



**GR-505GGBL5-DR**

**High Precision & Dead Reckoning GNSS Receiver (G-Mouse)**

**Datasheet**

## Revision History

| Date                       | Reversion | Description                             |
|----------------------------|-----------|-----------------------------------------|
| <a href="#">2023/07/20</a> | 1.0       | First Draft, Based on YIC               |
| <a href="#">2024/03/18</a> | 2.0       | Update Rate default 1Hz changed to 10Hz |
| <a href="#">2024/04/11</a> | 2.1       | Added a new model with MX4 connector    |
| <a href="#">2024/11/28</a> | 2.2       | Added a new model with JST connector    |

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## 1. Product Information

### 1.1 Product Description

The GR-505GGBL5-DR is a receiving module that supports dual frequency and multi-mode. It has built-in highly integrated GNSS receiver chip, supports multi band and multi system cm4f (main frequency 530 mhz, 12nm Technology) chip of Third- generation BeiDou Navigation Satellite System (BDS-3). Besides, it is capable of tracking all global civil navigation systems (GPS, GLONASS, Galileo, BDS, QZSS and SBAS) in all bands.

GR-505GGBL5-DR is based on the state of art BDS-3 architecture, integrating multi-band and multi-system GNSS RF and baseband. This newly designed architecture makes this chip achieve sub-meter level position accuracy without correction data from ground-based augmentation station and higher sensitivity, greater for improved jam resistance and multipath, provide a highly robust service in complicated environment.

GR-505GGBL5-DR contain MediaTek positioning engine inside with Dead Reckoning, featuring high sensitivity, low power consumption, and fast TTFF. The superior cold start sensitivity allows it to acquire, track, and get position fix autonomously in difficult weak signal environment. The receiver's superior tracking sensitivity allows continuous position coverage in nearly all outdoor application environments. The high performance signal parameter search engine is capable of testing 16 million time-frequency hypotheses per second, offering superior signal acquisition and TTFF speed.

### Applications

- LBS (Location Based Service)
- PND (Portable Navigation Device)
- Vehicle navigation system
- Mobile phone

## 1.2 Product Features

- Build on high performance, low-power MediaTek chip set
- Dead Reckoning, automatically inertial navigation positioning without GNSS signal
- Built-in TDK-42670 of 6-Axis acceleration sensor to define various gravity algorithms
- Concurrent reception of multi-band and multi-systemsatellite signals
- Supports BDS-3 signal
- Support satellite systems: GPS L1/L5, QZSS L1/L5 ,GLONASS ,Galileo , BDS and SBAS
- Supports all civil GNSS signals
- Ultra high track sensitivity: -165dBm
- Extremely fast TTFF at low signal level(Cold start  $\leq 25s$ , Hot start  $\leq 5s$ ).
- Multipath detection and suppression
- Works with passive and active antenna
- Low power consumption: Max 58mA@3.3V
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage: 3.0V ~ 5.5V
- Patch Antenna Size: 35x35x4 & 25x25x4 mm
- Small form factor: 52.7 $\pm$ 0.5x57.6 $\pm$ 0.5x20.72 $\pm$ 0.5mm
- Communication type: RS232
- Waterproof grade: IP67
- Recommended operating temperature range: -40°C to 85°C
- RoHS compliant (Lead-free)
- PPS

