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User Manual For David GNSS Receiver

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Notices

The following notices apply to DAVID receiver.

\wedge	Changes or modifications to this equipment not expressly approved by
<u> </u>	Tersus could void the user's authority to operate this equipment or
	even has risk to damage the DAVID.

Conventions

The following conventions are used in this manual:

<u>!</u>	Information that supplements or clarifies text.

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

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

NUWA is Tersus survey app, four tabs (Project, Device, Survey and Tools) are provided in the Nuwa® main window. So, in chapter 0, all the operations in the Survey software will start from these four tabs.

In all the figures, a line with two arrows at the two sides means it's a cable. A line with one arrow gives the installation direction.

Name	Description	Link
Log & Command document	Document giving all the loggings output from David and all the commands to David	https://www.tersus-gnss.com/ass ets/upload/file/20180420120508 17.pdf
Tersus GNSS Center	Graphical tool to communicate with David	https://www.tersus-gnss.com/ass ets/upload/file/20180418153351 742.zip
Nuwa	Survey application running in the Android platform, David can be configured with Nuwa.	
Tersus Geomatics Office	Post processing tool for static data	https://www.tersus-gnss.com/ass ets/upload/file/20180418153011 5.rar

Table 1 The document / software used in this user manual

	A tool to download files on	https://www.tersus-gnss.com/ass
TersusDownload	eMMC card	ets/upload/file/20180612144338
		<u>820.zip</u>

Support

If you have a problem and cannot find the information you need in the product documentation, request technical support using the Tersus website at

www.tersus-gnss.com, or mail to support@tersus-gnss.com

1. Overview

1.1 Introduction

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

Nuwa, a survey App on Android system, is working with David, which can communicate with an Android platform such as a phone or tablet via USB cable or an external Bluetooth module. The David can work as a base or a rover, it can support real-time RTK positioning as well as saving data for PPK application. Up to 4GB on-board EMMC card makes it easy to save data for PPK.

The RS-232 serial port, IP67 standard and the external Bluetooth module can remove most of the inconvenience for field workers. All the operating can be done in the App Nuwa except downloading raw measurement data file, which will be done with Tersus GNSS Center, see Table 1 and section 3.5 Download Files from Internal eMMC Card for detail.



Figure 1 Outlook of David GNSS receiver

1.2 Receiver Features

- Supports GPS L1/L2, BDS B1/B2 and GLONASS G1/G2.
- Support RTCM2.3/3.x, CMR, CMR+ corrections.

- Easy to connect an external powerful radio for longer range.
- Solution rate can be 5Hz.
- 20Hz raw measurements output for post processing.
- The accuracy of carrier phase can be 1mm.
- On-board 4GB eMMC card for data collection
- Static post-processing for mm-level accuracy.
- Bluetooth module makes wireless connection.
- Input power range is 5 12V, connect to battery bank directly.
- IP67 for water & dust proof, work reliably in harsh condition
- The Lemo connectors support mis-installation avoidance.

$1.3\,\mbox{Brief}$ Introduction of GNSS and RTK

Tersus BX306 GNSS receiver is integrated in David, the board is receiving the GNSS signals from satellites and RTK corrections from the base, and is outputting cm-level position, velocity and time. Figure 2 shows David system; see <u>https://www.tersus-gnss.com/product/bx306-oem-board</u> for more about BX306 receiver.



Figure 2 Outline of David System

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







Figure 4 Corrections transmitted with radios

If RTK corrections are transmitted via Internet, an Android phone will be included in the RTK system to transmit/receive the RTK corrections, see section 6.1 and section 6.2 for detailed operating.

2. Devices in David Package

This chapter will give detailed introduction about all the devices in the package.

David has seven variants, which are convenient for customers to select per their application. Different accessories are included in each variant. Table 2 gives a brief description of the seven variants. For more about them, refer to section 2.1 to section 2.7.

All the seven variants are shipped in a plastic box in Figure 5.



Figure 5 David in the box

Table 2 Seven David Variant	S
-----------------------------	---

David variants	Description
Rover Kit Mobile	The David receiver will receive RTK corrections from a
Mode	NTRIP caster or a TCP server.
Rover Kit with 1W	The David receiver will receive RTK corrections from an
Radio Station	external 1W 915Mhz radios.
Rover Kit with 2W	The David receiver will receive RTK corrections from an
Radio Station	external 2W 460MHz radios.
Base Kit Mobile	The David receiver will output RTK corrections to a
Mode	NTRIP caster or a TCP server.
Base Kit with 1W	The David receiver will output RTK corrections to an
Radio Station	external 1W 915Mhz radio.

Base Kit with 2W	The David receiver will output RTK corrections to an
Radio Station	external 2W 460MHz radio.
Base Kit with 30W	The David receiver will output RTK corrections to an
Radio Station	external 30W 460MHz radio.

<u>!</u>	1.	Rover Kit Mobile Mode and Base Kit Mobile Mode can work
		independently.
	2.	Rover Kit with 1W Radio Station must work with Base Kit with 1W
		Radio Station.
	3.	Rover Kit with 2W Radio Station must work with Base Kit with 2W
		Radio Station or Base Kit with 30W Radio Station.

2.1 Rover Kit Mobile Mode

In this variant, the David will be connected to an Android phone with Bluetooth module or with cables. Tersus Survey Nuwa[®] App will run in the Android phone to receive RTK corrections from a NTRIP caster or a TCP server.

Refer to section 6.1 for detailed operation.



Figure 6 Field photo 1 - 1



Figure 7 Field photo 1 - 2

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 . The nowel hank in Finite 7 is not included to the hackade

Table 3 Devices in rover mobile mode

Devices	Number	Items in the field photos
David GNSS receiver	1	5
GNSS antenna	1	1
CNSS antonna connector	1	Not in the field photo, refer
		to section 2.1.6 for detail.
GNSS antenna cable	1	3
2pin-USB power cable	1	8, see Figure 11
COMM1-Bluetooth module	1	6, refer to 2.1.4
COMM2-7pip-LISB & DB9 Data cable	1	Not in the field photo, refer
		to section 2.1.7
USB Type A Female to USB(Micro +	1	Not in the field photo, refer
Type C) OTG cable	I	to Figure 17
LISB Type A Male to DB9 Male cable	1	Not in the field photo, refer
		to Figure 16
Ranging pole	1	2
Hoight moasure accessory	1	Not in the field photo, See
Height measure accessory		Figure 18.
Bracket for rover	1	4, see section 2.1.5
Pottony bonk	1	7, see Figure 19 and 3.2
Dallery Dalik		Power on David

2.1.1 David Receiver



David has four interfaces, see Figure 8 David Receiver.

Figure 8 David Receiver

David's DC is for power input, COMM1 port is for COM1 and CAN ports, and COMM2 port is for COM2 and USB ports, see chapter 5 for detail.

Table 4 Definition of LEDs

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

Please see section 3.2 Power on David for more about the booting up procedure.

Refer to Chapter 5 for the specification of David receiver and the detailed definition of COMM1, COMM2 and DC ports.

2.1.2 GNSS Antenna

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



Figure 9 AX3702 antenna

If an antenna from other companies will be used, contact Tersus to get permission, or the David may not work as it's expected.



Figure 10 RF cable

2.1.3 The 2pin-USB Power Cable

The power cable is used to connect a battery bank to the DC port of David.



Figure 11 2pin-USB Power Cable

2.1.4 COMM1-bluetooth Module

This Bluetooth module will use the COM1 port of David.



Figure 12 Bluetooth Module

\triangle	The Bluetooth can only be installed to the COMM1 port of David.
<u> </u>	

The SSID for this Bluetooth module is BT420A-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.

2.1.5 Bracket for Rover

Bracket for rover is used to fix all the devices on the ranging pole, which bring much convenience to field staffs.



Figure 13 Bracket for Rover

2.1.6 GNSS Antenna Connector

The GNSS antenna connector is used to install the GNSS antenna or the 30W radio station antenna to a tripod.



