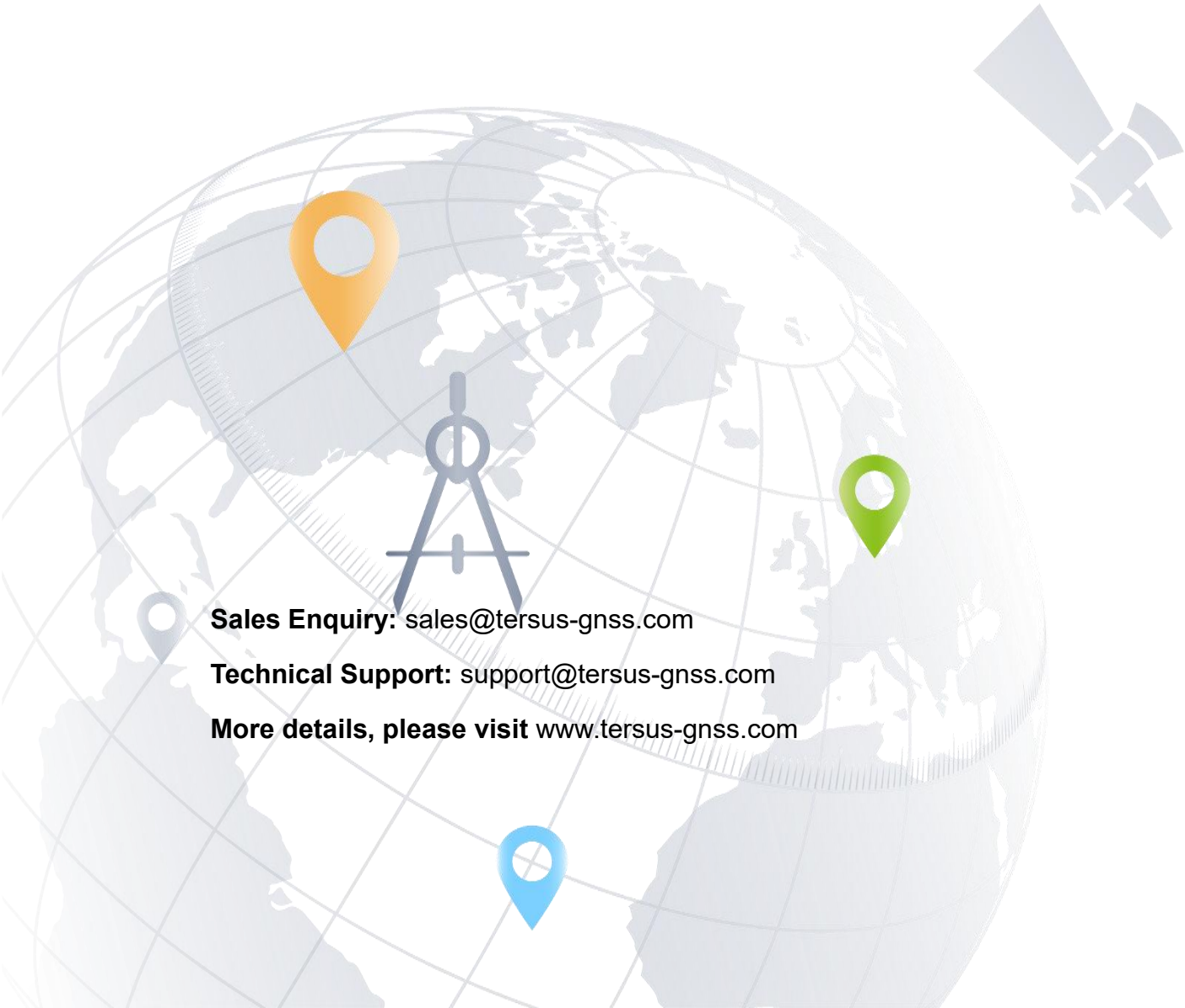
Oscar Trek GNSS Receiver

User Manual



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Revision History

Version	Revision Date	Change Summary
1.0	20241106	Initial Release
1.1	20251211	Updated Documentation

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may file a lawsuit in the court where Tersus GNSS is located.

Notices

Restriction of User of Certain Hazardous Substances (RoHS)

Tersus GNSS Inc. declares that Oscar Trek GNSS receiver is in compliance with the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) RoHS Directive 2011/65/EU and its Amendment Directives (EU) 2015/863.

Waste Electrical and Electronic Equipment (WEEE)

This product must not be disposed with household waste.

Dispose of the product appropriately in accordance with the national regulations in force in your country.

Always prevent access to the product by unauthorised personnel.

Product-specific treatment and waste management information can be received from your local Tersus distributor.

Safety Information

Make sure that you have read and understood all safety requirements before you start using Tersus product.

Conventions

The following conventions are used in this manual:

!	Information that supplements or clarifies text.

⚠	A caution that actions, operation or configuration may lead to incorrect or improper use of the hardware.

⚠	A warning that actions, operation or configuration may result in regulatory noncompliance, safety issues or equipment damage.

The following notices apply to all three versions of Oscar Trek GNSS receivers.

⚠	Operating or storing the receiver outside the specified temperature range can damage it.

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

⚠	DO NOT use the receiver in a thunderstorm as there is increasing risk of being stuck by lightning.

⚠	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.

⚠	Safety: exposure to radio frequency (RF) Exposure to RF energy is an important safety consideration. Although our product is compliance with the safety standard released by various standard organizations, the following precautions are recommended to ensure low exposure to radio frequency radiation. ● DO NOT operate the transmitter when someone is within the following distances of the antenna: ➢ Bluetooth, Wi-Fi, GSM/UTMS – less than 20cm ➢ 410-470MHz UHF radio – less than 47cm ● DO NOT operate the transmitter unless all RF connectors are secured and any open connectors are properly terminated. ● DO NOT operate the equipment near electrical blasting caps or in an explosive atmosphere. ● All equipment must be properly grounded. ● All equipment should be serviced only by a qualified technician.

Related Documentation

Table 0.1 Document and software used in this user manual

Name	Description	Link
Tersus Tool Suite	Tersus Tools including TersusDownload, TersusGeoPix, TersusGNSSCenter, TersusUpdate, TersusRinexConverter	https://www.tersus-gnss.com/software
Nuwa	Survey application running in the Android platform, David, Oscar Trek and other NMEA devices can be configured with Nuwa.	https://www.tersus-gnss.com/software/Oscar Trek-gnss-receiver
Tersus Geomatics Office	Post processing tool for static data.	https://www.tersus-gnss.com/software/david-receiver

Support

If there is any problem and the information needed cannot be found in the product documentation, log a technical support ticket in our tracking system https://tersus.supportsystem.com/ , or mail to support@tersus-gnss.com.

Table of Content

1. Introduction

This chapter includes overview, receiver features, and devices in the package.

1.1 Overview

The Oscar Trek GNSS receiver is a new generation GNSS RTK system. It supports calibration-free tilt compensation function which is immune to magnetic disturbances, leveling pole is not required. Easy configuration with 1.54 inch interactive screen. With an internal high-performance multi-constellation and multi-frequency GNSS board, the Oscar Trek GNSS receiver can provide high accuracy and stable signal detection. The high-performance antenna can speed up the time to first fix (TTFF) and improve anti-jamming performance. The built-in large capacity battery is detachable, two batteries support up to 14 hours of field work in 4G/3G/2G network and Rover radio mode. The built-in UHF radio module supports long distance communication. The rugged housing protects the equipment from harsh environments.

1.2 Receiver features

The Oscar Trek GNSS receiver has following features:

- Supports multiple constellations & frequencies
  - GPS L1C/A, L1C, L2C, L2P, L5C
  - GLONASS L1OF, L2OF, L3OC
  - BeiDou B1I, B2I, B3I, B1C, B2a, B2b
  - Galileo E1, E5a, E5b, E5AltBoc, E6
  - QZSS L1C/A, L1C, L2C, L5C
  - SBAS L1C/A, L5

- L-Band

- Supports 1792 channels.
- Supports 410-470MHz UHF radio, 4G network, Wi-Fi , Bluetooth, NFC.
- Tilt compensation without calibration, immune to magnetic disturbances .
- 16GB/8GB internal storage
- Up to 14 hours(1) working in 4G/3G/2G network and Rover radio mode
- IP68-rated dust- & waterproof enclosure, for reliability in harsh environmental conditions
- Free subscription of Tersus Caster Service (TCS): transmit the correction data from Base to Rover

Note:

(1) One battery lasts up to 7 hours when Oscar Trek works in 4G/3G/2G network and Rover radio mode. Two batteries add up to total 14 hours use.

1.3 Devices in the package

The devices in the package may vary according to the customer requirement. Here describes the major parts in the package.

1.3.1 Oscar Trek GNSS receiver

The Oscar Trek GNSS receiver has three versions which are shown as below.

Figure 1.1 Oscar Trek GNSS receiver

Buttons

Two buttons are equipped on Oscar Trek GNSS receiver.

[]: Power ON/OFF button. When the device is off, long press it for 2 seconds to power on the receiver. When the receiver is on, long press it for over 3 seconds to power off the receiver.

[]: Function (FN) button. This button has different functions which is listed in the table below.

Table 1.1 Usage of FN button

FN button	Trek
Selecting / Switching	On the Device Config page, press it once to lead the cursor jump to the next row or next page or previous page. When the cursor stops at an item, pressing the power button enters the sub menu of this item for function selecting or return.
Wake up	Tap the power button or FN button to wake up the OLED screen when the OLED screen is off.

Combination Function of the two buttons

Press and hold the FN button, continuously tap the ON/OFF button 5 times to reset the GNSS module and make it re-search the satellites. Detailed LED flash status related to this operation refers to the LED flash patterns table.

LED Indicators

Four LED indicators and **one** OLED display screen are for Oscar Trek GNSS receiver. The LEDs on the front panel indicate various operating conditions. The detailed LED Descriptions are shown in the tables below.

