

# S1216F8-RTK

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## Small-Size RTK Receiver for Mobile Platforms Requiring Centimeter-Level Accuracy

### Features

- Centimeter-level accuracy RTK receiver
- L1 GPS/GLONASS or L1 GPS + B1 BDS RTK
- 12mm x 16mm small size
- NMEA-0183 and RTCM 3.x protocol
- Easy to integrate
- Operating temperature -40 ~ +85°C
- RoHS compliant

### Applications

- Machine control & automation
- Unmanned aerial vehicle
- Precision agriculture
- Aerial photography
- GIS data collection

The S1216F8-RTK offers centimeter-level accuracy based on carrier phase RTK technique and can be used for a wide range of high-accuracy positioning applications. Its 12mm x 16mm form factor makes it ideal for mobile precision positioning application requiring small size.

The receiver receives RTCM 3.x data from a base station or a base-station-capable SkyTraQ carrier phase raw measurement receiver to perform carrier phase RTK processing, achieving centimeter level accurate relative positioning. For challenging environments where RTK positioning is not possible, S1216F8-RTK delivers high accuracy DGNSS and GNSS positioning.

The S1216F8-RTK receiver is based on SkyTraQ's very high-performance Venus8 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.

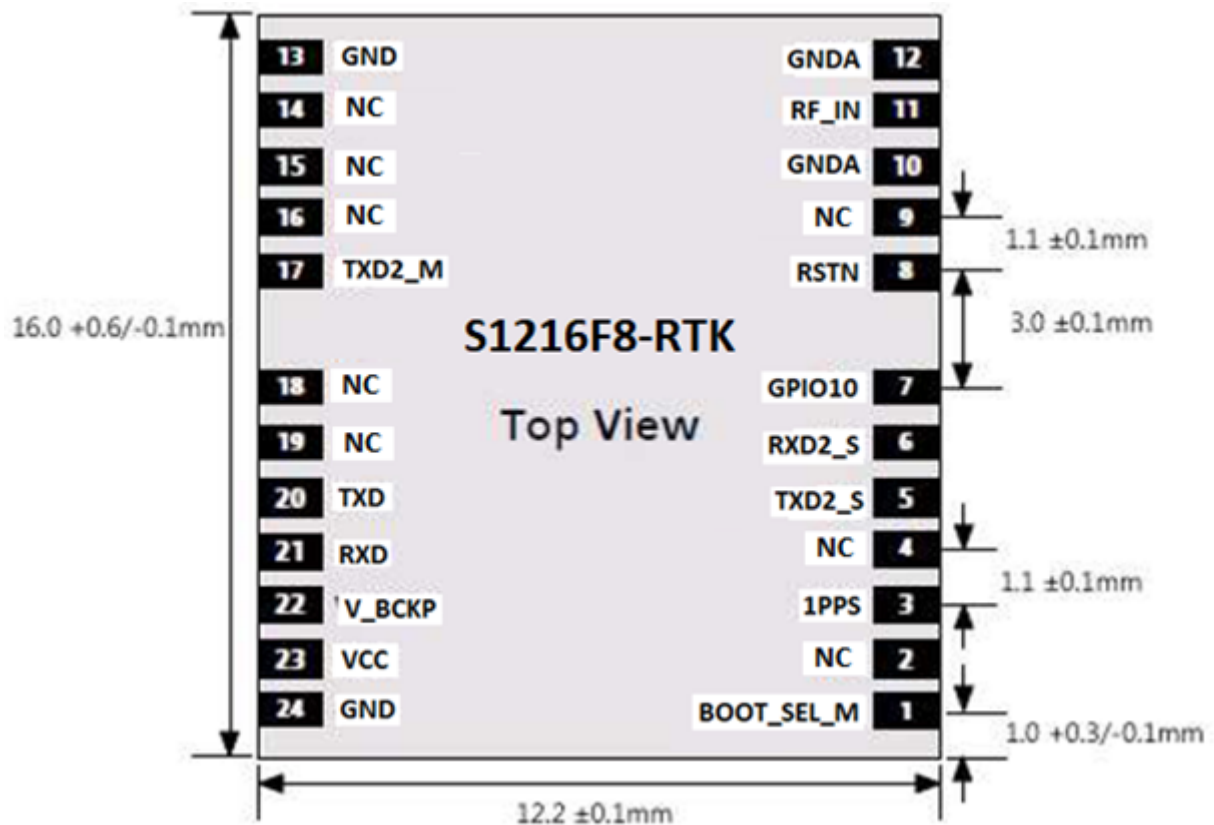
The receiver is optimized for applications requiring high precision centimeter-level accuracy, high-performance, low power, and lower cost.

