

S2525F8-BD-RTK



Industry-Leading Low-Power Small-Size RTK OEM Receiver for Mobile Platforms Requiring Centimeter-Level Accuracy

Features

- Centimeter-level accuracy RTK receiver
- GPS L1 + BDS B1 + SBAS C/A code
- 300mW low power consumption
- 25mm x 25mm small size
- Designed for demanding environments
- NMEA-0183 and RTCM 3.x protocol
- Easy to integrate
- Operating temperature -40 ~ +85°C
- RoHS compliant

Applications

- Construction, mining
- Machine control & automation
- Unmanned aerial vehicle
- Precision agriculture
- Aerial photography
- Land survey

The S2525F8-BD-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 25mm x 25mm form factor and 300mW power consumption makes it ideal for mobile precision positioning application requiring low power and small size.

The receiver receives RTCM 3.x data from a base station or a base-station-capable SkyTra 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, S2525F8-BD-RTK delivers high accuracy DGNSS and GNSS positioning.

The S2525F8-BD-RTK receiver is based on SkyTra'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.

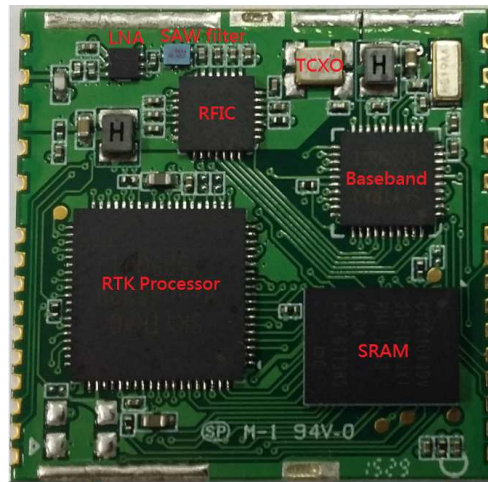
The receiver is optimized for applications requiring high precision centimeter-level accuracy, high-performance, low power, and lower cost.

TECHNICAL SPECIFICATIONS

Receiver Type	GPS L1 + BDS B1 + SBAS L1 C/A code, 167-channel		
Accuracy	Position	2.5m CEP < 1m centimeter-level	autonomous mode DGPS mode 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 st ambiguity fixed solution at 7Km baseline for example*		
Reacquisition	1s		
Sensitivity	-148dBm cold start -160dBm tracking		
Update Rate	1 Hz		
Operational Limits	Altitude < 18,000m or velocity < 515m/s		
Serial Interface	3.3V LVTTTL level		
Protocol	NMEA-0183 V3.01 GPGLL, GPGSA, BDGSA GPGSV, BDGSV, GPVTG, GPRMC 115200 baud, 8, N, 1		
	RTCM 3.0, 3.1 115200 baud, 8, N, 1		
Datum	Default WGS-84 User definable		
Input Voltage	3.3V DC +/-5%		
Current Consumption	90mA		
Dimension	25.4mm L x 25.4mm W		
Weight:	3g		
Operating Temperature	-40°C ~ +85°C		
Storage Temperature	-55 °C ~ +100°C		
Humidity	5% ~ 95% non-condensing		

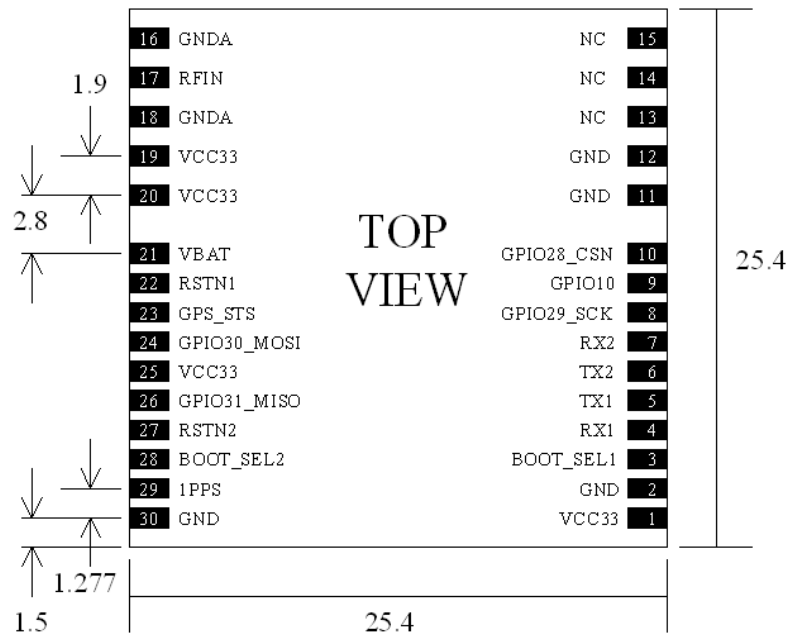
**Note: This time to first RTK fixed solution is dependent on number of satellites available, usable satellite geometry, signal strength, distance from base-station...etc. May take 1 ~ 10 minutes under open sky within 10Km baseline.*

