GPS Module

Datasheet

Name: Ultra High Sensitivity and Low Power GPS Receiver Module

Model No.: SKG12B

Revision: V2.02

Revision History:

Revision	Description	Approved	Date
V1.01	Initial release to V1.01	Woody	20120708
V2.01	Update office's address	George	20131119
V2.02	Update certification information	George	20170831

General Description

The SKG12B 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 MT3337 single-chip architecture, Its –162dBm 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.

Applications

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

Figure 1: SKG12B Top View

Features

- Ultra high sensitivity: -162dBm
- Extremely fast TTFF at low signal level
- Built-in 12 multi-tone active interference canceller
- Ultra low power consumption
- ±10ns high accuracy time pulse (1PPS)
- NMEA Output：GGA,GSA,GSV,RMC
- Advanced Features: AlwaysLocate; AIC
- QZSS、SBAS (WAAS, EGNOS, MSAS, GAGAN)
- UART interface: 4800/9600/38400/115200 bps
- Small form factor: 16.0 x 12.2 x 2.4mm
- FCC compliance
- RoHS compliance (Lead-free)
- CE certificated

Pin Assignment

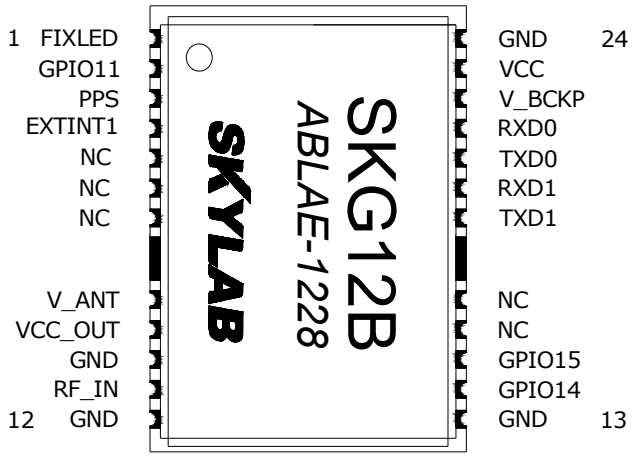

Figure 2: SKG12B Pin Package

Pin Description

Pin No.	Pin name	I/O	Description	Remark
1	FIXLED	O	Fixed LED Output	Leave open if not used
2	GPIO11	I/O	General Purpose I/O	Leave open if not used
3	PPS	O	Time Pulse Signal (Default 100ms)	Leave open if not used
4	EXTINT1	I	External Interrupt	Leave open if not used
5	NC			
6	NC			
7	NC			
8	V_ANT	I	Active Antenna External Voltage Supply	Leave open if not used
9	VCC_OUT	O	VCC power output	Leave open if not used
10	GND	G	Ground	
11	RF_IN	I	GPS Signal Input	50Ω@1.57542GHz, DC block inside
12	GND	G	Ground	
13	GND	G	Ground	
14	GPIO14	I	UART Baudrate Selection.	Leave open if not used
15	GPIO15	I	UART Baudrate Selection.	Leave open if not used
16	NC			
17	NC			
18	TXD1	I/O	UART Serial Data Output 1	Leave open if not used
19	RXD1	I/O	UART Serial Data Input 1	Leave open if not used
20	TXD0	O	UART Serial Data Output 0	Leave open if not used
21	RXD0	I	UART Serial Data Input 0	Leave open if not used
22	V_BCKP	I	RTC and backup SRAM power	This pin may be connect to Battery or Power Supply(2.0~4.2V)
23	VCC	P	Module Power Supply	Operating range: 3.0V to 4.2V
24	GND	G	Ground	Leave open if not used

Interfaces Configuration

Power Supply

Regulated power for the SKG12B 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.

Main power supply Vcc current varies according to the processor load and satellite acquisition. Maximum Vcc peak current is about 30 mA during acquisition.

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 SKG12B 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. Backup Battery Power V_BCKP draws typically 7 uA current in backup state.