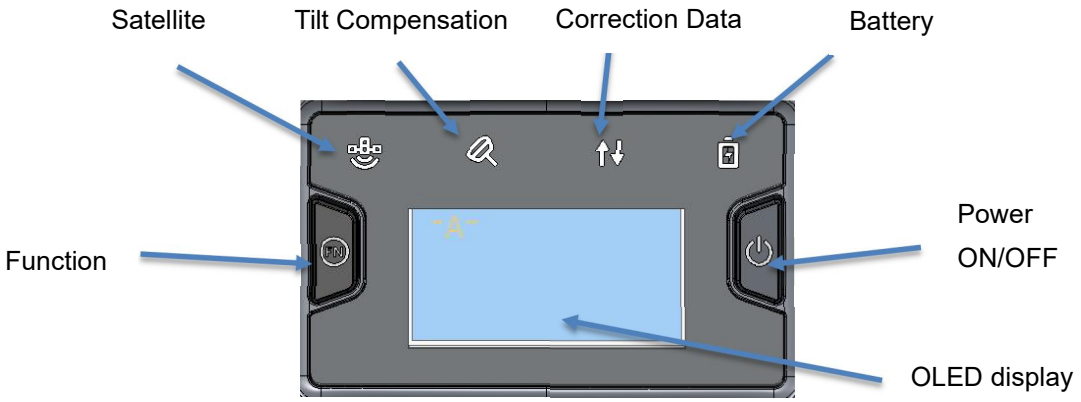


Figure 1.2 Buttons and display on Oscar Trek

Table 1.2 LED indicators

LED indicator	Description
Satellite	Green LED. Flashing every 5 seconds indicates that it is searching satellites. After satellites are searched, it flashes N times every 5 seconds, in which N indicates N satellites are found.
Tilt compensation	Green & Red LED. When tilt compensation is turned on, it is steady red; when it is preparing for tilt compensation, it flashes red; when tilt compensation is valid, the LED is steady green.
Correction data	Green and Red LED. Green indicates correction data, and red indicates solution status.
Battery	Green LED. Steady green in normal operation. Slow flash indicates the battery level is between 30% and 10%. Fast flash indicates the battery level is below 10% and reminds users to change battery.

LED Flash Patterns

The possible flash patterns of various states of receiver operation are listed in the table below.

Table 1.3 Possible LED flash patterns

Receiver mode	Button operation	LED flash patterns
Receiver OFF	N/A	All LEDs are off.
Receiver ON	Long press the power button for 2s	All LEDs are on, then all off, and each LED starts to indicate current status after initialization.

Low power	N/A	Battery LED flashes slow.
Battery exhausting	N/A	Battery LED flashes fast.
Searching satellites	N/A	Satellite LED flashes every 5s
Satellites tracked	N/A	Satellite LED flashes N times every 5s, in which N is the quantity of satellites tracked.
Receiving valid data packet	N/A	Correction data LED flashes green at 1Hz
Fixed solution	N/A	Correction data LED is steady red. If the correction data received at the same time, it will appear orange when the two overlap.
Floating solution	N/A	Correction data LED flashes red at 1Hz. If the correction data received at the same time, it will appear flashing red and flashing green, sometimes it may appear flashing orange when the two overlap.
Reset GNSS module	Press and hold the FN button, continuously tap the ON/OFF button 5 times	All LEDs light up for 5 seconds.

Receiver Ports

The bottom of Oscar Trek receiver is shown as below.

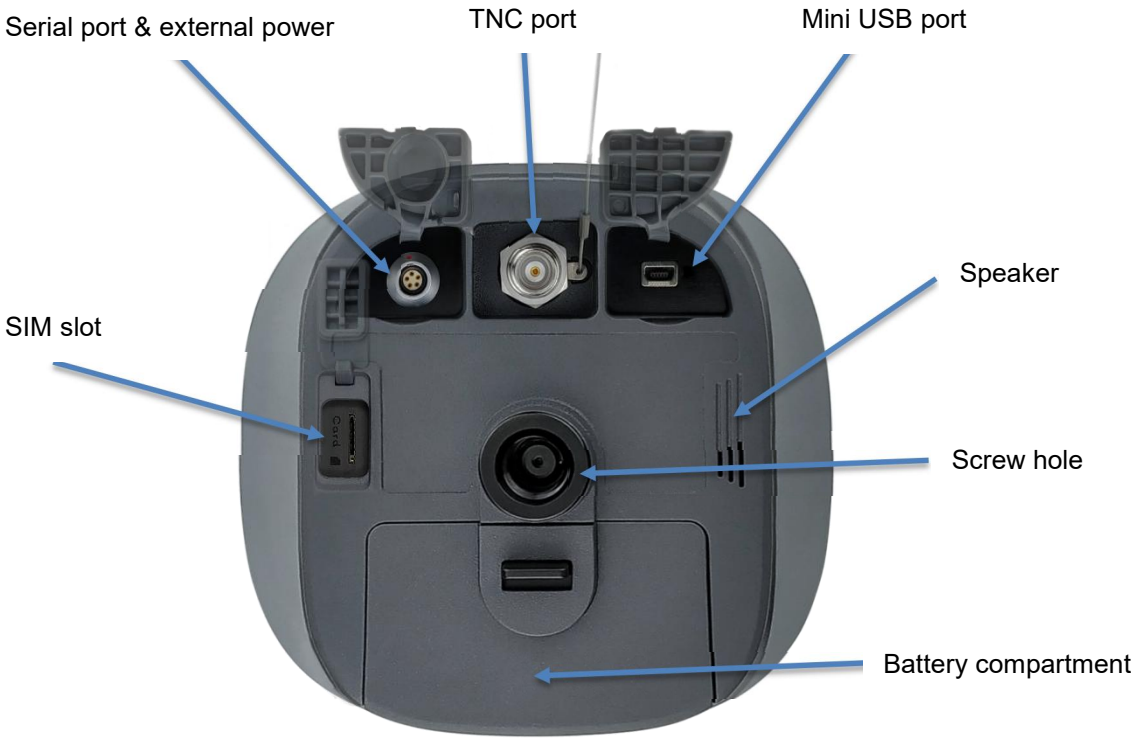
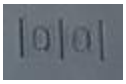


Figure 1.3 Bottom of Oscar Trek GNSS receiver

Table 1.4 Receiver ports on the bottom side

Icon	Connector	Name	Connections
		Serial port & external power	External power, RS-232 communication, external radio
		Mini USB port	Device, computer, USB drive
SIM		SIM slot	Nano SIM card
-		TNC port	410-470MHz radio antenna
-		Screw hole	5/8’’ x 11 UNC-2B connector for corresponding connector and pole.

1.3.2 Battery and charger

Oscar Trek equips smart lithium batteries which can detect electricity and display the power level intelligently. The Oscar Trek GNSS receiver can also be powered by external power source via serial data port. The built-in large capacity battery is detachable, two batteries support up to 14 hours of field work in 4G/3G/2G mode and rover radio mode.

The BN20 battery is shown as below. Press the button on the top, it shows the power level left to be consumed.

Figure 1.4 BN20 Battery

The CN20 Charger is able to charge two BN20 batteries at the same time which is shown in the figures below.

Figure 1.5 CN20 Charger

Place two BN20 batteries in the slots of CN20 charger.

Figure 1.6 CN20 Charger with two BN20 batteries

Insert the DC Jack connector of the adapter to the CN20 charger, then make the adapter with cable plug in the local AC outlet (100~240V AC) to start charging.

Figure 1.7 CN20 Charger Adapter

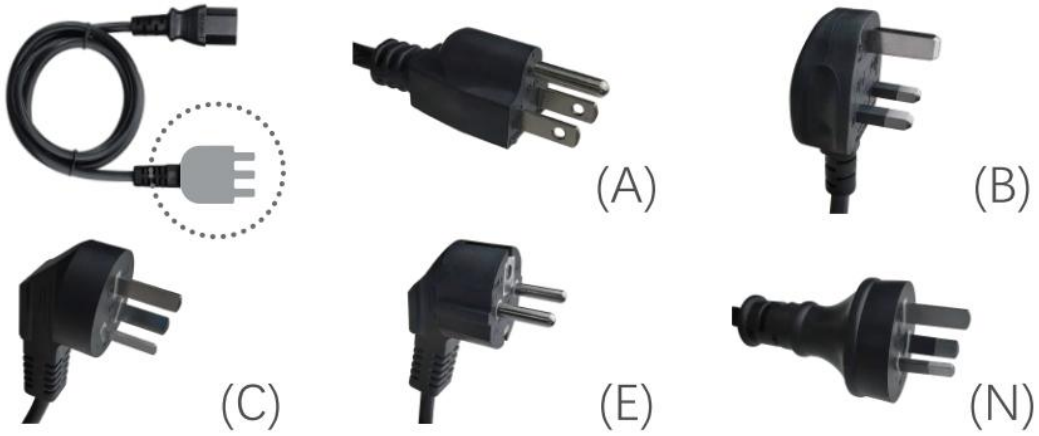


Figure 1.8 CN20 Charger Adapter Cable (A/B/C/E/N)

Note: The model of the CN20 charger adapter cable will be delivered according to customer requirements.

A: American, B: British, C: Chinese, E: European, N: Australian

Charge the battery completely before using it for the first time. The charging takes approximately 3 hours per battery at room temperature. If the battery has been stored for longer than three months, charge it before use.

1.3.3 TC80 controller

The Tersus TC80 Controller is a rugged multi-functional data controller with design of 5.5 inch sunlight readable HD touch screen and an alphanumerical keypad. Equipped with powerful processor and android operating system, it is perfect to adapt with Tersus survey software. With professional IP68 rating, it is robust and reliable for harsh operating conditions. The large capacity lithium battery guarantees more than 10 hours of field working for a whole day of multiple surveying tasks.

Features:

- 5.5 inch sunlight readable HD touch screen

- Octa-core 2.0GHz CPU
- Android 12 operating system
- 6GB RAM + 64GB ROM
- 5MP front camera and 13MP rear camera
- IP67 certified grade, water/shock/dust proof
- 7700mAh battery
- Wi-Fi, Bluetooth, NFC, 4G
- USB Type-C

Note: Although the TC80 controller uses chemical and impact resistant materials, precision instruments require careful use and maintenance and should be kept as dry as possible. In order to improve the stability and life cycle of the TC80 controller, avoid exposing the TC80 controller to extreme environments such as moisture, high temperatures, low temperatures, corrosive liquids or gases.

⚠	TC80 must be in the specified temperature range -20 °C ~ 55 °C when used and stored.

Power on: Press and hold the power button for 3 seconds

Power off: Press and hold the power button for 3 seconds, select ‘Power Off’ in the menu option.

Reboot: Press and hold the power button for 2 seconds and click "Restart" in the menu option.

Forced restart: Press and hold the power button for 8 seconds to force the controller to restart.

Introduction of functional keys：

- **Menu Key:** Select to show applications that was used recently.
- **Home Key:** Return to home screen. To view recent application, press and hold the home key.
- **Back Key:** Return to previous screen.
- **APP Key:** Quick start Nuwa application.
- **Positioning Key:** Perform the function of starting measurement in the Survey and Stakeout interface of Nuwa application.
- **Short Press on Power Key：** Control the screen on and off.

Enter Key: Execute the function of confirming in Nuwa application.

The accessories of TC80 Controller are listed below.

TC80 Lithium Battery (3.8V/7700mAh)

TC80 Charger (5V/1.67A, 7V/1.67A, 9V/1.67A)

Type-C Cable

Functions:

1. Connect to the USB port of computer for data downloading;

2. Connect to the charger to charge TC80 controller.

1.3.4 Other accessories

Other accessories may be packed according to customer requirements.

