STANDARD POSITIONING

PROTOCOL

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Standard Positioning Products

Revision History

Version	Revision History	Date
Ver. 1.0.0 Primary	Initial release revision	Jul, 2017
Ver.2.0.0 Alpha release	Perfect the NMEA protocol	Aug, 2017
Ver.3.2.1 Beta release	Mass production release	Dec, 2017
Ver.3.3.0 Beta release	● Add BD3 satellite with the number of 15-37 ● Update QZSS ID to 193/194/195/199 ● Limited to output GGA/GSA/GSV/RMC messages by default ● Add AIDTIME/AIDPOS/AIDINFO command	Apr, 2019
Ver.3.4.0 Beta release	● Add SBAS ● Add echo with #...	Jun, 2019
R3.5	● Revise table 1.4.2.2 ● Revise CFGPRT echo ● Revise CFGDYN echo ● Revise GGA Altref ● Revise RMC spd ● Add CFGGEOID and discrepancy instructions for multi-version firmware	2020-03-30
R4	● Add protocols supported by R3.2.10.0	2020-09-12
R4.1	● Add protocols supported by R3.2.10.100	2020-12-04
R4.2	● Update parameters of NMEA message	2020-12-31
R4.3	● Add CFGBLK command ● Add FCTATEST command and update talker ID of GLL/VTG/GST ● Remove CFGDYN command ● Change the bit2 of CFGSAVE mask field to reserve ● Update checksum description in section 1.2 ● Update default configuration of NOTICE	2021-04-08

R4.4	• Add CFGDYN, and revise the parameter description of CFGMOD • Update the field description of ANTSTAT1/ CFGLOWPOWER • Update NAVTIME	2021-06-24
R4.5	• Add ABNORMAL message • Add the baud rate of R3.4.0.19 version	2021-10-15
R4.6	• Add EPHABNORMAL command; • Add information about the firmware R3.2.20.100; • Revise the message syntax, examples, and descriptions according to the test results	2022-03-28
R4.7	• Add CFGNAV message • Revise the satellite ID of SBAS • Add raw observation message • Revise the parameter of the cold start reset	2022-08-09
R4.8	• Add firmware R3.4.20.0 and R3.4.21.0 in CFGCLR • Add OSNMA message • The baud rate 460800 is supported by specific versions of firmware	2023-02-08

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Contents

1 General Protocol

1.1 Messages

In the Unicore protocol, input and output statements are collectively called messages. Each message is a string of full ASCII characters.

The basic format of the message is:

$MSGNAME,data1,data2,data3,...[*CC]\r\n

All messages contain three data blocks:

The first data block is the message header, which starts with '$' (0x24) .

The second data block is the data field consisting of a number of parameters or data. The message header and data field are separated by ',' (0x2C).

The last data block is an optional checksum, which is separated from the previous data with '*'(0x2A).

The input message ends with '\r' (0x0D) or '\n' (0x0A) or any combination of the two.

The output message ends with '\r\n'. The total length of each message does not exceed 128 bytes.

Message header and parameters, as well as letters in checksums are not case-sensitive.

Certain parameters of certain input commands can be omitted (marked as optional in the command description). These parameters can be empty, that is, there is no character between the two commas.

Then, if there is no special instruction, this parameter will be ignored and the options it controls will remain unchanged.

Most of the message headers can be used for both input commands and output messages. The same message header is used as input to set parameters or to query the current configuration, and as output to output receiver information or configuration.

1.2 Checksum

The two characters after '*'(0x2A) in the message are the checksum, which is calculated as the xor of all characters (excluding '$' and '*') from '$' to '*', in hexadecimal (calculate the checksum according to the uppercase letters corresponding to the input information).

The checksum in the input command is optional. If the input statement contains '*' followed by the two characters, the checksum is examined. If the examination result is wrong, the command is not executed, and the receiver outputs the $fail message, in which a checksum error is indicated. If the statement does not contain a checksum, the command is executed directly.

If the parameters of the input message are empty and a checksum needs to be added, it should be followed by ','. It's not allowed to add an extra ',' when the parameter is not null.

Example: $PDTINFO,*62

The output message always contains a checksum. The description of the checksum in the Unicore protocol will be omitted in the following message definition.

1.3 Formats

In the Unicore protocol, the data in the message contains the following types:

String (STR)

The string consists of up to 32 ASCII characters except '\ r' and '\ n', such as GPSL1.

Unsigned Integer (UINT)

Unsigned integers range from 0 to 4294967295, and are defined in both decimal and hexadecimal. A decimal unsigned integer consists of ASCII characters from 0 to 9. Such as 123, 4291075193. A hexadecimal unsigned integer starts with the character h or H, followed by a string of 0 to 9 and a-f (or A-F), with a maximum of 8 characters (excluding the starting h or H). Such as hE10, hE41BA7C0.

Unsigned Long Integer (UINT64)

Unsigned long integers range from 0~18446744073709551615, and are defined in both decimal and hexadecimal. A decimal unsigned long integer consists of ASCII characters from 0 to 9. Such as 123 and 4291075193. A hexadecimal unsigned long integer starts

with h, or H, or 0x, or 0X, followed by a string of characters from 0 to 9 and a-f (or A-F), with a maximum of 16 characters (excluding the starting h, H, 0x, or 0X). Such as hE10 and hE41BA7C0, or 0xFFFFFF and 0XFFFFF.

Signed Integer (INT)

Signed integers are composed of ASCII characters from 0 to 9 and a negative sign, with a range of-2147483648 to 2147483647. Such as 123217754, -245278.

DOUBLE

Double-precision floating-point data consists of ASCII characters from 0 to 9, with a negative sign and a decimal point, ranging from -2^1023 to 2^1023. Such as 3.1415926, -9024.12367225

1.4 Coordinates

The position value observed by the product is based on the WGS84 coordinate system. If the position value of the output message is based on other coordinate system, it will be noted in the message explanation of this documentation. If the user expects to use a different reference coordinate, the position is very likely to be off by tens or even hundreds of meters.

1.5 Message Definition

1.5.1 Common Message

1.5.1.1 PDTINFO

Read Product Information

Syntax	$PDTINFO
Example	$PDTINFO
Description	Read product information, the receiver outputs PDTINFO message after receiving this command
Input/Output	Input
No parameters	

Output the Product Information

Syntax	$PDTINFO,pdtName,config,hwVer,fwVer,PN,SN	
Example	$PDTINFO,UM220,G1B1,V4.1,R3.0Build13260,080101000001,000101114303845	
Description	The receiver outputs the message of the product information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
pdtName	STR	Product name
Config	STR	Product configuration
hwVer	STR	Hardware version
fwVer	STR	Firmware version
PN	STR	Product number
SN	STR	Product serial number

1.5.1.2 RESET

Syntax	$RESET,type,clrMask	
Example	$RESET,0,h01 (Warm start)	
Description	Receiver reset	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
type	UINT (optional)	Reset type 0 - Software reset 1 - Chip-level reset (watchdog reset) 2 - Board-level reset

		3 - Receiver stopped
clrMask	UINT (optional)	Reset to clear the receiver's saved information. Setting the bit to 1 clears the signal upon reset. bit0 – Clear ephemeris bit1 – Reserve0 bit2 – Clear receiver position and time bit3 – Reserve1 bit4 – Clear ionospheric correction and UTC parameters bit5 – Reserve2 bit6 – Reserve3 bit7 – Clear almanac Several commonly used startup methods, the parameters are listed as follow: h00 – Hot start h01 – Warm start hff – Cold start

- The parameter of the cold start reset command is hff, and the mismatch of the reset parameters will cause the receiver to start in an incorrect state
- When a leap second occurs, the receiver may take up to 25 minutes to sync to UTC time after a cold start reset.

