CASIC Multimode Satellite Navigation Receiver Protocol specification

V3.6

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Document summary

Describes the CASIC multi-mode satellite navigation receiver protocol specification in detail, including the general standard NMEA0183 protocol, and Defined binary protocol.

date	version	Author	Description
2017.04.24	3.6		The size of the CASIC protocol "payload" is increased from 1kB Add to 2KB

1 NMEA protocol

1.1 NMEA protocol features

The CASIC receiver is compatible with the international standard NMEA0183 protocol, supports NMEA0183 version 4.0 by default, and is compatible with V2.3 And V3.X version, support the NMEA0183 V4.1 standard and the standard before V2.3 by sending commands.

Data is transmitted in serial asynchronous mode. The first bit is the start bit, followed by the data bit. Data bits follow the least significant bit first the rule of.

Data transfer method

Start bit D0 D1 D2 D3 D4 D5 D6 D7 Stop bit

Parameters for data transmission

Baud rate (bps)	Support 4800, 9600, 19200, 38400, 57600, 115200
Data bit	8-bit
Stop bit	1 person
Check Digit	no

1.2 NMEA protocol framework

NMEA messages are sent by the GNSS receiver and support the NMEA0183 protocol. Data format protocol framework

NMEA protocol framework

Calculation range of checksum

$	<address>	{,<number>}	*<Checksum>	<CR><LF>
Start character	Address segment	Data segment	Checksum segment	End sequence
Every sentence All start with'$' Start	Divided into two parts Sender identifier And statement type	Start with',', and the following number and Fixed length	Start with'*' The value length is variable and also According to (not including this Two characters) press XOR The result of the operation, Use hexadecimal numbers Value representation	Every sentence So <CR><LF> End

For detailed NMEA protocol standards refer to http://www.nmea.org/

On the basis of the NMEA protocol framework, this receiver protocol specification adds custom sentences to control the receiver's Work mode, and query receiver product information, etc. The identifier of the custom statement is'P'.

1.3 NMEA identifier and field type

1.3.1 Transmitter identifier

NMEA sentences distinguish different GNSS modes through transmitter identifiers, which are defined as follows:

Transmitter	Identifier
Beidou Navigation Satellite System (BDS)	BD
Global Positioning System (GPS, SBAS, QZSS)	GP
Global Navigation Satellite System (GLONASS)	GL
Global Navigation Satellite System (GNSS)	GN
Custom information	P

1.3.2 Satellite number identifier

Satellite system	Satellite number identifier in NMEA	The corresponding relationship between the satellite number of the satellite PRN and its PRN	
GPS	1~32	1~32	0+PRN
SBAS	33~51	120~138	87+PRN
GLONASS	65~88	1~24	64+PRN
BDS	1~37	1~37	0+PRN
QZSS	193~197	193~197	0+PRN

1.3.3 System identifier

The CASIC receiver supports a variety of NMEA data protocol formats. The difference between different protocols is reflected in the system indicator. The new version of the protocol has added some fields.

	NMEA4.0 and below	NMEA4.1
GGA	[1]Identification	[1]Identification
ZDA	[1]Identification	[1]Identification
GLL	[1]Identification	[1]Identification
RMC	[1]Identification	[1]Identification
VTG	[1]Identification	[1]Identification
GSA	[2]Identification	[1]Identification, adding additional fields to distinguish different systems
GSV	[2]Identification	[2]Identification

[1]Identification: If only BD, GPS, GLONASS, Galileo and other satellites are used for position calculation, the transmission identifier is For BD, GP, GL, GA, etc., if multiple satellite systems are used to obtain position calculations, GN is used to transmit the identifier.

[2]Identification: GP (GPS satellite), BD (BDS satellite), GL (GLONASS satellite)

As described in section 1.1, CASIC receivers support three versions of the NMEA0183 protocol standard. Now enumerate these three standards The differences are as follows.

The main differences between NMEA2.2 and 2.3/4.0 are:

1) The positioning mode (Mode) in GLL, RMC and VTG statements is not output.

2) For the positioning quality (FS) item in the GGA sentence, both the track calculation and the normal positioning use 1. (2.3 will be the track Estimated as 6)

NMEA 4.1 protocol adds some fields on the basis of 4.0:

1) Add systemId to the GSA statement.

2) Add signalId to the GSV statement.

3) Add navStatus to the RMC statement.

For details, please refer to the introduction of NMEA sentences in section 1.5.

1.3.4 Field Type

Field Type	symbol	definition
Special format field		
status	A	Single character field: A=Yes, the data is valid and the alarm flag is cleared; V=No, the data is invalid, and the alarm flag is set.
latitude	ddmm.mmmm	Fixed/variable length field dd means a fixed length of 2 degrees, the mm before the decimal point means Shows a fixed length of 2 minutes, mmmm after the decimal point means Decimal points with variable length.
longitude	dddmm.mmmm	Fixed/variable length field ddd represents a fixed length of 3 degrees, The mm before the decimal point means a fixed length of 2 minutes, the decimal point The mmmm after it represents the decimal point with variable length.
time	hhmmss.sss	Fixed length field hh means a fixed length of 2 hours, mm means a fixed length 2 minutes, ss before the decimal point means fixed length 2 Seconds, sss after the decimal point means a fixed length of 3 decimal seconds.
Determine the field		Some fields are specified for predefined constants.
Numeric field		
Variable number	xx	Variable length or floating point numeric fields
Fixed hexadecimal field	hh___	A fixed-length hexadecimal number with the most significant bit on the left
Variable hexadecimal field	h--h	A variable-length hexadecimal number with the most significant bit on the left
Information field		
Fixed letter field	aa___	Fixed-length uppercase or lowercase alphabetic character field
Fixed number field	xx___	Fixed-length numeric character field
Variable text	c--c	Variable length valid character field

1.4 Overview of NMEA messages

page	Message name	Class/ID	description
	NMEA standard message		Standard message
	GGA	0x4E 0x00	Receiver positioning data
	GLL	0x4E 0x01	Geographical Location-Latitude/Longitude
	GSA	0X4E 0x02	Factor of Precision (DOP) and effective satellites
	GSV	0x4E 0x03	Visible satellite
	RMC	0x4E 0x04	Recommended minimum dedicated navigation data
	VTG	0x4E 0x05	Ground speed and heading
	ZDA	0x4E 0x08	Time and date
	TXT	0x4E 0x11	Text transfer
	NMEA custom message		Custom message
	CAS00	-	Save configuration information
	CAS01	-	Communication protocol and serial port configuration information
	CAS02	-	Set target update rate
	CAS03	-	Enable or disable output information and its frequency
	CAS04	-	Set the initialization system and the number of channels
	CAS05	-	Set the sender identifier of the NMEA sentence
	CAS06	-	Query module software and hardware information
	CAS10	-	Start mode and auxiliary information configuration
	CAS20	-	Online upgrade instructions

1.5 NMEA standard message

1.5.1 GGA

information	GGA
description	Receiver time, location and positioning related data
Types of	Output
format	$--GGA,UTCtime,Lat,uLat,Lon,uLon,FS,numSv,HDOP,Msl,uMsl,Sep,uSep,DiffAge,DiffSta*CS<CR><LF>
Example	$GPGGA,235316.000,2959.9925,S,12000.0090,E,1,06,1.21,62.77,M,0.00,M,,*7B

Parameter Description

Field	name	format	Parameter Description
1	$--GGA	String	Message ID, GGA statement header,'--' is the system identifier
2	UTCtime	hhmmss.sss	UTC time of current positioning
3	Lat	ddmm.mmmm latitude, the first 2 characters indicate degrees, the following characters indicate minutes	
4	uLat	character	Latitude direction: N-North, S-South
5	Lon	dddmm.mmmm	Longitude, the first 3 characters indicate degrees, the following characters indicate minutes
6	uLon	character	Longitude direction: E-east, W-west
7	FS	Value	Indicates the current positioning quality (note [1]), this field should not be empty
8	numSv	Value	Number of satellites used for positioning, 00~24
9	HDOP	Value	Horizontal Factor of Precision (HDOP)
10	Msl	Value	Altitude, that is, the height of the receiver antenna relative to the geoid
11	uMsl	character	Height unit, meter, fixed character M
12	Sep	Value	Refer to the distance between the ellipsoid and the geoid, "-" means the earth The level is lower than the reference ellipsoid
13	uSep	character	Height unit, meter, fixed character M
14	DiffAge	Value	Differentially corrected data age, this field is empty when DGPS is not used
15	DiffSta	Value	ID of the differential reference station
16	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
17	<CR><LF>	character	Carriage return and line feed

Remarks [1] Positioning quality mark

Location quality mark	description
0	Targeting is unavailable or invalid
1	SPS positioning mode, effective positioning
6	The estimation mode (dead reckoning) is only valid for NMEA 2.3 and above

1.5.2 GLL

information	GLL
description	Information such as latitude, longitude, positioning time and positioning status.
Types of	Output
format	$--GLL,Lat,uLat,Lon,uLon, UTCtime,valid,Mode*CS<CR><LF>
Example	$GPGLL,2959.9925,S,12000.0090,E,235316.000,A,A*4E

Parameter Description

Field	name	format	Parameter Description
1	$--GLL	String	Message ID, GLL statement header,'--' is the system identifier

2	Lat	ddmm.mmmm latitude, the first 2 characters indicate degrees, the following characters indicate minutes	
3	uLat	character	Latitude direction: N-North, S-South
4	Lon	dddmm.mmm m	Longitude, the first 3 characters indicate degrees, the following characters indicate minutes
5	uLon	character	Longitude direction: E-east, W-west
6	UTCtime	hhmmss.sss	UTC time of current positioning
7	Valid	character	Data validity (note [1])
8	Mode	character	Positioning mode (note [2]), only valid for NMEA 2.3 and above
9	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
10	<CR><LF>	character	Carriage return and line feed

Remark [1] Data validity flag

Location quality mark	description
A	Data is valid
V	Invalid data

Remark [2] Positioning mode flag

Positioning mode flag	description
A	Autonomous mode
E	Estimation mode (dead reckoning)
N	Invalid data
D	Differential mode

1.5.3 GSA

information	GSA
description	Satellite number and DOP information used for positioning. Output GSA regardless of whether it is located or if there are available satellites Sentence; when the receiver is in multi-system joint work, the available satellites of each system correspond to a GSA sentence, Each GSA sentence contains PDOP, HDOP and VDOP obtained from the combined satellite system.
Types of	Output
format	$--GSA,Smode,FS{,SVID},PDOP,HDOP,VDOP*CS<CR><LF>
Example	$GPGSA,A,3,05,21,31,12,18,29,,,,,,2.56,1.21,2.25*01

