TIMING PRODUCTS

PROTOCOL

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UM220-IV L

Single Frequency Multi-GNSS Timing Module

Revision History

Version	Revision History	Date
R1	Initial version	2020-03-31
R1.1	Add RCVSTAT in section 1.4.2.3 and 1.4.6.3	2021-04-25

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Audience

This manual is created for the technical personnel, who possess the expertise of GNSS receivers.

Contents

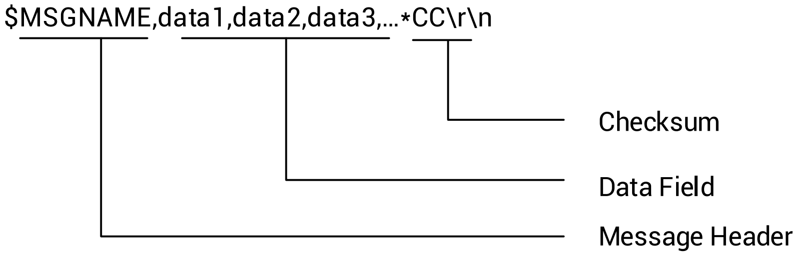
1 General Protocol

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 256 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.

The checksum in the input command is optional. If the input statement contains '*' followed by the two characters, the checksum is performed. If not, 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.

Signed Integers (INT)

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

DOUBLE

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

1.4 Message Definition

1.4.1 General Messages

1.4.1.1 PDTINFO: Product Information Inquiry

Table 1- 1 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	

Table 1- 2 Output the Product Information

Syntax	$PDTINFO,pdtName,config,hwVer,fwVer,PN,SN	
Example	$PDTINFO,UM220IV,G1B1,V1.0,R4.0Build5428,080101000001,000101114303845	
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

1.4.1.2 OK, FAIL Message Response Mechanism

Table 1- 3 Output the Message that the Command Excuted Correctly

Syntax	$OK
Example	$OK
Description	A response that the receiver executes command correctly
Input/Output	Output
No parameters	

Table 1- 4 Output the Message that the Command Excuted Incorrectly

Syntax	$FAIL,errorCode	
Example	$FAIL,0	
Description	A response that the input command is incorrect	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
errorCode	UINT	0 –Disable instruction or incorrect parameter 1 –Checksum error

1.4.1.3 RESET

Table 1- 5 Receiver Reset

Syntax	$RESET,type,clrMask	
Example	$RESET,0,h1	
Description	Receiver Reset	
Input/Output	Input	
Parameter Definition		
Parameter	**Format**	**Description**
type	UINT (optional)	Reset type: 0 – software reset
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 h85 – Cold start

When a leap second occurs, the receiver may take up to 25 minutes to sync to UTC time after a cold start reset.

1.4.1.4 CFGSAVE: Save the Configuration

Table 1- 6 Save the Current Receiver Configuration

Syntax	$CFGSAVE,mask	
Example	$CFGSAVE,h0F	
Description	Store the current receiver configuration. The current configuration is stored in the memory. The memory is divided into Flash and Retention memory according to different softwares.	
Input/Output	Input	
Parameter Definition		
Parameter	**Format**	**Description**
mask	UINT (oprional)	Configuration types to be saved bit0 – CFGPRT configuration bit1 – CFGMSG, CFGNMEA configuration bit2 – CFGTMF, CFGPMF configuration bit3 – CFGTP configuration bit4 – CFGGNSS configuration bit5 – CFGTM configuration bit6 – Reserved bit7 – CFGWNKROR, CFGLEPSEC, CFGUTCSTD configuration bit8 – CFGANT configuration If empty, save all configurations

☞ Do NOT power off the product within 1 second after entering the $ cfgsave command. The power outages during this process may cause the current receiver configuration to be damaged. At this time, the receiver configuration will be restored to the factory settings.

1.4.1.5 CFGCLR: Factory Reset

Table 1- 7 Clear the Current Receiver Configuration

Syntax	$CFGCLR,mask	
Example	$CFGCLR,h0F	
Description	Clear the current receiver configuration	
Input/Output	Input	
Parameter Definition		
Parameter	**Format**	**Description**
mask	UINT (optional)	Configuration types to be cleared: Bit definition is same as that in CFGSAVE If empty, clear all configurations

☞ The configuration modified by this command takes effect after resetting the receiver.

1.4.2 Configuration Messages

1.4.2.1 CFGPRT： Serial Port Configuration (Baud Rate, I / O Protocol Control)

Table 1- 8 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

Table 1- 9 Set/Output the Port Configuration

Syntax	$CFGPRT,portID,addr,baud,inPro,outPro	
Example	$CFGPRT,1,0,115200,3,3	
Description	Set or output the port configurtion	
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 (optional)	Fixed at 0
baud	UINT (optional)	Optional baud rate for UART: 4800/9600/14400/19200/38400/57600/115200/230400; The default baud rate of other interfaces is 0
inPro	UINT (optional)	Input protocol of the port, enabled by setting the corresponding bit to 1 bit0 – UNICORE bit1 – Reserve bit2 – Reserve bit3 – Reserve bit4 – Reserve bit5 – RTCM2.3 bit6 – Reserve bit7 – RTCM3.2 bit8 – Reserve bit9 – Odometer bit10 – MEMS bit11 – Reserve bit12 – Reserve (bit9, bit 10 are only supported by INS products)
outPro	UINT (optional)	Output protocol of the port, enabled by setting the corresponding bit to 1 bit0 – UNICORE bit1 – NMEA bit2 – RTCM

☞ It is recommended to set the baud rate to 115200 or higher when using DGNSS function.

1.4.2.2 CFGNMEA: NMEA Protocol Version Configuration

Table 1- 10 Read NMEA Configuration

Syntax	$CFGNMEA
Example	$CFGNMEA
Description	Read the NMEA output version. The receiver outputs a CFGNMEA message after receiving this command.
Input/Output	Input

No parameters

Table 1- 11 Set/Output NMEA Configuration

Syntax	$CFGNMEA,nmeaVer	
Example	$CFGNMEA,h30	
Description	Set or output the comfiguration of NMEA output version	
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)

1.4.2.3 CFGMSG: Message Output Frequency Configuration

Table 1- 12 Read Message Output Configuration

Syntax	$CFGMSG,msgClass,msgID	
Example	$CFGMSG,0,1	
Description	Read the receiver message configuration. The receiver outputs CFGMSG configuration information after receiving this command.	
Input/Output	Input	
Parameter Definition		
Parameter	**Format**	**Description**
msgClass	UINT	Message class, see Table 1- 14 Message Class and ID
msgID	UINT	Message ID, see Table 1- 14 Message Class and ID

Table 1- 13 Set/Output Message Output Frequency

Syntax	$CFGMSG,msgClass,msgID,rate	
Example	$CFGMSG,0,1,1	
Description	Set or output the configuration of receiver messages	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
msgClass	UINT	Message class, see Table 1- 14 Message Class and ID
msgID	UINT	Message ID, see Table 1- 14 Message Class and ID If empty, that means all messages under that class
rate	UINT	Output frequency 0: turn off the output, N: output once every N seconds. Range of N: 0 ~ 255

Table 1- 14 Message Class and ID

Message	Class	ID
NMEA Message		
GGA	0	0
GLL	0	1
GSA	0	2
GSV	0	3
RMC	0	4
VTG	0	5
ZDA	0	6
GST	0	7
DHV	0	8 (Only for NMEA Version 0xh30 protocol configuration)
Raw Measurement Message(1)		
RTCM MSM	2	2
RTCM EPH	2	3
RTCM BIT	2	4
Timing Message		
TPFINFO	5	0
TIMPOS	5	1
GPSTIME	5	2
BDSTIME	5	3
GALTIME	5	4
GLOTIME	5	5
LSINFO	5	6
UTCTIME	5	7
SVNUM	5	8
TSVNUM	5	9
PPSINFO	5	10
Misc Message		
JAM	6	0
ANTSTAT	6	1
NOTICE	6	4
RCVSTAT	6	3

(1): RTCM MSM, RTCM EPH, and RTCM BIT are the raw observations, ephemeris, and bitstream output in RTCM format, respectively.

