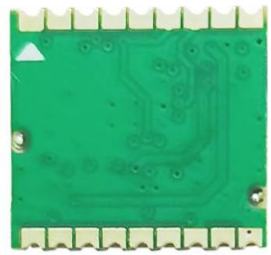
Accurate positioning

22°39'48.37"N 114°02'10.91"E

JS-TP10-2

PRODUCT SPECIFICATION

Data Sheet



Content

Updating history of Revision

Revision	Date	Contents of Revision Change	Remark
V1.0	2022-05-12	First release	汪伟
V1.1	2022-05-30	Some parameter corrections	汪伟
V1.2	2022-06-07	Add common protocols and command statements	汪伟

1 Functional description

1.1 Overview

JS-TP10-2 adopts multi-mode solution, low power consumption and low cost. It is a multi-mode single frequency (GPS, BDS, GLONASS, Galileo, QZSS and SBAS) positioning module to meet the requirements of a wide range of applications and terminal products. Developed based on requirements. Based on a high-performance SOC position engine, this receiver provides excellent sensitivity and acquisition time with interference suppression measures to achieve reliable positioning even under difficult signal conditions.

1.2 Product Features

- Based on high-performance GNSS SOC series
- 47 channels
- Cold start sensitivity is -148dBm, tracking sensitivity is -165dBm
- navigation Frequency of time pulse signal Up to 10Hz
- Support GPS、BDS、GLONASS、Galileo、QZSS & SBAS
- Support AGPS
- Indoor and outdoor multipath detection and compensation
- Integrated 12 multi-tone active interference cancellers
- Integrated TCXO, SAW and RTC
- Compact size（10.5mm x 9.7mm x 2.3mm±0.3mm），suitable for space-sensitive applications
- Support standard NMEA 0183 V3.01/V4.10
- Support 1PPS output

1.3 Performance

Parameter	Specification
Receiver type	■GPS/QZSS L1C L1C/A ■GLONASS L1 ■BDS B1I B1C ■Galileo E1 ■SBAS WAAS/EGNOS/MSAS/GAGAN
sensitivity	Tracking & Navigation -165dBm Reacquisition -148dBm
Time-To-First-Fix[1]	Cold start 24s Hot start 1s
GNSS Horizontal Position accuracy[2]	horizontal 2m vertical 3.75m
Time pulse accuracy	1PPS 10ns
Speed accuracy[3]	GNSS 0.1m/s SBAS 0.05m/s
Operational restrictions[4]	acceleration 4g Altitude 10000m speed limit 100m/s
Frequency of time pulse signal accuracy	1Hz
Baud rate	4800-921600 bps（ Default 115200 bps）[5]
Maximum navigation update rate	10Hz（Default 1Hz）

1 All satellites at -130dBm

2 Open sky, 24 hours static，-130dBm，>6SVs，CEP 50%

3 50%@30m/s dynamic operation

4 Assuming Airborne≤4g platform

5 To open the debug log, need to be able to support a higher baud rate of 230400bps or above.

1.4 Protocols

Protocol	Type
NMEA 0183 V3.01/V4.10	Input/output, ASCII

1.5 Antenna

JS-TP10-2 Modules designed for passive and active antennas

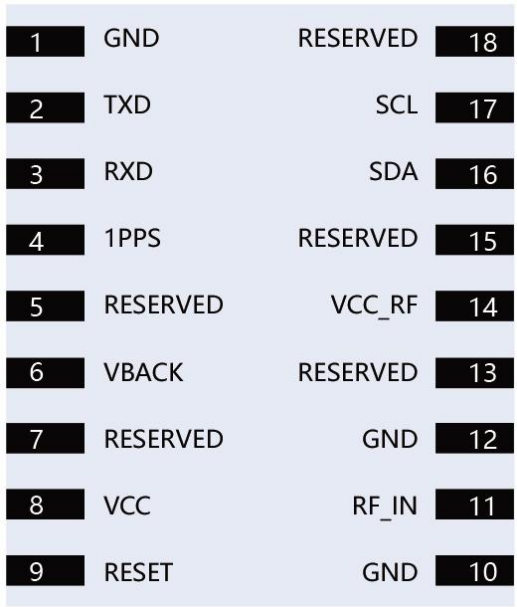
Antenna type	Specification
Active antenna recommendations	**Min gain** 15db (Compensating for signal losses in RF cables) **Max gain** 30db **max noise value** 1.5 dB