Parameter Description

Field	name	format	Parameter Description
1	$--GSA	String	Message ID, GSA statement header,'--' is the system identifier
2	Smode	character	Mode switching mode indication (Note [1])
3	FS	digital	Positioning status flag (remark [2])
4	{,SVID}	Value	Satellite number used for positioning, this field displays 12 available satellites in total No., if there are more than 12, only the first 12 will be output, if less than 12, no Fill in the space
5	PDOP	Value	Position precision factor (PDOP)
6	HDOP	Value	Horizontal Factor of Precision (HDOP)
7	VDOP	Value	Vertical factor of precision (VDOP)
8	systemId	Value	GNSS system ID number defined by NMEA (Note [3]) Only NMEA 4.1 and above are valid
9	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *)

			fruit
10	<CR><LF>	character	Carriage return and line feed

Remarks [1] Mode switch mode indication

Mode switch mode indication	description
M	Switch manually. Forced to 2D or 3D working mode
A	Automatic switching. The receiver automatically switches 2D/3D working mode

Remarks [2] Positioning status flag

Positioning status	description
1	Invalid targeting
2	2D positioning
3	3D positioning

Remarks [3] GNSS system ID

System ID	description
1	GPS system
2	GLONASS system
4	BDS system

1.5.4 GSV

information	GSV
description	The satellite number of the visible satellite and its elevation angle, azimuth angle, carrier-to-noise ratio and other information. The {satellite code in each GSV sentence Number, elevation angle, azimuth angle, carrier-to-noise ratio} The number of parameter groups is variable, the maximum is 4 groups, and the minimum is 0 groups.
Types of	Output
format	$--GSV,NumMsg,MsgNo,NumSv{,SVID,ele,az,cn0} *CS<CR><LF>
Example	$GPGSV,3,1,10,25,68,053,47,21,59,306,49,29,56,161,49,31,36,265,49*79
	$GPGSV,3,2,10,12,29,048,49,05,22,123,49,18,13,000,49,01,00,000,49*72
	$GPGSV,3,3,10,14,00,000,03,16,00,000,27*7C

Parameter Description

Field	name	format	Parameter Description
1	$--GSA	String	Message ID, GSA statement header,'--' is the system identifier
2	NumMsg	character	The total number of statements. Each GSV sentence can output up to 4 visible satellite signals Therefore, when the system can see more than 4 satellites, more GSV statement.
3	MsgNo	digital	Current sentence number
4	NumSv	Value	Total visible satellites
5	{,SVID,ele, az,cn0}	Value	as followed: Satellite number; Elevation angle, the value range is 0~90, the unit is degree; Azimuth, the value range is 0~359, the unit is degree; Carrier-to-noise ratio, the value range is 0~99, the unit is dB-Hz, if not The current satellite is tracked, and the space is filled (remark [3])
6	signalId	Value	GNSS signal ID defined by NMEA (0 means all signals) Only NMEA 4.1 and above are valid
7	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
8	<CR><LF>	character	Carriage return and line feed

1.5.5 RMC

information	RMC
description	Recommended minimum positioning information
Types of	Output
format	$--RMC,UTCtime,status,Lat,uLat,Lon,uLon,Spd,Cog,Date,mv,mvE,mode*CS<CR><LF>
Example	$GPRMC,235316.000,A,2959.9925,S,12000.0090,E,0.009,75.020,020711,,,A*45

Parameter Description

Field	name	format	Parameter Description
1	$--RMC	String	Message ID, RMC statement header,'--' is the system identifier
2	UTCtime	hhmmss.sss	UTC time of current positioning
3	status	String	Position valid flag. V=Receiver warning, invalid data A=Data is valid
4	Lat	ddmm.mmmm	latitude, the first 2 characters indicate degrees, the following characters indicate minutes
5	uLat	character	Latitude direction: N-North, S-South
6	Lon	dddmm.mmmm	Longitude, the first 3 characters indicate degrees, the following characters indicate minutes
7	uLon	character	Longitude direction: E-east, W-west
8	Spd	Value	Speed over the ground in knots
9	Cog	Value	True heading over ground, in degrees
10	Date	ddmmyy	Date (dd is day, mm is month, yy is year)
11	mv	Value	Magnetic declination, in degrees. Fixed empty
12	mvE	character	Magnetic declination direction: E-East, W-West. Fixed empty
13	mode	character	Positioning mode flag (remark [1]) Only valid for *NMEA 2.3* and above
14	navStatus	character	Navigation status indicator (V means the system does not output navigation status information) Only NMEA 4.1 and above are valid
15	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
16	<CR><LF>	character	Carriage return and line feed

Remarks [1] Positioning mode flag

Positioning mode flag	description
A	Autonomous mode
E	Estimation mode (dead reckoning)
N	Invalid data
D	Differential mode

1.5.6 VTG

information	VTG
description	Ground speed and ground heading information.
Types of	Output
format	$--VTG,Cogt,T,Cogm,M,Sog,N,kph,K,mode*CS<CR><LF>
Example	$GPVTG,75.20,T,,M,0.009,N,0.017,K,A*02

Parameter Description

Field	name	format	Parameter Description
1	$--VTG	String	Message ID, VTG statement header,'--' is the system identifier
2	Cogt	Value	True north heading over Earth, in degrees
3	T	character	True north indication, fixed as T
4	Cogm	Value	Heading to geomagnetic north, in degrees
5	M	character	Magnetic north indicator, fixed as M
6	Sog	Value	Speed over the ground in knots
7	N	character	Speed unit knot, fixed as N
8	kph	Value	Ground speed in kilometers per hour
9	K	character	Speed unit, kilometers per hour, fixed as K
10	mode	character	Positioning mode flag (remark [1]) Only valid for *NMEA 2.3* and above
11	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
12	<CR><LF>	character	Carriage return and line feed

Remarks [1] Positioning mode flag

Positioning mode flag	description
A	Autonomous mode
E	Estimation mode (dead reckoning)
N	Invalid data
D	Differential mode

1.5.7 ZDA

information	ZDA
description	Time and date information.
Types of	Output
format	$--ZDA,UTCtime,Day,Month,Year,Ltzh,Ltzn*CS<CR><LF>
Example	$GPZDA,235316.000,02,07,2011,00,00*51

Parameter Description

Field	name	format	Parameter Description

1	$--ZDA	String	Message ID, ZDA statement header,'--' is the system identifier
2	UTCtime	hhmmss.sss	UTC time when positioning
3	Day	Value	Day, fixed two digits, value range 01~31
4	Month	Value	Month, fixed two digits, value range 01~12
5	Year	Value	Year, fixed four digits
6	Ltzh	Value	This time zone is hour, not supported, fixed as 00
7	Ltzn	Value	Minutes in this time zone, not supported, fixed as 00
8	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
9	<CR><LF>	character	Carriage return and line feed

1.5.8 TXT

1) Product information

information	TXT
description	product information
Types of	Output, output once at boot
format	$GPTXT,xx,yy,zz,info*hh<CR><LF>
Example	$GPTXT,01,01,02,MA=CASIC*27
	Indicates the name of the manufacturer (CASIC)
	$GPTXT,01,01,02,IC=ATGB03+ATGR201*71
	Indicates the model of the chip or chipset (baseband chip model ATGB03, radio frequency chip model ATGR201)
	$GPTXT,01,01,02,SW=URANUS2,V2.2.1.0*1D
	Indicates the software name and version number (software name URANUS2, version number V2.2.1.0)
	$GPTXT,01,01,02,TB=2013-06-20,13:02:49*43
	Indicates the code compilation time (June 20, 2013, 13:02:49)
	$GPTXT,01,01,02,MO=GB*77
	Indicates the working mode of the receiver this time (GB means GPS+BDS dual-mode mode)
	$GPTXT,01,01,02,CI=00000000*7A
	Represents the customer number (the customer number is 00000000)

Parameter Description

Field	name	format	Parameter Description
1	$GPTXT	String	Message ID, TXT statement header

2	xx	Value	The total number of sentences in the current message is 01~99. If a message is too long, Need to be divided into multiple information display
3	yy	Value	Statement number 01~99
4	zz	Value	Text identifier. 00=error information; 01=Warning message; 02=Notification information; 07=User information.
5	info		Text message
6	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
7	<CR><LF>	character	Carriage return and line feed

2) Antenna status

information	TXT
description	Antenna status
Types of	Output
format	$GPTXT,xx,yy,zz,info*hh<CR><LF>
Example	$GPTXT,01,01,01,ANTENNA OPEN*25 Indicates antenna status (open circuit) $GPTXT,01,01,01,ANTENNA OK*35 Indicates antenna status (good) $GPTXT,01,01,01,ANTENNA SHORT*63 Indicates antenna status (short circuit)

Parameter Description

Field	name	format	Parameter Description
1	$GPTXT	String	Message ID, TXT statement header
2	xx	Value	The total number of sentences in the current message is 01~99. If a message is too long, It needs to be divided into multiple pieces of information display, which is fixed at 01.
3	yy	Value	Sentence numbers are 01~99, fixed to 01.
4	zz	Value	Text identifier. It is fixed to 01.
5	info		Text message ANTENNA OPEN=antenna open ANTENNA OK=The antenna is OK ANTENNA SHORT=Antenna short
6	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
7	<CR><LF>	character	Carriage return and line feed

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3) Leap second information

information	TXT
description	Leap second information
Types of	Output
format	$GPTXT,xx,yy,zz,system,valid,utcLS,utcLSF,utcTOW,utcWNT, utcDN,utcWNF,utcA0,utcA1,leapDt*hh<CR><LF>
Example	$GPZDA,090748.000,29,09,2013,00,00*56 The current UTC time is September 29, 2013, 09:07:48 $GPTXT,01,01,02,LS=0,3,16,16,57,224,7,158,0,-5,-39344868*5B The leap second information of GPS is valid and used for time service. The current leap second and the leap second event are the same, both are 16 seconds, indicating that the leap s The second event has taken effect, and the leap second event occurred before 39344868 (that is, the end of June 30, 2012). tail) $GPTXT,01,01,02,LS=1,1,2,2,0,148,7,82,4,0,-39344868*5B Beidou's leap second information is valid and not used for time service. The current leap second is the same as the leap second event, both are 2 seconds, indicating a leap second The event has taken effect, the leap second event occurred before 39344868 (that is, the end of June 30, 2012), Note: The leap seconds of GPS and Beidou are different, because their time start reference points are different

Parameter Description

Field	name	format	Parameter Description
1	$GPTXT	String	Message ID, TXT statement header
2	xx	Value	The total number of sentences in the current message is 01~99. If a message is too long, It needs to be divided into multiple pieces of information display, which is fixed at 01.
3	yy	Value	Sentence numbers are 01~99, fixed to 01.
4	zz	Value	Text identifier. Fixed at 02.
5	system	character	The system corresponding to the leap second information. 0=GPS 1=BDS (Beidou)
6	LS=	String	Leap second message identifier, fixed character.
7	valid	character	Leap second information valid sign. When multiple satellite systems are jointly positioned, only One of the systems is used for time service (calibration of 1PPS and UTC time) 0=Invalid leap second information 1=Leap second information is valid, but the system is not used for timing 2=The leap second information is invalid, but the system has been used for time service 3=Leap second information is valid, and the system has been used for time service
8	utcLS	Value	The current leap second, in seconds, a positive number means the satellite time is ahead of UTC time
9	utcLSF	Value	The predicted leap second (after the occurrence of a leap second event), in seconds, a positive number table Show satellite time ahead of UTC time
10	utcTOW	Value	The reference time of UTC correction parameters, within the week, the unit is second
11	utcWNT	Value	The reference time of UTC correction parameters, the number of weeks, the unit is week, modulo 256
12	utcDN	Value	The time when the leap second occurs, the number of days in the week, the value range is 1~7, and 1 means star The end of the period, 2 means the end of Monday, and so on, 7 forms Shows the end of Saturday
13	utcWNF	Value	The time when the leap second occurs, the number of weeks, the unit is weeks, mod 256
14	utcA0	Value	The time error between UTC time and satellite time (scale factor 2^-30),

			Unit is second
15	utcA1	Value	The rate of change of time error between UTC time and satellite time (scale factor 2^-50) in seconds/second
16	leapDt	Value	The time between the time of the leap second event and the current UTC time A positive number indicates that a leap second event will occur in the future
17	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
18	<CR><LF>	character	Carriage return and line feed

1.6 NMEA custom message

1.6.1 CAS00

information CAS00

description Save the current configuration information to FLASH, even if the receiver is completely powered off, the information in FLASH will not be lost.

