

# BE-252Q

## GNSS Module + Compass

### Datasheet

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Revision: 5.60

Date:2023.6



## Features:

Item	Description	
Electrical Characteristic	Chip	M10050
	Receiver type	GPS L1 C/A, QZSS L1 C/A/S, BDS B1I/B1C, Galileo E1B/C, SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN
	Default position system	GPS, BDS, GALILEO
	Augmentation system	SBAS, QZSS
	Channel	N/A
Sensitivity	Tracking & Navigation	-166dBm
	Reacquisition	-160dBm
	Cold start	-148dBm
	Hot Start	-160dBm
Accuracy	Horizontal position	2.0m CEP
	Velocity	0.05m/s
	Dynamic heading	0.3 deg
	Time pulse	RMS 30ns
		99% 60ns
Acquisition	Cold start	27s
	Hot start	1s
	Aided start	1s
Data Output	Baud rate	4800bps - 921600bps, default 115200bps
	Level	TTL level
	UBX messages	PVT
	Protocol	NMEA, UBX
	NMEA messages	RMC, VTG, GGA, GSA, GSV, GLL
	Update rate	0.25Hz-18Hz, default 10Hz
	FLASH	With FLASH, the configuration can be changed, and the power will not be lost
	Frequency of time pulse signal	Configurable from 0.25 Hz to 10 MHz, the default period is 1s, and the high level lasts for 100ms
Operational Limits	Altitude	80,000m
	Velocity	500m/s
	Dynamics	<4g
Power Consumption	Voltage	DC 3.6V-5.5V, typical: 5.0V
	Current	15mA/5.0V
Physical Specifications	Dimension	25mm*25mm*7.7mm
	Weight	13.5g
	Connector	1.00mm 6pins Connector

Temperature	Operating	-40 °C ~ +85°C
	Storage	-40°C ~ +105°C
LED	Built-in LED	TX LED: blue. The data output, TX LED flashing
		PPS LED: red. PPS LED not bright when GPS not fixed, flashing when fixed
Compass	Compass	Built-in compass, With electronic compass IC QMC5883

**Pin Description:**

PIN	Name	I/O	Description
1	TX	O	Serial Data Output.
2	RX	I	Serial Data input.
3	GND	G	Ground
4	VCC	I	DC 3.6V~ 5.5V supply input, Typical: 5.0V
5	SCL	I	Compass SCL
6	SDA	O	Compass SDA

**Indicator light:**

1. The blue light, the TX light, and the blue light flashes when power on, indicating that there is data output.
2. The red light, the PPS light, does not light up if it is not positioned; after 3D positioning, it starts to flash.



## Data output protocol

Joint Mode Protocol Header - GN  
GPS Mode Protocol Header-GP  
GLONASS Mode Protocol Header-GL  
Beidou mode protocol header - GB or BD

### Unlocated :

\$GNRMC,,V,,,,,,,,,N,V\*37  
\$GNVTG,,,,,,,,,N\*2E  
\$GNGGA,,,,,0,00,99.99,,,,,\*56  
\$GNGSA,A,1,,,,,,,,,99.99,99.99,99.99,1\*33  
\$GNGSA,A,1,,,,,,,,,99.99,99.99,99.99,3\*31  
\$GNGSA,A,1,,,,,,,,,99.99,99.99,99.99,4\*36  
\$GNGSA,A,1,,,,,,,,,99.99,99.99,99.99,5\*37  
\$GPGSV,1,1,00,0\*65  
\$GAGSV,1,1,00,0\*74  
\$GBGSV,1,1,00,0\*77  
\$GQGSV,1,1,00,0\*64  
\$GNGLL,,,,,V,N\*7A