1.6 Product Application

- •Automotive applications
- •Maritime navigation, fleet management
- •Intelligent logistics dispatch
- •Formation UAV art
- •smart robot
- •Ground vehicle tracking and urban intelligent traffic management
- •emergency rescue
- •Personal travel and wilderness adventures

2 Pin definitions

2.1 Pin assignment



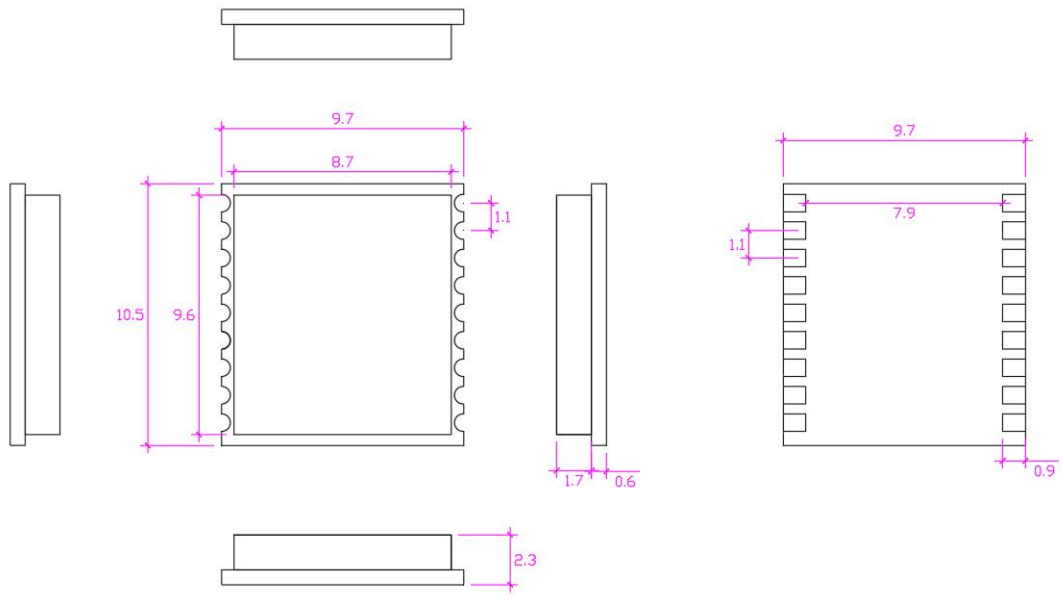
No.	Name	I/O	Description
1,10,12	GND	G	Ground
2	TXD	O	UART_TTL Output
3	RXD	I	UART_TTL Input
4	PPS	O	Time Pulse
5,7,13,15,18	RESERVED	-	Backup
6	VBACK	P	Backup power pin (for hot start) (1.62-3.63V)
8	VCC	P	Module main power supply (input)
9	RESET	I	Reset restart (active at low level, stay on when not in use)

11	RF_IN	I	GNSS signal input
14	VCC_RF	P	Antenna powered (3.3V)
16	SDA	I/O	I^2C data
17	SCL	O	I^2C clock

3 Electrical Specifications

Parameter	Symbol	Min	Type	Max	Units
Power supply voltage	VCC	2.8	3.3	3.6	V
Average supply current	Acquisition	31@3.3V	34@3.3V	38@3.3V	mA
	Tracking	30@3.3V	32@3.3V	35@3.3V	mA
Backup battery voltage			0.07		F
Backup battery current	I_BCKP		11@3.3V		uA
Digital IO voltage	Div	2.8		3.3	V
Storage temperature	Tstg	-40		105	°C
Operating temperature	Topr	-40		85	°C
Humidity				95	%