## 1.3 Product Specifications

| Parameter                    | Specification                                                                                                            |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| GNSS engine                  | GNSS engine has 135 channels and DSP accelerators                                                                        |
| GNSS reception               | GPS/QZSS: L1 C/A, L5<br>GLONASS: L1OF<br>GALILEO: E1(E1B+E1C), E5A<br>BEIDOU: B1I, B2A<br>SBAS: WAAS, EGNOS, MSAS, GAGAN |
| Update Rate                  | 10 Hz Default                                                                                                            |
| Position accuracy            | GNSS <1 m CEP                                                                                                            |
|                              | SBAS <1 m CEP                                                                                                            |
| Velocity & Time accuracy     | GNSS 0.01 m/s CEP                                                                                                        |
|                              | SBAS 0.05 m/s                                                                                                            |
|                              | 1PPS 10 ns                                                                                                               |
| Time to First Fix(TTFF)      | Hot start ≤5 sec                                                                                                         |
|                              | Cold start ≤25 secs                                                                                                      |
|                              | Cold start -149dBm                                                                                                       |
| Sensitivity                  | Hot start -155dBm                                                                                                        |
|                              | Reacquisition -158dBm                                                                                                    |
|                              | Tracking & navigation -165dBm                                                                                            |
| GNSS Operating limit         | Velocity 515 m/s (10m/s Minimum)                                                                                         |
|                              | Altitude 18000 m (80000m Maximum)                                                                                        |
| Datum                        | Default WGS-84 / Customized                                                                                              |
| Horizontal Locating Accuracy | GNSS inertial navigation <1.5 m CEP @-130 dBm                                                                            |
|                              | Without aid Sub-meter (3% CEP)                                                                                           |
| RS232 Port                   | RS232 Port: TXD and RXD                                                                                                  |
|                              | Supports baud rate from 9600bps to 961200bps. ( Default:115200bps)                                                       |
|                              | NMEA 0183 Protocol Ver. 4.00/4.10,MTK GNSS Receiver Protocol                                                             |

|                          |                                                   |
|--------------------------|---------------------------------------------------|
| Temperature Range        | Normal operation: -40°C ~ +85°C                   |
|                          | Storage temperature: -55°C ~ +125°C               |
|                          | Humidity: 5% ~ 95%                                |
| Physical Characteristics | Small form factor: 52.7±0.5x57.6±0.5x20.72±0.5 mm |
|                          | Wire interface type: 5 Pin , L= 3000 mm           |
|                          | Weight: Approx. 92.0g                             |

### Attentions

As a high-performance vehicle integrated navigation system, GR-505GGBL5-DR system also requires users to pay attention to some matters during application

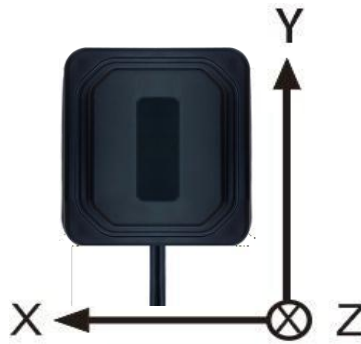


Figure 1-1: Coordinate System

| No | Initialization process of integrated navigation                                                                                                                                                                                                          | Importance |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 1  | No installation Angle requirements. Refer to Figure 1-1                                                                                                                                                                                                  |            |
| 2  | Before power on ,Fixed connected GR-505GGBL5-DR and vehicle                                                                                                                                                                                              | Required   |
| 3  | After power on, don't move GR-505GGBL5-DR                                                                                                                                                                                                                | Required   |
| 4  | Before the vehicle moves, please make sure the GNSS system output the correct protocol                                                                                                                                                                   | Required   |
| No | Initialization process of integrated navigation                                                                                                                                                                                                          | Importance |
| 1  | After power on, make static at least 5-10 seconds to complete the attitude initialization of the navigation system;                                                                                                                                      | Required   |
| 2  | In the course of the vehicle, it is necessary to keep the GR-505GGBL5-DR navigation system moves in an open area for some time, for the algorithm convergence of integrated navigation system, and then test it in complex environments such as tunnels. | Required   |

### Further Explain :

Summary : In integrated navigation system initialization, it is suggested that the vehicle drive under unobstructed environment for about a few minutes, then go into obstructed environment, the positioning effect will be better.



## 1.4 Block Diagram

The GR-505GGBL5-DR is a high performance (GPS, GLONASS, Galileo, BDS, QZSS and SBAS) in all bands (L1,L5). satellite navigation receiver in a compact surface mount package. It is based on the MediaTek positioning technology, providing high performance signal acquisition and tracking. The simple RS232 serial interface and the standard NMEA-0183 protocol make usage of GR-505GGBL5-DR very easy and straightforward.

The GR-505GGBL5-DR module can performs all the necessary system initialization, signal acquisition, signal tracking, data demodulation, and calculation of navigation solution autonomously.

