General Description

The GGM-5853F5-SKF4P100 is a satellite navigation receiver capable of using L5 NavIC , L1 GAGAN / GPS / GLONASS signal to provide 3D navigation in a single compact SMD module.The GGM-5853F5-SKF4P100 has 56 tracking channels and could track all in-view satellites. It is fully autonomous such that once power is applied, the receiver automatically searches, acquires and tracks satellite signals. When a sufficient number of satellites are tracked with valid measurements, the receiver produces 3D position and velocity outputs.

NavIC + GPS/GLONASS triple-satellite capability enables using greater number of satellite signal than GPS-only receivers. The increased satellite number offers superior performance in challenging urban canyon and multipath environments.

The GGM-5853F5-SKF4P100 module contains SkyTraq Venus 8 positioning engine inside, featuring high sensitivity, low power consumption, and fast TTFF. The superior cold start sensitivity allows it to acquire, track, and get position fix autonomously in difficult weak signal environment. The receiver's superior tracking sensitivity allows continuous position coverage in nearly all outdoor application environments. The high performance signal parameter search engine is capable of testing 16 million time-frequency hypotheses per second, offering superior signal acquisition and TTFF speed.

Applications

- LBS (Location Based Service)
- PND (Portable Navigation Device)
- Vehicle navigation system
- Mobile phone

Figure: GGM-5853F5-SKF4P100 Top View

Features

- Build on high performance, low-power SkyTraq Venus 8 chip set
- Ultra high Track sensitivity: -165dBm
- L1 / L5 signal reception
- Works with NavIC, GAGAN, GPS,GLONASS
- Extremely fast TTFF at low signal level (Less than 30 second cold start TTFF & 1 second hot start).
- Multipath detection and suppression
- Works with passive and active antenna
- Low power consumption: Max 110mA@5.0V
- Operating voltage: 3.3V to 5.5V
- NMEA-0183 compliant protocol or custom protocol
- Operating temperature range: -40to85℃
- Patch Antenna Size: 35x35x4mm & 25x25x4mm
- Small form factor: 52.7±0.5x57.6±0.5x20.72±0.5mm
- Communication type: UART
- Wire interface type: 4Pin, L=100cm
- Waterproofing grade: IP67
- RoHS compliant (Lead-free)

1. Functional Description

1.1. Key Features

Table 1: Key Features

Parameter	Specification
Power Supply	• Supply voltage: 3.3V~5.5V Typical: 5.0V
Power Consumption	• Acquisition: 110mA @VCC=5.0V • Tracking: 65mA @VCC=5.0V
Receiver Type	• Code 56 search channels ,22 synchronous tracking channels • L5 NavIC, L1 GAGAN/GPS/GLONASS C/A code Venus 8 engine
Sensitivity	• Better than -145/-144dBm GNSS/NavIC cold-start • Better than -154/-153dBm GNSS/NavIC hot-start • Better than -155/-154dBm GNSS/NavIC re-acquisition • Better than -160/-156dBm GNSS/NavIC tracking
TTFF (Autonomous)	• Cold start: 35s typ @-130dBm • Warm start: 30s typ @-130dBm • Hot start: 1s typ @-130dBm
Horizontal Position Accuracy (Autonomous)	• <2.5m CEP @-130 dBm Velocity: 0.1m/sec Time : 12nsec
Update Rate	• 1 / 2 / 4 / 5 / 8 / 10 Hz
TTFF (Autonomous)	• Cold start : 30s typ @-130dBm • Warm start : 25s typ @-130dBm • Hot start : 1s typ @-160dBm
A-GPS	• 7-day server-based AGPS • Self-aided ephemeris estimation
Dynamic Performance	• Maximum altitude: 18,000m • Maximum velocity: 515m/s • Acceleration: 4G (39.2m/sec^2) acceleration
Datum	• Default WGS-84, User definable
UART Port	• UART Port: TXD and RXD • Supports baud rate from 4800bps to 115200bps, 9600bps by default • UART port is used for NMEA output, MTK proprietary commands input.
Temperature Range	• Normal operation: -40°C ~ +85°C • Storage temperature: -55°C ~ +100°C • Humidity: 5% ~ 95%
Physical Characteristics	• Size: 52.7±0.50 × 57.6±0.50 ×20.72±0.50mm • Connecting line specifications: 4Pin, L=100cm • Weight: Approx.45g

1.2. Block Diagram

The GGM-5853F5-SKF4P100 is a high performance L5 NavIC + L1 GAGAN/GPS/GLONASS satellite navigation receiver in a compact surface mount package. It is based on the SkyTraq Venus 8 positioning technology, providing high performance signal acquisition and tracking. The simple UART serial interface and the standard NMEA-0183 protocol make usage of GGM-5853F5-SKF4P100 very easy and straightforward.

