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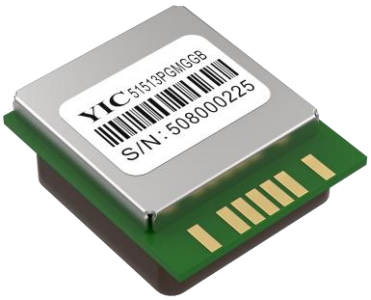


# YIC51513PGMGGB

## Ultra Low Power & Multi-Constellation GNSS Antenna Module

**Datasheet**

# Revision History

| Date | Reversion | Description |
|---|---|---|
| 2024/11/6 | 1.0 | First Draft, Based on YIC51513PGMGGB |
| | | |
| | | |

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# 1. Product Information

## 1.1 Product Description

The YIC51513PGMGGB features multi-constellation and ultra-low power consumption, with a highly integrated GNSS receiver chip built in to support multi-system Cortex®-M4F.

The YIC51513PGMGGB supports concurrent reception of four GNSS, (GPS, GLONASS, BeiDou, and Galileo) and augmentation systems (SBAS and QZSS). The multi-constellation enables the module to achieve an accuracy of approximately 1.5 meter and stable GNSS performance especially in challenging environments.

### Applications

- Automotive Navigation
- Personal Positioning
- Fleet Management
- Marine Navigation

## 1.2 Product Features

- Multi-constellation GPS/GLONASS/Galileo/BeiDou, QZSS and SBAS
- Ultra-Low Power Consumption: 12 mA@3.3V
- Ultra High Track Sensitivity: -165dBm
- Multipath detection and suppression
- Works with passive and active antenna
- Extremely Fast TTFF at Low Signal Level (Cold start ≤24s, Hot start ≤1s)
- NMEA-0183 Compliant Protocol or Custom Protocol
- RoHS Compliant

## 1.3 Product Specifications

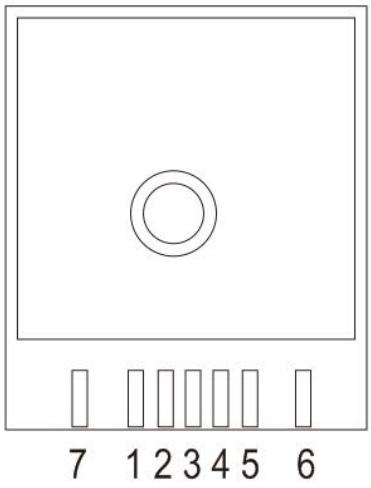
| GPS Receiver | | |
|---|---|---|
| Chip | MediaTek | |
| GNSS Reception | GPS/QZSS | L1 1575.42MHz |
| | GLONASS | L1 1602MHz |
| | Galileo | E1 1575.42MHz |
| | BeiDou | B1 1561MHz |
| | SBAS | WAAS, EGNOS, MSAS, GAGAN |
| Update Rate | GNSS | 10Hz Max. 1Hz by default |
| Position Accuracy | GNSS | 1.5m CEP |
| | SBAS | 1.5m CEP |
| Velocity & Time Accuracy | GNSS | 0.01m/s CEP |
| | SBAS | 0.05 m/s |
| | 1PPS | 25 ns |
| Accuracy Time | Hot start | 1 sec |
| | Cold start | 24 sec |
| Sensitivity | Cold start | -148dBm |
| | Hot start | -155dBm |
| | Tracking | -165dBm |
| | Reacquisition | -158dBm |
| GNSS Operating limit | Velocity | 515m/s |
| | Altitude | 18,000m (Default), 80,000m in Balloon Mode |
| Protocol Support | UART Port: TXD and RXD<br>115200bps (default), Supports baud rate 9600bps to 921600bps<br>NMEA 0183 Protocol | |
| Environment | Operation temperature | -40°C ~ +85°C |
| | Storage temperature | -55°C ~ +125°C |
| Physical Characteristics | Size | 18.3±0.5 × 18.2±0.5 × 6.52±0.5mm |
| | Weight | Approx. 7.0g |