## TECHNICAL SPECIFICATIONS

Receiver Type	L1 GPS/GLONASS or L1 GPS + B1 BDS C/A code, 167-channel		
Accuracy	Position	2.5m CEP	autonomous mode
		< 1m	DGPS mode
		1cm + 1ppm	RTK mode
	Velocity	0.1m/sec	
	Time	10ns	
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) 90sec to 1 <sup>st</sup> ambiguity fixed solution at 7Km baseline for example*		
Reacquisition	1s		
Sensitivity	-148dBm cold start		
	-160dBm tracking		
Update Rate	RTK 1 / 2 / 4 / 5 / 8 / 10 Hz		
	Moving Base RTK 1 / 2 / 4 / 5 Hz		
Operational Limits	Altitude < 18,000m or velocity < 515m/s		
Serial Interface	3.3V LVTTTL level		
Protocol	NMEA-0183 V3.01 GPGGA, GPGLL, GPGSA, BDGSA, GPGSV, BDGSV, GPVTG, GPRMC 115200 baud, 8, N, 1		
	RTCM 3.0, 3.1 or SkyTraq raw data binary 115200 baud, 8, N, 1		
Datum	Default WGS-84 and user definable		
Input Voltage	3.3V DC +/-5%		
Current Consumption	70mA		
Dimension	16mm L x 12mm W		
Weight:	2g		
Operating Temperature	-40°C ~ +85°C		
Storage Temperature	-55 °C ~ +100°C		
Humidity	5% ~ 95% non-condensing		

*\*Note: This time to first RTK fixed solution is dependent on number of satellites available, usable satellite geometry, signal strength, distance from base-station...etc. May take 1 ~ 10 minutes under open sky within 10Km baseline.*

## MECHANICAL CHARACTERISTICS



## PINOUT DESCRIPTION

Pin No.	Name	Description
1	BOOT_SEL_M	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 LVTTTL. The rising edge synchronized to UTC second when getting 3D position fix. The pulse duration is about 800usec at rate of 1 Hz.
4	NC	No connection, empty pin
5	TXD2_S	UART serial data output, 3.3V LVTTTL. Currently not used.
6	RXD2_S	UART serial data input, 3.3V LVTTTL. One full-duplex 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 S1216F8-RTK, ensure that this pin is not driven to HIGH when primary power to S1216F8-RTK is removed, or a 10K-ohm series resistor can be added to minimize leakage current from application to the powered off module.
7	GPIO10	GPIO pin, 3.3V LVTTTL. External trigger input for camera shutter synchronization*
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	NC	No connection, empty pin
10	GND A	Analog ground
11	RF_IN	RF input with 3.3V active antenna bias voltage
12	GND A	Analog ground
13	GND	Digital ground
14	NC	No connection, empty pin
15	NC	No connection, empty pin
16	NC	No connection, empty pin
17	TXD2_M	UART serial data output, 3.3V LVTTTL. Output carrier phase raw measurement data at 115200
18	NC	No connection, empty pin
19	NC	No connection, empty pin
20	TXD	UART serial data output, 3.3V LVTTTL. 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 LVTTTL. 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 S1216F8-RTK, ensure that this pin is not driven to HIGH when primary power to S1216F8-RTK is removed, or a 10K-ohm series resistor can be added to minimize leakage current from application to the powered off module.
22	V_BCKP	Backup supply voltage for internal RTC and backup SRAM, 2.5V ~ 3.6V. VBAT 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

