NS-HP-GN2 User's Guide



Rev. 0.7 May 16, 2022

Table of Contents

1.	INTRODUCTION	3
2.	FEATURES OF NS-HP-GN2	5
3.	APPLICATIONS	5
4.	PIN OUT DESCRIPTION	7
5.	CHECK OUT BASIC GPS FUNCTIONALITY	9
6.	SET UP NS-HP-GN2 AS RTK BASE13	3
	Known Base Antenna Position14	1
	Unknown Base Antenna Position15	5
	Base Stream Format17	7
7.	USE NS-HP-GN2 AS RTK ROVER20)
8.	MOVING BASE MODE	5
9.	ADVANCED MOVING BASE MODE	3
10.	ACTIVE ANTENNA CONSIDERATION	1
11.	FIRMWARE UPDATE	2
12.	POSSIBLE CONNECTION FOR QUADCOPTER APPLICATION	1
CHA	NGE LOG	5

1. INTRODUCTION

NS-HP-GN2 is a high performance multi-band multi-GNSS RTK receiver. It can accept RTCM 3.x message or SkyTraq carrier phase raw measurement data from a base station to perform carrier phase RTK processing, achieving centimeter-level accuracy relative positioning.

When used with RTCM base station, the supported RTCM message types are:

- Type 1004 Extended L1/L2 GPS RTK observables
- Type 1005 Stationary RTK Reference Station ARP
- Type 1012 Extended L1/L2 GLONASS RTK observables
- Type 1033 Receiver and antenna description
- Type 1074 GPS MSM4
- Type 1075 GPS MSM5
- Type 1076 GPS MSM6
- Type 1077 GPS MSM7
- Type 1084 GLONASS MSM4
- Type 1085 GLONASS MSM5
- Type 1086 GLONASS MSM6
- Type 1087 GLONASS MSM7
- Type 1094 Galileo MSM4
- Type 1095 Galileo MSM5
- Type 1096 Galileo MSM6
- Type 1097 Galileo MSM7
- Type 1114 QZSS MSM4
- Type 1115 QZSS MSM5
- Type 1116 QZSS MSM6
- Type 1117 QZSS MSM7
- Type 1124 BeiDou MSM4
- Type 1125 BeiDou MSM5
- Type 1126 BeiDou MSM6
- Type 1127 BeiDou MSM7
- Type 1230 GLONASS Code Phase Biases

For centimeter-level RTK accuracy, NS-HP-GN2 requires much better operating condition than conventional meter-level accuracy GPS receiver:

- * Under open sky without interference
- * Signal level over 37dB/Hz
- * 8 or more satellites above 15 degree elevation angle with good satellite geometry

If above condition is not met, NS-HP-GN2 will not get centimeter-level accuracy RTK solution.

Without base station data input, NS-HP-GN2 works like a normal GNSS receiver.

When used with a RTCM 3.x Virtual Reference Station (VRS) RTK base, one rover NS-HP-GN2 is needed. If one wishes to setup a local base station to work with rover, then two NS-HP-GN2 will be needed, one for base and another for rover.

Default NMEA output baud rate is 115200.

Rover expects RTCM 3.x or SkyTraq raw measurement data at input baud rate of 115200

2. FEATURES OF NS-HP-GN2

RTK Receiver Features

- * Support RTK base and rover modes
- * Supports GPS/QZSS L1/L2C + Beidou B1I/B2I + Galileo E1/E5b + GLONASS L1/L2 RTK
- * RTK position accuracy: 1cm + 1ppm
- * RTK initialization time: < 10sec
- * 100mA @ 3.3V

3. APPLICATIONS

NS-HP-GN2 may be used for:

- 1. GIS data collection
- 2. Precision farming machine guidance
- 3. Precision grass cutting machine guidance
- 4. Precision guidance of unmanned aerial vehicles
- 5. Precise position tracking of race cars for performance measurement

4. PIN OUT DESCRIPTION



Pin No.	Name	Description
J1		
1	BOOT_SEL	No connection for normal use. Pull-low for loading firmware into empty or corrupted Flash memory from ROM mode for the master processor.
2	NC	No connection, empty pin
3	1PPS	One-pulse-per-second (1PPS) time mark output, 3.3V LVTTL. The rising edge synchronized to UTC second when getting 3D position fix. The pulse duration is about 100msec at rate of 1 Hz.
4	TRIG	External trigger input for generating STI,005 time stamp, 3.3V LV-TTL
5	NC	No connection, empty pin
6	RX2	UART serial data input, 3.3V LVTTL. One simplex asynchronous serial UART port is implemented. This UART input is used for receiving RTCM-SC104 data or SkyTraq raw measurement data from the base at 115200.
7	NC	No connection, empty pin
8	RSTN	External active-low reset input to the receiver. Only needed when power supply rise time is very slow or software controlled reset is desired.
9	NC	No connection, empty pin
10	GND	Ground
11	NC	No connection, empty pin