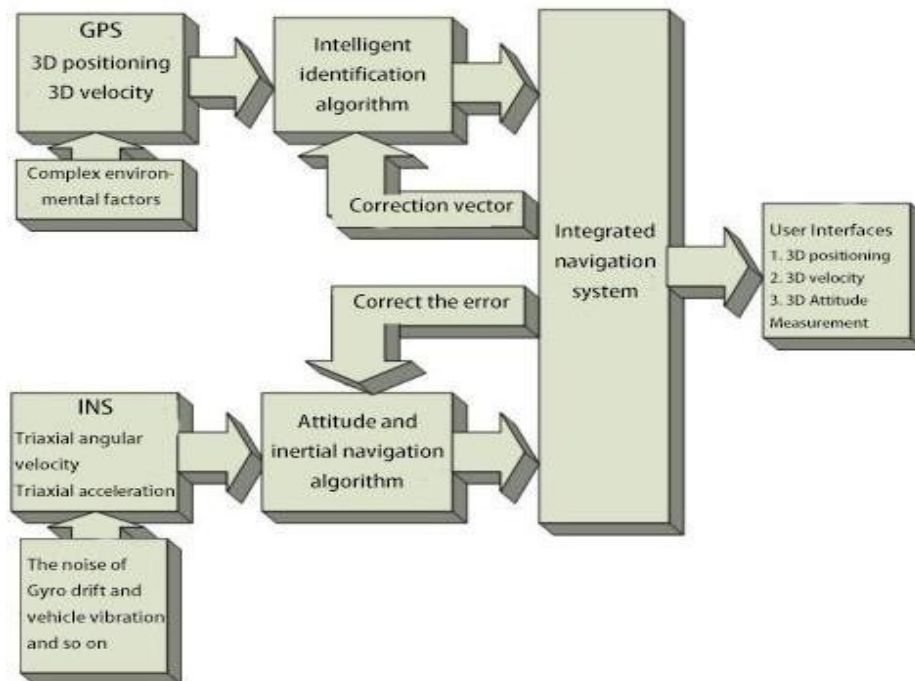


Figure 1-2 : Block Diagram

## 2. Physical Dimensions and Pin Assignment

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

### 2.1 No Connector

#### 2.1.1 Physical Dimensions

| P/N              | Mount    | Description                   |
|------------------|----------|-------------------------------|
| GR-505GGBL5-DR-N | Adhesive | No Connector, 5 Wire Open End |