1.5.1.3 Command Echo(1)

Syntax	#User command
Example	#CFGPRT,1,h0,115200,3,35
Description	Display the current Unicore command input by users
Input/Output	Output

No parameters

(1): This command is only supported by the firmware of R3.2.10.0, R3.2.20.0, R3.4.0.0 and above.

1.5.1.4 OK

Syntax	$OK
Example	$OK
Description	A response that the receiver executes command correctly The message is only output on the port where the command is received
Input/Output	Output
No parameters	

1.5.1.5 FAIL

Syntax	$FAIL,errorCode	
Example	$FAIL,0	
Description	A response that the input command is incorrect The message is only output on the port where the command is received	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
errorCode	UINT	Error code 0 –Illegal instruction or incorrect parameter 1 –Checksum error

1.5.2 Config Message

1.5.2.1 CFGPRT

Read Port Configuration

Syntax	$CFGPRT,portID	
Example	$CFGPRT,1	
Description	Read the receiver port configuration. The receiver outputs a CFGPRT message after receiving this command.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
portID	UINT (optional)	Port number,1~2 If empty, output the current port configuration

Set/Output the Port Configuration

Syntax	$CFGPRT,portID,addr,baud,inProto,outProto	
Example	$CFGPRT,1,h0,115200,1,3	
Description	Set or output the port configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
portID	UINT (optional)	Port number: 1 – UART1 2 – UART2 If empty, configure the current UART
addr	UINT	H0
baud	UINT	Optional baud rate for UART:

	(optional)	9600/115200/230400/460800(1) Meaningless if the output port is not UART.
inProto	UINT (optional)	Input protocol of the port, enabled by setting the corresponding bit to 1 bit0 – UNICORE(2) bit5 - Reserve bit7 - RTCM3.2 bit9 - Reserve bit10 - Reserve
outProto	UINT (optional)	Output protocol of the port, enabled by setting the corresponding bit to 1 bit0 - UNICORE bit1 - NMEA bit2 - RTCM3.2 (Set the baud rate to 115200 and above.) bit5 - Command echo(3)

(1) The baud rate of 460800 is only supported by specific versions of firmware.

(2) COM1 cannot disable the Unicore input protocol.

(3) Only supported by firmware R3.2.10.0, R3.2.20.0, R3.4.0.0 and above.

- The format of A-GNSS assisted positioning data complies with RTCM3.2.
- Concurrent output of RTCM 3.2 protocol at two serial ports is not supported.
- When continuously sending CFGPRT command, the time interval should be larger than 1s.

1.5.2.2 CFGMSG

Read Message Output Configuration

Syntax	$CFGMSG,msgClass,msgID
Example	$CFGMSG,0,1
Description	Read the message configuration. The receiver outputs CFGMSG configuration information after receiving this command.

Input/Output	input	
Parameter Definition		
Parameter	Format	Description
msgClass	UINT	Message class
msgID	UINT	Message ID

Set/Output Message Output Configuration

Syntax	$CFGMSG,msgClass,msgID,rate	
Example	$CFGMSG,0,1,1	
Description	Set or output the message output configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
msgClass	UINT	Message class
msgID	UINT (optional)	Message ID
switch	UINT	Message control

Message	Class	ID	Message Control
GGA	0	0	0: disable 1: enable
GLL	0	1	0: disable 1: enable
GSA	0	2	0: disable 1: enable
GSV	0	3	0: disable 1: enable

RMC	0	4	0: disable 1: enable
VTG	0	5	0: disable 1: enable
ZDA	0	6	0: disable 1: enable
GST	0	7	0: disable 1: enable
NAVPOS	1	0	0: disable 1: enable
NAVVEL	1	1	0: disable 1: enable
NAVTIME	1	2	0: disable 1: enable
NAVACC	1	3	0: disable 1: enable
LSF	3	0	0: disable 1: enable
ANTSTAT	3	1	0: disable 1: enable
Reserved	Reserved	Reserved	Reserved
ANTSTAT1	3	3	0: disable 1: enable
OSNMA(1)	5	1	0: disable 1: enable
NOTICE(2)	6	0	0: disable 1: enable
ABNORMAL(3)	6	4	0: disable 5: enable
EPHABNORMAL(4)	6	2	0: disable 10: enable

(1): Only supported by customized firmware.

(2): Only supported by the firmware R3.2.10.0, R3.2.10.100 and R3.2.20.100.

(3): Only supported by the firmware R3.4.0.19.

(4): Only supported by the firmware R3.2.20.0.

1.5.2.3 CFGTP

Read Timing Pulse Configuration

Syntax	$CFGTP
Example	$CFGTP
Description	Read the current timing pulse configuration. The receiver outputs a CFGTP message after receiving this command.
Input/Output	Input
No parameters	

Set Timing Pulse Configuration

Syntax	$CFGTP,interval,length,flag,antDelay,rfDelay,usrDelay	
Example	$CFGTP,1000000,500000,1,0,800,0	
Description	Set or output timing pulse configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
interval	UINT (optional)	Timing pulse frequency, unit: μs; set to 1000000 by default
length	UINT (optional)	Timing pulse width, unit: μs, and the maximum value is no more than interval – 1 μs. (High-level width when the rising edge is aligned with the integral timing pulse frequency , and low-level width when the falling edge is aligned with the integral timing pulse frequency)

flag	UINT (optional)	Configuration of the timing pulse: bit0 0 – Disable the time pulse output 1 – Enable the time pulse output bit1 0 – Rising edge aligned to an integral number of seconds 1 – Falling edge aligned to an integral number of seconds bit2 0 – Output when the timing is reliable 1 – Always output timing pulses bit3 0 –Disable TIMTP 1 – Enable TIMTP
antDelay	INT (optional)	Antenna delay, unit: ns; (-32768 ~ 32767)
rfDelay	INT (optional)	RF unit delay, unit: ns; (-32768~32767)
usrDelay	INT (optional)	User-set delay, unit: ns, range: -32768~32767 Set the latency to a negative value leads the delay of timing pulse edge. Modify the delay may decrease the precision of the pulse in the completely tuning period.

1.5.2.4 CFGNMEA

Read NMEA Configuration

Syntax	$CFGNMEA
Example	$CFGNMEA
Description	Read the NMEA configuration. The receiver outputs a CFGNMEA message after receiving this command.
Input/Output	Input
No parameters	

Set/Output NMEA Configuration

Syntax	$CFGNMEA,nmeaVer	
Example	$CFGNMEA,h30	
Description	Set or output the NMEA configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
nmeaVer	UINT	Output NMEA protocol version h30 – Extend Beidou related statements based on NMEA standard version 3.0 (NMEA 3.0) h51 –Extend Beidou related statements based on standard NMEA 4.1 (NMEA 4.1)

1.5.2.5 CFGSYS

Read Satellite System Configuration

Syntax	$CFGSYS
Example	$CFGSYS
Description	Read the current satellite system configuration. The receiver outputs a

	CFGSYS message after receiving this command.
Input/Output	Input
No parameters	

Set/Output Satellite System Configuration

Syntax	$CFGSYS,sysMask	
Example	$CFGSYS,H11	
Description	Set or output satellite system configuration. The receiver automatically reset while receiving the command, the configuration of enabling the satellite system works after the reset.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
sysMask	UINT	H01(1) –GPS L1+SBAS+QZSS joint positioning H10 – BDS B1 H101(2)– GPS+GLONASS+GALILEO+SBAS+QZSS joint positioning H11(3)– GPS+BDS+GALILEO+SBAS+QZSS joint positioning

(1): Firmware below R3.4.0.0 only supports GPS L1++QZSS joint positioning, R3.4.0.0 and above support GPS L1 + SBAS + QZSS joint positioning

(2): Only supported by the firmware with the version of R3.4.0.0 and above

(3): Firmware below R3.4.0.0 only supports GPS L1+BDS B1+QZSS, R3.4.0 and above support GPS+BDS+GALILEO+SBAS+QZSS joint positioning.

