General Description

The GGM-5853F5DKW-QXGBMX4P500 is a high -performance positioning module that integrates with super computing power positioning chip BG1101 and MEMS chip. It has high-precision RTK positioning and inertial navigation fusion algorithm,which can effectively to solve the interruption in positioning results caused by the displacement of satellite signals. Besides,it is capable of tracking all global civil navigation systems (BeiDou, GPS,GLONASS,Galileo, QZSS) in all bands.

GGM-5853F5DKW-QXGBMX4P500 is based on the state of art BDS-3 architecture, integrating dual-band and multi-system GNSS RF and base band. This newly designed architecture makes this single 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.

GGM-5853F5DKW-QXGBMX4P500 Gmouse contains MC280A module positioning engine inside, 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 not only allows continuous position coverage in nearly all outdoor application environments, but also can provide continuous high-quality positioning results in tunnels, underground warehouses, viaducts, urban canyons and other scenarios. The high perfor- mance 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 / Management
- Slow-Moving Machine (Robot)
- Agricultural Machine / Vehicle

Figure: GGM-5853F5DKW-QXGBMX4P500

Features

- Build in high performance, low-power BG1101 chip
- Ultra high Track sensitivity: -165dBm
- Concurrent reception of dual-band and multi-system satellite signals
- Supports all civil GNSS signals and BDS-3 signal
- Extremely fast TTFF at low signal level
- Multipath detection and suppression
- Works with passive and active antenna
- Low power consumption: Max 45mA@3.3V
- Supports RTK and INS; Protoco: RTCM3.2& QIANXUN SI protocol
- NMEA-0183 Ver4.1 compliant protocol or customization
- Operating voltage: 3.0V to 5.5V
- Patch Antenna Size:35x35x4+25x25x4mm
- Small form factor: 52.7±0.5x57.6±0.5x20.72±1.0mm
- Communication type: UART/TTL
- Wire interface type: Molex 4Pin , L=500cm
- Waterproofing grade: IP67
- Operating temperature -40 ~ +85ºC
- RoHS compliant (Lead-free)

1. Functional Description

1.1. Key Features

Table 1: Key Features

Parameter	Specification
Power Supply	• Supply voltage: 3.0V~5.5V Typical: 3.3V
Power Consumption	• Acquisition: 43mA @VCC=VBAT=3.3V • Tracking: 45mA @VCC=VBAT=3.3V • Standby: 20mA @VCC=VBAT=3.3V
GNSS engine	• 128 tracking channels with fast search engine
GNSS reception	• GPS/QZSS: L1C/A /L5 • GLONASS: L1 • GALILEO: E1/E5a • BEIDOU: B1I/B1C/B2a • SBAS: WAAS, EGNOS, MSAS, GAGAN
Update rate	• GNSS: Max 10Hz • The original observation of MEMS : 104Hz
RTK	• RTCM3.2
Position accuracy	• GNSS : ＜1m CEP50 • Dual band RTK : Horizontal 1cm+1ppm CEP50 : Height 2cm+1ppm CEP50 • Inertial navigation : 3‰*driving distance
Velocity & Time accuracy	• GNSS 0.05m/s CEP50 • SBAS 0.05 m/s • 1PPS ≤20ns 1σ
Time to First Fix(TTFF)	• Hot start ＜1 s • Cold start 28 s • AGPS 1.5s
Sensitivity	• Cold start -148dBm • Re-acquisition -158dBm • Hot start -165dBm • Tracking & navigation -165dBm
GNSS Operating limit	• Velocity 515m/s • Altitude 18000m
USRT Port	• UART Port: RTK/INS TXD and RTK/INS RXD • Supports baud rate from 9600bps to 961200bps, 115200bps by default. • NMEA 0183 Protocol Ver. 4.1, RTCM 3.2 &QIANXUN SI protocol • Supports batch data report mode
Temperature Range	• Normal operation: -40°C ~ +85°C • Storage temperature: -40°C ~ +105°C • Humidity: 5% ~ 95%
Physical Characteristics	• Size: 52.7±0.5x57.6±0.5x20.72±1.0mm • Weight: Approx. 150.0g

1.2. Power Supply

Regulated power for the GGM-5853F5DKW-QXGBMX4P500 is required. The VCC Pin Need a stable DC voltage supply. Power supply ripple must be less than 30mV. The input voltage Vcc should be 3.0V~5.5V, Recommended power supply voltage is 3.3V . maximum current is 45mA. Suitable decoupling must be provided by external decoupling circuitry.