Types of format	enter $PCAS00*CS<CR><LF>
Example	$PCAS00*01

Parameter Description

Field	name	format	Parameter Description
1	$PCAS00	String	Message ID, statement header
2	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
3	<CR><LF>	character	Carriage return and line feed

1.6.2 CAS01

information	CAS01
description	Set the baud rate of serial communication.
Types of	enter
format	$PCAS01,br*CS<CR><LF>
Example	$PCAS01,1*1D

Parameter Description

Field	name	format	Parameter Description
1	$PCAS01	String	Message ID, statement header
2	br	digital	Baud rate configuration. 0=4800bps 1=9600bps 2=19200bps 3=38400bps 4=57600bps 5=115200bps
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.3 CAS02

information	CAS02
description	Set the positioning update rate.
Types of	enter
format	$PCAS02,fixInt*CS<CR><LF>
Example	$PCAS02,1000*2E

Parameter Description

Field	name	format	Parameter Description
1	$PCAS02	String	Message ID, statement header
2	fixInt	Value	The positioning update interval, in ms. 1000=Update rate is 1Hz, output 1 positioning point per second 500=Update rate is 2Hz, output 2 positioning points per second 250=Update rate is 4Hz, output 4 positioning points per second 200=Update rate is 5Hz, output 5 positioning points per second 100=Update rate is 10Hz, output 10 positioning points per second
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.4 CAS03

information	CAS03
description	Set the NMEA sentence that requires output or stop output.
Types of	enter
format	$PCAS03,nGGA,nGLL,nGSA,nGSV,nRMC,nVTG,nZDA,nTXT*CS<CR><LF>
Example	$PCAS03,1,1,1,1,1,1,0,1*03

Parameter Description

Field	name	format	Parameter Description
1	$PCAS03	String	Message ID, statement header
2	nGGA	Value	GGA output frequency, sentence output frequency is based on the positioning update rate Accurate, n (0~9) means output once every n times, 0 means Do not output the sentence, and keep the original configuration if it is empty.
3	nGLL	Value	GLL output frequency, same as nGGA
4	nGSA	Value	GSA output frequency, same as nGGA
5	nGSV	Value	GSV output frequency, same as nGGA
6	nRMC	Value	RMC output frequency, same as nGGA
7	nVTG	Value	VTG output frequency, same as nGGA
8	nZDA	Value	ZDA output frequency, same as nGGA
9	nTXT	Value	TXT output frequency, same as nGGA
10	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
11	<CR><LF>	character	Carriage return and line feed

1.6.5 CAS04

information	CAS04
description	Configure the working system.
Types of	enter
format	$PCAS04,mode*hh<CR><LF>
Example	$PCAS04,3*1A Beidou and GPS dual mode
	$PCAS04,1*18 Single GPS working mode
	$PCAS04,2*1B Single Beidou working mode

Parameter Description

Field	name	format	Parameter Description
1	$PCAS04	String	Message ID, statement header
2	mode	digital	Working system configuration. For characteristic product models, the following parts are supported Sub-configuration. 1=GPS 2=BDS 3=GPS+BDS 4=GLONASS 5=GPS+GLONASS 6=BDS+GLONASS 7=GPS+BDS+GLONASS
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.6 CAS05

information	CAS05
description	Set NMEA protocol type selection. There are many types of protocols for multi-mode navigation receivers, and the data protocol standards are also More, this receiver product can support multiple protocols (optional configuration) .
Types of	enter

format $PCAS05,ver*CS<CR><LF>

Example $PCAS05,1*19

Parameter Description

Field	name	format	Parameter Description
1	$PCAS05	String	Message ID, statement header
2	mode	digital	NMEA protocol type selection (note [1])
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

Remarks [1] NMEA protocol type selection

2 Compatible with NMEA 4.1 and above

5 Compatible with the BDS/GPS dual-mode protocol of China Transportation Information Center, compatible with NMEA 2.3 and above, compatible NMEA4.0 protocol, the default protocol

9 Compatible with single GPS NMEA0183 protocol, compatible with NMEA 2.2 version

1.6.7 CAS06

information CAS06

description Query product information

Types of enter

format $PCAS06,info*CS<CR><LF>

Example $PCAS06,0*1B

Parameter Description

Field	name	format	Parameter Description
1	$PCAS06	String	Message ID, statement header
2	info	digital	Query the information type of the product. For information content, refer to 1.5.8. 0=Query firmware version number 1=Query hardware model and serial number 2=Query the working mode of the multimode receiver 3=Query the customer number of the product 5=Query upgrade code information
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.8 CAS10

information	CAS10
description	Receiver restart
Types of	enter
format	$PCAS10,rs*CS<CR><LF>
Example	$PCAS10,0*1C hot start
	$PCAS10,1*1D warm start
	$PCAS10,2*1E cold start
	$PCAS10,8*14 Factory start
	$PCAS10,9*15 Factory start

Parameter Description

Field	name	format	Parameter Description
1	$PCAS10	String	Message ID, statement header
2	rs	digital	Start mode configuration. 0=hot start. Do not use initialization information, back up all The data is valid. 1=Warm start. Clear the ephemeris without using the initialization information. 2=Cold start. Do not use the initialization information, clear the backup storage except All data outside the configuration. 3=Factory boot. Clear all data in the memory and reset the receiver To the factory default configuration. 8=Turn off the serial port output and radio frequency part to respond to the serial port configuration. 9=Start the serial port output and radio frequency part. Corresponds to 8.
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.9 CAS20

information	CAS20
description	Online upgrade instructions
Types of	enter
format	$PCAS20*CS<CR><LF>
Example	$PCAS20*03

Parameter Description

Field	name	format	Parameter Description
1	$PCAS20	String	Message ID, statement header
2	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (excluding $ and *) fruit
3	<CR><LF>	character	Carriage return and line feed

2 CASIC protocol

2.1 CASIC protocol features

CASIC receivers use a custom standard interface protocol (CSIP, CASIC Standard Interface Protocol)
Send data to the host, and the data is transmitted in asynchronous serial mode.

2.2 CASIC protocol framework

CSIP packet structure

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
Message header	Payload length	Message	Message number	Payload	Check value
0xBA,0xCE	Unsigned short 2 bytes	1 byte	1 byte	<2k bytes	Unsigned integer 4 bytes

Field 1: Message header (0xBA, 0xCE)

Four hexadecimal characters are used as the start and delimit characters of the message (message header), occupying two bytes.

Field 2: Payload length (len)

The message length (two bytes) indicates the number of bytes occupied by the payload (field 5), excluding the message header, message type, Message number, length and checksum field.

Field 3: Message class (class)

Occupies one byte, which represents the basic subset to which the current message belongs.

Field 4: Message ID (id)

After the message class is a one-byte message number.

Field 5: Payload

The payload is the specific content of the data packet transmission. Its length (number of bytes) is variable and is an integer multiple of 4.

Field 6: Check value (ckSum)

The checksum is the word-by-word of all data from field 2 to field 5 (including field 2 and field 5) (1 word includes 4 (Bytes) cumulative sum, occupying 4 bytes.

The calculation of the check value can follow the following algorithm:

```
ckSum = (class << 24) + (id << 16) + len;
for (i = 0; i <(len / 4); i++)
{
    ckSum = ckSum + payload [i];
}
```

In the formula, the payload contains all the information of field 5. In the calculation process, first the part from field 2 to field 4 Assemble (4 bytes form a word), and then group the data of field 5 in the order of a group of 4 bytes (the first received is the low bit) Accumulate.

2.3 CASIC type and number

Each type of interactive message of the CASIC receiver is a set of related messages.

first name	Types of	description
NAV	0x01	Navigation results: position, speed, time
TIM	0x02	Timing message: time pulse output, time mark result
RXM	0x03	Measurement information output by the receiver (pseudorange, carrier phase, etc.)
ACK	0x05	ACK/NAK message: response message to CFG message
CFG	0x06	Enter configuration message: configure navigation mode, baud rate, etc.

MEAS	0x07	Channel measurement information output by the receiver (pseudorange)
MSG	0x08	Satellite message information output by the receiver
MON	0x0A	Monitoring messages: communication status, CPU load, stack utilization, etc.
AID	0x0B	Auxiliary messages: ephemeris, almanac and other A-GPS data

2.4 CASIC payload definition rules

2.4.1 Data Encapsulation

In order to implement structured data encapsulation more conveniently, the data in the payload part is arranged in a specific way:

The data in the message is arranged closely, the 2-byte value is placed at an offset address that is a multiple of 2, and the 4-byte value is placed at an offset address that is a multiple of 4.

2.4.2 Message naming

The name of the message consists of a structure like "message type + message name". For example, the configuration message name for configuring PPS is:

CFG-PPS.

2.4.3 Data Type

Unless otherwise defined, all values of multiple characters are arranged in little endian format. All floating-point values are in accordance with IEEE754

Standard transmission of single precision and double precision.

Abbreviation	type	Bytes	remarks
U1	Unsigned character	1	
I1	Signed character	1	Complement
U2	Unsigned short	2	
I2	Signed short integer	2	Complement
U4	Unsigned long	4	
I4	Signed long integer	4	Complement
R4	IEEE754 single precision	4	
R8	IEEE754 double precision	8	

2.5 CASIC message exchange

Define the mechanism for the input and output of receiver messages. When the receiver receives a CFG type message, it needs to

Set whether the message processing is correct, and reply with an ACK-ACK or ACK-NACK message. Reply a received at the receiver

Before the CFG message, the sender must not send a second CFG message. Other messages received by the receiver do not need to reply.