The 410-470MHz radio whip antenna is to be installed on the TNC port to transmit or receive signal for the internal radio.

Figure 1.9 410-470MHz radio whip antenna

Figure 1.10 Mini USB cable

Mini USB cable functions:

1. Connect Oscar Trek to the USB port of computer for data downloading;

When upgrading firmware with a wire, you need a Mini-USB OTG cable. The detailed usage refers to section 2.4.1.

Figure 1.11 Mini-USB OTG cable

When using Oscar Trek as a rover, you need a ranging pole.

Figure 1.12 Ranging Pole

The bracket for TC80 controller is to fix the TC80 controller on a ranging pole.

Figure 1.13 Bracket for TC80

A yellow carrying case is to store all the devices and accessories except ranging pole, high gain radio antenna and telescopic pole.

Figure 1.14 Carrying Case

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

Figure 1.15 Tool bag

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 Oscar Trek using external power source instead of the BN20 battery.

Figure 1.16 Serial-5pin to DC JACK & DB9 male cable

Figure 1.17 DC JACK male with two wires

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

Figure 1.18 DB9 Female to USB Type A Male converter cable

2. General Operations

This chapter includes setting up, configuration and other related operations.

2.1 Setting up Oscar Trek

2.1.1 Insert the battery

Open the battery cover, notice the metal contact on the bottom, put one battery align the metal contact position, and make sure the button end is close to the battery compartment.

Figure 2.1 Open the battery cover

Push the battery in the direction of the arrow on the top, the battery is properly installed after a ‘click’, then close the cover and lock it.

Figure 2.2 Put one battery in Oscar Trek

More details about batteries refer to section 1.3.2 Battery and Charger.

⚠	DO NOT damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage. To prevent injury or damage: – 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. – DO NOT expose the battery to fire, high temperature, or direct sunlight. – DO NOT immerse the battery in water. – DO NOT use or store the battery inside a vehicle in hot weather. – DO NOT drop or puncture the battery. – DO NOT open the battery or short-circuit its contacts.
⚠	DO NOT contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage.

⚠	Discharge a Lithium-ion battery before disposing of it. Dispose of batteries in an environmentally sensitive manner, and adhere to any local and national regulations concerning battery disposal or recycling.

To remove the battery, slide the battery in the opposite direction of the arrow and then take out the battery from the battery compartment.

2.1.2 Insert the SIM card

When 4G/3G/2G network is chosen for survey operation, you need to insert a nano SIM card into Oscar Trek GNSS receiver. Insert the nano SIM card with the contacts facing outside which is shown as below.

Figure 2.3 Insert the SIM card

To eject the nano SIM card, slightly push it in to trigger the spring-loaded release mechanism.

Note: The SIM card is provided by your cellular network service provider.

2.1.3 Fix Oscar Trek on a ranging pole

Figure 2.4 Oscar Trek as a rover without radio antenna

Table 2.1 Devices to set Oscar Trek as a rover without radio antenna

Device Name	Quantity	Items in the figure
Oscar Trek GNSS receiver	1	1, details refer to section 1.3.1
Ranging pole	1	2, details refer to section 1.3.4
Bracket for TC80	1	3
TC80 Controller	1	4, details refer to section 1.3.3

2.2 Oscar Trek configuration

You can configure Oscar Trek GNSS receiver via buttons, controller or other android devices.

2.2.1 Configure via buttons

2.2.1.1Button configuration

The detailed definition of buttons on Oscar Trek GNSS receiver refers to Table 1.1, and related context.

Table 2.2 Button configuration for Oscar Trek

Action	Button operation	Description
Turn on the receiver	Press the power button for 2s	All four LEDs light up and remain for 3s, then all go off and battery LED is steady green if battery level is >30%.
Turn off the receiver	Press the power button for 3s	All four LEDs light off.
Wake up	Tap the power button or FN button to wake up the OLED screen when the OLED screen is off.	Screen off to on.
Select	Press FN button	
Confirm	Press the power button	Confirm, cancel, or return.
Reset GNSS module	Press and hold the FN button, continuously tap the power button 5 times	All LEDs light up for 5 seconds.

2.2.1.2Panel options and operation introduction

- SV & BAT

Press the power button to enter the next level of display interface.

Home Screen	Display	Description

Satellite Solution& Battery	Solution	NONE	No satellite searched.
		SINGLE	The receiver is in single point solution state.
		FLOAT	The receiver is in float point solution state.
		FIXED	The receiver is in fixed solution state.
	Satellites		Quantity of all visible satellites and satellite quantity of each constellation. G means GPS, R means GLONASS, B means Beidou, E means Galileo, S means SBAS, Q means QZSS.
	Battery		Shows battery percentage.

- Mode

The current working mode of the receiver is displayed.

Home Screen	Display	Description
Mode	Single	The receiver is in Single mode.
	Base	The receiver is in Base mode.
	Rover	The receiver is in Rover mode.

- Mode Configuration

Press the power button to enter the next level of display interface.

Home screen	Level 1	Level 2	Level 3
Mode Config	Base Mode	TCS (Tersus Caster Service)	Set Format: RTCMv2.3/ RTCMv3/ RTCMv3.2/ RTD/ CMR
			Check Device ID
			Set Server
		Ntrip Server	Set Format: RTCMv2.3/ RTCMv3 / RTCMv3.2/ RTD/ CMR
			Check historical IP address & Port

		Internal Radio	Set Protocol: TRANSEOT/ TT450/ SOUTH/ SATEL/ TRIMMK3
			Set Air-Baud-Rate: 9600/ 19200/ 4800
			Set Format: RTCMv2.3/ RTCMv3 / RTCMv3.2/ RTD/ CMR
			Set Power: 0.5W(Low) / 1W(Medium) / 2W(High)
			Set Channel: 0--9
			Set Customize Freq.
		External Radio	Set Serial Port Baud Rate: 9600/ 19200/ 38400/ 57600/ 115200/ 460800
			Set Data Speed (Full/ High/ Medium/ Low)
			Set Format: RTCMv2.3/ RTCMv3 / RTCMv3.2/ RTD/ CMR
	Rover Mode	TCS (Tersus Caster Service)	Set Base ID: ********
			Set Server
		NTRIP Client	Check historical IP Address & Port
		TCP Client	Check History & Add Address
		Internal Radio	Set Protocol: TRANSEOT/ TT450/ SOUTH/ SATEL/ TRIMMK3

			Set Air-Baud-Rate: 9600/ 19200/ 4800
			Set Channel: 0--9
			Set Customize Freq.
	Single Mode	Confirm/ Cancel	/
	Tilt.: ON/OFF	ON/OFF	/
		Pole Height	Input Pole Height
	Static: ON/OFF	Static:	AUTO/ MANUAL/ OFF
		Recording:	Check recording time(**min)
		Frequency:	Select 1Hz/5Hz/10Hz/20Hz/ 60s/30s/15s/10s/5s as Freq.
		Mask Elevation:	Input Mask Elevation Angle
		Duration:	Set recording duration(**min)
		Ant. Height:	Input Antenna Height(*.**m)
		Measure Type:	Select Vertical/ Pole/ Slant
		Data Format:	Select TRS/ OFF
		RINEX Format:	Select 2.10/ 3.02/ 3.04/ OFF

- Device Information

Press the power button to enter the next level of display interface.

Home screen	Level 1	Level 2	Level 3
Device Info	GNSS INFO	Constellation	Select GPS& GLONASS& BEIDOU& GALILEO& QZSS ON/ OFF
		RTK Mode	Select Mode：Normal/ Never Wrong
		Reset RTK	Reset GNSS module
		Hardware	Hardware Version
		Firmware	Firmware Version
	Voice	ON/ OFF	/
	Change BAT	ON/ OFF	/

	WIFI	WIFI：	Select AP/ OFF/ STA
		SSID/ IP/ MAC	Check Address
	Cellular	SIM card	Inserted/ Not Inserted
		IMEI/Network/Signal	/
	Int.Radio	Check Freq.& Power& Protocol& Air Baud& Channel	/
	Bluetooth	Name	TersusGNSS - ********(Device ID）
		Status	Connected/ Unconnected
		MAC	Address: **:**:**:**:**:**
	Disk Management	DiskUse: **%, Empty Disk, Download Log	/
	Data Broadcast	Bluetooth	ON/ OFF
		Serial Port	Serial Port: ON/ OFF
			Baud Select: 9600/ 19200/ 38400/ 57600/ 115200/ 460800
		TCP Cast	ON/ OFF
			Set Port
		TCP Push	ON/ OFF
			Set IP Address
			Set Port
		NMEA Select	Set GGA、GSA、GSV、GST、GLL、RMC、ZDA、VTG output Freq.
		Tilt Data	ON/ OFF
		Diff Data	ON/ OFF
	Debug Mode	ON/ OFF	/
		Debug Info Select	GNSS INFO ON/ OFF

			Tilt. ON/ OFF
			Int. Radio ON/OFF
			NTRIP ON/ OFF
	Language	Switch Language	Switch among 中文/繁體中文/日本語/ Français / Español / Türkçe / English
	Registration	Registered	/
		Unregistered	/
	SN	Serial Number	/
	PN	Product Number	/
	FW	Firmware Version	/
	HW	Hardware Version	/

2.2.2 Configure via TC80 controller

The detailed introduction of TC80 controller refers to section 1.3.3 and technical specification refers section 3.2. Here in this section describes how to configure Oscar Trek via Nuwa app which is installed in TC80 controller.

2.2.2.1Connect Oscar Trek in Nuwa

The general operations of Nuwa app refer to *User Manual for Nuwa App* which can be downloaded on Tersus official website.

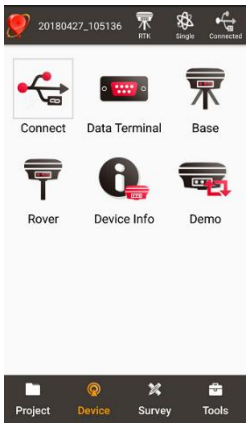


Figure 2.5 Device functional group

When Oscar Trek GNSS receiver is powered on, to connect Oscar Trek, put TC40/TC80 controller near the NFC logo on Oscar Trek, the TC40/TC80 controller connects to Oscar Trek's WiFi automatically; or click [Device] -> [Connect] under an opened project, and select [Oscar Trek] for the Device Type which is shown as below.

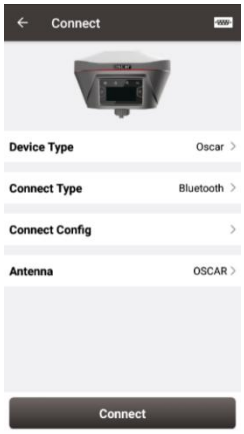


Figure 2.6 Connect Oscar Trek via WiFi

Click [Connect Config] to search and connect to Oscar Trek's WiFi. Then click [Connect] to enable the communication between TC40/TC80 controller and Oscar Trek.

