

## GPS & GLONASS Receiver Module

### 1. Product Information

#### 1.1 Product Name: YIC91612EBFGG-U8



#### 1.2 Product Description:

YIC91612EBFGG-U8 is a flash base, compact, high performance and low power consumption, standalone multiple GNSS module. The module can simultaneously acquire and track multiple satellite constellations that include GPS, GLONASS, BEIDOU, GALILEO, QZSS and SBAS. It features low power and small form factor.

YIC91612EBFGG-U8 is suitable for the following applications:

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

#### Product Features:

- High performance and low power consumption GNSS Chipset
- Very high sensitivity
- With 16Mbit flash
- Extremely fast TTFF (Time To First Fix) at low signal level
- Built-in LNA
- Compact size suitable for space-sensitive application
- One size component, easy to mount on another PCB board
- Support NMEA 0183 and binary protocol

## 1.3 Product Specifications

### GNSS Performance

| <b>GNSS Performance</b>        |  |
|--------------------------------|--|
| Chipset                        | u-blox M8 (UBX-M8030)  |
| Receiver type                  | GPS/QZSS L1 C/A, GLONASS L10F<br>Galileo E1B/C (additional Flash required)<br>SBAS L1 C/A: WAAS, EGNOS, MSAS           |
| Code                           | C/A Code   |
| Protocol                       | NMEA 0183<br>Default:GGA,GSA,GSV,RMC<br>Support:VTG,GLL,TXT binary and NMEA Command                                    |
| Available Baud Rate            | 9,600 bps (Default)  |
| Channels                       | 72   |
| Sensitivity                    | Tracking:-167dBm<br>Reacquisition:-160dBm<br>ColdStart:-148dBm<br>HotStart:-156dBm                                     |
| Cold Start                     | 26 seconds, average  |
| Aided Start                    | 2 seconds, average   |
| Hot Start                      | 1 second, average  |
| Accuracy                       | HorizontalPosition:Autonomous<2.5m average,<br>SBAS < 2.0m average<br>Velocity: 0.1 m/s<br>Timepulse signal: RMS 30 ns |
| Maximum Altitude               | 50,000 meter   |
| Maximum Velocity               | 500 m/s(1000 knots)  |
| Dynamics                       | ≅ 4G   |
| Update Rate                    | Single GNSS up to 18Hz<br>Concurrent GNSS up to 10Hz   |
| A-GPS                          | AssistNow on-line and off-line   |
| <b>Interface</b>               |  |
| I/O Pins                       | 1 serial ports   |
| <b>Physical Characteristic</b> |  |
| Type                           | 24 pin stamp holes   |
| Dimensions                     | 16.0mm * 12.2 mm * 2.4mm ±0.2mm  |

## 1.4 DC Electrical Characteristics

| Parameter                    | Symbol           | Conditions   | Min. | Typ.                           | Max.               | Units                |
|------------------------------|------------------|--|------|--------------------------------|--------------------|----------------------|
| Input Voltage                | VCC              |  | 2.7  | 3.3                            | 3.6                | V                    |
| Input Backup Battery Voltage | V_BCKP           |  | 1.4  |                                | 3.6                | V                    |
| Supply Current               | I <sub>ss</sub>  | VCC = 3.3V,<br>w/o active antenna,<br>Peak<br>Acquisition<br>Tracking<br>Standby |      | 24<br>16 <sup>(2)</sup><br>365 | 150 <sup>(1)</sup> | mA<br>mA<br>mA<br>uA |
| Backup Battery Current       | I <sub>bat</sub> | VCC = 0V   |      | 7                              |                    | uA                   |
| High Level Input Voltage     | V <sub>IH</sub>  |  | 2.0  |                                | 3.6                | V                    |
| Low Level Input Voltage      | V <sub>IL</sub>  |  | -0.3 |                                | 0.8                | V                    |
| High Level Input Current     | I <sub>IH</sub>  | no pull-up or down   | -1   |                                | 1                  | uA                   |
| Low Level Input Current      | I <sub>IL</sub>  | no pull-up or down   | -1   |                                | 1                  | uA                   |
| High Level Output Voltage    | V <sub>OH</sub>  |  | 2.4  |                                |                    | V                    |
| Low Level Output Voltage     | V <sub>OL</sub>  |  |      |                                | 0.4                | V                    |
| High Level Output Current    | I <sub>OH</sub>  |  |      | 2                              |                    | mA                   |
| Low Level Output Current     | I <sub>OL</sub>  |  |      | 2                              |                    | mA                   |

