



GPS Module DataSheet

Name: Ultra High Sensitivity and Low Power GPS Receiver Module

Model NO.: SKG16A

Revision: 002

Revision History:

Revision	Description	Approved	Date
001	Initial Release to 001	Neil	20090410
002	Added USB interface functions	Neil	20100701

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SkyNav SKG16A

Ultra High Sensitivity and Low Power GPS Receiver Module



General Description

The SkyNav SKG16A is a complete GPS engine module that features super sensitivity, ultra low power and small form factor. The GPS signal is applied to the antenna input of module, and a complete serial data message with position, velocity and time information is presented at the serial interface with NMEA protocol or custom protocol.

It is based on the high performance features of the MediaTek 3329 single-chip architecture, Its -165dBm tracking sensitivity extends positioning coverage into place like urban canyons and dense foliage environment where the GPS was not possible before. The small form factor and low power consumption make the module easy to integrate into portable device like PNDs, mobile phones, cameras and vehicle navigation systems.



Figure 1: SKG16A Top View

Features

- Ultra high sensitivity: -165dBm
- Extremely fast TTFF (Time To First Fix) at low signal level
- Low power consumption: Typical $45\text{mA}@3.3\text{V}$
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage: 3.0V to 4.2V
- Operating temperature range: -40 to 85°C
- SMD type with stamp holes
- Small form factor: $13.1 \times 15.9 \times 2.7\text{mm}$
- RoHS compliant (Lead-free)

Applications

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

Pin Assignment

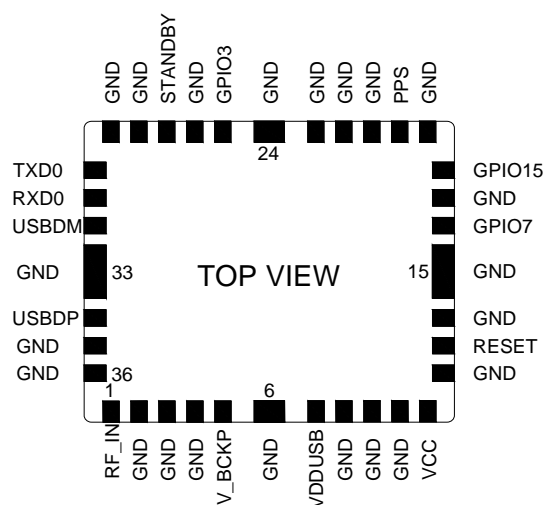


Figure 2: SKG16A Pin Package

Performance Specification

Parameter	Specification	
Receiver Type	L1 frequency band, C/A code, 22 Tracking / 66 Acquisition-Channel	
Sensitivity	Tracking	-165dBm
	Acquisition	-148dBm
Accuracy	Position	3.0m CEP50 without SA(Typical Open Sky)
	Velocity	0.1m/s without SA
	Timing (PPS)	60ns RMS
Acquisition Time	Cold Start	36s(Typical Open Sky)
	Warm Start	33s
	Hot Start	1s
	Re-Acquisition	<1s
Power Consumption	Tracking	40mA @3.3V Typical
	Acquisition	45mA @3.3V
Navigation Data Update Rate	1Hz	Max 10Hz
Operational Limits	Altitude	Max 18,000m
	Velocity	Max 515m/s
	Acceleration	Less than 4g

Interfaces Configuration

Power Supply: Regulated power for the SKG16A is required. The input voltage Vcc should be 3.0V to 4.2V range, current is no less than 100mA. Suitable decoupling must be provided by external decoupling circuitry(10uF and 1uF). It can reduce the Noise from power supply and increase power stability.

Antenna: The SKG16A GPS receiver is designed for supporting the active antenna or passive antenna connected with pin RF_IN. The gain of active antenna should be no more than 25dB. The maximum noise figure should be no more than 1.5dB and output impedance is at 50 Ohm.

UART Ports: The module supports one full duplex serial channels UART. the serial connections are at 2.85V LVTTTL logic levels, if need different voltage levels, use appropriate level shifters. the data format is however fixed: X, N, 8, 1, i.e. X baud rate, no parity, eight data bits and one stop bit, no other data formats are supported, LSB is sent first. It is strap pin, default must pull up. The RXD0 & TXD0 recommended to pull up

(10KΩ). It can increase the stability of serial data.

