

PX1120DP



Concurrent Quad-GNSS Dead Reckoning Receiver

Features

- 3-axis accelerometer & gyroscope
- Barometric pressure sensor altitude sensing
- 100% coverage
- Continuous position fix in tunnels
- Automatic sensor calibration
- 230 Channel receiver
- GPS/GLONASS/Galileo/Beidou/QZSS receiver
- Perform 16 million time-frequency hypothesis testing per second
- Open sky hot start 1 sec
- Open sky cold start 29 sec
- Accuracy 2.5m CEP
- Operating temperature -40 ~ +85°C
- RoHS compliant

Applications

- Automotive Navigation

The PX1120DP GNSS Dead-Reckoning receiver module combines GNSS position data, gyroscope data (measuring turning angle), and optional odometer data (measuring distance traveled) to formulate position solution. This enables accurate navigation solution in poor signal environment or signal blocked area such as inside tunnels. The PX1120DP is ideal for 4-wheel vehicle applications requiring accurate continuous navigation with 100% availability.

PX1120DP can operate in Automotive Dead Reckoning (**ADR**) mode if the vehicle wheel-tick odometer signal is connected; or operate in Odometer-less Dead Reckoning (**ODR**) mode if the odometer signal is not connected. The barometric pressure sensor provides superior performance differentiating floor levels in stacked highway and multi-story parking garage.

The Extended Kalman Filter algorithm combines GNSS and sensor data with weighting function dependent on GNSS signal quality. In poor signal reception area and multipath environment, the position error is reduced by dead reckoning.

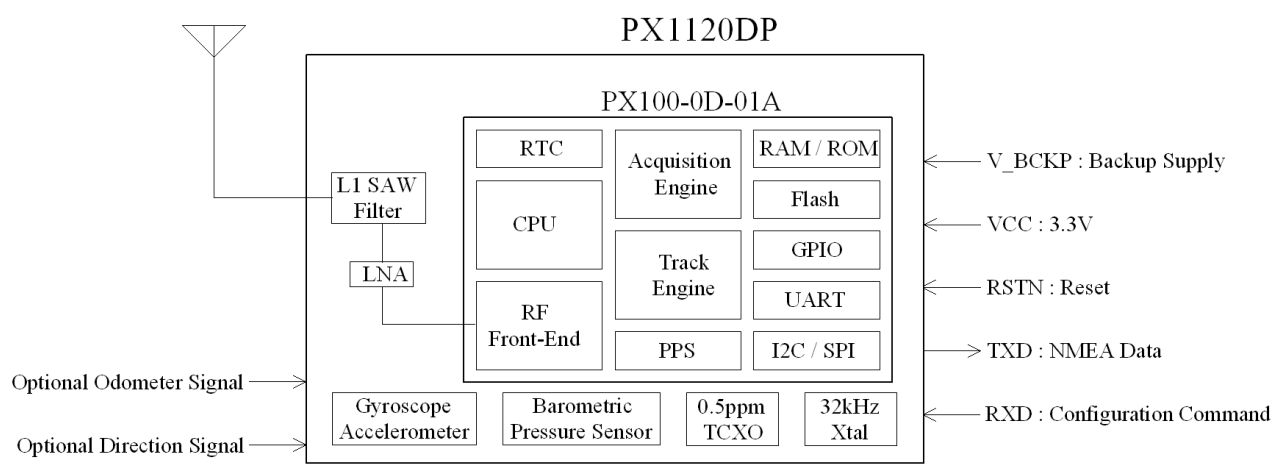
The PX1120DP with dead-reckoning feature, position is output as soon as power is applied to the module without the need of getting GPS/GNSS position fix.

The receiver is suitable for navigation and tracking systems that require high performance continuous positioning and velocity data.

TECHNICAL SPECIFICATIONS

Receiver Type	230-channel PHOENIX engine Concurrent GPS / GLONASS / Galileo / Beidou / QZSS / SBAS receiver		
Accuracy	Position	1.5m CEP	
	Velocity	0.1m/sec	
	Time	10ns	
Startup Time	1 second hot start under open sky 28 second warm-start under open sky (average) 29 second cold-start under open sky (average)		
Reacquisition	1s		
Sensitivity	-148dBm cold start -165dBm tracking		
Update Rate	1 / 2 / 4 / 8 / 10 Hz		
Operational Limits	Altitude < 18,000m and velocity < 515m/s		
Serial Interface	3.3V LVTTTL level		
Protocol	NMEA-0183 V4.1,	SkyTraq binary,	115200 baud, 8, N, 1
Datum	Default WGS-84 User definable		
Input Voltage	3.3V +/- 10%		
Input Current	Acquisition 85mA @ 3.3V, Tracking 75mA @ 3.3V		
Dimension	16.0mm L x 12.2mm W x 2.9mm H		
Weight:	2g		
Operating Temperature	-40°C ~ +85°C		
Storage Temperature	-55 ~ +100°C		
Humidity	5% ~ 95%		