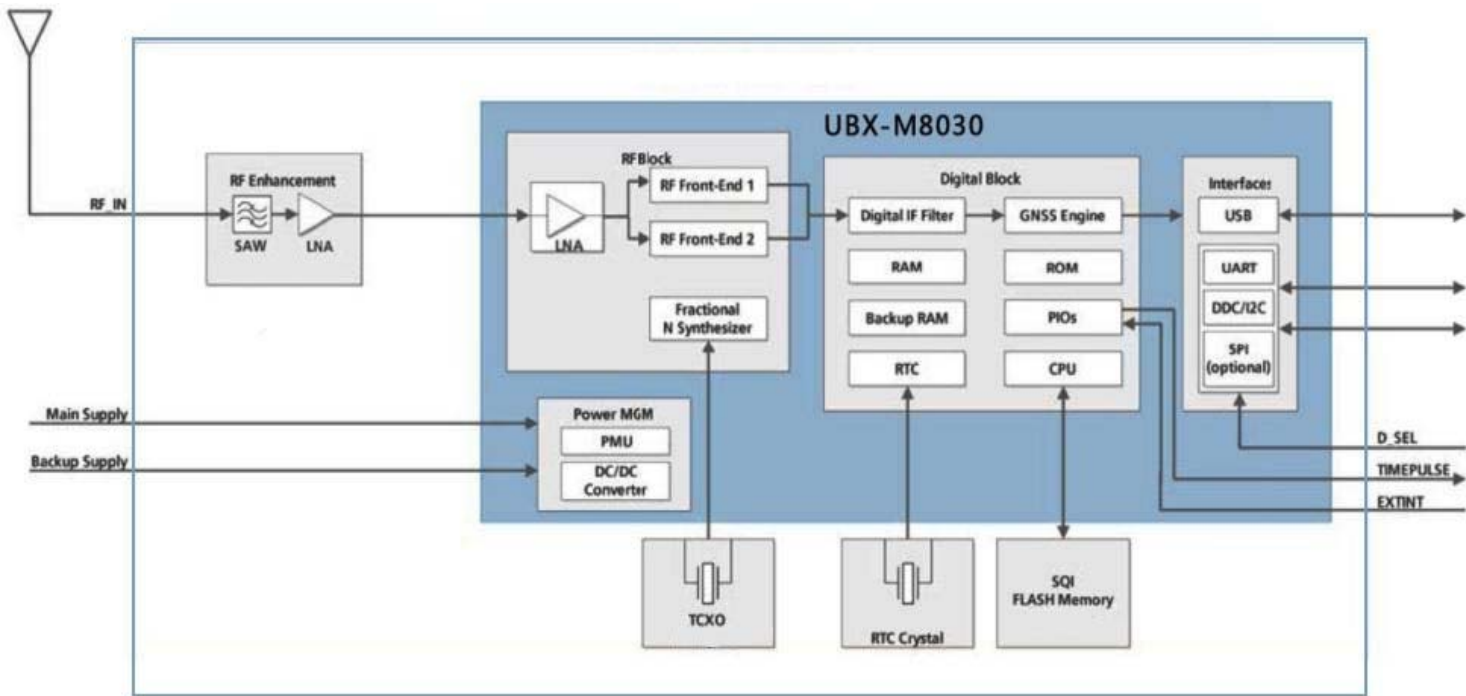
**Note 1:** This happens when downloading AGPS data to Module.

**Note 2:** 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 <sub>opr</sub> | -40  | 25   | 85   | °C    |
| Storage Temperature   | T <sub>stg</sub> | -40  | 25   | 85   | °C    |