1.5.2.6 CFGDYN

Read Dynamic Configuration

Syntax	$CFGDYN
Example	$CFGDYN

Description	Read the current dynamic configuration. The receiver outputs a CFGDYN message after receiving this command.
Input/Output	Input
No parameters	

Set/Output Dynamic Configuration

Syntax	$CFGDYN,mask,dynModel,staticHoldThresh	
Example	$CFGDYN,h01,0,1000	
Description	Set/output dynamic configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
Mask	UINT (optional)	Domain to be configured, enabled by setting the corresponding bit to 1 bit0 – dynModel bit1 - staticHoldThresh
dynModel	UINT	Dynamic model 0 – Portable 1 – Static The current default configuration is 0
staticHoldThresh	UINT	Speed threshold in cm/s in static hold mode If this value is 0, static hold mode is off

1.5.2.7 CFGGEOID

Read Elevation Configuration

Syntax	$CFGGEOID
Example	$CFGGEOID
Description	Read the current elevation configuration. The receiver outputs a CFGGEOID message after receiving this command.
Input/Output	Input
No parameters	

Set/Output Elevation Configuration

Syntax	$CFGGEOID,Model	
Example	$CFGGEOID,0	
Description	Set/Output elevation Configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
Model	UINT (optional)	0 - Elevation output is ellipsoid 1 - Elevation output is altitude

1.5.2.8 CFGSAVE

Syntax	$CFGSAVE
Example	$CFGSAVE
Description	Save the current receiver configuration, which is stored in NOR Flash
Input/Output	Input
No parameters	

☞ Do NOT cut off the power within one second after inputting $cfgsave. Power off will

damage the configuration of the receiver, and the receiver will be restored to factory settings.

1.5.2.9 CFGCLR

Syntax	$CFGCLR
Example	$CFGCLR
Description	Clear the current receiver configuration, the current configuration and that saved in Flash are restored to factory settings concurrently, which takes effect after the receiver is reboot or powered on again.
Input/Output	Input
No parameters	

- The configuration modified by this command takes effect after resetting the receiver.
- For R3.4.0.0, R3.4.20.0 and R3.4.21.0 versions, the configuration will not be cleared after sending this command.

1.5.2.10 CFGCWOUT

Query Interference Detection Command Configuration

Syntax	$CFGCWOUT
Example	$CFGCWOUT
Description	Query the output configuration of the interference detection command CWOUT.
Input/Output	Input
No parameters	

Set Interference Detection Command Configuration

Syntax	$CFGCWOUT,CWOutCtrl
Example	$CFGCWOUT,1

Description	Control the output of interference detection command	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
CWOutCtrl	UINT	1: Enable CWOUT output 0: Disable CWOUT output

1.5.2.11 AIDTIME

Syntax	$AIDTIME,year,month,day,hour,minute,second,millisecond	
Example	$AIDTIME,2018,4,9,17,41,36,200	
Description	Input time assistance information, UTC time	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
year	UINT	Year, > 1980
month	UINT	Month, 1~12
day	UINT	Day, 1~31
hour	UINT	Hour, 0~23
minute	UINT	Minute, 0~59
second	UINT	Second, 0~59
millisecond	UINT	Millisecond, 0~999

☞ The input information should be in accordance with the current time. Wrong input will cause the function to fail.

1.5.2.12 AIDPOS

Syntax	$AIDPOS,Latitude,N,Longitude,E,altitude	
Example	$AIDPOS,4002.229934,N,11618.096855,E,37.254	
Description	Input position assistance information	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
Latitude	DOUBLE	Latitude in the format of ddmm.mmmmmm dd - Degree mm.mmmmmm - Minute
N	STRING	North or South latitude indication N - North latitude S - South latitude
Longitude	DOUBLE	Longitude in the format of dddmm.mmmmmm ddd - Degree mm.mmmmmm - Minute
E	STRING	East longitude or west longitude indication E - East longitude W - West longitude
altitude	DOUBLE	Ellipsoid height in the unit of meter

1.5.2.13 AIDINFO

Query the Status of Assisted Data

Syntax	$AIDINFO
Example	$AIDINFO

Description	Query the status of assisted data, the receiver outputs $AIDINFO message after receiving this command
Input/Output	Input
No parameters	

Output the Status and Types of Assisted Data

Syntax	$AIDINFO,GPSRS,GPSUS,BDSRS,BDSUS,GALRS,GALUS,GLORS,GLOUS,AType	
Example	$AIDINFO,0x0FF7FFFBFF,0x0FF7FFFBFF,,,,,,0x0311*27	
Description	Output status and types of assisted data	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
GPSRS	UINT64	Receiving state of GPS ephemeris, as long as the received data is verified, the corresponding bit is set to 1. If the GPS system is not enabled, this field is empty
GPSUS	UINT64	GPS ephemeris is valid and can be used for positioning, the corresponding bit is set to 1, if the GPS system is not enabled, this field is empty
BDSRS	UINT64	Receiving state of BDS ephemeris, as long as the received data is verified, the corresponding bit is set to 1. If the BDS system is not enabled, this field is empty
BDSUS	UINT64	BDS ephemeris is valid and can be used for positioning, the corresponding bit is set to 1, if the BDS system is not enabled, this field is empty
GALRS	UINT64	Receiving state of GAL ephemeris, as long as the received data is verified, the corresponding bit is set to 1. If the GAL system is not enabled, this field is empty
GALUS	UINT64	GAL ephemeris is valid and can be used for positioning, the corresponding bit is set to 1, if the GAL system is not enabled, this field is empty

GLORS	UINT64	Receiving state of GLO ephemeris, as long as the received data is verified, the corresponding bit is set to 1. If the GLO system is not enabled, this field is empty
GLOUS	UINT64	GLO ephemeris is valid and can be used for positioning, the corresponding bit is set to 1, if the GLO system is not enabled, this field is empty
Atype	UINT	Assisted data type: bit0-3: with GPS/BDS/GAL/GLO ephemeris assistance bit4: assisted position is valid Bit5: use assisted position Bit6-7: reserve Bit8: assisted time is valid Bit9: use assisted time Bit10-15: reserve

☞ The AIDINFO command is applicable to firmware versions of R3.2.10.100 and above.