Figure 14 GNSS Antenna Connector

2.1.7 COMM2-7pin-USB & DB9 Data Cable

The COMM2-7pin-USB & DB9 Data Cable has three functions:

Table 5 Functions of COMM2-7pin-USB & DB9 Data Cable

- 1. Connect to an external 1W radio module.
- Connect to USB Type A Male to DB9 Male cable (see Figure 16) to download file saved on the internal eMMC card, refer to section 3.5 Download Files from Internal eMMC Card;
- 3. Connect to USB Type A Female to USB (Micro +Type C) OTG cable (see Figure 17) to connect the Android phone with David, refer to section 3.3.1.



Figure 15 COMM2-7pin-USB & DB9 Data Cable

<u>!</u>	The COMM2-7pin-USB cable can only be installed into the COMM2 port
	of David.

2.1.8 Other accessories

USB Type A Male to DB9 Data cable, USB Type A Female to USB (Micro + Type C) OTG cable and Height Measure Accessory are included in this variant.



Figure 16 USB Type A Male to DB9 Male cable

The driver for the cable above can be downloaded <u>https://www.ugreen.com/drivers/list-USB_To_RS232_Driver-en.html</u>



Figure 17 USB Type A Female to USB (Micro + Type C) OTG cable

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



Figure 18 Height Measure Accessory

A battery bank is used to power on the David, it's not included in the package, and has to be provided by the customers, see section 3.2 Power on David for more detail.



Figure 19 Battery Bank

2.2 Rover Kit with 1W Radio Station

In this variant, the David will be connected to an external 1W radio to receive RTK corrections from a base. With an external Bluetooth or with cables, the David will be connected to an Android phone, which is running Tersus Survey Nuwa[®] to configure the David.

!	Rover Kit with 1W Radio Station must work with Base Kit with 1W Radio
	Station.

<u>!</u> Rover Kit with 1W Radio Station can support Rover mobile mode.



Figure 20 Field Photo 2 - 1



Figure 21 Field Photo 2-2

!	The power bank in Figure 21 is not included in the package.
-	

Table 6 Rover Kit with 1W Radio Station

Devices	Number	Items in the field photos
David GNSS receiver	1	7
GNSS antenna	1	1
GNSS antenna connector	1	Not in the field photo, refer to section 2.1.6 for detail.
GNSS antenna cable	1	3
2pin-USB power cable	1	8
COMM1-Bluetooth module	1	10, refer to 2.1.4.
COMM2-7pin-USB & DB9 data cable	1	11, refer to section 2.1.7.
USB Type A Female to USB(Micro + Type C) OTG cable	1	Not in the field photo, refer to Figure 17
USB Type A Male to DB9 Male cable	1	Not in the field photo, refer to Figure 16
RS900C 1W/915MHz radio	1	5, refer to section 2.2.1.
RS900C radio antenna	1	4
Ranging pole	1	2
Height measure accessory	1	Not in the field photo, See Figure 18.
Bracket for rover	1	6, see section 2.1.5
Battery bank	1	9, see Figure 19 and 3.2 Power on David

2.2.1 RS900C 1W/915MHz Radio

This radio can work at 915MHz frequency only, the output power of this radio is 1W and the typical range is 3km. Refer to chapter 5 for detailed specification.



Figure 22 RS900C 1W Radio Station

Table 7 LED Definition

LED	Description	
	When power on, this LED will blink RED once and keep off.	
P/S	If data is transmitting, this LED will blink RED.	
	If data is receiving, this LED will blink BLUE.	

2.3 Rover Kit with 2W Radio Station

In this variant, the David will be connected to an external 2W radio to receive RTK corrections from a base. With an external Bluetooth or with cables, the David will be connected to an Android phone, which is running Tersus Survey Nuwa[®] to configure the David.

 Rover Kit with 2W Radio Station can work with Base Kit with 2W Radio
Station or Base Kit with 30W Radio Station.

!	Rover Kit with 2W Radio Station can support Rover mobile mode.



Figure 23 Field Photo 3 - 1



Figure 24 Field Photo 3 - 2

<u>!</u>	The power bank and the smartphone in Figure 24 are not included in the
	package.

Table 8 Rover Kit with 2W Radio Station

David variants	Number	Items in field photos
David GNSS receiver	1	9
GNSS antenna	1	2
	1	Not in the field photo,
GNSS antenna connector		refer to section 2.1.6 for
		detail.
GNSS antenna cable	1	3
2 Pin-USB power cable	1	10
COMM1-Bluetooth module	1	13, refer to 2.1.4
COMM2-7pin-USB & DB9 Data	1	Not in the field photo,
cable		refer to section 2.1.7.
USB Type A Female to		Not in the field photo,
USB(Micro + Type C) OTG	1	refer to Figure 17
cable		
USB Type A Male to DB9 Male	1	Not in the field photo,
cable	Ι	refer to Figure 16
COMM2-7pin-USB & 5pin cable		12, refer to Figure 26
(0.55m)		
RS400L2 2W/460MHz radio	1	8, refer to 2.3.1
2W/460MHz radio antenna	1	1

TNC-J/TNC-J cable 1.0M	1	5
TNC - TNC converter	1	6, see Figure 28
Ranging pole	1	4
Hoight moasure accessory	1	Not in the field photo, See
Height measure accessory		Figure 18.
Bracket for 460M antenna	1	7, see Figure 28
Bracket for rover	1	14, see section 2.1.5
Pottony book	1	11, see Figure 19 and 3.2
Dattery Datik		Power on David

2.3.1 RS400L2 2W/460MHz Radio

This radio can work at 460MHz frequency, the max. output power of this radio is 2W and the typical range is 5km. Refer to chapter 5 for detail specification.

Antenna Interface	TERSUS	
Channel Button	• H	Current Channel
Power Button		T/R Current
Protocol ———— Button	Cri	Power ON/OFF
Data Interface		Current Protocol

Figure 25 2W /460MHz Radio

Table 9 Button Manual

Button	Description
Channel	Press once, the current channel will increase 1, channel 0~9
Button	are available.
Power	Press once to select the output power, which can be 1W or
Button	2W.
Protocol	Protocol button is pressed to switch the protocol between TP
PIULUCUI	(Transparent EOT protocol), TT (TT450S protocol) and TS
DULLON	(Tersus protocol)

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

Table 10 LED Definition

LED	Description
	RED: 2W output is selected,
	BLUE: 1W output is selected.
тю	Blink RED: data is transmitting.
1/K	Blink BLUE: data is receiving.
	BLUE: Transparent protocol is selected.
TP/TT/TS	RED: TT450S protocol is selected.
	BLUE&RED: Tersus protocol is selected.
ON	Is solid on after the power is on.

2.3.2 Accessories

The COMM2-7pin-USB & 5pin Cable is used to connect the David to the 2W radio station & an Android phone, or connect the David to the 30W radio station & an Android phone. The cable's length can be 0.55m or 1m in different variants.



Figure 26 COMM2-7pin-USB & 5pin Cable



COMM2-7pin-USB & 5pin Cable can only be installed into the COMM2 port of David.



Figure 27 TNC-J/TNC-J cable 1.0M



Figure 28 TNC - TNC converter & Bracket for 460M antenna

2.4 Base Kit Mobile Mode

In this variant, the David, working as a base, will transmit RTK corrections to a NTRIP caster or a TCP sever.

The David will be connected to an Android phone with an external Bluetooth or with cables. Tersus Survey Nuwa[®] is running in the Android phone to configure the David.

<u>!</u>	Base Kit Mobile Mode can work independently or work with Rover Kit
	Mobile Mode.



Figure 29 Field Photo 4

<u>!</u>	The tripod, the battery bank, the tribrach and the smartphone are not
	included in the package.

