User Manual

Version V2.1-20211208

User Manual
For David30 GNSS Receiver
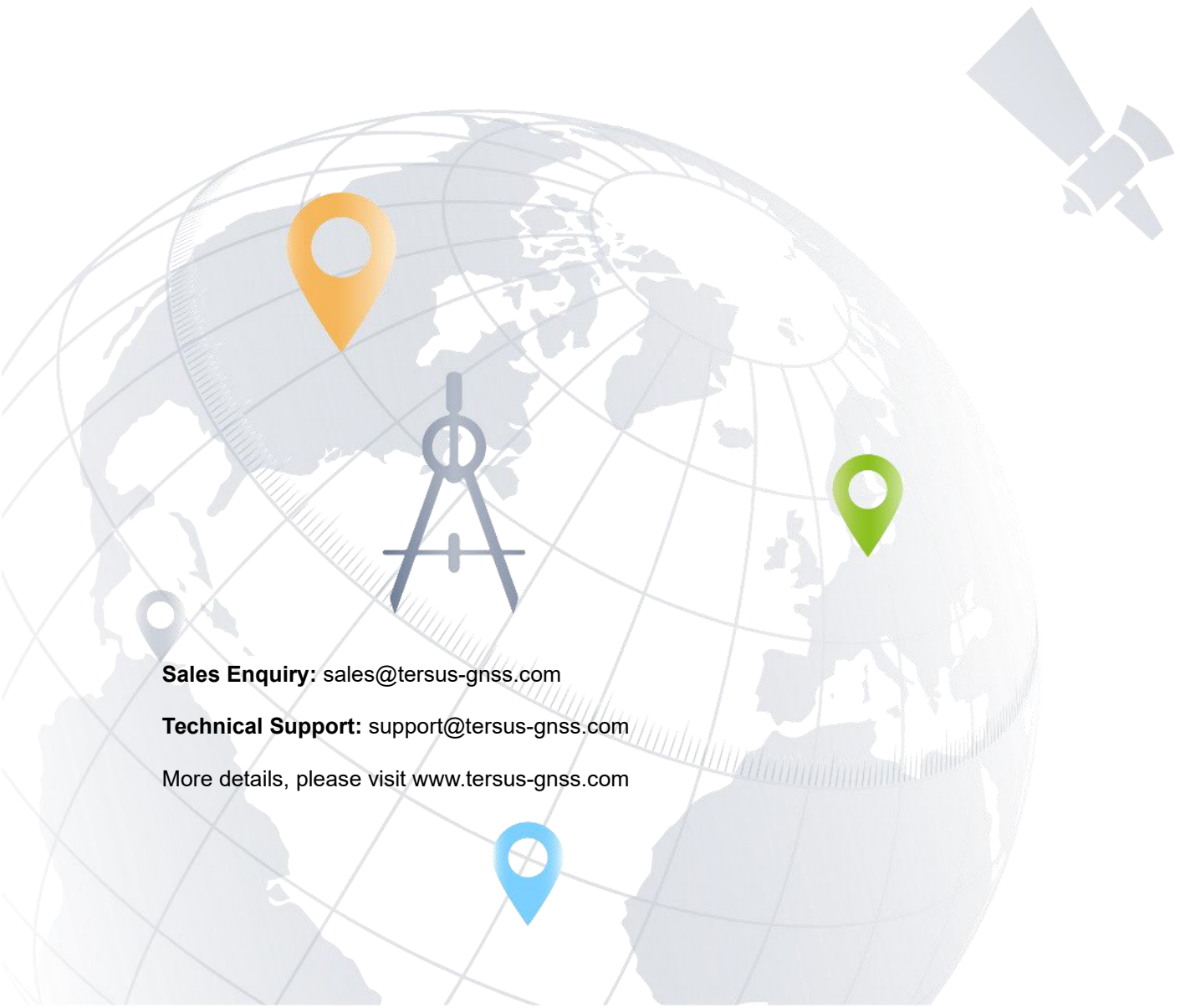
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Revision History

Version	Revision Date	Change summary
1.0	20210427	Initial Release
2.0	20210721	Add CE&FCC marks and section7; upgrade the information of 2W radio RS460H and 28w radio RS400H3.
2.1	20211208	Update section 5.1

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CE Marking

Tersus GNSS Inc. declares that David30 GNSS Receiver is in compliance with the essential requirements (radio performance, electromagnetic compatibility and electrical safety) and other relevant provisions of Radio Equipment Directive 2014/53/EU. Therefore the equipment is labeled with the following CE-marking.

$$C \, E$$

The Declaration of Conformity may be obtained from Tersus GNSS Inc.

FCC Notices

The David30 GNSS Receiver has been tested and found to comply with the radiated and conducted emission limits under FCC Rules and Regulations Part 15B for a Class A digital device. The Class A limits are designed to provide reasonable protection against harmful interference in a residential installation. Therefore the equipment is labeled with the following FCC-marking.

The following notices apply to David30 GNSS receiver.

⚠	Changes or modifications to this equipment not exactly approved by Tersus could void the user's authority to operate this equipment or even has risk to damage the David30.

⚠	Install the radio antenna before switching the radio transceiver to transmit mode, or the radio transceiver may be damaged due to overheating. The energy to be transmitted cannot be emitted out without the antenna, which may cause the temperature rise and overheat of the radio module.

Conventions

The following conventions are used in this manual:

!	Information that supplements or clarifies text.
⚠	A caution that actions, operations or configurations may lead to incorrect or improper use of the hardware.
⚠	A warning that actions, operations or configurations may result in regulatory noncompliance, safety issues or equipment damage.

NUWA is Tersus survey app, four tabs (Project, Device, Survey and Tools) are provided in the Nuwa main interface. All the operations in the Survey software start from these four tabs.

For all the figures in this manual, a line with two arrows at the two sides means a cable. A line with one arrow gives the installation direction.

Table 1 Document / software used in this user manual

Name	Description	Link
Log & Command document	Document providing all the loggings output from David30 and all the commands to David30	https://www.tersus-gnss.com/document under GNSS OEM Boards / User Manual
Tersus Tool Suite	Tersus Tools including TersusDownload, TersusGeoPix, TersusGNSSCenter, TersusUpdate, TersusRinexConverter	https://www.tersus-gnss.com/software/David30-receiver
Nuwa	Survey application running in the Android platform, David30 can be configured with Nuwa.	https://www.tersus-gnss.com/software/David30-receiver
Tersus Geomatics Office	Post processing tool for static data	https://www.tersus-gnss.com/software/David30-receiver

Support

If there is any problem and the information needed cannot be found in the product documentation, request technical support using the Tersus website at www.tersus-gnss.com, or mail to support@tersus-gnss.com

1. Overview

1.1   Introduction

Tersus David30 is a cost-efficient, palm-sized GNSS receiver, mainly for the mass survey market, and also for UAV / AGV / Agriculture application.

Nuwa, a survey app on Android system, works with David30 for the survey. And David30 receiver can communicate with an Android platform such as a device or tablet via USB cable or an external Bluetooth module. The David30 receiver can work as a base or a rover, it supports real-time RTK positioning as well as saving data for PPK application. Up to 8GB on-board eMMC makes it easy to save data for PPK application.

The RS-232 serial port, IP67 standard and the external Bluetooth module can remove most of the inconvenience for field workers. All the operations can be done in the Nuwa app except downloading raw measurement data file, which should be completed using Tersus GNSS Center, refer to Table 1 and section Download Files from Internal eMMC for detail.

Figure 1.1 Outlook of David30 GNSS receiver

1.2   Receiver Features

- Supports GPS L1 C/A, L2C, L2P, L5; GLONASS L1 C/A, L2 C/A; BeiDou B1I, B2I, B2a, B3I; Galileo E1, E5a, E5b; QZSS L1 C/A, L2C, L5

- Supports RTCM2.3/3.x, CMR, CMR+ corrections.

- Easy to connect an external powerful radio for longer range.

- Solution update rate can be 20Hz.

- 20Hz raw measurements output for post processing.

- The accuracy of carrier phase can be 1mm.

- On-board 8GB eMMC for data collection

- Static post-processing for mm-level accuracy.

- Bluetooth module makes wireless connection.

- Input power range is 5 – 28V DC.

- IP67 for water & dust proof, work reliably in harsh condition

1.3   Brief Introduction of GNSS and RTK

Tersus BX40C GNSS board is integrated in David30, the board is receiving the GNSS signals from satellites and RTK corrections from the base, and is outputting cm-level position, velocity and time. Figure 1.2 shows the outline of David30 system; refer to https://www.tersus-gnss.com/product/bx40c for more details about BX40C board.
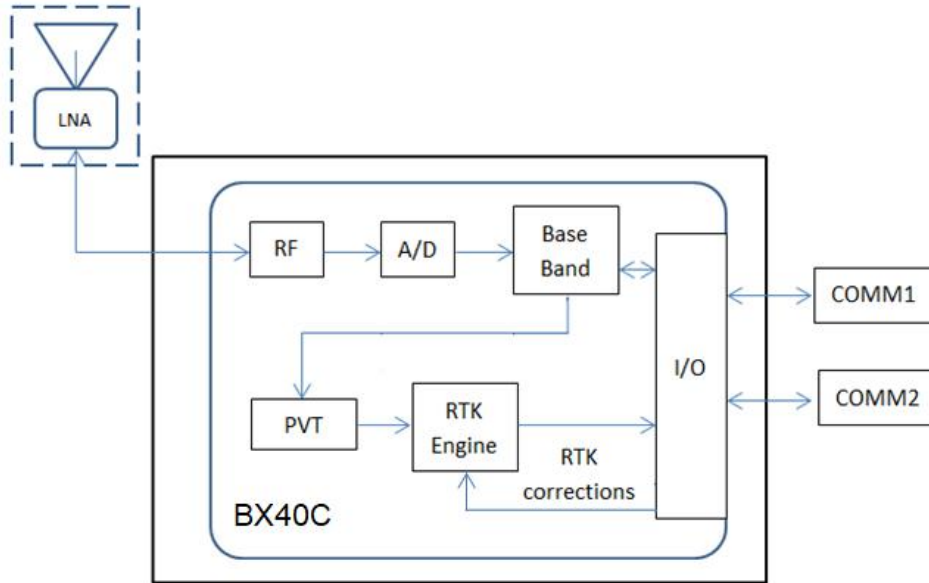
Figure 1.2 Outline of David30 System

The RTK corrections are transmitted from a base, which can be a CORS station or a David30 receiver. The RTK corrections can be transmitted to the rover via Internet or with external radios.
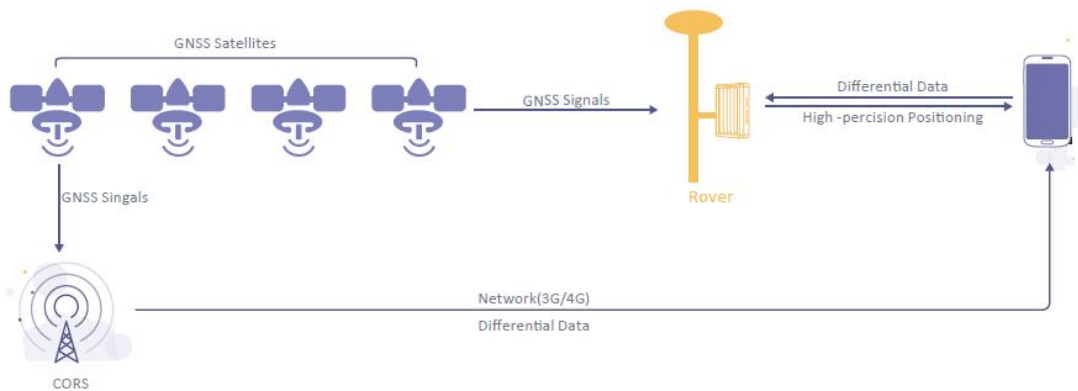
Figure 1.3 Corrections transmitted via Internet
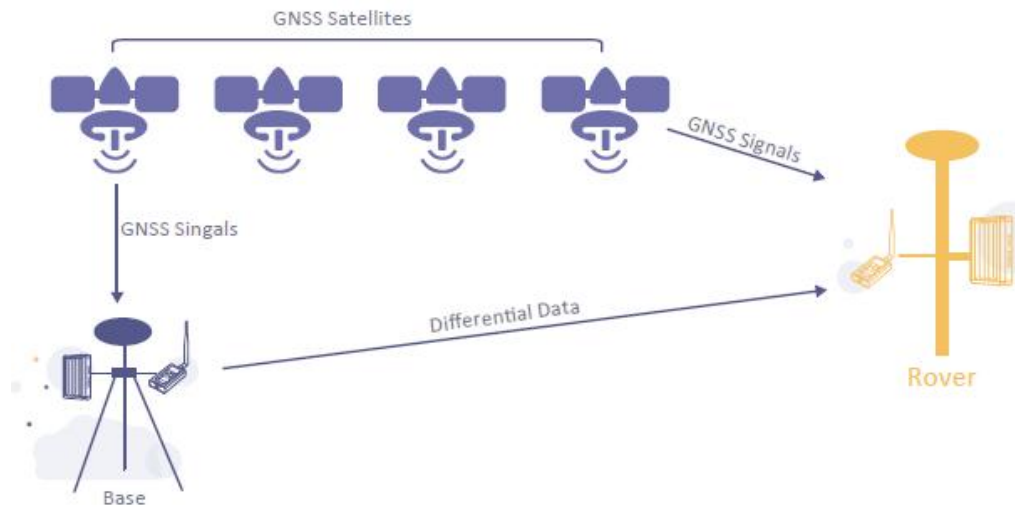
Figure 1.4 Corrections transmitted with radios

If RTK corrections are transmitted via Internet, an Android device or controller will be included in the RTK system to transmit/receive the RTK corrections, refer to section 6.1 and section 6.2 for detailed operations.

2. Devices in David30 Package

This chapter is to give detailed introduction about all the devices in the package. David30 has five variants, which are convenient for customers to select according to their application. Different accessories are included in each variant. Table 2 gives a brief description of the five variants. For more details, refer to section 2.1 to section 2.5. All the five variants are shipped in a yellow plastic box shown as below.

Figure 2.1 Devices in the box

Table 2 Five David30 Variants

David30 variants	Description
Rover Kit Network Mode	The David30 receiver will receive RTK corrections from a NTRIP caster or a TCP server.
Rover Kit with 2W Radio Station	The David30 receiver will receive RTK corrections from an external 2W radio.
Base Kit Network Mode	The David30 receiver will output RTK corrections to a NTRIP caster or a TCP server.
Base Kit with 2W Radio Station	The David30 receiver will output RTK corrections to an external 2W radio.
Base Kit with 28W Radio Station	The David30 receiver will output RTK corrections to an external 28W 410~470MHz radio.

!	1. Rover Kit Network Mode and Base Kit Network Mode can work independently.
	2. Rover Kit with 2W Radio Station must work with Base Kit with 2W Radio Station or Base Kit with 28W Radio Station.

2.1 Rover Kit Network Mode

In this variant, the David30 is connected to an Android device or controller with Bluetooth module or with cables. Tersus Survey Nuwa app is installed and run in the Android device or controller to receive RTK corrections from a NTRIP caster or a TCP server. If customer does not have an Ntrip Caster account or has any other questions, please contact the local dealer or Tersus sales by email sales@tersus-gnss.com for more details.

