## **User Manual**

Version V1.5-20191202



# User Manual For Nuwa App

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# 1. Nuwa Brief Introduction

- Introduction
- Installation
- Update Nuwa
- Main Interface



### **1.1 Introduction**

Nuwa is a survey application software based on Android OS (Operating System), designed by and all rights reserved to Tersus Inc. Nuwa is simple, easy to use and has friendly UI (User Interface). It is designed to work with Tersus products including David GNSS receiver, Oscar GNSS receiver, BX series OEM boards and other receivers which support NEMA-0183.

Main features of Nuwa App:

- Supports Bluetooth/USB connection and related operations for Tersus receivers.
- Powerful data management makes survey data management more convenient.
  Easy for data editing and import / export of several types of formats.
- Convenient to set up a base station or a rover, and supports setting to transmit and receive differential data through the radio, receiver network or PDA network.
- Optimized survey and stakeout, supports GNSS Linework, more functions, and more simple operation.
- Built-in a variety of ellipsoids, projections and various national coordinate systems. Supports user-defined coordinate system which is more adaptable.
- Provide tools for indirect measurement for easier work.
- Supports new release detection and online upgrades.



## **1.2 Installation**

There are two methods of installing Nuwa app in an android device.

1) Search Nuwa in Google Play Store, click [Install], install the application and open it after the installation is completed. The screenshots are as follows.



Figure 1.1 Nuwa in Google Play Store



Figure 1.2 Nuwa in Google Play Store - install





Figure 1.3 Nuwa in Google Play Store - open

2) Copy the .apk file to the storage of an Android device, click it to start installation. The

Nuwa icon will be on the desktop after it is installed successfully.



Figure 1.4 Nuwa copied in an android device



Figure 1.5 Nuwa icon on desktop





## 1.3 Update Nuwa

There are three methods of updating Nuwa app in an android device.

1) Update Nuwa in Google Play Store which is shown below.



Figure 1.6 Update Nuwa in Google Play Store - 1



Figure 1.7 Update Nuwa in Google Play Store - 2

- Update Nuwa by copying the latest .apk installation file to the storage of an android device. The process is the same with that in the above section of installation.
- 3) Update Nuwa in the 'Settings' page inside Nuwa app. In the condition that the android device is connected to internet and [Update Detection] is turned on, it automatically pops up an update prompt every time you open Nuwa and it can be seen that there is red 'new' on the right of version number if current Nuwa version is detected to be ready to update.





Figure 1.8 Version in Settings page

If [Update Detection] is not turned on, tap the row of version, it pops out a window indicating software update. Select [Update] to update the app automatically. Select [Later] to ignore this notification.

$\leftarrow$ Settings	
Coord Display	Degree(DD.DDDDDDDD) >
Length Unit	m >
Area Unit	Square.M >
No Software U New version d immediately? Ve	pdate
Zone	(UTC+08:00) >
Language	English >
Location Sharing	

Figure 1.9 Software Update notification



#### 1.4 Main Interface

Nuwa has four main functional groups: Project, Device, Survey and Tools. While Nuwa is running, slide left or right on the screen to enter other functional groups.



Figure 1.10 Nuwa Main Interface

Status Bar

<sup>20191012\_105628</sup>]: Project Information, the current project is displayed.

]: Device information, click it to check details about the receiver connected. Refer to section 3.5 for detailed description.



]: Satellites status, N/A indicates Not Applicable, satellite positioning status includes: Single, DGPS, Float and Fixed. Click this icon to view satellite information which is shown in the figures below.



]: Connection status, can be Connected or Disconnected. Click this icon to enter connect interface, refer details in section 3.1.

Menu area

List all the menu items in the current functional group.

Tabs Bar

Four functional groups: Project, Device, Survey and Tools.



← Sat	ellite Info			
Position	Skymap	SNR	Sat Tab	
Single	20	19-09-27 1	5:13:56	
WGS84 Lat	: N31.19	0418957		
WGS84 Lor	n: E121.5	93195904		
WGS84 H:	42.665	i6m		
Local N:	3452296.7	′963m		
Local E:	556541.28	56m		
Local h:	-66.0579	m		
Satellite:	22/24	Speed: 0	).01m/s	
	Diff Dela	y: N/A		
Di	stance to l	base: N/A		
Cutoff Ang	le(°)	1	5 Set	
HRMS	0.2264	HDOP	0.60	
VRMS	0.4674	VDOP	1.40	
RMS	0.5194	PDOP	1.50	
Base Shi	fted : N	0		
Datum Trans : Yes				
Plane Adjustment : No				
Height Fi	tting : N	lo		

Figure 1.11 Satellite Info – Position

In the figure above, 'Single' indicates the current solution status of the receiver. The solution status includes Fixed, Float, DGPS, Single, Base Manual and Base Auto. Clicking the box of date and time can switch time zone, clicking 'WGS84 Lat' or 'WGS84 Lon' can switch display from options of Degree (DD.DDDDDD), DM (DD:MM.MMMM) and

DMS (DD:MM:SS.SS), clicking 'WGS84 H' or 'Local N' or 'Local E' or 'Local h' can switch unit from options of km, m, inch, and feet.

'Satellite: 22/24' indicates that 22 satellites used and 24 satellites observed / tracked.

'Speed: 0.01m/s' is the moving speed of the receiving antenna.

'Diff Delay: 1' indicates that the differential delay is 1 second.

'Distance to base: 1.52m' means the distance between rover and base is 1.52m.

Elevation Mask Angle can be set between 0 and 90 degrees. Modifying the elevation mask angle does not show a change in the number of satellites observed and used.

HRMS, VRMS and RMS indicate the horizontal, vertical and total value of root mean square.



HDOP, VDOP and PDOP indicate the horizontal, vertical and position of dilution of precision.

The last four rows of this interface present the status of base shift, datum transformation, plane adjustment and height fitting.



Figure 1.12 Satellite Info – Skymap

In the figure above, the sky map displays the elevation angle and azimuth of satellites of different satellite systems. A satellite at the center of the circle means its elevation angle is 90 degrees, a satellite on the circumference means its elevation angel is 0 degree. At the bottom of this interface, one or more constellations can be ticked to display.



Figure 1.13 Satellite Info - SNR L1



In the figure above, it shows the SNR (Signal Noise Ratio) of different satellites in specified constellation. Clicking the histogram area can switch the SNR between L1, L2 and L5.



Figure 1.14 Satellite Info - LNR L2



Figure 1.15 Satellite Info – LNR L5



Position	Sky	map	S	NR	Sa	t Tab
Туре	Pm	Azi	Ele	L1	L2	Loci
GPS	2	152	14	32	28	Usec
GPS	5	83	36	43	42	Usec
GPS	13	34	49	45	37	Usec
GPS	15	321	70	47	46	Usec
GPS	21	312	36	43	36	Usec
GPS	24	180	36	40	43	Usec
GPS	29	231	22	43	37	Used
GLONASS	38	48	27	34	36	Usec
GLONASS	39	328	45	42	42	Used
GLONASS	48	71	29	38	41	Used
GLONASS	49	128	26	38	40	Used
GLONASS	54	278	50	42	41	Used
GLONASS	55	327	17	36	39	Used
GLONASS	61	206	38	35	29	Used
BeiDou	161	147	47	36	44	Used
BeiDou	162	237	36	33	43	Usec
BeiDou	163	200	51	35	43	Used
BeiDou	164	123	34	37	42	Used
BeiDou	165	256	15	32	37	Used
BeiDou	166	294	70	39	45	Usec
BeiDou	168	173	63	41	45	Used
BeiDou	169	255	49	39	43	Used

Figure 1.16 Satellite Info – Sat Tab

In the figure above, it shows the satellite information in table which including satellite type, PRN code, azimuth, elevation angle, SNR value of L1, SNR value of L2, and satellite using status.



# 2. Project

- Project
- CRS (CooRdinate System)
- Parameters
- Point
- Line
- Import
- Export
- Settings



Figure 2.1 Functions under Project



### 2.1 Project

This section introduces how to create a new project, open / delete / edit an existing project.

#### 2.1.1 New

A new project is necessary to manage all the data. On the Nuwa main interface as shown in Figure 1.10, click [Project] - > [New] to go to the following interface.



Figure 2.2 Create Project interface

[Project Name]: input the project name

[Creator]: input the name of the operator

[Creation date]: the date and time generates automatically.

[Project Template]: use an existing project settings

[Coordinate System]/ [Source Project]: select a coordinate system if project template

is not turned on; select a source project if using a project template.





Figure 2.3 New project created

After a project is created, it will prompt out a window asking whether close the current project and open the new created project. The projects in the list are sorted in reverse chronological order. Refer to section 2.1.5 for more details about project property.

#### 2.1.2 Import

In the Figure 2.3, an existing project can be imported from the storage of the android device by clicking [Import] on the bottom left of the interface.



Figure 2.4 Project folders in an Android device

When importing projects from other sources, click [Import], select the Project folder under



TersusSurvey which is shown in Figure 2.4, and click [OK] and Nuwa imports all the projects in this folder.



Figure 2.5 Sketch file containing the project info

Note: The imported project file should have a sketch file containing the project information (Project / Project-shm / Project-wal).

#### 2.1.3 Open

If there is need to operate in an existing project, find it in the project list and click it. Nuwa prompts to open the project, click [OK].



Figure 2.6 Open an existing project

#### 2.1.4 Delete

Click [Multiselect] at the right side of Project List, select (single select, inverse select or select all) projects to be deleted. After the projects are selected, click [Delete] button to delete them. Nuwa prompts to confirm, click [OK] to complete the deletion.



Note: The current Project cannot be deleted in Nuwa app.



Figure 2.7 Delete Project

#### 2.1.5 Edit Project Property

If a project is opened, the coordinate system can be edited, including ellipsoid, projection method and coordination transformation.

← Project	
Current Project	20191018_112947 >
Project List	Multiselect
20191018_1 Beijing 1954 3- test	12947 degree GK CM 075E 2019-10-18 11:29:47
20191015_13 Beijing 1954 3- test	74543 degree GK CM 075E 2019-10-15 17:45:43
20190506_1	51805
test	2019-05-06 15:18:05
Import	New

Figure 2.8 Project List

Click the [Current Project] to enter Project Property interface.



← Project P	roperty	7	
Coord System		Project Info	
Coord System Name Ellipsoid: WGS 84 a: 6378137.0 1/f:298.25723563 Projection method: False North(m): 0.00 Central Meridian(*): Origin Lat(*): 0.000 Positive Direction: £ Use seven paramete Dx(m): 0.0000 Dy(m): 0.0000 Dy(m): 0.0000 Use four parameters dDX(m): 0.0000 Use four parameters dDX(m): 0.0000 Rotation Angle: 0.01 Scale: 1.0000000R	: WGS84 Transver: 0000 0000 000000 East/Nort rs: No Rx(s): Ry(s): Rz(s): 00000 : No	k Se_Mercator 000000 h 0.000000 0.000000 0.000000	
Edit			
$\triangleleft$	0		

Figure 2.9 Project Property

Click [Edit] to input the ellipsoid parameters, projection type and coordination transformation, refer to section 2.2.2 for details.



Figure 2.10 Share Project Info

Click [Share] to share the project parameters with others. The detailed usage refers to section 2.2.1.

## 2.2 CRS (CooRdinate System)

Nuwa app supports user-defined coordinate system. A user-defined coordinate system can be saved as a template. A CRS can be created, imported, edited and deleted in the CRS management interface.



On the Nuwa main interface as shown in Figure 1.10, click [CRS] to get the coordinate system list which is shown below.

←	Coordinate Syst	tem
Coord	System List	Multiselect
В	J54.csd	
Ø	/GS84.csd	

Import	New	Edit

Figure 2.11 Coordinate System List

#### 2.2.1 New CRS



Figure 2.12 Create a new CRS

Click [New] to create a new CRS, input the coordinate system name, select the right ellipsoid, projection, datum transformation, plane adjustment, and height fitting, refer to the following screenshots:



Ellipsoid list	Multiselect
WGS 84	
a:6378137.0	1/f:298.257223563
Krassovsky 1942(BJ54)	
a:6378245.0	1/f:298.3
CGCS2000	
a:6378137.0	1/f:298.257222101
IAU 1976	
a:6378140.0	1/f:298.257
Bessel 1841	
a:6377397.155	1/f:299.1528128
Clarke 1880 mod.	
a:6378249.145	1/f:293.4663
WGS 60	
a:6378165.0	1/f:298.3
WGS 66	
a:6378145.0	1/f:298.25
WGS 72	
a:6378135.0	1/f:298.26

Figure 2.13 Ellipsoid list

[Ellipsoid]: Select the correct ellipsoid parameters, including ellipsoid name, semi-major axis, inverse flattening, etc. For a predefined ellipsoid, it automatically fills the semi-major axis and inverse flattening after selecting the ellipsoid; if the ellipsoid that meets the requirements is not found in the predefined ellipsoid, and you have the parameters of the ellipsoid, you can [Add] an ellipsoid to the list, enter your parameters and select it; If the ellipsoid that meets the requirements is not found in the predefined ellipsoid and you do not have the parameters for this ellipsoid, please contact Tersus technical support.

Note: The default ellipsoid is WGS84.

← Create Coo	ordinate Syst	문			
Coord System Input					
Ellipsoid Projection	Datum Trans	Plane A			
Projection	Transverse_Mer	cator >			
Origin Lat(°)	0.0	U			
Central Meridian(°)	117.0	U			
False North(m)		0.0			
False East(m)	5000	00.0			
Scale		1.0			
X->North		0			
Y->East		0			
ок					

Figure 2.14 Projection interface

[Projection]: Including Transverse Mercator, UTM, Lambert conformal conic 1SP, Lambert





conformal conic 2SP, and etc which is listed as below. If the required projection is not found in the predefined projection list, please contact Tersus technical support.

1	None	0	
Pr	Albers_Conic_Equal_Area	0	>
Or	Bonne	0	;
	Equidistant_Conic	0	
Le	Lambert_Conformal_Conic_1SP	0	1
Fa	Lambert_Conformal_Conic_2SP	0	)
Fa	Mercator	0	)
Se	Polyconic	0	,
	Transverse_Mercator	۲	
x	Universal_Transverse_Mercator	0	
I	Cassini(Cassini-Soldner)	0	
x	Oblique Stereographic Alternative	0	)
Y	Stereographic	0	)
	Transverse Cylindrical Equal Area	0	

Figure 2.15 Projection list

Origin latitude, central meridian and other parameters can also be configured in Projection interface which is shown above. Fill in these information according to the actual needs. Turn on  $[X \rightarrow North]$  to indicate that the positive part of X axis is north, negative part is south. Turn on  $[Y \rightarrow East]$  to indicate that the positive part of Y axis is east, negative part is west.



