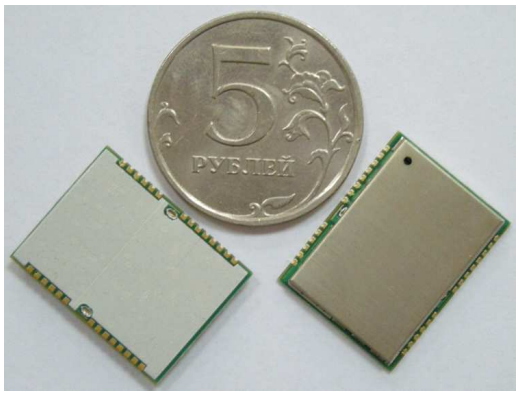
S1722G2F



S1722G2F

High-Performance 88 Channel GLONASS/GPS Receiver

Features

- 88 Channel GLONASS+GPS L1 C/A Code
- Perform 10 million time-frequency hypothesis testing per second
- Open sky hot start 1 sec
- Open sky cold start 29 sec
- Cold start sensitivity -146dBm
- Navigation sensitivity -162dBm
- Accuracy 2.5m CEP
- 350mW acquisition
- 200mW tracking
- Operating temperature -40 ~ +85ºC
- RoHS compliant

Applications

- Navigation and Positioning
- Tracking and Locating
- Automatic Vehicle Location
- Fleet Management

The S1722G2F is a compact form factor GLONASS/GPS module solution intended for a broad range of OEM products, where fast and easy system integration and minimal development risk is required. The user only need to provide DC power of 3.3V and GPS signal; the S1722G2F will output navigation solution in standard NMEA-0183 protocol format.

The S1722G2F features 88 channel GLONASS/GPS receiver with fast time to first fix and improved -146dBm cold start sensitivity. The superior cold start sensitivity allows it to acquire, track, and get position fix autonomously in difficult weak signal environment. The receiver's -162dBm navigation sensitivity allows continuous position coverage in nearly all application environments. The high performance search engine is capable of testing 10,000,000 time-frequency hypotheses per second, offering industry-leading signal acquisition and TTFF speed.

Measuring 17mm x 22mm, the S1722G2F contains integrated LNA, SAW filter, 0.5ppm TCXO, 88 channel positioning engine, RTC crystal, and low-leakage backup supply LDO regulator..

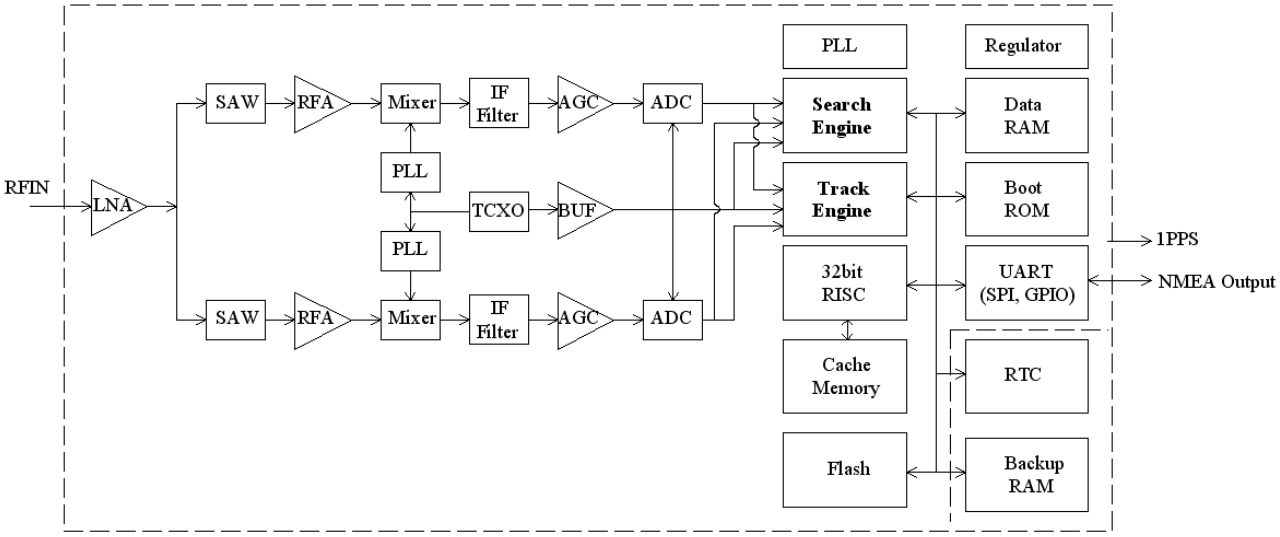
The receiver is optimized for applications requiring high performance, low power, and low cost; suitable for a wide range of OEM configurations including mobile phone, PND, asset tracking, and vehicle navigation products.