The GGM-5853F5-SKF4P100 module performs all the necessary system initialization, signal acquisition, signal tracking, da

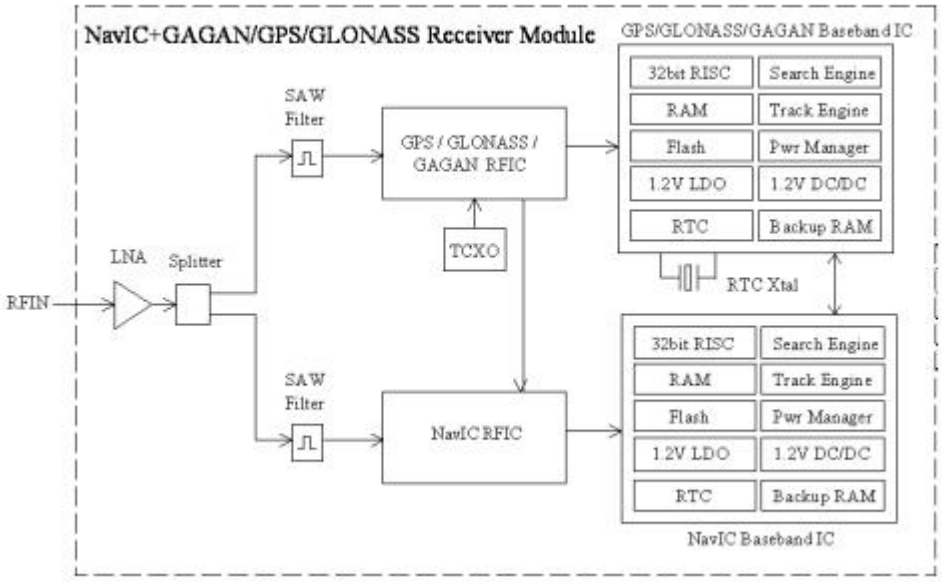

Figure 1: Block Diagram

2. Application

The module is equipped with a 4-pin DIP pad that connects to your application platform. Sub-interfaces included in the pad are described in details in the following chapters.

2.1. Pin Assignment

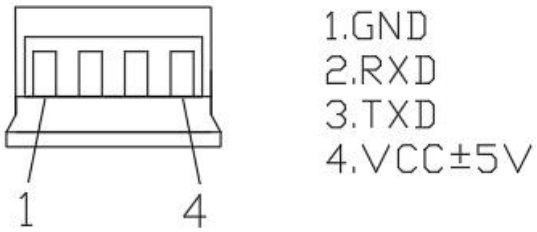

Figure 2: Pin Assignment

2.2. Pin Definition

Pin No.	Pin name	I/O	Description	Remark
1	GND	G	Ground	
2	RXD	I	UART Serial Data input	
3	TXD	O	UART Serial Data output	
4	VCC	I	Module Power Supply	3.3V-5.5V

2.3. Mechanical Dimensions

This chapter describes the mechanical dimensions of the GGM-5853F5-SKF4P100 Gmouse. Size unit（mm）.