1.4.2.4 CFGANT: Antenna Detection Mode Configuration

Table 1- 15 Read Antenna Detection Mode Configuration

Syntax	$CFGANT
Example	$CFGANT
Description	Read the current antenna detection mode configuration. The receiver outputs a CFGANT message after receiving this command.
Input/Output	Input
No parameters	

Table 1- 16 Set Antenna Detection Mode

Syntax	$CFGANT,detectType	
Example	$CFGANT,0	
Description	Set or output antenna detection configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
DetectType	UINT	Determine whether the ANT pin (GPIO2 inside the chip, output attribute) is configured as high or low High level 1: enable antenna feed Low level 0: disable antenna feed Diabled by default

1.4.2.5 CFGTMF: Observation Filtering Threshold in Fixed-location Timing Mode

Table 1- 17 Read Observation Filtering Threshold Configuration in Fixed-location Timing Mode

Syntax	$CFGTMF
Example	$CFGTMF
Description	Read the current observation filtering threshold. The receiver outputs a CFGTMF message after receiving this command.
Input/Output	Input
No paramenters	

Table 1- 18 Set Observation Filtering Threshold Configuration in Fixed-location Timing Mode

Syntax	$CFGTMF, maskAngle,minSatNum,CN0Th,singleSatCN0Th,posErrAlarmTh*cs
Example	$CFGTMF,5,1,20,30,100*05
Description	Set/output the observation filtering threshold in fixed-location timing mode

Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
maskAngle	UINT	Minimum elevation angle of available satellites, unit: degree, range (0 ~ 90)
minSatNum	UINT	Minimum number of available satellites, range (1 ~ 10)
CN0Th	UINT	Minimum CN0 of available satellites, unit: dBHz, range (15 ~ 30)
singleSatCN0Th	UINT	Minimum CN0 of a single available satellite, unit: dBHz, range (15 ~ 50), default is 30
posErrAlarmTh	UINT	Position error alarm threshold, unit: 10 meters, range (1 ~ 100), 3D error. When the receiver detects that the fixed position is far from the real-time positioning position, it will give a warning in time.
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.2.6 CFGPMF: Observation Filtering Threshold in Point Positioning Mode

Table 1- 19 Read Observation Filtering Threshold Configuration in Point Positioning Mode

Syntax	$CFGPMF
Example	$CFGPMF
Description	Read the current observation filtering threshold, the receiver outputs CFGPMF message after receiving this command
Input/Output	Input
No parameters	

Table 1- 20 Set Observation Filtering Threshold Configuration in Point Positioning Mode

Syntax	$ CFGPMF,maskAngle,minSatNum,CN0Th	
Example	$CFGPMF,5,5,15	
Description	Set/output observation filtering threshold configuration in point positioning mode	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
maskAngle	UINT	Minimum elevation angle of available satellites, unit: degree, range (0 ~ 90)
minSatNum	UINT	Minimum number of available satellites, range (3 ~ 10)
CN0Th	UINT	Minimum CN0 of available satellites, unit: dBHz, range (10 ~ 30)

Note: The principle of setting the PMF threshold is looser than TMF. If the user sets the PMF tighter, the TMF is subject to the PMF.

1.4.2.7 CFGTP: PPS Pulse Setting

Table 1- 21 Read Timing Pulse Configuration

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

Table 1- 22 Set Timing Pulse Configuration

Syntax	$CFGTP,interval,length,flag,gnssRef,timeBase,antDelay,rfDelay,usrDelay	
Example	$CFGTP,1000000,500000,9,0,0,0,800,0	
Description	Set or output timing configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
interval	UINT	Timing pulse frequency, unit: us; (set to 1000000 by default, only 1pps accuracy guaranteed) Only support the following specific pulse frequencies: 1000000, 500000, 200000, 100000
length	UINT	Timing pulse width, unit: us; (1 <= value <interval) (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	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 –Suppress TIMTP 1 – Output TIMTP

gnssRef	UINT	GNSS time base referenced by PPS 0: GPS 1: BDS 2: GAL 3: GLO 255: Up to the receiver
timeBase	UINT	Whether the PPS pulse is aligned to UTC time 0: GNSS system time 1: UTC (Each GNSS system corresponds to its own UTC standard)
antDelay	INT	Antenna latency, unit: ns; (-32768 ~ 32767)
rfDelay	INT	RF unit latency, unit: ns; (-32768~32767)
usrDelay	INT	User-set delay, unit: ns; (-32768 ~ 32767) Modifying the delay may result in a loss of precision for the second pulse during the tuning period

1.4.2.8 CFGTM: Timing Mode Configuration

Table 1- 23 Read Timing Mode Configuration

Syntax	$CFGTM
Example	$CFGTM
Description	Read the current receiver timing mode configuration and output a CFGTM message
Input/Output	Input
No parameters	

Table 1- 24 Set/Output Timing Mode Configuration

Syntax	$CFGTM,timMode,duration,accuracy,lat,lon,hae	
Example	$CFGTM,2,600,1000,0,0,0	
Description	Set/output timing mode configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
timMode	UINT	Timing mode configuration 0: Point timing real-time positioning timing 1: Fixed-location timing (user configures fixed coordinates) 2: Self-optimization fixed-location timing (it will automatically swithch to the fixed-location timing mode after the completion of this mode, but the optimized

		position will not be saved, and the optimization will still be performed after the next startup) 3: Automatically save the fixed position and timing mode after the autonomous optimization is completed
Duration	UINT	The shortest optimization time period under the self-optimization timing mode, in seconds (a value of 0 indicates the software automatically determines the mode), range: 0, 30 ~ 10800
accuracy	UINT	convergence precision threshold (3D error, estimated by the receiver), in centimeters; (a value of 0 indicates the accuracy is not considered), range: 0, 200 ~ 10000
Lat	DOUBLE	Reference latitude of fixed-location timing, in degree, range: -90~90. Default value is 0 in non-fixed location timing mode
Lon	DOUBLE	Reference longtitude of fixed-location timing, in degree, range: -180~180. Default value is 0 in non-fixed location timing mode
hae	DOUBLE	Reference height of fixed-location timing, in degree, range: -500~20000. Default value is 0 in non-fixed location timing mode.

