TIMING PRODUCT

PROTOCOL SPECIFICATION

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GNSS Timing Products

Protocol Specification

Revision History

Version	Revision History	Date
R1.0	First release	May., 2022
R2.0	Dual-frequency version ● Add GPSCNAVION, GPSCNAVUTC and GPSCNAVEPH ● Add HWSTATUS, GPSCNAV1RAWSUBFRAME, GPSCNAV2RAWSUBFRAME and BD3RAWSUBFRAME ● Update Table 1-16 and section 1.4.3.11 JAM ● Update section 1.4.7.12 CFGFREQMASK ● Add bit 14 description in section 1.4.1.4 CFGSAVE ● Add bit11 and bit14 description in section 1.4.1.5 CFGCLR ● Update the alt range and the default settings of Lat, Lon and alt ● Add HWSTATUS, GPSCNAV1RAWSUBFRAME, GPSCNAV2RAWSUBFRAME and BD3RAWSUBFRAME in section 1.4.7.4 CFGMSG ● Update the default settings of Lat, Lon and Hat in section 1.4.7.7 CFGTM ● Add the parameter RSV and update the example in section 1.4.3.12 SVNUM ● Update the example and update the range of nummsg and msgnum in section 1.4.3.14 NOTICE ● Delete the note in section 1.4.4.19 GPSRAWSUBFRAME ● Add a footnote to the parameter of HwFlag in section 1.4.4.20 GPSCNAV1RAWSUBFRAME ● Add the message type 1045 for GAL system in Table 1-115	Apr., 2023
R2.1	● Add 1.4.2.15 CFGAGNSS, 1.4.2.16 AIDPOS and 1.4.2.17 AIDTIME ● Add 1.4.3.10 GPSLSINFO and 1.4.3.16 STAINFO ● Add 1.4.4.32 SIGINFO, 1.4.4.33 AGNSSSTATUS and 1.4.4.34 PTOBSINFO ● Update Table 1-16 and Table 1-129 to add GPSLSINFO, STAINFO, SIGINFO, AGNSSSTATUS and PTOBSINFO ● Update section 1.4.1.4 CFGSAVE and section 1.4.1.5 CFGCLR to add Bit 15 ● Update the default rate in Table 1-125, and add a footnote: There are a few differences between the default settings of different versions. ● Remove the message AUTHCODE	Jun., 2024

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Foreword

This manual provides the protocol specifications of the UT986 module.

Target Readers

This manual applies to technicians who have certain knowledge in GNSS modules.

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1 General Protocol

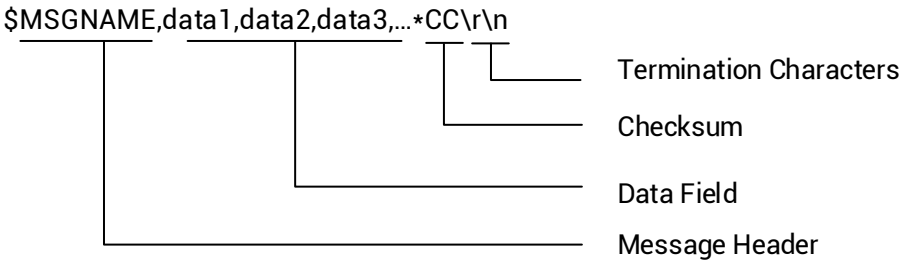
This manual is applicable to the all-system multi-frequency high-precision timing module UT986 developed by Unicore.

1.1 Messages

In the Unicore protocol, input and output commands are collectively called messages. Each message (except 1.4.4 Raw Observation Message) is a string composed of ASCII characters.

The basic format of the message is:

$MSGNAME,data1,data2,data3,…*CC\r\n



All messages (except 1.4.4 Raw Observation Message, unlog and freset) include the following parts:

- Message header. It starts with '$' (0x24).
- Data field. It follows a delimiter "," and consists of a number of parameters or data. The adjacent data are also separated by the delimiter ",".
- Checksum. It is separated from the previous data by '*' (0x2A). See section 1.2 for the details.
- Termination characters. 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 cannot exceed 256 bytes.

☞ Message header and parameters, as well as letters in the checksum are not case-sensitive.

Some parameters of the commands can be omitted (marked as optional in the command description), which means that those parameters can be empty and there is

no character between the two delimiters ‘,,’ or ‘,*’. If there is no special instruction, the parameter is ignored and the option it controls remains unchanged.

Most of the message headers can be used for both input commands and output messages. As the input, it sets parameters or queries the current configuration; as the output, it outputs the receiver information or configuration.

1.2 Checksum

The two characters after ‘*’(0x2A) in the message are the checksum, which is the XOR of all characters (excluding ‘$’ and ‘*’) from ‘$’ to ‘*’in hexadecimal.

The checksum in the input command is optional. If the input message contains ‘*’ followed by two characters, the checksum is examined. If it is wrong, the command is not executed, and the receiver outputs the $FAIL message, in which a checksum error appears. If the message does not contain a checksum, the command is executed directly.

If the parameter of the input message is empty and a checksum needs to be added, the parameter should be followed by ‘,’ in order to calculate the checksum. It's not allowed to add an extra ‘,’ when the parameter is not empty.

Example: $PDTINFO,*62

The output message always contains a checksum. The description of the checksum in the Unicore protocol is 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 Integers (UINT)

Unsigned integers range from 0 to 4294967295, and are defined in both decimal and hexadecimal. A decimal unsigned integer consists of ASCII characters 0 - 9, such as 123, 4291075193. A hexadecimal unsigned integer starts with the ASCII character h or H, followed by a string of 0 - 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 the ASCII characters 0 - 9 and a negative sign, in the range of -2147483648 to 2147483647, such as 123217754, -245278.

Double-precision Floating-point Data (DOUBLE)

Double-precision floating-point data consists of ASCII characters 0 - 9, a negative sign and decimal points, ranging from -2^1023 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 Product Information

Syntax	$PDTINFO,pdtName,rsv,hwVer,fwVer,PN,SN	
Example	$PDTINFO,UT986,,V2.0,R4.0Build9170,2310405000006,LQ20B5212400118*41	
Description	The receiver outputs product information.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
pdtName	STR	Product name
rsv	STR	Reserved
hwVer	STR	Hardware version
fwVer	STR	Firmware version
PN	STR	Product number
SN	STR	Serial number

1.4.1.2 OK, FAIL: Message Response Mechanism

Table 1-3 Correct Execution of a Command

Syntax	$OK,command
Example	$OK,CFGMSG,0,1,1*2F
Description	A response that the receiver executed the command correctly
Input/Output	Output
No parameters	

☞ This is a response message, and the returned format is **$OK**.

Table 1-4 Incorrect Execution of a Command

Syntax	$FAIL,command,errorCode	
Example	$FAIL,CFGTM,2,20,1000,0,0,0,PARSING FAILD PARAMETER ERROR*7F	
Description	A response that the input command is incorrect	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
errorCode	STR	False information

☞ When sending $reset command, the message response mechanism is different from other commands, and the response is: **$OK and system is rebooting...**

1.4.1.3 RESET

Table 1-5 Receiver Reset

Syntax	$RESET,type,clrMask	
Example	$RESET,0,h01	
Description	Receiver reset	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
type	UINT (optional)	Reset type: 0 – software reset If empty, only restart without clearing any information.
clrMask	UINT	Reset to clear the receiver's saved information. Setting the bit to 1 means to clear upon reset. Bit0 – Clear ephemeris Bit1 – Reserve0 Bit2 – Clear receiver's position and time Bit3 – Reserve1

		Bit4 – Clear ionospheric correction and UTC parameters Bit5 – Reserve2 Bit6 – Reserve3 Bit7 – Clear almanac Bit11 - Clear the local clock offset information The following list shows several booting methods that are frequently used: h00 – Hot start h01 – Warm start h85 – Cold start

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

1.4.1.4 CFGSAVE: Save the Configuration

Table 1-6 Save the Receiver's Configuration

Syntax	$CFGSAVE,mask	
Example	$CFGSAVE,h0F	
Description	Save the current configuration, which is stored in the memory.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
mask	UINT (optional)	Configuration types to be saved. Set the corresponding bit to 1 to save the configuration. Bit0 – CFGPRT Bit1 – CFGMSG, CFGNMEA Bit2 – CFGPMF Bit3 – CFGTP Bit4 – CFGGNSS Bit5 – CFGTM Bit6 – CFGTIMTH Bit7 – CFGWNKROR, CFGLEAPSEC, CFGUTCSTD Bit14 – CFGFREQMASK Bit15 – CFGAGNSS If empty, save all configurations

☞ Do NOT power off the product within one second after entering the **$cfgsave** command. A power off during this process may cause damage to the receiver's configuration, and the configuration will be restored to factory settings.

1.4.1.5 CFGCLR: Clear Receiver's Configuration

Table 1-7 Clear the Receiver's Configuration

Syntax	$CFGCLR,mask	
Example	$CFGCLR,h0F	
Description	Clear the current configuration of the receiver.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
mask	UINT (optional)	Configuration types to be cleared. Bit0 – CFGPRT Bit1 – CFGMSG, CFGNMEA Bit2 – CFGPMF Bit3 – CFGTP Bit4 – CFGGNSS Bit5 – CFGTM Bit6 – CFGTIMTH Bit7 – CFGWNKROR, CFGLEAPSEC, CFGUTCSTD Bit11 – CFGCSTMINFO Bit14 – CFGFREQMASK Bit15 – CFGAGNSS If empty, clear all configurations

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

1.4.1.6 unlog: Clear All Message Output

Table 1-8 Clear All Message Output

Syntax	unlog
Example	unlog
Description	Clear all message output
Input/output	Input
No parameters	

1.4.1.7 freset: Restore to Factory Settings

Table 1-9 Restore to Factory Settings

Syntax	freset
Example	freset
Description	Clear all user customized configurations, ephemeris, positioning information in the nonvolatile memory, and restore to factory settings, the baud rate of which is 460800 bps. This command results in a mandatory receiver restart.
Input/output	Input
No parameters	

1.4.2 Configuration Messages

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

Table 1-10 Read Port Configuration

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

Table 1-11 Set/Output Port Configuration

Syntax	$CFGPRT,portID,addr,baud,rsv,rsv	
Example	$CFGPRT,1,0,115200,,	
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 (optional)	Fixed at 0
baud	UINT (optional)	If the port is UART, the baud rate could be set as: 4800/9600/14400/19200/38400/57600/115200/230400 / 460800/921600; The default baud rate of other interface is 0
rsv	UINT (optional)	Reserved
rsv	UINT (optional)	Reserved

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

1.4.2.2 CFGNMEA: Configure NMEA Protocol Version

Table 1-12 Read NMEA Version

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

Table 1-13 Set/Output NMEA Version

Syntax	$CFGNMEA,nmeaVer	
Example	$CFGNMEA,h51	
Description	Set or output the NMEA protocol version	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
nmeaVer	UINT	NMEA protocol version h51 – Expanded NMEA 4.10 including BeiDou messages h52 – NMEA 4.11

1.4.2.3 CFGMSG: Configure Message Output Frequency

Table 1-14 Read Message Output Configuration

Syntax	$CFGMSG,msgClass,msgID	
Example	$CFGMSG,0,1	
Description	Read the message output configuration. The receiver outputs CFGMSG message after receiving this command.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
msgClass	UINT	Message class (see Table 1-16 Message Class and ID)
msgID	UINT	Message ID (see Table 1-16 Message Class and ID)

Table 1-15 Set/Output Message Output Frequency

Syntax	$CFGMSG,msgClass,msgID,rate	
Example	$CFGMSG,0,1,1	
Description	Set or output the message output frequency.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
msgClass	UINT	Message class (see Table 1-16 Message Class and ID)
msgID	UINT (optional)	Message ID (see Table 1-16 Message Class and ID) If empty, set/output all messages under the above class
rate	UINT	Output frequency 0: Disable the output; N: Output once every N seconds. Range of N: 0 - 255

Table 1-16 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
RTCM Message[1]		
RTCM MSM	2	2
RTCM EPH	2	3
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
TIMTP	5	11
GPSLSINFO	5	12
Misc Message		
JAM	6	0
PDTINFO	6	1
NOTICE	6	4
STAINFO	6	5
Raw Measurement Message		
OBSVM	7	0
GPSION	7	1
BDSION	7	2
GALION	7	3
BD3ION	7	4
GPSUTC	7	5
BDSUTC	7	6
GALUTC	7	7
BD3UTC	7	8
BD3EPH	7	10
GLOEPH	7	11
GPSEPH	7	12
BDSEPH	7	13

[1] RTCM MSM and RTCM EPH are raw observation data and ephemeris output in RTCM format. For specific definition of format, please refer to 1.4.6 RTCM Output.

GALEPH	7	14
GPSRAWSUBFRAME	7	15
BDSRAWSUBFRAME	7	16
GALFNAVRAWPAGE	7	17
GALINAVRAWWORD	7	18
GLORAWSTRING	7	19
SATHEALTHST	7	20
SYSCLKERR	7	21
LOGLIST	7	22
GPSCNAVEPH	7	23
GPSCNAVUTC	7	24
GPSCNAVION	7	25
HWSTATUS	7	26
GPSCNAV1RAWSUBFRAME	7	27
GPSCNAV2RAWSUBFRAME	7	28
BD3RAWSUBFRAME	7	29
SIGINFO	7	30
AGNSSSTATUS	7	31
PTOBSINFO	7	32
Debug Message		
RawDebugMessage[2]	11	1
ClockDt	11	2
BESTNAV	11	3

[2] RawDebugMessage is the debug information output by COM2:

Send $cfgmsg,11,1,1 to enable the debug information output by COM2;

Send $cfgmsg,11,1,0 to disable the debug information output by COM2. At this time, COM2 can be used to receive differential data.

1.4.2.4 CFGPMF: Configure Observation Filtering Threshold in Point Positioning Mode

Table 1-17 Read Observation Filtering Threshold 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 1-18 Set/Output Observation Filtering Threshold in Point Positioning Mode

Syntax	$ CFGPMF,maskAngle,minSatNum,CN0Th	
Example	$CFGPMF,5,5,15	
Description	Set/output observation filtering threshold 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: 1 - 5
CN0Th	UINT	Minimum CN0 of available satellites, unit: dB-Hz, range: 10 - 30

1.4.2.5 CFGTP: Configure PPS Pulse

Table 1-19 Read Time Pulse Configuration

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

Table 1-20 Set/Output Time 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 time pulse configuration.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
Interval[3]	UINT	Time pulse frequency, unit: μs. It is recommended to use the following frequencies: 4000000, 2000000, 1000000, 500000, 200000, 100000, 50000, 20000, 10000, 2, 1. The supported highest frequency is 1 MHz.
length	UINT	Time pulse width, unit: μs (1 ≤ length < Interval; when the Interval is set as 1, the length is fixed at 1, but the duty cycle is fixed at 50% at 1MHz.) (High-level when the rising edge is aligned to top of second; low-level when the falling edge is aligned to top of second)
flag	UINT	Time pulse configuration: Bit 0 0 – Disable time pulse output

[3] When the interval of PPS output frequency is not 1000000 (1Hz), Bit2 in the parameter **flag** should be set as 1.

		1 – Enable time pulse output Bit 1 0 – Rising edge at top of second 1 – Falling edge at top of second Bit 2 0 – Output when time is reliable 1 – Always output time pulses Bit 3 0 – Disable TIMTP output 1 – Enable TIMTP output
gnssRef	UINT	GNSS time reference for PPS 0: GPS 1: BDS 2: GAL 3: GLO 255: Up to the receiver
timeBase	UINT	Time base of PPS pulse 0: GNSS time 1: UTC (Every GNSS has its own UTC standard)
antDelay	INT	Antenna delay, unit: ns (-32768 to 32767)
rfDelay	INT	RF delay, unit: ns (-32768 to 32767)
usrDelay	INT	User-set delay, unit: ns (-32768 to 32767) Modifying the delay may result in a loss of precision when time pulse is adapting to the value.

1.4.2.6 CFGTM: Configure Timing Mode

Table 1-21 Read Timing Mode Configuration

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

Table 1-22 Set/Output Timing Mode Configuration

Syntax	$CFGTM,timMode,duration,accuracy,lat,lon,alt	
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: Real-time point positioning timing 1: Fixed-location timing (user sets the coordinates) 2: Self-optimization fixed-location timing (it automatically switches to fixed-location timing mode after the optimization is completed, but the optimized position is not saved, and the optimization is performed again at the next startup) 3: Automatically save the fixed position and timing mode after self-optimization is completed
duration	UINT	The shortest optimization time under the self-optimization timing mode, in seconds, range: 0, 30 to 10800 (0 indicates the software automatically determines the duration).
accuracy	UINT	Convergence precision threshold (3D error, estimated by the receiver), in centimeters, range: 0, 200 to 10000 (0 indicates the accuracy is ignored).
Lat	DOUBLE	Reference latitude of fixed-location timing, in degrees,

		range: -90 to 90. Default value is 0.000000000 in non-fixed location timing mode.
Lon	DOUBLE	Reference longitude of fixed-location timing, in degrees, range: -180 to 180. Default value is 0.000000000 in non-fixed location timing mode.
alt	DOUBLE	Reference height (ellipsoidal height) of fixed-location timing, in meters, range: -400 to 15000. Default value is 0.000 in non-fixed location timing mode.

1.4.2.7 CFGGNSS: Configure GNSS Constellation

Table 1-23 Read Satellite System Configuration

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

Table 1-24 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. Bit 0 – GPS L1 C/A Bit 2 – GPS L2C Bit 3 – GPS L5 Bit 4 – BDS B1I Bit 5 – BDS B1C

		Bit 6 – BDS B2a Bit 8 – GLO L1 Bit 12 – GAL E1 Bit 13 – GAL E5a Bit 14 – GAL E5b Bit 20 – QZSS L1 Bit 21 – QZSS L5 Bit 22 – QZSS L2C

1.4.2.8 CFGUTCSTD: Configure UTC Standard

Table 1-25 Read UTC Standard Configuration

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

Table 1-26 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

1.4.2.9 CFGLEAPSEC: Configure Leap Second Parameter

Table 1-27 Read Current Leap Second Mode

Syntax	$CFGLEAPSEC
Example	$CFGLEAPSEC
Description	Read the leap second mode of the current receiver
Input/Output	Input
No parameters	

Table 1-28 Set/Output Different Leap Second Modes

Syntax	$CFGLEAPSEC,DefaultMode,NavBitsEnable,UserSetGpsLeapSec,UserSetBdsLeapSec,UserSetGalLeapSec	
Example	$CFGLEAPSEC,1,1,18,4,18	
Description	Set/Output different leap second modes.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
DefaultMode	UINT	Default leap second mode 0 – default leap second in firmware 1 – leap second mode configured by user 2 – automatic calculation mode
NavBitsEnable	UINT	Enable the message to parse the UTC parameter 0 – disable 1 – enable
UserSetGpsLeapSec	UINT	GPS default leap second (0 to 255)
UserSetBdsLeapSec	UINT	BDS default leap second (0 to 255)
UserSetGalLeapSec	UINT	GAL default leap second (0 to 255)

NOTE:

- **DefaultMode** – Default leap second mode

  0 - Default leap second in firmware. Use the default leap second written in the firmware; suitable for real signal or simulator test. The simulator's leap second configuration should be consistent with the firmware's default leap second.

  1 - Configure leap second mode by user. Use **UserSetGpsLeapSec**, **UserSetBdsLeapSec** and **UserSetGalLeapSec** as the default leap second for GPS, BDS, and Galileo respectively; suitable for simulator test. Ensure that the

UserSetGpsLeapSec, **UserSetBdsLeapSec** and **UserSetGalLeapSec** are consistent with the simulator scenario.

2 - Automatic calculation mode. Automatically calculate the current leap second based on the receiver time and the leap second occurrence time saved in the firmware; suitable for data playback test. The leap second occurrence time and leap second performance (appears 23:59:60) will be consistent with the leap second in real scenario.

- **NavBitsEnable** – Enable to parse UTC parameters

  0 - Disable.

  The receiver only uses the default leap second set by the **DefaultMode**, thus the accuracy of UTC parameters depend on the default leap second configuration. (At initialization, use automatic calculation mode and enable to parse UTC parameters by default. If the leap second parsed from the UTC parameter is different from that got according to the input command in which **NavBitsEnable** = 0, then there is no response to the command.)

  1 - Enable.

  Use the UTC parameter to calculate the UTC time after the parameter is parsed. When the parameter is not parsed, use the default leap second.

- **UserSetGpsLeapSec**, **UserSetBdsLeapSec**, **UserSetGalLeapSec** – default leap second for GPS, BDS, and GAL. The three fields take effect if and only if DefaultMode is 1. If not, it does not matter whether you give value to the three fields as the value is ignored.
- It is not recommended to change the configuration. In addition, the user-configured leap second must be consistent with the actual scene, otherwise the receiver may work abnormally.

1.4.2.10 CFGWNKROR: Configure Week Number Rollover

Table 1-29 Read GPS Week Number Rollover Configuration

Syntax	$CFGWNKROR
Example	$CFGWNKROR
Description	Read GPS week number rollover configuration.
Input/Output	Input
No parameters	

Table 1-30 Set/Output GPS Week Number Rollover Configuration

Syntax	$CFGWNKROR,enable,baseWnk,rollNum	
Example	$CFGWNKROR,1,690,1	
Description	Set/output GPS week number rollover configuration.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
enable	UINT	Enable GPS week number rollover configuration or not 1: Enable 0: Disable
baseWnk	UINT	Base week within an epoch (0 to1023)
rollNum	UINT	Total number of GPS week rollover since 1980

☞ After sending the configuration, save and send cold start command to take effect.

