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# User Manual For Tersus GeoBee Cost-effective Solution for CORS

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Sales Enquiry: sales@tersus-gnss.com Technical Support: support@tersus-gnss.com More details, please visit www.tersus-gnss.com



# **Revision History**

Version	<b>Revision Date</b>	Change Summary	
1.0	20190121	Initial Release	
1.1	20190321	Update cover photo;	
		Update section 2.1.2 Configure David;	
		Add section 2.5 Observation Data Storage and 4.3 Check	
		Link Status using Web Portal	
1.2	20190712	Update photos of system structure and accessories;	
		Update COMM1 cable and COMM2 cable;	
		Update table 3 for David pin definition;	
		Update mechanical drawing for AX3702.	
1.3	20201210	Update section 2.1.2 commands to configure David;	
		Update section 2.1.3 for TR600 configurations.	
1.4	20210722	Add section 5	
1.5	20211129	Add section 4.4 group user managing function and	
		section 4.5 nearest base station.	



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# 1. Introduction

This chapter mainly introduces the overview, system structure, package list, and installation guide of the Tersus GeoBee.

### 1.1 Overview

The Tersus GeoBee is a dedicated and cost-effective solution to establish a permanent reference station. With Tersus Ntrip Caster Service, Ntrip Modem and David Receiver, the GeoBee opens the possibility for users to transmit Real Time Kinematic (RTK) corrections via Internet (Ethernet or 2G/3G/4G) in a simple, user-friendly way, just using a SIM card or Ethernet cable without any need of a static IP. GeoBee can also work as GNSS Rover to receive RTK corrections from Tersus Ntrip Caster or any CORS service.

Ntrip server mode: use David GNSS receiver to create a base station. This temporary base or CORS are for surveying, agriculture, UAV, machine control, and etc. It is also ideal for deformation monitoring. Tersus GNSS Inc. provides Ntrip Caster to transfer data.

Ntrip client mode: connect David or other Tersus GNSS receivers to Tersus Ntrip Caster or any Ntrip/CORS service. David is mainly used for surveying, and also used as a GNSS sensor in various applications, such as mobile mapping, UAV, machine control, agriculture, and etc.



# 1.2 System Structure

Set up the GeoBee system according to the figure below.



Figure 1.1 GeoBee System Structure

No.	Name
1	Antenna (AX3702 in the figure above, customizable)
2	TNC-J to SMA cable (25m by default, customizable)
3	David GNSS Receiver
4	Power Adapter (short for 'DC-2pin AC Power Adapter with 1.2m cable')
5	COMM1 cable (short for 'COMM1-7pin to DB9 male cable')
6	COMM2 cable (short for 'COMM2-7pin to TR600-DC-2pin & DB9 female & USB cable')
7	Ntrip Modem TR600
8	4G antenna for TR600
9	Wi-Fi antenna for TR600
10	Ethernet cable 1.5m



#### Note:

- There are two configuration modes for GeoBee. GeoBee system is configure-free if customer adopts GeoCaster provided by Tersus GNSS Inc., as GeoBee is pre-configured when shipped out of factory. GeoBee system needs to be configured if customers demand to set up caster by themselves.
- 2) David GNSS receiver uploads RTCM stream to the NTRIP caster using Ethernet (default) or Wi-Fi or 2G/3G/4G sorted by priority. For Ntrip Modem TR600, Wi-Fi client and Wi-Fi hotspot are both supported, however they cannot be enabled simultaneously. Wi-Fi client function is to use Wi-Fi connection to communicate with caster. Wi-Fi hotspot function is to share internet connection to other devices.
- 3) Place the antenna (AX3702 in the Figure 1.1) in the outdoor open environment. Install Wi-Fi antenna when Wi-Fi connection is available for communication. Install 4G antenna when 2G/3G/4G SIM card is used for communication.
- 4) GeoBee starts to work in auto start mode by default once it is powered up. According to the autonomous positioning (without RTK or DGPS), it smooth out the average value to be the base coordinate. GeoBee outputs the RTCM32 corrections data and sends to the Ntrip caster through LAN, WIFI or 2G/3G/4G mobile network.
- 5) For the known phase center coordinates of the AX3702 antenna, the two configuration methods are as follows:
- Use the 'DB9 Female to USB Type A Male converter cable' to connect the COMM1 cable in Figure 1.1 and a computer, open Tersus GNSS Center application on the computer, and type below commands in the command window:

POSAVE OFF	//Turn off position average
UNDULATION USER 0.0	//Set user specified undulation value for ellipsoid height <sup>1</sup>
FIX POSITION B L H	// B: latitude (degree), L: longitude (degree), H: height (m)
For	example: FIX POSITION 31.24523012 121.58922341 40.35
SAVECONFIG	//save configuration

**Note 1**: If customer needs to use global geoidal height model EGM96 for mean sea level height, type below command to replace the undulation command above.



