V90 Plus GNSS RTK System

HI-TARGET

Manual Revision

Revision Date	Revision No.	Description
Aug.,2015	1	V90 Plus GNSS RTK System Getting Started
Dec., 2018	2	V90 Plus GNSS RTK System Getting Started

Contents

Preface

Introduction

Welcome to the Hi-Target V90 Plus receiver. This introduction describes how to use this product.

Experience Requirement

In order to help you use Hi-Target series products better, Hi-Target suggests you carefully read the instructions. If you are unfamiliar with the products, please refer to http://www.hi-target.com.cn/

Tips for safe use

Note: The contents here are special operations, and need your special attention. Please read them carefully.

Warning: The contents here are very important. Wrong operation may damage the machine, lose data, break the system and endanger your safety.

Exclusions

Before using the product, please read these operating instructions carefully, they will help you to use it better. Hi-Target assumes no responsibility if you fail to operate the product according to the instructions, or operate it wrongly, due to misunderstanding the instructions.

Hi-Target is committed to constantly perfecting product functions and performance, improving service quality and we reserve the right to change these operating instructions without notice.

We have checked the contents of the instructions, the software and hardware, without eliminating

the possibility of error. The pictures in the operating instructions are for reference only. In case of non-conformity with products, the products shall prevail.

Technology and Service

If you have any technical issues, please call Hi-Target's technology department for help.

Relevant Information

You can obtain this introduction by:

1. Purchasing Hi-Target products: you will find this manual in the instrument container to guide you on operating the instrument.

2. Logging onto the Hi-Target official website, downloading the electronic version introduction at *Partners → Partner center*.

Advice

If you have any comments and suggestions for this product, please email info@hi-target.com.cn. Your feedback will help us to improve the product and service.

CHAPTER

1

Overview

This Section Describes:

- Foreword
- Features
- Precautions

1.1 Foreword

V90 Plus is a new type of GNSS receiver by Hi-Target that is used for measurements. With a hi-tech, fully integrated design, the conveniently sized V90 Plus is one of the most flexible choices for any measuring task. It has a built-in Linux 3.2.0 operating system, pre-loaded multiple smart applications, such as tilt surveying, electronic bubble calibration, NFC and voice DIY. The LEDs enable you to monitor satellite tracking, radio reception, the data logging status, Wi-Fi status, and power. The product's Bluetooth wireless technology provides cable-free communications between the receiver and controller. The V90 Plus GNSS system provides surveyors with industry-leading GNSS solutions.

Warning: The instructions do not provide a standard configuration. The articles within the box can be adjusted according to different user requirements. Suggestions before using the machine: First, check whether the product's packaging is damaged; please open the package carefully and confirm whether the articles are consistent with the list on the box. Please contact the local office or dealers immediately if the product and its accessories are lost or damaged. Please carefully read the operating instructions before you carry, transport or use the product.

1.2 Features

- Small and lightweight

Only weighs 950g

Measurements: Diameter 153mm x Height 83mm

- Multi-constellation tracking

220 tracking channels

Supports GPS, GLONASS, GALILEO, BDS, SBAS

NGS approved full-band GNSS antenna

- Smart application

Offers a tilt survey with a maximum tilt angle of 30 degrees.

Supports electronic bubble calibration

The internal NFC module makes Bluetooth communication quick and easy.

Intelligent voice assistance guides the field operations. The voice can be DIY.

The standard Rinex data and Hi-Target raw data are recorded simultaneously.

- Optional Transceiver UHF Radio

The transceiver UHF radio enables you to switch working modes between the base and the rover. Three types of internal UHF radio provide different frequencies, based on the user's requirements. The Pacific Crest TrimTalk© internal UHF radio is compatible with other radios.

- Multi-network Connection

Supports GPRS, GSM and WCDMA

Supports Wi-Fi

- Powerful Battery

The product is powered by a high-capacity (5000mAh) Li-ion battery in order to ensure it will operate for a full day.

- Rugged Design

IP67 dustproof and waterproof

Able to survive a natural 2-meter fall onto concrete

1.3 Precautions

1. Environmental Requirements

The receiver should be operated in a dry working environment, regardless of its waterproof materials. In order to increase the receiver's stability and service cycle, it should be kept away from extreme environments, such as:

- Moisture
- Temperatures above 65 degrees centigrade
- Temperatures below -40 degrees centigrade
- Corrosive liquids or gases
- 2. Electronic Jamming
- The receiver should not be installed in a place near to strong electric power or a signal that can cause interference, such as:
- An oil duct (spark plugs)
- Generator
- Battery-operated motorcycle
- DC-AC power supply changeover equipment

- Signal transmitting station (tower)
- Power supply

3. Battery safety

Warning:

1. You must use the battery and charger that has been configured by the manufacturer. Do not throw them into the fire or use the metallic short-circuit electrode.

2. There is a certain quantity of electricity already in the battery for its first use. Therefore, the battery should not be charged until this quantity of electricity has been used up. It should be charged for 12 hours the first three times and then it can be charged normally after that. Do not charge for more than 24 hours.

3. Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.

4. If the service life of the battery has been obviously shortened, please stop using the battery. This indicates that the battery is old, so please replace it with a new one.

CHAPTER

2

Product Introduction

This Section Describes：

- Hardware structure
- Button
- LED
- Wi-Fi password setting
- Static data collecting (by button operation)
- Web management system
- Firmware update

2.1 Hardware structure

Figure 2-1-1 Hardware Schematic Diagram

1. Guard Circle

2. Control Panel

3. 3G/UHF antenna interface

4. Bottom Cover

5. Upper Cover

V90 Plus mainly consists of three parts – the upper cover, bottom cover and the control panel.

In the middle of the mainframe is the control panel, which contains a power button and three indicator lamps. Only the power button can complete all of the functions and settings. There are three indicator lamps. These are, from left to right, a satellite lamp (a single green lamp), power lamp (a bi-color red and green lamp) and status lamp (a bi-color red and green lamp).

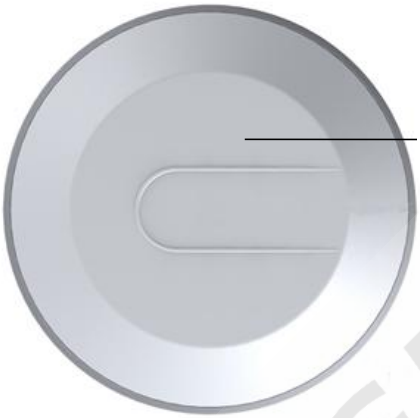


Figure 2-1-2 Upper Cover

The U-type anti-wear buffer can effectively prevent the instrument from being scratched.