Figure 2.16 Datum transformation options



[Datum Transformation]: Datum transformation is necessary when the source ellipsoid is different from the target ellipsoid. There are three options: No parameter, Bursa Parameters and Molodensky Badekas Parameters.

← Create	e Coordinate	Syst	5
Coord System	nput		
id Projection	Datum Trans	Plane A	djustme
Transformatio	n Burs	a Parame	ters >
Dx(m)		0.000	0000
Dy(m)		0.000	000
Dz(m)		0.000	0000
Rx(s)		0.00000	000
Ry(s)		0.00000	0000
Rz(s)		0.00000	0000
Scale(ppm)	0.0	0000000	0000
	ОК	-	

Figure 2.17 Bursa Parameters

[Bursa Parameter]: Axis shift, rotation and scale would be introduced in the datum transformation. Bursa-Wolf seven-parameter model is used from local coordinate to WGS84 system. At least three known points are necessary for accurate transformation. Only X/Y/Z shifts are required only if three parameter transformation is needed.

← Cre	ate Coordinat	e Syst	8
Coord Syster	<b>n</b> Input		
Datum Trans	Plane Adjustm	ent Heig	ht Fitting
PlaneGridNo	orth		>
PlaneGridEa	ist		>
Parameters	Calibrarion	No Paran	neter >
	ок		



Figure 2.18 Plane adjustment interface

Figure 2.19 Plane adjustment options



[Plane Adjustment]: Plane adjustment is for the transformation between two planes. There are two options for parameters calibration: No parameter and 4 parameters. The detailed information and usage of plane grid refer to section 2.2.5.

← Create Coordii	nate Syst 📋
Coord System Input	
Datum Trans Plane Adjus	tment Height Fittin
PlaneGridNorth	>
PlaneGridEast	>
Parameters Calibrarion	4 Parameters >
Dx(m)	0.0000
Dy(m)	0.0000
Rotation Angle(s)	0.0000000000
Scale	0.0000000000
ок	

Figure 2.20 4 Parameters

[4 Parameters]: X/Y axis shift, rotation angle and scale are necessary to be input as above.

ite Coordinate	e Syst 📋
Input	
lane Adjustment	Height Fitting
	>
Fitting	No Parameter >
	te Coordinato

Figure 2.21 Height fitting interface

Figure 2.22 Parameters fitting options

[Height Fitting]: Height fitting has two options: Geoid and Parameters Fitting. Parameters


fitting includes no parameter and detailed parameters fitting.

[Geoid]: Geoid supports .ggf, .grd, .gsf, and .osgb format files, the detailed information and usage of geoid files refer to section 2.2.5.

[Parameters Fitting]: currently three algorithms are supported: fixed difference correction, plane fitting and surface fitting.

← Create Coordi	inate Syst 🖯	
Coord System Input		
tum Trans Plane Adjustr	ment Height Fitting	J
Geoid	>	>
Parameters Fitting	Parameters Fitting >	>
A0	0.0	
A1	0.0	
A2	0.0	
A3	0.0	
A4	0.0	
ок		

Figure 2.23 Height Fitting – Parameters Fitting

After setting all parameters to create a new coordinate system, click [OK] to complete the configuration.

Click the scan icon in the top right corner of Figure 2.12, open the camera to scan other surveyor's coordinate system parameters QR code to copy information for creating a new CRS.





Figure 2.24 Scan QR code to get CRS info

The following shows detailed steps:

- The copied surveyor opens in turn: [Project] -> [Current Project] -> [Project]
   Information], then displays the complete QR code;
- 2) The current surveyor opens the camera when creating new CRS to scan the QR code displayed as shown in Figure 2.24 above and can copy its coordinate system parameters. The QR code screenshot in photo album can also be scanned to obtain the CRS parameters.

← c	reate Coor	dinate Syst	5
Coord Syst	em WGS	584	
Ellipsoid	Projection	Datum Trans	Plane A
Ellipsoi	d CGCS200	00	>
a:	6378137	7.0	
1/f:	298.257	222101	
	0	к	

Figure 2.25 CRS info obtained by scanning QR code

3) The coordinate system parameters are obtained as shown in the figure above.



## 2.2.2 Import CRS

Click [Import] on the bottom left of CRS interface which is shown in Figure 2.11, it shows predefined coordinate systems for users to choose.

← Predefined Coord	dinate syst
Continent	Africa >
Region	Algeria 🗦
Preview	Select

Figure 2.26 Predefined CRS

In the figure above, the predefined coordinate systems are classified by continent and region.

← Predefined Coordi	nate syst
Continent	Africa >
Region	Algeria >
Africa	۲
America	0
Asia	0
Europe	0
Oceania	0
World	0
Select	

Figure 2.27 Continent options

The continent option includes Africa, America, Asia, Europe, Oceania and World as shown in the figure above. Select a continent, a country or a region, then select a CRS and click [Preview].

← Pre	view Coo	ordinate Syste	em
Coord Syste	<b>n</b> Beiji	ng 1954 3-degi	ree GK
Ellipsoid F	Projection	Datum Trans	Plane A
Ellipsoid	Krassovs	sky 1942(BJ54)	>
a:	6378245	5.0	
1/f:	298.3		
	0	к	

Figure 2.28 Preview of predefined CRS

Figure 2.28 is a preview of 'Beijing 1954 3-degree GK CM 075E' coordinate system. Click [OK] and [Select] this CRS, the CRS file is imported to Coordinate System List as shown in Figure 2.29.

÷	Coordinate Syste	m
Coord	System List	Multiselect
€ C	Beijing 1954 3-de 175E.csd	gree GK CM
E	J54.csd	
€v	VGS84.csd	

Import	New	Edit

Figure 2.29 Example of CRS import

If the user cannot find the coordinate system of their country or region, but has ellipsoid, projection, datum transformation and other related parameters, you can create a new coordinate system or contact Tersus technical support and we help you create one.



## 2.2.3 Edit CRS

Click an existing CRS and click [Edit] to enter the Edit Coordinate System interface, refer to the following screenshot:

← Edi	t Coordin	ate System	
Coord Syste	<b>m</b> WGS	84	
Ellipsoid	Projection	Datum Trans	Plane A
Ellipsoid	WGS 84		>
a:	6378137	.0	
1/f:	298.2572	223563	
	0	к	

Figure 2.30 Edit Coordinate System

### 2.2.4 Delete CRS

The default two CRS cannot be deleted. Click [Multiselect] to select the CRS to be deleted and click [Delete] to finish the deletion.

← Coordinate System	ı
Coord System List	Cancel
WGS84.csd	
BJ54.csd	

Select All	Inverse	Delete
------------	---------	--------

Figure 2.31 Delete CRS



#### 2.2.5 Plane Grid and Geoid

Plane Grid and Geoid are adjustment methods for plane and height, which can improve survey accuracy.

Plane Grid includes plane grid north and plane grid east. Click [PlaneGridNorth] in Figure 2.18 Plane adjustment interface, it enters plane grid north list shown as below. Click [More] to enter download list, the plane grid files can be downloaded from online server. Click [Refresh] to view the current available plane grid files. The plane grid file supports .ggf, .grd, .gsf, and .osgb format. If customer cannot find suitable plane grid file, feel free to contact Tersus support via email support@tersus-gnss.com.

<del>~</del>	Geoid download	
Downl	oad List	
Greece th.grd	_HEPOS_dNor	46*91
Latitude Longitu	e [43.4,48.5 de [19.9,30.1	5] C ] C
OSTN1 ataFile	5_OSGM15_D .OSGB	1250*70
Latitude	[0.0,125000	0.0] 10
Longitu	de [0.0,700000	0.0] 10



Figure 2.33 Plane Grid download list

After downloading a required plane grid file, select it in the plane grid list and it returns to the plane adjustment interface.

Setting the PlaneGridEast is the same with the above method of setting PlaneGridNorth.

Geoid supports .ggf, .grd, .gsf, and .osgb format files, it optimizes data loading, reduces waiting time for different devices, simplifies algorithm calculation process and saves system resources. In a CRS setting, click [Geoid] under Height Fitting tab enter Geoid list which is shown as below. The list shows the coverage latitude, longitude and resolution of



the corresponding geoid model. Click [More] to enter download list, the geoid files can be

downloaded from online server.

÷	Geoid		
Curren	t Geoid		
Geoid	List		
IONE			
GM96	.ggf	72	1*1441
atitude	de	[-90.0,90.0]	0.250
longitu		[0.0,000.0]	0.200
Ref	resh	More	Select
	Figure	2.34 Geoi	d list

Click [Refresh] to view the current available geoid files. Contact Tersus Technical Support <u>support@tersus-gnss.com</u> to inquire more if customer cannot find suitable Geoid files. After downloading a required geoid file, select it in the geoid list and it returns to the height fitting interface.



Figure 2.36 Explore Geoid folder in the android device



Another method of importing geoid files: manually copy and paste the Geoid files under the Geoid folder of TersusSurvey as shown above, back to the Geoid list interface and click [Refresh] to view the available Geoid list as shown below.

Geoid List		
Geold List		
NONE		
EGM96.ggf	72	1*1441
Latitude	[-90.0,90.0]	0.250
ongitude	[0.0,360.0]	0.250
GM08-25.GGF	432	21*8640
atitude	[-90.0,90.0]	0.042
ongitude	[0.0,360.0]	0.042

Figure 2.37 Refresh to view the Geoid list

More

Select

Refresh

Select one suitable Geoid model and click [Select] to complete the Geoid configuration, and it returns to the height fitting interface.

### 2.3 Parameters

Seven Parameter and Three Parameter methods are introduced in this section.

Seven Parameter: this method can cover long distance range, generally more than 50 km.

At least three known points are required in local datum and in WGS84 system before calculating.

Three Parameter: at least one known point is required. This method can cover short distance range; the accuracy is determined by working area and decreased with the distance.

The following is an example of Seven Parameter. Click [Project] -> [Parameters] to enter the following interface.



← Parameters Calculation				
Calculate	Туре	Seven parameter >		
-	and a standard as an			
points*	ence calculation red	quires at least 3		
o features	ence calculation red	Multiselect		



Figure 2.38 Parameters Calculation

Select seven parameter for Calculate Type, click [Add] on the bottom left to input the known points.

$\leftarrow$ Add Point				
Source Coord				
Point Name	Point1 💡	I		
Lat(°)	31.11366366	U		
Lon(°)	121.41802714	U		
Height(m)	33.415			
Target Coord				
Point Name	CPT3	:=		
N(m)	3443651.	4325		
E(m)	39876.	1074		
h(m)	33	.415		
	ок			

Figure 2.39 Add Point for calculation

For the Source Coordinate, input Latitude, Longitude and Height by manual input, collected from a Tersus receiver or selected from the survey point list. For the Target Coordinate, input the local values from manual input or selected from the control point list.



#### Manual input

Input the point position according to the format required. The latitude/longitude format can be changed by clicking the U icon on the right.

Point library

Click [<sup>i=</sup>] to load points from point library. Points can be added by clicking [Add] in the Point interface.

• Smooth Acquisition

Click [ 9] to start smooth acquisition through Tersus receiver.

After points are added, click [Calculate] on the bottom right to do the parameter transformation. The result is shown as below screenshot:

← Result:	
Dx(m)	-30.007731
Dy(m)	-43.482974
Dz(m)	-70.657506
Rx(s)	-1.266068
Ry(s)	-2.440565
Rz(s)	1.498273
Scale(ppm)	3.6787135455
Max.HRMS	1.5829 NO.: 3
Cancel	Apply

Figure 2.40 Parameters Calculation Result interface

Note: Before this calculation, please make sure that the project parameters (ellipsoid, projection, etc.) are used correctly.

After the calculation is completed, click [Apply] to apply to the datum transformation parameters of the current project coordinate. When Max.HRMS is too large, the software will prompt a notice of whether continue to apply if the value is too large; if you click [Cancel], it will not be applied to the datum transformation parameters.



# 2.4 Point

Point library includes survey point library, control point library and stakeout point library. Points can be added into a library. Editing, searching and checking detail information can be done under this Point interface.

← F	oint		Q	
Survey Point Control Point Stakeout Point				
6 features		Mu	ltiselect	
id	Name	Point Type	Code	
S2	Base_0	Base		
S9	PT1	Detail	Line0	
S5	1	Input		
S6	Base_1	Base		
S7	Base_2	Base		
S8	PT2	Detail	Line0	



Figure 2.41 Point Interface

A point can be imported into the control point library or the stakeout point library. In the point library interface, slide in the left or right direction to check the point information, such as coordinates, collection time, and etc.

### 2.4.1 Add Point

Under the Point interface, click [Add] to enter the Add Point interface. The following figures take the control point as an example.

← Point			Q	
Survey P	oint	Contro	l Point	Stakeout Point
1 features			_	Multiselect
id	1	Name		Ν
1		C16	3462	2967.1757

٨dd	Edit	Import
Aaa	Εαιτ	impoi

Figure 2.42 Control Point interface

← Add Control Point	≣
Name	Input
Coord Type	NEH >
N(m)	Input
E(m)	nput
h(m)	Input
ок	

Figure 2.43 Add Control Point

Choose the coordinate type (including two types: BLH and NEh), input the point name and the coordinate values, or click the upper right icon to import the survey point directly.



<ul><li>← s</li></ul>	Survey Poin	t	
6 features		Mu	ltiselect
id	Pt	Point Type	Code
1	Base_0	Base	
2	Base_1	Base	
3	PT1	Detail	
4	PT2	Detail	
5	PT3	Detail	
6	PT4	Detail	

Add	Edit	Detail	Select

Figure 2.44 Import Survey Point

Under the Stakeout Point interface, adding stakeout point is similar with that of adding control point.

### 2.4.2 Search Point

1 features			
			Multiselect
id	Name		Ν
1	C16	3462	2967.1757

Add	Edit	Import

Figure 2.45 Control Point interface

Click the up-right I icon to enter Point Query interface which is shown in the figure above. Target Points can be survey points, control points or stakeout points.



← Point Query	
Target Points	Survey Points >
Query Condition	
Point Type	Detail >
Name	Input
Code	Input
Base	Input
Start Time	
	Ē
Stop Time	
	<b>(</b>
Select All Inverse	ок

Figure 2.46 Point Query interface

Query condition details are as follows:

[Point Type]: Detail, continuous, input point, calculate or base.

[Name]: Point name to be queried.

[Code]: Code number.

[Base]: The name of the base.

