

UM01649**IoT Discovery User Manual (RPi3)**

V3.2**Document Information**

Item	Content
Keyword	<i>LoRaWAN, UM, IoT, Wireless communication</i>
Abstract	This document describes how to use, test and configure RisingHF RHF2S001 IoT Discovery LoRa Kit

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1 Introduction

RisingHF IoT Discovery is a LoRa kit which integrates evaluation, development and quick test features which is designed by RisingHF. This document will describe the usage of IoT Discovery (RHF2S001) in details, include how to build up hardware, how to connect to a LoRaWAN network, how to test hardware and so on.

1.1 Product List

- 1 x Raspberry Pi
- 1 x RHF0M301
- 1 x RHF4T002
- 1 x RHF3M076
- 3 x RHF76-052
- 1 x USB to UART adapter
- 1 x 4 pin dual female splittable jumper wire
- 1 x SD Card
- 1 x 5V/2A Adapter
- 3 x USB cables
- 1 x Ethernet cable
- 2 x Antenna

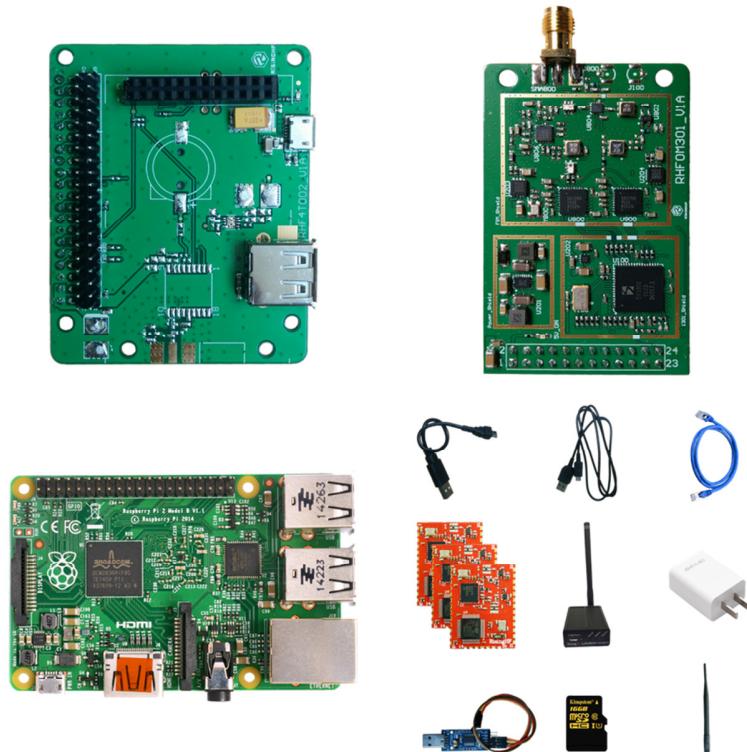


Figure 1 IoT Discovery Product list

2 Get started



Figure 2 RHF2S001 package

Open each box, and take out "RPi + RHF0M301 + RHF4T002", SD card is already burned RisingHF standard image. Please follow below description and pictures to connect the core gateway board.

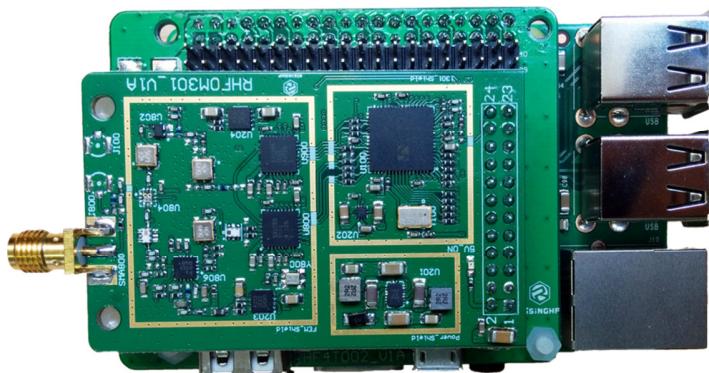


Figure 3 Raspberry Pi + RHF4T002 + RHF0M301 Top View

Definition of 4 connectors in below picture:

- **Yellow** Gateway kit main supply connector)
- **Red** USB Host connector, used to supply power for Raspberry Pi
- **Green** Raspberry Pi power input connector (Micro USB)
- **Blue** RPi Ethernet port

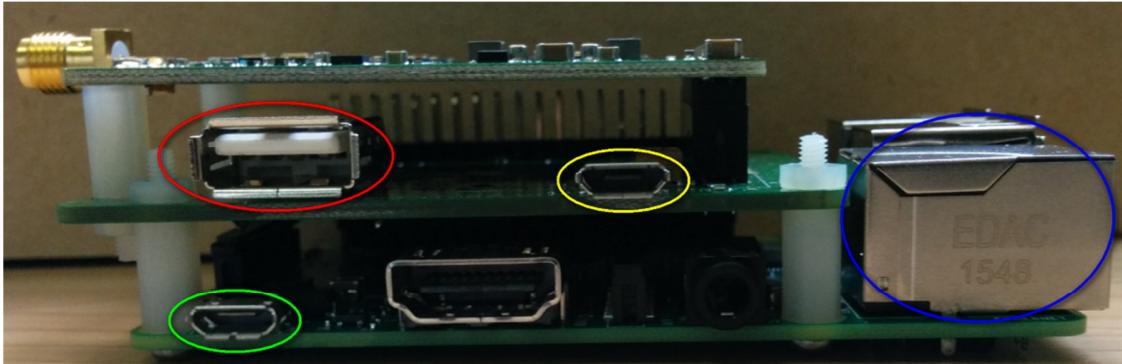


Figure 4 RPi+RHF4T002+RHF0M301 side view

Please follow below picture to connect short USB cable (15cm), long USB cable (1M) and 5V/2A adapter.