The double-color model makes the structure clear and its appearance beautiful.

Figure 2-1-3 Bottom

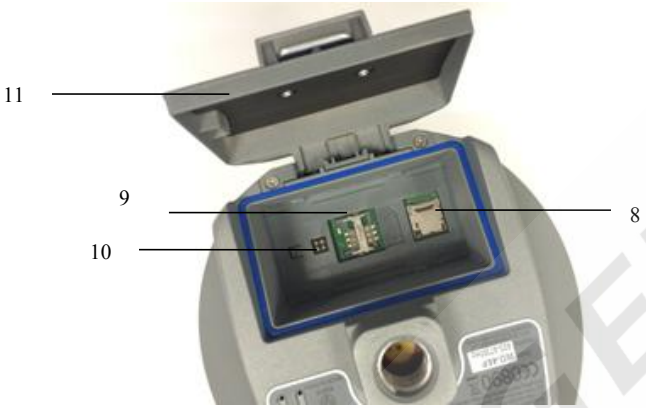


Figure 2-1-4 Inside the battery compartment

1. The USB interface and protective plug（which is used to both export data and upgrade firmware）

2. Speaker (operates the instrument and vocally broadcasts the status)

3. Metal buckle

4. Battery compartment

5. Connecting screw hole（used to fasten the instrument to the base or centering rod）

6. 5-pin socket and protective plug (used to output the NMEA-0183 and link the external radio and external power)

7. Antenna port and protective plug (to connect the transceiver antenna for receiving and transmitting the differential signal)

8. SD card slot (used to place the SD card, which can store a massive amount of static data)

9. SIM card slot power seat (used to place the SIM card when communicating with GSM data)

10. Spring contacts (used to connect the lithium battery and host)

11. Battery cover

Note:

1. Please cover the 5-core socket with the plug when the product is not in use.

2. The speaker is likely to fall silent or go hoarse when water enters it, but it can recover when the speaker is dry again.

Figure 2-1-5 3G/GPRS antenna（short）

Figure 2-1-6 UHF built-in radio antenna（long）

Note: The receiver is equipped with a UHF built-in radio antenna and a 3G/GPRS antenna. Select the right antenna type according to the different working mode you require. Please use the UHF built-in radio antenna when using the “UHF base station”/”UHF rover station” mode, and the 3G/GPRS antenna when using the “GSM base station”/”GSM rover station”.

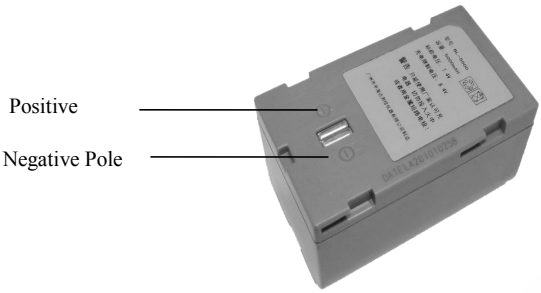


Figure 2-1-7 Batteries

The receiver has one rechargeable lithium-ion battery, which can be removed for charging. You can also connect the receiver to an external power source through the 5-pin socket.

Use the Hi-Target CL-8410 lithium battery charger to charge the BL-5000 lithium battery for about 7 hours. This is designed with a charge lamp, which turns red during the charging process and green when it is fully charged. The battery will continue to charge for another 1 to 1.5 hours.

2.2 Button

V90 Plus has an optimized and simplified design， with button operation and a more convenient and concise control panel.

1. Control panel

Most of the V90 Plus Receiver's settings and operations can be conducted by using the power button, which is below the control panel.

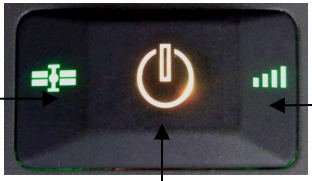


Figure 2-2-1 Control panel

2. Button functions

Table 2-2-1 Button functions

Functions	Detailed description
Power-on	Press power button for 1s to power-on.
Power-off	Long press the power button for more than 3s and less than 6s when the speaker makes the ding-dong sound. Release the button to power-off.
Auto-set base	In the power-off state, long press the power button for 6s when the voice prompts you to "set base automatically", and then release it. The receiver will now automatically set the base mode.
Working mode switch	Double-click the power button and enter the working mode switch; every double-click will switch to another working mode.
Working mode confirmation	Single click to confirm the current work mode.
Reset mainboard	In the power-on state, long press the power button for more than 6s

	when you hear the second ding-dong, and then release it.
Mandatory power-off	In the power-on state, long press the power button for more than 8s.

2.3 LED

Table 2-3-1 LED description

Lamp	Status	Description
Power lamp (yellow)	Always on	In normal voltage Battery＞7.6V External power supply＞12.6V
Power lamp (red）	Always on	In normal voltage 7.2V＜battery＜7.6V 11V＜external power supply＜12.6V
	Slow flash	Low voltage：battery≤7.2V; external≤11V
	Fast flash	Power status hints: once or four times in one min
Signal lamp （green for status）	Off	No GSM/Wi-Fi connection
	Always on	GSM/Wi-Fi module is connected to the server successfully
	Slow flash	GSM/Wi-Fi module is connected to the Internet successfully
	Fast flash	GSM/Wi-Fi module is connecting to the Internet server

Signal lamp (red for status)	Slow flash	1. It is receiving or transmitting data (it only receives data for the rover while transmitting for the base) 2. It is collecting static data in static mode
	Off	Communication failure – there is no data output
Satellite LED (green)	Always on	More than 4 satellites are being tracked successfully
	Slow flash	It has lost satellites and is trying to retrack them
	Off	1. Motherboard error, resulting in no data output while resetting the receiver 2. Motherboard error, resulting in no data output while in static mode
Anomaly flash of 3 lamps		Reset the main board or a static collecting error (insufficient storage space)

2.4 Wi-Fi password setting

The V90 Plus receiver can be used as a Wi-Fi hotspot, which supports a user-defined password. (The factory default password is 12345678)

Note: 1. See the attached list 1 for the Wi-Fi factory default password.

2. If you forget your password, you can reset your password by using the "GNSS Receiver Manager V1.0.3". For details of how to operate it, see the Appendix.

Figure 2-4-1 Wi-Fi password setting

2.5 Static data collecting (by button operation)

The V90 Plus GNSS Receiver can collect static data. To operate it, see the instructions below.

1. Set up the receiver on a control point, making sure that you center and level it.

2. Measure the height of the receiver three times, making sure that the difference of each measurement is less than 3mm and the final height of the receiver is the average height. Below is the schematic.