12	GND	Ground

Pin No.	Name	Description
J2		
1	GND	Ground
2	NC	No connection, empty pin
3	NC	No connection, empty pin
4	NC	No connection, empty pin
5	NC	No connection, empty pin
6	NC	No connection, empty pin
7	NC	No connection, empty pin
8	TXD	UART serial data output, 3.3V LVTTL. One full-duplex asynchronous serial UART port is implemented. This UART output is used for sending position, time and velocity information from the receiver in NMEA-0183 format. When idle, this pin output HIGH.
9	RXD	UART serial data input, 3.3V LVTTL. One full-duplex asynchronous serial UART port is implemented. This UART input is for sending commands or information to the receiver in SkyTraq binary protocol. In the idle condition, this pin should be driven HIGH.
10	V_ВСКР	Backup supply voltage for internal RTC and backup SRAM, 1.3V ~ 3.6V. V_BCKP must be applied whenever VCC is applied. This pin should be powered continuously to minimize the startup time. If VCC and V_BCKP are both removed, the receiver will be in factory default mode upon power up, all user configuration set is lost. For applications the does not care cold starting every time, this pin can be connect to VCC.
11	VCC	Power supply, 3.3V DC
12	GND	Ground

5. CHECK OUT BASIC GPS FUNCTIONALITY

Hook up as below, connect to an UART-to-USB bridge breakout board, connect antenna to RF_IN, and place antenna at a location having clear sky view. After driver for the UART-to-USB bridge chip has been installed, select proper COM port and 115200 baud rate on GNSS Viewer, click CLOSE, GNSS Viewer will show signal being acquired and tracked.





GNSS Viewer for Windows PC can be downloaded from:

http://navspark.mybigcommerce.com/content/GNSS Viewer.zip

http://navspark.mybigcommerce.com/content/GNSS-Viewer-User-Guide.rev0.2.pdf

If uncertain of the COM port, it can be found from the Windows Device Manager.



If wishing to change NMEA output baud rate, from Binary pull-down menu select Configure Serial Port, select desired baud rate and Update to SRAM+Flash.

GNSS Viewer Customer Release V2.1.012 for Phoenix								
File	Binary	Venus 8	Phoenix	RAW	RTK	INS DR	1	
File Com COI SG2 SG1 SG1 SG1 SG1 SG1 SG2 SG2 SG2 SG2 SG2 SG2 SG2 SG2 SG2 SG2	Binary Sy Sh Se Qu Se Qu Qu Qu Qu Qu Qu Qu Qu Qu Qu Qu Qu Qu	Venus 8 stem Resta iow Binary tt Factory D uery Clock tt Default C uery Softwa uery Softwa uery CRC C uery CRC C uery CRC C uery Positio uery Positio uery Positio uery Positio	Phoenix art Data Default Offset Clock Offset Clock Offset are Version Checksum Chech	RAW t Interval Rate	RTK	INS DR		
	Q Q Q	Query Elevation and CNR Mask Query GLONASS K-Number, Slot, CNR Query NMEA Talker ID						
•	Ca	onfigure Se	erial Port MEA Messa	age Inte	rval			

Configure Serail Por	t	×
This is a req the serial Com	uest message which wil Port, Baudrate.	configure
Baudrate :	38400	~
Attributes :	Update to SRAM+FLASH	⊣ ~
	Accept	Cancel

If wishing to change NMEA solution output updated rate, from Binary pull-down menu select Configure Position Update Rate, select desired update rate and Update to SRAM+Flash.