Figure 5 Connect USB Cables

2.1 USB Serial Tool

Follow below picture to connect FT232 USB to serial tool

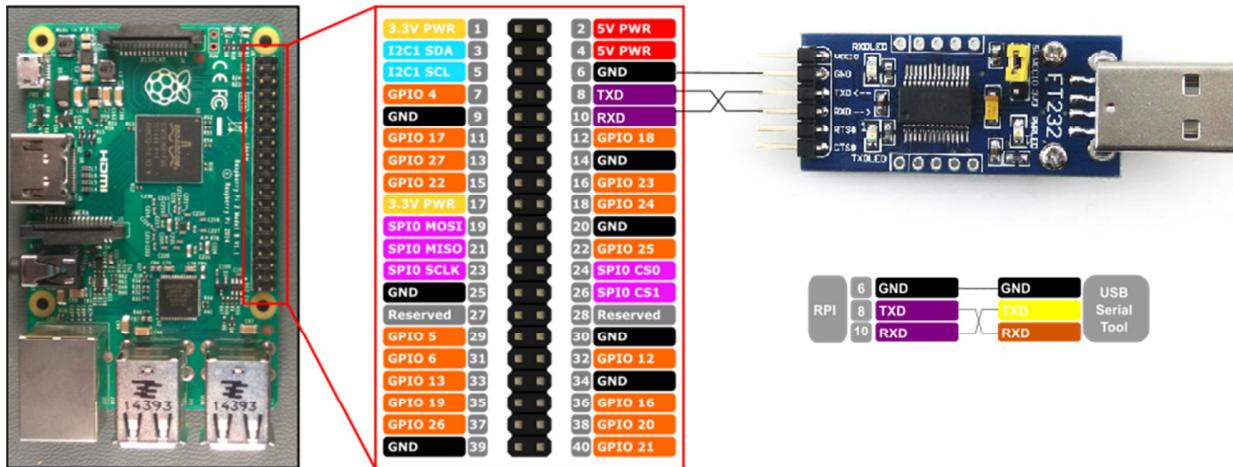


Figure 6 RPi and FT232 connection map

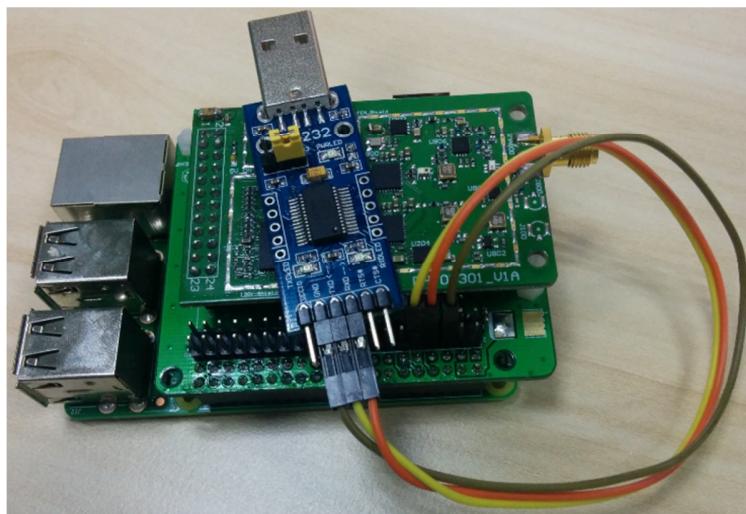


Figure 7 RPi and FT232 real product connections

2.2 Software Tools

In the following chapters, below tools will be needed, please install it to your computer¹:

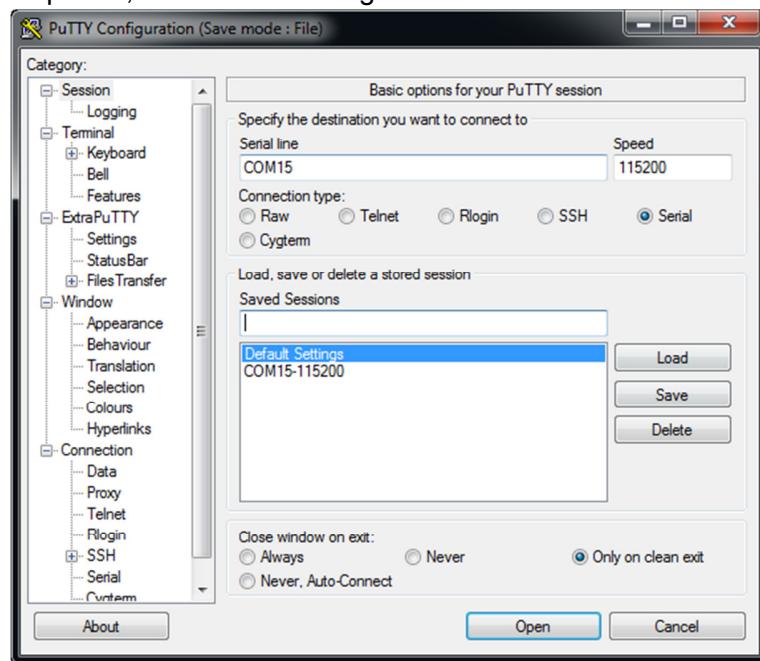
- SSCOM, portable serial tool, used to control RHF3M076
- ExtraPuTTY, terminal tool include both serial and SSH terminal, used to control RPi
- Internet browser, used to access RHF2S001 integrated LoRaWAN server (It is recommended to use Chrome or Firefox)

Please access [RisingHF Wiki Resources RHF2S001 Section](#) to download related tools. You may have your other favorite serial tools, if you have any trouble to use it, please make comparison test with the proposal tool.