☞ This configuration is only used for single GPS cold start mode. If other systems exist, the software automatically evaluates the parameters, and the parameters may not be effective.

☞ The priority of the command **CFGWNKROR** is lower than the command of system conversion. If the system conversion is verified, there is no response to the command CFGWNKROR.

1.4.2.11 CFGCSTMINFO: Configure User-defined Information

Table 1-31 User-defined Information

Syntax	$CFGCSTMINFO,1,customerInfo*cs	
Example	$CFGCSTMINFO,1,UnicorecommBDXT	
Description	Write user-defined information.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
1	UINT	Write-Enabled
customerInfo	STR	The string to be written in. The maximum length is 63. Can be numbers, letters, and other symbols. ‘,’, ‘:’, ‘@’, ‘*’ are not allowed.

☞ It is recommended to use it only in production, and cut off the power or reset after successful writing.

☞ Avoid frequently using this command to write information in flash for a long time, otherwise the flash life may be affected.

Table 1-32 Query User-defined Information

Syntax	$CFGCSTMINFO,0*cs	
Example	$CFGCSTMINFO,0*59	
Description	Query the currently user-defined information.	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
0	UINT	Query-Enabled

1.4.2.12 CFGSATMASK: Configure to Mask Specific Satellites

Table 1-33 Query the Configuration to Mask Specific Satellites

Syntax	$CFGSATMASK
Example	$CFGSATMASK
Description	Mask specific satellites
Input/Output	Input
No parameter	

Table 1-34 Set/Output the Configuration to Mask Specific Satellites

Syntax	$ CFGSATMASK,GPSSatMask1, GPSSatMask0, BDSSatMask1, BDSSatMask0, GLOSatMask1, GLOSatMask0, GALSatMask1, GALSatMask0,RSV,RSV,RSV,RSV	
Example	$CFGSATMASK, h00000001, h00000010, h00000100, h00001000, h00000001, h00000010, h00000100, h00001000, h00000001, h00000010, h00000100, h00001000	
Description	Set/Output the configuration to mask specific satellites	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
GPSSatMask1	UINT	Bitmask of GPS satellite, QZSS satellite 193 to 202, LSB (bit0:Sat193, bit9: Sat202)
GPSSatMask0	UINT	Bitmask of GPS satellite 1 to 32, LSB (bit0:Sat PRN1, bit31:Sat PRN32)
BDSSatMask1	UINT	Bitmask of BDS satellite 33 to 64, LSB (bit0:Sat PRN33, bit31:Sat PRN64)
BDSSatMask0	UINT	Bitmask of BDS satellite 1 to 32, LSB (bit0:Sat PRN1, bit31:Sat PRN32)
GLOSatMask1	UINT	Bitmask of GLO satellite, reserved
GLOSatMask0	UINT	Bitmask of GLO satellite 1 to 32, LSB (bit0:Sat PRN1, bit31: Sat PRN32)
GALSatMask1	UINT	Bitmask of GAL satellite 33 to 64, LSB (bit0:Sat PRN33, bit31:Sat PRN64)
GALSatMask0	UINT	Bitmask of GAL satellite 1to 32, LSB (bit0: Sat PRN1, bit31:Sat PRN32)
RSV	UINT	Reserved
RSV	UINT	Reserved
RSV	UINT	Reserved
RSV	UINT	Reserved

☞ RSV is reserved for marks of other systems and signals later.

1.4.2.13 CFGFREQMASK: Configure to Mask Specific Frequency

Table 1-35 Read the Satellite Information of Masked Frequency

Syntax	$CFGFREQMASK,SysFreq	
Example	$CFGFREQMASK,GPSL1CA	
Description	Read the satellite information of the masked frequency.	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
SysFreq	STR	System frequency masked: GPSL1CA GPSL1C GPSL2C GPSL5 BDSB1I BDSB1C BDSB2A GLOR1 GALE1 GALE5A GALE5B

Table 1-36 Set/Output the Configuration to Mask Frequency and Satellite Number

Syntax	$CFGFREQMASK,SysFreq,SatSvBitMask1,SatSvBitMask2	
Example	$CFGFREQMASK,GPSL1CA,H03,H01	
Description	Set/Output the configuration to mask frequency and satellite number	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
SysFreq	STR	System frequency masked: GPSL1CA GPSL1C GPSL2C GPSL5 BDSB1I BDSB1C BDSB2A GLOR1

		GALE1 GALE5A GALE5B
SatSvBitMask1	UINT	Satellite number: 1 to 32; Set corresponding bit to 1 to mask the satellite. Bit 0 corresponds to the satellite prn 1, and so on.
SatSvBitMask2	UINT	Satellite number: 33 to 64; Set corresponding bit to 1 to mask the satellite. Bit 0 corresponds to the satellite prn 33, and so on.

1.4.2.14 CFGTIMTH: Configure Threshold in Timing Application

Table 1-37 Read the Threshold Configuration in Timing Application

Syntax	$CFGTIMTH
Example	$CFGTIMTH
Description	Read the current threshold configuration of timing application. The receiver outputs CFGTIMTH message after receiving this command.
Input/Output	Input
No parameter	

Table 1-38 Set/Output the Threshold Configuration in Timing Application

Syntax	$CFGTIMTH,TimTPQlty2TH, NanTarWaitTimeTH,Rsv1,Rsv2	
Example	$CFGTIMTH,100,0,0,0	
Description	Set or output timing configuration	
Input/Output	Input/output	
Parameter Definition		
Parameter	Format	Description
TimTPQlty2TH	UINT	Threshold configuration of quality = 2 in TIMTP (see section 1.4.3.1); can be configured as 50 to 200, recommended to be 100; unit: ns
NanTarWaitTimeTH	UINT	The waiting time of time conversion under non-target GNSS timing; can be configured as 0 to 45, recommended to be 30; unit: s
Rsv1	UINT	Reserved
Rsv2	UINT	Reserved

1.4.2.15 CFGAGNSS: Configure AGNSS function

Table 1-10 Read AGNSS Configuration

Syntax	$CFGAGNSS
Example	$CFGAGNSS
Description	Read the configuration of AGNSS function. The receiver outputs CFGAGNSS message after receiving this command.
Input/Output	Input
No Parameters	

Table 1-11 Set/Output AGNSS Configuration

Syntax	$CFGAGNSS,control	
Example	$CFGAGNSS,1	
Description	Set or output the configuration of AGNSS function.	
Input/Output	Input/Output	
Parameter Definition		
Parameter	Format	Description
control	UINT	1: Enable AGNSS function 0: Disable AGNSS function

1.4.2.16 AIDPOS: Configure Assisted Position

Table 1-39 Read the Assisted Position

Syntax	$AIDPOS
Example	$AIDPOS
Description	Read the assisted position
Input/Output	Input
No Parameters	

Table 1-40 Input Assisted Position

Syntax	$AIDPOS,Latitude,LatDir, Longitude,LonDir,Altitude	
Example	$AIDPOS,4002.229934,N,11618.096855,E,37.254	
Description	Input the assisted position	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
Latitude	DOUBLE	Latitude; in the format of ddmm.mmmmmm: dd - Degree mm.mmmmmm - Minute
LatDir	STR	North or south latitude indicator: N - North latitude S - South latitude
Longitude	DOUBLE	Longitude; in the format of dddmm.mmmmmm: ddd - Degree

		mm.mmmmmm - Minute
LonDir	STR	East or west longitude indicator: E - East longitude W - West longitude
Altitude	DOUBLE	Ellipsoidal height; unit: m

1.4.2.17 AIDTIME: Configure Assisted Time

Table 1-41 Read the Assisted Position

Syntax	$AIDTIME
Example	$AIDTIME
Description	Read the assisted time
Input/Output	Input
No Parameters	

Table 1-42 Input Assisted Time Information

Syntax	$AIDTIME,Year,Month,Day,Hour,Minute,Second,Millisecond,Leapsec	
Example	$AIDTIME,2021,12,3,15,2,36,400,18	
Description	Input the assisted time, UTC time	
Input/Output	Input	
Parameter Definition		
Parameter	Format	Description
Year	UINT	Year
Month	UINT	Month
Day	UINT	Day
Hour	UINT	Hour
Minute	UINT	Minute
Second	UINT	Second
Millisecond	UINT	Millisecond
Leapsec	UINT	Leap second

1.4.3 Output Messages

1.4.3.1 TIMTP: PPS Timestamp

Table 1-43 Output the PPS Corresponding Time

Syntax	$TIMTP,quality,biasFlag,gnssRef,timeSource,timeBase,week,sow,msec*cs	
Example	$TIMTP,4,0,0,0401,0,2196,291946,0*68	
Description	Output message of the PPS corresponding time.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
quality	UINT	Timing pulse quality 0: No PPS output 1: Rely on the local clock, no GNSS time calibration, low accuracy 2: The convergence of PPS accuracy evaluated by the receiver Firmware fluctuates at ±100ns 3: The convergence of PPS accuracy evaluated by the receiver Firmware fluctuates at ±50ns 4: Accurate, the convergence of PPS accuracy evaluated by the receiver Firmware fluctuates at ±10ns
biasFlag	UINT	Status indicator of the current timing system (For each bit, it is effective when set to 1.) Bit0: PVT not positioning, external fixed coordinate; cannot evaluate the accuracy of timing Bit1: PVT positioning, evaluate Fix coordinate as invalid Bit2: PVT positioning, the coordinate of PPS module is fixed, evaluate Fix coordinate as invalid Bit8: The receiver's GNSS time is re-initialized
gnssRef	UINT	GNSS time datum referred by PPS (bit3:0) 0: GPS 1: BDS 2: GAL 3: GLO
timeSource	UINT	GNSS system used by the receiver (bit 3:0) 0: GPS 1: BDS 2: GAL 3: GLO GNSS frequencies used by the receiver (bit 11:8)

		Bit 8: the first frequency Bit 9: the second frequency Bit 10: the third frequency Bit 11: the fourth frequency For more details about frequencies, see Table 1-44.
timeBase	UINT	Time base of PPS 0: GNSS system time 1: UTC (Each GNSS system corresponds to its own UTC standard)
week	UINT	Week number
sow	UINT	Seconds of week
msec	UINT	Milliseconds

Table 1-44 Description of GNSS Frequencies

GNSS	1st frequency	2nd frequency	3rd frequency	4th frequency
GPS	L1C/A	L2C	L5	L1C
GLO	G1	/	/	/
BDS	B1C	B2A	B1I	/
GAL	E1	E5A	E5B	/

1.4.3.2 TPFINFO: Convergence State of Fixed Position Optimization

Table 1-45 Output Convergence State of Fixed Position Optimization

Syntax	$TPFINFO,Status,PosOptTime,meanV,meanLat,meanLon,meanAlt*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 the position optimization state 0: Real-time single point positioning mode 1: Fixed-location mode, the position is from external input 2: Optimizing 3: Completed, entered into fixed-location timing mode
PosOptTime	UINT	The elapsed optimization time, in seconds
meanV	UINT	3D standard deviation of the current optimized position, in centimeters
meanLat	DOUBLE	Latitude of the current optimized position, with north latitude being positive and south latitude being negative, in degrees
meanLon	DOUBLE	Longitude of the current optimized position, with east longitude being positive and west longitude being negative, in degrees
meanAlt	DOUBLE	Height of the current optimized position, in meters

1.4.3.3 TIMPOS: Real-time Position and Fixed Position

Table 1-46 Output the Receiver's Position Information

Syntax	$TIMPOS,mode,lat,lon,alt,fixLat,fixLon,fixAlt,pdop*cs	
Example	$TIMPOS,3,40.078971,116.236514,55.09,40.078970,116.236510,55.00,0.94*30	
Description	Output the receiver's 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, in degrees
lon	DOUBLE	Real-time longitude of the receiver with east latitude being positive and west latitude being negative, in degrees
alt	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 longitude of the receiver with east latitude being positive and west latitude being negative, in degrees
fixAlt	DOUBLE	Fixed ellipsoid height of the receiver, in meters
pdop	DOUBLE	Position dilution of precision, and the value is 99.99 when not positioning

1.4.3.4 GPSTIME: GPS Time

Table 1-47 Output GPS Time

Syntax	$GPSTIME,TimeQuality,week,sow,GpsTotalSec,lsf,lsfFlag*cs	
Example	$GPSTIME,3,2127,201265000.000000000,1286610865,18,2*72	
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	UINT	Week number, 0 if invalid
sow	DOUBLE	Seconds of week (nine digits after decimal point, nanosecond accuracy), 0 if invalid
GpsTotalSec	UINT	Total seconds since the start of GPS time (Jan 6, 1980)
Lsf	UINT	Leap second
lsfFlag	UINT	Leap second valid flag 0: Unknown 1: User configuration or default value 2: Synchronized with other GNSS systems 3: Leap second parameters broadcast by the current system

1.4.3.5 BDSTIME: BDS Time

Table 1-48 Output BDS Time

Syntax	$BDSTIME,TimeQuality,week,sow,BdsTotalSec,gpsWeek,gpsSow,lsf,lsfFlag*cs	
Example	$BDSTIME,3,771,201251000.000000000,466502051,2127,201265000.000000000,4,3*73	
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	UINT	Week number, 0 if invalid
sow	DOUBLE	Seconds of week (nine digits after decimal point, nanosecond accuracy), 0 if invalid
BdsTotalSec	UINT	BDS total seconds
gpsWeek	UINT	GPS week number, null if invalid
gpsSow	DOUBLE	GPS seconds of week (nine digits after decimal point, nanosecond accuracy), null if invalid
lsf	UINT	Leap second
lsfFlag	UINT	Leap second valid flag 0: Unknown 1: User configuration or default value 2: Synchronized with other GNSS systems 3: Leap second parameters broadcast by the current system

1.4.3.6 GALTIME: Galileo Time

Table 1-49 Output Galileo Time

Syntax	$GALTIME,TimeQuality,week,sow,GalTotalSec,gpsWeek,gpsSow,lsf,lsfFlag*cs	
Example	$GALTIME,3,1103,201265000.000000000,667295665,2127,201265000.000000000,18,3*6f	
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	UINT	Week number, null if invalid
sow	DOUBLE	Seconds of week (nine digits after decimal point, nanosecond accuracy), null if invalid
GalTotalSec	UINT	Galileo total seconds
gpsWeek	UINT	GPS week number, 0 if invalid
gpsSow	DOUBLE	GPS seconds of week (nine digits after decimal point, nanosecond accuracy), null if invalid
lsf	UINT	Leap second
lsfFlag	UINT	Leap second valid flag 0: Unknown 1: User configuration or default value 2: Synchronized with other GNSS systems 3: Leap second parameters broadcast by the current system

1.4.3.7 GLOTIME: GLONASS Time

Table 1-50 Output GLONASS Time

Syntax	$GLOTIME,TimeQuality,day,tod,GloTotalSec,gpsWeek,gpsSow,lsf,lsfFlag*cs	
Example	$GLOTIME,3,10514,39247000.000000000,908448847,2127,201265000.000000000,10800,1*56	
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	UINT	Day number, null if invalid
tod	DOUBLE	Seconds of day (nine digits after decimal point, nanosecond accuracy), null if invalid
GloTotalSec	UINT	GLONASS total seconds
gpsWeek	UINT	GPS week number, null if invalid
gpsSow	DOUBLE	GPS seconds of week (nine digits after decimal point, nanosecond accuracy), null if invalid
lsf	UINT	Fixed value, 3600 × 3 (the difference between GLONASS time and UTC is fixed at 3 hours)
lsfFlag	UINT	Fixed at 1, which means it is always valid

1.4.3.8 UTCTIME: UTC Time

Table 1-51 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)

1.4.3.9 LSINFO: Current Leap Second and Forecast Information

Table 1-52 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 that outputs leap second information 0: GPS 1: BDS 2: GAL 3: GLO
flag	UINT	Valid flag of leap second information 0: Invalid 1: Valid
week	UINT	Week number when the future leap second takes effect
sow	UINT	Seconds of week when the future leap second takes effect
currLeapSec	UINT	Current leap second
leapSecAdj	UINT	Leap second after adjustment

1.4.3.10 GPSLSINFO：GPS Leap Second Information

Table 1-53 GPS Leap Second Information

Syntax	$GPSLSINFO,Curr GPS Week,Curr GPS Ms,Rsv,SrcOfCurrLs,CurrentLeadSecond,SrcOfTLSF,TLSF,TimeToLsEvent,DateOfLeapSeco,ndGPSWn,DateOfLeapSecondGPSDayNum,ValidFlag,Rsv,Rsv*cs	
Example	$GPSLSINFO,2292,466457000,0,4,18,4,18,0,1417,7,1,0,0*45	
Description	Output the information of GPS leap second.	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
Curr GPS Week	USHORT	Current GPS week
Curr GPS Ms	UINT	Current GPS seconds of week; unit: ms
RSV	UINT	Reserved
SrcOfCurrLs	UCHAR	Source of the current leap second 0 = Default data stored in flash, maybe out of date 1 = Time difference between GPST and GLOSNASS time or BDT or Galileo time 2 = GPS 4 = BeiDou 5 = Galileo 6 = Assisted data 7 = Configuration 255 = Unknown
CurrentLeadSecond	LONG	Current number of leap second since start of GPST (Jan. 6th, 1980) which reflects how much GPST is ahead of UTC time. Galileo number of leap seconds is as same as GPS. BeiDou number of leap seconds is 14 less than GPS. GLONASS follows UTC time, so it has no leap seconds.
SrcOfTLSF	UCHAR	Source of the future leap second: 0 = No source 2 = GPS 4 = BeiDou 5 = Galileo 6 = GLONASS
TLSF	INT	The number of the future leap second from the start of GPST
TimeToLsEvent	INT	Number of seconds to the next leap second event or from the last leap second event broadcasted in the message if there is no future leap second. If > 0, event is in the future;

		= 0, event is at present; < 0, event is in the past. Valid only when ValidFlag = 1.
DateOfLeapSecondGPSWn	INT	GPS week number when the next leap second happens or when the last leap second happened if the next leap second is not received. Valid only when ValidFlag = 1.
DateOfLeapSecondGPSDayNum	INT	GPS day of week when the next leap second happens or when the last leap second happened if the next leap second is not received. Valid only when ValidFlag = 1.
ValidFlag	UINT	Bit 0 1 = Valid current leap second parsed from the message or input from the outside 0 = Unknown leap second Bit 1 1 = The parsed message tells that a leap second happens (TLSF is not equal to TLS)
RSV	UINT	Reserved
RSV	UINT	Reserved

1.4.3.11 PPSINFO: Internal Evaluation of 1PPS Phase Error

Table 1-54 Output Internal Evaluation of 1PPS Phase Error

Syntax	$PPSINFO,timeRef,phaseError,clockError,clkDrift*cs	
Example	$PPSINFO,2,-1,4121793,1200*4b	
Description	Output internal evaluation of 1PPS phase error	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
timeRef	UINT	Time reference for the internal evaluation of 1PPS phase error 0: No reference time, phaseError output is invalid 1: Time reference is calculated by real-time positioning 2: Time reference is calculated by fixed-location timing
phaseError	INT	1PPS phase error in previous second, unit: 0.1ns (internal evaluation by the software)
clockError	INT	Clock bias between the system in use and the local receiver, unit: 0.1ns
clkDrift	INT	Clock frequency offset, unit: 0.1m/s (internal calculation by the software)

1.4.3.12 JAM: Jamming and Deceptive Signal Detection

- Output the status of jamming detection, including the condition of the notch filters (consists of 12 cascaded notch filters) and the corresponding interference intensity.
- Output the status of deceptive signal detection, including three levels.

☞ Deceptive signal detection is to monitor suspicious satellite changes;

☞ Deceptive signal detection works only when a real satellite provides accurate positioning before a fake satellite appears;

☞ If the module first connects to a fake satellite, then the deceptive signal cannot be identified.