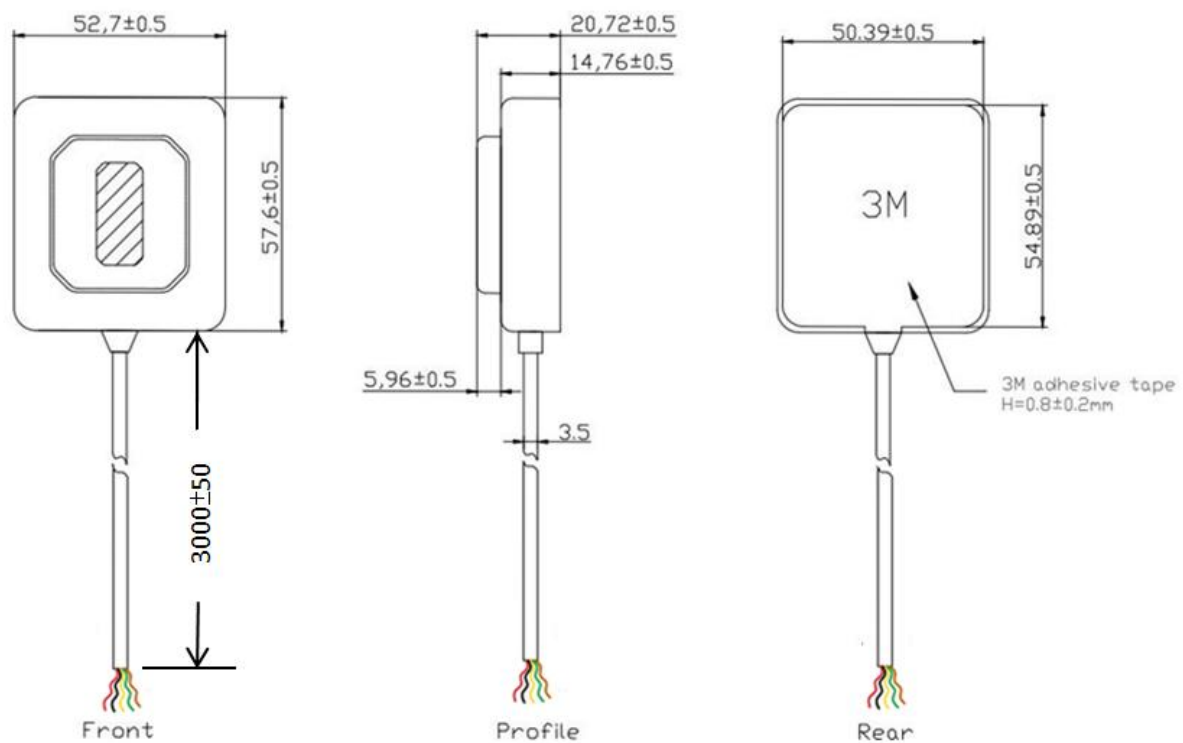


Figure1-3: Mechanical Dimensions (Unit: mm)

## 2.1.2 Pin Assignment



Figure1-4 : Pin Assignment

Table: Pin Description

| Pin No. | Pin name | Pin wire color | Description              | Remark                   |
|---------|----------|----------------|--------------------------|--------------------------|
| 1       | VCC      | Red            | Module Power Supply      | Voltage range: 3.0V~5.5V |
| 2       | GND      | Black          | Ground                   |                          |
| 3       | TXD      | Orange         | RS232 Serial Data output |                          |
| 4       | RXD      | Green          | RS232 Serial Data input  |                          |
| 5       | PPS      | Brown          | Time Pulse(1PPS)         |                          |

## 2.2 MX4 Connector

### 2.2.1 Physical Dimensions

| P/N                | Mount    | Description                                              |
|--------------------|----------|----------------------------------------------------------|
| GR-505GGBL5-DR-MX4 | Adhesive | 4 pin Molex Connector<br>Pitch - Mating Interface 3.00mm |

\* The Connector is compatible with Molex 430250400.