[Start/Stop Time]: Start and stop time of the points

Click [OK] to search all the points meeting the query conditions.

#### 2.4.3 Edit Point

Choose the points to be edited, and click [Edit] to enter the Edit interface.

Note: There is an exception that in the Survey Point tab, only the code info can be edited apart from the manual input points.



← Pc	oint		Q
Survey Poi	nt Control	Point	Stakeout Point
1 features			Multiselect
id	Name		N
1	C16	3462	2967.1757

Add	Edit	Import
Auu	Luit	

Figure 2.47 Control Point interface

← Edit C	ontrol Point	≣
Pt		TRSA
Coord Type		NEH >
N(m)	345	52237.3289
E(m)		253647.8
h(m)		23.85
	ОК	

Figure 2.48 Edit Control Point interface

Editing Stakeout Point is similar with the steps of editing control point.



## 2.4.4 Import Point

Survey Po	oint	Contro	Point	Stakeout Point
1 features				Multiselect
id	٢	Name		N
1		C16	3462	2967.1757

Add	Edit	Import
Auu	Eult	import

Figure 2.49 Control Point interface

Under the Control Point interface, click [Import] at the bottom right corner and then [Data Format].



Figure 2.50 Data format list

Select a format in the pop-up list which is shown in the figure above.



← Import Data	
Туре	Point >
Target Point	Control Point $\geq$
Data Format	Name, N, E, H $>$
File Format	.csv >
Column Header	
File Path	
/storage/emulated/0	
Preview	Import

Figure 2.51 Import Data info

Select file format and file path to import points. Then click [Import] to import the required points.

Under the Stakeout Point interface, click [Import] at the bottom right corner, select a source in the pop-up list. Choosing [From File] leads to the similar steps of importing Control Point. Choosing [From Survey Point] leads to the Figure 2.53 below. One or more points can be selected and imported as Stakeout Points.



Figure 2.52 Import source for Stakeout Point



13 feature	S		Cancel
id	Name	Point Type	Code
□1	Base_0	Base	
2	PT1	Detail	
3	PT2	Detail	
4	Base_1	Base	
5	PT3	Detail	
6	PT4	Detail	
7	PT5	Detail	
8	PT6	Detail	

Figure 2.53 Import from Survey Point

#### 2.4.5 Delete Point

Click [Multiselect] in the point interface to enter the following interface. Select the points to be deleted and click [Delete] to complete the deletion.

Survey Po	oint int Contro	l Point	Stakeout Point
l features			Cancel
id	Pt		x
□1	TRSA	3452	237.3289

Figure 2.54 Delete Point interface

# Note: The base point in the survey point library cannot be deleted.



# 2.5 Line

New lines can be added, existing lines can be searched, edited and deleted.

#### 2.5.1 Add Line

Click [Project] -> [Line] to enter the line interface. It shows Survey Line and Stakeout Line.

← Li	ne		Q
Surve	y Line	Staked	out Line
4 features			Multiselect
Name	Code	Start Point	End Point
Line0		PT1	PT4
Line1		PT5	PT14
Line2		PT15	PT21
Line3		PT22	PT67

Add	Detail
1.000	

Figure 2.55 Line interface

Click [Add] under Survey Line to enter the following interface.

← Ad	d Line	
Name		Line4
Code		Input
0 features		Multiselect
Name	Code	Length(m)

Add	Return

Figure 2.56 Add survey line interface

Input a line name or use the default name, input a code for comment purpose, click [Add] in the bottom left to select two points in the survey point library as below.

← s	urvey Poin	t	
74 features	3	Mu	ltiselect
id	Name	Point Type	Code
S1	Base_0	Base	
S2	PT1	Continuous	Line0
S3	PT2	Continuous	Line0
S4	PT3	Continuous	Line0
S5	PT4	Continuous	Line0
S6	PT5	Continuous	Line1
S7	PT6	Continuous	Line1
S8	PT7	Continuous	Line1
S9	PT8	Continuous	Line1
Add	Edit	Detail S	elect

Figure 2.57 Select two points from survey point library - 1

← Ad	d Line	
Name		Line4
Code		test
2 features		Multiselect
Name	Code	Length(m)
PT71		
PT72		0.0014

Add	Return
-----	--------

Figure 2.58 Select two points from survey point library – 2

Click [Return] and the new survey line has been added as below.

Survey	Line	Stakeout	Line
3 features		N	lultiselect
Name	Code	Start Point	End Poir
Line0	test	PT1	PT2
Line1	test	PT2	PT3
Line2	test	PT3	PT6

۸dd	Detail

Figure 2.59 Survey line added



The added survey line can be viewed under [Survey]-> [Point Survey] shown as below.



Figure 2.60 Survey line in survey interface

Click [Add] under Stakeout Line to enter the following interface, there are two methods.

÷	Add Stakeout I	_ine
Line Ty	/pe	Line >
Metho	d	Two point form >
Name		StakeLine1
Start P	Point	1
End Po	pint	:=
Start M	lileage	0
Stakeo	out Interval(m)	1
Offset	(m)	0
Descrit	be	
	ок	

Figure 2.61 Add stakeout line method 1



← Ac	d Stakeout Line
Line Type	Line >
Method	One point + Azimuth + Distance >
Name	StakeLine1
Start Point	:=
Start Milea	<b>ge</b> 0
Stakeout I	nterval(m) 1
Offset(m)	0
Length(m)	Input
Azimuth(d	Input
Describe	
	ок

Figure 2.62 Add stakeout line method 2

Two methods of adding a stakeout line: Two Points and One point + Azimuth +Distance.

• Two Points:

Input the name of the line, then click  $\equiv$  to import the start point and end point.

• One point + Azimuth + Distance

Input the name of the line, then click  $\equiv$  to import the start point from a point library. Input the other information for the line.

#### 2.5.2 Search Line

Click the **Q** icon at the up-right corner, the line query interface is shown as below. Input the search items and tick the item, click [OK] to search the line.



← Line Que	ry	
Query Condition		
Name		Input
Start Point		Input
End Point		Input
Length	0.0 -	0.0
	ОК	

Figure 2.63 Line Query interface

#### 2.5.3 Edit Line

In the Line interface, select the line to be edited. Then click [Detail] to enter the edit page, editing survey line is shown as below.

← Lin	e Detail	
Name		Line2
Code		test
2 features		Multiselect
Name	Code	Length(m)
PT3		(m)
PT6		0.0719

Add	Return

Figure 2.64 Edit a survey line 2

If not selecting a point, click [Add] to add a point at the end shown as Figure 2.65; if selecting a point, then click [Add] to insert a point before the selected point shown as Figure 2.67. After adding the point, the length will be recalculated, and then enter the survey interface to find that the added point is connected to the line shown as Figure 2.66 and Figure 2.68.



← Lin	e Detail	
Name		Line2
Code		test
3 features		Multiselect
Name	Code	Length(m)
PT3		
PT6		0.0719
PT5		0.0655



Figure 2.65 Add PT5 to the line end

Return

Add

Code		tes
3 features		Multisele
Name	Code	Length(m)
PT3		-
PT5		0.1200
PT6		0.0655

Figure 2.67 Add PT5 before PT6

Figure 2.66 The new Line2 in survey interface



Figure 2.68 The new Line2 in survey interface

Click [Multiselect] to select a point and click [Delete]. After the deletion, the length will be recalculated, and then enter the survey interface to find that the deleted point is no longer connected to the line. For example, after deleting PT5 in Line2, this point PT5 is no longer in Line2 shown as below.

Note: After deleting the point in the line, the point and its information will be retained in the point library. It exists as a point, but it is no longer connected to the line.

:=

► 0

556542.2909m>

12:40:06>

0.1166>

PT6



odetestreaturesCancelNameCodeLength(m)PT3PT6Image: Colspan="2">Image: Colspan="2">Image: Colspan="2">Image: Colspan="2">Image: Colspan="2">Image: Colspan="2"PT6Code.PT5Image: Colspan="2">Image: Colspan="2"Image: Colspa	test ures Cancel me Code Length(m) 273 C. Color 275 C.	ame		L	ine2
CancelNameCodeLength(m)PT3GodeGodePT6GodeGodePT5GodeGode5	uresCancelmeCodeLength(m)PT3-PT60.0719PT50.0655	de			test
Name         Code         Length(m)           PT3         -         -           PT6         -         0.0719           PT5         -         0.0655	me         Code         Length(m)           PT3         -         -           PT6         0.0719         -           PT5         0.0655         -	eatures			Cancel
PT3       .         PT6       0.0719         PT5       0.0655	PT3     -       PT6     0.0719       PT5     0.0655	Name	Code	Length(m)	
□ PT6     0.0719       ☑ PT5     0.0655	0.0719       PT5     0.0655	PT3		0 <b>7</b> 0	
<b>PT5</b> 0.0655	275 0.0655	PT6		0.0719	
		🖾 PT5		0.0655	

Figure 2.69 Delete PT5 in Line2

Figure 2.70 Line2 after deleting PT5

If editing a stakeout line, just select the stakeout line, click [Detail] to enter the edit page and edit the line parameters shown as below.

Cupue	Line	Ctokeout Lie	
Surve	/ Line	Stakeout Lir	le
1 features		Mult	iselect
Name	Start Point	End Point	Lenç
test	PT1	PT4	0.06



Figure 2.72 Edit a stakeout line

#### 2.5.4 Delete Line

In the Line interface, click [Multiselect] to enter the following interface. Tick the line to be deleted, then click [Delete] to complete deletion.

← Lin	e		Q
Survey Line 5 features		Stakeout	: Line
		Multiselect	
Name	Code	Start Point	End Poir
Line0		PT1	PT4
Line1		PT5	PT14
Line2		PT15	PT21
Line3		PT22	PT67
Line4	test	PT71	PT72

Figure 2.73 Line interface

← Lir	ne		Q
Survey Line		Stakeo	ut Line
5 features			Cancel
Name	Code	Start Point	End Point
Line0		PT1	PT4
Line1		PT5	PT14
Line2		PT15	PT21
Line3		P⊤22	PT67
🗾 Line4	test	P⊤71	PT72



Figure 2.74 Tick the line to be deleted

# 2.6 Import

There are two types of import: Coordinate Import and Other Import. Coordinate import is to import files with .csv and .dat format. Other Import is to import files with .dxf, .shp and .sima format.

2.6.1 Coordinate Import



Under the Coordinate Import interface, select Type, Target Point library to be added, Data Format, File Format and the file path where the file is located, click [Import] to complete the import.

← Import	
Coord Import	Other Import
Туре	Point >
Target Point	Control Point $\geq$
Data Format	Name, N, E, H $\geq$
File Format	.csv >
Column Header	
File Path	
/storage/emulated/0	
Preview	Import

Figure 2.75 Import interface

The figure above shows the parameters that should be selected or filled for coordinate import.

← Import		
Coord Import	Other Import	
Туре	Point >	
Target Point	Control Point >	
Data Format Point	Name N F H >	
Fi	0	
File Path		
Im	port	

Figure 2.76 Import Type

For point import, select [Point] for Type as shown above.





Figure 2.77 Target Point Library

The target point library has two options: control point and stakeout point as shown above.

÷	- Import		
F			1
Т	Name, N, E, H	۲	>
	Name, Code, N, E, H	0	
Та	Name, B, L, H	0	>
Da	Name, Code, B, L, H	0	>
Fil	Name N E H	0	>
H	Name Code N E H	0	H
Co	Name B L H	0	
Fi	Name Code B L H	0	
/st	CASS	0	
	User defined	0	
	Preview	Import	

Figure 2.78 Data Format options

The data format options for data import are listed in the figure above.



← Import	
Coord Import	Other Import
Туре	Point >
Target Point	Control Point >
Data Format .CSV	Name N F H >
Fi .dat	0 >
File Path	
	mport

Figure 2.79 File Format options

There are two options for file format of imported points: .csv and .dat files.

← Import	
Coord Import	Other Import
Туре	Line >
File Format	.Inb 🗧
File Path	
Imp	port

Figure 2.80 Import Line interface

For line import, select [Line] for Type in Figure 2.76 and it goes to the import line interface as shown in Figure 2.80 above. The file format for line is .lnb file.

The line file is a text file with the .Inb extension in nature. The detailed content in the text file is shown as below. The information from left to right is: starting point name, starting point N, starting point E, starting point h, 0, ending point name, ending point N, ending point E, ending point h, 0, 0.

5K+250-1,3453407.198,496492.9505,0,0,5K+250-2,3453312.565,496460.4625,0,0,0 5K+300-1,3453388.743,496542.6277,0,0,5K+300-2,3453300.967,496507.4977,0,0,0 5K+350-1,3453368.497,496589.9064,0,0,5K+350-2,3453277.249,496550.8326,0,0,0

Figure 2.81 Example content in the .Inb file

# 2.6.2 Other Import

Under the Other Import interface, select the file type and the file path, click [Import] to import the file. Currently this function is not support and is to be developed.

← Import	
Coord Import	Other Import
File Type	dxf >
File Path	
	Import

Figure 2.82 Other Import interface

4	- Import	
	Coord Import	Other Import
File Format		DXF >
Fi	le Path	
	DXF	•
	SHP	0
	SIMA	0
		Import

Figure 2.83 File Type for other import



# 2.7 Export

Correspondingly there are two types of export: Coordinate Export and Other Export. Coordinate Export is to export .csv files whose file name extension can be modified as .dat; Other Export is to export files with .kml, .shp, .dxf, .html, .xml and .sima format.

### 2.7.1 Coordinate Export

Under the Coordinate Export interface, select Point Type, Date range and Data Format, ensure the File Name and Storage Path is correct.

Coord Export		Other Export	
Point Type	Continuous	Calculation	
	Control	Stakeout	
Date	-		
Data Format		Name , N , E , H >	
File Name Export_20180807102229.csv			
Storage Pat	th		
/storage/emulated/0/TersusSurvey/ Projects/20180803_142251/Export			
	Evnor		

Figure 2.84 Export Interface

Thereafter click [Export] to complete the export.



÷	Export	
	Name , N , E , H	۲
Pc	Name , Code , N , E , H	0
	Name , B , L , H	0
Da	Name , Code , B , L , H	0
	Name N E H	0
	Name Code N E H	0
Da	Name B L H	0
Fi	Name Code B L H	0
St	CASS	0
Pre	User defined	0
	Export	

Figure 2.85 Data Format options

For Data Format, the user-defined format can be created or managed. Click [User defined] and it prompts out an option for data format: create data format and manage data format which are shown as below.