Table 1-55 Output Information of Deceptive Signal or Jamming Detection

Syntax	$JAM,GPS WeekNumber,GPS Time,decepStatus,CWFlag,Chan1Stat1,Chan1Stat2,Chan1Stat3,Chan2Stat1,Chan2Stat2,Chan2Stat3,Chan3Stat1,Chan3Stat2,Chan3Stat3,Chan4Stat1,Chan4Stat2,Chan4Stat3,Chan5Stat1,Chan5Stat2,Chan5Stat3,Chan6Stat1,Chan6Stat2,Chan6Stat3*cs	
Example	$JAM,2206,350488,0,0,00000000,00000000,330146FB,00000000,00000000,23005B3E,00000000,00000000,32005E80,00000000,00000000,2C00DB94,00000000,00000000,28005DF2,00000000,00000000,240022AA*4f	
Description	Output information of deceptive signal and jamming detection	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
GPS WeekNumber	UINT	GPS Week number
GPS Time	UINT	GPS seconds of week, unit: s
decepStatus	UINT	Detection status of the deceptive signals 0: Deceptive detection is not triggered 1: Slight deception 2: Serious deception
CWFlag	UINT	0: NO CW JAM 1: CW JAM 2: STRONG CW JAM (Choose the maximum value from all the signal channels)

Chan1Stat1[4]	UINT	Reserved
Chan1Stat2	UINT	Jamming level indicator of channel 1: Bit7:0 = Jamming strength of channel 1; range: 0 to 255; the bigger the value, the greater the impact on the signal Bit 18:16 = Jamming level of channel 1; corresponding to the value of CWFLag
Chan1Stat3	UINT	Status 3 of the jamming detection of channel 1: Bit 31:24 = AGC gain status Bit 23:0 = Background noise level of the current channel
Chan2Stat1	UINT	Reserved
Chan2Stat2	UINT	Jamming level indicator of channel 2: Bit7:0 = Jamming strength of channel 2; range: 0 to 255; the bigger the value the greater the impact on the signal Bit 18:16 = Jamming level of channel 2; corresponding to the value of CWFLag
Chan2Stat3	UINT	Status 3 of the jamming detection of channel 2: Bit 31:24 = AGC gain status Bit 23:0 = Background noise level of the current channel
…	…	
…	…	
Chan6Stat1	UINT	Reserved
Chan6Stat2	UINT	Jamming level indicator of channel 6: Bit7:0 = Jamming strength of channel 6; range: 0 to 255; the bigger the value, the greater the impact on the signal Bit 18:16 = Jamming level of channel 6; corresponding to the value of CWFLag
Chan6Stat3	UINT	Status 3 of the jamming detection of channel 6: Bit 31:24 = AGC gain status Bit 23:0 = Background noise level of the current channel

[4] The relationship between ChanX and signal channel is:

1 - GPS L1, 2 - GPS L2, 3 - GPS L5, 4 - BDS B1I, 5 - GAL E5b, 6 - GLO G1

1.4.3.13 SVNUM: Number of Searched Satellites of Each System

Table 1-56 Output the Number of Searched Satellites of Each System

Syntax	$SVNUM,gpsSvNum,gpsSvNum1,bdsSvNum,bdsSvNum1,galSvNum,galSvNum1,gloSvNum, gloSvNum1,qzssSvNum, qzssSvNum1,sbasSvNum,RSV*cs	
Example	$SVNUM,6,,12,,5,,5,,0,,0,*66	
Description	Output the number of searched satellites of each system	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
gpsSvNum	UINT	Number of searched satellites of GPS
gpsSvNum1	UINT	Reserved for other GPS frequencies, temporarily empty.
bdsSvNum	UINT	Number of searched satellites of BDS
bdsSvNum1	UINT	Reserved for other BDS frequencies, temporarily empty.
galSvNum	UINT	Number of searched satellites of GAL
galSvNum1	UINT	Reserved for other GAL frequencies, temporarily empty.
gloSvNum	UINT	Number of searched satellites of GLO
gloSvNum1	UINT	Reserved for other GLO frequencies, temporarily empty.
qzssSvNum	UINT	Number of searched satellites of QZSS
qzssSvNum1	UINT	Reserved for other QZSS frequencies, temporarily empty.
sbasSvNUm	UINT	Number of searched satellites of SBAS
RSV	UINT	Reserved

1.4.3.14 TSVNUM: Satellites Participating in Fixed-location Timing

Table 1-57 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[5]	UINT	GPS satellites that actually participate in fixed-location timing
bdsSatMask[5]	UINT	BDS satellites that actually participate in fixed-location timing
galSatMask[5]	UINT	Galileo satellites that actually participate in fixed-location timing
gloSatMask[5]	UINT	GLONASS satellites that actually participate in fixed-location timing

☞ This message only indicates which satellites are involved in timing, and it may not be synchronized with the Quality flag in TIMTP. In other words, there may be satellites involved in timing here, but the Quality in TIMTP may still be 0 or 1 due to the calibration of the algorithm (see section 1.4.3.1).

[5] The parameter format is hexadecimal. After being converted to binary, each bit from low to high represents the corresponding satellite number. If the bit is 1, it indicates that the satellite participates in fixed-location timing. If the bit is 0, it indicates that the satellite does not participate in fixed-location timing.

1.4.3.15 NOTICE

Table 1-58 Output Maintenance Information

Syntax	$NOTICE,nummsg,msgnum,text*cs	
Example	$NOTICE,4,1,99,2237,115744,1011,627,311,1,0,-320767,-40,2.2392,4,1228,2800,1;1000121,40a06*61	
Description	Output debug information	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
nummsg	UINT	Total number of messages, 1…99
msgnum	UINT	The position of this message, 1...99
text	STR	Contents of debuginformation, such as: Jamming Detect Signal Error Positioning Error Baseband Error …

1.4.3.16 STAINFO: Status Information

Table 1-59 Output Working Status of Receiver

Syntax	$STAINFO,GPSweek,GPSsow,mode,flag,RSV,RSV,ttff,msss*cs	
Example	$STAINFO,2250,385420000,3,0,0,0,23000,50000*72	
Description	Working status of the receiver	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
GPSweek	UINT	Week; fill 0 when invalid
GPSsow	UINT	Seconds of week (ms); fill 0 when invalid
mode	UINT	Positioning mode 0 = No fix (invalid position) 1 = Reserved 2 = 2D positioning 3 = 3D positioning 4 = Reserved 5 = Reserved 6 = Time only Fix
flag	UINT	Positioning status flag Bit0 = GPS Fix OK Bit1:31 = RSV
RSV	UINT	Reserved
RSV	UINT	Reserved
ttff	UINT	Time to first fix (ms)
msss	UINT	The total working seconds of the receiver; the number recounts when the receiver restarts

1.4.4 Raw Observation Message

1.4.4.1 Message Output Description

Raw observation message is the output protocol of UT986 designed for high precision applications. It is compatible with the message output configurations described in section 1.4.1.6, and supports the configuration methods described in this section.

Format of Raw Observation Output

The raw observation output currently supports ASCII format.

ASCII Format

Users and computers can directly view ASCII messages, and all ASCII messages follow the general agreements below:

- "#" is the leading character of each message;
- The variable length of each Log message or command relies on the data volume and format;
- Every data field is separated by ",", except for the following two cases:
  - The last Header field is followed by ";", indicating the beginning of the data message
  - The last data field is followed by "*", indicating the end of the data message
- At the end of each log message, there is a hexadecimal number starting with "*" and a carriage return character indicating the end of the line, for example: *1234ABCD[CR][LF]. The hexadecimal number is the 32-bit CRC checksum of all characters in this log message, but does not include "#" and "*" as well as the 8 CRC numbers after it.
- An ASCII string constitutes a field, which is quoted in double quotation marks, such as "ASCII string". If a delimiter is quoted in double quotation marks, it is neglected and the string is still considered as one field (e.g. "xxx,xxx"). Double quotation marks are not allowed to appear in a string.
- If the receiver detects wrong input, it returns a command error message.

The structure of ASCII messages:

header;data field...,data field...,data field...*xxxxxxxx[CR][LF]

As for the Header structure of the ASCII message, please refer to Table 1-60.

Table 1-60 ASCII Message Header Structure

ID	Field	Type	Description
1	Sync	CHAR	Synchronization character, ASCII message always starts with a “#”.
2	Message	CHAR	ASCII name of the log or command in this manual
3	CPUIDle	UCHAR	The minimum percentage of the CPU's idle time, calculated once per second
4	TimeRef	UCHAR	Time reference of the receiver (GPST or BDST)
5	TimeStatus	UCHAR	GPS time status. The current value is Unknown or Fine, and Unknown indicates that the receiver doesnot calculate accurate GPS time.
6	Wn	USHORT	GPS week number
7	Ms	ULONG	GPS seconds of week, accurate to ms
8	Res	ULONG	Reserved
9	Res	UCHAR	Reserved
10	Leap sec	UCHAR	Leap second
11	Res	USHORT	Reserved

Configuration of Raw Observation Output

The raw observation output can be configured by either “$cfgmsg," or the commands in the sections 1.4.4.2 to 1.4.4.24.

In the above mentioned sections, each has a description of the corresponding output message. Taking OBSVM as an example:

- OBSVMA COM1 1

This configuration means using COM1 to output ASCII message OBSVMA at the frequency of once per second, and the frequency can be configured.

- OBSVMA

Inputting this command only outputs one OBSVMA message.

- OBSVMA 2

This command means using the current port to output OBSVMA at the frequency of 1 in every 2 seconds, and the frequency can be configured.

Furthermore, for ION data, UTC data, EPH data, and raw navigation message bit stream, ONCHANGED output is supported (i.e. output message as soon as the solved parameters change) in addition to the above configurations configured by OBSVM.

For EPH data, the output frequency is required to be more than 10 s.

1.4.4.2 OBSVM: Observation Message

OBSVM contains the measurement information of the current receiver's tracking channels. For a dual-antenna receiver, OBSVM outputs the raw observation message of the masterantenna.

ASCII Syntax:

OBSVMA 1

Message Output:

#OBSVM,94,GPS,FINE,1971,280488800,0,0,18,1,0;85,0,2,21222412.195,-111524532.194196,4,54,-1782.123,4719,0,425.609,28101c24,0,2,21222405.863,-86902205.519989,8,81,-1388.729,4411,0,422.200,21301c2b,0,5,20411034.146,-107260712.085988,4,50,-816.267,4947,0,425.609,28101c44,0,5,20411030.509,-83579760.046225,6,65,-636.174,4630,0,422.200,21301c4b,0,5,20411031.210,-83579765.043571,4,50,-636.081,4853,0,421.400,22301c4b,0,7,24548211.750,-129001723.217278,9,83,-492.474,4131,0,425.609,28101c64,0,7,24548208.940,-100520803.516577,25,262,-384.232,3368,0,387.800,21301c6b,0,7,24548209.781,-100520788.511940,14,130,-383.832,3597,0,422.000,22301c6b,0,13,20815721.791,-109387361.837300,4,51,2021.631,4776,0,425.609,28101c84,0,13,20815717.958,-85236892.035139,8,78,1575.494,4456,0,422.000,21301c8b,0,15,22379191.797,-117603449.600393,6,66,3353.041,4468,0,425.609,28101ca4,0,15,22379189.076,-91639036.925472,14,126,2612.773,4018,0,422.200,21301cab,0,15,22379189.827,-91639065.914678,8,79,2612.726,4206,0,421.200,22301cab,0,20,21388092.919,-112395192.169932,6,66,1979.461,4465,0,425.609,28101cc4,0,20,21388089.017,-87580651.598371,11,99,1542.516,4145,0,422.000,21301ccb,0,29,21187657.649,-111341896.264768,4,50,-222.121,4893,0,425.609,28101ce4,0,29,21187654.225,-86759903.085141,8,81,-173.232,4410,0,421.800,21301ceb,0,29,21187654.757,-86759901.075208,5,62,-173.102,4557,0,278.000,22301ceb,0,30,23713834.684,-124617041.851852,9,87,1030.285,4054,0,425.609,28101d04,0,30,23713834.462,-97104182.152488,20,202,803.465,3657,0,159.800,21301d0b,0,30,23713835.930,-93058184.972318,5,62,769.370,4556,0,425.609,21d01d00,0,30,23713835.374,-97104185.157783,9,85,802.748,4091,0,420.600,22301d0b,0,21,25536540.787,-

134195417.985644,12,111,2945.978,3721,0,395.600,28101d64,0,21,25536539.796,-
104567879.721552,44,377,2294.391,2987,0,13.800,21301d6b,0,47,24088022.124,-
128402710.573309,11,99,-467.297,3816,0,145.000,28111c24,0,47,24088030.933,-
99868824.817024,21,216,-363.421,3024,0,421.000,20b11c2b,3,39,19373536.406,-
103380902.901757,4,50,-650.151,4929,0,421.000,28111c44,3,39,19373540.876,-
80407388.032978,4,50,-505.675,4992,0,421.000,20b11c4b,4,55,21181385.664,-
113067681.816258,4,55,3256.230,4692,0,423.000,28111c64,4,55,21181389.609,-
87941532.413022,5,59,2532.627,4602,0,423.000,20b11c6b,7,48,23828924.976,-
127334550.440490,7,74,2191.618,4302,0,423.000,28111c84,7,48,23828930.491,-
99038014.262927,10,91,1704.585,3979,0,423.000,20b11c8b,8,38,22348894.598,-
119467652.873635,7,70,-3389.813,4399,0,423.000,28111ca4,8,38,22348898.130,-
92919305.012375,11,97,-2636.373,3857,0,423.000,20b11cab,9,61,21534072.897,-
115152363.389579,10,91,-3937.846,3980,0,47.000,28111cc4,9,61,21534074.725,-
89562957.661143,16,152,-3062.768,3450,0,423.000,20b11ccb,11,54,19169428.543,-
102579481.097235,4,50,-467.535,4919,0,421.000,28111ce4,11,54,19169427.813,-
79784036.370922,4,50,-363.670,5027,0,423.000,20b11ceb,12,40,21320842.483,-
114132125.893984,6,65,2510.345,4487,0,423.000,28111d04,12,40,21320841.181,-
88769437.070578,5,58,1952.521,4626,0,423.000,20b11d0b,0,1,38058203.146,-
198179055.329748,8,80,-17.748,4195,0,429.209,2c141c24,0,1,38058191.636,-
153244568.938695,4,55,-13.751,4683,0,427.209,26341c2b,0,1,38058194.464,-
161036675.262810,6,62,-14.456,4550,0,427.609,26a41c20,0,2,37980441.830,-
197774134.361522,11,99,-11.797,3814,0,425.809,2c141c44,0,2,37980434.014,-
152931471.984884,5,61,-9.076,4575,0,427.409,26341c4b,0,2,37980437.293,-
160707659.255514,6,67,-9.558,4453,0,427.809,26a41c40,0,3,37520296.484,-
195378031.357099,9,86,-26.363,4068,0,429.209,2c141c64,0,3,37520289.036,-
151078660.605401,4,51,-20.336,4772,0,427.609,26341c6b,0,3,37520290.972,-
158760630.041439,5,61,-21.367,4570,0,427.609,26a41c60,0,4,38936240.668,-
202751230.928856,11,100,-23.196,3800,0,429.209,2c141c84,0,4,38936234.049,-
156780081.759398,6,67,-17.886,4441,0,427.409,26341c8b,0,4,38936235.116,-
164751955.098402,9,82,-18.862,4152,0,427.609,26a41c80,0,5,39849559.838,-
207507123.809685,13,120,-9.338,3662,0,429.209,2c141ca4,0,5,39849553.652,-
160457641.631816,7,74,-7.064,4319,0,426.009,26341cab,0,5,39849554.576,-
168616505.129904,10,89,-7.527,4020,0,426.009,26a41ca0,0,6,36206998.273,-
188539348.434993,6,62,211.339,4548,0,428.609,28141cc4,0,6,36206991.026,-
145790550.817916,4,50,163.479,5156,0,423.600,22341ccb,0,6,36206991.028,-
153203626.957558,4,50,171.762,5047,0,423.600,22a41cc0,0,8,36725569.798,-
191239681.033605,7,71,-864.311,4379,0,428.609,28141ce4,0,8,36725561.871,-
147878620.056780,4,50,-668.303,4938,0,423.600,22341ceb,0,8,36725561.526,-
155397868.878389,4,50,-702.257,4859,0,423.600,22a41ce0,0,13,35554344.045,-
185140805.845714,4,51,-314.216,4772,0,428.209,28141d04,0,13,35554343.509,-
143162608.914397,4,50,-242.959,5039,0,423.600,22341d0b,0,13,35554342.382,-
150442056.635603,4,50,-255.287,5057,0,423.600,22a41d00,0,14,23334957.821,-
121511248.468354,6,63,-2184.181,4540,0,428.009,28141d24,0,14,23334951.618,-
93960181.346592,4,50,-1688.921,5003,0,423.600,22341d2b,0,14,23334950.507,-

98737810.615348,4,50,-1774.786,4952,0,423.600,22a41d20,0,9,37652644.421,-196067202.836501,9,81,645.307,4163,0,428.009,28141d44,0,9,37652639.893,-151611579.737359,4,50,499.054,4897,0,423.600,22341d4b,0,9,37652637.797,-159320632.687244,4,54,524.425,4706,0,423.600,22a41d40,0,3,23183584.743,-121830562.192879,4,50,-181.086,4862,0,425.809,28331c24,0,3,23183584.764,-90977365.113084,4,50,-135.177,5124,0,425.809,21931c2b,0,3,23183582.116,-93350679.010208,4,50,-138.716,5411,0,426.809,22331c20,0,5,25507209.112,-134041287.534354,7,69,-2264.297,4417,0,424.209,28331c44,0,5,25507210.183,-100095768.136885,6,62,-1690.830,4543,0,418.000,21931c4b,0,5,25507207.050,-102706952.424800,4,52,-1734.882,4754,0,426.209,22331c40,0,8,23294166.581,-122411677.195573,8,75,2056.258,4299,0,424.609,28331c64,0,8,23294166.911,-91411315.900560,6,63,1535.476,4527,0,424.609,21931c6b,0,8,23294163.796,-93795949.141695,4,50,1575.635,4855,0,426.809,22331c60,0,18,28433603.739,-149419595.945807,16,147,-3788.807,3484,0,0.800,28331c84,0,18,28433614.471,-111579593.878126,11,94,-2829.213,3916,0,418.000,21931c8b,0,18,28433608.918,-114490346.606701,10,92,-2903.180,3941,0,424.809,22331c80,0,22,22981047.706,-120766218.441556,6,64,-2409.453,4520,0,425.409,28331ca4,0,22,22981047.503,-90182562.199915,4,50,-1799.236,4797,0,425.409,21931cab,0,22,22981044.529,-92535141.158436,4,50,-1846.156,5030,0,426.809,22331ca0*2E

Table 1-61 OBSVM Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	OBSVM header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	obs Number	Number of corresponding observations	ULONG	4	H
3	System Freq	GLONASS frequency number. (GLONASS frequency + 7), not for GPS, BDS, and Galileo.	USHORT	2	H+4
4	PRN/ slot	Satellite PRN number: BDS=1 to 63 GPS=1 to 32 GLONASS=38 to 61 Galileo=1 to 36 SBAS= 120 to 141 QZSS= 193 to 197	USHORT	2	H+6
5	psr	Pseudorange measurement, unit: m	DOUBLE	8	H+8
6	adr	Carrier phase (integral Doppler), unit: cycle	DOUBLE	8	H+16

ID	Field	Description	Format	Binary Bytes	Binary Offset
7	psr std	Pseudorange measurement standard deviation*100	USHORT	2	H+24
8	adr std	Carrier phase standard diviation*10000	USHORT	2	H+26
9	dopp	Instantaneous carrier Doppler frequency, unit: Hz	FLOAT	4	H+28
10	C/N0	Carrier to noise ratio C/N0 = 10[log10(S/N0)](dB-Hz); C/N0 ×100	USHORT	2	H+32
11	REV	Reserved	USHORT	2	H+34
12	locktime	Time of continuous tracking (no cycle slip), unit: s	FLOAT	4	H+36
13	ch-tr-status	Tracking status, refer to Table 1-62 Channel Tracking Status		4	H+40
14…	Next OBS offset = H+4+ (#obs x 40) An epoch contains the observations of all frequencies and all satellites. Each frequency observation accounts for 40 bytes and loops from the 3rd to the 13th field.				
Variable	xxxx	32-bit CRC	HEX	4	H+4+ (#obs x 40)
Variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 1-62 Channel Tracking Status

Nibble #	Bit #	Mask	Description	Range Value
N0	0	0x00000001	Reserved	
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010		
	5	0x00000020	SV channel number	0-n (0 = first, n = last) n depends on the receiver
	6	0x00000040		
	7	0x00000080		
N2	8	0x00000100		
	9	0x00000200		
	10	0x00000400	Carrier phase flag	0 = invalid, 1 = valid
	11	0x00000800	Reserved	
N3	12	0x00001000	Pseudorange flag	0 = invalid, 1 = valid
	13	0x00002000	Reserved	
	14	0x00004000		
	15	0x00008000		
N4	16	0x00010000	Satellite system	0 = GPS 1 = GLONASS 2 = SBAS 3 = GAL 4 = BDS 5 = QZSS 6-7 = Reserved
	17	0x00020000		
	18	0x00040000		
	19	0x00080000	Reserved	
N5	20	0x00100000	Reserved	
	21	0x00200000	Signal type	Depends on the supported satellite system:
	22	0x00400000		GPS: 0 = L1 C/A 9 = L2P (Y) 3 = L1C (Pilot) 11 = L1C (Data) semicodeless 6 = L5 (Data) 14 = L5 (Pilot) BDS: 0 = B1I 4 = B1Q 8 = B1C (Pilot) 23 = B1C (Data) 5 = B2Q 17 = B2I 12 = B2a (Pilot)
	23	0x00800000		
N6	24	0x01000000		

Nibble #	Bit #	Mask	Description	Range Value
	25	0x02000000		17 = L2C (L) GLONASS: 0 = L1 C/A 5 = L2 C/A QZSS: 0 = L1 C/A 6 = L5 (Data) 14 = L5 (Pilot) 17 = L2C (L) 28 = B2a (Data) 6 = B3Q 21 = B3I 13= B2b(I) GAL: 1 = E1B 2 = E1C 12 = E5A (Pilot) 17 = E5B (Pilot) SBAS: 0 = L1 C/A 6 = L5 (I)
	26	0x04000000	L2C flag bit	0: L2P(Y) 1: L2C
	27	0x08000000	Reserved	
N7	28	0x10000000	Reserved	
	29	Reserved	Reserved	
	30	0x40000000	Reserved	
	31	0x80000000	Reserved	

1.4.4.3 GPSION: GPS Ionosphere Parameters

This log provides GPS ionosphere model parameters.