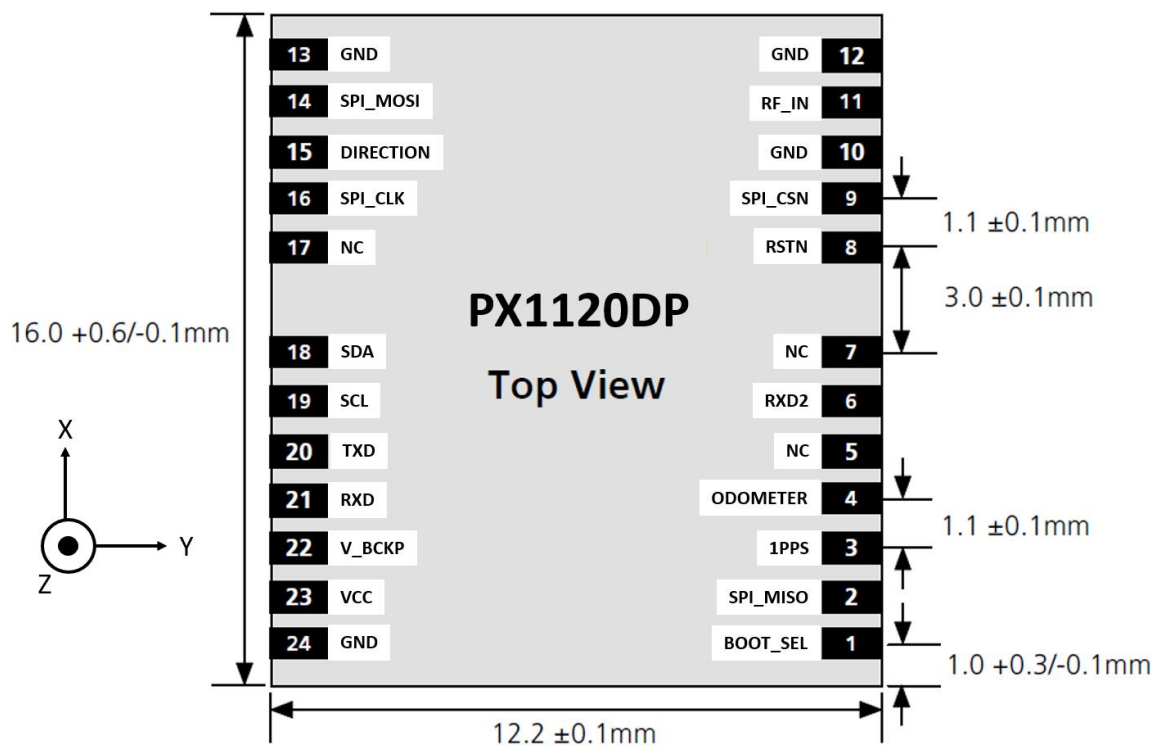
BLOCK DIAGRAM



Module block schematic

INTERFACE

PX1120DP

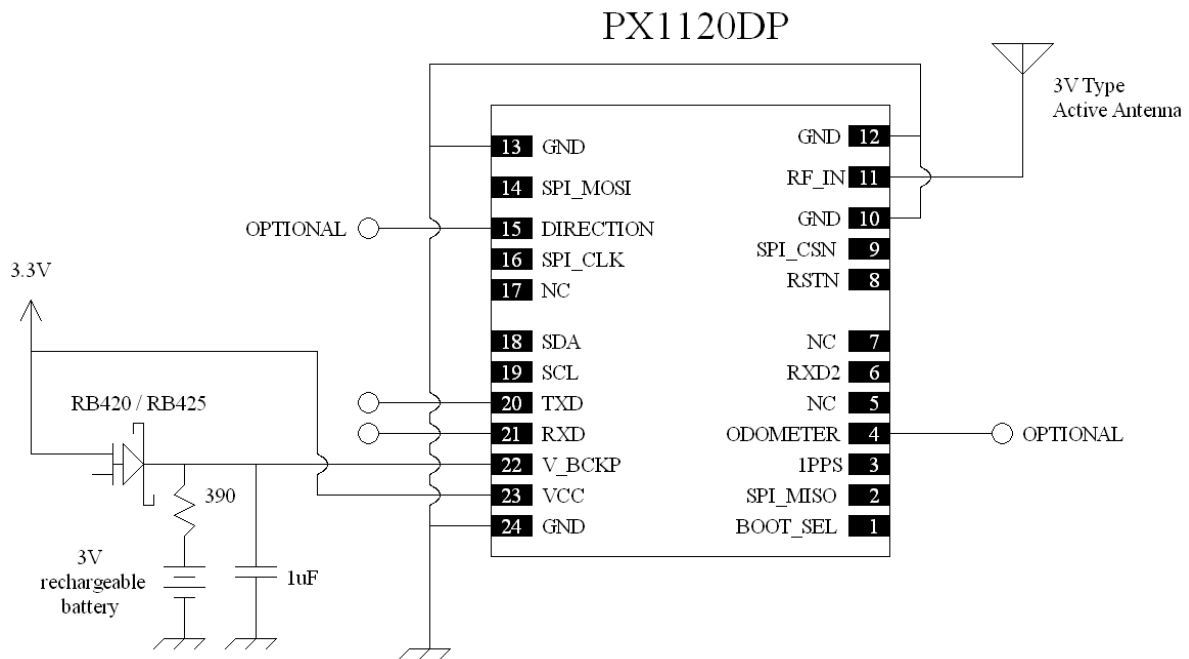


PINOUT DESCRIPTION

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	No connection for normal use.
3	1PPS	One-pulse-per-second (1PPS) time mark output, 3V LVTTTL. The rising edge synchronized to UTC second when getting 3D position fix. The pulse duration is 100msec at rate of 1 Hz.
4	ODOMETER	Optional car speed pulse input, frequency < 4kHz.
5	NC	No connection
6	RXD2	No connection for normal use.
7	NC	No connection
8	RSTN	External reset (active low). Can be left unconnected if unused.
9	SPI_CSN	No connection for normal use.
10	GND	Ground
11	RF_IN	RF input with 3.3V active antenna bias voltage
12	GND	Ground
13	GND	Ground
14	SPI_MOSI	No connection for normal use.

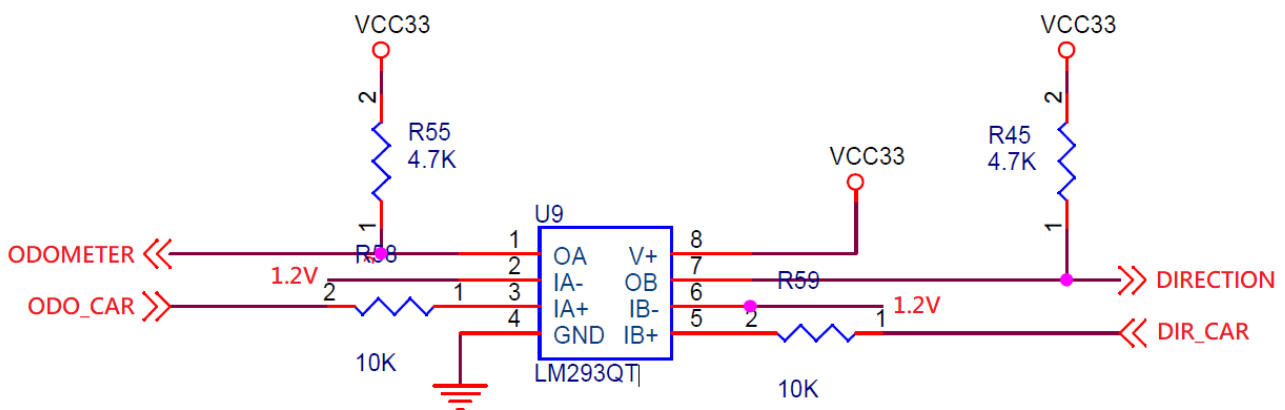
15	DIRECTION	Optional forward (LOW) or reverse direction (HIGH) input from vehicle.
16	SPI_CLK	No connection for normal use.
17	NC	No connection
18	SDA	No connection for normal use.
19	SCL	No connection for normal use.
20	TXD	1 st UART serial data output, 3.3V LVTTTL. This UART output is normally used for sending position, time and velocity information from the receiver in NMEA-0183 format. When idle, this pin output HIGH.
21	RXD	1 st UART serial data input, 3.3V LVTTTL. 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 PX1120DP, ensure that this pin is not driven to HIGH when primary power to PX1120DP is removed.
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 and for keeping DR calibration data. If VCC and V_BCKP are both removed, the receiver will be in factory default mode upon power up, all user configuration and calibrated DR parameters are lost.
23	VCC	Main 3.3V DC supply input
24	GND	Digital ground

APPLICATION CIRCUIT



Automotive Dead-Reckoning (ADR)

For ADR type of application where vehicle odometer wheel-tick pulse signal is available, connect pin-4 ODOMETER to the wheel-tick signal through appropriate level shifter such that the wheel-tick signal level is within range of LVTTTL (0V ~ 3.3V). Similarly connect pin-15 DIRECTION to the vehicle forward/reverse signal. For ADR applications that has no forward/reverse indication signal, simply ground the DIRECTION input. Below is a level shifter example circuitry.

