SX1262 868M LoRa HAT

From Waveshare Wiki

Instruction Resources FAQ Supports

Instruction

- This product is a Raspberry Pi expansion board based on SX1268/SX1262 chip, wireless serial port module with LoRa modulation function
- With multi-level relay to achieve ultra-long-distance communication, low power consumption wake-up communication, encrypted transmission, etc.
- This product uses a private protocol and does not support LoRaWAN

Features

- Standard Raspberry Pi 40PIN GPIO extension header, supports Raspberry Pi series boards
- Onboard CP2102 USB TO UART converter, for serial debugging
- Brings the UART control interface, for connecting host boards like Arduino/STM32
- 4x LED indicators, easy to check the module status
- LoRa spread spectrum modulation technology, up to 81 available signal channel, longer communication distance, more robust to interference
- Auto multi-level repeating, suit for ultra long range communication, allows multi network on the same region

Primary Attribute

Category:

Brand: Waveshare

Website

International: Website (https://www.waveshare.com/sx1262-868m-lora-hat.htm)

Chinese: 官网 (http://www.waveshare.net/shop/SX1262-868M-LoRa-HAT.htm)

Onboard Interfaces

RPi	**UART**

Related Products

- Pico-LoRa-SX1262-868M
- **SX1262 868M LoRa HAT**
- SX1262 915M LoRa HAT
- SX1268 433M LoRa HAT
- SX1268 470M LoRa HAT
- SX1302 868M LoRaWAN Gateway
- SX1302 LoRaWAN Gateway HAT

- Low power consumption features like deep sleeping and Wake on Radio, ideal for battery-powered applications
- Customizable communication key which won't be retrieved, greatly improves the security of user data
- Supports LBT, monitoring the signal c improves the success ratio under extr
- Supports RSSI signal intensity indicating, for evaluating signal quality, tuning the network
- Supports wireless parameter configuration, by sending wireless command/data packet, remotely configure or retrieve the module parameter
- Supports fixed-point transmission, broadcast, signal channel monitor
- Comes with development resources and manual (examples for Raspberry Pi/STM32)

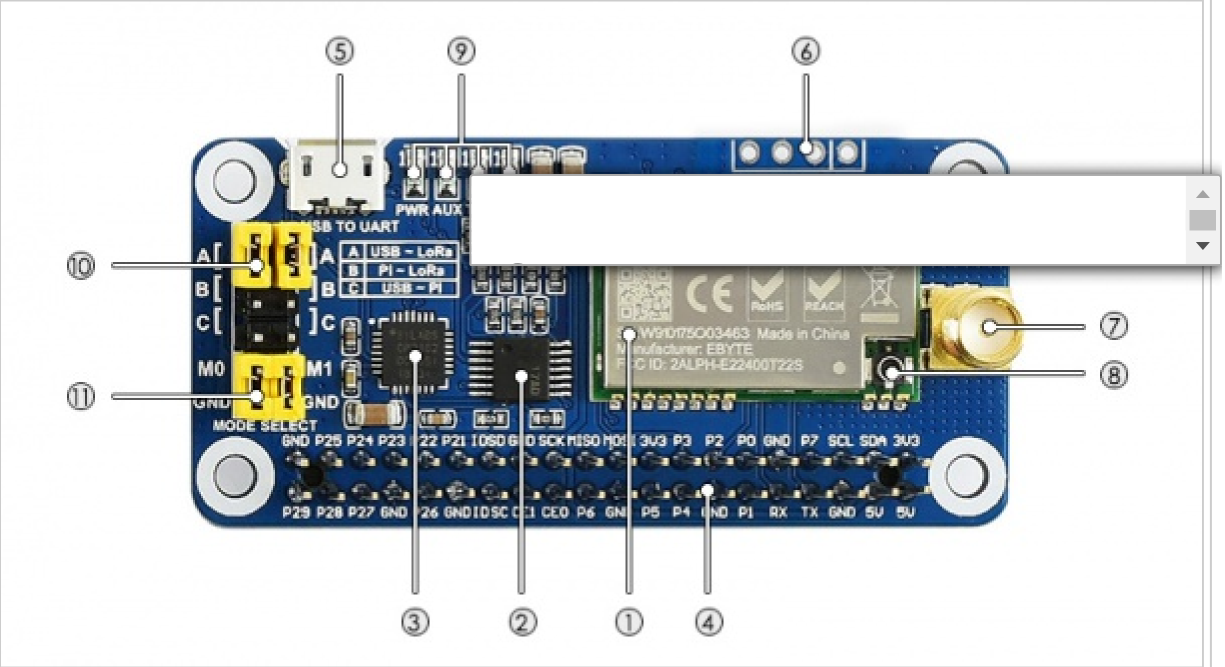
Specification

Specification of SX1268 433M LoRa HAT

Consumption	Transmit Current	110mA (Transient current)
	Receive Current	11mA
	Sleep Current	2uA (LoRa module deep sleep)
MAX Transmit Power		22.0dBm(10, 13, 17, 22dBm Selectable)
Transmit Length		240 Bytes (32, 64, 128, 240 Bytes Selectable)
Buffer		1000 Bytes
Working bands		410.125 ~ 850.125MHz
Receive Sensitivity		147dBm@0.3Kbps (On air)
Interface		UART
Range		5KM(Sunny day; open area; Antenna: AUX 5dBi, Height 2.5m; Air Speed: 2.4kbps)
Working voltage		5V
Logic voltage		3.3V
Working Temperature		40 ~ 85°C

Hardware description

1. SX1268/SX1262 LoRa module
2. 74HC125V: voltage level translator
3. CP2102: USB TO UART converter
4. Raspberry Pi GPIO connector: for connecting with Raspberry Pi
5. USB TO UART port
6. UART header: for connecting host boards like STM32/Arduino
7. SMA antenna connector



