DTU_LR_A Instructions

V1.0

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Catalogue

1.Brief introduction

DTU_LR_A is a wireless information transmission unit based on LoRa, which mainly uses LoRa modulation technology for data transmission. This DTU can run in two modes:

1. General transparent transmission mode, receiving or sending through AT instruction.
2. Master-slave transparent transmission mode, which can be set as Master or Slave, can interact according to modbus protocol.

Product features：

- Point-to-point communication protocol
- Support fixed-point sending mode
- Support master-slave mode
- Support data encryption transmission
- AT command configuration, supporting setting tools
- -148dBm receiving sensitivity (10.4 kHz, SF 12)
- 4000 meters transmission distance
- RS232/RS485 interface
- 12 ~ 36 VDC power supply
- ESD protection (level 4)
- Power surge protection (level 3)
- RS232/RS485 surge protection (Grade 3)
- Hardware watchdog

1.1 Parameter

Classify	Specifications	Parameter value
Radio frequency	Working frequency band	Determined by product identification (for example: 905-925 MHz
	Transmit power	21dBm
	Receiving sensitivity	- 148dBm@（10.4 kHz, SF 12）
	Antenna selection	The impedance of SMA antenna pedestal (outer screw inner hole) is 50 ohms.
Electric	Data interface	RS232/RS485 Baud rate: 1200bps-115200bps The default is 9600 bps
	Maximum transceiving length	240 bytes
	Operating voltage	12Vdc ~ 36Vdc
	Operational current	Emission current 40mA @ 12Vin (peak value) Standby current 3mA @ 12Vin
	Working temperature	-40℃ ~ + 85℃
	Storage temperature	-45℃ ~ + 125℃
	Working humidity	5~95%RH(non-condensation)
	Storage humidity	1~95%RH(non-condensation)

1.2. Interface description

Figure 5 Product interface

1. Antenna interface
   SMA antenna pedestal (outer screw inner hole) with impedance of 50 Ω.
2. Power source
   5.5*2. 1 standard DC power interface, input voltage 12-36V. The product power input has TVS protection.
3. Power source
   3.81*2P screw terminal is connected to DC power supply, and the input voltage is 12-36V. The product power input has TVS protection.
4. RS232

The serial port of the equipment is the female port (hole), with RS232 level (which can be directly connected to the serial port of the computer), and the pin sequence is consistent with the COM port of the computer. When connecting with the computer, it is necessary to use a cross line (2-3). A total of 3 lines are defined, and the rest are suspended.

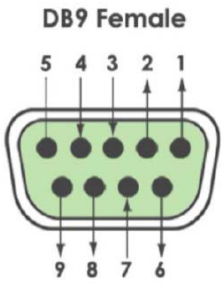

Figure 6 Serial interface

Pin definition

Pin	code name	function
2	RXD	Device data reception
3	TXD	Device data transmission
5	GND	Grounded

5. RS485
   3.81*3P screw terminal, RS485 has two leads, namely A (data+) and B (data-). When connecting with RS485, A (+) is connected to A (+), and B (-) is connected to B (-).
6. RST button
   This button is a system reset button. Press the device to restart.
7. RTD button
   Restore factory settings button, which can be pressed for 10 seconds to restore factory default parameter values.

1.3. Indicator light

There are five indicator lights in the equipment, from top to bottom:

Indicator light	Function	Explain
POWER	Power indicator (red)	Always on after power on.
LR_TX	LoRa data transmission indication (yellow)	LoRa transmitting signal is on for a long
LR_RX	LoRa data reception indication (green)	LoRa received the signal for a long time.
DTU_TX	DTU data sending indication (green)	DTU transmits data for a long time.
DTU_RX	DTU data reception indication (yellow)	DTU receives data for a long time.