Table 11 Base Kit Mobile Mode

Devices	Number	Items in field photo
David GNSS receiver	1	4
GNSS antenna	1	1
GNSS antenna connector	1	2
GNSS antenna cable	1	7
2 Pin-USB power cable	1	6
COMM1-Bluetooth module	1	8, refer to 2.1.4
COMM2-7pin-USB & DB9 Data	1	Not in the field photo, refer
cable		to section 2.1.7.
USB Type A Female to USB(Micro +	1	Not in the field photo, refer
Type C) OTG cable		to Figure 17
LISP Type A Male to DP0 Male apple	1	Not in the field photo, refer
USB Type A Male to DB9 Male cable	I	to Figure 16
Tape meter	1	See Figure 31
	1	Not in the field photo, See
Height measure accessory		Figure 18.
Bracket for base	1	3, see Figure 30
Battery bank	1	5, see Figure 19 and 3.2

Powe	r on David

2.4.1 Bracket for Base

This bracket is hooked on the tripod and all the devices in the field (an Android phone, a radio, a David and a battery bank) can be installed on it, which brings much convenience for field job.



Figure 30 Bracket for Base

2.4.2 Tape Meter

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



Figure 31 Tape Meter

2.5 Base Kit with 1W Radio Station

In this variant, the David, working as a base, will transmit RTK corrections to an external 1W radio.

The David will be connected to an Android phone with cables or with the Bluetooth module. Tersus Survey Nuwa[®] is running in the Android phone to configure the David.

<u>!</u>	Base Kit with 1W Radio Station can work with Rover Kit with 1W Radio
	Station only.



Figure 32 Field Photo 5

<u>!</u>	The tripod, the tribrach and the battery bank are not included in the
	package.

Table 12 Base Kit with 1W Radio Static	Table 12 B	ase Kit v	with 1W I	Radio S	Station
--	------------	-----------	-----------	---------	---------

Devices	Number	Items in field photo
David GNSS receiver	1	5
GNSS antenna	1	1
GNSS antenna connector	1	9
GNSS antenna cable	1	2

2 Pin-USB power cable	1	7
COMM1-Bluetooth module	1	Not in the field photo, refer to 2.1.4
COMM2-7pin-USB & DB9 Data Cable	1	8
USB Type A Female to USB(Micro + Type C) OTG cable	1	Not in the field photo, refer to Figure 17
USB Type A Male to DB9 Male cable	1	Not in the field photo, refer to Figure 16
RS900C 1W/915MHz radio	1	4
1W/915MHz radio antenna	1	3
Tape meter	1	See Figure 31Figure 31 Tape Meter
Height measure accessory	1	Not in the field photo, See Figure 18.
Bracket for base	1	6
Battery bank	1	see Figure 19 and 3.2 Power on David

2.6 Base Kit with 2W Radio Station

In this variant, the David, working as a base, will transmit RTK corrections to an external 2W radio.

The David will be connected to an Android phone with cables or with the Bluetooth module. Tersus Survey Nuwa[®] is running in the Android phone to configure the David.

<u>!</u>	Base Kit with 2W Radio Station can work with Rover Kit with 2W Radio
	Station only.

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



Figure 33 Field photo 6 - 1



Figure 34 Field Photo 6 - 2

<u>!</u>	The two tripods and the tribrach in Figure 33 and Figure 34 are not
	included in the package.

Table 13 Base Kit with 2W Radio Station

Devices	Number	Items in field photo
David GNSS receiver	1	9
GNSS antenna	1	5
GNSS antenna connector	2	4
GNSS antenna cable	1	6
2pin-USB power cable	1	Not in the photo, see Figure
Power cable for 30W radio	1	Not in the field photo, see Figure 36
2pin-Bullet DC CON Cable	1	10, see Figure 35
COMM1-Bluetooth module	1	11
COMM2-7pin-USB & DB9 Data Cable	1	refer to section 2.1.7
USB Type A Female to USB(Micro + Type C) OTG cable	1	Not in the field photo, refer to Figure 17
USB Type A Male to DB9 Male cable	1	Not in the field photo, refer to Figure 16
COMM2-7pin-USB & 5pin Cable (0.55m)	1	12, refer to Figure 26
RS400L2 2W/460MHz radio	1	8, refer to 2.3.1
30W radio antenna	1	1, see Figure 40
Metal plate for radio antenna	1	3
Telescopic pole for radio antenna	1	2, see Figure 41
Tape meter	1	See Figure 31
Height measure accessory	1	Not in the field photo, See Figure 18.
Hook and screws for David	1	See Figure 37
Hook and screws for 2W radio	1	See Figure 38
Bracket for Mobile	1	See Figure 39

2.6.1 Accessories



Figure 35 2pin-Bullet DC CON Cable



Figure 36 Power cable for 30W radio



Figure 37 Hook and Screws for David



Figure 38 Hook and Screws for 2W Radio



Figure 39 Bracket for Mobile



Figure 40 30W Radio Antenna


Figure 41 Telescopic Pole for Radio Antenna

2.7 Base Kit with 30W Radio Station

In this variant, the David, working as a base, will transmit RTK corrections to an external 30W radio.

The David will be connected to an Android phone with cables or with the Bluetooth module. Tersus Survey Nuwa[®] is running in the Android phone to configure the David.

<u>!</u>	Base Kit with 30W Radio Station can work with Rover Kit with 2W Radio
	Station only.

!	Base Kit with 30W Radio Station can support Base mobile mode.



Figure 42 Field Photo 7 - 1



Figure 43 Field Photo 7 - 2

<u>!</u>	The two tripods and the tribrach in Figure 42 and Figure 43 are not
	included in the package.

Table 14 Base Kit with 30W Radio Station

Devices	Number	Items in field photos
David GNSS receiver	1	12
GNSS antenna	1	5
GNSS antenna connector	2	4
GNSS antenna cable	1	7
2pin-USB power cable	1	Not in the photo, see Figure 11
COMM1-Bluetooth module	1	Not in the field photo, refer to 2.1.4
COMM2-7pin-USB & DB9 Data cable	1	Not in the field photo, refer to section 2.1.7.
USB Type A Female to USB (Micro + Type C) OTG cable	1	Not in the field photo, refer to Figure 17
USB Type A Male to DB9 Male cable	1	Not in the field photo, refer to Figure 16.
COMM2-7pin-USB & 5pin Cable (1m)	1	10, refer to Figure 26.
Power cable for 30W radio	1	9, refer to Figure 36
COMM cable for 30W radio	1	11, refer to Figure 45
RS400L30 30W radio	1	8, refer to 5.5 30W Radio RS400L30

30W radio antenna	1	1, see Figure 40
Metal plate for radio antenna	1	3
Telescopic pole for radio antenna	1	2, see Figure 41
Tape meter	1	Not in the field photo, See Figure 31 Tape Meter
Height measure accessory	1	Not in the field photo, See Figure 18.
Hook and screws for David	1	See Figure 38
Bracket for mobile	1	See Figure 39

2.7.1 30W Radio

The 30W radio is used when a longer baseline is required. The typical range is 15km, see chapter 5 for detail specification.



Figure 44 30W Radio Station

Table 15 and Table 16 give the definition of the control buttons and the LED, respectively.

Buttons	Function
	Press 1s to power on the radio
	Press 2s to power off the radio
ARROW UP/DOWN	To select the channel
RF PWR	Press 1s to select the RF output power

Table 15 The Definition of the Control Buttons

Table 16 Definition of LEDs

LEDs	Description
	RED: the input voltage is normal.
ON/OFF	Blink RED: the input voltage is out of the
	min limits.
TV/DV	Blink RED: the radio is transmitting.
	Blink BLUE if the radio is receiving.
Channel	Show the current channel
BAT CAP	Show the battery left.
	Show the current RF output power:
	OFF: 30W
RF PWR	BLUE: 20W
	RED: 10W
	RED+BLUE: 5W



Figure 45 COMM cable for 30W radio

3. General operation

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

1	To make David work, the customer must provide qualified power to
<u> </u>	David (refer to chapter 5 for requirement), power to the 30W radio
	(if 30W radio is used, refer to chapter 5 for detail) and an Android
	phone to run Tersus Survey Nuwa [®] software.
	David may be damaged if devices from other companies are used
	to replace the ones in the package. And the warranty may be void
	if that happen.

