SKYLAB
Simplify Your System

GPS Module DataSheet

Name: Ultra High Sensitivity and Low Power GPS Receiver Module

Model NO.: SKG25A1

Revision: 001

Revision History:

Revision	Description	Approved	Date
001	Initial Release to 001	Neil	20100110

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General Description

The SkyNav SKG25A1 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 Atheros AR1511 single-chip architecture, Atheros newest chipset technology. Its –160dBm 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: SKG25A1 Top View

Features

- Ultra high sensitivity: -160dBm
- Extremely fast TTFF at low signal level
- Built in high gain LNA
- Low power consumption: Typical 40mA@3.3V
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage: 3.0V to 3.6V
- Operating temperature range: -40 to 85℃
- SMD type with stamp holes
- Small form factor: 25.4x25.4x3.2mm
- RoHS compliant (Lead-free)

Pin Assignment

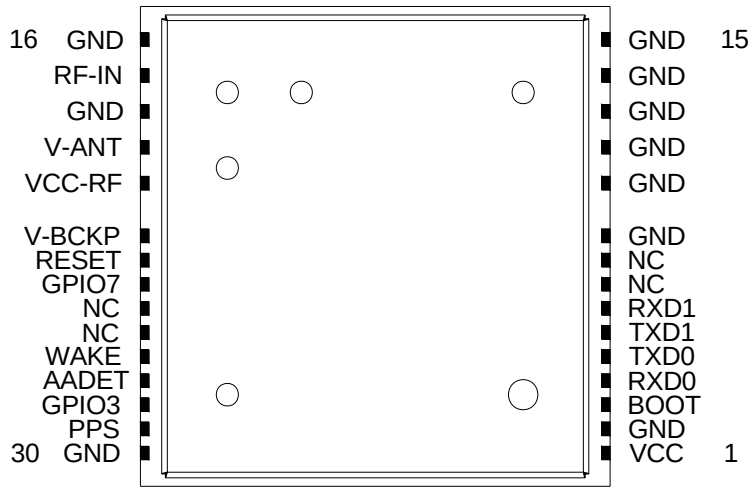

Figure 2: SKG25A1 Pin Package

Performance Specification

Parameter	Specification	
Receiver Type	L1 frequency band, C/A code, 20-channels	
Sensitivity	Tracking	-160dBm
	Acquisition	-144dBm
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	30s
	Hot Start	2s
	Re-Acquisition	<1s
Power Consumption	Tracking	35mA @3.3V Vcc(Typical)
	Acquisition	40mA
Navigation Data Update Rate	1Hz	
Operational Limits	Altitude	Max 18,000m
	Velocity	Max 515m/s
	Acceleration	Less than 4g

Interfaces Configuration

Power Supply: Regulated power for the SKG25A1 is required. The input voltage Vcc should be 3.0V ±10%, maximum, 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 SKG25A1 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 20dB (18~20dB Typical). The maximum noise figure should be no more than 1.5dB and output impedance is at 50 Ohm.

UART Ports: The module supports two full duplex serial channels UART0 and UART1. All serial connections are at 3V CMOS logic levels, if need different voltage levels, use appropriate level shifters. The baud rate of both serial ports are fully programmable, 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. The modules default baud rate is set up 9600bps, however, the user can change the default baud rate to any value from 4800 bps to 115kbps. UART0 is used e.g. for booting and NMEA interface. UART1 can be utilized for UBP protocol.

Boot Mode Select: The pin Boot is used to set the boot mode of the SKG25A1 GPS Receiver. By default the receiver will boot in normal GPS mode. If there are corrupted data in FLASH, it may be necessary to boot the receiver in test mode by pulling Boot pin high during a power cycle or hardware reset to update the firmware.

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 SKG25A1 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, and still need to add a bypassing capacitor (1uF) to V_BCKP pin, then can reduce noise and increase the stability.