Backup Battery Power: In case of a power failure on pin VCC, real-time clock and backup RAM are supplied through pin V_BCKP. This enables the SKG16A GPS Receiver to recover from power failure with either a hot start or a warm start (depending on the duration of Vcc outage). If no Backup Battery is connected, the receiver performs a cold start upon powered up. If you use backup battery, should be adding a bypassing capacitor (1uF) at V_BCKP pin. It can reduce noise and increase the stability.

USB Ports: The SKG16A has built-in high speed USB 2.0 interface which can be used to interface host devices. Only support 3.3V power supply. Do not connect USB +5V supply to VDDUSB; instead use external +3.3V regulator powered from USB +5V supply.

GPIO: The GPIOs functions are for customer used. it recommended to connect to serial resistance(220Ω), if use the GPIO function. If no use GPIO functions, it doesn't connect anything.

Pin Description

Pin No.	Pin name	I/O	Description	Remark
1	RF_IN	I	GPS Signal Input	50Ω@1.57542GHz
2	GND	G	Ground	GND
3	GND	G	Ground	GND
4	GND	G	Ground	GND
5	V_BCKP	I	RTC and backup SRAM power (2.0-4.3V)	May be connect to Battery or Power Supply
6	GND	G	Ground	GND
7	VDDUSB	P	USB Supply (Only Support 3.3V Power)	Connect 3.3V : enable USB
8	GND	G	Ground	GND
9	GND	G	Ground	GND
10	GND	G	Ground	GND
11	VCC	I	Module Power Supply	Operating range: 3.0V to 4.2V
12	GND	G	Ground	GND
13	RESET	I	Module Reset (Active Low Status)	Leave open if not used
14	GND	G	Ground	GND
15	GND	G	Ground	GND
16	GPIO7	I/O	General purpose I/O	Leave Open if not used
17	GND	G	Ground	GND
18	GPIO15	I/O	General purpose I/O	Leave Open if not used
19	GND	G	Ground	GND
20	PPS	O	Time pulse Signal (Default 100ms pulse/sec)	Leave Open if not used
21	GND	G	Ground	GND
22	GND	G	Ground	GND
23	GND	G	Ground	GND
24	GND	G	Ground	GND
25	GPIO3	I/O	General purpose I/O	Leave Open if not used
26	GND	G	Ground	GND
27	STANDBY	I	STANDBY Control Input Pin	Currently version do not support
28	GND	G	Ground	GND
29	GND	G	Ground	GND
30	TXD0	O	UART Serial Data Output 0	Leave Open if not used
31	RXD0	I	UART Serial Data Input 0	Leave Open if not used
32	USBDM	O	USB Data	Leave Open if not used
33	GND	G	Ground	GND
34	USBDP	I	USB Data	Leave Open if not used
35	GND	G	Ground	GND
36	GND	G	Ground	GND

Note : The Main Power supply Vcc has to be switched on simultaneously or before the USB power supply VDDUSB. Use external +3.3V regulator powered from USB +5V supply.

Electrical Characteristics

Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	VCC	-0.3	4.2	V
USB supply voltage	VDDUSB	-0.3	3.6	V
Input Pins				
Input voltage on any input connection	Vio	-0.3	3.6	V
Backup Battery	V_BCKP	-0.3	4.2	V
RF input power	RF_IN		10	dBm
Human Body Model ESD capability	RF_IN		2000	V
Machine Model ESD capability	RF_IN		100	V
Environment				
Storage Temperature	Tstg	-40	125	°C
Peak Reflow Soldering Temperature <10s	Tpeak		260	°C
Humidity			95	%

Note: Absolute maximum ratings are stress ratings only, and functional operation at the maxims is not guaranteed. Stress beyond the limits specified in this table may affect device reliability or cause permanent damage to the device. For functional operating conditions, refer to the operating conditions tables as follow.

The module is Electrostatic Sensitive Device (ESD) and may be damaged with ESD or spike voltage. Although it has built-in ESD protection circuitry at digital I/O, please handle with care to avoid permanent malfunction or performance degradation. Note that RFIN has no ESD protection circuits.