The metal RF shielding provides protection and allows standard surface mount device pick-and-place process in fully automated assembly process; enabling high-volume, very cost-efficient production. The S1722G2F is available in tape-and-reel form.

TECHNICAL SPECIFICATIONS

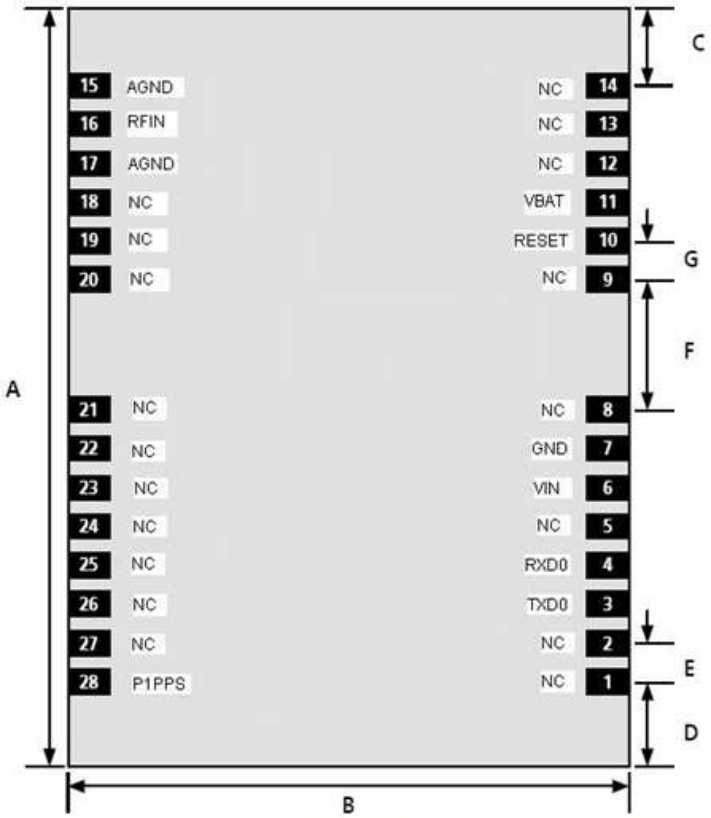
Receiver Type	L1 C/A code, 88-channel
Accuracy	Position 2.5m CEP Velocity 0.1m/sec Time 60ns
Startup Time	1 second hot start under open sky < 29 second warm start under open sky (average) 29 second cold start under open sky (average)
Reacquisition	1s
Sensitivity	-146dBm cold start -162dBm navigation
Update Rate	1Hz
Operational Limits	Altitude < 18,000m or velocity < 515m/s
Serial Interface	3.3V LVTTL level
Protocol	NMEA-0183 V3.01 GPGGA, GNGLL, GNGNS, GPGSA, GLGSA, GNGSA GPGSV, GLGSV, GNVTG, GNRMC 9600 baud, 8, N, 1
Datum	Default WGS-84 User definable
Input Voltage	3.3V DC +/-5%
Power Consumption	350mW acquisition 200mW tracking
Dimension	17mm L x 22.4mm W
Weight:	2g
Operating Temperature	-40^{o}C ~ +85^{o}C
Storage Temperature	-55 ~ +100^{o}C
Humidity	5% ~ 95%