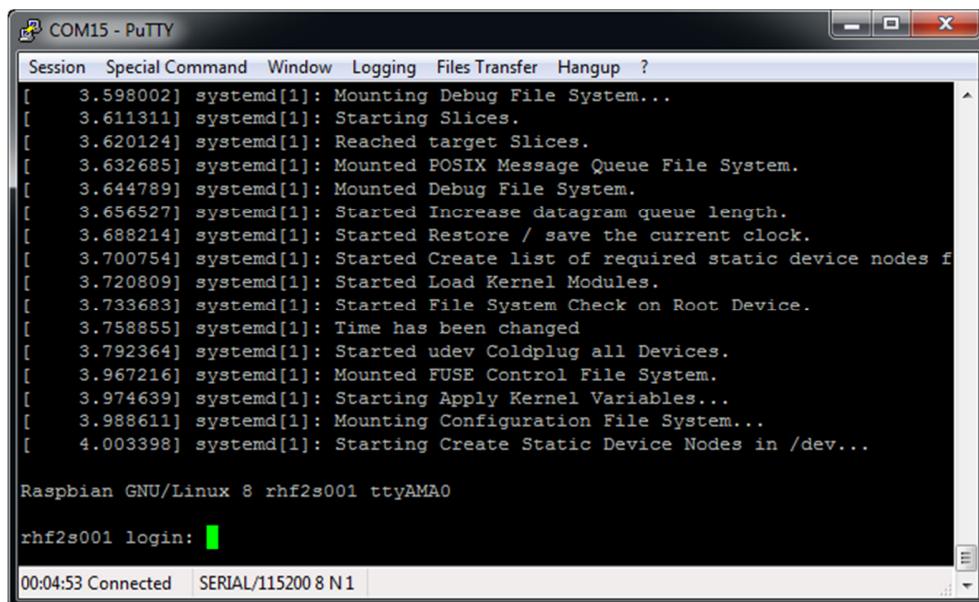
¹ This document assumes user use Windows operating system

2.3 Power Up

- First, make sure the serial tool and RPi (RHF4T002 Adapter) are connected correctly.
- Plug FT232 tool to PC (If COM port is not recognized correctly, please refer below driver installation chapter)
- Open “Device Manager” to get the right COM port. Like COM15 for example. Configure ExtraPuTTY according to below picture (Speed 115200, others use defaults), click “Open”. As the gateway is still not opened, so there is nothing in the terminal.



- Power the gateway up. Booting log will be showed in the ExtraPuTTY terminal, in the end it will prompt you to input your log in name. Please note it takes 1 or 2 minutes to get the prompt information.



- e) Please use RHF2S001 default user name and password to log in. (Username: **rxhf**, Password: **risinghf**). Note, when input the password, there is no any echo

A screenshot of a PuTTY terminal window titled "COM15 - PuTTY". The session log shows the following text:

```
[ 3.758855] systemd[1]: Time has been changed
[ 3.792364] systemd[1]: Started udev Coldplug all Devices.
[ 3.967216] systemd[1]: Mounted FUSE Control File System.
[ 3.974639] systemd[1]: Starting Apply Kernel Variables...
[ 3.988611] systemd[1]: Mounting Configuration File System...
[ 4.003398] systemd[1]: Starting Create Static Device Nodes in /dev...

Raspbian GNU/Linux 8 rhf2s001 ttyAMA0

rhf2s001 login: rxhf
Password:
Linux rhf2s001 4.1.19-v7+ #858 SMP Tue Mar 15 15:56:00 GMT 2016 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
rxhf@rhf2s001:~$
```

The password input is shown as plain text. The status bar at the bottom of the window shows "00:11:12 Connected SERIAL/115200 8 N 1".

- f) Connect RHF2S001 with router through ethernet cable
g) Run ifconfig to check the ip address and mac address. IP is in the red circle, MAC address is in white circle (Format: b8:27:eb:xx:xx:xx)

A screenshot of a PuTTY terminal window titled "COM15 - PuTTY". The session log shows the following text:

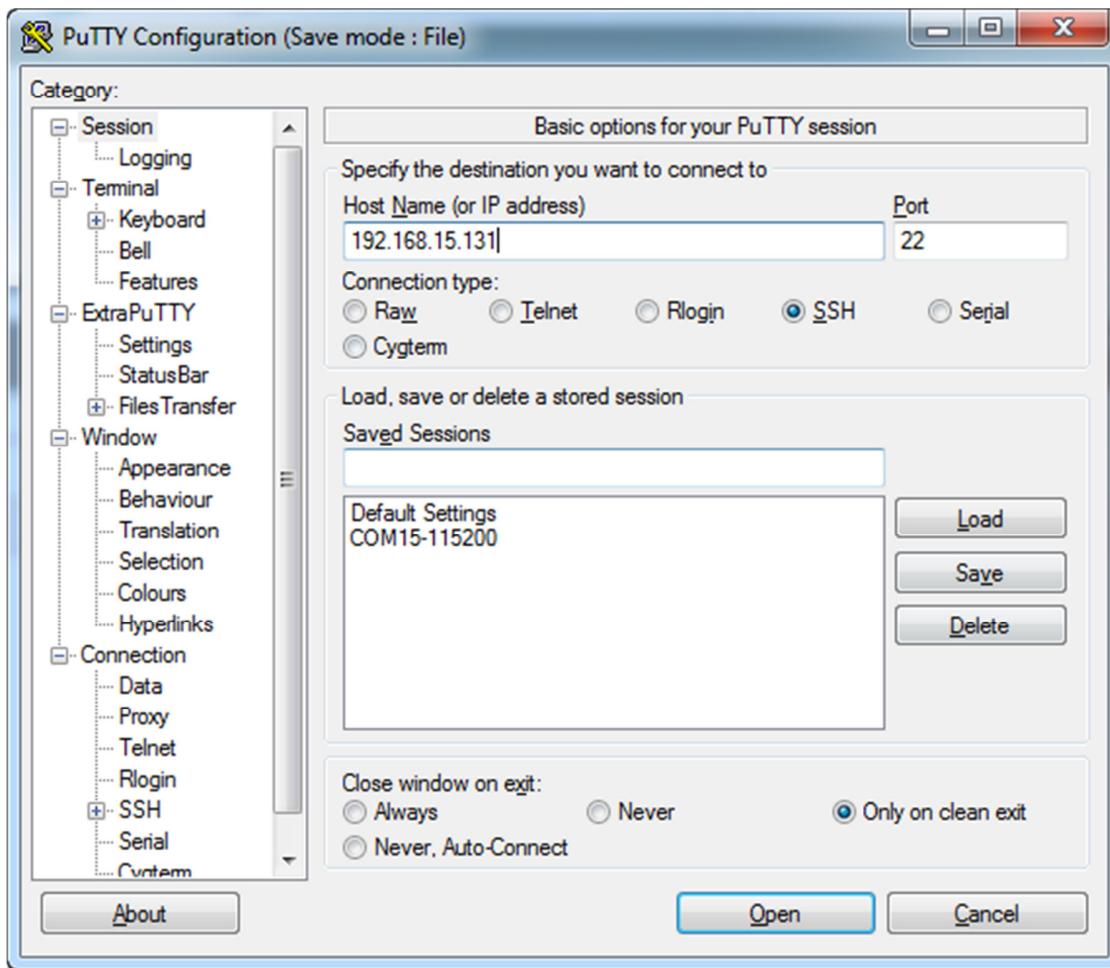
```
rxhf@rhf2s001:~$ ifconfig
eth0      Link encap:Ethernet HWaddr b8:27:eb:b8:27:eb
          inet addr:192.168.15.131 Bcast:192.168.15.255 Mask:255.255.255.0
          inet6 addr: fe80::eba3:a4c:5ef0:cf26/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:67 errors:0 dropped:0 overruns:0 frame:0
          TX packets:88 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:8707 (8.5 KiB) TX bytes:10383 (10.1 KiB)

lo       Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:23767 errors:0 dropped:0 overruns:0 frame:0
          TX packets:23767 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:1262086 (1.2 MiB) TX bytes:1262086 (1.2 MiB)

rxhf@rhf2s001:~$
```