2.6 CASIC message overview

Page	message name	Class/ID	length	Types of	description
	Class NAV			NAV navigation results	
	NAV-STATUS	0x01 0x00	80	cycle	Receiver navigation status
	NAV-DOP	0x01 0x01	28	cycle	Geometric precision factor
	NAV-SOL	0x01 0x02	72	cycle	Condensed PVT navigation information
	NAV-PV	0x01 0x03	80	cycle	Position and speed information
	NAV-TIMEUTC	0x01 0x10	twenty four	cycle	UTC time information
	NAV-CLOCK	0x01 0x11	64	cycle	Clock solving information
	NAV-GPSINFO	0x01 0x20	8+12*N	cycle	GPS satellite information
	NAV-BDSINFO	0x01 0x21	8+12*N	cycle	BDS satellite information
	NAV-GLNINFO	0x01 0x22	8+12*N	cycle	GLONASS satellite information
	Class TIM			TIM time message	
	TIM-TP	0x02 0x00	twenty four	cycle	Timing pulse information
	Class RXM			RXM receiver measurement information	
	RXM-MEASX	0x03 0x00	16+32*N	cycle	Pseudorange, carrier phase raw measurement information
	RXM-SVPOS	0x03 0x01	16+48*N	cycle	Satellite location information
	Class ACK			ACK/NACK message	
	ACK-NACK	0x05 0x00	4	Reply message	Reply indicates that the message was not received correctly
	ACK-ACK	0x05 0x01	4	Reply message	Reply indicates that the message was received correctly

Class CFG			CFG input configuration message	
CFG-PRT	0x06 0x00	0/8	Query/setting news	Query/Configure UART working mode
CFG-MSG	0x06 0x01	0/4	Query/setting news	Query/configuration information sending frequency
CFG-RST	0x06 0x02	4	Set message	Restart the receiver/clear the saved data structure
CFG-TP	0x06 0x03	0/16	Query/setting news	Query/configure the relevant parameters of the receiver PPS
CFG-RATE	0x06 0x04	0/4	Query/setting news	Query/Configure the navigation rate of the receiver
CFG-CFG	0x06 0x05	4	Set message	Clear, save and load configuration information
CFG-TMODE	0x06 0x06	0/28	Query/setting news	Query/Configure the PPS timing mode of the receiver
CFG-NAVX	0x06 0x07	0/44	Query/setting news	Query/professional configuration of navigation engine parameters
CFG-GROUP	0x06 0x08	0/56	Query/setting news	Query/configure GLONASS group delay parameters
CFG-POLLMSG	0x06 0x10	4	Inquire	Query the output frequency of the periodic output sentence of the receiver rate
Class MEAS			MEAS receiver channel measurement message	
MEAS	0x07 0x00 16+32*32 period			Receiver output channel measurement information
Class MSG			MSG receiver satellite message information	
MSG-BDSUTC	0x08 0x00	20	cycle	The receiver outputs BDS system UTC information.
MSG-BDSION	0x08 0x01	16	cycle	The receiver outputs BDS system ION information.
MSG-BDSEPH	0x08 0x02	92	cycle	The receiver outputs BDS system ephemeris information.
MSG-GPSUTC	0x08 0x05	20	cycle	The receiver outputs BDS system UTC information.
MSG-GPSION	0x08 0x06	16	cycle	The receiver outputs BDS system ION information.
MSG-GPSEPH	0x08 0x07	72	cycle	The receiver outputs GPS system ephemeris information.
MSG-GLNEPH	0x08 0x08	68	cycle	The receiver outputs GLN system ephemeris information.
Class MON			MON monitoring messages	
MON-VER	0x0A 0x04	64	Respond to queries	Output version information

MON-HW	0x0A 0x09	56	Cycle/query various configuration status of hardware
Class AID			AID auxiliary message
AID-INI	0x0B 0x01	56	Query/input auxiliary position, time, frequency, clock frequency deviation information
AID-HUI	0x0B 0x03	60	Query/input auxiliary health information, UTC parameters, ionospheric parameters

2.7 NAV (0x01)

Navigation results: position, speed, time, accuracy, heading, geometric precision factor, number of satellites, etc. NAV news divided There are several types, each containing different information.

2.7.1 NAV-STATUS (0x01 0x00)

information	NAV-STATUS				
description	Receiver navigation status				
Types of	Cycle/query				
Comment					
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	80	0x01 0x00	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	Unit	description
0	U4	-	runTime	ms	Running time from power on/reset
4	U2	-	fixInterval	ms	Positioning interval
6	U1	-	posValid	-	Positioning mark (remark [1])
7	U1	-	velValid	-	Speed mark (remark [2])
8	U1*32-		gpsMsgFlag	-	32 GPS satellites' almanac and ephemeris message validity Logo (Remark [3])
40	U1*24-		glnMsgFlag	-	24 GLONASS satellite almanacs and ephemeris messages Validity flag (remark [3])
64	U1*14-		bdsMsgFlag	-	Validity of the ephemeris and almanac of 14 BDS satellites Logo (Remark [3])
78	U1		gpsUtcionFlag	-	GPS's UTC and ionospheric information Journal (Remarks [4])
79	U1	-	bdsUtcionFlag	-	BDS's UTC and ionospheric information Journal (Remarks [4])

Remark [1]: Positioning mark

Value	description
0	Invalid targeting
1	External input location
2	Rough estimate of location
3	Keep the last positioning position
4	Dead reckoning
5	Quick mode positioning
6	2D positioning
7	3D positioning
8	GNSS+DR integrated navigation

Remark [2]: Speed flag

Value	description
0	Invalid speed
1	Speed of external input

2	Rough estimate of speed
3	Keep the last speed
4	Speed calculation
5	Speed of fast mode
6	2D speed
7	3D speed
8	GNSS+DR combined navigation speed

Remark [3]: Message validity flag

The upper 4 bits represent the validity flag of the almanac and the lower 4 bits represent the validity flag of the ephemeris

Value	description
0	Missing
1	Unhealthy
2	Expired
3	effective

Remark [4]: Message validity flag

The upper 4 bits represent the message validity flag of UTC parameters, and the lower 4 bits represent the message validity flag of ionospheric parameters

Value	description
0	Missing
1	Unhealthy
2	Expired
3	effective

2.7.2NAV-DOP (0x01 0x01)

information NAV-DOP

description	Positioning precision factor
Types of	Cycle/query
Comment	DOP values have no dimensions

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	28	0x01 0x01	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runtime	ms	Running time from power on/reset
4	R4	-	pDop	-	Location DOP
8	R4	-	hDop	-	Horizontal DOP
12	R4	-	vDop	-	Vertical DOP
16	R4	-	nDop	-	Northbound DOP
20	R4	-	eDop	-	Eastbound DOP
twenty four	R4	-	tDop	-	Time DOP

2.7.3 NAV-SOL (0x01 0x02)

information	NAV-SOL
description	PVT navigation information in ECEF coordinate system
Types of	Cycle/query
Comment	

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	72	0x01 0x02	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runTime	ms	Running time from power on/reset
4	U1	-	posValid	-	Positioning mark (remark [1])
5	U1		velValid	-	Speed mark (remark [2])
6	U1	-	timeSrc	-	Time source (note [3])
7	U1	-	system	-	Multi-mode receiving mode mask of the receiver (remark [4])
8	U1	-	numSV	-	Total number of satellites participating in the solution

9	U1	-	numSVGPS-		Number of GPS satellites participating in the calculation
10	U1	-	numSVBDS-		Number of BDS satellites participating in the calculation
11	U1	-	numSVGLO NASS	-	Number of GLONASS satellites participating in the calculation
12	U2	-	res	-	Keep
14	U2	-	week	-	Week number
16	R8	-	tow	s	During the week
twenty four	R8	-	ecefX	m	X coordinate in ECEF coordinate system
32	R8	-	ecefY	m	Y coordinate in ECEF coordinate system
40	R8	-	ecefZ	m	Z coordinate in ECEF coordinate system
48	R4	-	pAcc	M^2	Estimated accuracy of 3D position
52	R4	-	ecefVX	m/s	X speed in ECEF coordinate system
56	R4	-	ecefVY	m/s	Y speed in ECEF coordinate system
60	R4	-	ecefVZ	m/s	Z speed in ECEF coordinate system
64	R4	-	sAcc	(m/s)^2	3D speed estimation accuracy
68	R4	-	pDop	-	Location DOP

Remark [1]: Positioning mark

Value	description
0	Invalid targeting
1	External input location
2	Rough estimate of location
3	Keep the last positioning position
4	Dead reckoning
5	Quick mode positioning
6	2D positioning
7	3D positioning
8	GNSS+DR integrated navigation

Remark [2]: Speed flag

Value	description

0	Invalid speed
1	Speed of external input
2	Rough estimate of speed
3	Keep the last speed
4	Speed calculation
5	Speed of fast mode
6	2D speed
7	3D speed
8	GNSS+DR combined navigation speed

Remark [3]: Time source

Time source	description
0	GPS timing, that is, the time of the week and the number of weeks are the local time of the receiver obtained from the GPS satellite
1	BDS
2	GLONASS
3	RTC

Remark [4]: Multi-mode receiving mode

Bit	description
B0	1=GPS satellites are used for positioning
B1	1=BDS satellite is used for positioning
B2	1=GLONASS satellite is used for positioning

2.7.4 NAV-PV (0x01 0x03)

information	NAV-PV				
description	Position and velocity information in the geodetic coordinate system				
Types of	Cycle/query				
Comment					
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	80	0x01 0x03	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runTime	ms	Running time from power on/reset
4	U1	-	posValid	-	Positioning mark (remark [1])
5	U1		velValid	-	Speed mark (remark [2])
6	U1	-	system	-	Multi-mode receiving mode mask of the receiver (remark [4])
7	U1	-	numSV	-	Total number of satellites participating in the solution
8	U1	-	numSVGPS-		Number of GPS satellites participating in the calculation
9	U1	-	NumSVBDS-		Number of BDS satellites participating in the calculation
10	U1	-	numSVGLO NASS	-	Number of GLONASS satellites participating in the calculation
11	U1	-	res	-	Keep
12	R4	-	pDop	-	Location DOP
16	R8	-	lon	°	longitude
twenty four	R8	-	lat	°	latitude
32	R4	-	height	m	Earth height (take ellipsoid as reference)
36	R4	-	sepGeoid	m	Altitude abnormality (the difference between the ground height and the altitude)
40	R4	-	hAcc	m^2	Horizontal position accuracy
44	R4	-	vAcc	m^2	Vertical position accuracy
48	R4	-	velN	m/s	North speed in ENU coordinate system
52	R4	-	velE	m/s	Easting speed in ENU coordinate system
56	R4	-	velU	m/s	Sky speed in ENU coordinate system
60	R4	-	speed3D	m/s	3D speed
64	R4	-	speed2D	m/s	2D ground speed
68	R4	-	heading	°	course
72	R4	-	sAcc	(m/s)^2	Accuracy of ground speed
76	R4	-	cAcc	°^2	Heading accuracy