BLOCK DIAGRAM



Module block schematic

MECHANICAL CHARACTERISTICS



Top View

A	22.4mm
B	17.0mm
C	2.85mm
D	2.55mm
E	1.1mm
F	3.8mm
G	1.1mm

PINOUT DESCRIPTION

Pin No.	Name	Description
1,2	NC	No connection
3	TXD0	UART serial data output, 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.
4	RXD0	UART serial data input, 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 S1722G2F, ensure that this pin is not driven to HIGH when primary power to S1722G2F is removed, or a 10K-ohm series resistor can be added to minimize leakage current from application to the powered off module.
5	NC	No connection
6	VIN	Main power supply, 3.3V DC
7	GND	System ground
8,9	NC	No connection
10	RESET	External active-low reset input. Only needed when power supply rise time is very slow or software controlled reset is desired.
11	VBAT	Backup supply voltage for internal RTC and backup SRAM, 1.5V ~ 6V. VBAT must be applied whenever VIN is applied. This pin should be powered continuously to minimize the startup time. If VIN 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 VIN.
12,13,14	NC	No connection
15	AGND	RF ground
16	RFIN	GPS RF input, connect to antenna. There is 3.3V active antenna bias voltage on RFIN.
17	AGND	RF ground
18,19,20,21, 22,23,24,25,	NC	No connection
28	P1PPS	One-pulse-per-second (1PPS) time mark output, 3V LVTTL. The rising edge synchronized to UTC second when getting 3D position fix. The pulse duration is about 4msec at rate of 1 Hz.

ELECTRICAL SPECIFICATIONS

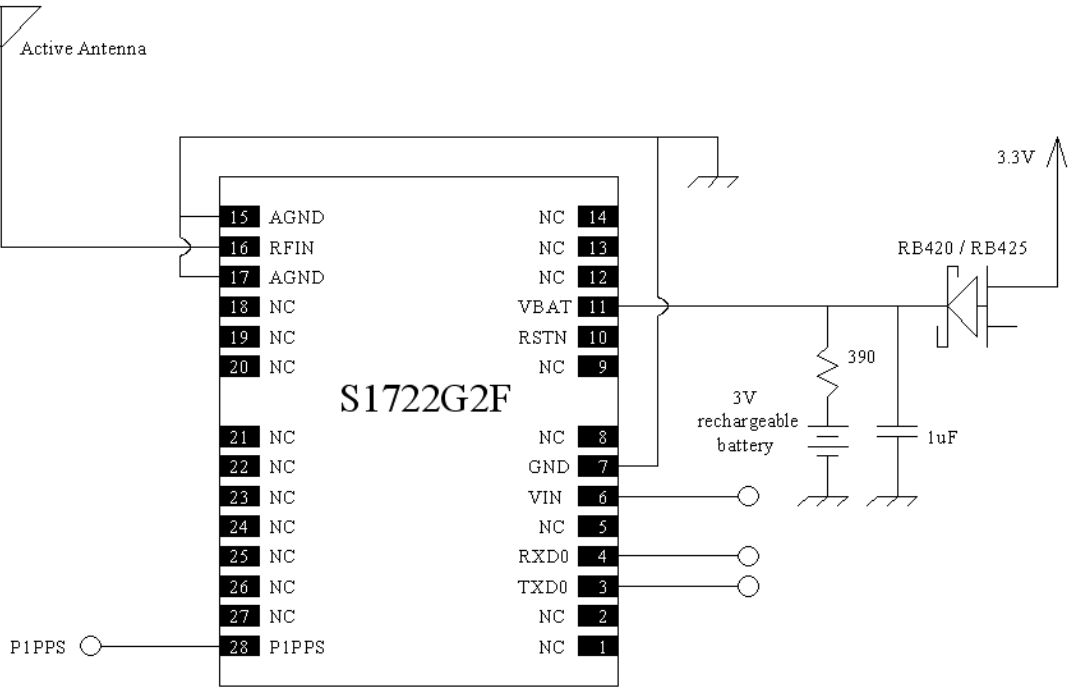
ABSOLUTE MAXIMUM RATINGS

Parameter	Minimum	Maximum	Condition
Supply Voltage (VIN)	-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