Hardware description of SX1268 LoRa HAT

8. IPEX antenna connector
9. Indicators:
    - RXD/TXD: UART RX/TX indicator
    - AUX: auxiliary indicator
    - PWR: power indicator
10. UART selection jumpers
    - A: control the LoRa module through USB TO UART
    - B: control the LoRa module through Raspberry Pi
    - C: access Raspberry Pi through USB TO UART
11. LoRa mode selection jumpers
    - short M0, short M1: transmission mode
    - short M0, open M1: configuration mode
    - open M0, short M1: WOR mode
    - open M0, open M1: deep sleep mode

【Note】

Mode 0: Transmission mode, Module transmit data when users send data to UART interface. Wireless receiving is enabled to receive data and send to UART interface when idle.
Mode 1:When it is defined to Transmit, user need to add wakeup codes before transmitting, receiving is same as Mode 0.
Mode 2: Wireless transmit and wireless receive are disabled, users can configure configuration according to #Registers Configuration
Mode 3: Wireless transmit and wireless receive are disabled, module enter deep sleep mode. Module will configure when switching to other modes.

Use Guides

Registers Configuration

If the module is set to configuration mode according to table below. (Baud rate: 9600,

Configure registers

Function	Descriptions				
Configure registers	Command format	0xC0 + Begin address + Length + Data			
	Answer format	0xC1 + Begin address + Length + Data			
	Examples 1: Set channel to 0x11				
		Head	Begin address	Length	Data
	Command	0xC0	0x05	0x01	0x11
	Answer	0xC1	0x05	0x01	0x11
	Examples 2: Set Module address (0x1234), NETID(0x00), UART(9600, 8N1), Air speed(1.2K)				
		Head	Begin address	Length	Data
	Command	0xC0	0x00	0x04	0x12 0x34 0x00 0x61
	Answer	0xC1	0x00	0x04	0x12 0x34 0x00 0x61
Read registers	Command format	0xC1 + Begin address + Length			
	Answer format	0xC1 + Begin address + Length + Data			
	Examples 1: Read channel				
		Head	Begin address	Length	Data
	Command	0xC1	0x05	0x01	
	Answer	0xC1	0x05	0x01	0x12 0x34 0x00 0x61
	Examples 2: Read Module address, NETID, Serial port and air speed.				
		Head	Begin address	Length	Data
	Command	0xC1	0x00	0x04	
	Answer	0xC1	0x00	0x04	0x12 0x34 0x00 0x61
Configure temporary registers	Command format	0xC2 + Begin address + Lenght + Data			
	Answer format	0xC1 + Begin address + Lenght + Data			
	Examples 1:Set channel to 0x11				

			Head	Begin address	Length	Data
	Command		0xC2	0x05	0x01	0x11
	Answer		0xC1	0x00	0x01	0x11
	Examples 2: Set moc					
			Head	Begin address	Length	Data
	Command		0xC2	0x00	0x04	0x12 0x34 0x00 0x61
	Answer		0xC1	0x00	0x04	0x12 0x34 0x00 0x61
Wireless configuration	Command format	0xCF 0xCF + Common command				
	Answer format	0xCD 0xCF + Common answer				
	Examples 1: Wireless set channel to 0x11					
		Wireless Head	Head(common)	Begin address	Length	Data
	Command	0xCF 0xCF	0xC2	0x05	0x01	0x11
	Answer	0xCD 0xCF	0xC1	0x05	0x01	0x11
	Examples 2: Wireless set module (0x1234), NETID(0x00), serial port(9600 8N1), Air speed(1.2K)					
		Wireless Head	Head (common)	Begin address	Length	Data
	Command	0xCF 0xCF	0xC2	0x00	0x04	0x12 0x34 0x00 0x61
	Answer	0xCD 0xCF	0xC1	0x00	0x04	0x12 0x34 0x00 0x61
Format error	Answer of Format error					
	0xFF 0xFF 0xFF					

【Note】

1. When wireless configuring, you need to firstly configure Modules address, NETID, Air speed and Key of both modules to same values. For example, if Modules A: Module address is 1, NETID is 1, Air speed is 2.4Kbps and Key is 1. Module B: Module address is 2, NETID is 2, Air speed is 62.5Kbps and Key is 2. If you want to use Module A to configure Module B via wireless network, you need to set Module A to be same as Module B. Then you can use 0xCF 0xCF command to configure Module B via wireless network.
2. After configure temporary registers, LoRa modules work by settings of temporary registers. If LoRa modules restart, the settings of temporary are invalid, LoRa

module will re-configure registers according to network settings by 0xC1 commands.

Registers Description

Descripti

NO.	Read/Write	Name	Description				Note
00H	R/W	ADDH	ADDH (Default:0)				High bits and Low bits of module address. Note thant when module address is 0xFFFF. It works as broadcasting and listening address and LoRa module doesn't filter address anymore
01H	R/W	ADDL	ADDL (Default:0)				
02H	R/W	NETID	NETID (Default: 0)				Network ID, it is used to distinguish network. If you want to communicating between two modules, you need to set their NETID to same ID
03H	R/W	REG0	Bit 7	Bit 6	Bit 5	UART baud rate (bps)	The baud rates and parity of modules which are intercommunicating can be different. Generally we recommend you to set their baud rate to same value to avoid data blocking or data losing
			0	0	0	Baud rate is 1200	
			0	0	1	Baud rate is 2400	
			0	1	0	Baud rate is 4800	
			0	1	1	Baud rate is 9600 (default)	
			1	0	0	Baud rate is 19200	
			1	0	1	Baud rate is 38400	
			1	1	0	Baud rate is 57600	
			1	1	1	Baud rate is 115200	
			Bit 4	Bit 3	Parity bit		The serial port of modules

