PX1125R

Small-Size Multi-Band GNSS Receiver for Centimeter-Level Accuracy Applications

Features

- Centimeter-level accuracy RTK receiver
- GPS L1/L5, Galileo E1/E5a, BDS B1I/B2a, GLONASS L1, NavIC L5
- 12.2mm x 16.0mm size
- NMEA-0183 and RTCM 3.x protocol
- Easy to integrate
- Operating temperature -40 ~ +85ºC
- RoHS compliant

Applications

- Machine control & automation
- Unmanned aerial vehicle
- Precision agriculture
- GIS data collection
- Precision heading & attitude

The PX1125R offers centimeter-level accuracy based on carrier phase RTK technique and can be used for a wide range of high-accuracy positioning applications. Its 12.2mm x 16.0mm form factor makes it ideal for mobile precision positioning application requiring small size.

The receiver receives RTCM 3.x data from a local base station, a virtual reference station (VRS) in a Network RTK configuration, or another SkyTraq RTK receiver setup as in base station mode to perform carrier phase RTK processing, achieving centimeter level accurate relative positioning.

The PX1125R receiver is based on SkyTraq's high-performance Phoenix GNSS chipset, featuring fast signal acquisition search engine and high-sensitivity track engine. Search engine performs 16 million time-frequency hypothesis testing per second, offering industry-leading signal acquisition performance.

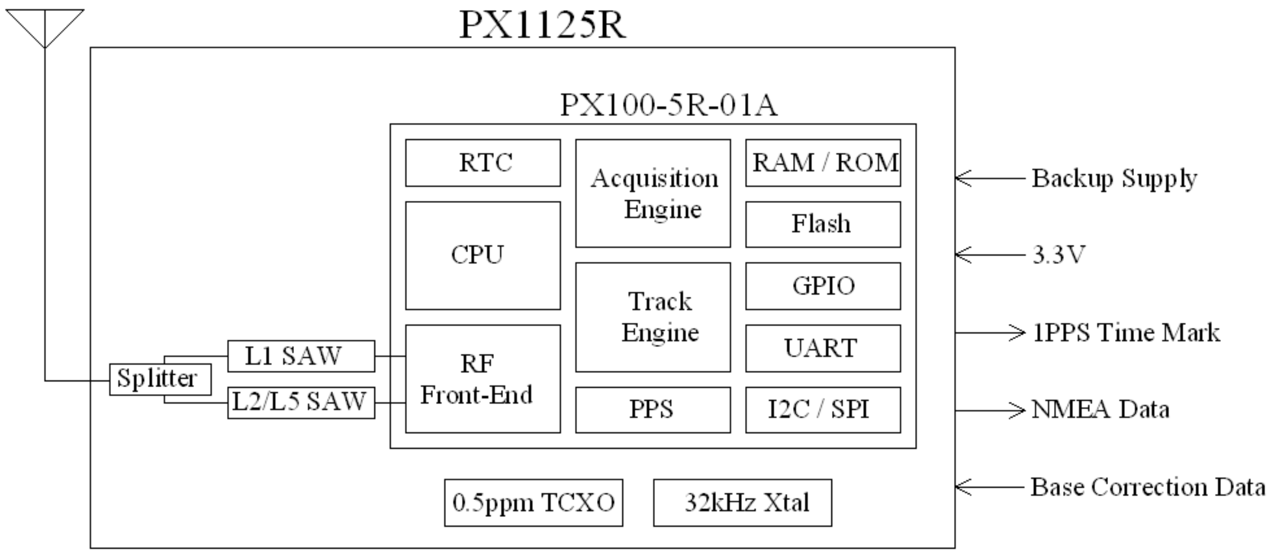
The receiver is optimized for mass market applications requiring high-precision centimeter-level accuracy, high-performance, low power, and lower cost.

TECHNICAL SPECIFICATIONS

Receiver Type	230 channel Phoenix GNSS engine GPS/QZSS L1/L5, Galileo E1/E5a, BDS B1I/B2a, NavIC L5, GLONASS L1
Accuracy	Position 1.5m CEP autonomous mode 1cm + 1ppm RTK mode Velocity 0.05m/sec*[1] Time 12ns Moving Base Heading 0.13 degree*[2]
Time to First Fix	1 second hot-start under open sky (average) 28 second warm-start under open sky (average) 29 second cold-start under open sky (average)
RTK Convergence	< 10sec
Reacquisition	1s
Max Update Rate	RTK 1 / 2 / 4 / 5 / 8 / 10 Hz Raw Measurement 1 / 2 / 4 / 5 / 8 / 10 / 20 Hz Moving Base RTK and Advance Moving Base RTK1 / 2 / 4 / 5 / 8 Hz RTK: for precise positioning. Moving-Base (MB) RTK for precise heading. Advanced Moving Base (AMB) RTK for precise positioning & heading.
Operational Limits	Altitude < 80,000m and velocity < 515m/s
Serial Interface	3.3V LVTTL level
Protocol	NMEA-0183 V4.1 GGA, GLL, GSA, GSV, RMC, VTG 115200 baud, 8, N, 1 RTCM 3.x or SkyTraq raw data binary 115200 baud, 8, N, 1
Datum	Default WGS-84 and user definable in stand-alone mode Depends on base reference frame when in RTK mode
Input Voltage	3.3V DC +/-10%
Current Consumption	115mA acquisition, 95mA tracking
Dimension	16.0mm L x 12.2mm W x 2.9mm H
Weight:	1.7g
Operating Temperature	-40°C ~ +85°C
Storage Temperature	-55 °C ~ +100°C
Humidity	5% ~ 95% non-condensing

*[1] 50% @ 30 m/s for dynamic operation
*[2] (1-sigma) heading accuracy using 1 meter baseline

FUNCTIONAL DESCRIPTION



Active antenna is required to use with PX1125R. The received signal goes through a signal splitter, to individual L1 and L2/L5 SAW filters to remove out-band interference, then to the PX100 GNSS receiver chip for RTK signal processing. Using correction data from an RTK base station, the rover PX1125R computes its position to centimeter-level accuracy relative to the base station.

SUPPORTED RTCM MESSAGES

When operating in rover mode, PX1125R can decode following RTCM 3.3 messages:

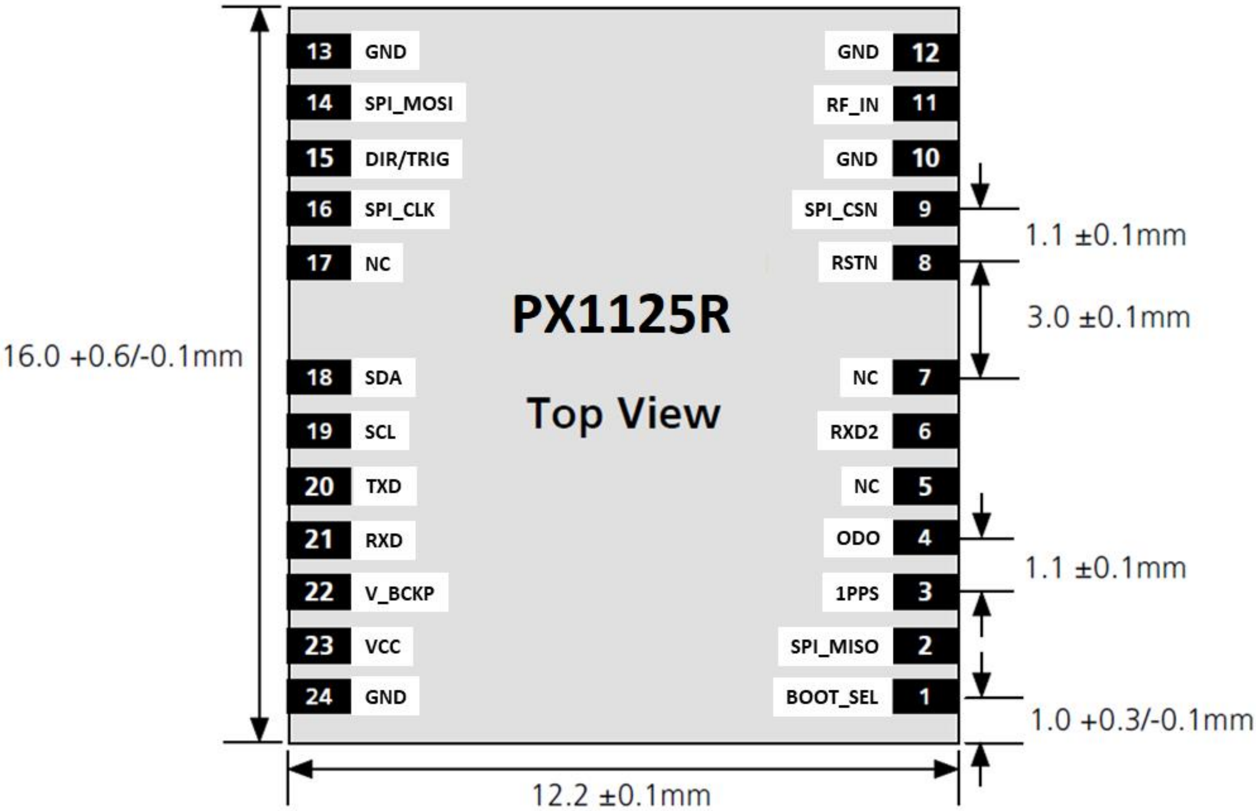
RTCM Message Type	Description
1005	Stationary RTK reference station antenna reference point
1006	Stationary RTK reference station ARP with antenna height
1033	Receiver and antenna description
1074	GPS MSM4
1075	GPS MSM5
1076	GPS MSM6
1077	GPS MSM7
1084	GLONASS MSM4
1085	GLONASS MSM5
1086	GLONASS MSM6
1087	GLONASS MSM7
1094	Galileo MSM4
1095	Galileo MSM5
1096	Galileo MSM6
1097	Galileo MSM7
1114	QZSS MSM4
1115	QZSS MSM5
1116	QZSS MSM6
1117	QZSS MSM7
1124	BeiDou MSM4

1125	BeiDou MSM5
1126	BeiDou MSM6
1127	BeiDou MSM7
1134	NavIC MSM4
1135	NavIC MSM5
1136	NavIC MSM6
1137	NavIC MSM7

When operating in base mode, PX1125R can output following RTCM 3.3 messages:

RTCM Message Type	Description
1005	Stationary RTK reference station antenna reference point
1074	GPS MSM4
1077	GPS MSM7
1084	GLONASS MSM4
1087	GLONASS MSM7
1094	Galileo MSM4
1097	Galileo MSM7
1114	QZSS MSM4
1117	QZSS MSM7
1124	BeiDou MSM4
1127	BeiDou MSM7
1134	NavIC MSM4
1137	NavIC MSM7

MECHANICAL CHARACTERISTICS



PINOUT DESCRIPTION

Pin No.	Name	Description
1	BOOT_SEL	No connection for normal use. Pull-low for loading firmware into empty or corrupted Flash memory from ROM mode.
2	SPI_MISO	Not used, leave unconnected
3	1PPS	One-pulse-per-second (1PPS) time mark output, 3.3V LV-TTL. The rising edge synchronized to UTC second when getting 3D position fix. The pulse duration is about 100msec at rate of 1 Hz.
4	ODO	External trigger input for generating STI,005 time stamp, 3.3V LV-TTL
5	NC	No connection, empty pin
6	RXD2	UART serial data input, 3.3V LVTTL. One simplex asynchronous serial UART port is implemented. This UART input is normally for sending RTCM-SC104 correction data or base station SkyTraq raw measurement data to the receiver at 115200 baud rate. In the idle condition, this pin should be driven HIGH. If the driving circuitry is powered independently of PX1125R, ensure that this pin is not driven to HIGH when PX1125R is put to sleep, or a 10K-ohm series resistor can be added to minimize leakage current.
7	NC	No connection, empty pin
8	RSTN	External active-low reset input to the baseband. Only needed when power supply rise time is very slow or software controlled reset is desired.
9	SPI_CSN	Not used, leave unconnected
10	GND	Ground

11	RF_IN	RF input with 3.3V active antenna bias voltage
12	GND	Ground
13	GND	Ground
14	SPI_MOSI	Not used, leave unconnected
15	DIR/TRIG	Not used, leave unconnected
16	SPI_CLK	Not used, leave unconnected
17	NC	No connection, empty pin
18	SDA	Not used, leave unconnected
19	SCL	Not used, leave unconnected
20	TXD	UART serial data output, 3.3V LVTTL. One full-duplex asynchronous serial UART port is implemented. This UART output is normally used for sending position, time and velocity information from the receiver in NMEA-0183 format. When idle, this pin output HIGH.
21	RXD	UART serial data input, 3.3V LVTTL. One full-duplex asynchronous serial UART port is implemented. This UART input is normally for sending commands or information to the receiver in SkyTraq binary protocol. In the idle condition, this pin should be driven HIGH. If the driving circuitry is powered independently of PX1125R, ensure that this pin is not driven to HIGH when PX1125R is put to sleep, or a 10K-ohm series resistor can be added to minimize leakage current.
22	V_BCKP	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.
23	VCC	Power supply, 3.3V DC
24	GND	Digital ground