## 1.4 DC Electrical Characteristics

| Parameter | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Input Voltage | | 2.8 | 3.3 | 3.6 | Volt |
| Power Supplier Current | | | | | |
| Acquisition | GPS/QZSS L1 + GL + GA + BD | | 11 | | mA |
| Tracking | GPS/QZSS L1 + GL + GA + BD | | 12 | | mA |
| Standby | GPS/QZSS L1 + GL + GA + BD | | 1.2 | | mA |
| UART Port Working Voltage | | | | | |
| Low Level Output Voltage (VOL) | | | | 0.4 | Volt |
| High Level Output Voltage (VOH) | | 2.4 | | | Volt |
| Low Level Input Voltage (VIL) | | | | 0.8 | Volt |
| High Level Input Voltage (VIH) | | 2.1 | | | Volt |
| Low Level Output Current (IOL) | | 10 | | | uA |
| High Level Output Current (IOH) | | -10 | | | uA |

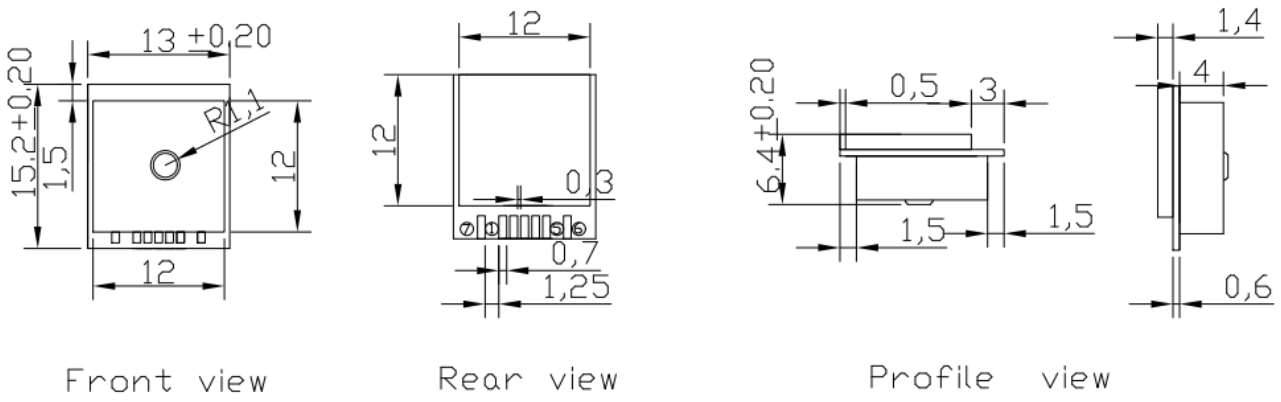
## 2. Technical Information

### 2.1 Module Pin Assignment




| Pin NO. | Pin Name | I/O | Remark |
|---|---|---|---|
| 1. | VBAT | I | RTC Battery Input , Voltage range: 1.5V – 4.3V |
| 2. | TXD | O | UART/TTL Serial Data Output |
| 3. | RXD | I | UART/TTL Serial Data Input |
| 4. | VCC | I | Module Power Supply |
| 5 | GND | G | Ground |
| 6 | PPS | O | Time Pulse(1PPS) |
| 7 | GPIO1 | I/O | General purpose I/O |

## 3. Dimensions



# 4. Installation Guidelines

## Introduction

Proper placement and installation of a GNSS antenna module significantly affects signal reception performance. This application note outlines key recommendations for integrating GNSS modules (especially those with built-in antennas) into a final product enclosure to ensure optimal positioning, minimum interference, and stable operation.

## 4-1 Prioritize Top or Upper Surface Placement

The GNSS antenna should face the sky directly, typically meaning the top side of the device enclosure. Avoid or minimize any obstruction above the antenna to ensure a clear line of sight to satellites.