1.4. Appearance size

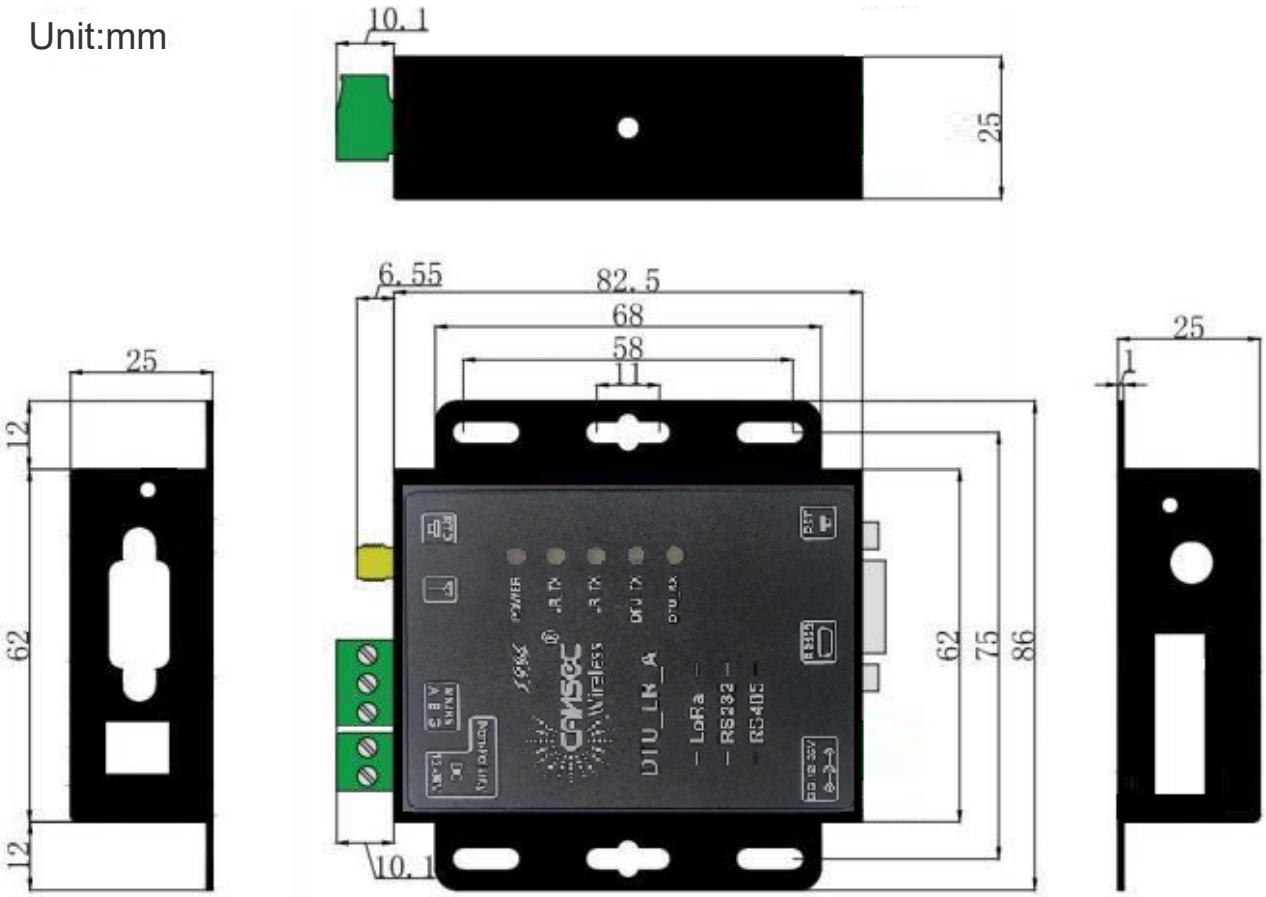

Figure 7 Appearance size

2.Application scenario

2.1 LoRa DTU Application scenario

The following figure is a schematic diagram of the situation where only LoRa DTU is used, and a LoRa host is connected to the server, which can be connected by RS232 or RS485.

On the server side, the ModBus command can be sent to the LoRa host, and the command will be transmitted by the LoRa host through LoRa. When the LoRa host finds that the command address is its own address, it will parse the command and execute it.

The RS485 interface of DTU slave connects several different Sensors or devices in series. As shown in DTUSlave2 node, the sensor, the ammeter and the remote IO power saving point are connected in series, and the server can communicate to the designated device through Modbus command, and then the device extracts the command, executes the command and returns the result.

In DTU-Slave n, an industrial tablet computer is connected in series. The tablet mainly updates the data inside through Modbus commands, and the server will send commands to update the content of the tablet computer according to the collected sensor data.

