



User Manual

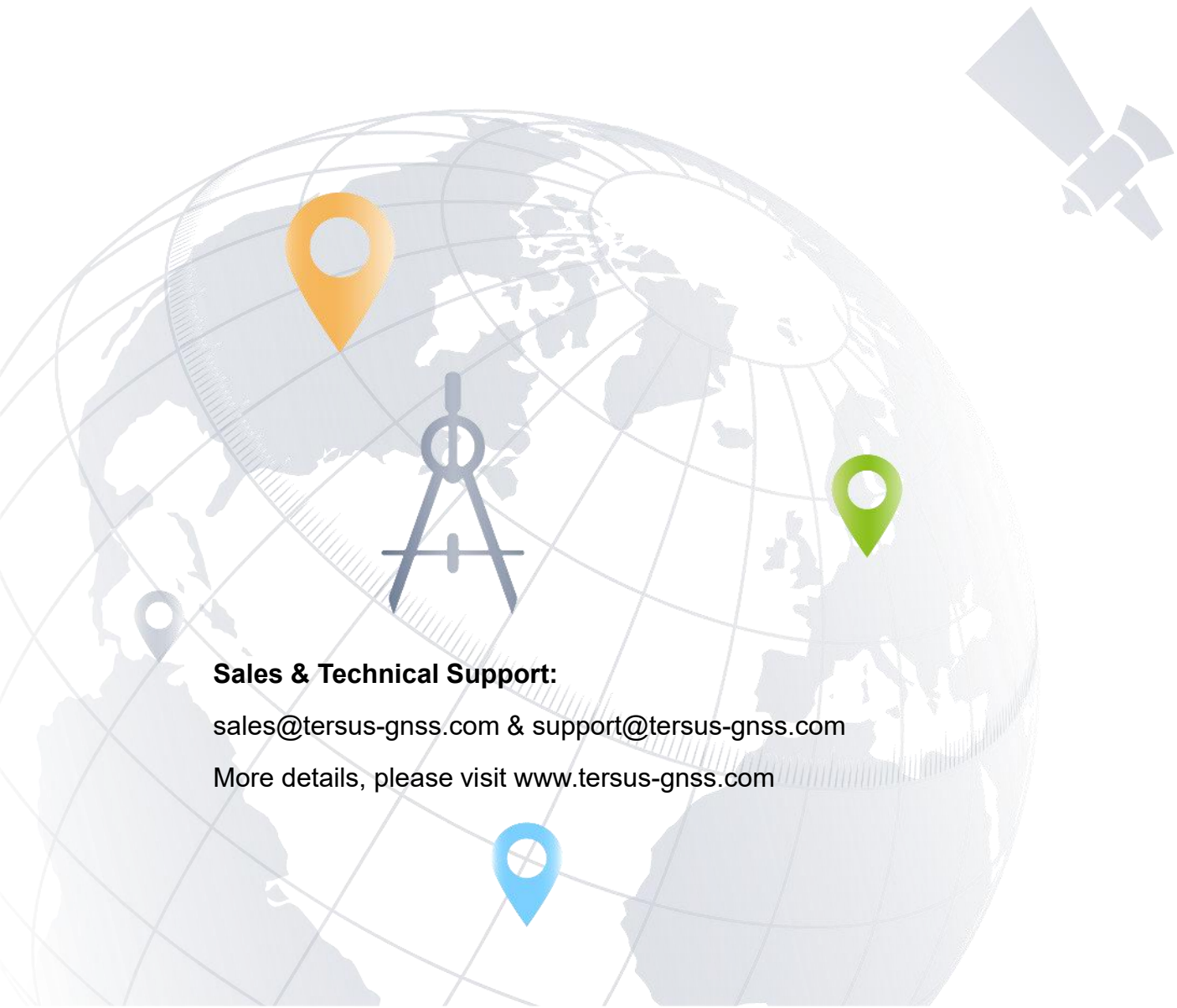
Version V1.0-20220224

User Manual

For Tersus Radio RS400H3-H

SMART AND HIGH EFFICIENT RADIO MODEM FOR RTK APPLICATIONS

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Revision History

Version	Revision Date	Change summary
1.0	20220224	Initial Release

Table of Content

Revision History.....	1
Table of Content.....	2
List of Figures.....	3
List of Tables.....	4
1. Introduction.....	5
1.1 Overview.....	5
1.2 Specification.....	6
1.3 Accessories.....	8
2. General Operation.....	12
2.1 Basic Operation.....	12
2.2 Software Configuration.....	19
2.3 Firmware Upgrade.....	23
2.4 Installation Tips.....	26
2.5 Radio Repeater.....	27
2.6 Network Repeater.....	28
3. Terminology.....	30

List of Figures

Figure 1.1	External Radio RS400H3-H.....	5
Figure 1.2	High Gain Radio Antenna	9
Figure 1.3	Telescopic pole for radio antenna	9
Figure 1.4	Serial-5pin to Ext-Radio-DC-5pin & Bullet-DC Cable.....	9
Figure 1.5	Bullet-DC to Alligator Clips.....	10
Figure 1.6	Serial-5pin to DC JACK & DB9 Male cable.....	10
Figure 1.7	DC JACK male with two wires.....	10
Figure 1.8	DB9 Female to USB Type A Male converter cable.....	11
Figure 1.9	Configuration cable for external radio.....	11
Figure 2.1	Hardware connection for software configuration.....	19
Figure 2.2	Radio configuration tool interface.....	20
Figure 2.3	Select serial port and baud rate.....	20
Figure 2.4	Read parameters successfully.....	21
Figure 2.5	Channel info.....	21
Figure 2.6	Personalized settings.....	21
Figure 2.7	Power Manager settings.....	22
Figure 2.8	Network settings.....	22
Figure 2.9	Firmware upgrade tool.....	23
Figure 2.10	Select serial port and baud rate.....	24
Figure 2.11	Select firmware upgrade file.....	24
Figure 2.12	Start upgrade.....	25
Figure 2.13	Upgrade firmware successfully.....	25
Figure 2.14	SIM installation.....	27
Figure 2.15	Configure radio repeater.....	28
Figure 2.16	Configure network repeater.....	29