## 4-2 Keep Away from Metal Parts

Avoid placing the GNSS antenna near internal metal components such as brackets, shielding covers, metal frames, battery packs, large metal housings, or bundled cables. Maintain a minimum distance of 1–2 cm from such structures; the farther, the better.

## 4-3 Avoid any High-Frequency Noise

Do not place the antenna close to noise-generating components, especially:

- Wi-Fi/Bluetooth modules
- Cellular transceivers (especially during transmission)
- High-speed digital circuits (e.g., CPUs, GPUs, data buses)
- Switching power supplies
- Motor drivers
- Display backlight drivers

These components emit electromagnetic interference that can overwhelm the weak GNSS signals.

## 4-4 Avoid Metal-Coated Plastic Enclosures

Some enclosures use metal spraying or electroplating for aesthetics or EMC reasons. These coatings may block satellite signals. Ensure the area directly above and around the antenna (at a certain radiation angle) is made of non-metallic materials such as pure plastic or glass.

## 4-5 Minimize Obstructions Around the Antenna

Avoid placing tall or dense components (e.g., battery packs, camera modules, speakers, or large connectors) directly above or around the antenna within a vertical angle of 5°–10°. These parts can block signal reception at low elevation angles.

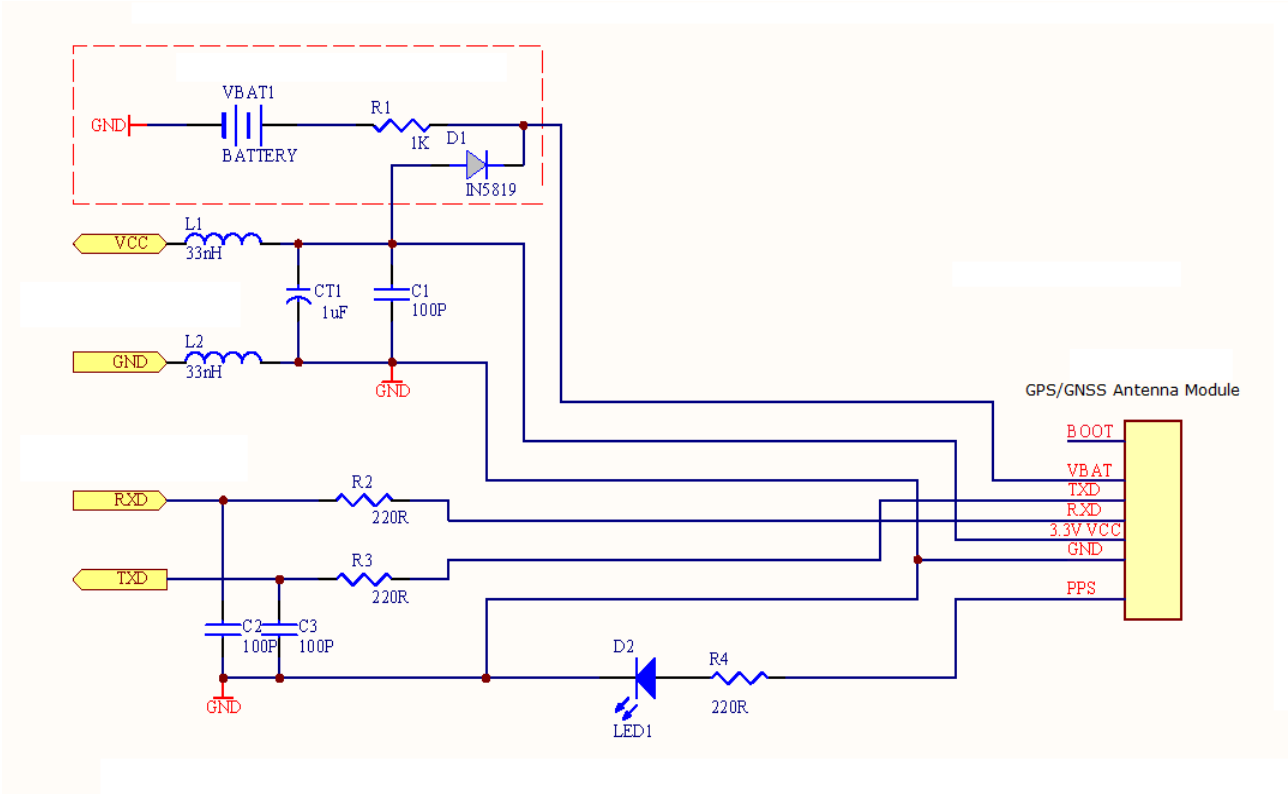
## 4-6 Ensure Clean and Stable Power Supply