1.3 Maximum parameter

Parameter	Index	Remark
Power Supply		
Voltage Supply	5.5 V	
Temperature Range		
Operation Temp	-40℃ to + 85℃	
Storage Temp	-40℃ to + 105℃	
Humidity	5~95%RH	

1.4 Electrical feature

Parameter	Index	Remark
Power Supply		
Input voltage	3.0~5.5V	
Current	45mA	
Consumption	300mW	
Time		
The time required for the first valid data	<30S	

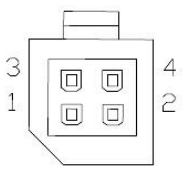
1.5 UART Ports

The module supports two full duplex serial channels UART. All serial connections are at 3.3V CMOS logic levels, if need different voltage levels, use appropriate level shifters. The baud rate of both serial ports are fully programmable, the data format is however fixed: X, N, 8, 1, i.e. X baud rate, no parity, eight data bits and one stop bit, no other data formats are supported, LSB is sent first. Supports baud rate from 4800bps to 961200bps, 115200bps by default, UART port can be used for NMEA output.

2. Application

The module is equipped with a 4-pin Molex plug that connects to your application platform. Mechanical Dimensions and Pin Assignment are described in details at the following chapters.

2.1 Pin Assignment



4PIN Molex connector

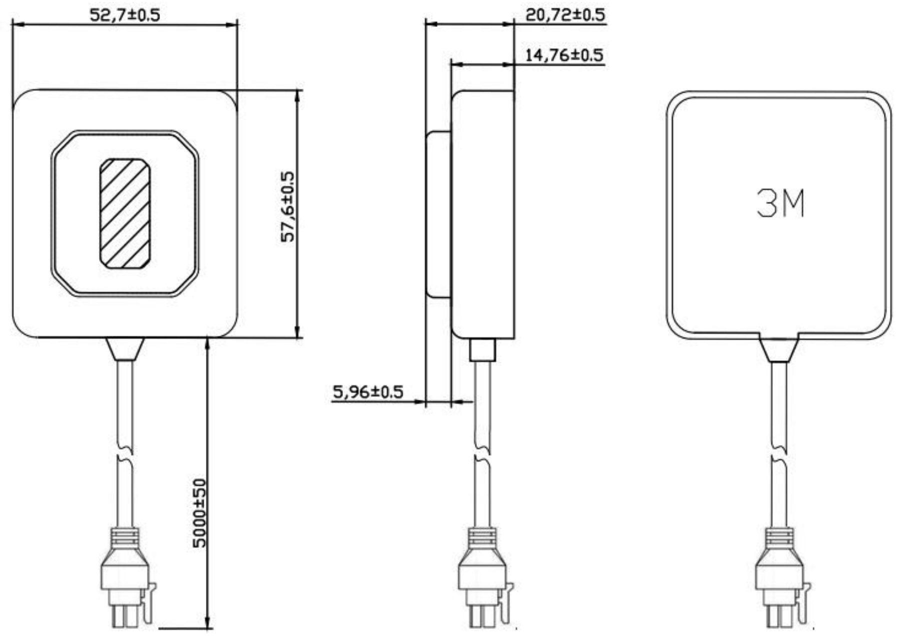
Figure 2: Pin Assignment

Table 2: CON Pin Description

Pin No.	Pin Name	I/O	Description	Remark
1	RTK/INS RXD	I	UART Serial Data input	
2	GND	G	Ground	
3	RTK/INS TXD	O	UART Serial Data Output	
4	VCC	I	Module Power Supply	Voltage range: 3.0v~5.5V

2.2 Mechanical Dimensions

This chapter describes the mechanical dimensions of the GGM-5853F5DKW-QXGBMX4P500 module. Size unit（mm）.