🌏 GI	GNSS Viewer Customer Release V2.1.012 for Phoenix											
File	Binary	Venus 8	Phoenix	RAW	RTK	INS DR	1F					
Com COI SG/ SGE SGI SGI	Sy Sh Qi Se Qi	stem Resta low Binary t Factory D uery Clock t Default C uery Softwa	art Data Default Offset Clock Offset are Version	t								
\$GI	0	uery CRC C	.necksum 2 Checksur				E					
\$GI	Q	uery SHA1	String		onfigu	e Position	Update Rate					\times
SPS SPS	Query SHAT String Query NMEA Message In Query Position Update R Query Position Pinning Query Power Mode Query DOP Mask Query Elevation and CNR Query GLONASS K-Numl Query NMEA Talker ID				Wa Plea	rning : ase disable Position I	SAEE before u Update Rate : Attribute :	sing multi-hz po 10 Update to SRA	sition up	date rat V SH V	e. Hz	
		onfigure Se onfigure Ni onfigure M onfigure Bi onfigure Po onfigure Po	rial Port MEA Messa essage Typ nary Messa osition Upd osition Pinr	age I e age Inte ate Rat	erval			Accept		Ca	ancel	

When changing to higher update rate, make sure baud rate in use can accommodate it. If baud rate is not fast enough, NMEA message output will be truncated.

6. SET UP NS-HP-GN2 AS RTK BASE

Hook up as below; connect to an UART-to-USB bridge breakout board for connecting to GNSS Viewer running on a Windows PC.



Known Base Antenna Position

When configured as base, NS-HP-GN2 will output its position along with carrier phase raw measurement data over UART TXD. If base NS-HP-GN2 antenna will be placed at a location with known position, the position information can be set into NS-HP-GN2 using GNSS Viewer.

From RTK pull-down menu, select Configure RTK Mode And Operational Function, select RTK base mode, select Static Mode and enter antenna latitude/longitude in degrees and ellipsoidal height in meter, update to SRAM+Flash.

GNSS Viewer Customer Release V2.1.012 for Phoenix										
File Binary Venus 8 Phoenix RAW	RTK INS DR 1PPS Timing Ephemeris AGPS DataLog Converter	r H								
Com PortBaudrateCOM4115200	Re-calculate GLONASS IFB RTK Pass-Through	,								
▼ Message Position fix una	Configure RTK Reference Static Started Position									
\$GAGSA,A,1,,,,,0.0,0.0,0.0,3*3E	Clear RIK Slave Backup Data	_								
\$GBGSA,A,1,,,,,,0.0,0.0,0.0,4*3A	Query RTK Mode And Operational Function	ł								
SGNRMC 002241 000 V0000 000000000000000000000000000	Query RTK Slave Serial Port Baud Rate									
\$GNVTG,000.0,T,,M,000.0,N,000.0,K,N*1	Configure RTK Mode And Operational Function	E								
\$GNZDA,002241.000,06,01,1980,00,00*4A	Configure RTK Slave Serial Port Baud Rate									
\$PSTI,030,002241.000,V,0000.0000000,N,0) Configure RTK GLONASS Carrier-Phase Inter-Frequency Bias									

С	Configure RTK Mode and Operational Function (Query successfully) X								
		RTK Mode :	RTK base mode	2	~				
		Receiver A	RTK rov	er mode	RTK precisely kinematic base mode				
	Receiver B		Normal/Float	Moving Base	Normal/Float				
	RTK	Kinematic		✓					
:	base mode	Survey/Static	✓		✓				
	RTK precisely kinematic base mode	Normal/Float		~					
	RTK Operation	al Function :	Static Mode	~]				
		Latitude :	24.000000]				
		Longitude :	121.000000]				
	Ellipso	oidal Height :	100.000000]				
		Attributes :	Update to SRA	M+FLASH ∨]				
			1	Accept	Cancel				

Unknown Base Antenna Position

If base antenna position is unknown, set to let it survey for 60sec upon power up. From GNSS Viewer RTK pull-down menu, select Configure RTK Mode And Operational Function, select Survey Mode and set Survey Length to 60 and Update to SRAM+Flash.

GNSS Viewer Customer Release V2.1.012 for Phoenix									
File Binary Venus 8 Phoenix RAW	RTK INS DR 1PPS Timing Ephemeris AGPS DataLog Converter								
Com Port Baudrate	Re-calculate GLONASS IFB								
COM4 ~ 115200 ~	RTK Pass-Through >								
 Message Position fix una 	Configure RTK Reference Static Started Position								
\$GAGSA A 1 000000 2*2E	Clear RTK Slave Backup Data								
\$GBGSA A 1 0000004*3A	Query RTK Mode And Operational Function								
\$GNGLL,0000.000000,N,00000.000000,J	Ouerv RTK Slave Serial Port Baud Rate								
\$GNRMC,002241.000,V,0000.0000000,N,0									
\$GNVTG,000.0,T,,M,000.0,N,000.0,K,N*1	Configure RIK Mode And Operational Function								
\$GNZDA,002241.000,06,01,1980,00,00*4.	Configure RTK Slave Serial Port Baud Rate								
\$PSTI,030,002241.000,V,0000.0000000,N,0	Configure RTK GLONASS Carrier-Phase Inter-Frequency Bias								
CDCTT 022 002241 000 060100 W #41									