2.2.2.2Registration

When the registration is not effective, follow below steps to complete the registration.

1) Connect the TC80 controller to your computer with a mini USB cable, and choose "Use USB for Transfer files" on the TC80 screen.
2) Click TC80 -> Internal storage -> TersusSurvey on the computer, then copy the license file obtained from Tersus Technical Support to the "TersusSurvey" folder.
3) Open Nuwa app on TC80, click [Register] in Device information interface. Click [Refresh] to update the registration status.

Note:

a) The registration file is text format file saved as xxx.txt.

b) The registration file name consists of the first three digits and the last five digits of the SN number. The example is as below.

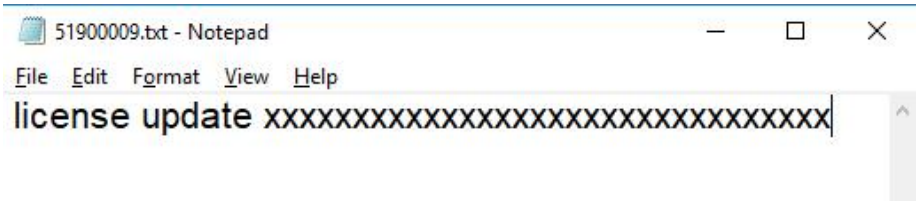


Figure 2.7 Example of Oscar Trek's registration file

The other method is registering using QR code.

Click the scan button at the top right of the device information interface and directly scan the QR code provided by Tersus to complete the registration.

2.2.2.3Configure rover

To configure Oscar Trek as a rover, back to Device interface which is shown in Figure 2.6 Device functional group, click [Rover], then create a work mode of detailed configurations for base or rover which are shown as below.

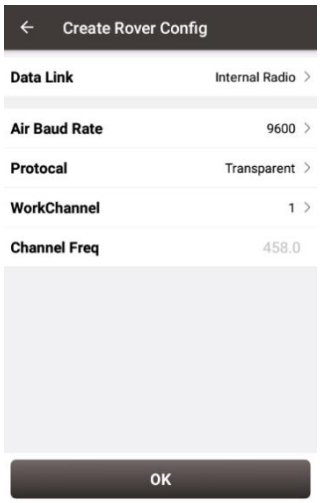


Figure 2.8 Rover configuration

Fill in the detailed information of rover configuration, then click [OK] and back to the work mode list, select this configuration to start data transmission for

rover which are shown as below.

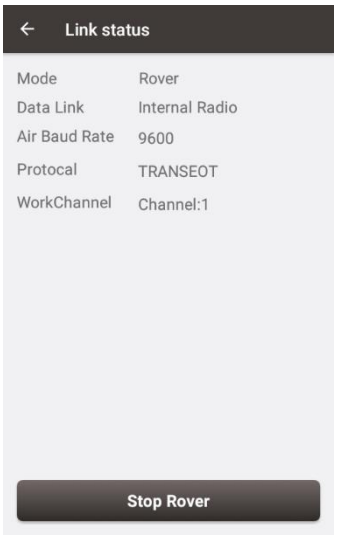


Figure 2.9 Link status of Rover

2.3 Data download

2.3.1 Connection

Oscar Trek can be used as an USB storage device when connecting with a computer. Before connecting Oscar Trek to a computer, ensure Oscar Trek is powered on. Use the Mini USB cable in the package to connect Oscar Trek to the USB port of a computer which is shown as below.

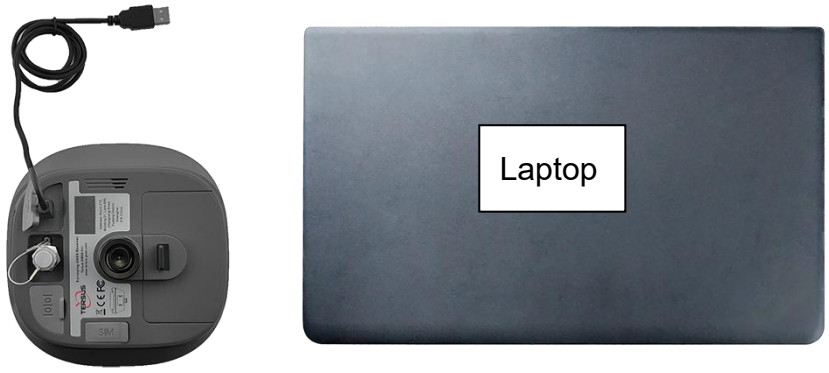


Figure 2.10 Connect Oscar Trek to a computer

After completing the connection, a USB device named \OscarData is listed in the file browser of the computer. Find the data file needed to download, copy and paste it to a designated folder in your computer.

2.3.2 Download static data

If you want to download the recorded static data for post processing, find \record\static folder in the USB drive shown as below, and then copy the specific file you need to your computer.

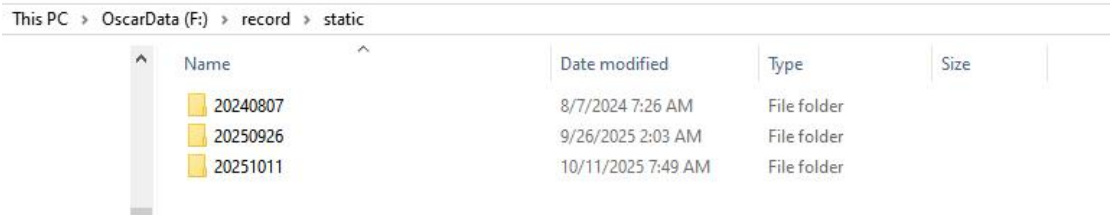


Figure 2.11 Static record folder

Each folder named after the date contains rinex format and tersus binary data, which can be downloaded and processed as you need.

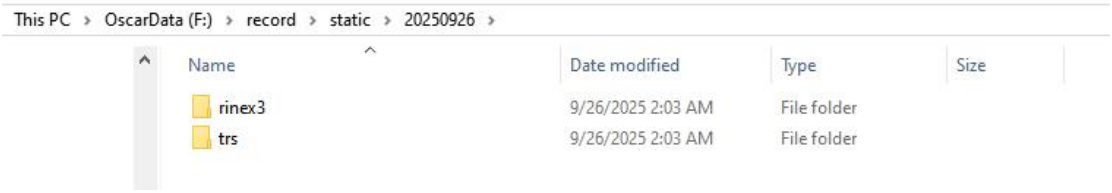


Figure 2.12 Static data for one day

2.3.3 Download debug data

When you don't turn on the debug mode, find \debug\xxx\LOG folder and you can see rtkmain.log file which includes all the operation information of the receiver.

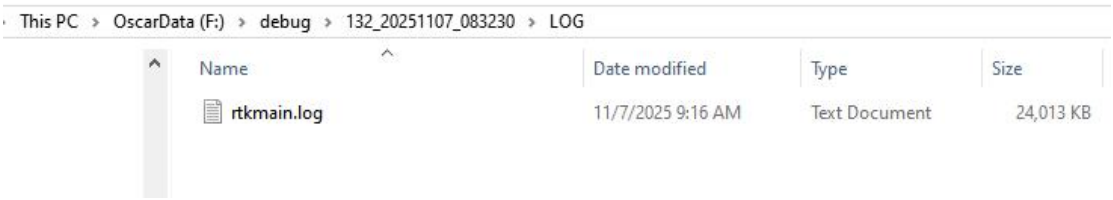


Figure 2.13 rtkmain.log file location

Click [Device] -> [Device Debug] -> [Set] in Nuwa app. The debug information includes GNSS, tilt, internal radio and NTRIP information. After you select some debug info to turn on and confirm, Oscar Trek will record them when you are doing survey work.

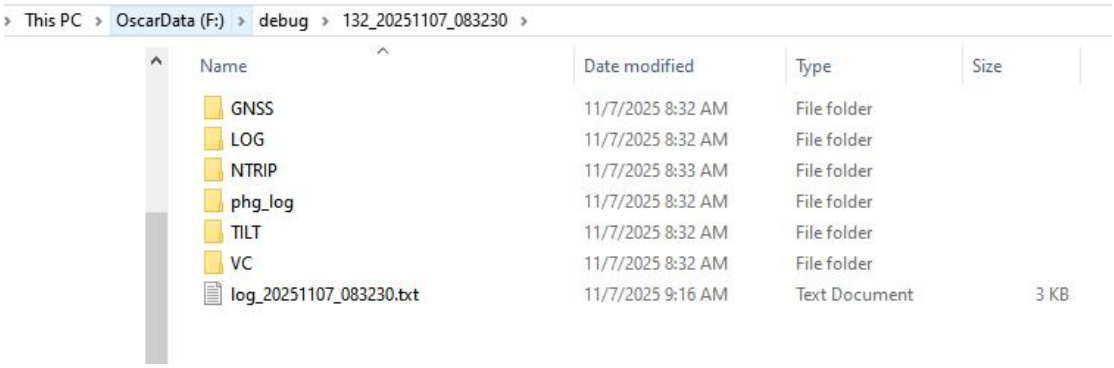


Figure 2.14 Debug info folders

Send these debug info to Tersus technical support team to help solve the problems you encountered.

2.4 Firmware upgrade

2.4.1 View Oscar Trek firmware version

When Oscar Trek GNSS receiver is powered on, go to [Device] -> [Connect] in Nuwa App, and select [Oscar Trek] as the Device Type. Tap [Connect Config] to search for and connect to the Oscar Trek’s WiFi. Then click [Connect] to enable the communication between controller and Oscar Trek.

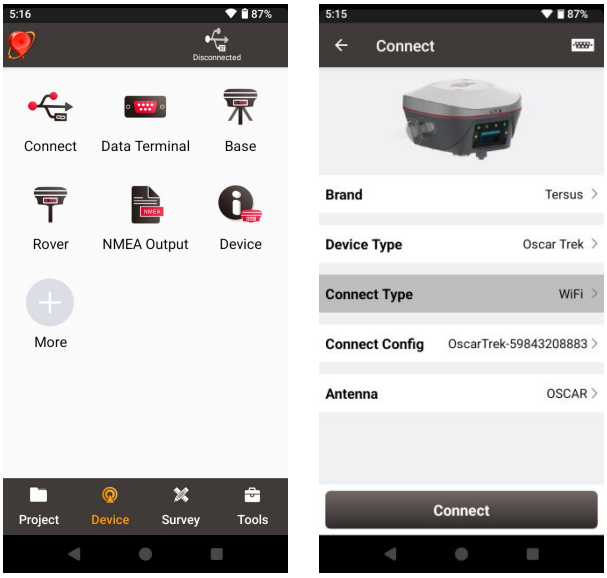


Figure 2.15 Connect to Oscar Trek via WiFi

Click [Device] -> [Device], the Oscar Trek info is shown as below. You can view Oscar Trek firmware version.