#### UNDULATION EGM96 //Set EGM96 geoidal height model

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

- b. Use the COMM1-Bluetooth module in the package, insert the Bluetooth module to the COMM1 port of David GNSS receiver. Launch Nuwa app on an android device, connect David by paring Bluetooth. Create a base configuration with manual start in radio mode, fill in the base coordinates and antenna height, and set Baud Rate as 115200 bps and Differential Format as RTCM3.2. Detailed operation refers to *User Manual for David GNSS Receiver*.
- 6) The known phase center coordinates of the AX3702 antenna can be obtained from surveying and mapping department of local government, or calculated from commercial software such as Bernese or Gamit.



## 1.3 Devices in GeoBee Package

### 1.3.1 David GNSS Receiver

David has four interfaces which is shown below.



Figure 1.2 David GNSS Receiver

The DC port of David is for power input, COMM1 port is for COM1 and CAN ports, and COMM2 port is for COM2 and USB ports, refer to section 3.1 for detailed specification of David.

Table 1	Definition	of LEDs
---------	------------	---------

LED	Colour	Description
PWR RED		ON: the David is power on.
	BLUE	ON: David in Fixed solution.
PV		Blink: David in Float solution
		OFF: David in other position types.



### 1.3.2 AX3702 GNSS Antenna

AX3702 GNSS antenna is used to receive the RF signal from the satellites, and it must be connected to the David with the GNSS antenna cable in the package.



Figure 1.3 AX3702 GNSS Antenna





Figure 1.4 TNC-J to SMA Cable (GNSS antenna cable, 25m by default)



## 1.3.3 TR600 Ntrip Modem



Figure 1.5 TR600 side view 1



Figure 1.6 TR600 side view 2



#### 1.3.4 Other accessories



Figure 1.7 COMM1-Bluetooth Module



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

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



Figure 1.8 DC-2pin AC Power Adapter with 1.2m cable





Figure 1.9 COMM2-7pin to TR600-DC-2pin & DB9 female & USB cable

The circular connector of the COMM2-7pin to TR600-DC-2pin & DB9
 female & USB cable can only be installed into the COMM2 port of David
 GNSS Receiver.

The COMM2-7pin to TR600-DC-2pin & DB9 female & USB cable has two functions:

- Connect to DB9 female to USB Type A Male converter cable (refer to Figure 1.13) to download the file saved on the internal eMMC, refer to section *Download Files from Internal eMMC* in David user manual;
- Connect to USB Type A Female to USB (Micro +Type C) OTG cable (refer to Figure 1.14) to connect the Android phone or controller with David.



Figure 1.10 COMM1-7pin to DB9 male Cable

<u>!</u>	The circular connector of the COMM1-7pin to DB9 male cable can only
	be installed into the COMM1 port of David GNSS Receiver.





Figure 1.11 RS232 to RS485 converter



Figure 1.12 DB9 female to TR600-RS485-5pin cable



Figure 1.13 DB9 Female to USB Type A Male converter cable



Figure 1.14 USB Type A Female to USB (Micro +Type C) OTG cable





Figure 1.15 4G antenna for TR600



Figure 1.16 Wi-Fi antenna for TR600



Figure 1.17 Ethernet cable 1.5m



## 1.4 Installation Guide

1.4.1 Install bottom plate for fixing David



Figure 1.18 Bottom plate for fixing David



Figure 1.19 Dimension of bottom plate

Use the screws in the package to secure the bottom plate to the back of the David GNSS receiver. Hence it can be fixed to the places required.



### 1.4.2 Install bracket and slide rail for TR600



Figure 1.20 TR600 dimension



Figure 1.21 Bracket for TR600



Figure 1.22 Slide rail for TR600 (20cm)



Figure 1.23 TR600 with bracket and slide rail

Fix the bracket to the back of the TR600 with two screws, slide the rail into the bracket, and then use screws to fix the whole set to the places required.



# 2. General Operation

This chapter introduces how to use GeoBee, configuration parameters, factory reset and firmware upgrade.

## 2.1 Configurations

#### 2.1.1 Accessories Required

The accessories required are listed below:

- 1) One Power Adapter (DC-2pin AC Power Adapter with 1.2m cable);
- 2) One COMM1 cable (COMM1-7pin to DB9 male cable);
- 3) One DB9 Female to USB Type A Male Converter cable;
- 4) One COMM1-Bluetooth module;
- 5) One Ethernet cable for connecting TR600 and PC or customized device.

#### 2.1.2 Configure David

Configuring David is able to be done using Tersus GNSS Center via cables or using Nuwa app via Bluetooth.

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

- 1) Use the 'DB9 Female to USB Type A Male Converter cable' to connect the COMM1 cable (COMM1-7pin to DB9 male cable) and a computer;
- 2) Open Tersus GNSS Center application on the computer and type below commands in the command window:



UNDULATION USER 0.0 //Set user specified undulation value for ellipsoid height<sup>2</sup> FIX POSITION B L H //B: latitude (degree), L: longitude (degree), H: height (m) For example: FIX POSITION 31.24523012 121.58922341 40.35 or POSAVE ON 0.02 //Turn on position average for 0.02 hour (72s) LOG COM2 RTCM1074 ONTIME 1 //output GPS RTK raw measurements LOG COM2 RTCM1084 ONTIME 1 //output GLONASS raw measurements LOG COM2 RTCM1124 ONTIME 1 //output BeiDou RTK raw measurements LOG COM2 RTCM1005 ONTIME 10 //output the base's position LOG COM2 RTCM1230 ONTIME 5 //output GLONASS bias information SAVECONFIG //save configuration

**Note 2**: If customer needs to use global geoidal height model EGM96 for mean sea level height, type below command to replace the undulation command above.