Pin Description

Pin No.	Pin name	I/O	Description	Remark
1	VCC	I	Module Power Supply	
2	GND	G	Ground	
3	BOOT	I	Boot Mode	Leave Open if not used
4	RXD0	I	UART Serial Data Input 0	Leave Open if not used
5	TXD0	O	UART Serial Data Output 0	Leave Open if not used
6	TXD1	O	UART Serial Data Output 1	Not Open
7	RXD1	I	UART Serial Data Input 1	Not Open
8	NC		Reserved for future use	Leave Open
9	NC		Reserved for future use	Leave Open
10	GND	G	Ground	
11	GND	G	Ground	
12	GND	G	Ground	
13	GND	G	Ground	
14	GND	G	Ground	
15	GND	G	Ground	
16	GND	G	Ground	
17	RF_IN	I	Antenna Input	50Ω@1.57542GHz
18	GND	G	Ground	
19	V_ANT	I	Active Antenna External Voltage Supply	
20	VCC_RF	O	Voltage Output for Active Antenna	May be connected to V_ANT, Leave Open if not used
21	V_BCKP	I	RTC Battery Input	Leave Open if not used
22	RESET	I	Module Reset(Active Low)	Leave Open in not used
23	GPIO7	I/O	General Purpose I/O	Leave Open in not used
24	NC		Reserved for future use	Leave Open
25	NC		Reserved for future use	Leave Open
26	WAKE	I	Wake Control Input Pin	Leave Open if not used
27	AADET	I	Active Antenna Open-circuit detection	Leave open in not used
28	GPIO3	I/O	General Purpose I/O	Leave Open if not used
29	PPS	O	Time pulse Signal (100ms)	Leave Open if not used
30	GND	G	Ground	

Electrical Characteristics

Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	VCC	-0.3	3.6	V
Input Pins				
Input Pin Voltage I/O	RESET	-0.3	3.6	V
Input Pin Voltage I/O	RXD0, RXD1	-0.3	3.6	V
Input Pin Voltage I/O	BOOT	-0.3	3.6	V
Antenna Bias DC Voltage	V_ANT	-0.3	5.0	V
Backup Battery	V_BCKP	2.0	3.6	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.

Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		3.0	3.3	3.6	V
Power supply voltage ripple	Vcc_PP	Vcc=3.3V			30	mV
Consumption current	Icc	Vcc=3.3V		40	45	mA
Input high voltage	V_{IH}		0.7xVcc		Vcc	V
Input low voltage	V_{IL}		-0.3		0.3xVcc	V
Output high voltage	V_{OH}		0.8xVcc		Vcc	V
Output low voltage	V_{OL}		0		0.2xVcc	V
Operating temperature	Topr		-40		85	˚C