Configure RTK Mode and Operational Function (Query successfully)								
		RTK Mode :	RTK base mode	2	~			
		Receiver A	RTK rov	er mode	RTK precisely kinematic base mode			
	Receiver B		Normal/Float	Moving Base	Normal/Float			
	RTK	Kinematic		✓				
	base mode	Survey/Static	✓		✓			
	RTK precisely kinematic base mode	Normal/Float		~				
	RTK Operation	al Function :	Survey Mode	~]			
	Survey Length (60	~1209600):	60]				
	Standard Deviati	ion(3~100):	30]			
		Attributes :	Update to SRA	M+FLASH ∨]			
			1	Accept	Cancel			

When later in use, after base NS-HP-GN2 gets position fix and self-surveyed for 60 seconds, it enters into static mode. On GNSS Viewer scatter plot view, one will see the blue dot stop drifting around after static mode is entered; Set Origin button may need to be clicked to center the view in order to see the scatter plot. *Next time powering on the base NS-HP-GN2, it will still start from survey mode again, self-survey for 60 seconds, with self-surveyed antenna location at different location unless static mode is chosen and a constant position is entered. To see what the self-surveyed latitude, longitude, and altitude values are, from GNSS Viewer RTK pull-down menu, select Query RTK Mode And Operational Function.*

To use the base at some fixed location, use these steps to self-survey and retrieve surveyed antenna position, then set the antenna position into the base NS-HP-GN2 so that it'll have the same entered position every time it's powered on later. No need to set the antenna position into base NS-HP-GN2 if only testing and becoming acquainted with it.

Once base NS-HP-GN2 has been properly configured, later usage require only connecting an RTK antenna, apply power, and send TXD base output data to the rover NS-HP-GN2.



Base Stream Format

After configuring NS-HP-GN2 to RTK base mode, NS-HP-GN2 output in RTCM MSM4 format by default. From GNSS viewer RAW pull-down menu, can select Configure RTCM Measurement Data Out, select Enable RTCM Output, select Stationary RTK Reference Station ARP , select MSM4s and Update to SRAM+FLASH.

(🜏 GNSS Viewer Customer Release V2.1.012 for Phoenix										
	File	Binary	Venus 8	Phoenix	RAW	RTK	INS DR	1PPS Timing	Ephemeris	AGPS	
Com Port Baudrate Query Base Position									1		
	COI	M4 ~	1152	00 ~		Query I	Binary Me	asurement Data	a Out		
	•	Messa	ge	Position		Query I	RTCM Mea	asurement Data	Out	5	
	\$GAGSA,A,1,,,,,0.0,0.0,0.0,3*					Config	ure Base F	osition			
	\$GE	BGSA,A,	1,0.	0,0.0,0.0,4*		Configure Binary Measurement Data Out					
	\$GN	NGLL,000	0.0000000	N,00000.00,		Configure RTCM Measurement Data Out					

Configure RTCM Measurment Data C	utput (Query failed)	×
Fnable RTCM Output		
Output Rate for MSM:	L v Hz	
Output MSM Type:	1SM4 V	
Stationary RTK Reference Station	ARP (Message Type 1005)	
GPS MSM4 (Message Type 1074)		
GLONASS MSM4 (Message Type 1	084)	
Galileo MSM4 (Message Type 1094	f)	
SBAS MSM4 (Message Type 1104)		
QZSS MSM4 (Message Type 1114))	
BDS MSM4 (Message Type 1124)		
GPS Ephemeris(Msg Type 1019)	Interval (1 ~ 255):	second(s)
GLONASS Ephemeris(Msg Type 10	20) Interval (1 ~ 255):	second(s)
Beidou Ephemeris(Msg Type 1042)) Interval (1 ~ 255):	second(s)
Galileo Ephemeris(Msg Type 1046)	Interval (1 ~ 255):	second(s)
Attributes: L	Jpdate to SRAM+FLASH \sim	
	Accept	Cancel

RTCM format has much less data rate requirement than binary raw measurement format. For applications that send base data over radio to the rover, RTCM format is preferred. A minimum of 9600bps data rate is required for MSM4 quad-GNSS operation; can be reduced to 4800 if using only two GNSS constellations.