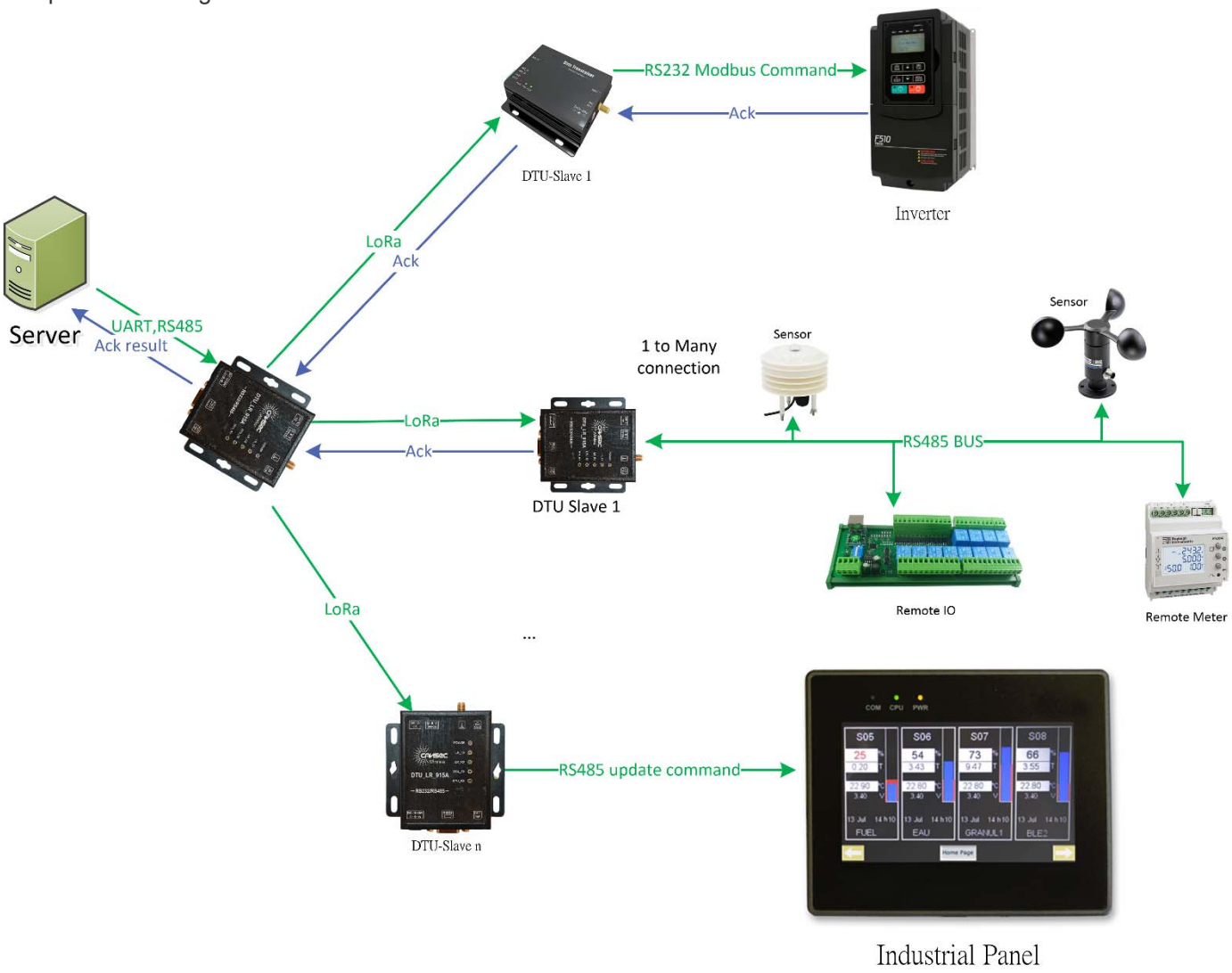

Figure 8 LoRa DTU Application scenario

2.2 LoRa DTU + 4G Application scenario

In the application scenario part, we can divide it into two application scenarios. The first one is the application that only needs to send the sensor data back to the server through the Cellular network in outdoor places.