Measurement Benchmark

Figure 2-5-1 Static data collecting

Note:

1. The instrument height should be measured from the control point to the upper part of the measurement benchmarker.

2. The height of the phase center is 0.1018 meters.

3. The radius of the measurement benchmark is 0.130 meters.

Below is the schematic.

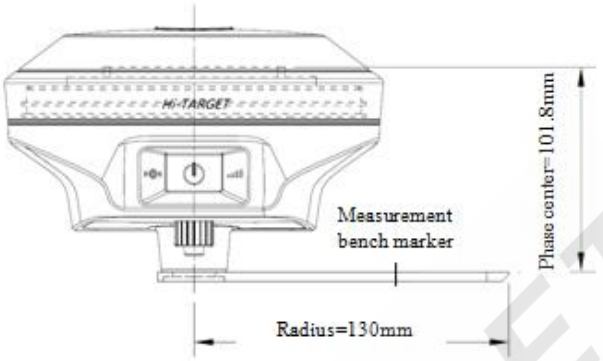


Figure 2-5-2 Benchmark

3. Record the point name, receiver S/N, receiver height and start time.

4. Press the power button to power-on the device and double-click the power button to set it to static collecting mode; then single-click the power button to confirm this.

Note: When the satellite lamp flashes, it means the receiver is searching the satellites. When the satellite lamp stays lit, it means the satellites are fixed. The status lamp flashes according to your set interval collection, which means that an epoch will be collected every flash.

5. Turn off the receiver once the static data has been collected and record the time you turned it off.

6. Download and post-process the static data.

Note: Don't move the tribrach or change the collecting set while the receiver is collecting data.

V90 Plus' default settings will not record Rinex format data. Users can change the relative settings by using the GNSS Receiver Manager software. Below is the GNSS Receiver Manager software interface.

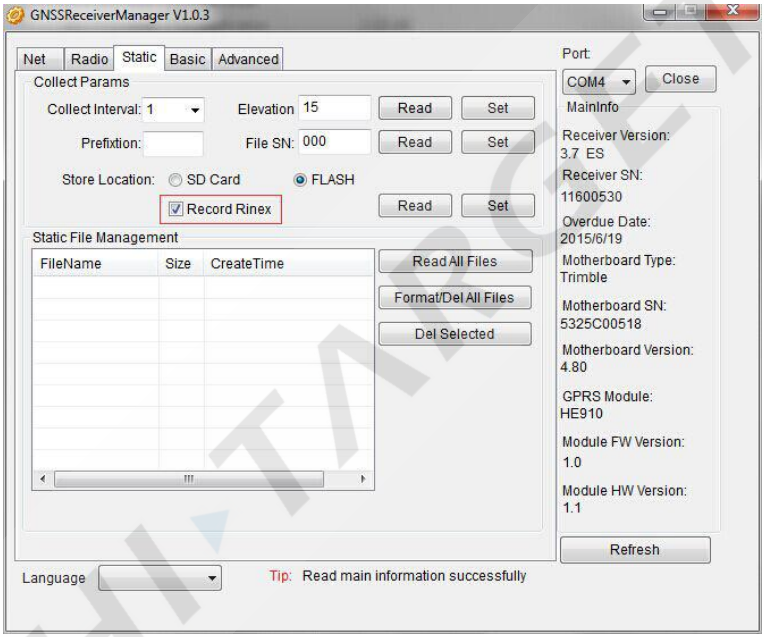


Figure 2-5-3 GNSS receiver manager

2.6 Web management system

V90 Plus has a built-in *WEB Management System* for both real-time controlling and free

configuration of the receiver. The device's Wi-Fi name is the S/N, and you can connect it with the controller or phone (without a password), and then input the IP address, which is 192.168.20.1, into the browser to log into the WEB management system.

2.6.1 Main menu

After logging into the WEB management system, you can click *Start* to enter the main menu interface. The main menu contains a drop-down menu for each option.