!	The controller is not included in the package. The TC20 controller is listed on https://www.tersus-gnss.com/product/tc20-controller

Table 3 Devices in Rover Network Mode

Device Name	Quantity	Remarks
AX4E02 GNSS antenna	1	Details refer to section2.1.2.
Ranging pole	1	Details refer to section2.1.9.
COMM1-Bluetooth module	1	Details refer to section 2.1.4.
DC-5pin to USB power cable	1	Details refer to Figure 2.1.3.
David30 GNSS receiver	1	Details refer to section 2.1.1.
Bracket for rover	1	Details refer to section 2.1.9.
GNSS antenna cable	1	Details refer to section 2.1.2.
GNSS antenna connector	1	Details refer to section 2.1.2.
COMM2-7pin to USB & DB9 cable	1	Details refer to section 2.1.5.
DB9 Male to USB Type A Male converter cable	1	Details refer to Figure 2.1.6.
USB Type A Female to USB (Micro + Type C) OTG cable	1	Details refer to Figure 2.1.7.
Height measure accessory	1	Details refer to Figure 2.1.8.
Magic tape	3	Details refer to Figure 2.1.9.

2.1.1 David30 GNSS Receiver

David30 has four interfaces, as shown below.

Figure 2.2 David30 GNSS Receiver

The DC port of David30 is for power input and CAN port, COMM1 port is for COM1, PPS and Event, and COMM2 port is for COM2 and USB ports, refer to section 5.1 for detailed specification of David30.

Table 4 Definition of LEDs

LED	Colour	Description
RTK	Red	ON: David30 in Fixed solution. Blink: David30 in Float and DGPS solution. OFF: David30 in other position types.
SV	Red	ON: Normal state. Blink: David30 is searching satellites.
PWR	Blue	ON: the David30 is power on.

Refer to section 3.2 Power on David30 for more details about the booting up procedure.Refer to Chapter 5 for the specification of David30 receiver and the detailed definition of COMM1, COMM2 and DC ports.

2.1.2 AX4E02 GNSS Antenna

AX4E02 GNSS antenna is used to receive the RF signal from the satellites, and it must be connected to the David30 with the GNSS antenna cable in the package.

Figure 2.3 AX4E02

⚠ If an antenna from other companies is used, contact Tersus to obtain permission, or the David30 receiver may not work as expected.

Figure 2.4 TNC-J to TNC-J cable 1.0m(GNSS Antenna cable)

Note: The TNC-J end of this cable can be only used for AX4E02 GNSS Antenna and David30. DO NOT connect the TNC-J end of the above cable to the RS460H radio, 28W Radio or other devices.

The GNSS antenna connector shown as below is used to install the AX4E02 GNSS antenna or the High Gain Radio antenna to a tripod.

Figure 2.5 GNSS Antenna connector

2.1.3 DC-5pin power cable

There are three types of DC-5pin power cable.

1. DC-5pin AC Power Adapter with 1.2m cable for Base station, which is not included in the package.

Figure 2.6 DC-5pin AC Power Adapter

2. The Serial-5pin to DC JACK & DB9 Male cable and the DC JACK male with two wires (the brown wire connects to power and the blue wire connects to ground) below are optional. It is to power David30 receiver using external power source, which is not included in the package.

Figure 2.7 Serial-5pin to DC JACK & DB9 male cable

Figure 2.8 DC JACK male with two wires

3. DC-5pin to USB Power Cable is used to connect a power bank to the DC port of David30 receiver.

Figure 2.9 DC-5pin to USB Power Cable

2.1.4   COMM1-Bluetooth Module

Figure 2.10 COMM1-Bluetooth Module

⚠	The Bluetooth can only be installed to the COMM1 port of David30.

This Bluetooth module is used to connect to the COMM1 port of David30 receiver.

The SSID of this Bluetooth module is BT420R-xxxxx_xxxxxx, where the first xxxxx is the last 5 digits of the Bluetooth serial number, which is printed on the Bluetooth module. No password is needed to pair with it.

2.1.5   COMM2-7pin to USB & DB9 Cable

The COMM2-7pin to USB & DB9 Cable can be connected to a computer to download files saved on the internal eMMC for debug purpose, refer to section Download Files from Internal eMMC.

The other function of this cable is to connect to USB Type A Female to USB (Micro +Type C) OTG cable (refer to Figure 2.12) to connect the Android device or controller with David30, refer to section 3.3.1.

Figure 2.11 COMM2-7pin to USB & DB9 Cable

!	The COMM2-7pin to USB & DB9 cable can only be installed into the COMM2 port of David30.

2.1.6 DB9 Male to USB Type A Male converter cable

DB9 Male to USB Type A Male converter cable to connect with the COMM2-7pin to USB & DB9 Cable in Figure 2.10 of section 2.1.5.

Figure 2.12 DB9 Male to USB Type A Male converter cable

The driver for the above cable can be downloaded from

https://www.tersus-gnss.com/software/David30-receiver

2.1.7   USB Type A Female to USB (Micro + Type C) OTG cable

This cable is to connect the device output with USB type A male connector to an android device with micro or type C interface.
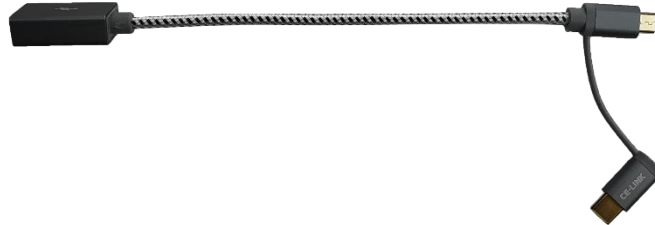
Figure 2.13 USB Type A Female to USB (Micro + Type C) OTG cable

2.1.8   Height Measure Accessory

The height measure accessory is used to determine the height of the antenna with higher accuracy.

Figure 2.14 Height Measure Accessory

2.1.9   Other accessories

Bracket for rover is used to fixate all the devices on the ranging pole, and magic tape is to tie the cables to the pole, which bring convenience to field staffs.

Figure 2.15 Bracket for Rover

Figure 2.16 Magic Tape

Figure 2.17 Ranging Pole

A yellow carrying case marked with GNSS ROVER is to store all the devices and accessories of rover kit.

Figure 2.18 Carrying Case for Rover

A power source can be used to power on the David30, however it is not included in the package, and is to be prepared by the customers, refer to section Power on David30 for more details.

Figure 2.19 Power bank

2.2 Rover Kit with 2W Radio Station

In this variant, the David30 receiver is connected to an external 2W radio to receive RTK corrections from a base. With an external Bluetooth or cables, the David30 receiver is connected to an Android device or controller, which runs Tersus Survey software Nuwa to configure the David30 GNSS receiver.

The descriptions of basic components for this kit refer to section 2.1. This section introduces additional devices required for Rover Kit with 2W Radio Station.

!	Rover Kit with 2W Radio Station can work with Base Kit with 2W Radio Station or Base Kit with 28W Radio Station.

!	Rover Kit with 2W Radio Station supports Rover network mode.

!	The controller is not included in the package. The TC20 controller is listed on https://www.tersus-gnss.com/product/tc20-controller.
!	When the 2W radio is in the work mode of transmitting power 2W, Please use a larger current power adapter or a large 12V battery to supply power to this system.

⚠	Install the radio antenna before switching the radio transceiver to transmit mode, or the radio transceiver may be damaged due to overheating. The energy to be transmitted cannot be emitted out without the antenna, which may cause the temperature rise and overheat of the radio module.

2.2.1 2W Radio RS460H

This radio works at 410~470MHz frequency, the max output power of this radio is 2W and the typical range is 5km. Refer to chapter 5 for specification details.
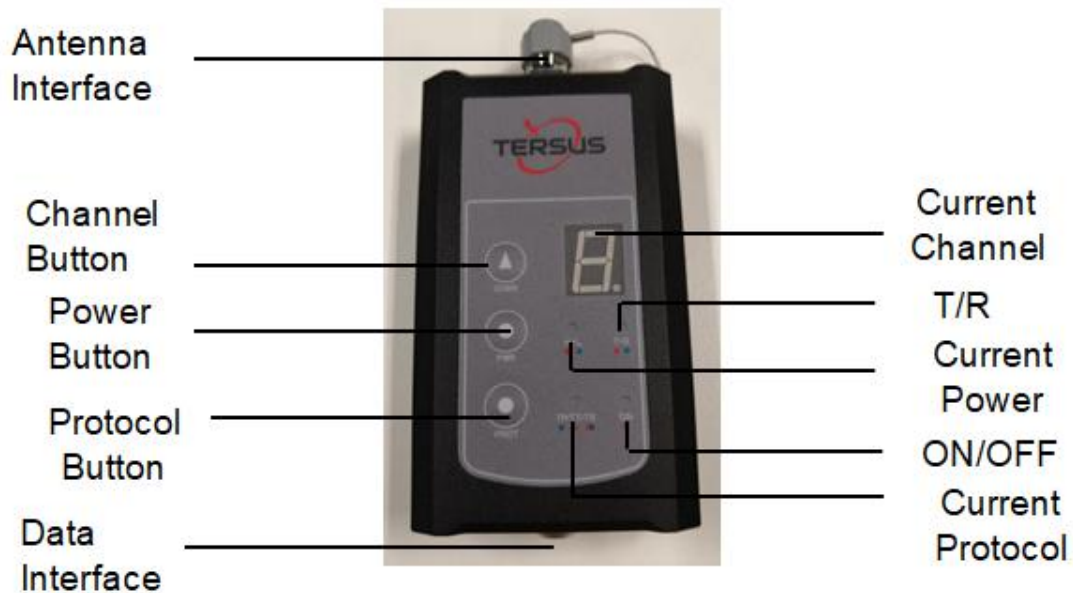
Figure 2.18 2W Radio RS460H

Table 5 Button Description for 2W Radio RS460H

Button	Description
Channel Button	Press once, the current channel will increase 1, channel 0~ 9 are available.
Power Button	Press once to select the output power, which can be 1W or 2W.
Protocol Button	Press protocol button to switch the protocols between Transparent , TT450,SOUTH, SATEL, and TRIMMK3.

!	Two 2W radios must have the same protocol and the same channel frequency before they can communicate with each other.

Table 6 LED Definition

LED	Description
H/L	RED: 2W output is selected, GREEN: 1W output is selected.
T/R	Blink RED: data is transmitting. Blink GREEN: data is receiving.
TP/TT/TS	GREEN: Transparent protocol is selected. RED: TT450 protocol is selected. GREEN FLASHING: SOUTH protocol is selected. RED FLASHING: SATEL protocol is selected. YELLOW: TRIMMK3 protocol is selected.
ON	It is solid on after the power is on.

2.2.2 410-470MHz Radio Whip Antenna

The 410-470MHz radio whip antenna is to be installed on 2W radio and receive radio signal.

Figure 2.19 410-470MHz radio whip antenna

2.2.3 COMM2-7pin to USB & 2W-Radio-5pin Cable

The COMM2-7pin to USB & 2W-Radio-5pin Cable is used to connect the

David30 receiver to the 2W radio station & an Android device. The length of the cable is 0.55m.

Figure 2.20 COMM2-7pin-USB & 2W-Radio-5pin Cable

⚠	COMM2-7pin to USB & 2W-Radio-5pin Cable can only be installed into the COMM2 port of David30.

2.2.4 TNC-J to TNC-J Cable 1.0m (Radio Antenna Extension Cable)

The TNC-J to TNC-J cable 1.0m is the extension cable between 2W radio RS460H and 410-470MHz radio whip antenna.

Figure 2.21 TNC-J to TNC-J cable 1.0m (Radio Antenna Extension Cable)

2.2.5 Bracket for 2W radio antenna with TNC-TNC converter

The bracket is to fix the position of the 2W radio antenna.

Figure 2.22 Bracket for 2W radio antenna with TNC – TNC converter

2.3   Base Kit Network Mode

In this variant, the David30, working as a base, transmits RTK corrections to a NTRIP caster or a TCP sever. The David30 is connected to an Android device with an external Bluetooth or with cables. Tersus Survey Nuwa app is installed in the Android device to configure the David30. If customer does not have an Ntrip Caster account or has any other questions, please contact the local dealer or Tersus sales by email sales@tersus-gnss.com for more details.

The descriptions of basic components for this kit refer to section 2.1. This section introduces different devices required for Base Kit Network Mode.

!	Base Kit Network Mode can work independently or work with Rover Kit Network Mode.

2.3.1 Bracket for Base

This bracket is hooked on the tripod and all the devices in the field (an Android device, a radio, a David30) are installed on it, which brings much convenience for field job.

Figure 2.23 Bracket for Base

2.3.2 Tape Measure

Working with height measure accessory, the tape measure gives position of a point on ground with mm-level accuracy.

Figure 2.24 Tape Measure

2.3.3 Other accessories

A yellow carrying case marked with GNSS BASE is to store all the devices and accessories of base kit.

Figure 2.25 Carrying Case for Base

2.4 Base Kit with 2W Radio Station

In this variant, the David30, working as a base, transmits RTK corrections to an external 2W radio. The David30 is connected to an Android device with cables or with the Bluetooth module. Tersus Survey Nuwa app is installed in the Android device to configure the David30.

The descriptions of basic components for this kit refer to section 2.1. This section introduces different devices required for Base Kit with 2W Radio Station.

!	Base Kit with 2W Radio Station can work with Rover Kit with 2W Radio Station only.

!	Base Kit with 2W Radio Station can support Base network mode.

Figure 2.26 Base Kit with 2W Radio

!	The two tripods and the tribrach in Figure 2.26 are not included in the package.
!	Power bank of 5V output is not suitable to supply power for Base kit with 2W Radio, a large battery of 12V output is recommended.
!	Power on the system after all connection is completed.

⚠	Install the radio antenna before switching the radio transceiver to transmit mode, or the radio transceiver may be damaged due to overheating. The energy to be transmitted cannot be emitted out without the antenna, which may cause the temperature rise and overheat of the radio module.

Table 7 Base Kit with 2W Radio Station

Device Name	Quantity	Items in field photo
AX4E02 GNSS antenna	1	1, refer to section 2.1.2
GNSS antenna connector	2	2, refer to section 2.1.2
2W radio RS460H	1	3, refer to section 2.2.1
COMM2-7pin to USB & 2W-Radio-5pin Cable	1	4, refer to section 2.2.3
COMM1-Bluetooth module	1	5, refer to section 2.1.4
DC-5pin to Bullet DC Power cable	1	6, refer to Figure 2.27
David30 GNSS receiver	1	7, refer to section 2.1.1
Metal plate for radio antenna	1	8, refer to Figure 2.30
GNSS antenna cable	1	9, refer to section 2.1.2
High Gain Radio Antenna	1	10, refer to Figure 2.29

2.4.1 DC-5pin Power cable

The DC-5pin of this cable is to connect to the DC port of David30 receiver, the Serial-5pin to DC JACK & DB9 Male cable in the figure below.

Figure 2.27 Serial-5pin to DC JACK & DB9 male cable

2.4.2 DC JACK male

The DC JACK male is to connect to the Serial-5pin to DC JACK & DB9 male cable in the figure above. The two wires of this cable is to connect to the positive and negative of external power supply.

Figure 2.28 DC JACK male with two wires

2.4.3 High Gain Radio Antenna

The gain of this high gain radio antenna is 5.5 dBi and the working frequency range is 450~470 MHz / 410~430 MHz / 430~450 MHz.

Figure 2.29 High Gain Radio Antenna

2.4.4 Metal plate for radio antenna

This metal plate is used to fixate the radio antenna to the tripod.