#### UNDULATION EGM96 //Set EGM96 geoidal height model

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

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

The detailed steps of configuring David via Bluetooth are listed below:

- Insert the 'COMM1-Bluetooth module' into the COMM1 port of David GNSS receiver;
- Connect the AX3702 GNSS antenna to David with the GNSS antenna cable;
- 3) Power on the David GNSS receiver by plugging the AC power adapter;
- 4) Run Nuwa app, click [Device] -> [Connect];



- 5) Select [David] in the option list of Device Type;
- 6) Select [Bluetooth] in the option list of Connect Type;
- Click [Connect Config] -> [Search]. The SSID is BT420R-xxxxx\_xxxxx. No password is needed to pair with it;
- 8) Click [Connect] to enable the communication with David;
- 9) After the Bluetooth module is connected with David successfully, configure David as a base with manual start in radio mode, fill in the base coordinates and antenna height, and set Baud Rate as 115200 bps and Differential Format as RTCM3.2. Detailed operation about David and Nuwa app refers to the User Manual for David GNSS Receiver and User Manual for Nuwa app which can be downloaded on Tersus website.

	← Create Base Config				
Startup Manual start				l start >	
E	Base C	coordniate	Ç		
	Lat(°	)	0.00000000	U	
	Lon(	°)	0.00000000	U	
	Height(m)		0	.000	
	<b>()</b> B	BLH(WGS84)	O NEH(Local)		
Ant Height(m)		ight(m)	SI	ant 0.0 >	
Data Link				Radio >	
Baud Rate		late	1	15200 >	
Differential Format		ntial Format	RT	смз.2 >	
	ок				

Figure 2.1 Configure David using Nuwa app

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



### 2.1.3 Configure TR600

The detailed steps of configuring TR600 are listed below:

1) Set IP address of the PC as 'Automatically obtain IP address';



Figure 2.2 Properties for Internet Protocol (TCP/IP)

/ if yo iur ne	our ne stworl	etwork k admir	supports histrator
y if yo iur ne	our ne tworl	etwork kadmir	supports histrator
	3	100	
50		19	
()	5	37.5	
2			
-			
	-	÷	
22			
		Ady	anced
	OK	1	Capce
	2	<u>2</u> ] ; , , ,	X

Figure 2.3 Set IP address as 'Obtain an IP address automatically'

 Using Ethernet cable to connect the LAN1/WAN port to a router to access Internet, connect the LAN2 port of TR600 to your PC;





Figure 2.4 Connect Ethernet cables

- 3) Type in 192.168.100.1 or 192.168.1.1 in the browser of PC to enter the web configuration login page;
- 4) Type in username 'root' and password '1234' in the login page;

00 TERSUS
ENGLISH V
登陆(login)

Figure 2.5 Login TR600 configuration interface

5) In the web configuration interface, check the current connection status.



atua	Stature:	
atus	Status.	
twork Settings	Product ID: 240305005050431	
N	Version: TR600-W4-1.0.2-11/30/18	
FI Hotspot	Running: O days O hours 5 minutes 1 seconds	
T Rule	Now: 2018/12/04 15:31:26	
RIP CFG	CPV Vsage: 12%	
rhub	RAM Usage: 49%	
stem Tools	Manufacturer Questel	
boot System	Model: EC2OF	
	Status: Module detected, SIM card not detected	
	Module IMEI: 862107041466806	
	ULX7 T LX70	
	WAN Connected to network, IP:192.168.6.48	
	Lonnection Status: Virhub connected.	
	P	
	Received (bytes). 500, 150	
	Sent(Bytes): 326,069	
	Receive Rate(Byte/s): 4,199	
	Send Rate(Byte/s): 42	

Figure 2.6 Check the current connection status

6) Select 'WAN&WIFI&MOBILE' for Network option in Network Settings, and

click [Save] to save this setting.

TERSUS	NTRIP Smart Device	[中文 English] Warning: Setting effect after reboo
<ul> <li>Status</li> <li>Network Settings</li> <li>Network Select</li> <li>Wireless Basic</li> <li>Wireless Advanced</li> <li>WAN</li> <li>WIFI Client</li> <li>LAN</li> <li>WIFI Hotspot</li> <li>NAT Rule</li> <li>NIRIP CFG</li> </ul>	Network Select Select the interface to connect. Network: VV/ ICMP Host: MC Backup ICMP Host: V/ Max Try: V/ External access: V/ Note 1: ICMP Host should be se V/ Note 2: Wifi hotspot will be clos Internet.	AN&WIFI&MOE DBILE(2G/3G/4G) AN FI AN&MOBILE AN&WIFI FI&MOBILE AN&WIFI&MOBILE N. ed when using wifi to connect to
• Virhub • System Tools • Reboot System	Save Revert	

Figure 2.7 Select network in Network Settings

7) For Wireless Basic, it is to configure 2G/3G/4G network parameters. Consult your local mobile carrier for the APN settings. Below screenshot is taking Telstra from Australia for example, Telstra.wap is auto selected as the APN. The APN mode can also be manually selected, prepare your local