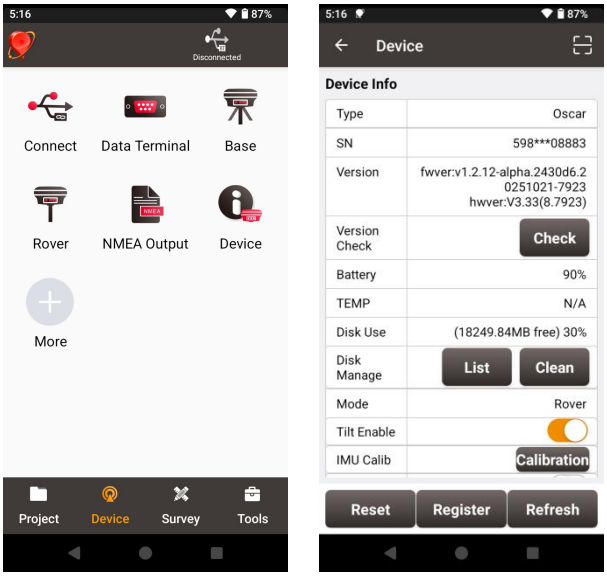


Figure 2.16 View Oscar Trek firmware version

You can also check the firmware version on the Trek LED panel.

In [Device Info] - [GNSS Info], view the firmware version of GNSS board.

In [Device Info] - [FW], view the Oscar Trek firmware version.

2.4.2 Upgrade the firmware through the built-in storage of the host

The detailed steps are as follows.

1) Download the latest firmware file from Tersus website

https://tersus-gnss.com/software/gnss-smart-antennas

Please be noted that the downloaded file is a .zip file, unzip this file to find the firmware file of .BIN format.

2) Prepare a Mini USB cable, when Oscar Trek is turned on, connect the Mini USB port of Oscar Trek to the computer with a Mini USB cable.

Figure 2.17 Mini USB cable connect the computer and Oscar Trek

3) The computer interface will automatically pop up two removable disks. As shown in the figure below.

Figure 2.18 Two Removable Disks

4) Choose the Oscar TrekUpdate removable disk and put the firmware file in the .BIN format on this removable disk. As shown in the figure below.

Figure 2.19 The FW is placed in the Oscar TrekUpdate removable disk

5) Unplug the Mini USB cable, press and hold the power button for 3 seconds to shut down Oscar Trek .

6) Make sure that Oscar Trek is turned off, then press and hold the power button for 2 seconds to turn on Oscar Trek. When the TERSUS icon appears, the boot is successful. Release the button and Oscar Trek will enter upgrade mode. During the upgrade, the device will automatically reboot several times while displaying the TERSUS icon. Please wait until the upgrade is complete.

Figure 2.20 Upgrading

After the LED panel displays the operation interface, you can check whether the Oscar Trek firmware upgrade is successful. If it is consistent with the latest firmware version in the removable disk, it means the firmware upgrade is successful.

Note: Please make sure the battery has enough power for the firmware upgrade. The GNSS board inside Oscar Trek will upgrade when the firmware is upgrading, any forced power failure will cause the system crash.

2.5 Operations of TC80 controller

2.5.1 Insert SIM card and SD card

Please note the direction of the card notch when inserting the card, inserting a non-standard card may cause damage to the SIM card slot of the controller.

To install the card you need to pull out the SIM card slot on the side.

Figure 2.21 SIM card slot

2.5.2 Using of touch screen

Single Click: To select an icon. For example, click dial to open the keypad which will be displayed on the screen.

Double Click: To zoom-in or zoom-out. For example, to zoom-in or out of a

photo, click twice when viewing a photo or browsing on the internet.

Hold: press and hold the screen, icon or input box to get more operation options.

a) Long-Time Click a picture in the gallery list interface, the status bar prompts to select a picture, you select to share or delete it.

b) Long-Time Click the blanks of home screen to add home screen widgets.

c) Long-Time Click the blanks of home screen wallpaper sources can be selected.

d) Long-Time Click the blanks of home screen to home settings.

Slide Upward: Slide up on the main screen (or click the upward arrow icon) to view more applications.

Slide Downward: Slide down on any interface to open the status bar and message board.

Slide Left and Right: Slide left and right on the main screen to switch the desktop interface.

3. Technical Specifications

This chapter mainly introduces the technical specifications of Oscar Trek GNSS receiver, TC80 Controller , external radio and internal radio whip antenna.

3.1 Oscar Trek GNSS receiver

Table 3.1 Oscar Trek GNSS receiver performance

GNSS Performance		
Position accuracy(RMS)	Single Point Positioning	1.5m (Horizontal)
		3.0m (Vertical)
	DGPS Positioning	0.25m (Horizontal)
		0.5m (Vertical)
	High Precision Static	2.5mm+0.1ppm (Horizontal)
		3.5mm+0.4ppm (Vertical)
	Static & Fast Static	2.5mm+0.5ppm (Horizontal)
		5mm+0.5ppm (Vertical)
	Post Processed Kinematic	2.5mm+1ppm (Horizontal)
		5mm+1ppm (Vertical)
	Real Time Kinematic	8mm+1ppm (Horizontal)
		15mm+1ppm (Vertical)
	Network Real Time Kinematic	8mm+0.5ppm (Horizontal)
		15mm+0.5ppm (Vertical)
Observation accuracy (zenith direction)	C/A code	10cm
	P code	10cm
	Carrier phase	1mm
Time To First Fix (TTFF)	Cold start	<35s
	Warm start	<10s
Reacquisition	<1s	
Tilt compensation accuracy (within 60°)	≤2cm	
Timing accuracy (RMS)	20ns	
Velocity accuracy (RMS)	0.03m/s	
Initialization (typical)	4s	
Initialization reliability	>99.99%	
System & Data		

Operating system	Linux	
Storage	built-in 16GB/8GB	
Data format	CMR, CMR+ (GPS only), RTCM 2.3, RTCM3.0, RTCM3.1, RTCM3.2	
Data output	RINEX, NMEA-0183, Tersus Binary	
Software Support		
Tersus Nuwa, MicroSurvey FieldGenius		
Communication		
Cellular	4G LTE/WCDMA/GSM	
Cellular bands	FDD LTE 1,3,7,8,20,28A | 2,4,5,12,13 TDD LTE 38,40,41 | WCDMA 1,8 | 2,5 GSM3,8 |	
Network protocols	Ntrip Client, Ntrip Server, Tersus Caster Service (TCS)	
Wi-Fi	802.11b/g	
Bluetooth	4.1	
Internal radio	RF transmit power	0.5W/1W/2W
	Frequency	410MHz ~ 470MHz
	Operating mode	Half-duplex
	Channel spacing	12.5KHz / 25KHz
	Modulation type	GMSK, 4FSK
	Air baud rate	4800/9600/19200 bps
	Distance (typical)	>5km
	Radio protocols	TrimTalk450, TrimMark 3, South, Transparent, Satel
USB OTG	USB 2.0 x1	
Serial ports	RS232 x1	
COM baud rate	Up to 921600bps	
Electrical		
Input voltage	+9 ~ 28V DC	
Power consumption	Network or radio receive mode	≈ 5W
	Radio transmit mode (0.5W)	≈ 8W
	Radio transmit mode (1W)	≈ 9W
	Radio transmit mode (2W)	≈ 11W
Lithium battery	7.4V 6400mAh x2	
Battery charging temperature:	+10°C ~ +45°C	
Battery working time	Up to 7 hours	
Physical		
Display	1.54" OLED	
Dimension	157*157*103 mm	
Weight	≈ 1.2kg (without battery), ≈ 1.4kg (with a battery)	

Screw hole for assembly	5/8"x11UNC-2B
Vibration	MIL-STD-810G,FIG.514.6C-1
Environmental	
Operating temperature	-40°C to +70°C
Storage temperature	-55°C to +85°C
Relative humidity	100% not condensed
Water & dust proof	IP68
Pole drop onto concrete	2m

The pin definition's view from outside to the serial port is as below.

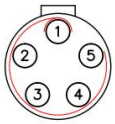


Figure 3.1 Serial data port of Oscar Trek

Table 3.2 Pin definition of the serial data port

Connector Pin No.	Pin Definition
1	GND
2	GND
3	PWR
4	TXD
5	RXD

The pin definition of the TNC connector is as below:

Table 3.3 Pin definition of the TNC connector

Connector Pin No.	Pin Definition
Inside	Signal
Outside	Ground

The pin definition of the battery contacts is as below:

Table 3.4 Pin definition of the battery contacts

Connector Pin No.	Pin Definition
1	+ Positive
2	Data
3	Clock
4	- Negative

Table 3.5 Default factory configuration for internal radio

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

Table 3.6 Detailed configuration information for internal radio

Protocol	Modulation type	Channel band	Air baud rate	COM baud rate
TrimTalk450	GMSK	12.5 KHz	4800 bps	9600/19200/38400/115200bps
	GMSK	25 KHz	9600 bps	9600/19200/38400/115200bps
TrimMark3	GMSK	50 KHz	19200 bps	9600/19200/38400/115200bps
Transparent	GMSK	12.5 KHz	4800 bps	9600/19200/38400/115200bps
	GMSK	25 KHz	9600 bps	9600/19200/38400/115200bps
Satel	4FSK	12.5 KHz	9600 bps	9600/19200/38400/115200bps
	4FSK	25 KHz	19200 bps	9600/19200/38400/115200bps
South	GMSK	12.5 KHz	4800 bps	9600/19200/38400/115200bps
	GMSK	25 KHz	9600 bps	9600/19200/38400/115200bps
	GMSK	50 KHz	19200 bps	9600/19200/38400/115200bps

3.2 TC80 controller

Table 3.7 TC80 technical specification

System

Operating System	Android 12
CPU	Octa-Core 2.0GHz
Memory	6GB RAM + 64GB ROM
External storage	Micro SD, up to 256GB
Display	5.5″ sunlight-readable capacitive touch screen
Resolution	720x1440
Camera	13MP Auto Focus Camera
Flash Light	High light Flash LED
Electrical	
Battery	7700mAh 3.8V
Battery Life	10 hours
Charging Time	<4 hours (fast charge)
Communication	
Wi-Fi	IEEE 802.11a/b/g/n 2.4G&5G
Cellular Mode	Dual SIM Dual Standby
SIM1 & SIM2	FDD-LTE B1/B3/B5/B7/B8 TDD-LTE B38/B39/B40/B41 WCDMA B1/B2/B5/B8 GSM B2/B3/B5/B8 CDMA/EVDO BC0/BC1
Bluetooth	BT5.0 (BLE)
USB	USB Type-C (supports OTG)
NFC	Protocol of ISO14443A/B, and ISO15693 Readable Distance 0~5cm
GNSS	GPS/GLONASS/BeiDou
Sensors:	G-Sensor, Compass, Light-Sensor, Gyro
Physical	

Dimension	221.3mmx77.7mmx19.6mm
Weight	320g (include battery)
Reliability	
Operating Temperature	-20°C ~ +60°C
Storage Temperature	-30°C ~ +70°C
Humidity	5% ~ 95%
Dustproof & Waterproof	IP68
Shock	1.5m drop onto concrete

3.3 Radio whip antenna

The 410-470MHz radio whip antenna is to be installed on the TNC port to transmit or receive signal for the internal radio. This antenna is elastic whip structure, resistant to bending.