Figure 2.30 Metal plate for radio antenna

2.4.5 Telescopic pole for radio antenna

The telescopic pole is used to extend the height for radio antenna.

Figure 2.31 Telescopic pole for radio antenna

2.4.6 Hook and Screws for 2W Radio

The hook and screws below are attached to 2W radio for hanging on the tripod.

Figure 2.32 Hook and Screws for 2W Radio (attached to 2W radio)

2.4.7 Hook and Screws for David30

The hook and screws below are attached to David30 receiver for hanging on the tripod.

Figure 2.33 Hook and Screws for David30 (attached to David30)

2.4.8 Bracket for Mobile

The bracket below is for fixating mobile terminal onto the tripod.

Figure 2.34 Bracket for Mobile

2.4.9 Other accessories

The tool bag below is to store high gain radio antenna and telescopic pole for radio antenna.

Figure 2.35 Tool bag

2.5 Base Kit with 28W Radio RS400H3

In this variant, the David30, working as a base, transmits RTK corrections to an external 28W radio RS400H3. The David30 is connected to an Android device with cables or with the Bluetooth module. Tersus Survey Nuwa app is installed in the Android device to configure the David30.

The descriptions of basic components for this kit refer to section 2.1 and 2.4. This section introduces different devices required for Base Kit with 28W Radio RS400H3.

!	Base Kit with 28W Radio Station can work with Rover Kit with 2W Radio Station only.

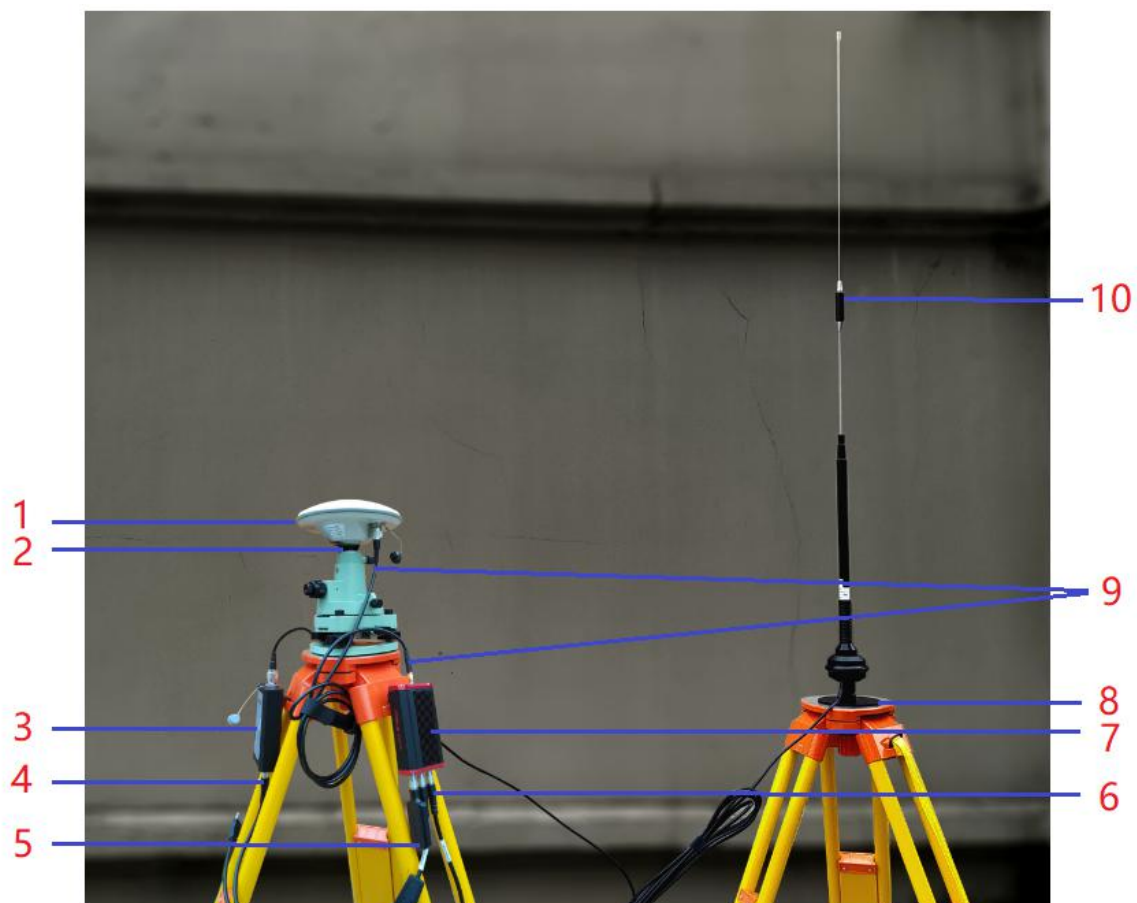| !	Base Kit with 28W Radio RS400H3 can support Base network mode.

!	Power bank of 5V output is not suitable to supply power for Base kit with 28W Radio, a large battery of 12V output is recommended.
!	Power on the system after all connection is completed.

⚠️	Install the radio antenna before switching the radio transceiver to transmit mode, or the radio transceiver may be damaged due to overheating. The energy to be transmitted cannot be emitted out without the antenna, which may cause the temperature rise and overheat of the radio module.

2.5.1 28W Radio RS400H3

The 28W radio RS400H3 is used when a longer baseline is required. The typical range is 15km, refer to chapter 5 for detailed specification.

Figure 2.36 28W Radio RS400H3

Below table present the definition of the LED indicators.

Table 8 Definition of LED indicators

LED	Description
BT	BT is Bluetooth green indicator light. Currently RS400H3 does not support Bluetooth.
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. Currently RS400H3 supports TX only.
POWER	POWER 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

2.5.2 28W-Radio power cable

The DC-5pin of the 28W-Radio power cable is to connect to the DC port of David30 receiver, the 28W-Radio-DC-5pin of this cable is to connect to the DC port of 28W radio, and the Bullet-DC is to connect with Bullet-DC to Alligator Clips in Figure 2.28. The COMM2-7pin of this cable is to connect to the COMM2 port of David30 receiver.

Figure 2.37 28W-Radio power cable

3. General operation

The general operation of David30 is related to the Tersus Survey Nuwa application, which is introduced in the software manual. This chapter describes how to do the hardware connection only.

⚠	■ To make David30 work properly, the customer needs to provide qualified power to David30 (refer to chapter 5 for requirement), power to the 28W radio (if 28W radio is used, refer to chapter 5 for details) and an Android device to run Tersus Survey Nuwa app. ■ David30 may be damaged if devices from other companies are used to replace the ones in the package. And the warranty may be void if this situation happens.

⚠	Install the radio antenna before switching the radio transceiver to transmit mode, or the radio transceiver may be damaged due to overheating. The energy to be transmitted cannot be emitted out without the antenna, which may cause the temperature rise and overheat of the radio module.

3.1 Install the GNSS antenna

Connect the AX4E02 GNSS antenna to David30 with the GNSS antenna cable. Please ensure the connectivity is reliable.

!	The ideal place for a GNSS antenna is a point without GNSS signals blockage from horizon to horizon and is far away from any potential interfering source. The specific distance depends on type of the interfering source.

3.2 Power on David30

The input voltage to David30 is 5 – 28 V DC.

⚠	After power on, the SV LED is ON for 3 to 5 seconds, then it turns OFF, which means the David30 is booting up successfully.
	If the SV LED is NOT acting as the above steps, it means the David30 is NOT booting up successfully.

⚠	If other power instead of a power bank is used to power on David30, the customer needs to prepare a power cable and take all the risks involved.

The working time of David30 depends on the capacity of the power supply.

The following formula can be used to estimate the operating time (assume the output voltage is 5V):

If no radio or an external 28W radio is connected to the David30:

$$\text{Time (hour)} = \text{capacity (mA.Hour)} *5 / (1000 * 3.2)$$

If 1W radio is connected to the David30:

$$\text{Time (hour)} = \text{capacity (mA.Hour)} *5 / (1000 * (3.0+3.2))$$

If 2W radio is connected to the David30:

$$\text{Time (hour)} = \text{capacity (mA.Hour)} *5 / (1000 * (6.5+3.2))$$

!	1) It is highly recommended the capacity of the power supply is 10,000 mAh or more.
	2) The working time above are theoretical values at 25°C temperature for reference only. However, according to experience, the real working time may be 2/3 or less of above values.

3.3Communication between Android device and David30

David30 can communicate with an Android device through Bluetooth.
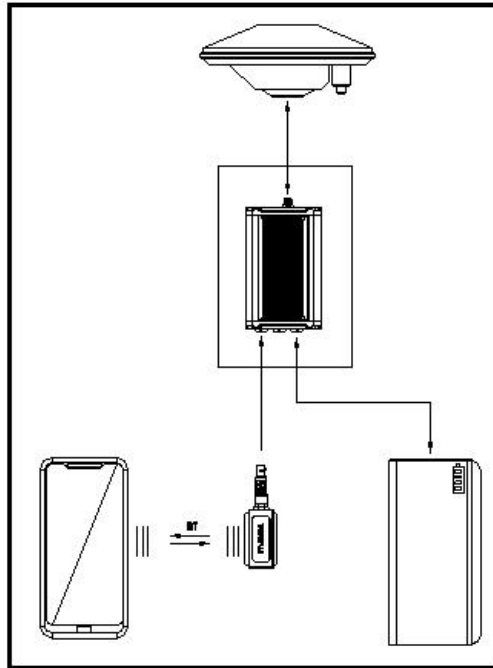
Figure 3.3 Outline of Android device to David30 with Bluetooth

!	All the five variants support connection with Bluetooth and cables.

The detailed steps are described as follows:

1. Install the Bluetooth module to the COMM1 port of David30.

2. Connect the AX4E02 GNSS antenna to David30 with the GNSS antenna cable.

3. Power on the David30 receiver with a power supply.

4. Run Nuwa app, click [Device] -> [Connect].

5. Select [Bluetooth] in the option list of Connect Type.

6. Click [Connect Config] -> [Search]. The SSID is BT420R-xxxxx_xxxxxx. No password is needed to pair with it

7. Click [Connect] to enable the communication with David30.
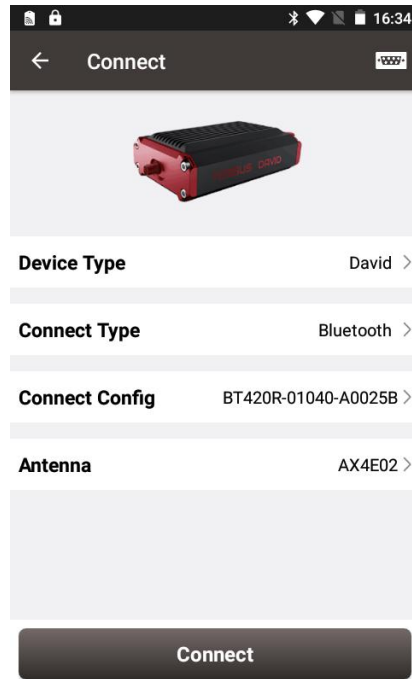
Figure 3.4 Connect using Bluetooth
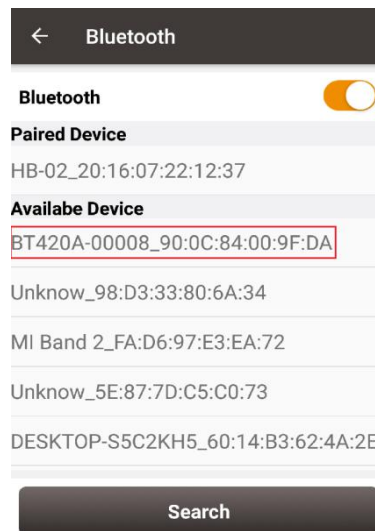
Figure 3.5 Search Bluetooth device

!	A Bluetooth device can be removed from the Available Device list by pressing it for a few seconds.

3.4 Firmware Update

3.4.1 Hardware Connection
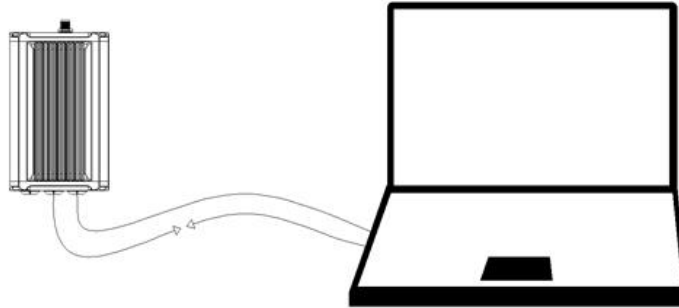
Figure 3.6 Outline of David30 connected to a Computer

The hardware connection for firmware update is described as follows:

1. Connect the COMM2 port of the **COMM2-7pin to USB & DB9 cable** to the COMM2 port of the David30 receiver.

2. Connect the DB9 port of the **DB9 Male to USB Type A Male converter cable** to the DB9 port of the **COMM2-7pin to USB & DB9 cable**.

3. Connect the USB port of the **DB9 Male to USB Type A Male converter cable** to the USB port of the computer.

4. Connect the DC-5pin port of the **DC-5pin AC Power Adapter** to the DC port of the David30 receiver.

5. Connect the AC Power Adapter of the **DC-5pin AC Power Adapter** to an external power supply.

3.4.2 USB to Serial COMM Port driver

After completing the hardware connection, David30 receiver is powered on automatically when the power cable is connected to a power source. Simultaneously the computer recognizes the COM port in the Computer Management as shown in Figure 3.7.

If the COM port is not recognized, right click the port name and click [Update Driver Software…] which is shown in Figure 3.8. In the pop-up window as shown in Figure 3.9, select [Search automatically for updated driver software] if the computer is connected on internet. Windows search and install the driver software automatically.