Provide the module with a power source that has low ripple and stable voltage. It is recommended to use an LDO or a low-noise DC-DC converter, and place sufficient decoupling capacitors close to the module's power pins (as specified in the module datasheet).

## 4-7 Product Placement Recommendations

During the mechanical design of a product, the GNSS antenna module's placement should be pre-defined. Typically, a plastic cavity or grid structure is reserved in the enclosure to securely fit the module. The structure should be dimensioned to tightly hold the module in place. If additional fixation is needed, apply a small amount of adhesive to the backside of the module to ensure it stays firmly in position.

## 5. Application Circuit：(Example)



## 6. Software Protocol

### 6.1 NMEA output message

| NMEA | Description |
|---|---|
| **$GNGGA** | Time, position, and fix related data of the receiver. |
| **$GNGLL** | Position, time and fix status. |
| **$GNGSA** | Used to represent the ID of satellites which are used for position fix. When GPS & GLONASS & Galileo & BDS satellites are used for positioning solutions, the ID of available positioning satellites is counted and output with multiple statements. |
| **$GPGSV**<br>**$GLGSV**<br>**$GAGSV**<br>**$GBGSV** | Satellite information about elevation, azimuth and CNR, satellites are used in position solution, $GPGSV sentence is used for GPS satellites, a $GLGSV sentence is used for GLONASS satellites, $GAGSV sentence is used for GALILEO satellites. And $GBGSV sentence is used for BDS satellites. |
| **$GNRMC** | Time, date, position, course and speed data. |
| **$GNVTG** | Course and speed relative to the ground. |
| **$GNZDA** | UTC, day, month and year and time zone. |

## 6.2 GGA – Global Positioning System Fix Data

Time, position and fix related data for a GNSS receiver.

Structure:

$GNGGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh

example: $GNGGA,175258.000,2447.0870,N,12100.5221,E,2,15,0.7,95.2,M,19.6,M,,0000*72

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | UTC Time | 175258.000 | UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999) |
| 2 | Latitude | 2447.08700 | Latitude in ddmm.mmmmm format Leading zeros transmitted |
| 3 | N/S Indicator | N | Latitude hemisphere indicator, 'N' = North, 'S' = South |
| 4 | Longitude | 12100.52210 | Longitude in dddmm.mmmmm format Leading zeros transmitted |
| 5 | E/W Indicator | E | Longitude hemisphere indicator, 'E' = East, 'W' = West |
| 6 | Quality Indicator | 2 | Quality Indicator<br>0: position fix unavailable<br>1: valid position fix, SPS mode<br>2: valid position fix, differential<br>GPS mode 3: GPS PPS Mode, fix valid<br>6: Estimated (dead reckoning) Mode |
| 7 | Satellites Used | 15 | Number of satellites in use, (00 ~ 56) |
| 8 | HDOP | 0.7 | Horizontal dilution of precision, (0.0 ~ 99.9) |
| 9 | Altitude | 95.2 | mean sea level (geoid), (-9999.9 ~ 17999.9) |
| 10 | Geoidal Separation | 19.6 | Geoidal separation in meters |
| 11 | Age pf Differential GPS data | | Age of Differential GPS data NULL when DGPS not used |
| 12 | DGPS Station ID | 0000 | Differential reference station ID, 0000 ~ 1023 |
| 13 | Checksum | 72 | |

## 6.3 GLL – Latitude/Longitude

Latitude and longitude of current position, time, and status.