Recommended Operating Condition

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		3.0	3.3	4.2	V
USB supply voltage	VDDUSB			3.3		V
Backup Battery	V_BCKP		2.0	3.3	4.2	V
Power supply voltage ripple	Vcc_PP	Vcc=3.3V			30	mV
Supply current, navigation	Icc	Vcc=3.3V		45	50	mA
Supply current, backup state	Ibckp	Vcc=3.3V		8		uA
Input high voltage	V _{IH}		2.0		3.6	V
Input low voltage	V _{IL}		-0.3		0.8	V
Output high voltage	V _{OH}		2.4		3.1	V
Output low voltage	V _{OL}		-0.3		0.4	V
Operating temperature	Topr		-40		85	°C

Mechanical Specification

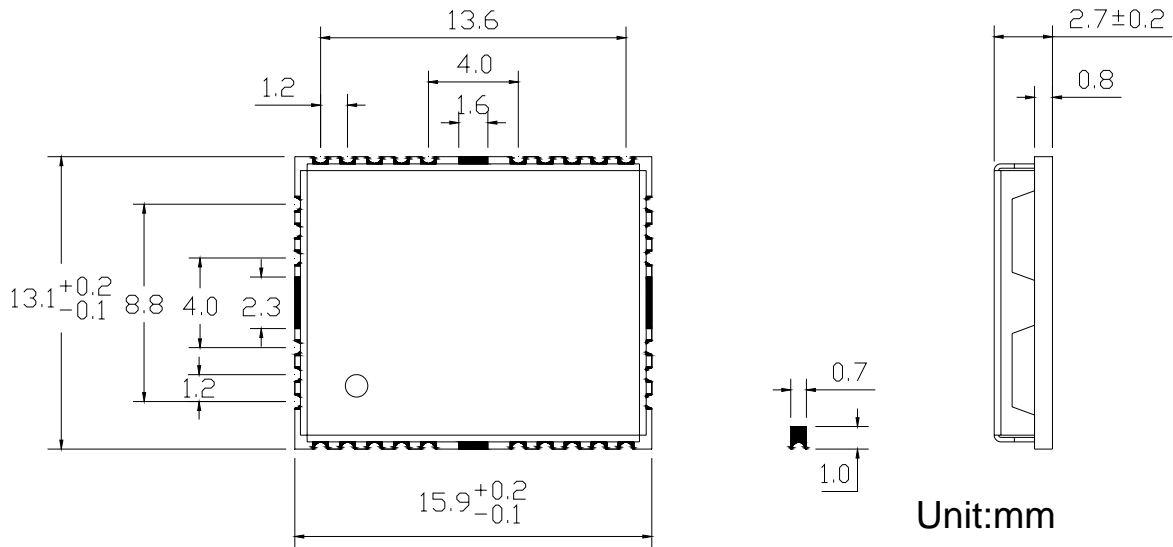


Figure 3: SKG16A Dimensions

Recommend Layout

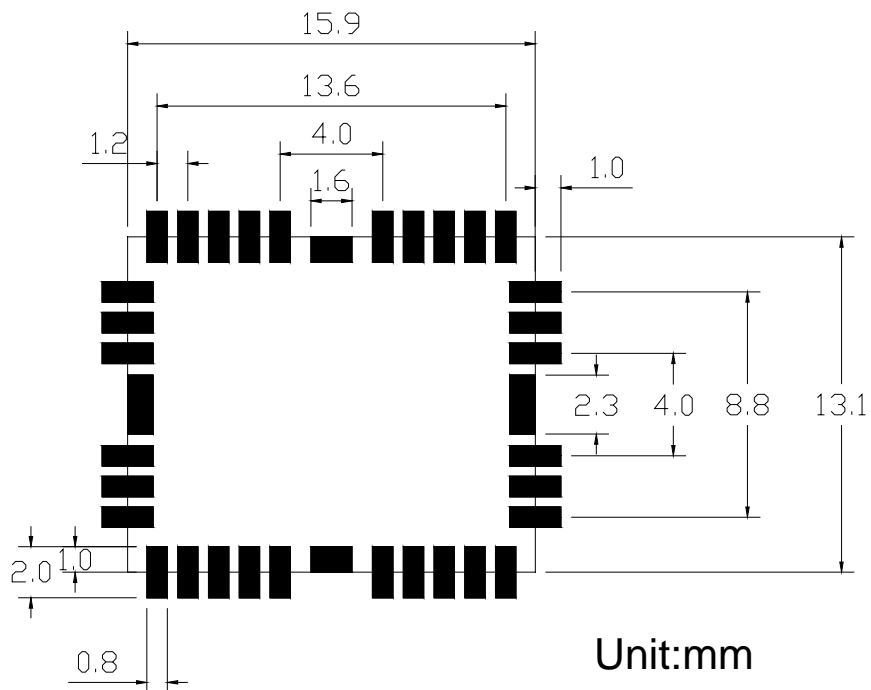


Figure 4: SKG16A Footprint

Packaging Specification

SKG16A modules are shipped in reel and with 1000 units per reel. Each tray is 'dry' package.

