



Comply Standard LoRaWAN protocol V1.0 LoRaWAN Gateway

Product Specification



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Note: Revision History

| Revision | Date | Comment |
|----------|--------|---------------|
| V1.0 | 2018-7 | First release |
| V1.1 | 2021-1 | Update format |
| | | |
| | | |

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1. Overview

LG1301-PF is the LoRaWAN gateway. It can work with any LoRaWAN node which comply Standard LoRaWAN protocol V1.0.

The gateway use linux platform as host. It mainly consists of concentrator ,GPS module ,WIFI and Ethernet. The GPS module send NMEA frames containing time and geographical coordinates data to the host. The GPS module also output one pulse to the sx1301 per second.

The gateway receives the RF data from nodes and sends to the server. It also receive data from the server and transmit to the nodes. The gateway connects to the server via Ethernet or WiFi.

2. Feature

- LoRaWAN protocol supported
- Uart interface
- AES128 encryption
- 8 channel communication simultaneously
- Configurable parameters

3. Application

- Smart city
- Smart Metering (Water, Electric, Gas meter)
- Agricultural Monitoring
- Irrigation control
- 4. Block Diagram

- GPS support
- Long range
- EU433M / EU868M / KR920M / AS923M /
- CN780M/ CN470M / US915M / AS915M
 - Internet of Things (IoT)
- M2M
- Wireless Sensors
- Wireless Alarm and Security Systems





5. Electrical Characteristics

| Parameter | Min | Min Typ. Max Unite Condition | | | | | | |
|-----------------------|-----------|------------------------------|-------|---------------|--------------------------|--|--|--|
| Working Condition | | | | | | | | |
| Working voltage range | 5 | 12 | 30 | V | | | | |
| Temperature voltage | -40 | | 85 | °C | | | | |
| Current Consumption | | | | | | | | |
| Receiving current | | <280 | | mA | @12v,9 channels all open | | | |
| Transmitting current | <450 | | mA | @12v,TX=24dBm | | | | |
| | Parameter | | | | | | | |
| | 429 | 433 | 440 | MHz | @433MHz | | | |
| _ | 470 | 480 | 490 | MHz | @470MHz | | | |
| Frequency range | 860.75 | 868.3 | 874.5 | MHz | @868MHz | | | |
| | 902 | 915 | 928 | MHz | @915MHz | | | |
| Output power | 0 | | 24 | dBm | | | | |
| Receiving sensitivity | | -133 | | dBm | @SF=10,,BW=125kHz | | | |

6. Function Description

1) Power on

Connect all the antennas to the corresponding SMA port. Connect the DC power supply and power up.

After powered on, the POWER LED will light on to indicate, the gateway start the initialization .

After 15s, the Linux system is ready, and then the Status LED will blink once per second to indicate the whole system is ready.

When the GPS works normaly and connect to the satellites, the GPS LED will blink once per second to indicate.

2) Communication

➢ Node and gateway

The Node must be added to the network before communicate with this gateway. The node will transmit the data to gateway, and received data from the gateway.

➢ Gateway and server

After connected to the server, the gateway will communicate with the server using the JSON Data Interchange Format. The detail of the communication protocol between gateway and server please refer to file LoRaWAN Network Server Demonstration: Gateway to Server Interface Definition.

3) Connect to server

Before communication, the gateway should connect to the internet via Ethernet or WIFI. It use the RJ45 for Ethernet.Use a network cable to connect the gateway to a router.

After power up, you should modify the server address and ports. And you need to open a UDP socket in your server to received the data send from the gateway. The gateway don't deal with the data received, it only forward it to the server. And you may need to build your server and implement the LoRaWAN protocol in the server side.

We don't develop server, so we use a public share server platform—TTN(The Things Network) to demonstrate the communication. The procedure please refer to file **Demonstration of communication between LoRaWAN gateway and server**.

4) Connect to WIFI

- Connect the gateway to a router use a network cable connect to the RJ45 port.
- Open the command prompt tool as below, path: Start > ALL Programs > Accessories > Command Prompt.