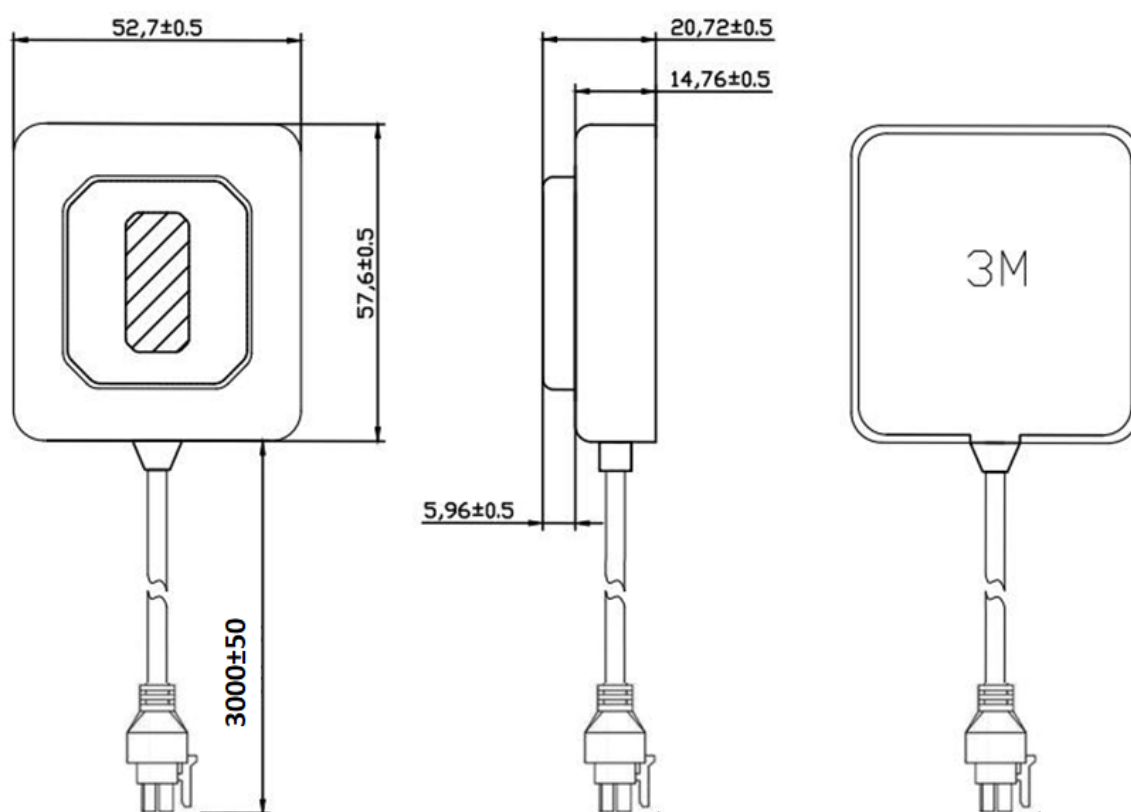


Figure1-5: Mechanical Dimensions (Unit: mm)

## 2.2.2 Pin Assignment



Figure1-6 : Pin Assignment

Table: Pin Description

| Pin NO. | Pin Name | I/O | Description              | Remark                   |
|---------|----------|-----|--------------------------|--------------------------|
| 1       | RX       | I   | RS232 Serial Data Input  |                          |
| 2       | GND      | G   | Ground                   |                          |
| 3       | TX       | O   | RS232 Serial Data Output |                          |
| 4       | VCC      | I   | Module Power Supply      | Voltage range: 3.0v~5.5V |

## 2.3 JST Connector

### 2.3.1 Physical Dimensions

| P/N                | Mount    | Description                       |
|--------------------|----------|-----------------------------------|
| GR-505GGBL5-DR-JST | Adhesive | 4 wire 1.25mm Pitch JST Connector |

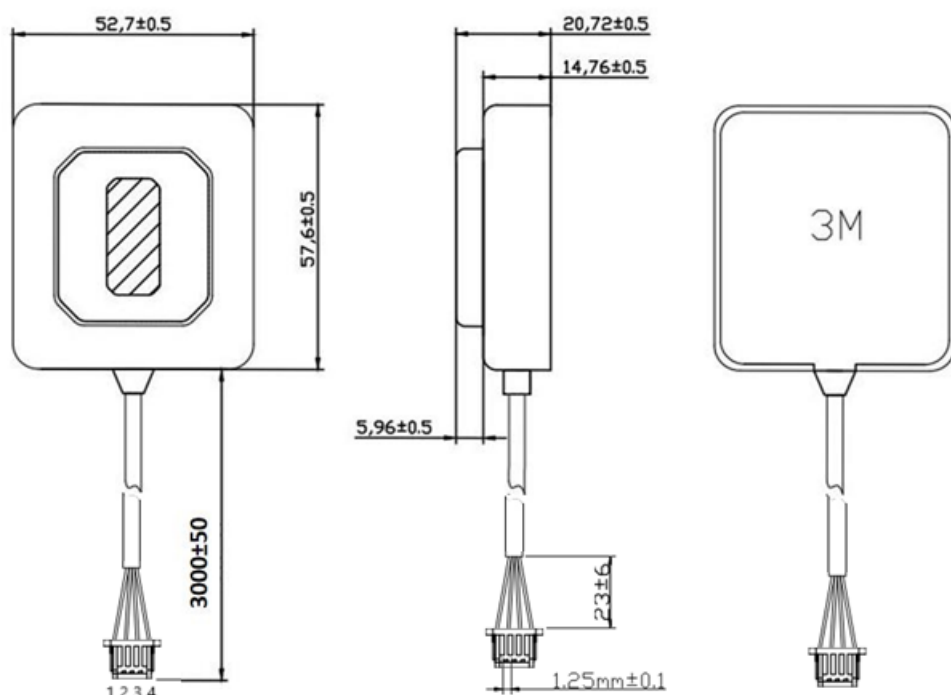


Figure1-7: Mechanical Dimensions (Unit: mm)

