General Description

The GGM-5853F5ADR-AGGB4P150 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 530mhz, 12NM Technology) chip of Third-generation BeiDou Navigation Satellite System (BDS-3). Besides, it is capable of tracking allglobal civil navigation systems (BDS, GPS, GLONASS, Galileo, QZSS and SBAS) in all bands.

GGM-5853F5ADR-AGGB4P150 module is based on the state of art CYNOSURE III 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.

GGM-5853F5ADR-AGGB4P150 module contains AT3335 AD 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 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

Figure: GGM-5853F5ADR-AGGB4P150 Top View

Features

- Build on high performance, low-power MediaTek AT3335AD chip set
- Ultra high track sensitivity: -165dBm
- Built-in TDK-42670 acceleration sensor to define various gravity algorithms
- Concurrent reception of multi-band and multi-system satellite signals
- Supports BDS-3 signal
- Support satellite systems: GPS,Glonass,Galileo, Beidou, QZSS, SBAS
- Supports all civil GNSS signals
- Automatically inertial navigation positioning
- without GNSS signal
- Extremely fast TTFF at low signal level
- (Cold start ≤24s, Hot start ≤1s).
- Multipath detection and suppression
- Works with passive and active antenna
- Low power consumption: Max 56mA@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±0.5x57.6±0.5x20.72±0.5mm
- Communication type: UART/TTL
- Wire interface type: Molex 4Pin , L=150cm
- Recommended operating temperature range:-40to75℃
- RoHS compliant (Lead-free)

1. Functional Description

1.1. Key Features

Table 1: Key Features

Parameter	Specification
GNSS engine	• GNSS engine has 135channels and DSP accelerators
GNSS reception	• GPS/QZSS: L1 C/A, L5 • GLONASS: L1OF • GALILEO: E1(E1B+E1C), E5A • BEIDOU: B1I, B2A • SBAS: WAAS, EGNOS, MSAS, GAGAN
Update rate	• GNSS 10Hz Maximum
Position accuracy [1]	• GNSS <1m CEP • SBAS <1m CEP
Velocity & Time accuracy	• GNSS 0.01m/s CEP • SBAS 0.05 m/s • 1PPS 25 ns
Time to First Fix(TTFF) [1]	• Hot start 1 sec • Cold start 24 secs
Sensitivity [1]	• Cold start -148dBm • Hot start -155dBm • Reacquisition -158dBm • Tracking & navigation -165dBm
GNSS Operating limit	• Velocity 515m/s • Altitude 18,000m
Datum	• Default WGS-84 / Customized
Horizontal Locating Accuracy	• GNSS inertial navigation <1.5m CEP @-130 dBm Without aid Sub-meter (3% CEP)
UART Port	• UART Port: TX and RX • Supports baud rate from 9600bps to 961200bps. • NMEA 0183 Protocol Ver. 4.00/4.10,Cynosure GNSS Receiver Protocol
Temperature Range	• Normal operation: -40°C ~ +85°C • Storage temperature: -55°C ~ +100°C • Humidity: 5% ~ 95%
Physical Characteristics	• Small form factor: 52.7±0.5x57.6±0.5x20.72±0.5mm • Communication type: UART/TTL • Wire interface type: Molex 4Pin , L=150cm • Weight: Approx. 90.1g

1.2. Attentions

As a high-performance vehicle integrated navigation system, GGM-5853F5ADR-AGGB4P150 system also requires users to pay attention to some matters during application.

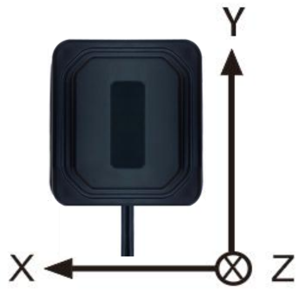

Figure 1: Coordinate System

No	Initialization process of integrated navigation	Importance
1	No installation Angle requirements.Refer to **Figure 1**	
2	Before power on ,Fixed connected GGM-5853F5ADR-AGGB4P150 and vehicle	Required
3	After power on,don't move GGM-5853F5ADR-AGGB4P150	Required
4	Before the vehicle moves,please make sure the GPS/BD 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 GGM-5853F5ADR-AGGB4P150 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.

1.3 Block Diagram

The GGM-5853F5ADR-AGGB4P150 is a high performance (BDS, GPS, GLONASS, Galileo, QZSS and SBAS) in all bands (L1,L5). satellite navigation receiver in a compact surface mount package. It is based on the AT3335AD positioning technology, providing high performance signal acquisition and tracking. The simple UART serial interface and the standard NMEA-0183 protocol make usage of GGM-5853F5ADR-AGGB4P150 very easy and straightforward.

The GGM-5853F5ADR-AGGB4P150 module can performs all the necessary system initialization, signal acquisition, signal tracking, data demodulation, and calculation of navigation solution autonomously.

