General Description

The GRM-5853F5LRKW-BKGB327-JP80 A3.0 is a receiving module that supports Dual-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,IRNSS and SBAS) in all bands.

GRM-5853F5LRKW-BKGB327-JP80 A3.0 is based on the state of art BDS-3 architecture, integrating multi-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.

GRM-5853F5LRKW-BKGB327-JP80 A3.0 module contains BK1662 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: GRM-5853F5LRKW-BKGB327-JP80 A3.0

Features

- Build on high performance, low-power BK1662 chip set
- Ultra high Track sensitivity: -163dBm
- Concurrent reception of dual-band and multi-system satellite signals
- Supports all civil GNSS signals
- Supports BDS-3 signal
- Supports RTK;Protocol:RTCM 3.3
- Extremely fast TTFF at low signal level
- Multipath detection and suppression
- Works with passive and active antenna
- Low power consumption: Max 50mA@3.3V
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage:3.0V to 5.5V
- Patch Antenna Size:35x35x4+25x25x4mm
- Small form factor: 53.0±0.5x57.5±0.5x19.8±1.0mm
- Communication type: RS232
- 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
GNSS engine	• 120 tracking channels with fast search engine
GNSS reception	• GPS/QZSS: L1,L5 • GLONASS: L1 • GALILEO: E1,E5 • BEIDOU: B1I, B1C , B2A • INRSS: L5 • SBAS: WAAS, EGNOS, MSAS, GAGAN
Update rate	• GNSS 10Hz
RTK	• RTCM3.3
Position accuracy	• GNSS 1m CEP • SBAS 1m CEP
Velocity & Time accuracy	• GNSS 0.01m/s CEP • SBAS 0.05 m/s • 1PPS 20 ns
Time to First Fix(TTFF)	• Hot start 1.0 s • Cold start 28 s • AGPS 1.5s
Sensitivity	• Cold start -148dBm • Hot start -163dBm • Re-acquisition -159dBm • Tracking & navigation -163dBm
GNSS Operating limit	• Velocity 515m/s • Altitude 18000m
Datum	• Default WGS-84, User definable
RS232 Port	• RS232 Port: RS232_TX and RS232_ RX • Supports baud rate from 9600bps to 961200bps, 460800bps by default. • NMEA 0183 Protocol Ver. 4.00/4.10, BK GNSS Receiver Protocol • Supports batch data report mode
Temperature Range	• Normal operation: -40°C ~ +85°C • Storage temperature: -55°C ~ +100°C • Humidity: 5% ~ 95%
Physical Characteristics	• Size: 53±0.5 × 57.5±0.5 × 19.8±1.0mm • Weight: Approx. 150.0g

1.2. Power Supply

Regulated power for the GRM-5853F5LRKW-BKGB327-JP80 A3.0 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 50mA. Suitable decoupling must be provided by external decoupling circuitry.

1.3. RS232 Ports

The module supports two full duplex serial channels RS232. All serial connections are at 5.5V RS232 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 460800bps, however, the user can change the default baud rate to any value from 4800bps to 921600bps. RS232 is used e.g. for booting and NMEA interface.

2. Application

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 Assignment

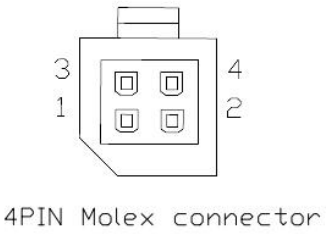


Figure 2: Pin Assignment

Table 2: CON Pin Description

Pin No.	Pin Name	I/O	Description	Remark
1	RXD	I	RS232 Serial Data input	
2	GND	G	Ground	
3	TXD	O	RS232 Serial Data Output	
4	VCC	I	Module Power Supply	Voltage range: 3.0v~5.5V