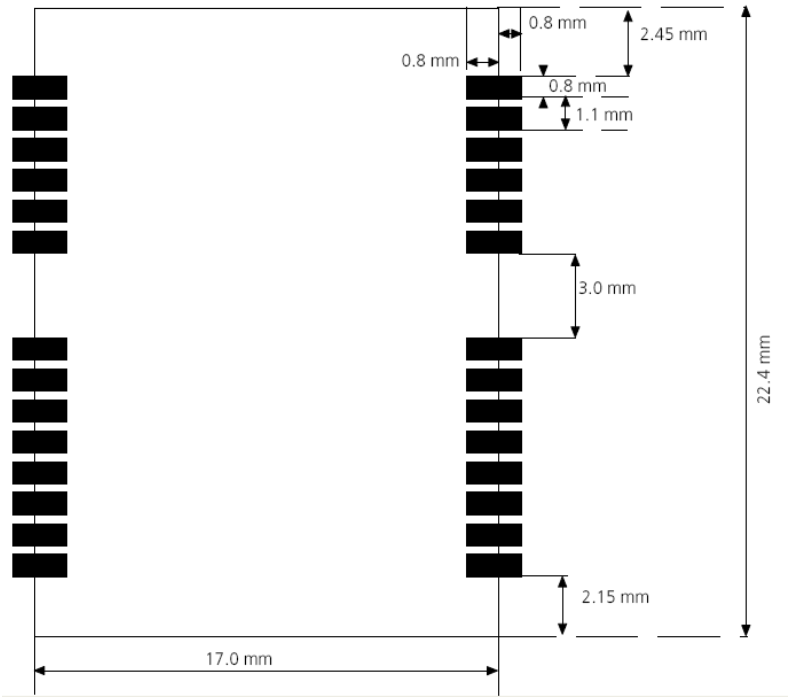
OPERATING CONDITIONS

Parameter	Min	Typ	Max	Unit
Supply Voltage (VIN)	3	3.3	3.6	Volt
Acquisition Current (exclude active antenna current)		105		mA
Tracking Current (exclude active antenna current)		60		mA
Backup Voltage (VBAT)	1.5		6	Volt
Backup Current (VIN voltage applied)			1.5	mA
Backup Current (VIN 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

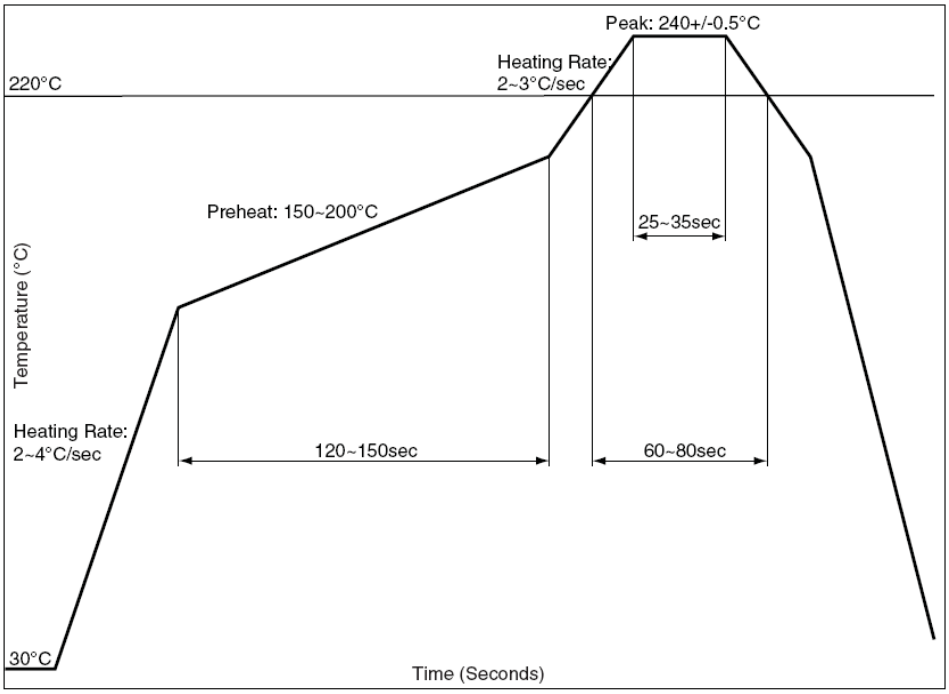
APPLICATION CIRCUIT



PRECOMMENDED LAYOUT PAD



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℃ / sec

ANTENNA CONSIDERATIONS

The S1722G2F is designed to be mainly used with GLONASS/GPS active antenna. Active antenna is essentially a passive antenna with built-in LNA and a coaxial cable to connect the antenna to the module. Active antenna with gain up to 30dB and noise figure less than 2dB can be used with S1722G2F.