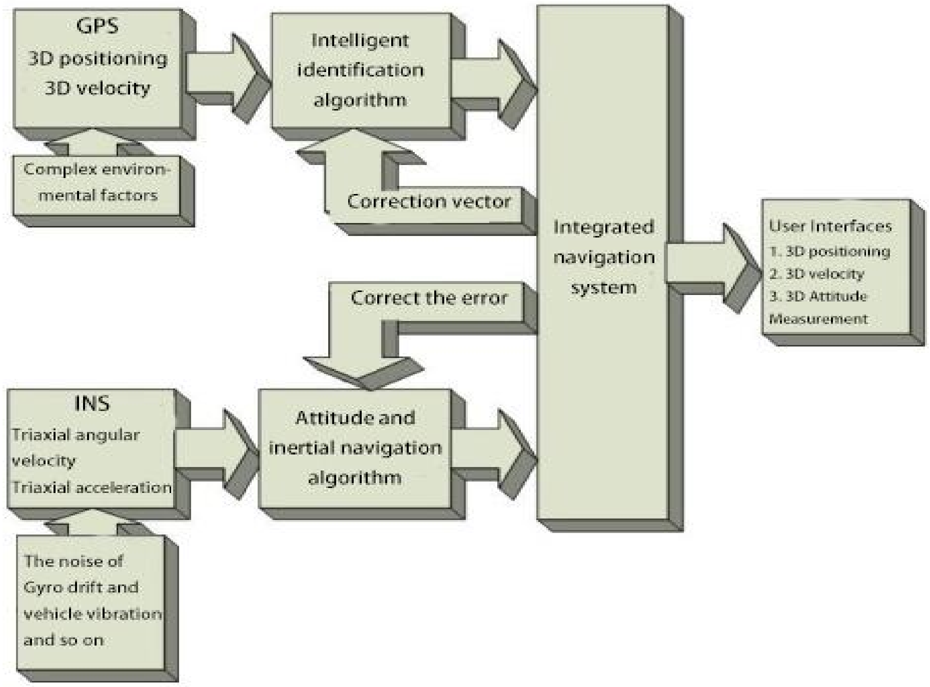

Figure 1-2 : Block Diagram

2. Mechanical Dimensions and Pin Assignment

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

2.1 Pin Definition

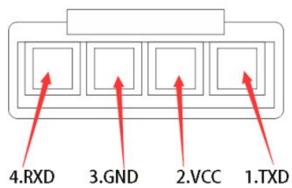

Figure3：Pin Assignment

Table: CON Pin Description

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

2.2 Dimensions

This chapter describes the mechanical dimensions of the module.

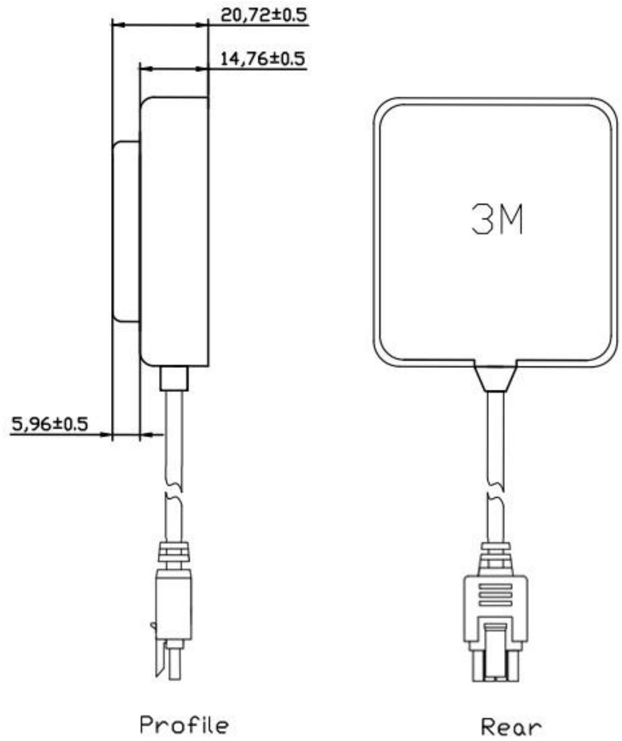

Figure2：Mechanical Dimensions (Unit：mm)

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.
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)

Table 4: Overview of NMEA messages

$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.
$GPGSV **$GLGSV** **$GAGSV** **$GBGSV**	Satellite information about elevation, azimuth and CNR, satellites are used in position solution, a $GPGSV sentence is used for GPS satellites, a $GLGSVsentence is used for GLONASS satellites, a $GAGSV sentence is used for GALILEO satellites. And $BDGSV 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.
$PAIRMSG	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.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 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	

3.2 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	

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,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 '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 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.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	

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 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode '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 (Rrefer to table A)

Table A

Field	Name	Example	Description
1	UTC	072520.000	UTC time
2	DR stage	3	DR_SOLUTION_UNKNOWN = 0 DR_SOLUTION_INIT = 1 DR_SOLUTION_COARSE = 2 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 (Rrefer to table B)
Statu 3：Alarm status (Rrefer to table C)

Table B

Field	Name	Example	Description
1	UTC	072520.000	UTC time
2	Dynamic status	1	UNKNOWN = 0 STATIC = 0x01 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 Straight harsh acceleration > 2.5m/s²
			HARSH_DECELERATION = 0x02 (2)	2: Harsh deceleration Straight harsh deceleration < -4.5m/s²
			HARSH_TURN = 0x04 (4)	4: Harsh turn Lateral turning acceleration > 4m/s² Heading angle > 45°
			HARSH_LANE_CHANGE = 0x08 (8)	8: Harsh line change Lateral turning deceleration > 4m/s² Heading angle < 20°
			HORIZONTAL_COLLISION = 0x10 (16)	16: Horizontal collision Straight harsh acceleration > 20m/s² pitch angle < 20° Flip angle< 20°
			ROLLOVER = 0x20 (32)	32: Rollover Pitch angle >70° Flip angle>70°
			STABILITY_WARNING = 0x40 (64)	64: Stability warning 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)	125: Euler_anomaly The pitch Angle and dump Angle of the vehicle, the larger value is greater than 20° and less than 70°.
4	Checksum	46	Checksum	

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