Figure 2.86 User defined data





Ontion		Selected
Name		ocieoteu
Code	>	
N	<	
E		
view		

0	
Option	Selected
Name	
Code	
N <	
E	
eview	

Figure 2.87 Create data format

Figure 2.88 Manage data format

### 2.7.2 Other Export

Under the Other Export interface, file format can be KML, SHP, DXF, HTML, XML or SIMA. Type in the export file name and click [Export] to complete the file export. Please be noted that KML file is the BLH coordinate under the WGS84 coordinate system, SHP / DXF file is the NEH format coordinate under the local coordinate system, HTML file contains task information, coordinate reference system and survey points, XML file supports EZSurve import.

← Expo	rt	
Coord Export		Other Export
File Format		KML >
File Name	Expo	ort_20180807102229
Storage Path		
/storage/emulated/0/TersusSurvey/ Projects/20180803_142251/Export		
Export		

Figure 2.89 Other Export interface



÷	- Export	
	Coord Export	Other Export
Fil	e Format	KML >
Fi St /st 20	KML SHP DXF	<ul> <li>Image: Constraint of the second second</li></ul>
l	HTML XML SIMA	0
	Exp	ort

Figure 2.90 File Format for other export

If selecting XML for the file format, select start date and stop date of the Stop&Go survey to ensure the XML file recorded the correct stop points during the Stop&Go survey work.

← Expor	t			
Coord Export		Other Export		
File Format			XML >	
File Name Export_20191104154958			4958	
Start Time				
Stop Time				
Storage Path  /storage/emulated/0/TersusSurvey/Projects/ 20191104_154939/Export				
Export				

Figure 2.91 Export XML file

Copy the XML file to a computer and open this XML file using a text reader software. Change the rover observation file name on the fifth row to the rover Rinex file name which is shown as below.





Figure 2.92 Preview of the XML file in text mode

Import the base observation file, rover observation file and the edited XML file to EZSurv application, and EZSurv will identify these files successfully.



# 2.8 Settings

Settings interface is shown as below, the function descriptions is as follows.

Degree(DD.DDDDDDDD) >
m >
Square.M >
$\bigcirc$
1.0.2.3
(UTC+08:00) >
English >
$\bigcirc$

Figure 2.93 Settings interface

[Coord Display]: can be selected from degree (DD.DDDDDDDDD), DM (DD:MM.MMMM) or DMS (DD:MM:SS.SS).

[Length Unit]: can be selected from Km, meter, Inch or Feet.

[Area Unit]: can be selected from Mu, Square Km, Square Meter, Hectare and Acre.

[Normally On]: the screen would be always on if it is enabled.

[Update Detection]: Auto update detection is on if it is enabled.

[Version]: the current version of the Nuwa app.

[Zone]: select the time zone according to the current position.

[Language]: support Auto, Chinese, English, French, Spanish, German, Portuguese, Italian, Russian, Japanese, Korean, Malay, Arabic, Thai, and Turkish.

[Location Sharing]: if it is enabled, it will automatically jump to the android system setting interface. Select Nuwa for the mock location app, the location would be shared with other apps.




- 3. Device
- Connect
- Data Terminal
- Base
- Rover
- Device Info



Figure 3.1 Functions under Device



# 3.1 Connect

There are two ways to enter the Connect interface: Click [Device] -> [Connect] or click

[ ] on the up right corner in the status bar. Screenshots and descriptions are as follows.



Figure 3.2 Device functional group



Figure 3.3 Connect interface - David



← Connect	-3337-	
Device Type	Oscar >	
Connect Type	Bluetooth >	
Connect Config	TersusGNSS-12378920 >	
Antenna	OSCAR >	
C	Connect	

Figure 3.4 Connect interface – Oscar

[Device Type]: can be selected from David, Oscar or NMEA<sup>1</sup> devices.

[Connect Type]: can be selected from USB or Bluetooth.

[Connect Config]: shows the device name to be connected

[Antenna]: can be selected from the antenna list. An antenna with user-defined parameters can be added and selected.

Note: NMEA devices should be able to output one of following data: GGA / GSA / GSV / GST / RMC/ RANGEB.



Figure 3.5 Two connection types for David



- USB connection: David can be connected to an android device using a 'USB Type A Female to USB (Micro+Type C) OTG cable' in the package. The detailed connection refers to User Manual for David GNSS Receiver.
- Bluetooth connection: David can be connected to an android device via wireless method – Bluetooth using 'COMM1-Bluetooth module' in the package.
  - Add Bluetooth to the list: select Bluetooth for the [Connect Type], click [Connect Config] and [Search], choose the Bluetooth module to be paired.

← Bluetooth
Bluetooth
Available Device(s)
TersusGNSS-51892111_84:EB: 18:35:52:DD
TersusGNSS-51800001_84:EB: 18:35:F0:83
DUA-AL00_B8:94:36:18:75:72
Unknow_5E:1E:09:91:9F:1C
BT420A-00037_90:0C:84:00:9F:E9
Unknow_43:AF:36:D1:AB:1E
TersusGNSS- 51800524_50:72:24:61:E3:12
DESKTOP-8EHSGCC_FC:01:7C:78:ED:98
HUAWEI Mate 30 Pro 5G_AC:E3:42:16:A3:19
Searching

Figure 3.6 Bluetooth searching



Figure 3.7 Bluetooth is pairing



Bluetooth	
Paired Device(s)	
TersusGNSS-51800001_84:EE 18:35:F0:83	3:
Available Device(s)	
TersusGNSS-51892111_84:EE 18:35:52:DD	3:
TersusGNSS-12378904_84:EE 18:35:53:EF	3:
Unknow_73:48:9D:45:A3:B4	
DUA-AL00_B8:94:36:18:75:72	
Unknow_5E:1E:09:91:9F:1C	
BT420A-00037_90:0C:84:00:9	F:E9
Unknow_52:B9:E6:78:35:B5	
Halman 40.45.04.01.40.15	
Cased	

Figure 3.8 Bluetooth paired

2) Remove paired Bluetooth: long press the paired Bluetooth name in the Bluetooth

list to remove this paired Bluetooth device in the list.



Figure 3.9 Connect interface – Oscar

Currently the connection type for Oscar is Bluetooth only, the other connection types are under development. Stay tuned for the updates. The Bluetooth connection of Oscar is the same with that of David. OSCAR is selected as default antenna for Oscar GNSS Receiver.





Figure 3.10 Connect interface – NMEA

Currently this connect interface is showing MatrixRTK as an example. In fact, other NMEA devices which support NMEA 0183 can also be connected. For NMEA devices, only Bluetooth is used for connect type.

Click [Antenna] to enter the Antenna Manage interface which is shown as below.

← Antenna Manage			
Ant List		1	Multiselect
Antenna	Radius	Phase Center	Bottom height
AX3702(HG)	0.13	0.0509	0.0
AX3702	0.13	0.054	0.0
OSCAR	0.13	0.094	0.0
New	Edit	s	elect

Figure 3.11 Antenna Manage interface

Click [New] in the left bottom corner to add new antenna parameters which is shown as below.



← Antenna Manage				
Ant List			Multiselect	
Antenna	Radius	Phase Center	Bottom height	
A New An	tenna			
Antenna			Input	
Radius		0.0		
Phase Center		0.0		
Bottom height			0.0	
Cancel OK				
New	New Edit		Select	
$\triangleleft$	0		)	

Figure 3.12 Parameters for New Antenna

[Antenna]: input the antenna name for the new antenna.

[Radius]: input the radius of the new antenna when measuring the slant height. Input 0.13

when using the height measure accessory provided by Tersus.

[Phase Center]: input the height from the antenna phase center to the antenna bottom.

[Bottom height]: input the height from the antenna circumference to the antenna bottom.

#### Note: the unit for the above three parameters is meter (m).

The following figure explains the above three parameters taking AX3702 antenna for example. R: Radius; P: Phase center; B: Bottom height.

### Antenna Phase Center



Figure 3.13 Antenna parameters explanation



# 3.2 Data Terminal

In the data terminal interface, the output loggings can be monitored as shown below. It is outputting ASCII data when David is connected with AX3702 GNSS antenna and it is working normally.

← Data Terminal
11.518,M"*53
\$GPVTG,0.000,T,0.000,M,0.008,N, 0.014,K,A*2E
\$GPGGA,081744.00,3111.4255792,N, 12135.5912693,E,1,28,0.6,30.442,M, 11.518,M,,*5C
\$GPVTG,0.000,T,0.000,M,0.006,N, 0.011,K,A*25
\$GPGGA,081745.00,3111.4255821,N, 12135.5912666,E,1,28,0.6,30.415,M, 11.518,M,,*52
\$GPVTG,0.000,T,0.000,M,0.025,N, 0.046,K,A*26
\$GPGGA,081746.00,3111.4255856,N, 12135.5912661,E,1,28,0.6,30.385,M, 11.518,M,,*58
Hex Paused Log Clear
log gpgga ontime 1;log gpvtg ontime 1;
Commands Send

Figure 3.14 Data Terminal interface

Check the box on the left of [Hex] to enable the above window output hex data which is shown below.

← Da	ata Terminal		
0A	0 32 30 31 30	131 32 31	34 20 00
3C 09 09 6 3A 4D 41 4 20 49 4E 5 48 20 33 3 34 31 36 0	3 6C 6F 73 65 4E 55 41 4C 2 4 45 52 4E 41 7 34 39 39 36 D 0A	5 28 6D 6F 9 20 22 22 4C 5F 46 30 20 33	64 65 20 30 4C 41 53 37 35 36
24 47 4E 4 30 30 2C 3 35 2C 4E 2 35 30 33 2 36 2C 32 3 2E 35 31 3	7 47 41 2C 30 3 31 31 31 2E C 31 32 31 33 C 45 2C 31 20 7 2E 37 33 37 8 2C 4D 2C 20	) 32 30 31 5 34 32 34 3 35 2E 35 7 32 36 2C 7 2C 4D 2C C 2A 34 35	31 33 2E 35 36 34 39 31 33 30 2E 31 31 5 0D 0A
24 47 4E 5 30 30 2C 4 36 34 35 2 31 33 35 3 20 30 2E 3 30 2C 45 2	2 4D 43 2C 30 1 2C 33 31 31 C 4E 2C 31 32 0 33 2C 45 2C 0 2C 32 36 31 C 41 2A 30 4	0 32 30 31 1 31 2E 34 2 31 33 35 2 30 2E 30 1 32 31 38 1 0D 0A	31 33 2E 32 34 35 2E 35 39 37 37 2C 2C 30 2E
Hex	Paused	Log	Clear
Please in	put order		
Comr	nands	Sen	d

Figure 3.15 Data Terminal outputs hex data

Check the box on the left of [Paused] to pause the output logging.



Check the box on the left of [Log] to start recording log data. The log data is saved in a .txt file. Create file name in the pop-up window as shown below.

		Data				
INT	TERN	AL_FL	ASH 37	49960 3	7564	16
\$G 5.5 2	NGG 9135	A,0202 69,E,1	203.00,3 ,26,0.6,2	8111.424 27.820,M	5520, ,11.5	N,1213 18,M,,*4
\$G 13! 0.0	NRM 5.591 ,261:	IC,020 3569, 218,0.0	203.00,/ E,0.057, ),E,A*06	4,3111.42 6	24552	20,N,12
\$C	Fil	e Nar	ne			.3,
5.	5. LOG20181226100122.txt 4					
\$0 13 0.		Cance	4		ок	2
	Hex		Paused	Log	C	Clear
	Co	mmar	ıds		Send	

Figure 3.16 Create File Name

Click [OK] to confirm the file name, it automatically starts recording log data and stores the

data in the default folder /storage/emulated/0/TersusSurvey/GpsLogger/xxxxx.txt.



Figure 3.17 Start recording log data

Uncheck the box on the left of [Log] is to stop recording log data.





Figure 3.18 Stop recording log data

Click [Clear] to clear the screen.

Click [Commands] to output common NMEA loggings (not available for connecting Oscar). Check the commands and click [OK], it will return to the command window with the typed commands which is shown in Figure 3.14. Then click [Send] to send the commands to communicate with Tersus receivers.

← Common Command				
Common Cor	nmand			
GPGGA	GPRMC	GPZDA		
GPGST	GPGSA	GPGSV		
GPVTG	GPHDT	GPNTR		

Figure 3.19 Common Command

ок

The detailed description of log and command refers to Log & Command Reference for

Tersus BX GNSS OEM boards which can be downloaded on Tersus website.

Note: [Commands] and [Send] are not available when Nuwa is connected with Oscar.



## 3.3 Base

Some default base configurations are provided for David and Oscar. Select a configuration file in the Work Mode List and click [Detail] to edit the base configuration. Click [Start] to complete the base configuration.

[Startup]: auto start or manual start

- > Auto start: the position of the base is achieved automatically.
- Manual start: base coordinate is achieved by averaging collection, loaded from a point library or input manually.

[Data Link]: radio or network for **David**.

- Radio: the corrections are output to an external radio, serial baud rate should be selected accordingly.
- Network: the corrections are uploaded to a Ntrip server or TCP host. The IP address, port, password and mount point of the Ntrip server should be input manually; The IP address and port of the TCP host should be input.

Four options for data link of **Oscar**.

- > External Radio: the corrections are transmitted via 25W radio for Oscar.
- Internal Radio: the corrections are transmitted via internal 2W radio of Oscar. Oscar internal radio currently supports three transmit powers of 0.5W, 1W, and 2W, and supports five protocols, TransEOT, TT450, SOUTH, SATEL, and TRIMMK3, and two corresponding air baud rates 9600bps and 19200bps. Each protocol supports ten channels and customized frequency. Select 0~9 channel on Nuwa will automatically read the corresponding frequency to the channel.
- Receiver Network: the corrections are uploaded to Ntrip server or TCP host, or Tersus Caster Service (TCS) using Oscar network. The IP address, port, password and mount point of the host should be input manually.



PDA Network: the corrections are uploaded to Ntrip or TCP host, or Tersus Caster Service (TCS) using a PDA device. The IP address, port, password and mount point of the host should be input manually.

[Baud Rate]: the serial baud rate can be selected from 9600 to 921600, the default is 38400bps for David and 115200bps for Oscar. The air baud rate for Oscar internal radio can be selected from 9600 and 19200.

[Differential Format]: CMR, CMR+, RTCM2.3, RTCM3.0 and RTCM3.2 are supported for David; RTCM2.3, RTCM3.0 and RTCM3.2 are supported for Oscar.

### 3.3.1. Set David as a Base

The detailed description for each configuration of **David** as a base is shown in below screenshots.

Click [New] to create a new base configuration. In the figure below, for auto start in radio mode, baud rate is 38400 by default and can be selected in the pop-up list below. The differential format is RTCM3.2 by default.