In the situations of automatic search failed and the computer not connecting to the internet, select [Browse my computer for driver software] and browse the location of the driver software which is downloaded from Tersus website https://www.tersus-gnss.com/software.
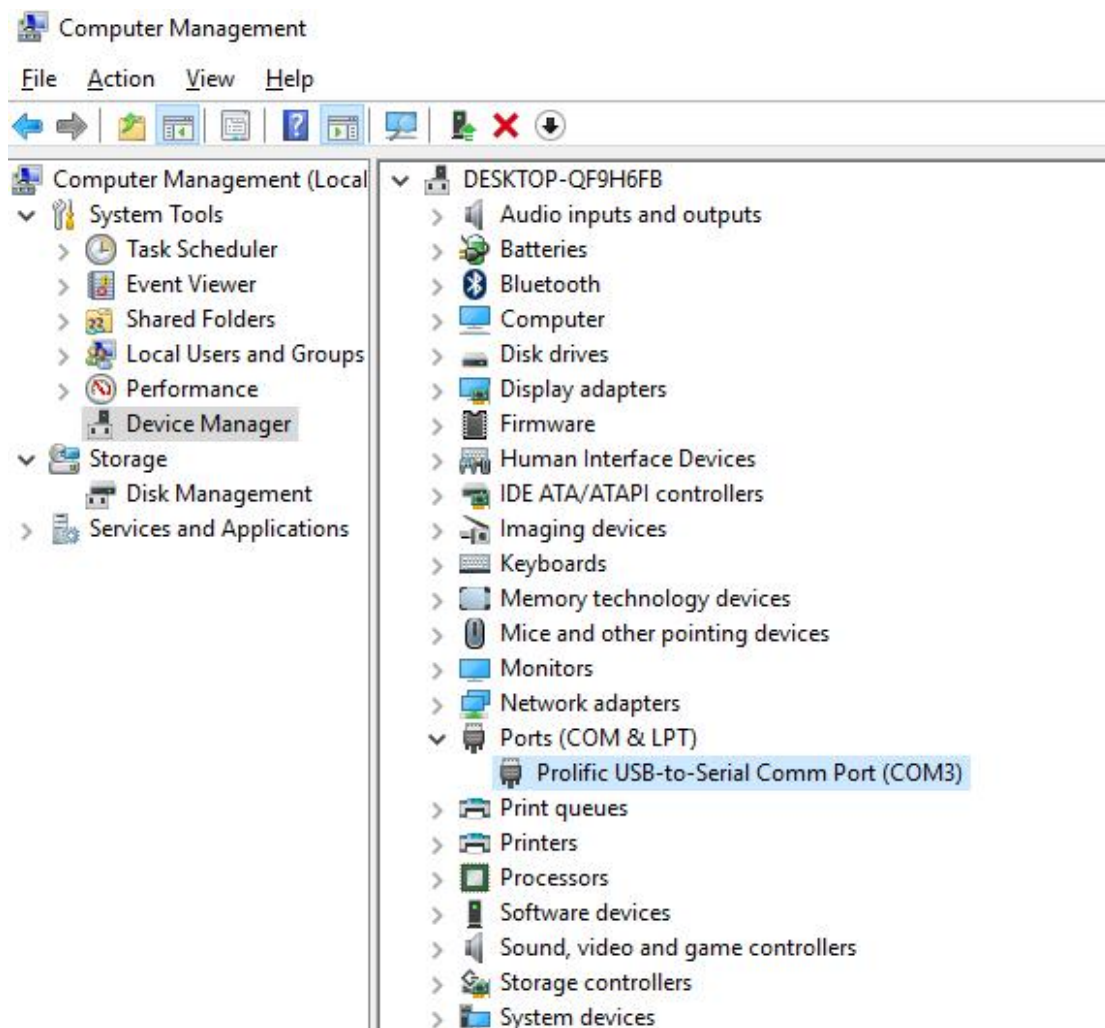
Figure 3.7 COM port is recognized by the computer in the Computer Management
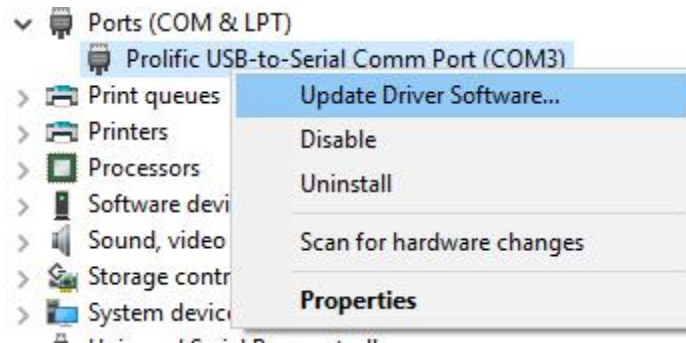
Figure 3.8 Update Driver Software manually
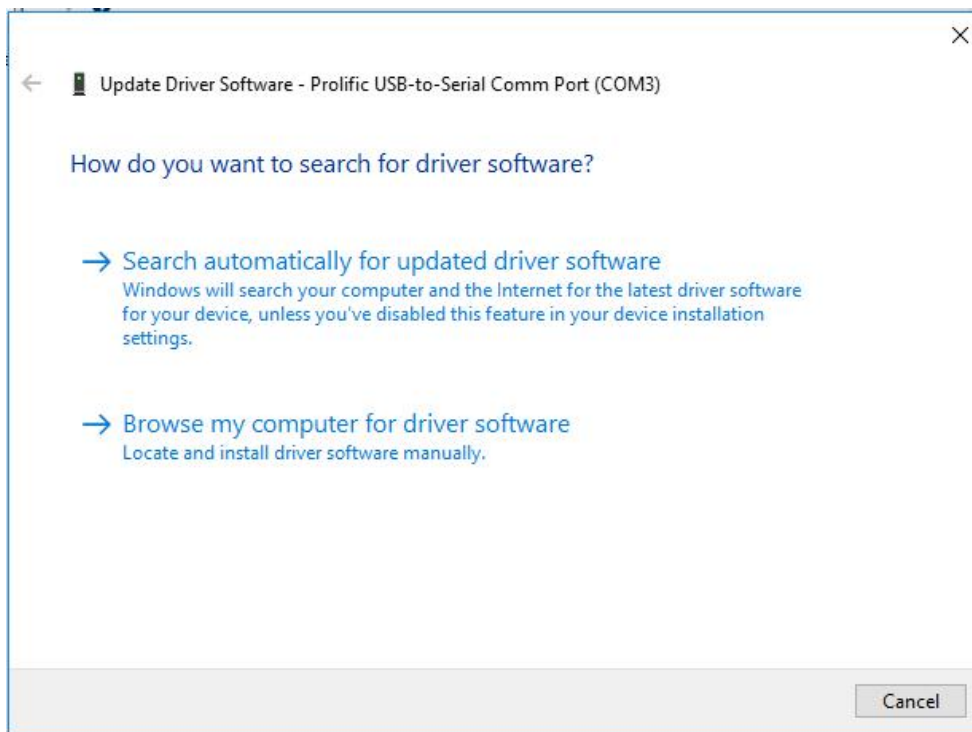
Figure 3.9 Two methods of searching for driver software

3.4.3 Firmware Update

The updated firmware is released and available for downloading on Tersus web site https://www.tersus-gnss.com/software, or it can be obtained from Tersus technical support.

The firmware version of the current David30 receiver can be examined in Tersus GNSS Center by typing 'LOG VERSION' in the command area, and in Nuwa app by clicking [Device] -> [Device Info].

The detailed steps for firmware update are as follows.

1. Use TersusUpdate software in the Tersus Tool Suite for the firmware update. Double click the icon on the desktop to launch the software.
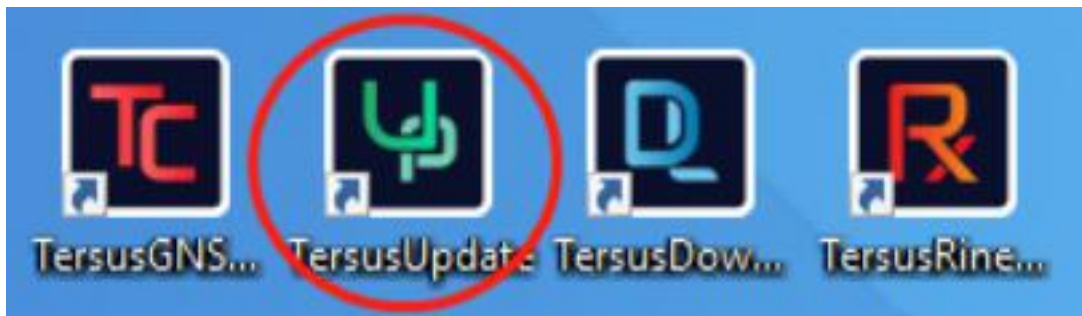
Figure 3.10 PC software icons on desktop

2. In the TersusUpdate interface, the software recognizes the serial port and scans the baud rate automatically. Select the Port which is connected to David30 receiver, browse the location for the updated firmware file, and click [Next] to enter the next step.
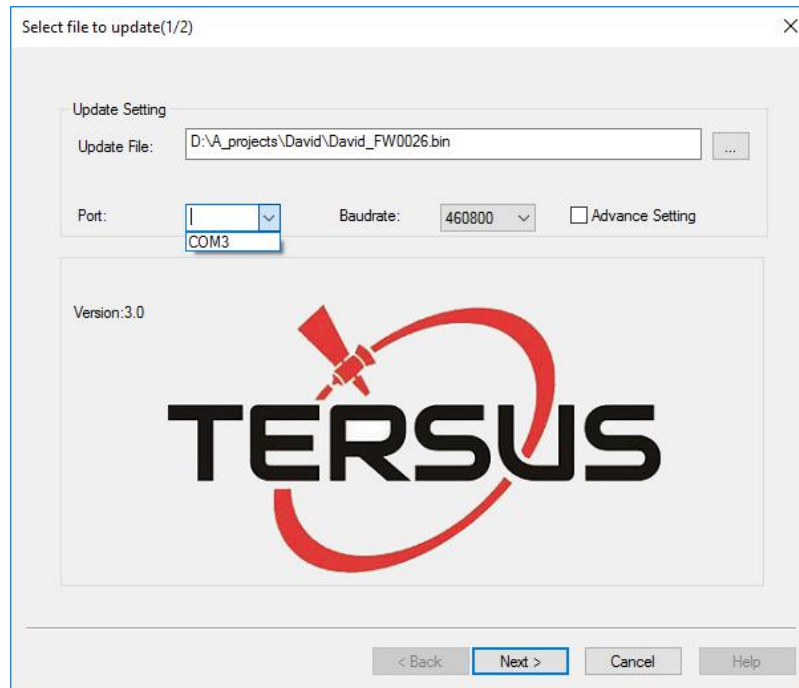
Figure 3.11 Firmware Settings in TersusUpdate software

3. The firmware is updating in progress as shown in Figure 3.12 below. Do not power off the receiver during the verification and update progress.
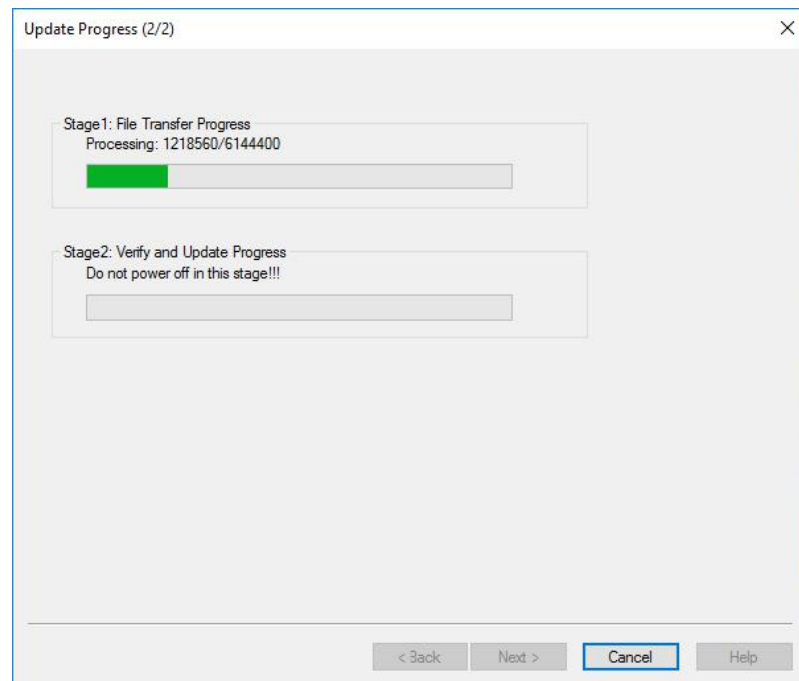
Figure 3.12 Update Progress of the firmware update

4. The update is successful is shown in the figure below.
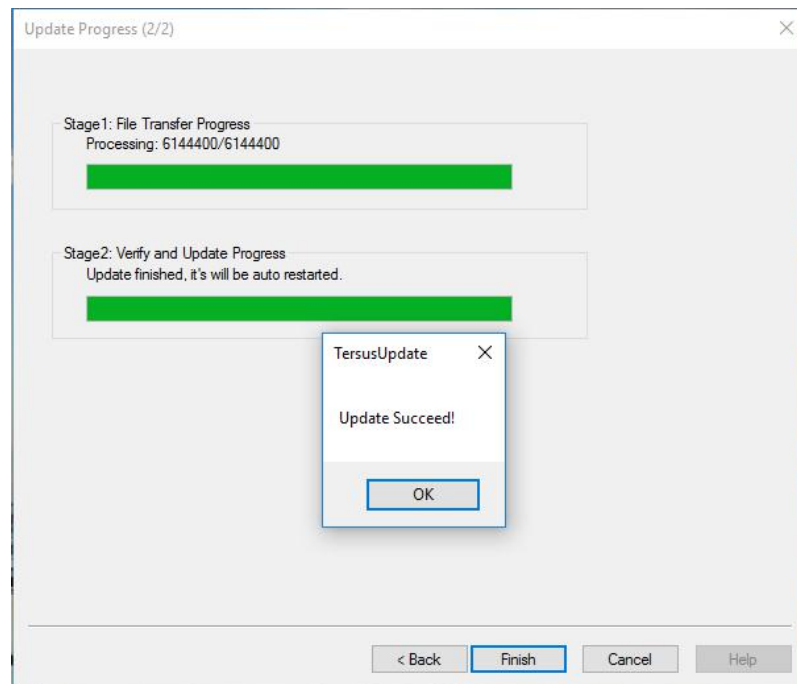
Figure 3.13 Firmware update successful interface

5. Click [OK] and [Finish] to close the firmware update window. The receiver would reset automatically.

6. After the David30 receiver is boot up, the current firmware version can be checked in Tersus GNSS Center by typing 'LOG VERSION' in the command area, and in Nuwa app by clicking [Device] -> [Device Info].

Note:

There is Advance Setting option in the firmware update window, if a David30 receiver

● cannot boot up successfully, or

● cannot work well after boot up, or

● cannot finish firmware update successfully according to the above steps,

[Advance Setting] option can be selected to start FW update again.

If the [Advance Setting] is checked, select [Manual Hardware Reset] in the pop-up window and click [OK]. Click [Next] in the previous interface, power off the David30 receiver, wait for five seconds and power on the receiver again.
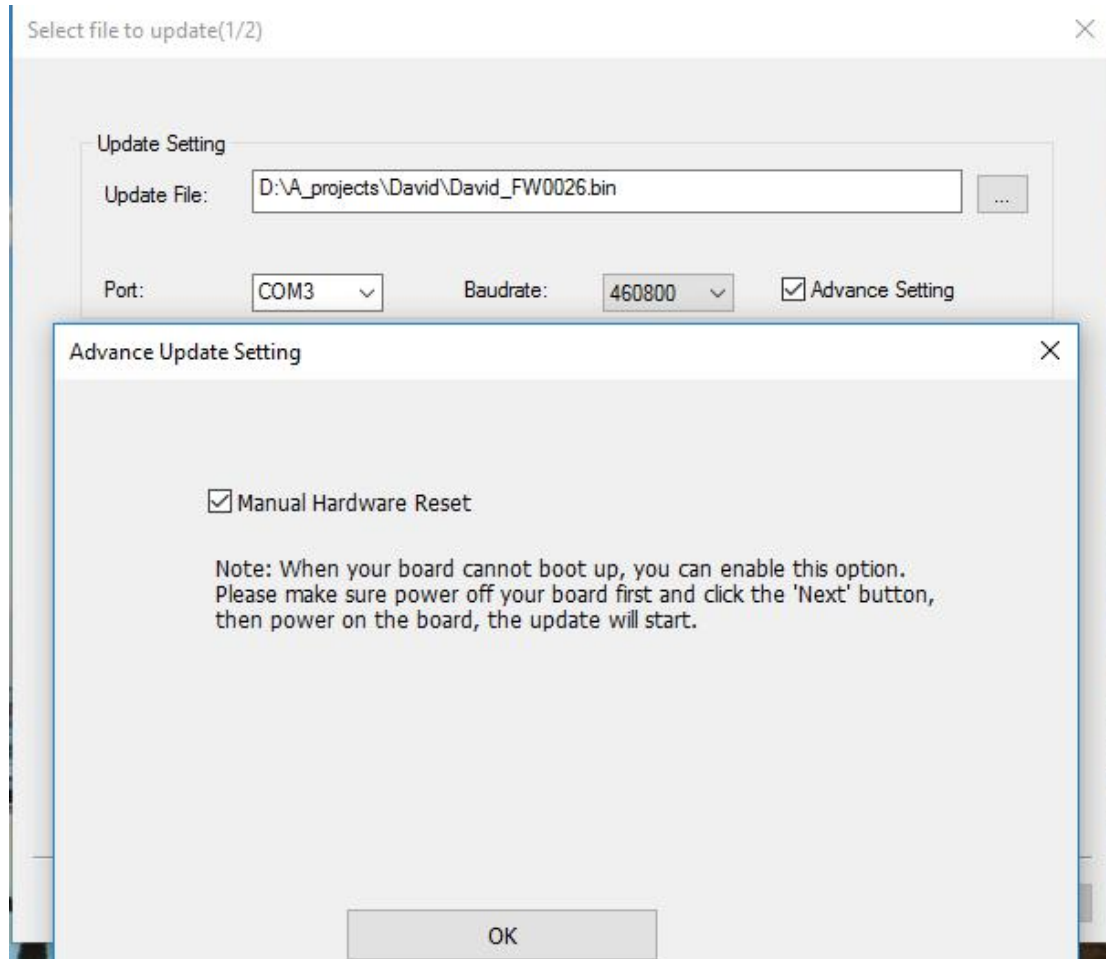
Figure 3.14 Advance Setting for firmware update

After firmware update is finished, power off the receiver, wait for five seconds and power on the receiver again.