## 2.3.2 Pin Assignment

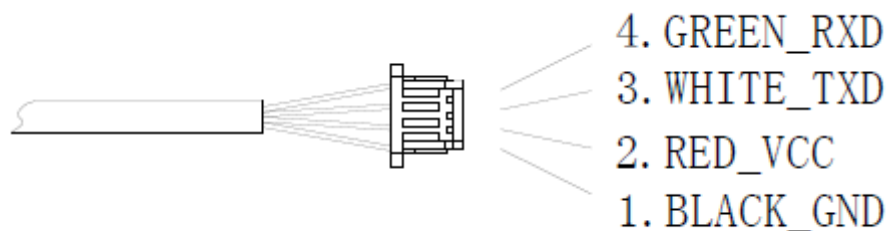


Figure1-8 : Pin Assignment

Table: Pin Description

| Pin NO. | Pin Name | Color | I/O | Description              | Remark                   |
|---------|----------|-------|-----|--------------------------|--------------------------|
| 1       | GND      | Black | G   | Ground                   |                          |
| 2       | VCC      | Red   | I   | Module Power Supply      | Voltage range: 3.0V~5.5V |
| 3       | TX       | White | O   | RS232 Serial Data Output |                          |
| 4       | RX       | Green | I   | RS232 Serial Data Input  |                          |

### 3. NMEA 0183 Protocol

The output protocol supports NMEA-0183 standard. The implemented messages include GGA, GLL, GSA, GSV, RMC, VTG, ZDA, and PAIRMSG messages. The NMEA message output has the following sentence structure:

\$AACCC,c-c\*hh

The detail of the sentence structure is explained in Table 1.

**Table 1: The NMEA sentence structure**

| character | HEX  | Description                                                                       |
|-----------|------|-----------------------------------------------------------------------------------|
| "\$"      | 24   | Start of sentence.                                                                |
| Aacc      |      | Address field. "aa" is the talker identifier. "ccc" identifies the sentence type. |
| ","       | 2C   | Field delimiter.                                                                  |
| C-c       |      | Data sentence block.                                                              |
| "*"       | 2A   | Checksum delimiter.                                                               |
| Hh        |      | Checksum field.                                                                   |
| <CR><LF>  | 0D0A | Ending of sentence. (carriage return, line feed)                                  |

**Table 2: Overview of NMEA messages**

|                                                                      |                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>\$GNGGA</b>                                                       | Time, position, and fix related data of the receiver.                                                                                                                                                                                                                                                   |
| <b>\$GNGLL</b>                                                       | Position, time and fix status.                                                                                                                                                                                                                                                                          |
| <b>\$GNGSA</b>                                                       | 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.                                                         |
| <b>\$GPGSV</b><br><b>\$GLGSV</b><br><b>\$GAGSV</b><br><b>\$GBGSV</b> | Satellite information about elevation, azimuth and CNR, satellites are used in position solution, a \$GPGSV sentence is used for GPS satellites, a \$GLGSV sentence is used for GLONASS satellites, a \$GAGSV sentence is used for GALILEO satellites. And \$BDGSV sentence is used for BDS satellites. |
| <b>\$GNRMC</b>                                                       | Time, date, position, course and speed data.                                                                                                                                                                                                                                                            |
| <b>\$GNVTG</b>                                                       | Course and speed relative to the ground.                                                                                                                                                                                                                                                                |
| <b>\$GNZDA</b>                                                       | UTC, day, month and year and time zone.                                                                                                                                                                                                                                                                 |
| <b>\$PAIRMSG</b>                                                     | Inertial navigation status.                                                                                                                                                                                                                                                                             |

✧ The formats of the supported NMEA messages are described as follows:

\$GNGGA,\$GNGLL,\$GNGSA,\$GPGSV,\$GLGSV,\$GAGSV,\$GBGSV,\$GNRMC,\$GNVTG,\$GNZDA,\$PAIRMSG



## 3.1 GGA – Global Positioning System Fix Data

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

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

For 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<br>Leading zeros transmitted                                                                                                                                              |
| 3     | N/S Indicator                | N               | Latitude hemisphere indicator, 'N' = North, 'S' = South                                                                                                                                                 |
| 4     | Longitude                    | 12100.5221<br>0 | Longitude in dddmm.mmmmm format<br>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 GPS mode<br>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<br>NULL when DGPS not used                                                                                                                                                 |
| 12    | DGPS Station ID              | 0000            | Differential reference station ID, 0000 ~ 1023                                                                                                                                                          |
| 13    | Checksum                     | 72              |                                                                                                                                                                                                         |