ELECTRICAL SPECIFICATIONS

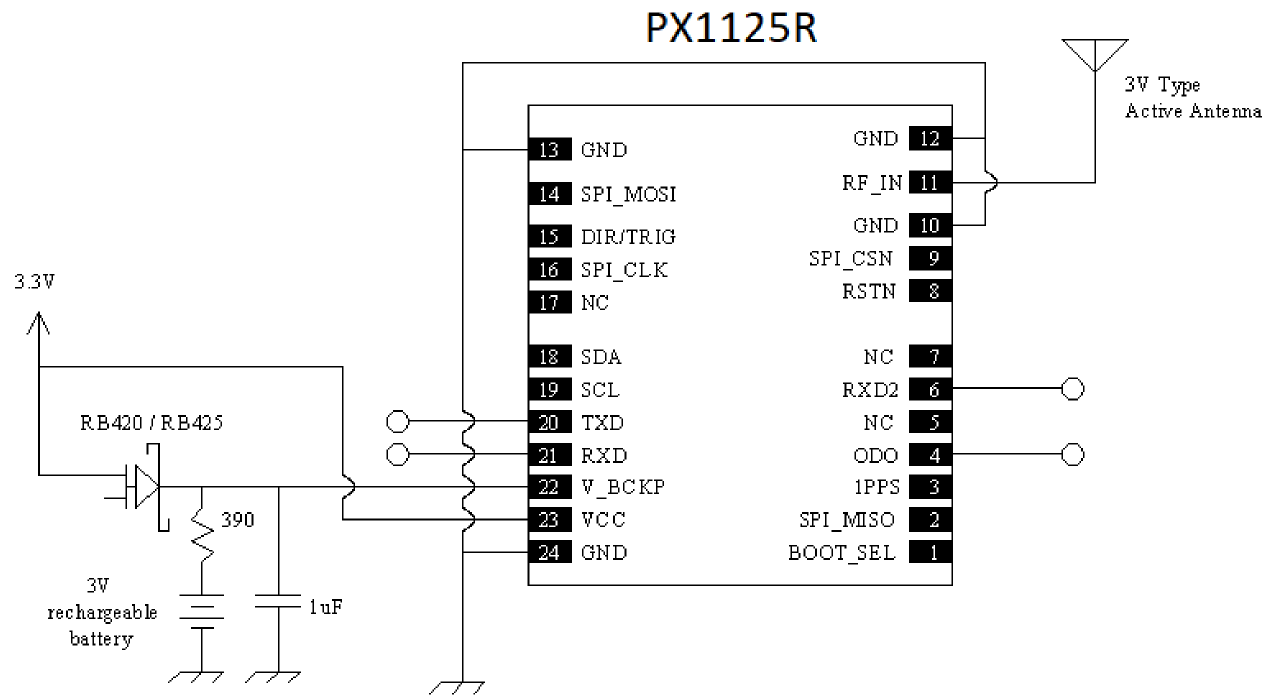
ABSOLUTE MAXIMUM RATINGS

Parameter	Minimum	Maximum	Condition
Supply Voltage (VCC)	-0.5	3.6	Volt
Backup Battery Voltage (V_BCKP)	-0.5	3.6	Volt
Input Pin Voltage	-0.5	VCC+0.5	Volt
Input Power at RF_IN		+5	dBm
Storage Temperature	-55	+100	degC

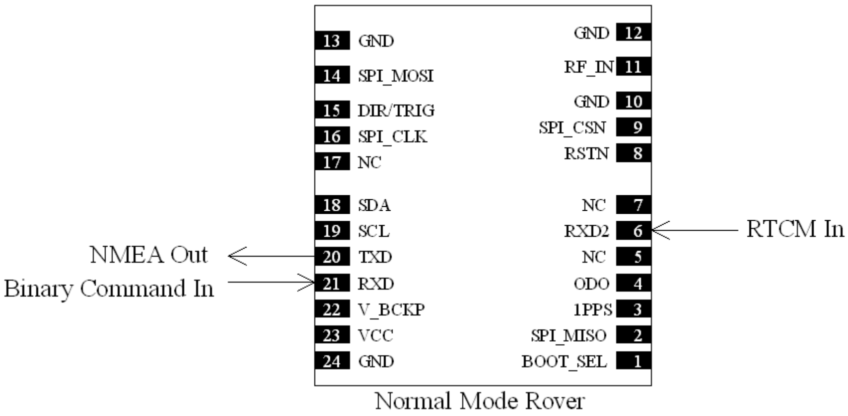
OPERATING CONDITIONS

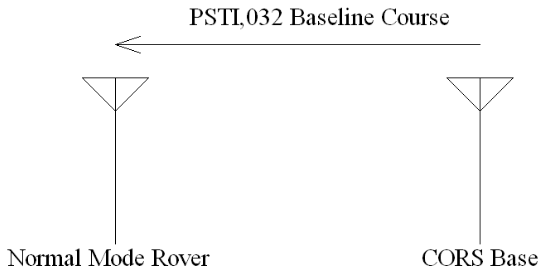
Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC)	3	3.3	3.6	Volt
Acquisition Current (exclude active antenna current)		115		mA
Tracking Current (exclude active antenna current)		95		mA
Backup Voltage (V_BCKP)	1.3		3.6	Volt
Backup Current (VCC voltage applied)		54		uA
Backup Current (VCC voltage off)		13		uA
Output Low Voltage			0.4	Volt
Output HIGH Voltage	2.4			Volt
Input LOW Voltage			0.8	Volt
Input HIGH Voltage	2			Volt
Input LOW Current	-10		10	uA
Input HIGH Current	-10		10	uA
RF Input Impedance (RF_IN)		50		Ohm

APPLICATION CIRCUIT

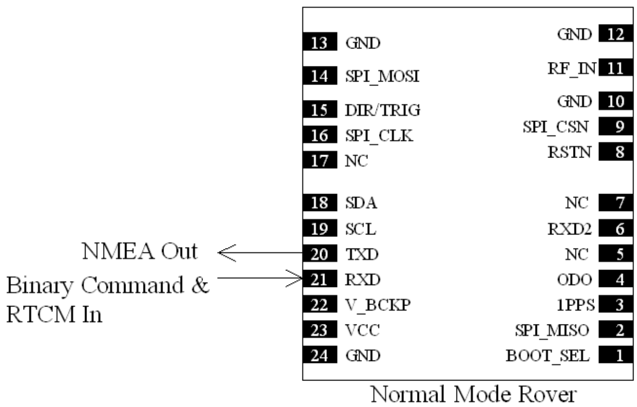


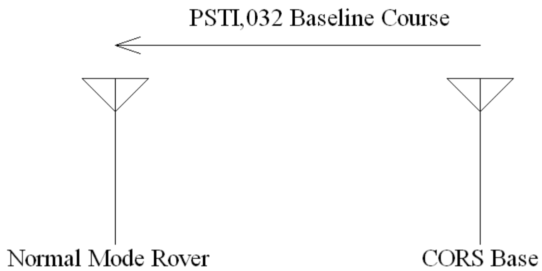
For Precise Positioning, Rover Mode Configuration 1