• Input ping nicerf and finish with ENTER, we can get the IP address of the gateway. As

example, it is 192.168.0.130.

| 哲理员: 命令提示符 日 回 | |
|---|---|
| Microsoft Windows [版本 6.1.7601] 版权所有 (c) 2009 Microsoft Corporation。保留所有权利。 | |
| C:\Users\Administrator>ping nicerf | |
| 正在 Ping nicerf [192.168.0.130] 具有 32 字节的数据: 来自 192.168.0.130 的回复: 字节=32 时间=1ms TTL=64 来自 192.168.0.130 的回复: 字节=32 时间=3ms TTL=64 来自 192.168.0.130 的回复: 字节=32 时间=5ms TTL=64 来自 192.168.0.130 的回复: 字节=32 时间=9ms TTL=64 | |
| 192.168.0.130 的 Ping 统计信息: 数据包: 已发送 = 4, 已接收 = 4, 丢失 = 0 <0% 丢失>, 往返行程的估计时间<以毫秒为单位>: 最短 = 1ms, 最长 = 9ms, 平均 = 4ms | |
| C:\Users\Administrator> | |
| | |
| 半: | - |

• After getting the IP address, we can remote login the gateway to modify the ssid and

password of the wifi.

a.

SSH, Telnet and Rlogin client Simon Tatham

to open the remote login tool **putty**.

- b. Input the IP we got in the last step. And click open.
- c. If a alert appear, ignore it and click Yes

Double click the icon

| ategory: | | |
|---|---|---|
| - Session | Basic options for your PuTTY session | WARNING - DOTENTIAL SECURITY RREACH |
| Logging Terminal Keyboard Bel Bel Peatures Window Appearance Behaviour Translation Selection Connection Data Proxy Teinet Riggin SSH Serial | Specify the destination you want to connect to Host Name (or IP address) Port 192.168.0.130 22 Connection type: Rlogin • SSH • S Load, save or delete a stored session Saved Sessions Default Settings Load Close window on exit: Always Always Never Only on clean exit | The server's host key does not match the one PuTTY has cached in the registry. This means that either the server administrator has changed the host key, or you have actually connected to another computer pretending to be the server. The new rsa2 key fingerprint is: ssh-rsa 2048 6c:92:4b:69:1b:7e:4e:00:15:c1:ef:e5:64:71:63:60 If you were expecting this change and trust the new key, hit Yes to update PuTTY's cache and continue connecting. If you want to carry on connecting but without updating the cache, hit No. If you want to abandon the connection completely, hit Cancel. Hitting Cancel is the ONLY guaranteed safe choice. |
| | | |

d. Prompt will appear, in the login as: input pi and ENTER, then input the password nicerf and ENTER. Then we login the gateway.



e. Copy this command and right click in the prompt to paste it . And input ENTER, the below screen will appear.

sudo vim /etc/wpa_supplicant/wpa_supplicant.conf

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| e [®] pi@nicerf: ~ | |
|---|-------|
| country=CN | A |
| ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev | |
| update_config=1 | |
| network={ | |
| ssid="TP-LINK_FBC2" | |
| psk="swwx1234" | |
| | |
| | |
| | |
| | |
| ~ | |
| ~ | |
| | |
| | |
| | |
| | E |
| | |
| | |
| | |
| | |
| ~ | |
| "/etc/wpa_supplicant/wpa_supplicant.conf" 8L, 139C 1,1 | A11 - |

f. Use the DOWN button and RIGHT button to make the cursor to the ssid="", input I button then we can change the ssid and psk. As example, the SSID is TP-LINK_FBC2, the PSK is swwx1234, you change these content corresponding to your own wifi.

Note: only after we input the I button, we can change the content, it will prompt the INSERT in the left bottom corner.



g. After modification, press ESC to exit the insert state, and then input :wq and



end with ENTER, we save the modification and exit.