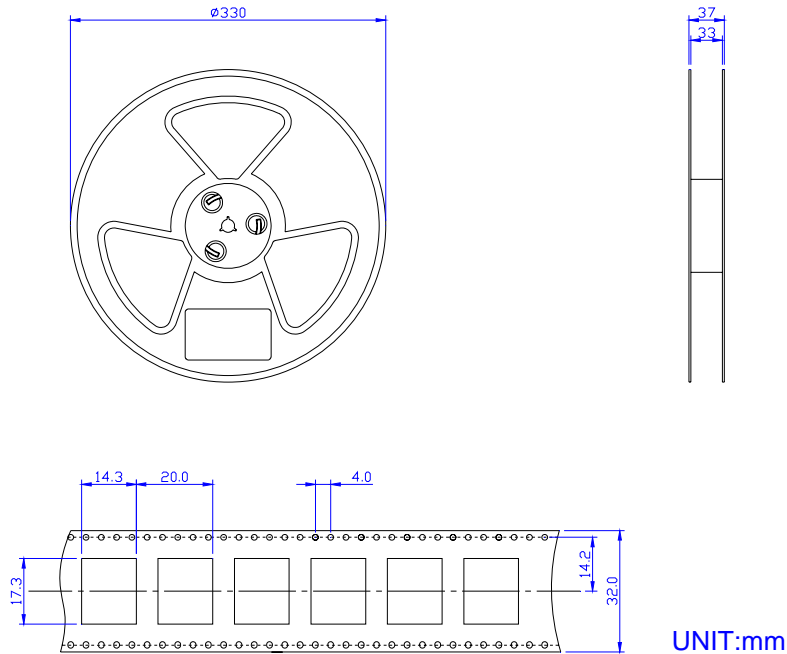


Figure 5: SKG16A Packaging

Manufacturing Process Recommendations

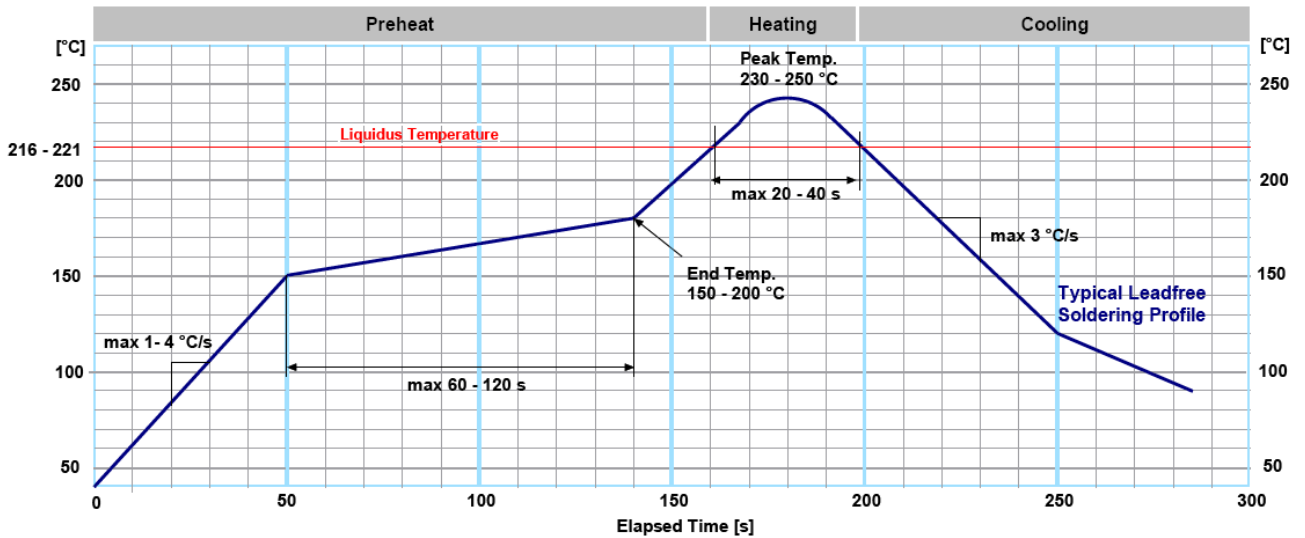


Figure 6: SKG16A Typical Leadfree Soldering Profile

Note: The final soldering temperature chosen at the factory depends on additional external factors like choice of soldering paste, size, thickness and properties of the baseboard, etc. Exceeding the maximum soldering temperature in the recommended soldering profile may permanently damage the module.