ASCII Syntax:

GPSIONA ONCHANGED

Message Output:

#GPSIONA,97,GPS,FINE,2172,438257000,0,0,18,10;5.587935447692871e-09,1.490116119384766e-08,-5.960464477539062e-08,-1.192092895507812e-07,7.782400000000000e+04,3.276800000000000e+04,-6.553600000000000e+04,-2.621440000000000e+05,0,0,0,0*aa6b593d

Table 1-63 GPSION Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSION	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	a0	Constant term of alpha parameter	DOUBLE	8	H
3	a1	1st order term of alpha parameter	DOUBLE	8	H+8
4	a2	2nd order term of alpha parameter	DOUBLE	8	H+16
5	a3	3rd order term of alpha parameter	DOUBLE	8	H+24
6	b0	Constant term of beta parameter	DOUBLE	8	H+32
7	b1	1st order term of beta parameter	DOUBLE	8	H+40
8	b2	2nd order term of beta parameter	DOUBLE	8	H+48
9	b3	3rd order term of beta parameter	DOUBLE	8	H+56
10	reserved	Reserved	USHORT	2	H+64
11	reserved	Reserved	USHORT	2	H+66
12	reserved	Reserved	ULONG	4	H+68
13	reserved	Reserved	ULONG	4	H+72
14	xxxx	32-bit CRC	HEX	4	H+76
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.4 BDSION: BDS Ionosphere Parameters

This log provides BDS ionosphere model parameters.

ASCII Syntax:

BDSIONA ONCHANGED

Message Output:

#BDSIONA,97,GPS,FINE,2172,438257000,0,0,18,10;1.117587089538574e-08,7.450580596923828e-08,-5.960464477539062e-07,9.536743164062500e-07,1.454080000000000e+05,-6.389760000000000e+05,4.128768000000000e+06,-2.883584000000000e+06,0,0,0,0*02b6dc72

Table 1-64 BDSION Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BDSION	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	a0	Constant term of alpha parameter	DOUBLE	8	H
3	a1	1st order term of alpha parameter	DOUBLE	8	H+8
4	a2	2nd order term of alpha parameter	DOUBLE	8	H+16
5	a3	3rd order term of alpha parameter	DOUBLE	8	H+24
6	b0	Constant term of beta parameter	DOUBLE	8	H+32
7	b1	1st order term of beta parameter	DOUBLE	8	H+40
8	b2	2nd order term of beta parameter	DOUBLE	8	H+48
9	b3	3rd order term of beta parameter	DOUBLE	8	H+56
10	reserved	Reserved	USHORT	2	H+64
11	reserved	Reserved	USHORT	2	H+66
12	reserved	Reserved	ULONG	4	H+68
13	reserved	Reserved	ULONG	4	H+72
14	xxxx	32-bit CRC	HEX	4	H+76
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.5 GALION: Galileo Ionosphere Parameters

This log provides Galileo ionosphere model parameters.

ASCII Syntax:

GALIONA ONCHANGED

Message Output:

#GALIONA,97,GPS,FINE,2172,438257000,0,0,18,10;6.575000000000000e+01,3.906250000000000e-02,8.636474609375000e-03,0,0,0,0,0,0*eedf0b91

Table 1-65 GALION Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GALION	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	a0	1st order term of alpha parameter	DOUBLE	8	H
3	a1	2nd order term of alpha parameter	DOUBLE	8	H+8
4	a2	3rd order term of alpha parameter	DOUBLE	8	H+16
5	SF1	Ionospheric disturbance flag for Region 1	DOUBLE	8	H+24
6	SF2	Ionospheric disturbance flag for Region 2	DOUBLE	8	H+32
7	SF3	Ionospheric disturbance flag for Region 3	DOUBLE	8	H+40
8	SF4	Ionospheric disturbance flag for Region 4	DOUBLE	8	H+48
9	SF5	Ionospheric disturbance flag for Region 5	DOUBLE	8	H+56
10	RSV	Reserved	ULONG	4	H+64
11	xxxx	32-bit CRC	HEX	4	H+68
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.6 BD3ION: BD3 Ionosphere Parameters

This log provides BD3 ionosphere model parameters.

ASCII Syntax:

BD3IONA ONCHANGED

Message Output:

#BD3IONA,97,GPS,FINE,2205,118352000,0,0,18,0;2.275000000000000e+01,2.000000000000000e+00,9.250000000000000e+00,7.125000000000000e+00,-9.125000000000000e+00,1.250000000000000e-01,5.000000000000000e-01,2.000000000000000e+00,1.500000000000000e+00,1*961a13d6

Table 1-66 BD3ION Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BD3ION	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	A1	Parameter 1 of Ionospheric Delay Correction Model	FLOAT	4	H
3	A2	Parameter 2 of Ionospheric Delay Correction Model	FLOAT	4	H+4
4	A3	Parameter 3 of Ionospheric Delay Correction Model	FLOAT	4	H+8
5	A4	Parameter 4 of Ionospheric Delay Correction Model	FLOAT	4	H+12
6	A5	Parameter 5 of Ionospheric Delay Correction Model	FLOAT	4	H+16
7	A6	Parameter 6 of Ionospheric Delay Correction Model	FLOAT	4	H+20
8	A7	Parameter 7 of Ionospheric Delay Correction Model	FLOAT	4	H+24
9	A8	Parameter 8 of Ionospheric Delay Correction Model	FLOAT	4	H+28
10	A9	Parameter 9 of Ionospheric Delay Correction Model	FLOAT	4	H+32
11	reserved	Reserved	ULONG	4	H+36
12	xxxx	32-bit CRC	HEX	4	H+40
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.7 GPSCNAVION: GPS Ionosphere Parameters in CNAV Message

This log provides the ionosphere parameter of GPS CNAV message.

ASCII Syntax:

GPSCNAVIONA ONCHANGED

Message Output:

#GPSCNAVIONA,97,GPS,FINE,2205,118658000,0,0,18,2;1.583248376846313e-08,1.490116119384766e-08,-2.980232238769531e-07,-1.192092895507812e-07,1.064960000000000e+05,6.553600000000000e+04,-1.966080000000000e+05,-1.966080000000000e+05,0,0,0,0*479ba94d

Table 1-67 GPSCNAVION Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSCNAVION	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	a0	The constant term of the parameter Alpha	DOUBLE	8	H
3	a1	The first order term of the parameter Alpha	DOUBLE	8	H+8
4	a2	The second order term of the parameter Alpha	DOUBLE	8	H+16
5	a3	The third order term of the parameter Alpha	DOUBLE	8	H+24
6	b0	The constant term of the parameter Beta	DOUBLE	8	H+32
7	b1	The first order term of the parameter Beta	DOUBLE	8	H+40
8	b2	The second order term of the parameter Beta	DOUBLE	8	H+48
9	b3	The third order term of the parameter Beta	DOUBLE	8	H+56
10	usSVID	The ID of the satellite used to solve ionosphere parameters	USHORT	2	H+64
11	reserved	Reserved	USHORT	2	H+66
12	reserved	Reserved	ULONG	4	H+68
13	reserved	Reserved	ULONG	4	H+72
14	xxxx	32-bit CRC	HEX	4	H+76

ID	Field	Description	Format	Binary Bytes	Binary Offset
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.8 GPSUTC: Conversion Parameters between GPST and UTC

This log provides time conversion parameters between GPST and UTC.

ASCII Syntax:

GPSUTCA ONCHANGED

Message Output:

#GPSUTCA,97,GPS,FINE,2172,438257000,0,0,18,12;2172,589824,-1.862645149230957e-09,2.664535259e-15,2185,7,18,18,0,0*1b0f9310

Table 1-68 GPSUTC Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSUTC	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	utc wn	UTC reference week number	ULONG	4	H
3	tot	Reference time of UTC parameters	ULONG	4	H+4
4	A0	GPST clock bias relative to UTC	DOUBLE	8	H+8
5	A1	GPST clock rate relative to UTC	DOUBLE	8	H+16
6	wn lsf	Week number when a new leap second takes effect (based on GPS time)	ULONG	4	H+24
7	dn	Day number of week when a new leap second takes effect (ranging from 1 to 7, Sunday=1, Saturday=7)	ULONG	4	H+28
8	deltat ls	Accumulated leap second correction of GPST relative to UTC before a new leap second takes effect	LONG	4	H+32
9	deltat lsf	Accumulated leap second correction of GPST relative to UTC after a new leap second takes effect	LONG	4	H+36
10	reserved	Reserved	ULONG	4	H+40

ID	Field	Description	Format	Binary Bytes	Binary Offset
11	reserved	Reserved	ULONG	4	H+44
12	xxxx	32-bit CRC	HEX	4	H+48
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.9 BDSUTC: Conversion Parameters between BDST and UTC

This log provides time conversion parameters between BDST and UTC.

ASCII Syntax:

BDSUTCA ONCHANGED

Message Output:

#BDSUTCA,97,GPS,FINE,2172,438257000,0,0,18,12;0,0,-2.793967723846436e-09,0.000000000e+00,829,6,4,4,0,0*9955c385

Table 1-69 BDSUTC Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BDSUTC	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	utc wn	UTC reference week number	ULONG	4	H
3	tot	Reference time of UTC parameters	ULONG	4	H+4
4	A0	BDT clock bias relative to UTC	DOUBLE	8	H+8
5	A1	BDT clock rate relative to UTC	DOUBLE	8	H+16
6	wn lsf	Week number when a new leap second takes effect (based on BDS time)	ULONG	4	H+24
7	dn	Day number of week when a new leap second takes effect (ranging from 0 to 6, Sunday=0, Saturday=6)	ULONG	4	H+28
8	deltat ls	Accumulated leap second correction of BDT relative to UTC before a new leap second takes effect	LONG	4	H+32
9	deltat lsf	Accumulated leap second correction of BDT relative to UTC after a new leap second takes effect	LONG	4	H+36

ID	Field	Description	Format	Binary Bytes	Binary Offset
10	reserved	Reserved	ULONG	4	H+40
11	reserved	Reserved	ULONG	4	H+44
12	xxxx	32-bit CRC	HEX	4	H+48
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.10 GALUTC: Conversion Parameters between Galileo Time and UTC

This log provides time conversion parameters between Galileo time and UTC.

ASCII Syntax:

GALUTCA ONCHANGED

Message Output:

#GALUTCA,97,GPS,FINE,2172,438257000,0,0,18,12;1.210719347000122e-08,-7.105427357601002e-15,18,120,1148,1161,7,18,1.434818841516972e-08,-8.881784197001252e-15,432000,60*94c5baf1

Table 1-70 GALUTC Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GALUTC	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	A0	Clock bias of Galileo time relative to UTC	DOUBLE	8	H
3	A1	Clock rate of Galileo time relative to UTC	DOUBLE	8	H+8
4	deltat ls	Accumulated leap second correction of Galileo time relative to UTC before a new leap second takes effect	LONG	4	H+16
5	tot	Reference time of UTC parameters	ULONG	4	H+20
6	utc wn	UTC reference week number	ULONG	4	H+24
7	ulWNlsf	Week number of Galileo time when a new leap second takes effect	ULONG	4	H+28

ID	Field	Description	Format	Binary Bytes	Binary Offset
8	dn	Day number of week when a new leap second takes effect (ranging from 1 to 7, Sunday=1, Saturday=7)	ULONG	4	H+32
9	deltat lsf	Accumulated leap second correction of Galileo time relative to UTC after a new leap second takes effect	LONG	4	H+36
10	dA0g	The constant term of the conversion parameter between Galileo time and GPST	LONG	8	H+40
11	dA1g	The first order term of the conversion parameter between Galileo time and GPST	ULONG	8	H+48
12	ulT0g	Reference seconds of week for conversion between Galileo time and GPST	ULONG	4	H+56
13	ulWN0g	Reference week number for conversion between Galileo time and GPST	ULONG	4	H+60
14	xxxx	32-bit CRC	HEX	4	H+64
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.11 BD3UTC: Conversion Parameters between BD3 Time and UTC

This log provides time conversion parameters between BDST and UTC.

ASCII Syntax:

BD3UTCA ONCHANGED

Message Output:

#BD3UTCA,97,GPS,FINE,2172,438257000,0,0,18,12;816,48,-2.793967723846436e-09,1.021405183e-14,0.000000000e+00,61,6,4,4,1,0*b345cd6b

Table 1-71 BD3UTC Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BD3UTC	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	utc wn	UTC reference week number	ULONG	4	H
3	tot	Reference time of UTC parameters	ULONG	4	H+4
4	A0	Deviation coefficient of BDST relative to UTC	DOUBLE	8	H+8
5	A1	Drift coefficient of BDST relative to UTC	DOUBLE	8	H+16
6	A2	Drift rate coefficient of BDST relative to UTC	DOUBLE	8	H+24
7	wn lsf	Week number when a new leap second takes effect (based on BDS time)	ULONG	4	H+32
8	dn	Day number of week when a new leap second takes effect (ranging from 0 to 6, Sunday=0, Saturday=6)	ULONG	4	H+36
9	deltat ls	Accumulated leap second correction of BDST relative to UTC before a new leap second takes effect	LONG	4	H+40
10	deltat lsf	Accumulated leap second correction of BDST relative to UTC after a new leap second takes effect	LONG	4	H+44
11	reserved	Reserved	ULONG	4	H+48
12	reserved	Reserved	ULONG	4	H+52
13	xxxx	32-bit CRC	HEX	4	H+56
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.12 GPSCNAVUTC: Conversion Parameters between GPST and UTC in CNAV Message

The log provides the conversion parameter between the GPS time and UTC in CNAV message.

ASCII Syntax:

GPSCNAVUTCA ONCHANGED

Message Output:

#GPSCNAVUTCA,97,GPS,FINE,2205,118532000,0,0,18,3;2205,48,-1.047737896442413e-09,0.000000000000000e+00,0.000000000000000e+00,1929,7,18,18,0,0*9f22f868

Table 1-72 GPSCNAVUTC Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSCNAVUTC	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	utc wn	UTC reference week number	ULONG	4	H
3	tot	Reference time of UTC parameters	ULONG	4	H+4
4	A0	GPST clock bias relative to UTC	DOUBLE	8	H+8
5	A1	GPST clock rate relative to UTC	DOUBLE	8	H+16
6	A2	Correction coefficient of GPST drift rate relative to UTC	DOUBLE	8	H+24
7	wn lsf	Week number when a new leap second takes effect (based on GPS time)	ULONG	4	H+32
8	dn	Day number of week when a new leap second takes effect (ranging from 1 to 7, Sunday=1, Saturday=7)	ULONG	4	H+36
9	deltat ls	Accumulated leap second correction of GPST relative to UTC before a new leap second takes effect	LONG	4	H+40
10	deltat lsf	Accumulated leap second correction of GPST relative to UTC after a new leap second takes effect	LONG	4	H+44
11	reserved	Reserved	ULONG	4	H+48
12	reserved	Reserved	ULONG	4	H+52
13	xxxx	32-bit CRC	HEX	4	H+56

ID	Field	Description	Format	Binary Bytes	Binary Offset
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.13 BD3EPH: BD3 Ephemeris

This log contains BD3 ephemeris information.

ASCII Syntax:

BD3EPHA COM1 60

Message Output:

#BD3EPHA,97,GPS,FINE,2170,283985000,0,0,18,1;46,0,3,1,19,19,2170,2170,271164.0,270000.0,-8.412890625e+01,1.277923584e-04,4.548046587e-09,-6.103769872e-16,-2.364035656e+00,7.630907930e-04,-5.803718850e-01,1.686625183e-06,4.534609616e-06,2.644570312e+02,3.521093750e+01,-9.220093489e-08,-6.891787052e-08,9.539709919e-01,2.123302730e-10,-1.292046100e+00,-7.216372019e-09,270000.0,-1.705484465e-08,-1.897569746e-08,-2.386514097e-09,-4.656612873e-10,1.376856817e-04,-1.747668676e-11,0.000000000e+00,902,0,27,0,7,0,0,1*04eeb13a

Table 1-73 BD3EPH Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BD3EPH header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	PRN	Satellite PRN number (BDS 1 to 63)	UCHAR	1	H
3	Health	Satellite health status, 0=healthy, 1=unhealthy	UCHAR	1	H+1
4	SatType	Satellite type (GEO/MEO/IGSO)	UCHAR	1	H+2
5	SISMAI	Spatial signal monitoring accuracy	UCHAR	1	H+3
6	IODE	Issue of data ephemeris	USHORT	2	H+4
7	IODC	Issue of data clock	USHORT	2	H+6
8	Week	GPS week number (GPS Week)	USHORT	2	H+8
9	Zweek	Z count cycle based on GPS week; the week of ephemeris subframe 1 (TOE week)	USHORT	2	H+10
10	Tow	Time stamp of subframe 1 (seconds)	DOUBLE	8	H+12

ID	Field	Description	Format	Binary Bytes	Binary Offset
11	Toe	Reference time of ephemeris (based on GPS time, in seconds)	DOUBLE	8	H+20
12	DeltaA	Deviation of the semi-major axis at the reference time relative to the reference value (meters)	DOUBLE	8	H+28
13	dDeltaA	Rate of change of the semi-major axis (m/s)	DOUBLE	8	H+36
14	ΔN	The difference between the mean angular velocity of the satellite and the calculated value at the reference time (Radians/second)	DOUBLE	8	H+44
15	dΔN	Rate of change of the difference between the mean angular velocity of the satellite and the calculated value at the reference time (Radians/second^2)	DOUBLE	8	H+52
16	M0	Mean anomaly at reference time (Radians)	DOUBLE	8	H+60
17	Ecc	Eccentricity	DOUBLE	8	H+68
18	ω	Argument of perigee (rad)	DOUBLE	8	H+76
19	Cuc	Argument of latitude (amplitude of cosine, rad)	DOUBLE	8	H+84
20	Cus	Argument of latitude (amplitude of sine, rad)	DOUBLE	8	H+92
21	crc	Orbit radius (amplitude of cosine, m)	DOUBLE	8	H+100
22	crs	Orbit radius (amplitude of sine, m)	DOUBLE	8	H+108
23	cic	Orbit Inclination angle (amplitude of cosine, rad)	DOUBLE	8	H+116
24	cis	Orbit Inclination angle (amplitude of sine, rad)	DOUBLE	8	H+124
25	I0	Inclination angle at reference time (rad)	DOUBLE	8	H+132
26	IDOT	Rate of change of the inclination angle (rad/s)	DOUBLE	8	H+140
27	Ω0	Right ascension of ascending node (rad)	DOUBLE	8	H+148

ID	Field	Description	Format	Binary Bytes	Binary Offset
28	Ω dot	Rate of change of the right ascension of ascending node (rad/s)	DOUBLE	8	H+156
29	toc	Reference time of satellite clock bias (s)	DOUBLE	8	H+164
30	Tgdb1cp	B1C pilot delay difference (s)	DOUBLE	8	H+172
31	dTgdb2ap	B2A pilot delay difference (s)	DOUBLE	8	H+180
32	ISCb2ad	Delay correction of B2A data relative to B2A pilot (s)	DOUBLE	8	H+188
33	ISCb1cd	Delay correction of B1C data relative to B1C pilot (s)	DOUBLE	8	H+196
34	af0	Satellite clock bias parameter (s)	DOUBLE	8	H+204
35	af1	Satellite clock drift parameter (s/s)	DOUBLE	8	H+212
36	af2	Change rate of satellite clock drift parameter (s/s^2)	DOUBLE	8	H+220
37	iTop	Time of week of data prediction	INT	4	H+228
38	SISAIoe	The tangential and normal accuracy index of the satellite orbit	UCHAR	1	H+232
39	SISAIocb	Accuracy index of satellite orbit radial and satellite clock fixed deviation	UCHAR	1	H+233
40	SISAIoc1	Accuracy index of satellite clock frequency offset	UCHAR	1	H+234
41	SISAIoc2	Accuracy index of satellite clock frequency drift	UCHAR	1	H+235
42	Reserved1	Reserved	INT	4	H+236
43	Reserved2	Reserved	INT	4	H+240
44	FreqType	Frequency type 0: B1C 1: B2A	UINT	4	H+244
45	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+248
46	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.14 GLOEPH: GLONASS Ephemeris

This log contains GLONASS ephemeris information. GLONASS ephemerides are referenced to the PZ90.02 geodetic datum. No adjustment of the GPS and GLONASS reference frames are made when positioning.