Figure 3.20 David base auto start - Radio



	Create Base Config		
St	artup	Auto start	
Da	9600	0	
	19200	0	
Ba	38400	۲	
Di	57600	0	
l	115200	0	
I	230400	0	
I	460800	0	
l	921600	0	
	ок		

Figure 3.21 Baud rate options

The detailed information of how to use radio refers to User Manual for David GNSS Receiver.

In the figure below, for auto start in network mode, the host IP can be manually typed or selected by clicking the icon IP on the right of row Host. It shows two Ntrip servers built by Tersus GNSS Inc. and can be selected depending on different area. The site list can added, edited and deleted. For Ntrip network, host IP, port, password and mount point should be input. For TCP network, host IP and port should be input. Contact Tersus technical support for password and mount point information if you bought products from Tersus.

← Create Base Config		
Startup	Auto start 🗦	
Data Link	Network >	
Protocol Type	Ntrip >	
Host	Input IP	
Port	Input	
Password	Input	
Mount Point	Input	
Differential Format	RTCM3.2 >	
ок		

← Create Base Co	nfig
Startup	Auto start >
Data Link	Network >
Protocol Type	TCP >
Host	Input IP
Port	Input
Differential Format	RTCM3.2 >
ок	

Figure 3.22 David base auto start – Ntrip

Figure 3.23 David base auto start – TCP



← Ntrip Site Manager		
Site List	M	ultiselect
Name	IP	Port
Default	asiacaster1.tersus- gnss.com	2201
Default	usacaster1.tersus- gnss.com	2101
New	Edit Se	lect

Figure 3.24 Ntrip Site Manager

Ntrip status viewing method when the base station is connected to Ntrip server:

Take asiacaster for example, open any browser on the computer (accessible to internet)

and enter the following URL in the address bar:

http://asiacaster1.tersus-gnss.com:2201/Ntrip.html?usr=<mark>username</mark>&pwd=password in which, the username and password should be obtained from Tersus GNSS Inc.

In the figure above, for manual start in radio mode, the base coordinate should be typed manually or obtained by clicking the location icon or imported from the survey point library by clicking the list icon. The other parameters setting is the same with that in auto start radio mode.



← Create Base Config	
Startup	Manual start $>$
Base Coordniate	<b>♀ ≔</b>
Lat(°)	0.000000000 U
Lon(°)	0.000000000 U
Height(m)	0.0000
BLH(WGS84)	O NEH(Local)
Ant Height(m)	Slant 0.0 >
Data Link Radio >	
Baud Rate	38400 >
Differential Forma	t RTCM3.2 >
ок	

Figure 3.25 David base manual start – Radio

In the figure below, for manual start in network mode, the base coordinate setting is the same with the method mentioned above, the network host setting is the same with the method described for auto start in network mode.

← Create Base Config	
Startup	Manual start 🗦
Base Coordniate	<b>♀ ∷</b>
Lat(°)	þ.0000000000 U
Lon(°)	0.000000000 U
Height(m)	0.0000
BLH(WGS84)	O NEH(Local)
Ant Height(m)	Slant 0.0 >
Data Link	Network >
Protocol Type	Ntrip >
Host	Input IP
Port	Input
Password	Input
Mount Point	Input
Differential Forma	t RTCM3.2 >
	ок

Figure 3.26 David base manual Start – Network



### 3.3.2. Set Oscar as a Base

The detailed description for each configuration of Oscar as a base is shown in below

screenshots.

Click [New] to create a new base configuration.



Figure 3.27 Oscar base auto start - 4 data link options

- External Radio: the configuration method of Oscar base with external radio is similar with that of David base with radio stated above. The difference is that the default serial baud rate of Oscar 25W radio is 115200bps.
- Internal Radio: if choosing to use the internal radio of Oscar, user needs to select proper air baud rate, transmitting power, protocol, channel and frequency.

← Create Base Confi	g
Startup	Auto start 🗦
Data Link	Internal Radio $>$
Air Baud Rate	9600 >
Transmitting Power	Low(0.5W) >
Protocal	Transparent $>$
WorkChannel	1 >
Channel Freq	458.0
Differential Format	RTCM3.2 >
ок	

Figure 3.28 Oscar base auto start – internal radio



Receiver Network: if choosing to use receiver network to transmit corrections, there are three protocol options to select: Ntrip, TCP and TCS (Tersus Caster Service). Fill in the corresponding IP address, port, password, mount point and base ID if necessary to connect to the receiver network.

← Create Base Config	
Startup	Auto start 🗧
Data Link	Receiver Network >
Protocol Type	Ntrip >
He Ntrip	۲
Pc TCP	0
Pa TCS	0
Mount Point	Input
Differential Format	RTCM3.2 >
ок	

← Create Base Config	
Startup	Auto start >
Data Link	Receiver Network >
Protocol Type	Ntrip >
Host	Input IP
Port	Input
Password	Input
Mount Point	Input
Differential Format	RTCM3.2 >
о	K

>

>

>

>

Figure 3.29 Oscar base auto start - receiver Figure 3.30 Oscar base auto start - Ntrip network

← Create Bas	se Config
Startup	Auto start 🔾
Data Link	Receiver Network
Protocol Type	TCP
Host	Input IP
Port	Input
Differential Format	RTCM3.2
	ок

network options

Figure 3.31 Oscar base auto start – TCP network Figure 3.32 Oscar base auto start – TCS network



PDA Network: there are also three protocol options of PDA network to select: Ntrip, TCP and TCS (Tersus Caster Service). The required information to input for different protocol is different, refer to the screenshots above.

$\leftarrow$ Create Base C	Config
Startup	Auto start 🗧
Data Link	PDA Network 🗧
Protocol Type	Ntrip >
H¢ Ntrip	۲
Pc TCP	0 t
Pa TCS	0
Mount Point	Input
Differential Format	RTCM3.2 >
ок	

Figure 3.33 Oscar base auto start – PDA network options

For Oscar manual start in radio mode and network mode, the base coordinate should be typed manually or obtained by clicking point library by clicking the list icon. The data link options configuration are the same with the method mentioned above in Oscar base auto start in radio and network modes.

### 3.4 Rover

Some default rover configurations are provided for David and Oscar. Select a configuration file in the Work Mode List and click [Detail] to edit the rover configuration. Click [Start] to complete the rover configuration.

### 3.4.1. Set David as a Rover

The detailed description for each configuration of **David** as a rover is shown in below screenshots.



Click [New] to create a new rover configuration. In Figure 3.34 below, for rover

configuration in radio mode, the baud rate is 38400 by default and can be selected from 9600 to 921600 in the pop-up list as shown in Figure 3.21.

← Create Rover Config	
Data Link	Radio >
Baud Rate	38400 >
ок	

Figure 3.34 Create Rover Configuration for David - Radio

In Figure 3.35 below, for rover configuration in network mode, the protocol type can be selected from Ntrip and TCP.

← Create Rover Config	
Data Link	Network >
Protocol Type	Ntrip >
Host	nput IP
Port	Input
Username	Input
Password	Input
Mount Point	Update SourceTable
Is VRS	
	ок

Figure 3.35 Create Rover Configuration for David – Ntrip Network



← Create Rover Config	
Data Link	Network >
Protocol Type	Ntrip >
Host	nput IP
Pt Ntrip Ut TCP Password Mount Point Update Sour	Input
Is VRS	
ок	

Figure 3.36 Protocol type options

When Ntrip network is selected, the host can by manually typed or selected by clicking the icon IP on the right of row Host as mentioned in Figure 3.24 above. The username and password should be obtained from Tersus technical support. The box on the right of Mount Point displays the mount point and differential format after clicking the refresh icon C to update the source table. The example is shown below.

← Edit Rover Config		
Name	USA Ntrip	
Data Link	Network >	
Protocol Type	Ntrip >	
Host usacaster1.tersus-gnss.com		
Port	2101	
Username	u00001	
Password		
Mount Point 008001174910 6(RTCM3)	<sup>000015</sup>	
Is VRS		
ок		

Figure 3.37 Edit Rover Configuration

When TCP is selected for protocol type, fill in the information of host and port according to customer requirements to complete the configuration.





Figure 3.38 Create Rover Configuration for David – TCP Network

### 3.4.2. Set David as a Rover

The detailed description for each configuration of **Oscar** as a rover is shown in below screenshots.

Click [New] to create a new rover configuration. It shows the rover configuration using the internal radio of Oscar as below. Choose appropriate baud rate, communication protocol, work channel and channel frequency. Click [OK] and type the configuration name to complete creating a rover configuration of Oscar.

← Create Rover C	config
Data Link	Internal Radio 🗦
Air Baud Rate	9600 >
Protocal	Transparent >
WorkChannel	1 >
Channel Freq	458.0
OH	(

Figure 3.39 Create Rover Configuration for Oscar - Internal Radio

The data link can be selected from an option list: Internal Radio, Receiver Network and PDA Network shown as below.



÷	- Create Rov	er Config
Da	ta Link	Internal Radio 🗦
Ai	r Baud Rate	9600 >
Pr	otocol	Transparent >
W Cł	Internal Radio Receiver Network PDA Network	<ul> <li>•</li> <li>•</li></ul>
		ж

Figure 3.40 Oscar rover data link options

When Receiver Network is selected for Oscar rover communication, there are three protocol options to select: Ntrip, TCP and TCS (Tersus Caster Service). Fill in the corresponding host, port, password, mount point and base ID if necessary to connect to the receiver network.

← Create Rover Config			
Data Link Receiver Network			
Protocol Type	Ntrip >		
Host	Input IP		
Pc <sub>Ntrip</sub>	۲		
U: TCP	0		
Pa TCS	0		
Mount Point Update SourceTable			
Is VRS			
01	< Contract of the second secon		

Figure 3.41 Oscar rover using receiver network - protocol options

When PDA Network is selected for Oscar rover communication, there are also three protocol options of PDA network to select: Ntrip, TCP and TCS (Tersus Caster Service).



Figure 3.42 Oscar rover using PDA network – protocol options



# 3.5 Device Info

Under the Device functional group, click [Device Info] to check the detailed information about the device connected.

← Devia	ce Info			
Device Info				
Туре		Oscar		
SN		120		
Version	2019 h	fwver:V1.2.2- 0923.1d7157e wver:V2.0.1A6		
Battery		93%		
Mode		General		
Tilt Enable		$\bigcirc$		
Device Debug		$\bigcirc$		
Electron Bubble		Adjust		
egister Info				
Register State	Effecti	ve registration		
Expired Date		20		
FilePath	/storage	e/emulated/0/ TersusSurvey		
Register Co	de			
Reset	Register	Refresh		

Figure 3.43 Device Info interface

In the figure above, the SN row displays complete serial number for David, while only displays 8 digits number for Oscar which is used for Bluetooth pairing, registration, TCS connection, and etc. The battery row displays remaining battery level for Oscar, not for David. The mode row displays current working mode, which includes General, Base and Rover.

When the David receiver has an unknown error, turning on Device Debug to record Tersus specific data to troubleshoot receiver which can help us better improve receiver's function. *Note: This function and static survey cannot be turned on at the same time. Please manually turn off the static survey before using Device Debug. This function is not applicable for Oscar.* 



#### **Electronic Bubble (eBubble)**

This function is only available for Oscar GNSS Receiver. Make the body of Oscar stand on a leveled Tribrach before eBubble calibration.

Click Adjust on the right of electronic bubble to adjust bubble. On the screenshot below, the eBubble is not in the black circle and its color is red for warning purpose.





Click Adjust on the right, the eBubble is calibrated to the center inside the black circle

and the bubble color turns blue.



Figure 3.45 eBubble after adjusting



When the registration is not effective, click [Register] after putting the registration file (obtained from Tersus Technical Support) into the specified FilePath /storage/emulated/0/TersusSurvey, then click [Refresh] to update the registration status.

Clicking [Reset] resets the receiver into factory settings.





- 4. Survey
- Survey
- Point Stakeout
- Line Stakeout
- Static Survey
- Point Correction
- Survey Config
- Base Shift



Figure 4.1 Functions under Survey



# 4.1 Survey

The Survey interface includes: status bar, background map, tools and information.



Figure 4.2 Survey – Drawing mode

÷	Point Surve	Drawing	Config Connected
<b>X)</b> 24/2 SAT0.90	24 🖗 Fixed SOL		BAT 85%
E(m) N(m) h(m)	556474.041 3452289.03 92.6455	0 826	
Point T	уре		Continuous >
Point N	lame		PT12
Code			>
Ant Hei	ight(m)		Pole 1.8 >
	Points	s	Start

Figure 4.3 Survey – Text mode



#### Status Bar

[**I**]: the main interface is shown in text mode or drawing mode, click this icon to switch between the two modes.



]: Survey Configuration, refer to section 4.6 for more details.

Connect

]: connection status with a Tersus GNSS receiver, refer to Connect for more

details.

[SAT130]: number of satellite traced, e.g., 23 means 23 satellites are used, 24 means 24 satellites are tracked, and 1.30 indicates the PDOP value.



]: solution status, includes Single, Float, Fixed, DGPS and Base.

 $\begin{bmatrix} \mathcal{O} & \text{NET} \\ \text{Link}^{2s} \end{bmatrix}$ : the upper right word indicates the data link type: radio or network; the lower right time is the latency of the data link.

[BAT<sup>99%</sup>]: indicates the remaining battery power of Oscar GNSS receiver. Currently it is not supported of displaying the battery of David as there is no embedded battery in David receiver.

Background Map

[<sup>1111</sup>]: view and edit the survey point library.

[<sup>[C]</sup>]: click it to switch among none, OSM online map, Google online map and Google online map (China).

[+]: zoom in the map.

[=]: zoom out the map.

 $[\Phi]$ : zoom with the current location at the center.

[<sup>60</sup>]: place all the points in one view.

Tools

[ ]: electronic bubble: indicates leveling bubble calibration status. The bubble is blue when it is calibrated to the center inside the black circle, and is red when it is not calibrated to the center circle.



[ ]: Linework function: After clicking this icon, enter the line name and other information. Click [OK] and the hollow line becomes a solid line in the icon. Then it starts collecting the survey points (including continuous points and smooth points) which will be connected into a line. The line is saved in the line list. When the acquisition is completed, click again this icon. The icon changes back to the initial state and ends line acquisition. After this, the collecting survey points will not be connected to the line.

If entering the existing line name instead of a new one, it supports to continue the linework survey selecting from start or from end point.