4 Mechanical Specifications

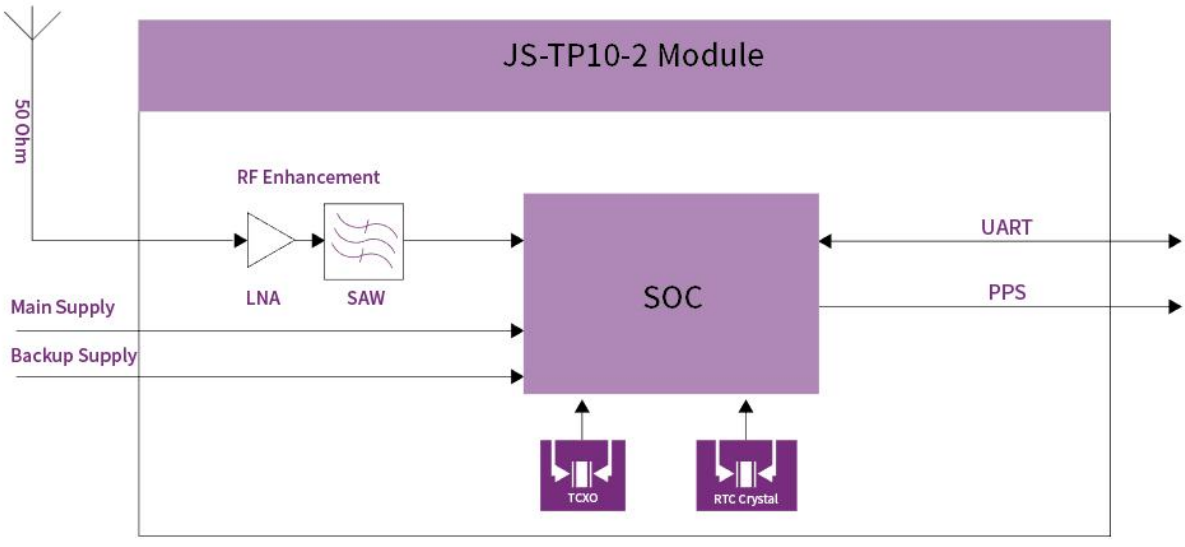


Unit: mm Error:±0.3mm

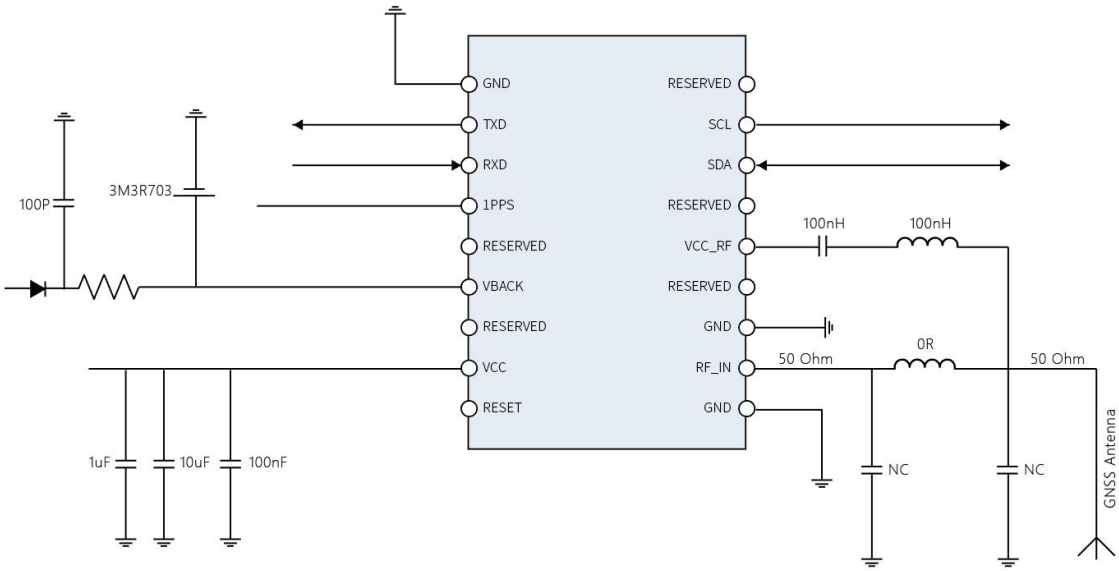
5 Selection list

5.1 Interface Description

5.1.1 Block Diagram



5.1.2 Application Circuit



6 ROHS

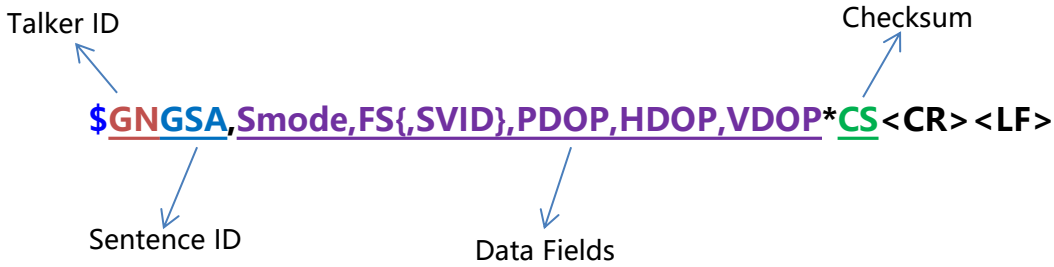
This product is RoHS compliance

7 NMEA

This module supports National Marine Electronics Association (NMEA) messages based on NMEA 0183 v3.01/v4.10. The following section shows the structure of NMEA protocol messages and the corresponding common standard message format.

7.1 NMEA protocol

Generally, NMEA messages start with the $ character, followed by talker ID, sentence ID, data fields, and checksum, and then end with ‘<CR>’ ‘<LF>’, as shown in the figure below.



NMEA protocol details

Parameter	string length	Description
preamble	1	$
Talker ID	2	Suitable for various GNSS configurations such as GP/GL/GA/GB/GN
Sentence ID	3	Field description, such as GGA/GSA/GSV/RMC
Data Field	~	A comma symbol must be inserted before each data field to help the decoder process the Data Field
*	1	The asterisk * marks the end of the Data Field
Checksum	2	Checksum of data between preamble and *
CR, LF	2	These two bytes are used to identify the end of the packet

Talker ID description

Talker ID	Description
GP	GPS
GL	GLONASS
GA	Galileo
GB*	BDS
GI*	NavIC
GN	Multi-GNSS

* NMEA v3.01/v4.10 Not defined BDS /NavIC Talker ID. GB / GI Only defined in NMEA v4.11

