# GPS Module DataSheet

Name: Ultra High Sensitivity and Low Power GPS Receiver Module

Model NO.: EG25A1

Revision: 001

Revision History:

| Revision | Description | Approved | Date |
|---|---|---|---|
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## General Description

The SkyNav EG25A1 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: EG25A1 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

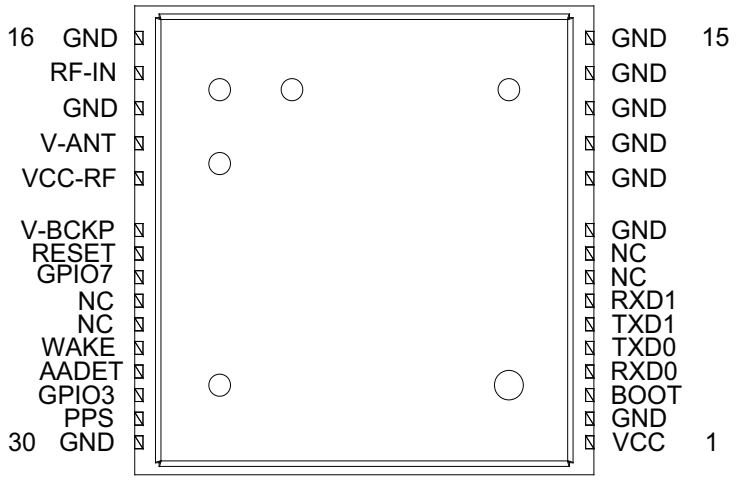


**Figure 2: EG25A1 Pin Package**

## 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 EG25A1 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 EG25A1 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 EG25A1 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 EG25A1 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