List of Tables

Table 1.1	Specifications of Radio RS400H3-H.....	6
Table 1.2	LED indicators.....	8
Table 2.1	Buttons description of radio RS400H3-H.....	12
Table 2.2	Devices in Figure 2.1.....	19

1. Introduction

This chapter mainly introduces the overview and specification of the Tersus Radio RS400H3-H.

1.1 Overview

The Tersus Radio RS400H3-H is a base radio solution for wireless applications. It provides reliable data communications for mission-critical applications where a combination of stability, superior performance and long range are required.

The RS400H3-H provides high speed, high power, wireless data links and has been designed to survive the rigors of GNSS/RTK surveying and precise positioning applications. Up to 35W transmit power maximizes range and supports operation in difficult urban areas. The RS400H3-H is equipped with OLED display and keypads which are used for checking the operating status, changing the operating channel, and transmitting power level.

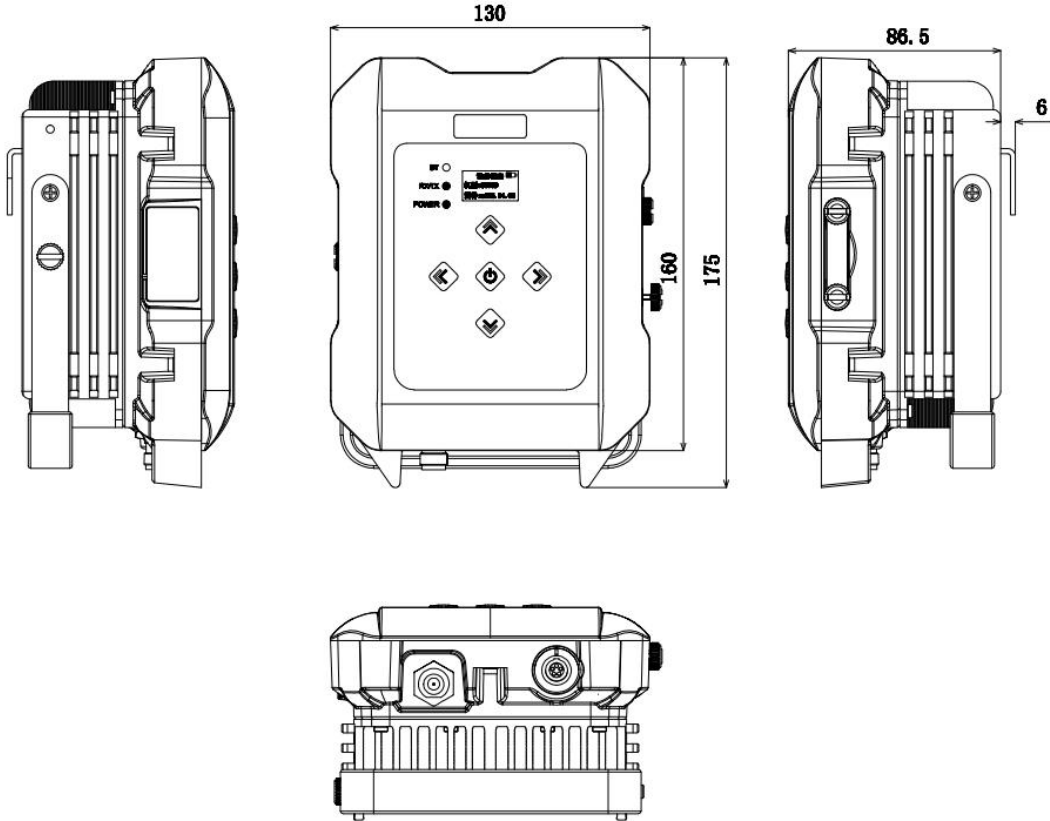
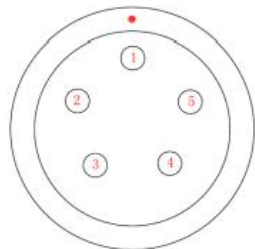


Figure 1.1 External Radio RS400H3-H

1.2 Specification

Table 1.1 Specifications of Radio RS400H3-H

General Specification		
Frequency range	410~470MHz	
Operating mode	Transmitter, Receiver, Radio Repeater, Network Repeater	
Channel width	25KHz, 12.5KHz	
Channels	200	
Operating voltage	9~16V DC	
Power consumption	High power (35W)	85W @ DC 12V
	Medium power (22W)	60W @ DC 12V
	Low power (5W)	35W @ DC 12V
	Standby	2W @ DC 12V
Frequency stability	≤ ±1.0ppm	
Transmitter		
RF output power	High level (35W)	45.4±0.5dBm @ DC 12V
	Medium level (22W)	43.4±0.5dBm @ DC 12V
	Low level (5W)	37±1dBm @ DC 12V
Power stability	±1dBm	
Adjacent channel power	>50dB	
Distance(Typical)	18-21KM	
Receiver		
Sensitivity	<-114dBm@BER 10 ⁻³ , 9600bps	
Co-channel rejection	>-12dB	
Antenna		
Antenna Impedance	50 Ohm	
Antenna Interface	TNC female	
Modem		
Air baud rate	4800bps, 9600bps, 19200bps	
Modulation Type	GMSK/4FSK	
Serial port baud rate	9600, 19200, 38400, 57600, 115200(default) bps	
Protocol	TRIMTALK, TRIMMK3, TRANSEOT,SOUTH, SATEL	
Bluetooth		
Bluetooth Version	2.0/4.0	
Bluetooth Antenna	Built-in	
4G		
4G bands(MHz)	B1(2100), B3(1800), B7(2600), B8(900), B20(800)	
3G bands(MHz)	B2(2100), B8(900)	
2G bands(MHz)	B3(1800), B8(900)	