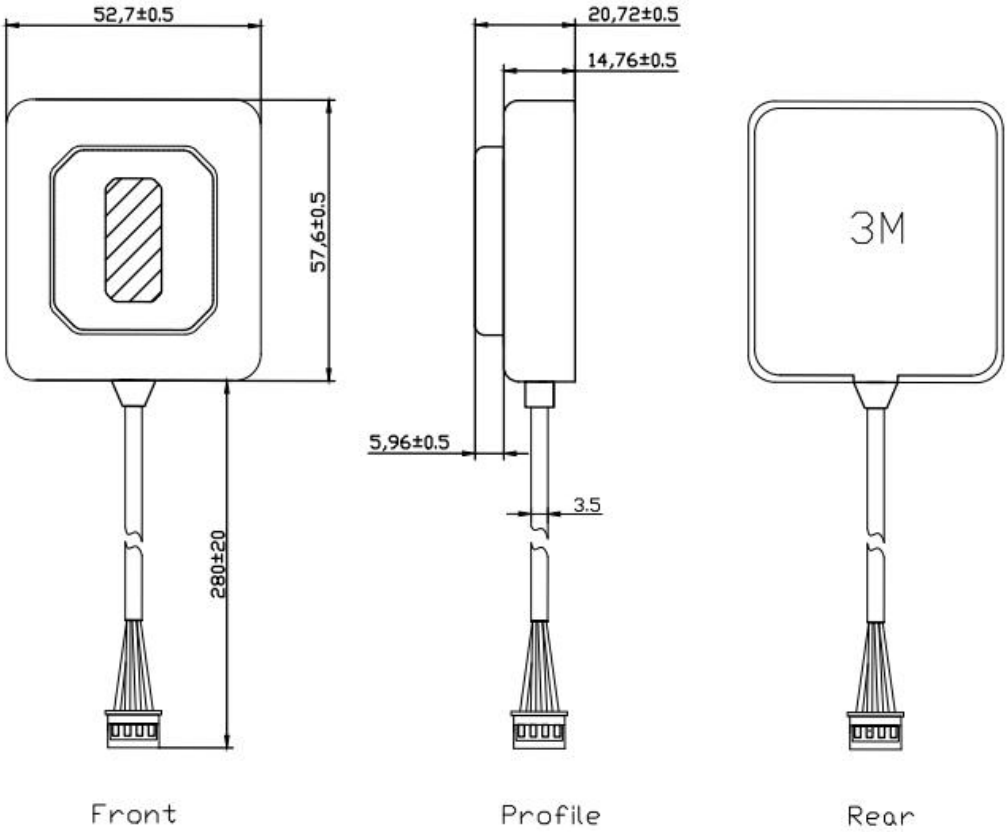

Figure 3: Specification size chart

2.4. Electrical Specification

Absolute Maximum Ratings

Parameter	Minimum	Maximum	Condition
Supply Voltage (VCC)	-0.5	5.5	Volt
Input Pin Voltage	-0.5	VCC+0.5	Volt
Storage Temperature	-55	+100	degC

2.5.Operating Conditions

Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC)	3.3	5.0	5.5V	Volt
Acquisition Current (exclude active antenna current)		106		mA
Tracking Current (exclude active antenna current)		96		mA
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

2.6.UART port:

TXD: Send data to the RXD1 signal line of DTE.
RXD: Receive data from the TXD1 signal line of DTE.

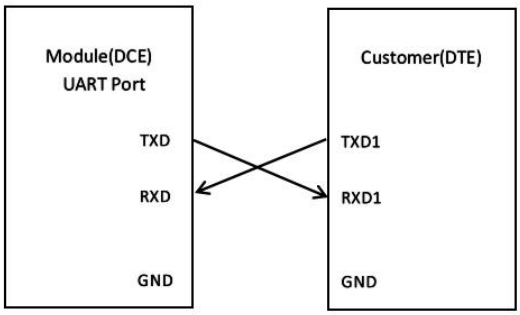

Figure 4: Connection of Serial Interfaces

3. UART port features:

This UART port has the following features:

- UART port can be used for NMEA Protocol output and proprietary commands input.
- The default output NMEA type setting is GGA, GLL, GSA, GSV, VTG, RMC, and ZDA.
- UART port supports the following data rates:
  4800, 9600, 14400, 19200, 38400, 57600, 115200bps.
  The default setting is 9600bps, 8 bits, no parity bit, 1 stop bit.
- Hardware flow control and synchronous operation are not supported.

The UART port does not support the TTL level but only CMOS level. If the module's UART port is connected to the UART port of a computer, it is necessary to add a level shift circuit between the module and the computer. Please refer to the following figure.