\* Available only for S1216F8-RTK-S version with precision time/position stamp

## ELECTRICAL SPECIFICATIONS

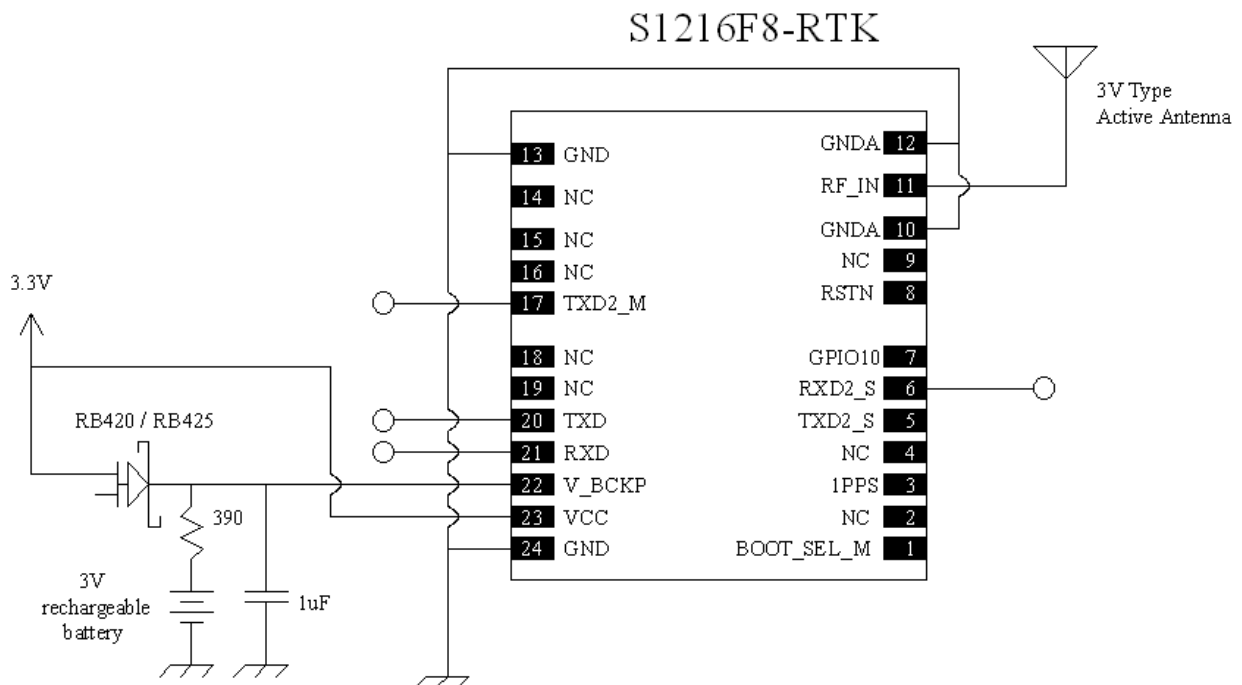
### ABSOLUTE MAXIMUM RATINGS

Parameter	Minimum	Maximum	Condition
Supply Voltage (VCC)	-0.5	3.6	Volt
Backup Battery Voltage (V_BCKP)	-0.5	6.0	Volt
Input Pin Voltage	-0.5	VCC+0.5	Volt
Input Power at RF_IN		+5	dBm
Storage Temperature	-55	+100	degC

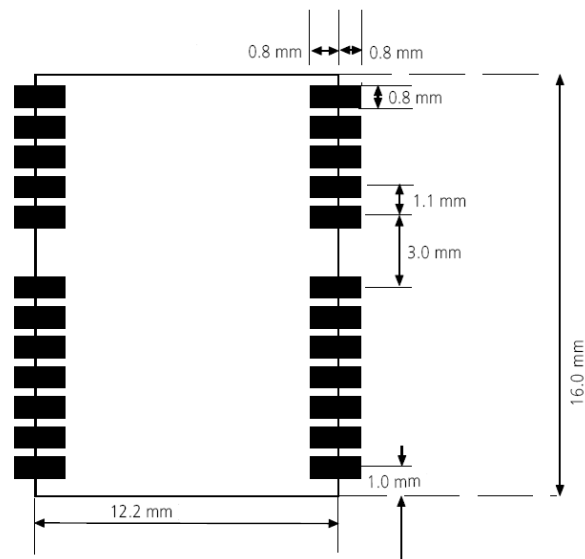
## OPERATING CONDITIONS

Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC)	3	3.3	3.6	Volt
Acquisition Current (exclude active antenna current)		70		mA
Tracking Current (exclude active antenna current)		50		mA
Backup Voltage (V_BCKP)	2.5		3.6	Volt
Backup Current (VCC voltage applied)			1.5	mA
Backup Current (VCC voltage off)			35	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 (RFIN)		50		Ohm