Environmental		
Temperature	Operating	-40 ~ +65°C
	Storage	-50 ~ +85°C
Dustproof and waterproof	IP67	
Physical Description		
Dimension	175 x 130 x 86.5 mm	
Weight	About 2.0kg	
Data & Power interface	LEMO 5pin	
Installation	Hook	
Mechanical Drawing		
		
Signal Definition		
Data & power interface	 View from outside to radio	Pin 1: PWR (9~16V DC) Pin 2: Power GND Pin 3: RXD Pin 4: Signal GND Pin 5: TXD

The definition of the LED indicators are as follows.

Table 1.2 LED indicators

LED	Description
GPRS/BT	GPRS is GPRS module red indicator light; BT is Bluetooth green indicator light.
RX/TX	RX/TX is data transmitting-receiving red and green indicator light, green indicator light represents data receiving, red indicator light represents data transmitting.
POWER/ALM	POWER/ALM is bi-color indicator light for normal power supply and under-voltage, green indicator light represents normal power supply, red indicator light represents abnormal voltage.

Bluetooth Module:

Users can configure and query the radio parameters by the means of Bluetooth, Bluetooth V4.0 is supported;

Network Module

Users can transmit their data via network, now radio can be used as CORS station, without the need of RTK device, thus saving cost and simplifying outdoor operation. In addition, network module supports 4G.

1.3 Accessories

When using Radio RS400H3-H to set up a base with Oscar GNSS receiver, a high gain radio antenna and a telescopic pole are needed which are shown as below.



Figure 1.2 High Gain Radio Antenna



Figure 1.3 Telescopic pole for radio antenna

The following Serial-5pin to Ext-Radio-DC-5pin & Bullet-DC Cable and Bullet-DC to Alligator Clips are used to communicate with Oscar and connect to external power supply.



Figure 1.4 Serial-5pin to Ext-Radio-DC-5pin & Bullet-DC Cable



Figure 1.5 Bullet-DC to Alligator Clips

The Serial-5pin to DC JACK & DB9 Male cable and the DC JACK male with two wires below are optional. It is to power Oscar using external power source instead of the BN20 battery.



Figure 1.6 Serial-5pin to DC JACK & DB9 Male cable



Figure 1.7 DC JACK male with two wires

The DB9 Female to USB Type A Male converter cable is to convert DB9 male to USB Type A male connector, so that it can connect to the USB port of a computer.



Figure 1.8 DB9 Female to USB Type A Male converter cable

The Configuration cable for external radio below is used to configure parameters of the external radio instead of the default setting.



Figure 1.9 Configuration cable for external radio

2. General Operation






2.1 Basic Operation

The basic operations include buttons, indicator status and device menu.

1) Buttons

There are five buttons on the radio RS400H3-H. The following table shows the detailed description of these buttons.

Table 2.1 Buttons description of radio RS400H3-H

Icon	Button	Function
	Power	It is used to control radio power-on and power-off, with specific functions as follows: <ul style="list-style-type: none"> ● Short press the power button for about 1 second to power on, the green power indicator light illuminates when successful power-on (under normal power supply). ● While power-on, long press the power button for 3 seconds to power off, the power indicator light turns off and the display is off. ● Parameter confirmation in the menu.
	Left	Switch over various functions in the menu.
	Right	
	Up	Select corresponding item in the current menu.
	Down	

2) Indicator status

Normal power on/off of the radio has memory function, abnormal power on/off does not have memory function. The detailed functions are as follows.

- In the case of abnormal shutdown for the last time, power on again after outage, the radio powers on automatically;
- In the case of normal shutdown for the last time, short press the power button about 1 second to power on the radio;
- If the voltage is lower than the under-voltage threshold value (11.0V by default, depending on the user's actual setting value), the red power indicator light flickers twice in one second;
- If the voltage is lower than the forbidden threshold value (10.2V by default, depending on the user's actual setting value), the red power indicator light flickers once in one second;
- If the voltage is higher than the under-voltage threshold value (11.0V by default, depending on the user's actual setting value), the green power indicator light illuminates constantly;
- When the voltage alarm appears, if it is under-voltage alarm, it is needed to add 0.3V based on the under-voltage threshold value to resume to the normal operating voltage (the green power indicator light illuminates constantly);

Note:

- ◆ Abnormal shutdown means not powering off by long pressing the power button, for example, directly disconnecting power;
- ◆ Normal shutdown refers to power off by long pressing the power button.