1.5.2.14 CFGMOD

Set to Static Application Mode

Syntax	$CFGMOD, Model	
Example	$CFGMOD,0	
Description	Set or output positioning configuration	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
Model	UINT	0 – Disable static application mode 1 – Enable static application mode

☞ Only supported by the firmware with the version of R3.2.10.100 and R3.2.20.100

☞ This mode cannot be used in conjunction with dynamic speed threshold mode (CFGDYN)

1.5.2.15 CFGNAV

Read the Navigation Configuration

Syntax	$CFGNAV
Example	$CFGNAV
Description	Read the navigation configuration
Input/Output	Input
No parameters	

Set/Output the Navigation Configuration

Syntax	$CFGNAV,measRate,navRate,correctionMask	
Example	$CFGNAV,200,1000,3	
Description	Set/output the navigation configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
measRate	UINT (optional)	Observation measurement rate, unit: ms 1000 - 1Hz 200 - 5Hz
navRate	UINT	Positioning rate, unit: ms 1000 - 1Hz
correctionMask	UINT (optional)	Atmosphere correction, enabled if the corresponding bit is set to 1. bit0 – ionospheric correction

		bit1 –tropospheric correction

☞ Only supported by R3.6.2.0 and R3.6.3.0.

1.5.3 NMEA Message

The message format described in this section is for the versions shown as below:

- The version of Beidou related messages extended on the basis of NMEA 3.0 (nmeaVer in CFGNMEA command is h30)
- The version of Beidou related messages extended on the basis of standard NMEA 4.1 ($GBGSA, nmeaVer in CFGNMEA command is h51)

BD3 satellites are involved in NMEA4.1 to support BDS satellites with number of 1~37. With the increasing of satellites, only output GGA, GSV, GSA and RMC messages by default to prevent data loss at the rate of 9600. When the amount of data at 9600 baud rate is allowed, the maximum number of satellites will be output, but it is limited to the amount of output data at 9600 baud rate. Under the strong sky signal, there will be a phenomenon of incomplete output of the number of satellites. If the user inputs other commands, priority is given to ensuring the complete output of the message added by the user. The number of satellites and satellite information in the GSV message will be reduced accordingly.

The baud rate of 115200 is supported, which is able to output all satellite information, and the default output messages include GGA, GSV, GSA and RMC after switching. If other messages are required, send the command separately.

1.5.3.1 NmeaVer h51

GGA

Syntax	$--GGA,time,Lat,N,Lon,E,FS,NoSV,HDOP,msl,M,Altref,M,DiffAge,DiffStation*cs
Example	$GPGGA,060845.00,4004.74005,N,11614.19613,E,1,10,0.85,53.5,M,,M,,*7B
Description	GNSS positioning data
Input/Output	Output

Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS joint positioning GB - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.ss hh – Hour mm – Minutes ss.ss – Seconds
Lat	STR	Latitude, in the format of ddmm.mmmmm dd - Degrees mm.mmmmm - Minutes
N	STR	North or south latitude indicator N - North latitude S - South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmm ddd - Degrees mm.mmmmm - Minutes
E	STR	East longitude or west longitude indicator E - East longitude W - West longitude
FS	UINT	Positioning status indicator 0-Invalid

		1-Point positioning 2-Differential positioning 6-Recursive positioning(2)
NoSV	UINT	Number of satellites participating in positioning
HDOP	DOUBLE	Horizontal dilution of precision, 0.00 ~ 99.99, the value is 99.99 when not positioning
msl	DOUBLE	Ellipsoid height, fixed output one decimal place or altitude (CFGGEOID is set to 1)
M	STR	Unit of ellipsoid height or altitude, specified to constant M. The field is empty when not positioning.
Altref	DOUBLE	Sea level separation, only valid when CFGGEOID is set to 1, otherwise it is fixed to empty.
M	STR	Unit of Sea level separation, specified to constant M. The field is empty when not positioning.
DiffAge	DOUBLE	Differential correction latency in seconds Null for non-differential positioning
DiffStation	DOUBLE	Reference station ID Null for non-differential positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

(2): Only supported by R3.2.10.0.

GLL

Syntax	$--GLL,Lat,N,Lon,E,time,Valid,Mode*cs
Example	$GPGLL,4004.74005,N,11614.19613,E,060845.00,A,A*6F

Description	Geographic longitude/latitude	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS joint positioning GB - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
Lat	STR	Latitude, in the format of ddmm.mmmmm dd - Degrees mm.mmmmm - Minutes
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmm ddd - Degrees mm.mmmmm - Minutes
E	STR	East longitude or west longitude indicator E – East longitude W – West longitude
time	STR	UTC time, in the format of hhmmss.ss hh - Hours mm - Minutes ss.ss - Seconds

Valid	STR	Position valid indicator V – Invalid A – Valid
Mode	STR	Positioning system mode indicator N – Not positioning A – Point positioning D – Differential positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

GSA

Syntax	$--GSA,Smode,FS,sv1,sv2,sv3,sv4,sv5,sv6,sv7,sv8,sv9,sv10,sv11,sv12,PDOP,HDOP,VDOP,systemID*cs
Example	$GPGSA,A,3,02,03,06,09,12,17,19,23,28,25,,,,1.34,0.85,1.04,1*1E
Description	GNSS dilution of precision and effective satellite information
Input/Output	Output

Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS joint positioning GB - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning

		GN - Multiple system joint positioning
Smode	STR	Positioning mode specified states M– Manually specify 2D or 3D positioning A– Automatically switch to 2D or 3D positioning
FS	UINT	Positioning mode 1– Not positioning 2– 2D positioning 3– 3D positioning
sv1 ~ sv12	UINT	Participating satellite ID When there are less than 12 satellites participating in the positioning, the insufficient area is filled in empty and it only outputs the first 12 satellites if there are more than 12 satellites GPS satellite ID is 01 ~ 32 BDS satellite ID is 01 ~ 37 GLO satellite ID is 65 ~ 92(2) GAL satellite ID is 01 ~ 36(3) SBAS satellite ID is 33~64(4) QZSS satellite ID: 193, 194, 195, 199
PDOP	DOUBLE	Position dilution of precision, 0.00~99.99, the value is 99.99 when not positioning
HDOP	DOUBLE	Horizontal dilution of precision, 0.00 ~ 99.99, the value is 99.99 when not positioning
VDOP	DOUBLE	Vertical dilution of precision, 0.00 ~ 99.99, the value is 99.99 when not positioning
systemID	UINT	GNSS system ID as defined by the NMEA protocol 1 - GPS system ID 2 - GLO system ID(5) 3 - GAL System ID (6)

		4 - BDS System ID
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

(2) (3) (4) (5) (6): Only supported by firmware with the version of R3.4.0.0 or above.