RESET

The SKG12B modules include a RESET pin. Driving RESET low activates a hardware reset of the system. RESET is only an input and will not reset external circuitry. At power down the reset is forced when the Vcc drops below 2.7V.

NOTE

If not used, leave RESET not connected (floating).

Antenna

The SKG12B 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 (18~20dB Typical). The maximum noise figure should be no more than 1.5dB and output impedance is at 50 Ohm.

NOTE

With passive antenna keep the cable loss at minimum(<1dB).

Vcc_out

Antenna power output pin. When user wants to use external active antenna. The pin supply power for active antenna.

UART Ports

There are several function in SKG12B related to UATR communication, such as UART data transmission/receive and NMEA sentences input/output. In general, UART0 is as NMEA output and PMTK command input, UAR1 as RTCM input. The bit rates are selectable from 4800,9600,38400,115200 bps (see table).

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Baud rate	Pin14	Pin15
9600bps	NC	NC
4800bps	10K pull-down	NC
115200bps	NC	10K pull-down
38400bps	10K pull-down	10K pull-down

EINT1

The default EINT1 function is Standby mode control but the function is not supported; leave signal floating (not connected).

RF_IN

The transmission line must to be control impedance from RF_IN pin to the antenna or antenna connector of your choice. (Impedance 50Ω)

PPS

A pulse per second (1 PPS) is an electrical signal that very precisely indicates the start of a second. Depending on the source, properly operating PPS signals have an accuracy ranging 10ns. The PPS signals are used for precise timekeeping and time measurement.

FIXLED

The default FIXLED function is valid fix indicator output. Without a valid fix the signal is at low state; during valid fix condition the signal outputs 50ms pulses every seconds.

Advanced Software Features

AlwaysLocate™

AlwaysLocateTM is an intelligent controller of periodic mode. Depending on the environment and motion conditions, GPS module can adaptively adjust working/standby time to achieve balance of positioning accuracy and power consumption. In this mode, the host CPU does not need to control GPS module until the host CPU needs the GPS position data. The following flow chart is an example to make GPS module go into AlwaysLocateTm mode and then back to normal operation mode.

Embedded Logger function

The Embedded Logger function don't need host CPU (MCU) and external flash to handle the operation , GPS Engine will use internal flash (embedded in GPS chipset) to log the GPS data (Data format : UTC, Latitude , longitude, Valid ,Checksum), the max log days can up to 2 days under AlwaysLocate™ condition .

AIC_Multi-tone active interference canceller

Because different application (Wi-Fi , GSM/GPRS,3G/4G,Bluetooth)are integrated into navigation system , the harmonic of RF signal will influence the GPS reception , The multi- tone active-interference canceller can reject external RF interference which come from other active components on the main board , to improve the capacity of GPS reception without any needed HW change in the design .SKG12B can cancel up to 12 independent channel interference continuous wave.

Performance Specification

Parameter	Specification	
Receiver Type	L1 frequency band, C/A code, 22 Tracking / 66 Acquisition-Channel	
Sensitivity	Tracking Acquisition	-162dBm Typical -145dBm Typical
Accuracy	Position Velocity Timing (PPS)	3.0m CEP50 without SA(Typical Open Sky) 0.1m/s without SA 10ns RMS
Acquisition Time	Cold Start Warm Start Hot Start Re-Acquisition	23s(Typical Open Sky) 23s 1s <1s
Power Consumption	Tracking Acquisition	17mA @3.3V Typical 20mA @3.3V
Navigation Data Update Rate	Max 10Hz	Default 1Hz
Operational Limits	Altitude Velocity Acceleration	Max 18,000m Max 515m/s Less than 4g

Electrical Characteristics

Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	VCC	-0.3	4.3	V
Input Pins				
Input voltage on any input connection	VIO	-0.3	3.6	V
Backup Battery	V_BCKP	-0.3	4.3	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 SKG12B 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.

Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		3	3.3	4.2	V
Backup Battery	V_BCKP		2	3.3	4.2	V
Power supply voltage ripple	Vcc_PP	Vcc=3.3V			30	mV
Supply current, navigation	Icc	Vcc=3.3V		17	21	mA
Supply current, backup state	Ibckp	Vcc=3.3V		7		uA
VCC_OUT Antenna bias supply	VCC_OUT	I_{ANT} = 18 m A		3		V
Input high voltage	V_{IH}		2		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

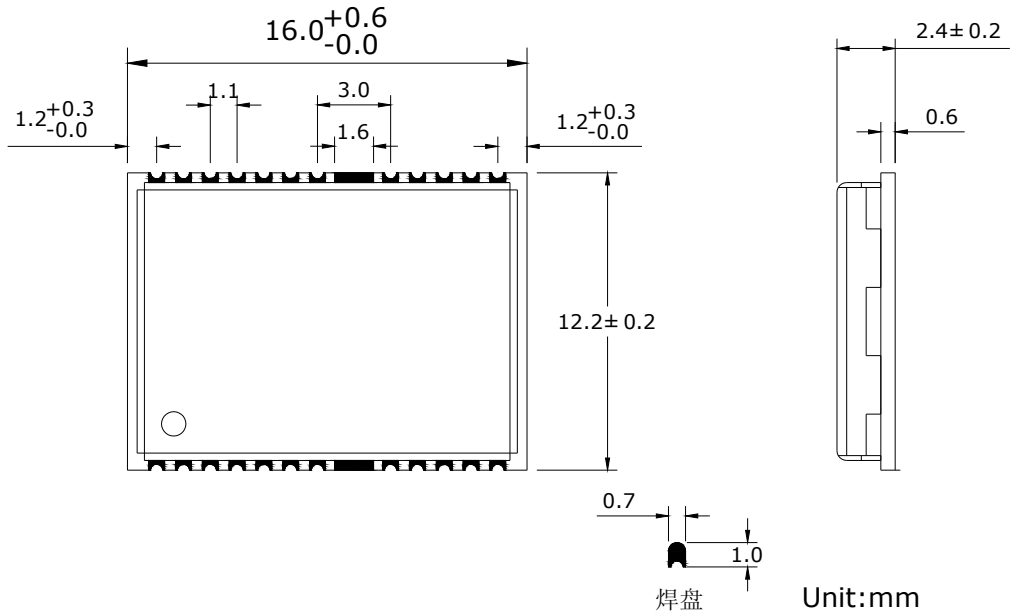

Figure 3: SKG12B Dimensions

Recommend Layout

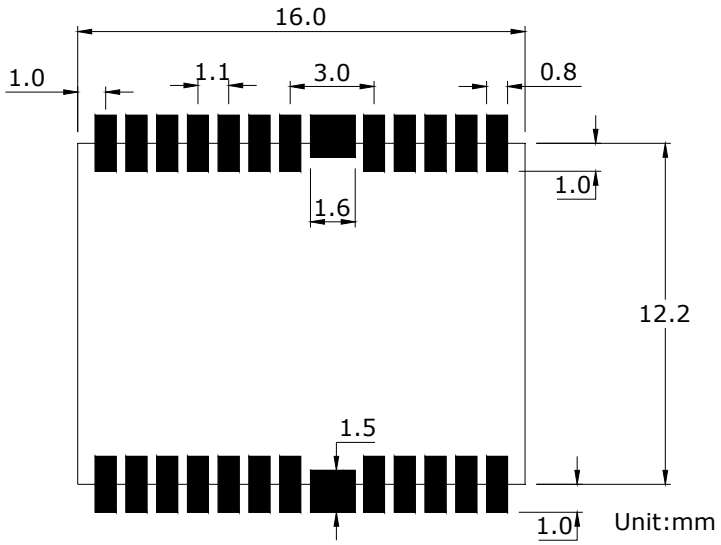

Figure 4: SKG12B Footprint

Reference design schematic

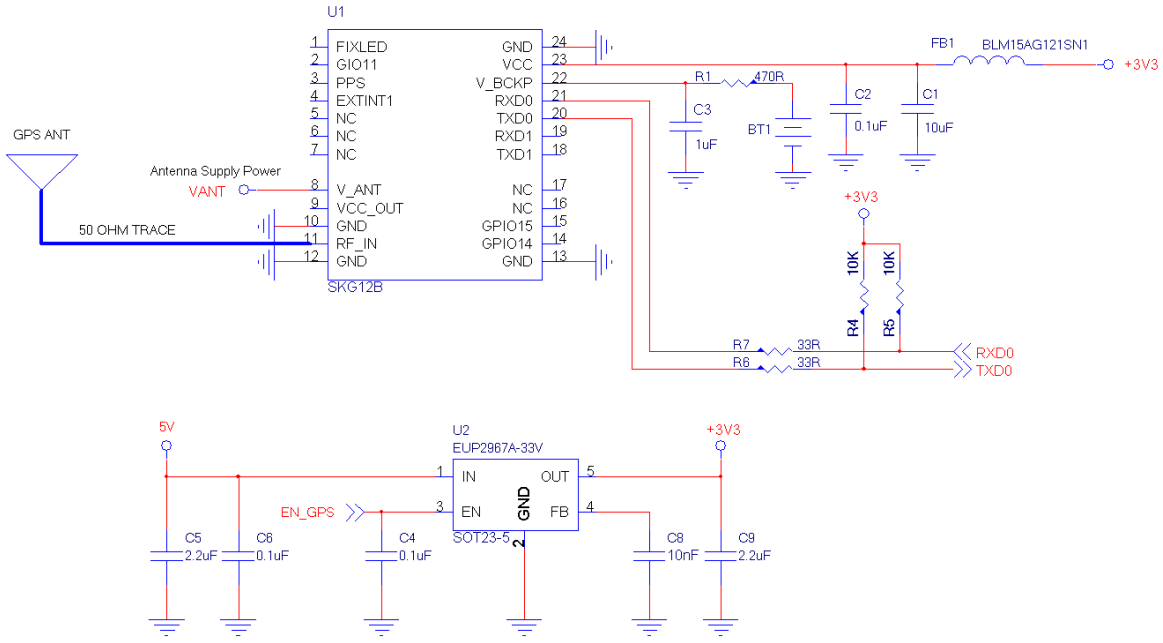

Figure 5: SKG12B Typical Reference design schematic

Packaging Specification

SKG12B modules are shipped in reel and with 1200 units per reel. Each tray is ‘dry’ package.