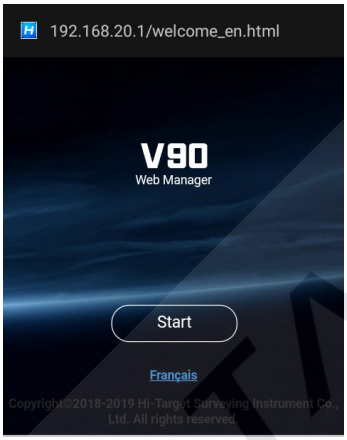


Figure 2-6-1 Welcome page

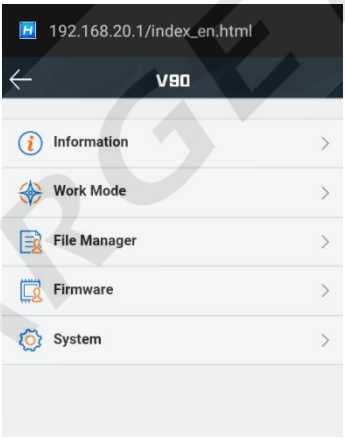


Figure 2-6-2 Main menu

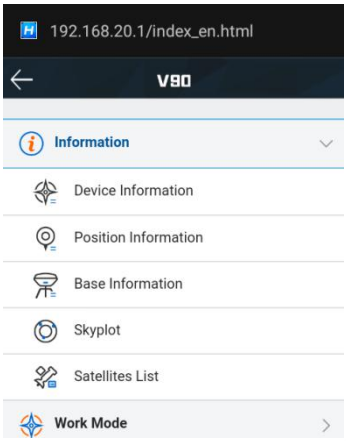


Figure 2-6-3 Information

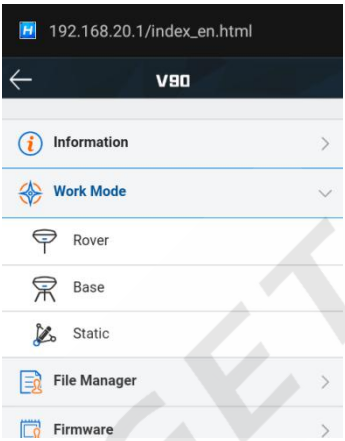


Figure 2-6-4 Work mode

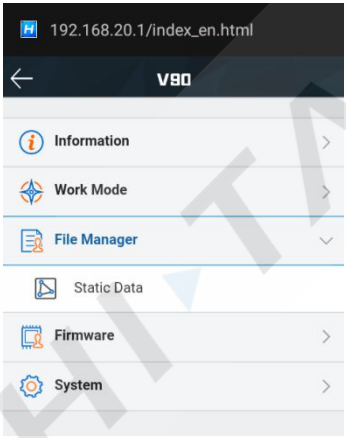


Figure 2-6-5 File manager

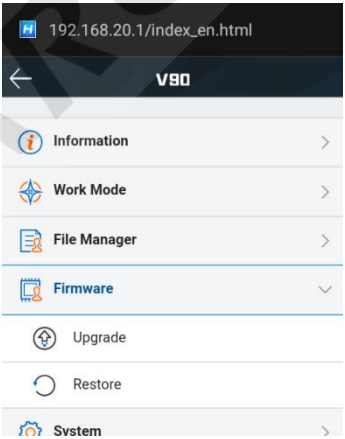


Figure 2-6-6 Firmware

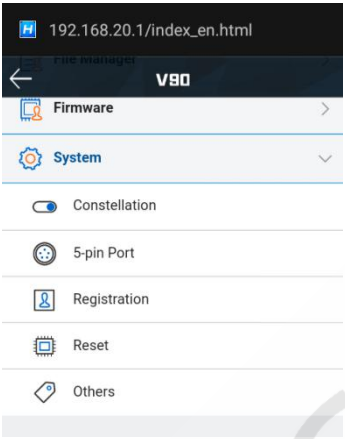


Figure 2-6-7 System

Table 2-6-1 Menu description

Main menu	Sub-menu	Description
Information	Device information	Device model, version, registration information, etc.
	Position information	Coordinates, satellite tracking, solution state, etc.
	Base information	Coordinates and distance to the base.
	Skyplot	Check the skyplot.
	Satellites list	Satellite tracking information.
Work mode	Rover	Data link and parameter settings of the rover.
	Base	Data link and parameter settings of the base.
	Static	Static measurement parameter settings.
File manager	Static data	Download, delete and format the static data.

Firmware	Upgrade	Select and upgrade the firmware.
	Restore	Restart the iRTK5 and update the OTA firmware.
System	Constellation	Switches for the satellite tracking.
	5-pin port	The output settings of the 5-pin port.
	Radio	Radio frequency settings.
	Registration	Device registration and information.
	Others	Switch for the static RINEX and voice changes.

2.6.2 Information view

1. Device information

Includes the main device information: device model, S/N, firmware version, battery power, work mode, configuration parameters, etc.

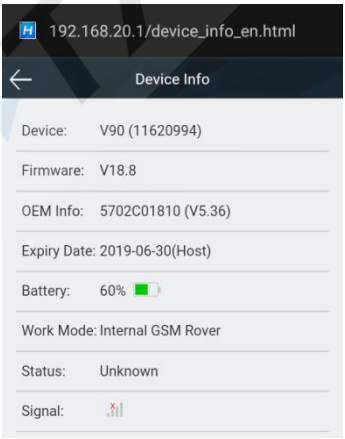


Figure 2-6-8 Device info

2. Position information

Includes the device position, satellites, solution state, local time, etc.

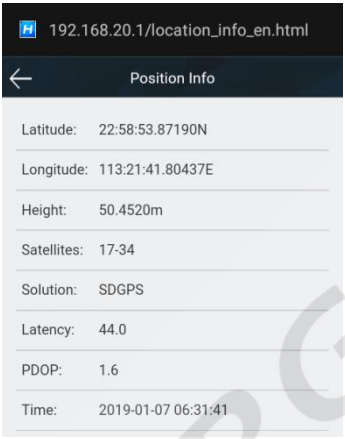


Figure 2-6-9 Position info

3. Base information

Includes the coordinates and distance of the base when it is in the rover mode.

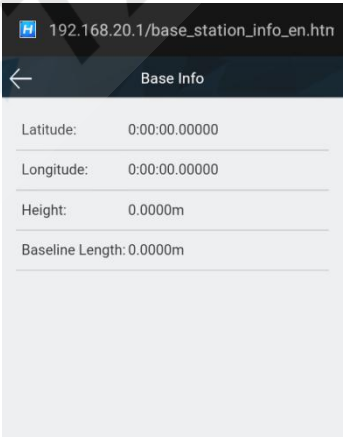


Figure 2-6-10 Base info

4. Skyplot

Includes the skyplot, which can switch to different constellations.

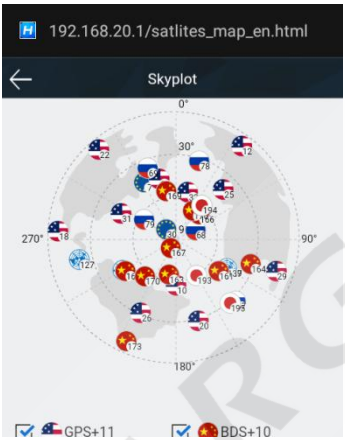
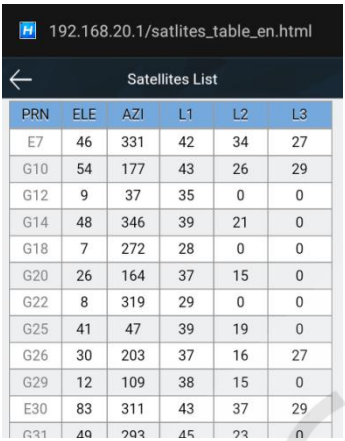


Figure 2-6-11 Skyplot

5. Satellites list

Shows information about the tracked satellites.



PRN	ELE	AZI	L1	L2	L3
E7	46	331	42	34	27
G10	54	177	43	26	29
G12	9	37	35	0	0
G14	48	346	39	21	0
G18	7	272	28	0	0
G20	26	164	37	15	0
G22	8	319	29	0	0
G25	41	47	39	19	0
G26	30	203	37	16	27
G29	12	109	38	15	0
E30	83	311	43	37	29
G31	49	293	45	23	0

Figure 2-6-12 Satellites list

2.6.3 Work mode

1. Rover

Set up the data link and the rover's parameters.

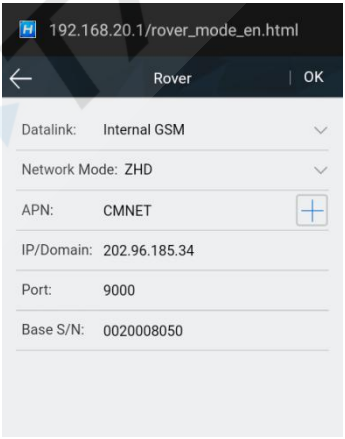


Figure 2-6-13 Rover

2. Base

Set up the data link and parameters of the base and then get the point coordinates by averaging.

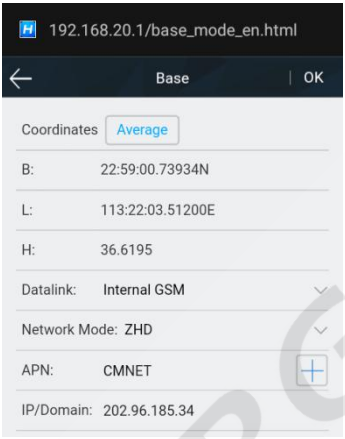


Figure 2-6-14 Base

3. Static

Set up the file name and the parameters of the static collection.