GSV

Syntax	$--GSV,NoMsg,MsgNo,NoSv,sv1,elv1,az1,cn01,sv2,elv2,az2,cn02,sv3,elv3,az3,cn03,sv4,elv4,az4,cn04, signalID*cs	
Example	$GPGSV,3,01,11,02,34,277,41,03,16,043,35,05,04,215,35,06,69,333,48,0*57 $GPGSV,3,02,11,09,25,110,41,12,31,305,43,17,55,116,46,19,76,088,46,0*56 $GPGSV,3,03,11,23,23,077,40,25,04,328,32,28,05,171,36,0*67 $GBGSV,3,01,12,01,37,145,42,02,34,225,39,03,44,188,42,04,25,123,37,0*4C $GBGSV,3,02,12,05,17,249,36,06,30,169,38,07,03,188,31,08,69,027,43,0*4E $GBGSV,3,03,12,09,09,186,34,10,15,211,36,12,26,306,40,13,60,316,44,0*48	
Description	Visible GNSS satellites Each GSV message contains information for only 4 satellites. When the number of satellites exceeds 4, the receiver sends multiple GSV messages continuously	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	System identification GP-GPS satellite information GB-BDS satellite information

		GL-GLO satellite Information(1) GA-GAL satellite Information(2)
NoMsg	UINT	Total number of GSV messages, the minimum value is 1 NoMsg is the total number of GSV messages in this system, for example: NoMsg in GPGSV is the total number of GPGSV messages, excluding the number of GBGSV messages
MsgNo	UINT	Number of this GSV message. The minimum value is 1. MsgNo is the number of the GSV message in this system
NoSv	UINT	Total number of visible satellites in this system
sv1 ~ sv4	UINT	Satellite number of the first to fourth satellite GPS satellite number is 01 ~ 32 BDS satellite number is 01 ~ 37 GLO satellite number is 65 ~ 92 (3) GAL satellite number is 01 ~ 36 (4) QZSS satellites are 193, 194, 195, 199 SBAS(5) satellite number is 33~64
elv1 ~ elv4	UINT	Elevation angle of the first to fourth satellite (0 ~ 90 degrees), fixed output of 2 digits, add leading zeros if less than 2 digits
az1 ~ az4	UINT	Azimuth of the first to fourth satellite (0 ~ 359 degrees), fixed output of 3 digits, add leading zeros if less than 3 digits
cn01~cn04	UINT	CNR of the first to fourth satellite (0 ~ 90dBHz), fixed output of 2 digits, add leading zeros if less than 2 digits fill null for untracked satellites
signalID	UINT	Signal ID defined by NMEA protocol (fixedly output 0)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1) (2) (3) (4) (5): Only supported by firmware with the version of R3.4.0.0 or above.

> Due to the excessive number of satellites in GN mode, at 9600 baud rate, GSV will have the problem of incomplete printing of satellite information. For complete satellite information, please switch the baud rate to 115200

RMC

Syntax	$--RMC,time,status,Lat,N,Lon,E,spd,cog,date,mv,mvE,mode,navStates*cs	
Example	$GPRMC,060845.00,A,4004.74005,N,11614.19613,E,,,180817,,,A,V*0B	
Description	The recommended minimum data	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+ SBAS (1)+QZSS joint positioning GB - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.ss hh - Hours mm - Minutes ss.ss - Seconds
status	STR	Position valid indicator V – Invalid A – Valid
Lat	STR	Latitude, in the format of ddmm.mmmmm

		dd - Degrees mm.mmmmm - Minutes
N	STR	North or south latitude indicator N - North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmm ddd - Degrees mm.mmmmm - Minutes
E	STR	East longitude or west longitude indicator E – East longitude W – West longitude
spd	DOUBLE	Speed over ground, unit: knot
cog	DOUBLE	Course over ground, unit: degree Calculated clockwise from north. If the speed measurement fails or the static scene speed is extremely small, the output is empty.
date	STR	UTC date, in the format of ddmmyy dd - Day mm - Month yy - Year
mv	DOUBLE	Magnetic declination, specified to null
mvE	STR	Magnetic declination direction, specified to null
mode	STR	Positioning mode N – Not positioning A – Point positioning D – Differential positioning
navStates	STR	Navigation states flag, fixedly output 'V'

		V-Device does not provide navigation state information
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

VTG

Syntax	$--VTG,cogt,T,cogm,M,sog,N,kph,K,mode*cs	
Example	$GPVTG,,T,,M,0.000,N,0.000,K,A*23	
Description	Course over ground and ground speed	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS [(1)]+QZSS joint positioning GB - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
cogt	DOUBLE	Course over ground with reference to true north (0.00 ~ 359.99 degrees). If the speed measurement fails or the static scene speed is extremely small, the output is empty.
T	STR	Course flag, specified to constant T
cogm	DOUBLE	Course over ground with reference to MN (0.000 ~ 359.999 degrees). The field is empty by default.
M	STR	Course flag, specified to constant M
sog	DOUBLE	Speed over ground, unit: knot

N	STR	Unit of speed, specified to constant N
kph	DOUBLE	Speed over ground, unit: km/h
K	STR	Unit of speed, specified to constant K
mode	STR	Positioning mode N – Not positioning A – Point positioning D – Differential positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

ZDA

Syntax	$--ZDA,time,day,mon,year,ltzh,ltzn*cs	
Example	$GPZDA,060845.00,18,08,2017,00,00*6C	
Description	Date and time	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS (1)+QZSS joint positioning GB - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.ss

		hh - Hours mm - Minutes ss.ss - Seconds
day	UINT	UTC day with two digits, 01 ~ 31
mon	UINT	UTC month with two digits, 01 ~ 12
year	UINT	UTC year with four digits
ltzh	UINT	Hours in local time zone (fixed output 00)
ltzn	UINT	Minutes in local time zone (fixed output 00)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

GST

Syntax	$--GST,time,rngRMS,stdMajor,stdMinor,hdg,stdLat,stdLon,stdAlt*cs	
Example	$GPGST,060845.00,0.6,,,,0.07,0.09,0.09*47	
Description	GNSS pseudorange error statistics	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS [1]+QZSS joint positioning GB - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning

time	STR	UTC time, in the format of hhmmss.ss hh - Hours mm - Minutes ss.ss - Seconds
rngRMS	DOUBLE	Standard deviation of pseudorange error in meters, with a maximum of 3750000
stdMajor	DOUBLE	Semi-major axis of the error ellipse, in meters. Specified to null
stdMinor	DOUBLE	Semi-minor axis of the error ellipse, in meters. Specified to null
hdg	DOUBLE	Semi-major axis direction of the error ellipse in degrees, clockwise from north. Specified to null
stdLat	DOUBLE	Standard deviation of latitude error, in meters
stdLon	DOUBLE	Standard deviation of longitude error, in meters
stdAlt	DOUBLE	Standard deviation of altitude error, in meters
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

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GGA

Syntax	$--GGA,time,Lat,N,Lon,E,FS,NoSV,HDOP,msl,M,Altref,M,DiffAge,DiffStation*cs
Example	$GPGGA,063952.000,4002.229934,N,11618.096855,E,1,4,2.788,37.254,M,0,M,,*71
Description	GNSS positioning data

Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS joint positioning BD - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.sss hh - Hours mm - Minutes ss.sss - Seconds
Lat	STR	Latitude, in the format of ddmm.mmmmmm dd - Degrees mm.mmmmmm - Minutes
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmmm ddd - Degrees mm.mmmmmm - Minutes
E	STR	East longitude or west longitude indicator E – East longitude W – West longitude

FS	UINT	Positioning status indicator 0-Invalid 1-Point positioning 2-Differential positioning 6-Recursive positioning(2)
NoSV	UINT	Number of satellites participating in positioning
HDOP	DOUBLE	Horizontal dilution of precision, 0.0~127.000
Msl	DOUBLE	Ellipsoid height, fixed output one decimal place or altitude (CFGGEOID is set to 1)
M	STR	Unit of ellipsoid height or altitude, specified to constant M. The field is empty when not positioning.
Altref	DOUBLE	Sea level separation, only valid when CFGGEOID is set to 1, otherwise it is fixed to empty.
M	STR	Unit of Sea level separation, specified to constant M. The field is empty when not positioning.
DiffAge	DOUBLE	Differential correction latency in seconds Null for non-differential positioning
DiffStation	DOUBLE	Reference station ID Null for non-differential positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

(2): Only supported by R3.2.10.0.

