

GPS/GNSS Receiver Module

1. Product Information

1.1 Product Name: YIC51009EB-37



1.2 Product Description:

YIC51009EB-37 is a compact, high performance, and low power consumption GNSS engine board.

It uses the chipset which can track up to 66 channels at a time and perform fast TTFF in weak signal environments.

YIC51009EB-37 is suitable for the following applications:

- Automotive navigation
- Personal positioning
- Fleet management
- Mobile phone navigation
- Marine navigation

1.3 Product Features:

- MediaTek high sensitivity solution
- Support 66-channel GPS
- Ultra low power consumption
- Fast TTFF at low signal level
- Built-in 12 multi-tone active interference canceller
- Free hybrid ephemeris prediction to achieve faster cold start
- Built-in DC/DC converter to save power
- Up to 10 Hz update rate
- ± 1 ns high accuracy time pulse (1PPS)
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Support Japan QZSS
- Indoor and outdoor multi-path detection and compensation
- Small form factor 10.1 * 9.7 * 2.5mm ± 0.2 mm
- SMD type with stamp holes
- RoHS compliant

1.4 Product Specifications

GPS Performance

| GPS Receiver | | |
|---|--------------------------------|---|
| Chip | MediaTek MT3337(ROM) | |
| Frequency | L1 1575.42MHz, C/A code | |
| Channels | Support 66 channels | |
| Update rate | 1Hz default, up to 10Hz | |
| Sensitivity | Tracking | -162dBm, up to -165dBm (with external LNA) |
| | Cold Start | -143.5dBm, up to -148dBm (with external LNA) |
| Acquisition Time | Hot start (Open Sky) | < 1s (typical) |
| | Hot start (Indoor) | < 30s |
| | Cold Start (Open Sky) | 32s (typical) without AGPS |
| < 15s (typical) with AGPS (hybrid ephemeris prediction) | | |
| Position Accuracy | Autonomous | 3m (2D RMS) |
| | SBAS | 2.5m (depends on accuracy of correction data) |
| Max. Altitude | < 18,000 m | |
| Max. Velocity | < 515 m/s | |
| Protocol Support | NMEA 0183 | 9600 bps, 8 data bits, no parity, 1 stop bits (default) |
| | | 1Hz: GGA, GLL, GSA, GSV, RMC, VTG |
| Physical Characteristic | | |
| Type | 18 pin stamp holes | |
| Dimensions | 10.1mm * 9.7 mm * 2.5mm ±0.1mm | |