Reference design schematic

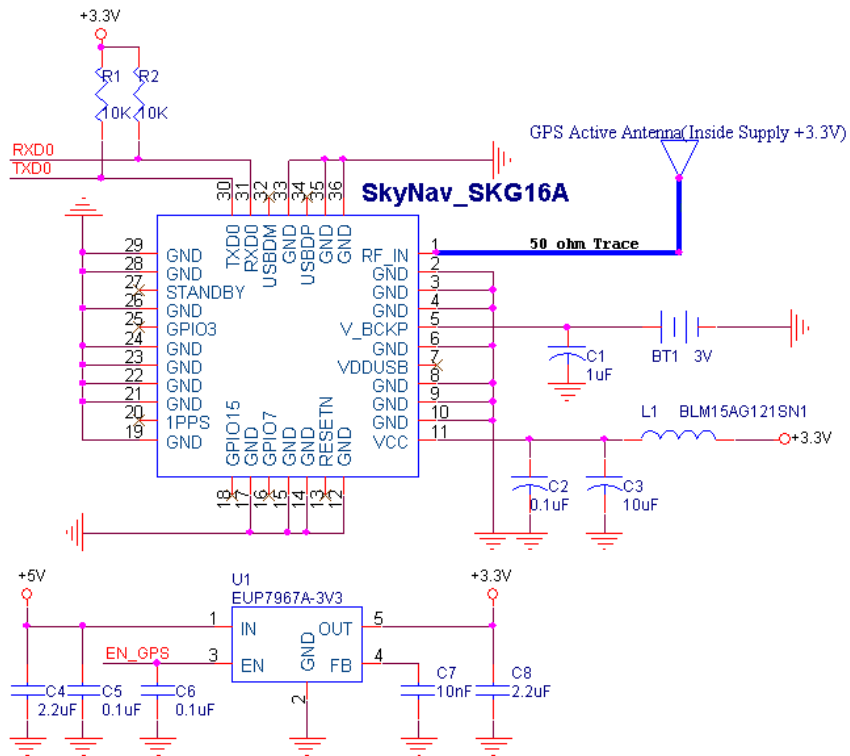


Figure 7: SKG16A_UART Typical Reference design schematic

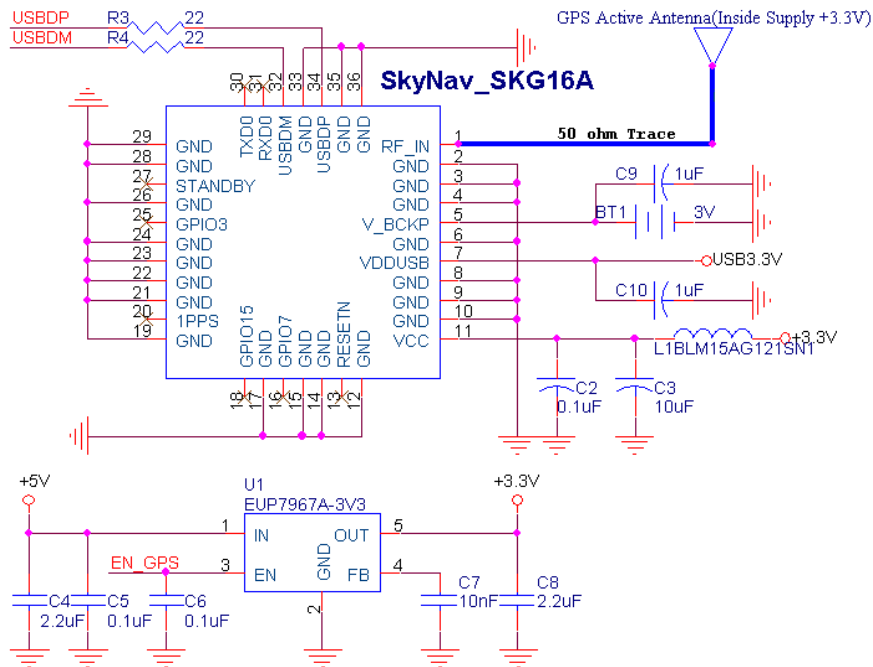


Figure 8: SKG16A_USB Typical Reference design schematic

Software Protocol

NMEA 0183 Protocol

The NMEA protocol is an ASCII-based protocol. Records start with a \$ and with carriage return/line feed. GPS specific messages all start with \$GPxxx where xxx is a three-letter identifier of the message data that follows. NMEA messages have a checksum, which allows detection of corrupted data transfers.

The SkyNav SKG12A supports the following NMEA-0183 messages: GGA, GLL, GSA, GSV, RMC, VTG, ZDA. The module default NMEA-0183 output is set up GGA, GSA, RMC, GSV, and default baud rate is set up 9600bps.

Table 1: NMEA-0183 Output Messages

NMEA Record	Description	Default
GGA	Global positioning system fixed data	Y
GLL	Geographic position—latitude/longitude	N
GSA	GNSS DOP and active satellites	Y
GSV	GNSS satellites in view	Y
RMC	Recommended minimum specific GNSS data	Y
VTG	Course over ground and ground speed	N
ZDA	Date and Time	N

GGA-Global Positioning System Fixed Data

This sentence contains the position, time and quality of the navigation fix.

See RMC for Fix Status, Fix Mode, Fix Date, Speed, and True Course.

See GSA for Fix Type, PDOP, and VDOP.

\$GPGGA,021514.000,2232.1799,N,11401.1823,E,1,6,1.25,84.0,M,-2.2,M,,*74

Table 2: GGA Data Format

Name	Example	Units	Description
Message ID	\$GPGGA		GGA protocol header
UTC Position	021514.000		hhmmss.sss
Latitude	2232.1799		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	11401.1823		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 2-1
Satellites Used	6		Range 0 to 12
HDOP	1.25		Horizontal Dilution of Precision
MSL Altitude	84.0	meters	Altitude (referenced to the Ellipsoid)
AltUnit	M	meters	Altitude Unit
GeoSep	-2.2	meters	Geoidal Separation