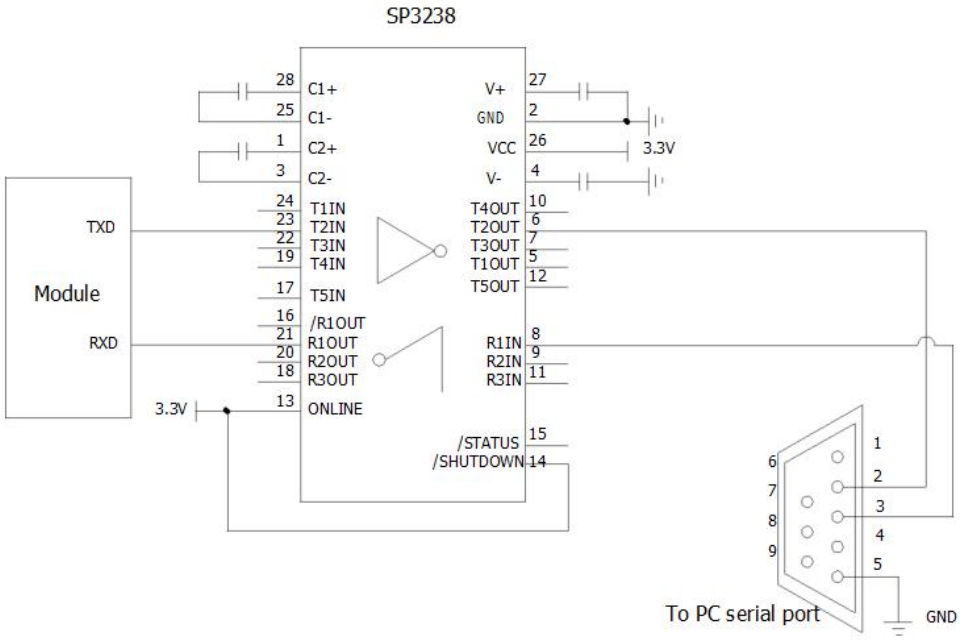

Figure 5: RS-232 Level Shift Circuit

Antenna Type	Passive	Active
GAGAN/GPS Frequency (MHz)	1575.42 +/- 2	1575.42 +/- 2
GLONASS Frequency (MHz)	1602 +/- 4	1602 +/- 4
NavIC Frequency (MHz)	1176.45 +/- 2	1176.45 +/- 2
VSWR	< 2 (typical)	< 2 (typical)
Polarization	RHCP	RHCP
Antenna Gain	> 0dBi	> -2dBi
LNA Gain		20dB (typical)
Noise Figure		< 1.5dB
Total Gain		> 18dBi

4.Power Supply Requirement

GGM-5853F5-SKF4P100 requires a stable power supply, avoid ripple on VCC pin (<50mVpp). Power supply noise can affect the receiver's sensitivity. Bypass capacitors of 10uF and 0.1uF is recommended to be placed close to the module VCC pin; the values could be adjusted according to the amount and type of noise present on the supply line.

5.ESD handling precautions

GGM-5853F5-SKF4P100 series modules are Electrostatic Sensitive Devices (ESD). Observe precautions for handling! Failure to observe these precautions can result in severe damage to the GPS receiver!

GPS receivers are Electrostatic Sensitive Devices (ESD) and require special precautions when handling. Particular care must be exercised when handling patch antennas, due to the risk of electrostatic charges. In addition to standard ESD safety practices, the following measures should be taken into account whenever handling the receiver:

- ✧ Unless there is a galvanic coupling between the local GND (i.e. the work table) and the PCB GND, then the first point of contact when handling the PCB must always be between the local GND and PCB GND.
- ✧ Before mounting antenna patch,connect ground of the device When handling the RF pin, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (e.g. patch antenna ~10pF, coax cable ~50-80pF/m, soldering iron, …)
- ✧ To prevent electrostatic discharge through the RF input, do not touch any exposed antenna area. If there is any risk that such exposed antenna area is touched in non ESD protected work area, implement proper ESD protection measures in the design.
- ✧ When soldering RF connectors and patch antennas to the receiver's RF pin, make sure to use an ESD safe soldering iron (tip).

