

## GPS & BDS Antenna Module



### 1. Product Information

1.1 Product Name: **YIC51513GMGB-33**

1.2 Product Description:

**YIC51513GMGB-33** is a complete standalone GPS/GNSS antenna module. It can simultaneously acquire and track multiple satellite constellations that include GPS, BeiDou, GALILEO, QZSS and SBAS. It features low power and small form factor.

**YIC51513GMGB-33** 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 99-channel (33 Tracking, 99 Acquisition)
- 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 data logger
- Built-in DC/DC converter to save power
- Up to 10 Hz update rate
- $\pm 1$  ns high accuracy time pulse (1PPS)
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Support Japan QZSS
- Indoor and outdoor multi-path detection and compensation
- SMD type with stamp holes
- RoHS compliant

## 1.4 Product Specifications

### GNSS Performance

| GNSS Receiver           |  |  |
|-------------------------|--|--|
| Chip                    | MediaTek MT3333  |  |
| Frequency               | GPS, GALILEO, QZSS: L1 1575.42MHz, C/A code<br>BeiDou : B1L1 1561.098MHz |  |
| Channels                | Support 99 channels (33 Tracking, 99 Acquisition)                        |  |
| Update rate             | 1Hz default, up to 10Hz  |  |
| Sensitivity             | Tracking   | -161dBm, up to -165dBm (with external LNA)   |
|                         | Cold start   | -142.5dBm, up to -148dBm (with external LNA)   |
| Acquisition Time        | Hot start (Open Sky)   | < 1s   |
|                         | Cold Start (Open Sky)  | < 38s  |
|                         |  | < 18s with AGPS  |
| Position Accuracy       | Autonomous   | 5m (2D RMS).   |
|                         | SBAS   | 2.5m (depends on accuracy of correction data).   |
| Max. Altitude           | < 18,000 m, up to 50,000m by request                                     |  |
| Max. Velocity           | Velocity < 515 m/s   |  |
| Protocol Support        | NMEA 0183  | 9600 bps, 8 data bits, no parity, 1 stop bits<br>(default) 1Hz: GGA, GLL, GSA, GSV, RMC, VTG |
| Physical Characteristic |  |  |
| Dimensions              | 15.0.0mm * 13.0 mm * 6.8mm ±0.2mm  |  |

## 1.5 DC Electrical characteristics

| Parameter                    | Symbol | Conditions                                 | Min. | Typ.              | Max.               | Units |
|------------------------------|--------|--|------|-------------------|--------------------|-------|
| Input Voltage                | VCC    |  | 3.0  | 3.3               | 4.3                | V     |
| Input Backup Battery Voltage | V_BCKP |  | 3.0  |                   | 3.6                | V     |
| Supply Current               | Iss    | VCC = 3.3V,<br>w/o active antenna,<br>Peak |      |                   | 150 <sup>(1)</sup> | mA    |
|                              |        | Acquisition                                |      | 35                |                    | mA    |
|                              |        | Tracking                                   |      | 30 <sup>(2)</sup> |                    | mA    |
|                              |        | Standby                                    |      | 350               |                    | uA    |
| Backup Battery Current       | Ibat   | VCC = 0V                                   |      | 7                 |                    | uA    |
| High Level Input Voltage     | VIH    |  | 2.0  |                   | 3.6                | V     |
| Low Level Input Voltage      | VIL    |  | -0.3 |                   | 0.8                | V     |
| High Level Input Current     | IIH    | no pull-up or down                         | -1   |                   | 1                  | uA    |
| Low Level Input Current      | IIL    | no pull-up or down                         | -1   |                   | 1                  | uA    |
| High Level Output Voltage    | VOH    |  | 2.4  |                   | 3.3                | V     |
| Low Level Output Voltage     | VOL    |  |      |                   | 0.4                | V     |
| High Level Output Current    | IOH    |  |      | 2                 |                    | mA    |
| Low Level Output Current     | IOL    |  |      | 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.