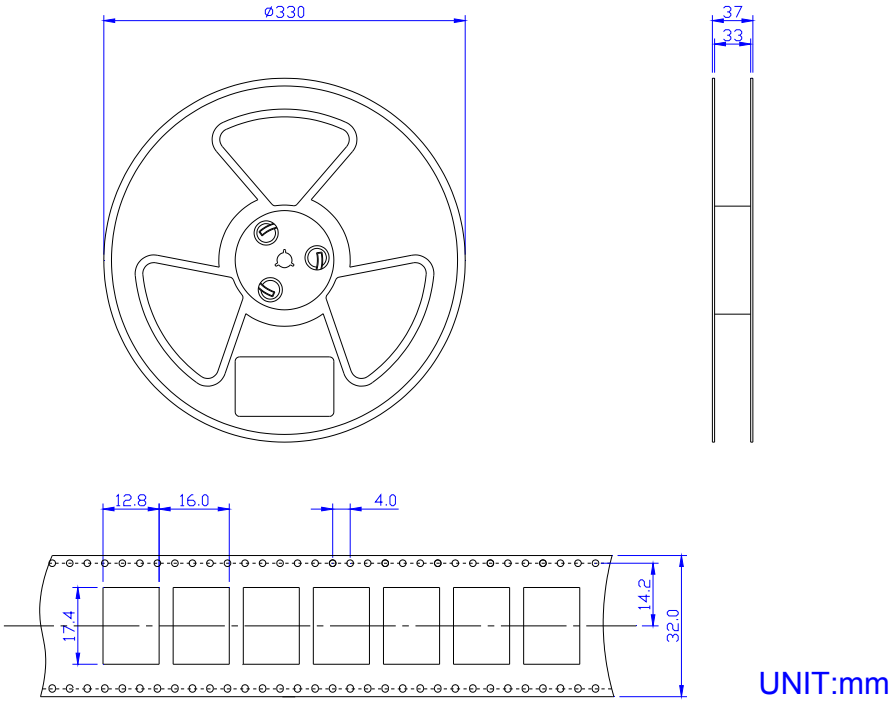

Figure 6: SKG12B Packaging

Manufacturing Process Recommendations

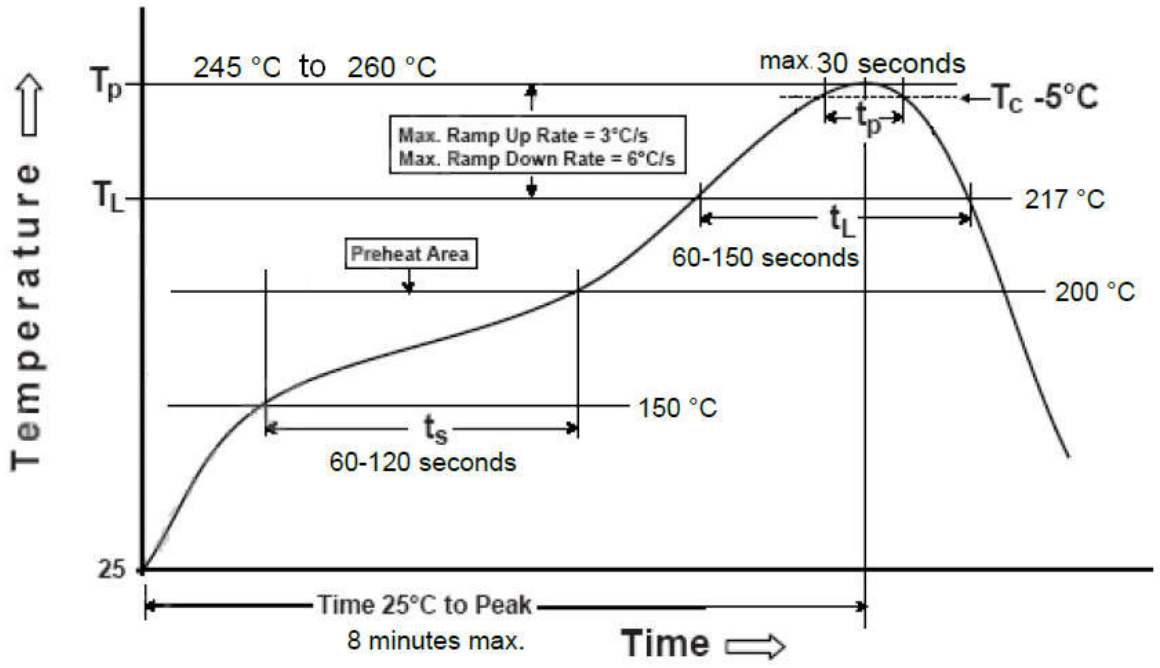

Figure 7: SKG12B Typical Leadfree Soldering Profile

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.

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 Skylab SKG12B supports the following NMEA-0183 messages: GGA, GSA, GSV, RMC. The module default NMEA 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
GSA	GNSS DOP and active satellites	Y
GSV	GNSS satellites in view	Y
RMC	Recommended minimum specific GNSS data	Y

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

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 3: 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 3-1: Mode 1

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

Table 3-2: 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 4: 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)
Azinmuth	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 5: 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

NMEA CMD List

NMEA CMD TYPE	NMEA CMD Example:
Hot Restart	$PMTK101*32<CR><LF>
Warm Restart	$PMTK102*31<CR><LF>
Cold Restart	$PMTK103*30<CR><LF>
Full Cold Restart	$PMTK104*37<CR><LF>
port baudrate	$PMTK251,38400*27<CR><LF>

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