⚠	**This option is for experienced users. If you're not sure whether it should be selected, contact Tersus technical support before selecting this option.**

3.5   Auth Code

An auth code is used to determine the features and valid time for a David30 receiver. If the auth code is expired, the receiver will not work.

To get a new auth code to register, check information as follows:

1. Follow the connection in Figure 3.6 and the detailed steps in section 3.4.1 to create communication between a David30 receiver and Tersus GNSS Center.

2. Input 'LOG VERSION' (get the version info) and 'LOG AUTHLIST' (get the auth list info) in the command window of Tersus GNSS Center, and send the output info to Tersus support. If the output auth code is approved by Tersus, a registration file in xxx.txt format (xxx is the SN number of David30) would be provided to customer. In the registration file there is auth code, copy the auth code and paste it in the text console window of Tersus GNSS Center shown as below, press Enter to complete the registration.
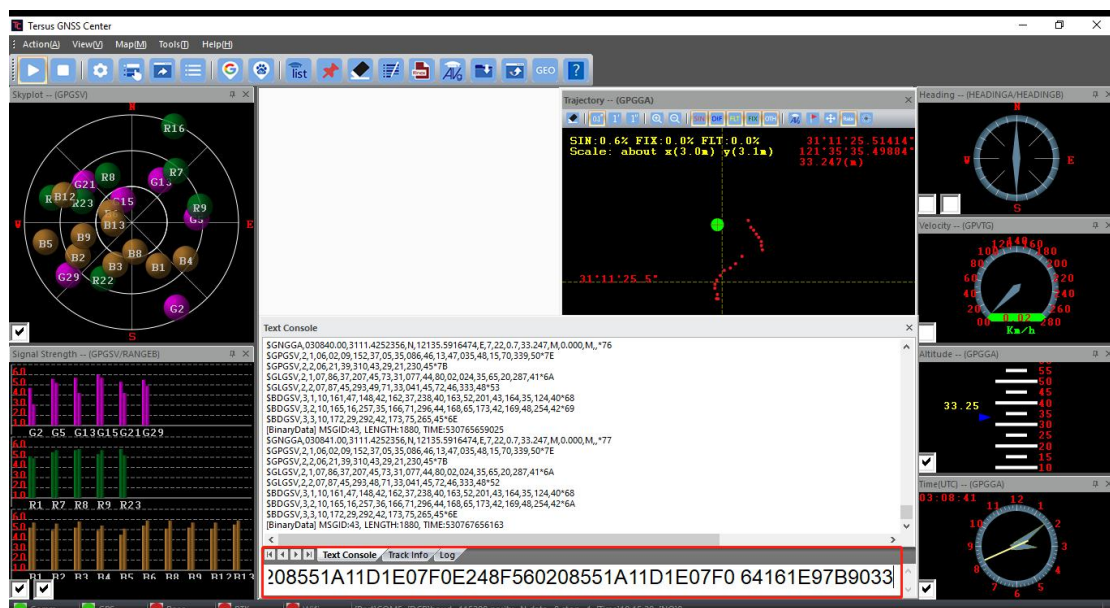
Figure 3.15 Register via Tersus GNSS Center

3. Or connect the David30 with Nuwa app, click [Device] -> [Device Info] to get the register info. Copy the auth code in the registration file and paste it to the TersusSurvey folder of the android device, click [Register] to complete the registration and the auth code will be shown in the window below.
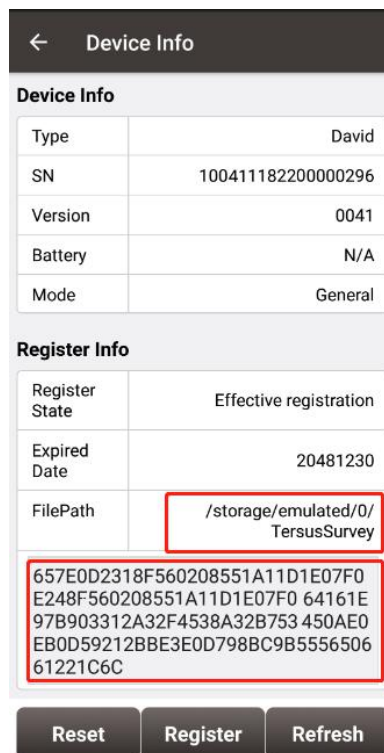
Figure 3.16 Device Information interface on Nuwa app

3.6 Download Files from Internal eMMC

The files saved on David30's internal eMMC can be downloaded to the computer via a serial port or an USB port (recommended and used in the following example).
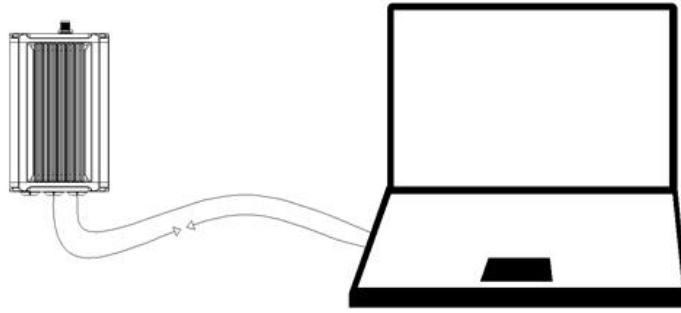
Figure 3.17 Download file from eMMC

The detailed steps of downloading files from eMMC are as follows:

1. Connect the COMM2 port of David30 receiver to the USB port of a computer using COMM2-7pin to USB & DB9 cable or COMM2-7pin to USB & 2W-Radio-5pin cable or COMM2-7pin to 28W-Radio power cable.

2. Power on the David30 receiver.

3. The GNSS_U disk will display on the computer.

4. Open the GNSS_U disk and there are two folders：inner and user. As shown in figure 3.18 below.

5. Copy the inner and user folders to see the related information from eMMC.

Figure 3.18 Folders in the GNSS_U disk

!	It is recommended to ensure the computer has available CPU and memory when downloading files.

3.7　Input command directly to the GNSS board

Users can input commands directly to the BX40C board inside David30 to

configure the receiver, the steps are described as below.

1. Follow the instructions in section 3.3.1 or section 3.3.2 to connect the android device to the David30 receiver.

2. Run Nuwa app, click [Device] -> [Data Terminal].

3. Users can input commands in the command window according to the Log & Command document.

4. Click [Send] to input the command to the BX40C board.
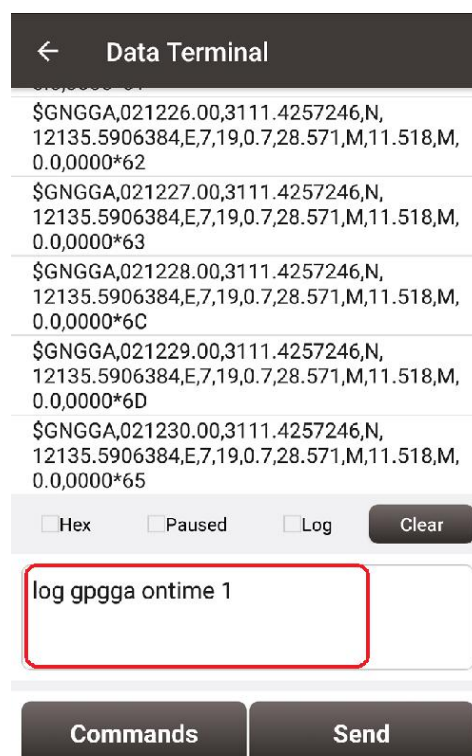
Figure 3.19 Input command in Data Terminal on Nuwa app

4. Introduction of Nuwa

Nuwa is the Tersus survey app, which runs in an Android device. All the configuration commands for David30 are input of Nuwa, and all the operations of David30 are completed on Nuwa. Four menu tabs are provided in the main interface which are Project, Device, Survey and Tools. Refer to the user manual for Nuwa app for details.

Figure 4.1 Booting up page of Nuwa app

!	Tersus Survey Nuwa app supports Android operating system; currently the IOS version is not available.

⚠	The minimal requirements for Android device: 1) The device must support OTG, otherwise, it cannot be connected to David30 with cables, but only with Bluetooth. 2) The Android system is 6.0 or later version.

!	1) There are lots of Android versions in market, therefore an Android device meeting the minimal requirements above may still have

problems to run Nuwa app.

2) Nuwa is tested with: Huawei Mate 7/Honor 7/9, Oppo A57, Vivo X9, Samsung C7 Pro and Tersus TC20 Controller.

3) It is highly recommended that an Android device with better hardware performance than those above is used to run Nuwa app.
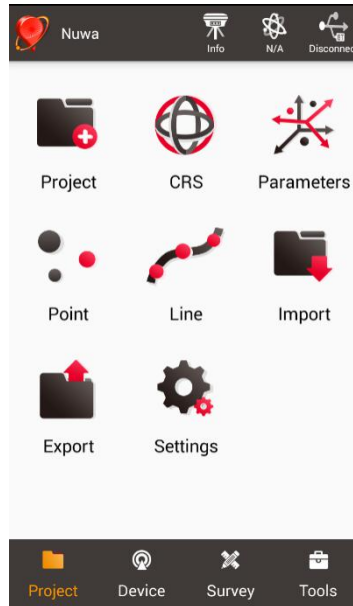
Figure 4.2 Nuwa app interface 1 – Project
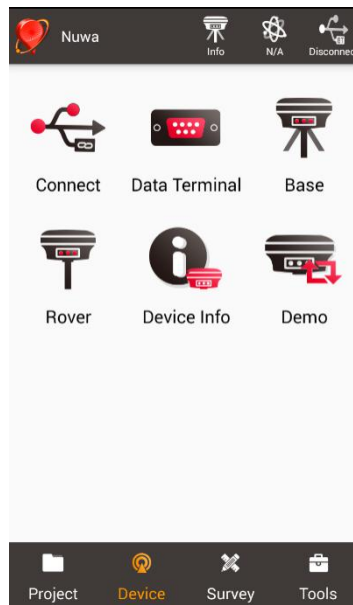
Figure 4.3 Nuwa app interface 2 – Device
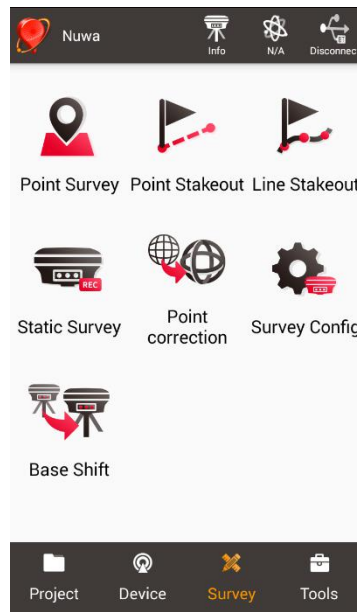
Figure 4.4 Nuwa app interface 3 – Survey
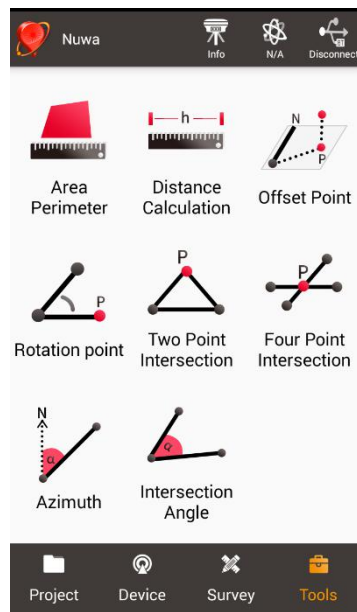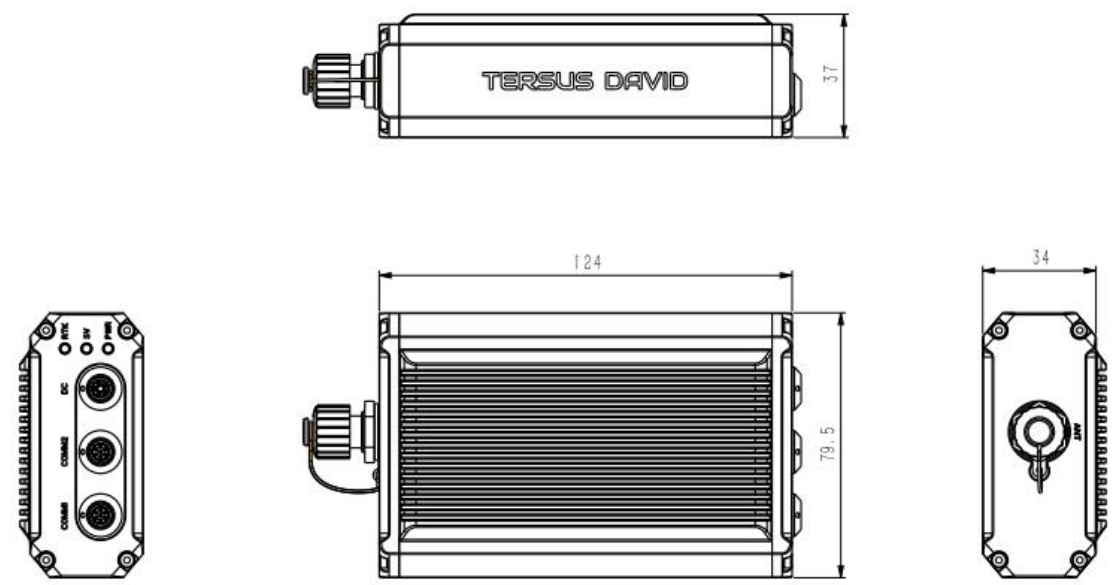
Figure 4.5 Nuwa app interface 4 – Tools