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2.7.5NAV-TIMEUTC (0x01 0x10)

information NAV-TIMEUTC

description UTC time information

Types of Cycle/query

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	twenty four	0x01 0x10	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runTime	ms	Running time from power on/reset
4	R4	-	tAcc	s^2	Time estimation accuracy
8	R4	-	msErr	ms	Residual error after rounding milliseconds
12	U2	-	ms	ms	The millisecond part of UTC time, the value range is 0~999
14	U2	-	year	year	UTC year (1999~2099)
16	U1	-	month	Month	UTC month (1~12)
17	U1	-	day	Day	UTC day of the month (1~31)
18	U1	-	hour	Hour	Hours within UTC days (0~23)
19	U1	-	min	min	UTC hour and minute (0~59)
20	U1	-	sec	s	UTC minute and second (0~59)
twenty one	U1	-	valid	-	Time valid mark (remark [1])
twenty two	U1	-	timeSrc	-	Timing system logo (Note [2])
twenty three	U1	-	res	-	Keep

Remarks[1]: Time valid sign

Value	description
0	Invalid time
1	RTC time
2	Roughly estimated time based on satellite launch time
3	Undefined
4	Time calculation
5	Time gained in fast mode
6	Undefined
7	Exact time

Remarks [2]: Timing system logo

Value	description
0	GPS timing
1	BDS timing
2	GLONASS timing

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2.7.6NAV-CLOCK (0x01 0x11)

information NAV-CLOCK

description Clock solving information

Types of Cycle/query

Comment

news structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	64	0x01 0x11	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runTime	ms	Running time from power on/reset
4	R4	1/c	freqBias	s/s	Clock drift (clock frequency deviation)
8	R4	-	tAcc	s^2	Time accuracy
12	R4	1/c^2	fAcc	-	Frequency accuracy
Start of repeating part (N=0 means GPS, 1 means BDS, 2 means GLONASS)					
16+16*N	R8	-	tow	ms	Time of week
24+16*N	R4	-	dtUtc	s	The fractional second of the difference between satellite time and UTC time
28+16*N	U2	-	wn	-	Week number
30+16*N	I1	-	leapS	-	UTC leap second, the whole difference between satellite time and UTC time A few seconds
31+16*N	U1	-	valid	-	Time validity flag
The repeating part ends, the maximum value of N is (SYSTEM_ALL-1), and the value of the current version is 2					

2.7.7 NAV-GPSINFO (0x01 0x20)

information NAV-GPSINFO

description GPS satellite information

Types of Cycle/query

Comment Each sentence only contains the satellite information of the same satellite system. For multiple systems, the sentence will output multiple

news structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	8+12*N	0x01 0x20	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runTime	-	Running time from power on/reset
4	U1	-	numViewSv	-	The number of visible satellites, the effective range is 0~32
5	U1	-	numFixSv	-	Number of satellites used for positioning
6	U1		system	-	System type (remark [1])

7	U1	-	res		Keep
Start of repeated part (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	Channel number
9+12*N	U1	-	svid	-	Satellite number
10+12*N	U1	-	flags	-	Satellite state mask (Remarks [2])
11+12*N	U1	-	quality	-	Quality indicator for signal measurement (note [3])
12+12*N	U1	-	CN0	dB-Hz	Signal carrier to noise ratio
13+12*N	I1	-	elev	°	Satellite elevation angle (-90~90)
14+12*N	I2	-	azim	°	Satellite azimuth (0~360)
16+12*N	R4	-	prRes	m	Pseudorange residual
End of repeat					

Remarks[1]: System type

Value	description
0	GPS
1	BDS
2	GLONASS

Remark [2]: Satellite status

Bit	description
B0	1=Satellite participates in the calculation
B1	1=Differential correction data of satellite is available
B2	1=The orbit information of the satellite is available (ephemeris or almanac)
B3	1=Satellite orbit information comes from ephemeris
B4	1=The satellite is not healthy
B5	1=Satellite orbit information comes from enhanced almanac
B7:B6	00=No forecast information 01=No capture 10=Prediction information obtained from estimated position 11=Predicted information obtained from accurate location

Remark [3]: Quality indicator of signal measurement

Value	description
0	Satellite is idle and no channel is allocated
1	During capture
2	capture
3	Signal detected, but not available
4	Code phase lock
5, 6	Keep
7	Code phase and carrier phase lock

2.7.8NAV-BDSINFO (0x01 0x21)

information NAV-BDSINFO

description BDS satellite information

Types of Cycle/query

Comment Each sentence only contains the satellite information of the same satellite system. For multiple systems, the sentence will output multiple

news structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	8+12*N	0x01 0x21	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runTime	-	Running time from power on/reset
4	U1	-	numViewSv	-	The number of visible satellites, the effective range is 0~32
5	U1	-	numFixSv	-	Number of satellites used for positioning
6	U1	-	system	-	System type (refer to 2.7.7 Remark [1])
7	U1	-	res		Keep
Start of repeated part (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	Channel number
9+12*N	U1	-	svid	-	Satellite number
10+12*N	U1	-	flags	-	Satellite status mask (Refer to 2.7.7 Remark [2])
11+12*N	U1	-	quality	-	The quality indicator of signal measurement (refer to 2.7.7 Preparation Note [3])
12+12*N	U1	-	CN0	dB-Hz	Signal carrier to noise ratio
13+12*N	I1	-	elev	°	Satellite elevation angle (-90~90)
14+12*N	I2	-	azim	°	Satellite azimuth (0~360)
16+12*N	R4	-	prRes	m	Pseudorange residual
End of repeat					

2.7.9 NAV-GLNINFO (0x01 0x22)

information	NAV-GLNINFO				
description	GLONASS satellite information				
Types of	Cycle/query				
Comment	Each sentence only contains the satellite information of the same satellite system. For multiple systems, the sentence will output multiple				
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	8+12*N	0x01 0x22	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runTime	-	Running time from power on/reset
4	U1	-	numViewSv	-	The number of visible satellites, the effective range is 0~32
5	U1	-	numFixSv	-	Number of satellites used for positioning
6	U1	-	system	-	System type (refer to 2.7.7 Remark [1])
7	U1	-	res		Keep
Start of repeated part (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	Channel number
9+12*N	U1	-	svid	-	Satellite number
10+12*N	U1	-	flags	-	Satellite status mask (Refer to 2.7.7 Remark [2])
11+12*N	U1	-	quality	-	The quality indicator of signal measurement (refer to 2.7.7 Preparation Note [3])
12+12*N	U1	-	CN0	dB-Hz	Signal carrier to noise ratio
13+12*N	I1	-	elev	°	Satellite elevation angle (-90~90)
14+12*N	I2	-	azim	°	Satellite azimuth (0~360)
16+12*N	R4	-	prRes	m	Pseudorange residual
End of repeat					

2.8 TIM (0x02)

2.8.1 TIM-TP (0x02 0x00)

Message name TIM-TP

description Timing pulse information

Types of Cycle/query

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	twenty four	0x02 0x00	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	runTime	ms	Running time from power on/reset
4	R4	-	qErr	s	Time quantization error corresponding to the next time pulse
8	R8	-	tow	s	The time within the week corresponding to the next time pulse
16	U2	-	Wn	-	The number of weeks corresponding to the next time pulse
18	U1	-	refTime	-	Reference time (Remark [1])
19	U1	-	utcValid	-	Valid flag (remark [2])
20	U4	-	Res	-	Keep

Remarks[1]: reference time of timing pulse

Value	description
0	UTC time
1	Satellite time

Remark [2]: UTC parameter valid flag

Value	description
0	Missing
1	Keep
2	Expired
3	effective

2.9 RXM (0x03)

Measurement value message.

2.9.1 RXM-MEASX (0x03 0x10)

information RXM-MEASX

description Pseudorange, carrier phase raw measurement information

Types of Cycle/query

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	16+32*N	0x03 0x10	See table below	4 Bytes

Payload content:

character Offset	data Types of	proportion Zoom	first name	unit	description
0	R8	-	tow	s	Receiver time, within the week
8	I2	-	wn	week	Receiver time, week number
10	I1	-	leapS	-	Leap second value
11	U1	-	numMeas	-	Number of measurement values, valid range 0~32
12	U1	-	recStat	-	Receiver status [Note 1]
13	U1	-	timeSource		Receiver time source, 0=GPS, 1=BDS
14	U1	-	rcvrid	-	Receiver number. 0=first receiver 1=second receiver . . .
15	U1	-	res1	-	Keep
Start of repeated part (N=numMeas, valid range 0~32)					
16+32*N	R8	-	prMes	m	Pseudorange measurement
24+32*N	R8	-	cpMes	cycles carrier phase	
32+32*N	R4	-	doMes	Hz	Doppler measurement
36+32*N	U1	-	gnssid	-	System type. 0=GPS, 1=BDS, 2=GLONASS
37+32*N	U1	-	svid	-	Satellite number
38+32*N	U1	-	res2	-	Keep
39+32*N	U1	-	glnFreqid	-	Frequency number (offset 8), for GLONASS effective
40+32*N	U2	-	lockTime	s	Time when the code ring is locked
42+32*N	U1	-	cn0	dB-Hz	Carrier to noise ratio
43+32*N	U1	-	res3	-	Keep
44+32*N	U1	-	res4	-	Keep
45+32*N	U1	-	res5	-	Keep
46+32*N	U1	-	trkStat	-	Satellite tracking status [Note 2]
47+32*N	U1	-	res6	-	Keep
End of repeat					

Remark [1]: Receiver status

recStat	Description
BIT0	=1, means leapS is valid (UTC correction parameter is valid)
BIT1	=1, it means GPS receiver clock reset
BIT2	=1, means the BDS receiver clock is reset

Remark [2]: Satellite tracking status

recStat	Description
BIT0	=1, indicating that the pseudorange measurement value prMes is valid
BIT1	=1, indicating that the carrier phase measurement value cpMes is valid
BIT2	=1, means the half-cycle ambiguity is valid (inverted PI correction is valid)
BIT3	=1, which means the half-cycle ambiguity is subtracted from the carrier phase measurement

2.9.2 RXM-SVPOS (0x03 0x11)

information RXM - SVPOS

description Satellite location information

Types of Cycle/query

Comment

news structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	16+48*N	0x03 0x11	See table below	4 Bytes

Payload content:

character Offset	data Types of	proportion Zoom	first name	unit	description
0	R8	-	tow	s	Receiver time, within the week
8	I2	-	wn	week	Receiver time, week number
10	U1	-	numMeas	-	Number of measurement values, valid range 0~32
11	U1	-	rcvrid	-	Receiver number. 0=first receiver 1=second receiver . . .
12	I4	-	res2	-	Keep
Start of repeated part (N=numMeas, valid range 0~32)					
16+48*N	R8	-	x	m	Satellite coordinates
24+48*N	R8	-	y	m	Satellite coordinates
32+48*N	R8	-	z	m	Satellite coordinates
40+48*N	R4	-	svdt	m	Satellite clock difference
44+48*N	R4	-	svdf	m/s	Satellite frequency deviation
48+48*N	R4	-	tropDelay	m	Tropospheric delay
52+48*N	R4	-	ionoDelay	m	Ionospheric delay
56+48*N	U1	-	svid	-	Satellite number
57+48*N	U1	-	glnFreqid	-	Frequency number (offset 8), for GLONASS effective
58+48*N	U1	-	gnssid	-	System type, 0=GPS, 1=BDS, 2=GLONASS
59+48*N	U1	-	res3	-	Keep
60+48*N	U4	-	res4	-	Keep
End of repeat					

2.10 ACK (0x05)

ACK and NACK are used to reply the received CFG message.