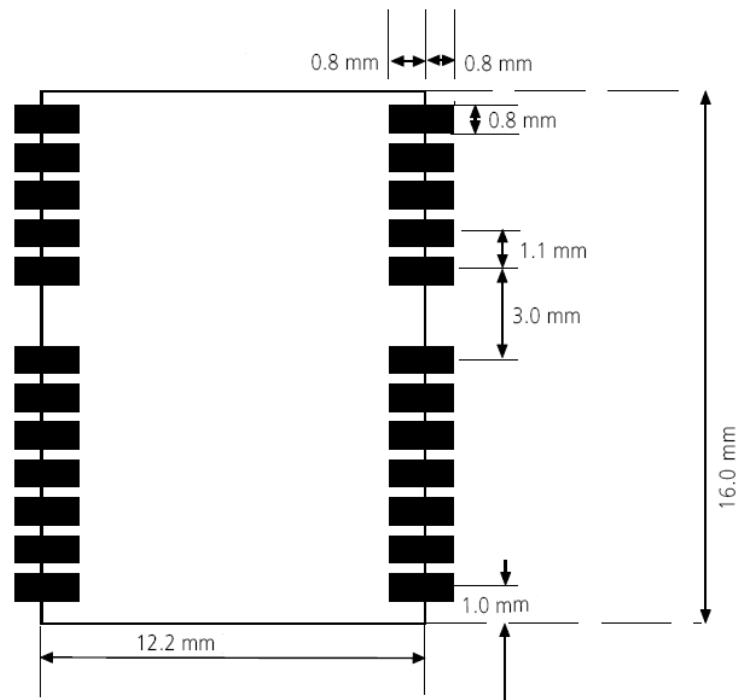


Odometer-less Dead-Reckoning (ODR)

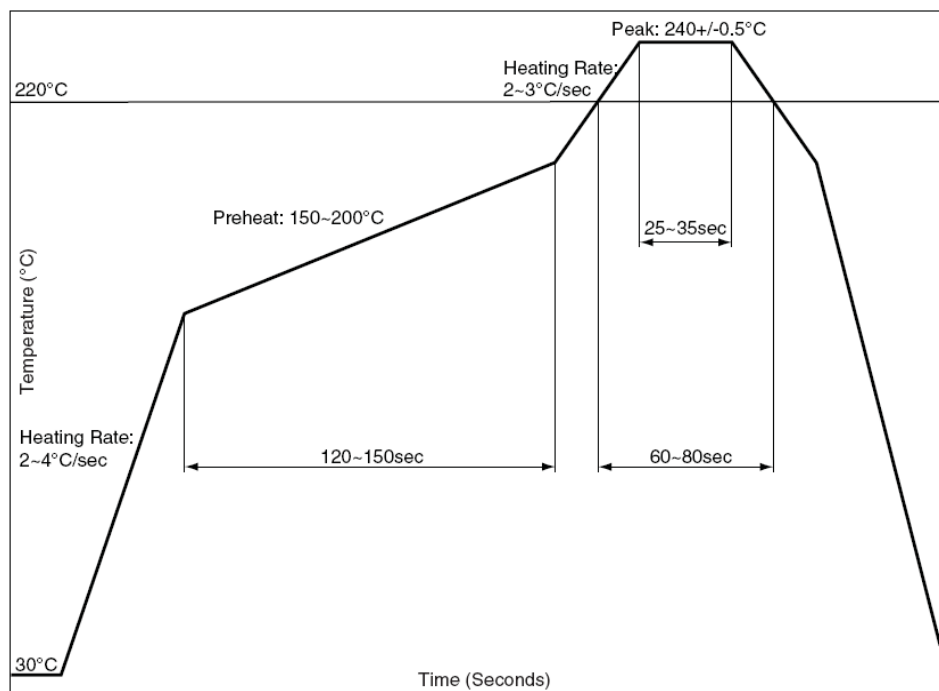
If the vehicle odometer wheel-tick pulse signal is not available, then PX1120DP can operate in odometer-less dead-reckoning mode without the need of external connection to ODOMETER and DIRECTION pins.

When changing between ADR and ODR mode of operation, cold start command should be issued, or the V_BCKP power should be removed such that internal DR state will be cleared and PX1120DP will re-do DR calibration.