KEY FUNCTIONAL PARTS



MECHANICAL CHARACTERISTICS

Unit: mm



PINOUT DESCRIPTION

Pin No.	Name	Description
1	VCC33	Main power supply, 3.3V DC
2	GND	Digital ground
3	BOOT_SEL1	No connection for normal use. Pull-low for loading firmware into empty or corrupted Flash memory from ROM mode for the baseband chip.
4	RX1	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 S2525F8-BD-RTK, ensure that this pin is not driven to HIGH when primary power to S2525F8-BD-RTK is removed, or a 10K-ohm series resistor can be added to minimize leakage current from application to the powered off module.
5	TX1	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.
6	TX2	UART serial data output, 3.3V LVTTTL. Currently not used.
7	RX2	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 to the receiver. In the idle condition, this pin should be driven HIGH. If the driving circuitry is powered independently of S2525F8-BD-RTK, ensure that this pin is not driven to HIGH when primary power to S2525F8-BD-RTK is removed, or a 10K-ohm series resistor can be added to minimize leakage current from application to the powered off module.
8	GPIO29_SCK	GPIO pin, 3.3V LVTTTL. Also function as SPI master clock, used to stream carrier phase raw measurement data over SPI.
9	GPIO10	GPIO pin, 3.3V LVTTTL. External trigger input for camera shutter synchronization

10	GPIO28_CSN	GPIO pin, 3.3V LVTTL. Also function as SPI chip select, used to stream carrier phase raw measurement data over SPI.
11,12	GND	Digital ground
13,14,15	NC	No connection, empty pin
16	ANT_GND	Antenna ground
17	RFIN	GPS RF input connects to antenna. 3.2V active antenna bias on RFIN.
18	ANT_GND	Antenna ground
19,20	VCC33	Main power supply, 3.3V DC
21	VBAT	Backup supply voltage for internal RTC and backup SRAM, 2.5V ~ 3.6V. VBAT must be applied whenever VCC33 is applied. This pin should be powered continuously to minimize the startup time. If VCC33 and VBAT 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 VCC33.
22	RSTN1	External active-low reset input to the baseband. Only needed when power supply rise time is very slow or software controlled reset is desired.
23	GPS_STS	GPS fix indicator, 3.3V LVTTL. Active low, output LOW for no position fix, toggles each second when position fix.
24	GPIO30_MOSI	GPIO pin, 3.3V LVTTL. Also function as SPI MOSI, used to stream carrier phase raw measurement data over SPI.
25	VCC33	Main power supply, 3.3V DC
26	GPIO31_MISO	GPIO pin, 3.3V LVTTL. Also function as SPI MISO, used to stream carrier phase raw measurement data over SPI.
27	RSTN2	External active-low reset input to the RTK processor. Only needed when power supply rise time is very slow or software controlled reset is desired.
28	BOOT_SEL2	No connection for normal use. Pull-low for loading firmware into empty or corrupted Flash memory from ROM mode for the RTK processor.
29	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 800usec at rate of 1 Hz.
30	GND	Digital ground