GeoSepUnit	M	meters	Geoidal Separation Unit
Age of Diff.Corr.	<Null>	second	Null fields when it is not Used

Diff.Ref.Station ID	<Null>		Null fields when it is not Used
Checksum	*74		
EOL	<CR> <LF>		End of message termination

Table 2-1: Position Fix Indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid

GLL-Geographic Position – Latitude/Longitude

This sentence contains the fix latitude and longitude.

\$GPGLL,2232.1799,N,11401.1824,E,021513.000,A,A*50

Table 3: GLL Data Format

Name	Example	Units	Description
Message ID	\$GPGLL		GLL protocol header
Latitude	2232.1799		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11401.1824		dddmm.mmmm
E/W Indicator	E		E=east or W=west
UTC Position	021513.000		hhmmss.sss
Fix Status	A		A=data valid or V=data not valid
Fix Mode	A		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*50		
EOL	<CR> <LF>		End of message termination

GSA-GNSS DOP and Active Satellites

This sentence contains the mode of operation, type of fix, PRNs of the satellites used in the solution as well as PDOP, HDOP and VDOP.

\$GPGSA,A,3,26,05,18,15,27,29,,,,,,1.52,1.25,0.87*0F

Table 4: GSA Data Format

Name	Example	Units	Description
Message	\$GPGSA		GSA protocol header
Mode 1	A		See Table 4-2
Mode 2	3		See Table 4-1
ID of satellite used	26		Sv on Channel 1
ID of satellite used	05		Sv on Channel 2
...
ID of satellite used	<Null>		Sv on Channel 12 (Null fields when it is not Used)
PDOP	1.52		Position Dilution of Precision

HDOP	1.25		Horizontal Dilution of Precision
VDOP	0.87		Vertical Dilution of Precision
Checksum	*0F		
EOL	<CR> <LF>		End of message termination

Table 4-1: Mode 1

Value	Description
1	Fix not available
2	2D Fix
3	3D Fix

Table 4-2: Mode 2

Value	Description
M	Manual-forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

GSV-GNSS Satellites in View

This sentence contains the PRNs, azimuth, elevation, and signal strength of all satellites in view.