RECOMMENDED FOOTPRINT



RECOMMENDED 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

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)	3.0	3.3	3.6	Volt
Supply Current (exclude active antenna current)		85		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

POWER SUPPLY REQUIREMENT

PX1120DP requires a stable power supply, avoid ripple on VCC pin ($<50\text{mVpp}$). 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. DR calibration data is also kept in this SRAM. If V_BCKP is not maintained when main power is removed, the receiver will need to go through auto calibration process before DR could take effect every time it's powered on. The backup current drain is less than $35\mu\text{A}$. In normal powered on state, the internal processor access the SRAM and current drain is higher in active mode

ANTENNA CONSIDERATION

3.3V GPS/GLONASS/Galileo/Beidou active antenna with 10dB ~ 20dB gain and noise figure less than 1.5dB can be used with PX1120DP.

Antenna Type	Active
L1 GNSS Frequency (MHz)	1558 ~ 1606
VSWR	< 2 (typical)
Polarization	RHCP
Antenna Gain	$> -2\text{dBi}$
LNA Gain	17dB (typical)
Noise Figure	$< 1.5\text{dB}$
Total Gain	$> 15\text{dB}$

CALIBRATION of DR

PX1120DP performs calibration of gyro bias and odometer scale automatically using GNSS. Customer is not required to perform calibration at installation.

For product testing or benchmarking, the following procedure steps can achieve efficient calibration quickly after a short period of time:

1. Find a open sky place.
2. Start PX1120DP and stand still for 60 seconds until position fix is achieved.
3. Drive straight for 500m at speed of at least 40km/hr.
4. For next 3 minutes, drive straight and make at least 360-deg turns (either two 90-degrees left turns and right turns, or four left turns, or four right turns) then drive straight for at least another 300m.

NMEA Output Description

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

\$aacc,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.
Aacc		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 GPS 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.
\$GPGSV \$GLGSV \$GAGSV \$GBGSV	Satellite information about elevation, azimuth and CNR, \$GPGSV is used for GPS satellites, while \$GLGSV is used for GLONASS satellites, while \$GAGSV is used for GALILEO satellites, while \$GBGSV is used for BEIDOU 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.

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.mmmmm,a,ddmm.mmmmm,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 13

Example:

\$GNGGA,052315.000,2447.09094,N,12100.52369,E,2,12,0.6,97.9,M,19.6,M,,0000*6B<CR><LF>

Field	Name	Example	Description
1	UTC Time	025315.000	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
2	Latitude	2447.09094	Latitude in ddmm.mmmm mformat Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
4	Longitude	12100.52369	Longitude in dddmm.mmmmm format Leading zeros transmitted
5	E/W Indicator	E	Longitude hemisphere indicator, 'E' = East, 'W' = West
6	Quality Indicator	2	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	12	Number of satellites in use, (00 ~ 12)
8	HDOP	0.6	Horizontal dilution of precision, (0.0 ~ 99.9)
9	Altitude	97.9	mean sea level (geoid), (-9999.9 ~ 17999.9)
10	Geoidal Separation	19.6	Geoidal separation in meters
11	Age pf Differential GPS data		Age of Differential GPS data NULL when DGPS not used
12	DGPS Station ID	0000	Differential reference station ID, 0000 ~ 1023
13	Checksum	6B	

GLL – Latitude/Longitude

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

Structure:

\$GNGLL,ddmm.mmmmm,a,ddmm.mmmmm,a,hhmmss.sss,A,a*hh<CR><LF>

1 2 3 4 5 6 7 8

Example:

\$GNGLL,2447.09094,N, 12100.52369,E, 052315.000,A,D*4A<CR><LF>

Field	Name	Example	Description
1	Latitude	2447.09094	Latitude in ddmm.mmmmm format Leading zeros transmitted
2	N/S Indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
3	Longitude	12100.52369	Longitude in dddmm.mmmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
5	UTC Time	052315.000	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	4A	

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,x.x,x.x,x.x,x*hh<CR><LF>
1 2 3 3 3 3 3 3 3 3 3 3 3 4 5 6 7 8

Example:

\$GNGSA,A,3,10,12,14,20,21,24,25,31,32,193,,,1.1,0.6,0.9,1*01<CR><LF>
\$GNGSA,A,3,69,70,73,79,80,,,,,,,,1.1,0.6,0.9,2*3C<CR><LF>
\$GNGSA,A,3,01,02,03,06,09,10,14,16,21,22,26,,1.1,0.6,0.9,4<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	10, 12, 14, 20, 21, 24, 25, 31, 32, 193	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	1.1	Position dilution of precision (0.0 to 99.9)
5	HDOP	0.6	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.