The second application scenario is mainly changed from 4G DTU version to 4G-to-LoRa gateway application scenario by concatenating LoRa DTU. The related application scenario diagram is as follows:

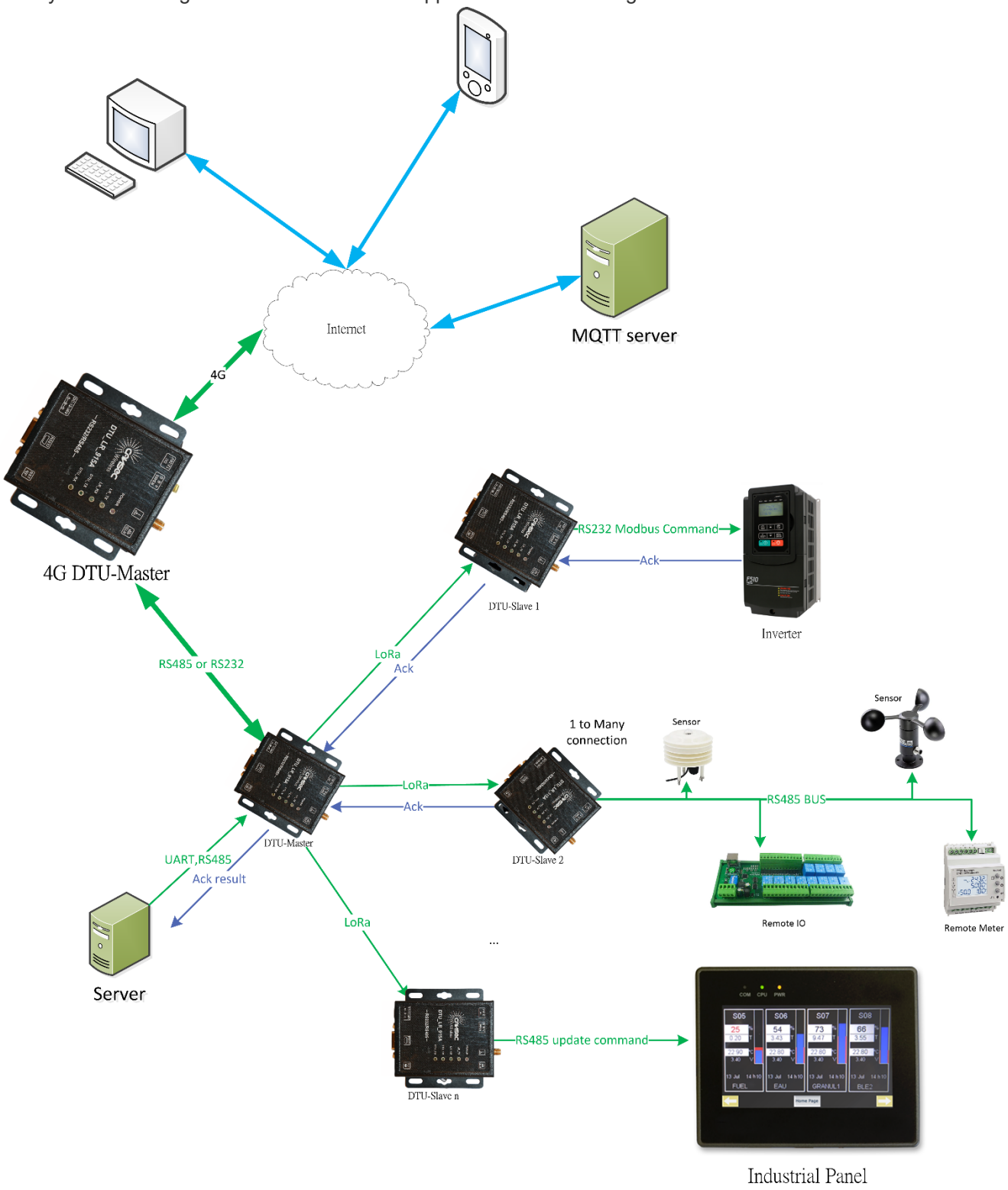

Figure 9 LoRa DTU + 4G DTU Application scenario

3.Work pattern

This DTU mainly has two working modes, namely general transparent transmission mode and master-slave transparent transmission mode.

In the general transparent transmission mode, all actions in DTU use AT command to tell DTU what behavior it wants, such as letting DTU enter the receiving state now, or letting DTU transmit data. In this whole process, AT command is used to control DTU.

If DTU is in Master,Slave transparent transmission mode, DTU will have two roles: master and slave. As soon as DTU is powered on, it will enter the receiving state, and always listen to whether there is any data to receive. When there is any data received, it will be transmitted to RS232 and RS485. At this time, when RS232 or RS485 has data to ACK, it will be transmitted DTU,DTU through RS232 or RS485, and DTU will then transmit the data to the Master through LoRa.

