

# YIC



## **Multi-Constellation GNSS Receiver (G-Mouse)**

**GR-502GGB**

**GR-502MGGB**

**Datasheet**

## Revision History

| Date      | Reversion | Description                                |
|-----------|-----------|--|
| 2023/3/10 | 1.0       | First Draft, Based on GR-502GGB/GR-502MGGB |
|           |           |  |
|           |           |  |

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## 1. Product Information

### 1.1 Product Description

The GR-502GGB/GR-502MGGB features multi-constellation and ultra-low power consumption, with a highly integrated GNSS receiver chip built in to support multi-system Cortex®-M4F.

The GR-502GGB/GR-502MGGB supports concurrent reception of four GNSS (GPS/QZSS, GLONASS, BeiDou, and Galileo) and augmentation systems (SBAS). The multi-constellation enables the module to achieve an accuracy of approximately 1.5M 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/BeiDou/Galileo, QZSS and SBAS
- Ultra-Low Power Consumption: 13 mA@3.3V
- Ultra High Track Sensitivity: -165dBm
- Communication Type: RS232
- 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 C/A, L1C                   |
|                          | GLONASS   | L1                            |
|                          | Galileo   | E1                            |
|                          | BeiDou  | B1I                           |
|                          | SBAS  | WAAS, EGNOS, MSAS, GAGAN      |
| Update Rate              | GNSS  | 1Hz                           |
| 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                       |
| Protocol Support         | RS232 Port: RS232_TXD and RS232_RXD<br>115200bps (default), Supports baud rate 4800bps to 921600bps<br>NMEA 0183 Protocol |                               |
| Environment              | Operation temperature   | -40°C ~ +85°C                 |
|                          | Storage temperature   | -55°C ~ +100°C                |
| Physical Characteristics | Size  | 45±0.20 × 38±0.20 × 13±0.50mm |
|                          | Weight  | Approx. 49g                   |

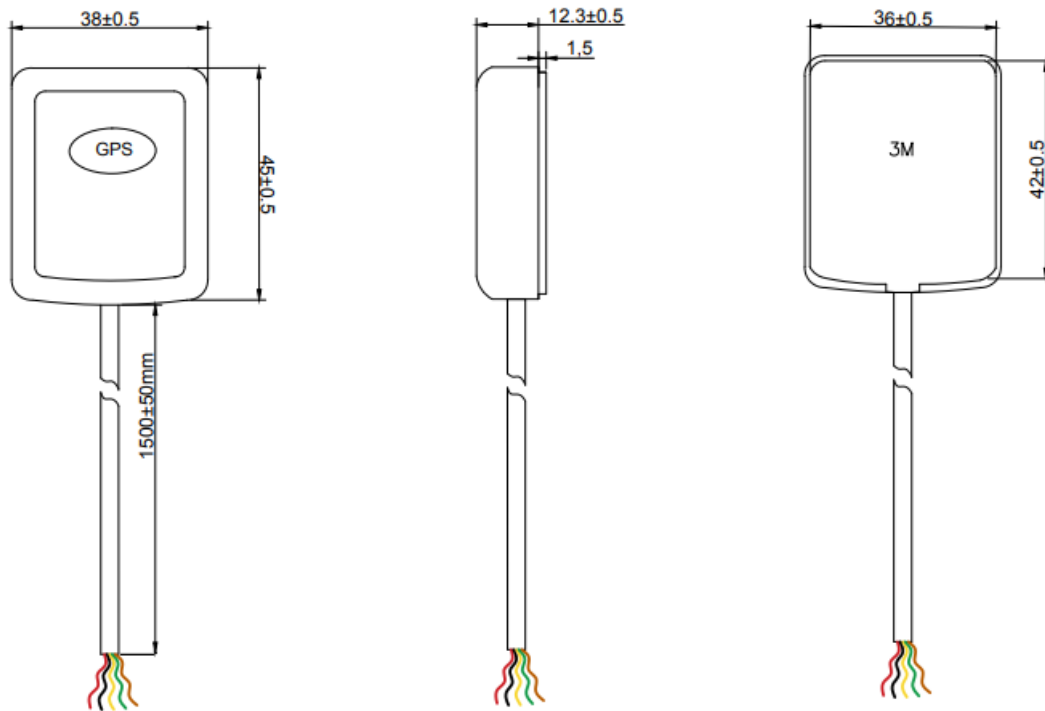
## 1.4 DC Electrical Characteristics

| Parameter                       |                              | Min. | Typ. | Max. | Units |
|---------------------------------|------------------------------|------|------|------|-------|
| Input Voltage                   |                              | 3.0  | 3.3  | 5.5  | Volt  |
| Power Supplier Current          |                              |      |      |      |       |
| Acquisition                     | GPS L1 + GL + GA + BD + QZSS |      | 13   |      | mA    |
| Tracking                        | GPS L1 + GL + GA + BD + QZSS |      | 14   |      | mA    |
| RS232 Port Working Voltage      |                              |      |      |      |       |
| Low Level Output Voltage (VOL)  |                              |      |      | 5    | Volt  |
| High Level Output Voltage (VOH) |                              | -3   |      |      | Volt  |
| Low Level Input Voltage (VIL)   |                              |      |      | 5    | Volt  |
| High Level Input Voltage (VIH)  |                              | -3   |      |      | Volt  |
| Low Level Output Current (IOL)  |                              | 1    |      | 4    | mA    |
| High Level Output Current (IOH) |                              | 1    |      | 4    | mA    |

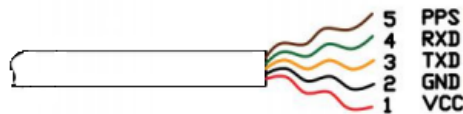
## 2. Physical Dimensions

(Different Cables & Connectors can be Specified According to Requirements)

| P/N          | Mount               | Description                   |
|--------------|---------------------|-------------------------------|
| GR-502GGB-N  | Adhesive            | No Connector, 5 Wire Open End |
| GR-502MGGB-N | Adhesive + Magnetic | No Connector, 5 Wire Open End |



### 2.1 Pin Description



| Pin NO. | Pin Name | Pin Color | Remark                   |
|---------|----------|-----------|--------------------------|
| 1       | VCC      | Red       | Module Power Supply      |
| 2       | GND      | Black     | Ground                   |
| 3       | TXD      | Orange    | RS232 Serial Data Output |
| 4       | RXD      | Green     | RS232 Serial Data Input  |
| 5       | PPS      | Brown     | Time Pulse (1PPS) Output |

## 3. Software Protocol

### 3.1 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.   |



## 3.2 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 of 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          |   |

## 3.3 GLL – Latitude/Longitude

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

Structure: \$GNGLL,ddmm.mmmmm,a,dddmm.mmmmm,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<br>'S' = South  |
| 3     | Longitude      | 12100.52210 | Longitude in dddmm.mmmmm format Leading zeros transmitted   |
| 4     | E/W Indicator  | E           | Longitude hemisphere indicator 'E' = East<br>'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<br>'N' = Data not valid<br>'A' = Autonomous mode<br>'D' = Differential mode<br>'E' = Estimated (dead reckoning) mode |
| 8     | Checksum       | 42          |   |

## 3.4 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,<br>20, 24, 10,<br>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  |  |

## 3.5 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      |  |

## 3.6 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.mmmmm,a,dddmm.mmmmm,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          |  |

## 3.7 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      |   |

## 3.8 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