Front view　　　Profile view　　　Rear view

Figure 3: Specification size chart

➢ **Interface specifier :**

The common wire connector of this product is shown in the following table. The connector can also be customized according to customer requirements, and the interface definition can be changed.

3. Packaging information

The follow packing way is for reference only, and the actual packing way can be customized according to customer requirements.

Figure 4: Packaging physical figure

Model Name	MOQ for MP	Minimum Package: 1000pcs
GGM-5853F1DKW-AGGBMX4P500	100pcs	Size: 365mm × 350mm × 53mm N.W: 15.0kg G.W: 16.0kg

4. Application Instruction

To ensure the normal operation of the integrated navigation module, you need to refer to the following installation and configuration procedures.

✧ Remark: you need to ensure that the module is firmly connected to the car before power-on. If the installation Angle or position of the module is changed,you should power it on again.

4.1 The Installation Angle and Arm Lever are configured according to the installation position and Angle.

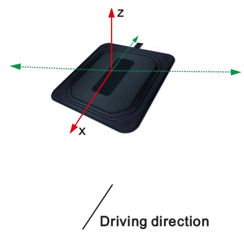
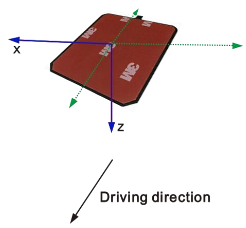
(1) Installation Angle configuration:

The installation Angle of the product can be configured in **Self-Adaptive Mode** and **Command Configuration Mode**. The default mode is self-adaptive mode. After determining the installation Angle, the user can select the configuration mode to speed up the calibration time. After power on, make static at least 5-10 seconds to complete the attitude initialization of the navigation system. While the vehicle is moving, it is necessary to keep the GGM-5853F1DKW-AGGBMX4P500 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.

a) **Self-Adaptive Mode** [1]: It will estimate the installation Angle by itself, which is suitable for use when the user is not clear about the installation Angle of the module; The onfiguration command is $QXCFGMSA,1.

b) **Command Configuration Mode**: When you know the installation Angle of the module, you can configure the installation Angle according to the following Table3:

Table3: Example of manual installation instructions.

Z Axis	X Axis	Axis Flag	Example	Sample Figure
Z-Axis points up	X-axis points front (See Figure5)	51	$qxcfgmsa,2,51	 Figure5
	X-axis points right	52	$qxcfgmsa,2,52	
	X-axis points back	53	$qxcfgmsa,2,53	
	X-axis points left	54	$qxcfgmsa,2,54	
Z-axis points down	X-axis points front	61	$qxcfgmsa,2,61	 Figure6
	X-axis points right (See Figure6)	62	$qxcfgmsa,2,62	
	X-axis points back	63	$qxcfgmsa,2,63	
	X-axis points left	64	$qxcfgmsa,2,64	

- [1] **Note:** After the adaptive mode enters the fusion state, send the configuration command $qxcfgmsa,2,66 can automatically convert the current installation Angle result to the configuration mode; Then send $qxcfgsave to save the current configuration.

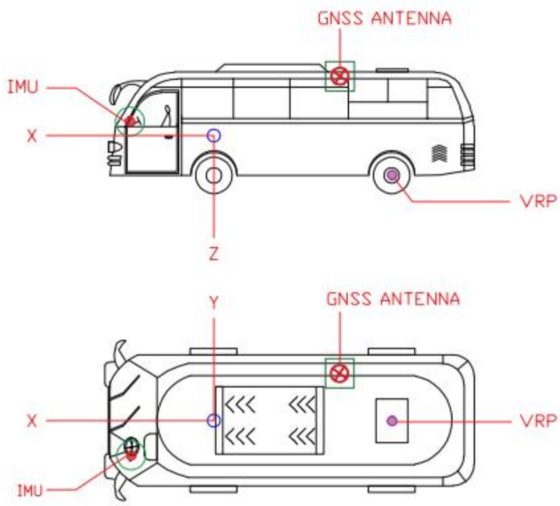


Figure 7: Antenna, VRP, Module Coordinate System

(2) Arm Lever Configuration：（Module to satellite Antenna：IMU2ANT）

a) Take IMU as the origin, set the front right lower part of the car body as the coordinate system.

