



RS485-LN -- RS485 to LoRaWAN Converter User Manual

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1. Introduction

1.1 What is RS485-LN RS485 to LoRaWAN Converter

The Dragino RS485-LN is a RS485 to LoRaWAN Converter. It converts the RS485 signal into LoRaWAN wireless signal which simplify the IoT installation and reduce the installation/maintaining cost.

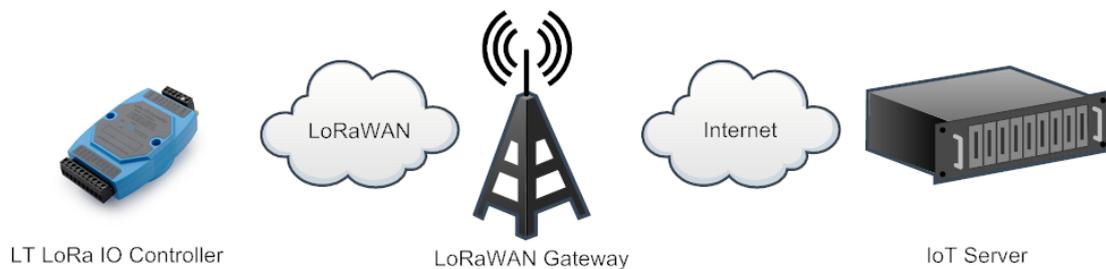
RS485-LN allows user to monitor / control RS485 devices and reach extremely long ranges. It provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption. It targets professional wireless sensor network applications such as irrigation systems, smart metering, smart cities, smartphone detection, building automation, and so on.

For data uplink, RS485-LN sends user-defined commands to RS485 devices and gets the return from the RS485 devices. RS485-LN will process these returns according to user-define rules to get the final payload and upload to LoRaWAN server.

For data downlink, RS485-LN runs in LoRaWAN Class C. When there downlink commands from LoRaWAN server, RS485-LN will forward the commands from LoRaWAN server to RS485 devices.

图片需要改:

LoRa I/O Controller Network Structure



1.2 Specifications

Hardware System:

- STM32L072CZT6 MCU
- SX1276/78 Wireless Chip
- Power Consumption (exclude RS485 device):
 - ✧ Idle: 32mA@12v
 - ✧ 20dB Transmit: 65mA@12v

Interface for Model:

- RS485
- Power Input 7~ 24V DC.

LoRa Spec:

- Frequency Range:
 - ✓ Band 1 (HF): 862 ~ 1020 Mhz
 - ✓ Band 2 (LF): 410 ~ 528 Mhz
- 168 dB maximum link budget.
- +20 dBm - 100 mW constant RF output vs.
- +14 dBm high efficiency PA.
- Programmable bit rate up to 300 kbps.
- High sensitivity: down to -148 dBm.
- Bullet-proof front end: IIP3 = -12.5 dBm.
- Excellent blocking immunity.
- Low RX current of 10.3 mA, 200 nA register retention.
- Fully integrated synthesizer with a resolution of 61 Hz.
- FSK, GFSK, MSK, GMSK, LoRaTM and OOK modulation.
- Built-in bit synchronizer for clock recovery.
- Preamble detection.
- 127 dB Dynamic Range RSSI.
- Automatic RF Sense and CAD with ultra-fast AFC.
- Packet engine up to 256 bytes with CRC.

1.3 Features

- ✓ LoRaWAN Class A & Class C protocol (default Class C)
- ✓ Frequency Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865/RU864
- ✓ AT Commands to change parameters
- ✓ Remote configure parameters via LoRa Downlink
- ✓ Firmware upgradable via program port
- ✓ Support multiply RS485 devices by flexible rules

1.4 Applications

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

1.5 Firmware Change log

[RS485-LN Image files – Download link](#)

Image v1.0

- Release

2. Power ON Device

The RS485-LN can be powered by 7 ~ 24V DC power source. Connection as below

- ✓ Power Source VIN to RS485-LN VIN+
- ✓ Power Source GND to RS485-LN VIN-

Once there is power, the RS485-LN will be on.



3. Operation Mode

3.1 How it works?

The RS485-LN is configured as LoRaWAN OTAA Class C mode by default. It has OTAA keys to join network. To connect a local LoRaWAN network, user just need to input the OTAA keys in the network server and power on the LT. It will auto join the network via OTAA.

In case user can't set the OTAA keys in the network server and has to use the existing keys from server. User can [use AT Command](#) to set the keys in the devices.