GPRS and Bluetooth Operating Condition

Include various operating conditions of the GPRS module and Bluetooth module shown as below, if any module is abnormal, this condition can be

convenient for users to locating the problem:

If GPRS enters the condition of network data transmission successfully, the red indicator light flickers once in three second;

If GPRS is detecting SIM card, the red indicator light flickers twice in three second;

If GPRS is trying to access network, the red indicator light flickers four times in three second;

If GPRS is re-connecting to the Corse station or server successfully, the red indicator light flickers five times in three second;

Bluetooth led (green) is reserved

3) Device menu

The device menu is divided into two categories: basic radio parameter menu and other features/functions menu.

- Device information

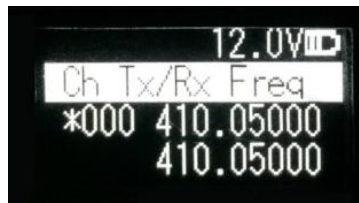
Under the information bar, the current channel number, current transmitting frequency, current receiving frequency, current protocol, current transmitting power, battery status, device model, firmware version, hardware version and serial number are displayed.



- Channel and frequency

Under this menu, you can set up the current transmitting/receiving frequency, select required communication frequency through up and down buttons, and press the power key to select this frequency as the current communication

frequency, the star character “*” will appear after selection.



- Data protocol

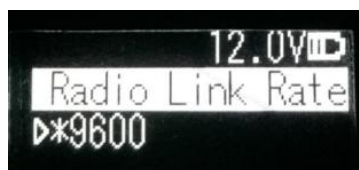
Under this menu, you can set up the current communication protocols such as TRANSEOT, TRIMTALK and TRIMMK3. Select required communication protocol through up and down buttons, and press the power key to select this protocol as the current communication protocol, the star character “*” will appear after selection.



Note: After changing the protocol, you need reselect the air baud rate supported by the current protocol in the menu of “wireless link rate”.

- Air baud rate

Under this menu, you can set up the current communication air baud rate. Different protocols support different types of air baud rates. For example, TRANSEOT supports 4800 and 9600 bps, while TRIMMK3 supports 19200bps. Select required air baud rate through up and down buttons, and press the power button to select this air baud rate as the current communication air baud rate, the star character “*” will appear after selection.



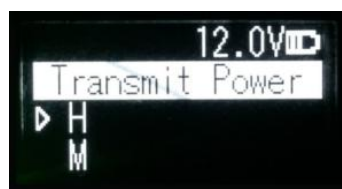
- Transmitting/Receiving mode

In this menu column, you can set up the current radio transmitting/receiving mode. Now, four types of transmitting/receiving modes are supported: transmitting-receiving, single transmitting, single receiving and relaying mode. Select required transmitting/receiving mode through up and down buttons, and press the OK key to select this transmitting/receiving mode as the current communication transmitting/receiving mode, the character of "*" will appear after selection



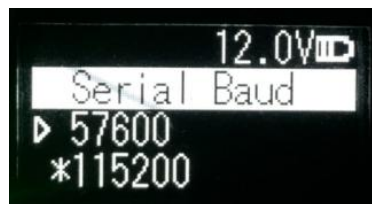
- Transmit power

Under this menu, you can set up the current wireless transmitting power level. Currently three levels of power, high, medium and low, are supported. These three levels of power values can be customized according to the demands of users. Select required transmitting power through up and down buttons, and press the power button to select this transmitting power as the current communication transmitting power, the star character "*" will appear after selection.



- Serial baud rate

Under this menu, you can set up the current serial port communication baud rate. Currently it supports following baud rates: 9600, 19200, 38400, 57600, and 115200 bps. Select required serial port communication baud rate through up and down buttons, and press the power button to select this serial port communication baud rate as the serial port baud rate of the current communication, the star character “*” will appear after selection.



- Serial baud rate self-adaption

Under this menu, there are two options: self-adaptive master switch and triggering enabling. The former has memory function, if turning on the switch, ON is displayed on the menu; if off, then OFF is displayed. Self-adaptive triggering enabling does not have memory function, the system remains in the power up status after power-on; only if the self-adaptive master switch has been turned on can the adaptive function of serial port baud rate work normally.

If the serial port baud rate is successfully self-adaptive, a message box pops up indicating successful self-adaptive matching, meanwhile, self-adaptive triggering enabling stops automatically. If the serial port baud rate is not successfully self-adaptive, this function is always operating.



- OLED sleep mode

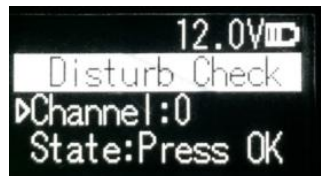
Only if the “Function” is switched to “On” can the OLED display enter the sleep mode. Sleep time has the following levels: 1min, 5min, 10min, 15min, 20min, 25min, and 30min.



Note: After the OLED display enters sleep, it can be waken up through button and pop-up message.

- Interference detection

To detect whether there is any interference in the current channel, you can modify the detection channel number manually and press the power button for detection. There are three levels of detection result: superior, moderate, poor.



- Language

Set the display language, Chinese and English are supported.



2.2 Software Configuration

The detailed steps of software configuration are as follows:

1) Hardware connection

Use the accessory cables listed in section 1.3 to connect the radio to the computer following the connection in the figure below. Power on the radio using 12V external power supply.