Table 1: ESD Endurance Table (Temperature : 25°C, Humidity: 45%)

Pin	Contact Discharge	Air Discharge
VCC	±5KV	±10KV
UART	±3KV	±6KV
Others	±2KV	±4KV

6. NMEA 0183 Protocol

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:

$aaccc,c–c*hh<CR><LF>

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

Table 3: The NMEA sentence structure

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

Table 4: Overview of SkyTraq receiver's NMEA messages

$GNGGA	Time, position, and fix related data of the receiver.
$GNGLL	Position, time and fix status.
$GNGSA **$GPGSA** **$GLGSA** **$GIGSA**	Used to represent the ID's of satellites which are used for position fix. When GPS,GLONASS and NavIC satellites are used in position solution, a $GNGSA sentence is used for GPS satellites, a $GNGSA sentence is used for GLONASS satellites, and a $GNGSA sentence is used for NavIC satellites. When only GPS satellites are used for position fix, a single $GPGSA sentence is output. When only GLONASS satellites are used for position fix, a single $GLGSA sentence is output. When only NavIC satellites are used, a single $GIGSA sentence is output.
$GPGSV **$GLGSV** **$GIGSV**	Satellite information about elevation, azimuth and CNR, $GPGSV is used for GPS satellites, $GLGSV is used for GLONASS satellites, while $GIGSV is used for NavIC satellites
$GNRMC	Time, date, position, course and speed data.
$GNVTG	Course and speed relative to the ground.
$GNZDA	UTC, day, month and year and time zone.

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

6.1 GGA – Global Positioning System Fix Data

Time, position and fix related data for a GNSS receiver.
Structure:
$GNGGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,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,175258.000,2447.0870,N,12100.5221,E,2,15,0.7,95.2,M,19.6,M,,0000*72<CR><LF>

Field	Name	Example	Description
1	UTC Time	175258.000	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
2	Latitude	2447.0870	Latitude in ddmm.mmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
4	Longitude	12100.5221	Longitude in dddmm.mmmm format Leading zeros transmitted
5	E/W Indicator	E	Longitude hemisphere indicator, 'E' = East, 'W' = West

6	Quality Indicator	2	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 6: Estimated (dead reckoning) Mode
7	Satellites Used	15	Number of satellites in use, (00 ~ 56)
8	HDOP	0.7	Horizontal dilution of precision, (0.0 ~ 99.9)
9	Altitude	95.2	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	72	

6.2 GLL – Latitude/Longitude

Latitude and longitude of current position, time, and status.
Structure:
$GNGLL,ddmm.mmmm,a,dddmm.mmmm,a,hhmmss.sss,A,a*hh<CR><LF>
1 2 3 4 5 6 7 8
Example:
$GNGLL,2447.0870,N,12100.5221,E,175258.000,A,D*42<CR><LF>

Field	Name	Example	Description
1	Latitude	2447.0870	Latitude in ddmm.mmmm format Leading zeros transmitted
2	N/S Indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
3	Longitude	12100.5221	Longitude in dddmm.mmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
5	UTC Time	175258.000	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 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode
8	Checksum	42	

6.3 GSA – GNSS DOP and Active Satellites

GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA sentence and DOP values.
Structure:
$GNGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,x*hh<CR><LF>
1 2 3 3 3 3 3 3 3 3 3 3 3 3 4 5 6 7 8
Example:
$GNGSA,A,3,21, 12,15,18,20,24,10,32,25,13,,,1.2,0.7,1.0,1*18<CR><LF>
$GNGSA,A,3,03,04,05,07,,,,,,,,,1.2,0.7,1.0,4*34<CR><LF>
$GNGSA,A,3,76,86,71,72,65,85,87,77,,,,,1.0,0.5,0.9,2*32

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	21, 12, 15, 18, 20, 24, 10, 32, 25, 13	01 ~ 32 are for GPS; 33 ~ 64 are for SBAS (PRN minus 87); 65 ~ 96 are for GLONASS (64 plus slot numbers); 01 ~ 07 are for NavIC. GPS, GLONSS and NavIC satellites are differentiated by the GNSS System ID. Maximally 12 satellites are included in each GSA sentence.
4	PDOP	1.2	Position dilution of precision (0.0 to 99.9)
5	HDOP	0.7	Horizontal dilution of precision (0.0 to 99.9)
6	VDOP	1.0	Vertical dilution of precision (0.0 to 99.9)
7	GNSS System ID	1	1 for GPS, 2 for GLONASS, 4 for NavIC
8	Checksum	18	