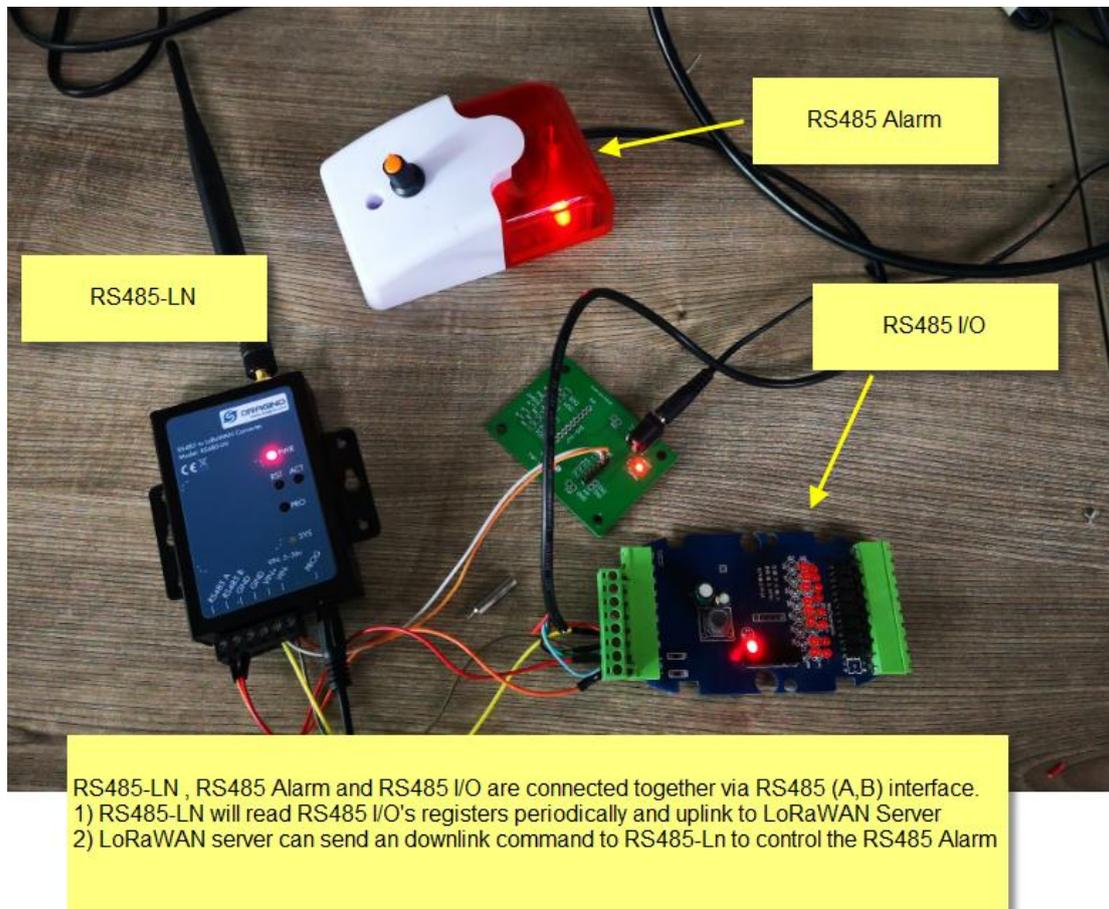
3.2 Example to join LoRaWAN network

Here shows an example for how to join the TTN Network. Below is the network structure, we use our LG308 as LoRaWAN gateway here.

Use LT33222 + LG308 in TTN network



The RS485-LN in this example connected to two RS485 devices for demonstration, user can connect to other RS485 devices via the same method. The connection is as below:



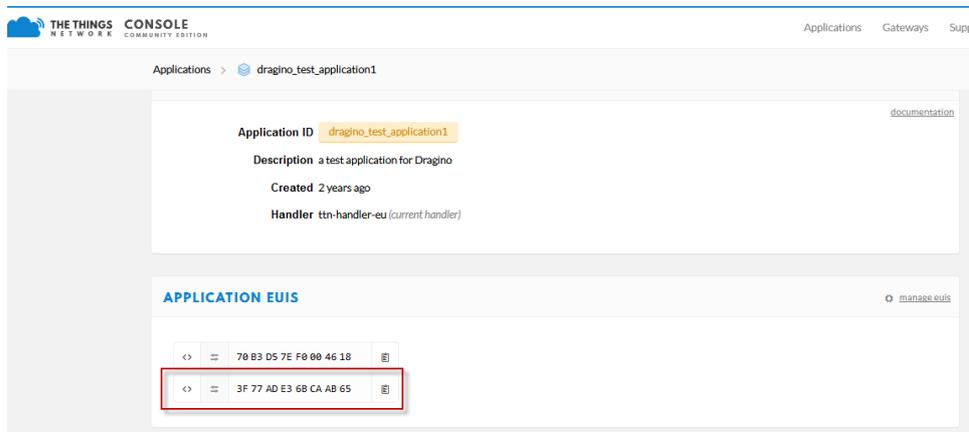
The LG308 is already set to connect to [TTN network](#). So what we need to now is only configure the TTN:

Step 1: Create a device in TTN with the OTAA keys from RS485-LN.

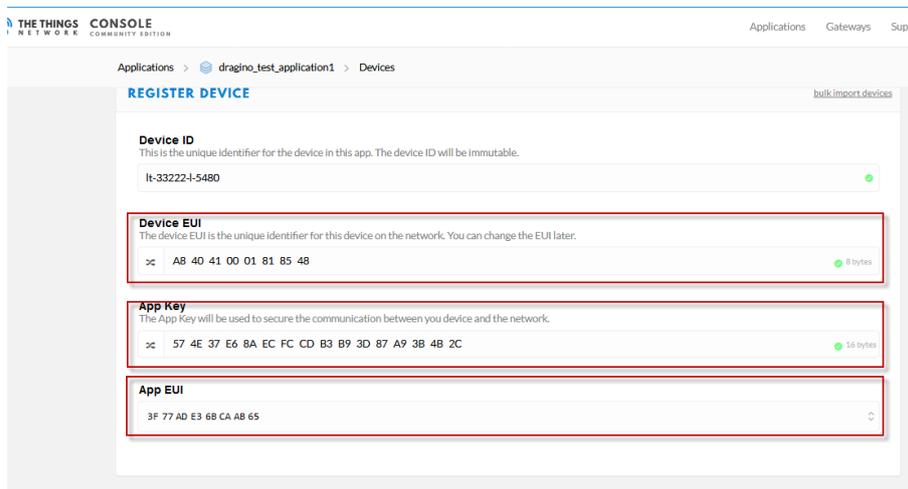
Each RS485-LN is shipped with a sticker with unique device EUI:



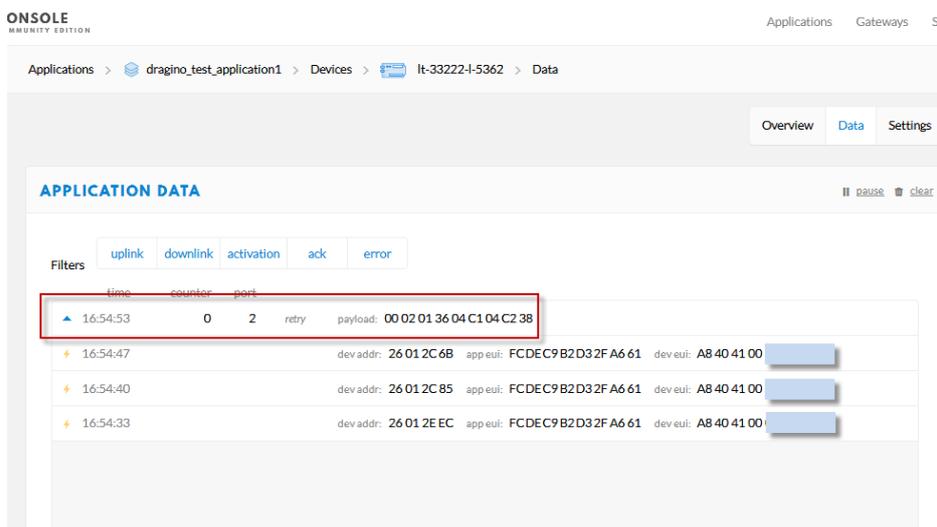
User can enter this key in their LoRaWAN Server portal. Below is TTN screen shot:
Add APP EUI in the application.



Add APP KEY and DEV EUI



Step 2: Power on RS485-LN and it will auto join to the TTN network. After join success, it will start to upload message to TTN and user can see in the panel.



3.3 Configure Commands to read data

There are plenty of RS485 devices in the market and each device has different command to read the valid data. To support these devices in flexible, RS485-LN supports flexible command set. User can use AT Commands to configure what commands RS485-LN should send for each sampling and how to handle the output from RS485 devices.

The AT Commands include:

| AT Commands | Description | Example |
|--------------|--|--|
| AT+BAUDR | Set the baud rate to communicate with RS485 device. Default Value is: 9600. | AT+BAUDR=9600 Options: (1200,2400,4800,14400,19200,115200) |
| AT+CFGDEV | This command is used to configure the RS485 devices; they won't be used during sampling. AT+CFGDEV=xx xx xx xx xx xx xx xx xx xx,m m: 0: no CRC, 1: add CRC-16/MODBUS in the end of this command | AT+CFGDEV=xx xx xx xx xx xx xx xx xx xx xx xx,m |
| AT+COMMAND1 | This command will be sent to RS485 devices during each sampling. AT+COMMAND1=xx xx xx xx xx xx xx xx xx xx,m m: 0: no CRC, 1: add CRC-16/MODBUS in the end of this command | |
| AT+DATA CUT1 | Get valid data from COMMAND1 return AT+DATA CUT1=a,b,c: a: total length of return string. b: start position for valid string. c: stop position of valid string. | If return1 is: 01 02 01 20 a0 00 AT+DATA CUT1=6,4,4 will get the 4 th byte, which is 0x20 |
| AT+COMMAND2 | This command will be sent to RS485 devices during each sampling. AT+COMMAND2=xx xx xx xx xx xx xx xx xx xx,m m: 0: no CRC, 1: add CRC-16/MODBUS in the end of this command | |
| AT+DATA CUT2 | Get valid data from COMMAND2 return AT+DATA CUT2=a,b,c: a: total length of return string. b: start position for valid string. c: stop position of valid string. | If return2 is: 01 01 01 00 a0 00 AT+DATA CUT2=6,4,4 will get the 4 th byte, which is 0x20 |
| AT+DATA CAT | Connect the result of Command1 and Command2: AT+DATA CAT=x,y Connect x&y. | |

| Connect y&x. | |
|--------------|------------------------------------|
| AT+PAYLOAD | Set PAYLOAD version (size: 1 byte) |

Command1 and Command2 will auto run before each uplink.

In this example, we use command1 to get the RS485 IO's DI status, use command2 to get the RS485 IO's DO status.

The RS485 I/O we use here use Modbus RTU to communicate.

- ✓ The command to get DI status is: 01 02 00 40 00 08 78 18. Where 01 02 00 40 00 08 is the Modbus command to read the register 00 40 where stored the DI status. The 78 18 is the CRC-16/MODBUS which calculate manually.
And RS485 I/O will return: 01 02 01 20 a0 00, where 20 here is the value for DI status.
- ✓ The command to get DO status is: 01 01 00 20 00 08 3C 06. Where 01 01 00 20 00 08 is the Modbus command to read the register 00 40 where stored the DI status. The 3C 06 is the CRC-16/MODBUS which calculate manually.
And RS485 I/O will return: 01 01 01 00 51 00, where 00 is the value for DO status.