1.5 DC Electrical Characteristics

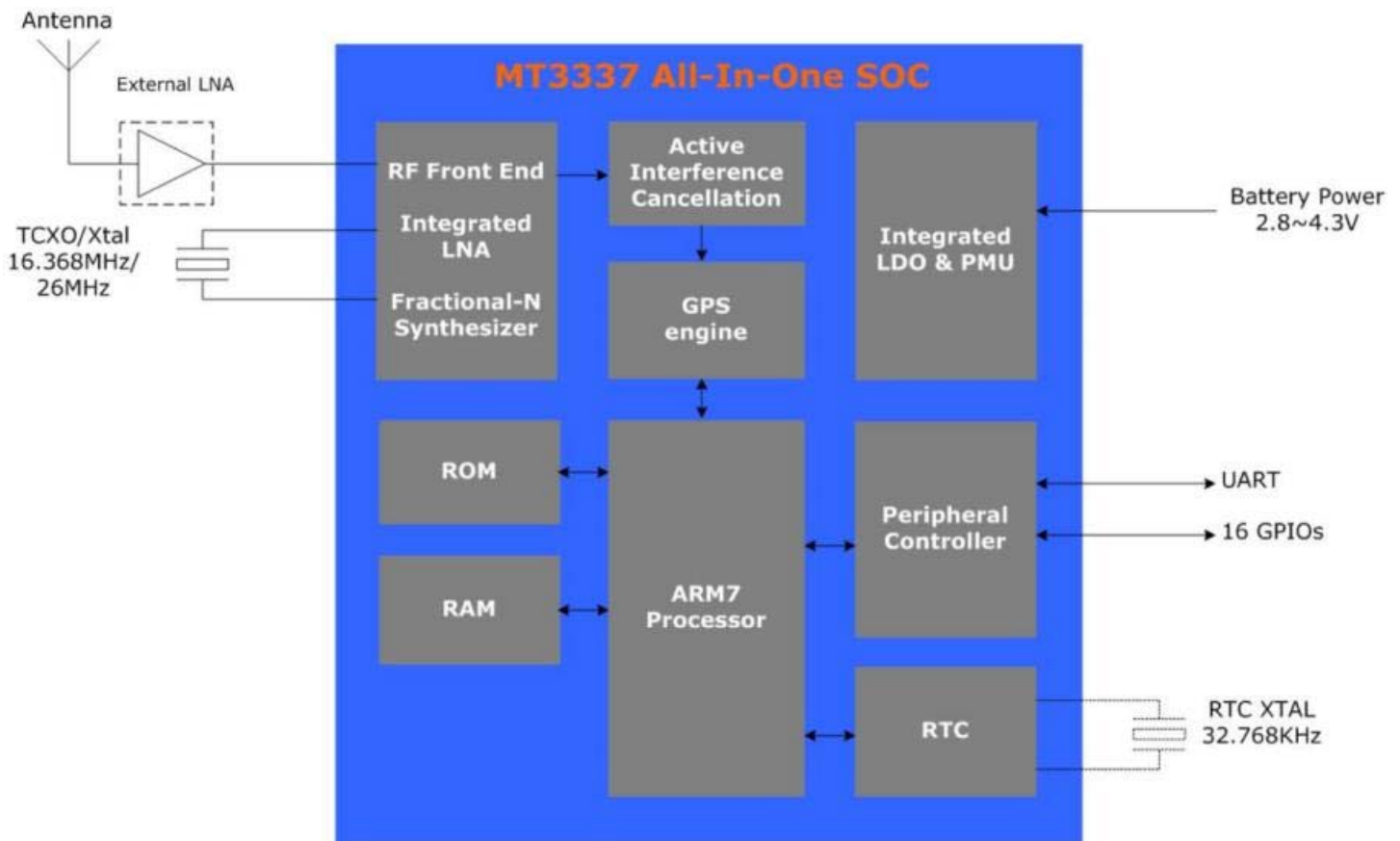
| Parameter | Symbol | Conditions | Min | Typ | Max | Units | |
|------------------------------|------------------|-----------------------------------|------|-------------------|-----|-------|----|
| Input Voltage | VCC | I _{out} = 0 | 3.0 | 3.3 | 4.3 | V | |
| Input Backup Battery Voltage | V_BAT | | 2.0 | | 4.3 | V | |
| Supply Current | I _{ss} | VIN = 3.0V, w/o active antenna | | | | | |
| | | Peak | | | 87 | mA | |
| | | Acquisition | | 20 | | | mA |
| | | Tracking | | 20 ⁽¹⁾ | | | mA |
| | | Standby | | 170 | | uA | |
| Backup Battery Current | I _{bat} | VCC = 0V | | 6 | | uA | |
| High Level Input Voltage | V _{IH} | | 2.0 | | 3.6 | V | |
| Low Level Input Voltage | V _{IL} | | -0.3 | | 0.8 | V | |
| High Level Input Current | I _{IH} | no pull-up or down | -1 | | 1 | uA | |
| Low Level Input Current | I _{IL} | no pull-up or down | -1 | | 1 | uA | |
| High Level Output Voltage | V _{OH} | | 2.4 | | | V | |
| Low Level Output Voltage | V _{OL} | | | | 0.4 | V | |
| High Level Output Current | I _{OH} | | | 2 | | mA | |
| Low Level Output Current | I _{OL} | | | 2 | | mA | |

Note 1: Measured when position fix (1Hz) is available, input voltage is 3.3V and the function of self-generated ephemeris prediction is inactive.