5. Specification

5.1   David30 Receiver

Table 9 David30 GNSS Performance

GNSS Performance			
Signal tracking	GPS L1 C/A, L2C, L2P, L5; GLONASS L1 C/A, L2 C/A; BDS B1, B2, B3, support BDS-3; Galileo E1, E5a, E5b; QZSS L1 C/A, L2C, L5		
Position Accuracy	Single positioning	1.5m RMS (Horizontal)	
		3.0m RMS (Vertical)	
	RTK Positioning	8mm+1ppm (Horizontal)	
		15mm+1ppm (Vertical)	
	DGPS	0.25m RMS (Horizontal)	
		0.5m RMS (Vertical)	
	High-Precision Static	2.5mm+0.1ppm (Horizontal)	
		3.5mm+0.4ppm (Vertical)	
GNSS Channels	576		
Time to First Fix	Cold Start: <50s Warm Start: <30s		
Reacquisition	<2s		
Data Rate	Measurements	20Hz	
	Position	20Hz	
Time Accuracy	20ns RMS		
Velocity Accuracy	0.03m/s RMS		
Measurement Precision	C/A Code	10cm	
	P Code(zenith direction)	10cm	
	Carrier Phase (zenith direction)	1mm	
Storage	In-built 8GB		
Physical Description			

Dimension	124*79.5*37 mm (David30 only)
Weight	≈360g (David30 only)

Mechanical Drawing

Environmental

Operating Temperature	-40°C to +70°C
Storage Temperature	-40°C to +85°C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)
Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g)
	Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)
Water & dust proof	IP67

Power Requirement

Input Voltage	+5 ~ 28 V DC
Power Consumption	6.8W without external Radio
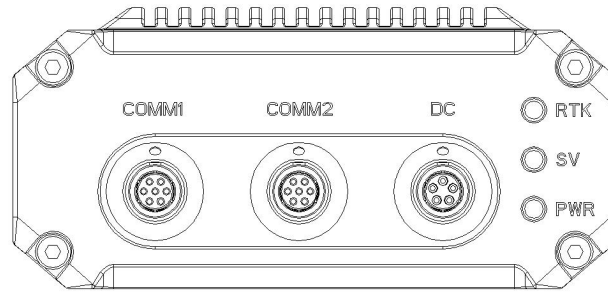
Figure 5.1 Panel of David30

Table 10 Pin Definition of connectors on David30

Connector Pin No.	COMM1 RS-232	COMM2 RS-232	DC
1	PWR	PWR	GND
2	GND	GND	TXD3
3	TXD1	TXD2	RXD3
4	RXD1	RXD2	GND
5	GND	GND	PWR
6	PPS	USB D+	
7	EVENT	USB D-	

The pin definition's view from outside to David30 is as below.
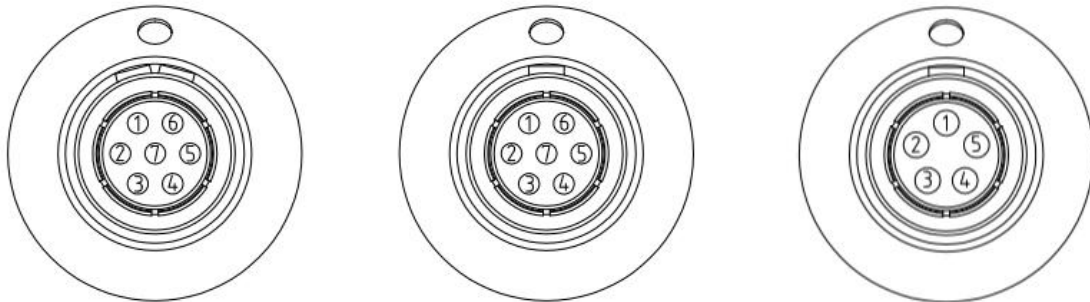
Figure 5.2 Pin Definition of the COMM1/COMM2/DC ports

5.2 Antenna AX4E02

Table 11 Antenna AX4E02

Antenna Specification	
Tracking signals	GPS L1/L2/L5/L-Band, GLONASS L1/L2/L3, BeiDou B1/B2/B3, Galileo E1/E5a/E5b/E6, QZSS L1/L2/L5/L6, SBAS L1/L5 and IRNSS L5
Impedance	50 Ohm
Polarization	RHCP
Axial Ratio	≤ 3dB
Azimuth Coverage	360°
Output VSWR	≤ 2.0
Peak Gain	≤ 5.5dBi
Phase Center Offset	59.14mm
Phase Center Accuracy	± 2mm
LNA Specification	
LNA Gain	40±2dB
Noise Figure	≤ 2.0dB
VSWR	≤ 2.0
Input Voltage	3.3~12V DC
Operating Current	≤ 45mA
Ripple	± 2dB
Physical Description	
Dimension	Φ152*62.2mm
Weight	≤500g
Signal Connector	TNC Female
Installation connector	5/8'' x 11 UNC-2B
Environmental	
Operating temperature	-45°C - +85°C

Storage temperature	-55°C - +85°C
Damp	45% - 95%

Mechanical Drawing

SIDE VIEW   BOTTOM VIEW

5.3 2W Radio RS460H

Table 12 Specifications of 2W Radio RS460H

Voltage and Power	
Input voltage	DC 5 ~ 12V
Power consumption in transmitting	6W (DC 5V, transmitting power 2W) 5W (DC 5V, transmitting power 1W)
Power consumption in receiving	0.5W (DC 5V)
External Antenna	
Impedance	50 ohm
VSMR	≤ 1.5
Interface	TNC female
Transmitter & Receiver	
Frequency range	410MHz – 470MHz
Channel width	12.5KHz/25KHz
Modulation type	GMSK, 4FSK
Transmission power	High power (2W)	33.5 ± 0.5dBm @ DC5V

	Low power (1W)	30.5 ± 1.0dBm @ DC5V
Power stability	±1dB	
Sensitivity	115dBm@BER 10^{-3}, 9600bps	
Co-channel rejection	>-12dB	
Adjacent channel selectivity	>50dB@25KHz	
Distance(Typical)	5-7KM	
Modem		
Air baud rate	19200/9600/4800bps	
Serial baud rate	115200/38400（default）/19200/9600bps	
Radio protocol	TrimTalk450, TrimMark3, South, Transparent, Satel	
Environment		
Temperature	-30°C - +60°C (operating)	
	-40°C - +85°C (storage)	
Mechanical		
Dimension	107 * 62 * 26.6mm	
Weight	≈200g	
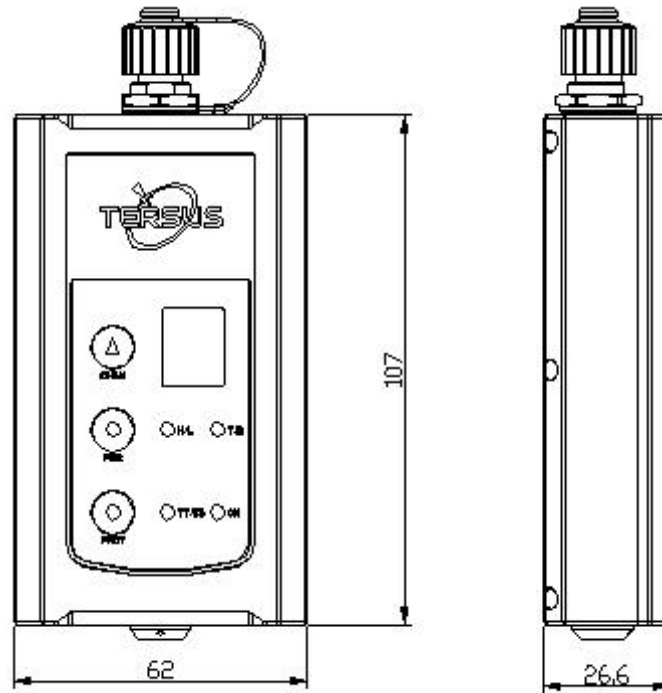
Table 13 Default factory configuration for RS460H

Channel	Frequency
00	457.550MHz
01	458.050MHz
02	458.550MHz
03	459.050MHz
04	459.550MHz
05	460.550MHz
06	461.550MHz
07	462.550MHz
08	463.550MHz
09	464.550MHz
Customized frequency	410~470MHz

5.4 28W Radio RS400H3

Table 14 Specifications of 28W Radio RS400H3

General Specification		
Frequency range	410~470MHz	
Operating mode	Simplex	
Channel width	25KHz, 12.5KHz	
Modulation Type	GMSK/4FSK	
Operating voltage	9~16V DC	
Power consumption	High power (28W)	78W @ 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 (28W)	44.5±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	
Antenna		
Antenna Impedance	50 Ohm	
Antenna Interface	TNC female	

Modem	
Air baud rate	4800bps, 9600bps, 19200bps
Modulation Type	GMSK/4FSK
Serial port baud rate	9600bps, 19200bps, 38400bps, 57600bps, 115200bps
Protocol	TRIMTALK, TRIMMK3, TRANSEOT,SOUTH, SATEL
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** | | |
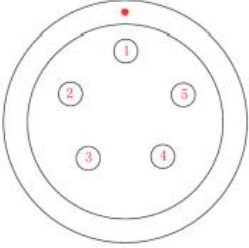
Data & power interface	 View from outside to radio	Pin 1: PWR (9~16V DC) Pin 2: Power GND Pin 3: RXD Pin 4: Signal GND Pin 5: TXD

Table 5 Default factory configuration for RS400H3

Channel	Frequency
00	457.550MHz
01	458.050MHz
02	458.550MHz
03	459.050MHz
04	459.550MHz
05	460.550MHz
06	461.550MHz
07	462.550MHz
08	463.550MHz
09	464.550MHz
Customized frequency	410~470MHz

6. Typical operation

	■ It is highly recommended to double check the module/cable before they are installed to the correct ports. ■ Mis-installation with force can damage the David30 receiver.

	The following may be used for David30 system: ● An Android device ● An external large capacity power if a base kit with 28W or with 2W radio station is used. ● A tripod (optional). ● A tribrach (optional)

	It is highly recommended that a David30 base variant is installed on a tripod.

!	It is normal that the metal case of David30 is hot during operation.

6.1 David30 as a Rover to receive corrections from Internet

!	From section 6.1 to section 6.4, David30 and Android device are connected via cables; refer to section 3.3 for the connection via Bluetooth.

Figure 6.1 Outline of Android device to David30 with Wire – Rover

!	Two cables are used to connect the COMM2 port of David30 to the USB port of the Android device which are: ● COMM2-7pin to USB & DB9 cable or COMM2-7pin to USB & 2W-Radio-5pin cable or COMM2-7pin to 28W-Radio power cable. ● USB Type A Female to USB (Micro + Type C) OTG cable

The detailed steps of David30 as a Rover receiving corrections from Internet are as follows:

1. Install the GNSS antenna on a ranging pole at a designated point.

2. Connect the antenna to David30 with the GNSS antenna cable.

3. Connect the COMM2 port of David30 to the USB port of an android device

with cables.

4. Power on David30 with a power supply.

5. Run Nuwa app, click [Device] -> [Connect].

6. Select [Bluetooth] in the option list of Connect Type as shown in Figure 6.2.

7. Click [Connect Config] to update configuration accordingly.

8. Click [Connect] to enable the communication with David30.

9. Back to [Device] -> [Rover]

10. Select [Default: PDA Network+Default Server1] as shown in Figure 6.3, click [Detail] to configure the parameters of the Network.

11. Select [Network] for Data Link.

12. Input IP, Port, Username, Password and Mount Point if Ntrip is selected for Protocol Type.

13. Input IP and Port if TCP is selected for Protocol Type.

14. Back to Rover interface, click [Start]

15. When all the configurations above are correct, the rover is receiving RTK corrections as shown in Figure 6.5.

Figure 6.2 Connect David30 via Bluetooth
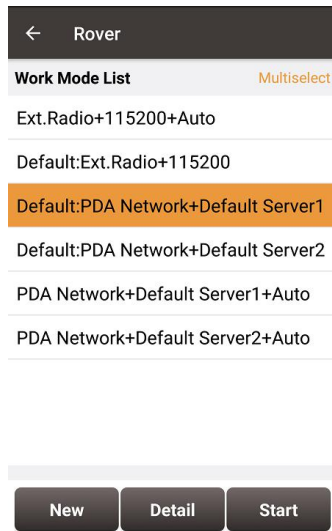
Figure 6.3 Rover setting interface

Figure 6.4 Edit Rover configuration

Figure 6.5 Rover is receiving RTK corrections

The detailed steps of configuring David30 using Tersus GNSS Center via cables are listed below:

1) Use the 'COMM2-7pin to USB&DB9 cable' to connect the COMM2 cable and a computer; or Use the 'COMM1-7pin to DB9 cable' to connect the COMM1 cable and a computer ; the 'COMM1-7pin to DB9 cable' shown as below:

2) Open Tersus GNSS Center application on the computer and type below commands in the command window:

UNLOGALL   //remove all logs
FIX NONE   //cancel the fixed coordinate of a base station

LOG GPGGA ONTIME 1　　//output GPS fix data and undulation

LOG GPGSV ONTIME 1　　//output GPS satellites in view

SAVECONFIG　　　　　　//save configuration

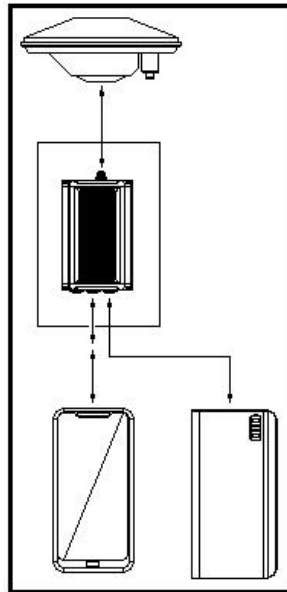## 6.2　David30 as a Base to transmit corrections to Internet
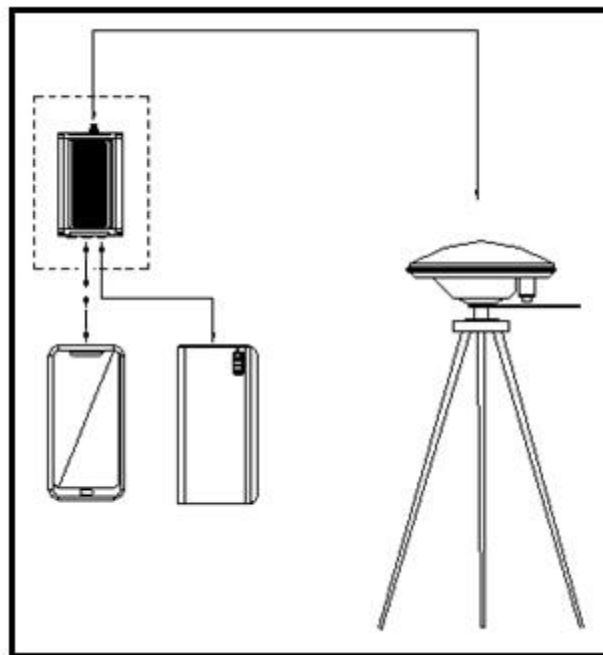
Figure 6.6 Outline of Android device to David30 with Wire – Base

!	Two cables are used to connect the COMM2 port of David30 to the USB port of the Android device which are: ● COMM2-7pin to USB & DB9 cable or COMM2-7pin to USB & 2W-Radio-5pin cable or COMM2-7pin to 28W-Radio power cable. ● USB Type A Female to USB (Micro + Type C) OTG cable.