We want to get the DI status & DO status from RS485 IO and upload to LoRaWAN server, we might have different RS485-LN to connect to different RS485 devices and upload different payloads, so it will be good to use different Payload Version to tell the LoRaWAN server what devices we have connected.

Below are the commands we need to set in RS485-LN:

`AT+PAYVER=2 // Set Payload version to 2 (0x02)`

`AT+COMMAND1=01 02 00 40 00 08,1 // Send 01 02 00 40 00 08 to RS485 network, add CRC-16/MODBUS at the end.`

`AT+DATACUT1=6,4,4 // get 6 bytes from the return, and choose the 4th byte as the valid payload for command 1`

`AT+COMMAND2=01 01 00 20 00 08,1 // Send 01 01 00 20 00 08 to RS485 network, add CRC-16/MODBUS at the end.`

`AT+DATACUT2=6,4,4 // get 6 bytes from the return, and choose the 4th byte as the valid payload for command 2`

`AT+DATA CAT=1,2 // Link valid payload1 and valid payload2.`

Final Payload to be uplink will be:

`PAYVER + CMD1 VALID RETURN + CMD2 VALID RETURN`

| | | |
|--|----|---------|
| A8 mm xx xx xx xx xx mm: 1: add CRC-16/MODBUS ; 0: no CRC xx: The command want to sent | | |
| Set Command1 (Same as AT+COMMAND1) A9 mm xx xx xx xx xx mm: 1: add CRC-16/MODBUS ; 0: no CRC xx: The command1 to be sent. | A9 | Not fix |
| Cut command1 (Same as AT+DATA CUT1): AA mm nn kk mm: total length nn:start kk:end | AA | 4 |
| Set Command2 (Same as AT+COMMAND2) A9 mm xx xx xx xx xx mm: 1: add CRC-16/MODBUS ; 0: no CRC xx: The command1 to be sent. | AB | Not fix |
| Cut command2 (Same as AT+DATA CUT2): AA mm nn kk mm: total length nn:start kk:end | AC | 4 |
| Cat command (Same as AT+DATA CAT) AD mm nn mm:start nn:end | AD | 3 |
| PAYLOAD_VER (Same as AT+PAYVER) AE kk KK:version | AE | 2 |

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

Example Downlink payload setting in TTN:

DOWNLINK

Scheduling

replace first last

FPort

2

Confirmed

Payload

bytes fields 01 00 00 3C 4 bytes

Type Code 0x04

If payload = 0x04FF, it will reset the RS485-LN.

Type Code 0x08

If payload = 0x08FF, RS485-LN will immediately send an uplink.

Type Code 0xA8

0xA8 downlink command can be used to control the RS485 devices via LoRaWAN.

For example,

The RS485 Alarm we use here use Modbus RTU to communicate.

- ✓ The command to active alarm is: 0A 05 00 04 00 01 4C B0. Where 0A 05 00 04 00 01 is the Modbus command to read the register 00 40 where stored the DI status. The 4C B0 is the CRC-16/MODBUS which calculate manually.
- ✓ The command to deactivate alarm is: 0A 05 00 04 00 00 8D 70. Where 0A 05 00 04 00 00 is the Modbus command to read the register 00 40 where stored the DI status. The 8D 70 is the CRC-16/MODBUS which calculate manually.

So if user want to use downlink command to control to RS485 Alarm, he can use:

A8 01 0A 05 00 04 00 01 : to activate the RS485 Alarm

A8 01 0A 05 00 04 00 00: to deactivate the RS485 Alarm

A8 is type code and 01 means add CRC-16/MODBUS at the end.

3.6 Buttons

| Button | Feature |
|--------|---|
| ACT | If RS485 joined in network, press this button for more than 1 second, RS485 will upload a packet, and the SYS LED will give a Blue blink |
| RST | Reboot RS485 |
| PRO | Use for upload image, see How to Update Image |

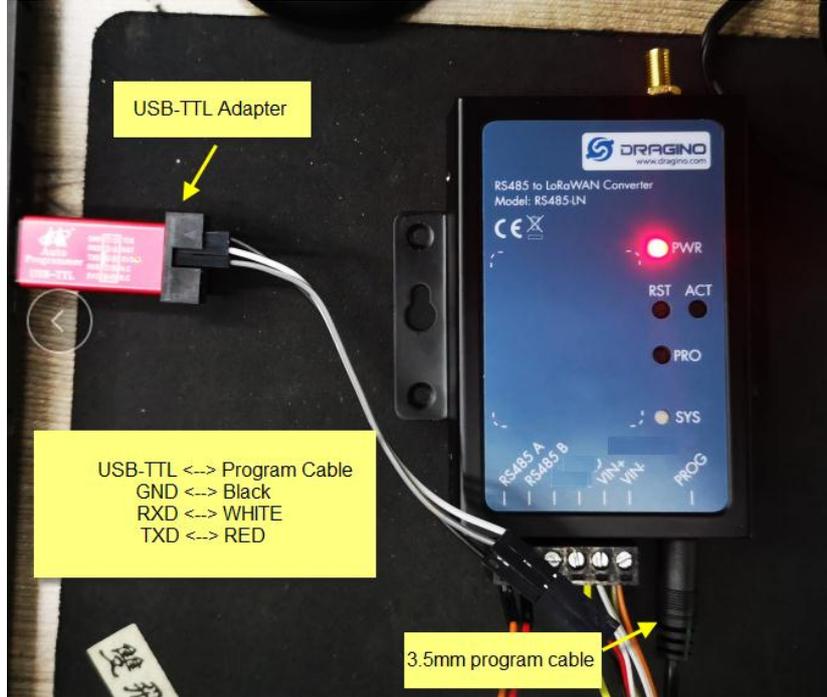
3.7 LEDs

| LEDs | Feature |
|------|---|
| PWR | Always on |
| RST | Reboot RS485 |
| PRO | Use for upload image, see How to Update Image |