Table 3.8 Radio whip antenna technical specification

Technical Specification	
Frequency Range	410~470MHz
Bandwidth	60MHz
Polarization Mode	Vertical
Gain	2dBi
Input Impedance	50Ω
VSWR	≤2.5
Maximum Power	20W
Connector	TNC Male
Antenna Length	168mm
Antenna Weight	About 50g

Extreme Wind Speed	120 Km/h

4. Typical Applications

This chapter introduces typical applications of Oscar Trek GNSS receiver, and solutions for some possible issues.

⚠	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.

4.1 Rover operation

Figure 4.1 Oscar Trek as a Rover - Network Mode

Table 4.1 Devices of Oscar Trek as a rover network mode

NO.	Device Name
1	Oscar Trek GNSS receiver
2	Ranging pole
3	Bracket for TC80
4	TC80 Controller

Figure 4.2 Oscar Trek as a Rover - Internal Radio

Table 4.2 Devices of Oscar Trek as a rover internal radio mode

NO.	Device Name
1	Oscar Trek GNSS receiver
2	410–470MHz radio whip antenna
3	Bracket for TC80
4	Ranging pole
5	TC80 Controller

Detailed steps of button operation:

1. Set up Oscar Trek according section 2.1 Setting up Oscar Trek after all the components above are ready, ensure one battery and one SIM card are installed in Oscar Trek;
2. Long press the power button to power on Oscar Trek;
3. Press FN button to select [Mode Config], press the power button to enter the work mode options;
4. Select [Rover Mode] and press power button;
5. If using Tersus Caster Service, select [TCS] and press the power button to enter TCS network settings; Set the Base ID, server and press the power button to confirm.

6. If using internal radio, select [Internal Radio] and press the power button to enter radio setting; Set protocol, channel and frequency same as Base, press the power button to confirm.
7. If using NTRIP Client, select [NTRIP Client] and press the power button to enter NTRIP setting; set IP address with correct port and press the power button to confirm.
8. Above all, setting Oscar Trek as a rover is completed.

Detailed steps of software operation:

1. Set up Oscar Trek according section 2.1 Setting up Oscar Trek after all the components above are ready, ensure one battery and one SIM card are installed in Oscar Trek;
2. Long press the power button to power on Oscar Trek;
3. Use NFC function to launch Nuwa app. While the screen of TC40/TC80 Controller is unlocked, put TC40/TC80 Controller close to the Oscar Trek NFC logo. The WiFi connects automatically after a beep and Nuwa is launched requesting to open the latest project. Click [OK] and start configuring Oscar Trek from step 7. Also you can click [Cancel] to create a new project or open an existing project, and then start configuring Oscar Trek from step 7.
4. If using an android device without NFC function, ensure Oscar Trek is powered on, and launch Nuwa application on the android device. Click [Project] in the main interface to create a new project or open an existing project and connect Oscar Trek manually.
5. Back to the main interface of Nuwa app, click [Device] -> [Connect] under an opened project;
6. Select [Oscar Trek] for the Device Type, select [WiFi] for the Connect Type,

click [Connect Config] to search and connect to Oscar Trek's WiFi, select [Oscar] for the Antenna and click [Connect] to enable communication between the android controller and Oscar Trek.

7. Back to [Device] - > [Rover], click [New] to create a new configuration for base.

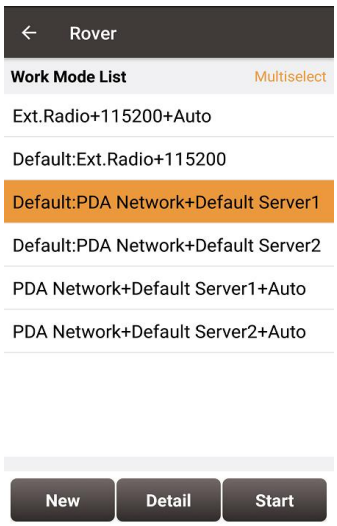


Figure 4.3 Rover setting interface

8. Edit rover configuration for Oscar Trek GNSS receiver under different data link selections. The Receiver Network and PDA Network have three protocol options respectively: Ntrip, TCP and Tersus Caster Service (TCS).

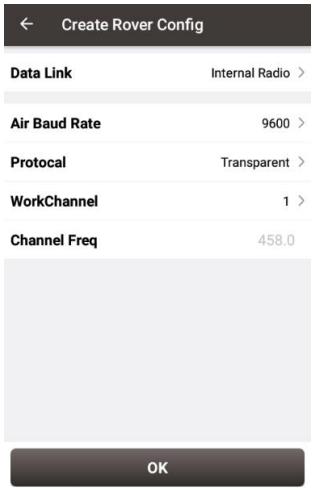


Figure 4.4 Rover configuration - Internal Radio

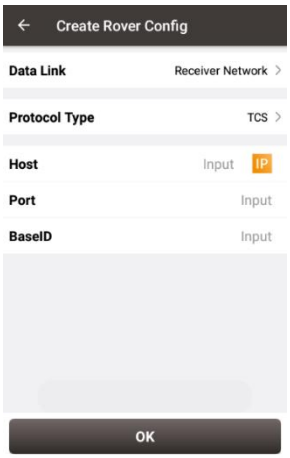


Figure 4.5 Rover configuration - Receiver Network (TCS)

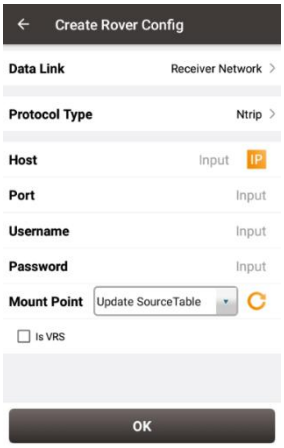


Figure 4.6 Rover configuration - Receiver Network (Ntrip)

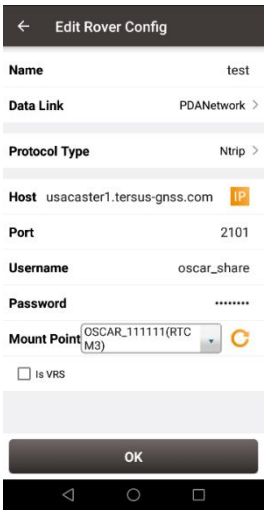


Figure 4.7 Rover configuration - PDA Network (Ntrip)

Note: Select PDANetwork when using cellular network of a PDA such as TC80 Controller.

9. After filling the information for the above configuration, click [OK]. Select this configuration in the work mode list and click [Start] to start data transmission for rover which is shown as below.

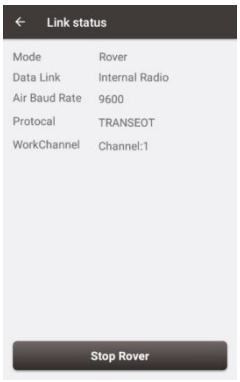


Figure 4.8 Link status of Rover using internal radio

4.2 Static survey

Before performing static survey, ensure one battery is installed in Oscar Trek GNSS receiver.

Detailed steps of button operation:

1. Long press the power button to power on Oscar Trek;
2. Press FN button to select [Mode Config], press the power button to enter the work mode options;
3. Select [Static: OFF] and press the power button to enter configuration options for static survey;
4. Set Frequency, Mask Elevation, Duration, Antenna Height, Measure Type, Data Format and RINEX Format;
5. Turn on static when the cursor is on ‘STATIC: OFF‘, then it becomes

'STATIC: ON', press the power button to confirm;

6. Above all, setting static survey is completed.

Detailed steps of software operation:

1. Long press the power button to power on Oscar Trek;
2. Use NFC function to launch Nuwa app. While the screen of Controller is unlocked, put Controller close to the Oscar Trek NFC logo. The WiFi connects automatically after a beep and Nuwa is launched requesting to open the latest project. Click [OK] and start configuring Oscar Trek from step 6. Also you can click [Cancel] to create a new project or open an existing project, and then start configuring Oscar Trek from step 6.
3. If using an android device without NFC function, ensure Oscar Trek is powered on, and launch Nuwa application on the android device. Click [Project] in the main interface to create a new project or open an existing project and connect Oscar Trek manually.
4. Back to the main interface of Nuwa app, click [Device] -> [Connect] under an opened project;
5. Select [Oscar Trek] for the Device Type, select [WiFi] for the Connect Type, click [Connect Config] to search and connect to Oscar Trek's WiFi, select [Oscar] for the Antenna and click [Connect] to enable communication between the android controller and Oscar Trek.
6. Click [Survey] -> [Static Survey], fill in the parameters of interval, cutoff angle, and etc. Then click [Start] to start static survey.

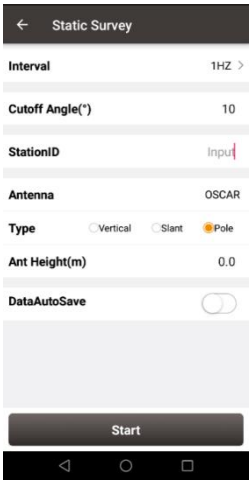


Figure 4.9 Static Survey configuration

7. If the DataAutoSave function is turned on, the static data is recorded automatically in the internal storage when power up Oscar Trek next time. You can download data file refer to section 2.3.

4.3 Tilt survey and stakeout

Tilt function is only applicable for Oscar Trek GNSS receiver Ultimate version under rover mode.

4.3.1 Tilt initialization

The tilt compensation of Oscar Trek GNSS receiver is free of complex calibration. The tilt compensation will be initialized when the surveyor walks forward naturally for several meters after turning on the tilt compensation function. You can start tilt survey right after you walk to the survey point.

There are two methods to turn on or off tilt compensation. One is turning on or off tilt compensation on Device Info on the OLED via buttons. Another method

is through Nuwa app. After the Oscar Trek GNSS receiver is connect in Nuwa app, and we configure it working as a Rover. Click the device icon 

on the top or click [Device] under the device functional group to enter the device information interface. Turn on the [Tilt Enable] on the device interface.

When tilt function is turned on, the tilt LED on the Oscar Trek OLED display lights on with steady red, a few seconds later it starts flashing red. At this time, walk a few steps ahead, tilt the pole at any direction, then the tilt LED turns steady green which indicates tilt compensation is valid. Now you can start tilt survey.