6.4 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,4,1,13,02,72,109,43,24,69,035,48,18,52,330,42,21,49,246,43,1*69<CR><LF>
$GPGSV,4,2,13,20,47,118,42,15,39,046,44,41,39,242,41,12,28,129,42,1*68<CR><LF>
$GPGSV,4,3,13,10,25,321,38,25,15,170,35,32,14,278,36,13,06,063,35,1*64<CR><LF>
$GPGSV,4,4,13,05,04,126,36,1*57<CR><LF>
$GIGSV,2,1,07,07,63,158,46,05,61,202,44,04,57,199,44,03,39,243,42,4*7F<CR><LF>
$GIGSV,2,2,07,01,00,000,39,02,00,000,24,06,00,266,,4*44<CR><LF>
$GLGSV,3,1,09,72,60,135,48,71,40,047,50,86,37,048,50,87,30,336,49,1*7B<CR><LF>
$GLGSV,3,2,09,65,24,184,44,77,23,278,43,76,16,218,44,85,05,095,40,1*7E<CR><LF>
$GLGSV,3,3,09,78,00,000,31,1*4C<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	13	Total number of satellites in view (00 ~ 20)
4	Satellite ID	02	01 ~ 32 are for GPS; 33 ~ 64 are for SBAS (PRN minus 87); 65 ~96 are for GLONASS (64 plus slot numbers); 01 ~ 07 are for NavIC. GPS, GLONASS and NavIC satellites are differentiated by the GNSS System ID. Maximally 4 satellites are included in each GSV sentence.
5	Elevation	72	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	109	Satellite azimuth angle in degrees, (000 ~ 359)
7	SNR	43	C/No in dB (00 ~ 99) Null when not tracking
8	Signal ID	1	1 for L1/CA, 4 for L5/CA
9	Checksum	69	

6.5 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.mmmm,a,dddmm.mmmm,a,x.x,x.x,ddmmyy,,,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11
Example:
$GNRMC,175258.000,A,2447.0870,N,12100.5221,E,000.0,000.0,220617,,,D*75<CR><LF>

Field	Name	Example	Description
1	UTC time	175258.000	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.0870	Latitude in dddmm.mmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.5221	Longitude in dddmm.mmmm 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	220617	UTC date of position fix, ddmmyy format
10	Mode indicator	D	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode
11	checksum	75	

6.6 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><L>
1 2 3 4 5
Example:
$GNVTG,000.0,T,,M,000.0,N,000.0,K,D*16<CR><LF>

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

6.7 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,175258.000,22,06,2017,00,00*46<CR><LF>

Field	Name	Example	Units	Description
1	UTC time	175258.000		UTC time in hhmmss.ss format (000000.00 ~ 235959.99)
2	UTC Day	22		UTC time: day (01 ~ 31)
3	UTC Month	06		UTC time: month (01 ~ 12)
4	UTC Year	2017		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	46		Checksum

6.8 IRNSF-NavIC Sub-Frame Data (Periodic)

Sub - frame data decoded after preamble. It begins with telemetry word (TLM) and ends with tail bits.
Structure:
$PIRNSF, x, x, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx, xx,
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

xx, xx, xx, xx, xx, xx, xx, xx, xx, x *hh <CR> <LF>

30 31 32 33 34 35 36 37 38 39 40
Example:

$PIRNSF,3,1,8B,1F,AA,83,A2,17,54,18,09,9C,00,0B,D4,BF,40,05,E8,B8,F8,43,2D,E2,C5,7F,F4,00,0E,D8,B2,BB,CB,9A,00,B2,12,D0,0*0C<CR><LF>

Field	Name	Example	Description
1	SVID	3	NAVIC Satellite PRN
2	SFID	1	Sub - frame ID (1 - 4)
3~38	SF_DATA	8B~D0	Decoded sub - frame data after preamble, begin with telemetry word (TLM).
39	SF_DATA	0	Decoded sub - frame data Tail bits.
40	Checksum	0C	

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