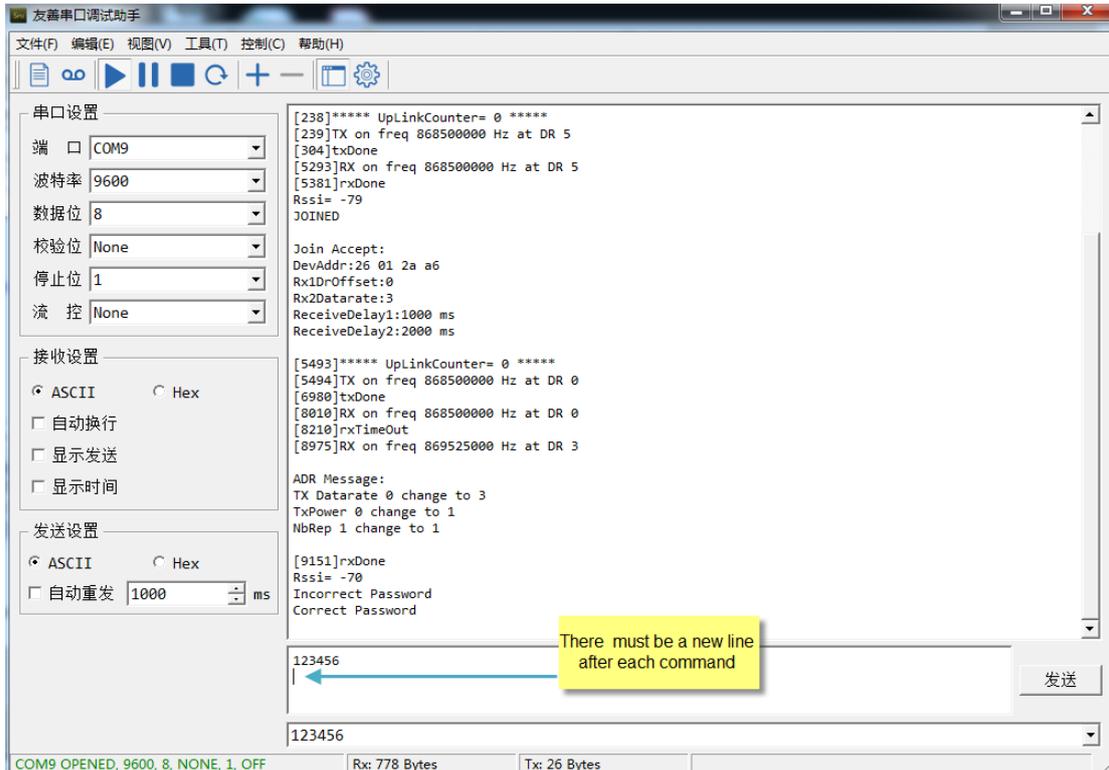
4. Use AT Command

4.1 Access AT Command

RS485-LN supports AT Command set. User can use a USB to TTL adapter plus the 3.5mm Program Cable to connect to RS485-LN to use AT command, as below.



In PC, User needs to set **serial tool**(such as [putty](#), SecureCRT) baud rate to **9600** to access to access serial console of RS485-LN. Below is the output for reference:



More detail AT Command manual can be found at [AT Command Manual](#)

4.2 Common AT Command Sequence

4.2.1 Multi-channel ABP mode (Use with SX1301/LG308)

If device has not joined network yet:

```
123456
AT+FDR
123456
AT+NJM=0
ATZ
```

If device already joined network:

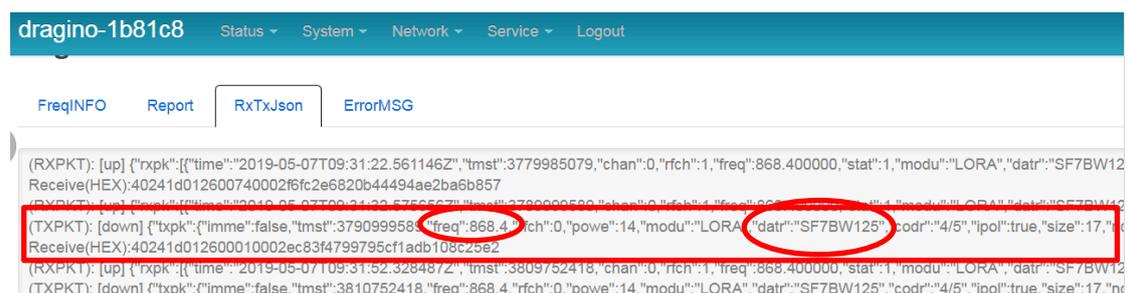
```
AT+NJM=0
ATZ
```

4.2.2 Single-channel ABP mode (Use with LG01/LG02)

```
123456 Enter Password to have AT access.
AT+FDR Reset Parameters to Factory Default, Keys Reserve
123456 Enter Password to have AT access.
AT+CLASS=C Set to work in CLASS C
AT+NJM=0 Set to ABP mode
AT+ADR=0 Set the Adaptive Data Rate Off
AT+DR=5 Set Data Rate
AT+TDC=60000 Set transmit interval to 60 seconds
AT+CHS=868400000 Set transmit frequency to 868.4Mhz
AT+RX2FQ=868400000 Set RX2Frequency to 868.4Mhz (according to the result from server)
AT+RX2DR=5 Set RX2DR to match the downlink DR from server. see below
AT+DADDR=26 01 1A F1 Set Device Address to 26 01 1A F1, this ID can be found in the LoRa
Server portal.
ATZ Reset MCU
```

Note:

1. Make sure the device is set to ABP mode in the IoT Server.
2. Make sure the LG01/02 gateway RX frequency is exactly the same as AT+CHS setting.
3. Make sure SF / bandwidth setting in LG01/LG02 match the settings of AT+DR. refer [this link](#) to see what DR means.
4. The command AT+RX2FQ and AT+RX2DR is to let downlink work. to set the correct parameters, user can check the actually downlink parameters to be used. As below. Which shows the RX2FQ should use 868400000 and RX2DR should be 5



5. FAQ

5.1 How to upgrade the image?

The RS485-LN LoRaWAN Controller is shipped with a 3.5mm cable, the cable is used to upload image to RS485-LN to:

- ✓ Support new features
- ✓ For bug fix
- ✓ Change LoRaWAN bands.

Below shows the hardware connection for how to upload an image to RS485-LN:



Step1: Download [flash loader](#).

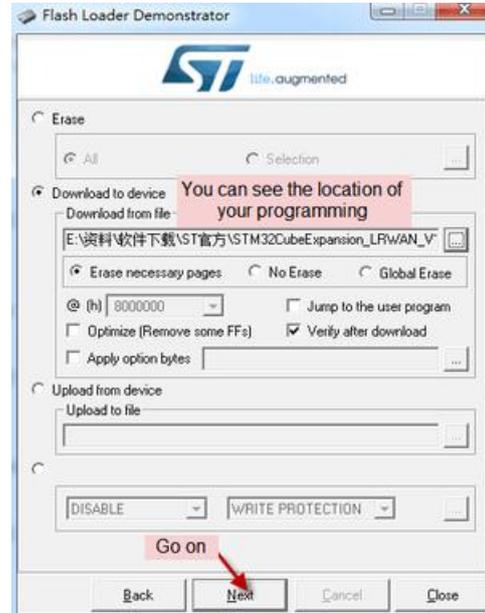
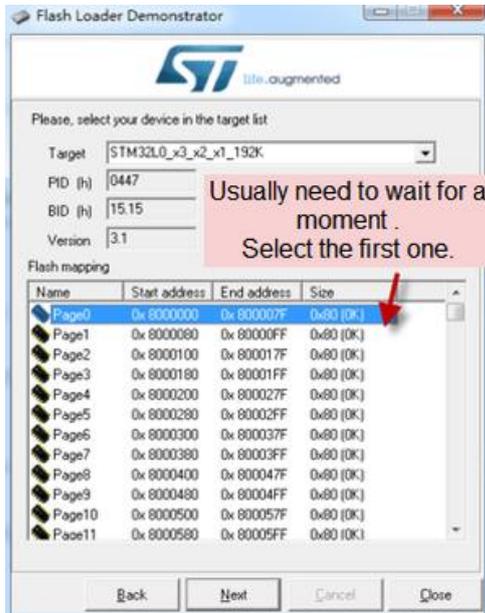
Step2: Download the [LT Image files](#).

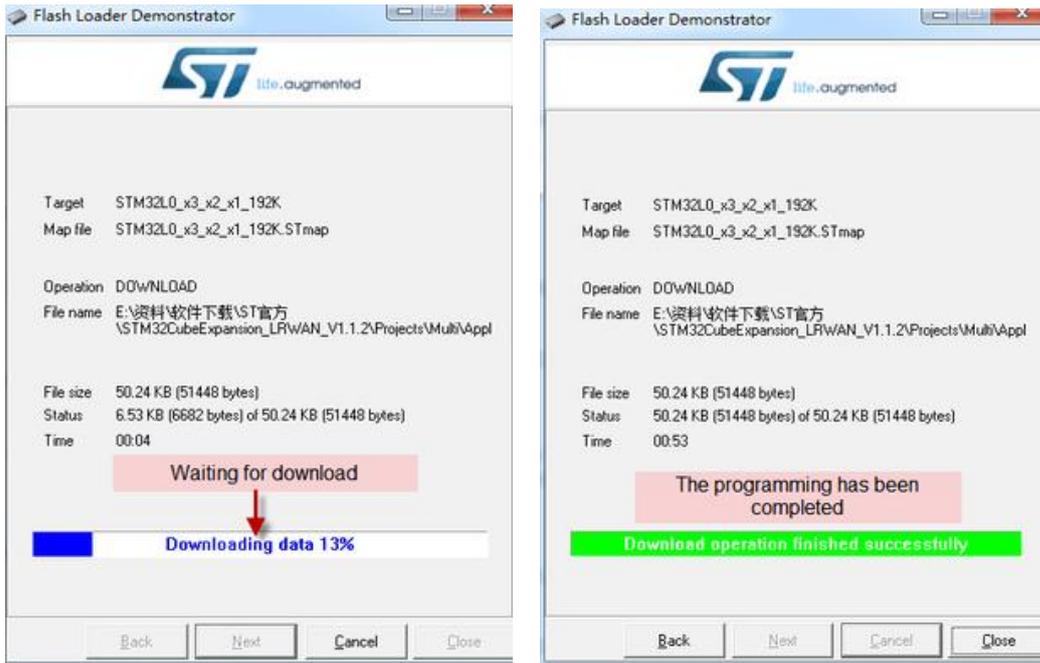
Step3: Open flashloader; choose the correct COM port to update.