Sentence ID Description

Sentence ID	Description
GGA	Receiver positioning data
GLL	Latitude and longitude, and time location and status
GSA	Factor of Precision (DOP) and Effective Satellite
GSV	Visible satellite information
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed
ZDA	GNSS date and time

Different GNSS system Talker ID display (for NMEA 0183 v3.01)

Talker ID	GPS only	GLONASS only	Galileo only	Beidou only	NavIC only	Multi-GNSS GPS+GLO+GAL+BDS+NavIC
GGA	GP	GL	GA	GB*	GI*	GN
GLL						
RMC						
VTG						
ZDA						
GSA**						GP+GL+GA+GB+GI
GSV						

Different GNSS system Talker ID display (For NMEA 0183 v4.10)

Talker ID	GPS only	GLONASS only	Galileo only	Beidou only	NavIC only	Multi-GNSS GPS+GLO+GAL+BDS+NavIC
GGA	GP	GL	GA	GB*	GI*	GN
GLL						
RMC						
VTG						
ZDA						
GSA**						
GSV						GP+GL+GA+GB+GI

* NMEA v3.01/v4.10 Not defined BDS/NavIC Talker ID. GB/GI is only defined in NMEA v4.11.

** The difference between Talker ID's NMEA 0183 v3.01 and v4.10 is GSA.

7.2 Standard information

Standard NMEA messages are GGA/GLL/GSA/GSV/RMC/VTG/ZDA. The definitions of satellite ID, system ID, and signal ID in the NMEA statement are shown in the following table. Below are the details of these messages based on NMEA 0183 v4.10.7.2.1 GGA

Fixation of time, location and related data. The output position will be affected by the selected datum. The default data is WGS84.