			0	0	8N1 (Default)		which are intercommunicating can set to different paramters
			0	1	8O1		
			1	0	8E1		
			1	1	8N1 (same as 00)		
			Bit 2	Bit 1			
			0	0	0	Air speed is 0.3K	The air speed of two modules which are intercommunicating must be same. Higher the speed, smaller the latency and shorter the communicating distance.
			0	0	1	Air speed is 1.2K	
			0	1	0	Air speed is 2.4K (default)	
			0	1	1	Air speed is 4.8K (default)	
			1	0	0	Air speed is 9.6K	
			1	0	1	Air speed is 19.2K	
			1	1	0	Air speed is 38.4K	
			1	1	1	Air speed is 62.5K	
04H	R/W	REG1	Bit 7	Bit 6	Setting of dividing packet		If the size of data transmitted are shorter than the length of divided packet. Data are continuous sent to serial port after receiving; If the size of data transmitted are longger than the length of divided packet. Data are divided and sent to serial port after receiving.
			0		240 bytes (default)		
			0	1	128 bytes		
			1	0	64 bytes		
			1	1	32 bytes		
			Bit 5	Enable ambient noise			After enabling, You can send command 0xC0 0xC1 0xC2 0xC3 to read register in Transmit Mode or WOR Mode; Register 0x00: RSSI of current ambient noise Register 0x01: The RSSI of last communicating (current noise of channel is dBm = - RSSI/2);
			0	Disable (default)			
			1	enable			

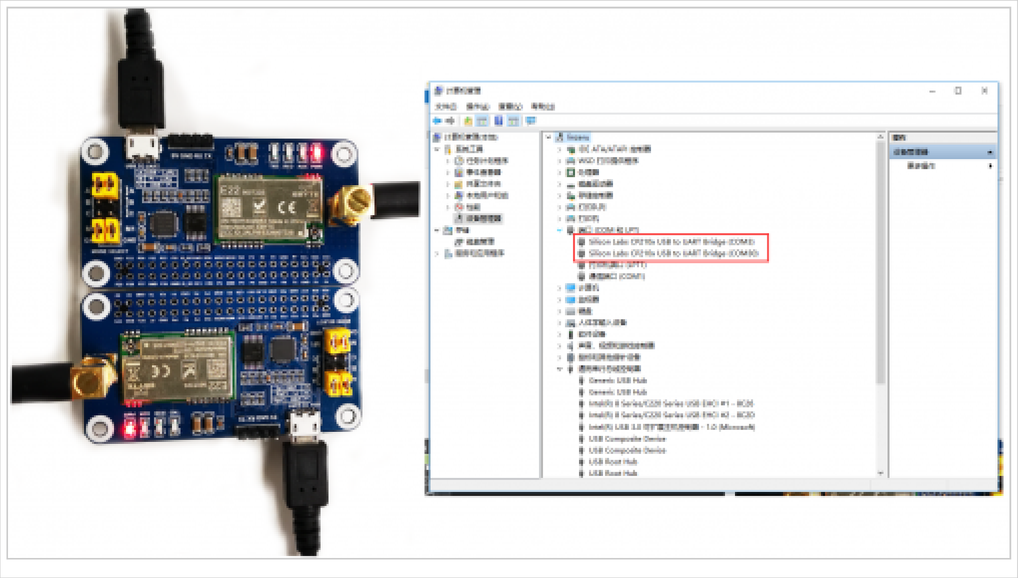
							Command format: 0xC0 0xC1 0xC2 0xC3 + Begin address + Read length; Answer format: 0xC1 + Address + Read length + Command: 0xC0 0xC1 0xC2 0xC3 0x00 0x01 Answer: 0xC1 0x00 0x01 RSSI (The address should begin from 0x00)
			Bit 4	Bit 3	Bit 2	Reserved	
			Bit 1	Bit 0	Transmit power		The relationship between power and current is non-linear. If power is maximum, the power efficiency is highest. Current will not small in the same proportion of power.
			0	0	22dBm (default)		
			0	1	17dBm		
			1	0	12dBm		
			1	1	10dBm		
05H	R/W	REG2	Channel control (CH) 0-83. 84 channels in total				Actually frequency is 850.125 + CH *1MHz. Default 868.125MHz(SX1262),or 410.125 + CH *1MHz. Default 433.125MHz(SX1268)
06H	R/W	REG3	Bit 7	Enable RSSI byte			After enabling, data sent to serial port is added with a RSSI byte after receiving
			0	Disable (default)			
			1	Enable			
			Bit 6	Transmitting mode			When point to point transmitting, module will recognize the first three byte as Address High + Address Low + Channel. and wireless transmit it
			0	Transparent transmitting (default)			
			1	Point to Point Transmitting			
			Bit 5	Relay function			If target address is not module itself, module will forward data; To avoid data echo, we recommend you to use this function in point to point mode, that is target address is different with source address
			0	Disable (default)			
			1	Enable			
			Bit 4	Enable LBT			Module will listen before transmit wireless data.