## 3.2 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<br>Leading zeros transmitted                                                                          |
| 2     | N/S Indicator  | N           | Latitude hemisphere indicator 'N' =North<br>'S' = South                                                                             |
| 3     | Longitude      | 12100.52210 | Longitude in dddmm.mmmmm<br>formatLeading 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          |                                                                                                                                     |

## 3.3 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,x.x,x.x,x.x,x\*hh

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, 32,<br>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                                           |                                                                                                                                                                                                                                                                                                                                              |

## 3.4 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, 4 for L5/CA                                                                                                                                                                                                                                                                                                                     |
| 9     | Checksum           | 69      |                                                                                                                                                                                                                                                                                                                                              |

## 3.5 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<br>Leading zeros transmitted                                                                         |
| 4     | N/S indicator      | N           | Latitude hemisphere indicator 'N' = North 'S' = South                                                                               |
| 5     | Longitude          | 12100.52210 | Longitude in dddmm.mmmmm format<br>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<br>'D' = Differential mode<br>'E' = Estimated (dead reckoning) mode |
| 11    | checksum           | 75          |                                                                                                                                     |

## 3.6 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      |                                                                                                                                     |

## 3.7 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,175258.000,22,06,2017,00,00\*46<CR><LF>

| Field | Name               | Example    | Description                                          |
|-------|--------------------|------------|------------------------------------------------------|
| 1     | UTC time           | 175258.000 | UTC time in hhmmss.ss format (000000.00 ~ 235959.99) |
| 2     | UTC Day            | 22         | UTC time: day (01 ~ 31)                              |
| 3     | UTC Month          | 06         | UTC time: month (01 ~ 12)                            |
| 4     | UTC Year           | 2017       | 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                                             |

## 3.8 \$PAIRMSG – Inertial navigation status.

Inertial navigation status.

\$PAIRMSG,90

For Example : \$PAIRMSG,90,072520.000,3\*59

Statu 1: UTC

Statu 2: DR STAGE (Refer to table A)

**Table A**

| Field | Name     | Example    | Description                                                                                         |
|-------|----------|------------|-----------------------------------------------------------------------------------------------------|
| 1     | UTC      | 072520.000 | UTC time                                                                                            |
| 2     | DR stage | 3          | DR_SOLUTION_UNKNOWN = 0<br>DR_SOLUTION_INIT = 1<br>DR_SOLUTION_COARSE = 2<br>DR_SOLUTION_STABLE = 3 |
| 3     | Checksum | 59         | Checksum                                                                                            |

\$PAIRMSG,91

For Example : \$PAIRMSG,91,072520.000,1,0\*46

Statu 1: UTC

Statu 2: Dynamic status (Refer to table B)

Statu 3: Alarm status (Refer to table C)

**Table B**

| Field | Name           | Example    | Description                                    |
|-------|----------------|------------|------------------------------------------------|
| 1     | UTC            | 072520.000 | UTC time                                       |
| 2     | Dynamic status | 1          | UNKNOWN = 0<br>STATIC = 0x01<br>DYNAMIC = 0x02 |



**Table C**

| Field | Name         | Example | Description                      | Vehicle status alarm                                                                                                                       |
|-------|--------------|---------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 3     | Alarm status | 0       | UNKNOWN = 0                      | 0: UNKNOWN                                                                                                                                 |
|       |              |         | HARSH_ACCELERATION = 0x01 (1)    | 1: Harsh acceleration<br>Straight harsh acceleration > 2.5m/s <sup>2</sup>                                                                 |
|       |              |         | HARSH_DECELERATION = 0x02 (2)    | 2: Harsh deceleration<br>Straight harsh deceleration < -4.5m/s <sup>2</sup>                                                                |
|       |              |         | HARSH_TURN = 0x04 (4)            | 4: Harsh turn<br>Lateral turning acceleration > 4m/s <sup>2</sup> Heading angle > 45°                                                      |
|       |              |         | HARSH_LANE_CHANGE = 0x08 (8)     | 8: Harsh line change<br>Lateral turning deceleration > 4m/s <sup>2</sup> Heading angle < 20°                                               |
|       |              |         | HORIZONTAL_COLLISION = 0x10 (16) | 16: Horizontal collision<br>Straight harsh acceleration > 20m/s <sup>2</sup> pitch angle < 20°<br>Flip angle < 20°                         |
|       |              |         | ROLLOVER = 0x20 (32)             | 32: Rollover<br>Pitch angle > 70°Flip angle > 70°                                                                                          |
|       |              |         | STABILITY_WARNING = 0x40 (64)    | 64: Stability warning<br>The vehicle continuously changes heading Angle at a speed greater than 50°/s for a period of more than 3 seconds. |
|       |              |         | EULER_ANOMALY = 0x80 (128)       | 128: Euler_anomaly<br>The pitch Angle and dump Angle of the vehicle, the larger value is greater than 20° and less than 70°.               |
| 4     | Checksum     | 46      | Checksum                         |                                                                                                                                            |