3.1 Install the GNSS antenna

Connect the antenna to David with the RF cable. Please ensure the connectivity is reliable.

<u>!</u>	The ideal place for a GNSS antenna is a point without GNSS signals
	blockage from horizon to horizon and is far away from any potential
	interfering source.

3.2 Power on David

The input voltage to David is 5 - 12 VDC.

\triangle	It's highly recommended to power on David with an USB port (5VDC and 2A or more current output) from a battery bank with the power
	cable in the package, or the David may not boot up successfully.

\triangle	After power on, the PV LED will be ON for 3 to 5 seconds, then it will be OFF, which means the David is booting up successfully.
	If the PV LED is NOT acting as the above, it means the David is NOT

booling up successiony.

\triangle	If other power than a battery bank is used to power on David, the
	customer has to make a power cable themselves and take all the risks
	involved.

The working time of David depends on the capacity of the battery bank.

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

If no radio or an external 30W radio is connected to the David: Time (hour) = capacity (mA.Hour) *5 / (1000 * 3.2)

If 1W radio is connected to the David: Time (hour) = capacity (mA.Hour) *5 / (1000 * (3.0+3.2))

If 2W radio is connected to the David:

Time (hour) = capacity (mA.Hour) *5 / (1000 * (6.5+3.2))

<u>!</u>	1) It's highly recommended the capacity of the battery bank is					
	10,000mA.H or more.					
	2) The working time above are only theoretical values at 25°C					
	temperature. But according to our experience, the real working time					
	may be 2/3 of even less of above values.					

3.3 Communication between Android phone and David

David can communicate with an Android phone with wires or with Bluetooth.

3.3.1 With Wires



Figure 46 Outline of Android phone to David with Wires

-	
<u>!</u>	Two cables are used to connect the COMM2 port of David to the USB port of the Android phone. They are:
	 COMM2-7pin-USB & DB9 Male cable or COMM2-7pin-USB & 5pin cable.
	 USB Type A Female to USB (Micro + Type C) OTG cable
!	The Android phone will NOT be charged when it's connected to David
	with wires.

Table 17 Detailed steps

1.	. Connect the David's COMM2 port to the USB port of the Android phone with cables.					
2.	2. Connect the antenna to David with the RF cable (optional).					
3.	Power on the David with	a battery bank				
4.	Run Nuwa, Device ->De	vice Connect				
	← Connect	•	5. 6. 7.	Connect Type " USB" Press Connect Config to update accordingly. Press Connect to enable the communication with		
	Device Type	David $>$		the David.		
	Connect Type	USB >				
	Connect Config	>				
	Ant type	AX3702(HG)>				
	Connect					

3.3.2 With an External Bluetooth



Figure 47 Outline of Android phone to David with Bluetooth

<u>!</u>	All the seven variants can support connection with Bluetooth as well as
	with cables.

Table 18 Detailed steps

- 1. Install the Bluetooth module to the David's COMM1 port.
- 2. Connect the antenna to David with the RF cable (optional).
- 3. Power on the David with a battery bank.
- 4. Run Nuwa, Device ->Device Connect

← Connect	•2227•	← Bluetooth		
		Bluetooth		
	-040	Paired Device		
	US DHILL	HB-02_20:16:07:22:12:37		
		Availabe Device		
Device Type	David >	BT420A-00008_90:0C:84:00:9F:DA		
		Unknow_98:D3:33:80:6A:34		
Connect Type	Bluetooth >	MI Band 2_FA:D6:97:E3:EA:72		
Connect Config	BT420A-00010>	Unknow_5E:87:7D:C5:C0:73		
Ant type	AX3702(HG)>	DESKTOP-S5C2KH5_60:14:B3:62:4A:2E		
		Search		
Conne	ct			
5. Bluetooth is select	ed for Connect Ty	ре		
 Connect Config	 Connect Config -> Search. The SSID is BT420A-xxxxx_xxxxx. No password is needed to pair with it 			
7. Press Connect to e	7. Press Connect to enable the communication with the David.			
! You can remove	<u>!</u> You can remove a Bluetooth device from the Available Device list by			

3.4 FW Upgrade & Auth code

pressing it for several seconds.



Figure 48 Outline of David connected to a Computer

Table 19 Preparation for FW update

На	ardware Installation					
1.	Install the USB Type A Male to DB9 Male cable to a computer's USB					
	port. The cable will be mapped to a serial port, check the port number					
	in the Device Manager of the computer.					
2.	Install the COMM2-USB + DB9 cable to the COMM2 port of the David.					
3.	Connect the two cables together.					
4.	Power on the David with the computer's USB port or with an external					
	battery bank.					
5.	Run Tersus GNSS Center, fill the parameters in the Config page, press					
Г	OK to communicate with the David.					
	Config ×					
	Connection Type: Serial Serial Setting Port: COM53 Baud Rate: 115200 OFF					
	Demo File Setting					
	Input File :					
	Play Speed Loop					
	Apply Ok Cancel					

	The default baud rate for the serial port is 115200, which will change to
<u>!</u>	921600 temporarily during FW updates by Tersus GNSS Center, see
	section 3.4.1 Firmware Updates for detail.

3.4.1 Firmware Updates

If a new firmware update is released, it will be available on the Tersus web site <u>https://www.tersus-gnss.com/software</u>, or you can get the updates from Tersus support.

The FW version of David receiver can be updated in field. Connect the David with Tersus GNSS Center, and input 'LOG VERSION', the following information will be output:

VERSION COM2 0 0.0 UNKNOWN -1 0.000 0000000 0 20161214

< 1

< BX306 G2SB2G2 008001174910000171 0021 20161123 3.0 Apr 24 2018 12:23:48

0021 is the FW version. See 'VERSION' in Tersus GNSS Log & Command Reference document for more detail about this log.

Table 20 Detailed Steps for FW update



Updat	e File bar. Select the port and baud rate, press Next
	Select file to update(1/2)
	Update Setting Update File: C:\Users\saiwa\Desktop\Firmware Update\BX306_BX316D\BX306_316D.bin
	Port COMIG Baudrate: 460800 Advance Setting
4. The f	ollowing figure shows the FW is upgrading, two progresses are ed in the FW update.
Do not	power off the receiver during the verify and update process.
l l	Update Progress (2/2) X
	Stage1: File Transfer Progress Processing: 6013328/6013328
5 After t	Stage2: Verify and Update Progress Do not power off in this stage!!! Do not power off in this stage!!!

		Update Progress (2/2) × Stage 1: File Transfer Progress Processing: 5882256/5882256 Processing: 5882256/5882256 • Update finished, it's will be auto restarted TersusUpdate Update finished, it's will be auto restarted • Update Succeed! • OK •
		< Back Finish Cancel Help
6.	Press	OK and Finish buttons to close the FW upgrade windows, the
	receive	er will reset automatically.
7.	After th	he board is booted, you can confirm the FW version by connecting to
	the rec	eiver and input 'LOG VERSION' and check the FW version.

There is Advance Setting option in the FW update page, If a receiver

- can't boot up successfully, or
- can't work well after boot up, or
- can't finish FW update successfully according to the above steps, you can select Advance Setting option to start FW update again.

Select file to update(1/2)	×		
Update Setting				
Update File: C:\Users\叶成兵\Desktop\Release\BX306+BX316D_V1_20.bin				
Port:	COM16 V Baudrate: 460800 V Advance Setting			

If it's selected, the following page will be displayed, select 'Manual Hardware Reset' and press OK.

Advance Update Setting	×
Manual Hardware Keset	
Note: Normally update app need the dev response to contiue, If the dev failed to work normal(poweroff in update process maybe cause this question), Use this option to forced to upgrade and you must power cycle after click next step.	
ОК	

Press Next in the former page and power off the receiver, wait for 5 seconds and power on it again.

After FW update is finished, power off the receiver, wait for 5 seconds and power on it again.