The IP address (192.168.15.131) and MAC address (b8:27:eb:xx:xx:xx) are highlighted with red and white circles respectively. The status bar at the bottom of the window shows "00:16:54 Connected SERIAL/115200 8 N 1".

After you get the IP, it is recommended to login RHF2S001 again through SSH. Because SSH is faster (Ethernet than UART) and stable. We normally use serial tool to get the IP. Reopen ExtraPuTTY input the IP and use default port 22 to connect again.



- h) Please note, the RHF2S001 connects to internal server by default. The following chapter will show you how to use the internal server.

2.4 Expand SD Card File System

By default, the image enables only 2GB for Raspbian System, it is recommended to expand to use the whole SD card (8GB or 16GB). Or the SD card will be full soon.

Run below command to start raspi-config,

```
sudo raspi-config
```

Choose "Expand Filesystem", when finished reboot to make it effect. Run command "df -h" to know to SD card capacity and usage.

Please refer to Raspberry Pi raspi-config tool instruction for details.

<https://www.raspberrypi.org/documentation/configuration/raspi-config.md>

3 Use RHF2S001 integrated LoRaWAN server

3.1 Connect Gateway with internal server

Run below commands, and check the status:

```
sudo systemctl status pktfwd
```

If pktfwd service is not active, run below command to start it:

```
sudo systemctl enable pktfwd  
sudo systemctl restart pktfwd
```

3.2 Frequency Plan

3.2.1 Change Frequency Plan

```
cd ~/risinghf/pktfwd
```

Run either of below four commands to select needed frequency plan:

CN470

```
ln -sf global_conf_cn470.json global_conf.json
```

CN433

```
ln -sf global_conf_cn433.json global_conf.json
```

AS920

```
ln -sf global_conf_as920.json global_conf.json
```

EU868

```
ln -sf global_conf_eu868.json global_conf.json
```

Detailed channel definition:

	CN433	CN470	AS920	EU868
CH0	433.3	471.5	921.5	867.1
CH1	433.5	471.7	921.7	867.3
CH2	433.7	471.9	921.9	867.5
CH3	433.9	472.1	922.1	867.7
CH4	434.1	472.3	922.3	867.9
CH5	434.3	472.5	922.5	868.1
CH6	434.5	472.7	922.7	868.3
CH7	434.7	472.9	922.9	868.5

Restart gateway service to make new updated configuration valid:

```
sudo systemctl restart pktfwd
```

3.2.2 Access Internal Server Console

Access ip of your gateway to get the web server console, which is showed as below:

3.2.3 ABP Mode

- a) Use SSCom to get device ID

```
at+id
+ID: DevAddr, 00:82:2c:96
+ID: DevEui, 47:97:c5:34:90:1d:00:48
+ID: AppEui, 52:69:73:69:6e:67:48:46
```

- b) Create a new application at Applications page, fill into Name, Owner and EUI, among them EUI is 8 bytes hexadecimal number

Applications

Below is a list of LoRa applications on the network. Use the fields at the top to set up a new one on the server.

Name	Owner	EUI (AppEUI)	Configured Motes
New: rhf3m076	rxhf	0000000000000001	Add
defaultApp	[Unknown]	00-00-00-00-00-00-00	Delete 0
null	[Unknown]	FF-FF-FF-FF-FF-FF-FE	Delete 0

- c) When finished, click button behind application to configure device.

rfh3m076 Motes

Below are the motes configured for this application. A new one may be commissioned using over-the-air protocol or personalisation.

Text Size A A
Print

Over-the-Air Motes

Motes ordinarily join the network by negotiating with the server using an application key. Enter this key below to prepare the server.

Mote (DevEUI)	Application Key (AppKey)
New: <input type="text"/>	<input type="text"/> <input type="button" value="Add"/>

Personalised Motes

Personalised motes are configured with the network address, application session key and network session key already present, so they are ready to communicate on the network. Enter these same details below to prepare the server.

Mote (DevEUI)	Network Address (DevAddr)	Application Session Key (AppSKey)	Network Session Key (NwkSKey)
New: <input type="text"/>	<input type="text"/>	<input type="text"/> <input type="button" value="Add"/>	<input type="text"/>

- d) Fill ABP mode related information, DevEui/DevAddr/NwkSKey/AppSKey.

DevEui: RHF3M076 get through AT+ID command

DevAddr: RHF3M076 get through AT+ID command

NWKSKEY: Default value 2B7E151628AED2A6ABF7158809CF4F3C

APPSKEY: Default value 2B7E151628AED2A6ABF7158809CF4F3C

Personalised Motes

Personalised motes are configured with the network address, application session key and network session key already present, so they are ready to communicate on the network. Enter these same details below to prepare the server.