Hold down the PRO button and then momentarily press the RST reset button and the SYS led will change from OFF to ON, While SYS LED is RED ON, it means the RS485-LN is ready to be program.



Board detected





Notice: In case user has lost the program cable. User can hand made one from a 3.5mm cable. The pin mapping is:



5.2 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.

5.3 How to set up RS485-LN to work in other 8 channel mode in US915, AU915, CN470 bands?

By default, the frequency bands US915, AU915, CN470 works in 8~15 (CHE=2) frequencies. User can set to the frequencies to work in other channels, by using the AT+CHE command.

For example, in US915 band, the frequency table is as below. By default, end node will use all channels (8~15) for OTAA Join process. After OTAA JOINED, end node will use these channels (8~15) to send uplink packets.

| CHE | US915 Uplink Channels(125KHz,4/5,Unit:MHz,CHS=0) | | | | | | | | |
|-----|--|-------|-------|-------|-------|-------|-------|-------|---------------|
| 0 | ENABLE Channel 0-63 | | | | | | | | |
| 1 | 902.3 | 902.5 | 902.7 | 902.9 | 903.1 | 903.3 | 903.5 | 903.7 | Channel 0-7 |
| 2 | 903.9 | 904.1 | 904.3 | 904.5 | 904.7 | 904.9 | 905.1 | 905.3 | Channel 8-15 |
| 3 | 905.5 | 905.7 | 905.9 | 906.1 | 906.3 | 906.5 | 906.7 | 906.9 | Channel 16-23 |
| 4 | 907.1 | 907.3 | 907.5 | 907.7 | 907.9 | 908.1 | 908.3 | 908.5 | Channel 24-31 |
| 5 | 908.7 | 908.9 | 909.1 | 909.3 | 909.5 | 909.7 | 909.9 | 910.1 | Channel 32-39 |
| 6 | 910.3 | 910.5 | 910.7 | 910.9 | 911.1 | 911.3 | 911.5 | 911.7 | Channel 40-47 |
| 7 | 911.9 | 912.1 | 912.3 | 912.5 | 912.7 | 912.9 | 913.1 | 913.3 | Channel 48-55 |
| 8 | 913.5 | 913.7 | 913.9 | 914.1 | 914.3 | 914.5 | 914.7 | 914.9 | Channel 56-63 |
| | Channels(500KHz,4/5,Unit:MHz,CHS=0) | | | | | | | | |
| | 903 | 904.6 | 906.2 | 907.8 | 909.4 | 911 | 912.6 | 914.2 | Channel 64-71 |

When user uses the TTN network, the US915 frequency bands use are:

- ✓ 903.9 - SF7BW125 to SF10BW125
- ✓ 904.1 - SF7BW125 to SF10BW125
- ✓ 904.3 - SF7BW125 to SF10BW125
- ✓ 904.5 - SF7BW125 to SF10BW125
- ✓ 904.7 - SF7BW125 to SF10BW125
- ✓ 904.9 - SF7BW125 to SF10BW125
- ✓ 905.1 - SF7BW125 to SF10BW125
- ✓ 905.3 - SF7BW125 to SF10BW125
- ✓ 904.6 - SF8BW500

If user want to hopping is all channels. , user can access the device via AT Command and run:

AT+CHE=0

ATZ

to set the end node to work in all 72 channel mode.

AU915 is similar. Below is the AU915 Uplink Channels.

| CHE | AU915 Uplink Channels(125KHz,4/5,Unit:MHz,CHS=0) | | | | | | | | |
|-------------------------------------|--|-------|-------|-------|-------|-------|-------|-------|---------------|
| 0 | ENABLE Channel 0-63 | | | | | | | | |
| 1 | 915.2 | 915.4 | 915.6 | 915.8 | 916 | 916.2 | 916.4 | 916.6 | Channel 0-7 |
| 2 | 916.8 | 917 | 917.2 | 917.4 | 917.6 | 917.8 | 918 | 918.2 | Channel 8-15 |
| 3 | 918.4 | 918.6 | 918.8 | 919 | 919.2 | 919.4 | 919.6 | 919.8 | Channel 16-23 |
| 4 | 920 | 920.2 | 920.4 | 920.6 | 920.8 | 921 | 921.2 | 921.4 | Channel 24-31 |
| 5 | 921.6 | 921.8 | 922 | 922.2 | 922.4 | 922.6 | 922.8 | 923 | Channel 32-39 |
| 6 | 923.2 | 923.4 | 923.6 | 923.8 | 924 | 924.2 | 924.4 | 924.6 | Channel 40-47 |
| 7 | 924.8 | 925 | 925.2 | 925.4 | 925.6 | 925.8 | 926 | 926.2 | Channel 48-55 |
| 8 | 926.4 | 926.6 | 926.8 | 927 | 927.2 | 927.4 | 927.6 | 927.8 | Channel 56-63 |
| Channels(500KHz,4/5,Unit:MHz,CHS=0) | | | | | | | | | |
| | 915.9 | 917.5 | 919.1 | 920.7 | 922.3 | 923.9 | 925.5 | 927.1 | Channel 64-71 |

5.4 How to set up RS485-LN to work with Single Channel Gateway such as LG01/LG02?

In this case, users need to set RS485-LN to work in ABP mode & transmit in only one frequency. Assume we have a LG02 working in the frequency 868400000 now , below is the step.