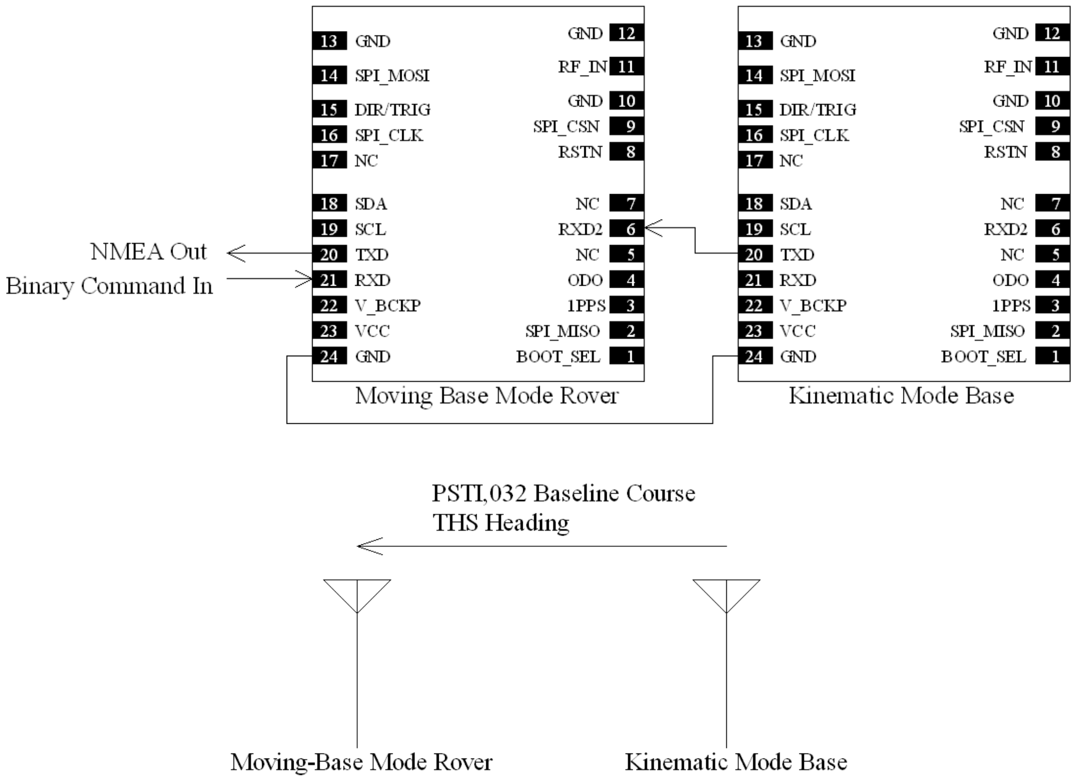


For Precise Positioning, Rover Mode Configuration 2

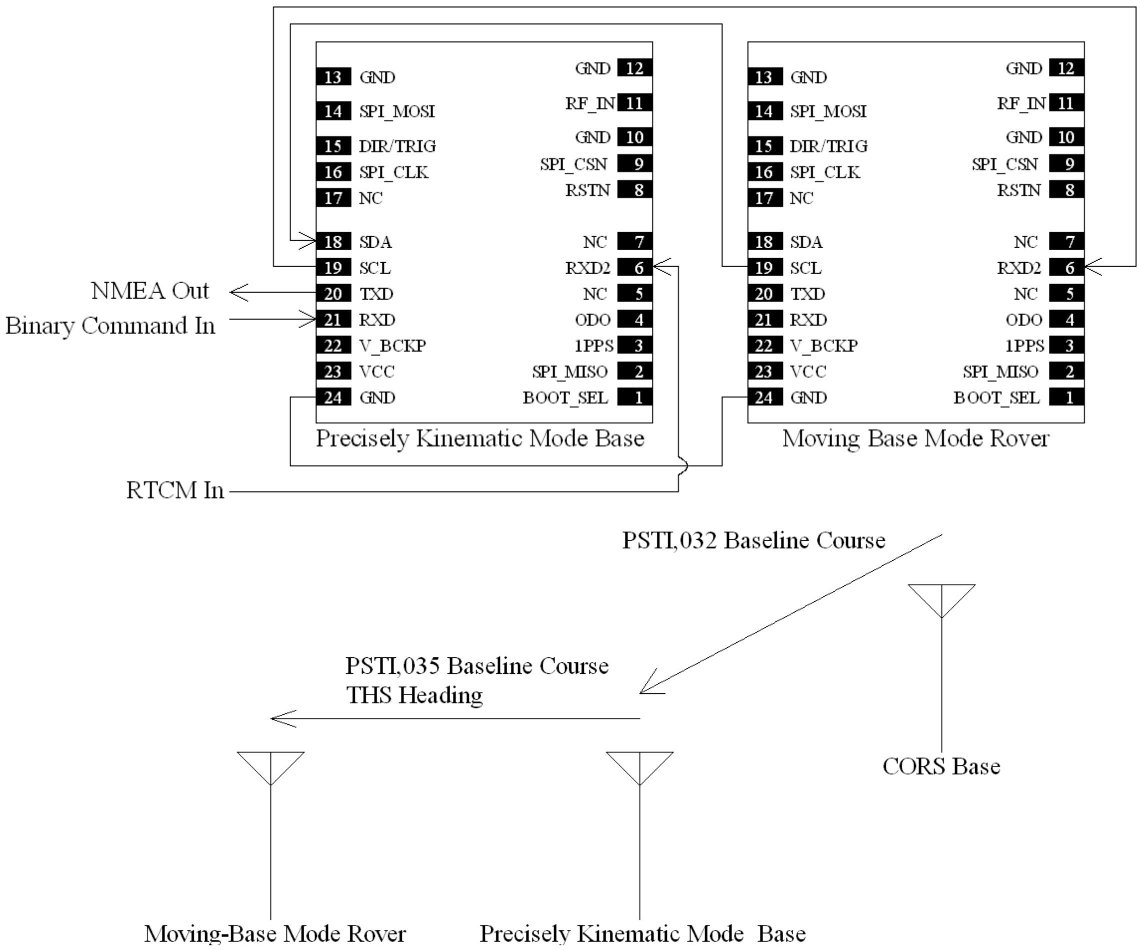




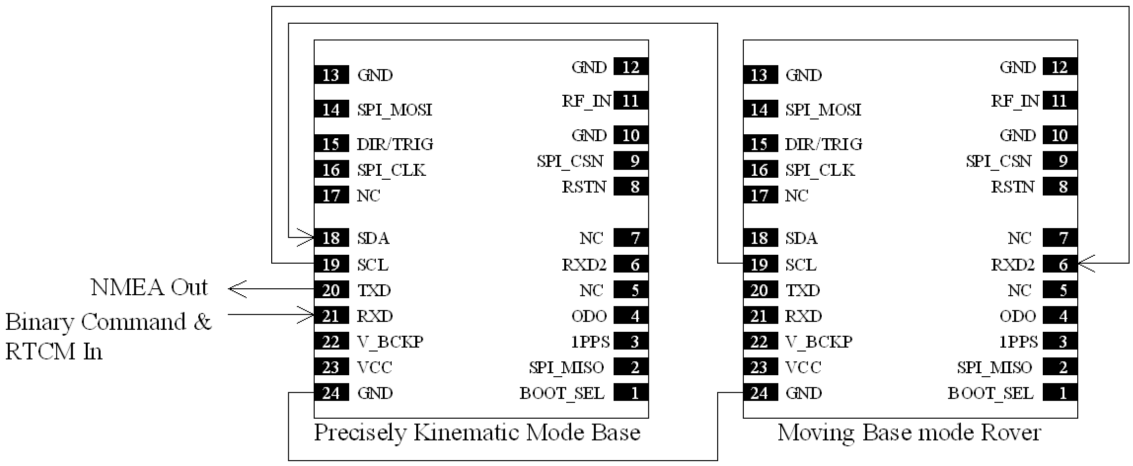
For Precise Heading, Moving Base Mode Configuration