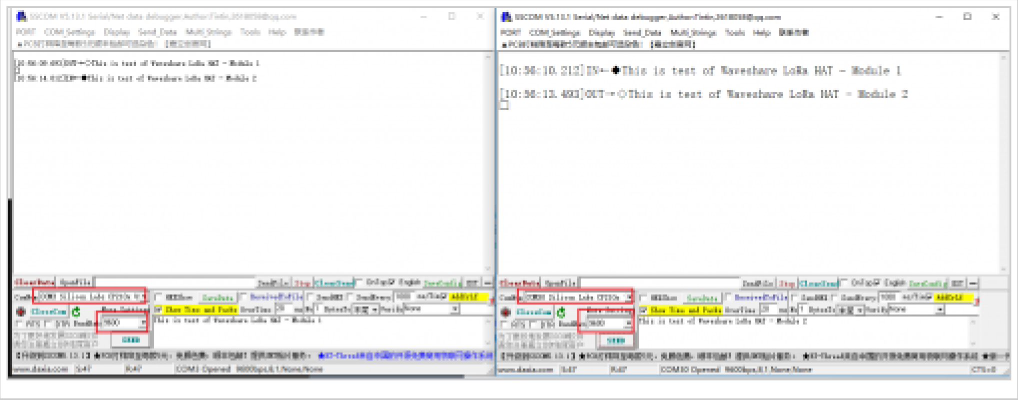
			0	Disable(default)			This function can be used to avoid interference, however, it also clause longer latency; The MAX LBT time is 2s, after 2s, data is forced to transmit
			1	Enable			
			Bit 3	WOR Mo control			This setting only work for Mode 1; Receiver waits for 1000ms after receive wirelesss data and forward,and then enter WOR mode again User can send data to serial port and forward via wireless network during this interval, Every serial byte will refresh this interval time (1000ms); You much send the first byte in 1000ms.
			0	WOR transmit (default) Module is enabled to receive/transmit, and wakeup code is added to transmitted data.			
			1	WOR Sender Module is disable to send data. Module is working in WOR listen mode. Consumption is reduced			
			Bit 2	Bit 1	Bit 0	WOR Period	This setting only work for Mode 1; Period is equal to T = (1 + WOR) * 500ms; MAX 4000ms, MIN 500ms Longer the Period time of WOR listen, lower the average consumption, however, longer the latency **The settings of receiver and sender must be same.**
			0	0	0	500ms	
			0	0	1	1000ms	
			0	1	0	1500ms	
			0	1	1	2000ms	
			1	0	0	2500ms	
			1	0	1	3000ms	
			1	1	0	3500ms	
			1	1	1	4000ms	
07H	W	CRYPT_H	High bytes of Key (default 0)				Only write enable, the read result always be 0; This key is used to encrypting to avoid wireless data intercepted by similar modules; This key is work as calculation factor when module is encrypting wireless data.
08H	W	CRYPT_L	Low bytes of key (default 0)				
80H ~ 86H	R	PID	Information of module (7 bytes)				7 bytes data of module information

Using with PC

SSCOM connection test

1. To test, you need two SX1268 LoRa HAT (hereafter called LoRa HAT), two micro USB cables.
2. Connect SMA antennas to LoRa HA
GND.
3. Connect USB to UART interfaces of two LoRa HATs to PC by micro USB cables
4. Check the COM ports on Devices Manager
5. Open SSCOM software, Set serial ports to 9600, 8N1 and try to send data.





```
[10:56:10.212]IN←◆This is test of Waveshare LoRa HAT - Module 1
[10:56:13.493]OUT→◇This is test of Waveshare LoRa HAT - Module 2
```

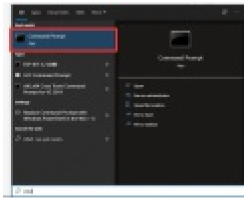
terminal

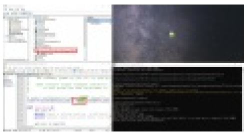
This test uses a Windows PC to connect to the LoRa HAT, and the jump settings will not change according to the factory location 1. Install python3 on Windows, then enter cmd in the launch bar to search and open the Windows terminal

2. Enter the path of python3 into the terminal, the default address is generally as shown in the figure below, pay attention to check the user's own python3 path, install pyserial

3. Use the upper computer software to set up LoRa HAT, unplug the M1 jumper when setting, connect to the M1 jumper and close the serial port of the upper computer after the setting is completed, and set the parameters as follows

4. Unzip the sample program to the desktop, open the main.py file to modify the COM port, and then run





SX1268-433M-LoRa-HAT-111

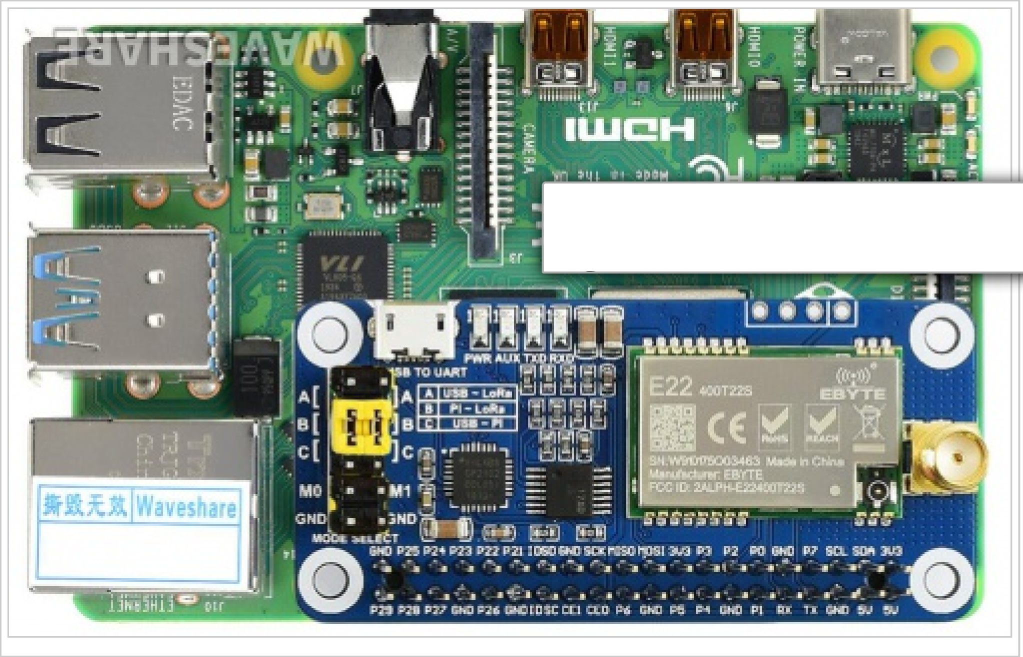
Using with Raspberry Pi

In this chapter, the example demonstrates 1 use two LoRa HATs to connect to two Raspberry Pis for receiving and sending tests, and the example demonstrates 2 using 3 LoRa HATs for relay communication receiving and sending tests.