When the tilt compensation is valid, click the Satellite info icon to view the detailed information of tilt compensation including tilt status, tilt direction, tilt angle, heading and their quality index. Among them, the tilt direct indicates which direction is tilted, that is, the angle between the projection of the ranging pole on the ground and the north direction after tilting; the tilt angle indicates the degree of tilt, that is, the angle between the tilted pole and the vertical direction; Heading indicates the surveyor's orientation (the facing of Oscar Trek's back, we consider Oscar Trek's panel is always facing the surveyor).

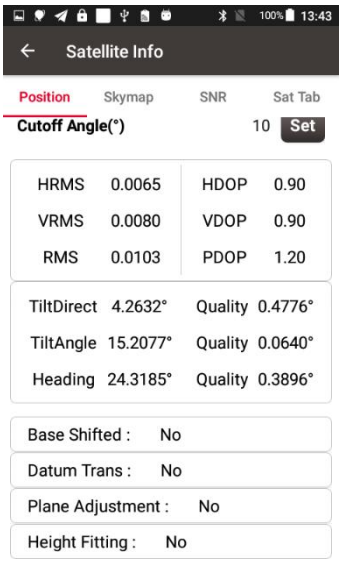


Figure 4.10 Detailed information of tilt compensation

4.3.2 Tilt survey

After turning on [Tilt Enable] and tilt initialization is finished, enter Survey interface and start tilt survey.

The tilt status is displayed at the top of the survey interface. When the tilt status is ON, it is considered that the tilt compensation accuracy is high and it is in a usable state. You can start survey using the tilted ranging pole. Please ensure that the antenna height setting is correct which will affect the tilt measurement results.

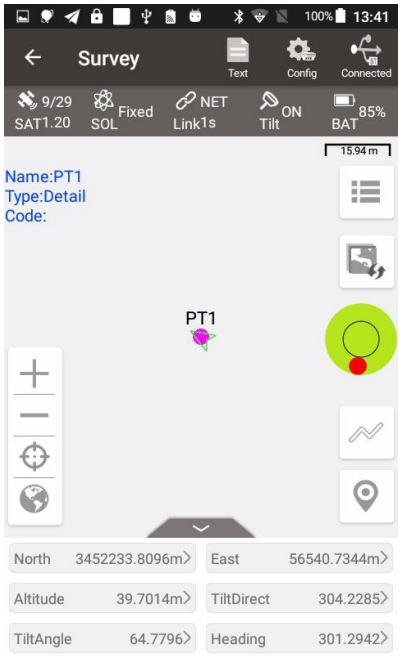


Figure 4.11 Tilt status is ON

When the status is displayed as N/A and blinking, it is considered that the accuracy of tilt compensation is reduced and it is in a state that is not recommended. At this time, the tilt indicator of the Oscar Trek OLED display turns flashing red. This may be caused by the surveyor standing for too long, rotating the ranging pole, or hitting the ranging pole to the ground. When the status is N/A, you need to redo the initialization. Generally, you do not need to stand still, just hold the ranging pole and walk forward to the next point, the initialization is complete automatically.

Note: during the tilt survey, please keep the Oscar Trek OLED display facing the surveyor as much as possible. Please do not rotate the pole or hit the pole to the ground, which will invalidate the initialization or affect the accuracy of the tilt compensation. In addition, during the tilt point survey, if it does not continue at the third epoch reached when it is set smoothing 5 epochs for surveying points, please check whether the tilt compensation is invalid. It is not allowed to continue to complete the survey in the case where the tilt initialization

accuracy is low.

4.3.3 Tilt stakeout

After turning on [Tilt Enable] and tilt initialization is finished, enter the Point Stakeout or Line Stakeout interface and start tilt stakeout. The tilt state is also added at the top of the stakeout interface to indicate the current tilt available state.

During the tilt stakeout process, if you enter the threshold range of the stakeout setting, the software will display a virtual tilt ranging pole along with the beep sounds. It is drawn according to the tilt direction angle. When the pole is tilted in a certain direction among east, west, south and north, the virtual tilt ranging pole on the interface will also tilt in a certain direction.

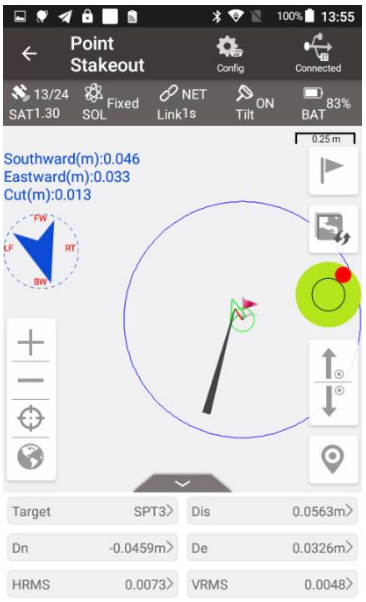


Figure 4.12 Point stakeout when tilt compensation is on

4.4 Issues and solutions

This section lists possible issues and effective solutions to solve them. Please read this section before contacting Tersus technical support.

1. Trek GNSS receiver cannot receive satellite signals.

Solution:

(1) Change the survey environment, and restart Trek in an open space.

(2) Reset the GNSS module by Reset button in Device interface.

2. The communication between Nuwa and Trek fails.

Solution:

(1) Check whether the Trek is powered on;

(2) Re-search and connect the WiFi;

(3) Upgrade Nuwa to the latest version.

3. There is no correction data for rover when using receiver network Ntrip work mode.

Solutions:

(1) Check whether the IP address, port, user name, password is correct.

(2) Try to connect to CORS via controller network and receive correction data to ensure there is no issue on CORS service, then switch back to receiver network mode.

(3) Check whether the 4G SIM card is properly installed, and whether it can be used normally.

(4) Go to [Device] - [Cellular], check the registration status of the network. Try entering APN name and restarting cellular module.

(5) Try to log in with the same configuration and get a compared result if there is an extra receiver.

4. How to export static observation data from Trek?

Solutions:

(1) Connect Trek receiver with a computer through a USB Type-C cable.

(2) The computer detects the Trek receiver as an external disk.

(3) Open the \Data\record folder, find the trs file and rinex file in its storage according to recording date.

(4) Copy the static observation data and paste them to the designated folder in your computer.

5. How to apply Geoid model file correctly?

Solutions:

(1) Prepare the Geoid file at first and placed in the path of Internal storage\TersusSurvey\Geoid.

(2) Next step, launch Nuwa and go to select Project - Current Project and edit Coordinate System. Find the Height Fitting - Geoid and select Geoid, or directly download Geoid files from Tersus server after clicking More.

6. How to configure Trek serial port output NMEA log?

Solutions:

Nuwa can configure to output NMEA by the NMEA option. It can be specified the Baud Rate, the kind of sentence.

7. A base receiver is working well, the rover receiver cannot get correction data via UHF, how to fix this?

Solutions:

(1) Check whether the radio antenna connects well with receiver. Carefully check whether the interface is tightened.

(2) Check whether the air baud rate, Protocol, Bandwidth, Frequency match right with that of the base receiver.

(3) Switchover the radio frequency to avoid the possible interference from

nearby devices.

(4) Get a compared result when an extra receiver is configured as rover with the same settings.

8. The Trek rover works at a short distance (not normal distance) at the radio mode?

Solutions:

(1) Check whether the rover connects a radio antenna.

(2) Adjust the radio of base at the high power gear.

(3) Check the environment if there exists radio interference along the propagation line.

5. Visual Positioning

5.1 Introduction

Visual Positioning for Tersus Trek GNSS Receiver is an innovative integration of GNSS, IMU and visual positioning technology. Equipped with a global shutter camera, the Trek not only captures the coordinates of points of interest from recorded video but also generates point cloud data on-site in real time.

5.2 Connect and Take Video

1) Connect Trek via WiFi and start rover mode to get a fixed solution.

2) Turn on Tilt, input the correct pole height and finish the tilt initialization.

3) Go to [Survey] - [Visual Positioning]. The main interface shows Trek camera shooting screen. When the upper-right precision estimate is too large and the icon shows red, shake the pole or move Trek according to the animation shown to take tilt initialization and visual positioning initialization until the upper-right precision estimate meets the requirements, the icon shows green and the animation disappears.

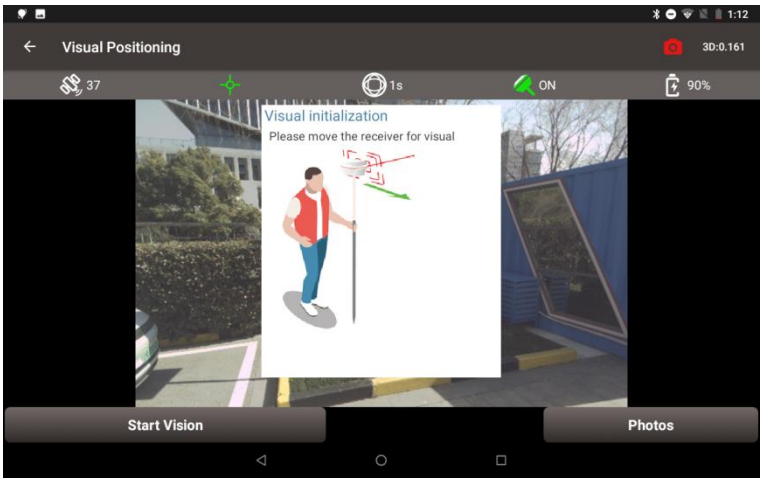


Figure 5.1 Visual Positioning Initialization

4) Click [Start Vision], keep the camera on Trek facing the target points, move Trek to take photos of the target points from different directions.

5) Click [Stop] to end recording. Check the quality and the number of pictures for this visual positioning and enter the group name..

Figure 5.2 Start Vision

Note:

- ✧ **Ensure that the Trek is located in an open sky environment, without any obstruction to the GNSS antenna, throughout the initialization process.**
- ✧ **Remember not to rotate the receiver violently during the initialization process. To improve visual measurement performance, focus on ensuring sufficient moving, as rotation does not enhance it.**
- ✧ **During the initialization phase, the camera should be turned back toward the surveyor to avoid obstruction of the view by their body.**
- ✧ **In the moving stage, the camera should not be pointed at non-textured objects, such as the sky and white walls.**
- ✧ **3D values in the upper right corner indicates the predicted 3D measuring error at 10 meter distance.**

5.3 Photo Groups

Click [Photos] to view all groups of photos taken for further measurement. Click on the mode button on the upper right corner in photos screen, there are four modes to take measurement for visual positioning.