3.4.2 Auth Code

An auth code is used to determine the features and valid time for a David receiver. If the auth code is expired, the receiver will not work. And a license requirement is output from all the ports.

Before you contact Tersus for new auth code, please:

	communication between a David receiver and Tersus GNSS Center.
1)	Follow Figure 48 and the detailed steps in Table 19 to create

2) Input:

LOG VERSION LOG AUTHLIST //get the version info //get the auth list info

to the David receiver, and send all the output info to Tersus support. If the auth code application is approved by Tersus, you will get a reg.txt file, in which

r			
AUTHCODE of them to the Date	command with the coo avid receiver in the co	ill be given, copy all of them and input e window of Tersus GNSS Center, or	
← Dev	vice Info		3) Connect the David with Nuwa Ap go to Device -> Device Info, th
Version	0021		right window will be shown
Battery	Battery N/A		4) Confirm the reg.txt file is copied to
Mode	General		the FilePath.
Register Inf	0		window below, press Register to
Register State	Register StateEffective registrationExpired Date0FilePath/storage/emulated/0/ TersusSurvey		input the new auth code.
Expired Date			
FilePath			
4229748B9D36BD6197823C06CE3200 DAD7E77E369FAED5710CBA4A49DBE CA5C11464110D0D8F775365B5B9236 836C1A9264F02DE664603FDE70A25D 692BD7A39			
Res	et Register		

3.5 Download Files from Internal eMMC Card

The files saved on David's internal eMMC card can be copied to the computer via a serial port or an USB port (recommended and used in the following example).



Figure 49 Download file from eMMC card

Table 21 Detailed Steps to download files from eMMC card Hardware Installation

1.	Connect the David's COMM2 port to a computer's USB port with	
	COMM2-7pin-USB & DB9 data cable or COMM2-7pin-USB & 5pin cable.	

2.	. Power on the David.						
So	Software Configure						
3.	3. Run the TersusDownload, the following page will display:						
		🔒 TersusD	ownloa	d		×	
		DownLoad P DownLoad S Progress Inf	Port: Speed: fo:	use current baudrate	:(USB:80KB/Second, Serial:8~32 \		
				Open Serial	Show FileDialog		
				Close Serial	Reset Tersus		
		Notice: Th the lower	ne softwa speed or	are normally retry when confirm the cpu perfor	n failed to download, You also can o rmance when failed to download.	hange	
4.	Choo	se the se	erial p	ort to commu	nicate with the David	t	
		DownLoad P	Port:	СОМ9 СОМ9		~	
5.	Choo	se the do	wnlo	ad speed (the	e example is using l	JSB port. S	Select the
	baud	rate if a s	serial	port is used t	o download the file)		
			use 92 use 92 use 46 use 23 use 11 use cu	rrent baudrate(USB 1600 baudrate to d 0800 baudrate to d 0400 baudrate to d 5200 baudrate to d rrent baudrate(USB	:80KB/Second, Serial:8~32 ownload(32KB/Second) ownload(32KB/Second) ownload(16KB/Second) ownload(8KB/Second) :80KB/Second, Serial:8~32KB		
6	Press	the One	n Sei	rial button all	the files on the Day	_ id's eMMC	card will
0.	be re	ad and sh	nown	, see the follo	wing figure:		

DownloadPath	E:\TersusGNSS_DAT	FA\20180705		Select View
Media	EMMC	FreeSpace 3753	1420 KB	SelectAll
FileName 00047_203 00047_203 00047_203	.80705082411.dat .80705082457.dat .80705082849.dat	UTC Time 20180705 8:24 20180705 8:24 20180705 8:28	Size 177260 1298870 1577387	status
<				>
Refresh	Download	deletefile	Stop	Hide Window
ive the do ownload bu Dialog DownloadPath	wnloadpath a utton to start o E:\TersusGNSS_DAT	and select the downloading: A\20180705	e files to b	e downloaded, ×
Media	EMMC	FreeSpace 3753	056 KB	SelectAll
FileName 00047_2014 00047_2014 00047_2014 00047_2014	30705082411.dat 30705082457.dat 30705082849.dat	UTC Time 20180705 8:24 20180705 8:24 20180705 8:28	Size 177260 1298870 1950151	status Downloading
٢				>

The files will be saved on the DownloadPath directory.

<u>!</u>	The downloading rate is about 2M/min, the downloading time can be
	estimated based on it.

 $3.6 \mbox{Input}$ command directly to the GNSS board

Users can input commands to the BX306 board inside the David directly, the steps are given in Table 22.

Table 22 Input commands to the BX306 directly

Hardware Installation				
Follow section 3.3.1 or section 3.3.2 to connect the Android phone to the David.				
Software Configure				
 1) Run Nuwa and go to Device -> Data Terminal 2) The page at the right will be shown; users can input all the commands in the Log & Command document in the window. 3) Then press Send button, the command will be input to the BX306 board. 	✔ Data Terminal \$GNGGA,021226.00,3111.4257246,N, 12135.5906384,E,7,19,0.7,28.571,M,11.518,M, 0.0,0000*62 \$GNGGA,021227.00,3111.4257246,N, 12135.5906384,E,7,19,0.7,28.571,M,11.518,M, 0.0,0000*63 \$GNGGA,021228.00,3111.4257246,N, 12135.5906384,E,7,19,0.7,28.571,M,11.518,M, 0.0,0000*6C \$GNGGA,021229.00,3111.4257246,N, 12135.5906384,E,7,19,0.7,28.571,M,11.518,M, 0.0,0000*6D \$GNGGA,021230.00,3111.4257246,N, 12135.5906384,E,7,19,0.7,28.571,M,11.518,M, 0.0,0000*6D \$GNGGA,021230.00,3111.4257246,N, 12135.5906384,E,7,19,0.7,28.571,M,11.518,M, 0.0,0000*6D \$GNGGA,021230.00,3111.4257246,N, 12135.5906384,E,7,19,0.7,28.571,M,11.518,M, 0.0,0000*65 Hex Paused Log Clear Iog gpgga ontime 1			

4. Introduction of Nuwa®

Nuwa® is the Tersus survey app, which is running in the Android phone. All the configure commands for the David are input with Nuwa®, and all the operation of David are done with Nuwa[®]. Four tabs menus are provided in the main window. They are Project, Device, Survey and Tools. See the Nuwa[®] user manual for detail.



Figure 50 Booting up page

 Tersus Survey Nuwa[®] is supporting Android system; no IOS version is available now.

\wedge	The minimal requirements for Android phone:
<u> </u>	1) The phone must support OTG, otherwise, it can't be connected to
	David with cables, but only with Bluetooth.
	2) The Android system is 6.0 or later version.

<u>!</u>	1)	There are lots of Android versions in market, so an Android phone
		meeting the minimal requirements above may still have problems to
		run Nuwa.
	2)	Nuwa is tested with: Huawei Mate 7/Honor 7/9, Oppo A57, Vivo X9
		and Samsung C7 Pro.
	3)	It's highly recommended that an Android phone with better hardware
		performance than those above is used to run Nuwa.