Hardware connection, install library, enable Raspberry Pi serial port, download sample program

1. Hardware connection

To test the codes, you need to setup device with RaspberryPi board like below picture,
set jumpers to B and remove M0, M1 jumpers
Powering on Raspberry Pi



Enter the following commands one by one to install the python library, the first command enables the Raspberry Pi serial port

```
sudo raspi-config
cd Documents
wget https://www.waveshare.com/w/upload/9/9d/SX126X_LoRa_HAT_Demo.zip
unzip SX126X_LoRa_HAT_Demo.zip
```

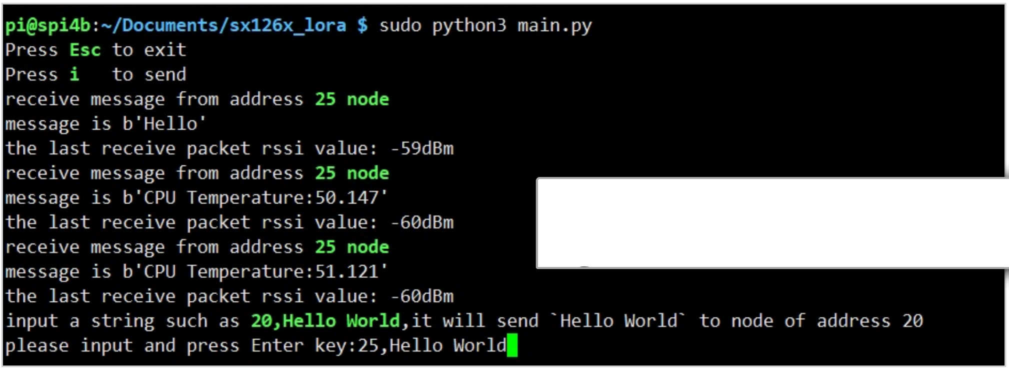
2. Enable serial port

Open Terminal of Raspberry Pi
Run command **sudo raspi-config** to open Configure interface
Choose Interfacing Options -> Serial -> No -> Yes

Transparent example

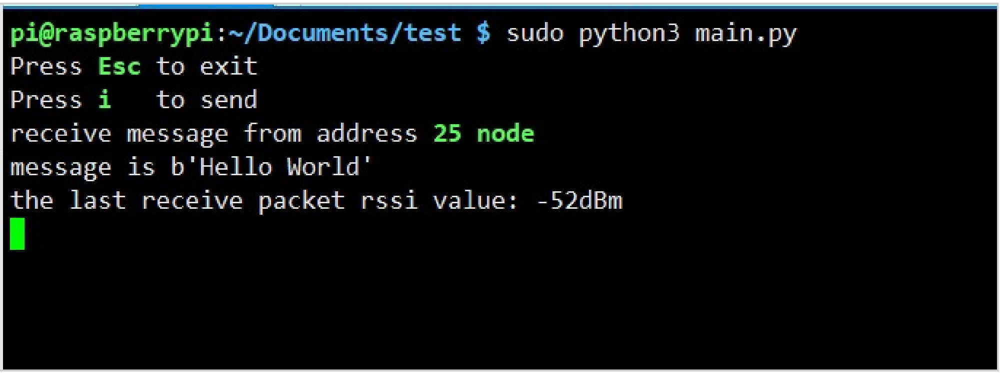
After executing the following command, the node will automatically print to the terminal when it receives the data sent by other nodes. When the node needs to send data to other nodes, press the keyboard i, and then enter the input according to the prompt, as shown in the figure below:

```
cd ~/Documents/SX126X_LoRa_HAT_Code/raspberrypi/python/
sudo python3 main.py
```



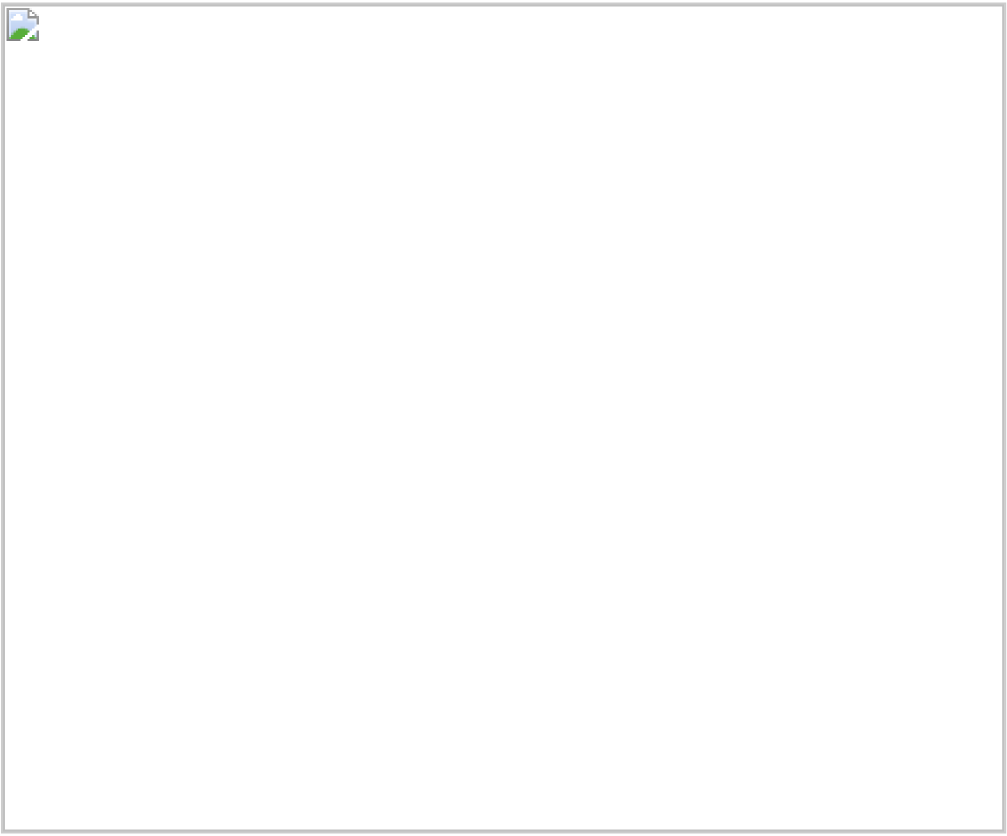
```
pi@spi4b:~/Documents/sx126x_lora $ sudo python3 main.py
Press Esc to exit
Press i   to send
receive message from address 25 node
message is b'Hello'
the last receive packet rssi value: -59dBm
receive message from address 25 node
message is b'CPU Temperature:50.147'
the last receive packet rssi value: -60dBm
receive message from address 25 node
message is b'CPU Temperature:51.121'
the last receive packet rssi value: -60dBm
input a string such as 20,Hello World,it will send `Hello World` to node of address 20
please input and press Enter key:25,Hello World
```