1.4.2.9 CFGGNSS: GNSS Constellation Configuration

Table 1- 25 Read Satellite System Configuration

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

Table 1- 26 Set/Output Satellite System Configuration

Syntax	$CFGGNSS,sysMask	
Example	$CFGGNSS,h11	
Description	Set/output satellite system configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
sysMask	UINT	The enabled satellite frequency, set the corresponding bit to 1 to enable it bit0 – GPS L1 bit4 – BDS B1 bit8 – GLO L1

		bit12 – GAL E1 bit16 – BDS B1C (not supported for now) bit20 – QZSS L1 bit24 – SBAS

⚠ GLONASS and BDS systems cannot coexist. If a switch occurs between the two systems, the receiver will reset and restart. The previous configuration will be invalidated if not saved.

1.4.2.10 CFGUTCSTD: UTC Standard Configuration

Table 1- 27 Read UTC Standard Configuration

Syntax	$CFGUTCSTD
Example	$CFGUTCSTD
Description	Read UTC standard configuration, the receiver outputs a CFGUTCSTD message after receiving this command
Input/Output	Input
No parameters	

Table 1- 28 Set/Output UTC Standard Configuration

Syntax	$CFGUTCSTD,utcStd	
Example	$CFGUTCSTD,0	
Description	Set/output UTC standard configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
utcStd	UINT	UTC standard for converting system time to UTC time 0: USNO (GPS) 1: NTSC (BDS) 2: TBD (GAL) 3: SU (GLO) 255: Automatic, determined by the receiver itself

1.4.2.11 CFGLEAPSEC: Leap Second Parameter Configuration

Table 1- 29 Set different leap second modes

Syntax	$CFGLEAPSEC,DefaultMode,NavBitsEnable,UserSetGpsLeapSec,UserSetBdsLeapSec， UserSetGalLeapSec
Example	$CFGLEAPSEC,1,1,18,4,18

Description	Set different leap second modes	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
DefaultMode	UNIT	Default leap second mode 0 – default leap second in firmware 1 – leap second mode configured by user 2 – automatic estimation mode
NavBitsEnable	UNIT	Enable the message to parse the UTC parameter 0 – disable 1 – enable
UserSetGpsLeapSec	UNIT	GPS default leap second (0~255)
UserSetBdsLeapSec	UNIT	BDS default leap second (0~255)
UserSetGalLeapSec	UNIT	GAL default leap second (0~255)

NOTE:

- DefaultMode – Default leap second mode

  0- Default leap second in firmware. Use the default leap second written in the current firmware, which is suitable for the real signal or emulator test with the leap second configuration consistent with the firmware's default leap second.

  1- Configure leap second mode. Use UserSetGpsLeapSec, UserSetBdsLeapSec, and UserSetGalLeapSec as the default leap seconds for GPS, BDS, and GALILEO respectively, and suitble for simulator testing. It is required to ensure that UserSetGpsLeapSec, UserSetBdsLeapSec and UserSetGalLeapSec are consistent with the simulator scenario.

  2- Automatic estimation mode. Automatically estimate the current leap second based on the current receiver time and the leap second that has occurred and saved in the firmware. Suitable for the playback test scenario of prior data, and the leap second occurrence time and leap second performance (appears 23: 59:60) will also be consistent with the leap second in the real scene.

- NavBitsEnable – Enable the message to parse the UTC parameter

  0- Disable. At this point, the receiver will only use the default leap second obtained according to DefaultMode. The accuracy of UTC parameter depends on the default leap second configuration.

- Enable. Use the default leap second when the UTC parameter of the message has not been parsed, and use the UTC parameter of the message to calculate the UTC time after parsing the UTC parameter of the message.
- UserSetGpsLeapSec, UserSetBdsLeapSec, UserSetGalLeapSec – default leap second for GPS, BDS, GAL, the three fields takes effect if DefaultMode is 1. If not 1, these three fields can be entered, but it will be ignored even if there is input.
- It is not recommended that users change the configuration. In addition, the user configured leap second must be consistent with the actual scene, otherwise the receiver will work abnormally.

1.4.2.12 CFGWNKROR: Week Number Rollover Start Time Configuration

Table 1- 30 Read GPS Kilocycle System Configuration

Syntax	$CFGWNKROR
Example	$CFGWNKROR
Description	Read GPS kilocycle system configuration
Input/Output	Input
No parameters	

Table 1- 31 Set/Output GPS Kilocycle System Configuration

Syntax	$CFGWNKROR,enable,baseWnk,rollNum	
Example	$CFGWNKROR,1,690,1	
Description	Set/output GPS kilocycle rollover initial configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
enable	UINT	Enable GPS kilocycle rollover system configuration
baseWnk	UINT	Initial base within kilocycle (0~1023)
rollNum	UINT	Total number of GPS weeks rollover since 1980

Note:

- After sending configuration, save and send cold start to take effect.
- This configuration is only used for single GPS cold start mode, if other systems exist, the software will automatically evaluate this parameter, and this parameter may not be effective.

1.4.2.13 CFGCSTMINFO: User-defined Writing of Product Information

Table 1- 32 User-defined Writing of Product Information

Syntax	$CFGCSTMINFO,1,customerInfo*cs	
Example	$CFGCSTMINFO,1,UnicorecommBDXT*3B	
Description	User-defined writing of product information	
Input/Output	Input	
Parameter Definition		
Parameter	**Format**	**Description**
1	UINT	Write-enabled
customerInfo	STR	The string to be written. The maximum length is 63. Can be numbers, letters, and other symbols. ',', ':', '@', '*' are not available

Note:

- It is recommended to use it only in production, and there will be power off or reset operation after successful writing.
- Avoid frequently using this command to write flash information for a long time, otherwise the flash life may be affected.

Table 1- 33 Query the Product Information

Syntax	$CFGCSTMINFO,0*cs	
Example	$CFGCSTMINFO,0*59	
Description	Query user-written product information	
Input/Output	Input/output	
Parameter Definition		
Parameter	**Format**	**Description**
0	UINT	Query-Enabled

1.4.3 Output Messages

1.4.3.1 TIMTP: PPS Pulse Timestamp

Table 1- 34 Output PPS Second Pulse Corresponding Time

Syntax	$TIMTP,quality,errFlag,gnssRef,timeSource,timeBase,week,sow,msec*cs
Example	$TIMTP,4,0,0,0,0,2072,60480,0
Description	PPS second pulse corresponding time output message
Input/Output	Output
Parameter Definition	

Parameter	Format	Description
quality	UINT	Timing pulse quality 0: No PPS pulse output 1: Rely on the drive of the local clock, no GNSS time calibration, poor accuracy 2: Rely on the conversion of GNSS system time, the system time difference compensation is a preset value and there is a certain error 3: Rely on the conversion of GNSS system time. The system time difference compensation is the result of the previous solution, there is a certain error 4: Accurate
errFlag	UINT	bit0 – Invalid week count bit1 – System time synchronization failed bit2 – UTC parameter unavailable bit4 – In the self-optimization position mode, the fixed position has not yet converged and has not entered the fixed mode. bit5 – In the fixed-location timing mode, there may be large errors in the current fixed position
gnssRef	UINT	GNSS system time reference to PPS pulse 0: GPS 1: BDS 2: GAL 3: GLO
timeSource	UINT	Real time source system inside the receiver. For example, configure the PPS pulse edge align to the GPS system, but when the GPS signal is abnormal, the BDS system will be used for conversion. At this time, the real time source system is the BDS. 0: GPS 1: BDS 2: GAL 3: GLO
timeBase	UINT	Whether the PPS pulse is aligned to UTC time 0: GNSS system time 1: UTC (Each GNSS system corresponds to its own UTC standard)
week	UINT	Week number
sow	UINT	Seconds into the week
msec	UINT	Milliseconds
cs	STR	Checksum