💓 Nuwa 2.0	RTK	N/A Disconnect	Į	🞐 Nuwa 2.0) Trik	N/A Disconnect
•		*			o **** o	▼
Project	CRS	Parameters		Connect	Data Terminal	Base
••	مم			T	6	
Point	Line	Import		Rover	Device Info	Demo
Export	C Settings					
	a	-			• ••	A
Project De	😧 🌠 vice Surve	ey Tools		Project	Device Survey	/ Tools
🍠 Nuwa 2.0	RTK	N/A Disconnect		🤵 Nuwa	2.0 RTK	N/A Disconnec
Nuwa 2.0	RTK	NA Disconnect		Nuwa		N/A Disconnec
Nuwa 2.0 Point Survey P	RTK	NA Disconnect		Nuwa	2.0 RK	KA Disconnec
Nuwa 2.0 Point Survey P	RTK	Image: NA Image: Disconnect Image: Disconnect Image: Disconnect Image: Disconnect Image: Disconnect Image: Disconnect Image: Disconnect		Nuwa Rerime	2.0 RTK	A Disconnect Disconnect Offset Point
Nuwa 2.0 Nuwa 2.0 Point Survey Point Survey Static Survey	Point Correction	NA Disconnect Line Stakeout Constant Survey Config		Nuwa Nuwa Area Perime Rotation po	2.0 Two Point	NA Disconnection N Disconnection Offset Point Disconnection Point Disconnection
Nuwa 2.0 Nuwa 2.0 Point Survey Point Survey Static Survey	Point Stakeout Point Correction	Image: NA Image: Disconnect Image: Disconnect Image: Disconnect		Nuwa Area Perime Rotation po	2.0 RTK	Image: Note of the sector with
Nuwa 2.0 Point Survey Point Survey Static Survey Base Shift	Point Stakeout Point Correction	NA Disconnect Line Stakeout Constant Survey Config		Nuwa Area Perime Rotation po	2.0 RK	Image: NAImage: NAImage

Figure 51 Four Main Windows of Nuwa

APPENDIX A

5. Specification

5.1 David Receiver

Table 23 David GNSS Performance

GNSS Performance					
	.	1.5m RMS (Horizontal)			
	Single positioning	3.0m RMC (Vertical)			
		10mm+1ppm (Horizontal)			
Position Accuracy	RIK Positioning	15mm+1ppm (Vertical)			
		3mm+0.5ppm (Horizontal)			
	Static post processing	5mm+0.5ppm (Vertical)			
Time to First Fiv	Cold Start: <50s				
	Warm Start: <30s				
Popequisition	0.5 s L1 (typical)				
Пеасциізшоп	1.0 s L2 (typical)				
Data Rate	Measurements	20Hz			
	Position	5Hz			
Time Accuracy	20ns RMS				
Velocity Accuracy	0.03m/s RMS				
	C/A Code	10cm			
Massurament Procision	P Code(zenith direction)	10cm			
	Carrier Phase(zenith	1mm			
	direction)				
	Physical Description				
Size 104*65*31 mm ³ (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		
	6.2W with external 1W radio RS900C		
	9.8W with external 2W radio RS400L2		



Figure 52 Panel of David

Table	24	Pin	Definition
Iable	4-	1 11 1	Deminuon

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

Note 1: The default configure for pin6 and pin7 in COMM1 port are CAN_H and CAN_L. The two signals are multiplexed with PPS and EVENT. This feature is related to FW release, contact <u>support@tersus-gnss.com</u> for confirmation.



Figure 53 Pin Definition of the COMM1/COMM2/DC ports

5.2 ANTENNA AX3702

Table 25 Antenna AX3702

Ante	enna Specification
Treeling eigenele	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
LI	NA Specification
LNA Gain	40±2dB
Noise Figure	≤ 2.0dB
VSWR	≤ 2.0
Input Voltage	3.3~12V DC
Operating Current	≤ 45mA
Ripple	±2dB
Phy	vsical Description
Dimension	Φ152*62.2mm
Signal Connector	TNC Female
Installation connector	5/8" x 11
	Environment
Operating temperature	-45°C - +85°C
Storage temperature	-45°C - +85°C
Damp	45% - 95%
Ме	chanical Drawing
	<u> </u>
	-27.3 -
aug.	
1 th	
\mathbf{X}	
Top View	Side View Bottom View
TOP VIEW	Side view Bottom view

5.3 1W Radio RS900C

Table 26 Specification for RS900C

General Specification		
Working Frequency	915MHz	
Data level	RS-232	
Serial port baud rate	115200	
Data interface	DB-9 male	
Size	78 * 51.5 * 26.4 mm ³	
Operating Temperature	-40 - +85 ℃	
Antenna impedance	50Ω	
Input voltage	DC 5V – 12V	
Power concumption	3.0W (transmitting)	
	180mW (receiving)	
Receiver Spo	ecification	
Sensitivity	-123dBm (20kbps)	
Spurious response immunity	≥ 65dB	
Intermodulation immunity	≥ 60dB	
Stand by current	≤ 65mA	
saturation	≥ 90dB	
Distortion	≤ 5%	
Error rate	≤ 0.001%	
Transmission s	specification	
Modulation	QPSK/BPSK	
Transmission power	>1000mW	
Modulation distortion	≤ 3%	
Maximum frequency deviation	≤ 5KHz	
Transmission current	≤ 1000mA/DC 5V	
Carrier frequency tolerance	≤ 5*10-6	
Spurious frequency components	≤ -65dB	
Sleep current	≤ 5uA	
Working range	>2km (@1Mbps)	
	>5Km (@20Kbps)	
Mechanical Drawing		



5.4 2W Radio RS400L2

Table 27 Specification for RS400L2

Communication Interface				
Interface	9.6kbps in the air			
Intenace	Lemo connector, RS-232, baud rate 38400			
Voltage and Power				
Input voltage	nput voltage DC 5 – 12V			
Power	6.5W (DC 12V,	transmitting power 2W)		
consumption in	4W (DC 12V, t	ransmitting power 1W)		
transmitting				
Power				
consumption in	<400mW (DC 5	V)		
receiving				
	External Ant	enna		
Impedance	50 Ohm			
VSMR	≤ 1.5			
Interface	MCX female			
Мс	odulation & Den	nodulation		
Modulation	GMSK			
Data rate in air	9600bps@25K	Ηz		
RF sensitivity	Better than 13dB@-119dBm			
Code sensitivity	-116 dBm BER 10E-5@9600bps			
Protocol Transparent EOT, TT450S and Tersus				
RF Specification				
Frequency range 10MHz (457MHz – 467MHz)				
Channel width	25KHz			
Frequency	±1.5 ppm(25C)			
stability				
Channel number	10 configurable channels			
Adjacent channel				
selectivity	≥ p∩gR			
	High power			
	(2) (λ)	$33.5\pm0.5\text{dBm}@\text{DC5.5V}$		
Transmission	(200)			
power	Low power			
	(1)()	$30.0\pm0.5\text{dBm}@\text{DC5.5V}$		
	(100)			
Environment				
Temperature	-30°C - +60°C (operating)		
-40°C - +85°C (storage)				
Mechanical				
Size	107 * 62 * 26.6			



5.5 30W Radio RS400L30

Table 28 RS400L30 Radio S	pecification
	peomodion

Communication Interface				
DTE-DCE Interface	9.6kbps in the air			
	Serial port: RS-232, Band rate 38400			
Interaction				
	High (about 30W)		PWR LED: OFF	
	2 nd high (about 20W)	PWR LED: BLUE	
Power level	Middle (about 10W)		PWR LED: RED	
	Low (about 5W)		PWR LED: RED&BLUE blink	
Charging Alarm	DC 11.60 ± 0.2V			
	B4	D	C 13.00 ± 0.2V	
	B3	D	C 12.50 ± 0.2V	
Battery Monitor	B2	D	C 12.00 ± 0.2V	
	B1	D	C 11.60 ± 0.2V	
	Power In/Out			
Input voltage	DC	10	.5 – 15.0V	
	85W (DC 12.8V, 30)	N (output)	
Power in transmitting	65W (DC 12.8V, 20W output)			
(typical)	46W (DC 12.8V, 10W output)			
	33W (DC 12.8V, 5W	0	utput)	
Transmitting prohibition	DC 11.40 \pm 0.2V (de	DC 11.40 \pm 0.2V (default)		
voltage	DC 10.50 – 11.5V (configure range)			
Power in receiving (typical) <3W (Input voltage DC 12.8V)		; 12.8V)		
	Antenna			
Input Impedance	50 Ohm			
VSWR	≤ 1.5			
Interface	TNC female			
Modulation/Demodulation			on	
Modulation	GMSK			
Data rate in air	9600bps@25KHz			
RF sensitivity	Better than 13dB@-	11	9dBm	
Decode sensitivity	-116 dBm BER 10E-5@9600bps			
Protocol	Transparent EOT, SOUTH			
	Radio			
Frequency range	457 – 467MHz			
Channel width	25KHz			
Stability	±1.5ppm (25C)			

Channel number	116 (channel 00 – 15 are configurable, channel 16 – 116 are fixed)		
Adjacent channel selectivity	≥60dB		
	Environment		
Temperature	Operating	-30 - +60°C	
	Storage	-40 – 85°C	
Dust proof and waterproof	IP68		
	Physical Description	on	
Size	165 * 74 * 185.5 mn	n ³ with plastic protector	
Weight	About 1.75Kg		
Data port	LEMO EGA.0B.305		
Power input port	LEMO EGG.1B.302) ·	
Installation	Hook		
	Mechanical Drawin	ng	
Data Port		Pin 1: GND Pin 2: GND Pin 3: Output power (3A, same voltage as the input) Pin 4: RXD Pin 5: TXD	

Power input port		Pin 1: GND Pin2: PWR input
------------------	--	-------------------------------

6. Typical operating

The LEMO connectors in the David system support mis-installation avoidance. But it's highly recommended to double check the module/cable before they are installed to the correct ports. Mis-installation with force can damage the David.