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
BDS	4 (BD)	7	L1-BC
		0	All signals
		1	B1
		5	B2A
		B	B2
		8	B3
IRNSS	6 (GI)	3	B1C
		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,4,1,15,10,79,250,50,194,73,072,,193,69,127,45,25,64,114,46,1*67<CR><LF>
$GPGSV,4,2,15,20,54,175,45,32,44,334,46,41,39,242,43,12,36,055,46,1*68<CR><LF>
$GPGSV,4,3,15,31,32,256,45,14,25,310,39,24,15,049,38,21,07,191,35,1*61<CR><LF>
$GPGSV,4,4,15,15,04,106,18,29,03,144,,26,01,206,,1*56<CR><LF>
$GLGSV,2,1,06,80,77,332,44,69,55,098,49,70,46,347,43,73,29,221,45,1*79<CR><LF>
$GLGSV,2,2,06,79,25,026,42,71,01,325,,1*76<CR><LF>
$GBGSV,3,1,12,21,77,107,50,26,73,278,49,06,59,009,45,03,58,203,43,1*7D<CR><LF>
$GBGSV,3,2,12,16,58,002,47,07,55,180,,01,53,142,43,09,47,329,43,1*73<CR><LF>
$GBGSV,3,3,12,02,40,241,39,10,31,200,40,22,25,134,41,14,19,321,41,1*77<CR><LF>
```

Field	Name	Example	Description
1	Number of message	4	Total number of GSV messages to be transmitted (1-5)
2	Sequence number	1	Sequence number of current GSV message
3	Satellites in view	15	Total number of satellites in view (00 ~ 20)
4	Satellite ID	10	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	79	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	250	Satellite azimuth angle in degrees, (000 ~ 359)
7	SNR	50	C/No in dB (00 ~ 99) Null when not tracking
8	GNSS System ID	1	Signal ID*
9	Checksum	67	

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

RMC – Recommended Minimum Specific GNSS Data

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

Structure:

\$GNRMC,hhmmss.sss,A,dddmm.mmmmm,a,dddmm.mmmmm,a,x.x,x.x,ddmmyy,,,a,a*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 101112

Example:

\$GNRMC,052315.000,A,2447.09094,N,12100.52369,E,000.0,169.9,261219,,,D,V*0F<CR><LF>

Field	Name	Example	Description
1	UTC time	052315.000	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.09094	Latitude in dddmm.mmmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.52369	Longitude in dddmm.mmmmm 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	169.9	Course over ground in degrees (000.0 ~ 359.9)
9	UTC Date	261219	UTC date of position fix, ddmmyy format
10	Mode indicator	D	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		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	0F	

VTG – Course Over Ground and Ground Speed

The actual course and speed relative to the ground.

Structure:

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

Example:

\$GNVTG,169.9,T,,M,000.0,N,000.0,K,D*11<CR><LF>

Field	Name	Example	Description
1	Course	169.9	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	11	

ZDA – TIME AND DATE

UTC, day, month, year and local time zone

Structure:

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

Example:

\$GNZDA,052315.000,26,12,2019,00,00*45<CR><LF>

Field	Name	Example	Units	Description
1	UTC time	052315.000		UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	UTC Day	26		UTC time: day (01 ~ 31)
3	UTC Month	12		UTC time: month (01 ~ 12)
4	UTC Year	209		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	45		Checksum

STI,20 – Dead Reckoning Status message

Structure:

PSTI,xx,x,x,x,xx,x,x,x,xxx.xx,xx.xx,xx.xx,x.xx*xx<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13

Example:

\$PSTI,20,1,1,1,32,A,0,1,821.95,20.73,-13.45,6.63*40<CR><LF>

Field No.	Example	Format	Unit	Description
1	20	numeric	-	Proprietary message identifier: 20
2	1	numeric	-	DR Calibration Status 1: calibrated 0: not calibrated
3	1	numeric	-	Gyro Calibrate Status 1: calibrated 0: not calibrated