#### APN info and fill in manually.

• Status	Basic Cfg
<ul> <li>Network Settings</li> <li>Network Select</li> </ul>	Get the params of mobile operation before using it.
<ul> <li>Wireless Basic</li> <li>Wireless Advanced</li> <li>WAN</li> <li>WIFI Client</li> <li>LAN</li> <li>WIFI Hotspot</li> <li>NAT Rule</li> <li>NIRIP CFG</li> <li>Virhub</li> <li>System Tools</li> <li>Reboot System</li> </ul>	APN Mode       Auto Select         APN:       Telstra.wap         Service Code:       *99#         Select Network Manually:

Figure 2.8 Mobile communication network settings

8) For the WAN setting, use the default DHCP as most routers support DHCP. The WAN is connected to your router's LAN, then the router will assign an IP address to the TR600 modem.

Status	WAN	
Status Network Settings Network Select Wireless Basic Wireless Advanced WAN WIFI Client LAN WIFI Hotspot NAT Rule NIRIP CFG Virhub System Tools Reboot System	WAN Set up the WAN inte WAN MAC: Type: PPFOE Account: PPFOE Password: Static IP: Mask: Gateway: DNS1: DNS1: DNS2: Note:	erface.
	Save	

Figure 2.9 WAN setting

9) If WIFI Client is chosen to access internet, click WIFI Client in Network Settings, select a SSID to be used and type in the WIFI password in the PSK pin area, click [Save] to save this setting.



[For more information please visit: TERSUS ]

Figure 2.10 WiFi Client setting

10)For LAN setting, the LAN configuration is obtained automatically when the

TR600 modem is connected to the router.

• Status	LAN		
• Network Settings	Set up the router	r IP of LAN and set the	DHCP function.
• WIFI Hotsnot	Gateway IP:	192.168.2.1	]
• NAT Rule	Mask:	255.255.255.0	
NTRIP CFG	DHCP Start IP:	192.168.2.20	]
Virhub	DHCP End IP:	192.168.2.254	]
System Tools	DNS IP:		
Reboot System	DHCP Lease:	86400 Leas	e: (1~200000)
	DHCP Service:	ON 🔻	
	Note : Cateway IF	° and DHCP Settings mus	t be in the same network.

Figure 2.11 LAN setting



11)Set corresponding NTRIP information in NTRIP configuration interface as shown in the upper red box according to the NTRIP information attached as a label on the Ntrip Modem TR600. The information for Data Center 1 in the lower red box is pre-configured as default if Tersus mserver is used. Contact Tersus Technical Support if users need other server for Data Center.

FERSUS	NIRIP Smart Devic	C Warning: Setting effect after rebo
<ul> <li>Status</li> <li>Network Settings</li> <li>LAN</li> <li>WIFI Hotspot</li> <li>NAT Rule</li> <li>NTRIP CFG</li> <li>Virhub</li> <li>System Tools</li> <li>Reboot System</li> </ul>	Basic Cfg NTRIP Info. NTRIP Info NTRIP Caster Address: NTRIP Caster Port: NTRIP Caster Port: NTRIP Type NTRIP Username: NTRIP Password: Nount: Selfdefined Mount: Selfdefined Mead1: Selfdefined Head2: Selfdefined Head3: Data Source:	
	DC1 DC IP or Dnsname: DC Port: Connect mServer: Data Source:	

Figure 2.12 Set Ntrip info in Ntrip configuration interface

12)Turn on the virtual hub function and configure Virhub according to the information which is shown below. It is pre-configured as default. Contact Tersus Technical Support if users need other server for the Virhub configuration.



• Status	VIRTUAL HUB	
<ul> <li>Network Settings</li> <li>LAN</li> <li>WIFI Hotspot</li> </ul>	This Page: Enable or disable	virhub function.
<ul> <li>NAT Rule</li> <li>NTRIP CFG</li> <li>Virhub</li> </ul>	Main DC IP(Or Dnsname): Main DC Port: Transfer Protocol:	mserver.tersus-gnss.com 2180 (1~65535) UDP V
* System Tools • Reboot System	Account: Remote Access IP: Remote Access Mask: Disable Broadcast Packet: Heartbeat Interval: Data Auto:	192.168.168.1 255.255.255.0 OFF ▼ 30 ON ▼

Figure 2.13 Set Virhub configuration

13)After setting the above configurations, click [Save] and reboot the device to active the configuration. The configuration becomes effective only after the Ntrip Modem TR600 is restarted.

Note: the mserver software and Verhub software are under development, stay tuned.

### 2.2 Configuration Parameters

The configuration menu of David GNSS receiver can be viewed on Nuwa app, the detailed usage of Nuwa app refers to the user manual of Nuwa app which can be downloaded on Tersus official website

https://www.tersus-gnss.com/document/david-receiver under the User Manual section.



Each configuration menu of Ntrip Modem TR600 has multiple parameters, and some of them have sub-menus. The detailed configuration parameters refer to section 2.2 of the user manual of Ntrip Modem TR600.