!	It's highly recommended that a base David30 is installed on a tripod.

The detailed steps of using Nuwa app to configure David30 as a base transmitting corrections to Internet are as follows:

1. Install the tripod at a designated point.

2. Install a Tribrach on the tripod, adjust it to horizontal level and install the GNSS antenna and the antenna connector on it.

3. Connect the antenna to David30 with the GNSS antenna cable.

4. Connect the COMM2 port of David30 to the USB port of an android device with cables.

5. Power on David30 with a power supply.

6. Run Nuwa app, click [Device] –> [Connect].

7. Select [Bluetooth] in the option list of Connect Type.

8. Click [Connect Config] to update configuration accordingly.

9. Click [Connect] to enable the communication with David30.

10. Back to [Device] -> [Base].

11. Select [Default: Auto Startup+PDA Network+Default Server1+RTCM32], then click [Detail] to configure the parameters about the Network.

12. If [Auto Start] is selected for start method, skip to step 14.

13. If [Manual Start] is selected for start method, input the position of the base manually.

14. If Ntrip protocol is selected, input information include: IP, Port, Username, Password and Mount Point.

15. Back to [Device] -> [Base], click [Start].

16. When all the configurations above are correct, the base is transmitting RTK corrections as shown in Figure 6.10.
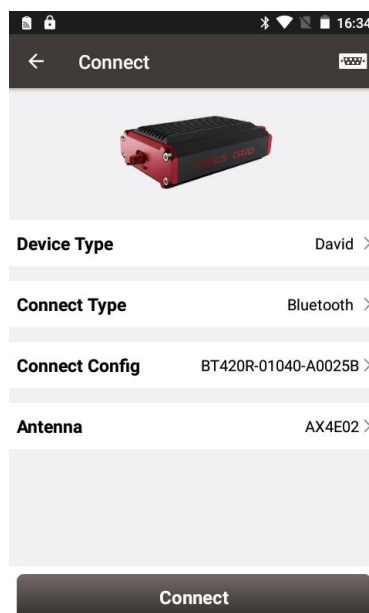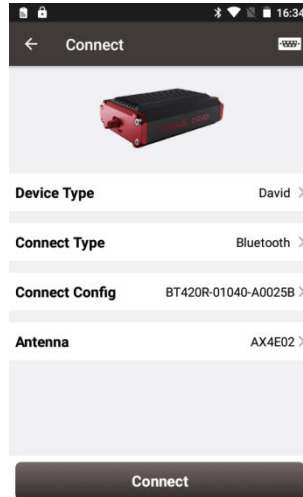
Figure 6.7 Connect David30 via Bluetooth
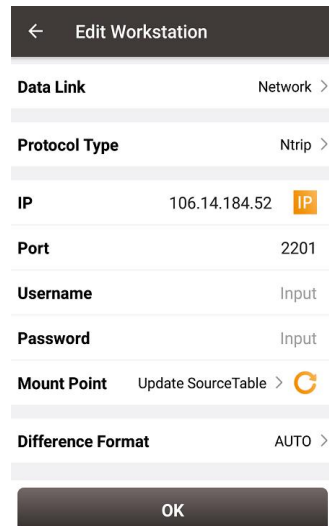

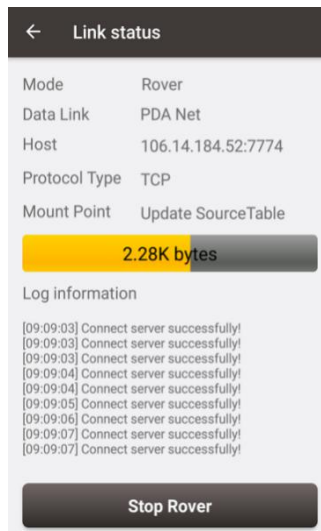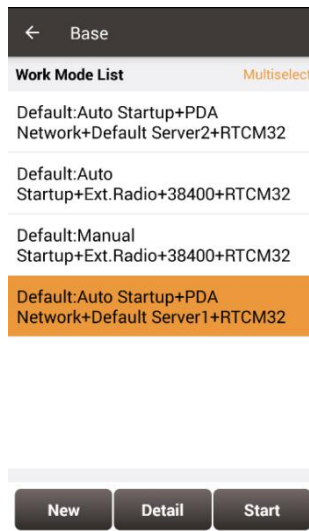Figure 6.8 Base setting interface
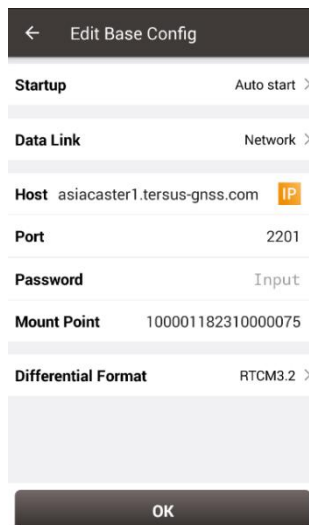
Figure 6.9 Edit Base configuration
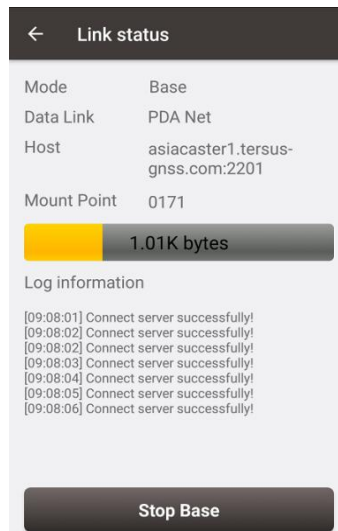
Figure 6.10 Base is transmitting corrections

The detailed steps of configuring David30 using Tersus GNSS Center via cables are listed below:

1. Use the 'COMM2-7pin to USB&DB9 cable' to connect the COMM2 cable and a computer; or Use the 'COMM1-7pin to DB9 cable' to connect the COMM1 cable and a computer ; the 'COMM1-7pin to DB9 cable' shown as below:

2. Open Tersus GNSS Center application on the computer and type below commands in the command window:

UNLOGALL   //remove all logs

UNDULATION USER 0.0 //Set user specified undulation value for ellipsoid height[2]

FIX POSITION B L H   //B: latitude (degree), L: longitude (degree), H: ellipsoid height (m)

75

For example: FIX POSITION xx.xxxxxx xx.xxxxxxx xx.xx

or POSAVE ON 0.02   //Turn on position average for 0.02 hour (72s)

LOG COM2 RTCM1006 ONTIME 10   //output the base coordinate

LOG COM2 RTCM1074 ONTIME 1   //output GPS observations

LOG COM2 RTCM1084 ONTIME 1   //output GLONASS observations

LOG COM2 RTCM1094 ONTIME 1   //output Galileo observations

LOG COM2 RTCM1114 ONTIME 1   //output QZSS observations

LOG COM2 RTCM1124 ONTIME 1   //output BeiDou observations

LOG COM2 RTCM1230 ONTIME 10   //output GLONASS bias information

LOG COM2 RTCM1033 ONTIME 10   //output antenna, receiver information

(Below commands output ephemerides, not default configuration)

LOG COM2 RTCM1019 ONTIME 5   //GPS ephemerides

LOG COM2 RTCM1020 ONTIME 5   //GLONASS ephemerides

LOG COM2 RTCM1042 ONTIME 5   //BeiDou ephemerides

LOG COM2 RTCM1044 ONTIME 5   //QZSS ephemerides

LOG COM2 RTCM1046 ONTIME 5   //Galileo ephemerides

SAVECONFIG   //save configuration

Note: If customer needs to use global geoidal height model EGM96 for mean sea level height, type below command to replace the undulation command above.

UNDULATION EGM96   **//Set EGM96 geoidal height model**

More details about logs and commands refer to *BX40C Log & Command* document.

3) Power cycle the receiver or input RESET command to make the above configuration effective.

6.3 Radios Transmit RTK Corrections between Two David30

!	● 2W base should work with 2W rover.
	● 28W base should work with 2W rover.

This section introduce the configuration of 28W base and 2W rover for reference.
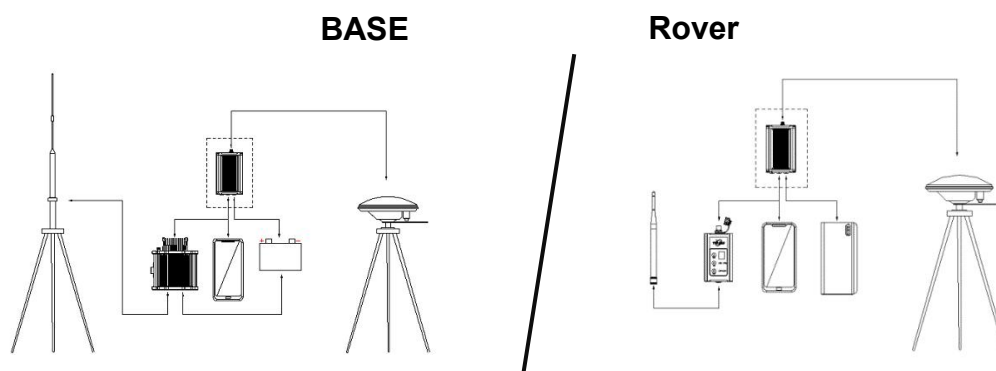
BASE   **Rover**

Figure 6.11 Outline of Base/Rover with Radios

The detailed steps of David30 with 28W radio as a base transmitting corrections to a David30 with 2W radio as a rover are as follows:

Hardware connection for David30 as a base with 28W radio

1. Install the two tripods at the designated points.

2. Install the High Gain Radio Antenna with the telescopic pole for radio antenna if needed.

3. Install the metal plate, the GNSS antenna connector and the High Gain Radio Antenna on one tripod.

4. Install a Tribrach on the other tripod, adjust it to horizontal level and install the AX4E02 GNSS antenna and the antenna connector on the tripod.

5. Connect the AX4E02 antenna to the base David30 with the GNSS antenna cable.

6. Connect the COMM2 port of the David30 receiver to the USB port of an Android device using COMM2-7pin to USB & 28W-Radio-5pin cable.

7. Install the GNSS antenna cable from the telescopic pole to the 28W radio station.

8. Connect DC-5pin of the 28W-Radio power cable to the DC port of David30 receiver, and the 28W-Radio-DC-5pin of this cable is to connect to the DC port of 28W radio, and the Bullet-DC is to connect with Bullet-DC to Alligator Clips in Figure 2.28.

9. Double check the connections above and connect the alligator clips to the external battery.

Hardware connection for David30 as a rover with 2W radio

10. Install the AX4E02 GNSS antenna on a ranging pole and place it at the designated point.

11. Connect the AX4E02 antenna to the rover David30 with the GNSS antenna cable and connect the 410-470MHz radio whip antenna to the 2W radio.

12. Install the COMM2-7pin to USB & 2W-Radio-5pin cable to the COMM2 port of the rover David30, and connect the other two connectors to the USB port of the Android device with cables and to the 2W radio station, respectively.

13. Power on David30 with an external battery.

Software configuration for David30 as a base with 28W radio

14. Refer to section 3.3.1 for the communication between an Android device

and the David30 as a base.

15. Run Nuwa app, click [Device] -> [Base].

16. Select [Auto Startup+Ext.Radio+38400+RTCM32], click [Detail].

17. If [Auto Start] is selected for start method, skip to step 20.

18. If [Manual Start] is selected for start method, input the position of the base manually

19. Click [OK] to return to the Base interface, click [Start] to complete the configuration.

Figure 6.12 Base work mode list
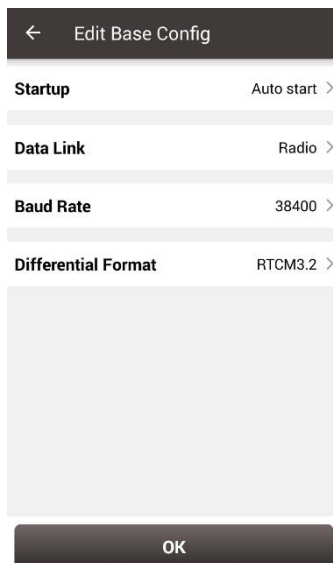
Figure 6.13 Edit base configuration

Software configuration for David30 as a rover with 2W radio

20. Refer to section 3.3.1 for the communication between an Android device and the David30 as a rover.

21. Run Nuwa app, click [Device] -> [Rover].

22. Select [Ext.Radio+38400], click [Detail].

23. Ensure the Data Link is Radio and Baud Rate is correct.

24. Click [OK] to return to the Rover interface, click [Start] to complete the configuration
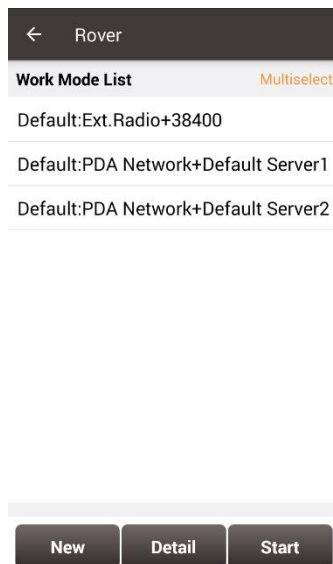
Figure 6.14 Rover work mode list
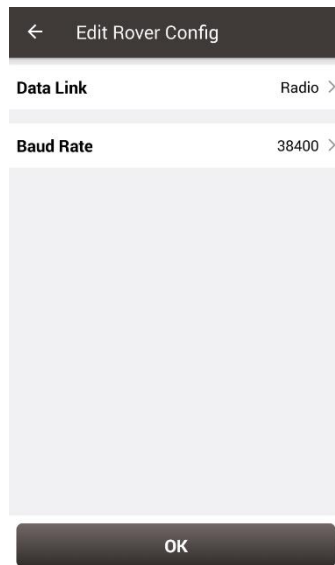
Figure 6.15 Edit rover configuration

6.4 Data Collection for Post Processing

!	The size of the logging: Collect raw measurements at 1Hz (about 110Kbyte/min if 20 satellites are tracked, about 165Kbyte/min if 30 satellites are tracked) If the collection frequency increases, the data size would increase proportionately.

⚠	David30 provides up to 8GB internal eMMC for data collection, before data collection, estimate whether the free space is enough for the data collection. Refer to section 3.6 to delete the files on eMMC to get more free space.

⚠	During data collection, the antenna should be installed on a tripod.
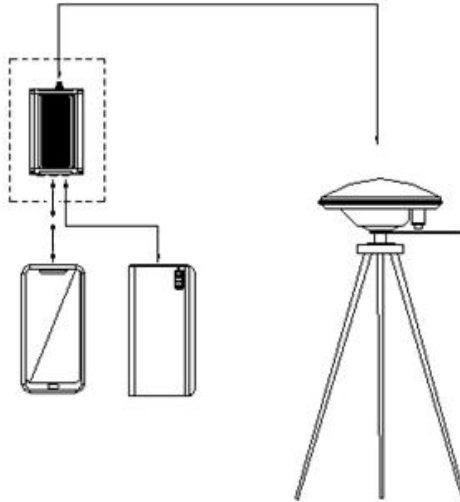
Figure 6.16 Outline of Static Data Collection

The detailed steps for static data collection are as follows:

Hardware connection

1. Install a tripod at a designated point.

2. Install a tribrach on the tripod, adjust it to horizontal level and install the GNSS antenna and the antenna connector on the tribrach.