Temperature characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Units |
|-----------------------|------------------|------|------|------|-------|
| Operating Temperature | T _{opr} | -40 | | 85 | °C |
| Storage Temperature | T _{stg} | -40 | 25 | 85 | °C |

2. Block Diagram

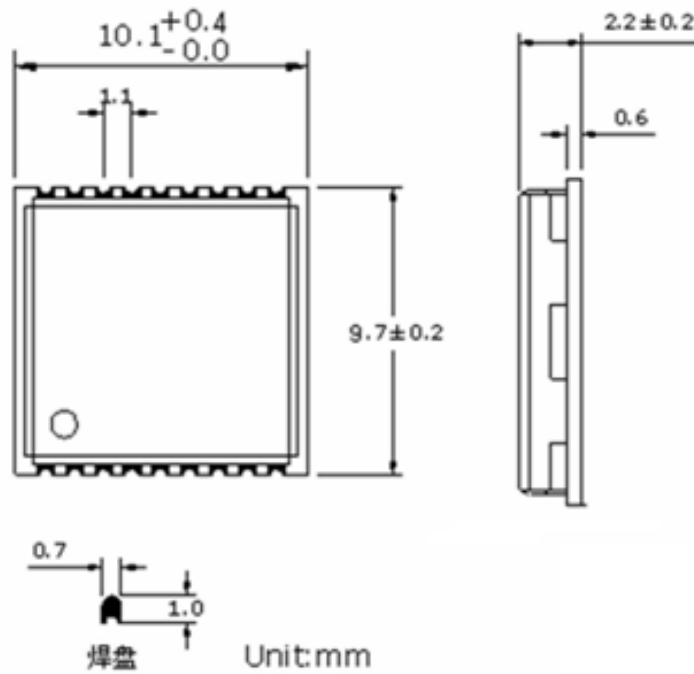


3. Module Pin Assignment

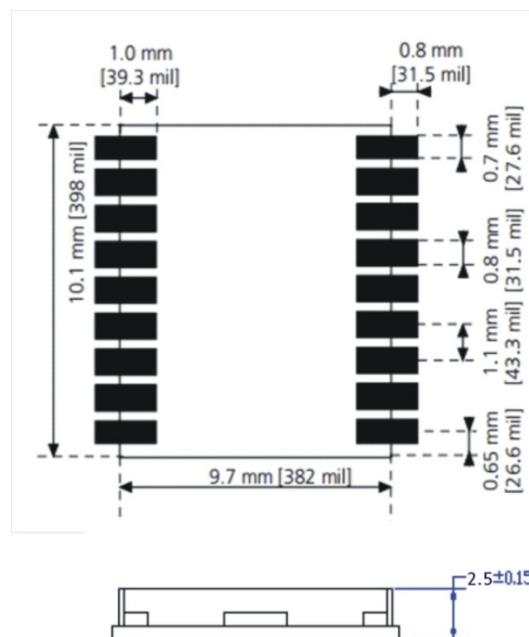
| | | | |
|----|--------|-----------|---|
| 10 | GND | VRESET | 9 |
| 11 | RF_IN | VCC | 8 |
| 12 | GND | NC | 7 |
| 13 | NC | V_BCKP | 6 |
| 14 | VCC_RF | NC | 5 |
| 15 | NC | TIMEPULSE | 4 |
| 16 | NC | RXD1 | 3 |
| 17 | NC | TXD1 | 2 |
| 18 | NC | GND | 1 |

| Pin NO. | Pin Name | I/O | Remark |
|---------|-----------|-----|--|
| 1. | GND | G | Ground. |
| 2. | TXD1 | O | |
| 3. | RXD1 | I | |
| 4. | TIMEPULSE | O | 1 Pulse per second |
| 5. | NC | N | Not connected |
| 6. | V_BCKP | PWR | Backup battery supply voltage |
| 7. | NC | N | Not connected |
| 8. | VCC | PWR | Main power supply to the engine board. |
| 9. | VRESET | I | Reset |
| 10. | GND | G | Ground. |
| 11. | RF_IN | RF | GPS antenna input |
| 12. | GND | G | Ground. |
| 13. | NC | N | Not connected |
| 14. | VCC_RF | | |
| 15. | NC | N | Not connected |
| 16. | NC | N | Not connected |
| 17. | NC | N | Not connected |
| 18. | NC | N | Not connected |