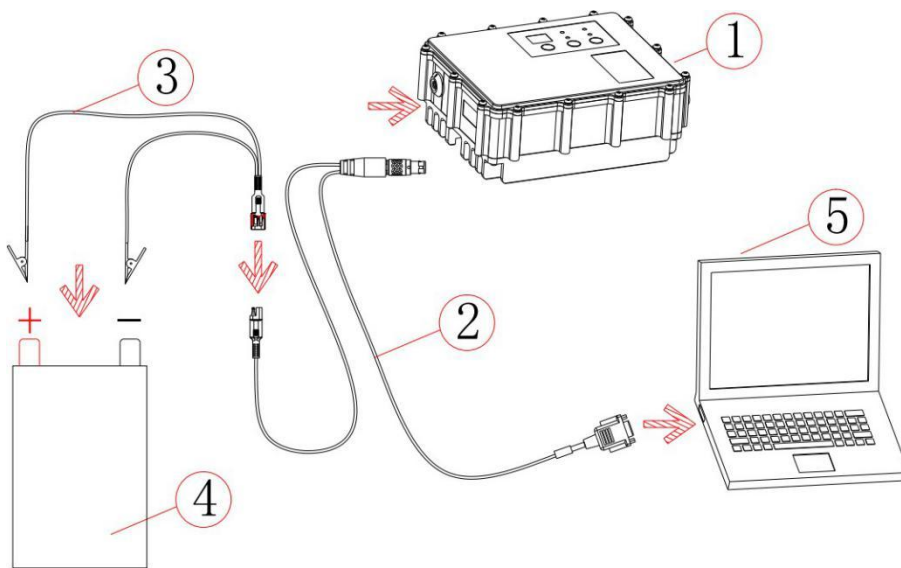


Figure 2.1 Hardware connection for software configuration

Table 2.2 Devices in Figure 2.1

No.	Device Name
1	Radio RS400H3-H
2	Configuration cable for external radio
3	Bullet-DC to Alligator Clips
4	12V external power supply
5	Computer (Desktop/Laptop)

2) Radio Config Tool installation

Run the radio config tool installation file as administrator, and click “Next” until installation is completed. The shortcut will appear on the desktop. Right-click

the shortcut on the desktop and select “Run as administrator”, the software interface is shown as below.

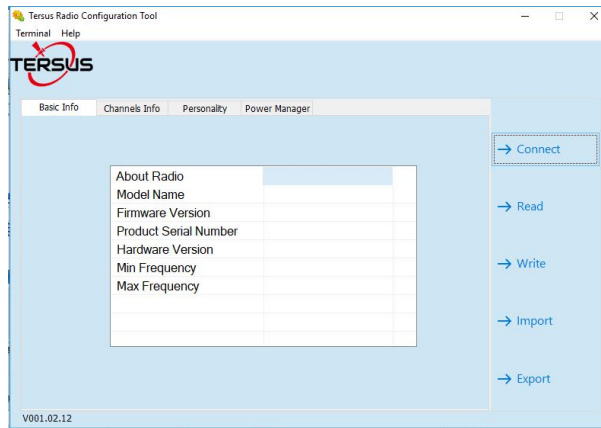


Figure 2.2 Radio configuration tool interface

Note:

During the use of the configuration tool for radio parameter configuration and query, the radio is not allowed to enter the background parameter configuration mode by the buttons and OLED display.

3) Radio parameter query

After the connection is successful, click the [Read] and select the correct serial port number and the current operating baud rate in the pop-out window. Then click [Connect] and [Read] on the right to read the radio configuration parameters.