Mote (DevEUI)	Network Address (DevAddr)	Application Session Key (AppSKey)	Network Session Key (NwkSKey)
New: <input type="text"/> 47:97:c5:34:00:1d:00:48	<input type="text"/> 00:82:2c:96	<input type="text"/> 2B7E151628AED2A6ABF7158809CF4F3C	<input type="text"/> 2B7E151628AED2A6ABF7158809CF4F3C <input type="button" value="Add"/>

- e) Test through below commands:

at+mode=lwabp

+MODE: LWABP

```
AT+CMSGHEX="0a 0b 0c 0d 0e"
+CMSGHEX: Start LoRaWAN transaction
+CMSGHEX: TX "0A 0B 0C 0D 0E "
+CMSGHEX: Wait ACK
+CMSGHEX: ACK Received
+CMSGHEX: RXWIN1, RSSI -47, SNR 3.25
+CMSGHEX: Done
```

3.2.4 OTAA Mode

- a) Delete device which is just added, avoid DevEui collision
 b) Check AppEui from Application page

Applications

Below is a list of LoRa applications on the network. Use the fields at the top to set up a new one on the server.

Name	Owner	EUI (AppEUI)	Configured Motes
New: <input type="text"/>	<input type="text"/>	<input type="text"/> <input type="button" value="Add"/>	
defaultApp	[Unknown]	00-00-00-00-00-00-00	<input type="button" value="Delete"/> 0
null	[Unknown]	FF-FF-FF-FF-FF-FF-FE	<input type="button" value="Delete"/> 0
rhf3m076	rxhf	00-00-00-00-00-00-01	<input type="button" value="Delete"/> 0

- c) Use **at+id=appeui, "00-00-00-00-00-00-01"** command to set RHF3M076 APPEUI
at+id=appeui, "00-00-00-00-00-00-01"

d) Fill in DevEui and AppKey

Over-the-Air Motes

Motes ordinarily join the network by negotiating with the server using an application key. Enter this key below to prepare the server.

Mote (DevEUI)	Application Key (AppKey)	
New: 47:97:c5:34:00:1d:00:48	2B7E151628AED2A6ABF7158809CF4F3C	Add

```
at+mode=lwotaa
```

```
+MODE: LWOTAA
```

```
at+join
```

```
+JOIN: Starting
```

```
+JOIN: NORMAL, count 1, 0s, 0s
```

```
+JOIN: Network joined
```

```
+JOIN: NetID 000000 DevAddr 00:82:2c:96
```

```
+JOIN: Done
```

```
AT+CMSGHEX="0a 0b 0c 0d 0e"
```

```
+CMSGHEX: Start LoRaWAN transaction
```

```
+CMSGHEX: TX "0A 0B 0C 0D 0E "
```

```
+CMSGHEX: Wait ACK
```

```
+CMSGHEX: ACK Received
```

```
+CMSGHEX: RXWIN1, RSSI -47, SNR 3.25
```

```
+CMSGHEX: Done
```

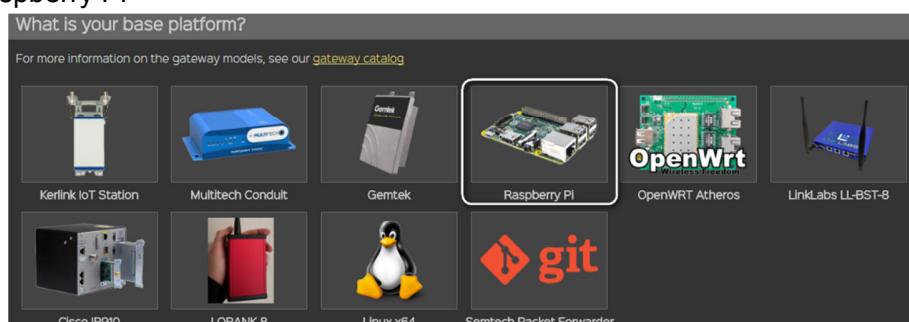
4 Connect To Loriot Server

4.1 Loriot Server Gateway Registration

- New user need register an account first, registration address <https://cn1.loriot.io/register.html>. Fill in UserName, Password and email address to register, after registration an email will be sent to you, please follow the instruction in the email to activate.
- After successful activation, access <https://cn1.loriot.io/home/login.html> to log in. Default tier is "Community Network", it supports 1 Gateway (RHF2S001) and 10 nodes.

The screenshot shows the Loriot Dashboard interface. On the left is a sidebar with links: Dashboard, Applications, Gateways, Documentation, and Account. The main area has a header "Community Network" and "demo@risinghf.com". Below this is a "Dashboard" section with "account information" (Email: demo@risinghf.com, Name: RisingHF Demo, Logout button), a "tier COMMUNITY NETWORK" section with a welcome message, and a "COMMUNITY NETWORK features" section listing: No account expiration, Roaming among all community gateways, OpenLoRa Forum support, and One Free Network Application. At the bottom are sections for "News" (with four items from March 28, 2016) and "Gateways last 10 shown" (listing Shenzhen, MAC, Model, Version, and a checked checkbox). There is also an "Applications last 10 shown" section.

- Enter Dashboard -> Gateway, click "Add Gateway" start to add Gateway
- Select "Raspberry Pi"



- Raspberry Pi model -> Raspberry Pi 2
- Concentrator model -> SX1301/SX1255 Reference (for RHF2S001-434, RHF2S001-470)
SX1301 Reference (for RHF2S001-868, RHF2S001-920, RHF2S001-780)
- Connected over -> SPI

What is your base platform?

For more information on the gateway models, see our [gateway catalog](#)

Raspberry Pi model: Raspberry Pi 2

Concentrator model: SX1301/SX1255 Reference

Connected over: SPI

Raspberry Pi can be turned into a universal, inexpensive base for a LoRa gateway - for either development or real deployment. Several USB and SPI attached concentrators are supported.

[Choose a different base platform](#)

- f) Fill in the MAC address of your RHF2S001, should be in format of b8:27:eb:xx:xx:xx. And also input Gateway Location information.
- g) Click “Register Raspberry Pi gateway” to finish the registration.
- h) Click the registered gateway to enter configuration page, switch “Frquency Plan” manually, your plan here is decided by the type of your RHF2S001 type, available plan are CN470, CN473, CN434, CN780, EU868, after selected please refresh the page to get the exact channel.
- i) Run command:

```
cd /home/rxhf/loriot/1.0.2  
sudo systemctl stop pktfwd  
sudo gwrst  
.lrt -f -i eth0 -s cn1.loriot.io
```

To start loriot gateway service and connect the gateway to loriot server. Replac cn1.loriot.io with the server you choose(ap1.loriot.io / eu1.loriot.io / us1.loriot.io etc.)