The RTK base can also be configured to output in SkyTraq RAW measurement protocol. The outputted messages include:

- 1) Message type 0xDF Receiver Navigation Status
- 2) Message type 0xE0 GPS Subframe Data
- 3) Message type 0xE1 GLONASS String Data
- 4) Message type 0xE2 –Beidou D1 Subframe Data
- 5) Message type 0xE3 –Beidou D2 Subframe Data
- 6) Message type 0xE5 Extended RAW Measurement
- 7) Message type 0xE6 General Subframe Data
- 8) Message type 0xE7 GNSS SV and Channel Status
- 9) Message type 0xE8 –GNSS SV Elevation and Azimuth Status

The necessary message types of base stream used for NS-HP-GN2 RTK rover mode are only "Receiver Navigation Status (0xDF)" and "Extended RAW Measurement (0xE5)". To decrease the throughput of base stream, other unnecessary message types can be disabled from the base stream. From GNSS Viewer RAW pull-down menu, select Configure Binary Measurement Data Out, disable unnecessary message types, select necessary message types and Update to SRAM+FLASH.

GNSS Viewer Customer Release V2.1.012 for Phoenix									
File Binary Venus 8 Phoenix	RAW	RTK	INS DR	1PPS Timing	Ephemeris	AGPS			
Com Port Baudrate		Query I	Base Posi	tion		1			
COM4 ~ 115200 ~		Query I	Binary Me	easurement Dat	a Out				
▼ Message Position		Query I	RTCM Me	asurement Data	Out				
\$GAGSA,A,1,,,,0.0,0.0,0.0,3*		Config	ure Base I	Position		- 1			
\$GBGSA,A,1,,,,,,0.0,0.0,0.0,4*		Config	ure Binan	y Measurement	Data Out	þ			
\$GNGLL,0000.0000000,N,00000.00		Config	ure RTCM	Measurement	Data Out	-			

Configure Binary Measur	ment Data	Output (Que	ry successfully) ×
Binary measurement out	put rate :	1	~	Hz
Enable Meas Time				
Enable Raw Meas				
Enable SV CH Status				
Enable RCV Status				
Enable Extended Rav	v Meas			
Subframe Enabling of dif	ferent cons	tellation		
GPS		NASS		
Galileo	Beid	lou		
Attrib	outes : Up	date to SRAM	+FLASH V	
	A	ccept	Cancel	

It's deserved to be mentioned that it's necessary to restart rover receiver if the format of base stream is changed.

7. USE NS-HP-GN2 AS RTK ROVER

NS-HP-GN2 is configured as rover during production. If NS-HP-GN2 has been previously configured as base, to re-configure it as rover, hook up as below; connect to an UART-to-USB bridge breakout board for connecting to GNSS Viewer running on a Windows PC.



From GNSS Viewer RTK pull down menu, select Configure RTK Mode and Operational Function, select RTK rover mode, Normal RTK Operational Function and update to SRAM+Flash

GNSS Viewer Customer Release V2.1.012	2 for P	hoenix					
File Binary Venus 8 Phoenix RAW	RTK	INS DR	1PPS Timing	Ephemeris	AGPS	DataLog	Converter
Com Port Baudrate		Re-calcul	ate GLONASS IF	FB			
COM4 ~ 115200 ~		RTK Pass-	Through				>
 Message Position fix upar 		Configure	e RTK Reference	Static Starte	d Positio	n	
\$GAGSA A 1 0000003*3E		Clear RTK	Slave Backup D)ata			
\$GBGSA,A,1,		Query RT	K Mode And Op	perational Fu	nction		
\$GNGLL,0000.000000,N,00000.0000000,E		Query RT	K Slave Serial Po	ort Baud Rate			
\$GNRMC,000223.000,V,0000.0000000,N,00		Configure	RTK Mode Ap	d Operationa	Eurotic	n an	
\$GNVTG,000.0,T,,M,000.0,N,000.0,K,N*1		connigure	E KIK WOUE AIN	u operaciona	- uncue	/11	
\$GNZDA,000223.000,06,01,1980,00,00*40		Configure	e RTK Slave Seria	al Port Baud I	Rate		1
\$PSTI,030,000223.000,V,0000.0000000,N,0		Configure	RTK GLONASS	Carrier-Phas	e Inter-F	requency E	Bias