3. Connect the AX4E02 GNSS antenna to the David30 with the GNSS antenna cable.

4. Create communication between the David30 and the Android device with cables, refer to section 3.3.1.

Software configuration

5. Run Tersus Survey app Nuwa, click [Survey] -> [Static Survey].

6. Ensure the necessary parameters including interval, cutoff angle, etc. are filled, then click [Start].

7. Repeat steps 1 – 6 above to collect static data at other designated points.
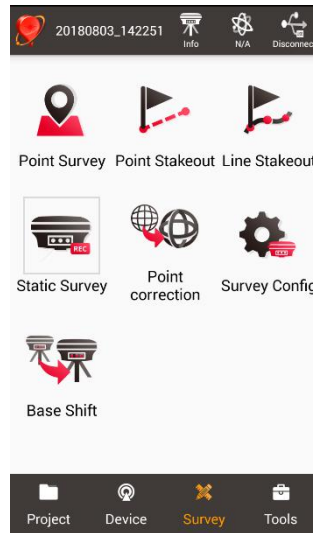
Figure 6.17 Survey interface on Nuwa app
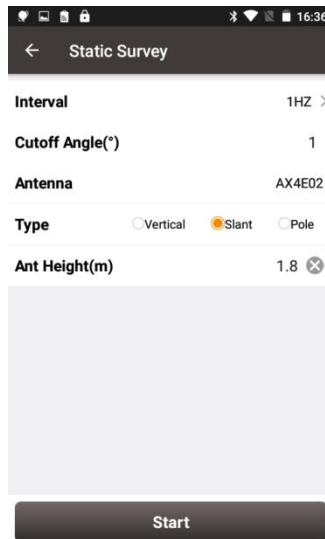
Figure 6.18 Static survey configuration

The detailed steps of configuring David30 using Tersus GNSS Center via cables are listed below:

1. Use the 'COMM2-7pin to USB&DB9 cable' to connect the COMM2 cable and a computer; or Use the 'COMM1-7pin to DB9 cable' to connect the COMM1 cable and a computer ; the 'COMM1-7pin to DB9 cable' shown as below:

2. Open Tersus GNSS Center application on the computer and type below commands in the command window:

UNLOGALL   //remove all logs

LOG FILE RANGECMPB ONTIME 15.00 NOHOLD   //save the compressed version of the RANGE log

LOG FILE GPSEPHEMB ONCHANGED NOHOLD   //save the decoded GPS ephemeris.

LOG FILE BDSEPHEMERISB ONCHANGED NOHOLD   //save the decoded BDS ephemeris.

LOG FILE GLOEPHEMERISB ONCHANGED NOHOLD   //save the decoded GLONASS ephemeris.

LOG FILE GALINAVEPHEMERISB ONCHANGED NOHOLD   //save the decoded Galileo INAV ephemeris

LOG FILE QZSSEPHEMERISB ONCHANGED NOHOLD   //save the decoded QZSS ephemeris

SAVECONFIG   //save configuration

6.5　Auto Base Station List Function

If a base is setup with command POSAVE, according to its original definition, after a power cycle, the fixed position may be different even if the receiver is installed at the same point. More details about command POSAVE refer to the Log & Command document. For the users who need the base to keep the same fixed position after a power cycle, auto base station list function is introduced.

The procedure is introduced as below:

1. Follow Figure 3.6 and the detailed steps in section 3.4.1 to create communication between a David30 receiver and Tersus GNSS Center.
2. Under the menu, click [Tool] -> [Auto Base Station List] to get below interface.

Figure 6.19 Auto Base Station List interface

3. Input the valid position range, check PosAve On, and click [Modify]. It is recommended that valid position range is >20m.

4. After the specific time (in the example, 0.01 hour is 36 seconds), the base is fixed within 36 seconds averaging position.

5. Click [Refresh], the fixed position is displayed as below.

Figure 6.20 Fixed position for base station

6. After a power cycle, if the base is moved less than 20m away from the last position, it would fix with the same position. In the above example, latitude keeps 31.19042830, longitude keeps 121.59319162 and ellipsoid height keeps 37.4168.

6.6   2W Radio operation

6.6.1 Radio Function Description
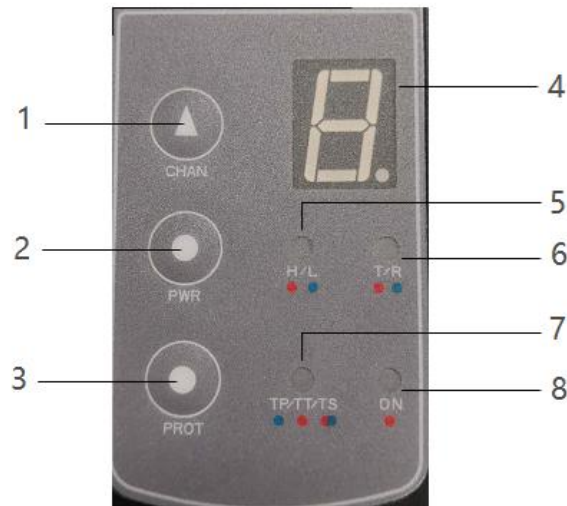
Figure 6.21 Front Panel of the 2W Radio

No.	Definition
1	Channel switching button
2	Power switching button
3	Protocol switching button
4	Current channel display
5	Power indicator (H/L)
6	Transceiver mode indicator
7	Protocol indicator
8	Power Supply indicator

1) Boot up

The radio module is boot up directly when powered on.

2) Channel switching

Press the channel switching button once, the channel is increased by one; the

LED displays the current channel value; the channel display is 0 to 9, and the default is 0.

3) Power switching

Press the power switching button once, the power is switched once; the power indicator is steady red to indicate high power 2W, and indicator is steady green to indicate low power 1W, and the default is high power.

4) Protocol switching

Press the protocol switching button once, the protocol is switched once. The green light on represents Transparent, the red light on represents TT450, the green light flashing represents South, the red light flashing represents SATEL, the yellow light on represents TRIMMK3.

5) Transceiver mode switching

Simultaneously press and hold the channel switching button and power switching button for 1 second to switch the transceiver mode; T is steady red for transmit mode, and red light is flashing for transmitting data; R is steady green for receive mode, and green light is flashing for receiving data; the default is the receive mode.

6) Restore default configuration

Simultaneously press and hold the power switching button and protocol switching button for 1 second to recover to the default configuration.

6.6.2 Radio Installation

As a transmission, the radio is hooked on a tripod; as a rover station, the radio

is installed in the rover station bracket.

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.

6.6.3 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.

6.7　28W Radio operation

6.7.1 Radio basic operation

1) Buttons

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

Table 6 Buttons description of radio RS400H3

Icon	Button	Function
	Power	It is used to control radio power-on and power-off, with specific functions as follows: ● 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.

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.

Figure 6.22 Device information

- 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.

Figure 6.23 Channel and frequency

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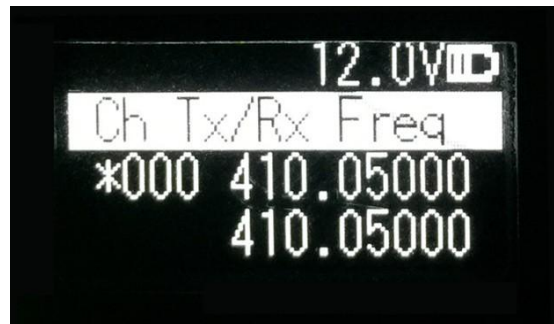
Note: After changing the protocol, you need reselect the air baud rate supported by the current protocol in the menu of "wireless link rate".

Figure 6.24 Data protocol

● 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.
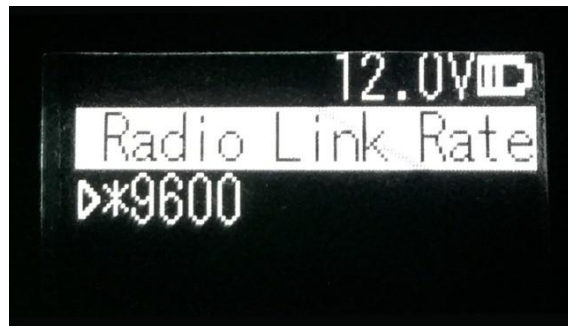
Figure 6.25 Air baud rate

● 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.

Figure 6.22 Transmit power

● 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.
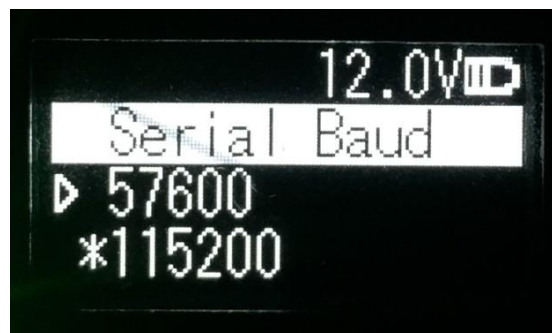
Figure 6.27 Serial baud rate

● 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.

Figure 6.23 Serial baud rate self-adaption

● 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.

Figure 6.29 OLED sleep mode

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.
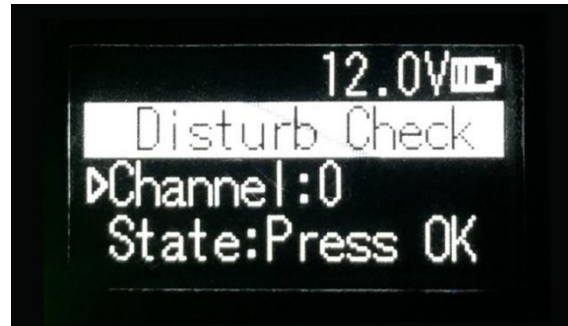
Figure 6.30 Interference detection

● Language
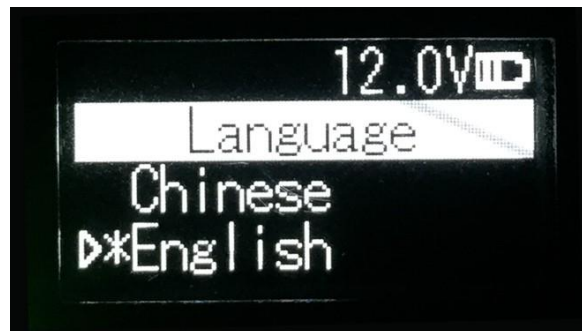
Figure 6.31 Language setting

Set the display l

6.7.2 Radio Installation

The 28W radio is hooked on a tripod for the base station.

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.

6.7.3 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 high gain radio antenna is in the designated antenna for 28W radio. 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.

7. Lightning-Proof Design

The regional surface displacement monitoring system of the ground disaster monitoring uses lightning rods for direct lightning protection, single power supply arrester and communication cable arrester for inductive lightning protection.

7.1 Direct lightning protection

As the specific lightning protection method required, the distance between the lightning rod and the protected object must be not less than 3m. The height of lightning rod is determined in accordance with the 'Rolling Ball Rule' and can be roughly calculated.
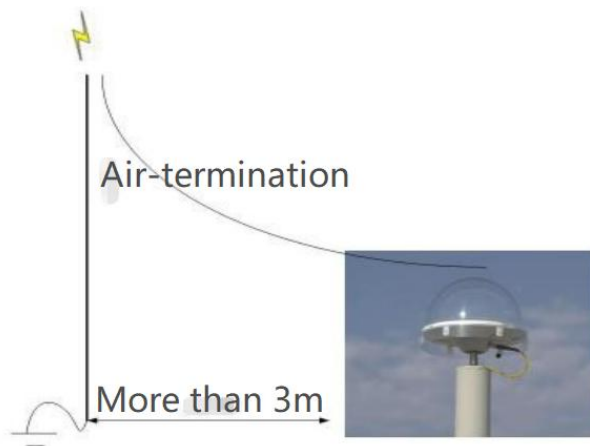

Figure 7.1 Schematic diagram of direct lightning prevention

ZGZ-200-2.1 type is selected as the lightning rod:

Figure 7.2 Lightning rod

Technical Parameters

1) Lightning current capacity(KA): 200;

2) Resistance(Ω): ≤1;

3) Height(m): 2.1;

4) Weight(kg): 4.8;

5) Maximum wind resistance(m/s): 40;

6) Installation size(mm): φ70±0.26.

7.2 Inductive lightning protection

7.2.1Power lightning protection

Metal cabinet is used to shield inductive lightning, and the power unit is additionally assisted with lightning protection socket and single power supply arrester.
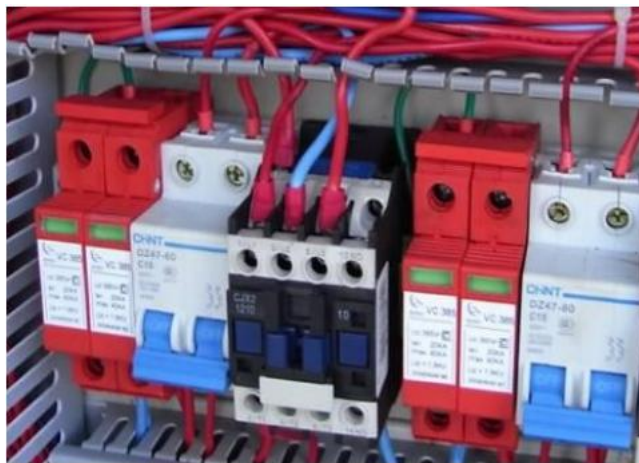

Figure 7.3 Single power lightning arrester

7.2.2Lightning protection for communication cables

Install lightning protection devices at both ends of the communication cable. One end is close to the sensor to avoid current damage to the sensor due to the inductive lightning. And the other device is as close as possible to the data

processing equipment.

The grounding terminal of the arrester is connected to the lightning protection net, with anti-rust paint on the connection to ensure conductivity, and the grounding resistance is less than 4 Ω .

The lightning arrester has certain insertion loss, which has an impact on the strength of the data signal. So as to be necessary to equip the signal amplifier and other related equipment according to the actual situation.

Figure 7.4 The lightning arrester for communication cable

7.2.3Grounding net

For the construction of grounding net, four 50*50*5mm hot dip galvanized angle steels are used as vertical poles L=2.5m, which are inter connected by 40*4mm hot dip galvanized flat steels, and the buried depth of the ground pole is more than 0.7 meters. The base of the lightning rod is 500*500*60mm reinforced concrete, which is connected with ground net by two 40*4mm hot dip galvanized flat steels(the connection must be welded). The ground resistance is less than 10 Ω .

8. Terminology

Table 17 List of Terminology

Abbreviation	Definition
ASCII	American Standard Code for Information Interchange
CMR	Compact Measurement Record
CORS	Continuously Operating Reference Stations
DC	Direct Current
ESD	Electro Static Discharge
ECEF	Earth Center Earth Fixed
GLONASS	GLObal Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IF	Intermediate Frequency
IMU	Inertial Measurement Unit
IO	Input / Output
LED	Light Emitting Diode
LNA	Low Noise Amplifier
MPU	Micro Processing Unit
NMEA	National Marine Electronics Association
PC	Personal Computer
PPK	Post Processing Kinematic
PPS	Pulse Per Second
RF	Radio Frequency
RINEX	Receiver Independent Exchange format
RMS	Root Mean Squares
RTK	Real-Time Kinematic
RTCM	Radio Technical Commission for Maritime Services
SMA	Sub-Miniature-A interface

SSID	Service Set Identifier
TTFF	Time to First Fix
TTL	Transistor-Transistor Logic level
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial BUS
WGS84	World Geodetic System 1984

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