$--GGA,hhmmss.sss,ll.llll,a,yyy.yyyy,a,x,xx,x.xx,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

No.	Format	Description
1	hhmmss.sss	The UTC time of the current location
2	ll.llll,a	Latitude - N/S
3	yyy.yyyy,a	Longitude - E/W
4	x	GNSS Quality Index
5	xx	Number of satellites in use, may differ from number seen
6	x.xx	horizontal precision factor
7	x.x,M	Altitude mean sea level (geoid), unit: M
8	x.x,M	Geoid separation, unit: M
9	x.x	Differential GPS data age
10	xxxx	Differential reference station ID, 0000-1023

7.2.2 GLL

Positioning time and positioning status.

$--GLL,ll.llll,a,yyy.yyyy,a,hhmmss.sss,A,a*hh<CR><LF>

No.	Format	Description
1	ll.llll,a	Latitude - N/S
2	yyy.yyyy,a	Longitude - E/W
3	hhmmss.sss	The UTC time of the current location
4	A	Status A = data is valid, V = data is invalid
5	a	Positioning status indication. A=autonomous mode, V=estimate mode (dead reckoning), N=invalid, D=differential mode

7.2.3 GSA

Dispersion Factor of Precision (DOP) and Effective Satellites.

$--GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.xx,x.xx,x.xx,h*hh<CR><LF>

No.	Format	Description
1	a	**model**： M = Manual, forces 2D or 3D mode; A = Automatic, allows automatic 2D/3D switching
2	x	Mode: 1 = not available, 2 = 2D, 3 = 3D
3	xx	Satellite number used for positioning. This field displays a total of 12 available satellite numbers. If there are more than 12 satellites, only the first 12 will be output. If there are less than 12, the insufficient area will be filled in (please refer to the Satellite ID in the NMEA sentence)
4	x.xx	PDOP
5	x.xx	HDOP
6	x.xx	VDOP
7	h	GNSS System ID (1:GPS, 2:GLONASS, 3:Galileo, 4:Beidou, 6:NavIC) (only supports NMEA v4.10 format, refer to the system and signal ID in the NMEA sentence)

7.2.4 GSV

Observed number of GNSS satellites, PRN, elevation angle, azimuth angle and signal-to-noise ratio.

$--GSV,x,x,xx,xx,xx,xxx,xx,……..……..,xx,xx,xxx,xx,h*hh<CR><LF>

No.	Format	Description
1	x	total number of statements
2	x	Current statement number
3	xx	Total number of visible satellites
4	xx	Satellite number
5	xx	Elevation angle, maximum 90°
6	xxx	Azimuth angle, 000 to 359°
7	xx	Signal-to-noise ratio (C/No) 00- 99 dB-Hz, empty when no tracking
8	h	Signal ID (only supports NMEA v4.10 format, refer to the system and signal ID in the NMEA sentence)

7.2.5 RMC

The minimum recommended specific GNSS data is position, SOG, COG and time.

$--RMC,hhmmss.sss,A,ll.llll,a,yyy.yyyy,a,x.xx,x.xx,xxxxxx,x.x,a,a,a*hh<CR><LF>

No.	Format	Description
1	hhmmss.sss	The UTC time of the current location
2	A	Status A = Autonomous mode, V = Inactive, D = Differential mode
3	ll.llll,a	Latitude - N/S
4	yyy.yyyy,a	Longitude - E/W
5	x.xx	Speed over ground, unit: knots
6	x.xx	True heading to ground, unit: degrees
7	xxxxxx	Date (ddmmyy)
8	x.x,a	Magnetic declination, unit: degrees. Magnetic declination direction: E-east, W-west. Fixed to empty
9	a	Status Bar. A=autonomous mode, V=estimate mode (dead reckoning), N=invalid, D=differential mode
10	a	Navigation status (only supports NMEA v4.10 format)

7.2.6 VTG

Course on Ground (COG) and Speed on Ground (SOG) information.

$--VTG,x.xx,T,x.xx,M,x.xx,N,x.xx,K,a*hh<CR><LF>

No.	Format	Description
1	x.xx	Heading to true north above ground, unit: degrees (000-359°)
2	T	True north indication, fixed to T
3	x.xx	Heading to magnetic north in degrees (000-359°)
4	M	Magnetic North indication, fixed at M
5	x.xx	Speed over ground, unit: knots (000-999 knots)
6	N	The unit of speed is knots, fixed at N = knots/hour
7	x.xx	Ground speed (000-999 kilometers/hour)
8	K	Speed unit, fixed at K=km/h
9	a	Positioning mode status. A=autonomous mode, V=estimate mode (dead reckoning), N=invalid, D=differential mode

7.2.7 ZDA

GNSS time and date.