POWER SUPPLY REQUIREMENT

S1722G2F requires a stable power supply, avoid ripple on VIN pin (<50mVpp). Power supply noise can affect the receiver's sensitivity. Bypass capacitors should be placed close to the module VIN 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 10μA. 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 (4ms 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 300nsec. 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 S1722G2F), 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.

NMEA Output Description

The NMEA message output by the SkyTraq GPS/GLONASS receiver 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 the sentence/message
aaccc		address field. The first 2 characters “aa” identify the talker/transmitting terminal (talker identifier). The last 3 characters “ccc” identify the NMEA message type.
“,”	2C	the field delimiter
c--c		the data sentence block
“*”	2A	the checksum delimiter
hh		checksum field
<CR><LF>	0D0A	end of sentence/message (carriage return, line feed)

There are three types of talker identifiers (see section six, NMEA 0183 standard) for the NMEA output from SkyTraq GPS/GLONASS receiver. The three types of talker identifiers are GP, GL and GN and they stand for the data related to the GPS, GLONASS and the combined system, respectively.

In the default setting, SkyTraq GPS/GLONASS receiver calculates the PVT solution using the combination of GPS and GLONASS satellites. In some circumstances, however, only the GPS or the GLONASS satellite signals are available for the GPS/GLONASS receiver. The solution may be then performed based on either single or combined satellite systems according to the actual satellite constellation.

Currently, the messages GGA/GNS/GSA/GSV/RMC/VTG are supported in the GPS/GLONASS receiver. The NMEA messages and the corresponding information content are listed in Table 2. The matching talker identifiers for each NMEA message are also listed in Table 2. The combination of talker identifiers and the NMEA messages is used for reporting satellite and navigation information under different satellite constellations. The detail is explained in the following.

Table 2: Supported NMEA Message List

NMEA Message	**Information Content**	**Possible Talker Identifiers**
GGA	Time, position, and fix related data for the SkyTraq receiver.	GP
GNS	Time, position and fix related data of GPS, GLONASS or combined systems.	GN
GSA	Receiver operating mode, satellites used in the PVT solution, and DOP values.	GP, GL, GN
GSV	Number of satellites in view, satellite ID, elevation, azimuth and SNR value.	GP, GL
VTG	Course and speed relative to the ground.	GN
RMC	Time, date, position, course and speed data.	GN

GGA - Global Positioning System Fix Data
Time, position and fix related data for a GPS receiver.

Format:
$--GGA,hhmmss.ss,llll.lll,a,yyyyy.yyy,a,x,uu,v.v,w.w,M,x.x,M,,zzzz*hh<CR><LF>

Field	Name	Description
hhmmss.ss	UTC Time	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
llll.lll	Latitude	Latitude in ddmm.mmmm format Leading zeros transmitted
a	N/S Indicator	Latitude hemisphere indicator, ‘N’ = North, ‘S’ = South
yyyyy.yyy	Longitude	Longitude in dddmm.mmmm format Leading zeros transmitted
a	E/W Indicator	Longitude hemisphere indicator, 'E' = East, 'W' = West
x	GPS quality indicator	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
uu	Satellites Used	Number of satellites in use, (00 ~ 24)
v.v	HDOP	Horizontal dilution of precision, (00.0 ~ 99.9)
w.w	Altitude	mean sea level altitude (-9999.9 ~ 17999.9) in meter
x.x	Geoidal Separation	In meter
zzzz	DGPS Station ID	Differential reference station ID, 0000 ~ 1023 NULL when DGPS not used
hh	Checksum	

When the GGA message is turned on, the talker identifier is always set to GP, regardless of whether the position solution is based on GPS, GLONASS satellites or the combination.

GNS message:

Format:

$--GNS,hhmmss.ss,llll.lll,a,yyyyy.yyy,a,cc,uu,v.v,w.w,x.x,,*hh<CR><LF>

Field	Name	Description
hhmmss.ss	UTC Time	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
llll.lll,	Latitude	Latitude in ddmm.mmmm format Leading zeros transmitted
a	N/S Indicator	Latitude hemisphere indicator, ‘N’ = North, ‘S’ = South
yyyyy.yyy	Longitude	Longitude in dddmm.mmmm format Leading zeros transmitted
a	E/W Indicator	Longitude hemisphere indicator, 'E' = East, 'W' = West
cc	Mode Indicator	Two characters with the first indicate the use of GPS satellites, and the second indicate the use of GLONASS satellites. N: No fix A: Autonomous, non-differential mode D: Differential mode P: Precise, no SA, higher resolution (P-code) used R: Real Time Kinematic. System used in RTK mode with fixed integers F: Float RTK. Satellite system used in RTK mode. Floating integers E: Estimated (dead reckoning) Mode M: Manual Input Mode S: Simulator Mode
uu	Satellites Used	Number of satellites in use, (00 ~ 24)
v.v	HDOP	Horizontal dilution of precision, (00.0 ~ 99.9)
w.w	Altitude	Mean sea level altitude (-9999.9 ~ 17999.9) in meter
x.x	Geoidal Separation	In meter
hh	Checksum	

By default, the receiver uses the GNS message to report the position data. For the GNS message, currently supported talker identifier is GN. The mode indicator is used to denote which GNSS type is used in the navigation solution. There are two characters in the mode indicator. The first character is for GPS system while the second character is for GLONASS system. For example, when only GPS satellites are used for (non-differential) navigation solution, the mode indicator will be “AN”. When only GLONASS satellites are used for (non-differential) navigation solution, the mode indicator will be “NA”. Only when both GPS and GLONASS satellites are used in the (non-differential) navigation solution, the mode indicator will become “AA”.

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.

Format:
$--GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,u.u,v.v,z.z*hh<CR><LF>

Field	Name	Description
a	Mode	Mode 'M' = Manual, forced to operate in 2D or 3D mode 'A' = Automatic, allowed to automatically switch 2D/3D
x	Mode	Fix type 1 = Fix not available 2 = 2D 3 = 3D
xx	Satellite used 1~12	Satellite ID number, 01 to 32, of satellite used in solution, up to 12 transmitted
u.u	PDOP	Position dilution of precision (00.0 to 99.9)
v.v	HDOP	Horizontal dilution of precision (00.0 to 99.9)
z.z	VDOP	Vertical dilution of precision (00.0 to 99.9)
hh	Checksum	

When only GPS satellites are used in position solution, the talker identifier is GP. When only GLONASS satellites are used in position solution, the talker identifier is GL. When both GPS and GLONASS satellite are used together in the position solution, the talker identifier will be GN. In the third case, the receiver creates two GSA sentences for every epoch. The first GNGSA sentence is used for GPS satellites while the second one is for the GLONASS satellites. In the GSA message, the satellite ID number of the GLONASS satellite is 64+satellite slot number.

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

Format:
$--GSV,x,u,xx,uu,vv,zzz,ss,uu,vv,zzz,ss,…,uu,vv,zzz,ss*hh<CR><LF>

Field	**Name**	**Description**
x	Number of message	Total number of GSV messages to be transmitted (1-3)
u	Sequence number	Sequence number of current GSV message
xx	Satellites in view	Total number of satellites in view (00 ~ 12)
uu	Satellite ID	Satellite ID number, GPS: 01 ~ 32, SBAS: 33 ~ 64 (33 = PRN120)
vv	Elevation	Satellite elevation in degrees, (00 ~ 90)
zzz	Azimuth	Satellite azimuth angle in degrees, (000 ~ 359)
ss	SNR	C/No in dB (00 ~ 99) Null when not tracking
hh	Checksum	

The GSV sentence has two possible talker identifiers: GP and GL. The GPS/GLONASS receiver outputs separate GSV sentences to report satellite information for GPS and GLONASS systems. The GPGSV is for GPS satellites while GLGSV is for GLONASS satellites. The GN identifier is not supported in GSV message. In the GSV message, the satellite ID number of the GLONASS satellite is 64+satellite slot number.

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

Format:
$--RMC,hhmmss.sss,x,llll.lll,a,yyyyy.yyy,a,x.x,u.u,xxxxxx,,,v*hh<CR><LF>

Field	Name	Description
hhmmss.sss	UTC time	UTC time in hhmmss.sss format (000000.000 ~ 235959.999)
x	Status	Status 'V' = Navigation receiver warning 'A' = Data Valid
llll.lll	Latitude	Latitude in dddmm.mmmm format Leading zeros transmitted
a	N/S indicator	Latitude hemisphere indicator 'N' = North 'S' = South
yyyyy.yyy	Longitude	Longitude in dddmm.mmmm format Leading zeros transmitted
a	E/W Indicator	Longitude hemisphere indicator 'E' = East 'W' = West
x.x	Speed over ground	Speed over ground in knots (000.0 ~ 999.9)
u.u	Course over ground	Course over ground in degrees (000.0 ~ 359.9)
xxxxxx	UTC Date	UTC date of position fix, ddmmyy format
v	Mode indicator	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'S' = Simulator mode
hh	checksum	

The GPS/GLONASS receiver uses talker identifier GN for the RMC messages to indicate that it is operating in the combined GPS/GLONASS mode.