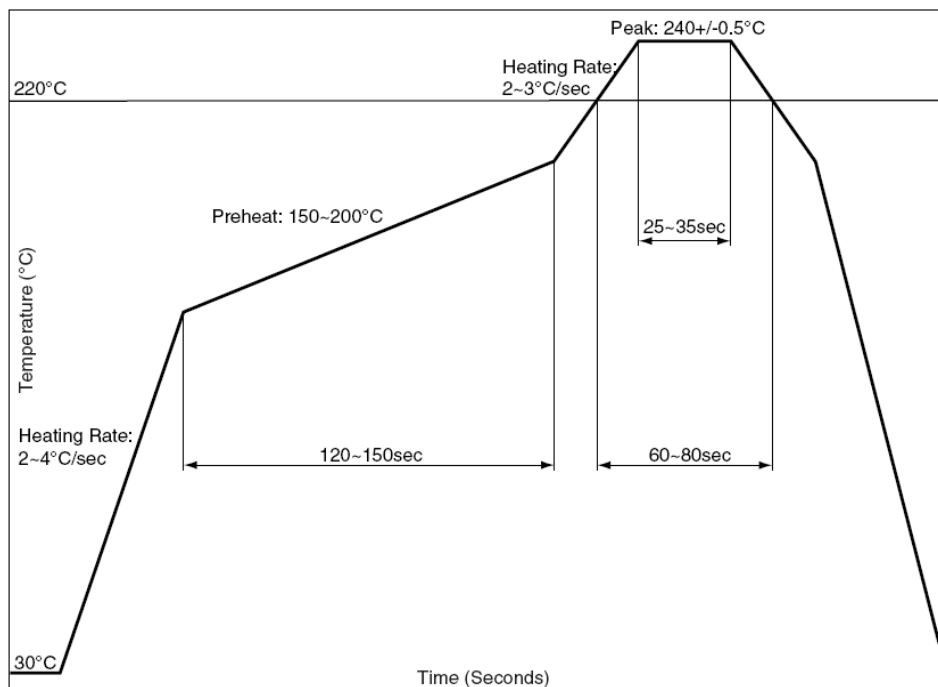
## APPLICATION CIRCUIT



## PRECOMMENDED LAYOUT PAD



## 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

## ANTENNA CONSIDERATIONS

The S1216F8-RTK is designed to be used with GPS/GLONASS/BDS active antenna. Antenna with gain up to 30dB 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

S1216F8-RTK 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 35 $\mu$ A. 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 (800us 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.

## 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 S1216F8-RTK), 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 S1216F8-RTK 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.

S1216F8-RTK 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, S1216F8-RTK will only have float or DGPS/3D solution and behave like a normal GPS/GLONASS/BDS receiver.

- \* Base and rover distance under 10Km
- \* Open sky environment without interference
- \* Signal over 37dB/Hz
- \* 10 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:

\$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

<b>\$GPGGA</b>	Time, position, and fix related data of the receiver.
<b>\$GPGLL</b>	Position, time and fix status.
<b>\$GPGSA</b> <b>\$GLGSA</b> <b>\$BDGSA</b>	Used to represent the ID's of satellites which are used for position fix. When GPS satellites are used for position fix, \$GPGSA sentence is output. When GLONASS satellites are used for position fix, \$GLGSA sentence is output. When BDS satellites are used for position fix, \$BDGSA sentence is output.
<b>\$GPGSV</b> <b>GLGSV</b> <b>\$BDGSV</b>	Satellite information about elevation, azimuth and CNR, \$GPGSV is used for GPS satellites, \$GLGSV is used for GLONASS satellites, while \$BDGSV is used for BDS satellites
<b>\$GPRMC</b>	Time, date, position, course and speed data.
<b>\$GPVTG</b>	Course and speed relative to the ground.
<b>\$GPZDA</b>	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.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,202434.000,2447.0936188,N,12100.5253729,E,4,22,0.6,96.186,M,19.600,M,,0000\*65<CR><LF>

Field	Name	Example	Description
1	UTC Time	202434.000	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
2	Latitude	2447.0936188	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
4	Longitude	12100.5253729	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	Satellites Used	22	Number of satellites in use, (00 ~ 28)
8	HDOP	0.6	Horizontal dilution of precision, (0.0 ~ 99.9)
9	Altitude	96.186	mean sea level (geoid), (-9999.9 ~ 17999.9)
10	Geoidal Separation	19.600	Geoidal separation in meters
11	Age of 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	65	

### GLL – Latitude/Longitude

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

Structure:

\$GPGLL,ddmm.mmmmmmm,a,dddmm.mmmmmmm,a,hmmss.sss,A,a\*hh<CR><LF>  
1 2 3 4 5 6 7 8

Example:

\$GPGLL,2447.0877990,N,12100.5225238,E,075310.000,A,F\*58<CR><LF>

Field	Name	Example	Description
1	Latitude	2447.0877990	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
2	N/S Indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
3	Longitude	12100.5225238	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
5	UTC Time	075310.000	UTC time in hhmmss.sss format (000000.000 ~ 235959.999)
6	Status	A	Status, 'A' = Data valid, 'V' = Data not valid
7	Mode Indicator	F	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'F' = Float RTK. Satellite system used in RTK mode, floating integers 'R' = Real Time Kinematic. System used in RTK mode with fixed integers
8	Checksum	58	

**GSA – GNSS DOP and Active Satellites**

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

Structure:

```
$GPGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,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
```

Example:

```
$GPGSA,A,3,01,07,08,11,19,27,30,32,193,03,16,09,1.0,0.6,0.8*0A<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	01,07,08,11,19,27,30,32,193,03,16,09	01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 197 are for QZSS; 01 ~ 37 are for BDS (BD PRN). GPS and BDS satellites are differentiated by the GP and BD prefix. Maximally 12 satellites are included in each GSA sentence.
4	PDOP	1.0	Position dilution of precision (0.0 to 99.9)
5	HDOP	0.6	Horizontal dilution of precision (0.0 to 99.9)
6	VDOP	0.8	Vertical dilution of precision (0.0 to 99.9)
7	Checksum	0A	

### 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 *hh<CR><LF>  
  1 2 3 4 5 6 7 4 5 6 7 8
```