ASCII Syntax:

GLOEPHA COM1 60

Message Output:

#GLOEPHA,97,GPS,FINE,2170,283960000,0,0,18,1;61,9,1,0,2170,252918000,10782,589,0,0,5,0,-1.122654931640625e+07,-1.202745068359375e+07,1.949492529296875e+07,-5.287437438964844e+02,-2.617497444152832e+03,-1.922264099121094e+03,-0.000002793967724,-3.725290298461914e-06,-9.313225746154785e-07,-5.400180816650391e-05,3.725290298e-09,1.818989403545856e-12,3600,2,2,0,13*73d533f6

Table 1-74 GLOEPH Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GLOEPH header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	Sloto	Slot information – PRN identification (Slot + 37)	USHORT	2	H
3	freqo	Frequency channel for satellite in the range of 0 to 20	USHORT	2	H+2
4	sat type	Satellite type: 0 = GLO_SAT 1 = GLO_SAT_M (M type)	UCHAR	1	H+4
5	Reserved	Reserved	UCHAR	1	H+5
6	e week	Reference week of ephemeris (GPS Week)	USHORT	2	H+6
7	e time	Reference time of ephemeris, ms (relative to GPS time)	ULONG	4	H+8
8	t offset	Integer seconds between GPST and GLONASS time. A positive value implies GLONASS time is ahead of GPST	ULONG	4	H+12
9	Nt	Number of days past from the Jan 1st of a leap year	USHORT	2	H+16
10	Reserved	Reserved	UCHAR	1	H+18
11	Reserved	Reserved	UCHAR	1	H+19

ID	Field	Description	Format	Binary Bytes	Binary Offset
12	issue	15-minute interval number corresponding to the ephemeris reference time	ULONG	4	H+20
13	health	Ephemeris health: 0 = Healthy 1 = Unhealthy	ULONG	4	H+24
14	pos x	X coordinate for satellite at reference time (PZ-90.02), in meters	DOUBLE	8	H+28
15	pos y	Y coordinate for satellite at reference time (PZ-90.02), in meters	DOUBLE	8	H+36
16	pos z	Z coordinate for satellite at reference time (PZ-90.02), in meters	DOUBLE	8	H+44
17	vel x	X coordinate for satellite velocity at reference time (PZ-90.02), in meters/s	DOUBLE	8	H+52
18	vel y	Y coordinate for satellite velocity at reference time (PZ-90.02), in meters/s	DOUBLE	8	H+60
19	vel z	Z coordinate for satellite velocity at reference time (PZ-90.02), in meters/s	DOUBLE	8	H+68
20	LS acc x	X coordinate for lunisolar acceleration at reference time (PZ-90.02), in meters/s^2	DOUBLE	8	H+76
21	LS acc y	Y coordinate for lunisolar acceleration at reference time (PZ-90.02), in meters/s^2	DOUBLE	8	H+84
22	LS acc z	Z coordinate for lunisolar acceleration at reference time (PZ-90.02), in meters/s^2	DOUBLE	8	H+92
23	tau_n	Correction to the n^{th} satellite time t_n relative to GLONASS time t_c, in seconds	DOUBLE	8	H+100
24	delta_tau_n	Time difference between the RF signal transmitted by L2 sub-band and that by L1 sub-band of the n^{th} satellite, in seconds	DOUBLE	8	H+108
25	gamma	Frequency correction, in seconds/s	DOUBLE	8	H+116
26	Tk	Time of frame start (since start of GLONASS day), in seconds	ULONG	4	H+124

ID	Field	Description	Format	Binary Bytes	Binary Offset
27	P	Technological parameter[6]	ULONG	4	H+128
28	Ft	Prediction of user range accuracy	ULONG	4	H+132
29	age	Age of data, in days	ULONG	4	H+136
30	Flags	Information flags, see Table 1-75 GLONASS Ephemeris Flags Coding	ULONG	4	H+140
31	xxxx	32-bit CRC	HEX	4	H+144
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 1-75 GLONASS Ephemeris Flags Coding

Bit	Description	Value	Mark
0	P1, time interval between two adjacent tb parameters	See Table 1-76 P1 Flag Range Values	00000001
1			00000002
2	P2, Odd or Even flag of tb parameter	0=even, 1=odd	00000004
3	P3, satellite numbers in the almanac within the current subframe	0=5, 1=4	00000008
4	Reserved		
…			
31			

Table 1-76 P1 Flag Range Values

State	Description
00	0 minute
01	30 minutes
10	45 minutes
11	60 minutes

[6] Bit 0:2 = Bn; Bit 3 = In; All other bits = 0.

1.4.4.15 GPSEPH: GPS Ephemeris

This log contains GPS ephemeris information.

ASCII Syntax:

GPSEPHA COM1 60

Message Output:

#GPSEPHA,97,GPS,FINE,2170,283933000,0,0,18,1;39,283410.0,0,89,89,2170,2170,28440
0.0,4.216596427e+07,0.000000000e+00,-3.077942042e-02,1.2056564447e-
04,4.3970043497e-01,1.816079021e-06,3.221817315e-05,-
9.96281250e+02,5.55312500e+01,-3.019347787e-06,1.840293407e-
06,1.0053524141e-03,0.000000000e+00,-2.586478979e+00,9.61468620e-
10,857,284400.0,-5.587935448e-09,1.9092113e-
08,0.0000000e+00,0.0000000e+00,FALSE,7.291650850e-05,7.84000000e+00*de117dc1

Table 1-77 GPSEPH Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSEPH header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	PRN	Satellite PRN number (GPS: 1 to 32)	ULONG	4	H
3	tow	Time stamp of subframe 0, in seconds	DOUBLE	8	H+4
4	health	Health status - a 6-bit health code defined in ICD-GPS-200a	ULONG	4	H+12
5	IODE1	Issue of data 1, ephemeris	ULONG	4	H+16
6	IODE2	Issue of data 2, ephemeris = GPS IODE1	ULONG	4	H+20
7	Week	GPS week	ULONG	4	H+24
8	Z Week	Z count week number. This is the week number from subframe 1 of the ephemeris. The “TOW week” (field #7) is derived from here, used to describe rollover.	ULONG	4	H+28
9	Toe	Reference time of ephemeris, in seconds	DOUBLE	8	H+32
10	A	Semi-major axis of the satellite orbit, in meters	DOUBLE	8	H+40
11	ΔN	Correction of the satellite mean angular velocity, in radians/second	DOUBLE	8	H+48
12	M0	Mean anomaly at TOE time, in radians	DOUBLE	8	H+56

ID	Field	Description	Format	Binary Bytes	Binary Offset
13	Ecc	Eccentricity of satellite orbit	DOUBLE	8	H+64
14	ω	Argument of perigee, in radians	DOUBLE	8	H+72
15	cuc	Argument of latitude (amplitude of cosine, rad)	DOUBLE	8	H+80
16	cus	Argument of latitude (amplitude of sine, rad)	DOUBLE	8	H+88
17	crc	Orbit radius (amplitude of cosine, m)	DOUBLE	8	H+96
18	crs	Orbit radius (amplitude of sine, m)	DOUBLE	8	H+104
19	cic	Inclination (amplitude of cosine, rad)	DOUBLE	8	H+112
20	cis	Inclination (amplitude of sine, rad)	DOUBLE	8	H+120
21	I0	Inclination angle at TOE time, rad	DOUBLE	8	H+128
22	IDOT	Rate of change of inclination angle, rad/s	DOUBLE	8	H+136
23	Ω0	Right ascension of ascending node, rad	DOUBLE	8	H+144
24	Ω dot	Rate of change of the right ascension of ascending node, rad/s	DOUBLE	8	H+152
25	iodc	Issue of data clock	ULONG	4	H+160
26	toc	Reference time of satellite clock bias, in seconds	DOUBLE	8	H+164
27	tgd	Group delay, in seconds	DOUBLE	8	H+172
28	af0	Satellite clock bias parameter, in seconds	DOUBLE	8	H+180
29	af1	Satellite clock rate parameter, s/s	DOUBLE	8	H+188
30	af2	Satellite clock drift parameter, s/s^2		8	H+196
31	AS	Anti-spoofing: 0 = FALSE 1 = TRUE	ENUM	4	H+204
32	N	Corrected mean angular velocity, rad/s	DOUBLE	8	H+208
33	URA	User range accuracy, m^2. The ICD gives an algorithm that converts the URAI index in the original ephemerides into a nominal standard deviation. Here outputs the square (variance) of the nominal value.	DOUBLE	8	H+216
34	xxxx	32-bit CRC	HEX	4	H+224
35	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.16 BDSEPH: BDS Ephemeris

This log contains BDS ephemeris information.

ASCII Syntax:

BDSEPHA COM1 60

Message Output:

#BDSEPHA,97,GPS,FINE,2170,283902000,0,0,18,1;60,283320.0,0,13,1,2170,2170,280800.0,4.216449998e+07,7.240658745e-09,5.142464261e-02,3.9341778029e-04,-2.2785445745e+00,2.092681825e-06,-2.987403423e-05,9.16250000e+02,7.05937500e+01,-5.401670933e-08,-3.771856427e-08,8.3275400366e-02,3.785871982e-11,-1.030780163e+00,-6.44205405e-09,1,280800.0,4.980000000e-08,4.980000000e-08,-8.5274223e-07,-3.5793590e-13,0.0000000e+00,TRUE,7.292754225e-05,4.00000000e+00*19a74a39

Table 1-78 BDSEPH Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BDSEPH header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	PRN	Satellite PRN number (BDS: 1 to 63)	ULONG	4	H
3	Tow	Time flag of subframe 1 (based on GPS time), in seconds	DOUBLE	8	H+4
4	Health	Health status - a 1-bit health code as defined in BDS ICD	ULONG	4	H+12
5	AODE	Age of data ephemeris	ULONG	4	H+16
6	AODE	Age of data ephemeris (same as the 5th field)	ULONG	4	H+20
7	Week	GPS week number (GPS Week)	ULONG	4	H+24
8	Z Week	Z count week number based on GPS week. It is the week number from subframe 1 of the ephemeris. The “TOE week” (field #7) is derived from this to account for rollover.	ULONG	4	H+28
9	Toe	Reference time of ephemeris (based on GPS time), s	DOUBLE	8	H+32
10	A	Semi-major axis of the orbit, m	DOUBLE	8	H+40
11	ΔN	Correction of the satellite mean angular velocity, rad/s	DOUBLE	8	H+48
12	M0	Mean anomaly at reference time, rad	DOUBLE	8	H+56

ID	Field	Description	Format	Binary Bytes	Binary Offset
13	Ecc	Eccentricity	DOUBLE	8	H+64
14	ω	Argument of perigee, rad	DOUBLE	8	H+72
15	Cuc	Argument of latitude (amplitude of cosine, rad)	DOUBLE	8	H+80
16	Cus	Argument of latitude (amplitude of sine, rad)	DOUBLE	8	H+88
17	crc	Orbit radius (amplitude of cosine, m)	DOUBLE	8	H+96
18	crs	Orbit radius (amplitude of sine, m)	DOUBLE	8	H+104
19	cic	Inclination (amplitude of cosine, rad)	DOUBLE	8	H+112
20	cis	Inclination (amplitude of sine, rad)	DOUBLE	8	H+120
21	I0	Inclination angle at reference time, rad	DOUBLE	8	H+128
22	IDOT	Rate of change of inclination angle, rad/s	DOUBLE	8	H+136
23	Ω0	Right ascension of ascending node, rad	DOUBLE	8	H+144
24	Ω dot	Rate of change of the right ascension of ascending node, rad/s	DOUBLE	8	H+152
25	AODC	Age of data clock	ULONG	4	H+160
26	toc	Reference time of clock bias (based on GPS time), s	DOUBLE	8	H+164
27	tgd1	B1 group delay (equipment time delay differential for B1 signal), s	DOUBLE	8	H+172
28	tgd2	B2 group delay (equipment time delay differential for B2 signal), s	DOUBLE	8	H+180
29	af0	Clock bias parameter, s	DOUBLE	8	H+188
30	af1	Clock rate parameter, s/s	DOUBLE	8	H+196
31	af2	Clock drift parameter, s/s^2	DOUBLE	8	H+204
32	AS	Anti-spoofing: 0 = FALSE 1 = TRUE	ENUM	4	H+212
33	N	Corrected mean angular velocity, rad/s	DOUBLE	8	H+216

ID	Field	Description	Format	Binary Bytes	Binary Offset
34	URA	User range accuracy, m^2. The ICD gives an algorithm that converts the URAI index in the original ephemerides into a nominal standard deviation. Here outputs the square (variance) of the nominal value.	DOUBLE	8	H+224
35	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+232
36	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.17 GALEPH: Galileo Ephemeris

This log contains Galileo ephemeris information.

ASCII Syntax:

GALEPHA COM1 60

Message Output:

#GALEPHA,97,GPS,FINE,2170,289734000,0,0,18,1;36,TRUE,TRUE,0,0,0,0,0,0,107,0,97,288600,5.44060634e+03,2.7394e-09,1.89146653e+00,9.796698578e-05,1.549239689e+00,7.4618e-06,6.6701e-06,2.112e+02,1.607e+02,4.8429e-08,2.4214e-08,9.953479913e-01,3.3323e-10,1.272931685e+00,-5.59559022e-09,288600,-2.468156745e-04,-5.201173e-12,0.0e+00,288600,-2.468145685e-04,-5.201173e-12,0.0e+00,6.054e-09,6.985e-09*d2ba934e

Table 1-79 GALEPH Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GALEPH header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	SatId	Satellite ID (Galileo: 1 to 38)	ULONG	4	H
3	FNAVReceived	Indicates FNAV ephemeris data received	BOOL	4	H+4
4	INAVReceived	Indicates INAV ephemeris data received	BOOL	4	H+8
5	E1BHealth	E1b health status (only valid if INAVReceived is TRUE)	UCHAR	1	H+12
6	E5aHealth	E5a health status (only valid if FNAVReceived is TRUE)	UCHAR	1	H+13
7	E5bHealth	E5b health status (only valid if INAVReceived is TRUE)	UCHAR	1	H+14

ID	Field	Description	Format	Binary Bytes	Binary Offset
8	E1BDVS	E1b data validity status (only valid if INAVReceived is TRUE)	UCHAR	1	H+15
9	E5aDVS	E5a data validity status (only valid if FNAVReceived is TRUE)	UCHAR	1	H+16
10	E5bDVS	E5b data validity status (only valid if INAVReceived is TRUE)	UCHAR	1	H+17
11	SISA	Signal in space accuracy	UCHAR	1	H+18
12	Reserved	Reserved	UCHAR	1	H+19
13	IODNav	Issue of data ephemeris	ULONG	4	H+20
14	T0e	Reference time of ephemeris, unit: s	ULONG	4	H+24
15	RootA	Square root of semi-major axis, m	DOUBLE	8	H+28
16	DeltaN	Correction of satellite mean angular velocity, rad/s	DOUBLE	8	H+36
17	M0	Mean anomaly at TOE time, rad	DOUBLE	8	H+44
18	Ecc	Eccentricity of satellite orbit	DOUBLE	8	H+52
19	Omega	Argument of perigee, rad	DOUBLE	8	H+60
20	Cuc	Argument of latitude (amplitude of cosine, rad)	DOUBLE	8	H+68
21	Cus	Argument of latitude (amplitude of sine, rad)	DOUBLE	8	H+76
22	Crc	Orbit radius (amplitude of cosine, m)	DOUBLE	8	H+84
23	Crs	Orbit radius (amplitude of sine, m)	DOUBLE	8	H+92
24	Cic	Inclination (amplitude of cosine, rad)	DOUBLE	8	H+100
25	Cis	Inclination (amplitude of sine, rad)	DOUBLE	8	H+108
26	I0	Inclination angle at TOE time, rad	DOUBLE	8	H+116
27	IDot	Rate of change of the inclination angle, rad/s	DOUBLE	8	H+124
28	Omega0	Right ascension of ascending node, rad	DOUBLE	8	H+132
29	OmegaDot	Rate of change of the right ascension of ascending node, rad/s	DOUBLE	8	H+140
30	FNAVT0c	Satellite clock bias parameter, in seconds, (only valid if FNAVReceived is TRUE)	ULONG	4	H+148

ID	Field	Description	Format	Binary Bytes	Binary Offset
31	FNAVAf0	Satellite clock bias parameter, in seconds, (only valid if FNAVReceived is TRUE)	DOUBLE	8	H+152
32	FNAVAf1	Satellite clock rate parameter, in s/s, (only valid if FNAVReceived is TRUE)	DOUBLE	8	H+160
33	FNAVAf2	Satellite clock drift parameter, in s/s^2, (only valid if FNAVReceived is TRUE)	DOUBLE	8	H+168
34	INAVT0c	Satellite clock bias parameter, in seconds, (only valid if INAVReceived is TRUE)	ULONG	4	H+176
35	INAVAf0	Satellite clock bias parameter, in seconds, (only valid if INAVReceived is TRUE)	DOUBLE	8	H+180
36	INAVAf1	Satellite clock rate parameter, in s/s, (only valid if INAVReceived is TRUE)	DOUBLE	8	H+188
37	INAVAf2	Satellite clock drift parameter，in s/s^2, (only valid if INAVReceived is TRUE)	DOUBLE	8	H+196
38	E1E5aBGD	E1, E5a broadcast group delay	DOUBLE	8	H+204
39	E1E5bBGD	E1, E5b broadcast group delay, (only valid if INAVReceived is TRUE)	DOUBLE	8	H+212
40	xxxx	32-bit CRC	HEX	4	H+220
41	[CR][LF]	Sentence terminator (ASCII only)	-		-

1.4.4.18 GPSCNAVEPH: GPS Ephemeris in CNAV Message

This log contains GPS ephemeris information in CNAV message.

ASCII Syntax:

GPSCNAVEPHA 60

Message Output:

#GPSCNAVEPHA,97,GPS,FINE,2205,118740000,0,0,18,2;14,1,0,1,0,0,0,0,21764,0,253,251,2,7,2205,2205,115254.0,120600.0,3.988164062e+02,3.6768913269e-03,4.9019899018e-09,-2.055662496e-14,3.888642175e-01,1.69380318e-03,3.04593378e+00,3.473833203e-07,6.387941539e-06,2.5276171875e+02,7.148437500e+00,2.700835466e-08,-1.769512892e-08,9.528935403e-01,-5.103784022e-10,1.30335e+00,-8.25689e-09,120600.0,0.000000000e+00,0.000000000e+00,0.000000000e+00,0.000000000e+00,0.000000000e+00,0.000000000e+00,0.000000000e+00,-1.016447204e-04,-2.845723657e-12,0.000000000e+00*f7ea74c5

Table 1-80 GPSCNAVEPH Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSCNAVEPH header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	PRN	Satellite PRN number (GPS: 1 to 32; QZSS: 33 to 42)	UCHAR	1	H
3	Health	Satellite health status	UCHAR	1	H+1
4	ISF	Integrity status flag	UCHAR	1	H+2
5	Reserved[5]	Reserved; Reserved[0] = 1 is L5 ephemeris; Reserved[0] = 0 is L1C ephemeris;	UCHAR	1*5	H+3
6	Top	Time of week broadcasting CEI data series	USHORT	2	H+8
7	WNop	Number of the week broadcasting CEI data series	USHORT	2	H+10
8	URAIndex [4]	Parameter of user range accuracy: ED accuracy/NED accuracy index/NED accuracy change index/NED accuracy change rate index	UCHAR	1*4	H+12
9	Week	GPS week	USHORT	8	H+16

ID	Field	Description	Format	Binary Bytes	Binary Offset
10	Zweek	Z count week number	USHORT	8	H+24
11	TOW	Time stamp of information type 10	DOUBLE	8	H+32
12	TOE	Reference time of ephemeris, in seconds	DOUBLE	8	H+40
13	DeltaA	Bias of semi-major axis at reference time relative to the reference value	DOUBLE	8	H+48
14	dDeltaA	Semi-major axis change rate	DOUBLE	8	H+56
15	DeltaN	Mean angular velocity at reference time minus the computed value; unit: Rad/s	DOUBLE	8	H+64
16	dDeltaN	The change rate of the parameter DeltaN	DOUBLE	8	H+72
17	M0	Mean anomaly at TOE time, in radians	DOUBLE	8	H+80
18	Ecc	Eccentricity of satellite orbit	DOUBLE	8	H+88
19	Omega	Argument of perigee, in radians	DOUBLE	8	H+96
20	Cuc	Argument of latitude (amplitude of cosine, rad)	DOUBLE	8	H+104
21	Cus	Argument of latitude (amplitude of sine, rad)	DOUBLE	8	H+112
22	Crc	Orbit radius (amplitude of cosine, m)	DOUBLE	8	H+120
23	Crs	Orbit radius (amplitude of sine, m)	DOUBLE	8	H+128
24	Cic	Inclination (amplitude of cosine, rad)	DOUBLE	8	H+136
25	Cis	Inclination (amplitude of sine, rad)	DOUBLE	8	H+144
26	I0	Inclination angle at TOE time, rad	DOUBLE	8	H+152
27	IDot	Change rate of inclination angle, rad/s	DOUBLE	8	H+160
28	Omega0	Right ascension of ascending node, rad	DOUBLE	8	H+168

ID	Field	Description	Format	Binary Bytes	Binary Offset
29	OmegaDot	Change rate of the right ascension of ascending node, rad/s	DOUBLE	8	H+176
30	toc	Reference time of satellite clock bias, in seconds	DOUBLE	8	H+184
31	Tgd	Group delay, in seconds	DOUBLE	8	H+192
32	ISCL1CP	Group delay bias between L1P(Y) and L1C (pilot)	DOUBLE	8	H+200
33	ISCL1CD	Group delay bias between L1P(Y) and L1C (data)	DOUBLE	8	H+208
34	ISCL1CA	Group delay bias between L1P(Y) and L1C/A	DOUBLE	8	H+216
35	ISCL2C	Group delay bias between L1P(Y) and L2C	DOUBLE	8	H+224
36	ISCL5I5	Group delay bias between L1P(Y) and L5I5	DOUBLE	8	H+232
37	ISCL5Q5	Group delay bias between L1P(Y) and L5Q5	DOUBLE	8	H+240
38	Af0	Satellite clock bias parameter, in seconds	DOUBLE	8	H+248
39	Af1	Satellite clock drift parameter, s/s	DOUBLE	8	H+256
40	Af2	Change rate of satellite clock drift parameter, s/s^2	DOUBLE	8	H+264
36	xxxx	32-bit CRC	HEX	4	H+272
37	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.19 GPSRAWSUBFRAME: GPS Raw Subframe

This log contains GPS raw subframe data. Each subframe has 300 bits, including the parity check which amounts to 60 bits (10 groups, 6 bits/group) in each subframe. For more information about GPS raw subframe data, please refer to GPS ICD document.