Mechanical Specification

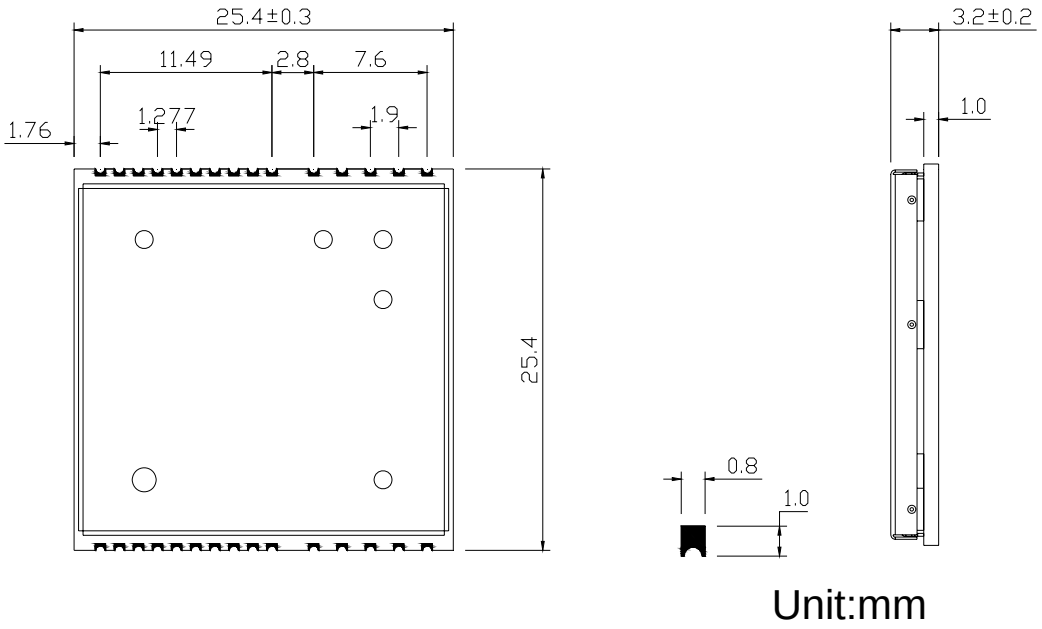

Figure 3: SKG25A1 Dimensions

Recommend Layout

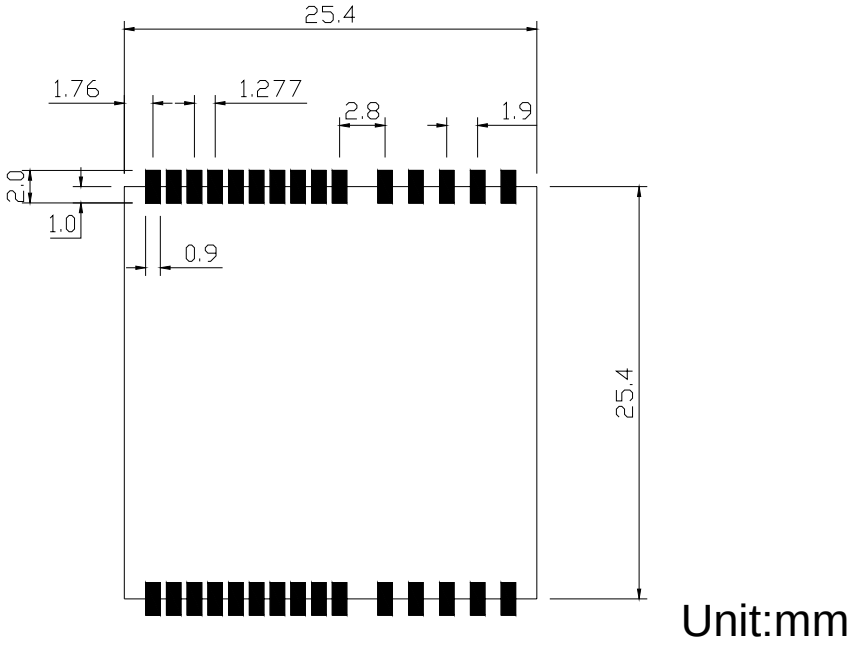

Figure 4: SKG25A1 Footprint

Packaging Specification

SKG25A1 modules are shipped in tray and with 40 units per tray. Each tray is 'dry' package.