2.10.1 ACK-NACK (0x05 0x00)

information ACK-NACK

description Reply to a message that was incorrectly received

Types of Reply

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x05 0x00	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U1	-	clsID	-	Type of incorrectly received information
1	U1	-	msgID	-	The number of the message received incorrectly
2	U2	-	res	-	Keep

2.10.2 ACK-ACK (0x05 0x01)

information ACK-ACK

description Respond to the information received correctly

Types of Reply

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x05 0x01	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U1	-	clsID	-	Type of information received correctly
1	U1	-	msgID	-	Number of correct received message
2	U2	-	res	-	Keep

2.11 CFG (0x06)

Configuration information, such as setting dynamic mode, baud rate, etc. When the effective length is 0, it means to query the configuration information, and the system will Output data with the same identifier.

2.11.1 CFG-PRT (0x06 0x00)

Message	CFG-PRT				
description	Query the working mode of UART				
Types of	Inquire				
Comment					
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x00	0	4 Bytes

Message	CFG-PRT				
description	Set the working mode of UART				
Types of	Settings/response to queries				
Comment					
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	8	0x06 0x00	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	Unit	description
0	U1	-	portID	-	Port identification symbol (0 and 1 correspond to UART0 and UART1)
1	U1	-	protoMask	-	Protocol control mask, each port can support several protocols at the same time Discussion. The protocol is enabled when the corresponding bit is equal to 1 (Note [1])
2	U2	-	mode	-	Bit mask of UART working mode (Remark [2])
4	U4	-	baudRate	bps	Baud rate

Remark [1]: Protocol control mask

Bit	description
B0	1=Binary protocol input
B1	1=Text protocol input
B4	1=Binary protocol output
B5	1=Text protocol output

Remark [2]: UART working mode bit mask

Bit	Value	description
[7:6]	00	5bits
	01	6bits
	10	7bits
	11	8bits
[11:9]	10x	No verification
	001	Odd parity
	000	Even parity
	x1x	Keep

[13:12]	00	A stop bit
	01	1.5 stop bits
	10	Two stop bits
	11	Keep

2.11.2 CFG-MSG (0x06 0x01)

information	CFG-MSG
description	Read/set information sending frequency
Types of	Read/set
Comment	

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x01	See table below	4 Bytes

Payload content

Offset	character data Types of	proportion Zoom	first name	Unit	description
0	U1	-	clsID	-	Information type
1	U1	-	msgID	-	Message number
2	U2	-	rate	-	Information sending frequency (remark [1])

Remark [1]: Frequency of sending information

Value	description
0	No output
1	Each time positioning, output once
2	Position twice, output once
N	N times positioning, output once
0xFFFF	Immediately output once, and only once, which is equivalent to query output

2.11.3 CFG-RST (0x06 0x02)

Message name	CFG-RST				
description	Restart the receiver/clear the saved data structure				
Types of	Set up				
Comment					
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x02	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U2	-	navBbrMask	-	Clear battery-powered RAM. If a bit of the mask is set 1, then clear the data indicated on this bit (note [1])
2	U1	-	resetMode	-	Reset method (Note [2])
3	U1	-	startMode	-	Start method (remark [3])

Remark [1]: Clear field

Bit	description
B0	Ephemeris
B1	Almanac
B2	Health information
B3	Ionospheric parameters
B4	Receiver location information
B5	Clock drift (clock frequency deviation)
B6	Crystal parameters
B7	UTC correction parameters
B8	RTC
B9	Configuration information

Remark [2]: Reset method

Value	description
0	Immediate hardware reset (implemented by WATCHDOG)
1	Controlled software reset
2	Controlled software reset (GPS only)
4	Hardware reset after shutdown (realized by WATCHDOG)
8	Controlled GPS stop
9	Controlled GPS activation

Remark [3]: Startup method

Value	description
0	Hot Start
1	Warm start

2	Cold start
3	Factory boot
8	Turn off the serial output and radio frequency part, and respond to serial commands
9	Turn on the serial output and RF section

2.11.4 CFG-TP (0x06 0x03)

information CFG-TP

description Query time pulse parameters

Types of Inquire

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x03	0	4 Bytes

information CFG-TP

description Read/set time pulse parameters

Types of Read/set

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	16	0x06 0x03	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	interval	us	Time interval between pulses (pulse period)
4	U4	-	width	us	Pulse Width
8	U1	-	enable	-	Enable flag (note [1])
9	U1	-	polar	-	Pulse polarity configuration (note [2)
10	U1	-	timeRef	-	Reference time (Remarks [3)
11	U1	-	timeSource	-	Time source (note [4)
12	R4	-	userDelay	s	User time delay

Remark [1]: Pulse enable flag

Value	description
0	Off pulse
1	Enable pulse
2	The pulse is enabled and output continuously. When it is unable to locate normally, automatically maintain the pulse update rate
3	Output pulses during normal positioning, when the receiver cannot be positioned normally, do not output pulses

Remark [2]: Pulse polarity configuration

0	Rising edge
1	Falling edge

Remarks [3]: Reference time

0	UTC time
1	Satellite time

Remark [4]: Satellite time source

Value	description
0	Mandatory single GPS time service
1	Mandatory single BDS timing
2	Mandatory single GLN timing
3	Keep
4	Main BDS, when BDS is not available, it can automatically switch to other timing systems
5	Main GPS, when GPS is unavailable, it can automatically switch to other timing system

6	Mainly use GLN, when GLN is unavailable, it can automatically switch to other timing system
7	Keep
other	Automatic selection of timing system

2.11.5 CFG-RATE (0x06 0x04)

Message name	CFG-RATE				
description	Query positioning time interval				
Types of	Inquire				
Comment	The receiver supports different navigation rates (the default rate is one update per second). The navigation rate directly affects power consumption, The faster the speed, the greater the CPU and communication burden				
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x04	0	4 Bytes

Message name	CFG-RATE				
description	Set positioning interval				
Types of	Set up				
Comment	The receiver supports different navigation rates (the default rate is one update per second). The navigation rate directly affects power consumption, The faster the speed, the greater the CPU and communication burden				
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x04	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U2	-	interval	ms	The time interval between two positioning
2	U2	-	res	-	Keep

2.11.6 CFG-CFG (0x06 0x05)

information	CFG- CFG				
description	Clear, save and load configuration information				
Types of	command				
Comment					
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x05	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U2	-	mask	-	Mask of configuration information (Remark [1])
2	U1	-	mode	-	Operation mode for configuration information (Note [2])
3	U1	-	res	-	Keep

Remark [1]: Configure information mask

Bit	description
B0	IO port configuration information (CFG-PRT)
B1	Message configuration (CFG-MSG)
B2	INF message configuration (CFG-INF)
B3	Navigation configuration (CFG-RATE, CFG-TMODE)
B4	Time pulse configuration (CFG-TP)
B5	Group delay (CFG-GROUP)

Remark [2]: Operation mode

Value	description

0	Clear permanent configuration
1	Save current configuration to permanent configuration
2	Permanent configuration loaded into the current configuration

2.11.7 CFG-TMODE (0x06 0x06)

information	CFG-TMODE				
description	Query timing mode				
Types of	Inquire				
Comment					
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x06	0	4 Bytes

information	CFG-TMODE				
description	Read/set time service mode				
Types of	Read/set				
Comment					
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	40	0x06 0x06	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	mode	-	Time service mode (Note [1])
4	R8	-	fixedPosX	m	X coordinate in ECEF coordinate system
12	R8	-	fixedPosY	m	Y coordinate in ECEF coordinate system
20	R8	-	fixedPosZ	m	Z coordinate in ECEF coordinate system
28	R4	-	fixedPosVar	m^2	3D variance of position
32	U4	-	svinMinDur	s	When the time service mode is 1, the minimum measurement time interval
36	R4		svinVarLimit	m^2	When the timing mode is 1, positioning error limit

Remark [1]: Time service mode

Value	description
0	Autonomous positioning and simultaneous timing
1	After autonomous positioning for a period of time to obtain a user position with sufficient accuracy, only use all available satellites to calculate User clock parameters for time service. In this mode, when the user's position is fixed, single satellite timing can be realized
2	The user enters the current position and only uses all available satellites to calculate the user clock parameters for timing. In this mode Single star timing can be realized under

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2.11.8 CFG-NAVX (0x06 0x07)

Message name	CFG-NAVX				
description	Query professional configuration of navigation engine				
Types of	Inquire				
Comment	Query navigation related parameters				
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x07	0	4 Bytes

Message name	CFG-NAVX				
description	Navigation engine professional configuration				
Types of	Set up				
Comment	Configure navigation related parameters				
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	44	0x06 0x07	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	mask	-	Parameter mask, only the corresponding bit mask is set to 1, the parameter Application only after setting (Remark [1])
4	U1	-	dyModel	-	Dynamic mode (Remarks [2])
5	U1	-	fixMode	-	Positioning mode (note [3])
6	U1	-	minSVs	-	Minimum number of satellites used for positioning
7	U1	-	maxSVs	-	Maximum number of satellites used for positioning
8	U1	-	minCNO	dB-Hz	Minimum satellite signal carrier-to-noise ratio for positioning
9	U1	-	res1	-	Keep
10	U1		iniFix3D		Initial positioning must be 3D positioning mark (0/1)
11	I1	-	minElev	°	Minimum elevation angle of GNSS satellite for positioning
12	U1	-	drLimit	s	Maximum DR time without satellite signal
13	U1	-	navSystem	-	Navigation system enable flag (note [4])
14	U2	-	wnRollOver	-	GPS week number
16	R4	-	fixedAlt	m	Fixed height during 2D positioning
20	R4	-	fixedAltVar	m^2	Fixed height error during 2D positioning
twenty four	R4	-	pDop	-	Maximum position DOP
28	R4	-	tDop	-	Time DOP maximum
32	R4	-	pAcc	m^2	Maximum position accuracy
36	R4	-	tAcc	m^2	Maximum time accuracy
40	R4	-	staticHoldTh	m/s	Keep still threshold