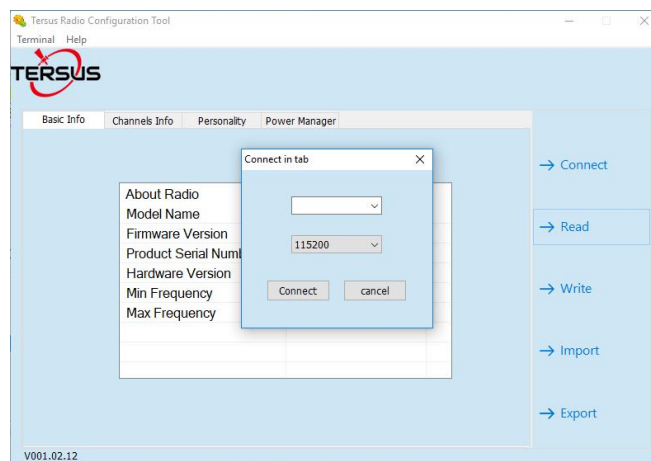


Figure 2.3 Select serial port and baud rate

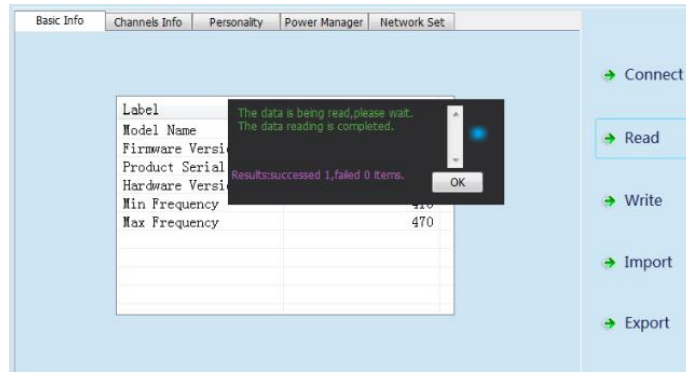


Figure 2.4 Read parameters successfully

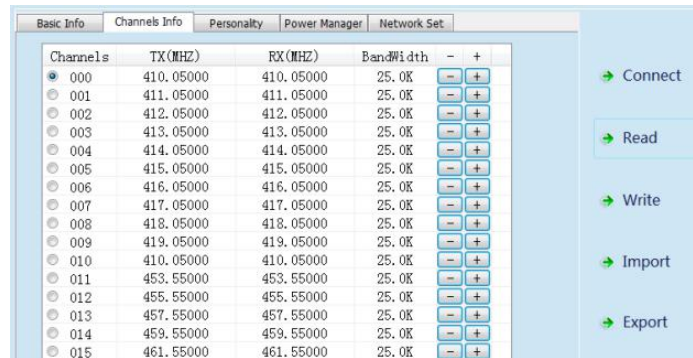


Figure 2.5 Channel info

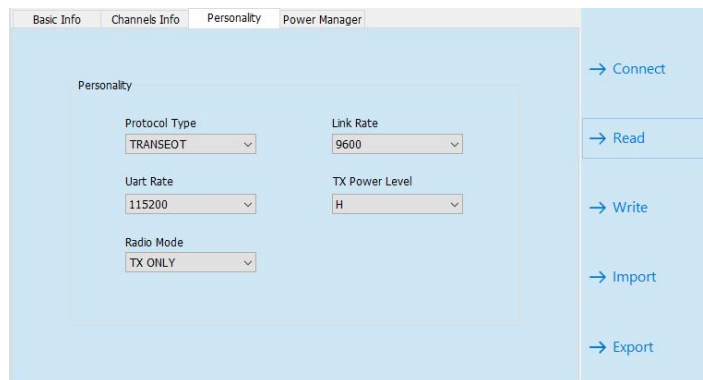


Figure 2.6 Personalized settings

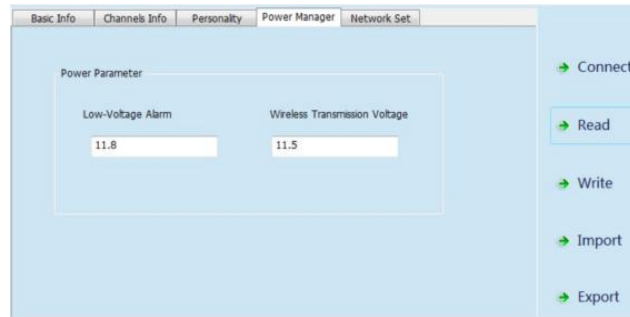


Figure 2.7 Power Manager settings

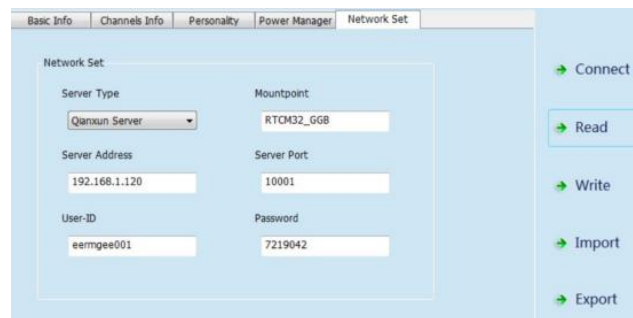




Figure 2.8 Network settings

4) Radio parameter configuration

- In the basic information tab, only radio information can be queried, configurations are not supported;
- In the channel information tab, the frequency range setting is between 410~470MHz,   signs '-' and '+' can be used to add and delete.
- In the personalization setting tab, users can set up communication protocol, air baud rate, serial port baud rate, transmitting power level and transmitting/receiving mode ;
- In the power management tab, users can set up the low-voltage alarm threshold value for radio operation and wireless data transmission voltage.
- In the network setting column, users can select the corresponding server type and set up related information such as IP address, port number and mounting point.

Note: if the operating voltage of the radio is lower than the low-voltage alarm threshold value, the red power indicator light flickers twice in one second; if the operating voltage of the radio is lower than wireless data transmission voltage, the radio stops transmitting user data; when setting up, the low-voltage alarm threshold value must be larger than wireless data transmission voltage.

2.3 Firmware Upgrade

When the radio runs under the normal operating mode (data transmission mode), online upgrade by serial port is supported. The firmware upgrade procedures are as follows:

- 1) First, use Serial-5pin to DC JACK & DB9 Male cable and the DC JACK male with two wires to connect to the Radio RS400H3-H with 9~16V DC power supply. Use DB9 Female to USB Type A Male converter cable to connect to the DB9 male connector of the above cable and the USB port of a computer. Power on the radio, or long press the power button for 3 seconds if it is not powered on. Make sure the radio system enters into the normal operating mode.
- 2) Find the firmware upgrade tool, and open the software.

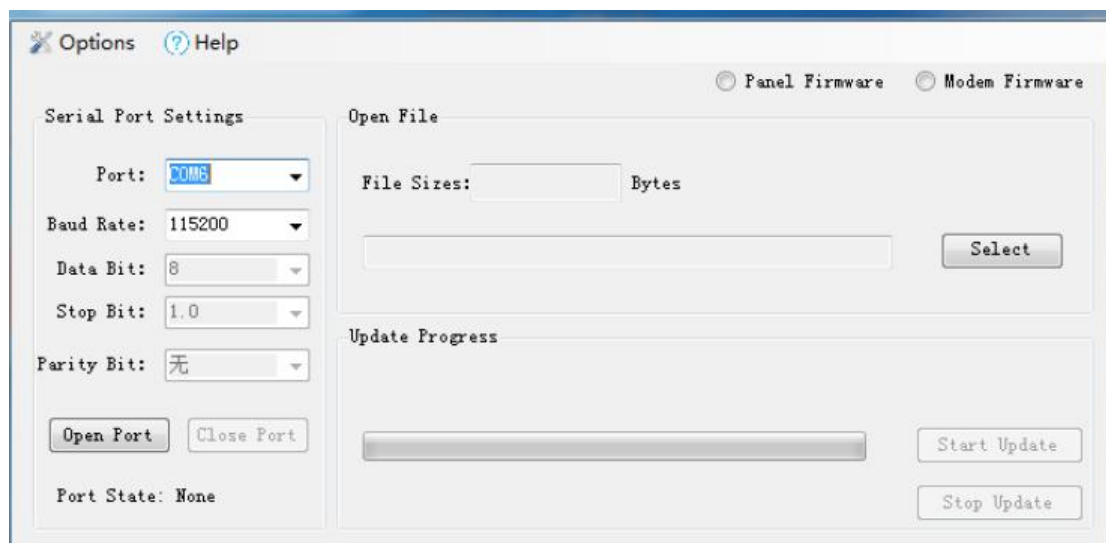


Figure 2.9 Firmware upgrade tool

- 3) Select the correct serial port number and baud rate, open the serial port and select internally installed radio.