Example:

```
$GPGSV,3,1,12,05,54,069,45,12,44,061,44,21,07,184,46,22,78,289,47*72<CR><LF>  
$GPGSV,3,2,12,30,65,118,45,09,12,047,37,18,62,157,47,06,08,144,45*7C<CR><LF>  
$GPGSV,3,3,12,14,39,330,42,01,06,299,38,31,30,256,44,32,36,320,47*7B<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	12	Total number of satellites in view (00 ~ 20)
4	Satellite ID	05	01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 197 are for QZSS; 01 ~ 37 are for BDS (BD PRN). GPS and BDS satellites are differentiated by the GP and BD prefix. Maximally 4 satellites are included in each GSV sentence.
5	Elevation	54	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	069	Satellite azimuth angle in degrees, (000 ~ 359 )
7	SNR	45	C/No in dB (00 ~ 99) Null when not tracking
8	Checksum	72	

**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\*hh<CR><LF>  
                   1      2          3          4          5          6  7  8      9      10  11

Example:

\$GPRMC,075400.000,A,2447.0862197,N,12100.5222844,E,000.0,000.0,180915,,,R\*74<CR><LF>

Field	Name	Example	Description
1	UTC time	075400.000	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.0862197	Latitude in dddmm.mmmmmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.5222844	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	180915	UTC date of position fix, ddmmyy format
10	Mode indicator	R	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'F' = Float RTK. Satellite system used in RTK mode, floating integers 'R' = Real Time Kinematic. System used in RTK mode with fixed integers
11	checksum	74	

### 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:

\$GPVTG,000.0,T,,M,000.0,N,000.0,K,R\*1E<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	R	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'F' = Float RTK. Satellite system used in RTK mode, floating integers 'R' = Real Time Kinematic. System used in RTK mode with fixed integers
5	Checksum	1E	

**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:

\$GPZDA,202434.000,25,11,2015,00,00\*54<CR><LF>

Field	Name	Example	Units	Description
1	UTC time	202434.000		UTC time in hhmmss.ss format (000000.00 ~ 235959.99)
2	UTC Day	25		UTC time: day (01 ~ 31)
3	UTC Month	11		UTC time: month (01 ~ 12)
4	UTC Year	2015		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	54		Checksum



**GST – GNSS Pseudorange Error Statistics**

GNSS Pseudorange error statics.

Structure:

\$GPGST,hhmmss.sss,x.xxx,x.xxx,x.xxx,x.x,x.xxx,x.xxx,x.xxx\*hh<CR><LF>  
                   1      2      3      4      5      6      7      8      9

Example:

\$GPGST,080331.600,0.004,0.002,0.002,62.7,0.002,0.002,0.003\*5C<CR><LF>

Field	Name	Example	Description
1	UTC time	080311.600	UTC time of the GGA or GNS fix associated with this sentence in hhmmss.sss format (000000.000 ~ 235959.999)
2	RMS value of the standard deviation of the range	0.004	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudoranges & DGNSS corrections.
3	Standard deviation of semi-major axis	0.002	Standard deviation of semi-major axis of error ellipse in meters
4	Standard deviation of semi-minor axis	0.002	Standard deviation of semi-minor axis of error ellipse in meters
5	Orientation of semi-major axis	62.7	Orientation of semi-major axis of error ellipse in degrees from true north.
6	Standard deviation of latitude error	0.002	Standard deviation of latitude error in meters
7	Standard deviation of longitude error	0.002	Standard deviation of longitude error in meters
8	Standard deviation of altitude error	0.003	Standard deviation of altitude error in meters
9	checksum	5C	

**STI,005 – Time & Position Stamp Output \***

An output message, ID 0x005, contains GPIO 10 event-triggered time & position stamp. The trigger input should be spaced more than 1.5sec apart. Time error less than 100nsec, maximum position error of 0.278mm per km/hr times the moving speed added on top of RTK positioning error.

Structure:

\$PSTI,005,hhmmss.ssssss,xx,xx,xxxx,ddmm.mmmmmm,a,dddmm.mmmmmm,a,x.x\*hh<CR><LF>

1            2            3 4 5            6            7            8            9 10 11

Example:

\$PSTI,005,030718.1408380,27,11,2015,2447.0924110,N,12100.5227860,E,103.323\*2C<CR><LF>

Field	Name	Example	Description
1	ID	005	Proprietary NMEA message identifier
2	UTC time	030718.1408380	Time-stamp UTC time in hhmmss.ssssss format (000000.0000000 ~ 235959.9999999)
3	UTC Day	27	Time-stamp UTC time: day (01 ~ 31)
4	UTC Month	11	Time-stamp UTC time: month (01 ~ 12)
5	UTC Year	2015	Time-stamp UTC time: year (4 digit format)
6	Latitude	2447.0924110	Latitude in ddmm.mmmmmm format Leading zeros transmitted
7	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
8	Longitude	12100.5227860	Longitude in dddmm.mmmmmm format Leading zeros transmitted
9	E/W Indicator	E	Longitude hemisphere indicator, 'E' = East, 'W' = West
10	Altitude	103.323	mean sea level (geoid), (-9999.999 ~ 17999.999)
11	Checksum	29	Checksum

\* Available only for S1216F8-RTK-5S and -10S, 5Hz and 10Hz RTK version with precision time/position stamping

**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,030,044606.000,A,2447.0924110,N,12100.5227860,E,103.323,0.00,0.00,0.00,180915,R,1.2,4.2\*02<CR><LF>

Field	Name	Example	Description
1	UTC time	044606.000	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.0924110	Latitude in dddmm.mmmmmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.5227860	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
6	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
7	Altitude	103.323	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	0.00	'Up' component of ENU velocity (m/s)
11	UTC Date	180915	UTC date of position fix, ddmmyy format
12	Mode indicator	R	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'S' = Simulator mode 'F' = Float RTK. Satellite system used in RTK mode, floating integers 'R' = Real Time Kinematic. System used in RTK mode with fixed integers
13	RTK Age	1.2	Age of differential
14	RTK Ratio	4.2	AR ratio factor for validation
15	Checksum	02	

**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>

Example:

\$PSTI,032,041457.000,170316,A,R,0.603,-0.837,-0.089,1.036,144.22,,,,\*30

Field	Name	Example	Description
1	UTC time	041457.000	UTC time in hhmmss.sss format (000000.000~235959.999)
2	UTC Date	170316	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	0.603	East-projection of baseline, meters
6	North-projection of baseline	-0.837	North-projection of baseline, meters
7	Up-projection of baseline	-0.089	Up-projection of baseline, meters
8	Baseline length	1.036	Baseline length, meters
9	Baseline course	144.22	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	30	

**ORDERING INFORMATION**

<b>Model Name</b>	<b>Description</b>
S1216F8-RTK	GNSS RTK Receiver Module
S1216F8-RTK-S	GNSS RTK Receiver Module with precision time/position stamping function

## Revision History

Revision	Date	Description
1	May 23, 2018	Initial release
2	July 1, 2018	Removed S1216F8-RTK-5 / 5S / 10 / 10S related

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