### Positioned :

\$GNRMC,054411.00,A,2243.08151,N,11401.10827,E,0.008,,230423,,,A,V\*1E  
\$GNVTG,,T,,M,0.008,N,0.016,K,A\*32  
\$GNGGA,054411.00,2243.08151,N,11401.10827,E,1,12,0.56,93.2,M,-2.7,M,,\*64  
\$GNGSA,A,3,30,03,14,06,07,17,01,19,,,,,1.15,0.56,1.00,1\*0D  
\$GNGSA,A,3,30,13,15,34,27,02,,,,,1.15,0.56,1.00,3\*01  
\$GNGSA,A,3,27,28,30,01,02,03,37,38,40,,,,,1.15,0.56,1.00,4\*04  
\$GNGSA,A,3,02,07,03,04,,,,,1.15,0.56,1.00,5\*00  
\$GPGSV,3,1,12,01,27,034,37,03,44,087,39,06,38,241,42,07,15,180,35,1\*64  
\$GPGSV,3,2,12,14,78,359,45,17,43,333,38,19,28,303,39,30,34,212,39,1\*6C  
\$GPGSV,3,3,12,39,29,252,33,40,20,257,40,41,46,237,44,50,60,149,39,1\*65  
\$GPGSV,1,1,01,11,00,228,,0\*5C  
\$GAGSV,2,1,06,02,30,136,38,13,23,238,40,15,68,289,42,27,37,324,30,7\*7E  
\$GAGSV,2,2,06,30,83,091,42,34,41,026,41,7\*70  
\$GBGSV,3,1,11,01,47,123,36,02,46,234,37,03,63,189,38,04,,,31,1\*49  
\$GBGSV,3,2,11,05,,,34,27,52,351,44,28,24,046,37,30,31,283,40,1\*46  
\$GBGSV,3,3,11,37,43,178,40,38,70,172,40,40,57,034,39,1\*48  
\$GQGSV,1,1,04,02,63,125,42,03,59,044,39,04,38,131,38,07,60,149,36,1\*6C  
\$GNGLL,2243.08151,N,11401.10827,E,054411.00,A,A\*71

\$xxGGA,time,lat,NS,lon,EW,quality,numSV,HDOP,alt,altUnit,sep,sepUnit,diffAge,diffStation\*c  
s<CR><LF>

Example:

```
$GPGGA,092725.00,4717.11399,N,00833.91590,E,1,08,1.01,499.6,M,48.0,M,,*5B
```

Field No.	Name	Unit	Format	Example	Description
0	xxGGA	-	string	\$GPGGA	GGA Message ID (xx = current Talker ID, see NMEA Talker IDs table)
1	time	-	hhmmss.ss	092725.00	UTC time, see note on UTC representation
2	lat	-	ddmm. mmmm	4717.11399	Latitude (degrees & minutes), see format description
3	NS	-	character	N	North/South indicator
4	lon	-	dddmm. mmmm	00833.91590	Longitude (degrees & minutes), see format description
5	EW	-	character	E	East/West indicator
6	quality	-	digit	1	Quality indicator for position fix, see position fix flags description <a href="#">Flags in NMEA 4.10 and above</a>
7	numSV	-	numeric	08	Number of satellites used (range: 0-12)
8	HDOP	-	numeric	1.01	Horizontal Dilution of Precision
9	alt	m	numeric	499.6	Altitude above mean sea level
Field No.	Name	Unit	Format	Example	Description
10	altUnit	-	character	M	Altitude units: M (meters, fixed field)
11	sep	m	numeric	48.0	Geoid separation: difference between ellipsoid and mean sea level
12	sepUnit	-	character	M	Geoid separation units: M (meters, fixed field)
13	diffAge	s	numeric	-	Age of differential corrections (null when DGPS is not used)
14	diffStation	-	numeric	-	ID of station providing differential corrections (null when DGPS is not used)
15	cs	-	hexadecimal	*5B	Checksum
16	<CR><LF>	-	character	-	Carriage return and line feed

```
$xxGLL,lat,NS,lon,EW,time,status,posMode*cs<CR><LF>
```