		A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.2 TPFINFO: Convergence State of Fixed Position Optimization

Table 1- 35 Output Convergence State of Fixed Position Optimization

Syntax	$TPFINFO,Status,PosOptTime,meanV,meanLat,meanLon,meanHae*cs	
Example	$TPFINFO,1,300,690,40.078971,116.236514,55.09*63	
Description	The convergence state of fixed position optimization	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
Status	UINT	Current timing mode, including position optimization status 0: The current configuration is single point real-time positioning mode 1: The external configuration is fixed mode, and the fixed position is external input 2: Optimizing 3: Completed, fixed-location timing mode entered
posOptTime	UINT	The elapsed optimization convergence time, in seconds
meanV	UINT	3D standard deviation of the current optimized position, in centimeters
meanLat	DOUBLE	Latitude of the current optimization position, with north latitude being positive and south latitude being negative, in degrees
meanLon	DOUBLE	Longitude of the current optimization position with east longitude being positive and west longitude being negative, in degrees
meanHae	DOUBLE	Elevation of the current optimization position, in meters
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.3 TIMPOS: Real-time Position and Fixed Position

Table 1- 36 Output Receiver Position Information

Syntax	$TIMPOS,mode,lat,lon,hae,fixLat,fixLon,fixHae,pdop*cs
Example	$TIMPOS,3,40.078971,116.236514,55.09,40.078970,116.236510,55.00,0.94*30
Description	Output receiver position information
Input/Output	Output

Parameter Definition		
Parameter	**Format**	**Description**
Mode	UINT	Positioning mode 1: Not positioning (invalid position) 2: 2D positioning 3: 3D positioning
Lat	DOUBLE	Real-time latitude of the receiver with north latitude being positive and south latitude being negative, unit: degree
Lon	DOUBLE	Real-time longtitude of the receiver with east latitude being positive and west latitude being negative, in degrees
hae	DOUBLE	Real-time ellipsoid height of the receiver, in meters
fixLat	DOUBLE	Fixed latitude of the receiver with north latitude being positive and south latitude being negative, in degrees
fixLon	DOUBLE	Fixed longtitudeof the receiver with east latitude being positive and west latitude being negative, in degrees
fixHae	DOUBLE	Fixed ellipsoid height of the receiver, in meters
pdop	DOUBLE	Position dilution of precision
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.4 GPSTIME: GPS Time

Table 1- 37 Output GPS Time

Syntax	$GPSTIME, TimeQuality,week,sow,lsf,lsfFlag*cs	
Example	$GPSTIME,3,2072,265657.999755936,18,3*6A	
Description	Output GPS time	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
TimeQuality	UINT	Time quality with the following accuracy levels: 0: Time unknown 1: Rough (millisecond accuracy) 2: Extrapolation (microsecond accuracy) 3: Accurate (3D normal positioning or fixed-location timing mode, nanosecond accuracy)
Week	INT	Week number, null if invalid
Sow	DOUBLE	Seconds into the week (nine digits after decimal point, nanosecond accuracy), null if not valid
Lsf	UINT	Leap second
lsfFlag	UINT	Leap second valid flag

		0: Unknown 1: User configuration or default value 2: Synchronized by other GNSS systems 3: Leap second parameters of broadcast message in this system
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.5 BDSTIME: BDS Time

Table 1- 38 Output BDS Time

Syntax	$BDSTIME,TimeQuality,week,sow,gpsWeek,gpsSow,lsf,lsfFlag*cs	
Example	$BDSTIME,3,716,265643.999755940,2072,265657.999755936,4,3*6B	
Description	Output BDS time	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
TimeQuality	UINT	Time quality with the following accuracy levels: 0: Time unknown 1: Rough (millisecond accuracy) 2: Extrapolation (microsecond accuracy) 3: Accurate (3D normal positioning or fixed-location timing mode, nanosecond accuracy)
Week	INT	Week number, null if invalid
Sow	DOUBLE	Seconds into the week (nine digits after decimal point, nanosecond accuracy), null if not valid
gpsWeek	INT	GPS week number, null if invalid
gpsSow	DOUBLE	GPS seconds into the week (nine digits after decimal point, nanosecond accuracy), null if not valid
Lsf	UINT	Leap second
lsfFlag	UINT	Leap second valid flag 0: Unknown 1: User configuration or default value 2: Synchronized by other GNSS systems 3: Leap second parameters of broadcast message in this system
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.6 GALTIME: Galileo Time

Table 1- 39 Output Galileo Time

Syntax	$GALTIME,TimeQuality,week,sow,gpsWeek,gpsSow,lsf,lsfFlag*cs	
Example	$GALTIME,2,1048,265657.999755933,2072,265657.999755936,18,2*75	
Description	Output Galileo time	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
TimeQuality	UINT	Time quality with the following accuracy levels: 0: Time unknown 1: Rough (millisecond accuracy) 2: Extrapolation (microsecond accuracy) 3: Accurate (3D normal positioning or fixed-location timing mode, nanosecond accuracy)
Week	INT	Week number, null if invalid
Sow	DOUBLE	Seconds into the week (nine digits after decimal point, nanosecond accuracy), null if not valid
gpsWeek	INT	GPS week number, null if invalid
gpsSow	DOUBLE	GPS seconds into the week (nine digits after decimal point, nanosecond accuracy), null if not valid
Lsf	UINT	Leap second
lsfFlag	UINT	Leap second valid flag 0: Unknown 1: User configuration or default value 2: Synchronized by other GNSS systems 3: Leap second parameters of broadcast message in this system
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.7 GLOTIME: GLONASS Time

Table 1- 40 Output GLONASS Time

Syntax	$GLOTIME,TimeQuality,day,tod,gpsWeek,gpsSow,lsf,lsfFlag*cs
Example	$GLOTIME,0,10130,17239.999755933,2072,265657.999755936,10800,1*4F
Description	Output GLONASS time
Input/Output	Output
Parameter Definition	

Parameter	Format	Description
timeQuality	UINT	Time quality with the following accuracy levels: 0: Time unknown 1: Rough (millisecond accuracy) 2: Maintained by system clock (microsecond accuracy) 3: Accurate (3D normal positioning or fixed-location timing mode, nanosecond accuracy)
day	INT	Day number, null if invalid
tod	DOUBLE	Seconds into the day (nine digits after decimal point, nanosecond accuracy), null if not valid
gpsWeek	INT	GPS week number, null if invalid
gpsSow	DOUBLE	GPS seconds into the week (nine digits after decimal point, nanosecond accuracy), null if not valid
lsf	UINT	The fixed value is 3600 * 3 (the fixed difference between GLONASS system and UTC is 3 hours)
lsfFlag	UINT	The fixed value is 1, which means it is always valid
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.8 UTCTIME: UTC Time