<u>!</u>	The following may be used for David system:
	 A battery bank for David An Android phone An external large capacity power if a base kit with 30W or with 2W radio station is used. A tripod (optional). A tribrach (optional)

\geq	It's highly recommended that a David base variant is installed on a
2:2	tripod.

6.1 David as a Rover to receive corrections from Internet

<u>!</u>	From section 6.1 to section 6.4, David and Android phone are
	connected with cables; refer to section 3.3.2 for the connection with
	Bluetooth.



Figure 54 Outline of Android phone to David with Wire

<u>!</u>	Two cables are used to connect the COMM2 port of David to the USB
	port of the Android phone. They are:
	• COMM2-7pin-USB & DB9 Male cable or COMM2-7pin-USB & 5pin
	cable.
	USB Type A Female to USB (Micro + Type C) OTG cable

Table 29 Detailed steps for rover receive corrections from Internet

Hardware Installation						
1.	Install the GNSS antenna on a ranging pole at a point interested.					
2.	Connect the antenna to David with the RF cable.					
3.	Connect the David's COMM2 port to the USB port of the Android					
	phone with cables.					
4.	Power on the David with a battery bank.					
Software Configure						
5.	Run Nuwa, Device ->Device Connect					

← Connect	·2007•			
	HIMLE CAVE	 Connea Press update Press communication 	ect Type " USB' Connect Co accordingly. Connect to er unication wi	B" Config to enable the with the
Device Type	vice Type David >		d.	
Connect Type	USB >			
Connect Config				
Ant type	AX3702(HG)>			
Co	onnect			
9. Go back to:	Device -> Rover Station	on		
← Rover		← Edit	Workstation	
Work Mode List	Multiselect	Data Link		Network >
Ext.Radio+11520	0+Auto	Protocol Type	Ntrip >	
Default:Ext.Radio	+115200	ID	106 14 1	84 52 IP
Default:PDA Netv	vork+Default Server1	Port	100.14.1	2201
Default:PDA Netv	vork+Default Server2	Username		Input
PDA Network+De	Password Input			
PDA Network+De	fault Server2+Auto	Mount Point Update SourceTable > C		
		Difference Fo	ormat	AUTO >
			ОК	
New C	Detail Start			
10. Select PDA Network+Default	← Link status			
---------------------------------------	--			
Server1, then press Detail to				
configure the parameters about	Mode Rover			
the Network.	Data Link PDA Net			
11. Select Network for Data Link	Host 106.14.184.52:7774			
12. If Ntrip is selected for Protocol	Protocol Type TCP			
type, please input: IP, Port,	Mount Point Update SourceTable			
Point.	2.28K bytes			
13. If TCP is selected for Protocol	Log information			
type, please input: IP and Port.	[09:09:03] Connect server successfully!			
14. Go back to the Rover Station	09:09:03] Connect server successfully! [09:09:03] Connect server successfully!			
page and press "Start".	09:09:04] Connect server successfully! [09:09:04] Connect server successfully!			
15. If all the configure above are	09:09:05] Connect server successfully			
correct, the right page will show	[09:09:07] Connect server successfully! [09:09:07] Connect server successfully!			
the rover is receiving RTK				
corrections.	Stop Rover			

6.2 David as a Base to transmit corrections to Internet



Figure 55 Outline of Android phone to David with Wire

<u>!</u>	Two cables are used to connect the COMM2 port of David to the USB
	port of the Android phone. They are:

•	COMM2-7pin-USB & DB9 Male cable or COMM2-7pin-USB & 5pin
	cable.
•	USB Type A Female to USB (Micro + Type C) OTG cable

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

Table 30 Detailed steps for Base transmit corrections to Internet

Hardware Instal	llation		
1. Install the trip	od at a point intereste	d.	
2. Install a tribrach on the tripod, adjust it to horizontal level and install			
the GNSS an	tenna and the antenna	a coi	nnector on it.
3. Connect the a	antenna to David with	the	RF cable.
4. Connect the	David's COMM2 por	t to	the USB port of the Android
phone with ca	ables.		
5. Power on the	David with a battery t	bank	•
Software Config	gure	1	
6. Run Nuwa, D	evice ->Device Conne	ect	
← Connect	•8889•		
		7	Connect Type " USB"
		8.	Press Connect Config to
	HAND DAVD		update accordingly.
0		9.	Press Connect to enable the
			communication with the
Device Type	David >		David.
Connect Type			
connect Type			
Connect Config	/dev/bus/usb/001/004>		
connect coning	/00//00//00//004/		
Anthree	AX2702(LIC)		
Апт туре	AX3702(HG)2		
C	onnect		
10. Go back to:	Device -> Base Statio	n	

← Base	← Edit Workstation
Work Mode List Multiselect	Start Way Auto start >
Auto Startup+PDA Network+Default Server1+Auto	Data Link Network >
Auto Startup+PDA Network+Default Server2+Auto	IP 106.14.184.52 IP
Manual Startup+Ext.Radio +115200+Auto	Port 2201
Auto Startup+Ext.Radio +115200+Auto	Password Input Mount Point Input
Default:Auto Startup+PDA Network +Default Server1+RTCM32	Difference Format AUTO >
Default:Auto Startup+PDA Network	
New Detail Start	ОК
 Select Auto Startup+PDA Network+Default Server1+Auto, then press Detail to configure the parameters about the Networ If Auto Start is selected for Start Way, go to Step 14. If Manual Start is selected for Start Way, input the base's position manually. If Ntrip protocol is selected, please input: IP, Port, Username, Password and Mount Point. Go back to the Base Station page and press "Start" 	✓ Link status Mode Base Data Link PDA Net Host asiacaster1.tersus- gnss.com:2201 Mount Point 0171 Lout K bytes Log information 109:08:01 Connect server successfully! 109:08:02 Connect server successfully! 109:08:02 Connect server successfully! 109:08:02 Connect server successfully! 109:08:03 Connect server successfully! 109:08:04 Connect server successfully! 109:08:05 Connect server successfully! 109:08:06 Connect server successfully! 109:08:06 Connect server successfully!
 If all the configure above are correct, the right page will show the base is transmitting RTK corrections. 	Stop Base

$6.3 \quad \text{Radios Transmit RTK Corrections between Two Davids}$

<u>!</u>	•	1W base must work with 1W rover.
	•	2W base must be work with 2W rover.
	•	30W base must work with 2W rover.

Only 30W base and 2W rover are given in this section since the other two configure are very simple.