Example:

```
$GPGLL,4717.11364,N,00833.91565,E,092321.00,A,A*60
```

Field No.	Name	Unit	Format	Example	Description
0	xxGLL	-	string	\$GPGLL	GLL Message ID (xx = current Talker ID, see NMEA Talker IDs table)

1	lat	-	ddmm. mmmm	4717.11364	Latitude (degrees & minutes), see format description
2	NS	-	character	N	North/South indicator
3	lon	-	dddmm. mmmm	00833.91565	Longitude (degrees & minutes), see format description
4	EW	-	character	E	East/West indicator
5	time	-	hhmmss.ss	092321.00	UTC time, see note on UTC representation
6	status	-	character	A	Data validity status, see position fix flags description
7	posMode	-	character	A	Positioning mode, see position fix flags description (only available in NMEA 2.3 and later)
Field No.	Name	Unit	Format	Example	Description
8	cs	-	hexadecimal	*60	Checksum
9	<CR><LF>	-	character	-	Carriage return and line feed

\$xxGSA,opMode,navMode{,svid},PDOP,HDOP,VDOP,systemId\*cs<CR><LF>

Example:

\$GPGSA,A,3,23,29,07,08,09,18,26,28,,,,,1.94,1.18,1.54,1\*0D

Field No.	Name	Unit	Format	Example	Description
0	xxGSA	-	string	\$GPGSA	GSA Message ID (xx = current Talker ID, see NMEA Talker IDs table)
1	opMode	-	character	A	Operation mode: M = Manually set to operate in 2D or 3D mode A = Automatically switching between 2D or 3D mode
2	navMode	-	digit	3	Navigation mode, see position fix flags description
Start of repeated block (12 times)					
3 + 1*N	svid	-	numeric	29	Satellite number
End of repeated block					
15	PDOP	-	numeric	1.94	Position dilution of precision
16	HDOP	-	numeric	1.18	Horizontal dilution of precision
17	VDOP	-	numeric	1.54	Vertical dilution of precision
18	systemId	-	numeric	1	NMEA defined GNSS System ID, see Signal Identifiers table (only available in NMEA 4.10 and later)
19	cs	-	hexadecimal	*0D	Checksum
20	<CR><LF>	-	character	-	Carriage return and line feed

\$xxGSV,numMsg,msgNum,numSV{,svid,elv,az,cno},signalId\*cs<CR><LF>

Example:

```
$GPGSV,3,1,09,09,,17,10,,40,12,,49,13,,35,1*6F
```

```
$GPGSV,3,2,09,15,,44,17,,45,19,,44,24,,50,1*64
```

```
$GPGSV,3,3,09,25,,40,1*6E
```

```
$GPGSV,1,1,03,12,,42,24,,47,32,,37,5*66
```

```
$GAGSV,1,1,00,2*76
```

Field No.	Name	Unit	Format	Example	Description
0	xxGSV	-	string	\$GPGSV	GSV Message ID (xx = GSV Talker ID, see NMEA Talker IDs table). Talker ID GN shall not be used
1	numMsg	-	digit	3	Number of messages, total number of GSV messages being output (range: 1-9)
2	msgNum	-	digit	1	Number of this message (range: 1-numMsg)
3	numSV	-	numeric	10	Number of known satellites in view regarding both the talker ID and the signalId
Start of repeated block (1..4 times)					
4 + 4*N	svid	-	numeric	23	Satellite ID
5 + 4*N	elv	deg	numeric	38	Elevation (range: 0-90)
6 + 4*N	az	deg	numeric	230	Azimuth (range: 0-359)
7 + 4*N	cno	dB Hz	numeric	44	Signal strength (C/N0, range: 0-99), null when not tracking
End of repeated block					
Field No.	Name	Unit	Format	Example	Description
5.. 16	signalId	-	numeric	0	NMEA defined GNSS Signal ID, see Signal Identifiers table (only available in NMEA 4.10 and later)
6.. 16	cs	-	hexadecimal	*7F	Checksum
7.. 16	<CR><LF>	-	character	-	Carriage return and line feed