Table 1- 41 Output UTC Time

Syntax	$UTCTIME,timeQuality,year,month,day,hour,min,sec,utcStd*cs	
Example	$UTCTIME,2,2019,09,28,04,25,44.999625685,0*42	
Description	Output UTC time	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
timeQuality	UINT	Time quality with the following accuracy levels: 0: Time unknown 1: Rough (millisecond accuracy) 2: Maintained by system clock (microsecond accuracy) 3: Accurate (3D normal positioning or fixed-location timing mode, nanosecond accuracy)
year	UINT	Year
month	UINT	Month
day	UINT	Day
hour	UINT	Hour
min	UINT	Minute
sec	DOUBLE	Second (nine digits after decimal point, nanosecond accuracy)
utcStd	UINT	UTC standard 0: USNO (GPS)

		1: NTSC (BDS) 2: TBD (GAL) 3: SU (GLO)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.9 LSINFO: Current Leap Second and Forecast Information

Table 1- 42 Output current leap second and forecast information

Syntax	$LSINFO,system,flag,week,sow,currLeapSec,leapSecAdj*cs	
Example	$LSINFO,0,1,2185,604800,18,19*14	
Description	Output the current leap second and its forecast information	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
system	UINT	System for outputting leap second information GPS: 0 BDS: 1 GAL: 2 GLO: 3
flag	UINT	Valid flag of leap second information 0: Invalid 1: Valid
week	UINT	Week number when future leap seconds take effect
sow	UINT	Seconds into the week when future leap seconds take effect
currLeapSec	UINT	Current leap second
leapSecAdj	UINT	Leap second value after leap second adjustment
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.10 PPSINFO: 1PPS Internal Evaluation Phase Error Information

Table 1- 43 Output 1PPS Internal Evaluation Phase Error Information

Syntax	$PPSINFO,timeRef,phaseError,clkDrift*cs
Example	$PPSINFO,2,-4,-10.13*5A
Description	Output 1PPS internal evaluation phase error information
Input/Output	Output
Parameter Definition	

Parameter	Format	Description
timeRef	UINT	Time reference for 1PPS internal evaluation phase error 0: No reference time, phaseError output is invalid at this time 1: Time reference is calculated by real-time positioning 2: The time reference is calculated by fixed-location timing
phaseError	UINT	1PPS phase error in the previous second, in seconds (internal evaluation by software)
clkDrift	UINT	Clock frequency offset, in m/s (internal calculation by software)
cs	UINT	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.11 ANTSTAT: Antenna Detection Information

1) By default, the antenna feed is diabled. At this time, the antenna detection circuit is out of operation, and the antenna detection information message will not be output (refer to the definition of $CFGANT);

2) Enable the antenna feed, and the antenna detection circuit outputs three states: open-circuit, normal, and short-circuit. These three states are valid only when V_ANT is normally powered;

3) If the antenna short circuit is detected, the software will automatically cut off the antenna feed;

Table 1- 44 Output Antenna Detection Information

Syntax	$ANTSTAT,stat*cs	
Example	$ANTSTAT,0*53	
Description	Output antenna detection information	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
stat	UINT	Antenna detection status, as defined below: 0: Open-circuit 1: Unknown 2: Normal 3: Short-circuit
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.12 JAM: Deceptive Signal or Jamming Detection Information

1) Output jamming detection status, including the conditions of two sets of notch filter (each group includes 12 cascaded notch filter), and the corresponding interference intensity

2) Output deceptive signal detection status, including three levels.

Note:

- Deceptive signal detection is to monitor suspicious satellite changes;
- Deceptive signal detection works only when a real satellite is accurately located before a fake satellite;
- If the module first connects to a fake satellite, then the detection of the deceptive signal cannot be identified;
- The detection of deceptive-jamming signals mainly depends on the multi-satellite system. For example, the module works in GPS+BDS. When GPS signal is deceptive, BDS can still work normally.

Table 1- 45 Output Deceptive Signal or Jamming Detection Information

Syntax	$JAM,decepStatus,notch0stat,notch1stat,cwFlag0,cwFlag1,cwRatio0,cwRatio1*cs	
Example		
Description	Output detection information of deceptive signal and jamming detection	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
decepStatus	UINT	Detection status of deceptive signals 0: Deceptive detection is not triggered 1: Slight deception 2: Serious deception
decepType	UINT	Software not implemented yet
notch0stat	UINT	State of notch filter group 0
notch1stat	UINT	State of notch filter group 1
cwFlag0	UINT	interference intensity of notch filter group 0 1: No jamming 2: Jamming occurred 3: Strong jamming signal has affected receiver positioning
cwFlag1	UINT	interference intensity of notch filter group 1 1: No jamming 2: Jamming occurred

		3: Strong jamming signal has affected receiver positioning
cwRatio0	UINT	Interference intensity, 0 ~ 255, 0 means no interference, 255 means strong interference
cwRatio1	UINT	Interference intensity, 0 ~ 255, 0 means no interference, 255 means strong interference
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.13 SVNUM: Satellite Searching Number of Each System

Table 1- 46 Output Satellite Searching Number of Each System

Syntax	$SVNUM,gpsSvNum,gpsSvNum1,bdsSvNum,bdsSvNum1,galSvNum,galSvNum1,gloSvNum, gloSvNum1,qzssSvNum, qzssSvNum1,sbasSvNum*cs	
Example	$SVNUM,12,,13,,0,,5,,3,,0*6F	
Description	Output the number of satellite searching of each system	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
gpsSvNum	UINT	Number of satellite searching of GPS
gpsSvNum1	UINT	Reserved for satellite searching number of other GPS frequencies, temporarily empty.
bdsSvNum	UINT	Number of satellite searching of BDS
bdsSvNum1	UINT	Reserved for satellite searching number of other BDS frequencies, temporarily empty.
galSvNum	UINT	Number of satellite searching of GAL
galSvNum1	UINT	Reserved for satellite searching number of other GAL frequencies, temporarily empty.
gloSvNum	UINT	Number of satellite searching of GLO
gloSvNum1	UINT	Reserved for satellite searching number of other GLO frequencies, temporarily empty.
qzssSvNum	UINT	Number of satellite searching of QZSS
qzssSvNum1	UINT	Reserved for satellite searching number of other QZSS frequencies, temporarily empty.
sbasSvNUm		Number of satellite searching of SBAS
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.14 TSVNUM: Satellites Participating in Fixed-location Timing

Table 1- 47 Satellites Participating in Fixed-location Timing

Syntax	$TSVNUM, gpsSatMask,bdsSatMask,galSatMask,gloSatMask*cs	
Example	$TSVNUM,0F202104A5,00000C10CB,002100001,000000000*71	
Description	Satellites participating in fixed-location timing	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
gpsSatMask(1)	UINT	GPS satellites that actually participate in fixed-location timing
bdsSatMask(2)	UINT	BDS satellites that actually participate in fixed-location timing
galSatMask(3)	UINT	GALILEO satellites that actually participate in fixed-location timing
gloSatMask(4)	UINT	GLONASS satellites that actually participate in fixed-location timing
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

(1)(2)(3)(4): The parameter format is hexadecimal. After being converted to binary, each bit in turn represents the corresponding satellite number. A bit of 1 indicates that the satellite participates in fixed-location timing. A bit of 0 indicates that the satellite does not participate in fixed-location timing.
Note: This sentence is only meaningful after entering the fixed position, otherwise it must be all 0, which means that no satellite participates in fixed-location timing.