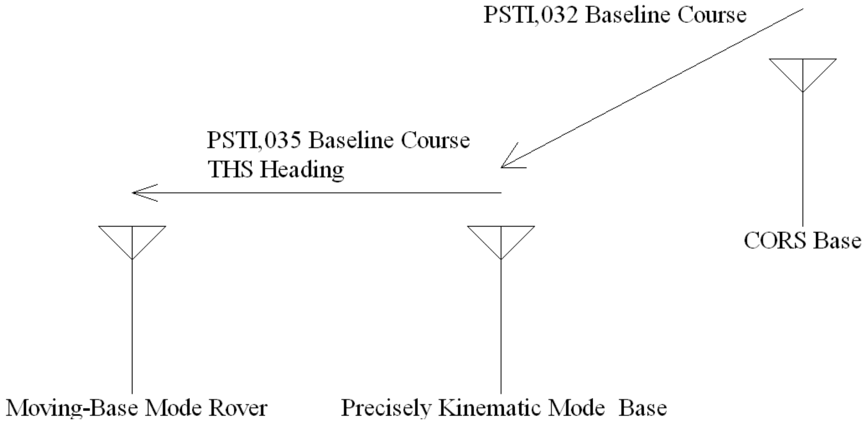


For Precise Positioning & Heading, Advanced Moving Base Mode Configuration #1

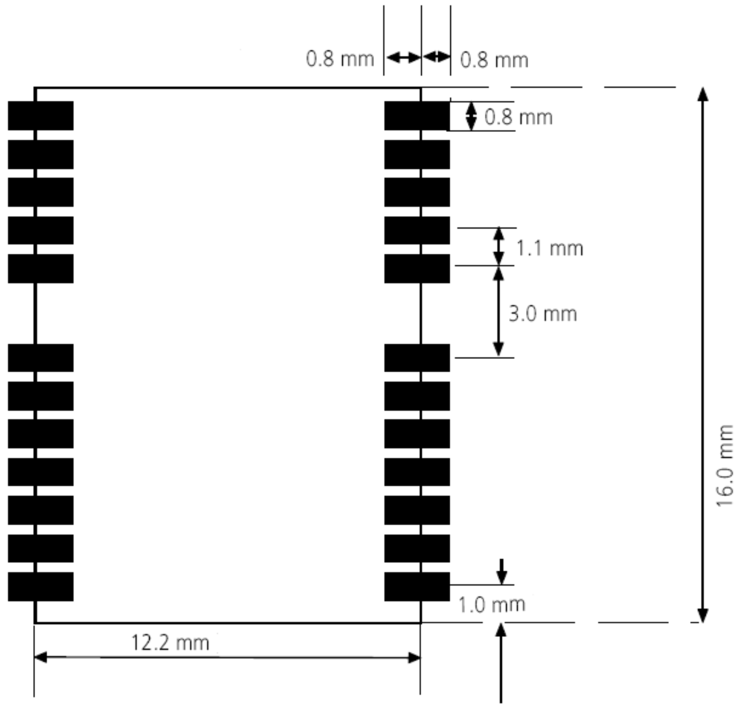


For Precise Positioning & Heading, Advanced Moving Base Mode Configuration #2

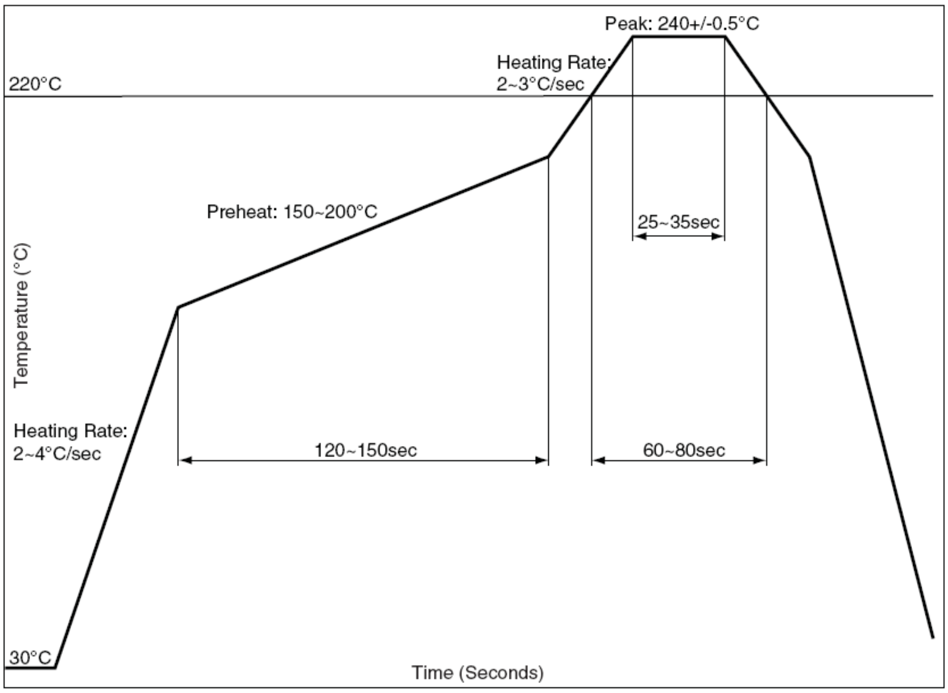




PRECOMMENDED LAYOUT PAD



RECOMMANDED REFLOW PROFILE



The reflow profile shown above should not be exceeded, since excessive temperatures or transport times during reflow can damage the module. Cooling temperature fall rate: max 3°C / sec

ANTENNA CONSIDERATIONS

The PX1125R is designed to be used with GPS L1/L5, Galileo E1/E5a, BDS B1I/B2a multi-frequency active antenna. Antenna with gain up to 40dB and noise figure less than 2dB can be used. It is important to select a high-performance antenna to achieve optimal RTK performance.

POWER SUPPLY REQUIREMENT

PX1125R requires a stable power supply, avoid ripple on VCC pin (<50mVpp). Power supply noise can affect the receiver's sensitivity. Bypass capacitors should be placed close to the module VCC pin, with values adjusted depending on the amount and type of noise present on the supply line.

BACKUP SUPPLY

The purpose of backup supply voltage pin (V_BCKP) is to keep the SRAM memory and the RTC powered when the module is powered down. This enables the module to have a faster time-to-first-fix when the module is powered on again. The backup current drain is less than 55µA. In normal powered on state, the internal processor access the SRAM and current drain is higher in active mode

1PPS OUTPUT

A 1 pulse per second signal (100msec HIGH duration) is generated on 1PPS pin when the receiver has 3D position fix using 4 or more satellites. The rising edge of the pulse is aligned with UTC second, with accuracy of about 10nsec. It outputs constant LOW when no position fix is available initially.

LAYOUT GUIDELINES

Separate RF and digital circuits into different PCB regions.

It is necessary to maintain 50-ohm impedance throughout the entire RF signal path. Try keeping the RF signal path as short as possible.

Do not route the RF signal line near noisy sources such as digital signals, oscillators, switching power supplies, or other RF transmitting circuit. Do not route the RF signal under or over any other components (including PX1125R), or other signal traces. Do not route the RF signal path on an inner layer of a multi-layer PCB to minimize signal loss.

Avoid sharp bends for RF signal path. Make two 45-deg bends or a circular bend instead of a single 90-degree bend if needed.

Avoid vias with RF signal path whenever possible. Every via adds inductive impedance. Vias are acceptable for connecting the RF grounds between different layers. Each of the module's ground pins should have short trace tying immediately to the ground plane below through a via.

The bypass capacitors should be low ESR ceramic types and located directly adjacent to the pin they are for.

HANDLING GUIDELINE

The PX1125R modules are rated MSL4, must be used for SMT reflow mounting within 72 hours after taken out from the vacuumed ESD-protective moisture barrier bag in factory condition < 30degC / 60% RH. If this floor life time is exceeded, or if the received ESD-protective moisture barrier bag is not in vacuumed state, then the device need to be pre-baked before SMT reflow process. Baking is to be done at 85degC for 8 to 12 hours. Once baked, floor life counting begins from 0, and has 72 hours of floor life at factory condition < 30degC / 60% RH.

PX1125R module is ESD sensitive device and should be handled with care.

RTK Usage Guideline

Below conditions are required for getting RTK fix solution. If the conditions are not met, PX1125R will only have float or DGPS/3D solution and behave like a normal GNSS receiver.

* Base and rover distance under 30Km
* Open sky environment without interference
* Signal over 37dB/Hz
* 8 or more satellites above 15 degree elevation angle with good satellite geometry or low DOP value; generally more satellites will have faster RTK fix

NMEA Output Description

The output protocol supports NMEA-0183 standard. The implemented messages include GGA, GLL, GSA, GSV, VTG, RMC, ZDA and GNS messages. The NMEA message output has the following sentence structure:

$aaccc,c–c*hh<CR><LF>

The detail of the sentence structure is explained in Table 1.