first node



```
pi@raspberrypi:~/Documents/test $ sudo python3 main.py
Press Esc to exit
Press i   to send
receive message from address 25 node
message is b'Hello World'
the last receive packet rssi value: -52dBm
```

second node



transpareant transfer diagram

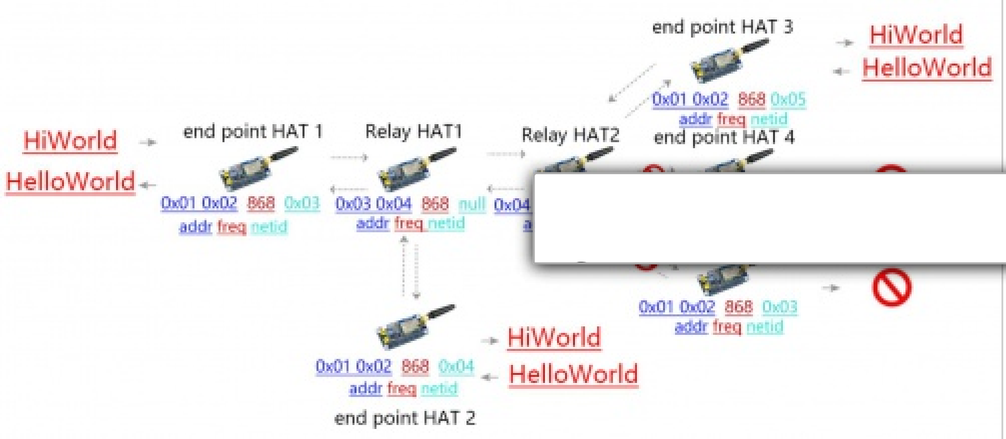
Relay example

After executing the following command, the node will automatically print to the terminal when it receives the data sent by other nodes. When the node needs to send data to other nodes, press the keyboard i, and then enter the input according to the prompt, as shown in the figure below:

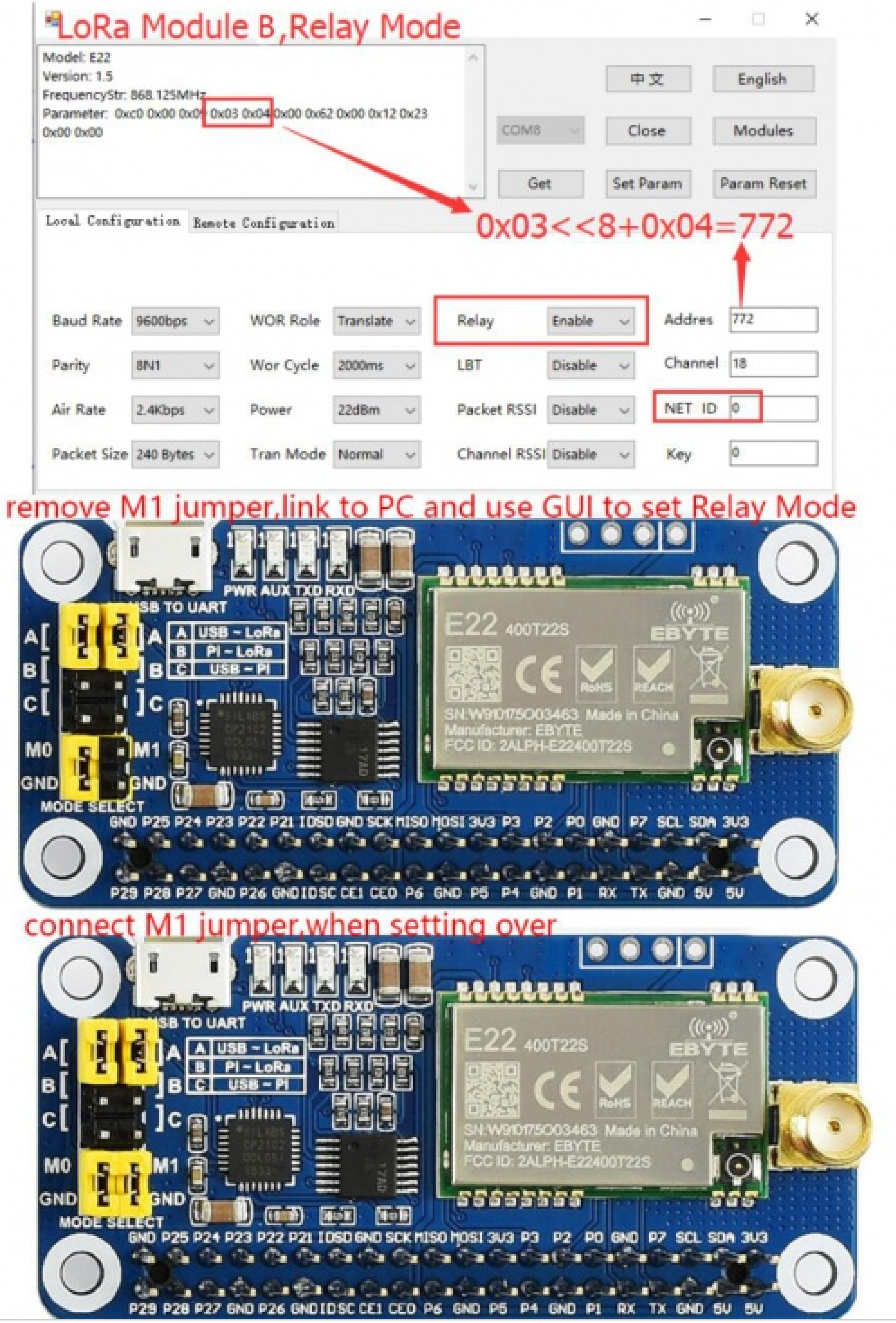
【Note】 To test Relay example, you require at least three LoRa HATs.