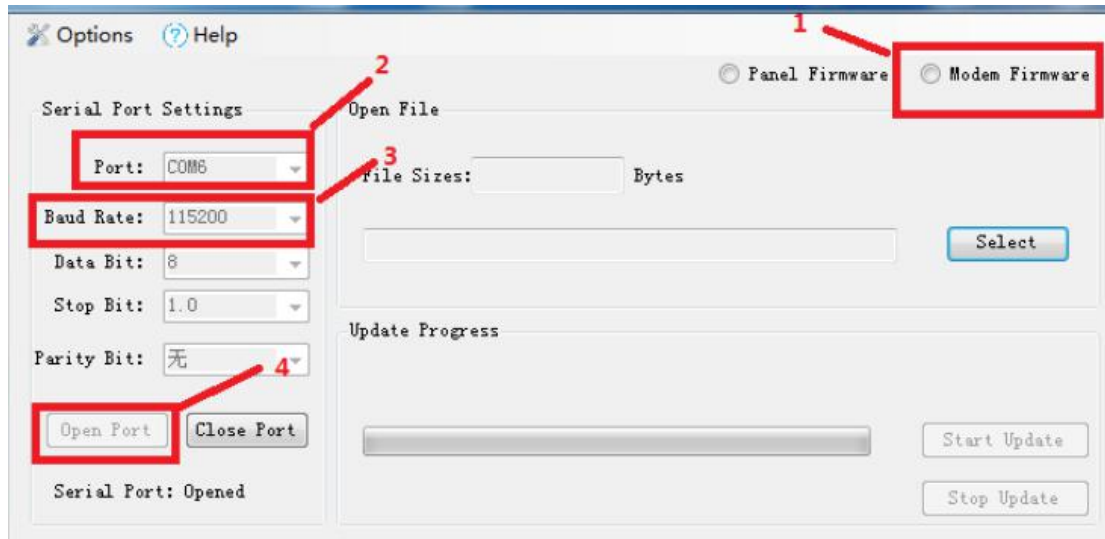


Figure 2.10 Select serial port and baud rate

- 4) Click [Select] to select the firmware upgrade file (xxxx.dwn).

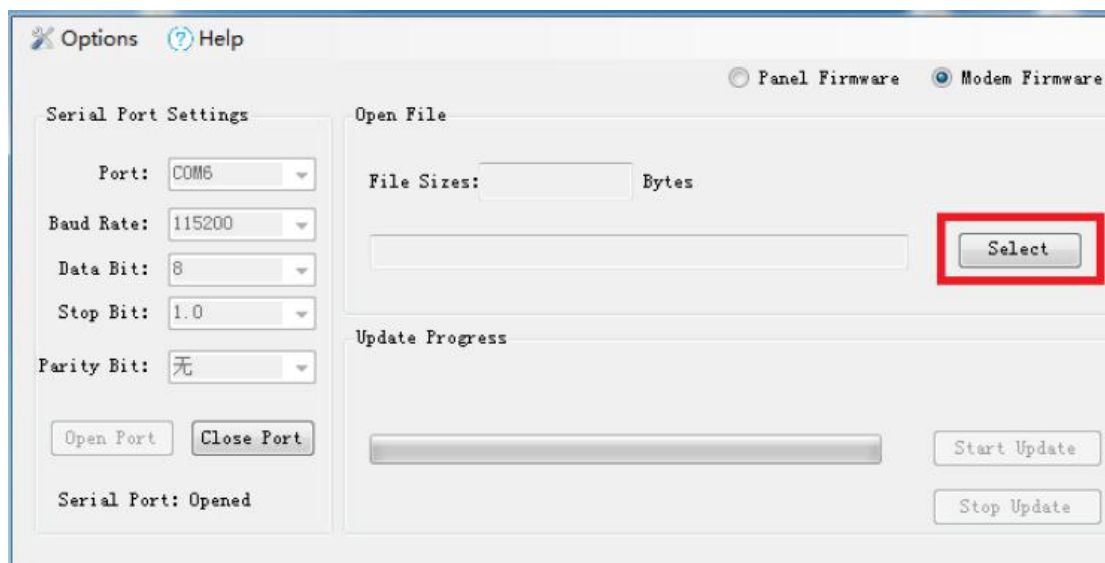


Figure 2.11 Select firmware upgrade file

- 5) Click [Start Update], it will pop out a confirmation window. Click [OK] and it will enter the upgrade status immediately.



Figure 2.12 Start upgrade

- 6) After upgrade, it pops out indicating successful upgrade, click [OK] to complete the firmware upgrade.



Figure 2.13 Upgrade firmware successfully

- 7) The radio will power off and power on again. If the radio cannot be powered on, short press the power button for 1 second to power it on.