\$xxRMC,time,status,lat,NS,lon,EW,spd,cog,date,mv,mvEW,posMode,navStatus\*cs<CR><LF>

Example:

```
$GPRMC,083559.00,A,4717.11437,N,00833.91522,E,0.004,77.52,091202,,A,V*57
```

Field No.	Name	Unit	Format	Example	Description
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0	xxRMC	-	string	\$GPRMC	RMC Message ID (xx = current Talker ID, see NMEA Talker IDs table)
1	time	-	hhmmss.ss	083559.00	UTC time, see note on UTC representation
2	status	-	character	A	Data validity status, see position fix flags description
3	lat	-	ddmm. mmmm	4717.11437	Latitude (degrees & minutes), see format description
4	NS	-	character	N	North/South indicator
5	lon	-	dddmm. mmmm	00833.91522	Longitude (degrees & minutes), see format description
6	EW	-	character	E	East/West indicator
7	spd	kno ts	numeric	0.004	Speed over ground
8	cog	deg ree s	numeric	77.52	Course over ground
Field No.	Name	Unit	Format	Example	Description
9	date	-	ddmmyy	091202	Date in day, month, year format, see note on UTC representation
10	mv	deg ree s	numeric	-	Magnetic variation value. Only supported in ADR 4.10 and later
11	mvEW	-	character	-	Magnetic variation E/W indicator. Only supported in ADR 4.10 and later
12	posMode	-	character	A	Mode Indicator, see position fix flags description (only available in NMEA 2.3 and later)
13	navStatus	-	character	V	Navigational status indicator: V (Equipment is not providing navigational status information, fixed field, only available in NMEA 4.10 and later)
14	cs	-	hexadecimal	*57	Checksum
15	<CR><LF>	-	character	-	Carriage return and line feed

\$xxVTG,cogt,cogtUnit,cogm,cogmUnit,sogn,sognUnit,sogk,sogkUnit,posMode\*cs<CR><LF>

Example:

\$GPVTG,77.52,T,M,0.004,N,0.008,K,A\*06

Field No.	Name	Unit	Format	Example	Description
0	xxVTG	-	string	\$GPVTG	VTG Message ID (xx = current Talker ID, see NMEA Talker IDs table)

1	cogt	degrees	numeric	77.52	Course over ground (true)
2	cogtUnit	-	character	T	Course over ground units: T (degrees true, fixed field)
3	cogm	degrees	numeric	-	Course over ground (magnetic). Only supported in ADR 4.10 and above
4	cogmUnit	-	character	M	Course over ground units: M (degrees magnetic, fixed field)
5	sogn	knots	numeric	0.004	Speed over ground
6	sognUnit	-	character	N	Speed over ground units: N (knots, fixed field)
Field No.	Name	Unit	Format	Example	Description
7	sogk	km/h	numeric	0.008	Speed over ground
8	sogkUnit	-	character	K	Speed over ground units: K (kilometers per hour, fixed field)
9	posMode	-	character	A	Mode Indicator, see position fix flags description (only available in NMEA 2.3 and later)
10	cs	-	hexadecimal	*06	Checksum
11	<CR><LF>	-	character	-	Carriage return and line feed

## Flags in NMEA 4.10 and above

NMEA Message	GLL, RMC	GGA	GLL, VTG	RMC, GNS
Field	status	quality	posMode	posMode
No position fix (at power-up, after losing satellite lock)	V	0	N	N
GNSS fix, but user limits exceeded	V	0	N	N
Dead reckoning fix, but user limits exceeded	V	6	E	E
Dead reckoning fix	A	6	E	E
RTK float	A	5	D	F
RTK fixed	A	4	D	R
2D GNSS fix	A	1/2	A/D	A/D
3D GNSS fix	A	1/2	A/D	A/D
Combined GNSS/dead reckoning fix	A	1/2	A/D	A/D
	See below (1)	See below(2)	See below(3)	See below(3)