b) As shown in the Figure8, assuming that the satellite antenna is 1.00m behind the IMU, 0.5m to the right, and 0.6m above the IMU2ANT, then the arm lever coordinates of IMU2ANT are x:-2.0m,y:1.0m , z:-0.8m .Then the configuration instruction is : **$QXCFGLA,0,0,-200,100,-80.**

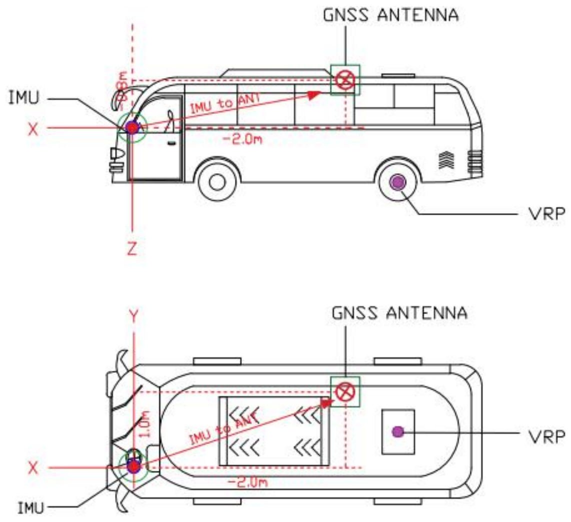


Figure8: Coordinate System：Module to Satellite Antenna (IMU2ANT)

(2) Arm Lever Configuration：（Rear wheel center to module：VRP2IMU）

a) Take the rear wheel center (VRP) as the origin, set the front right lower part of the car body as the coordinate system.

b) As shown in the Figure9, assuming that the satellite antenna is 1.9m before the the rear wheel center, 0.6m to the left, and 0.6m above the IMU, then the arm lever coordinates of VRP2IMU are x:2.5m,y:-0.8m,z:-0.8m. Then the configuration instruction is : **$QXCFGLA,1,0,250,-80,-80.**

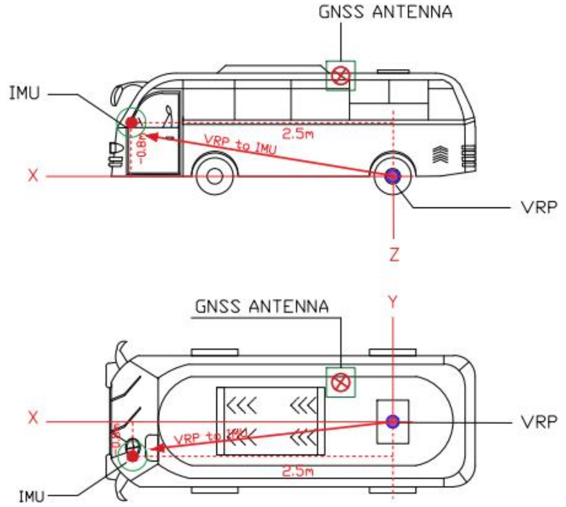


Figure9: Coordinate System：Rear wheel center to module (VRP2IMU)

➢ In case the configuration lost after the power failure, you need to save it in time after the configuration is completed.

4.2 Drive in an open environment until positioning mode enters the fusion state.

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

The recommended steps are as follows:

1) Power on and position in an open environment;
2) Drive more than 30km/h for 3 minutes, including more than 5 linear acceleration and deceleration;
3) Dynamic driving for 3 minutes, including acceleration and deceleration and 90 degree turns twice or more;
4) the self-calibration process needs to meet the above parking, satellite quality, engine drive and other conditions. The $QXDRS statement can be used to check whether the calibration has completed successfully. When the status reaches 4 or above (4, available; 5, good), the self-calibration is completed into the fusion state, otherwise the above steps need to be repeated until the self-calibration is successful.