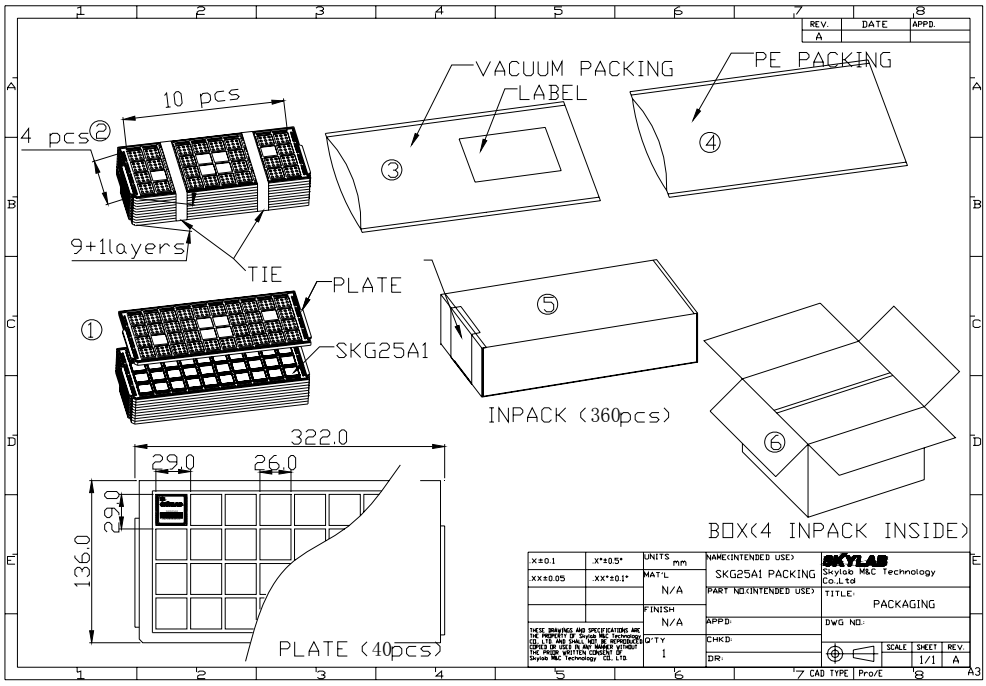

Figure 5: SKG25A1 Packaging

Manufacturing Process Recommendations

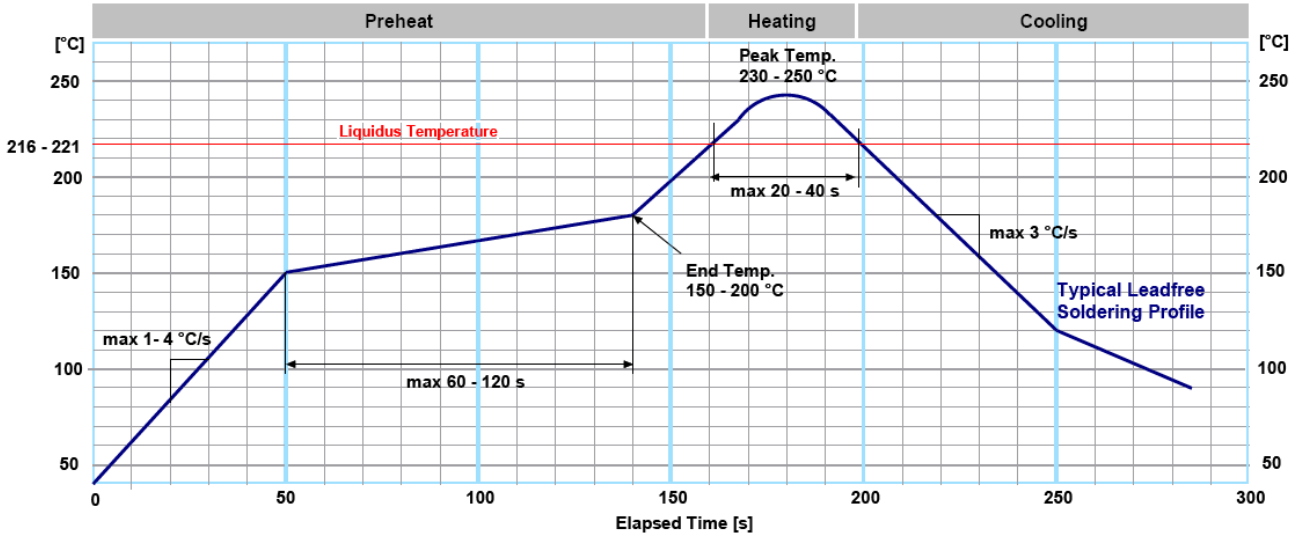

Figure 6: SKG25A1 Typical Leadfree Soldering Profile

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

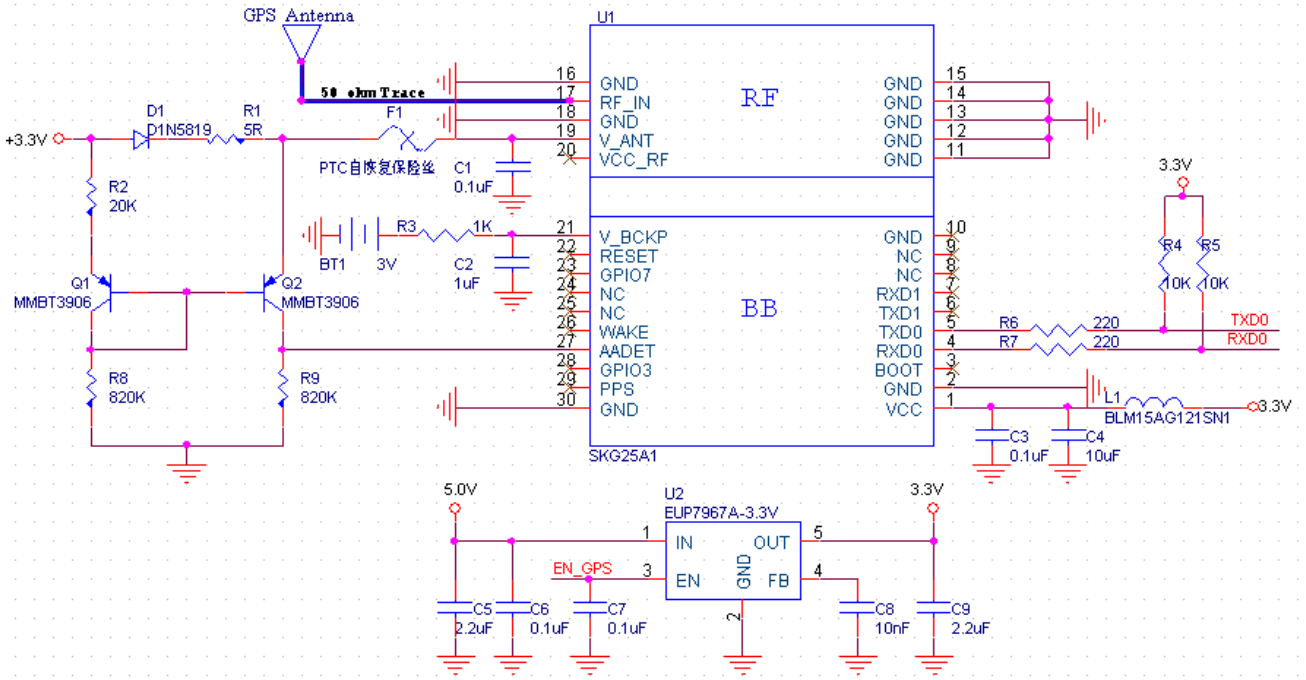

Figure 7: SKG25A1 Typical Reference design schematic

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 SKG25A1 module supports the following NMEA-0183 messages: GGA, GLL, GSA, GSV, RMC VTG, ZDA and DTM. The module default NMEA-0183 output is set up GGA, GSA, GSV, RMC 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
DTM	Datum reference	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,033410.000,2232.1745,N,11401.1920,E,1,07,1.1,107.14,M,0.00,M,,*64
Table 2: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Position	033410.000		hhmmss.sss
Latitude	2232.1745		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	11401.1920		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 2-1
Satellites Used	07		Range 0 to 12
HDOP	1.1		Horizontal Dilution of Precision
MSL Altitude	107.14	meters	Altitude (referenced to the Ellipsoid)
AltUnit	M	meters	Altitude Unit
GeoSep	0.00	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	*64		
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,2232.1843,N,11401.1905,E,035059.000,A,A*54
Table 3: GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	2232.1843		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11401.1905		dddmm.mmmm