Figure 4.4 Enter an existing line name



Figure 4.5 Continue the existing line options

After survey points are collected, information in blue color is displayed at the up left corner. There are two methods to collect survey points:

[▶]: Auto collect when selecting continuous for survey mode, refer to section 4.6.1

Common Config for more details.

[ ]: Manual collect, it will display this icon when selecting detail for survey mode.



#### Information Bar

Six information items are displayed, each can be chosen from the 18 items in the following screenshots.



Figure 4.6 Information option list - part 1



Figure 4.7 Information option list - part 2



# 4.2 Point Stakeout



Figure 4.8 Point Stakeout interface

The above screenshot is the main interface of point stakeout, which is similar to that of point survey.

The main steps of point stakeout are as follows:

- Add stakeout point: click to enter the stakeout point library which is shown in Figure 4.9 below, refer to section 2.4 for point library management.
- > Select the point to be stakeout: select the point, then click [Select].
- > The offset between the current point and the target point is displayed on the screen.

The arrow icons 1 and 1 are used to switch the stakeout points in the library.



← Stakeout Point				
5 features		Multiselect		
id	Name	Ν		
L5	SPT1	3452290.9209		
L2	SPT2	3452290.9220		
L3	SPT3	3452290.9269		
L4	SPT4	3452290.9225		
L6	SPT9	3452248.6325		



Figure 4.9 Add stakeout point

In the point stakeout interface,

- The red flag indicates the location of the stakeout point.
- The red dotted line is the connection between the current point and the point to be staked.
- The green arrow is the point to be staked.
- The green arrow pointing towards the surveyor heading.
- The blue arrow prompts the surveyor that the point to be staked is in the front/rear/left/right position.
- The blue number shows the distance from the point to be staked in different directions.



## 4.3 Line Stakeout



Figure 4.10 Line Stakeout interface

The above screenshot is the main interface of line stakeout, which is similar to that of point survey. The main steps are as follows:

Click to enter stakeout line library shown as below. Click [Add] to add a new stakeout line or click [Detail] at an existing stakeout line to edit the stakeout line.

← Nu	wa		
1 features		Mu	ultiselect
Name	Start Point	End Point	Leng
StakeLine0	PT1	Base_0	3496867 9
Add	Detai	il Sel	lect
gure 4.11	Enter sta	akeout lir	ne libra

Figure 4.12 Edit an existing stakeout line

In the above screenshot of line detail,



Method: two methods to add a stakeout line, details refer to section 2.5.1.

Start Mileage: the mileage at the starting point, used to calculate mileage at subsequent points.

Stakeout Interval (m): the interval distance of the points on the stakeout line, which means stake out a point every certain distance.

Offset (m): the offset when staking out the points on the stakeout line. When it is negative, it is to the left of the line forward direction. When it is positive, it is to the right of the line forward direction.

- Select the stakeout line, click [Select].
- Stake out from the starting point (+ offset), stake out the next point every interval distance. The distance from the current position to the target position will be displayed on the screen

# 4.4 Static Survey

← Stat	ic Survey		
Interval			1HZ >
Cutoff Angle	(°)		15
StationID		12	378940
Rinex Forma	t	Ri	nex3.02 >
Antenna			OSCAR
Туре	OVertical	Slant	OPole
Ant Height(n	n)		1.8
DataAutoSav	e		$\bigcirc$
	Start		

Figure 4.13 Static Survey interface

[Interval]: selected from 10HZ, 5HZ, 1HZ, 5S and 10S. The max rate is determined by the device connected.

[Cutoff Angle]: the elevation mask angle, usually set to 15°.



[StationID]: the name of the surveying station.

[Rinex Format]: selected from Rinex2.10, Rinex3.02, and NONE. If configure using Nuwa,

it will save trs file by default.

[Antenna]: the antenna type.

[Type]: selected from vertical, slant or pole.

[Ant Height]: the height of the antenna.

[DataAutoSave]: if this function is turned on, the receiver will record the static survey data automatically after restart.



Figure 4.14 Static data recording

After all the parameters are confirmed, click [Start] to start data collection. The static data is recording as shown in Figure 4.14.

*Note: Static Survey and Device Debug cannot be used at the same time. Please turn off Device Debug as shown in* Figure 3.43 Device Info interface *manually before recording static data.* 

### Static data download and post-processing

4.4.1 Static data download for David

Device preparation


- A David GNSS receiver
- A DC-2pin to USB power cable
- A COMM2-7pin to USB & DB9 cable
- A power bank
- A computer running TersusDownload tool



Figure 4.15 Preparation for Static Data Process

After the static survey in fields is completed, connect the David receiver to the computer according to the following figure and power on the David receiver. The USB port is mapped to a serial port (COM5 in the following example) in the computer, which can be checked in the Device Manager.



Figure 4.16 Connections of David, computer and power bank

It is recommended to type UNLOGALL in the command window of Tersus GNSS Center software before executing below steps. Open the TersusDownload on the computer, select the serial port to communicate with the David receiver.



	TersusDownload		×
	DownLoad Port: DownLoad Speed: Progress Info:	vuse current baudrate(USB:80KB/Second, Serial:8~32 v	
TersusDowni oad		Start	
	Notice: The softwa the lower speed of	are normally retry when failed to download, You also can change r confirm the cpu performance when failed to download.	

Figure 4.17 TersusDownload interface

Select the download speed. Select 'use current baudrate' when using USB port to download files as shown below. Select baud rate 460800bps if a serial port is used to download files.



Figure 4.18 Download speed options

After completing the above steps, click [Start] and it pops out below window. Select the DownloadPath, select the files to be downloaded, click [Download] to start downloading:

Media	EMMC	FreeSpace	3749960	КВ	SelectAll
FileName		UTC Time	Size	status	Station ID
00125_	20181119035301.dat	20181119 3:54	79648		[Click To Edit]
00125	20181120035303.dat	20181120 4:25	2343784		[Click To Edit]
00125_	20181210080444.dat	20181210 8:5	50052		3352
00125_	20181210080536.dat	20181210 8:5	3137426		[Click To Edit]
00125_	20181219092951.dat	20181219 9:32	201820		[Click To Edit]
00125_	20181219093252.dat	20181219 9:33	10080		[Click To Edit]
00125_	20181219093325.dat	20181219 9:35	141416		TS01
00125_	20181221061515.dat	20181221 6:19	288268		ID6665
00125_	20181221083722.dat	20181221 8:41	322936		[Click To Edit]

Figure 4.19 File selected for download

In this interface, click the number in red box 1 to edit Station ID if necessary, or it can be edited in Figure 4.13 in section 4.4 Static Survey. Check the box in the left of red box 2 to enable or disable auto create RINEX file after download.

<u>!</u>	The downloading rate is about 2MB/min, the downloading time can be estimated
	based on it.
<u>!</u>	It is recommended to ensure the computer has available CPU and memory when
	downloading files.

Open the RINEX file using notepad or other text viewing software, the antenna height is vertical height which is from the phase center of the antenna to the point on the ground. The value of the antenna height can be found as shown below.



	3.02	OBSERVATION D	ATA M (MIXED)	RINEX V	ERSION / TYPE			
Ters Test	us	Tersus	2019-03-19 10:12	PGM / R MARKER MARKER	UN BY / DATE NAME NUMBER			
Ters	us	Tersus		OBSERVE REC # /	R / AGENCY TYPE / VERS			
		TRSAX37	02 NONE	ANT # /	TYPE			
-28	68999 0400	4651726.0655 328	3992.2949	APPROX	POSITION XYZ	- anter	na height	
	1.0375		0.0000	ANTENNA INTERVA	: DELTA H/E/N L	uncer	marneight	
G	8 C1C L1C I	DIC 51C C2P L2P D2	P S2P	SYS / #	/ OBS TYPES			
с	8 C1I L1I I	01I S1I C7I L7I D7	I 57I	SYS / #	/ OBS TYPES			
R	8 C1C L1C I	D1C S1C C2P L2P D2	P S2P	SYS / #	/ OBS TYPES			
20	19 3	19 9 38	19.0000000 GPS	TIME OF	FIRST OBS			
20	19 3	19 10 12	3.0000000 GPS	TIME OF	LAST OBS			
10.00				END OF	HEADER			
> 20	19 03 19 09	38 19.0000000 0	24					
G01	20477692.4	14 107611001.758	1744.113	46.000	20477694.438	83852737.918	1359.066	47.000
GØ7	20644342.4	108486749.574	-771.430	46.000	20644342.602	84535126.090	-601.168	44.000
G08	21771518.5	55 114410099.551	-1845.258	45.000	21771520.914	89150736.824	-1437.852	43.000
G11	20218292.34	106247839.395	437.070	44.000	20218290.375	82790516.031	340.543	39.000
G16	24614137.04	47 129348152.883	-2549.102	35.000	24614137.047	100790757.469	-1986.465	20.000
G18	20084844.0	105546570.480	-180.441	45.000	20084844.602	82244079.199	-140.668	39.000
G22	23999749.84	4 126119558.992	2465.613	38.000	23999748.195	98274979.070	1921.180	26.000
G27	24046037.7	126362774.551	-2662.340	38.000	24046039.195	98464502.613	-2074.566	39.000
G28	23831380.4	77 125234751.008	2417.512	40.000	23831378.719	97585516.570	1883.742	25.000
G30	21610795.93	38 113565496.465	1380.316	45.000	21610798.203	88492604.246	1075.527	43.000
C01	36967716.5	192500600.000	10.000	44.000	36967709.789	148853647.844	7.664	47.000
C02	38306562.9	1 199472321.852	20.707	39.000	38306558.727	154244635.484	16.035	44.000
C03	36909363.7	192196740.523	6.414	45.000	36909361.086	148618701.039	4,969	46.000
C04	38123486.3	13 198518996.797	15.398	42.000	38123483.750	153507470.684	11.938	45.000
697	35729677 0	186853881 926	245 375	46 999	35729672 734	143868586 336	189 785	47 000

Figure 4.20 View antenna height in the RINEX file

### 4.4.2 Static data download for Oscar

Device preparation

- An Oscar GNSS receiver
- A mini USB cable
- A computer running RinexConverter tool

Before connecting Oscar to a computer, ensure Oscar is powered on. Use the Mini USB Cable in the package to connect Oscar to the USB port of a computer which is shown as below.



Figure 4.21 Connect Oscar to a computer



After completing the connection, the computer prompts a USB device, open it to view the files as below. Copy the folders and paste them to the computer.

F:\re	cord			
^	Name	Date modified	Туре	
	20191024	10/24/2019 8:58 AM	File folder	
	20191104	11/4/2019 2:50 AM	File folder	
	20191105	11/5/2019 6:52 AM	File folder	

Figure 4.22 Static data recorded by Oscar

Note: When configuring static survey, if configure using buttons only, or configure using Nuwa with selecting None for Rinex format, Oscar only records trs format files. It is necessary to convert trs files to Rinex files before data post-processing.

Open Tersus Rinex Converter software, choose source file path, save path, source format, Rinex version, and click [Process] to complete the format conversion.

	Source File:	C:\Users\Mki\Desktop\201911	05\trs\51800001309G53.TRS		Open
	Save Path:	C:\Users\Miki\Desktop\201911	05		Save as
	Source Format:	Oscar 🗸	Options Station Name:	51800001309G53	
<u>R</u>	Rinex Version:	3.02 ~	Maker Number:		
usRinexC nverter		•	Time start(GPST):	2017/07/01 00:00:00	
	Т		Time end(GPST):	2019/11/05 07:46:46	
	1.6		Constellation:	SPS GLO BDS Dutput .pos File	GAL
	Tersus Rine Copyright	ex Converter V3.6 2018 Tersus GNSS	Proces	sed Epoch:	

Figure 4.23 Tersus Rinex Converter interface

The Rinex files can be found in the save path as below.



#### C:\Users\Miki\Desktop\20191105

^	Name	Date modified	Туре	Size
	rinex2	11/5/2019 3:40 PM	File folder	
	🔜 rinex3	11/5/2019 3:40 PM	File folder	
	trs	11/5/2019 3:40 PM	File folder	
	51800001309G53.19c	11/5/2019 3:48 PM	19C File	8 KB
	51800001309G53.19g	11/5/2019 3:48 PM	19G File	4 KB
	51800001309G53.19I	11/5/2019 3:48 PM	19L File	6 KB
	📋 51800001309G53.19n	11/5/2019 3:48 PM	19N File	8 KB
	51800001309G53.19o	11/5/2019 3:48 PM	190 File	153 KB
	51800001309G53.19p	11/5/2019 3:48 PM	19P File	24 KB

Figure 4.24 The Rinex files after conversion

# 4.4.3 Data post-processing

Open TERSUS Geo Office software:

	TERSUS Geomatics Office	-	×
	File(F) Baseline(B) Adjust(N) Tool(T) Options(O) Help(H)		
TERSUS Geo Office	Coatrol 4 X Project New Project Open Project Project Propertie ordinate Parame		
	Import Process Baselin Ressage		ŧ×
	etwork Adjustmi Export Details		_
	Ready		13

Figure 4.25 TERSUS Geomatics Office interface

After a project is created, click [Import] -> [Import Files]

File Type RINEX File	Extention *.??O:*.OBS	Select Files(S)
SP3 File	*.SP3	
GNSS Raw File	*.GNS	Select Folder(F)
		Auto
		Cancel(C)

Figure 4.26 Import Files in TERSUS Geo Office



Click [Select Files] to load the Rinex files created in section 7.2.2.

After the above step of importing, the default configuration of the observation data is correct. There is no need to modify the configurations of antenna height, antenna type, and etc. The default configuration of the imported files is shown as follows.

Receiver		
e center		
TRSAX3702 V	Apply to( <u>A</u> )	This 🗸 🗸
nna correction: No		
	9	241
Anttena Bottom $\sim$	Apply to( <u>M</u> )	This $\checkmark$
nt(m): 1.0375	Apply to( <u>H</u> )	This 🗸
· · · · · · · · · · · · · · · · · · ·		
	Receiver   e center   TRSAX3702   nna correction:   No   Anttena Bottom     ht(m):   1.0375	Receiver   e center   TRSAX3702   Apply to(A)   nna correction:   No   Anttena Bottom  Apply to(M) at(m): 1.0375 Apply to(H)

Figure 4.27 Default configuration of the observation data

Refer to the user manual of Tersus Geo Office for more details on data post processing.





# **4.5 Point Correction**

The point correction is to find the mathematical conversion relationship (transition parameter) between WGS84 and the local plane Cartesian coordinate system. There are three calculation types: four-parameter, height-fitting, and four-parameter + height-fitting.

