General Description

The GAM-4121F1PBZ-BKGB is a receiving module that supports L1 single-band&multi-mode. It has built-in highly integrated GNSS receiver chip, supports multi band and multi system cm4f (main frequency 350mhz, 22nm Technology) chip of Third-generation BeiDou Navigation Satellite System (BDS-3). Besides,it is capable of tracking all global civil navigation systems (BDS,GPS,GLONASS,Galileo,QZSS,and SBAS) in all bands.

GAM-4121F1PBZ-BKGB module is based on the state of art BDS-3 architecture, integrating Single-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.

GAM-4121F1PBZ-BKGB module contains BK1616P 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

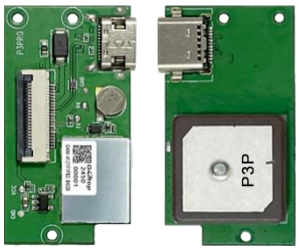


Figure: GAM-4121F1PBZ-BKGB Top View

Features

- Build on high performance, low-power BK1616P chip set
- Ultra high Track sensitivity: -165dBm
- Support Windog function, and RTC
- Concurrent reception of L1 band and multi-system satellite signals
- Supports all civil GNSS signals
- Supports BDS-3 signal
- Extremely fast TTFF at low signal level
- Multipath detection and suppression
- Works with passive and active antenna
- Low power consumption: Max 32mA@3.3V
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage:3.0V~5.5V
- Patch Antenna Size: 18x18x4mm
- Small form factor: 41±0.5x21±0.5x6.8±0.5mm
- Interface type: Type-c & FPC
- Weight: Approx. 9g（±2%）
- 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: 32mA @VCC=VBAT=3.3V • Tracking: 30mA @VCC=VBAT=3.3V • Backup: 14uA @VBAT=3.3V
GNSS engine	• 96 tracking channels with fast search engine
GNSS reception	• GPS/QZSS: L1 • GLONASS: G1 • GALILEO: E1 • BEIDOU: B1I, B1C • SBAS: WAAS, EGNOS, MSAS, GAGAN
NMEA messages	• $GNGGA,$GNGSA,$GPGSV,$BDGSV,$GLGSV,$GAGSV,$GNRMC
Update rate	• GNSS: 10Hz maximum, 1Hz by default
Position accuracy	• GNSS: <1.5m CEP
Velocity & Time accuracy	• GNSS: 0.1m/s CEP • 1PPS: 20 ns
Time to First Fix(TTFF)	• Hot start: 1s • Cold start: 28 s • AGPS: 1.5s
Sensitivity	• Cold start: -148dBm • Hot start: -165dBm • Re-acquisition: -159dBm • Tracking & navigation: -165dBm
GNSS Operating limit	• Velocity: 515m/s • Altitude: 18000m
Datum	• Default WGS-84, User definable
USB Port	• USB Port: USB_DM&USB_DP • Supports baud rate from 9600bps to 961200bps, 9600bps by default. • NMEA 0183 Protocol Ver.4.10, BK GNSS Receiver Protocol • Supports batch data report mode
Temperature Range	• Normal operation: -40°C ~ +85°C • Storage temperature: -40°C ~ +105°C • Humidity: 5% ~ 95%

1.2 Power Supply

Regulated power for the GAM-4121F1PBZ-BKGB 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 32mA. Suitable decoupling must be provided by external decoupling circuitry.

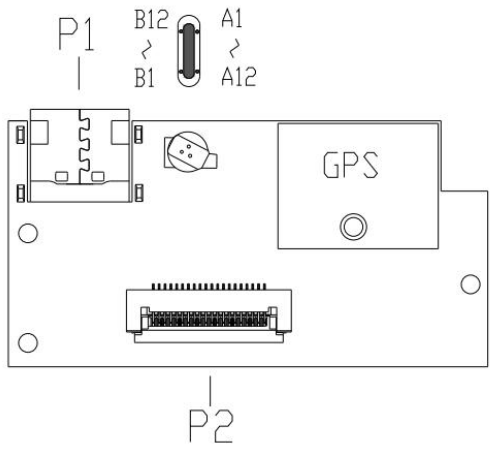
1.3 USB Ports

The module supports two full duplex serial channels USB. All serial connections are at 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. The modules default baud rate is set up 9600bps, however, the user can change the default baud rate to any value from 9600bps to 961200bps. USB port can be used for firmware upgrade, NMEA output and PBK proprietary commands input.

2. Application

The module is equipped with a Type_C and a FPC connector that connects to your application platform. The GAM-4121F1PBZ-BKGB module It consists of a BK1616P single chip GPS IC which includes the RF part and Baseband part, a patch antenna, a LNA, a SAW filter, a TCXO, a crystal oscillator, Also comes with a 0.07F crystal capacitor ,can backup satellite ephemeris about 2 hour.

2.1. Pin Assignment



P1: Type-C

A1. GND	B1. GND
A2. AHD_IN	B2. AHD_IN
A3. NC	B3. NC
A4. VCC_USB	B4. VCC_USB
A5. CC1	B5. CC2
A6. USB_DP	B6. USB_DP
A7. USB_DM	B7. USB_DM
A8. ACC_5V	B8. ACC_5V
A9. VCC_USB	B9. VCC_USB
A10. VCC_ACAM	B10. VCC_ACAM
A11. VCC_ACAM	B11. VCC_ACAM
A12. GND	B12. GND

P2: FPC

1. VCC_USB	13. USB_DP
2. VCC_USB	14. USB_DM
3. VCC_USB	15. GND
4. VCC_USB	16. GND
5. VCC_USB	17. VCC_ACAM
6. GND	18. VCC_ACAM
7. ACC_5V	19. VCC_ACAM
8. GND	20. GND
9. GPS-IN	21. AHD_IN
10. GND	22. GND
11. GPS-3.3V	23. PGND
12. GND	24. PGND