Remarks[1]: parameter mask

Bit	description
B0	Apply dynamic mode settings
B1	Application targeting mode settings
B2	Application of the maximum/minimum number of navigation satellites setting
B3	Apply the minimum signal-to-noise ratio setting
B4	Keep
B5	Apply initial positioning 3D settings

B6	Apply minimum elevation angle setting
B7	Apply DR restriction settings
B8	Application navigation system enable
B9	Apply GPS week rollover setting
B10	Application height assistance
B11	Application location DOP restrictions
B12	Application time DOP limit
B13	Apply static hold settings

Remark [2]: Dynamic mode

mode	description
0	Portable mode
1	Static mode
2	Walking mode
3	Car mode
4	Nautical mode
5	Flight mode acceleration <1g
6	Flight mode acceleration<2g
7	Flight mode acceleration<4g

Remark [3]: Positioning mode

mode	description
0	Keep
1	2D positioning
2	3D positioning
3	2D/3D positioning automatic switching

Remark [4]: Navigation system enable

Bit	description
B0	1=GPS
B1	1=BDS
B2	1=GLONASS

2.11.9 CFG-GROUP (0x06 0x08)

Message name CFG-GROUP

description Query the group delay of GLONASS

Types of Inquire

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x08	0	4 Bytes

Message name CFG-GROUP

description	Configure GLONASS group delay
Types of	Set up
Comment	

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	56	0x06 0x08	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	R4[14]	-	groupDealy	m	GLONASS group delay corresponding to each frequency, Characterized by distance (group delay time multiplied by the speed of light to get To distance)

2.11.10 CFG-POLLMSG (0x06 0x10)

Query the sending frequency of the receiver's output information.

information	CFG-POLLMSG
description	Query the sending frequency of the receiver's periodic output information
Types of	Read/set
Comment	

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x10	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	Unit	description
0	U1	-	clsID	-	Information type
1	U1	-	msgID	-	Message number
2	U2	-	Res	-	Keep

information	CFG-POLLMSG
description	Return the sending frequency of the receiver's periodic output information
Types of	Read/set
Comment	

news	head	Length (bytes)	Identifier	Payload	Checksum

structure	0xBA 0xCE	4	0x06 0x10	See table below	4 Bytes

Payload content

Offset	character Types of	data proportion Zoom	first name	Unit	description
0	U1	-	clsID	-	Information type
1	U1	-	msgID	-	Message number
2	U2	-	rate	-	Sentence frequency

2.12 MEAS (0x07)

The original measurement data of the receiver, the message type is 0x07.

2.12.1 MEAS (0x07 0x00)

information MEAS

description Raw measurement data

Types of Cycle/query

Comment

news structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	16+32*32	0x07 0x00	See table below	4 Bytes

Payload content

Offset	character Types of	data proportion Zoom	first name	unit	description
0	R8	-	tow	s	Receiver time, within the week
8	I4	-	wn	week	Receiver time, week number
12	U1	-	numFixBds	-	Number of satellites available for BDS
13	U1	-	numFixGps	-	GPS satellites available
14	U1	-	numFixGln	-	GLONASS number of satellites available
15	U1	-	res3	-	Keep
Start of repeated part (N=0…31)					
16+32*N	R8	-	pr	m	Pseudorange
24+32*N	R8	-	prRate	m/s	Pseudorange change rate
32+32*N	R8	-	tdcp	cycle	Time difference carrier phase (carrier at current moment Phase minus the carrier phase at the previous moment)
40+32*N	U1	-	valid	-	Valid flag of measured value (remark [1])
41+32*N	U1	-	cn0	dB-Hz	Carrier to noise ratio
42+32*N	U1	-	svid	-	Satellite number
43+32*N	U1	-	system	-	System type. 0=GPS, 1=BDS, 2=GLONASS
44+32*N	U1	-	chn	-	Tracking channel number corresponding to the measured value
44+32*N	U1	-	res1	-	Keep
44+32*N	I2	-	res2	-	Keep
End of repeat					

Remarks [1]: valid mark of measured value

Value	Description
<3	Invalid measured value
3	Code phase locked, but not synchronized
5	Code phase locked and synchronized
>8	Measured value available

2.13 MSG (0x08)

The receiver navigation message, the message type is 0x08.

2.13.1 MSG-BDSUTC (0x08 0x00)

Information MSG-BDSUTC

Describe BDS fixed-point UTC data (synchronized parameters with UTC time)

Types of cycle

Comment

news structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	20	0x08 0x00	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	Unit	description
0	U4	-	Res1	-	Keep
4	I4	2^{-30}	A0UTC	s	BDT clock difference with respect to UTC
8	I4	2^{-50}	A1UTC	s/s	BDT clock speed relative to UTC
12	I1	-	dtls	s	Before the new leap second takes effect, the cumulative leap second change of BDT relative to UTC Positive number
13	I1	-	dtlsf	s	After the new leap second takes effect, the cumulative leap second of BDT relative to UTC is changed Positive number
14	U1	-	Res2	-	Keep
15	U1	-	Res3	-	Keep
16	U1	-	wnlsf	week	Week count for the new leap second to take effect
17	U1	-	dn	day	Count of days of the week when the new leap second takes effect
18	U1	-	valid	-	Information available sign (remark [1])
19	U1	-	Res4	-	Keep

Remark [1]: Information available sign

Value	Description
0	invalid
1	Unhealthy
2	Expired
3	effective

2.13.2 MSG-BDSION (0x08 0x01)

Information MSG-BDSION

Describe the BDS8 parameter fixed-point ionospheric data

Types of cycle

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	16	0x08 0x01	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	Res1	-	Keep
4	I1	2^{-30}	alpha0	s	Ionospheric parameters
5	I1	2^{-27}	alpha1	s/π	Ionospheric parameters
6	I1	2^{-24}	alpha2	s/π^2	Ionospheric parameters
7	I1	2^{-24}	alpha3	s/π^3	Ionospheric parameters
8	I1	2^{11}	beta0	s	Ionospheric parameters
9	I1	2^{14}	beta1	s/π	Ionospheric parameters
10	I1	2^{16}	beta2	s/π^2	Ionospheric parameters
11	I1	2^{16}	beta3	s/π^3	Ionospheric parameters
12	U1	-	valid	-	Information available sign (remark [1])
13	U1	-	Res2	-	Keep
14	U2	-	Res3	-	Keep

Remark [1]: Information available sign

Value	Description
0	invalid
1	Unhealthy
2	Expired
3	effective

2.13.3 MSG-BDSEPH (0x08 0x02)

information MSG-BDSEPH

description BDS Ephemeris

Types of cycle

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum

structure	0xBA 0xCE	92	0x08 0x02	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	Res1	-	Keep
4	U4	2^{-19}	sqra	$m^{1/2}$	The square root of the semi-major axis of the satellite orbit
8	U4	2^{-33}	es	-	Satellite orbit eccentricity
12	I4	2^{-31}	ω	π	Argument of Perigee
16	I4	2^{-31}	M_0	π	Mean anomaly of reference time
20	I4	2^{-31}	i_0	π	Orbital inclination at reference time
twenty four	I4	2^{-31}	Ω_0	π	Ascension of ascending node calculated by reference time
28	I4	2^{-43}	Ω	π/s	Ascension change rate of ascending node
32	I2	2^{-43}	Δn	π/s	The difference between the average speed of the satellite and the calculated value
34	I2	2^{-43}	IDOT	π/s	Orbital inclination change rate
36	I4	2^{-31}	cuc	rad	The cosine harmonic of the argument of latitude and the amplitude of the correction term
40	I4	2^{-31}	cus	rad	The sine harmonic of the argument of latitude and the amplitude of the correction term
44	I4	2^{-6}	crc	m	Cosine harmonics of orbit radius and amplitude of correction term
48	I4	2^{-6}	crs	m	The sine harmonic of the orbit radius and the amplitude of the correction term
52	I4	2^{-31}	cic	rad	Cosine harmonic of orbital inclination and amplitude of correction term
56	I4	2^{-31}	cis	rad	The sine harmonic of the orbital inclination and the amplitude of the correction term
60	U4	2^{3}	toe	s	Ephemeris reference moment
64	U2	-	wne	-	Full weeks of reference time
66	U2	-	Res2	-	Keep
68	U4	2^{3}	toc	s	Reference time of clock error parameter in this period
72	I4	2^{-33}	af0	s	Satellite ranging code phase time offset coefficient
76	I4	2^{-50}	af1	s/s	Satellite ranging code phase time offset coefficient
80	I2	2^{-66}	af2	s/s^{2}	Satellite ranging code phase time offset coefficient
82	I2	0.1	tgd	ns	Delay of on-board equipment
84	U1	-	iodc	-	Clock data age
85	U1	-	iode	-	Ephemeris data age
86	U1	-	ura	-	User distance accuracy
87	U1	-	health	-	Satellite autonomous health sign
88	U1	-	svid	-	Satellite number
89	U1	-	valid	-	Information available sign (remark [1])
90	U2	-	Res3	-	Keep

Remark [1]: Information available sign

Value	Description
0	invalid
1	Unhealthy

2	Expired
3	effective

2.13.4 MSG-GPSUTC (0x08 0x05)

Information MSG-GPSUTC

Describe GPS fixed-point UTC data (synchronized parameters with UTC time)

Types of cycle

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	20	0x08 0x05	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	Res1	-	Keep
4	I4	2^{-30}	A0UTC	s	GPST clock difference relative to UTC
8	I4	2^{-50}	A1UTC	s/s	GPST clock speed relative to UTC
12	I1	-	dtls	s	Before the new leap second takes effect, the cumulative BDT relative to UTC Leap second correction
13	I1	-	dtlsf	s	After the new leap second takes effect, the cumulative BDT relative to UTC Leap second correction
14	U1	2^{12}	tot	s	Reference time of UTC data
15	U1	-	wnt	week	UTC reference week number
16	U1	-	wnlsf	week	Week count for the new leap second to take effect
17	U1	-	dn	day	Count of days of the week when the new leap second takes effect
18	U1	-	valid	-	Information available sign (remark [1])
19	U1	-	Res2	-	Keep

Remark [1]: Information available sign

Value	Description
0	invalid
1	Unhealthy
2	Expired
3	effective

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2.13.5 MSG-GPSION (0x08 0x06)