• Input the below two command and end with ENTER to restart the wifi.

| sudo ifdown wlan0 | |
|--|------------|
| sudo ifup wlan0 | |
| pi@nicerf:~ \$ sudo vim /etc/wpa_supplicant/wpa_suppl: pi@nicerf:~ \$ sudo ifdown wlan0 pi@nicerf:~ \$ sudo ifup wlan0 pi@nicerf:~ \$ | icant.conf |



5) Setting mode

After powered up, press SET key to enter setting mode. The Status LED will be turned on to indicate.

Press SET key again to exit setting mode, the Status LED will blink once a second in normal mode.

In setting mode, we can use the Serial Port Tool to send HEX commands to set the radio parameters,

and send the AT commands to set the server patameters. The protocol please refer to UART Protocol

of NiceRF LoRaWAN Gateway (Packet Forwarder) v1.x.

6) Default parameters of gateway

➢ Uart parameter :

| Baud rate | Data bit | Parity bit | Stop bit |
|-----------|----------|------------|----------|
| 115200 | 8 | Ν | 1 |

➤ SX1301 configuration:

| Regional | EU433M | EU868M | KR920M | AS923M | CN780M |
|------------------------|---------|--------|--------|--------|--------|
| Min TX frequence | 430 | 865 | 920 | 920 | 778 |
| Max TX frequence | 440 | 875 | 930 | 930 | 788 |
| Radio_0 RX center freq | 433.575 | 868.50 | 922.30 | 923.60 | 779.90 |
| Radio_1 RX center freq | 434.175 | 869.10 | 922.90 | 924.20 | 780.90 |

| CN470M | US915M | AS915M |
|--------|--------|--------|
| 500 | 920 | 920 |

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LG1301-PF

| 510 | 930 | 930 |
|--------|-------|-------|
| 470.70 | 902.7 | 915.6 |
| 471.30 | 903.3 | 916.2 |

| Multiple SF Channel configuration | | | | | | | | |
|-----------------------------------|--------------|----------|----------|---------|---------------|--------|--------|--|
| channel | Enable | rf_chain | IF | | CH_Freq (Mhz) | | | |
| | (true/false) | (0 / 1) | (hz) | EU433M | EU868M | KR920M | AS923M | |
| CH0: | true | 0 | -400 000 | 433.175 | 868.10 | 921.90 | 923.20 | |
| CH1: | true | 0 | -200 000 | 433.375 | 868.30 | 922.10 | 923.40 | |
| CH2: | true | 0 | 0 | 433.575 | 868.50 | 922.30 | 923.60 | |
| CH3: | true | 1 | -400 000 | 433.775 | 868.70 | 922.50 | 923.80 | |
| CH4: | true | 1 | -200 000 | 433.975 | 868.90 | 922.70 | 924.00 | |
| CH5: | true | 1 | 0 | 434.175 | 869.10 | 922.90 | 924.20 | |
| CH6: | true | 1 | 200 000 | 434.375 | 869.30 | 923.10 | 924.40 | |
| CH7: | true | 1 | 400 000 | 434.575 | 869.50 | 923.30 | 924.60 | |

| Multiple SF Channel configuration | | | | | | | |
|-----------------------------------|---------------|--------|--------|--|--|--|--|
| | CH_Freq (Mhz) | | | | | | |
| CN780M | CN470M | US915M | AS915M | | | | |
| 779.50 | 470.30 | 902.3 | 915.2 | | | | |
| 779.70 | 470.50 | 902.5 | 915.4 | | | | |
| 779.90 | 470.70 | 902.7 | 915.6 | | | | |
| 780.50 | 470.90 | 902.9 | 915.8 | | | | |
| 780.70 | 471.10 | 903.1 | 916.0 | | | | |
| 780.90 | 471.30 | 903.3 | 916.2 | | | | |
| 781.10 | 471.50 | 903.5 | 916.4 | | | | |
| 781.30 | 471.70 | 903.7 | 916.6 | | | | |