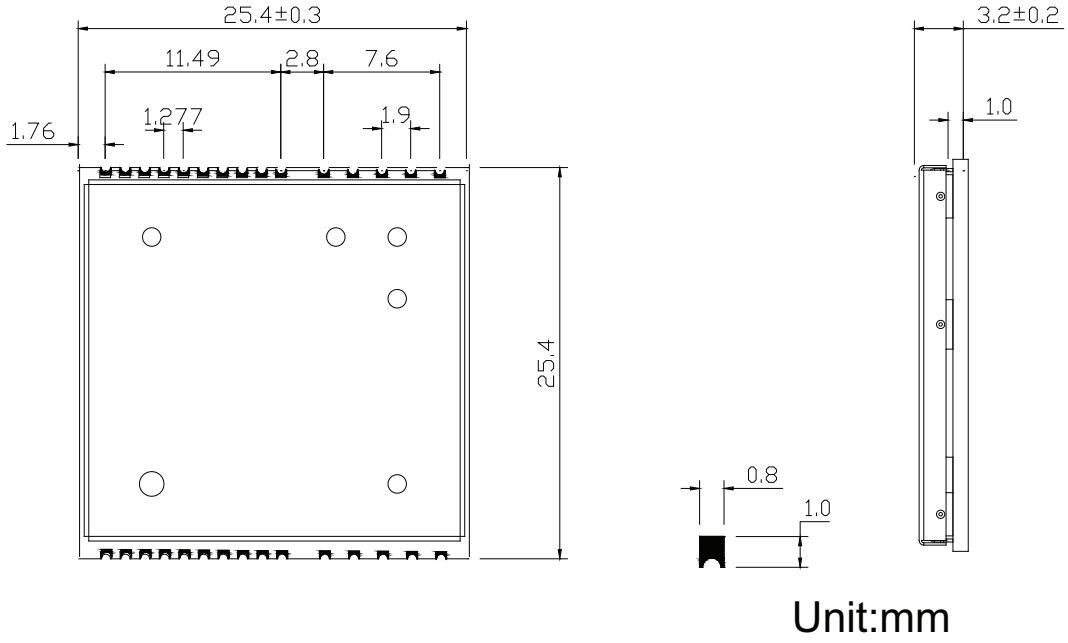


**Figure 3: EG25A1 Dimensions**

## Recommend Layout

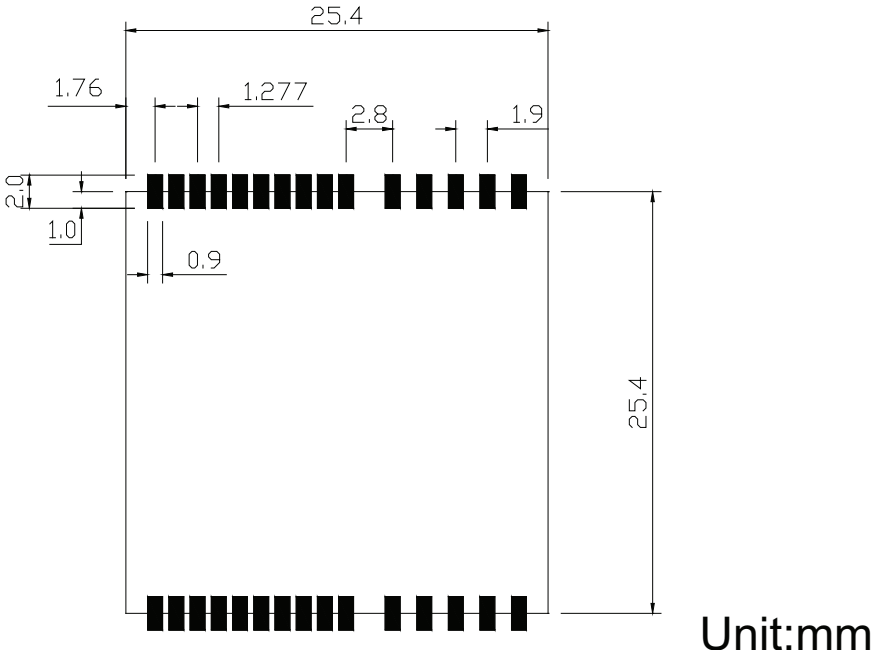


**Figure 4: EG25A1 Footprint**

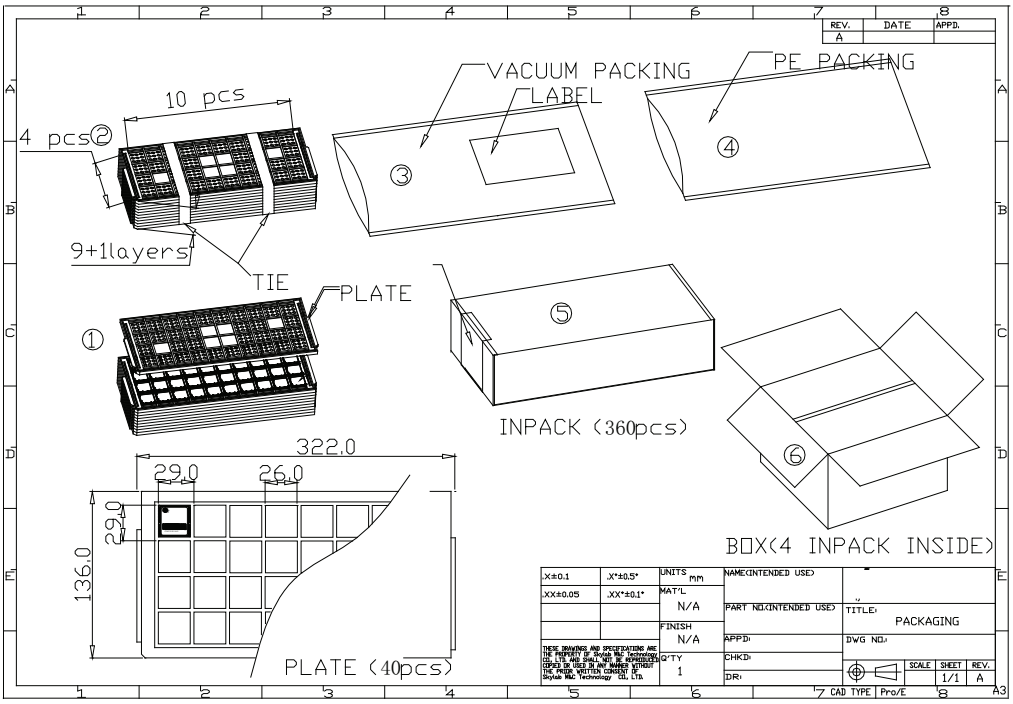


**Figure 5: EG25A1 Packaging**

## Manufacturing Process Recommendations

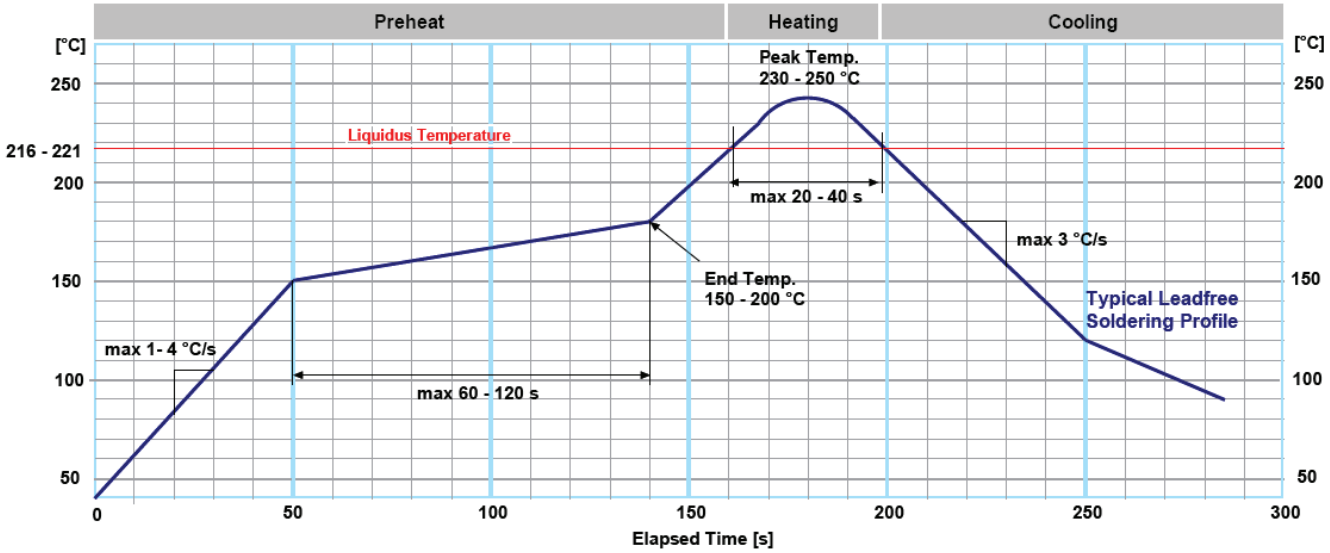


