General Description

Figure: EB1612L5DK-GGB **Top View**

EB1612L5DK-GGB is a receiver module that supports dual-band&multi-mode. It is made of the BK166X series GNSS chip, and six axis acceleration sensor.It is a multiple function communication module which has integrated the advanced online adaptive integrated navigation algorithm and GNSS location engine, it can provide real-time, high-precision vehicle location, speed measurement and direction measurement information in any environment (such as indoor, tunnel, underground garage, etc.). When the signal accuracy is reduced and even satellite signals are lost in GNSS system, without using the odometer information, EB1612L5DK-GGB can use only inertial navigation technology to locate, measure the vehicle carrier accurately for a long time.

EB1612L5DK-GGB is a concurrent receiver module with built-in multiple positioning systems that support simultaneous reception of BDS,GPS,Glonass, Galileo,QZSS,IRNSS and SBAS L1&L5 bands. It has 200 tracking channels, enable it to capture and track any multiple satellite signals.Compared with single GPS system, the multiple positioning system (BDS,GPS,Glonass, Galileo,QZSS,IRNSS and SBAS) ofEB1612L5DK-GGB makes a great increase in the number of visible and available satellites, at the same time, the first positioning time is greatly reduced, even in complex urban environment, it can achieve higher positioning precision and accuracy.

Applications

- Vehicle High Precision Navigation
- ITS (Intelligent Traffic System)
- Vehicle Remote Monitoring

Features

- Build on high performance, low-power GNSS BK166X chip set
- Built-in ST-LSM6DSRTR acceleration sensor to define various gravity algorithms
- Supports BDS-3 signals
- Supports inertial navigation mode（DR）
- Supports RTK;Protocol:RTCM 3.3
- Simultaneously receiving dual-band&multi-system satellite signals and all civil GNSS signals.
- Multipath signal detection and interference suppression.
- Support assive or active antennas
- Built-in high gain LNA to improve receiving sensitivity
- Support satellite systems: BDS, GPS,Glonass,Galileo, QZSS,IRNSS and SBAS
- Ultra high track sensitivity: -165dBm
- Baud rate:115200, 1-10Hz
- Protocol compliant NMEA-0183
- Supports automatic inertial navigation and positioning without GNSS signal
- Automatically save GNSS log information
- Operating voltage: 2.8V~3.6V
- Power consumption: 30 mA@3.3V
- SMD type with stamp holes
- Small form factor: 16±0.6x12.2±0.2x2.4±0.2mm
- Product weight：0.9 g
- Recommended operating temperature range:-40to85℃
- RoHS compliant (Lead-free)

1. Performance Description

1.1 Features

item	Features	item	Features
Gyroscopic drift	High precision attitude heading information is obtained by eliminating gyro driftwo	Component selection	High performance three axis gyroscope and three axis accelerometer
Acceleration noise	Eliminate vibration acceleration and obtain high accurate velocity information	Error compensation	Complete quadrature error / temperature drift and other error compensation
Zero speed correction	Zero speed correction algorithm prevents navigation data drift	Preventing pirate	Each product calibration code is inconsistent for preventing pirate
Software algorithm	Adaptive extended Calman filtering algorithm	Physical Dimensions	Compact modular design saves user product space
Intelligent identification	Identify and isolate GNSS data with large errors	Communication protocol	Plug and use standard communication protocol NEMA-0183
Independent of odometer	High precision positioning by using inertial navigation	Engineering installation	No installation angle, convenient for users to install on board
Navigation technology	Switch between integrated navigation and inertial navigation technology	Sub - meter	Support RTCM3.3 protocol / sub-meter level navigation in complex environment