$ --ZDA,hhmmss.sss,xx,xx,xxxx,xx,xx*hh<CR><LF>

No.	Format	Description
1	hhmmss.sss	UTC time, hhmmss (hours, minutes and seconds) format
2	xx	UTC date, 01 to 31
3	xx	UTC date, January to December
4	xxxx	UTC date, year
5	xx	Current time, hour
6	xx	Current time, minutes

Satellite ID in NMEA sentences

satellite	PRN numbers	Satellite ID (AIROHA)	Satellite ID (NMEA 0183 v4.10)
GPS	1-32	1-32	1-32
SBAS	120-138	33-51	33-64
GLONASS	1-24	65-88	65-99
Galileo	1-36	1-36	1-36
Beidou	1-63	1-63	N/A
QZSS	193-199	193-199	N/A
NavIC	1-14	1-14	N/A

System/Signal ID in NMEA sentence

satellite	System ID (AIROHA)	Signal ID (AIROHA)	System ID (NMEA 0183 v4.10)	Signal ID (NMEA 0183 v4.10)
GPS L1C/A	1	1	1	1
GPS L5Q	1	8	1	8
GLONASS L1	2	1	2	1
GalileoE1-BC	3	7	3	7
Galileo E5a	3	1	3	1
Beidou B1I	4*	1*		
Beidou B2a	4*	4*		
NavIC L5	6*	1*		

*BDS/NavIC is not defined in NMEA v4.10

8 Common command switches

Since the check code of each command is different, other configuration commands not given in the following common configurations must pass the check before sending the command before they can be applied.

Comparison table of response results sent by the command

Data Format	$PAIR001,<Command_ID>,<Result>*CS<CR><LF>	
illustrate	Command_ID：The command/message type is confirmation response	
	Result：The results of command execution 0, 1, 2, 3, 4, 5 are as follows	
●	0	Command issued successfully
●	1	Indicates that the command is being processed and needs to wait for the result.
●	2	Failed to send command
●	3	Indicates that the command ID is not supported
●	4	Command parameter error (out of range/some parameters missing/checksum error)
●	5	MNL server is busy. You can try again soon

Note: The above is the response result of the command. This command is automatically sent by the GNSS system. Do not send directly to GNSS system

POWER_ON/POWER_OFF

1	$PAIR002*38\r\n	POWER_ON (Please send this command before using any location services)
Return after sending command	$PAIR001,002,1*38\r\n ==> The power-on process is running. Please wait $PAIR001,002,0*39\r\n ==> Booted successfully	
2	$PAIR003*39	POWER_OFF（After executing this command, location services are unavailable）
Return after sending command	$PAIR001,003,1*39\r\n ==> The power-off process is running. Please wait $PAIR001,003,0*38\r\n ==> Shut down successfully	

save command

1	$PAIR513*3D\r\n	Save current configuration from RTC RAM to flash
Return after sending command	$PAIR001,003,1*39\r\n ==> Success	

Note: If the module outputs at multiple Hz, you need to send $PAIR003*39\r\n to make the system POWER_OFF before executing this command. However, there is no such restriction for 1Hz.

Support satellite configuration

Data Format	$PAIR066,<GPS_Enabled>,<GLONASS_Enabled>,<Galileo_Enabled>,<BDS_Enabled>,<QZSS_Enabled>,<NavIC_Enabled>*CS		
Example	$PAIR066,1,1,1,1,1,0*3B		
illustrate	“0” disable (do not search for satellites); “1” enable (search for satellites)		
	Command (send)	**Output information**	**illustrate**
1	$PAIR066,1,1,1,1,1,0*3B\r\n	GPS+GLONASS+Galileo+BDS+QZSS	L1 frequency supported Satellite combination configuration
2	$PAIR066,1,0,0,0,0,0*3B\r\n	GPS	
3	$PAIR066,1,1,0,0,0,0*3A\r\n	GPS+GLONASS	
4	$PAIR066,1,0,1,0,0,0*3A\r\n	GPS+Galileo	
5	$PAIR066,1,0,0,1,0,0*3A\r\n	GPS+BDS	
Return after sending command	$PAIR001,066,0*3B\r\n ==> Success		