Figure 1: Pin Assignment

Table 2: Pin Definition-Type_C

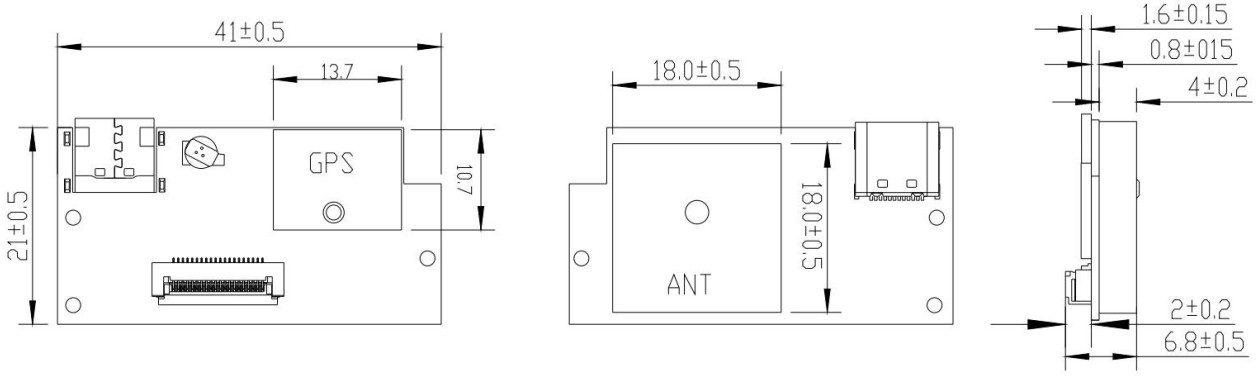
Pin No.	Pin name	I/O	Description	Remark
A1.B1 A12.B12	GND	G	Ground	
A2.B2	AHD_IN	I	UART Serial Data output	
A3.B3	NC			
A4.B4 A9.B9	VCC_USB	I	Module Power Supply	Voltage range:3.0~5.5V
A5	CC1	I/O	Signal confirmation	
B5	CC2	I/O	Signal confirmation	
A6.B6	USB_DP	I/O	USB Data (D+)	
A7.B6	USB_DM	I/O	USB Data (D-)	
A8.B9	ACC_5V	I	ACC power input 5V	
A10.B10 A11.B11	VCC_ACAM	I	ACAM power input	

Table 3: Pin Definition-FPC

Pin No.	Pin name	I/O	Description	Remark
1.2.3.4.5	VCC_USB	I	Module Power Supply	Voltage range:3.0~5.5V
6.8.10.12 15.16.20 22	GND	G	Ground	
7.	ACC_5V	I	ACC power input 5V	
9	GPS-IN	I	GPS Data input	
11	GPS-3.3V	I	GPS power Supply	
13	USB_DP	I/O	USB Data (D+)	
14	USB_DM	I/O	USB Data (D-)	
17.18.19	VCC_ACAM	I	ACAM power input	
21	AHD_IN	I	AHD IN	
23.24	PGND	G	Ground	

3. Mechanical Dimensions

This chapter describes the mechanical dimensions of the module.



Front view Rear view Profile view

Figure 2: Specification size chart

4. NMEA 0183 Protocol

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

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

$GNRMC,$GNGLL,$GNGGA,$GNGSA$GPGSV,$BDGSV,$GLGSV,$GAGSV,$GNVTG

4.1 GGA – Global Positioning System Fix Data

Time, position and fix related data for a GNSS receiver.
Structure:$GNGGA,hhmmss.sss,ddmm.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	

4.2 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 . 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	

4.3 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 . 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	

4.4 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	

4.5 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	

4.6 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

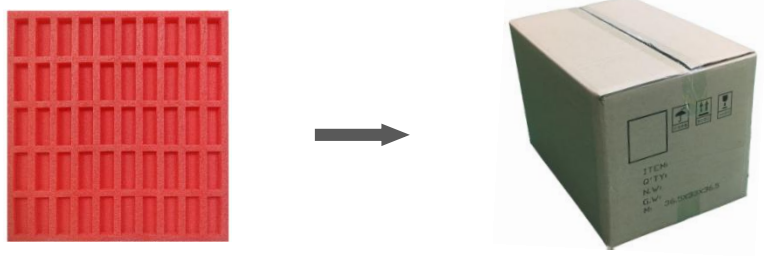
Field	Name	Example	Description
1	Latitude	2447.08700	Latitude in ddmm.mmmmm format Leading zeros transmitted
2	N/S Indicator	N	Latitude hemisphere indicator 'N' = North, 'S' = South
3	Longitude	12100.52210	Longitude in dddmm.mmmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere 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	

5. Packaging Information

The following packing is for reference only, the specific packing information is subject to the actual delivery situation. Also, Packaging can be customized.

Packing Details

Unit: mm
Quantity per tray:50pcs
Quantity per carton: 600pcs



Tray Carton

Figure 3: Packaging physical Figure

Model Name	MOQ for MP	Minimum Package: 600pcs
GAM-4121F1PBZ-BKGB	600pcs	Size: 365mm ×330mm ×365mm N.W: 5.40 kg (±2%) G.W: 6.36 kg (±5%)

Revision History

Version	Date	Author	Description
1.0.0	2025-01-15	Bella	Compile and release

Gotop Technology Co. ， LTD

Add:AreaC,4th layer,A1 building,QingHu Silicon Valley Power,LongHua district ,Shenzhen ,China
Phone: 86-755-23804156
fax: 86-755-23804155
N 22° 32' 17", E 114° 07' 07“
http://www.gotop-zzu.com