1.2 Technical Parameter

Item	Parameter Specification
GNSS Receiver Type	Channels: 200 tracking channel and DSP accelerator GPS/QZSS: L1 C/A, L5 GLONASS: L1OF GALILEO: E1(E1B+E1C), E5 BEIDOU: B1I, B1C , B2A INRSS: L5 SBAS: WAAS, EGNOS, MSAS, GAGAN
GNSS Sensitivity	Tracking : -165dBm Capture : -148dBm Re-capture: -159dBm
TTFF (Autonomous)	Cold start: 28s（AVG）@-130 Warm start: 25s（AVG）@-130 Hot start: 1s（AVG）@-130
Position accuracy	GNSS : <1.5m CEP @-130 dBm SBAS : <1.5m CEP @-130 dBm RTK: 1cm+1ppm (CEP50）@-130 dBm
DR Accuracy	DR: Without aid: Sub-meter (6% CEP@120s)
Acceleration Accuracy	Without aid: $0.1m/s^2$
GNSS Dynamic Performance	Velocity: 515m/s Altitude: 18000m Maximum Acceleration 4G
Update rate	GNSS: 20Hz Maximum,1Hz by default RTK: 10Hz Maximum,1Hz by default

2. Application

2.1 Block Diagram

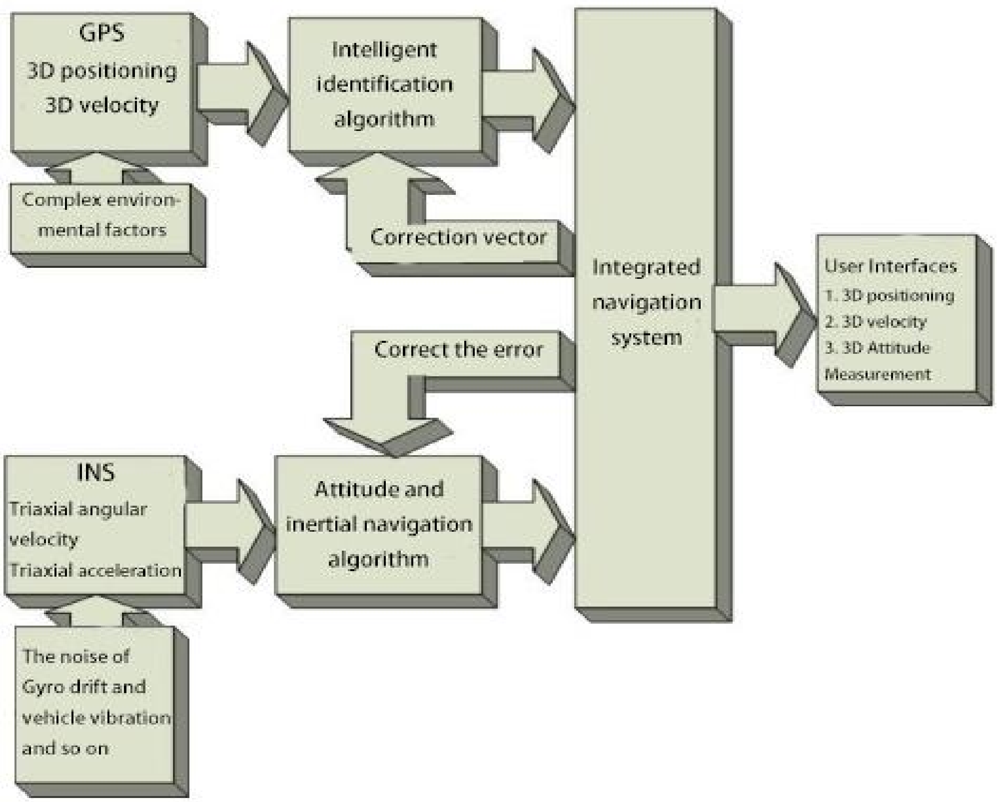


Figure 1: Block Diagram

2.2 System Introduction

2.2.1 Satellite navigation system:

Satellite navigation system has the advantages of global application, all-weather extension and high precision navigation; But satellite navigation systems are vulnerable to environmental influences, such as trees, buildings and so on, resulting in multi path effect to cause the accuracy of positioning result reduced or even lost, especially in the indoor environment, such as tunnels, satellite navigation system cannot be used.