1.4.3.15 NOTICE

Table 1- 48 Output Maintenance Information

Syntax	$NOTICE,nummsg,msgnum,text*cs	
Example	$NOTICE,01,01,antenna short*1B	
Description	Output maintenance information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
nummsg	UNIT	Total number of messages, 01…99
msgnum	UNIT	The position of this message in this data, 01…99
text	STR	Contents of maintenance information, such as: Antenna open

		Antenna short Antenna position error:***m Jamming detect Signal Error Positioning Error Baseband Error ...
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.3.16 RCVSTAT[1]: Receiver Status Information

Table 1- 49 Receiver Status Information

Syntax	$RCVSTAT,field1,field2,field3,......*cs
Example	$RCVSTAT,25269,0,1,0A,0A,0A,2,010000,0000,C050,C050,C050,0110,10AEEE18,255,01500482,33*42
Description	The information of receiver status
Input/Output	Output

1.4.4 Standard NMEA Messages Output

The message format described in this section is for the version of Beidou related messages extended on the basis of NMEA 3.0 (nmeaVer in CFGNMEA command is h30), and the version of Beidou related messages extended on the basis of standard NMEA4.1 (nmeaVer in CFGNMEA command is h51)

1.4.4.1 NmeaVer h51

GGA

Table 1- 50 Output GNSS Positioning Data

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 system standalone positioning BD – BDS system standalone positioning

[1] This message is held internally.

		GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or 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
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	Altitude, fixedly output one decimal place
M	STR	Unit of altitude, specified to constant M
Altref	DOUBLE	Sea level separation, fixed output of one decimal place
M	STR	Unit of Sea level separation, specified to constant M
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

GLL

Table 1- 51 Output Geographic Longitude/Latitude

Syntax	$--GLL,Lat,N,Lon,E,time,Valid,Mode*cs	
Example	$GPGLL,4004.74005,N,11614.19613,E,060845.00,A,A*6F	
Description	Eographic longitude/latitude	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
Lat	STR	Latitude, in the format of ddmm.mmmmm dd – Degrees mm.mmmmm – Minutes
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmm ddd – Degrees mm.mmmmm – Minutes
E	STR	East longitude or west longitude indicator E – East longitude W – West Longitude
time	STR	UTC time, in the format of hhmmss.ss hh – Hours mm – Minutes ss.ss – Seconds
Valid	STR	Position valid indicator V – Invalid A – Valid
Mode	STR	Positioning system mode indicator N – Not positioning A – Point positioning D – Differential positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

GSA

Table 1- 52 Output GNSS Dilution of Precision and Effective Satellite Information

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 system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or 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 01 ~ 32 BDS satellite ID is 01 ~ 37 GLO satellite ID is 65 ~ 92 GAL satellite ID is 01 ~ 36 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 4– BDS System ID 3– GAL System ID

		2– GLO system ID
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

GSV

Table 1- 53 Output Visible GNSS Satellites

Syntax	$--GSV,NoMsg,MsgNo,NoSv,sv1,elv1,az1,cno1,sv2,elv2,az2,cno2,sv3,elv3,az3,cno3,sv4,elv4,az4,cno4,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 GA-GAL Satellite Information GL-GLO Satellite Information
NoMsg	UINT	Total number of SV 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 this 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 1 ~ 32 BDS satellite number is 1 ~ 37 GAL satellite number is 1 ~ 36 GLO satellite number is 65 ~ 92 QZSS satellites are 193, 194, 195, 199 SBAS satellite number is 120 ~ 139

elv1 ~ elv4	UINT	Elevation of the first to fourth satellite (0 ~ 90 degrees), fixed output of 2 digits, add zero up front if less than 2 bits
az1 ~ az4	UINT	Azimuth of the first to fourth satellite (0 ~ 359 degrees), fixed output of 3 digits, add zero up front if less than 3 bits
cno1~cno4	UINT	CNR of the first to fourth satellite (0 ~ 90dBHz), fixed output of 2 digits, add zero up front if less than 2 bits 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

RMC

Table 1- 54 Output the Minimum Recommended Data

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,0.000,,180817,,,A,V*0B	
Description	The minimum recommended data	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or 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 Fixedly output 3 decimal places
cog	DOUBLE	Course over ground, unit: degree Calculated clockwise from north
date	STR	UTC date, in the format of dmmyy 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

VTG

Table 1- 55 Output Track Direction and Ground Speed

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	Track direction and ground speed	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
cogt	DOUBLE	Course over ground with reference to true north (0.000 ~ 359.999 degrees)
T	STR	Course flag, specified to constant T
cogm	DOUBLE	Course over ground with reference to MN (0.000 ~ 359.999 degrees)

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

ZDA

Table 1- 56 Output Date and Time

Syntax	$--ZDA,time,day,mon,year,ltzh,ltzn*cs	
Example	$GPZDA,060845.00,18,08,2017,00,00*6C	
Description	Date and time	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.ss hh – Hour mm – Minutes ss.ss – Seconds
day	UINT	UTC day with two digits, 01 ~ 31
mon	UINT	UTC month with two digits, 01 ~ 12
year	UINT	UTC year with four digits
ltzh	UINT	Hours in local time zone (fixed output 00)
ltzn	UINT	Minutes in local time zone (fixed output 00)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

GST

Table 1- 57 Output GNSS Pseudorange Error Statistics

Syntax	$--GST,time,rngRMS,stdMajor,stdMinor,hdg,stdLat,stdLon,stdAlt*cs	
Example	$GPGST,060845.00,0.6,,,,0.07,0.09,0.09*47	
Description	GNSS pseudorange error statistics	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.ss hh – Hour mm – Minutes ss.ss – Seconds
rngRMS	DOUBLE	Mean square error of pseudorange error in meters, with a maximum of 3750000
stdMajor	DOUBLE	Semi-major axis of the error ellipse, in meters. Specified to null
stdMinor	DOUBLE	Semi-minor axis of the error ellipse, in meters. Specified to null
hdg	DOUBLE	Semi-major axis direction of the error ellipse in degrees, clockwise from north. Specified to null
stdLat	DOUBLE	The mean square error along the latitudinal direction, in meters
stdLon	DOUBLE	The mean square error along the longitudinal direction, in meters
stdAlt	DOUBLE	The mean square error along the altitudinal direction, in meters
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.4.2 NmeaVer h30

GGA

Table 1- 58 Output GNSS Positioning Data

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 system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.sss hh – Hour 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
NoSV	UINT	Number of satellites participating in positioning
HDOP	DOUBLE	Horizontal dilution of precision, 0.0~127.000
msl	DOUBLE	Altitude, fixedly output one decimal place
M	STR	Unit of altitude, specified to constant M
Altref	DOUBLE	Sea level separation
M	STR	Unit of Sea level separation, specified to constant M
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

GLL

Table 1- 59 Output Geographic Longitude/Latitude

Syntax	$--GLL,Lat,N,Lon,E,time,Valid,Mode*cs	
Example	$GPGLL,4002.217867,N,11618.105743,E,123400.000,A,A*5B	
Description	Eographic longitude/latitude	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
Lat	STR	Latitude, in the format of ddmm.mmmmmm dd –Degrees mm.mmmmmm –Minutes
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmmm ddd –Degrees mm.mmmmmm –Minutes
E	STR	East longitude or west longitude indicator E – East longitude W – West longitude
time	STR	UTC time, in the format of hhmmss.sss hh – Hour mm – Minutes ss.sss –Seconds
Valid	STR	Position valid indicator V – Invalid A – Valid
Mode	STR	Positioning mode V – Invalid A – Valid
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