4. Dimensions



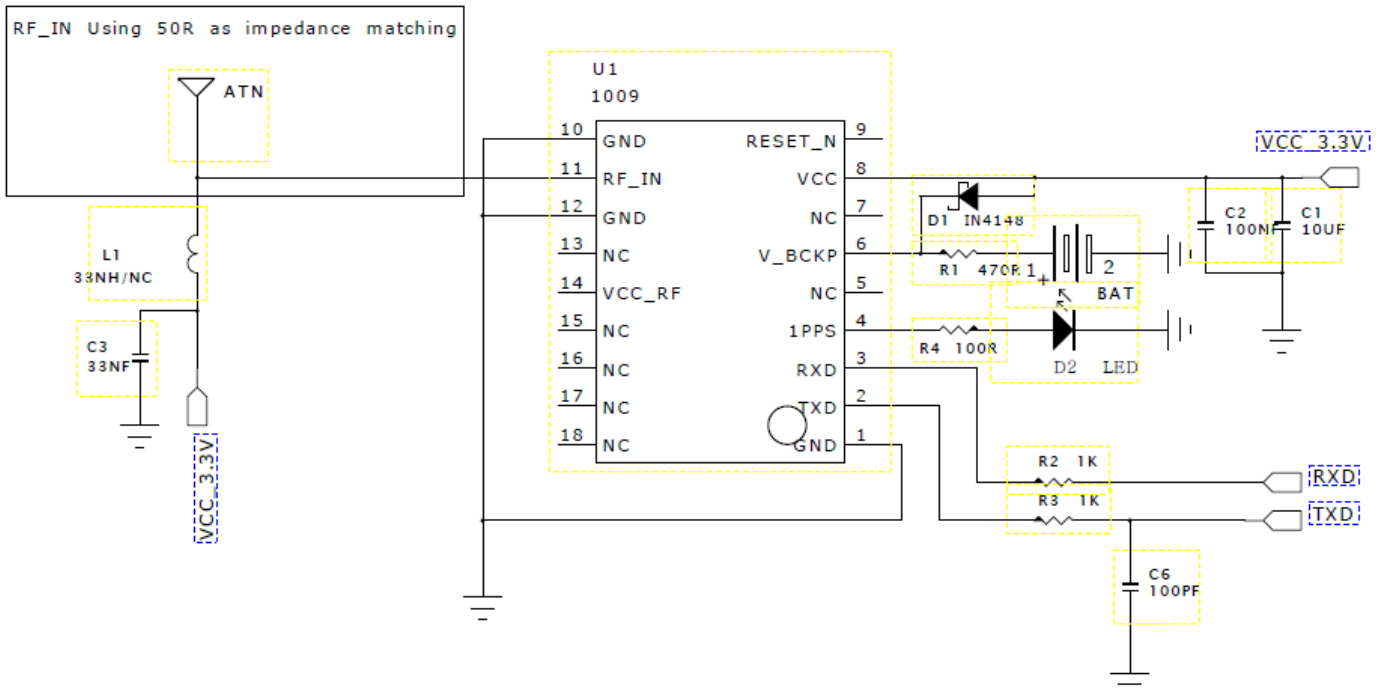
5. Recommended Footprint



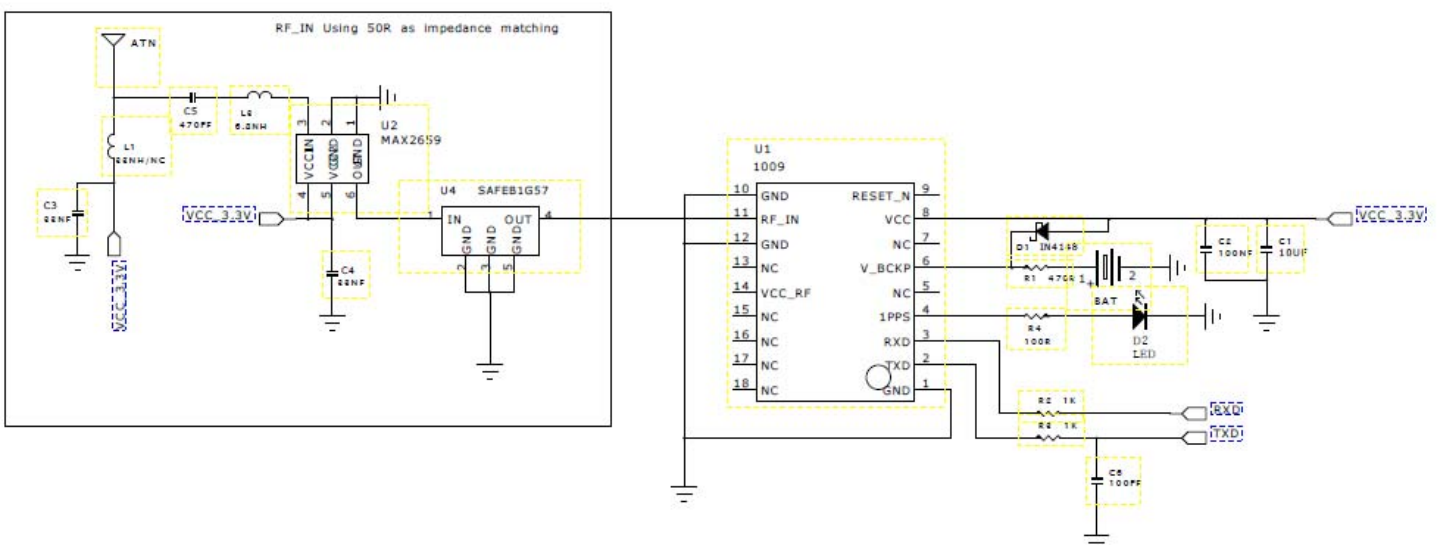
unit: mm
 Tolerance: ± 0.1

6. Application Circuit

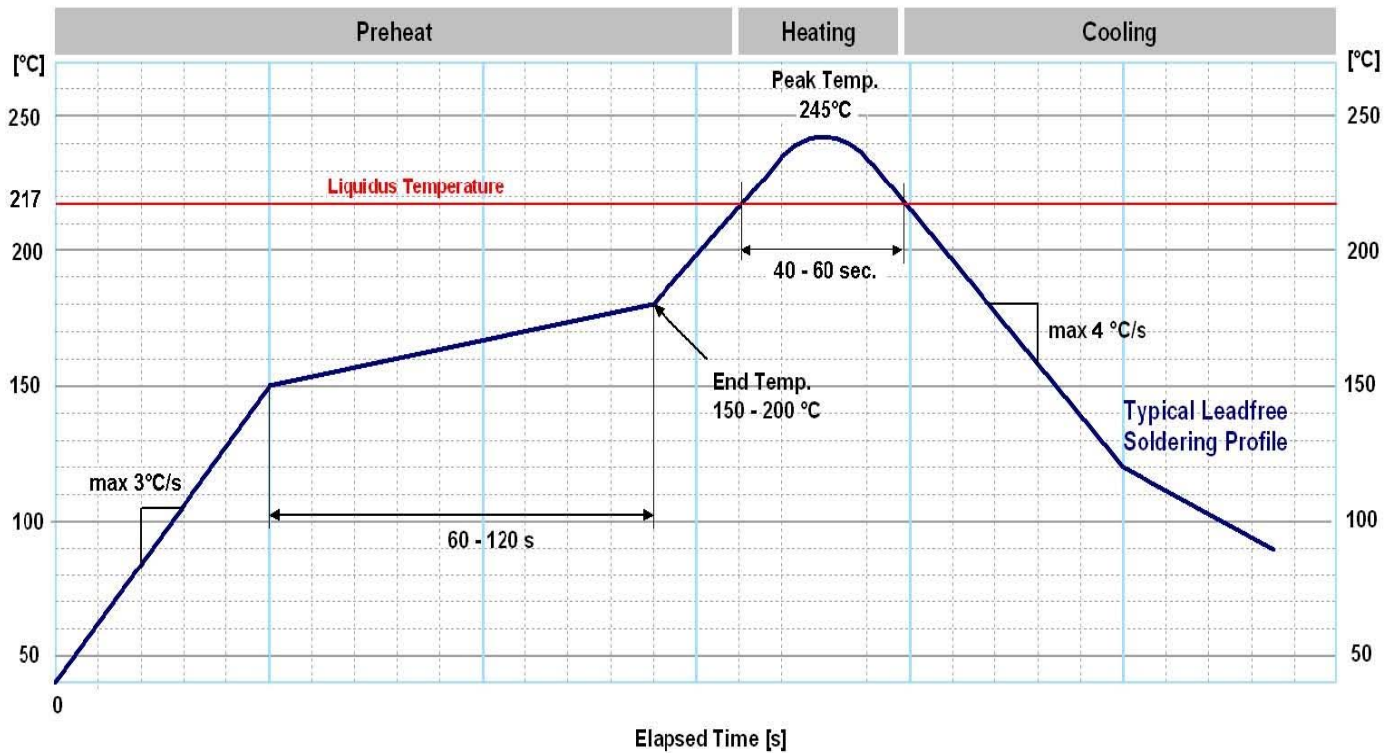
6.1 With Active Antenna