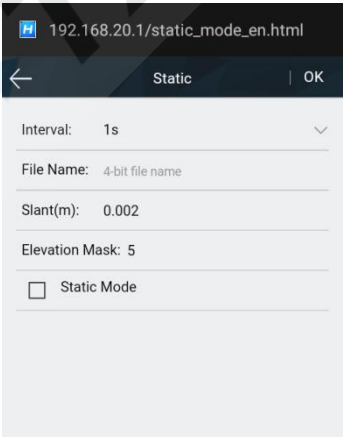


Figure 2-6-15 Static

2.6.4 File management

Static data: to show the static data files - it supports both the *Download* and *Delete* options.

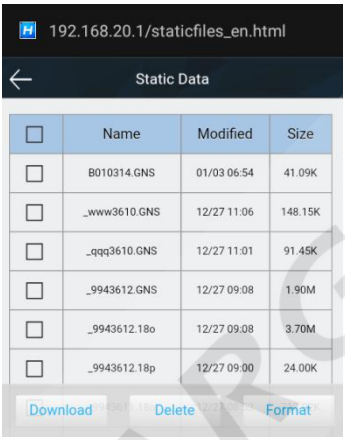


Figure 2-6-16 Static data

2.6.5 Firmware management

1. Upgrade

Includes the specific device version information, and supports the firmware upgrade function.

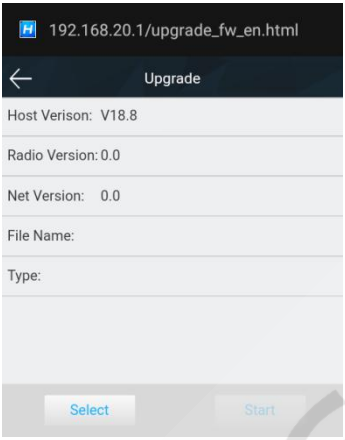


Figure 2-6-17 Upgrade

2. Restore

Restart the iRTK5 and start the OTA firmware update.

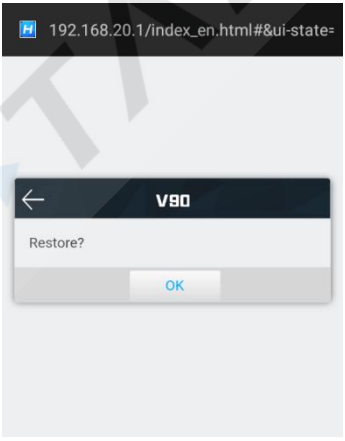


Figure 2-6-18 Restore

2.6.6 System settings

1. Constellation

Switches of the satellite tracking.

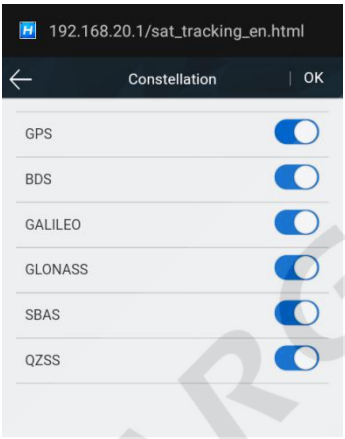


Figure 2-6-19 Constellation

2. 5 - Pin port

Message type switches and output frequency adjustments.

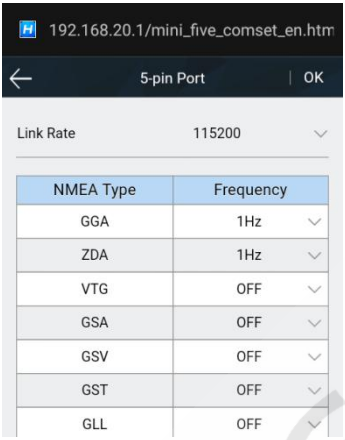


Figure 2-6-20 5-Pin port

3. Registration

Includes the registration information, serial number, etc. Provides online registration.

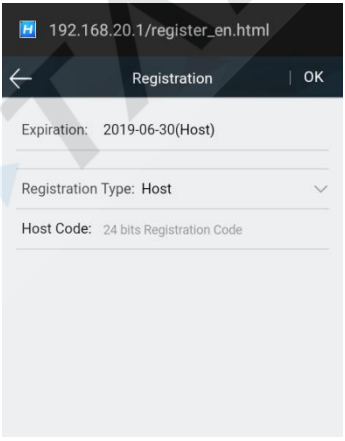


Figure 2-6-21 Registration

4. Others

Static RINEX switch and adjust the volume of the device.

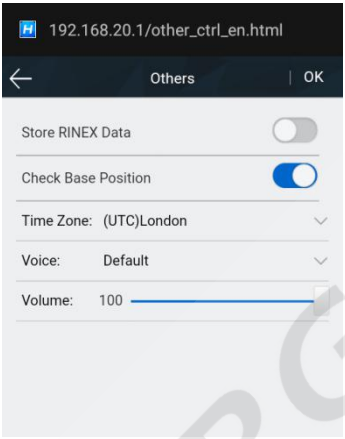


Figure 2-6-22 Others

2.7 Firmware update

The receiver uses a 3G network, and the host firmware can be automatically upgraded through the network (please refer to the Hi-Survey Road software guide). The user can also choose to do a manual upgrade by using the U-Disk.

The two steps to upgrading the firmware by using the USB cable are：

1. Turn on the receiver and connect it to the computer with the cable attached. It will show the update drive when you click on the computer.

2. Copy the firmware (you can download it from our official website or get it from the technical team) to the update drive. Then disconnect the computer and receiver, and restart the receiver.

Figure 2-7-1 Update drive

CHAPTER 3

Hi-Survey Road Software Quick Start

This Section Describes:

- Create a project
- Set the base
- Set the rover
- Parameter calculation
- Detail survey
- Stake out
- Data transfer
- Connect the controller to download data

This section provides a Quick Start guide to operating of the V90 Plus with Hi-Survey Road.