onfigure RTK Mode and Operational Function (Query successfully) × RTK Mode : RTK rover mode ✓ Receiver A RTK rover mode RTK precisely kinematic base mode RTK Kinematic ✓ RTK precisely Normal/Float ✓ RTK precisely Normal/Float ✓							
	RTK Mode :	RTK rover mod	e	~			
	Receiver A	RTK rov	er mode	RTK precisely kinematic base mode			
Receiver B		Normal/Float	Moving Base	Normal/Float			
RTK	Kinematic		✓				
base mode	Survey/Static	✓		✓			
RTK precisely kinematic base mode	Normal/Float		~				
RTK Operation	al Function :	Normal	~]			
	Attributes :	Update to SRA	M+FLASH ∨				
		4	Accept	Cancel			

To use NS-HP-GN2 as RTK rover, connect antenna, place antenna at location with clear open sky view, apply base data to UART RX2 input and apply power, NMEA result will come out from UART TXD output. The base data may come from a NS-HP-GN2 base sent over wireless radio, or a remote RTCM 3.x base station retrieved by NTRIP client over Internet and send over Bluetooth-to-Serial or USB-to-Serial interface.



To become acquainted with NS-HP-GN2 RTK rover operation, it's best to first use GNSS Viewer to monitor and interact with it. One possible setup scenario is as below.



With two antennas connected and placed at location having clear sky view to receive GNSS signal, base connected to laptop USB port for power, rover output NMEA data to GNSS Viewer, one should see rover state going from Position Fix 3D or DGPS mode, to Float RTK, to Fix RTK if earlier mentioned pre-conditions for RTK operation is met.

GNSS Viewer Internal Use V2.0.172 fo	or Venus 8	SNSS Viewer Internal Use V2.0.1	78 for Venus 8
<u>File Binary Venus 8 1PPS Timing</u>	<u>E</u> phemeris	File Binary Venus 8 1PPS Tim	ing Ephemeris
Com Port Baudrate	Connect	Com Port Baudrate	Connect
COM3 - 115200 -	-00-	COM3 - 115200 -	=0=
 Message Position fix 	k 3D.	▼ Message DC	GPS mode
GNSS Viewer Internal Use V2.0.172 fo	or Venus 8	GNSS Viewer Internal Use V2.0	.172 for Venus 8
<u>File Binary Venus 8 1PPS Timing</u>	<u>E</u> phemeris	<u>File Binary V</u> enus 8 <u>1</u> PPS Tim	ning <u>E</u> phemeris
Com Port Baudrate	Connect	Com Port Baudrate	Connect
COM3 - 115200 -	= O =	COM3 v 115200 v	-0-
▼ Message Float R	тк	▼ Message	Fix RTK

Number values (RTK Age, RTK Ratio, etc.) will be displayed on RTK Info label after Float RTK state is entered. When RTK Ratio number is over 3.0, receiver state changes to Fix RTK; below 3.0, receiver state shows Float RTK.

RTK Age indicates the lag delay in received base data. If RTK Age is 30 or more, indicating lag of 30 second or more, receiver state will show Position Fix 3D, NS-HP-GN2 will not try to compute RTK solution. Large RTK Age indicates some problem with transmission causing severe lag delay.



Although a minimum of 6 GPS satellites could result in Fix RTK solution during zero-baseline GPS simulator testing, 8 or more satellites spread across 4 quadrants of the sky is preferred in getting faster RTK fix with reliable result; lesser number of satellites will take longer time getting RTK fix and may sometimes have reported position decimeters off from true location.

Once becoming acquainted with NS-HP-GN2 RTK operation, one can replace base/rover wire connection with wireless radio connection to operate over distance as below shows. The rover NMEA output, besides sending to application microcontroller, can also be sent to a wireless transmitter for monitoring using GNSS Viewer on a laptop with wireless receiver.



To use NS-HP-GN2 with Android smartphone or tablet, improving its GPS accuracy 100-fold to centimeter-level RTK for the Apps, a tutorial is available here:

http://www.navspark.com.tw/high-precision/#20151204 1

8. MOVING BASE MODE

Normally GPS heading is derived from velocity; when GPS receiver is not moving, it could not have correct heading information. Moving base mode allows reporting of highly accurate heading direction, from base antenna to rover antenna, even when the antennas are static. PSTI,032 message output this heading and baseline information; THS message gives heading only information; see PX1122R datasheet for details.