### 2.3 Factory Reset

The factory reset of David GNSS receiver can be completed on Nuwa app by clicking [Reset] on the Device Info interface. The detailed usage of Nuwa app refers to the user manual of Nuwa app which can be downloaded on Tersus official website <u>https://www.tersus-gnss.com/document/david-receiver</u> under the User Manual section.

In the TR600 configuration interface, select 'Restore Set' under 'System Tools', click [Restore Set] to reset to factory settings; or long press the RESET button to reset.

TERSUS	NTRIP Smart Device	[中文 English] Warning: Setting effect after reboo
<ul> <li>Status</li> <li>Network Settings</li> <li>LAN</li> <li>WIFI Hotspot</li> <li>NAT Rule</li> <li>NTRIP CFG</li> <li>Virhub</li> <li>System Tools</li> <li>System Tools</li> <li>System Log</li> <li>BTU Log</li> <li>Restore Set</li> <li>Upgrade Firmware</li> <li>Change Password</li> <li>Reboot System</li> </ul>	Restore Set Click this button to revert to factory settings! Restore Set	

Figure 2.14 Factory Reset for TR600

### 2.4 Firmware Upgrade

The updated firmware is released and available for downloading on Tersus



web site <u>https://www.tersus-gnss.com/software</u>, or it can be obtained from Tersus technical support. After completing the hardware connection mentioned in 2.1.2 Configure David, launch the TersusUpdate software on the desktop or click [Tools] -> [UpdateFirmware] in Tersus GNSS Center software.

In the TersusUpdate interface, the software recognizes the serial port and scans the baud rate automatically. Select the Port which is connected to David receiver, browse the location for the updated firmware file, and click [Next] to update the firmware.



Figure 2.15 Update firmware for David

Contact Tersus Support for firmware file to upgrade Ntrip Modem TR600. Select 'Upgrade Firmware' under 'System Tools' in the TR600 configuration interface, choose the firmware file, and click [Upload/Download] to upload the firmware.



TERSUS	NTRIP S	mart Device	[中文   English ] Warning: Setting effect after reboot
• Status • Network Settings • LAN	Upgrade Firmware Upload the fir	mware or Download it from Internet	and reboot automatically after
• WIFI Hotspot • NAT Rule • NIRIP CFG • Virhab	update. Upload Firmware: Download By	Choose File No file chosen	Must be
- System Tools • System Set • System Log	URL:		connected to Internet.
• DTV Log • Restore Set • Vpgrade Firmware • Change Password	Upload/Download leave this page.	] Note : It need about 1 minu	ite to upload the firmware, please not
• Reboot System			

Figure 2.16 Update firmware for TR600

Wait for a few minutes until 'Update' is shown, choose 'Delete the former file'. Click [Update], it will prompt that the file system has been updated, the original setting is cleared, and the system is rebooting.

### 2.5 Observation Data Storage

Since it is not supported to download observation data remotely, it is recommended using RTKLIB, an open source program for GNSS positioning, to store the observation data as a file in the computer.

The detailed steps of how to store observation data into a computer are as follows:

- Download RTKLIB software from its official website <u>http://www.rtklib.com/</u>, unzip the zip file and find the application rtklaunch.exe
- Double click rtklaunch.exe and then click the third icon to launch STRSVR function.





Figure 2.17 Launch STRSVR in RTKLIB

 In the STRSVR interface, select 'NTRIP Client' as input type, click the Opt button on the right, fill all the information for NTRIP Client Options and then click [OK].

2019/03/12 1	10:15:04 GPST C			Connect Time: 0	d 00:00:00		
Stream	Type	Opt	Cmd	Conv Bytes 0	Bps 0		
□ (1) Output □ (2) Output	File .	<b>-</b>		NTRIP Client Optic NTRIP Caster Host 106.14.184.52	ons	~	> Port 7774
(3) Output		¥ (0)		Mountpoint TEST ~	User-ID		Password
				String			1
► <u>S</u> tart	t		tions.		20 <u>-</u>		

Figure 2.18 Input NTRIP Client information

4) Select 'File' as output type, click the Opt button on the right, browse a location for the Output File Path, and click [OK].

								2.00.10 GFD1	2019/03/13 0
				tes Bps	Conv I	Cmd Co	Opt	Туре	Stream
				ns	File Opt			NTRIP Client $$	🗌 (0) Input
				le Path	Output			File 🗸 🗸	🗌 (1) Output
			ਜ	Miki\Desktop\TEST	C:\User		100	~	🗌 (2) Output
ancel	<u>C</u> ar	QK	✓ H ?	ag Swap Intv	Time		100	~	🗌 (3) Output
and	Car	Ōĸ	н — Ун ? [	ig Swap Intv	C: User	••••		~	(2) Output

Figure 2.19 Output information

5) Go back to the main page, and click [Start]. The observation data will be



stored in file of the designated folder. The file is being saved as shown below.