Structure: $GNGLL,ddmm.mmmm,a,dddmm.mmmm,a,hhmmss.sss,A,a*hh

For example: $GNGLL,2447.0870,N,12100.5221,E,175258.000,A,D*42

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | Latitude | 2447.08700 | Latitude in ddmm.mmmmm format Leading zeros transmitted |
| 2 | N/S Indicator | N | Latitude hemisphere indicator 'N' = North 'S' = South |
| 3 | Longitude | 12100.52210 | Longitude in dddmm.mmmmm format Leading zeros transmitted |
| 4 | E/W Indicator | E | Longitude hemisphere indicator 'E' = East 'W' = West |
| 5 | UTC Time | 175258.000 | UTC time in hhmmss.sss format (000000.000 ~ 235959.999) |
| 6 | Status | A | Status, 'A' = Data valid, 'V' = Data not valid |
| 7 | Mode Indicator | D | Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode |
| 8 | Checksum | 42 | |

## 6.4 GSA – GNSS DOP and Active Satellites

GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA sentence and DOP values.

Structure: $GNGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,x*hh
For example: $GNGSA,A,3,21, 12,15,18,20,24,10,32,25,13,,,1.2,0.7,1.0,1*18

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | Mode | A | Mode<br>'M' = Manual, forced to operate in 2D or 3D mode<br>'A' = Automatic, allowed to automatically switch 2D/3D |
| 2 | Mode | 3 | Fix type<br>1 = Fix not available<br>2 = 2D<br>3 = 3D |
| 3 | Satellite used 1~12 | 21, 12, 15, 18, 20, 24, 10, 32,25, 13 | 01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 197 are for QZSS; 65 ~ 88 are for GLONASS (GL PRN) ; 01 ~ 36 are for GALILEO (GA PRN); 01 ~ 37 are for BDS (BD PRN). GPS, GLONASS, GALILEO and BDS satellites are differentiated by the. GNSS system ID in table 3. Maximally 12 satellites are included in each GSA sentence. |
| 4 | PDOP | 1.2 | Position dilution of precision (0.0 to 99.9) |
| 5 | HDOP | 0.7 | Horizontal dilution of precision (0.0 to 99.9) |
| 6 | VDOP | 1.0 | Vertical dilution of precision (0.0 to 99.9) |
| 7 | GNSS System ID | 1 | 1 for GPS, 2 for GLONASS, 3 for GALILEO, 4 for BDS |
| 8 | Checksum | 18 | |

## 6.5 GSV – GNSS Satellites in View

Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value. Four satellites maximum per transmission.

Structure: $GPGSV，x，x，xx，xx，xx，xx，xx，...，xx，xx，xx，xx，xx，x*hh
For example: $GPGSV，4,1，13，02,72，109，43,24，69,035，48,18，52,330，42,21，49,246，43，1*69

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | Number of message | 4 | Total number of GSV messages to be transmitted (1-5) |
| 2 | Sequence number | 1 | Sequence number of current GSV message |
| 3 | Satellites in view | 13 | Total number of satellites in view (00 ~ 20) |
| 4 | Satellite ID | 02 | 01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 197 are for QZSS; 65 ~ 88 are for GLONASS (GL PRN) ; 01 ~ 36 are for GALILEO (GA PRN); 01 ~ 37 are for BDS (BD PRN). GPS, GLONASS, GALILEO and BDS satellites are differentiated by the GNSS system ID in table 3. Maximally 12 satellites are included in each GSA sentence |
| 5 | Elevation | 72 | Satellite elevation in degrees, (00 ~ 90) |
| 6 | Azimuth | 109 | Satellite azimuth angle in degrees, (000 ~ 359 ) |
| 7 | SNR | 43 | C/No in dB (00 ~ 99) Null when not tracking |
| 8 | Signal ID | 1 | 1 for L1/CA |
| 9 | Checksum | 69 | |

## 6.6 RMC – Recommended Minimum Specific GNSS Data

Time, date, position, course and speed data provided by a GNSS navigation receiver.