5. Supported GNSS augmentation systems

DGNSS – Differential GNSS

The RTK navigation mode needs to work in the data mode provided by RTCM ver.3.2. The GGM-5853F5DKW-QXGBMX4P500 supports DGNSS function according to RTCM 3.2 protocol. The decoded RTCM3.2 message is shown in the following Table4:

Table 4

No.	Data type	Message type	Description
1	RTCM 1074	MSM4	GPS pseudo-distance,Carrier phase,Carrier-noise ratio
2	RTCM 1077	MSM7	High precision GPS pseudo-distance,Carrier phase,Doppler,Carrier-noise ratio
3	RTCM 1084	MSM4	GLONASS pseudo-distance,carrier phase,carrier-noise ratio
4	RTCM 1087	MSM7	High precision GLONASS pseudo-distance,Carrier phase,Doppler,Carrier-noise ratio
5	RTCM 1094	MSM4	Galileo pseudo-distance,Carrier phase,Carrier-noise ratio
6	RTCM 1097	MSM7	High precision Galileo pseudo-distance,Carrier phase,Doppler,Carrier-noise ratio
7	RTCM 1104	MSM4	SBAS pseudo-distance,Carrier phase,Carrier-noise ratio
8	RTCM 1107	MSM7	High precision SBAS pseudo-distance,Carrier phase,Doppler,Carrier-noise ratio
9	RTCM 1114	MSM4	QZSS pseudo-distance,Carrier phase,Carrier-noise ratio
10	RTCM 1117	MSM7	High precision QZSS pseudo-distance,Carrier phase,Doppler,Carrier-noise ratio
11	RTCM 1124	MSM4	BeiDou pseudo-distance,Carrier phase,Carrier-noise ratio
12	RTCM 1127	MSM7	High precision BeiDou pseudo-distance,Carrier phase,Doppler,Carrier-noise ratio

6. NMEA 0183 Protocol

The output protocol supports NMEA-0183 standard. The implemented messages include RMC, GGA, GSV ,GSA and DRSmessages. The NMEA message output has the following sentence structure: $AACCC ,c-c*hh.

Table 5: The NMEA sentence structure

Character	HEX	Description
“$”	24	Start of sentence.
Aaccc		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)

➢ **The formats of the supported NMEA messages are described as follows: $GNRMC,$GNGGA,$GPGSA,$BDGSA,$GAGSA,$GLGSA,GPGSV,$BDGSV,$GAGSV,$GLGSV,$QXDRS.**

6.1 $QXDRS Data Description

Name	QXDRS		
Function description	For DR Status output		
Message typ	output		
Example	$ QXDRS,time,FUSION,IMU,PVT,MISA,ODO,ZERO,MMF,ERR*CS		
Example	$QXDRS,072301.400,1,2,4,2,0,0,0,0*78		
Parameter description			
Parameter Name	Data Type	description	
Time	hhmmss.sss	The fixed-length field hh indicates hours with a fixed length of 2, mm indicates minutes with a fixed length of 2, and ss before the decimal point indicates seconds with a fixed length of 2 and sss after the decimal point. Represents a decimal second of fixed length of 3.	
FUSION	UINT	Fusion state estimation	
IMU	UINT	IMU state	0: close;
PVT	UINT	PVTstate	1:initializing;
MISA	UINT	Installation Angle condition	2:initialization is complete;
0DO	UINT	Odometer status	3: Interrupt;
ZERO	UINT	Zero speed state.	4:available;
MMF	UINT	Map matching feedback status	5:good;
ERR	UINT	Abnormal status. To be confirmed.	255:abnormal;

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

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 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 0: position fix unavailable 1: valid position fix, SPS mode 2: valid position fix, differential GPS mode 3: GPS PPS Mode, fix valid 4:RTK fix 5:RTK float fix 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 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:$GPGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,x*hh

For example:$GPGSA,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 'M' = Manual, forced to operate in 2D or 3D mode 'A' = Automatic, allowed to automatically switch 2D/3D
2	Mode	3	Fix type 1 = Fix not available 2 = 2D 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 8.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	

6.4 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 8. Maximally 12 satellites are included in each GSV 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	

6.5 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.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 'V' = Navigation receiver warning '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 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode
11	checksum	75	

Revision History

Version	Date	Author	Description
1.0.0	2023-07-26	Bella	Compile and release

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