ASCII Syntax:

GPSRAWSUBFRAMEA 60

GPSRAWSUBFRAMEA ONCHANGED

Message Output:

#GPSRAWSUBFRAME,97,GPS,FINE,2147,300952000,0,0,18,2;11,28,3,22c06327,187dcb57,001e17e2,121dd917,002449d5,2af42b6d,09ff324d,03689262,3fea0a1b,127ec14f,11*acc54d58

Table 1-81 GPSRAWSUBFRAME Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	RAWGPSSUBFRAME header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	decode #	Decoded frame number	LONG	4	H
3	PRN	Satellite PRN	ULONG	4	H+4
4	subfr id	Subframe ID	ULONG	4	H+8
5	Data[0]	Raw subframe data	HEX	4	H+12
6	Data[1]	Raw subframe data	HEX	4	H+16
7	Data[2]	Raw subframe data	HEX	4	H+20
8	Data[3]	Raw subframe data	HEX	4	H+24
9	Data[4]	Raw subframe data	HEX	4	H+28
10	Data[5]	Raw subframe data	HEX	4	H+32
11	Data[6]	Raw subframe data	HEX	4	H+36
12	Data[7]	Raw subframe data	HEX	4	H+40
13	Data[8]	Raw subframe data	HEX	4	H+44
14	Data[9]	Raw subframe data	HEX	4	H+48
15	chan	Channel number of the signal that outputs frame information	ULONG	4	H+52
16	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+56
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.20 GPSCNAV1RAWSUBFRAME: GPS CNAV1 Raw Subframe

This log contains the raw subframe of L2C and L5 signals in CNAV message.

ASCII Syntax:

GPSCNAV1RAWSUBFRAMEA 60

GPSCNAV1RAWSUBFRAMEA ONCHANGED

Message Output:

#GPSCNAV1RAWSUBFRAME,96,GPS,FINE,2229,130682000,0,0,18,2;151,32,L5I,2,000008b8,202a8a08,d697385b,fcdd77f9,a78009c0,048851f2,be4339bd,a2bfffa6,a13f79a8,f9892c7b*e15a79d

#GPSCNAV1RAWSUBFRAME,96,GPS,FINE,2229,130683000,0,0,18,2;76,26,L2C,3,000008b6,8b2a8a0e,15b4c977,1c9887a9,9bf20f08,1600bfff,b60067b0,02620600,d27005aa,91ac1b72*aceeebca

Table 1-82 GPSCNAV1RAWSUBFRAME Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSCNAV1RAWSUBFRAME header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	Signal Channel	Signal channel providing bit	ULONG	4	H
3	PRN	Satellite PRN	ULONG	4	H+4
4	DataSource	Data Source			
5	Frame Id	Frame ID	ULONG	4	H+8
6	Data	Raw frame data	HEX[38]	38	H+12
16	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+50
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 1-83 GPSCNAV1RAWSUBFRAME Message Structure

ASCII	Description
L2C	Data from B1C/D1 signal
L5I	Data from B1C/D2 signal

1.4.4.21 GPSCNAV2RAWSUBFRAME GPS CNAV2 Subframe[7]

This log contains the raw subframe of L1C signal in CNAV message.

ASCII Syntax:

GPSCNAV2RAWSUBFRAMEA 60
GPSCNAV2RAWSUBFRAMEA ONCHANGED

Table 1-84 GPSCNAV2RAWSUBFRAME Message Output

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSCNAV2RAWSUBFRAME header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	Signal Channel	Signal channel providing bit	ULONG	4	H
3	PRN	Satellite PRN	ULONG	4	H+4
4	Frame Id	Frame ID	ULONG	4	H+8
5	Data	Raw frame data	HEX[112]	112	H+12
16	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+124
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

[7] Supported later

1.4.4.22 BDSRAWSUBFRAME: BDS Raw Subframe

This log contains BDS raw subframe data from which the parity check has been removed. It only outputs subframe data that pass the parity check. For more information about BDS raw subframe data, please refer to BDS ICD document.

ASCII Syntax:
BDSRAWSUBFRAMEA 60
BDSRAWSUBFRAMEA ONCHANGED

Message output:
#BDSRAWSUBFRAME,97,GPS,FINE,2147,301232000,0,0,18,1;47,60,D2,5,38905499,3c627154,00000000,00000000,00000000,00000000,00000000,00000000,00000000,00000000*8cc71c37

Table 1-85 BDSRAWSUBFRAME Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BDSRAWNAVSUBFRAME header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	signal channel	Signal channel number	ULONG	4	H
3	satellite ID	Satellite ID	ULONG	4	H+4
4	data source	Data source	ENUM	4	H+8
5	subframe ID	Subframe ID	ULONG	4	H+12
6	Data[0]	Raw subframe data	HEX	4	H+16
7	Data[1]	Raw subframe data	HEX	4	H+20
8	Data[2]	Raw subframe data	HEX	4	H+24
9	Data[3]	Raw subframe data	HEX	4	H+28
10	Data[4]	Raw subframe data	HEX	4	H+32
11	Data[5]	Raw subframe data	HEX	4	H+36
12	Data[6]	Raw subframe data	HEX	4	H+40
13	Data[7]	Raw subframe data	HEX	4	H+44
14	Data[8]	Raw subframe data	HEX	4	H+48
15	Data[9]	Raw subframe data	HEX	4	H+52
16	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+56
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.23 BD3RAWSUBFRAME BD3 Raw Subframe

This log contains BD3 raw subframe.

ASCII Syntax:

BD3RAWSUBFRAMEA 60
BD3RAWSUBFRAMEA ONCHANGED

Message Output:

#BD3RAWSUBFRAME,96,GPS,FINE,2229,130677000,0,0,18,2;258,26,B1CD1,0,00001a3a,00000000,00000000,03692400,00000000,001b4920,10106c30,01d03c00,54ee573c,fff14000,00000000,00000000,006d2480,4041b0c0,0740f001,53b95cf3,ffc501df,b7d02801,948c1a1d,6c901610,026cb63c,d0da1cc4,e0f5caea,138e7fa8,44c21330,36000000,00000000,00d2a26d*e877e8ad
#BD3RAWSUBFRAME,96,GPS,FINE,2229,130683000,0,0,18,2;340,25,B2AD1,0,6682a88c,02006cb6,3ab8da1c,c0d88da5,14a7b27e,ced6104a,cc47fa80,00000000,0073f632*9c6d2cb3

Table 1-86 BD3RAWSUBFRAME Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BD3RAWNAVSUBFRAME header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	signal channel	Signal channel number	ULONG	4	H
3	satellite ID	Satellite ID	ULONG	4	H+4
4	Data Source	Data source	ENUM	4	H+8
5	reserved	Reserved	ULONG	4	H+12
6	Raw Sub Frame Data	Raw subframe data	HEX[112]	112	H+16
16	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+128
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 1-87 BD3RAWSUBFRAME Message Structure

ASCII	Description
B1CD1	Data from B1C/D1 signal
B1CD2	Data from B1C/D2 signal
B2AD1	Data from B2A/D1 signal
B2AD2	Data from B2A/D2 signal

1.4.4.24 GALFNAVRAWPAGE: GAL F-NAV Raw Page

This log contains raw Galileo F-NAV data page.

ASCII Syntax:
GALFNAVRAWPAGEA 60
GALFNAVRAWPAGEA ONCHANGED

Message output:
#GALFNAVRAWPAGE,97,GPS,FINE,2147,301142000,0,0,18,2;114,9,1074001bfffe0000000
000000012486389e2490018c0491a4c2528*f2c33f41

Table 1-88 GALFNAVRAWPAGE Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GALFNAVRAWPAGEA header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	SigChanNum	Signal channel number	ULONG	4	H
3	SatId	Satellite SVID	ULONG	4	H+4
4	RawFrameData	Raw F/NAV data page (214 bits), not including CRC and tail bits	HEX[27]	27	H+8
5	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+35
6	[CR][LF]	Sentence terminator (ASCII only)	-		

1.4.4.25 GALINAVRAWWORD: GAL I-NAV Raw Word

This log contains raw Galileo I-NAV word.

ASCII Syntax:
GALINAVRAWWORDA 60
GALINAVRAWWORDA ONCHANGED

Message Output:
#GALINAVRAWWORD,97,GPS,FINE,2147,301185000,0,0,18,1;56,9,GALE1,0255555555555555555555554634987d*eff9b644

Table 1-89 GALINAVRAWWORD Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GALINAVRAWWORD header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	SigChanNum	Signal channel number	ULONG	4	H
3	SatId	Satellite SVID	ULONG	4	H+4
4	SignalType	Signal type	ENUM	4	H+8
5	RawFrameData	Raw I/NAV data (128 bits)	HEX[16]	16	H+12
6	xxxx	32-bit CRC (ASCII and	HEX	4	H+28
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.26 GLORAWSTRING: GLONASS Raw String

This log contains raw GLONASS string. For specific information, please refer to GLONASS ICD document.

ASCII Syntax:
GLORAWSTRINGA 60
GLORAWSTRINGA ONCHANGED

Message Output:
#GLORAWSTRING,97,GPS,FINE,2147,301209000,0,0,18,2;12,4,09063875db3697fe22bace*77d29537

Table 1-90 GLORAWSTRING Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GLORAWSTRING header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	slot	Slot identification	UCHAR	1	H
3	freq	Frequency number, ranging from -7 to +13	CHAR	1	H+1
4	String	GLONASS raw string	UCHAR [11]	11	H+2
5	Reserved		UCHAR	1	H+13
6	xxxx	32-bit CRC (ASCII and Binary only)	ULONG	4	H+14
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.27 SATHEALTHSTAT: Satellite Health Status

This log contains the health status of each satellite system.

ASCII Syntax

SATHEALTHSTAT 1

Message Output:

#SATHEALTHSTAT,97,GPS,FINE,2147,302503000,0,0,18,0;0000000000000000,0000004728B520E5,0000000000000000,040027BB2D5036DF,00000000,0087E107,0000000000000000,0000000825004592,00000000,00000000*55a9446b

Table 1-91 SATHEALTHSTAT Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	SATHEALTHSTAT header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	GPSSatHealthFlag	The validity of GPS satellite health flag (whether the Health information is found in the ephemeris) 0: not found, 1: found	UINT64	8	H
3	GPSSatHealthStatus	GPS satellite health status 1: healthy, 0: others	UINT64	8	H+8
4	BDSSatHealthFlag	The validity of BDS satellite health flag (whether the Health information is found in the ephemeris) 0: not found, 1: found	UINT64	8	H+16
5	BDSSatHealthStatus	BDS satellite health status 1: healthy, 0: others	UINT64	8	H+24
6	GLOSatHealthFlag	The validity of GLO satellite health flag (whether the Health information is found in the ephemeris) 0: not found, 1: found	UINT32	4	H+32
7	GLOSatHealthStatus	GLO satellite health status 1: healthy, 0: others	UINT32	4	H+36
8	GALSatHealthFlag	The validity of GAL satellite health flag (whether the Health information is found in the ephemeris) 0: not found, 1: found	UINT64	8	H+40
9	GALSatHealthStatus	GAL satellite health status 1: healthy, 0: others	UINT64	8	H+48
10	RSV	Reserved	UINT64	8	H+56
11	RSV	Reserved	UINT64	8	H+64
12	xxxx	32-bit CRC	HEX	4	H+72
13	[CR][LF]	Sentence terminator (ASCII only)			

Note:

- For GPS satellite system, bit 31:0 marks PRN 32~1, bit 63:32 marks QZSS. The satellite is healthy only when the 6 bits that indicate the health status of GPS ephemeris are all 0s. At this time, the flag bit that marks the satellite PRN outputs 1; otherwise it outputs 0.
- For BDS satellite system, bit 63:0 marks PRN 64:1. The satellite is healthy when the 1 bit that indicates the health status of BDS ephemeris is 0. At this time, the flag bit that marks the satellite PRN outputs 1; otherwise it outputs 0.
- For GLO satellite system, bit 23:0 marks PRN 24:1. The satellite is healthy only when the health status bit B_n is 0 (At this time, the flag bit outputs 1); in other cases, the satellite status is abnormal.
- For GAL satellite system, bit 63:0 marks PRN 64:1. When Data Validity Status and Health Status (see field 5 to field 10 in Table 1-69) are both 0s (healthy), the health flag bit of this satellite is 1.

1.4.4.28 SYSCLKERR: System Clock Error

ASCII Syntax:

SYSCLKERR 1

Message Output:

#SYSCLKERR,97,GPS,FINE,2206,463007000,0,0,18,1;00003330,0,244242,244195,244263*ab48ed60

Table 1-92 SYSCLKERR Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	SYSCLKERR header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	Clock Status	Clock model status Bit of every system: GPS: bit 3:0 BDS: bit 7:4 GLO: bit 11:8 GAL: bit 15:12 RSV: bit 31:16 Meaning of the value in every 4 bits: 3 = VALID; 0: INVALID	UINT	4	H
3	GPS Offset	The receiver's clock offset relative to GPS time, unit: ns; a positive value means that the receiver's clock is ahead of GPS time.	INT	4	H+4
4	BDS Offset	The receiver's clock offset relative to BDS time, unit: ns; a positive value means that the receiver's clock is ahead of BDS time.	INT	4	H+8
5	GLO Offset	The receiver's clock offset relative to GLO time, unit: ns; a positive value means that the receiver's clock is ahead of GLO time.	INT	4	H+12
6	GAL Offset	The receiver's clock offset relative to GAL time, unit: ns; a positive value means that the receiver's clock is ahead of GAL time.	INT	4	H+16
7	xxxx	32-bit CRC	HEX	4	H+20
8	[CR][LF]	Sentence terminator (ASCII only)			

1.4.4.29 BESTNAV: Best Position and Velocity

This log contains information about the best position (in meters) and velocity of GPS and INS (if available) that the receiver's master antenna calculated. In addition, the receiver also reports several status indicators, including differential age, which is very useful for predicting the abnormality caused by the interruption of differential correction. If the age is 0, it means that the differential correction is not used.

Recommended Input:
BESTNAVA 1

Message Output:
#BESTNAVA,97,GPS,FINE,2198,114813000,0,0,18,10;SOL_COMPUTED,SINGLE,40.07899359447,116.23661772534,66.5707,-8.4923,WGS84,1.4282,1.3291,3.4479,"0",0.000,0.000,50,28,28,1,16,12,01,41,SOL_COMPUTED,DOPPLER_VELOCITY,0.000,0.000,0.0019,7.989858,-0.0016,0.0215,0.0127*434e90a8

Table 1-93 BESTNAV Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BESTNAV header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	p-sol status	Solution status (see Table 1-77 Solution Status)	ENUM	4	H
3	pos type	Position type (see Table 1- 78 Position or Velocity Type)	ENUM	4	H+4
4	lat	Latitude, in degrees	DOUBLE	8	H+8
5	lon	Longitude, in degrees	DOUBLE	8	H+16
6	hgt	Altitude, in meters	DOUBLE	8	H+24
7	undulation	Geoid undulation - the distance between the geoid and the WGS84 ellipsoid (m)	FLOAT	4	H+32
8	datum id#	Coordinate ID, only support WGS84 (binary=61)	ENUM	4	H+36
9	lat σ	Standard deviation of latitude (m)	FLOAT	4	H+40
10	lon σ	Standard deviation of longitude (m)	FLOAT	4	H+44
11	hgt σ	Standard deviation of height (m)	FLOAT	4	H+48
12	stn id	Base station ID, default=0	CHAR[4]	4	H+52
13	diff_age	Differential age, in seconds	FLOAT	4	H+56
14	sol_age	Solution age, in seconds	FLOAT	4	H+60

ID	Field	Description	Format	Binary Bytes	Binary Offset
15	#SVs	Number of satellites tracked	UCHAR	1	H+64
16	#solnSVs	Number of satellites used in the solution	UCHAR	1	H+65
17	Reserved	Reserved	UCHAR	1	H+66
18	Reserved	Reserved	UCHAR	1	H+67
19	Reserved	Reserved	UCHAR	1	H+68
20	ext sol stat	Status of extended solution, see Table 1-98 Extended Solution Status	HEX	1	H+69
21	Galileo sig mask	Galileo signals used mask. See Table 1-97 Galileo Signal-Used Mask	HEX	1	H+70
22	GPS, GLONASS and BDS sig mask	GPS, GLONASS and BDS signals used mask (see Table 1-96 GPS/GLONASS/BDS Signal-Used Mask)	HEX	1	H+71
23	V-sol status	Solution status (see Table 1-77 Solution Status)	ENUM	4	H+72
24	vel type	Velocity type, (see Table 1- 78 Position or Velocity Type)	ENUM	4	H+76
25	latency	A measure of latency calculated according to the velocity time tag, in seconds. Subtracting latency from epoch time will get a more accurate velocity.	FLOAT	4	H+80
26	age	Differential age, in seconds	FLOAT	4	H+84
27	hor spd	Horizontal speed over ground, m/s	DOUBLE	8	H+88
28	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	DOUBLE	8	H+96
29	vert spd	Vertical speed, m/s, positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	DOUBLE	8	H+104
30	Verspd std	Standard derivation of vertical speed, m/s	FLOAT	4	H+112
31	Horspd std	Standard derivation of horizontal speed, m/s	FLOAT	4	H+116

ID	Field	Description	Format	Binary Bytes	Binary Offset
32	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+120
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 1-94 Solution Status

Solution Status		Description
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
2	NO_CONVERGENCE	No convergence
4	COV_TRACE	Covariance trace exceeds maximum (trace > 1000 m)

Table 1-95 Position or Velocity Type

Decimal	ASCII	Description
0	NONE	No solution
1	FIXEDPOS	Position fixed by the FIX POSITION command
2	FIXEDHEIGHT	Not supported for now
8	DOPPLER_VELOCITY	Velocity computed using instantaneous Doppler
16	SINGLE	Single point positioning
17	PSRDIFF	Pseudorange differential solution
18	SBAS	SBAS positioning
32	L1_FLOAT	L1 float solution
33	IONOFREE_FLOAT	Ionosphere-free float solution
34	NARROW_FLOAT	Narrow-lane float solution
48	L1_INT	L1 fixed solution
49	WIDE_INT	Wide-lane fixed solution
50	NARROW_INT	Narrow-lane fixed solution
52	INS	INS positioning solution
53	INS_PSRSP	INS and single point positioning combined solution
54	INS_PSRDIFF	INS and pseudorange differential positioning combined solution
55	INS_RTKFLOA	INS and RTK float combined solution
56	INS_RTKFIXED	INS and RTK fix combined solution

Table 1-96 GPS/GLONASS/BDS Signal-Used Mask

Bit	Mask	Description
0	0x01	GPS L1 used in solution
1	0x02	GPS L2 used in solution
2	0x04	GPS L5 used in solution
3	0x08	BDS B3 used in solution
4	0x10	GLONASS L1 used in solution
5	0x20	GLONASS L2 used in solution
6	0x40	BDS B1 used in solution
7	0x80	BDS B2 used in solution

Table 1-97 Galileo Signal-Used Mask

Bit	Mask	Description
0	0x01	GALILEO E1 used in solution
1	0x02	GALILEO E5B used in solution
2	0x04	GALILEO E5A used in solution
3	0x08	Reserved
4	0x10	Reserved
5	0x20	Reserved
6	0x40	Reserved
7	0x80	Reserved

Table 1-98 Extended Solution Status

Bit	Mask	Description
0	0x01	RTK solution verification 0 = unchecked 1 = checked
1-3	0x0E	Pseudorange ionospheric correction 0 = unknown 1 = Klobuchar, broadcast ephemeris correction 2 = SBAS, Ionospheric grid correction 3 = multi-frequency correction 4 = pseudorange differential correction

1.4.4.30 HWSTATUS: Hardware Status Information

This log contains the hardware status information, only supporting 1 Hz output.