Table 1: The NMEA sentence structure

character	HEX	Description
"$"	24	Start of sentence.
Aaccc		Address field. "aa" is the talker identifier. "ccc" identifies the sentence type.
","	2C	Field delimiter.
C–c		Data sentence block.
"*"	2A	Checksum delimiter.
Hh		Checksum field.
<CR><LF>	0D0A	Ending of sentence. (carriage return, line feed)

Table 2: Overview of SkyTraq receiver's NMEA messages

$GPGGA	Time, position, and fix related data of the receiver.
$GNGLL	Position, time and fix status.
$GNGSA	Used to represent the ID's of satellites which are used for position fix. When GPS satellites are used for position fix, $GNGSA sentence is output with system ID 1. When GLONASS satellites are used for position fix, $GNGSA sentence is output with system ID 2. When Galileo satellites are used for position fix, $GNGSA sentence is output with system ID 3. When BDS satellites are used for position fix, $GNGSA sentence is output with system ID 4. When NAVIC satellites are used for position fix, $GNGSA sentence is output with system ID 6.
$GPGSV **$GLGSV** **$GAGSV** **$GBGSV** **$GIGSV**	Satellite information about elevation, azimuth and CNR, $GPGSV is used for GPS satellites, $GLGSV is used for GLONASS satellites, $GAGSV is used for GALILEO satellites, while $GBGSV is used for BDS satellites, while $GIGSV is used for NAVIC satellites
$GNRMC	Time, date, position, course and speed data.
$GNVTG	Course and speed relative to the ground.
$GNZDA	UTC, day, month and year and time zone.
$GNTHS	True Heading and Status.

The formats of the supported NMEA messages are described as follows:

GGA – Global Positioning System Fix Data

Time, position and fix related data for a GPS receiver.

Structure:

$GPGGA,hhmmss.sss,ddmm.mmmmmmm,a,dddmm.mmmmmmm,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12

Example:

$GPGGA,072120.000,2447.0913289,N,12100.5212111,E,4,27,0.5,94.715,M,19.600,M,2.000,0000*49<CR><LF>

Field	Name	Example	Description
1	UTC Time	072120.000	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
2	Latitude	2447.0913289	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
4	Longitude	12100.5212111	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
5	E/W Indicator	E	Longitude hemisphere indicator, 'E' = East, 'W' = West
6	GPS quality indicator	4	GPS quality indicator 0: position fix unavailable 1: valid position fix, SPS mode 2: valid position fix, differential GPS mode 3: GPS PPS Mode, fix valid 4: Real Time Kinematic. System used in RTK mode with fixed integers 5: Float RTK. Satellite system used in RTK mode., floating integers 6: Estimated (dead reckoning) Mode 7: Manual Input Mode 8: Simulator Mode
7	Satellites Used	27	Number of satellites in use, (00 ~ 12)
8	HDOP	0.5	Horizontal dilution of precision, (0.0 ~ 99.9)
9	Altitude	94.715	mean sea level (geoid), (-9999.9 ~ 17999.9)
10	Geoidal Separation	19.600	Geoidal separation in meters
11	Age pf Differential GPS data	2.000	Age of Differential NULL when not in RTK fix or RTK float
12	DGPS Station ID	0000	Differential reference station ID, 0000 ~ 1023
13	Checksum	49	

GLL – Latitude/Longitude

Latitude and longitude of current position, time, and status.

Structure:

$GNGLL,ddmm.mmmmmmm,a,dddmm.mmmmmmm,a,hhmmss.sss,A,a*hh<CR><LF>

1 2 3 4 5 6 7 8

Example:

$GNGLL,2447.0913289,N,12100.5212111,E,072120.000,A,D*4E<CR><LF>

Field	Name	Example	Description
1	Latitude	2447.0913289	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
2	N/S Indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
3	Longitude	12100.5212111	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
5	UTC Time	072120.000	UTC time in hhmmss.sss format (000000.000 ~ 235959.999)
6	Status	A	Status, 'A' = Data valid, 'V' = Data not valid
7	Mode Indicator	D	Mode indicator 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'S' = Simulator mode 'N' = Data not valid
8	Checksum	4E	

GSA – GNSS DOP and Active Satellites

GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA or GNS sentence and DOP values.

Structure:

```
$GNGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,x*hh<CR><LF>
         1 2 3  3 3  3  3 3  3 3  3 3  3  3 4   5   6 7  8
```

Example:

```
$GNGSA,A,3,02,05,06,12,13,19,20,193,195,199,,,1.0,0.5,0.9,1*01<CR><LF>
$GNGSA,A,3,03,05,09,36,,,,,,,,,1.0,0.5,0.9,3*34<CR><LF>
$GNGSA,A,3,06,07,08,09,10,19,22,29,35,38,39,40,1.0,0.5,0.9,4*38<CR><LF>
$GNGSA,A,3,44,,,,,,,,,,,,1.0,0.5,0.9,4*39<CR><LF>
$GNGSA,A,3,02,03,,,,,,,,,,,1.1,0.5,1.0,6*33<CR><LF>
```

Field	Name	Example	Description
1	Mode	A	Mode 'M' = Manual, forced to operate in 2D or 3D mode 'A' = Automatic, allowed to automatically switch 2D/3D
2	Mode	3	Fix type 1 = Fix not available 2 = 2D 3 = 3D
3	Satellite used 1~12	02,05,06,12,13,19,20,193,195,199	01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 197 are for QZSS; 65 ~ 88 are for GLONASS (GL PRN) ; 01 ~ 36 are for GALILEO (GA PRN); 01 ~ 37 are for BDS (BD PRN). GPS, GLONASS, GALILEO and BDS satellites are differentiated by the GNSS system ID in table 3. Maximally 12 satellites are included in each GSA sentence.
4	PDOP	1.0	Position dilution of precision (0.0 to 99.9)
5	HDOP	0.5	Horizontal dilution of precision (0.0 to 99.9)
6	VDOP	0.9	Vertical dilution of precision (0.0 to 99.9)
7	GNSS System ID	1	GNSS system ID* 1 = GPS 2 = GLONASS 3 = GALILEO 4 = BDS 5 = IRNSS
8	Checksum	01	

*GNSS System ID identifies the GNSS system ID according to Table 3.

*GNSS Signal ID identifies the GNSS signal name according to Table 3.

Table 3: GNSS Identification Table for GSA, GSV

System	System ID (Talker)	Signal ID	Signal Name
GPS	1 (GP)	0	All signals
		1	L1 C/A
		2	L1 P(Y)
		3	L1C
		4	L2 P(Y)
		5	L2C-M
		6	L2C-L
		7	L5-I
		8	L5-Q
GLONASS	2 (GL)	0	All signals
		1	G1 C/A
		2	G1P
		3	G2 C/A
		4	GLONASS (M) G2P
GALILEO	3 (GA)	0	All signals
		1	E5a
		2	E5b
		3	E5 a+b
		4	E6-A
		5	E6-BC
		6	L1-A
		7	L1-BC
BDS	4 (BD)	0	All signals
		1	B1
		5	B2A
		B	B2
		8	B3
		3	B1C
IRNSS	6 (GI)	0	All signals
		1	L5

GSV – GNSS Satellites in View

Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value. Four satellites maximum per transmission.