In addition, even in an open environment, when the carrier speed is very low, the satellite navigation system will also be unable to get precise carrier azimuth information (heading angle).

2.2.2 Inertial navigation system:

The inertial navigation is based on Newton's laws of mechanics to conduct integrating to time and change it into navigation coordinates by measuring the acceleration of the carrier in the inertial reference frame, thus, it can get information about speed, yaw angle, and position in navigation coordinates, as well as the carrier information. However, due to the serious drift of gyro and the shock of vehicle, the inertial navigation system can not obtain high precise azimuth and velocity information by directly integrating acceleration, that is, existing micro inertial navigation systems are difficult to work independently for a long time.

2.2.3 Integrated navigation system：

Satellite / inertial integrated navigation takes full advantage of inertial navigation to obtain optimal navigation results based on he integration of optimal estimation algorithm and the kalman algorithm ; Especially when the satellite navigation system cannot work, the inertial navigation system is used to make the navigation system continue to work, to ensure the normal operation of the navigation system, and to improve the stability and reliability of the system.

2.2.4 Independence to odometer

Conventional vehicle navigation systems often rely on EB1612L5DK-GGB schemes of odometer and gyroscopes to realize high precision navigation and positioning in complex environment of vehicle, for many automotive aftermarket, the connection of odometer signal is extreme complex, and it involves auto safety. After years of research and development, when the signal accuracy in GNSS system is reduced and even satellite signals are lost, only by using pure inertial navigation technology, the vehicle carrier can be accurately positioned, measured in a long time. Compared with the existing products on the market, the performance has been greatly improved.

Of course, the EB1612L5DK-GGB system can also connect with odometer signals and will achieve better performance indicators.

2.2.5 Vehicle attitude angle

EB1612L5DK-GGB navigation system achieves filtering of gyro drift and acceleration vibration signals using research experience in MEMS inertial devices for many years by adaptive filtering algorithm, and furthermore, it can get high precision attitude information, so as to meet various needs of vehicle monitoring and navigation applications in ramp detection.

2.2.6 Navigation system

EB1612L5DK-GGB navigation system provides intelligent recognition algorithm for satellite navigation accuracy to identify the positioning accuracy of satellite navigation based on the high precision navigation information provided by integrated navigation, if the satellite navigation accuracy is better, integrated navigation will be carried out, once satellite navigation signals are found to be very poor and even lost, pure inertial navigation is carried out, in a word, EB1612L5DK-GGB navigation system realizes autonomous switching between integrated navigation and pure inertial navigation.

2.3 Product feature

2.3.1 Maximum parameter

Parameter	Index	Unit
Power Supply		
Voltage Supply	3.6V	
Temperature Range		
Operation Temp	-40℃~ + 85℃	
Storage Temp	-55℃~ + 125℃	
Humidity	20~90%RH	

2.3.2 Electrical feature

Parameter	Index	Remark
Power Supply		
Input voltage	2.8~3.6V	
Current	30mA@3.3V	
Consumption	99mW	
Time		
The time required for the first valid data	<30S	

2.4 Performance Index

2.4.1 Mileage timing

GNSS signal loss time	Receiver positioning mode	Horizontal position[1]	Horizontal velocity[1]	Pitch roll Angle	Heading angle1
5 s	Standard	1.0-2.0m	0.05m/s	0.3deg	1.0
10s	Standard	1.5-5.5m	N/A	N/A	N/A
30s	Standard	3.0m	N/A	N/A	N/A
60s	Standard	5.0m	0.30m/s	0.4deg	1.0deg