2019/03/13	02:00:49 GPS	5T		C	Connect 7	Fime: Od	00:00:11
Stream	Туре		Opt	Cmd	Conv	Bytes	Bps
(0) Input	NTRIP Client	~				5,356	3,376
(1) Output	t File	~		100		5,356	4,375
🗌 (2) Outpu	t	~		100	***	0	C
🗌 (3) Outpu	t	~		122	***	0	C
	(0) geobeeca	ster:	2.ters	us-gn	ss.com/12	34	

Figure 2.20 Start saving observation data



# 3. Specifications

This chapter includes the specifications of David GNSS Receiver, AX3702 GNSS Antenna and TR600 Ntrip Modem.

### 3.1 David GNSS Receiver

Table 2 David GNSS Performance

GNSS Performance					
Signal tracking	GPS L1, L2; GLONASS L1, L2; B	eiDou B1, B2			
GNSS channels	384				
		1.5m RMS (Horizontal)			
	Single positioning	3.0m RMS (Vertical)			
	DTK Desitioning	10mm+1ppm (Horizontal)			
Position Accuracy	RTK Positioning	15mm+1ppm (Vertical)			
	Ctatic mast analysis	3mm+0.5ppm (Horizontal)			
	Static post processing	5mm+0.5ppm (Vertical)			
	Cold Start: <50s				
	Warm Start: <30s				
Deservisition	0.5s L1 (typical)				
Reacquisition	1.0s L2 (typical)				
Data Data	Measurements	20Hz			
Data Rate	Position	5Hz			
Time Accuracy	20ns RMS				
Velocity Accuracy	0.03m/s RMS				
	C/A Code	10cm			
Measurement Precision	P Code(zenith direction)	10cm			
	Carrier Phase (zenith direction)	1mm			
	Physical Description	•			



Dimension	104*65*31 mm (David only)
Weight	250g (David only)
	Mechanical Drawing
	TERSUS DAVID
	Environmental
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +95°C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)
Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g)
	Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75
	g)
Water & dust proof	IP67
	Power Requirement
Input Voltage	+5 ~ 12 VDC
Power Consumption	3.2W without external Radio
	9.8W with external 2W radio





Figure 3.1 Panel of David

#### Table 3 Pin Definition of connectors on David

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

The pin definition's view from outside to David is as below.



Figure 3.2 Pin Definition of the COMM1/COMM2/DC ports



# 3.2 AX3702 GNSS Antenna

#### Table 4 AX3702 GNSS Antenna

Antenna Specification				
<b>T</b>	GPS L1/L2/L5; BDS B1/B2/B3;			
I racking signals	GLONASS L1/L2			
Impedance	50 Ohm			
Polarization	RHCP			
Axial Ratio	≤ 3dB			
Azimuth Coverage	360°			
Output VSWR	≤ 2.0			
Peak Gain	5.5dBi			
Phase Center Error	± 2mm			
l	-NA Specification			
LNA Gain	40±2dB			
Noise Figure	≤ 2.0dB			
VSWR	≤ 2.0			
Input Voltage	3.3~12V DC			
Operating Current	≤ 45mA			
Ripple	± 2dB			
PI	nysical Description			
Dimension	Φ152*62.2mm			
Weight	374g			
Signal Connector	TNC Female			
Installation connector	5/8" x 11			
	Environmental			
Operating temperature	-45°C - +85°C			
Storage temperature	-45°C - +85°C			
Damp	45% - 95%			





# 3.3 TR600 Ntrip Modem

Table 5 Ntrip Modem TR600 specifications

	Electrical			
Input Voltage	+12 ~ +48V DC			
Operating Current	350mA @ +12V DC			
Standby Current	250mA @ +12V DC			
Power Consumption	4.2W (typical)			
	Network			
Chinese version	2G: GSM/GPRS/EDGE/CDMA2000 1x			
	3G:UMTS/WCDMA/HDSPA/HSPA+/TD-SCDMA/CDMA2000			
	EVDO			
	4G: TDD-LTE/FDD-LTE			
Eurasian version (Europe,	2G: GSM/GPRS/EDGE			
Middle East, Africa, South	3G: UMTS/WCDMA/HDSPA/HSPA+			
Korea, Thailand)	4G: TDD-LTE/FDD-LTE			
North American version	3G: UMTS/WCDMA/HDSPA/HSPA+			
	4G: FDD-LTE			
Australian version (New	2G: GSM			
Zealand, Australia, South	3G: WCDMA			



America)	4G: FDD-LTE/TDD-LTE
	Operating Frequency Band
Chinese version	TDD-LTE B38/B39/B40/B41
	FDD-LTE B1/B3/B8
	UMTS/HSDPA/HSPA+ B1/B8
	TD-SCDMA B34/B39
	CDMA2000 1x/EVDO BC0
	GSM/GPRS/EDGE 900/1800 MHz
Eurasian version	TDD-LTE B38/B40
	FDD-LTE B1/B3/B7/B8/B20
	UMTS/HSDPA/HSPA+ B1/B8
	GSM/GPRS/EDGE 900/1800 MHz
North American version	FDD-LTE B2/B4/B5/B17
	UMTS/HSDPA/HSPA+ B2/B5
Australian version	FDD-LTE B1/B2/B3/B4/B5/B7/B8/B28
	TDD-LTE B40
	WCDMA B1/B2/B5/B8
	GSM 850/900/1800/1900
	Interfaces
Serial Port	RS232 x1, RS485 x1
Ethernet	RJ45 x2 (LAN, LAN/WAN)
Antenna Connector	SMA Female x1
	Physical
Dimension	118x91x34mm (w/o connectors)
Weight	335g
Operating Temperature	-30°C ~ +80°C
Relative Humidity	95% @ +40°C



# 4. Typical Application

Typically, GeoBee can work under both Ntrip server mode and Ntrip client mode. The system structure for them is the same, the configuration of Ntrip Modem TR600 is different.