GLL

Syntax	$--GLL,Lat,N,Lon,E,time,Valid,Mode*cs	
Example	$GPGLL,4002.217867,N,11618.105743,E,123400.000,A,A*5B	
Description	Geographic longitude/latitude	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS joint positioning BD - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
Lat	STR	Latitude, in the format of ddmm.mmmmmm dd - Degrees mm.mmmmmm - Minutes
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmmm ddd - Degrees mm.mmmmmm - Minutes
E	STR	East longitude or west longitude indicator E – East longitude W – West longitude

time	STR	UTC time, in the format of hhmmss.sss hh - Hours mm - Minutes ss.sss - Seconds
Valid	STR	Position valid indicator V – Invalid A – Valid
Mode	STR	Positioning mode N – Not positioning A – Point positioning D – Differential positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

GSA

Syntax	$--GSA,Smode,FS,sv1,sv2,sv3,sv4,sv5,sv6,sv7,sv8,sv9,sv10,sv11,sv12,PDOP,HDOP,VDOP*cs	
Example	$GPGSA,A,3,14,22,18,31,,,,,,,,,5.572,2.788,4.824*36	
Description	GNSS dilution of precision and effective satellite information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS joint positioning

		BD - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
Smode	STR	Positioning mode specified states M – Manually specify 2D or 3D positioning A – Automatically switch to 2D or 3D positioning
FS	UINT	Positioning mode 1– Not positioning 2– 2D positioning 3– 3D positioning
sv1 ~ sv12	UINT	Participating satellite ID When there are less than 12 satellites participating in the positioning, the insufficient area is filled in empty and it only output the first 12 satellites if there are more than 12 satellites GPS satellite ID is 1 ~ 32 BDS satellite ID is 161 ~ 197(160 +BDS PRN) GLONASS satellite ID is 65 ~ 92(2) Galileo satellite ID is 101~136(3) QZSS satellite ID is 193, 194 , 195, 199 SBAS satellite ID is 33~64(4)
PDOP	DOUBLE	Position dilution of precision, 0.0~127.000
HDOP	DOUBLE	Horizontal dilution of precision, 0.0~127.000
VDOP	DOUBLE	Vertical dilution of precision, 0.0~127.000
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all

		characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

(2) (3) (4): Only supported by firmware with the version of R3.4.0.0 or above.

GSV

Syntax	$--GSV,NoMsg,MsgNo,NoSv,sv1,elv1,az1,cn01,sv2,elv2,az2,cn02,sv3,elv3,az3,cn03,sv4,elv4,az4,cn04*cs	
Example	$GPGSV,3,1,11,3,82,133,50,6,70,73,50,7,21,311,45,13,46,275,50*75 $GPGSV,3,2,11,16,52,51,49,19,52,194,49,21,12,49,37,23,40,222,49*7C $GPGSV,3,3,11,30,31,69,46,31,8,127,19,1,5,,44*77 $BDGSV,2,1,5,161,35,140,47,163,33,224,47,164,24,124,43,167,47,73,48*54 $BDGSV,2,2,5,168,5,,50*52	
Description	Visible GNSS satellites Each GSV message contains information for only 4 satellites. When the number of satellites exceeds 4, the receiver sends multiple GSV messages continuously	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS satellite information BD - BDS satellite information GA - Galileo satellite information GL - GLONASS satellite information
NoMsg	UINT	Total number of GSV messages, the minimum value is 1 NoMsg is the total number of GSV messages in this system, for example:

		NoMsg in GPGSV is the total number of GPGSV messages, excluding the number of BDGSV messages
MsgNo	UINT	Number of this GSV message. The minimum value is 1. MsgNo is the number of this GSV message in this system. Continuous output GPGSV and BDGSV are numbered separately
NoSv	UINT	Total number of visible satellites in this system
sv1 ~ sv4	UINT	Satellite number of the first to fourth satellite GPS satellite number is 1 ~ 32 BDS satellite number is 161 ~ 197 (160 + BDS PRN) GLONASS satellite number is 65 ~ 92(2) Galileo satellite number is 101~136(3) QZSS satellite number is 193, 194 , 195 , 199 SBAS(4) satellite number is 33~64
elv1 ~ elv4	UINT	Elevation of the first to fourth satellite (0 ~ 90 degrees)
az1 ~ az4	UINT	Azimuth of the first to fourth satellite (0 ~ 359 degrees)
cn01~cn04	UINT	CNR of the 1st to 4th satellites (0 ~ 90dBHz), fill null for untracked satellites
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

(2) (3) (4): Only supported by firmware with the version of R3.4.0.0 or above.

☞ Due to the excessive number of satellites in GN mode, GSV at 9600 baud rate will have the problem of incomplete printing of satellite information. For complete satellite information, please switch the baud rate to 115200

RMC

Syntax	$--RMC,time,status,Lat,N,Lon,E,spd,cog,date,mv,mvE,mode*cs	
Example	$GPRMC,123400.000,A,4002.217821,N,11618.105743,E,0.026,181.631,180411,,E,A*2C	
Description	The minimum recommended data	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS[1]+QZSS joint positioning BD - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.sss hh - Hours mm - Minutes ss.sss - Seconds
status	STR	Position valid indicator V – Invalid A – Valid
Lat	STR	Latitude, in the format of ddmm.mmmmmm dd - Degrees mm.mmmmmm - Minutes
N	STR	North or south latitude indicator N – North latitude

		S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmmm ddd - Degrees mm.mmmmmm - Minutes
E	STR	East longitude or west longitude indicator E – East longitude W – West longitude
spd	DOUBLE	Speed over ground, unit: knot
cog	DOUBLE	Course over ground, unit: degree Calculated clockwise from north. If the speed measurement fails or the static scene speed is extremely small, the output is empty.
date	STR	UTC date, in the format of ddmmyy dd - Day mm - Month yy - Year If the exact year, month, and day are not parsed, the date part appears blank
mv	DOUBLE	Magnetic declination, specified to null
mvE	STR	Magnetic declination direction, specified to constant E
mode	STR	Positioning mode N – Not positioning A – Point positioning D – Differential positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

VTG

Syntax	$--VTG,cogt,T,cogm,M,sog,N,kph,K,mode*cs	
Example	$GNVTG,0.000,T,,M,0.000,N,0.000,K,A*13	
Description	Course over groundand ground speed	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS joint positioning BD - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
cogt	DOUBLE	Course over ground with reference to true north (0.000 ~ 359.999 degrees). If the speed measurement fails or the static scene speed is extremely small, the output is empty.
T	STR	Course flag, specified to constant T
cogm	DOUBLE	Course over ground with reference to MN (0.000 ~ 359.999 degrees). The field is empty by default.
M	STR	Course flag, specified to constant M
sog	DOUBLE	Speed over ground, unit: knot
N	STR	Unit of speed, specified to constant N
kph	DOUBLE	Speed over ground, unit: km/h
K	STR	Unit of speed, specified to constant K
mode	STR	Positioning mode

		N – Not positioning A – Point positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

ZDA

Syntax	$--ZDA,time,day,mon,year,ltzh,ltzn*cs	
Example	$GNZDA,083927.000,21,11,2013,00,00*4C	
Description	Date and time	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS+SBAS(1)+QZSS joint positioning BD - BDS system standalone positioning GA - Galileo system standalone positioning GL - GLONASS system standalone positioning GN - Multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.sss hh - Hours mm - Minutes ss.sss - Seconds
day	UINT	UTC day with two digits, 01 ~ 31
mon	UINT	UTC month with two digits, 01 ~ 12

year	UINT	UTC year with four digits
ltzh	UINT	Hours in local time zone (fixedly output 00)
ltzn	UINT	Minutes in local time zone (fixedly output 00)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1): SBAS is only supported by firmware with the version of R3.4.0.0 or above.