ELECTRICAL SPECIFICATIONS

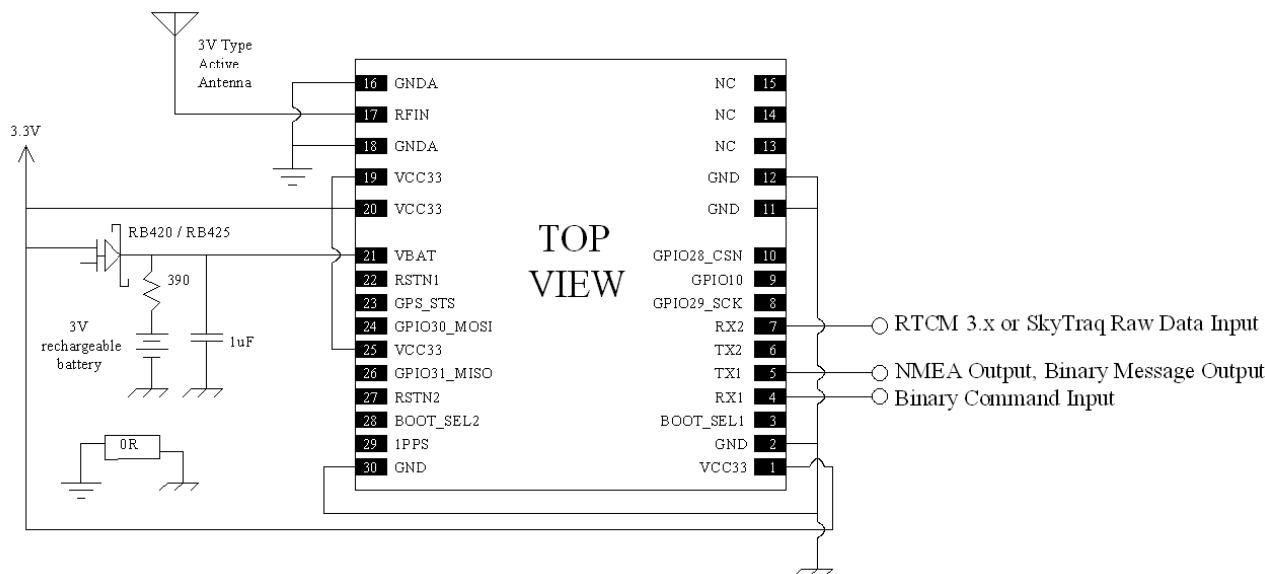
ABSOLUTE MAXIMUM RATINGS

Parameter	Minimum	Maximum	Condition
Supply Voltage (VCC33)	-0.5	3.6	Volt
Backup Battery Voltage (VBAT)	-0.5	6.0	Volt
Input Pin Voltage	-0.5	VCC+0.5	Volt
Input Power at RFIN		+5	dBm
Storage Temperature	-55	+100	degC

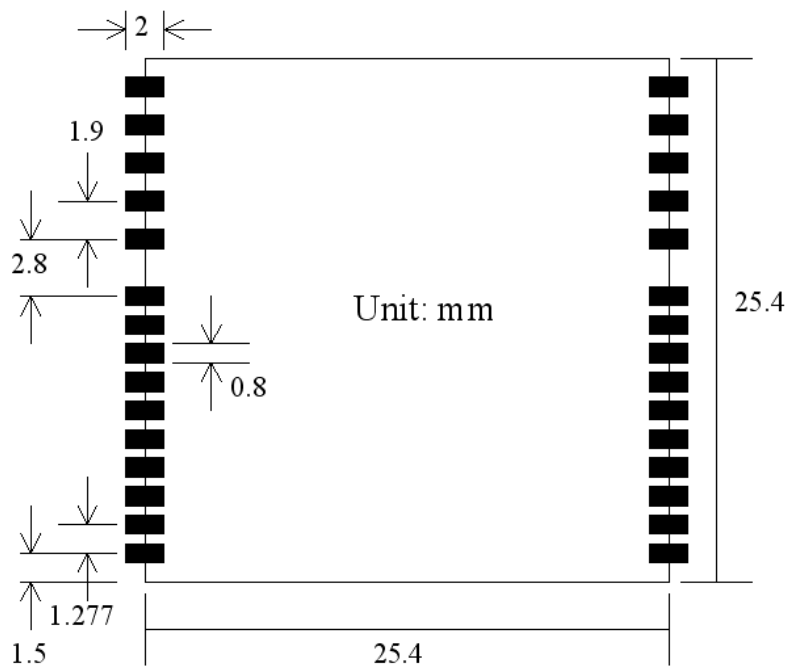
OPERATING CONDITIONS

Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC33)	3	3.3	3.6	Volt
Acquisition Current (exclude active antenna current)		90		mA
Tracking Current (exclude active antenna current)		87		mA
Backup Voltage (VBAT)	2.5		3.6	Volt
Backup Current (VCC33 voltage applied)			1.5	mA
Backup Current (VCC33 voltage off)			10	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