### 4.1 GeoBee working under Ntrip server mode

If GeoBee is configured to work under Ntrip server mode, fill in the Ntrip information under the [NTRIP CFG] sub menu. Select [server] in the drop-down menu of Ntrip Type, type in the Ntrip password and click [Save] at the bottom of this page to complete the configuration.

The Ntrip information can be found on Ntrip Modem TR600. If there is any question, please contact Tersus Technical Support by email <u>support@tersus-gnss.com</u> without any hesitate.

TERSUS	NTRIP Smart Devic	e [中文 English] Warning: Setting effect after reboo
<ul> <li>Status</li> <li>Network Settings</li> <li>LAN</li> <li>WIFI Hotspot</li> <li>NAT Rule</li> <li>NTRIP CFG</li> <li>Virhub</li> <li>System Tools</li> <li>Reboot System</li> </ul>	Basic Cfg NTRIP Info. NTRIP Info NTRIP Caster Address: NTRIP Caster Port: NTRIP Type NTRIP Username: NTRIP Vsername: NTRIP Password: Mount Point: Head1: Head1: Head3: Date Semen:	©

Figure 4.1 GeoBee under Ntrip server mode



## 4.2 GeoBee working under Ntrip client mode

If GeoBee is configured to work under Ntrip client mode, fill in the Ntrip information under the [NTRIP CFG] sub menu. Select [client] in the drop-down menu of Ntrip Type, type in the Ntrip Username and Ntrip password, and click [Save] at the bottom of this page to complete the configuration.

The Ntrip information can be found on Ntrip Modem TR600. If there is any question, please contact Tersus Technical Support by email <u>support@tersus-gnss.com</u> without any hesitate.

TERSUS	NTRIP Smart Dev	ice	[中文   English ] Warning: Setting effect after reboot
<ul> <li>Status</li> <li>Network Settings</li> <li>LAN</li> <li>WIFI Hotspot</li> <li>NAT Rule</li> <li>NTRIP CFG</li> <li>Virhub</li> <li>System Tools</li> <li>Reboot System</li> </ul>	Basic Cfg NTRIP Info. NTRIP Info NTRIP Caster Address: NTRIP Caster Port: NTRIP Type NTRIP Vsername: NTRIP Vsername: NTRIP Password: Mount Point: Head1: Head2: Head3: Data Source:	Image: Second state st	(1°65535)

Figure 4.2 GeoBee under Ntrip client mode



## 4.3 Check Link Status using Web portal

Open any browser on your computer (accessible to the Internet) and enter the following URL in the address bar: <u>http://geobeecaster2.tersus-gnss.com:2101/</u> In the login window, type the (Ntrip) Client User and (Ntrip) Client Password which are shown on the label of the Ntrip Modem TR600.

NtripName: geobeecaster2.tersus-gnss.com
NtripPort: 2101
Client User: geobeetest1
Client Password: s65uhkJd
Default Mount Point: 240305085154981

Figure 4.3 the login window

After a successful login, the link status and statistics are shown in the figure

#### below:

Current Time:19-03-19 03:56:19(-0000)

Server/	/Client Cur	rrent S	Status													
S/C	C From IP MountPoint S		StartTime		Data Bytes	Bytes(KB) DataType		pe la	lat/long/ellipsoid height							
Server	221. 178. 1	24. 152	2403050050	19	9-03-19 02:02:35	(-0000)	) 2896.824		RTCM3		594690	)/1.	.883409/	107.4	1092	
Statist	tics															
MountP	oint	First	Start Time		PAS Count/ideal	tota1	online rate	e(%)	Error/V	/alid	Package	lat/	/long/elli	psoi	d heigh	ıt
240305	0050	18-12-	13 02:52:14(-0	0000)	2569/4610	55.74			0/15265	5991		1	594690/11	.8	83409/1	07.4092
2- 0	4030500505 <b>)0 01 02 03</b>	0828 H 04 05	ourly online 1 06 07 08 09 10	rate 11 13	from 03/17 to 03 2 13 14 15 16 17 1	/19(-0 1 <b>8 19 2</b>	0000) <b>0 21 22 23</b>									
03/17	00 100 99 100	100 97	87 98 99 100 97	100 99	0 100 100 100 100 100 1	00 100 10	00 100 100 100									
03/18	00 100 100 100	100 100	100 99 100 100 100	100 10	0 100 100 100 100 100 1	00 100 10	00 100 100 100									
03/19	00 100 99 93															

Figure 4.4 the link status and statistics



## 4.4 Group User Management Function

The Group User function is mainly used for regional agent to manage and configure Client end-users with different privileges after using GeoBee builds a certain number of base stations in a region.