1.5.4 Navigation Result Message

1.5.4.1 NAVPOS

Syntax	$NAVPOS,time,system,quality,X,Y,Z,lat,lon,height*cs	
Example	$NAVPOS,282201000,5,3,-2160481.168,4383619.182,4084735.203,40.078998,116.236534,52.843847*1C	
Description	Output the receiver position information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
time	UINT	Time corresponding to the positioning solution The time definition depends on the current positioning system, the priority is GPS>BDS>GAL>GLO
system	UINT	Current positioning system bit0-GPS bit2-BDS bit5-GAL bit4-GLO
quality	UINT	Current positioning quality

		0 - Invalid 1 - External configuration 2 - Coarse 3 - Precise
X	DOUBLE	X of ECEF, in meters
Y	DOUBLE	Y of ECEF, in meters
Z	DOUBLE	Z of ECEF, in meters
lat	DOUBLE	The latitude of the receiver, which is positive in north latitude and negative in south latitude, in degrees
lon	DOUBLE	The longitude of the receiver, which is positive in east longitude and negative in west longitude, in degrees
height	DOUBLE	The ellipsoidal height of the receiver, in meters
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.5.4.2 NAVVEL

Syntax	$NAVVEL,time,system,quality,Vx,Vy,Vz,clockDrift*cs	
Example	$NAVVEL,282201000,5,3,0.000,0.000,0.000,31.785*2F	
Description	Output the receiver velocity information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
time	UINT	Same as time definition in NAVPOS
system	UINT	Same as system definition in NAVPOS
quality	UINT	Same as quality definition in NAVPOS

Vx	DOUBLE	Vx of ECEF coordinate system, in m/s
Vy	DOUBLE	Vy of ECEF coordinate system, in m/s
Vz	DOUBLE	Vz of ECEF coordinate system, in m/s
clockDrift	DOUBLE	Equivalent speed of crystal drift, in m/s
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.5.4.3 NAVTIME

Syntax	$NAVTIME,GPSW,GPST,GPSQ,GLOY,GLOD,GLOT,GLOQ,BDW,BDT,BDQ,BDGPSDiff,GLOGPSDiff*cs
Example	$NAVTIME,1848,282201.000291049,3,0,0,0.000000000,0,492,282187.000291134,3,0.000000085,0.000000000*63
Description	Output the receiver time information
Input/Output	Output

Parameter Definition		
Parameter	Format	Description
GPSW	UINT	GPS week
GPST	DOUBLE	GPS seconds of week
GPSQ	UINT	GPS time quality 0 - Invalid 1 - External configuration 2 - Coarse 3 - Precise
GLOY	UINT	GLONASS year
GLOD	UINT	GLONASS day
GLOT	DOUBLE	GLONASS seconds of day

GLOQ	UINT	GLONASS time quality, the definition is same as that of GPSQ
BDW	UINT	BDS week
BDT	DOUBLE	BDS seconds of week
BDQ	UINT	BDS time quality, the definition is same as that of GPSQ
BDGPSDiff	DOUBLE	Time difference between BDS time and GPS time, in seconds
GLOGPSDiff	DOUBLE	Time difference between GLONASS time and GPS time, in seconds
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.5.4.4 NAVACC

Syntax	$NAVACC,time,status,pAcc,vAcc,cAcc*cs	
Example	$NAVACC,085206.00,A,2480, 70,1250*7D	
Description	Output accuracy information of receiver positioning speed measurement	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
time	STR	UTC time, in the format of hhmmss.sss hh - Hours mm - Minutes ss.sss - Seconds
status	UINT	Data validity identification V - Invalid

		A - Valid
pAcc	UINT	Horizontal positioning accuracy, standard deviation of two-dimensional horizontal positioning error, in 0.001m
vAcc	UINT	Accuracy of horizontal velocity measurement, standard deviation of two-dimensional horizontal velocity error, unit: 0.001 m/s
cAcc	UINT	Ground course accuracy, in 0.001 degrees
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.5.5 Misc Message

1.5.5.1 ANTSTAT

Query Antenna Detection Information

Syntax	$ANTSTAT,antType
Example	$ANTSTAT,1
Description	Query antenna detection information
Type	antType: Null: External 0: External 1: Internal
No parameters	

Output Antenna Detection Information

Syntax	$ANTSTAT,status1,status2
Example	$ANTSTAT,0,0
Description	Output antenna detection information and antenna type

Input/Output	Output
Parameter Definition	

Parameter	Format	Description
status1,Status2	INT	Antenna detection status, as defined below: $ANTSTAT,0,0 Normal, active antenna $ANTSTAT,0,1 Short-circuit $ANTSTAT,1,0 Open-circuit or passive antenna $ANTSTAT,1,1 Hardware abnormality

☞ When the external antenna detection circuit does not exist, the information of the antenna detection output (type: external) is invalid.

☞ For the antenna detection circuit, please refer to the hardware reference design.

	PIO_14 (ANT_OPEN)	PIO_15 (ANT_SHORT)
GPIO Status	Input- Level triggered	Input- Level triggered
No active antenna connected	1	0
Active antenna connected	0	0
Active Antenna shorted out	0	1

1.5.5.2 LSF

Query Leap Seconds Forecast Information

Syntax	$LSF,system
Example	$LSF,0
Description	Query leap seconds forecast information of the specified satellite system, the receiver outputs LSF message after receiving the command
Input/Output	Input
Parameter Definition	

Parameter	Format	Description
system	UINT	Query the system corresponding to the leap seconds forecast information 0: GPS 1: BDS 2: GLO 3: GAL

Output Leap Seconds Forecast Information

Syntax	$LSF,system,flag,utcTLS,utcTLSF,utcTOT,utcWN,utcDN,utcWNLSF,utcA0,utcA1	
Example	$LSF,0,1,15,16,462836,82,6,86,7811626,14	
Description	Input/output leap seconds forecast information	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
System	UINT	The system corresponding to the output of leap second forecast information, which is the same as the query instruction parameter
Flag	UINT	Valid flag of leap second forecast information 0: Invalid 1: Valid
utcTLS	UINT	Time difference between UTC and system before a leap second event, in seconds; GLO system does not have this parameter
utcTLSF	UINT	Time difference between UTC and system after a leap second event, in seconds; GLO system does not have this parameter ;

utcTOT	UINT	UTC reference seconds of week, in seconds(BDS system parameter is 0) GLO system: the parameter corresponds to GLO UTC A0;
utcWN	UINT	Number of UTC reference week, in weeks (BDS system parameter is 0) GLO system: the parameter corresponds to GLO UTC A1;
utcDN	UINT	Days of week when leap second event occurs, in days. GLO system: the parameter corresponds to GLO UTC DN;
utcWNLSF	UINT	Number of UTC week when leap second event occurs, in weeks GLO system: the parameter corresponds to GLO UTC KP;
utcA0	INT	Constant coefficient A0 of UTC polynomial (scale factor 2-30) , in s GLO system: the parameter corresponds to GLO UTC tc;
utcA1	INT	First-order coefficient A1 of UTC polynomial (scale factor 2-50) , in s/s GLO system: the parameter corresponds to GLO UTC tg;