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

Format:
$--VTG,x.x,T,,M,v.v,N,u.u,K,m*hh<CR><LF>

Field	Name	Description
x.x	Course	True course over ground in degrees (000.0 ~ 359.9)
v.v	Speed	Speed over ground in knots (000.0 ~ 999.9)
u.u	Speed	Speed over ground in kilometers per hour (0000.0 ~ 1800.0)
m	Mode	Mode indicator 'N' = not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'S' = Simulator mode
hh	Checksum	

The GPS/GLONASS receiver uses talker identifier GN for the VTG messages to indicate that it is operating in the combined GPS/GLONASS mode.

In the following examples, we illustrate the use of GNS/GSA/GSV messages for different satellite constellations.

Examples:

Case 1: Only GPS satellites are available for the navigation solution.

$GNGNS,083613.333,2447.0963,N,12100.5393,E,AN,07,1.6,138.8,19.6,,0000*60
$GPGSA,A,3,03,19,24,08,20,32,28,,,,,2.7,1.0,2.5*23
$GPGSV,3,1,12,11,82,240,20,07,62,241,21,08,45,304,28,19,35,038,31*72
$GLGSV,1,1,01,75,67,268,25,,,,,,,,,,,,*B3 (this sentence is present if GLONASS satellites are tracked by the receiver)
:
:
:

Case 2: Only GLONASS satellites are available for the navigation solution.

$GNGNS,083613.333,2447.0963,N,12100.5393,E,NA,04,1.6,138.8,19.6,,0000*60
$GLGSA,A,3,71,72,87,86,,,,,,,,,2.7,1.0,2.5*25
$GPGSV,1,1,1,11,82,240,20,,,,,,,,,,,,*2A (this sentence is present if GPS satellites are tracked by the receiver)
$GLGSV,2,1,05,71,73,268,38,72,45,279,37,87,42,000,33,86,36,287,35*65
$GLGSV,2,2,05,74,39,268,28,,,,,,,,,,,,*34
:
:
:

Case 3: Both GPS and GLONASS satellites are available for the navigation solution.

$GNGNS,083613.333,2447.0963,N,12100.5393,E,AA,08,1.6,138.8,19.6,,0000*60
$GNGSA,A,3,03,19,24,08,20,32,,,,,,,2.7,1.0,2.5*23
$GNGSA,A,3,87,72,,,,,,,,,,,,2.7,1.0,2.5*25
$GPGSV,3,1,7,03,82,240,41,19,62,241,40,24,45,304,39,08,35,038,38*72
$GPGSV,3,2,7,20,35,143,38,32,51,221,37,02,04,135,27,,,,*72
$GLGSV,1,1,03,87,73,268,38,72,42,041,36,65,36,287,,,,,*78
:
:

Summary
The supported NMEA messages of SkyTraq GPS/GLONASS receiver and the meaning are summarized in the following list.

NMEA message with the talker identifier	Meaning
GPGGA	The fix data from GPS/GLONASS receiver.
GNGNS	The fix data from GPS/GLONASS receiver.
GPGSA	The information of the satellites used in GPS-only navigation solution
GLGSA	The information of the satellites used in GLONASS-only navigation solution
GNGSA	Navigation solution based on combined satellite systems is provided. Two sentences are output for every navigation epoch. The first and the second sentence provide information about GPS and GLONASS satellites which are used in the navigation solution, respectively.
GPGSV	The information of the GPS satellites in view of the receiver.
GLGSV	The information of the GLONASS satellites in view of the receiver.
GNRMC	Time, date, position, course and speed information for GPS/GLONASS receiver.
GNVTG	Course and speed information relative to the ground for GPS/GLONASS receiver.

ORDERING INFORMATION

Model Name	Description
S1722G2F	Flash Version GLONASS/GPS Receiver Module