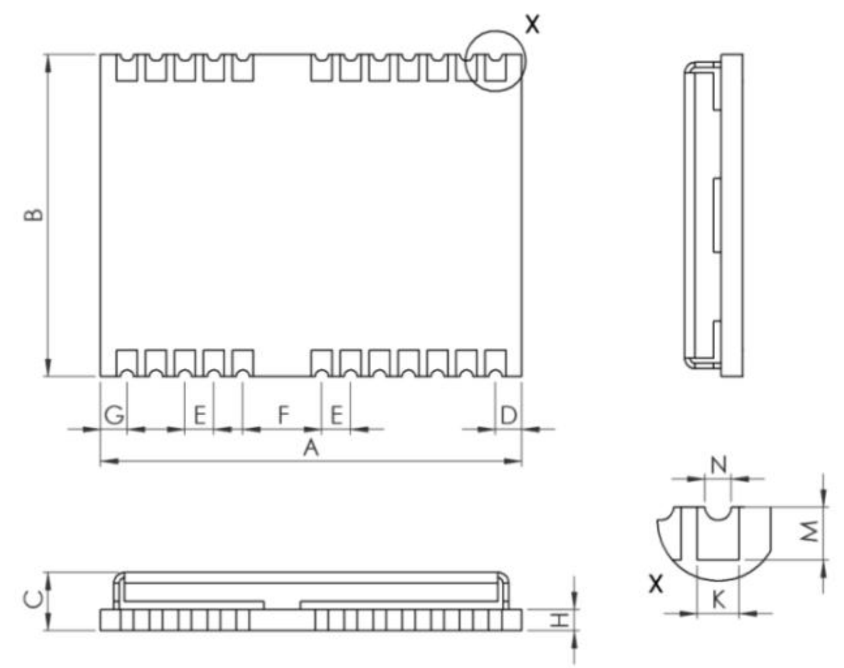
2.4.2 No Mileage Timing

GNSS signal loss time	Receiver positioning mode	Horizontal position[1]	Horizontal velocity[1]	Pitch roll Angle	Heading angle1
5 S	Standard	2.0-3.5m	0.05m/s	0.5deg	1.0
10 S	Standard	5.0m	N/A	N/A	N/A
60 S	Standard	25.0m	N/A	N/A	N/A
120 S	Standard	60.0m	0.5m/s	1.0deg	2.0deg

3. Mechanical Dimensions and Pin Assignment

3.1 Dimensions

This chapter describes the mechanical dimensions of the module.



Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
A	15.4	16.0	16.6
B	12.0	12.2	12.4
C	2.2	2.4	2.6
D	0.9	1.0	1.3
E	1.0	1.1	1.2
F	2.9	3.0	3.1
G	0.9	1.0	1.3
H		0.82	
K	0.7	0.8	0.9
M	0.8	0.9	1.0
N	0.4	0.5	0.6

Figure 2：Mechanical Dimensions (Unit：mm)

Reference Charging Size for PCB (unit: mm)

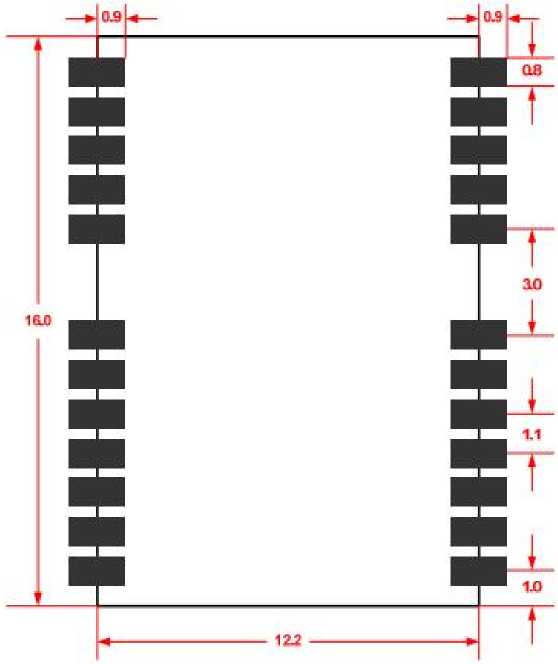


Figure 3: Reference Charging Size for PCB (unit: mm)

3.2 Pin Assignment

The module is equipped with a 24-pin SMT pad that connects to your application platform. Sub-interfaces included in the pad are described in details in the following chapters.