3.1 Create a project

1. Open the Hi-Survey software, the software main interface is as follows:

Figure 3-1-1 Main interface

2. Create a new project, click *Project→Project Info* to enter the project name and click *OK*.

Figure 3-1-2 Project info

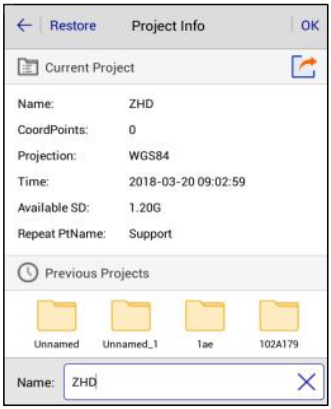


Figure 3-1-3 New project

3. Project Settings: select the projection, set the source ellipsoid and projection parameters.

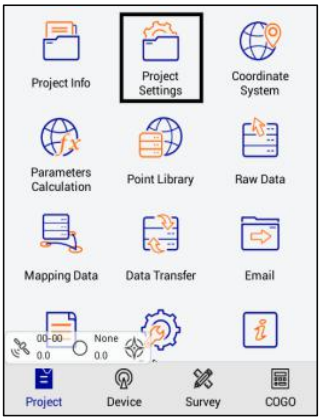


Figure 3-1-4 Project settings

Figure 3-1-5 Coordinate system

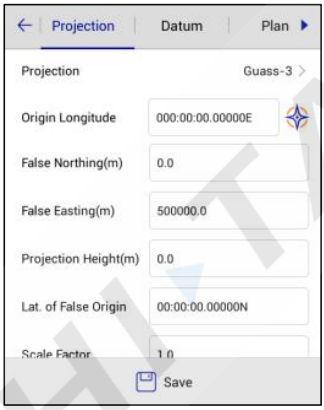


Figure 3-1-6 Projection

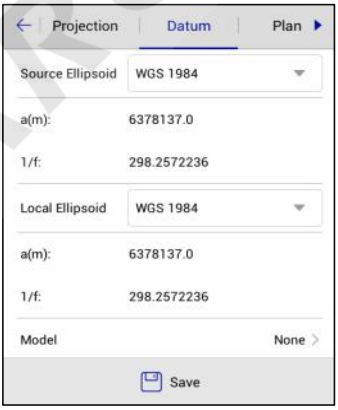


Figure 3-1-7 Datum

3.2 Set the base

Connect the device, click *Device→Device Connection→Connect* to select the base station number for Bluetooth pair connection.

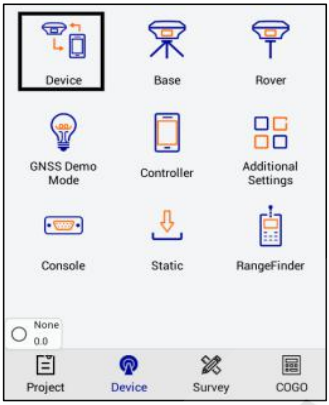


Figure 3-2-1 Device

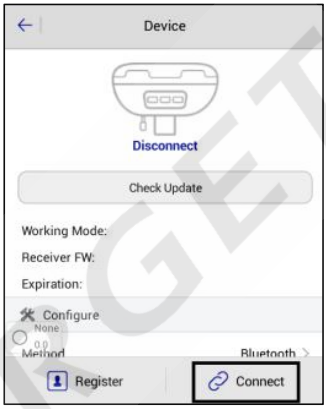


Figure 3-2-2 Connect

Figure 3-2-3 Device number

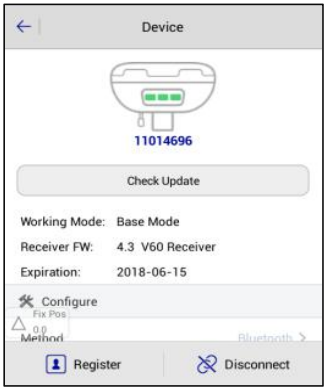


Figure 3-2-4 Disconnect

Set the base station and receiver position, then set the *Datalink* and *Other*.

1. Select antenna type to enter the height and type.

2. Set the base location. If the base station is located at a known point and know the conversion parameters, you may not select the smooth, direct input or select the point of the WGS-84 BLH coordinates from point library, or open the conversion parameters in advance, enter the local NEZ coordinates, so that the base station puts the point of the WGS-84 BLH coordinates as a reference and does the transmission of differential data. If the base station is set as unknown, click *Average* , and click *OK* after smoothing to complete the coordinates of the base station.

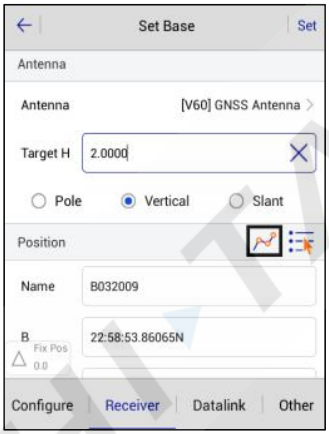


Figure 3-2-5 Set base

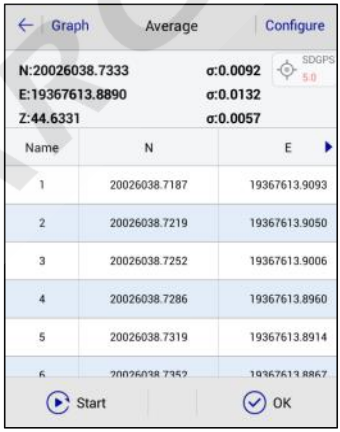


Figure 3-2-6 Average

3. Click *Data Link*, select the data link type and enter the relevant parameters.

(eg: when you use the Hi-Target server data to transfer operation, you need to set the parameters and select the built-in network; where the packet number and group number can be changed, the packet number is seven digits, the group number is three digits less than 255. When you use the

radio station to work, you should select the *Internal UHF* as the data link, and then select the radio channel).

Radio mode is the traditional data link mode, and the built-in radio mode is taken as an example, to illustrate the introduction of radio station mode using simple steps.

- *Internal UHF*: built-in radio

- *Channel*: 0 ~ 115 any number, but the mobile station settings should be consistent with the base station.

- *Airborne baud rate*: 9600/19200 optional, the choice of mobile stations should be consistent with the base station

- *Power:* High / Middle/ Low

Figure 3-2-7 Data link

4. Click *Other*, select the differential mode, the text format, click *Set* and it will promptly set up successfully. The parameters of the base station must be consistent with the rover station settings.

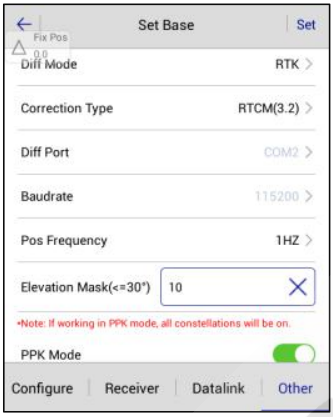


Figure 3-2-8 Others

5. Check whether the host differential light is flashing once every second (2/sec in power-saving mode). When using the external radio station, the radio will flash once every second, if it is normal, it will prompt *Base station is ready, do you want to set Rover now?*

After the parameter is set, click *Set* and the host will have a voice prompt, the host light will flash twice every second, indicating that the base station is set up successfully and sending the differential data.