3.1 General transparent transmission mode

The following figure shows the sequence diagram of the general transparent transmission mode. We use two LoRa nodes for illustration, namely LoRa1 Node and LoRa2 Node, and these two nodes are controlled by two users, namely Side 1 User and Side 2 User.

First of all, Side 1 User used LoRa1 node to issue the AT command, which made LoRa1 Node enter the receiving mode with a duration of 5 seconds, as shown in No.1 and No.2 of the label.

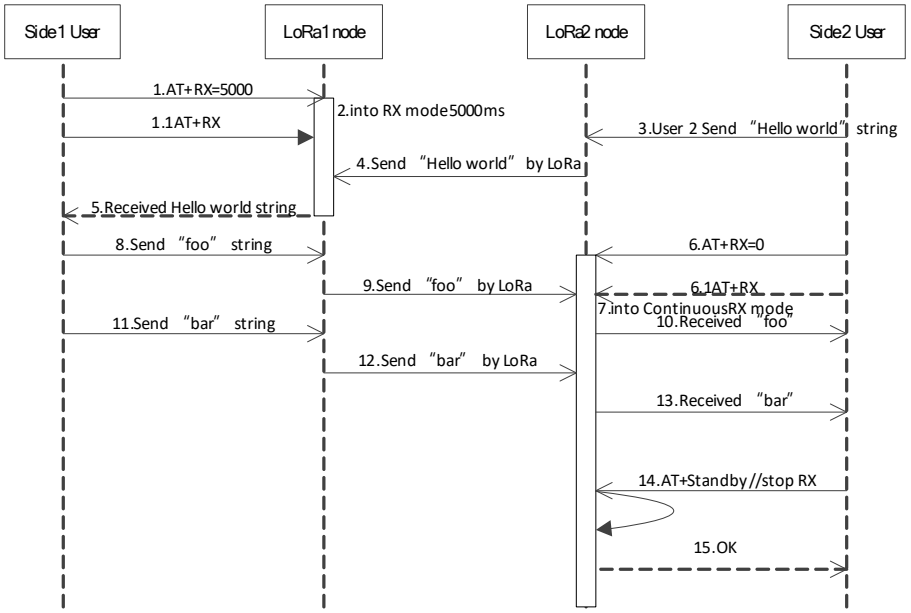

Figure 10 sequence chart

At this time, Side 2 User sends a string of Hello world to LoRa2 Node. After LoRa2 node receives this string, it will send it out wirelessly through LoRa modulation technology, as shown in numbers 3 and 4.

While in LoRa1 node, because it is still in the RX state, it will receive the Hello world string and transmit it to Side 1 User via RS485/RS232, as shown in No.5..

Next, change side 2 user to make LoRa 2 enter the continuous receiving mode, because side 2 user sends AT+RX=0 and then sends AT+RX to make it enter the continuous receiving state, as shown in numbers 6-7. On the side 1, the user sends the foo string and the bar string through the Node1, as shown by the reference numerals 8, 9, 11 and 12, and since the Node2 is currently in a continuous receiving state, it will receive the foo and bar strings, as shown by the reference numerals 10 and 13.

Finally, side 2 user used AT+Standby to make LoRa 2 node stop receiving.

The above is a description of the general mode. As can be seen from the above figure, in the general mode, the LoRa node is mainly a password and an action, and any operATion must be driven by the at command of the host controller to drive LoRa DTU into any working state.

3.2 Master-slave transparent transmission mode

After entering the master-slave mode, it means that there is a master with the concept of slave. When the host is idle, it will wait for RS485 or RS232 to see if there is any data coming in, and if there is any data coming in, it will transmit it to the slave. Suppose the following settings are made in LoRa DTU.

```
AT+Freq=920000000
AT+SF=7
AT+BW=2
AT+CR=1
AT+Mode=1  //Set DTU as the master mode.
//Press the reset key to reset and make it start working.
```

After the above settings are completed, the internal process of LoRa DTU runs as follows:

After pressing the reset key, DTU will enter the continuous receiving mode after initialization, and it will wait for RS485 or RS232 to see if there is any data coming in. If there is any data coming in, it will send the data through LoRa TX, and after the launch is successful, it will wait for receiving.