2.2 Maximum parameter

Parameter	Index	Remark
Power Supply		
Voltage Supply	5.5 V	

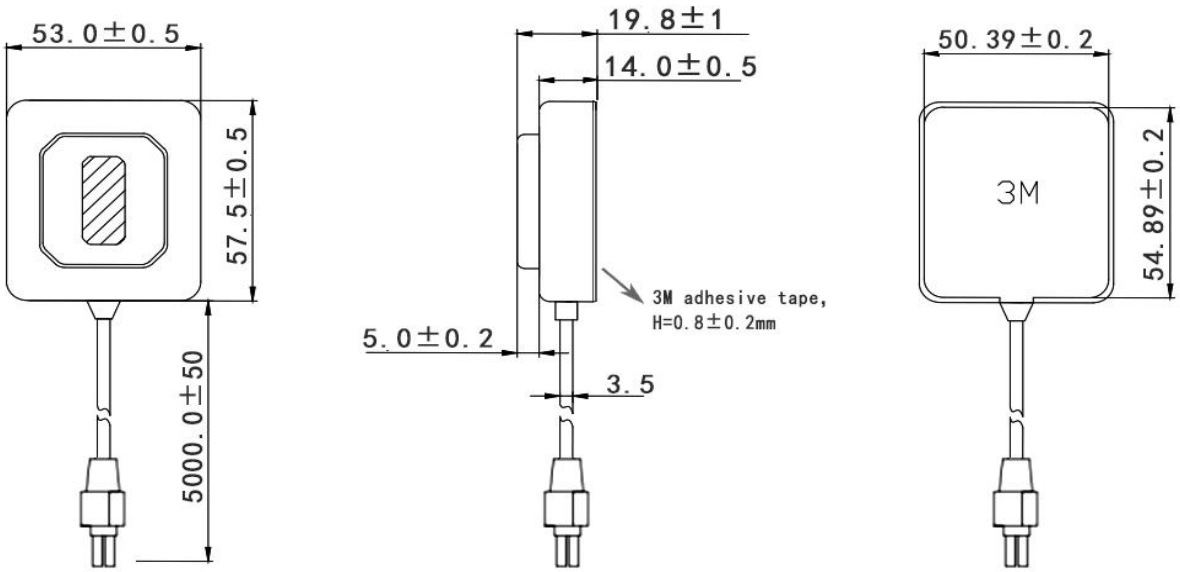
Temperature Range		
Operation Temp	-40℃ to + 80℃	
Storage Temp	-40℃ to + 105℃	
Humidity	20~90%RH	

2.3 Electrical feature

Parameter	Index	Remark
Power Supply		
Input voltage	3.0~5.5V	
Current	50mA	
Consumption	300mW	
Time		
The time required for the first valid data	<30S	

2.4 Mechanical Dimensions

This chapter describes the mechanical dimensions of the GRM-5853F5LRKW-BKGB327-JP80 A3.0 module. Size unit（mm）.



Front **Profile** **Rear**

Figure 3: Specification size chart

3. Supported GNSS augmentation systems

3.1 DGNSS – Differential GNSS

The RTK navigation mode needs to work in the data mode provided by RTCM version 3.3. The GRM-5853F5LRKW-BKGB327-JP80 A3.0 supports DGNSS function according to RTCM 10403.3 protocol. The decoded RTCM3.3 message is shown in the following table:

Table 2

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

4. NMEA 0183 Protocol

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

Table 3: 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:
$GNGGA,$GNGSA,$GPGSV,$BDGSV,$GLGSV,$GAGSV,$IRGSV,$GNVTG,$GNRMC.

Table 4: Overview of NMEA messages

$GNGGA	Time, position, and fix related data of the receiver.
$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** **$GAGSV** **$BDGSV** **$IRGSV**	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. $BDGSV sentence is used for BDS satellites. And $IRGSV sentence is used for IRNSS satellites.
$GNVTG	Course and speed relative to the ground
$GNRMC	Time, date, position, course and speed data.

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,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	

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 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	

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 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	

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	

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