Turn off NMEA statement command

1	$PAIR062,0,0*3E\r\n	Close GGA statement
2	$PAIR062,1,0*3F\r\n	Close GLL statement
3	$PAIR062,2,0*3C\r\n	Close GSA statement
4	$PAIR062,3,0*3D\r\n	Close GSV statement
5	$PAIR062,4,0*3A\r\n	Close RMC statement
6	$PAIR062,5,0*3B\r\n	Close VTG statement
7	$PAIR062,6,0*38\r\n	Close ZDA statement
Return after sending command $PAIR001,062,0*3F\r\n ==> Success		

Open NMEA statement command

1	$PAIR062,0,1*3F\r\n	Open GGA statement
2	$PAIR062,1,1*3E\r\n	Open GLL statement
3	$PAIR062,2,1*3D\r\n	Open GSA statement
4	$PAIR062,3,1*3C\r\n	Open GSV statement
5	$PAIR062,4,1*3B\r\n	Open RMC statement
6	$PAIR062,5,1*3A\r\n	Open VTG statement
7	$PAIR062,6,1*39\r\n	Open ZDA statement
Return after sending command $PAIR001,062,0*3F\r\n ==> Success		

Set navigation mode

Format	$PAIR080,<CmdType>*CS<CR><LF>	
Example	$PAIR080,1*2F\r\n ==> Enter fitness mode	
1	$PAIR080,0*2E\r\n	Normal mode
2	$PAIR080,1*2F\r\n	Fitness mode (for running and walking activities <5m/s)
3	$PAIR080,4*2A\r\n	Still mode (this module is not supported yet)
4	$PAIR080,5*2B\r\n	Drone mode (such as hovering, cruising, etc.)
5	$PAIR080,7*29\r\n	swimming mode
6	$PAIR080,9*27\r\n	Cycling mode (this module is not supported yet)
Return after sending command $PAIR001,080,0*33\r\n ==> Success		
Note: If ULP (ultra-low power consumption) is enabled, setting it to non-fitness mode will fail.		

Static drift settings

Format	$PAIR070,<Speed_threshold>*CS<CR><LF>	
1	$PAIR070,0*21\r\n	Static drift is set to 0 dm/s (default)
2	$PAIR070,1*20\r\n	Static drift is set to 1 dm/s
3	$PAIR070,4*25\r\n	Static drift is set to 4 dm/s
4	$PAIR070,10*10\r\n	Static drift is set to 10 dm/s
5	$PAIR070,20*13\r\n	Static drift is set to 20 dm/s
Illustrate： <Speed_threshold>为 1 dm/s~20 dm/s (1 dm/s = 0.1m/s) **Return after sending command** $PAIR001,070,0*3C\r\n ==> Success		

Query the static drift speed threshold

1	$PAIR071*3C\r\n	Static drift speed threshold query command
Return after sending command $PAIR001,071,0*3D\r\n ==> Success		

$PAIR071,0.4*3A\r\n ==> The static drift speed threshold is 0.4m/s (the minimum threshold is 0.1m/s, the maximum is 2.0m/s)

Hot and cold start setting instructions

1	$PAIR004*3E\r\n	Hot start
2	$PAIR005*3F\r\n	Warm start
3	$PAIR006*3C\r\n	Cold start

Statement output frequency setting

Format	$PAIR062,<NMEA type>,<output frequency>*CS<CR><LF>
Example	$PAIR062,0,3*3D\r\n → Output GGA statement once every 3 seconds
NMEAt ype	0=GGA、1=GLL、2=GSA、3=GSV、4=RMC、5=VTG、6=ZDA、7=GRS、8=GST
Output frequency	0=no output, 1=1 second/time, 2=2 seconds/time, 5=5 seconds/time, and so on (can be set from 0 to 20, the default is 1 second/time)