Step1: Log in TTN, Create an ABP device in the application and input the network session key (NETSKEY), app session key (APPSKEY) from the device.

The screenshot shows the TTN Console interface for configuring a device. The device is named 'dragino_test_application1' and is in 'ABP' mode. The configuration fields are as follows:

- Application ID: dragino_test_application1
- Device ID: 23232
- Description: LT-33222-L-5645
- Activation Method: ABP
- Device EUI: 00 B9 14 BE 07 0A 90 34
- Application EUI: 70 B3 D5 7E F0 00 46 18
- Device Address: 26 01 1A F1
- Network Session Key: DD 86 97 F6 BD 8E 7F 43 CE 69 44 4F 26 64 16 41
- App Session Key: 78 48 B2 5C D6 BE 8B 2F 8B C8 47 88 13 21 FE 14

A yellow callout box states: "In ABP mode, The device Address, Network Session Key, App Session Key must match between the End Node and LoRaWAN server".

Note: user just need to make sure above three keys match, User can change either in TTN or Device to make them match. In TTN, NETSKEY and APPSKEY can be configured by user in setting page, but Device Addr is generated by TTN.

Step2: Run AT Command to make LT work in Single frequency & ABP mode. Below is the AT commands:

```
123456 Enter Password to have AT access.
AT+FDR Reset Parameters to Factory Default, Keys Reserve
123456 Enter Password to have AT access.
AT+NJM=0 Set to ABP mode
AT+ADR=0 Set the Adaptive Data Rate Off
AT+DR=5 Set Data Rate (Set AT+DR=3 for 915 band)
AT+TDC=60000 Set transmit interval to 60 seconds
AT+CHS=868400000 Set transmit frequency to 868.4Mhz
AT+DADDR=26 01 1A F1 Set Device Address to 26 01 1A F1
ATZ Reset MCU
```

As shown in below:

```
***** UpLinkCounter= 0 *****
TX on Freq 865402500 Hz at DR 5
txDone
Correct Password
rxTimeout
AT+rxTimeout
FD
***** UpLinkCounter= 0 *****
TX on Freq 865402500 Hz at DR 5
txDone
R
DRAGINO LT-33222-L Device
Image Version: v1.0
Frequency Band: IN865
DevEui= A8 40 41 00 01 81 85 EE
Enter Password to Active AT Commands

Please set the parameters or reset Device to apply change
Correct Password
AT+NJM=0
OK
AT+ADR=0
OK
AT+DR=5
OK
AT+TDC=60000
OK
AT+CHS=868400000
OK
AT+DADDR=26 01 1A F1
OK
ATZ
DRAGINO LT-33222-L Device
Image Version: v1.0
Frequency Band: IN865
DevEui= A8 40 41 00 01 81 85 EE
Enter Password to Active AT Commands

JOINED

***** UpLinkCounter= 0 *****
TX on Freq 868400000 Hz at DR 5
txDone
rxTimeout
rxTimeout
```

6. Trouble Shooting

6.1 Downlink doesn't work, how to solve it?

By default, LT will open two RX windows to get downlink message after uplink. If the server's radio parameter is not match with the radio parameters in downlink, the downlink message won't arrive. And in UART access to LT, user will see below message:

```
txDone
rxTimeout
rxTimeout
```

If user see below output:

```
txDone
rxDone
rxTimeout
```

It means the downlink message arrive but not parse. In this case, user need to set FPORT=2 in the server side for downlink message.

6.2 Why I can't join TTN in US915 /AU915 bands?

It is about the channels mapping. Please see [this link](#) for detail.

7. Order Info

Part Number: RS485-LN-XXX

XXX:

- **EU433:** frequency bands EU433
- **EU868:** frequency bands EU868
- **KR920:** frequency bands KR920
- **CN470:** frequency bands CN470
- **AS923:** frequency bands AS923
- **AU915:** frequency bands AU915
- **US915:** frequency bands US915
- **IN865:** frequency bands IN865
- **CN779:** frequency bands CN779

8. Packing Info

Package Includes:

- ✓ RS485-LN x 1
- ✓ Stick Antenna for LoRa RF part x 1
- ✓ Program cable x 1

Dimension and weight:

- ✓ Device Size: 13.5 x 7 x 3 cm
- ✓ Device Weight: 105g
- ✓ Package Size / pcs : 14.5 x 8 x 5 cm
- ✓ Weight / pcs : 170g

9. Support

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

support@dragino.com

10. Reference

- ✧ [Product Page](#)
- ✧ [Image Download](#)
- ✧ [AT Command Manual](#)
- ✧ [Hardware Source](#)