## 2. Block Diagram

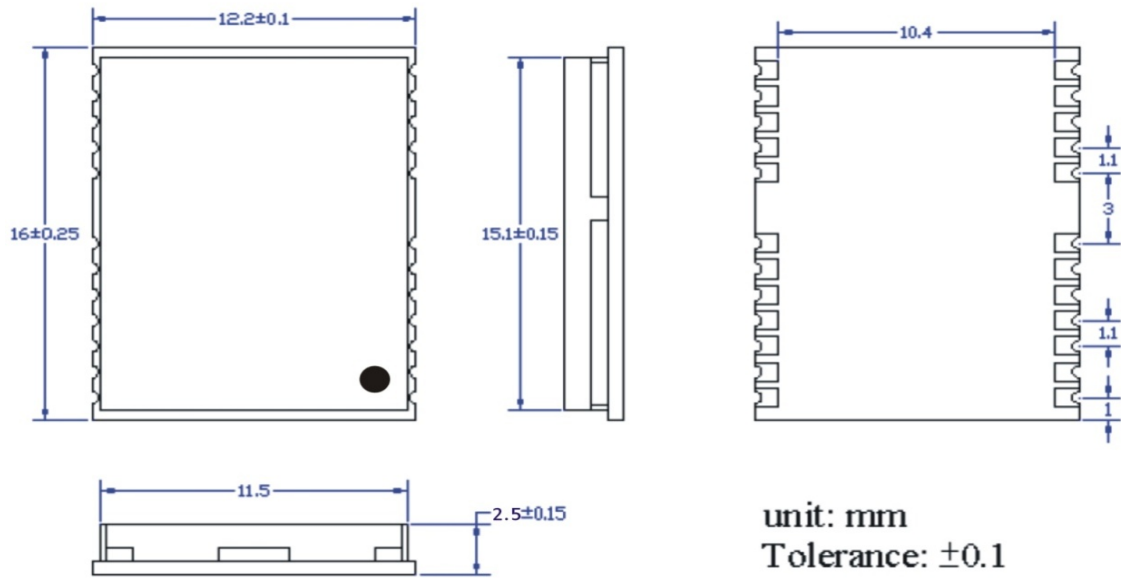


## 3. Module Pin Assignment

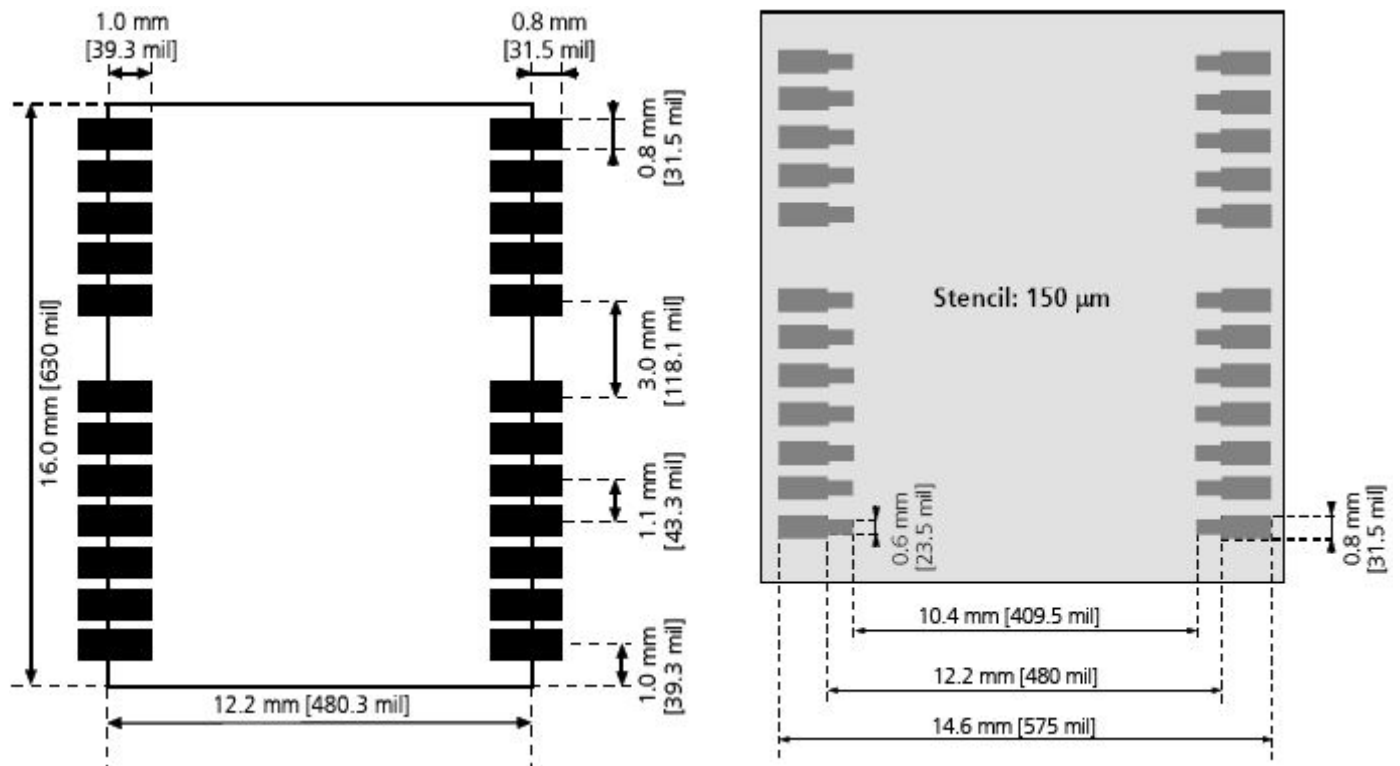
|                   |           |           |
|-------------------|-----------|-----------|
| <b>13</b> GND     | GND       | <b>12</b> |
| <b>14</b> ANT_OK  | RF IN     | <b>11</b> |
| <b>15</b> ANT_OFF | GND       | <b>10</b> |
| <b>16</b> RESET_N | VCC RF    | <b>9</b>  |
| <b>17</b> EXTINT1 | NC        | <b>8</b>  |
| <b>18</b> SDA     | VDD_USB   | <b>7</b>  |
| <b>19</b> SCL     | USB DP    | <b>6</b>  |
| <b>20</b> TXD     | USB_DM    | <b>5</b>  |
| <b>21</b> RXD     | EXTINT0   | <b>4</b>  |
| <b>22</b> V_BAT   | TIMEPULSE | <b>3</b>  |
| <b>23</b> VCC     | NC        | <b>2</b>  |
| <b>24</b> GND     | SAFEBOOT  | <b>1</b>  |