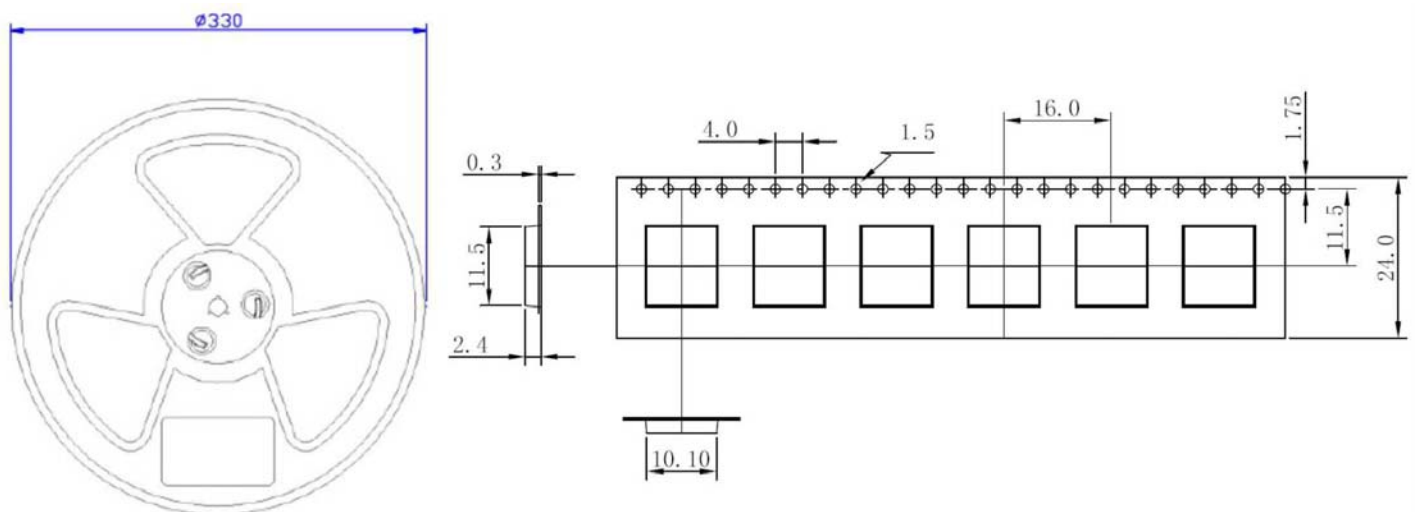
6.2 With Passive Antenna ,LNA & SAW Filter



7. Reflow Profile



8. Tape & Reel (unit : mm)



9. Software Interface

NMEA output message

Table 9.1 NMEA output message

| NMEA | Description |
|------|--|
| GGA | Global positioning system fixed data |
| GLL | Geographic position - latitude/longitude |
| GSA | GNSS DOP and active satellites |
| GSV | GNSS satellites in view |
| RMC | Recommended minimum specific GNSS data |
| VTG | Course over ground and ground speed |