1	$PAIR062,0,1*3F\r\n	Output GGA statement once per second - 1Hz
2	$PAIR062,1,1*3E\r\n	Output GLL statement once per second - 1Hz
3	$PAIR062,2,1*3D\r\n	Output GSA statement once per second - 1Hz
4	$PAIR062,3,1*3C\r\n	Output GSV statement once per second - 1Hz
5	$PAIR062,4,1*3B\r\n	Output RMC statement once per second - 1Hz
6	$PAIR062,5,1*3A\r\n	Output VTG statement once per second - 1Hz
7	$PAIR062,6,1*39\r\n	Output ZDA statement once per second - 1Hz
8	$PAIR062,7,1*38\r\n	Output GRS statement once per second - 1Hz
9	$PAIR062,8,1*37\r\n	Output a GST sentence once per second - 1Hz
10	$PAIR062,3,2*3F\r\n	Output GSV statement once every 2 seconds - 0.5Hz
11	$PAIR062,3,5*38\r\n	Output GSV statement once every 5 seconds - 0.2Hz

Setting output less than 1000 milliseconds (range: 100~1000ms) is only applicable to GGA and RMC statements

1	$PAIR050,1000*12\r\n	Output GGA and RMC statements once per second - 1Hz
2	$PAIR050,500*26\r\n	Output GGA and RMC statements twice per second - 2Hz
3	$PAIR050,200*21\r\n	Output GGA and RMC statements 5 times per second - 5Hz
4	$PAIR050,100*22\r\n	Output GGA and RMC statements 10 times per second - 10Hz

Note: If you configure multi-Hz output, you need to send $PAIR003*39 (turn off GNSS) before sending the save command. When configuring the statement to output once a second or multiple seconds, just send the save command directly.

Set NMEA output format

Format	$PAIR100,<NMEA mode>,<proprietary mode>*CS<CR><LF>
Example	$PAIR100,1,0*3A\r\n ==> ASCII NMEA v4.1，Do not output proprietary statements
NMEA mode	0=disable NMEA, 1=ASCII NMEA v4.1 (default), 2=ASCII NMEA v3.0
Proprietary mode	0=Do not output proprietary statements (default), 1=Output proprietary statements

1	$PAIR100,1,0*3A\r\n	Output ASCII NMEA v4.1, no proprietary statements
2	$PAIR100,2,0*39\r\n	Output ASCII NMEA v3.0, no proprietary statements
3	$PAIR100,0,1*3A\r\n	Output proprietary sentences, do not output NMEA sentences

Query NMEA output format

Format	$PAIR101,<NMEA mode>,<Proprietary mode>*CS<CR><LF>

Example	Send $PAIR101*3A\r\n Return $PAIR101,0,1*3B==>Disable NMEA output, enable proprietary statements	
NMEA Mode	0=disable NMEA, 1=ASCII NMEA v4.1 (default), 2=ASCII NMEA v3.0	
Proprietary mode	0=Do not output proprietary statements (default), 1=Output proprietary statements, 2=Enable proprietary statements and output before NMEA	
1	$PAIR101*3A\r\n	NMEA output format query command

Set baud rate

1	$PAIR864,0,0,9600*13\r\n	Support 9600 bps
2	$PAIR864,0,0,38400*23\r\n	Support 38400 bps
3	$PAIR864,0,0,57600*28\r\n	Support 57600 bps
4	$PAIR864,0,0,115200*1B\r\n	Support 115200 bps
5	$PAIR864,0,0,230400*19\r\n	Support 230400 bps
6	$PAIR864,0,0,460800*16\r\n	Support 460800 bps
7	$PAIR864,0,0,921600*10\r\n	Support 921600 bps
8	$PAIR864,0,0,3000000*2F\r\n	Support 3000000 bps
Note: After modifying the port baud rate, you need to restart the device. Changes will take effect after reboot.		

Baud rate query command

1	$PAIR865,0,0*31\r\n	Port baud rate query

Restore default settings

1	$PAIR514*3A\r\n	Clear current configuration and restore default settings
Note: $PAIR003*39\r\n ==> POWER_OFF must be sent before sending the restore default settings command.		
2	$PAIR007*3D\r\n	Clear system/user configuration

sleep mode

1	$PAIR382,0*2F\r\n	Unlock sleep mode
2	$PAIR382,1*2E\r\n	Lock sleep mode (system will not go to sleep)
Description: Return after sending the command $PAIR001,382,0*32\r\n ==> Success		