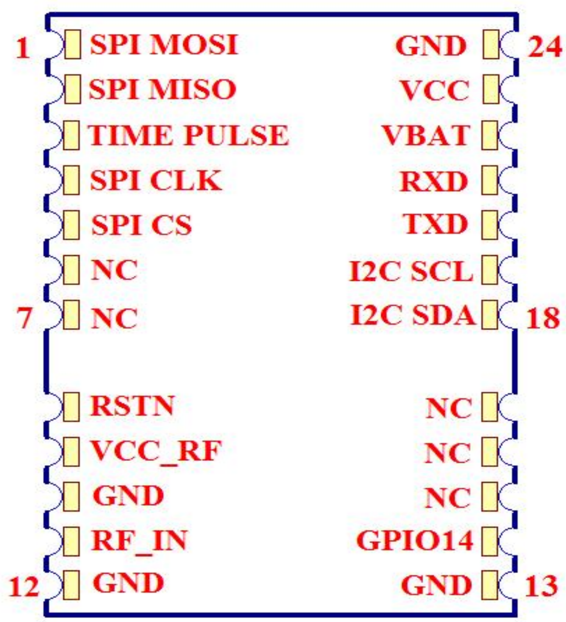


Figure 4: Pin Assignment

3.2.1 Pin Definition

Pin No.	Name	Description
1	SPI MOSI	Serial port SPI MOSI port,leave it vacant when not in use
2	SPI MISO	Serial port SPI MISO port,leave it vacant when not in use
3	TIME PULSE	PPS OUT PUT
4	SPI CLK	Serial port SPI CLK port,leave it vacant when not in use
5	SPI CS	Serial port SPI CS port,leave it vacant when not in use
6.7.15.16.17	NC	No connect
8	RSTN	RESET leave it vacant when not in use
9	VCC_RF	Active antenna power supply
10	GND	Power GND
11	RF_IN	L1+L5 RF input
12	GND	Power GND
13	GND	Power GND
14	GPIO14	JTAG_TDO,leave it vacant when not in use
18	I2C SDA	Serial port I2C SDA port,leave it vacant when not in use
19	I2C SCL	Serial port I2C SCL port,leave it vacant when not in use
20	TXD	Serial port TXD port
21	RXD	Serial port RXD port
22	VBAT	Backup battery2.8V--3.3V,leave it vacant when not in use
23	VCC	Working voltage：2.8-3.6V,Recommended use：3.3V
24	GND	

3.3 Electrical Specification

Operating Conditions

Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC)	2.8	3.3	3.6	Volt
Acquisition Current (exclude active antenna current)		27		mA
Tracking Current (exclude active antenna current)		30		mA
I/O port &UART port working voltage ：				
Output Low Voltage	-		0.4	Volt
Output HIGH Voltage	2.4		-	Volt
Input LOW Voltage	0.3		0.7	Volt
Input HIGH Voltage	2.1		4.2	Volt
Input LOW Current	-10		10	uA
Input HIGH Current	-10		10	uA
RF Input Impedance (RFIN)		50		Ohm

4. Coordinate System and Installation Direction

4.1 Attentions

As a high-performance vehicle integrated navigation system, EB1612L5DK-GGB system also requires users to pay attention to some matters during application.

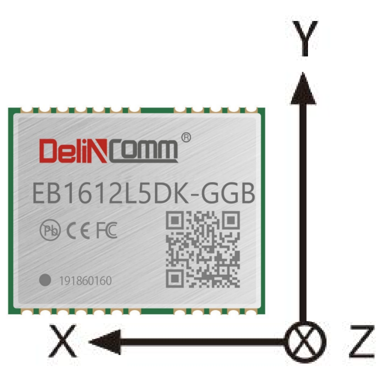


Figure 5: Coordinate System

Installation Direction

No	Initialization process of integrated navigation	Importance
1	No installation Angle requirements.Refer to **Figure 5**	
2	Before power on，Fixed connected EB1612L5DK-GGB and vehicle	Required
3	After power on，don’t move EB1612L5DK-GGB	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 EB1612L5DK-GGB 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