Structure: $GNRMC,hhmmss.sss,A,dddmm.mmmm,a,dddmm.mmmm,a,x.x,x.x,ddmmyy,,,a*hh For example: $GNRMC,175258.000,A,2447.0870,N,12100.5220,E,000.0,000.0,220617,,,D*75

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | UTC time | 175258.000 | UTC time in hhmmss.sss format (000000.00 ~ 235959.999) |
| 2 | Status | A | Status<br>'V' = Navigation receiver warning<br>'A' = Data Valid |
| 3 | Latitude | 2447.08700 | Latitude in dddmm.mmmmm format Leading zeros transmitted |
| 4 | N/S indicator | N | Latitude hemisphere indicator 'N' =North 'S' = South |
| 5 | Longitude | 12100.52210 | Longitude in dddmm.mmmmm format Leading zeros transmitted |
| 6 | E/W Indicator | E | Longitude hemisphere indicator 'E' = East 'W' = West |
| 7 | Speed over ground | 000.0 | Speed over ground in knots (000.0 ~ 999.9) |
| 8 | Course over ground | 000.0 | Course over ground in degrees (000.0 ~ 359.9) |
| 9 | UTC Date | 220617 | UTC date of position fix, ddmmyy format |
| 10 | Mode indicator | D | Mode indicator<br>'N' = Data not valid<br>'A' = Autonomous mode 'D' = Differential mode<br>'E' = Estimated (dead reckoning) mode |
| 11 | checksum | 75 | |

## 6.7 VTG – Course Over Ground and Ground Speed

The actual course and speed relative to the ground.

Structure: $GNVTG,x.x,T,,M,x.x,N,x.x,K,a*hh

For example: $GNVTG,000.0,T,,M,000.0,N,000.0,K,D*16

| Field | Name | Example | Description |
|---|---|---|---|
| 1 | Course | 000.0 | True course over ground in degrees (000.0 ~ 359.9) |
| 2 | Speed | 000.0 | Speed over ground in knots (000.0 ~ 999.9) |
| 3 | Speed | 000.0 | Speed over ground in kilometers per hour (000.0 ~ 1800.0) |
| 4 | Mode | D | Mode indicator<br>'N' = Data not valid<br>'A' = Autonomous mode 'D' =<br>Differential mode<br>'E' = Estimated (dead reckoning) mode |
| 5 | Checksum | 16 | |

## 6.8 ZDA – TIME AND DATE

UTC, day, month, year and local time zone

Structure:

$GNZDA,hhmmss.sss,xx,xx,xxxx,xx,xx*hh<CR><LF>

For example:

$GNZDA,175258.000,30,08,2022,00,00*46<CR><LF>

| Field | Name | Example | Units | Description |
|---|---|---|---|---|
| 1 | UTC time | 175258.000 | | UTC time in hhmmss.ss format (000000.00 ~ 235959.99) |
| 2 | UTC Day | 30 | | UTC time: day (01 ~ 31) |
| 3 | UTC Month | 28 | | UTC time: month (01 ~ 12) |
| 4 | UTC Year | 2022 | | UTC time: year (4 digit format) |
| 5 | Local zone hour | 00 | | Local zone hours (00 ~ +/- 13) |
| 6 | Local zone minutes | 00 | | Local zone minutes (00 ~59) |
| 7 | Checksum | 46 | | Checksum |

★ZDA is optional