Ca	alculate Typ	e	Four parameter >
*N	eed at least 2 p	aired pt for local	param calculation*
0	features		
	Four parar	neter	
	Height fitti	ng	0
	Four parar	neter + Heigh	it fitting
1	Add	Edit	Calculate

Figure 4.28 Calculation Type options

There are three methods for height-fitting: fixed difference correction, plane fitting and surface fitting.

		correction		
Ca	lculate Typ	eFour parameter	+ Height fitt	
Н	ight Fitting	Fixed differen	ce correction	>
*N *N	eed at least 2 p eed at least 1 p	aired pt for local par aired pt for Fixed Di	am calculation* ference*	
0	Fixed differ	rence correctior	n 🔘	
	Plane fittin	g	0	00
	Surface fitt	ing	0	
-				
	Add	Edit	Calculate	

Figure 4.29 Height Fitting options



### 4.5.1 Four Parameter

At least two paired points are needed for Four Parameter type. Click [Add] to input the original coordinate values and the target coordinate values. Refer to section 2.4 about how to add points in the library.

### 4.5.2 Height Fitting

The number of points is different when different height fitting methods are used, the details are as follows:

Fixed Difference Correction: at least one paired point is needed.

Plane Fitting: at least three paired points are needed.

Surface Fitting: at least six paired points are needed.

Refer to section 2.4 about how to add points in the library.

### 4.5.3 Four Parameter + Height Fitting

The number of points is different when different height fitting methods are used, the details are as follows:

*Fixed Difference Correction*: at least two paired points for local parameter calculation and one paired point for fixed difference are needed.

*Plane Fitting*: at least two paired points for local parameter calculation and three paired points for plane fitting are needed.

*Surface Fitting*: at least two paired points for local parameter calculation and six paired points for surface fitting are needed.

Refer to section 2.4 about how to add points in the library.

### 4.5.4 Application Example

This section introduces an example of a calculation when Four Parameter + Height Fitting is selected for Calculate Type and Fixed Difference Correction is selected for Height



Fitting.

← Po	oint correction	
Calculate	<b>Type</b> Four parameter	+ Height fitt $>$
Height Fitt	ting Fixed different	ce correction >
*Need at leas *Need at leas	t 2 paired pt for local par t 1 paired pt for Fixed Dif	am calculation* fference*
0 features Multis		Multiselect
id	Source Coord	Target Coo



Figure 4.30 Application example for point correction

Click [Add] to add point for source coordinate and target coordinate.

← Add Point				
Source Coord				
Point Name	Input 💡 🗮			
Lat(°)	Input U			
Lon(°)	Input U			
Height(m)	Input			
Target Coord				
Point Name	Input			
N(m)	Input			
E(m)	Input			
h(m)	Input			
0	к			

Figure 4.31 Add point for point correction

The source coordinate can be typed manually or obtained by clicking 🝳 the location icon

or imported from the survey point library by clicking 📒 the list icon.

The target coordinate can be typed manually or imported from the control point library by

clicking 📒 the list icon.

In this example, two pairs of points are type manually for calculation, which are shown below.

← Add Point		
Source Coord		
Point Name	e006 💡	
Lat(°)	31.19889139	U
Lon(°)	120.71634815	U
Height(m)	3.9	914
Target Coord		
Point Name	e006	
N(m)	3453071.0	576
E(m)	496716.0	053
h(m)	1.9	974
	ок	

Figure 4.32 The 1<sup>st</sup> pair of points for calculation

← Add Point				
Source Coord				
Point Name	e007 💡	I		
Lat(°)	31.20232084	U		
Lon(°)	120.72919000	U		
Height(m)	4	.025		
Target Coord				
Point Name	e007			
N(m)	3453451	.621		
E(m)	497939	.999		
	2	054		

Figure 4.33 The 2<sup>nd</sup> pair of points for calculation

Click [OK] and two pairs of points are shown below.

Height Fitting Fixed difference correction >			
*Need at least 2 paired pt for local param calculation* *Need at least 1 paired pt for Fixed Difference*			
2 feature	25	Multiselect	
id	Source Coord	Target Coo	
1	B:31.198891390 L:120.716348150 H:3.9140	N:3453071.6760 E:496716.0530 H:1.9740	
2	B:31.202320840 L:120.729190000 H:4.0250	N:3453451.6210 E:497939.9990 H:2.0540	

Figure 4.34 Two pairs of points for calculation



Click [Calculate] and the data is calculated with the result shown below.

← Result:				
Local Para Result:				
dDX(m): 89.3786 dDY(m): -7.7020				
Rotation Angle : 3.1718797057				
Scale : 0.9999680227				
Height Fitting Result:				
A0: 106.76839	A1: 0.00000			
A2: 0.00000	A3: 0.00000			
A4: 0.00000	A5: 0.00000			
Max.HRMS	0.0000 NO.: 1			
Max.VRMS	0.0154 NO.: 1			
Cancel	Apply			

Figure 4.35 Calculation Result

Click [Apply] to apply the point correction result to the current project coordinate system,

and it prompts that 'Apply result successfully!'.

← Point correction				
Calculate Type Four parameter + Height fitt >				
Height Fitting Fixed difference correction >				
*Need at least 2 paired pt for local param calculation* *Need at least 1 paired pt for Fixed Difference*				
2 features Multiselect				
id	5	Source Coord	Target Coo	
1	B:31. L:120 H:3.9	198891390 0.716348150 140	N:3453071.6760 E:496716.0530 H:1.9740	
2	B:31. L:120 H:4.0	N:3453451.6210 E:497939.9990 H:2.0540		
	Ap	ply result successfu	liy!	
Add		Edit	Calculate	

Figure 4.36 Point correction results applied to current project

Slide left of the title bar to view the values of Residual results as shown below.



Height	Fitting Fixed differen	ce correction
*Need at *Need at	east 2 paired pt for local par east 1 paired pt for Fixed Di	ram calculation* fference*
2 feature	25	Multiselec
id	- Target Coord	Residual
1	N:3453071.6760 E:496716.0530 H:1.9740	H:0.0000 V:0.0154
2	N:3453451.6210 E:497939.9990 H:2.0540	H:0.0000 V:-0.0154

Figure 4.37 Slide left to view residual results

The results applied to the current project coordinate system can be checked in Project

Property interface below.

← Project P	Property
Coord System	Project Info
False East(m) : 500 Central Meridian(°) : Origin Lat(°) : 0.000 Scale Factor : 1.000 Positive Direction :	000.00000 : 120.750000000 000000 000000 East/North
Use seven parameter Dx(m) : 0.0000 Dy(m) : 0.0000 Dz(m) : 0.0000 Scale(ppm) : 0.0000	ers : No Rx(s) : 0.000000 Ry(s) : 0.000000 Rz(s) : 0.000000
Use four parameters dDX(m) : 89.3786 dDY(m) : -7.7020 Rotation Angle : 3.1 Scale : 0.99996802	s : Yes 7187971
Use height fitting: \ A0 : 106.768388 A2 : 0.000000 A4 : 0.000000 Use Geoid : No Geoid Name : N/A	A1 : 0.000000 A3 : 0.00000 A5 : 0.00000
	Edit

Figure 4.38 Updated project property after point correction

# 4.6 Survey Config

During data collection, restrictions are given to solution type and HRMS limits, hence only

the data meeting the restrictions can be saved. More details are as follows:

## 4.6.1 Common Config



_		_	
÷	Survey Confi	g	
Co	nmon Config	Display (	Config
Soluti	on Limited		Single >
HRMS	Limited		3.0
VRMS	Limited		5.0
Base	Nove		0.05
0			D-1-II >
Surve	/ Mode		Detail
керо	t File		$\bigcirc$
Surve	/ Epochs		5
Surve	prompt tone		
Stake	out prompt tone		
0.1		(1	0.5
Stake	out prompt dista	ince(iong)	0.5
Stake	out prompt dista	ince(short)	0.05
Stake	out prompt type	North and so	outh dir >
Anten	na		
Туре	OVertica	I OSlant	Pole
Ant H	eight(m)		1.8

Figure 4.39 Survey Config - Detail

Figure 4.40 Survey Config – Continuous

[Solution Limited]: includes Single, DGPS, SBAS, Float and Fixed. The solution accuracy (from high to low) is: Fixed > Float > SBAS > DGPS > Single. Select different solution limits, the default HRMS, VRMS limit will change accordingly.

[HRMS Limited]: horizontal RMS limit. Data would not be collected if its HRMS is greater than this limit.

[VRMS Limited]: vertical RMS limit. Data would not be collected if its VRMS is greater than this limit.

[Base Move]: If the base moves over this limit, there will be a new base point and the rover coordinates will be recalculated according to the new base.

[Survey Mode]: can be selected from detail and continuous.

[Report File]: If Detail is selected, and turn on report file function, the coordinate of the

survey epoch will be saved as a .txt file under project folder.

[Auto Collect]: if select continuous, data can be collected according to Time or Distance.

If Time is selected, ensure to input the time interval.

If Distance is selected, ensure to input the distance interval.





[Survey Epochs]: if select detail, the survey epoch can be modified. The survey epoch can

be integer such as 2, 3, 5 or 10. Normally set to 5s.

[Survey Prompt Tone]: can be enable or disabled.

[Stakeout Prompt Tone]: can be enable or disabled.

[Stakeout tone distance(long)]: the distance threshold of the stakeout tone. For example,

set 0.5 means the stakeout tone beeps every 2 seconds if distance is less than 0.5m.

[Stakeout tone distance(short)]: the distance threshold of the stakeout tone. For example,

set 0.05 means the stakeout tone beeps every 1 seconds if distance is less than 0.05m.

[Stakeout Prompt Type]: can be North and South direction or Forward and Backward.

[Antenna]: Antenna name.

[Type]: height type, can be vertical, slant or pole.

[Ant Height]: value of the antenna height according the specified measuring type.

# 4.6.2 Display Config

← Survey Config					
Common Config	Display Config				
V Display Point Type					
Detail					
Continuous					
Input					
Calculate					
V Display Point Name					
Display All Stakeout Point					
☑ Display Electronic Bubble					
Survey Style Simple					
Survey Point Color	• >				
Advanc	e				

Figure 4.41 Survey Config – Display Config

Select the Display Point Type, Display Point Name, Display all stakeout point or Display Electronic Bubble according to the application requirement.



Select Survey Style: Simple or Detailed.



Figure 4.42 Survey Point Color

Click [Survey Point Colour] to select a colour on the outer ring for the survey points and

click the inner pie to confirm the colour.

← Advanced C	onfig
Point Filter	
Display Range	То
o	к

Figure 4.43 Advanced Config for Display Config

Click [Advance] to filter the displayed points.

# 4.7 Base Shift

In 'Auto Start' mode for base station, if the base is moved, re-erected or restarted at an unknown point, base shift should be performed to ensure the points collected by the current base station is consistent with that before the base is moved or powered off.



Briefly, find a known point, measure the coordinates of this point, then use this point to calculate the offset of the base shift, apply the base shift to all the survey points under the current base coordinates to make the reference coordinate system of the base remains the same as the previous base station.

The detailed steps are as follows:

Click [Base Shift] to enter the following interface, Figure 4.44 shows the calculation result for the base shift; Figure 4.45 shows the source of the base shift calculation. Click the list icon on the right of GNSS Point to select a survey point which is measured at the known point and click the list icon on the right of Known Point to select a known point in the control point library (details of control point refers to section 2.4 Point). Click [Calculate] and the base shift is calculated automatically. Click [Apply] to apply the base shift to all the points surveyed and to be surveyed under the current base station.

← Base Shift	
Result	Calculate
BaseShift parameter	
Base	Base_0
N shift	0.0
E shift	0.0
h shift	0.0
Current Point	
N:	
E:	
h:	
Apply	

Figure 4.44 Base Shift interface - 1



← Base Shift	
Result	Calculate
GNSS Point	:=
Base	Base_0
WGS84 Lat:	
WGS84 Lon:	
WGS84 H:	
Known Point	:=
N(m)	
E(m)	
h(m)	
Calcu	late

Figure 4.45 Base Shift interface – 2

At this time, select the base point in the survey point library to view the details. It can be found that the current NEh shift amount is recorded in the base point information, and the NEh coordinates of all the survey points under this base station change accordingly.

If you need to reset (cancel) the base shift, just enter [base shift], and manually modify the three parameters of north shift, east shift and height shift to 0. At this time, return to the survey point library to view the details of the base point. The NEh shift amount in the base point information is automatically changed to 0, and all survey points NEh coordinates under the base station are restored to the coordinates before the base shift.



# 5. Tools

- Area Perimeter
- Azimuth Distance
- Offset Point
- Rotation Point
- Two Points Intersection
- Four Points Intersection
- Intersection Angle



Figure 5.1 Functions under Tools



## 5.1 Area Perimeter

This tool is used to calculate area and perimeter. The points can be imported from the point library by clicking the list icon on the upper right corner. The unit is meter for perimeter and square meter for area.

← Are	a Perimeter	=
Coord List		Multiselect
id	Point Name	Code
1	PT1	
2	PT2	
3	PT3	

Graphic	Calculate

Figure 5.2 Area Perimeter interface

[Graphic]: shows the closed polygon formed by the points.

[Calculate]: calculates the area and perimeter of the closed polygon.

[Multiselect]: enters point edit interface to inverse or delete.

*Note: The calculation results are all plane results (point elevation does not participate in the calculation). It is suitable for all sections in this chapter except section 5.3 Offset Point.* 

### **5.2 Azimuth Distance**

There are two kinds of azimuth distance calculation: point to point, and point to line. The points can be imported from the point library.



## 5.2.1 Point to Point Distance

← Azimuth Di	stance	
Point to point	Point to line	
A B Know:A Calcula	B Two point coordinate te:The Distance and Azimuth of AB	
Point A	:=	
Point B	:=	
Calculate Result		
Clear	Calculate	

Figure 5.3 Azimuth Distance – Point to Point

Import point A and point B from the point library.

[Calculate]: calculate the distance between the two points and the azimuth.

[Clear]: clear the result.

### 5.2.2 Point to Line Distance



Figure 5.4 Azimuth Distance - Point to Line

Import points from the library to calculate the distance from point A to line BC.

[Calculate]: calculate the distance.



[Clear]: clear the result.

# 5.3 Offset Point

Given the azimuth of point A & P, AP's horizontal length L and height H, calculate the

coordinate of P. The steps are as follows:

← Off	set Point
A	Know:The azimuth angle of point A PA, the horizontal distance L and the Height difference H ( N is north direction ) Calculate:Point P
Point A	Base_0
L(m)	25
H(m)	55
Azimuth(°)	3
Cle	ar Calculate

Figure 5.5 Offset Point interface

← Result	
Point Name	PT5
Code	>
x	24.9657
Y	1.3084
z	55.00
Cancel	Save

Figure 5.6 Offset Point calculation result

[Calculate]: calculate the coordinate of point P.