Remark：

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

NOTE：

(1) Installation Angle

The product needs to be firmly connected with the car before it is powered on. When the vehicle is running, we will deal with the installation Angle according to the following two situations:

Situation 1: when the product is installed for the first time: When the vehicle is moving, the product identifies the installation Angle according to the acceleration and deceleration of the vehicle and other movements.That means, the product can obtain the installation Angle only after the car has been driving for a period of time, and the product will store the installation Angle data in a Flash after it has been identified several times.

Situation 2: If the product is installed for second time or more, the information about installation Angle is already in a Flash. When the vehicle is moving, the inertial navigation product will enter the integrated navigation state according to the last installation Angle.

(2) Training

When the installation Angle is obtained , the product will immediately enter the inertial navigation training state , and then the vehicle should drive for about 3 minutes before the inertial navigation training is successful , and finally the product will enter the integrated navigation state . In this case , the user can enter the tunnel or garage and other areas without satellite positioning .

5. Instructions

5.1 Sensor Calibration

Because the chip manufacturing process, each sensor element of EB1612L5DK-GGB (three axis gyroscope, three axis accelerometer), sensitivity and zero temperature drift parameters are not the same, in order to make each EB1612L5DK-GGB reach the same performance, before leaving the factory, various error compensation has been made for each sensor element of EB1612L5DK-GGB .

The calibration parameters of sensor components are different for each product, if using the same parameters, it will lead to greater navigation error. This uniqueness can be used to prevent system piracy, thereby improving the reliability of the products for users.

5.2 Communication interface

The EB1612L5DK-GGB system provides two serial ports, wherein the serial port 1 is used for transmitting satellite information and receiving differential information, and the serial port 2 is used for receiving the odometer information.

Both serial ports do not provide a hardware handshake, and the use of 8 bit data bits, 0 bit parity bit, 1 bit stop bit (8-N-1) mode, baud rate default is 9600bps, and according to user requirements, it can be modified to 115200bps.

5.3 Communication frequency

The system supports the output of 1Hz、5Hz、10Hz、20Hz data refresh frequency, the default frequency is 10HZ.

5.4 Communication protocol

At present, the EB1612L5DK-GGB system outputs common NMEA0183 protocols, in addition, in order to output vehicle attitude information.

6. Manufacturing, Packaging and Ordering Information

6.1 Assembly and Soldering

EB1612L5DK-GGB module is intended for SMT assembly and soldering in a Pb-free reflow process on the top side of the PCB. It is suggested that the minimum height of solder paste stencil is 100um to ensure sufficient solder volume. Pad openings of paste mask can be increased to ensure proper soldering and solder wetting over pads. It is suggested that the peak reflow temperature is 220~240ºC (for SnAg3.0Cu0.5 alloy). The absolute maximum reflow temperature is 260ºC. To avoid damage to the module when it is repeatedly heated, it is suggested that the module should be mounted after reflow soldering for the other side of PCB has been completed. Recommended reflow soldering thermal profile is shown below:

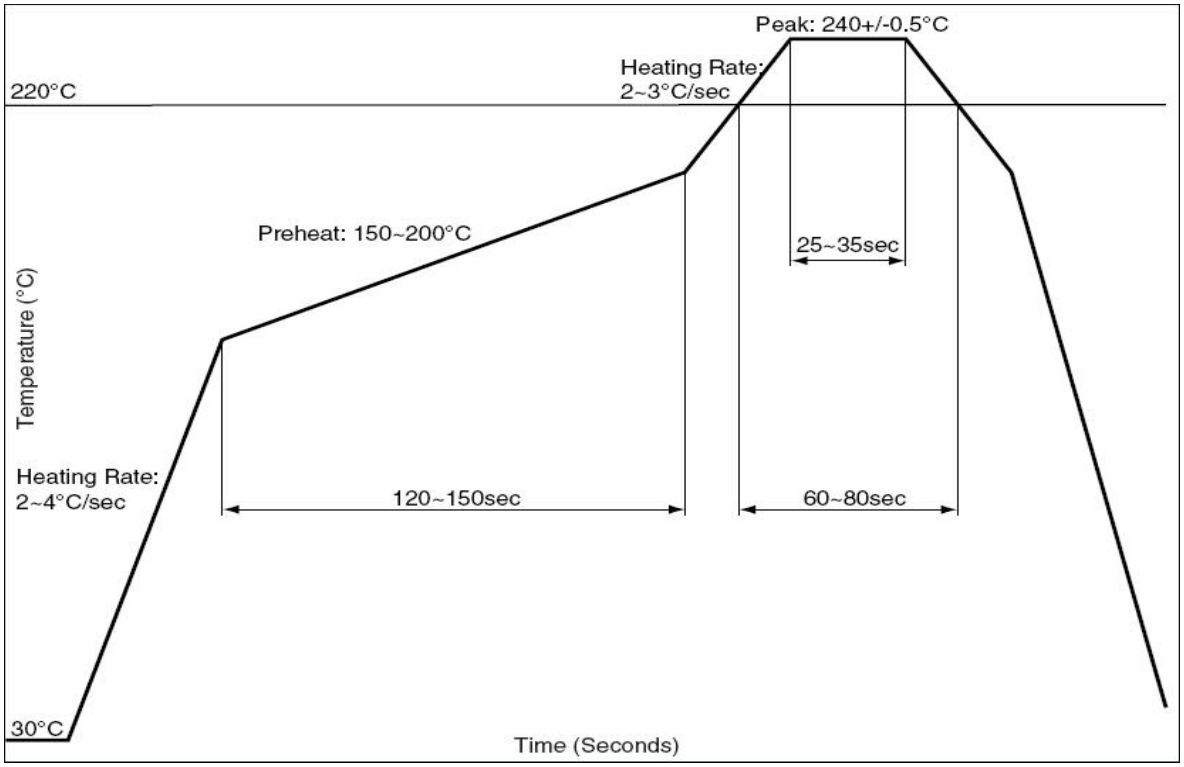


Figure 6: Recommended Reflow Soldering Thermal Profile

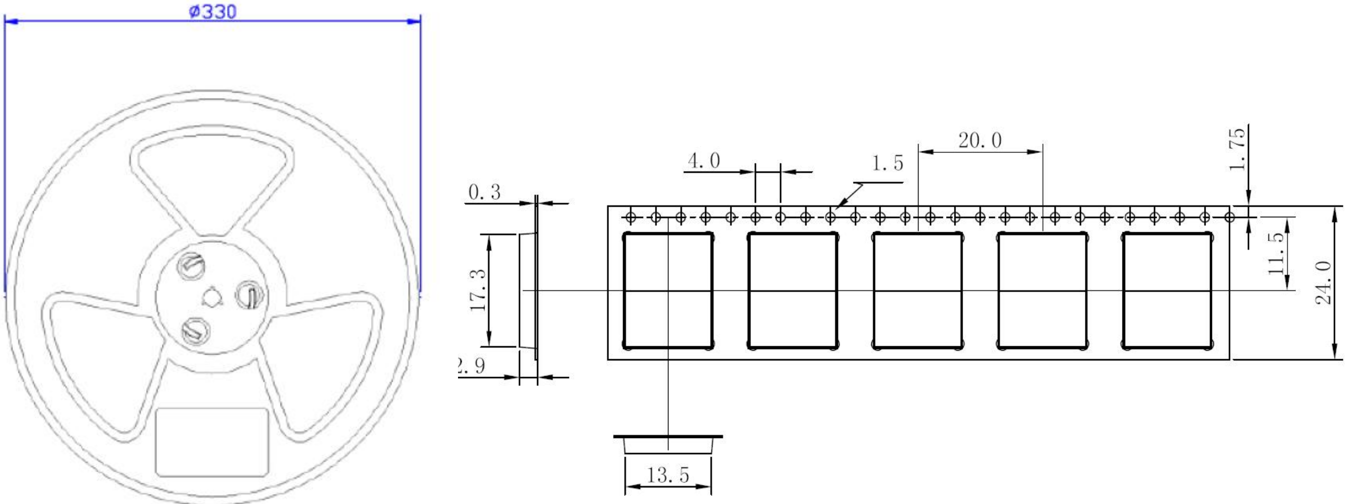
6.2 Moisture Sensitivity

EB1612L5DK-GGB module is sensitive to moisture. To prevent EB1612L5DK-GGB from permanent damage during reflow soldering, baking before reflow soldering is required in following cases:

- ✧ Humidity indicator card: One or more indicating spots are no longer blue.
- ✧ The seal is opened and the module is exposed to excessive humidity.

EB1612L5DK-GGB shall be baked for 192 hours in a cryogenic environment at 40°C+5°C/-0°C and <5%RH, or for 24 hours in a high-temperature environment at 125°C±5°C.As the plastic packaging tape is not heat-resistant, the module should be removed from the tape before baking, otherwise, the tape will be damaged due to high temperature heating, you can also refer to the actual production technology of the SMT factory.

6.3 Tape and Reel Packaging



Unit: mm

Quantity per reel:1000pcs

Lengh per reel: 20m

Figure 7: Tape and Reel Specifications

Figure 8: Packaging physical Figure

Reel Packaging

Model Name	MOQ for MP	Minimum Package: 1000pcs
EB1612L5DK-GGB	1000pcs	Size: 365mm × 350mm × 53mm N.W: 0.90 kg G.W: 1.30 kg

7. DGNSS – Differential GNSS

The RTK navigation mode needs to work in the data mode provided by RTCM 3.3. The EB1612L5DK-GGB supports DGNSS function according to RTCM3.3 protocol. The decoded RTCM3.3 message is shown in the following table.

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

8. NMEA Data Analysis

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

The EB1612L5DK-GGB output statement format is shown below:

$GNRMC,$POINS,$GNGLL,$GNGGA,$GNGSA,$GPGSV,$BDGSV.

8.1 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	