The base needs to be set to Kinematic Mode and the rover needs to be set to Moving Base Mode. With the two antennas are at fixed distance from each other, the distance number is entered as the baseline length information.

onfigure RTK Mode a	and Operation	al Function (Q	uery successf	ully) ×		
	RTK Mode :	RTK base mode	2	~		
	Receiver A	RTK rov	er mode	RTK precisely kinematic base mode		
Receiver B		Normal/Float	Moving Base	Normal/Float		
RTK	Kinematic		✓			
base mode	Survey/Static	~		✓		
RTK precisely kinematic base mode	Normal/Float		~			
RTK Operation	al Function :	Kinematic Mode	• ~]		
Attributes : Update to SRAM+FLASH V						
		4	Accept	Cancel		

Configure RTK Mode and Operational Function (Query successfully) ×							
	RTK Mode :	RTK rover mod	e	~			
	Receiver A	RTK rov	er mode	RTK precisely kinematic base mode			
Receiver B		Normal/Float	Moving Base	Normal/Float			
RTK	Kinematic		✓				
base mode	Survey/Static	✓		√			
RTK precisely kinematic base mode	Normal/Float		~				
RTK Operation	al Function :	Moving base]			
Input 0) for unknown o	r variable.	icy values				
Baseline leng	gth (meter) :	0.000000					
	Attributes :	Update to SRA	M+FLASH ∨]			
		4	ccept	Cancel			

RTK Mode	Remark
Normal	* 1 / 2 / 4 / 5 / 8 / 10 Hz rover only require 1Hz base
	* rover require same update rate base
Moving Base	* maximum 8Hz update rate
	* at 4Hz or higher update rate must use 230400 baud rate to send data over UART

For N-Hz NS-HP-GN2 in Normal RTK mode, it only needs to work with 1Hz base. For N-Hz rover in moving base mode RTK mode, it needs to work with N-Hz base.

For rover in moving base RTK mode, format of the base stream output can be configured to RTCM format for lower data rate and reduced latency.

9. ADVANCED MOVING BASE MODE

Advanced moving base mode allows reporting of highly accurate position, heading direction and baseline information. The heading direction reported by (advanced) moving base mode is the course between north direction and baseline vector (from base antenna B to rover antenna C) direction, so called azimuth. To get both highly accurate position and heading direction information, advanced moving base mode needs totally three receivers:

Receiver	RTK mode	RTK operational function
А	RTK base mode	Static/Survey
В	RTK precisely kinematic base mode	Normal/Float
С	RTK rover mode	Moving base

In below figure SCL/SDA pins are mapped to become UART pin function.



In the sub-system of receiver A and receiver B, receiver A and receiver B are used as base and rover receiver, respectively. However, receiver B not only output NMEA but also binary raw measurement data because it is configured to RTK precisely kinematic base mode. Therefore, receiver B can also be used as base receiver for another rover receiver (whose RTK operational function should be configured to moving base). In the sub-system of receiver B and receiver C, receiver B and receiver C are used as base and rover receiver, respectively. Receiver B can be configured using GNSS Viewer to output in RTCM format to reduce latency, RAW --> Configure RTCM Measurement Data Out

When using advanced moving base mode at 4Hz or higher update rate, receiver B TXD UART need to be configured to 230400 baud rate to output 4Hz or higher update rate NMEA data; receiver C moving base rover RXD2 UART need to be configured to 230400 baud rate in order to receive 4Hz or higher moving base data; receiver B & C I2C mapped UART need to be configured to 230400 baud rate in order to send/receive 4Hz or higher moving base data.

Use below to configure receiver C RXD2 baud rate.

	GNSS Viewer Customer Release V2.1.04	6 for F	Phoenix
	File Binary Venus 8 Phoenix RAW	RTK	INS DR 1PPS Timing Ephemeris AGPS DataLog Converter H
	Com Port Baudrate COM6 115200 Message Position fix una		Query RTK Mode And Operational Function Query RTK Slave Serial Port Baud Rate Query RTK Precisely Kinematic Base Serial Port Baud Rate
	\$GPVTG,000.0,T,,M,000.0,N,000.0,K,N*0		Configure RTK Mode And Operational Function
L	\$GPZDA,122354.000,28,06,2006,00,00*51		Configure RTK Slave Serial Port Baud Rate
	SGPGGA,122355.000,0000.0000,N,00000. SGPGLL.0000.0000.N.00000.0000.E.12235		Configure RTK Precisely Kinematic Base Serial Port Baud Rate

Use below to configure receiver B & C I2C mapped UART baud rate.