4	1	numeric	-	Sensor input available 1: available 0: not available
5	32	numeric	Pulse	ADR: odometer pulse count ODR: 0
6	A	character	-	Position Mode indicator: A=GPS fix, N = Data not valid, E = Estimated(dead reckoning) mode
7	0	numeric	-	Backward Status ADR 1: activated, moving backward 0: normal, moving forward ODR 0
8	1	numeric	-	Antenna detection (Reserved) 1: antenna available 0: antenna not available
9	821.95	numeric	0.002V	Z-axis gyro bias
10	20.73	numeric	cm/pulse	ADR: odometer scaling factor ODR: 100
11	-13.45	numeric	Deg/sec	Z-axis rotation rate
12	6.63	numeric	m	ADR: distance moved per second ODR: 0
13	40	hexadecimal	-	Checksum

Additional Messages (default disabled)

PSTI,060 – Attitude Information Message (Optional)

Structure:

PSTI,xx,x,x,x,x,x,x,x,X,,,,,,,,,*xx<CR><LF>
1 2 3 4 5 6 7 14 15

Example:

\$PSTI,060,1,V,1.3,-3.2,76.3,,,,,,,,*7F<CR><LF>

Field No.	Example	Format	Unit	Description
1	060	numeric	-	Proprietary message identifier: 060
2	1	numeric	-	Attitude Status 1: Valid 0: Not valid
3	V	character	-	Vehicle Frame
4	1.3	numeric	Degree	Vehicle Roll, range -180.0 ~ 180.0
5	-3.2	numeric	Degree	Vehicle Pitch, range -90.0 ~ 90.0
6	76.3	numeric	Degree	Vehicle Heading 0.0 ~ 360.0
7				Reserved
8				Reserved
9				Reserved
10				Reserved
11				Reserved
12				Reserved
13				Reserved
14				Reserved
15	7F	hexadecimal	-	Checksum

*The module x/y axis should be aligned with vehicle roll/pitch axis

*Additional Messages (default disabled)

PSTI,063 – 3 Axis Gyro Data and Bias (Optional)

Structure:

PSTI,xxx,x,xxx.xx,xxx.xx,xxx.xx,x,xxx.xx,xxx.xx,xxx.xx,*xx<CR><LF>
1 2 3 4 5 6 7 8 9 10

Example:

\$PSTI,063,G,-0.84,0.05,1.93,C,-0.83,0.06,1.90*04<CR><LF>

Field No.	Example	Format	Unit	Description
1	063	numeric	-	Proprietary message identifier: 063
2	G	character	-	Sensor Type G: Gyro
3	-0.84	numeric	Deg/s	Average Gyro Data-X
4	0.05	numeric	Deg/s	Average Gyro Data-Y
5	1.93	numeric	Deg/s	Average Gyro Data-Z
6	C	character	-	Calibration indicator: N = Not Calibrated, C = Calibrated
7	-0.83	numeric	Deg/s	Gyro Bias-X
8	0.06	numeric	Deg/s	Gyro Bias-Y
9	1.90	numeric	Deg/s	Gyro Bias-Z
10	04	hexadecimal	-	Checksum
11	-13.45	numeric	Deg/sec	Z-axis rotation rate
12	6.63	numeric	m	ADR: distance moved per second ODR: 0
13	40	hexadecimal	-	Checksum

*Additional Messages (default disabled)

PSTI,065 – 3 Axis Accelerometer Data and Bias (Optional)

Structure:

PSTI,xxx,x,xxx.xx,xxx.xx,xxx.xx,x,xxx.xx,xxx.xx,xxx.xx,*xx<CR><LF>
1 2 3 4 5 6 7 8 9 10

Example:

\$PSTI,065,A,-1.09,-1.02,10.22,C,-0.78,0.04,0.43*18<CR><LF>

Field No.	Example	Format	Unit	Description
1	065	numeric	-	Proprietary message identifier:065
2	A	character	-	Sensor Type A: Accelerometer
3	-1.09	numeric	m/(s*s)	Average Accelerometer Data-X
4	-1.02	numeric	m/(s*s)	Average Accelerometer Data-Y
5	10.22	numeric	m/(s*s)	Average Accelerometer Data-Z
6	C	character	-	Calibration indicator: N = Not Calibrated, C = Calibrated
7	-0.78	numeric	m/(s*s)	Accelerometer Bias-X
8	0.04	numeric	m/(s*s)	Accelerometer Bias-Y
9	0.43	numeric	m/(s*s)	Accelerometer Bias-Z
10	18	hexadecimal	-	Checksum

*Additional Messages (default disabled)

PSTI,067 – Odometer Sentence (Optional)

Structure:

PSTI,xxx,x,xxx,x,x,xxx.xx,xxx.xx*xx<CR><LF>
1 2 3 4 5 6 7 8

Example:

\$PSTI,067,O,240,0,C,0.03,6.64*0E<CR><LF>

Field No.	Example	Format	Unit	Description
1	067	numeric	-	Proprietary message identifier: 067
2	O	character	-	Sensor Type O: Odometer
3	240	numeric	pulse	Odometer pulse count