Wait until the green light flashes once every second (2/sec in power-saving mode) and the radio red light flashes once every second, indicating that the base station is successfully operating, and is transmitting the signal. If the signal does not blink, you can restart the receiver host and re-operate once again.

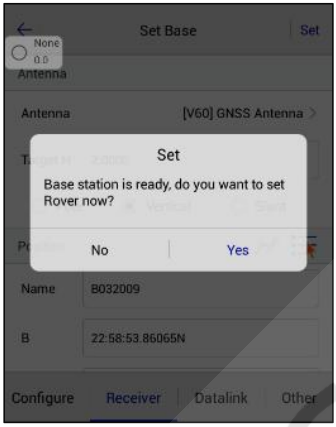


Figure 3-2-9 Set prompt

3.3 Set the rover

Connect to the rover by Bluetooth, and confirm that the rover data link and other parameters are consistent with the base station. The setting of the rover station is the same as that of the base station. The data link parameters of the rover station must be the same as the base station, to receive differential data. Then click *Set* and the host will do a voice prompt. Wait until it shows *Fix Pos*, and then start the measurement.

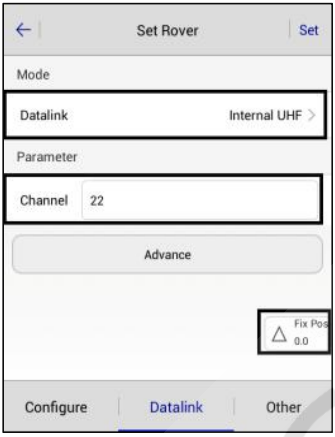


Figure 3-3-1 Set rover

3.4 Parameter calculation

First set the control point library in *Point Library→ Control Point* to add control points, enter the name and the corresponding coordinates by manual input, real-time collecting, point library or map selection, and then click *OK*.

Figure 3-4-1 Point library

Figure 3-4-2 Control point

Figure 3-4-3 Edit point

Click *Parameter Calculation*, select *Plane + Height Fitting* type and *Constant Vertical Offset* in *Height* (the *Height* can be selected as *Plane Fitting* when there are three points above), and then add point pairs, select the point as the source point, enter the corresponding control point coordinate in the target point, then click *Save*.

Figure 3-4-4 Parameters calculation

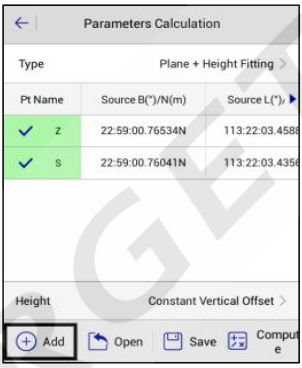


Figure 3-4-5 Add point

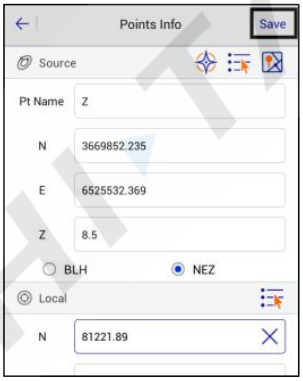


Figure 3-4-6 Save point

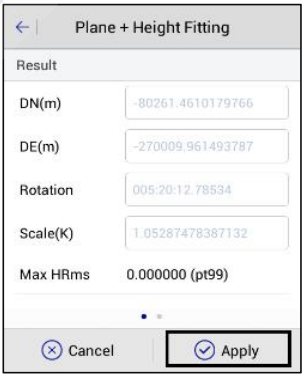


Figure 3-4-7 Result

After adding more than two points, click *Calculate*, it will show the calculated *Plane + Height Fitting* results, mainly to see the rotation and scale. The result of the plane translation is

generally smaller in the north and east, the rotation is about zero, the scale is between 0.9999 and 1.0000 (in general, the closer to 1, the better the scale is), the smaller the plane and elevation residual is, the better the result . Click *Apply* and the software will automatically use the new parameters to update the coordinate point library.

3.5 Detail survey

In the *Detail Survey* interface, start the acquisition coordinates work when the display can be fixed. After the rover station on the unknown point is OK, you can press the acquisition key and enter the *Name*, *Target H* and *Target-H type*. Then press *OK* to record the point.

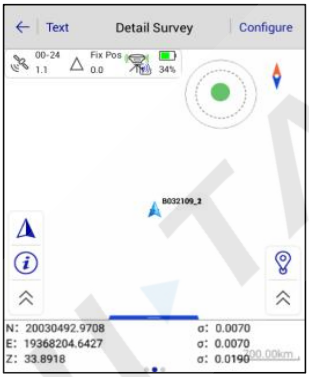


Figure 3-5-1 Detail survey

Figure 3-5-2 Save point

3.6 Stake out

Click *Stake Points* to enter the point staking-out interface and click the button to select the staked-out point, then, according to the direction and distance, tips to find the staked-out points.

There is a process to make the current point (triangle mark) close to the target point (round plus cross sign). When the staking-out circle turns red, it is finished and meets the precision parameters.

In the process of staking-out, you can also collect detail points, by the *Store* on the interface or store keying on the hand-held.

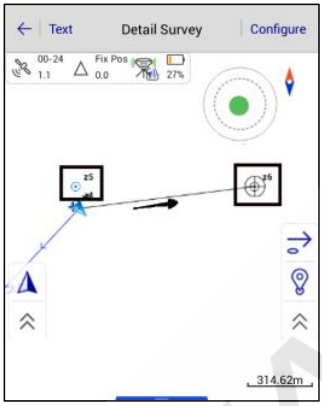


Figure 3-6-1 Staking point

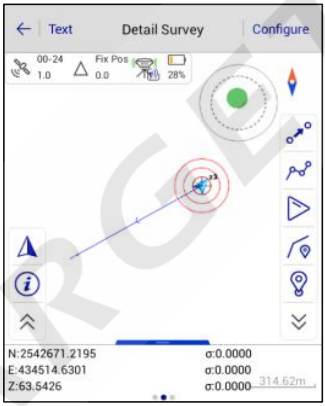


Figure 3-6-2 Stake success

3.7 Data transfer

In the *Data Transfer* interface, select *Raw Data*, and select the exchange type for export, select the corresponding format export or *User-defined* export, input the file name, select the file save the path, and then click *OK* to export data. If it's *User-defined* export, after clicking *OK*, you can enter the custom format settings to select export content, then click *OK* to export the data.