GSA

Table 1- 60 Output GNSS Dilution of Precision and Effective Satellite Information

Syntax	$--GSA,Smode,FS,sv1,sv2,sv3,sv4,sv5,sv6,sv7,sv8,sv9,sv10,sv11,sv12,PDOP,HDOP,VDOP*cs	
Example	$GPGSA,A,3,14,22,18,31,,,,,,,,5.572,2.788,4.824*36	
Description	GNSS dilution of precision and effective satellite information	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
Smode	STR	Positioning mode specified states M – Manually specify 2D or 3D positioning A – Automatically switch to 2D or 3D positioning
FS	UINT	Positioning mode 1– Not positioning 2– 2D positioning 3– 3D positioning
sv1 ~ sv12	UINT	Participating satellite ID When there are less than 12 satellites participating in the positioning, the insufficient area is filled in empty and it only output the first 12 satellites if there are more than 12 satellites GPS satellite ID is 01 ~ 32 BDS satellite ID is 01 ~ 37 GLO satellite ID is 65 ~ 92 GAL satellite ID is 01 ~ 36 QZSS satellite ID: 193, 194, 195, 199 SBAS satellite ID is 120~139
PDOP	DOUBLE	Position dilution of precision, 0.0~127.000
HDOP	DOUBLE	Horizontal dilution of precision, 0.0~127.000
VDOP	DOUBLE	Vertical dilution of precision, 0.0~127.000
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

GSV

Table 1- 61 Output Visible GNSS Satellites

Syntax	$--GSV,NoMsg,MsgNo,NoSv,sv1,elv1,az1,cno1,sv2,elv2,az2,cno2,sv3,elv3,az3,cno3,sv4,elv4,az4,cno4*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 $BDGSV,2,2,5,168,5,,50*52	
Description	Visible GNSS satellites Each GSV message contains information for only 4 satellites. When the number of satellites exceeds 4, the receiver sends multiple GSV messages continuously	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
--	STR	System identification GP-GPS satellite information GB-BDS satellite information GA-GAL Satellite Information GL-GLO Satellite Information
NoMsg	UINT	Total number of SV messages, the minimum value is 1 NoMsg is the total number of GSV messages in this system, for example: NoMsg in GPGSV is the total number of GPGSV messages, excluding the number of BDGSV messages
MsgNo	UINT	Number of this GSV message. The minimum value is 1. MsgNo is the number of this GSV message in this system. Continuous output GPGSV and BDGSV are numbered separately
NoSv	UINT	Total number of visible satellites in this system
sv1 ~ sv4	UINT	Satellite number of the first to fourth satellite GPS satellite number is 1 ~ 32 BDS satellite number is 1 ~ 37 GAL satellite number is 1 ~ 36 GLO satellite number is 65 ~ 96 QZSS satellites are 193, 194, 195, 199 SBAS satellite number is 120 ~ 139
elv1 ~ elv4	UINT	Elevation of the first to fourth satellite (0 ~ 90 degrees)
az1 ~ az4	UINT	Azimuth of the first to fourth satellite (0 ~ 359 degrees)
cno1~cno4	UINT	CNR of the 1st to 4th satellites (0 ~ 90dBHz), fill null for untracked satellites
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

RMC

Table 1- 62 Output the Minimum Recommended Data

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 system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.sss hh – Hour 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
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

VTG

Table 1- 63 Output Track Direction and Ground Speed

Syntax	$--VTG,cogt,T,cogm,M,sog,N,kph,K,mode*cs	
Example	$GNVTG,0.000,T,,M,0.000,N,0.000,K,A*13	
Description	Track direction and ground speed	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
cogt	DOUBLE	Course over ground with reference to true north (0.000 ~ 359.999 degrees)
T	STR	Course flag, specified to constant T
cogm	DOUBLE	Course over ground with reference to MN (0.000 ~ 359.999 degrees)
M	STR	Course flag, specified to constant M
sog	DOUBLE	Speed over ground, unit: knot
N	STR	Unit of speed, specified to constant N
kph	DOUBLE	Speed over ground, unit: km/h
K	STR	Unit of speed, specified to constant K
mode	STR	Positioning mode N – Not positioning A – Point positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

ZDA

Table 1- 64 Output Date and Time

Syntax	$--ZDA,time,day,mon,year,ltzh,ltzn*cs	
Example	$GNZDA,083927.000,21,11,2013,00,00*4C	
Description	Date and time	
Input/Output	Output	
Parameter Definition		
Parameter	**Format**	**Description**
--	STR	Positioning system flag GP – GPS system standalone positioning BD – BDS system standalone positioning GA – GAL system standalone positioning GL – GLO system standalone positioning GN – Dual or multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.sss hh – Hour mm – Minutes ss.sss –Seconds
day	UINT	UTC day with two digits, 01 ~ 31
mon	UINT	UTC month with two digits, 01 ~ 12
year	UINT	UTC year with four digits
ltzh	UINT	Hours in local time zone (fixedly output 00)
ltzn	UINT	Minutes in local time zone (fixedly output 00)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this statement

1.4.5 Raw Data Output

1.4.5.1 Raw Observation Output

The raw observations are output via RTCM MSM. The MSM Message number for each constellation is defined as follows:

Table 1- 65 MSM Message Type of Each Constellation

Constellation	Message Number
GPS	1075
GLO	1085
GAL	1095
BDS	1125

Constellation	Message Number
QZSS	1115
SBAS	1105

Base Station Information

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

1.4.5.2 Raw Ephemeris Output

The raw Ephemeris are output via RTCM EPH, using RTCM3.3 protocol. The used protocols are collated based on RTCM3.3 for the convenience of users as shown in the table below.

No	Item	Index Corresponding to RTCM STANDARD 10403.3
1	TRANSPORT LAYER	4 TRANSPORT LAYER
Ephemeris Data		
2	GPS Ephemeris Data Format	3.5.8 GPS Ephemerides： Table 3.5-21 Contents of GPS Satellite Ephemeris Data, Message Type 1019
3	BDS Ephemeris Data Format	3.5.20 BDS Ephemerides： Table 3.5-113 Contents of BDS Satellite Ephemeris Data, Message Type 1042
4	GLO Ephemeris Data Format	3.5.9 GLONASS Ephemerides： Table 3.5-22 Contents of GLONASS Satellite Ephemeris Data, Message Type 1020
5	GAL Ephemeris Data Format	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 Ephemeris Data Format	3.5.19 QZSS Ephemerides： Table 3.5-112 Contents of QZSS Satellite Ephemeris Data, Message Type 1044
Differential Data		
7	MSM Description	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
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

No	Item	Index Corresponding to RTCM STANDARD 10403.3
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

Self-Defined Ephemeris Output Instructions

The current software supports ephemeris output, including GPS, BDS, GAL, GLO, SBAS, and QZSS systems, and only systems configured to participate in timing will output ephemeris. The enablement of SBAS or QZSS requires the GPS system to be enabled and SBAS or QZSS system to be ebabled correspondingly before the output.

The data output uses the standard format of the RTCM protocol. The data header and end check are subject to the RTCM encoding rules. The effective information is encoded in the data area. The RTCM message frame structure is shown inTable 1- 69 RTCM Message Frame Structure. The message types are shown in Table 1- 66 Ephemeris Message Types for Each System.