## 4. Abbreviation

| Abbreviation | Description                                                                    |
|--------------|--------------------------------------------------------------------------------|
| AGNSS        | Assisted GNSS                                                                  |
| AIC          | Active Interference Cancellation                                               |
| CEP          | Circular Error Probable                                                        |
| DGPS         | Differential GPS                                                               |
| EASY         | Embedded Assist System                                                         |
| EGNOS        | European Geostationary Navigation Overlay Service                              |
| EPO          | Extended Prediction Orbit                                                      |
| ESD          | Electrostatic Discharge                                                        |
| GPS          | Global Positioning System                                                      |
| GNSS         | Global Navigation Satellite System                                             |
| GGA          | GNSS Fix Data                                                                  |
| GLL          | Geographic Position – Latitude/Longitude                                       |
| GLONASS      | Global Navigation Satellite System                                             |
| GSA          | GNSS DOP and Active Satellites                                                 |
| GSV          | GNSS Satellites in View                                                        |
| HDOP         | Horizontal Dilution of Precision                                               |
| I/O          | Input / Output                                                                 |
| Kbps         | Kilo Bits Per Second                                                           |
| LNA          | Low Noise Amplifier                                                            |
| MSAS         | Multi-Functional Satellite Augmentation System                                 |
| MOQ          | Minimum Order Quantity                                                         |
| NMEA         | National Marine Electronics Association                                        |
| PDOP         | Position Dilution of Precision                                                 |
| PMTK         | MTK Proprietary Protocol                                                       |
| PPS          | Pulse Per Second                                                               |
| PRN          | Pseudo Random Noise Code                                                       |
| QZSS         | Quasi-Zenith Satellite System                                                  |
| RHCP         | Right Hand Circular Polarization                                               |
| RMC          | Recommended Minimum Specific GNSS Data                                         |
| SBAS         | Satellite-based Augmentation System                                            |
| SAW          | Surface Acoustic Wave                                                          |
| SPDT         | Single-Pole Double-Throw                                                       |
| TTF          | Time To First Fix                                                              |
| UART         | Universal Asynchronous Receiver & Transmitter                                  |
| VDOP         | Vertical Dilution of Precision                                                 |
| VTG          | Course over Ground and Ground Speed, Horizontal Course and Horizontal Velocity |
| WAAS         | Wide Area Augmentation System                                                  |
| Inom         | Nominal Current                                                                |
| Imax         | Maximum Load Current                                                           |
| Vmax         | Maximum Voltage Value                                                          |
| Vnom         | Nominal Voltage Value                                                          |

|        |                                         |
|--------|-----------------------------------------|
| Vmin   | Minimum Voltage Value                   |
| VIHmax | Maximum Input High Level Voltage Value  |
| VIHmin | Minimum Input High Level Voltage Value  |
| VILmax | Maximum Input Low Level Voltage Value   |
| VILmin | Minimum Input Low Level Voltage Value   |
| VImax  | Absolute Maximum Input Voltage Value    |
| VImin  | Absolute Minimum Input Voltage Value    |
| VOHmax | Maximum Output High Level Voltage Value |
| VOHmin | Minimum Output High Level Voltage Value |
| VOLmax | Maximum Output Low Level Voltage Value  |
| VOLmin | Minimum Output Low Level Voltage Value  |
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