Status is showed as below after the gateway is connected:

Status	
Connected	<input checked="" type="checkbox"/> Connected
Version	1.0.1
Latency	75 ms
Last keep-alive	a few seconds ago 17th May 2016, 17:37:45
Last data	never
Last connect	3 minutes ago 17th May 2016, 17:35:10
Remote time offset	no data

- j) Finish gateway registration. Next is to register node.

4.2 Loriot Server Connect Node device

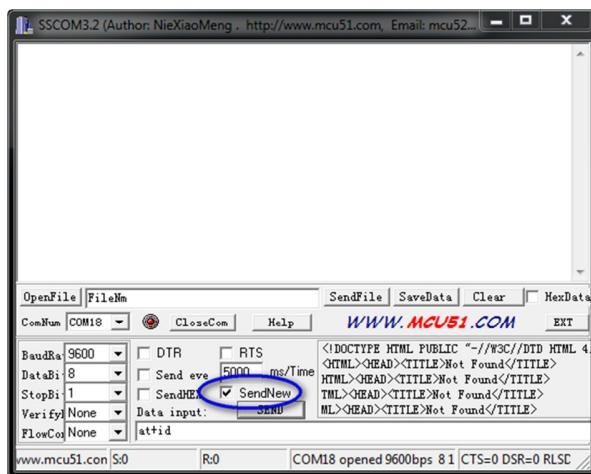
4.2.1 RHF3M076 Configuration

Connect RHF3M076 with your PC befores configuration, like below picture:



图 8 RHF3M076

- a) RHF3M076 will be recognized as a USB CDC (COM Port) device. Please refer to UM01516 about how to install driver. The driver file could be downloaded from RisingHF Wiki or contact support@risinghf.com
- b) Open SSCOM tool, please note SSCOM only scan com port when it is opened, if the device is connected after SSCOM is opened, please reopen SSCOM to refresh device list.
- c) Make sure "SendNew" option is checked this will make SSCOM append Windows newline "\r\n" for every command. So that RHF3M076 could recognize the command.



- d) Send "AT+CH" to get channel lis. RHF3M076 work at 868MHz by default.

at+ch

+CH: 3; 0,868100000,DR0,DR5; 1,868300000,DR0,DR5; 2,868500000,DR0,DR5;

- e) Configure RHF3M076 channels according to the selected frequency plan. Current gateway channels could be got from "Dashboard -> Gateway -> Your Gateway" Use below command to reconfigure the channels:

(For exmpale: CN470)

at+ch=0,471.5

at+ch=1,471.7

at+ch=2,471.9

At lease set 3 channels to overwrite all default channels, when finished execute "at+ch" to check channel list:

at+ch

+CH: 3; 0,471500000,DR0,DR5; 1,471700000,DR0,DR5; 2,471900000,DR0,DR5;

- f) Send "AT+ID" to check device DEVADDR, DEVEUI, APPEUI

```
at+id
```

```
+ID: DevAddr, 00:82:2c:96
+ID: DevEui, 47:97:c5:34:90:1d:00:48
+ID: AppEui, 52:69:73:69:6e:67:48:46
```

- g) After get DEVADDR, DEVEUI, APPEUI, go back Loriot server to add node

4.2.2 ABP Mode

- a) Log in Loriot server , Click "Dash Board" -> "Applications" -> "SimpleApp"

- b) Click "Import ABP" , input below items:

DevAddr: RHF3M076 get through "AT+ID" command (Note: Loriot doesn't support colon connector, need remove manually)

FCntUp: Set to 1

FCntDn: Set to 1

NWKSKEY: Default value 2B7E151628AED2A6ABF7158809CF4F3C

APPSKEY: Default value 2B7E151628AED2A6ABF7158809CF4F3C

EUI: DEVEUI, RHF3M076 get through "AT+ID" command

Import existing ABP device			
Parameter	LoRaWAN name	Format	
End-device address	DevAddr	8 hex digits	00822c96
Sequence number uplink	FCntUp	Decimal	1
Sequence number downlink	FCntDn	Decimal	1
Network session key	NWKSKEY	32 hex digits	2B7E151628AED2A6ABF7158809CF4F3C
Application session key	APPSKEY	32 hex digits	2B7E151628AED2A6ABF7158809CF4F3C
EUI (optional)	DevEUI	16 hex digits	4797c534901d0048
			Import device
<small>If you want to Import existing device with an APPKEY, please use the Import OTAA function. If your device doesn't have an EUI assigned, one will be generated for it from a pool of private addresses.</small>			

- c) Click "Import Device" finish device import

- d) "Dashboard -> Applications -> SampleApp", click "Devices" in the left side, continue click DevAddr to add the device

- e) Set "Seqno checking" to "Relaxed" (Relaxed mode will allow device sequence number reset)

- f) Back to SSCOM, send command:

```
AT+CMSGHEX="0a 0b 0c 0d 0e"
+CMSGHEX: Start LoRaWAN transaction
+CMSGHEX: TX "0A 0B 0C 0D 0E "
+CMSGHEX: Wait ACK
+CMSGHEX: ACK Received
+CMSGHEX: RXWIN1, RSSI -47, SNR 3.25
+CMSGHEX: Done
```

LORIOT		Connected to BE7C0003						
Device EUI	Local time	Freq [MHz]	Data rate	RSSI	SNR	Seq #	Port	Payload
4797C534901D0048	6:41:32 PM					1		(enqueued data sent)
4797C534901D0048	5/17/2016, 6:41:32 PM	471.500	SF12 BW125 4/5	-38	8.8	1	8	0a 0b 0c 0d 0e

4.2.3 OTAA Mode

Note: OTAA mode is unavailable for free Loriot account

a) Delete already joined ABP mode device to avoid DEVEUI collision

b) Log in Loriot server, click “Dash Board” -> “Applications” -> “SimpleApp”

Click "Import ABP" , input below items:

DevEui: RHF3M076 get through "AT+ID" command

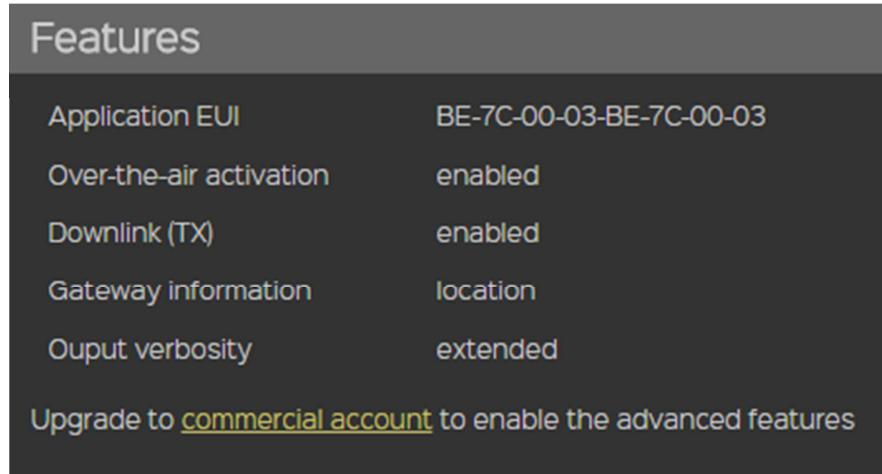
APPKEY: Default value 2B7E151628AED2A6ABF7158809CF4F3C

Parameter	LoRaWAN name	Format
Device EUI	DevEUI	16 hex digits, can include dashes
Application key	APPKEY	32 hex digits

Import device

Other keys (NWKSKEY, APPSKEY) and parameters (DevAddr) will be re-generated upon every network join.

c) Check AppEui from SampleApp page (Note: unavailable for free account)



d) Use at+id=appeui,"BE-7C-00-03-BE-7C-00-03" command to set RHF3M076 APPEUI.

at+id=appeui,"BE-7C-00-03-BE-7C-00-03

e) Run below commands in sequence to set OTAA mode work as OTAA mode

at+mode=lwotaa

+MODE: LWOTAA

at+join

+JOIN: Starting

+JOIN: NORMAL, count 1, 0s, 0s

+JOIN: Network joined

+JOIN: NetID 4C5254 DevAddr a9:4b:5c:0a

+JOIN: Done

AT+CMSGHEX="0a 0b 0c 0d 0e"

+CMSGHEX: Start LoRaWAN transaction

+CMSGHEX: TX "0A 0B 0C 0D 0E "

+CMSGHEX: Wait ACK

+CMGHEX: ACK Received

+CMGHEX: RXWIN1, RSSI -47, SNR 3.25

+CMGHEX: Done

5 Connect to Aisenz loraflo.io Server

New RHF2S001 image integrates Aisenz loraflo SDK by default. Aisenz LoRaWAN server address <https://loraflo.io>.

Aisenz SDK is enabled by default and open a packet forwarder UDP port at 1580. To switch to Aisenz server:

```
cd /home/rxhf/risinghf/pktfwd  
ln -sf local_conf_1580.json local_conf.json  
sudo systemctl restart pktfwd
```

5.1 Get Started

- a) Register account <https://loraflo.io>
- b) Check RPi MAC address, register gateway
- c) Run `AT+ID` command to check DevAddr, DevEui and AppEui, use the information to register device
- d) Configure device channel use AT+CH command
- e) Configure device RX2 window through AT+RXWIN2 command
- f) Send message through MSG / CMSG or MSGHEX / CMSGHEX command

Refer to Aisenz online document for more about how to add gateway and add devices

<https://loraflo.io/static/docs/en/GettingStarted.html> (English)

<https://loraflo.io/static/docs/zh/index.html> (Chinese)

5.2 Reference

Download related documents at <http://wiki.risinghf.com/doku.php?id=extranet:resources>

6 Connect to TTN server

RHF2S001 built-in TTN SDK, TTN server currently support both 868MHz and 915MHz, the default device using the 868MHz, with the node default to use OTAA mode. TTN server address <https://www.thethingsnetwork.org>.

Enable the TTN SDK

```
cd /home/rxhf/ttn/
```

```
sudo ./install.sh
```

Disable the TTN SDK

```
sudo systemctl disable ttn-gw
```

```
sudo systemctl stop ttn-gw
```

6.1 Get Started

- a) Change the gateway_ID to the desired ID, the ID in the TTN server is unique, preferably including the device's mac address.
Eg: The device's mac address b8:27:eb:e7:c8:2f to gateway_ID b827eb0000e7c82f.
vi /home/rxhf/ttn/packet_forwarder/poly_pkt_fwd/local_conf.json
- b) New user should register a new account. Skip this step if user had already registered.
<https://account.thethingsnetwork.org/register>
- c) Login to TTN server, enter "Gateway->register gateway".

The screenshot shows a registration form for a gateway. At the top, there is a breadcrumb navigation: 'Gateways > Register'. The main section is titled 'REGISTER GATEWAY'. It contains several input fields:

- Gateway ID:** A text input field with placeholder text: 'A unique, human-readable identifier for your gateway. It can be anything so be creative!'. Below it is a note: 'Select this if you are using the legacy Semtech packet forwarder.' followed by a checkbox labeled 'I'm using the legacy packet forwarder'.
- Description:** A text input field with placeholder text: 'A human-readable description of the gateway'.
- Frequency Plan:** A dropdown menu with placeholder text: 'The frequency plan this gateway will use' and 'no selection'.
- Router:** A dropdown menu with placeholder text: 'The router this gateway will connect to. To reduce latency pick a router that is in a region which is close to the location of the router itself'.

Fill in the registration information, and select "I'm using the legacy packet forwarder", click "Register Gateway" to complete the registration.

- d) Enter "Applications->add application"

Applications > Add Application

ADD APPLICATION

Application ID
The unique identifier of your application on the network

Description
A human readable description of your new app
Eg. My sensor network application

Application EUI
An application EUI will be issued for The Things Network block for convenience, you can add your own in the application settings page.
EUI issued by The Things Network

Handler registration
Select the handler you want to register this application to
ttn-handler-eu

Fill in the registration information, click "Add application".

