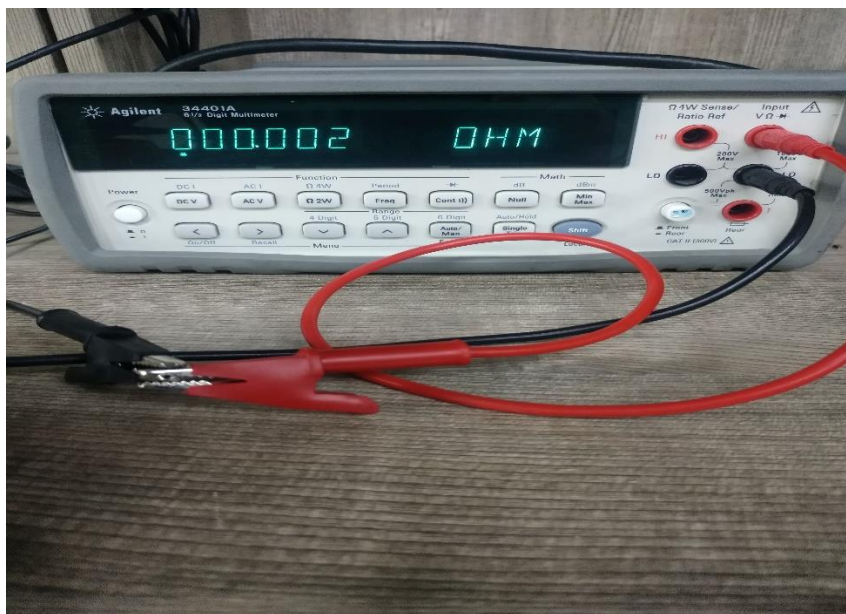
Input password and ATZ to activate LTC2,As shown below:



6.2 How to connect a customized PT100 cable?

The LTC2 has two channels means it can connect 2 x PT100 cables. Besides use the PT100 cables provided by Dragino, User can connect their PT100 probes. When connect to a user PT100 probe, we recommend that user do a calibration to eliminate the effect from the cables so to get the best accuracy. Below is the step for calibrate on a **three wire PT100** probes. There is no step for 2 wire probe calibration at the moment.

Step 1: You need a multimeter can measure the accuracy of 0.001 ohm. We use Agilent 34401A digit multimeter. And will do test to make sure the multimeter accuracy before the measurement. Check the shortcut resistance of the multimeter.



We know that the Multimeter has a shortcut resistance 0.002 ohm.

Step 2: Measure the resistance between the two shorted wires of PT100 Probe. ‘;



As example, in this step, we check the shorted wire (both red) with 0.594 ohm, So we know that each wire of PT100 has $(0.594-0.002)/2=0.296R$ (Where 0.002 is the value we got from step 1) .

Step 3: Run Calibrate Command.

Run this command to both channels to use 0.296R calibrate resistance.

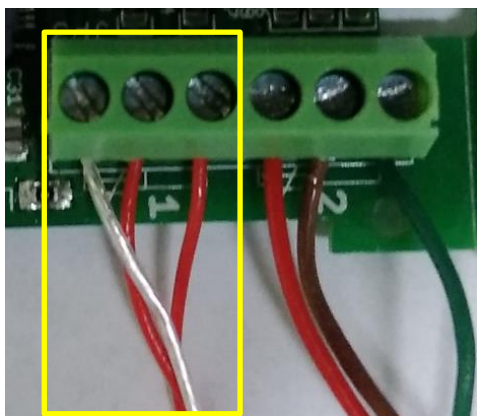
`AT+RCABLE=296,0` --> Calibrate Channel 1 with 0.296R

Or use LoRaWAN downlink command (0xA8 Code) to set:

`0xA801280000`

User can use 0xA9 downlink command to poll the current calibration value.

Step 4: Connect the PT100 to LTC2



For a 3 wire PT100, there are two wire are shortcut, for example, as per above photo Channel 1, there are two red wire , which are shortcut in PT100, connect them as the photo. The 3rd wire (white wire) connect to the left pin of Channel -1.

6.3 What is the frequency range of LTC2 LoRa part?

Different LTC2 version supports different frequency range, below is the table for the working frequency and recommend bands for each model:

Version	LoRa IC	Working Frequency	Best Tune Frequency	Recommend Bands
433	SX1278	Band2(LF): 410 ~525 Mhz	433Mhz	CN470/EU433
868	SX1276	Band1(HF):862~1020 Mhz	868Mhz	EU868/IN865/RU864
915	SX1276	Band1(HF):862 ~1020 Mhz	915Mhz	AS923/AU915/ KR920/US915

6.4 How to change the LoRa Frequency Bands/Region?

User can follow the introduction for [how to upgrade image](#). When download the images, choose the required image file for download.

7. Trouble Shooting

8. Order Info

Part Number: **LTC2-XX-YYY**

XX: Probe Version.

- ✓ **SI**: Standard IP68 probe x 1
- ✓ **LT**: Low Temperature probe x 1
- ✓ **HT**: High Temperature probe x 1
- ✓ **FS**: Food Safety probe x 1
- ✓ **FT**: Flat Type probe x 1
- ✓ **NA**: No probe

YYY: 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

9. Packing Info

Package Includes:

- ✓ LTC2 LoRaWAN Temperature Transmitter x 1

Dimension and weight:

- ✓ Device Size:
- ✓ Device Weight:
- ✓ Package Size:
- ✓ Package Weight:

10. Support

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

support@dragino.com