Figure 56 Outline of Base/Rover with Radios

Table 31 Detailed steps for David with Radios

Hardware Installation for the 30W Base
1. Install the two tripods at the points interested.
2. Install the 30W radio antenna with the telescopic pole for radio
antenna.
3. Refer to Figure 42, install the metal plate, the GNSS antenna
connector and the 30W radio antenna on one tripod.
4. Install a tribrach on the other tripod, adjust it to horizontal level and
install the GNSS antenna and the antenna connector on it.
5. Connect the antenna to the base David with the RF cable.
6. Connect the David's COMM2 port to the USB port of the Android
phone with cables.
7. Install the RF cable from the telescopic pole to the 30W radio station.
8. Connect the COMM cable to 30W radio, and to the base Daivd's DC
port, respectively. Then connect it to the power cable for 30W radio.
9. Double check the cables above and connect the power cable to the
external battery.
Hardware Installation for the 2W Rover
10. Install the GNSS antenna on a ranging pole and place it at the point
interested.
11. Connect the rover antenna to the rover David with the RF cable.
12. Install the COMM2-7pin-USB & 5pin cable to the COMM2 port of the
rover David, and connect the other two connectors to the USB port of
the Android phone with cables and to the 2W radio station,
respectively.

13. Power on the Dav	id with an exte	rnal k	attery ba	nk.		
Software Configure	for the 30W B	ase				
14. Refer to 3.3.1 to c	ommunicate th	e Ano	droid phoi	ne with th	ne base D	avid.
15. In Survey Nuwa, g	go to: Device ->	> Bas	e Station			
← Base			← Edit V	Workstation	I	
Work Mode List	Multiselect		Startup		Auto star	t >
Default:Auto Startup+F Network+Default Serve	DA r1+RTCM32		Data Link		Radio	>
Default:Auto Startup+F Network+Default Serve	PDA r2+RTCM32	L	Baud Rate		38400) >
Default:Manual Startup+Ext.Radio+115	200+RTCM32		Differential F	ormat	RTCM3.2	2 >
Default:Auto Startup+Ext.Radio+115	200+RTCM32					
Auto+Ext.Radio+38400	+RTCM 32					
New Detail	Start			ОК		
16. Select Auto +Ex.F	adio+38400+R	RTCM	132, pres	s Detail		
17. If Auto Start is sel	ected for Start	Way,	go to Ste	p 20.		
nanual Start is	selected in for	Star	t way, in	put the b	base's pos	sition
19. Press OK to go ba	ack to the Base	pade	e, press S	Start.		
Software Configure	for the 2W Ro	ver	· · · · · ·			
20.Refer to 3.3.1 to David.	communicate	the	Android	phone v	with the r	over
21.Go back to: Devic	e -> Rover Sta	tion				

← Rover		← Edit Wo	orkstation
Work Mode List	Multiselect	Data Link	Radio 🗦
Default:Ext.Radio+115200			
Default:PDA Network+Defau	ult Server1	Baud Rate	38400 >
Default:PDA Network+Defau	ult Server2		
Ext.Radio+38400			
New Detail	Start		ок
22. Select Ext.Radio+384	00, press D	etail	
23. Data Link is Radio and	d ensure th	e Band Rate is	correct.
24. Go back to the rover p	bage, and p	ress Start.	

6.4 Data Collection for Post Processing

<u>!</u>	The size of the logging:
	Collect raw measurements at 1Hz (about 110KByte/min if 20 satellites are tracked, about 165KByte/min if 30 satellites are tracked)
	If the collection frequency increased, the data size will be increased proportionately.

\wedge	David provides up to 4GB internal eMMC card for data collection,
<u> </u>	before data collection, estimate whether the free space is enough for
	the data collection. Refer to Table 21 to delete the files on eMMC card
	to get more free space.

	1	Λ	
1	/	i,	1

During data collection, the antenna must be installed on a tripod.

-	
!	Rules for the file name & update time in the internal eMMC card:
-	
	1) Name: file name is the 0000xxxx.dat, totally 8 digits, in which xxxx
	is the working time (seconds/100) of the David. For example, the
	David has worked 500 hours 40min, (500*3600 + 40*60)/100 =
	18024, the file name will be 00018024.dat.
	2) Update time: if the David hasn't gotten the GNSS time, the update
	time of the files will be19800000 0:0 (YYYYMMDD HH:MM). If the
	David has gotten the GNSS time, the update time will be the UTC
	time.



Figure 57 Outline of Static Data Collection

Table 32 Detailed Steps for Static Data Collection

Hardware Installation		
1.	Install a tripod at a point interested.	
2.	Install a tribrach on the tripod, adjust it to horizontal level and install	
	the GNSS antenna and the antenna connector on it.	
3.	Connect the antenna to the David with the RF cable.	

4. Create communication between the David and the Android phone with cables, refer to section 3.3.1.		
Software Configure		
5. In Tersus Survey Nuwa, go to Sur	rvey->Static Survey	
Tersus survey 2.0 Tersus survey 2.0	← Static Survey	
	Interval 20HZ >	
Point Survey Point Stakeout Line Stakeout	Cutoff Angle(°) Input	
	Ant type AX3702(HG)>	
	Type Overtical Oslant OPole	
Point Survey Config	Ant Height(m) 3.0	
Project Device Survey Tools	Start	
 Ensure the necessary parameter cutoff angle, etc. Press Start. 	ers, including data frequency and	
7. Follow steps 1 - 6 above to interested.	collect static data at other points	

6.5 Auto Base Station List Function

If a base is setup with command POSAVE, according to its origianl definition, even if the receiver is installed at the same point. Aftera a power cycle, the fixed position may be different, see more about coommand POSAVE in the Log & Command document. For the users who what the base to keep the same fixed position after a power cycle, auto base station list function is

introduced.

The procedure is introduced below:

- 1) Follow Figure 48 and the detailed steps in Table 19 to create communication between a David receiver and Tersus GNSS Center.
- 2) Go to Menu Tool -> Base Network for Posave, the follwing page will be displayed.

Option	(0. diaphla, dafaulti 20)	20	
allo Position Range	(0: disable, default:50)	20 m	Modify
PosAve On	O PosAve Off	0.0100	
Base Station Positio	on Network		
Select All			
LAT	LNG	HEIGHT (Ellipsoidal)	MarkID

- 3) Fill the valid position range, PosAve On and fill the time (unit is hour), press the Modify button. It's recommended that valid position range is >20m.
- 4) After the time (in the example, 0.01 hour, that is, 36 seconds), the base will be fixed with the 36 seconds averaging position.
- 5) Press Refresh button, the fixed position will be displayed on the window.

Auto Base Station L	ist		
Option Valid Position Range(C): disable, default:30) ○PosAve Off	20 m 0.0100	Modify
Base Station Position	1 Network		
LAT	LNG	HEIGHT (Ellipsoidal)	MarkID
31.19042830	121.59319162	37.41683394	0

6) Then after a power cycle, if the base is not moved 20m away from the last position, it will fixed with the same position, in the example, latitude will keep 31.19042830, longitude will keep 121.59319162 and ellipsoid height will keep 37.4168.

7. Terminology

Table 33 List of terminology				
Abbreviation	Definition			
ASCII	American Standard Code for Information Interchange			
CMR	Compact Measurement Record			
DC	Direct Current			
ESD	Electro Static Discharge			
ECEF	Earth Center Earth Fixed			
GLONASS	GLObal NAvigation Satellite System			
GNSS	Global Navigation Satellite System			
GPS	Global Positioning System			
IF	Intermediate Frequency			
IMU	Inertial Measurement Unit			
IO	Input/Output			
LED	Light Emitting Diode			
LNA	Low Noise Amplifier			
MPU	Micro Processing Unit			
NMEA	National Marine Electronics Association			
PC	Personal Computer			
PPS	Pulse Per Second			
RF	Radio Frequency			
RINEX	Receiver Independent Exchange format			
RMS	Root Mean Squares			
RTK	Real-Time Kinematic			
RTCM	Radio Technical Commission for Maritime Services			
SMA	Sub-Miniature-A interface			
TTFF	Time to First Fix			
TTL	Transistor-Transistor Logic level			
UART	Universal Asynchronous Receiver/Transmitter			
USB	Universal Serial BUS			
WGS84	Word Geodetic System 1984			