| Pin NO. | Pin Name  | I/O | Remark  |
|---------|-----------|-----|---|
| 1.      | SAFEBOOT  | I   | Leave Open if not used                                      |
| 2.      | NC        | I   | Leave Open if not used                                      |
| 3.      | TIMEPULSE | I/O | Time pulse (1PPS)   |
| 4.      | EXTINT0   | I   | External Interrupt Pin                                      |
| 5.      | USB_DM    | I/O | USB Data  |
| 6.      | USB_DP    | I/O | USB Data  |
| 7.      | VDD_USB   | I   | USB Supply  |
| 8.      | NC        | I   | Leave Open if not used                                      |
| 9.      | RF_VCC    | O   | Output Voltage RF section                                   |
| 10.     | GND       | G   | Ground.   |
| 11.     | RF_IN     | I   | GNSS Signal Input   |
| 12.     | GND       | G   | Ground.   |
| 13.     | GND       | G   | Ground.   |
| 14.     | ANT_OK    | I/O | Antenna status of antenna supervisor                        |
| 15.     | ANT_OFF   | I/O | Antenna power control of antenna supervisor                 |
| 16.     | RESET_N   | I/O | Leave Open if not used                                      |
| 17.     | EXTINT1   | I   | External Interrupt Pin                                      |
| 18.     | DDC_SDA   | I/O | DDC Data  |
| 19.     | DDC_SCL   | I/O | DDC Clock   |
| 20.     | TXD       | O   | UART Serial Data Output Pull up (75K $\Omega$ ) if not used |
| 21.     | RXD       | I   | UART Serial Data Input Pull up (75K $\Omega$ ) if not used  |
| 22.     | V_BAT     | P   | Backup battery supply voltage                               |
| 23.     | VCC       | P   | DC supply voltage   |
| 24.     | GND       | G   | Ground.   |