\$GPGSV,3,1,12,15,79,333,42,42,50,127,,29,45,263,44,02,36,124,30*7E

\$GPGSV,3,2,12,26,36,226,34,05,35,046,22,27,33,161,29,21,16,319,*7D

\$GPGSV,3,3,12,10,15,066,31,18,14,285,45,24,12,319,15,08,09,047,18*7E

Table 5: GSV Data Format

Name	Example	Units	Description
Message ID	\$GPGSV		GSV protocol header
Number of Message	3		Total number of GSV sentences (Range 1 to 3)
Message Number	1		Sentence number of the total (Range 1 to 3)
Satellites in View	12		Number of satellites in view
Satellite ID	15		Channel 1(Range 01 to 32)
Elevation	79	degrees	Channel 1(Range 00 to 90)
Azimuth	333	degrees	Channel 1(Range 000 to 359)
SNR(C/NO)	42	dB-Hz	Channel 1(Range 00 to 99, null when not tracking)
...			...
Satellite ID	02		Channel 4(Range 01 to 32)
Elevation	36	degrees	Channel 4(Range 00 to 90)
Azimuth	124	degrees	Channel 4(Range 000 to 359)
SNR(C/NO)	30	dB-Hz	Channel 4(Range 00 to 99, null when not tracking)
Checksum	*7E		
EOL	<CR> <LF>		End of message termination

Depending on the number of satellites tracked multiple messages of GSV data may be required.

RMC-Recommended Minimum Specific GNSS Data

This sentence contains the recommended minimum fix information.

See GGA for Fix Quality, Sats Used, HDOP, Altitude, Geoidal Separation, and DGPS data.

See GSA for Fix Type, PDOP and VDOP.

\$GPRMC,023345.000,A,2232.1767,N,11401.1953,E,0.18,151.55,100410,,,A*6B

Table 6: RMC Data Format

Name	Example	Units	Description
Message ID	\$GPRMC		RMC protocol header
UTS Position	023345.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2232.1767		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11401.1953		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.18	Knots	
Course Over Ground	151.55	Degrees	True Course
Date(UTC)	100410		ddmmyy
Magnetic variation	<Null>	Degrees	Null fields when it is not Used
Magnetic Variation Direction	<Null>		E=east or W=west (Null fields when it is not Used)
Fix Mode	A		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*6B		
EOL	<CR> <LF>		End of message termination

VTG-Course Over Ground and Ground Speed

This sentence contains the course and speed of the navigation solution.

\$GPVTG,148.81,T,,M,0.13,N,0.24,K,A*3D

Table 7: VTG Data Format

Name	Example	Units	Description
Message ID	\$GPVTG		VTG protocol header
Tcourse	148.81	Degrees	True Course
Reference	T		T = True
Mcourse	<Null>	Degrees	Magnetic Course (Null fields when it is not Used)
Reference	M		M = Magnetic (Null fields when it is not Used)
Speed over ground	0.13	Knots	Nautical Miles per Hour
Units	N		Knots
Speed over ground	0.24	Km/hr	in Kilometers per Hour
Units	K		Kilometer per hour
Mode	A		A=Autonomous, N=No fix, D=DGPS, E=DR
Checksum	*3D		
EOL	<CR> <LF>		End of message termination

ZDA-Date and Time

This sentence contains UTC date & time, and local time zone offset information.

\$GPZDA,023345.000,10,04,2010,,*50

Table 8: ZDA Data Format

Name	Example	Units	Description
Message ID	\$GPZDA		ZDA protocol header
UTC Time	023345.000		hhmmss.sss
Day	10		UTC time: day (01 ... 31) dd
Month	04		UTC time: month (01 ... 12) mm
Year	2010		UTC time: year (4 digit year) yyyy
local zone hours	<null>		Local Time Zone Offset Hours (Null fields when it is not Used)
local zone minutes	<null>		Local Time Zone Offset Minutes (Null fields when it is not Used)
Checksum	*50		
EOL	<CR> <LF>		End of message termination