[Clear]: clear the current result.



# **5.4 Rotation Point**

Given the coordinates of point A, B and the rotation angle (clockwise), calculate the coordinate of point B after rotation.

← Rot	ation point
A L P	Know:Two-point coordinates of A B and the angle of clockwise rotation around A point Calculate:Coordinates of point B after rotation
Point A	TRSA
Point B	TRE2
Rotation any	<b>Jle(°)</b> 36
Clea	r Calculate

Figure 5.7 Rotation Point interface

← Result	
Point Name PT1	
Code	>
x	1071400.4418
Y	-1786459.5177
z	0.00
Cancel	Save

Figure 5.8 Rotation Point Calculation result

[Calculate]: calculate the coordinate of point B after rotation.



## 5.5 Two Points Intersection

There are two types of models listed below:

- Model 1: Given the coordinates of point A and B, the angle α between line AB and AP, the angle β between line AB and PB, calculate the coordinate of point P.
- Model 2: Given the coordinates of point A and B, the length of line AP and BP, calculate the coordinate of point P.

← Two	Point Intersection
A B	Know:The coordinate of A,B,the angle between A and B,the distance between A and P,and the distance between B and P. Calculate:Point P
Point A	:=
Туре	Angle >
α(D)	Input
Point B	:=
Туре	Angle >
β(D)	Input
Clea	Calculate

Figure 5.9 Two Point Intersection – Angle

← Tv	o Point Intersection
	Know:The coordinate of A,B,the angle between A and B,the distance between A and P,and the distance between B and P. Calculate:Point P
Point A	:=
Туре	Distance >
Dis:	Input
Point B	:=
Туре	Distance $>$
Dis:	Input
Cle	ear Calculate

Figure 5.10 Two Point Intersection – Distance

[Calculate]: calculate the coordinate of the intersection P.



# **5.6 Four Points Intersection**

Given the coordinates of point A, B, C and D, calculate the coordinate of the intersection point P between line AB and line CD.

← Foi	r Point Intersection
A P C	Know:Point A,B,C,D Calculate:Intersection coordin- ates between AB and CD
Point A	Pt1
Point B	PT2
Point C	Hai
Point D	Mi 📒
Cla	ar Calculate
Cie	

Figure 5.11 Four Point Intersection interface

Point Name	PT1
Code	>
x	129.9216
Y	448.1081
z	0.00

Figure 5.12 Four Point Intersection result

[Calculate]: calculate the coordinate of the intersection P.



# 5.7 Intersection Angle

Given the coordinates of point A, B and C, calculate the angle  $\ \angle ABC$ 

← Inte	rsection Angle	
в	Know:Point A,B,C Calculate:Angle	
Point A		Pt1
Point B		PT2
Point C		Mi
Calculate Res	sult	
Angle 41.4°		
Clea	ır Calc	ulate

Figure 5.13 Intersection Angle calculation

[Calculate]: calculate the angle  $\angle ABC$ .



# 6. TC20 Controller and application

# 6.1 Overview of TC20 Controller

The Tersus TC20 Controller is a rugged smart phone with design of 4.3" touch screen and an alphanumerical keypad. Equipped with powerful processor, it is perfect to adapt with Tersus Survey software. With professional IP67 rating, it is robust and reliable for harsh operating conditions.

#### Features:

- Rugged smart phone 4.3" display
- > 4G GSM unlocked Android 6.0
- Quad-Core 1.3GHz CPU
- > 2GB RAM + 16GB ROM
- > 8 MP Auto Focus camera
- > IP67 certified grade, water/shock/dust proof
- > 6500 mAh battery
- A-GPS supported
- ➢ Wi-Fi, Bluetooth, NFC
- > Two color options: red and yellow

Note: Although the TC20 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 TC20 controller, avoid exposing the TC20 controller to extreme environments such as moisture, high temperatures, low temperatures, corrosive liquids or gases.





## 6.2 Outlook of TC20 Controller

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.



Physical Keyboard

Figure 6.1 Four sides of TC20 controller

Menu Key: Select to show the available menu in current screen.

Home Key: Return to home screen. To view recent application, press and hold the home

key.

Back Key: Return to previous screen.

Volume Key: Adjust the volume of the ringtone.

Reset Key: Shut down the phone when the device is abnormal.

Camera key: Short press to enter camera in home screen. Long press it to open torch.



# 6.3 Accessories of TC20 Controller

TC20 Lithium Battery (3.7V/6500mAh)



Figure 6.2 TC20 Lithium battery

TC20 Charger Adapter (5V/1A) with one USB port



Figure 6.3 TC20 Charger Adapter



Figure 6.4 TC20 Charger Adapter Plugs

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

Put the plug in in the back of the adapter to assemble the TC20 Charger.

The hand strap below is for easy handling of TC20 controller.





Figure 6.5 TC20 Controller hand strap

The stylus pen below is for easy touch of screen on TC20 controller.



Figure 6.6 Stylus Pen for TC20

The mini USB cable below is to charge TC20 controller or transfer files between TC20 controller and a computer.



Figure 6.7 Mini USB cable

# 6.4 General Operations

6.4.1 Insert SIM card and Micro SD card

1. **Remove the back cover**: Loosen the screws on the back side - to rotate the screws anti-clockwise until open the back cover as shown in Figure 6.8.





Figure 6.8 Remove the back cover

2. **Take off the back cover**: Remove the back cover by lifting it up from the bottom part as shown in Figure 6.9 and take out the battery.



Figure 6.9 Take off the back cover

3. **Put the SIM Card in the holder**: Put the SIM card into the slot touching the SIM contacts of the phone as shown in Figure 6.10.





Figure 6.10 Put the SIM card in the holder

4. **Insert Micro SD card**: Open Micro SD card holder and insert Micro SD card into the slot, then close Micro SD card holder as shown in Figure 6.11.



Figure 6.11 Insert Micro SD card

5. **Insert the back cover**: Insert the back cover and rotate screws clockwise to lock the back cover as shown in Figure 6.12.





Figure 6.12 Insert the back cover

Note: Please power off the phone before plug in or pull out the SIM card.

### 6.4.2 Micro SD card

 Connect USB, turn on USB storage.
 It automatically pops up USB connected interface after connecting USB, and then click [Transfer Files] to turn on USB storage to use the files in the Micro-SD card.





Figure 6.13 Select USB function

### 6.4.3 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: Click and hold the screen, icon or input box to get more operation options.

- 1) Long-Time Click a picture in the gallery list interface, the status bar prompts to select a picture, you select to share or delete.
- 2) Long-Time Click the blanks of home screen to add home screen shortcut.
- 3) Long-Time Click the blanks of home screen wallpaper sources can be selected.

**Drag the screen:** You can drag the screen to view more applications which are not displayed in one screen.



# 7. Technical Appendix

# 7.1 Quick Start

1. Create a new project

Go to [Project] -> [Project], click [New], input the project name, select a CRS or edit with a template CRS, click [OK] to create a project.

#### 2. Connect a device

Go to [Device] -> [Connect], select the device type, connect type, connect config and antenna type, and click [Connect]. Click in the status bar can also connect to the device.

3. Configure the base and the rover

A base transmits RTK corrections to a radio or to network. The position of the base must be input manually or auto start. Nuwa supports RTK uploading to a NTRIP host, which brings convenience for a number of applications.

A rover receives RTK corrections from a radio or from network. NTRIP, TCP and TCS protocols are supported if corrections are received from network.

All the configuration can be managed, such as created, edited and deleted in Nuwa App. A device can be configured to work as a base or as a rover.

### 4. Point Correction and Base Shift

The point correction is to find the mathematical conversion relationship (transition parameter) between WGS84 and the local plane Cartesian coordinate system. There are three calculation types: four-parameter, height-fitting, and four-parameter + height-fitting.

There are three methods for height fitting: Fixed Difference Correction, Plane Fitting and Surface Fitting.



In Auto Start mode, if a base is moved, re-installed or powered off, Base Shift is necessary to make the points have the same coordinates before and after the change. Main steps: Go to [Survey] -> [Base Shift], select GNSS points and known points, click [Calculate], the offsets parameters are calculated automatically. The user can apply the parameters on the points to be surveyed. Base Shift also influence coordinates value of other points with this base.

Steps 5 – 8 are action points in fields, select one or more in fields.

#### 5. Survey

Go to [Survey] -> [Survey] to enter survey interface, which can be in text mode or drawing mode. The main difference between the two modes is whether the drawing is displayed. The configuration refers to section 4.6.1 Common Config for more details.

Two collection modes: Auto Collect and Manual Collect, refer to section 4.1 Survey for details. All the detailed information about the survey points can be checked in the survey point library.

#### 6. Point Stakeout

Go to [Survey] -> [Point Stakeout] to enter point stakeout interface. Stakeout points must be saved in the stakeout point library before. Select the points to be stakeout and find the target point according to the prompt information by Nuwa, refer to section 4.2 Point Stakeout for details.

#### 7. Line Stakeout

Go to [Survey] -> [Line Stakeout] to enter line stakeout interface. Stakeout lines muse be saved in the stakeout line library. Select the lines to be stakeout and find all the points on the target line according to the prompt information by Nuwa, refer to section 4.3 Line Stakeout for details.

#### 8. Static Survey

Go to [Survey] -> [Static Survey] to enter static survey interface. Select the parameters, such as interval, cut off angle, antenna parameters and click [Start], refer to section 4.4 Static Survey for details.


### 9. Export

Go to [Project] -> [Export] to enter export interface. The supporting file formats include: csv, kml, shp, dxf, html and kml. The data to be exported can be filtered by point type and collection time. Click [Export] after all the options are filled.

10. Import

Go to [Project] -> [Import] to enter import interface, which can be divided into Coordinate Import and Other Import.

Coordinate import is to import points in a .csv file or .dat file, mainly to import points to a library.

Other import is to import the DXF or SHP files for the background. Click [File Path] to select the file directory.



# 7.2 Issues and Solutions

#### 1. Bluetooth / USB cannot be connected with David.

(1) Check if other devices have connected to Bluetooth (COMM1-Bluetooth module only supports Android phones);

(2) Check if the Bluetooth model matches the David GNSS receiver, the David-R model matches the BT420R model of Bluetooth module, and the David model matches the BT420A model of Bluetooth module;

(3) Check if the David GNSS receiver is powered on normally. If the receiver's LED is bright but cannot search for the Bluetooth name, please delete the matched Bluetooth in the phone and search again. If you still cannot find the Bluetooth device name, please contact the supplier for assistance;

- (4) Reconnect USB and allow USB device to connect when USB cannot be connected;
- (5) If the radio base station mode is used, check the power supply. At this time, only the

12V battery can be used for power supply. Do not use 5V power bank for power supply.

#### 2. David GNSS receiver cannot be located.

- (1) Check if the GNSS antenna is properly connected;
- (2) Check if the GNSS antenna cable and connector are intact or damaged.
- (3) Ensure that the GNSS antenna is placed in an open outdoor environment;
- (4) Check if David's LED light is in normal startup state.

#### 3. The rover with 2W radio kit cannot obtain a fixed solution.

(1) Check if the radio 'T/R' LED is in the receiving state with blue light. If it is not in the receiving state, press and hold the 'CHAN' and 'PWR' buttons for about 1 second to switch to the receiving state.

(2) Check whether the number of channels and the transmission protocol of the rover are consistent with that of the base radio;

(3) Check whether the baud rate of the serial port of the 2W radio and the base radio is



normal. The baud rate of the serial port of the 2W radio and the 30W radio is 38400bps, and the baud rate of the serial port of the 1W radio is 115200bps.

# 4. The rover network mode cannot obtain a fixed solution.

(1) Check if the network of the rover is normal, and whether the controller (an android device) can connect to the network normally;

(2) Check if the rover's user name and password are correct, pay attention to case sensitivity, and there is no '@' character at the beginning of the rover's password;

(3) Check if the rover's MountPoint is consistent with that of the base. It is recommended

to use the default base serial number as MountPoint;

(4) Check if the base has sent corrections data normally.

## 5. The base radio constantly restarts.

(1) In the base radio mode, only 12V battery can be used for power supply, and 5V power bank cannot be used for power supply;

(2) Check if the battery is low power or insufficient voltage.

# 6. The local coordinate deviation of the rover is large.

(1) Check if the coordinate system of the project in Nuwa application is configured correctly;

(2) If point correction or parameter calculation is not performed, the base needs to be configured by manual start, and the known point coordinates of the base configuration should be consistent with the known point of the actual installation;

(3) If point correction or parameter calculation is performed, check whether the coordinate of the control point is incorrectly entered, whether the coordinate deviation of the control point and the distribution of the control point is uniform, and whether the scale is close to 1 in the parameter calculation result.

# 7. It prompts that the coordinate deviation is large when configuring base.

(1) If the input is WGS84 coordinates, check whether the input coordinates are the same



point, and the coordinate difference cannot be greater than 30m;

(2) If the input is local coordinates, check whether the configured coordinate system is consistent with the coordinates that need to be input.

### 8. The time for the rover to get a fixed solution is too long.

(1) Check the number of satellites for the rover, the satellite distribution (whether the occlusion is serious), and the satellite signal-to-noise ratio (whether the maximum signal-to-noise ratio is greater than 50);

(2) Check if the antenna connection is loose;

(3) Check whether the correction data of the base is normal, and whether it includes correction data of GPS, GLONASS, and BeiDou systems.





# 8. Terminology

Abbreviation	Definition
CRS	Coordinate System
GNSS	Global Navigation Satellite System
HDOP	Horizontal Dilution of Precision
HRMS	Horizontal Root Mean Square
OS	Operating System
PDA	Personal Digital Assistant
PDOP	Position Dilution of Precision
RINEX	Receiver Independent Exchange format
RMS	Root Mean Squares
RTCM	Radio Technical Commission for Maritime Services
RTK	Real-Time Kinematic
SNR	Signal Noise Ratio
UI	User Interface
UTC	Coordinated Universal Time
UTM Projection	Universal Transverse Mercator Projection
VDOP	Vertical Dilution of Precision
VRMS	Vertical Root Mean Square



# 9. File Format

- [.apk]: android app installation file
- [.csd]: coordinate system file
- [.csv]: excel file
- [.dat]: data file
- [.dxf]: CAD data file developed by Autodesk
- [.ggf]: Geoid file
- [.kml]: landmark file developed by Google
- [.Inb]: line file
- [.shp]: shape file developed by ESRI
- [.txt]: text file





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