GGA--- Global Positioning System Fixed Data

Table 9.2 contains the values for the following example:

\$GPGGA,060406.000,2503.7148,N,12138.7451,E,2,17,0.71,116.7,M,15.3,M,0000,0000*6D

Table 9.2 GGA Data Format

| Name | Example | Units | Description |
|------------------------|------------|--------|-----------------------------------|
| Message ID | \$GPGGA | | GGA protocol header |
| UTC Time | 060406.000 | | hhmmss.sss |
| Latitude | 2503.7148 | | ddmm.mmmm |
| N/S indicator | N | | N=north or S=south |
| Longitude | 12138.7451 | | dddmm.mmmm |
| E/W Indicator | E | | E=east or W=west |
| Position Fix Indicator | 2 | | See Table 9.3 |
| Satellites Used | 17 | | Range 0 to 33 |
| HDOP | 0.71 | | Horizontal Dilution of Precision |
| MSL Altitude | 116.7 | mters | |
| Units | M | mters | |
| Geoid Separation | 15.3 | mters | |
| Units | M | mters | |
| Age of Diff. Corr. | 0000 | second | Null fields when DGPS is not used |
| Diff. Ref. Station ID | 0000 | | |
| Checksum | *6D | | |
| <CR> <LF> | | | End of message termination |

Table 9.3 Position Fix Indicators

| Value | Description |
|-------|---------------------------------------|
| 0 | Fix not available or invalid |
| 1 | GPS SPS Mode, fix valid |
| 2 | Differential GPS, SPS Mode, fix valid |
| 3-5 | Not supported |
| 6 | Dead Reckoning Mode, fix valid |

GLL--- Geographic Position – Latitude/Longitude

Table 9.4 contains the values for the following example:

\$GNGLL,2503.7148,N,12138.7451,E,060406.000,A,D*46

Table 9.4 GLL Data Format

| Name | Example | Units | Description |
|---------------|------------|-------|--|
| Message ID | \$GNGLL | | GLL protocol header (GPGLL or GNGLL; GP indicates the device receives GPS satellites signal only and GN indicates the position is calculated with BEIDOU satellite signal) |
| Latitude | 2503.7148 | | ddmm.mmmm |
| N/S indicator | N | | N=north or S=south |
| Longitude | 12138.7451 | | dddmm.mmmm |
| E/W indicator | E | | E=east or W=west |
| UTC Time | 060406.000 | | hhmmss.sss |
| Status | A | | A=data valid or V=data not valid |
| Mode | D | | A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse Position, S=Simulator |
| Checksum | *46 | | |
| <CR> <LF> | | | End of message termination |

GSA---GNSS DOP and Active Satellites

Table 9.5 contains the values for the following example:

\$GNGSA,A,3,22,21,18,12,24,25,14,15,193,,,,,1.18,0.71,0.95*2C

\$GNGSA,A,3,205,207,210,202,201,203,209,208,,,,,1.18,0.71,0.95*1C

Table 9.5 GSA Data Format

| Name | Example | Units | Description |
|----------------------|---------|-------|--|
| Message ID | \$GNGSA | | GSA protocol header (GNGSA or GPGSA; GP indicates the device receives GPS satellites signal only and GN indicates the position is calculated with BEIDOU satellite signal).First row of GSA message contains GPS & QZSS satellites and second row of GSA message contains BEIDOU satellites. |
| Mode 1 | A | | See Table 9.6 |
| Mode 2 | 3 | | See Table 9.7 |
| ID of satellite used | 22 | | Sv on Channel 1 |
| ID of satellite used | 21 | | Sv on Channel 2 |
| | | | |
| ID of satellite used | | | Sv on Channel 12 |
| PDOP | 1.18 | | Position Dilution of Precision |
| HDOP | 0.71 | | Horizontal Dilution of Precision |
| VDOP | 0.95 | | Vertical Dilution of Precision |
| Checksum | *2C | | |
| <CR> <LF> | | | End of message termination |

Table 9.6 Mode 1

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

Table 9.7 Mode 2

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

GSV---GNSS Satellites in View

Table 9.8 contains the values for the following example:

\$GPGSV,6,1,21,18,78,169,36,209,72,273,36,22,63,309,38,207,63,328,38*7B

\$GPGSV,6,2,21,203,58,205,39,25,56,138,39,201,55,141,34,206,50,168,*45

\$GPGSV,6,3,21,210,49,282,34,12,48,076,39,204,39,118,,14,38,322,37*77

\$GPGSV,6,4,21,193,37,180,34,202,36,246,29,24,23,041,34,31,21,244,*71

\$GPGSV,6,5,21,21,17,198,33,205,16,258,28,15,12,092,33,208,09,169,30*7B

\$GPGSV,6,6,21,51,,,*7E

Table 9.8 GSV Data Format

| Name | Example | Units | Description |
|---------------------------|---------|---------|--|
| Message ID | \$GPGSV | | GSV protocol header |
| Total number of messages1 | 6 | | Range 1 to 6 |
| Message number1 | 1 | | Range 1 to 6 |
| Satellites in view | 21 | | |
| Satellite ID | 18 | | Channel 1 (Range 01 to 237), GPS Satellites ID : 01~32, SBAS Satellites ID : 33~64, QZSS Satellites ID:193~196, &BEIDOU Satellites ID : 201~214 |
| Elevation | 78 | degrees | Channel 1 (Range 00 to 90) |
| Azimuth | 169 | degrees | Channel 1 (Range 000 to 359) |
| SNR (C/No) | 36 | dB-Hz | Channel 1 (Range 00 to 99, null when not tracking) |
| | | | |
| Satellite ID | 207 | | Channel 4 (Range 01 to 237) , GPS Satellites ID : 01~32, SBAS Satellites ID : 33~64, QZSS Satellites ID:193~196, &BEIDOU Satellites ID : 201~214 |
| Elevation | 63 | degrees | Channel 4 (Range 00 to 90) |
| Azimuth | 328 | degrees | Channel 4 (Range 000 to 359) |
| SNR (C/No) | 38 | dB-Hz | Channel 4 (Range 00 to 99, null when not tracking) |
| Checksum | *7B | | |
| <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

Table 9.9 contains the values for the following example:

\$GNRMC,060406.000,A,2503.7148,N,12138.7451,E,0.01,0.00,180313,,D*78

Table 9.9 RMC Data Format

| Name | Example | Units | Description |
|--------------------|------------|---------|--|
| Message ID | \$GNRMC | | RMC protocol header (GNRMC or GPRMC; GP indicates the device receives GPS satellites signal only and GN indicates the position is calculated with BEIDOU satellite signal) |
| UTC Time | 060406.000 | | hhmmss.sss |
| Status | A | | A=data valid or V=data not valid |
| Latitude | 2503.7148 | | ddmm.mmmm |
| N/S Indicator | N | | N=north or S=south |
| Longitude | 12138.7451 | | dddmm.mmmm |
| E/W Indicator | E | | E=east or W=west |
| Speed over ground | 0.01 | knots | True |
| Course over ground | 0.00 | degrees | |
| Date | 180313 | | ddmmyy |
| Magnetic variation | | degrees | |
| Variation sense | | | E=east or W=west (Not shown) |
| Mode | D | | A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse Position, S=Simulator |
| Checksum | *78 | | |
| <CR> <LF> | | | End of message termination |

VTG---Course Over Ground and Ground Speed

Table 9.10 contains the values for the following example:

\$GPVTG,0.00,T,,M,0.01,N,0.02,K,D*3B

Table 9.10 VTG Data Format

| Name | Example | Units | Description |
|--------------------|---------|---------|--|
| Message ID | \$GPVTG | | VTG protocol header |
| Course over ground | 0.00 | degrees | Measured heading |
| Reference | T | | True |
| Course over ground | | degrees | Measured heading |
| Reference | M | | Magnetic |
| Speed over ground | 0.01 | knots | Measured speed |
| Units | N | | Knots |
| Speed over ground | 0.02 | km/hr | Measured speed |
| Units | K | | Kilometer per hour |
| Mode | D | | A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse Position, S=Simulator |
| Checksum | *3B | | |
| <CR> <LF> | | | End of message termination |