Specifically, under previous versions of Caster software, after the regional agent sends data from the GeoBee base station (NtripServer) in the region to the Caster software (NtripCaster) using the username and password distributed by Tersus, the end-user (NtripClient) in the region can only get the differential correction data using corresponding user name and password with the GeoBee base station, and the regional agent can not realize the configuration of the end-user's duration, limit days, available base station and other permissions. The new version of Caster software's Group User management function will make up for this weakness. The operation is as follows.

1)Log in to the specified web page and use the designated password to log in to the Group User management function.



Figure 4.5 login interface for group user

2)After logging into Group User, enter the Group User interface, Group means the area where the regional agent is located. The next step is to pull the GeoBee base stations in the area into Group, by entering the user name and password of the GeoBee base stations distributed by Tersus and clicking Add.





letur	n		
Statio	n-User	Name	
Statio	n-Pass	sword	
Add	Del	4	

① Enter	the	user	name	and
password	of	Geo	Bee	base

Current Time:20-10-12 10:13:18(+0800)



Figure 4.5 base station list

If you want to remove a GeoBee base station that has been added to the Group, you need to enter the corresponding username and password and click the Del button. We need to make sure that the username and password are correct to prevent the base station from being accidentally removed.

3) Start to configure the client end-users in the regional group. Click the Manage Share User button, and enter the ShareUser configuration interface.



Figure 4.6 manage share user



4)The regional agent inputs the username, password, expired date, limit days and limit numbers of the Client end-user to be configured. Please try to set a complex username and password according to the recommended rules to avoid the cases that different regional agents set the same username and password to cause end-users to connect to different regional base stations. The password is recommended to set a string consisting of letters or numbers.



Return USER PASSWORD ExpireDate(YYYYMMDD) Limit-Days Limit-Nums Add/Edit Del

Current Time:20-10-21 15:10:30(+0800)

 Share User List

 Username
 Password
 ExpiredDate
 LimitDays
 UsedDays
 LimitNums
 Current Nums

 test1
 test1
 20501231
 500D
 0D - 00:00:00
 2
 0

 test2
 test2
 10D
 0D - 00:00:00
 1
 1

#### Figure 4.7 the share user list

After setting the expired date of an end-user, once the end-user expires, the end-user will not be able to connect to Caster software to get the differential data. If not setting expired date, the Caster system will have no limit for the user's expired date.

After setting the limit days of end-user, the used days of end-user will be refreshed every time the end-user disconnects. When the used days reaches the limit days, the end-user will not be able to connect to Caster software to get the differential data. If more than one NtripClient uses the same user name and password to get the differential data at the same time, the used days of this user will be accumulated. If the limit days is not set, the Caster system will have no limit for the user's limit days.

After setting the limit number of concurrent online users, when every end-user



connects to the Caster system with this username and password, the current connection number will increase by 1. When the current number of connection reaches the limit number of concurrent online user allowed, the system will not be able to connect using this username and password. If the limit number of concurrent online users is not set, the Caster system will have no limit for the concurrent online user using this username and password.

It should be noted that after this update of Caster software, Client end-users are still allowed to use the username and password of GeoBee base station to connect and get differential data, and the username and password has no limitation of expiration date, allowable days or concurrently online users. In other words, if the regional agent does not use the new Group User management function, the end-users in the region can keep the previous login method unchanged.



## 4.5 Nearest Base Station Function

This version of Caster software adds the Nearest Base Station function which will automatically select the nearest base station among all the base stations that is allowed to connect to according to the GGA uploaded by the NtripClient end-user and establish the connection.

The Nearest Base Station operation is very simple, NtripClient end-user can select NearBy mount point when obtaining the Mountpoint. The distance calculation and selection of Nearest Base Station will be done inside Caster software.



Figure 4.8 select nearby mount point



# 5. Lightning-Proof Design

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

## 5.1 Direct lightning protection

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



Figure 5.1 Schematic diagram of direct lightning prevention ZGZ-200-2.1 type is selected as the lightning rod:

Figure 5.2 Lightning rod



#### **Technical Parameters**

- 1) Lightning current capacity(KA): 200;
- 2) Resistance( $\Omega$ ):  $\leq$ 1;
- 3) Height(m): 2.1;
- 4) Weight(kg): 4.8;
- 5) Maximum wind resistance(m/s): 40;
- 6) Installation size(mm):  $\phi$  70±0.26.

## 5.2 Inductive lightning protection

#### 5.2.1 Power lightning protection

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



Figure 5.3 Single power lightning arrester

#### 5.2.2Lightning protection for communication cables

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



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

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



Figure 5.4 The lightning arrester for communication cable

#### 5.2.3Grounding net

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



# 6. Terminology

APN	Access Point Name
BDS	BeiDou Navigation Satellite System
DC	Direct Current
eMMC	Embedded Multi Media Card
EXIF	Exchangeable Image File Format
GLONASS	GLObal NAvigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
MSL	Mean Sea Level
PC	Personal Computer
PPK	Post-Processing Kinematic
PPS	Pulse Per Second
RINEX	Receiver Independent Exchange format
RMS	Root Mean Squares
RTK	Real-Time Kinematic
RTCM	Radio Technical Commission for Maritime Services
UAV	Unmanned Aerial Vehicle, drone
USB	Universal Serial BUS

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