(1) Possible values for status: V = Data invalid, A = Data valid

(2) Possible values for quality: 0 = No fix, 1 = Autonomous GNSS fix, 2 = Differential GNSS fix, 4 = RTK fixed, 5 = RTK float, 6 = Estimated/Dead reckoning fix

(3) Possible values for posMode: N = No fix, E = Estimated/Dead reckoning fix, A =

**UBX-NAV-PVT (0x01 0x07)**
**Navigation Position Velocity Time Solution**

Message	<b>UBX-NAV-PVT</b>					
Description	<b>Navigation Position Velocity Time Solution</b>					
Firmware	Supported on: • with <a href="#">protocol version 27.11</a>					
Type	Periodic/ Polled					
Comment	<p>Note that during a leap second there may be more or less than 60 seconds in a minute.</p> <p>See the section Leap seconds in <a href="#">Integration manual</a> for details.</p> <p>This message combines position, velocity and time solution, including accuracy figures</p>					
Message Structure	Header	Class	ID	Length (Bytes)	Payload	Checksum
	0xB5 0x62	0x01	0x07	92	see below	CK_A CK_B
Payload Contents:						
Byte Offset	Number Format	Scaling	Name	Unit	Description	
0	U4	-	iTOW	ms	GPS time of week of the navigation epoch. See the section iTOW timestamps in <a href="#">Integration manual</a> for details.	
4	U2	-	year	y	Year (UTC)	
6	U1	-	month	month	Month, range 1..12 (UTC)	
7	U1	-	day	d	Day of month, range 1..31 (UTC)	
8	U1	-	hour	h	Hour of day, range 0..23 (UTC)	
9	U1	-	min	min	Minute of hour, range 0..59 (UTC)	
10	U1	-	sec	s	Seconds of minute, range 0..60 (UTC)	
11	X1	-	valid	-	Validity flags ( see <a href="#">graphic below</a> )	
12	U4	-	tAcc	ns	Time accuracy estimate (UTC)	
16	I4	-	nano	ns	Fraction of second, range -1e9 .. 1e9 (UTC)	
20	U1	-	fixType	-	GNSSfix Type: 0: no fix 1: dead reckoning only 2: 2D-fix 3: 3D-fix 4: GNSS + dead reckoning combined	

					5: time only fix
21	X1	-	flags	-	Fix status flags ( see <a href="#">graphic below</a> )
22	X1	-	flags2	-	Additional flags ( see <a href="#">graphic below</a> )
23	U1	-	numSV	-	Number of satellites used in Nav Solution

## UBX- NAV- PVT continued

Byte Offset	Number Format	Scaling	Name	Unit	Description
24	I4	1e-7	lon	deg	Longitude
28	I4	1e-7	lat	deg	Latitude
32	I4	-	height	mm	Height above ellipsoid
36	I4	-	hMSL	mm	Height above mean sea level
40	U4	-	hAcc	mm	Horizontal accuracy estimate
44	U4	-	vAcc	mm	Vertical accuracy estimate
48	I4	-	velN	mm/ s	NED north velocity
52	I4	-	velE	mm/ s	NED east velocity
56	I4	-	velD	mm/ s	NED down velocity
60	I4	-	gSpeed	mm/ s	Ground Speed (2-D)
64	I4	1e-5	headMot	deg	Heading of motion (2- D)
68	U4	-	sAcc	mm/ s	Speed accuracy estimate
72	U4	1e-5	headAcc	deg	Heading accuracy estimate ( both motion and vehicle)
76	U2	0.01	pDOP	-	Position DOP
78	X1	-	flags3	-	Additional flags ( see <a href="#">graphic below</a> )
79	U1[5]	-	reserved1	-	<a href="#">Reserved</a>
84	I4	1e-5	headVeh	deg	Heading of vehicle (2- D)
88	I2	1e-2	magDec	deg	Magnetic declination
90	U2	1e-2	magAcc	deg	Magnetic declination accuracy