- GPS Week (GPS Week) is the time system adopted in the GPS system. Time Zero is defined as: 0 a.m. on January 6, 1980. Every 1024 weeks (7168 days) is a cycle. The first GPS cycle point is 0000:00 and 000:00 on August 22, 1999. That is, from this moment on, the number of weeks starts again from zero. The rule for counting the number of weeks is: Sunday is 1, and in turn is 1-7.
- The Beidou satellite navigation time system starts at 000:00 and 000:00 UTC ON 1 January 2006. Use Week and seconds into the week count. The rule for counting the number of weeks is: Sunday is 0, and in turn is 0-6
- utcWNLSF: A decimal number converted from the lower eight bits of the binary week when a leap second occurs. For example: A leap second occurs in the 900th week (binary: 1110000100) and it is broadcast in 132 (Binary: 10000100).
- Conversion method of GPS leap second occurrence week:

  STEP1: Convert GPSW in Navtime to binary, set the lower eight bits to zero, and then

convert to decimal.

STEP2: Add the number in STEP1 to utcWNLSF to get the week when a leap second occurs.

☞ Conversion method of BDS leap second occurrence week:

STEP1: Convert the BDW in Navtime to binary, set the lower eight bits to zero, and then convert to decimal.

STEP2: Add utcWNLSF to the number in STEP1 to get the week when a leap second occurs.

☞ UTCDN: Days of the week in which a leap seconds occurs: GPS: 1-7 from Sunday to Saturday; BDS: 0-6 from Sunday to Saturday

☞ Leap seconds occur at 23:59:59

1.5.5.3 CWOUT

Output Interference Detection Information

Syntax	$CWOUT,CWFlagOut,CWRatioOut	
Example	$CWOUT,1,0	
Description	Output interference detection information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
CWFlagOut	UINT	Interference 1: No interference 2: Interference detected 3: Strong interference, has affected the receiver positioning
CWRatioOut	UINT	Interference intensity, 0~255, 0 means no interference, 255 means strong interference

1.5.5.4 FCTATEST

Production Test Mode

Syntax	$fctatest,Model	
Example	$fctatest,1	
Description	Enable test mode of CW wave	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
Model	UINT	0: disable 1: enable

☞ This test mode only supports carrier-to-noise ratio detection of signals modulated with carrier and pseudo code, and the command can only be used for production line test. In actual positioning application, abnormal positioning may occur when sending the command, and power off the receiver or disable the command to recover

1.5.5.5 ABNORMAL

Query the Output Configuration of the Injected Ephemeris

Syntax	$CFGMSG,msgClass,msgID
Example	$CFGMSG,6,4
Description	Read the output configuration of $ABNORMAL message
Input/Output	Input
No parameters	

Output the Status of the Injected Ephemeris

Syntax	$ABNORMAL,DataLen,AbnLevel
Example	$ABNORMAL,0,3*13

Description	Output the status of the injected ephemeris	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
DataLen	INT	Input data length from the serial port after starting up.
AbnLevel	INT	The absence level of the number of predicted ephemerides that have been injected, of which the value could be 0, 1, 2, 3. The larger the value is, the more absent satellites there are.

☞ Note: This statement is output every 5s. If the satellite absence level is 0, it will not be output. Only supported by R3.4.0.19 version.

1.5.5.6 EPHABNORMAL

Query the Status of the Injected Ephemeris

Syntax	$CFGMSG,msgClass,msgID
Example	$CFGMSG,6,2
Description	Read the output configuration of $EPHABNORMAL message
Input/Output	Input
No parameters	

Output the Status of the Injected Ephemeris

Syntax	$EPHABNORMAL,status	
Example	$EPHABNORMAL,1*50	
Description	Output the status of the injected ephemeris	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
status	INT	Value 1 means incomplete ephemeris.

☞ Note: The value is fixed at 1. The output of the message indicates the incompleteness of the ephemeris injection, and the default output frequency is once every 10s.

☞ This command is only applicable to version R3.2.20.100, and only when the ephemeris injection is incomplete will this message be output.

1.5.5.7 OSNMA

Output Galileo I/NAV Message

Syntax	$PNAVMSG,svid,wordtype,x1,x2,x3,…,x30	
Example	$PNAVMSG,1,0,BE,DA,49,72,CB,C3,80,EA,AA,AA,4D,41,0A,3F,40	
Description	Output Galileo I/NAV message	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
svid	UINT	Satellite ID
wordtype	UINT	Galileo I/NAV message word type, range: 1~32
x1, x2, x3, …, x30	UINT	Odd and even part of I/NAV message, range: -128~127

☞ This command is only supported by customized firmware.

1.5.6 Raw Observation Message

1.5.6.1 Raw observation Output

Raw observations are output via the RTCM MSM. The message number of each GNSS MSM is defined as follows:

Message Number of each GNSS MSM

GNSS	Message Number
GPS	1075

GNSS	Message Number
GAL	1095
BDS	1125
QZSS	1115

Base Station Information:

Base station information is transmitted via the RTCM protocol message 1005 or 1006.

1.5.6.2 Raw Ephemeris Output

Raw ephemeris data are output via the RTCM EPH messages in RTCM version 3.3.

The following contents are excerpted from the *RTCM STANDARD 10403.3* for your reference.

No.	Items	Chapters in *RTCM STANDARD 10403.3*
1	TRANSPORT LAYER	4 TRANSPORT LAYER
Ephemerides		
2	GPS Ephemerides	3.5.8 GPS Ephemerides: Table 3.5-21 Contents of GPS Satellite Ephemeris Data, Message Type 1019
3	BDS Ephemerides	3.5.20 BDS Ephemerides: Table 3.5-113 Contents of BDS Satellite Ephemeris Data, Message Type 1042
5	GAL Ephemerides	3.5.18.2 Galileo I/NAV Ephemeris: Table 3.5-111 Contents of Galileo I/NAV Satellite Ephemeris Data, Message Type 1046
6	QZSS Ephemerides	3.5.19 QZSS Ephemerides: Table 3.5-112 Contents of QZSS Satellite Ephemeris Data, Message Type 1044
Differential data		
7	MSM Structure	3.5.16.3.4 General Message Structure: Table 3.5-77 Content of an MSM Message, and Sequence of Blocks
8	Message Header	3.5.16.3.5 Message Header Description: Table 3.5-78 Content of Message Header for MSM1, MSM2, MSM3, MSM4, MSM5, MSM6 and MSM7

No.	Items	Chapters in *RTCM STANDARD 10403.3*
9	Satellite Data	3.5.16.3.6 Satellite Data Description: Table 3.5-80 Content of Satellite Data for MSM4 and MSM6
10	Signal Data	3.5.16.3.7 Message Types Signal Data Description: Table 3.5-85 Content of Signal Data for MSM4
11	Base Station Information	3.5.3 Stationary Antenna Reference Point Messages: Table 3.5-6 Contents of the Type 1005 Message – Stationary Antenna Reference Point, No Height Information
12	Data Types	3.3 Data Types: Table 3.3-1 Data Type Table
13	Data Fields	3.4 Data Fields: Table 3.4-1 Data Field Table

☞ Only supported by firmware R3.6.2.0 and R3.6.3.0. Output raw observations of GPS, BDS, Galileo, and QZSS.

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