Structure:

```
$GPGSV,x,x,xx,xx,xx,xxx,xx,…,xx,xx,xxx,xx,x *hh<CR><LF>
        1 2 3 4 5   6 7    4  5  6  7 8   9
```

Example:

$GPGSV,3,1,11,195,73,125,46,193,71,078,46,199,60,166,41,02,56,002,46,1*59<CR><LF>
$GPGSV,3,2,11,11,54,011,45,20,53,298,47,06,46,061,45,05,40,268,45,1*6F<CR><LF>
$GPGSV,3,3,11,19,36,148,45,13,27,186,41,12,23,260,43,1*59<CR><LF>
$GPGSV,1,1,04,195,73,125,44,193,71,078,43,199,60,166,45,06,46,061,45,8*56<CR><LF>
$GAGSV,2,1,07,05,74,099,45,18,58,157,48,36,48,080,43,03,39,201,43,7*70<CR><LF>
$GAGSV,2,2,07,09,29,043,36,02,10,211,,11,07,112,,7*40<CR><LF>
$GAGSV,2,1,05,05,74,099,43,18,58,157,46,36,48,080,42,03,39,201,43,1*7D<CR><LF>
$GAGSV,2,2,05,09,29,043,37,1*41<CR><LF>
$GBGSV,4,1,13,35,78,358,50,22,60,245,50,19,58,025,48,38,53,351,46,1*75<CR><LF>
$GBGSV,4,2,13,08,49,356,41,29,43,129,47,06,36,170,42,40,35,211,44,1*74<CR><LF>
$GBGSV,4,3,13,10,35,224,43,39,31,181,44,07,28,198,42,44,25,322,40,1*7C<CR><LF>
$GBGSV,4,4,13,09,16,189,37,1*4E<CR><LF>
$GBGSV,2,1,08,35,78,358,43,22,60,245,45,19,58,025,44,38,53,351,42,5*73<CR><LF>
$GBGSV,2,2,08,29,43,129,42,40,35,211,41,39,31,181,40,44,25,322,36,5*7A<CR><LF>
$GIGSV,2,1,07,03,37,239,44,02,25,278,41,04,00,000,44,09,00,000,33,1*76<CR><LF>
$GIGSV,2,2,07,07,00,000,46,05,00,000,45,01,00,000,39,1*40<CR><LF>

Field	Name	Example	Description
1	Number of message	3	Total number of GSV messages to be transmitted (1-5)
2	Sequence number	1	Sequence number of current GSV message
3	Satellites in view	11	Total number of satellites in view (00 ~ 20)
4	Satellite ID	195	01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 197 are for QZSS; 65 ~ 88 are for GLONASS (GL PRN) ; 01 ~ 36 are for GALILEO (GA PRN); 01 ~ 37 are for BDS (BD PRN). GPS, GLONASS, GALILEO and BDS satellites are differentiated by the GNSS system ID in table 3. Maximally 4 satellites are included in each GSV sentence.
5	Elevation	73	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	125	Satellite azimuth angle in degrees, (000 ~ 359)
7	SNR	46	C/No in dB (00 ~ 99) Null when not tracking
8	Signal ID	1	Signal ID*
9	Checksum	59	

RMC – Recommended Minimum Specific GNSS Data
Time, date, position, course and speed data provided by a GNSS navigation receiver.

Structure:
$GPRMC,hhmmss.sss,A,dddmm.mmmmmmm,a,dddmm.mmmmmmm,a,x.x,x.x,ddmmyy,,,a,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 1011 12
Example:
$GNRMC,072120.000,A,2447.0913289,N,12100.5212111,E,000.0,000.0,050721,,,R,V*14<CR><LF>

Field	Name	Example	Description
1	UTC time	072120.000	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status ‘V’ = Navigation receiver warning ‘A’ = Data Valid
3	Latitude	2447.0913289	Latitude in dddmm.mmmmmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator ‘N’ = North ‘S’ = South
5	Longitude	12100.5212111	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
6	E/W Indicator	E	Longitude hemisphere indicator ‘E’ = East ‘W’ = West
7	Speed over ground	000.0	Speed over ground in knots (000.0 ~ 999.9)
8	Course over ground	000.0	Course over ground in degrees (000.0 ~ 359.9)
9	UTC Date	050721	UTC date of position fix, ddmmyy format
10	Mode indicator	R	Mode indicator ‘A’ = Autonomous mode ‘D’ = Differential mode ‘E’ = Estimated (dead reckoning) mode ‘F’ = Float RTK. Satellite system used in RTK mode, floating integers ‘M’ = Manual Input Mode ‘N’ = Data not valid ‘P’ = Precise ‘R’ = Real Time Kinematic. System used in RTK mode with fixed integers ‘S’ = Simulator Mode
11	Navigation status	V	Navigation status indicator according to IEC61108 requirement on ‘Navigational (or Failure) warnings and status indicators’. ‘S’ = Safe ‘C’ = Caution ‘U’ = Unsafe ‘V’ = Navigation status not valid, equipment is not providing navigation status indicator.
12	checksum	14	

VTG – Course Over Ground and Ground Speed
The actual course and speed relative to the ground.

Structure:
GPVTG,x.x,T,,M,x.x,N,x.x,K,a*hh<CR><LF>
1 2 3 4 5

Example:
$GNVTG,000.0,T,,M,000.0,N,000.0,K,D*16<CR><LF>

Field	Name	Example	Description
1	Course	000.0	True course over ground in degrees (000.0 ~ 359.9)
2	Speed	000.0	Speed over ground in knots (000.0 ~ 999.9)
3	Speed	000.0	Speed over ground in kilometers per hour (000.0 ~ 1800.0)
4	Mode	D	Mode indicator 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'N' = Data not valid 'P' = Precise 'S' = Simulator mode
5	Checksum	16	

ZDA – TIME AND DATE
UTC, day, month, year and local time zone

Structure:
$GPZDA,hhmmss.sss,xx,xx,xxxx,xx,xx*hh<CR><LF>
1 2 3 4 5 6 7

Example:
$GNZDA,072120.000,05,07,2021,00,00*4D<CR><LF>

Field	Name	Example	Description
1	UTC time	072120.000	UTC time in hhmmss.ss format (000000.00 ~ 235959.999)
2	UTC Day	05	UTC time: day (01 ~ 31)
3	UTC Month	07	UTC time: month (01 ~ 12)
4	UTC Year	2021	UTC time: year (4 digit format)
5	Local zone hour	00	Local zone hours (00 ~ +/- 13)
6	Local zone minutes	00	Local zone minutes (00 ~59)
7	Checksum	4D	Checksum

THS – True Heading and Status

Actual vessel heading in degrees True produced by any device or system producing true heading. This sentence includes a “Mode indicator” field providing critical safety related information about the heading data, and replaces the HDT sentence.

Structure:

$GPTHS, x.x,a*hh<CR><LF>

1 2 3

Example:

$GNTHS, 349.10.A*34<CR><LF>

Field	Name	Example	Description
1	Heading	349.10	Heading, degrees True
2	Mode	A	Mode indicator ‘A’ = Autonomous ‘E’ = Estimated (dead reckoning) ‘M’ = Manual input ‘S’ = Simulator ‘V’ = Data not valid
3	Checksum	34	Checksum

STI,005 – Time Stamp Output

An output message, ID 0x005, contains module pin-4 event-triggered time stamp. The trigger input should be spaced more than 1msec apart, not more than 10 triggers between update rate interval.

Structure:
$PSTI,005,hhmmss.sssssss,xx,xx,xxxx,,,,,*hh<CR><LF>
1 2 3 4 5 11

Example:
$PSTI,005,072120.0000003,05,07,2021,,,,,*33<CR><LF>

Field	Name	Example	Description
1	ID	005	Proprietary NMEA message identifier
2	UTC time	072120.0000003	Time-stamp UTC time in hhmmss.sssssss format (000000.0000000 ~ 235959.9999999)
3	UTC Day	05	Time-stamp UTC time: day (01 ~ 31)
4	UTC Month	07	Time-stamp UTC time: month (01 ~ 12)
5	UTC Year	2021	Time-stamp UTC time: year (4 digit format)
6	Reserved		
7	Reserved		
8	Reserved		
9	Reserved		
10	Reserved		
11	Checksum	33	Checksum

STI,030– Recommended Minimum 3D GNSS Data

Time, date, position, course and speed data provided by a GNSS navigation receiver.