ASCII Syntax:

HWSTATUSA 1

Message Output:

#HWSTATUSA,97,GPS,FINE,2221,111183000,0,0,18,15;66807,0.920,1.020,0.908,1,-0.693,0.0,0x00,0,0x0377,0,0*9d7ce51d

Table 1-99 HWSTATUS Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	HWSTATUS Header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	Temp1	Temperature°C×1000 The junction temperature of the chip, which is different from environmental temperature.	INT	4	H
3	DC08	ADC actual quantization value /ADC full scale quantization value ×1.5V; the computed voltage and the normal range of the measured voltage is 0.85 V to 1.0 V; three digits after decimal point	FLOAT	4	H+4
4	DC10	ADC actual quantization value /ADC full scale quantization value ×1.5V; the computed voltage and the normal range of the measured voltage is 0.95 V to 1.1 V; three digits after decimal point	FLOAT	4	H+8
5	DC18	ADC actual quantization value /ADC full scale quantization value ×1.5V; the computed voltage and the normal range of the measured voltage is 0.85 V to 1.0 V; three digits after decimal point	FLOAT	4	H+12
6	Clockflag	ClockDrift validity flag: 0 = Invalid 1 = valid	UINT	4	H+16

ID	Field	Description	Format	Binary Bytes	Binary Offset
7	ClockDrift	The equivalent value of crystal oscillator drift, in m/s	FLOAT	4	H+20
8	reserved	Reserved	FLOAT	4	H+24
9	hwFlag[8]	Hardware status flag, see Table 1-100 for the bit description	UCHAR	1	H+28
10	reserved	Reserved	UCHAR	1	H+29
11	PLL_LOCK	PLL status	USHORT	2	H+30
12	reserved	Reserved	UINT	4	H+32
13	reserved	Reserved	UINT	4	H+36
14	Xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+40
15	[CR][LF]	Sentence terminator (ASCII only)			

Table 1-100 HWFLAG Bit Description

Bit	Description
Bit0	0= Oscillator; 1= Crystal
Bit1	0=VCXO; 1=TCXO
Bit2	0=26 MHz oscillator; 1=20 MHz oscillator
Bit3	0= Only support oscillator; 1= support oscillator and crystal
Bit4	
Bit5	
Bit6	
Bit7	Check status 0= Unknown; 1= Valid

[8] Not supported currently.

1.4.4.31 LOGLIST: LOG Output by Current Receiver

This command is to output the log by the current receiver, including the log output frequency and serial port.

ASCII Syntax:

LOGLISTA 1

Message Output:

#LOGLISTA,97,GPS,FINE,2172,441054000,0,0,18,0;GPSTIME COM1 1,GNGGA COM1 1,GNGSA COM1 1,GNGSV COM1 1,GNRMC COM1 1,TPFINFO COM1 1,TIMPOS COM1 1,BDSTIME COM1 1,GALTIME COM1 1,GLOTIME COM1 1,SVNUM COM1 1,TSVNUM COM1 1,PPSINFO COM1 1,TIMTP COM1 1,PDTINFO COM1 1,NOTICE COM1 1,SATHEALTHSTA COM1 1,LOGLISTA COM1 1*6492c2c2

Table 1-101 LOGLIST Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	LOGLIST header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	LOG output message	Including LOG name, output serial port, output frequency	STRING		
3	xxxx	32-bit CRC (ASCII and Binary only)	HEX		
10	[CR][LF]	Sentence terminator (ASCII only)			

1.4.4.32 SIGINFO: GNSS Satellite Information

ASCII Syntax:

SIGINFOA 1

Message Output:

#SIGINFOA,94,GPS,FINE,2252,440558000,2197,0,18,5;77,43,10,2,5,39,0,32,21,20,4,54,281,0,45,21,17,46,20,20,8,19,196,0,38,21,17,39,20,20,9,26,311,0,40,21,17,41,20,10,16,76,308,0,46,21,20,18,11,78,0,35,21,17,37,20,20,26,53,50,0,46,21,17,47,20,20,27,47,174,0,46,21,17,45,20,20,28,19,111,0,37,21,17,40,20,20,31,29,106,0,43,21,17,40,20,25,194,69,78,0,44,21,17,48,20,25,195,27,137,0,41,21,17,42,20,25,196,12,172,0,37,21,17,37,20,25,199,42,163,0,36,21,17,44,20,11,42,38,230,00,48,21,11,52,57,9,00,51,21,11,61,27,49,00,45,21,14,1,34,141,00,41,21,14,2,32,224,00,38,21,14,3,41,188,00,41,21,14,4,25,124,00,38,00,14,6,80,140,00,45,21,14,7,60,217,00,44,21,14,9,81,312,00,46,21,14,10,47,222,00,42,21,14,16,76,136,00,47,21,24,19,30,268,00,42,21,12,44,20,24,20,20,215,00,40,21,12,42,20,24,22,11,319,00,41,21,12,40,20,24,27,32,145,00,46,21,12,45,20,24,28,38,82,00,45,21,12,42,20,24,37,48,72,00,47,21,12,49,20,24,39,64,142,00,46,21,12,49,20,24,40,68,207,00,47,21,12,49,20,24,43,6,33,00,39,21,12,36,20,24,46,59,310,00,48,21,12,51,20,14,59,37,145,00,43,21,33,2,41,53,02,42,21,12,48,20,17,50,20,33,7,55,269,02,45,21,12,49,20,17,51,20,33,8,38,186,02,42,21,12,45,20,17,48,20,33,27,23,257,02,38,21,12,43,20,17,45,20,33,30,71,305,02,46,21,12,50,20,17,52,20,33,36,16,76,02,38,01,12,38,00,17,41,00*a3f9bb6c

Table 1-102 SIGINFO Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	SIGINFO header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	obs Number	Observations number	USHORT	2	H+2
3	Sat number	Satellites number	USHORT	2	H+4
4	GnssidSigNum	● Bit0-3: System type Gnssid 0 = GPS Gnssid 1 = GLONASS Gnssid 3 = Galileo Gnssid 4 = BDS Gnssid 5 = QZSS ● Bit4-7: Signal number corresponding to the system type	UCHAR	1	H+5

ID	Field	Description		Format	Binary Bytes	Binary Offset
5	PRN/ slot	PRN number: BDS = 1 to 63 GPS = 1 to 32 GLONASS = 38 to 61 Galileo = 1 to 36 SBAS = 120 to 141 QZSS = 193 to 197		USHORT	2	H+7
6	Elev	Elevation		USHORT	2	H+9
7	Azim	Azimuth		USHORT	2	H+11
8	sigId	Signal ID: <u>GPS:</u> 0 = L1 C/A 9 = L2P (Y) 3 = L1C (Pilot) 11 = L1C (Data) semicodeless 6 = L5 (Data) 14 = L5 (Pilot) 17 = L2C (L) <u>GLONASS:</u> 0 = L1 C/A 5 = L2 C/A <u>QZSS:</u> 0 = L1 C/A 6 = L5 (Data) 14 = L5 (Pilot) 17 = L2C (L)	<u>BDS:</u> 0 = B1I 4 = B1Q 8 = B1C (Pilot) 23 = B1C (Data) 5 = B2Q 17 = B2I 12 = B2a (Pilot) 28 = B2a (Data) 6 = B3Q 21 = B3I 13= B2b(I) <u>GAL:</u> 1 = E1B 2 = E1C 12 = E5A (Pilot) 17 = E5B (Pilot) <u>SBAS:</u> 0 = L1 C/A 6 = L5 (I)	UCHAR	1	H+13
9	C/N0	Carrier to noise ratio; C/N0 = 10[log10(S/N0)] (dB-Hz);		UCHAR	1	H+15

ID	Field	Description	Format	Binary Bytes	Binary Offset
10	SignalFlag	Signal status flag ● Bit0: whether signals participating in the positioning solution 1 = Yes 0 = No ● Bit5: whether signals participating in the timing solution 1 = Yes 0 = No	HEX	1	H+17
11…	An epoch contains the observations of all frequencies and all satellites in view. Each satellite observation accounts for (7+((GnssidSigNum>>4)&0x0f)*3) bytes and each frequency observation loops from the 8th to the 10th field.				
Variable	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	
Variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

1.4.4.33 AGNSSSTATUS: Assisted Positioning Status Information

The log is used to check the information of assisted positioning status.

ASCII Syntax:

AGNSSSTATUSA 1

Message Output:

#AGNSSSTATUSA,77,GPS,FINE,2216,457483000,0,0,18,9;0000004EF7FFFFFF,0C003FFF BFFCBFFF,0000000000DF7FFF,0000000B67945FDF,0,F,01,07,2022,0,070418.26,18,0,0,40 04.73963848,11614.19678280,57.9901*67b51741

Table 1-103 AGNSSSTATUS Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	AGNSSSTATUS Header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2,3,4,5	Source	GPS: 64 bits; a bit stands for a satellite BDS: 64 bits; a bit stands for a satellite GLO: 64 bits; a bit stands for a satellite GAL: 64 bits; a bit stands for a satellite Parsing status of source data. Set the corresponding bit to 1 when receiving the available corrections of a satellite. Displayed in hexadecimal.	UINT[2]	8	H
6	Reserved	Reserved	UINT	4	H+32
7	Calculate status	● Bit0: assisted source data input 0 = No source data input 1 = Source data input ● Bit1: available satellites 0 = Insufficient 1= Sufficient;	UINT	4	H+36

ID	Field	Description	Format	Binary Bytes	Binary Offset
		The broadcasted Ephemeris may be not matched with the observations ● Bit2: assisted time 0 = Invalid 1 = Valid ● Bit3: assisted position 0 = Invalid 1 = Valid			
8	Aid day	Day of UTC time received; two digits; range: 01 to 31	UINT	4	H+40
9	Aid mon	Month of UTC time received; two digits; range: 01 to 12	UINT	4	H+44
10	Aid year	Year of UTC time received; four digits	UINT	4	H+48
11	Reserved	Reserved	UINT	4	H+52
12	Aid Time	Received assisted time; hhmmss.sss (Hour Minute Second)	DOUBLE	8	H+56
13	Aid LeapSecond	Received leap second	USHORT	2	H+64
14	Reserved	Reserved	USHORT	2	H+66
15	Reserved	Reserved	UINT	4	H+68
16	Aid Lat	Received assisted latitude; ddmm.mmmmmmmm	DOUBLE	8	H+72
17	Aid Lon	Received assisted longitude; dddmm.mmmmmmmm	DOUBLE	8	H+80
18	Aid Height	Received assisted height with four decimal places; unit: m	DOUBLE	8	H+88
19	xxxx	32-bit CRC	HEX	4	H+96
20	[CR][LF]	Sentence terminator (ASCII only)			

1.4.4.34 PTOBSINFO: Raw Observations Evaluation Information of Production Test

The log is used to output the information related to the evaluation results of raw observations in the production tests.

ASCII Syntax:
PTOBSINFOA1

Message Output:
#PTOBSINFOA,96,GPS,FINE,2262,265707000,10838,0,18,0;0,1,51,51,2,14.80,63,0,0,0,003f f,43.04,41.84,47.55,46.19,46.43,44.03,45.22,42.89,45.55,46.47,0.00,0.00,0.00,0.00,0.00,0. 00,0.00,0.00*c67fcff2

Table 1-104 PTOBSINFO Message Structure

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	PTOBSINFO header	Header. For more information, please refer to Table 1-60 ASCII Message Header Structure		H	0
2	RTC Flag	RTC validity flag 0: Unknown 1: Valid 2: Invalid	INT	4	H
3	Clock drift Flag	Clock drift flag 0: Valid 1: Invalid	INT	4	H+4
4	PsrValidNum	Valid observation number of PSR	INT	4	H+8
5	AdrValidNum	Valid observation number of ADR	INT	4	H+12
6	ADRNumValidFlag	ADR number validity flag 0: Invalid 1: Valid	INT	4	H+16
7	ADRPrecise	ADR accuracy; unit: mm	FLOAT	4	H+20
8	Reserved	Reserved	INT[4]	16	H+24
9	SignalValid	Frequency validity flag; see Table 1-105 Index of SignalValid and SignalAvgCN0 for the details.	UINT	4	H+40

ID	Field	Description	Format	Binary Bytes	Binary Offset
10	SignalAvgCN0	Average CN0 of a certain frequency; unit: dB-Hz; see Table 1-105 Index of SignalValid and SignalAvgCN0 for the details.	FLOAT [18]	4*18	H+44
11	xxxx	32-bit CRC	HEX	4	H+116
12	[CR][LF]	Sentence terminator (ASCII only)			

Table 1-105 Index of SignalValid and SignalAvgCN0

Frequency	Master Antenna Index	Slave Antenna Index
GPS L1C/A	0	9
GPS L2C	1	10
GLO G1	2	11
GLO G2	3	12
BDS B1	4	13
BDS B3	5	14
GAL E1	6	15
GAL E5B	7	16
GAL E5A	8	17

1.4.5 Standard NMEA Message Output

This section introduces the messages of NmeaVer h51 and h52 (defined by the parameter nmeaVer in the command CFGNMEA).

h51: Expanded NMEA 4.10 including BeiDou messages

h52: NMEA 4.11.

See section 1.4.51 and 1.4.5.2 for more details.

1.4.5.1 NmeaVer h51

GGA

Table 1-106 Output Global Positioning System FixData

Syntax	$--GGA,time,Lat,N,Lon,E,FS,NoSV,HDOP,msl,M,Altref,M,DiffAge,DiffStation*cs	
Example	$GNGGA,121605.00,4004.73928025,N,11614.19675535,E,1,13,0.80,58.5371,M,0.0,M,,*78	
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.ss hh – Hour mm – Minute ss.ss – Second
Lat	STR	Latitude, in the format of ddmm.mmmmmmmm dd – Degree mm.mmmmmmmm – Minute
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmmmmm ddd – Degree mm.mmmmmmmm – Minute

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 7-Manual input mode
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 4 decimal places
M	STR	Unit of altitude, specified to constant M
Altref	DOUBLE	Geoidal separation, fixedly output one decimal place. Null when solution is not computed.
M	STR	Unit of Geoidal separation, specified to constant M
DiffAge	DOUBLE	Differential correction latency, in seconds Null when DGPS is not used
DiffStation	DOUBLE	Differential 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 message

GLL

Table 1-107 Output Geographic position - 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	Geographic position - 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 – Degree mm.mmmmm – Minute

N	STR	North or south latitude indicator N – North S – South
Lon	STR	Longitude, in the format of dddmm.mmmmm ddd – Degree mm.mmmmm – Minute
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 – Hour mm – Minute ss.ss – Second
Valid	STR	Position valid indicator V – Invalid A – Valid
Mode	STR	Positioning system mode indicator N – Not positioning A – Single Point positioning D – Differential positioning
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this message

GSA

Table 1-108 Output GNSS Dilution of Precision and Active Satellites

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 active satellites	
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	ID of satellites participating in positioning When there are less than 12 satellites participating in positioning, the insufficient area is filled in empty; when there are more than 12 satellites, it only outputs the first 12 satellites. GPS satellite ID is 01~32 BDS satellite ID is 01~63 GLO satellite ID is 38~61 GAL satellite ID is 01~36 QZSS satellite ID is 193~202
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 message

GSV

Table 1-109 Output GNSS Satellites in View

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	GNSS satellites in view 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 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 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 satellite number is 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 digits
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 digits
cno1~cno4	UINT	CNR of the first to fourth satellite (0~99 dB-Hz), fixed output of 2 digits, add zero up front if less than 2 digits. Fill null for untracked satellites
signalID	UINT	Signal ID defined by NMEA protocol (fixedly output 1)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this message

RMC

Table 1-110 Output the Recommended Minimum 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 recommended minimum 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 – Minute ss.ss – Second
status	STR	Position valid indicator V – Invalid A – Valid
Lat	STR	Latitude, in the format of ddmm.mmmmm dd – Degree mm.mmmmm – Minute
N	STR	North or south latitude indicator

		N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmm ddd – Degree mm.mmmmm – Minute
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. Output null or a value of [0,360] when solution is not computed.
date	STR	UTC date, in the format of ddmmyy dd – Day mm – Month yy – Year
mv	DOUBLE	Magnetic variation, specified to null
mvE	STR	Magnetic variation 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 message

VTG

Table 1-111 Output Course over Ground 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	Course over ground 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 magnetic north (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 message

ZDA

Table 1-112 Output Time and Date

Syntax	$--ZDA,time,day,mon,year,ltzh,ltzn*cs	
Example	$GPZDA,060845.00,18,08,2017,00,00*6C	
Description	Time and date	
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 – Minute ss.ss – Second
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	Local zone hours (fixed output 00)
ltzn	UINT	Local zone minutes (fixed output 00)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this message

GST

Table 1-113 Output GNSS Pseudorange Error Statistics

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

1.4.5.2 NmeaVer h52

GGA

Table 1-114 Output GNSS Positioning Data

Syntax	$--GGA,time,Lat,N,Lon,E,FS,NoSV,HDOP,msl,M,Altref,M,DiffAge,DiffStation*cs	
Example	$GNGGA,121605.00,4004.73928025,N,11614.19675535,E,1,13,0.80,58.5371,M,0.0,M,,*78	
Description	GNSS positioning data	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS system standalone positioning GB - BDS system standalone positioning GA - GAL system standalone positioning GL - GLO system standalone positioning GI - IRNSS system standalone positioning GN - Dual or multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.ss hh – Hour mm – Minute ss.ss – Second
Lat	STR	Latitude, in the format of ddmm.mmmmmmmm dd – Degree mm.mmmmmmmm – Minute
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmmmmm ddd – Degree mm.mmmmmmmm – Minute
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 7 - Manual input mode
NoSV	UINT	Number of satellites participating in positioning
HDOP	DOUBLE	Horizontal dilution of precision, 0.0 - 99.99, the value is 99.99 when not positioning
msl	DOUBLE	Altitude, fixedly output 4 decimal places

M	STR	Unit of altitude, specified to constant M
Altref	DOUBLE	Geoidal separation, fixedly output 1 decimal place. Null when solution is not computed.
M	STR	Unit of geoidal separation, specified to constant M
DiffAge	DOUBLE	Differential correction latency in seconds Null for non-differential positioning
DiffStation	DOUBLE	Differential 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 message

GLL

Table 1-115 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	Geographic longitude/latitude	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS system standalone positioning GB - BDS system standalone positioning GA - GAL system standalone positioning GL - GLO system standalone positioning GI – IRNSS system standalone positioning GN - Dual or multiple system joint positioning
Lat	STR	Latitude, in the format of ddmm.mmmmmmmm dd - Degree mm.mmmmmmmm- Minute
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmmmmm ddd - Degree mm.mmmmmmmm - Minute
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 - Hour mm - Minute

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

GSA

Table 1-116 Output GNSS Dilution of Precision and Active Satellites

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 active satellites	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS system standalone positioning GB - BDS system standalone positioning GA - GAL system standalone positioning GL - GLO system standalone positioning GI–IRNSS system standalone positioning GQ–QZSS 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 or INS positioning 3– 3D positioning
sv1 ~ sv12	UINT	ID of satellites participating in positioning When there are less than 12 satellites participating in

		positioning, the insufficient area is filled in empty; when there are more than 12 satellites, it only outputs the first 12 satellites. GPS satellite ID is 01 ~ 32 BDS satellite ID is 01 ~ 62 GLO satellite ID is 65 ~ 92 GAL satellite ID is 01 ~ 36 QZSS satellite ID is 193, 194, 195, 199 SBAS satellite ID is 120~138 IRNSS satellite ID is 01~15
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 /SBAS system ID 4 - BDS system ID 3 - GAL system ID 2 - GLO system ID 5 - QZSS system ID 6 - IRNSS system ID
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this message

GSV

Table 1-117 Output GNSS Satellites in View

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,2,1,05,03,47,073,45,14,54,176,42,17,70,000,48,19,55,315,43,1*60 $GPGSV,2,2,05,28,,,43,1*6C $GPGSV,1,1,03,03,47,073,46,14,54,176,45,17,70,000,46,6*50 $GPGSV,1,1,02,03,47,073,50,14,54,176,47,8*69 $GLGSV,1,1,03,76,22,194,39,87,54,321,44,88,23,276,37,1*44 $GAGSV,2,1,06,02,17,320,38,10,,,50,11,68,288,43,12,44,047,43,1*46 $GAGSV,2,2,06,24,43,180,43,25,57,280,42,1*75 $GAGSV,2,1,06,02,17,320,39,10,,,51,11,68,288,46,12,44,047,46,2*45 $GAGSV,2,2,06,24,43,180,47,25,57,280,46,2*76 $GAGSV,2,1,06,02,17,320,34,10,,,48,11,68,288,40,12,44,047,41,7*44 $GAGSV,2,2,06,24,43,180,42,25,57,280,41,7*71