| Standard LoRa Channel configuration | | | | | | | |
|-------------------------------------|--------------|----------|------|-----------|----|---------|--------|
| channel | Enable | rf_chain | IF | bandwidth | SF | Freq (| Mhz) |
| | (true/false) | (0 / 1) | (hz) | | | EU433M | EU868M |
| CH8: | false | 0 | 0 | 500k | 7 | 433.575 | 868.50 |

| Standard LoRa Channel configuration | | | | | |
|-------------------------------------|--------|--------|--------|--------|--------|
| Freq (Mhz) | | | | | |
| KR920M | AS923M | CN780M | CN470M | US915M | AS915M |
| 922.30 | 923.60 | 779.90 | 470.70 | 902.7 | 915.6 |

FSK Channel configuration



www.nicerf.com



| ahannal | Enable | rf_chain | IF | handwidth | datarata | Freq (N | ſhz) |
|--------------|--------------|----------|----------------|-----------|----------|---------|--------|
| (true/false) | (true/false) | (0 / 1) | (hz) bandwidth | uatarate | EU433M | EU868M | |
| CH9: | false | 1 | 300000 | 125k | 50000 | 434.475 | 869.40 |

| FSK Channel configuration | | | | | |
|---------------------------|--------|--------|--------|--------|--------|
| Freq (Mhz) | | | | | |
| KR920M | AS923M | CN780M | CN470M | US915M | AS915M |
| 921.20 | 924.50 | 781.20 | 471.60 | 903.6 | 916.5 |

Note: $CH_Freq = Radio_x_RX_center_freq + IF.$

Example, CH0 map to rf_chain 0 (radio 0), so it's Radio_x_RX_center_freq is 922.3 MHz, it's IF is -400 000 Hz. So the CH_Freq = 922.3 – 0.4 = 921.9 MHz.

 \succ Tx power table:

| TXLUT INDEX | TX POWER(dBm) | DIG | DAC | РА | MIX |
|----------------|------------------|-----|-----|----|-----|
| 0 | 1 | 0 | 3 | 1 | 12 |
| 1 | 3 | 0 | 3 | 1 | 14 |
| 2 | 5 | 0 | 3 | 2 | 10 |
| 3 | 7 | 0 | 3 | 2 | 11 |
| 4 | 9 | 0 | 3 | 2 | 12 |
| 5 | 10 | 0 | 3 | 2 | 13 |
| 6 | 12 | 0 | 3 | 2 | 14 |
| 7 | 14 | 0 | 3 | 3 | 10 |
| 8 | 16 | 0 | 3 | 3 | 11 |
| 9 | 18 | 0 | 3 | 3 | 12 |
| 10 | 20 | 0 | 3 | 3 | 13 |
| 11 | 23 | 0 | 3 | 3 | 15 |

Gateway configuration:

| server_address: | router.as1.thethings.network |
|-------------------|------------------------------|
| server_port_up: | 1700 |
| server_port_down: | 1700 |



7. Pin definition





| No. | Definition | Description |
|-----|----------------|---|
| 1 | SET | Press to enter/exit setting mode |
| 2 | Power input | 9~30V |
| 3 | RJ45 | Connect to the internet |
| 4 | Micro USB | Connect to PC for configuration |
| 5 | Power LED | Green LED, indication of powered on. |
| 6 | GPS LED | Green LED, indication of the GPS module is running. |
| 7 | Status LED | Light on in setting mode, and blinks once per second in normal mode |
| 8 | LoRaWAN ANT | Connected with Antenna for lora RF radio. |
| 9 | WiFi ANT | Connected with Antenna for WiFi. |
| 10 | GPS ANT | Connected with Antenna for GPS module. |



8. Mechanical dimension(Unit:mm)



9. Appendix

1. LoRaWAN Network Server Demonstration: Gateway to Server Interface Definition

2. Demonstration of communication between LoRaWAN gateway and server

3. UART Protocol of NiceRF LoRaWAN Gateway (Packet Forwarder) v1.x