E/W Indicator	E		E=east or W=west
UTC Position	035059.000		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	*54		
EOL	<CR> <LF>		End of message temination

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,3,02,09,10,15,18,24,27,29,,,,,1.8,0.9,1.5*39

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	02		Sv on Channel 1
ID of satellite used	09		Sv on Channel 2
…	…		…
ID of satellite used	<Null>		Sv on Channel 12 (Null fields when it is not Used)
PDOP	1.8		Position Dilution of Precision
HDOP	0.9		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*39		
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,3,1,12,02,35,123,25,24,22,321,48,15,78,335,53,29,45,261,45*77

$GPGSV,3,2,12,26,22,223,28,05,34,046,30,10,16,064,39,18,14,284,48*75

$GPGSV,3,3,12,27,32,161,31,33,,,30,09,25,170,34,21,15,318,*4B

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	02		Channel 1(Range 01 to 32)
Elevation	35	degrees	Channel 1(Range 00 to 90)
Azinmuth	123	degrees	Channel 1(Range 000 to 359)
SNR(C/NO)	25	dB-Hz	Channel 1(Range 00 to 99, null when not tracking)
…			…
Satellite ID	29		Channel 4(Range 01 to 32)
Elevation	45	degrees	Channel 4(Range 00 to 90)
Azimuth	261	degrees	Channel 4(Range 000 to 359)
SNR(C/NO)	45	dB-Hz	Channel 4(Range 00 to 99, null when not tracking)
Checksum	*77		
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,075747.000,A,2232.8990,N,11405.3368,E,3.9,357.8,260210,,,A*6A

Table 6: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTS Position	075747.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2232.8990		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11405.3368		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	3.9	Knots	
Course Over Ground	357.8	Degrees	True Course
Date(UTC)	260210		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	*6A		

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,303.8,T,,,0.0,N,0.0,K,A*48

Table 7: VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Tcourse	303.8	Degrees	True Course
Reference	T		T = True
Mcourse	<Null>	Degrees	Magnetic Course (Null fields when it is not Used)
Reference	<Null>		M = Magnetic (Null fields when it is not Used)
Speed over ground	0.0	Knots	Nautical Miles per Hour
Units	N		Knots
Speed over ground	0.0	Km/hr	in Kilometers per Hour
Units	K		Kilometer per hour
Mode	A		A=Autonomous, N=No fix, D=DGPS, E=DR
Checksum	*48		
EOL	<CR> <LF>		End of message termination

ZDA-Date and Time

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

$GPZDA,060819.000,22,03,2010,,*50

Table 8: ZDA Data Format

Name	Example	Units	Description
Message ID	$GPZDA		ZDA protocol header
UTC Time	060819.000		hhmmss.sss
Day	22		UTC time: day (01 ... 31) dd
Month	03		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

DTM - Datum reference

This sentence contains the ID of the datum selected, along with configured offsets.

$GPDTM,W84,,0.000000,S,0.000000,W,0.00,W84*50

Table 9: DTM Data Format

Name	Example	Units	Description
Message ID	$GPDTM		DTM protocol header
DatumID	W84		Local Datum ID
DatumSubD	<null>		Datum Subdivision Code (Null fields when it is not Used)
LatOfs	0.000000		Latitude Offset (in minutes)
LatDirection	S		N = North S = South
LonOfs	0.000000		Longitude Offset (in minutes)
LonDirection	W		E = East W = West
AltOfs	0.00		Altitude Offset (in meters)
RefDatum	W84		Reference Datum ID
Checksum	*50		
EOL	<CR> <LF>		End of message termination