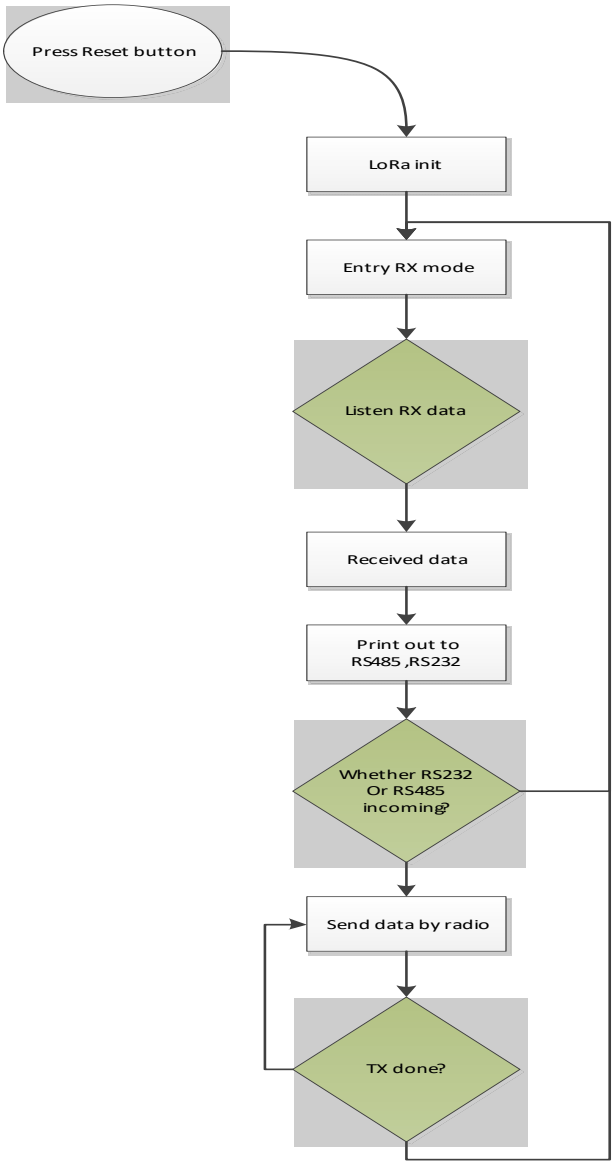

Figure 11 Host transparent transmission flow chart

If DTU sets the slave state in master-slave mode, when DTU is idle, it will turn on LoRa receiving mode, and it will wait for whether there is any data coming in the radio frequency. If there is any data coming in, it will send the data to the host controller via RS232 and RS485.

Suppose the following settings are made in LoRa DTU.

```
AT+Freq=920000000
AT+SF=7
AT+BW=2
AT+CR=1
AT+Mode=2 //Set DTU as the slave mode of master-slave mode.
//Press the reset key to reset and make it start working.
```

After the above settings are completed, the internal process of LoRa DTU runs as follows:

After pressing the reset key, DTU will enter the receiving state after initialization. When receiving data from the radio frequency, it will transmit the data to the host controller through RS485/RS232. When the host controller receives the data, if it needs to send back the data, At this time, the host controller will send the data to the LoRa slave through RS485/RS232, and after LoRa receives the data from the slave, it will send the data to the LoRa host through radio frequency, and then LoRa will continue to return to the RX continuous receiving mode from the slave, waiting for whether there is any data coming in. The flow chart is shown below.