Figure 3-7-1 Data Transfer

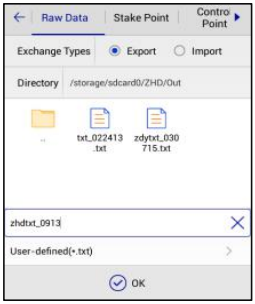


Figure 3-7-2 Export

Figure 3-7-3 Custom Format

3.8 Connect the controller to download data

Connect the hand-held to the computer with the USB data cable. Click *USB Storage* in the following dialogue box, then click *OK* in the dialog box when that appears.

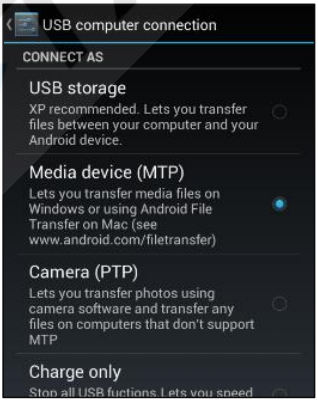


Figure 3-8-1 Transfer by USB

Find the path to export the data file on the hand-held (default: *ZHD\Out*), copy it to the computer, and then the RTK measure is finished.

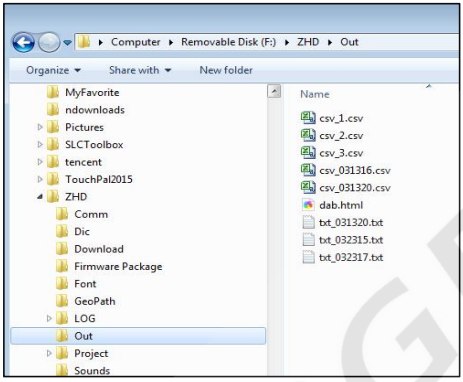


Figure 3-8-2 Exported data

CHAPTER

4

Technical Specification

This Section Describes:

- Technical Parameters

Table 4-1-1 Technical Parameters

Configuration		Detailed indicators
GNSS Configuration	Satellite signals	Channels:220
		BeiDou: B1, B2
		GPS: L1C/A, L2C, L2E, L5
		GLONASS: L1C/A, L1P, L2C/A (GLONASS M only), L2P
		GALILEO: L1 BOC, E5A, E5B, E5AltBOC[1]
		SBAS: L1 C/A, L5 (EGNOS,WAAS,MSAS,GAGAN,QZSS)
		QZSS: L1 C/A, L1 SAIF, L2C, L5
System Configuration	Data storage	16GB Internal storage+ Internal Micro SD Card memory (Support up to 32GB extension); records GNS and RINEX formats simultaneously
	Data Formats	(1Hz positioning output, up to 50Hz - depends on installed option) CMR: sCMRx, CMR, CMR+input and output RTCM: RTCM 2.1, 2.2, 2.3, 3.0, 3.1, 3.2 input and output Navigation outputs ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GGK, GGA, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS Navigation outputs binary: GSOF
Accuracy and Reliability[2]	High-precision static	Horizontal: 2.5mm + 0.1ppm RMS
		Vertical: 3.5mm + 0.4ppm RMS

	Static and fast static	Horizontal: 2.5mm + 0.5ppm RMS
		Vertical: 5mm + 0.5ppm RMS
	Post processing kinematic (PPK/ Stop & Go)	Horizontal: 8mm + 1ppm RMS
		Vertical: 15mm + 1ppm RMS
		Initialization time: Typically 10 minutes for base while 5 minutes for rover; Initialization reliability: Typically > 99.9%
	RTK(Single baseline)	Horizontal: 8mm + 1ppm RMS
		Vertical: 15mm + 1ppm RMS
	Network RTK (VRS, FKP, MAC)	Horizontal: 8mm + 0.5ppm RMS
		Vertical: 15mm + 0.5ppm RMS
		Initialization time: Typically 2-10s Initialization reliability: Typically > 99.9%
	Code differential GNSS positioning	Horizontal: 25cm + 1ppm RMS
		Vertical: 50cm + 1ppm RMS
		SBAS[3]: 0.5m(H), 0.85m(V)
I/O Interface	Bluetooth, NFC,standard USB2.0port ,TNC antenna connector, RS232 serial port,DC power input (5-pin), MicroSD card port	
Communication	Cellular mobile	WCDMA, compatible with GPRS, GSM
	WiFi	2.4G, supports the standard protocol 802.11b/g/n
	HI-TARGET internal UHF radio	Frequency: 457-467 MHz with 116 channels
		Transmitting power: 0.5W, 1W, 2W adjustable
		Transmitting speed: 9.6Kbps, 19.2Kbps
		Working range: 3-5km typically, 8~10km optimal
	SATEL internal UHF radio (optional)	Frequency: 403~473MHz
		Transmitting power: 0.1W ~1W adjustable

		Transmitting speed: 9.6Kbps, 19.2Kbps
		Support most of radio communication protocol
		Working range: 3~5km typically, 8~10km optimal
	HI-TARGET external UHF radio	Frequency: 460MHz with 116 channels
		Transmitting power: 5W, 10W, 20W, 30W adjustable
		Transmitting speed: Up to 19.2Kbps
		Working range: 8~10km typically, 15~20km optimal
	Advanced external UHF radio (optional)	Frequency: 410~470MHz
		Transmitting power: 5W/25W
		Compatible with third party radio
		Working range: 8~10km typically, 15~20km optimal
Sensor	Electronic bubble	Intelligent levelling
	Tilt survey	Tilt correction system will continue to monitor the inclination of the centering rod, and compensate to correct the coordinates
Physical	Internal battery	Rechargeable, removable 7.4V, 5000mAh Lithium-ion battery Static more than 12 hours; RTK Rover (UHF/GPRS/3G) 10 hours RTK base more than 8 hours
	External power	Power 6V to 28V DC external power input
	Dimensions	153mm x 83mm (6.02inch x 3.27inch)
	Weight	950g (2.09lb) without internal battery

	Power consumption	≤ 3.5W
Environment	Water/dustproof	IP67
	Free fall	Designed to survive a 2m natural fall onto concrete
	Humidity	100%, condensing
	Operation temperature	-40℃~+75℃ (-40℉~+167℉)
	Storage temperature	-50℃~+85℃ (-58℉~+185℉)

Note:

1 Developed under a License of the European Union and the European Space Agency.

2 Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The speci cations stated recommend the use of stable mounts in an open sky view, EMI and multipath clean environment, optimal GNSS constellation con gurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation times appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static speci cation.

3 GPS only and depends on SBAS system performance. FAA WAAS accuracy speci cations are <5 m 3DRMS.