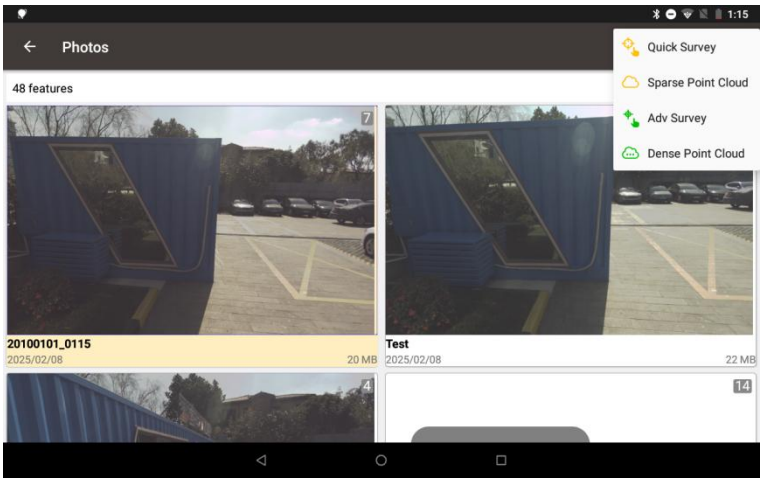


Figure 5.3 Four Measurement Modes

If needed, click the [Multi-select] button and choose the photo group to export. Then connect the Trek to a computer and locate the exported image group in the directory for 3D modeling post-processing.

5.4 Quick Survey

This section introduces Quick Survey mode. Quick Survey use the traditional Pick point - Calculate - Adjust process. Calculations are performed at the receiver side. The advantage of quick survey is that there are no controller performance requirements and calculations are faster.

1) Click on a photo group to slide through all the photos in the group.

2) Click on one of the photos that contains target points to enter the photo measurement interface. Click the target point directly on the picture, then the clicked position will show a blue cross, and you can change the position of the blue cross by dragging. You can also zoom in and out of the picture to make it easier to align the blue cross to the target point.

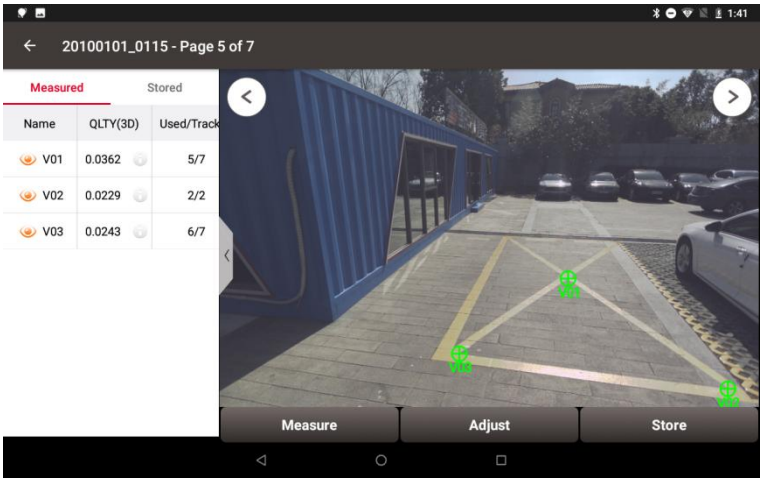


Figure 5.4 Quick Survey

3) Click [Measure], the blue cross will turn green, and the measured point list will show 3D quality and the number of used photos. Continue to select other target points in this way.

4) Switch to other photos, check whether the green cross is aligned with the target point. If failed to match on some photos, it will be shown as a red circle.

5) Click [Adjust], select the point and drag to align target manually. It will be recalculated and generally the quality will become higher and the used photos will increase.

6) Confirm that all points are measured correctly. Click the white icon to check the detailed information and edit point name. Then click [Store] and enter points information to store visual positioning points into the point database.

Note:

- ✧ **Hold the receiver steady and keep a normal walking speed while capturing images.**
- ✧ **For optimal accuracy and performance, capture the object of interest from a distance between 2m and 10m.**
- ✧ **Avoid using it in dark conditions or when directly facing the sun, as it may lead**

to difficulty in recognizing enough features in the captured images to make a match.

- ✧ **Try to select feature points on an image directly in front of the target object. For example, choose an image in the middle of the captured images.**
- ✧ **Multiple feature points can be selected at a time.**

5.5 Sparse Point Cloud

This section introduces Sparse Point Cloud mode. In this mode, you need to circle the position around the target point first, then after the sparse point cloud being generated, select the nearest point in the sparse point cloud to obtain coordinates directly.

Calculations are performed at the receiver side. The advantage of this mode is that there are no controller performance requirements and calculations are faster, while at the same time the operations are simpler without adjustments.

1) Click on a photo group and click on one of the photos that contains target points. Click the circle button  and draw a circle containing the target point.

2) After the calculation, the sparse point cloud of the circled position will be displayed on the picture. If the points in the sparse point cloud are too far away from the target, draw another circle near the target position to generate more point clouds.

3) Click the select button  and click one of the point in sparse point cloud to select. If a wrong point is selected, use the button  to cancel the selection.

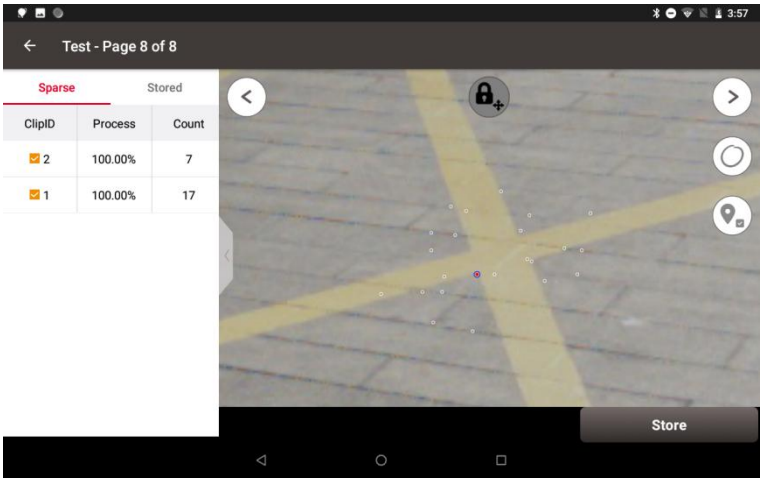


Figure 5.5 Sparse Point Cloud

4) Continue to select other target points in the way above. Then click [Store] and enter points information to store visual positioning points into the point database

5.6 Adv Survey

This section introduces Adv Survey mode. In Advanced Survey mode, the software will prepare the dense point cloud automatically first. The user only need to pick the point on the picture and the software will automatically generate the dense point cloud around the target, select the corresponding point in point cloud and give the results directly.

Calculations are performed at the controller side and therefore has performance requirements for the controller. The advantage of this mode is that the point cloud is dense and accurate, simplest for the user to operate and very accurate in measurement.

1) Click on a photo group and click on one of the photos that contains target points. It may take some time to prepare dense point cloud.

2) Click the target point directly on the picture, then the clicked position will

show a blue cross, and you can change the position of the blue cross by dragging. You can also zoom in and out of the picture to make it easier to align the blue cross to the target point.

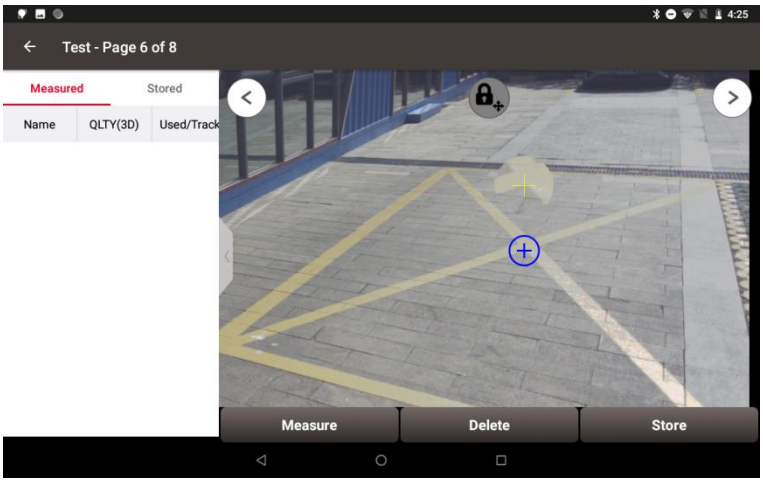


Figure 5.6 Advanced Survey

3) Click [Measure], and it may take some time to calculate the dense point cloud. The blue cross will turn green after the calculation. Select other target points in the same way.

4) Click the white icon to check the detailed information and edit point name. Click [Store] to store visual positioning points into the point database.

5.7 Dense Point Cloud

This section introduces Dense Point Cloud mode. The measurement process in this mode is similar to that of the sparse point cloud. More importantly, we can export the dense point cloud.

Calculations are performed at the controller side and therefore has performance requirements for the controller.

1) Click on a photo group and click on one of the photos that contains target points. It may take some time to prepare dense point cloud.

2) Click the button  and wait for global 3D point cloud reconstruction results the dense point cloud of the circled position will be displayed on the picture.

3) Click [Export] and select the path to the las file. Then open las file to check the dense point cloud generated by Trek visual positioning on site.

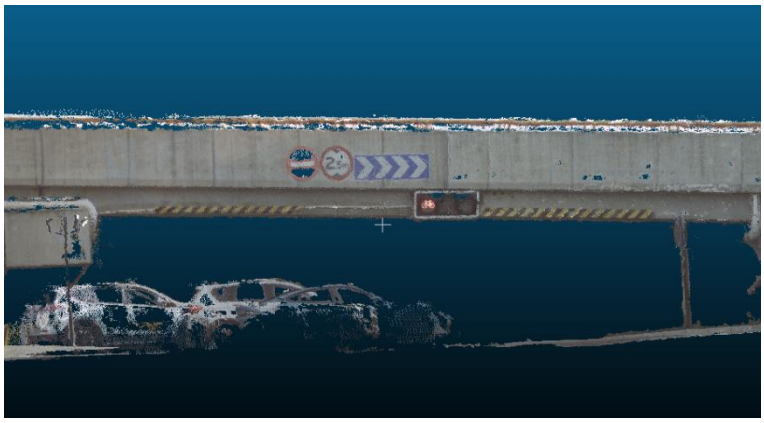


Figure 5.7 Export Dense Point Clouds

6. Terminology

Abbreviation	Description
AC	Alternating Current
BDS	BeiDou Navigation Satellite System
CMR	Compact Measurement Record
DC	Direct Current
eMMC	Embedded Multi Media Card
GLONASS	GLObal NAvigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
LED	Light Emitting Diode
OLED	Organic Light-Emitting Diode
PDA	Personal Digital Assistant
PPK	Post-Processing Kinematic
PPS	Pulse Per Second
QZSS	Quasi-Zenith Satellite System
RINEX	Receiver Independent Exchange format
RMS	Root Mean Squares
RTK	Real-Time Kinematic
RTCM	Radio Technical Commission for Maritime Services
SIM	Subscriber Identification Module
TCP	Transmission Control Protocol
UAV	Unmanned Aerial Vehicle, drone
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial BUS
UTC	Universal Time Coordinated