🌏 G	SNSS Viewer Customer Release V2.1.046 for Phoenix								
File	Binary	Venus 8	Phoenix	RAW	RTK	INS DR	11		
Cor CO SG SG SG SG SG SG SG SG SG SG SG SG SG	Sinaly Sy Sh Se Qi Se Qi Qi Qi Qi Qi Qi Qi Qi Qi Qi Qi Qi Qi	venus o stem Resta iow Binary it Factory I uery Clock it Default C uery Softw uery Softw uery CRC C uery CRC C uery CRC 3 uery SHA1 uery NME/ uery Positi uery Positi uery Positi uery Positi uery Positi uery Positi uery DOP I uery Elevat uery GLON	art Data Default Offset Clock Offse are Version Checksum	t Interval Rate VR Mask nber, SI	c ot, CN	R			
-	Co	onfigure Se	erial Port		1				
	C	onrigure N	IVIEA IVIESS	age inte	IVal				

Use below to configure receiver B TXD UART output baud rate

10. ACTIVE ANTENNA CONSIDERATION



For RTK application, the active antenna must be able to provide signal over 37dB under open sky. Antennas vary in price, from under \$50 to over \$300; they mainly differ in interference rejection capability, multipath rejection capability, antenna phase center stability, and weight. Usually more expensive antenna claims to have superior interference and multipath rejection capability. Phase center of expensive survey grade antenna remains constant as the azimuth and elevation angle of the satellites change; signal reception is unaffected by the rotation of the antenna or satellite elevation. Helix antennas are expensive mostly due to light weight feature for UAV applications.

Under open sky no interference no multipath environments, performance difference between the wide price range of antennas may not be much. Depending on budget and application environment signal conditions, user can choose appropriate antenna for the required application.

11. FIRMWARE UPDATE

When there is firmware update release, it'll be made available on the NS-HP-GN2 web store product page.

To update firmware using GNSS Viewer:

1. Connect TXD and RXD to an UART-to-USB bridge breakout board for connecting to a Windows PC



 Connect GNSS Viewer with NS-HP-GN2 using correct COM port and set Baudrate 115200, then click the icon under Connect. The icon becomes green if they connect correctly.



3. Click ... to select firmware to update, then click Download button to update firmware



4. Firmware has default set to rover mode. If using NS-HP-GN2 as base, procedure for setting up base mode and antenna position needs to be done again after firmware update,

12. POSSIBLE CONNECTION FOR QUADCOPTER APPLICATION

Pixhawk Rover Connection



Ground Base Connection



For the 3.3V Regulator in above figure, if you already have the UART-to-USB Adapter breakout board from the web-store, you can modify as below adding a wire connecting pin-stick to capacitor (red wire) and have a 5V-to-3.3V LDO regulator to use.



CHANGE LOG

Version 0.7 May 16, 2022

1. Updated NS-HP-GN2 figures with SMA connector.

Version 0.6 January 22, 2021

1. Section 9 Advanced Moving Base added more descriptions.

Version 0.5 January 11, 2021

1. Added PSTI,035 to Advance Moving Base mode figure on section 9.

Version 0.4 August 21, 2020

- 1. Update RTCM message types and figures.
- 2. Added Advanced Moving Base mode

Version 0.3 March 18, 2020

1. Removed Galileo E1/E5b from page-4 footnote

Version 0.2 January 17, 2020

- 1. Updated supported base input RTCM message types
- 2. Updated current consumption number

Version 0.1, December 18, 2019

1. Initial release

The information provided is believed to be accurate and reliable. These materials are provided to customers and may be used for informational purposes only. No responsibility is assumed for errors or omissions in these materials, or for its use. Changes to specification can occur at any time without notice.

These materials are provides "as is" without warranty of any kind, either expressed or implied, relating to sale and/or use including liability or warranties relating to fitness for a particular purpose, consequential or incidental damages, merchantability, or infringement of any patent, copyright or other intellectual property right. No warrant on the accuracy or completeness of the information, text, graphics or other items contained within these materials. No liability assumed for any special, indirect, incidental, or consequential damages,

including without limitation, lost revenues or lost profits, which may result from the use of these materials.

The product is not intended for use in medical, life-support devices, or applications involving potential risk of death, personal injury, or severe property damage in case of failure of the product.