Suppose there is the three LoRa modules,LoRa module A, LoRa module B, and LoRa module C

Use the Windows PC to set the relay LoR module B and LoRa module C. LoRa module A is directly connected to the Raspberry Pi, as shown in the following figure



relay transfer diagram



LoRa Module B,Relay Mode

Model: E22
Version: 1.5
FrequencyStr: 868.125MHz
Parameter: 0xc0 0x00 0x0? 0x03 0x04 0x00 0x62 0x00 0x12 0x23 0x00 0x00

0x03<<8+0x04=772

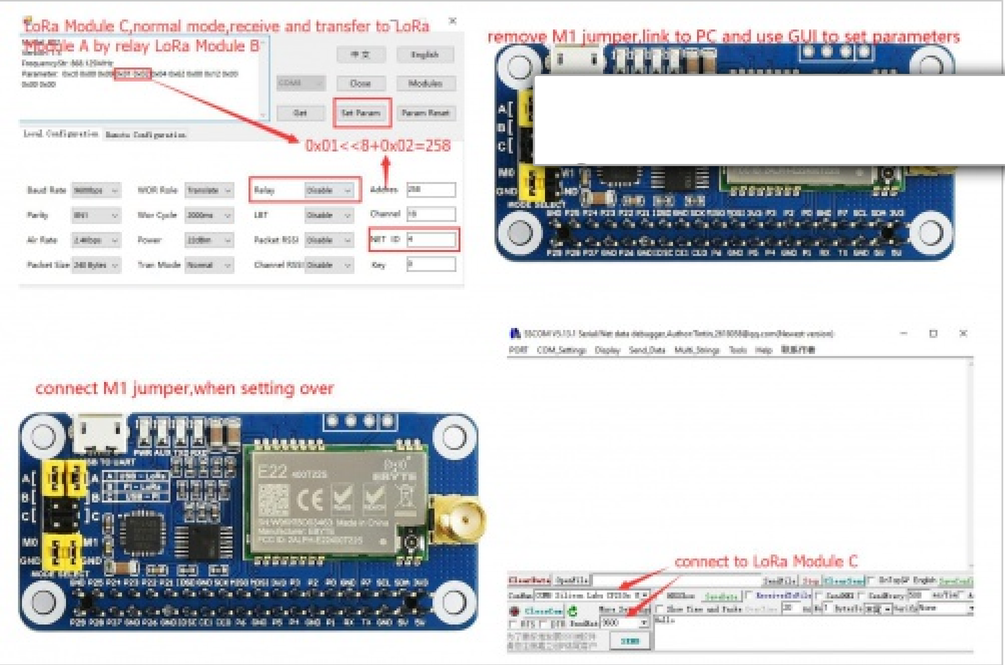
Baud Rate 9600bps
WOR Role Translate
Relay Enable
Addres 772
Parity 8N1
Wor Cycle 2000ms
LBT Disable
Channel 18
Air Rate 2.4Kbps
Power 22dBm
Packet RSSI Disable
NET ID 0
Packet Size 240 Bytes
Tran Mode Normal
Channel RSSI Disable
Key 0

remove M1 jumper,link to PC and use GUI to set Relay Mode

PWR AUX TXD RXD
USB TO UART
A USB - LoRa
B PI - LoRa
C USB - PI
A
B
C
M0
M1
GND
MODE SELECT
E22 400T22S
EBYTE
SN:W910175003463 Made in China
Manufacturer: EBYTE
FCC ID: 2ALPH-E22400T22S
GND P25 P24 P23 P22 P21 IDSD GND SCK MISO MOSI 3V3 P3 P2 P0 GND P7 SCL SDA 3V3
P29 P28 P27 GND P26 GND IDSC CE1 CE0 P6 GND P5 P4 GND P1 RX TX GND 5V 5V

connect M1 jumper,when setting over

lora module B setting



LoRa Module C,normal mode,receive and transfer to LoRa Module A by relay LoRa Module B

0x01<<8+0x02=258

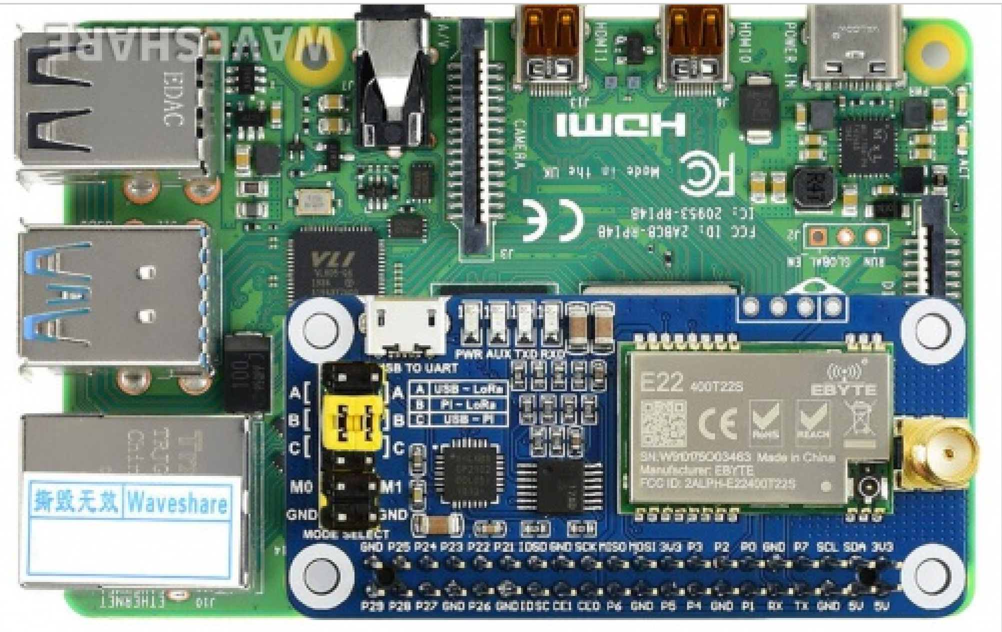
Baud Rate 9600bps, WOR Role Translate, Relay Disable, Address 258
Parity 8N1, Wor Cycle 2000ms, LBT Disable, Channel 18
Air Rate 2.4Kbps, Power 22dBm, Packet RSSI Disable, NET ID 4
Packet Size 240 Bytes, Tran Mode Normal, Channel RSSI Disable, Key 0