## 1.6 Temperature characteristics

| Parameter             | Symbol | Min. | Typ. | Max. | Units |
|-----------------------|--------|------|------|------|-------|
| Operating Temperature | Topr   | -40  | 25   | 85   | °C    |
| Storage Temperature   | Tstg   | -40  | 25   | 85   | °C    |

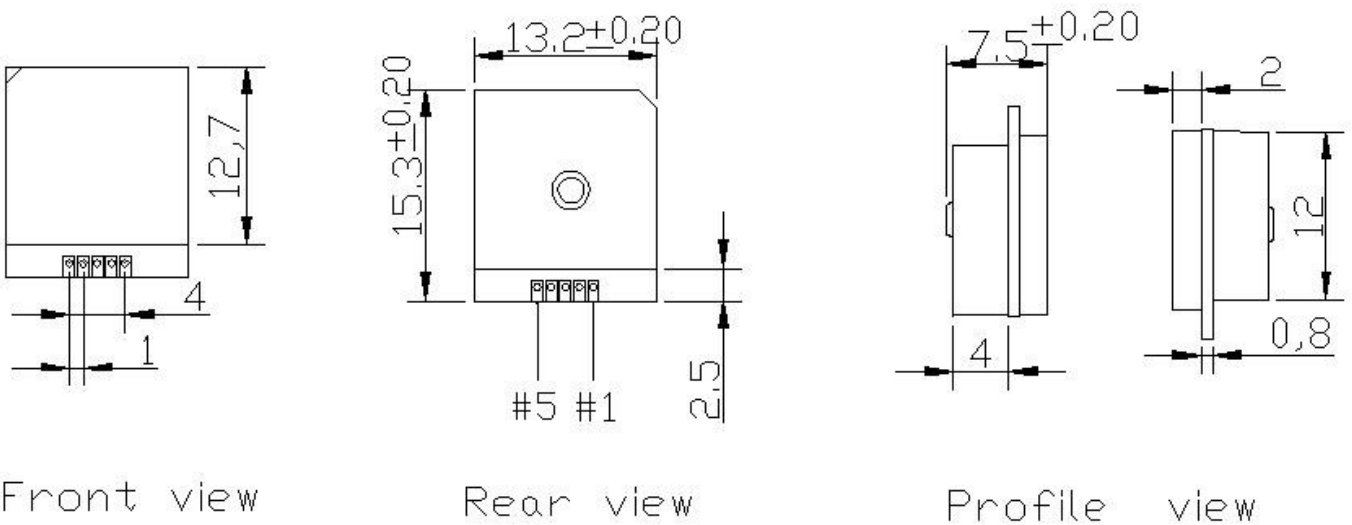
## 2. Technical Information

### 2.1 Module Pin Assignment



| Pin NO. | Pin Name | I/O | Remark                                   |
|---------|----------|-----|--|
| 1.      | VBAT     | I   | RTC Battery Input                        |
| 2.      | TXD      | O   | UART Serial Data Output                  |
| 3.      | RXD      | O   | UART Serial Data Input                   |
| 4.      | VCC      | I   | Module Power Supply, Module Power Supply |
| 5.      | GND      | G   | Ground                                   |

### 2.2 Dimensions



## 3. Software Interface

### NMEA output message

Table 3.1 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 3.2 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

Table3. 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 3.3                     |
| Satellites Used        | 17         |        | Range 0 to 33                     |
| HDOP                   | 0.71       |        | Horizontal Dilution of Precision  |
| MSL Altitude           | 116.7      | meters |                                   |
| Units                  | M          | meters |                                   |
| Geoid Separation       | 15.3       | meters |                                   |
| Units                  | M          | meters |                                   |
| 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        |

Table3.3 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

Table3.4 contains the values for the following example:

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

Table3.4 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 3.5 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

Table3. 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 3.6  |
| Mode 2               | 3       |       | See Table 3.7  |
| 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   |

Table3.6 Mode 1

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

Table 3.7 Mode 2

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

## GSV---GNSS Satellites in View

Table 3.8 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 3.8 GSV Data Format

| Name                                  | Example | Units   | Description  |
|---------------------------------------|---------|---------|--|
| Message ID                            | \$GPGSV |         | GSV protocol header  |
| Total number of messages <sup>1</sup> | 6       |         | Range 1 to 6   |
| Message number <sup>1</sup>           | 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 3.9 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 3.9 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 6.10 contains the values for the following example:

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

Table 6.10 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  |