<table>
<tr><td></td><td colspan="2">$GBGSV,5,1,20,01,35,139,42,03,43,188,38,04,26,123,37,07,73,167,46,1*71
$GBGSV,5,2,20,08,58,219,38,10,80,237,44,12,50,296,40,13,42,221,38,1*79
$GBGSV,5,3,20,19,27,064,40,22,32,125,44,24,37,244,38,25,20,307,34,1*73
$GBGSV,5,4,20,26,16,196,37,34,23,280,32,35,37,071,43,38,70,215,45,1*79
$GBGSV,5,5,20,40,67,131,49,44,68,336,48,59,36,145,42,60,32,230,37,1*76
$GBGSV,3,1,09,19,27,064,40,22,32,125,40,24,37,244,37,25,20,307,31,3*70
$GBGSV,3,2,09,26,16,196,37,35,37,071,41,38,70,215,44,40,67,131,48,3*74
$GBGSV,3,3,09,44,68,336,46,3*47
$GBGSV,3,1,10,19,27,064,43,22,32,125,42,24,37,244,40,25,20,307,38,5*76
$GBGSV,3,2,10,26,16,196,38,34,23,280,36,35,37,071,44,38,70,215,47,5*70
$GBGSV,3,3,10,40,67,131,48,44,68,336,48,5*7D
$GQGSV,1,1,03,193,19,136,32,195,68,082,48,196,40,141,41,1*6E
$GQGSV,1,1,03,193,19,136,35,195,68,082,49,196,40,141,42,6*6C
$GQGSV,1,1,01,193,19,136,35,8*6C</td></tr>
<tr><td>Description</td><td colspan="2">GNSS satellites in view
Each GSV message contains information for only 4 satellites. When the number of satellites exceeds 4, the receiver sends multiple GSV messages continuously</td></tr>
<tr><td>Input/Output</td><td colspan="2">Output</td></tr>
<tr><td colspan="3">Parameter Definition</td></tr>
<tr><td>Parameter</td><td>Format</td><td>Description</td></tr>
<tr><td>--</td><td>STR</td><td>System identification
GP – GPS/SBAS satellite information
GB - BDS satellite information
GA - GAL satellite information
GL - GLO satellite information
GI – IRNSS satellite information
GQ – QZSS satellite information</td></tr>
<tr><td>NoMsg</td><td>UINT</td><td>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</td></tr>
<tr><td>MsgNo</td><td>UINT</td><td>Number of this GSV message. The minimum value is 1.
MsgNo is the number of this GSV message in this system.</td></tr>
<tr><td>NoSv</td><td>UINT</td><td>Total number of visible satellites in this system</td></tr>
<tr><td>sv1 ~ sv4</td><td>UINT</td><td>Satellite number of the first to fourth satellite
GPS satellite number is 1~32
BDS satellite number is 1~62
GAL satellite number is 1~36
GLO satellite number is 65~96
QZSS satellite number is 193, 194, 195, 199
SBAS satellite number is 120~138</td></tr>
</table>

		IRNSS satellite number is 01~15
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 digits
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 digits
cno1~cno4	UINT	CNR of the first to fourth satellite (0 ~ 99 dBHz), fixed output of 2 digits, add zero up front if less than 2 digits. Fill null for untracked satellites
signalID	UINT	Signal ID defined by NMEA protocol GPS: 1 = L1 C/A 4 = L2P(Y) 5 = L2C-M 6 = L2C-L 7 = L5-I 8 = L5-Q 9 = L1C Galileo: 1 = E5AQ 2 = E5BQ 7 = E1 BeiDou: 1 = B1I 3 = B1C 5 = B2a GLONASS: 1 = L1 C/A IRNSS: 1 = L5 SPS QZSS: 1 = L1 6 = L2C-L 8 = L5-Q
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this message

RMC

Table 1-118Output the Recommended Minimum 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 recommended minimum data	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS system standalone positioning GB - BDS system standalone positioning GA - GAL system standalone positioning GL - GLO system standalone positioning GI – IRNSS system standalone positioning GN - Dual or multiple system joint positioning
time	STR	UTC time, in the format of hhmmss.ss hh - Hour mm - Minute ss.ss - Second
status	STR	Position valid indicator V – Invalid A – Valid
Lat	STR	Latitude, in the format of ddmm.mmmmmmmm dd - Degree mm.mmmmmmmm- Minute
N	STR	North or south latitude indicator N – North latitude S – South latitude
Lon	STR	Longitude, in the format of dddmm.mmmmmm ddd –Degree mm.mmmmmm –Minute
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. Output null or a value of [0,360] when solution is not computed.
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 E – INS positioning
navStates	STR	Navigation state flag, fixed output of 'V' V – The equipment does not provide information about navigation state
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this message

VTG

Table 1-119 Output Course over Groundand 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	Course over groundand ground speed	
Input/Output	Output	
Parameter Definition		
Parameter	Format	Description
--	STR	Positioning system flag GP - GPS system standalone positioning GB - BDS system standalone positioning GA - GAL system standalone positioning GL - GLO system standalone positioning GI – IRNSS 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 magnetic north (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 M – Manual mode D – Differential positioning or SBAS P – Precise Point Positioning (PPP)
cs	STR	Checksum A hexadecimal number obtained by calculating an XOR of all characters from '$' to '*' in this message

ZDA

Table 1-120 Output Date and Time

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

GST

Table 1-121 Output GNSS Pseudorange Error Statistics

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

1.4.6 RTCM Output

1.4.6.1 Raw Observation Output

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

Table 1-122 MSM Message Type of Each Constellation

Constellation	Message Number
GPS	1075
GLO	1085
GAL	1095
BDS	1125
QZSS	1115

☞ Raw observations of 1 Hz can be output via $cfgmsg,2,2,1. If the required frequency is more than 1Hz, send the following command: RTCM1075 0.1, RTCM1085 0.1, RTCM1095 0.1, RTCM1125 0.1, RTCM1115 0.1, to output raw observations of 10Hz.

Base Station Information

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

1.4.6.2 Raw Ephemeris Output

The raw Ephemeris are output via RTCM EPH, using RTCM3.3 protocol. Excerpts of *RTCM STANDARD 10403.3* are shown in the table below for the convenience of users.

Table 1-123 Excepts of *RTCM STANDARD 10403.3*

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	GALF/NAV Ephemeris Data Format	3.5.18.1 Galileo F/NAV Ephemeris: Table 3.5-110 Contents of Galileo F/NAV Satellite Ephemeris Data, Message Type 1045
6	GALI/NAV 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

No.	Item	Index Corresponding to RTCM STANDARD 10403.3
7	QZSS Ephemeris Data Format	3.5.19 QZSS Ephemerides: Table 3.5-112 Contents of QZSS Satellite Ephemeris Data, Message Type 1044
Differential Data		
8	MSM Format	3.5.16.3.4 General Message Structure: Table 3.5-77 Content of an MSM Message, and Sequence of Blocks
9	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
10	Satellite Data	3.5.16.3.6 Satellite Data Description: Table 3.5-80 Content of Satellite Data for MSM4 and MSM6
11	Signal Data	3.5.16.3.7 Message Types Signal Data Description: Table 3.5-85 Content of Signal Data for MSM4
12	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
13	Data Types	3.3 Data Types: Table 3.3-1 Data Type Table
14	Data Fields	3.4 Data Fields: Table 3.4-1 Data Field Table

Table 1-124 Ephemeris Message Types for Each System

GNSS	GPS	BDS	GAL	GLO	QZSS
Message Type	1019	1042	1045, 1046	1020	1044

1.4.7 Default Configuration

1.4.7.1 Serial Port Configuration (CFGPRT)

Table 1-125 Serial Port Configuration[9]

Parameter	Default Configuration	Description
UART1		
baud	115200	
UART2		
baud[10]	115200	

1.4.7.2 NMEA Protocol Version Configuration (CFGNMEA)

Table 1-126 NMEA Protocol Version Configuration

Parameter	Default Configuration	Description
nmeaVer	H52	NMEA 4.11

1.4.7.3 GNSS Constellation Configuration (CFGGNSS)

Table 1-127 GNSS Constellation Configuration

Parameter	Default Configuration	Description
sysMask	H70717D	Enabled by default GPS (L1C/A +L2C+L5)+BDS (B1I+B1C+B2A)+GAL (E1+E5a+E5b)+GLO (L1)+QZSS(L1+L5+L2C)

1.4.7.4 Message Output Frequency Configuration (CFGMSG)

Table 1-128 Message Output Frequency Configuration

Parameter	Default 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

[9] There are a few differences between the default settings of different versions.

[10] When the command is **$cfgmsg,11,1,1**, UART2 takes the role as the debug interface and outputs the debug message with a baud rate of 921600; when the command is **$cfgmsg,11,1,0**, disable the debug output and the baud rate of UART2 is 460800.

ZDA	0	Disabled
GST	0	Disabled
RTCM Measurement Message		
RTCM MSM	0	Disabled
RTCM EPH	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
TIMTP	1	Output at 1Hz
GPSLSINFO[11]	1	Output at 1Hz
Misc Message		
JAM	0	Disabled
PDTINFO	1	Output at 1Hz
NOTICE	1	Output at 1Hz
STAINFO[11]	1	Output at 1Hz
Raw Measurement Message		
OBSVM	0	Disabled
GPSION	0	Disabled
BDSION	0	Disabled
GALION	0	Disabled
BD3ION	0	Disabled
GPSUTC	0	Disabled
BDSUTC	0	Disabled
GALUTC	0	Disabled
BD3UTC	0	Disabled
BD3EPH	0	Disabled
GLOEPH	0	Disabled
GPSEPH	0	Disabled

[11] There are a few differences between the default settings of different versions.

BDSEPH	0	Disabled
GALEPH	0	Disabled
GPSCNAVEPH	0	Disabled
GPSRAWSUBFRAME	0	Disabled
GPSCNAV1RAWSUBFRAME	0	Disabled
GPSCNAV2RAWSUBFRAME	0	Disabled
BDSRAWSUBFRAME	0	Disabled
BD3RAWSUBFRAME	0	Disabled
GALFNAVRAWPAGE	0	Disabled
GALINAVRAWWORD	0	Disabled
GLORAWSTRING	0	Disabled
SATHEALTHSTAT	1	Output at 1Hz
SYSCLKERR	0	Disabled
HWSTATUS	0	Disabled
LOGLIST	0	Disabled
SIGINFO[11]	1	Output at 1Hz
AGNSSSTATUS	0	Disabled
PTOBSINFO	0	Disabled
Debug Message		
RawDebugMessage	0	Disabled
ClockDt	0	Disabled
CLKDT	0	Disabled
BESTNAV	0	Disabled

1.4.7.5 Observation Filtering Threshold in Point Positioning Mode (CFGPMF)

Table 1-129 Observation Filtering Threshold in Point Positioning Mode

Parameter	Default Configuration	Description
maskAngle	5	Minimum elevation: 5 degrees
minSatNum	1	Minimum number of satellites: 1
CN0Th	10	Minimum CN0: 10dB-Hz

1.4.7.6 PPS Configuration (CFGTP)

Table 1-130 PPS Configuration

Parameter	Default Configuration	Description
interval	1000000	PPS output at 1Hz

length	100000	Duty cycle of 10%
flag	13	● Enable the pulse output ● Align the rising edge ● Always output time pulses ● Output TIMTP message
gnssRef	0	Take GPS time as reference
timeBase	0	Align to GNSS system time
antDelay	0	Antenna latency is 0
rfDelay	0	RF latency is 0
usrDelay	0	User latency is 0

1.4.7.7 Timing Mode Configuration (CFGTM)

Table 1-131 Timing Mode Configuration

Parameter	Default Configuration	Description
timMode	2	Self-optimization fixed-location timing
Duration	180	The shortest optimization time is 180 seconds
accuracy	1000	Convergence accuracy is within 10 meters
Lat	0.000000000	Valid only if the position is set by the user, fill in 0.000000000 here
Lon	0.000000000	Valid only if the position is set by the user
hat	0.000	Valid only if the position is set by the user

1.4.7.8 UTC Standard Configuration (CFGUTCSTD)

Table 1-132 UTC Standard Configuration

Parameter	Default Configuration	Description
utcSta	0	USNO (GPS)

1.4.7.9 Leap Second Configuration (CFGLEAPSEC)

Table 1-133 Leap Second Standard Configuration

Parameter	Default Configuration	Description
DefaultMode	0	Firmware default leap second
NavBitsEnable	1	Disable to parse UTC parameters
UserSetGpsLeapSec	0	GPS default leap second
UserSetBdsLeapSec	0	BDS default leap second
UserSetGalLeapSec	0	GAL default leap second

1.4.7.10 Week Number Rollover Start Time Configuration (CFGWNKROR)

Table 1-134 Week Number Rollover Start Time Configuration

Parameter	Default Configuration	Description
enable	0	Disable week number rollover start time configuration

1.4.7.11 Mask Specific Satellite Configuration (CFGSATMASK)

Table 1-135 Mask Specific Satellite Configuration

Parameter	Default Configuration	Description
GPSSatMask1	0	Unmask
GPSSatMask0	0	Unmask
BDSSatMask1	0	Unmask
BDSSatMask0	0	Unmask
GLOSatMask1	0	Unmask
GLOSatMask0	0	Unmask
GALSatMask1	0	Unmask
GALSatMask0	0	Unmask
RSV	0	Reserved
RSV	0	Reserved
RSV	0	Reserved
RSV	0	Reserved

1.4.7.12 Mask Specific Frequency Configuration (CFGFREQMASK)

Table 1-136 Mask Specific Frequency Configuration

Parameter	Default Configuration	Description
SysFreq	Frequency	Unmask
SatSvBitMask1	0	Unmask
SatSvBitMask2	0	Unmask

Note: CFGFREQMASK does not mask any frequency by default. You can mask the related satellite according to the frequency. If you want to query the satellite information of the current masked frequency, use the command **$CFGFREQMASK,SysFreq**. See section 1.4.2.13 for more information.

1.4.7.13 Threshold Configuration for Timing Applications (CFGTIMTH)

Table 1-137 Threshold Configuration for Timing Applications

Parameter	Default Configuration	Description
TimTPQlty2TH	100	The threshold configuration when quality=2 in TIMTP (see section 1.4.3.1) is 100ns
NanTarWaitTimeTH	30	The waiting time of time conversion for GNSS non-target system is set to 30s
RSV	0	Reserved
RSV	0	Reserved

2 Reference

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

[2] NMEA 0183 Standard for Interfacing Marine Electronic Devices, Version 4.11, November 2018

NMEA 0183 Standard for Interfacing Marine Electronic Devices, Version 4.1.

3 Appendix

Explanation of 32-bit CRC

Both ASCII format and binary format log contain 32-bit CRC to further ensure data transmission and reception.

An example of C language generating CRC is provided as below:

```
const ULONG aulCrcTable[256] =
{
    0x00000000UL, 0x77073096UL, 0xee0e612cUL, 0x990951baUL, 0x076dc419UL,
0x706af48fUL,
    0xe963a535UL, 0x9e6495a3UL, 0x0edb8832UL, 0x79dcb8a4UL, 0xe0d5e91eUL,
0x97d2d988UL,
    0x09b64c2bUL, 0x7eb17cbdUL, 0xe7b82d07UL, 0x90bf1d91UL, 0x1db71064UL,
0x6ab020f2UL,
    0xf3b97148UL, 0x84be41deUL, 0x1adad47dUL, 0x6ddde4ebUL, 0xf4d4b551UL,
0x83d385c7UL,
    0x136c9856UL, 0x646ba8c0UL, 0xfd62f97aUL, 0x8a65c9ecUL, 0x14015c4fUL,
0x63066cd9UL,
    0xfa0f3d63UL, 0x8d080df5UL, 0x3b6e20c8UL, 0x4c69105eUL, 0xd56041e4UL,
0xa2677172UL,
    0x3c03e4d1UL, 0x4b04d447UL, 0xd20d85fdUL, 0xa50ab56bUL, 0x35b5a8faUL,
0x42b2986cUL,
    0xdbbbc9d6UL, 0xacbcf940UL, 0x32d86ce3UL, 0x45df5c75UL, 0xdcd60dcfUL,
0xabd13d59UL,
    0x26d930acUL, 0x51de003aUL, 0xc8d75180UL, 0xbfd06116UL, 0x21b4f4b5UL,
0x56b3c423UL,
```

0xcfba9599UL, 0xb8bda50fUL, 0x2802b89eUL, 0x5f058808UL, 0xc60cd9b2UL, 0xb10be924UL,

0x2f6f7c87UL, 0x58684c11UL, 0xc1611dabUL, 0xb6662d3dUL, 0x76dc4190UL, 0x01db7106UL,

0x98d220bcUL, 0xefd5102aUL, 0x71b18589UL, 0x06b6b51fUL, 0x9fbfe4a5UL, 0xe8b8d433UL,

0x7807c9a2UL, 0x0f00f934UL, 0x9609a88eUL, 0xe10e9818UL, 0x7f6a0dbbUL, 0x086d3d2dUL,

0x91646c97UL, 0xe6635c01UL, 0x6b6b51f4UL, 0x1c6c6162UL, 0x856530d8UL, 0xf262004eUL,

0x6c0695edUL, 0x1b01a57bUL, 0x8208f4c1UL, 0xf50fc457UL, 0x65b0d9c6UL, 0x12b7e950UL,

0x8bbeb8eaUL, 0xfcb9887cUL, 0x62dd1ddfUL, 0x15da2d49UL, 0x8cd37cf3UL, 0xfbd44c65UL,

0x4db26158UL, 0x3ab551ceUL, 0xa3bc0074UL, 0xd4bb30e2UL, 0x4adfa541UL, 0x3dd895d7UL,

0xa4d1c46dUL, 0xd3d6f4fbUL, 0x4369e96aUL, 0x346ed9fcUL, 0xad678846UL, 0xda60b8d0UL,

0x44042d73UL, 0x33031de5UL, 0xaa0a4c5fUL, 0xdd0d7cc9UL, 0x5005713cUL, 0x270241aaUL,

0xbe0b1010UL, 0xc90c2086UL, 0x5768b525UL, 0x206f85b3UL, 0xb966d409UL, 0xce61e49fUL,

0x5edef90eUL, 0x29d9c998UL, 0xb0d09822UL, 0xc7d7a8b4UL, 0x59b33d17UL, 0x2eb40d81UL,

0xb7bd5c3bUL, 0xc0ba6cadUL, 0xedb88320UL, 0x9abfb3b6UL, 0x03b6e20cUL, 0x74b1d29aUL,

0xead54739UL, 0x9dd277afUL, 0x04db2615UL, 0x73dc1683UL, 0xe3630b12UL, 0x94643b84UL,

0x0d6d6a3eUL, 0x7a6a5aa8UL, 0xe40ecf0bUL, 0x9309ff9dUL, 0x0a00ae27UL, 0x7d079eb1UL,

0xf00f9344UL, 0x8708a3d2UL, 0x1e01f268UL, 0x6906c2feUL, 0xf762575dUL, 0x806567cbUL,

0x196c3671UL, 0x6e6b06e7UL, 0xfed41b76UL, 0x89d32be0UL, 0x10da7a5aUL, 0x67dd4accUL,

0xf9b9df6fUL, 0x8ebeeff9UL, 0x17b7be43UL, 0x60b08ed5UL, 0xd6d6a3e8UL,

0xa1d1937eUL,
0x38d8c2c4UL, 0x4fdff252UL, 0xd1bb67f1UL, 0xa6bc5767UL, 0x3fb506ddUL, 0x48b2364bUL,
0xd80d2bdaUL, 0xaf0a1b4cUL, 0x36034af6UL, 0x41047a60UL, 0xdf60efc3UL, 0xa867df55UL,
0x316e8eefUL, 0x4669be79UL, 0xcb61b38cUL, 0xbc66831aUL, 0x256fd2a0UL, 0x5268e236UL,
0xcc0c7795UL, 0xbb0b4703UL, 0x220216b9UL, 0x5505262fUL, 0xc5ba3bbeUL, 0xb2bd0b28UL,
0x2bb45a92UL, 0x5cb36a04UL, 0xc2d7ffa7UL, 0xb5d0cf31UL, 0x2cd99e8bUL, 0x5bdeae1dUL,
0x9b64c2b0UL, 0xec63f226UL, 0x756aa39cUL, 0x026d930aUL, 0x9c0906a9UL, 0xeb0e363fUL,
0x72076785UL, 0x05005713UL, 0x95bf4a82UL, 0xe2b87a14UL, 0x7bb12baeUL, 0x0cb61b38UL,
0x92d28e9bUL, 0xe5d5be0dUL, 0x7cdcefb7UL, 0x0bdbdf21UL, 0x86d3d2d4UL, 0xf1d4e242UL,
0x68ddb3f8UL, 0x1fda836eUL, 0x81be16cdUL, 0xf6b9265bUL, 0x6fb077e1UL, 0x18b74777UL,
0x88085ae6UL, 0xff0f6a70UL, 0x66063bcaUL, 0x11010b5cUL, 0x8f659effUL, 0xf862ae69UL,
0x616bffd3UL, 0x166ccf45UL, 0xa00ae278UL, 0xd70dd2eeUL, 0x4e048354UL, 0x3903b3c2UL,
0xa7672661UL, 0xd06016f7UL, 0x4969474dUL, 0x3e6e77dbUL, 0xaed16a4aUL, 0xd9d65adcUL,
0x40df0b66UL, 0x37d83bf0UL, 0xa9bcae53UL, 0xdebb9ec5UL, 0x47b2cf7fUL, 0x30b5ffe9UL,
0xbdbdf21cUL, 0xcabac28aUL, 0x53b39330UL, 0x24b4a3a6UL, 0xbad03605UL, 0xcdd70693UL,
0x54de5729UL, 0x23d967bfUL, 0xb3667a2eUL, 0xc4614ab8UL, 0x5d681b02UL, 0x2a6f2b94UL,
0xb40bbe37UL, 0xc30c8ea1UL, 0x5a05df1bUL, 0x2d02ef8dUL
};

// Calculate and return the CRC for usA binary buffer

```
ULONG CalculateCRC32( const UCHAR *szBuf, INT iSize, ULONG    ulCRC )
{
      INT       iIndex;

      for (iIndex=0; iIndex<iSize; iIndex++)
      {
            ulCRC = aulCrcTable[(ulCRC ^ szBuf[iIndex]) & 0xff] ^ (ulCRC >> 8);
      }

                        return ulCRC;
}
```

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