Table 1- 66 Ephemeris Message Types for Each System

GNSS	GPS	BDS	GAL	GLO	QZSS	SBAS
Message Type	1019	1042	1046	1020	1044	4018

SBAS is an extended protocol. See Table 1- 67 4018 Message Data Field. The data field of the 4018 message is for other types. The ephemeris of other types complies with the standard RTCM3.3 protocol. For the data fields, please refer to the RTCM3.3 protocol.

Table 1- 67 4018 Message Data Field

Field	Length (BIT)	Scale Factor	Remark
SVID	4	1	1-24
PRN	8	1	40-64. Match the observation measurement number, the difference from the PRN is 80
URA	4	1	
T0	16	16s	
AF0	12	1	
AF1	8	1	
X	30	0.08m	
Y	30	0.08m	

Field	Length (BIT)	Scale Factor	Remark
Z	25	0.4m	
Vx	17	0.000625mps	
Vy	17	0.000625mps	
Vz	18	0.004mps	
Ax	10	0.0000125 m/s^2	
Ay	10	0.0000125 m/s^2	
Az	10	0.0000125 m/s^2	
Health	6		
Reserved	—		
CRC	24		

1.4.5.3 Raw Bit Stream Output

The raw bit stream is output via RTCM BIT. The current software supports raw message stream output, including GPS, BDS, GAL, GLO, SBAS, and QZSS systems, and only systems configured to participate in timing will output ephemeris. The enablement of SBAS or QZSS requires the GPS system to be enabled and SBAS or QZSS system to be ebabled correspondingly before the output.

The data output follows the system message design structure. After the frame synchronization and checking, the data is sent in frames. The message types and basic information of each system are shown inTable 1- 68 Message Information for Each System.

Table 1- 68 Message Information for Each System

GNSS	Message Type	Frame Length	Remark
GPS	4011	300bit	
BDS	4012	300bit	Block interleaving decoded
GAL	4013	220bit	Viterbi decoded
GLO	4014	85bit	MeanderCode stripped
QZSS	4015	300bit	
SBAS	4016	250bit	Viterbi and FEC decoded

The data output adopts the self-defined format of the RTCM protocol. The data header and end check are subject to the RTCM encoding rules. The effective information is encoded in the data area. The RTCM message frame structure is shown inTable 1- 68 RTCM Message Frame Structure. The data field filling structure is shown in Table 1- 70

Data Field Filling Structure.

Table 1- 69 RTCM Message Frame Structure

Name	Number of Bits	Units	Range	Description
Prefix	8	—	—	Fixed Boot Indicator, 11010011
Reserved Field	6	—	—	Reserved field, specified to 000000
Data Field Length	10	byte	0~1023	
Data Field	—	—		The total length is determined by the length of the data field
Check Field	24	1	—	CRC24Q check

Table 1- 70 Data Field Filling Structure

Field	Message Type	Satellite ID	Message Length	Message Bit	Filling Field
Number of Bits	12	6	10	—	Fill in 0 at the end for 8bit alignment

1.4.6 Default Configuration

1.4.6.1 Serial Port Configuration (CFGPRT)

Table 1- 71 Serial Port Configuration

Parameter	Deafault Configuration	Description
UART1		
baud	115200	
inProto	1	UNICORE
outProto	3	UNICORE+NMEA
UART2		
baud	115200	
inProto	1	UNICORE
outProto	3	UNICORE+NMEA

1.4.6.2 GNSS Constellation Configuration (CFGGNSS)

Table 1- 72 GNSS Constellation Configuration

Parameter	Deafault Configuration	Description
sysGnss	H101011	GPS+BDS+GAL+QZSS

1.4.6.3 Message Output Frequency Configuration (CFGMSG)

Table 1- 73 Message Output Frequency Configuration

Parameter	Deafault Configuration	Description
NMEA Message		
GGA	1	Output at 1Hz
GLL	0	Disabled
GSA	1	Output at 1Hz
GSV	1	Output at 1Hz
RMC	1	Output at 1Hz
VTG	0	Disabled
ZDA	0	Disabled
GST	0	Disabled
DHV	0	Disabled
Raw Measurement Message		
RTCM MSM	0	Disabled
RTCM EPH	0	Disabled
RTCM BIT	0	Disabled
Timing Message		
TPFINFO	1	Output at 1Hz
TIMPOS	1	Output at 1Hz
GPSTIME	1	Output at 1Hz
BDSTIME	1	Output at 1Hz
GALTIME	1	Output at 1Hz
GLOTIME	1	Output at 1Hz
LSINFO	0	Disabled
UTCTIME	0	Disabled
SVNUM	1	Output at 1Hz
TSVNUM	1	Output at 1Hz
PPSINFO	1	Output at 1Hz
Misc Message		
JAM	0	Disabled
ANTSTAT	0	Disabled
NOTICE	1	Output at 1Hz
RCVSTAT	1	Output at 1Hz

1.4.6.4 Observation Filtering Threshold in Fixed-location Timing Mode (CFGTMF)

Table 1- 74 Observation Filtering Threshold in Fixed-location Timing Mode

Parameter	Deafault Configuration	Description
maskAngle	5	Minimum elevation: 5 degrees
minSatNum	1	Minimum number of satellites: 1
CN0Th	25	Minimum CN0: 25dBm
singleSatCN0Th	30	Minimum CN0: 15dBm
posErrAlarmTh	100	Pre-warning threshold:1000 meters

1.4.6.5 Observation Filtering Threshold in Point Positioning Mode (CFGPMF)

Table 1- 75 Observation Filtering Threshold in Point Positioning Mode

Parameter	Deafault Configuration	Description
maskAngle	5	Minimum elevation: 5 degrees
minSatNum	3	Minimum number of satellites: 5
CN0Th	10	Minimum CN0: 10dBm

1.4.6.6 PPS Pulse Configuration (CFGTP)

Table 1- 76 1.4.5.6 PPS Pulse Configuration

Parameter	Deafault Configuration	Description
interval	1000000	Second puilse output at 1Hz
length	100000	Duty cycle of 10%
flag	13	(1) Enable the pulse output (2) Align the rising edge (3) Output when the timing is reliable (4) Output TIMTP message
gnssRef	0	Take GPS system as reference
timeBase	0	When aligning to a GNSS system
antDelay	0	Antenna latency is 0
rfDelay	0	RF latency is 0
usrDelay	0	User latency is 0

1.4.6.7 Timing Mode Configuration (CFGTM)

Table 1- 77 Configure Timing Mode

Parameter	Deafault Configuration	Description
timMode	2	Self-optimization fixed position
Duration	180	The shortest optimization time is 180 seconds
accuracy	1000	Convergence accuracy is within 10 meters
Lat	0	Valid only if the mode is set by the user, fill in 0 here
Lon	0	Valid only if the mode is set by the user
hat	0	Valid only if the mode is set by the user

1.4.6.8 Antenna Detection Mode Cofiguration (CFGANT)

Table 1- 78 Antenna Detection Mode Cofiguration

Parameter	Deafault Configuration	Description
DetectType	0	Disable antenna feed

2 Reference List

[1] RTCM STANDARD 10403.3, DIFFERENTIAL GNSS(GLOBAL NAVIGATION SATELLITE SYSTEMS) SERVICES – VERSION 3, (OCTOBER 7, 2016)

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