8.2 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:$GNGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,x*hh
For example:$GNGSA,A,3,21, 12,15,18,20,24,10,32,25,13,,,1.2,0.7,1.0,1*18

Field	Name	Example	Description
1	Mode	A	Mode '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	

8.3 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: $XXGSV , x , x , xx , xx , xx , xx , xx , ... , xx , xx , xx , xx , xx , x*hh
For example：$XXGSV , 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	

8.4 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	

8.5 PO_INS

Output integrated navigation solution status and information.
Structure:$POINS,GPS_week,GPS_seconds,INS_status,IMU_status,GNSS_status,odometer_status,motion_status,IMU_type,work_mode*cs<CR><LF>
For example:$POINS,2259,197506.000,2,1,1,0,1,3,1*48

Field	Name	Example	Description
0	$POINS	$POINS	Message ID, BK protocol CLK item
1	GPS_week		GPS week
2	GPS_seconds		GPS seconds
3	INS_status		Combinatorial solution running status： 0：NOT ACTIVE 1：Initial configuration 2：Check installation status 3：Initial check 4：Combinatorial solution entered but did not converge 5：Combinatorial solution has converged

4	IMU_status		IMU status： 0：No Data 1：Normal data 2：Device data is faulty and lost data 3：Device installation failure, that the device is not firmly connected to carrier
5	GNSS_status		GNSS status： 0：No Data 1：Normal data
6	odometer _status		Odometer status： 0：No Data 1：Normal data
7	motion_status		Carrie rmotion_status： 0：Action - Unknown 1：motionless 2：motion 3：straight line motion 4：Curved motion
8	IMU_type		IMU type： LSM6DSR
9	work_mode		work mode： 0：invalid 1：HTC CAR 2：key on engine off

8.6 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	