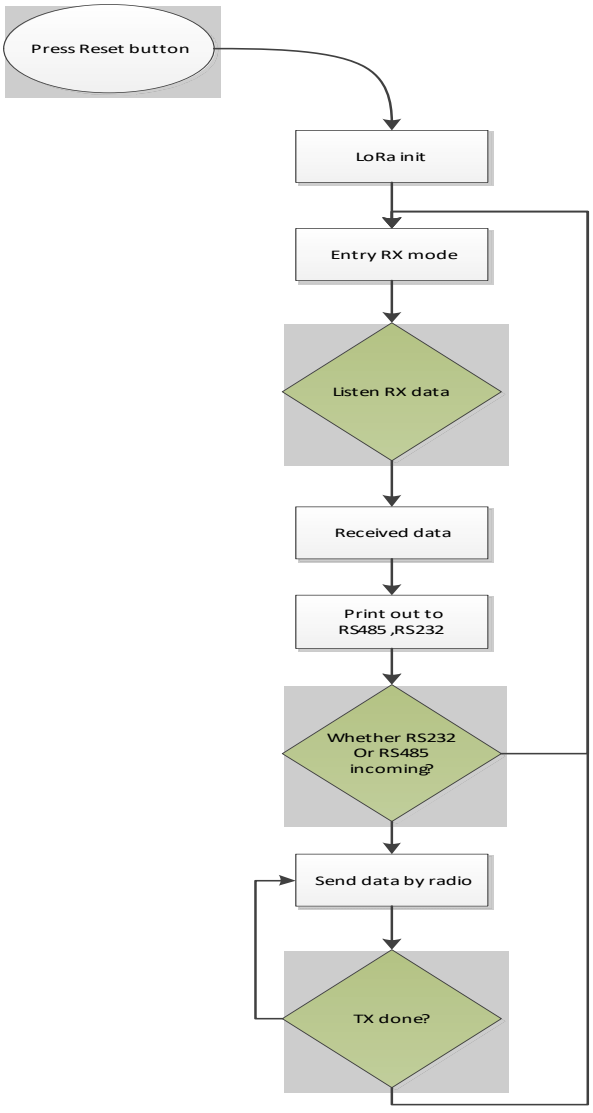

Figure 11 Host transparent transmission flow chart

3.2.1 Co-frequency transmission mode

In the same frequency transmission mode, DTU is in the master-slave mode, and the uplink frequency and downlink frequency will use the same frequency to send and receive. Suppose we prepare two DTUs as the master and slave respectively, and make the following settings in the master and slave.

Host side setting
AT+Freq=920000000 AT+SF=7 AT+BW=2 AT+CR=1 AT+Mode=**1** //Set DTU as the master mode. **AT+ModBusFDDMode=0 //Set to the same frequency transmission.** //Press the reset key to reset and make it start working.

Slave end setting
AT+Freq=920000000 AT+SF=7 AT+BW=2 AT+CR=1 AT+Mode=**2** //Set DTU as the slave mode of master-slave mode. **AT+ModBusFDDMode=0 //Set to the same frequency transmission.** //Press the reset key to reset and make it start working.

After that, when DTU master and slave transmit data, we will find that their uplink frequency and downlink frequency will use 920Mhz for transmission. As shown in Figure 12:

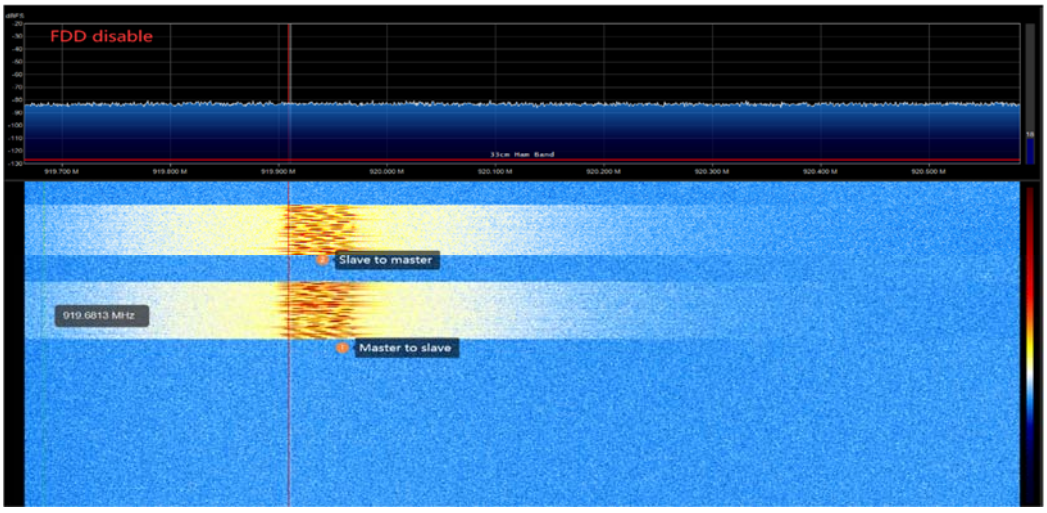

Figure 12 Waterfall diagram of same frequency transmission

3.2.2 Asynchronous transmission mode

In the different frequency transmission mode, DTU is in the master-slave mode, and the uplink frequency and downlink frequency will be sent and received separately. Suppose we prepare two DTUs as the master and slave respectively, and make the following settings in the master and slave.