**Figure 6: EG25A1 Typical Leadfree Soldering Profile**

**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

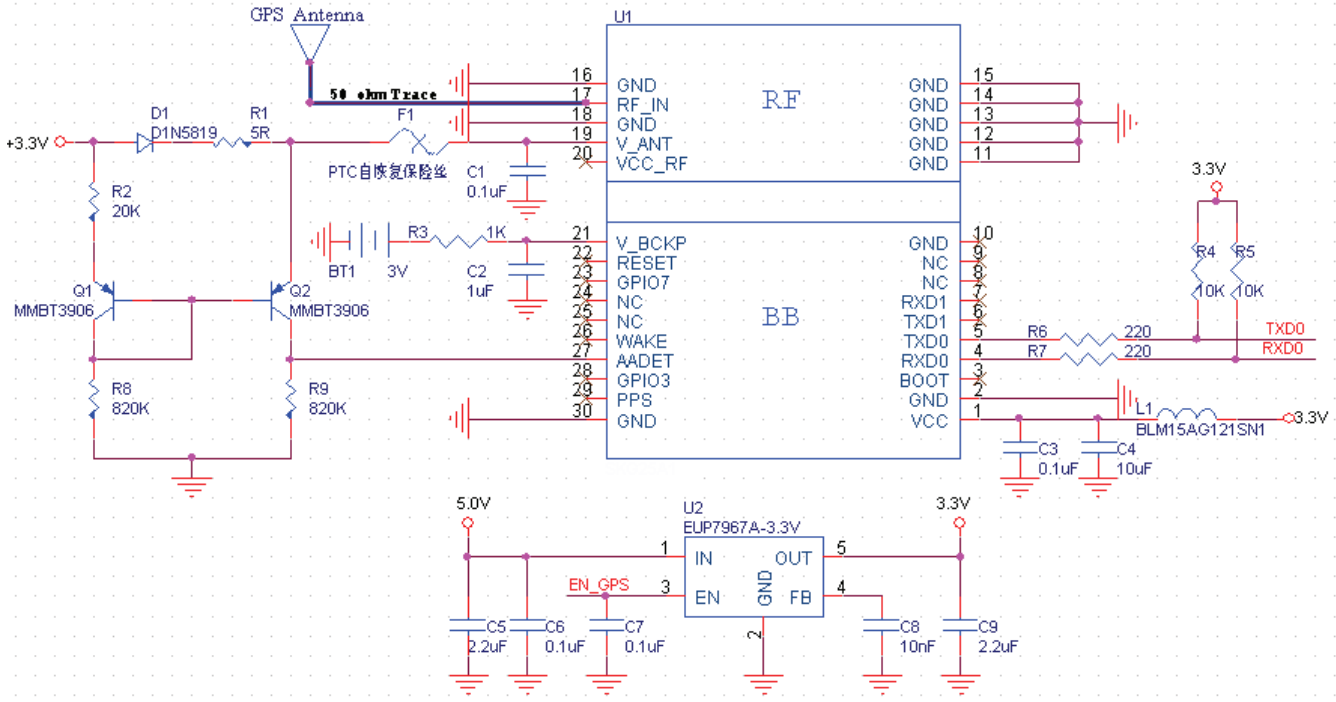


**Figure 7: EG25A1 Typical Reference design schematic**

## 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 EG25A1 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: GGA 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 |