4	0	character	-	Forward/Backward Status 1: activated, moving backward 0: normal, moving forward
5	C	character	-	Calibration indicator: N = Not Calibrated, C = Calibrated
6	0.03	numeric	m/pulse	Odometer Scaling Factor
7	6.64	numeric	m	Distance
8	0E	hexadecimal	-	Checksum

*Additional Messages (default disabled)

PSTI,068 – Barometer States (Optional)

Structure:

PSTI,xxx,x,xxxx.xx,xxxx.xx,x,xxxxx.xx,xxxxx.xx*xx<CR><LF>
1 2 3 4 5 6 7 8

Example:

\$PSTI,068,B,1007.31,1013.25,C,49.56,-1.05*1A<CR><LF>

Field No.	Example	Format	Unit	Description
1	068	numeric	-	Proprietary message identifier: 068
2	B	character	-	Sensor Type B: Barometer
3	1007.31	numeric	hPa(mbar)	Pressure
4	1013.25	numeric	hPa(mbar)	Reference Pressure
5	C	character	-	Calibration indicator: N = Not Calibrated, C = Calibrated
6	49.56	character	m	Raw Altitude
7	-1.05	numeric	m	Altitude(Ellipsoid Height)
8	1A	hexadecimal	-	Checksum

*Additional Messages (default disabled)

PSTI,070 – Temperature States (Optional)

Structure:

PSTI,xxx,x,x,xxx.x*xx<CR><LF>
1 2 3 4 5

Example:

\$PSTI,070,T,B,27.2*26 <CR><LF>

Field No.	Example	Format	Unit	Description
1	070	numeric	-	Proprietary message identifier: 070
2	T	character	-	Temperature
3	B	character	-	Sensor Type A:Accelerometer B: Barometer G: Gyroscope I: Inertial Sensor (Accelerometer+Gyroscope) T: Standalone Temperature Sensor
4	27.2	numeric	°C	Sensor Temperature
5	26	hexadecimal	-	Checksum

*Additional Messages (default disabled)

PSTI, 071 – Raw MemS Sensor States (Optional)

Structure:

\$PSTI,xxx,xxxx,xxxxxx.xxx,x,xxx,xxx,xxx,x,xxx,xxx,xxx*xx<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12

Example:

\$PSTI,071,1988,217364.500,G,-0.01,-0.00,0.00,A,0.76,-1.43,-10.01*12<CR><LF>

Field No.	Example	Format	Unit	Description
1	071	numeric	-	Proprietary message identifier: 071
2	1988	numeric	-	Week number
3	217364.500	numeric	s	Time of week
4	G	character	-	G for Gyro
5	-0.01	numeric	Deg/s	Average Gyro Data-X over set period
6	-0.00	numeric	Deg/s	Average Gyro Data-Y over set period
7	0.00	numeric	Deg/s	Average Gyro Data-Z over set period
8	A	character	-	A for Accelerometer
9	0.76	numeric	m/(s*s)	Average Accelerometer Data-X over set period
10	-1.43	numeric	m/(s*s)	Average Accelerometer Data-Y over set period
11	-10.01	numeric	m/(s*s)	Average Accelerometer Data-Z over set period
12	12	hexadecimal	-	Checksum

*Additional Messages (default disabled)

Example Message

\$PSTI,071,1993,269811.000,G,0.37,1.87,-0.15,A,-0.33,0.11,10.31*26
\$GNGGA,025633.000,2447.0885,N,12100.5242,E,1,18,0.7,96.9,M,19.6,M,,0000*76
\$GNGLL,2447.0885,N,12100.5242,E,025633.000,A,A*45
\$GNGSA,A,3,32,14,193,31,194,195,25,10,26,29,12,22,1.2,0.7,1.0*1F
\$GNGSA,A,3,71,74,72,73,75,70,,,,,,1.2,0.7,1.0*28
\$GNRMC,025633.000,A,2447.0885,N,12100.5242,E,000.0,116.1,210318,,,A*7C
\$GNVTG,116.1,T,,M,000.0,N,000.0,K,A*14
\$GNZDA,025633.000,21,03,2018,00,00*42
\$PSTI,20,0,1,1,0,A,0,0,15.21,100.00,-0.00,0.00*46
\$PSTI,063,G,0.37,1.86,-0.15,C,0.36,1.83,-0.15*07
\$PSTI,065,A,-0.34,0.11,10.31,N,0.00,0.00,0.00*17
\$PSTI,067,O,0,0,N,1.00,0.00*03
\$PSTI,068,B,1010.45,1013.25,N,23.34,119.93*30
\$PSTI,070,T,B,30.8*2A
\$PSTI,070,T,I,31.4*2C

ORDERING INFORMATION

Model Name	Description
PX1120DP	GNSS Dead Reckoning receiver module with barometric pressure sensor for superior altitude sensing performance

Revision History

Revision	Date	Description
1	July 15, 2021	Initial release
2	July 28, 2021	Updated block diagram
3	June 19, 2023	Updated Interface and NMEA section

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