- e) Enter “Devices->register device”

Applications > testaassdasda > Devices

Device ID
This is the unique identifier for the device in this app. The device ID will be immutable.

Device EUI
The device EUI is the unique identifier for this device on the network. You can change the EUI later.
 0 bytes

App Key
The App Key will be used to secure the communication between your device and the network.
 this field will be generated

App EUI
 70 B3 D5 7E D0 00 6D B2

Fill in with the nodes DevAddr, DevEui and APPKEY, and click "Register".

- f) Configure the nodes to the OTAA mode and join the network.

For more information on how to configure the RHF76-052AM/RHF3M076B modem, please refer to RisingHF RHF3M076 user manual "[RHF-PS01509]LoRaWAN Class AC AT Command Specification - v4.3"

AT+ID=AppEui,"70 B3 D5 7E D0 00 6D B2"

AT+MODE=LWOTAA

AT+JOIN=FORCE

- a) Do uplink demo and data received in TTN server.

The screenshot shows two main sections of the IoT Discovery interface.

Top Section (Devices View):

- Path: Applications > testaassdasda > Devices
- Toolbar: Overview, Devices (highlighted), Payload Formats, Integrations, Data, Settings
- Section: DEVICES
- Actions: register device
- Count: 1 — 1 / 1
- Device ID: 0140f463 (highlighted with a red box)
- Hex payload: 47 68 C4 0A 00 37 00 29

Bottom Section (Data View):

- Path: Applications > testaassdasda > Devices > 0140f463 > Data
- Toolbar: Overview, Data (highlighted), Settings
- Section: APPLICATION DATA
- Actions: pause, clear
- Filters: uplink, downlink, activation, ack, error
- Table Headers: time, counter, port
- Data Rows:
 - ▲ 17:58:06 1 8 payload: 11 22 33
 - ⚡ 17:55:27 dev addr: 26 01 2EDF app eui: 70 B3 D5 7ED0 00 6D B2 dev eui: 47 68 C4 0A 00 37 00 29

7 Advanced Usage

7.1 Hardware Performance Test

This chapter is just for hardware developer who wants to integrate RHF0M301 to their own design.

Make sure there is no background process is accessing RHF0M301 module:

- a) Stop pktfwd

```
sudo systemctl stop pktfwd
```

- b) Stop Loriot binary if you once start it

Test command list:

- a) Enter test directory

```
cd ~/risinghf/test
```

- b) Hardware reset

```
sudo gwrst
```

- c) Hardware connection validation

```
./test_loragw_reg
```

- d) RX test

```
// Different frequency use different configuration file, syncword34 directory  
contains LoRaWAN format data packet receiving configuration file
```

```
./util_rx_test -c ./cfg/freq_conf_470.json
```

- e) TX test

Use util_tx_test and util_tx_continuous, refer to the help information (-h parameter could be used to get help information)

- f) Channel scan to use util_rssi_histogram (Note: SX1301 RSSI value precision is very limited).

Detailed usage:

```
rxhf@rhf2s001:~/risinghf/test$ ./util_rssi_histogram -h
```

Available options:

-h print this help

--file log file name

--fmin start frequency in Hz, default is 863 MHz

--fmax stop frequency in Hz, default is 870 MHz

--fstep frequency resolution in Hz, default is 50 kHz

-n number of RSSI captures, each capture is 4096 samples long, default is 90 (3s for 125Khz capture rate)

-p div ratio of capture rate (32 MHz/p), default is 256 (125 kHz)

Eg:

```
./util_rssi_histogram --fmin 470000000 --fmax 471000000 --file a.csv
```

8 Others

8.1 RHF3M076 Driver Installation

Reference:

http://wiki.risinghf.com/lib/exe/fetch.php?media=extranet:rhf-um01516_lorawan_modem_driver_installation_guide.pdf

8.2 FT232 Driver Installation

Refer to FTDI Official document:

FTDI:

http://www.ftdichip.com/Support/Documents/AppNotes/AN_119_FTDI_Drivers_Installation_Guide_for_Windows7.pdf

RisingHF mirror

http://wiki.risinghf.com/lib/exe/fetch.php?media=extranet:an_119_ftdi_drivers_installation_guide_for_windows7.pdf

8.3 Recover SD Card

Contact support@risinghf.com to get image address and extract password. And refer to below document to burn SD card.

<https://www.raspberrypi.org/documentation/installation/installing-images/windows.md>

8.4 Raspberry Pi Raspbian Version

RisingHF Image is based on 2016-03-18-raspbian-jessie-lite.img

8.5 Configure Static IP Address

a) Backup files which will be modified

`cp /etc/dhcpcd.conf /etc/dhcpcd.conf.bak`

b) Configure new IP address. Please replace below ip_address, routers, domain_name_servers withc the one you need. Take effect after reboot

```
sudo su
cp /etc/dhcpcd.conf.bak /etc/dhcpcd.conf
echo "interface eth0" >> /etc/dhcpcd.conf
echo "static ip_address=172.0.41.196/16" >> /etc/dhcpcd.conf
echo "static routers=172.0.0.254" >> /etc/dhcpcd.conf
echo "static domain_name_servers=223.5.5.5" >> /etc/dhcpcd.conf
```

If configuration has something wrong, please use below command to rescue

`cp /etc/dhcpcd.conf.bak /etc/dhcpcd.conf`

8.6 Internal MySQL Database

RHF2S001 internally integrated LoRaWAN server depends on MySQL, because of Raspberry Pi data is saved at SD card, and MySQL will erase and write data to SD card frequently, this will lead to

potential risk to damage SD card. So please be warned, during your testing and development, please backup your data in time in case of any lost.

Usernmae: root
Passwrod: root

Command to log in mysql:

`mysql -u root -p`

For users who need use phpMyAdmin, please install through apt-get command

Revision

V3.2 2017-09-21

+ Revise

V3.1 2017-08-30

+ Add connect to TTN server

V2.1 2016-12-07

+ Update sections which are not aligned

V2.0 2016-11-23

+ This branch is for Seeed only
+ Add US915 support for SeeedStudio

V1.2 2016-07-26

+ Fix typo

V1.1 2016-06-22

+ AT+CMSGHEX format

V1.0 2016-05-17

+ Draft

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