Structure:

$PSTI,030,hhmmss.sss,A,dddmm.mmmmmmm,a,dddmm.mmmmmmm,a,x.x,x.x,x.x,x.x,ddmmyy,a.x.x,x.x*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Example:

$PSTI,030,072120.000,A,2447.0913289,N,12100.5212111,E,94.715,0.00,-0.00,0.02,050721,R,2.000,10.000*28 <CR><LF>

Field	Name	Example	Description
1	UTC time	072120.000	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.0913289	Latitude in dddmm.mmmmmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.5212111	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
6	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
7	Altitude	94.715	mean sea level (geoid), (-9999.999 ~ 17999.999)
8	East Velocity	0.00	'East' component of ENU velocity (m/s)
9	North Velocity	-0.00	'North' component of ENU velocity (m/s)
10	Up Velocity	0.02	'Up' component of ENU velocity (m/s)
11	UTC Date	050721	UTC date of position fix, ddmmyy format
12	Mode indicator	R	Mode indicator 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'F' = Float RTK. Satellite system used in RTK mode, floating integers 'M' = Manual input mode 'N' = Data not valid 'P' = Precise 'R' = Real Time Kinematic. System used in RTK mode with fixed integers 'S' = Simulator mode
13	RTK Age	2.000	Age of differential
14	RTK Ratio	10.000	AR ratio factor for validation
15	Checksum	28	

STI,032– RTK Baseline Data

Time, date, status and baseline related data provided by a GNSS navigation receiver.

Structure:

$PSTI,032,hhmmss.sss,ddmmyy,A,R,x.xxx,x.xxx,x.xxx,x.xxx,x.xx,,,,,*hh<CR><LF>

1 2 3 4 5 6 7 8 9

Example:

$PSTI,032,072120.000,050721,A,R,-1.821,9.457,0.634,9.651,349.10,,,,,*3A

Field	Name	Example	Description
1	UTC time	072120.000	UTC time in hhmmss.sss format (000000.000~235959.999)
2	UTC Date	050721	UTC date of position fix, ddmmyy format
3	Status	A	Status ‘V’ = Void ‘A’ = Active
4	Mode indicator	R	Mode indicator ‘F’ = Float RTK. System used in RTK mode with float ambiguity ‘R’ = Real Time Kinematic. System used in RTK mode with fixed ambiguity
5	East-projection of baseline	-1.821	East-projection of baseline, meters
6	North-projection of baseline	9.457	North-projection of baseline, meters
7	Up-projection of baseline	0.634	Up-projection of baseline, meters
8	Baseline length	9.651	Baseline length, meters
9	Baseline course	349.10	Baseline course (angle between baseline vector and north direction), degrees
10	Reserve		Reserve
11	Reserve		Reserve
12	Reserve		Reserve
13	Reserve		Reserve
14	Reserve		Reserve
15	Checksum	3A	

STI,033– RTK RAW Measurement Monitoring Data

Time, date, and raw measurement monitoring data provided by a GNSS navigation receiver.

Structure:

$PSTI,033,hhmmss.sss,ddmmyy,x,R,x,G,x,x,,,C,x,x,,,E,x,x,,,R,,,,,I,x,,,*hh <CR><LF>

1 2 3 4 56 78 11 16 21

Example:

$PSTI,033,072120.000,050721,2,R,0,G,0,0,,,C,0,0,,,E,0,0,,,R,,,,,I,0,,,*27

Field	Name	Example	Description
1	UTC time	072120.000	UTC time in hhmmss.sss format (000000.000~235959.999)
2	UTC Date	050721	UTC date of position fix, ddmmyy format
3	Version	2	
4	Receiver	R	R – Rover; B – Base
5	Number of total cycle-slipped raw measurements	0	Number of total cycle-slipped raw measurements, this statistic is only summed by the measurements which are valid for RTK
6	Designate system type	G	GPS
7	Number of cycle-slipped raw measurements of designate signal type of GPS L1	0	Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK
8	Number of cycle-slipped raw measurements of designate signal type of GPS L2	0	Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK
9	Reserve for GPS frequency band		Reserve
10	Reserve for GPS frequency band		Reserve
11	Designate system type	C	BDS
12	Number of cycle-slipped raw measurements of designate signal type of BDS B1	0	Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK
13	Number of cycle-slipped raw measurements of designate signal type of BDS B2	0	Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK
14	Reserve for BDS frequency band		Reserve
15	Reserve for BDS frequency band		Reserve
16	Designate system type	E	Galileo
17	Number of cycle-slipped raw measurements of designate signal type of Galileo E1	0	Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK
18	Number of cycle-slipped raw measurements of designate signal type of Galileo E5b	0	Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK
19	Reserve for Galileo frequency band		Reserve
20	Reserve for Galileo frequency band		Reserve
21	Designate system type	R	Glonass
22	Number of cycle-slipped raw measurements of designate signal type of Glonass G1		Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK
23	Number of cycle-slipped raw measurements of designate signal type of Glonass G2		Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK

24	Reserve for Glonass frequency band		Reserve
25	Reserve for Glonass frequency band		Reserve
26	Designate system type	I	NAVIC
27	Number of cycle-slipped raw measurements of designate signal type of NAVIC L5	0	Number of cycle-slipped raw measurements of designate signal type of all satellite type, this statistic is only summed by the measurements which are valid for RTK
28	Reserve		Reserve
29	Reserve		Reserve
20	Reserve		Reserve
31	Checksum	27	

STI,035 – RTK Baseline Data of Rover Moving Base Receiver

Time, date, status and baseline related data of GNSS rover moving base receiver provided by GNSS precisely kinematic base receiver.

Structure:

$PSTI,035,hhmmss.sss,ddmmyy,A,R,x.xxx,x.xxx,x.xxx,x.xxx,x.xx,,,,,*hh<CR><LF>

1 2 3 4 5 6 7 8 9

Example:

$PSTI,035,072120.000,050721,A,R,-1.821,9.457,0.634,9.651,349.10,,,,,*3D

Field	Name	Example	Description
1	UTC time	072120.000	UTC time in hhmmss.sss format (000000.000~235959.999)
2	UTC Date	050721	UTC date of position fix, ddmmyy format
3	Status	A	Status 'V' = Void 'A' = Active
4	Mode indicator	R	Mode indicator 'F' = Float RTK. System used in RTK mode with float ambiguity 'R' = Real Time Kinematic. System used in RTK mode with fixed ambiguity
5	East-projection of baseline	-1.821	East-projection of baseline, meters
6	North-projection of baseline	9.457	North-projection of baseline, meters
7	Up-projection of baseline	0.634	Up-projection of baseline, meters
8	Baseline length	9.651	Baseline length, meters
9	Baseline course	349.10	Baseline course (angle between baseline vector and north direction), degrees
10	Reserve		Reserve
11	Reserve		Reserve
12	Reserve		Reserve
13	Reserve		Reserve
14	Reserve		Reserve
15	Checksum	3D	

ORDERING INFORMATION

Model Name	Description
PX1125R	L1/L5 GNSS RTK Receiver Module GPS/QZSS L1/L5 + Galileo E1/E5a + Beidou B1I/B2a + NavIC L5 signal reception
PX1125R-01	L1/L5 GNSS RTK Receiver Module GPS/QZSS L1/L5 + Galileo E1/E5a + Beidou B1I/B2a + GLONASS L1 signal reception

Revision History

Revision	Date	Description
1	July 5, 2021	Initial release
2	July 21, 2022	Added L5 NavIC support
3	Sep. 1, 2023	Added Ordering Information options