2.4 Installation Tips

2.4.1 Radio installation

As a transmission, the radio is hooked on a tripod.

(1) Large amount of heat would be generated when the radio is in transmission. When the radio is working, please do not place the radio in poor ventilated box, wrap or cover any item on the surface of the radio.

(2) In an environment with a high temperature of more than 40°C or intense sunlight, the surface of the radio would be hot when it is transmitting at high power. It may cause scald if the surface of the machine is touched directly. Please pay special attention.

2.4.2 Antenna installation

Whether the antenna is properly installed and erected would seriously affect the transmission distance of the radio, hence the correct connection and installation of the antenna is of high importance.

(1) It is strictly forbidden to use a damaged antenna. The output impedance of the antenna interface of this radio is 50 ohms. Please use antennas and feeders with input impedance of 50 ± 2 ohms and VSWR less than 1.5. Using an antenna that is not strictly matched with this radio would result in a shortened transmission distance for the radio, and it is possible to damage the radio if the mismatch is particularly serious.

(2) The original antenna of this radio is strictly matched with this radio, and the performance meets the requirements of this radio. The original antenna of this radio would better play the performance of this radio.

(3) Under normal circumstances, the height of the antenna installed from the ground would significantly increase the transmission distance and improve

the transmission effect.

(4) Carefully check the connection of the antenna, feeder, connector and the components of the radio to ensure well contact and reliable connection between the antenna and the connector of the radio.

2.4.3 SIM installation

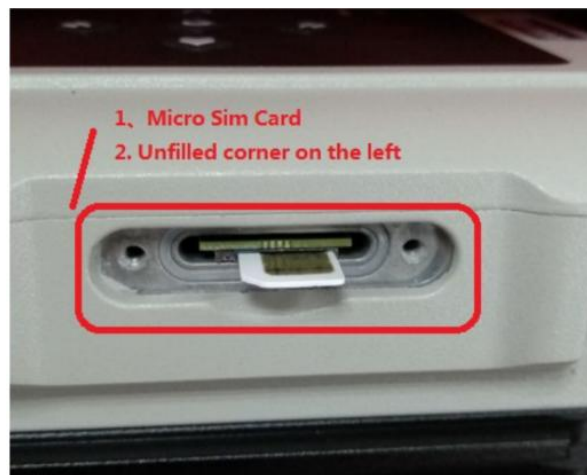


Figure 2.14 SIM installation

2.5 Radio Repeater

The detailed steps of radio repeater configuration are as follows:

- 1) Set the protocol and air baud rate of RS400H3-H to be the same as the protocol and air baud rate of transmitting device and receiving device.
- 2) The transmission and reception frequency of RS400H3-H are configured as follows:

The current transmitting frequency of RS400H3-H = the receiving frequency of receiving device;

The current receiving frequency of RS400H3-H = the transmitting frequency of transmitting device;

3) Configure the [Radio Mode] of RS400H3-H to [Radio Repeater].

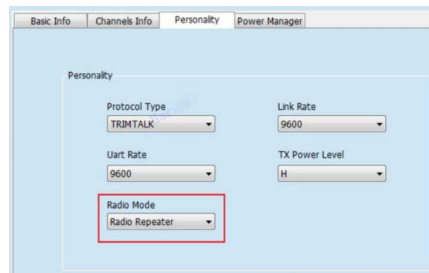


Figure 2.15 Configure radio repeater

Note:

RS400H3-H transmits data in half-duplex mode when using radio repeater function. If the amount of data is large, it is recommended to set the air baud rate and serial baud rate to the maximum value. At the same time, adjust the data transmission interval of the transmitting device to 2 seconds.

2.6 Network Repeater

RS400H3-H first obtains differential data from CORS station through the network, and then broadcasts the currently received differential data to realize the sharing of network differential data to rover stations in the same area. RS400H3-H supports two ways to access CORS server: TCP / IP and NTRIP.

The detailed steps of network repeater configuration are as follows:

1) Configure the [Radio Mode] of RS400H3-H to [Network Repeater], and configure relevant parameters as follows: protocol, air baud rate, transmitting frequency and transmitting power level;

2) Configure network related parameters;

TCP/IP transmits network differential data in transparent, that is, just set the Server address and Port; In addition to setting the Server address and Port, Ntrip also needs to set the User-ID, Password and Mount point.

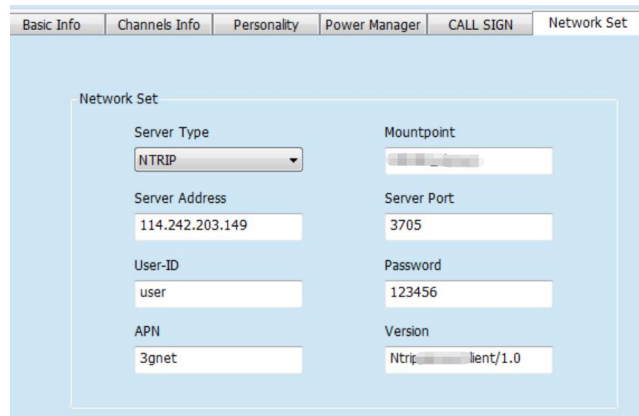


Figure 2.16 Configure network repeater

3) After configuring all the above parameters, power off the RS400H3-H and restart it to enter the normal working mode.

3. Terminology

APN	Access Point Name
ASCII	American Standard Code for Information Interchange
BT	Bluetooth
DC	Direct Current
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IP	Internet Protocol
LED	Light Emitting Diode
USB	Universal Serial BUS
VSWR	Voltage Standing Wave Ratio

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