## 4. Dimensions

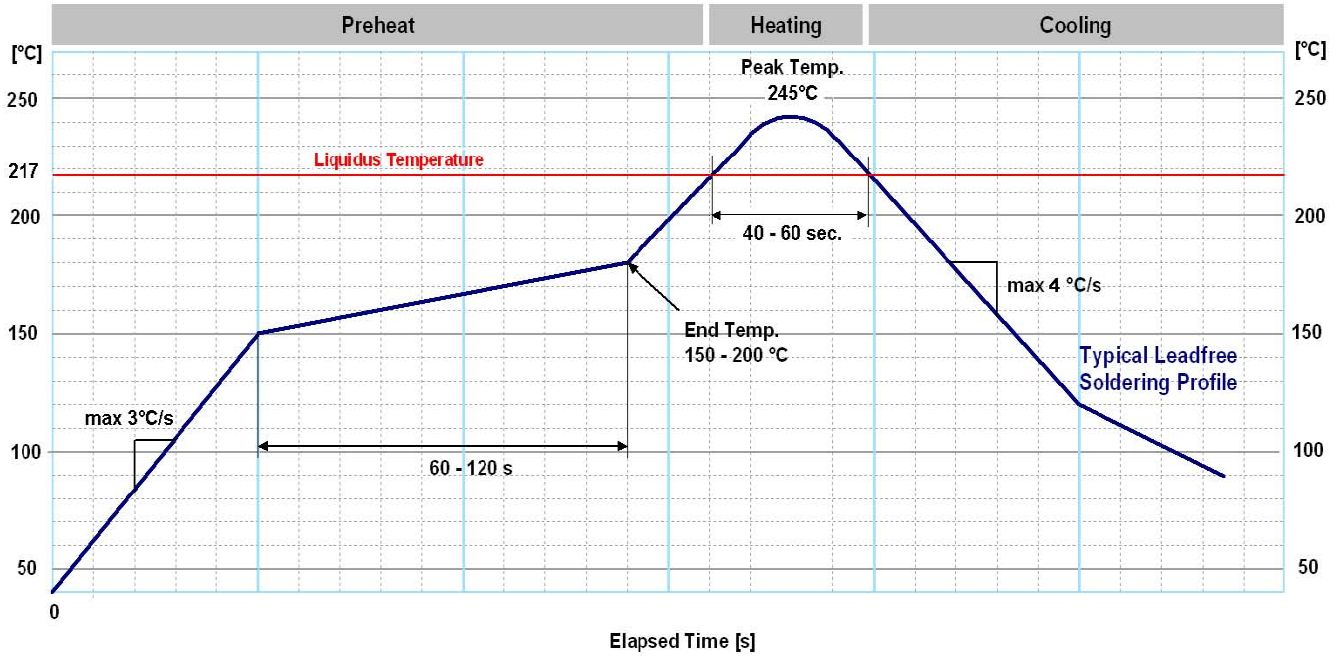


## 5. Recommended Footprint

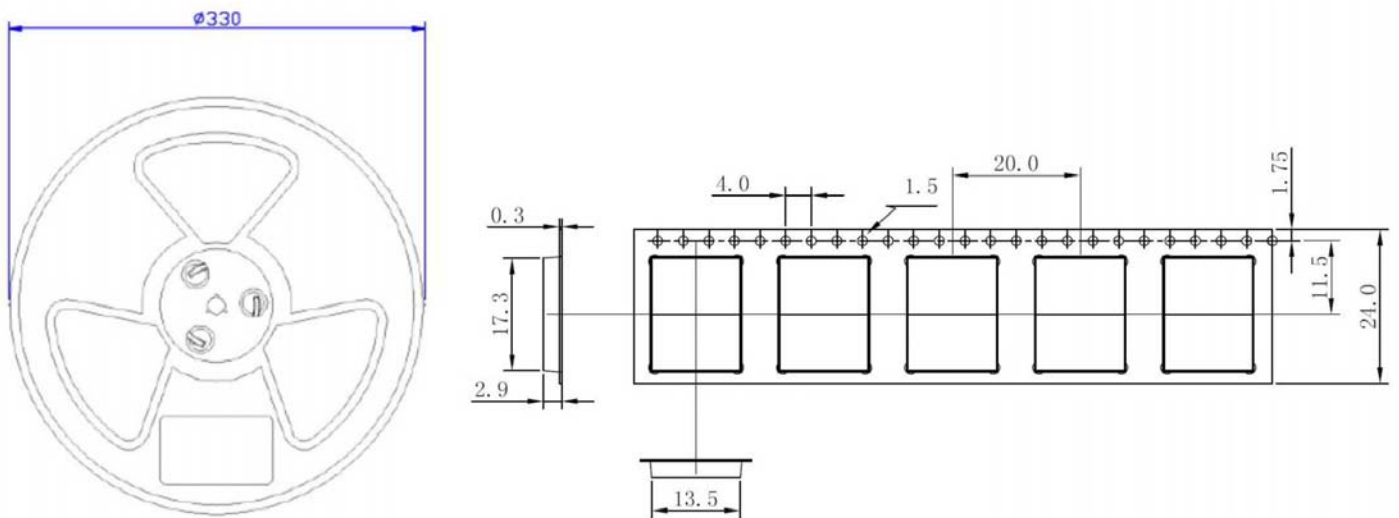




## 7. Reflow Profile



## 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,<br>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   |