remove M1 jumper,link to PC and use GUI to set parameters

connect M1 jumper,when setting over

connect to LoRa Module C

lora module C setting



lora module A setting

After LoRa module A is connected to the Raspberry Pi, open the main.py file, change line 66, change realy=False to realy=True, execute the following command, LoRa module C will print the data from the serial port after receiving the data, and relay the LoRa module B will not print any data from the serial port, enter the following command:

```
cd ~/Documents/SX126X_LoRa_HAT_Code/RaspberryPi/python/
# node = sx126x.sx126x(serial_num = "/dev/ttyS0",freq=868,addr=0,power=22,rssi=True,air_speed=2400,relay=True)
sudo python3 main.py
```

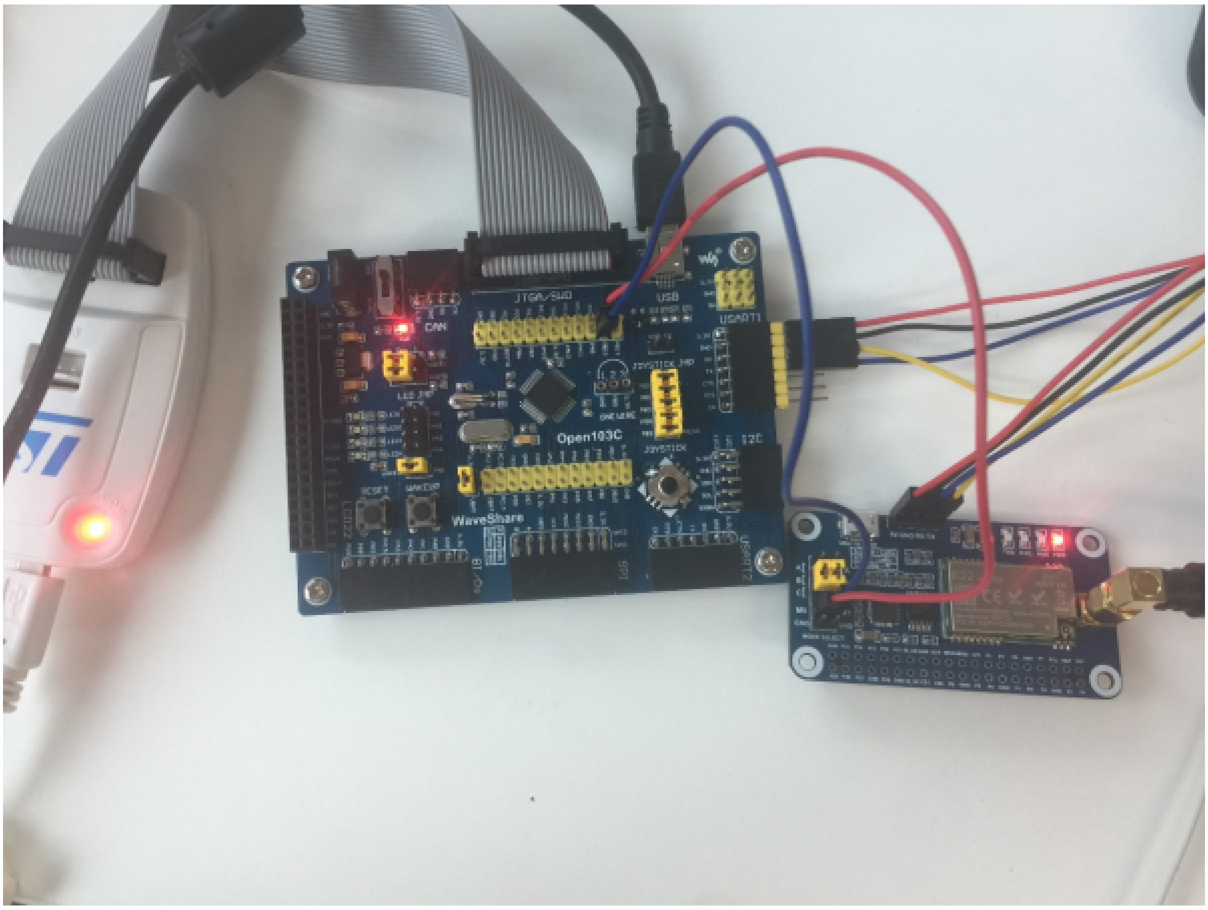
Using with STM32

The examples for STM32 are based on Ope
(https://www.waveshare.com/open103c-sta

1. Hardware connection

Set jumpers to B, and connect LoRa HAT to STM32 board pins by pins:

SX1268 LoRa HAT	STM32
5V	5V
GND	GND
RXD	PA10
TXD	PA9
M1	PB15
M0	PB14



2. Expected result

The connection of other LoRa HATs (if required) you can refer to the Raspberry Pi example parts.

Open the project, and modify the definition on main.c file for different communicating modes

```
#define TRASNSPARENT
//#define RELAY
//#define WOR
```

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