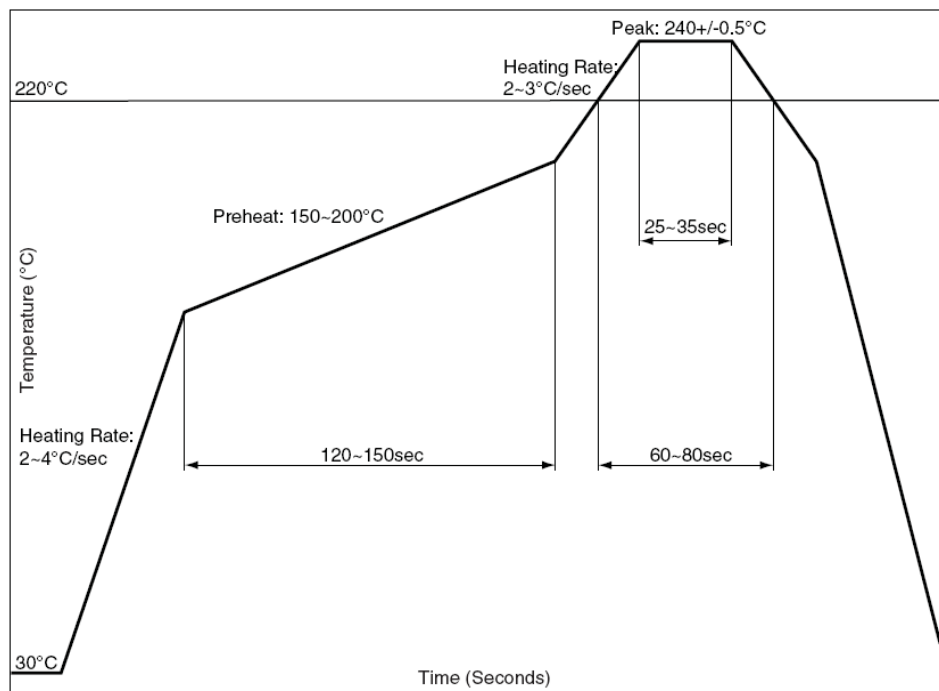
APPLICATION CIRCUIT



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 S2525F8-BD-RTK is designed to be used with GPS/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

S2525F8-BD-RTK requires a stable power supply, avoid ripple on VCC33 pin (<50mVpp). Power supply noise can affect the receiver's sensitivity. Bypass capacitors should be placed close to the module VCC33 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 (VBAT) 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 10 μ 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 S2525F8-BD-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 S2525F8-BD-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.

S2525F8-BD-RTK module is ESD sensitive device and should be handled with care.

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.
Aaacc		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.
\$GPGLL	Position, time and fix status.
\$GPGSA \$BDGSA	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 BDS satellites are used for position fix, \$BDGSA sentence is output.
\$GPGSV \$BDGSV	Satellite information about elevation, azimuth and CNR, \$GPGSV is used for GPS satellites, while \$BDGSV is used for BDS satellites
\$GPRMC	Time, date, position, course and speed data.
\$GPVTG	Course and speed relative to the ground.
\$GPZDA	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,075402.000,2447.0862197,N,12100.5222811,E,4,19,0.7,93.9,M,19.6,M,,0000*64<CR><LF>

Field	Name	Example	Description
1	UTC Time	075402.000	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
2	Latitude	2447.0862197	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
4	Longitude	12100.5222811	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	19	Number of satellites in use, (00 ~ 24)
8	HDOP	0.7	Horizontal dilution of precision, (0.0 ~ 99.9)
9	Altitude	93.9	mean sea level (geoid), (-9999.9 ~ 17999.9)
10	Geoidal Separation	19.6	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	64	

GLL – Latitude/Longitude

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

Structure:

\$GPGLL,ddmm.mmmmmmm,a,dddmm.mmmmmmm,a,hhmmss.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,3,05,12,21,22,30,09,18,06,14,01,31,,1.2,0.8,0.9*36<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	05,12,21,22,30,09,18,06,14,01,31,,	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	1.2	Position dilution of precision (0.0 to 99.9)
5	HDOP	0.8	Horizontal dilution of precision (0.0 to 99.9)
6	VDOP	0.9	Vertical dilution of precision (0.0 to 99.9)
7	Checksum	36	

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 (1-3)
2	Sequence number	1	Sequence number of current GSV message
3	Satellites in view	12	Total number of satellites in view (00 ~ 12)
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,024611.08,25,03,2002,00,00*6A<CR><LF>

Field	Name	Example	Units	Description
1	UTC time	024611.08		UTC time in hhmmss.ss format (000000.00 ~ 235959.99)
2	UTC Day	25		UTC time: day (01 ~ 31)
3	UTC Month	03		UTC time: month (01 ~ 12)
4	UTC Year	2002		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	6A		Checksum

ORDERING INFORMATION

Model Name	Description
S2525F8-BD-RTK	GPS/BDS RTK Receiver Module

Revision History

Revision	Date	Description
1	Sep 18, 2015	Initial release
2	Sep 22, 2015	Baud rate changed to 115200
3	Oct 7, 2015	Added GPIO10 camera shutter synchronization description. Added GPIO[31:28] SPI interface for simultaneous carrier phase raw measurement output. Changed accuracy number.

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or severe property damage in case of failure of the product.