Host side setting
AT+Freq=920000000 AT+SF=7 AT+BW=2 AT+CR=1 AT+Mode=**1** //Set DTU as the master mode. **AT+ModBusFDDMode=1 //Set to different frequency transmission.** **AT+UNKFreq=920500000//Set the uplink frequency to 920.5Mhz** //Press the reset key to reset and make it start working.

Slave end setting
AT+Freq=920000000 AT+SF=7 AT+BW=2 AT+CR=1 AT+DTURxWindow=50 //Set the time to open the RX window after sending the data as follows //50*100ms=5Seconds AT+Mode=**2** //Set DTU as the slave mode of master-slave mode. **AT+ModBusFDDMode=1 //Set to different frequency transmission.** **AT+UNKFreq=920500000 //Set the uplink frequency to 920.5Mhz** //Press the reset key to reset and make it start working.

After the above settings, we set the two DTUs into different frequency transmission mode. After that, when DTU Master and Slave transmit data, we will find that 920Mhz is used to send instructions to Slave in Master, while 920.5Mhz is used to send instructions to master in slave. As shown in Figure 13:

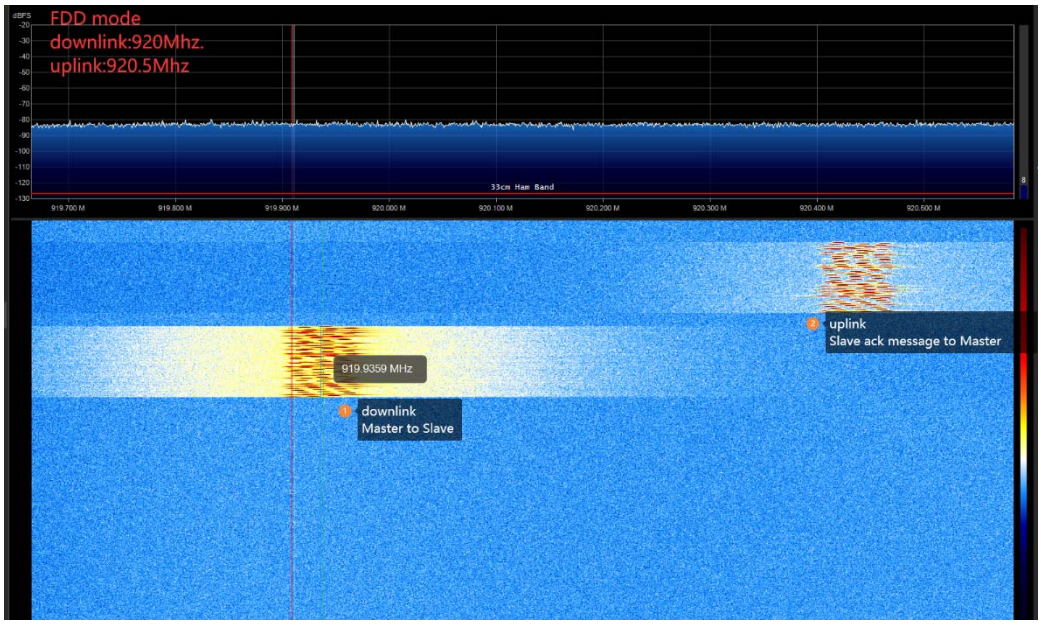

Figure 13 Waterfall diagram of different frequency transmission

4.Contact information

CANSEC Catalog

CANSEC Taobao Website

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grace@rf-products.com
norman@rf-products.com
jimmy@rf-products.com
Technical Support: zhaoyaxi@rf-products.com
Addr: Rm.1002, Block B China Railway Venture building, No.28 Pingguoyuan Rd., Shijingshan District, Beijing, 100041,China.
Website: www.rf-products.com

5.Update history

Data	version	describe	Write	Approve
2023-2-14	V1.0	First draft	Weili Wang	

6. Installation

1.this device will not be sold to the general public, it will be sold to dealers only.

2.this device requires controlled installation location by professional installers.

3.the device requires professional configuration for use.

Warning

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.