Information MSG-GPSION

Describe GPS8 parameter fixed-point ionospheric data

Types of cycle

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	16	0x08 0x06	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	Res1	-	Keep
4	I1	2^{-30}	alpha0	s	Ionospheric parameters
5	I1	2^{-27}	alpha1	s/π	Ionospheric parameters
6	I1	2^{-24}	alpha2	s/π^2	Ionospheric parameters
7	I1	2^{-24}	alpha3	s/π^3	Ionospheric parameters
8	I1	2^{11}	beta0	s	Ionospheric parameters
9	I1	2^{14}	beta1	s/π	Ionospheric parameters
10	I1	2^{16}	beta2	s/π^2	Ionospheric parameters
11	I1	2^{16}	beta3	s/π^3	Ionospheric parameters
12	U1	-	valid	-	Information available sign (remark [1])
13	U1	-	Res2	-	Keep
14	U2	-	Res3	-	Keep

Remark [1]: Information available sign

Value	Description
0	invalid
1	Unhealthy
2	Expired
3	effective

2.13.6 MSG-GPSEPH (0x08 0x07)

Information RXM-GPSEPH

Describe GPS ephemeris

Types of cycle

Comment

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	72	0x08 0x07	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	Res1	-	Keep
4	U4	2^{-19}	sqra	$m^{1/2}$	The square root of the semi-major axis of the satellite orbit
8	U4	2^{-33}	es	-	Satellite orbit eccentricity
12	I4	2^{-31}	ω	π	Argument of Perigee
16	I4	2^{-31}	M_0	π	Mean anomaly of reference time
20	I4	2^{-31}	i_0	π	Orbital inclination at reference time
twenty four	I4	2^{-31}	Ω_0	π	Ascension of ascending node calculated by reference time
28	I4	2^{-43}	Ω	π/s	Ascension change rate of ascending node
32	I2	2^{-43}	Δn	π/s	The difference between the average speed of the satellite and the calculated value
34	I2	2^{-43}	IDOT	π/s	Orbital inclination change rate
36	I2	2^{-29}	cuc	rad	The cosine harmonic of the argument of latitude and the amplitude of the correction term
38	I2	2^{-29}	cus	rad	The sine harmonic of the argument of latitude and the amplitude of the correction term
40	I2	2^{-5}	crc	m	Cosine harmonics of orbit radius and amplitude of correction term
42	I2	2^{-5}	crs	m	The sine harmonic of the orbit radius and the amplitude of the correction term
44	I2	2^{-29}	cic	rad	Cosine harmonic of orbital inclination and amplitude of correction term
46	I2	2^{-29}	cis	rad	The sine harmonic of the orbital inclination and the amplitude of the correction term
48	U2	2^{4}	toe	s	Ephemeris reference time
50	U2	-	wne	-	Full weeks of reference time
52	U4	2^{4}	toc	s	Reference time of clock error parameter in this period
56	I4	2^{-31}	af0	s	Satellite ranging code phase time offset coefficient
60	I2	2^{-43}	af1	s/s	Satellite ranging code phase time offset coefficient
62	I1	2^{-55}	af2	s/s^{2}	Satellite ranging code phase time offset coefficient
63	I1	2^{-31}	tgd	s	Delay of on-board equipment
64	U2	-	iodc	-	Clock data age
66	U1	-	ura	-	User distance accuracy
67	U1	-	health-		Satellite autonomous health sign
68	U1	-	svid	-	Satellite number
69	U1	-	valid	-	Information available sign (remark [1])
70	U2	-	Res2	-	Keep

Remark [1]: Information available sign

Value	Description
0	invalid
1	Unhealthy
2	Expired
3	effective

2.13.7 MSG-GLNEPH (0x08 0x08)

Information RXM-GLNEPH

Describe the GLONASS ephemeris

Types of cycle

Comment news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	68	0x08 0x08	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	res1	-	Keep
4	I4	2^{-30}	Taon	s	The correction value of the nth satellite relative to GLONASS time
8	I4	2^{-11}	x	km	Satellite position coordinates in PZ-90 coordinate system
12	I4	2^{-11}	y	km	Satellite position coordinates in PZ-90 coordinate system
16	I4	2^{-11}	z	km	Satellite position coordinates in PZ-90 coordinate system
20	I4	2^{-20}	dx	km/s	Satellite speed in PZ-90 coordinate system
twenty four	I4	2^{-20}	dy	km/s	Satellite speed in PZ-90 coordinate system
28	I4	2^{-20}	dz	km/s	Satellite speed in PZ-90 coordinate system
32	I4	2^{-31}	taoc	s	GLONASS time relative to UTC time scale correction amount
36	I4	2^{-30}	taoGPS	day	Correction amount from GLONASS time to GPS time
40	I2	2^{-40}	gamman-		The relative deviation of the satellite's predicted carrier frequency
42	U2	-	tk	_	Within the day of the current frame, a total of 12 bits
44	U2	-	nt	day	The current date from January of the previous leap year
46	I1	2^{-30}	ddx	km/s ^{2}	Satellite acceleration in PZ-90 coordinate system
47	I1	2^{-30}	ddy	km/s ^{2}	Satellite acceleration in PZ-90 coordinate system
48	I1	2^{-30}	ddz	km/s ^{2}	Satellite acceleration in PZ-90 coordinate system
49	I1	2^{-30}	dtaon	s	The difference in propagation time between the L2 signal and the L1 signal of the nth satellite
50	U1	-	bn	_	Health sign
51	U1	900	tb	s	The intraday time of the current time (according to UTC+3)
52	U1	-	M	_	GLONASS satellite category
53	U1	-	P	-	Control technical parameters
54	U1	-	ft	-	Prediction accuracy of satellite pseudorange
55	U1	-	en	day	Satellite ephemeris age
56	U1	-	p1	-	Ephemeris information update time flag
57	U1	-	p2	-	tb parity flag
58	U1	-	p3	-	The almanac passed in the current frame contains the number of satellites
59	U1	-	p4	-	Ephemeris data update flag: 1 means updated
60	U1	-	ln	-	Satellite health sign (GLONASS-M satellite)
61	U1	-	n4	-	Time counting (starting in 1996, with a four-year cycle)
62	U1	-	svid	-	Satellite number
63	U1	-	nl	-	Frequency number

64	U1	-	valid	-	Information available sign (remark [1])
65	U1	-	res2	-	Keep
66	U2	-	res3	-	Keep

Remark [1]: Information available sign

Value	Description
0	invalid
1	Unhealthy
2	Expired
3	effective

2.14 MON (0x0A)

Monitoring information, such as configuration status, task status, etc.

2.14.1 MON-VER (0x0A 0x04)

information MON-VER
description Version Information
Types of Respond to queries
Comment

news structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	64	0x0A 0x04	See table below	4 Bytes

Payload content:

character Offset	data Types of	proportion Zoom	first name	unit	description
0	CH[32]-		swVersion	-	Software version string
32	CH[32]-		hwVersion	-	Hardware version string

2.14.2 MON-HW (0x0A 0x09)

information	MON-HW
description	Hardware status
Types of	Cycle/query
Comment	Various configuration status of the hardware, including antenna status, IO port status, noise level, AGC information, etc.

news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	56	0x0A 0x09	See table below	4 Bytes

Payload content:

character Offset	data Types of	proportion Zoom	first name	unit	description
0	U4	-	noisePerMs0	-	DIF0 IF data noise power
4	U4	-	noisePerMs1	-	DIF1 IF data noise power
8	U4	-	noisePerMs2	-	DIF2 IF data noise power
12	U2	-	agcData0	-	The number of 1s in the amplitude bit of the DIF0 intermediate frequency data
14	U2	-	agcData1	-	The number of 1s of the amplitude bit of the DIF1 intermediate frequency data
16	U2	-	agcData2	-	The number of 1s of the amplitude bit of the DIF2 intermediate frequency data
18	U2	-	res	-	Keep
20	U1	-	antStatus	-	Antenna status (remark [1])
twenty one	U1	-	res	-	Keep
twenty two	U1	-	res	-	Keep
twenty three	U1	-	res	-	Keep
twenty four	U4[8]	2^24	jamming	-	Center frequency of interference signal (normalized)

Remark [1]: antenna status

Value	description
0	Initialization process
1	Unknown status
2	normal
3	Short circuit
4	open circuit

2.15 AID (0x0B)

Auxiliary information, such as the initial position and time of the receiver.

2.15.1 AID-INI (0x0B 0x01)

information	AID-INI				
description	Auxiliary position, time, frequency, clock frequency deviation information				
Types of	Query/enter				
Comment	Configure navigation related parameters				
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	56	0x0B 0x01	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
0	R8	-	ecefXOrLat	m or 1°	X coordinate or latitude in ECEF coordinate system
8	R8	-	ecefYOrLon	m or 1°	Y coordinate or longitude in ECEF coordinate system
16	R8	-	ecefZOrAlt	m or 1°	Y coordinate or height in ECEF coordinate system
twenty four	R8	-	tow	s	GPS time of the week
32	R4	-	freaBias	m/s or ppm	Clock frequency drift
36	R4	-	pAcc	m	Estimated accuracy of 3D position
40	R4	-	tAcc	s	Time estimation accuracy
44	R4	-	fAcc	m/s or ppm	Accuracy of clock frequency drift
48	U4	-	res	-	Keep
52	U2	-	wn	-	GPS weekday
54	U1	-	timeSource	-	Time source
55	U1	-	flags	-	Logo mask (remark [1])

Remark [1]: Logo mask

Bit	description
B0	1=Position valid
B1	1=Time is valid
B2	1=The clock frequency drift data is valid
B3	Keep
B4	1=The clock frequency data is valid
B5	1=Location is in LLA format
B6	1=Invalid height
B7	Keep

2.15.2 AID-HUI (0x0B 0x03)

information AID-HUI

description	Auxiliary health information, UTC parameters, ionospheric parameters				
Types of	Query/enter				
Comment	Configure navigation related parameters				
news	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	60	0x0B 0x03	See table below	4 Bytes

Payload content

character Offset	data Types of	proportion Zoom	first name	unit	description
4	U4	-	HeaGps	-	GPS satellite health information (Remarks [1])
8	U4	-	HeaBds	-	Health information of BDS satellites (Remarks [1])
12	U4	-	HeaGln	-	Health information of the GLONASS satellite (Remarks [1])
16	I4	2^{-30}	utcGpsA0	s	UTC parameter A0, the clock difference of GPS time relative to UTC
20	I4	2^{-50}	utcGpsA1	s/s	UTC parameter A1, the clock speed of GPS time relative to UTC
twenty four	I1	-	utcGpsLS	s	GPS time relative to UTC before the new jump second
25	I1	-	utcGpsLSF	s	GPS time relative to UTC after the new jump second
26	U1	-	utcGpsTow	s	Reference time of week for GPS UTC parameters
27	U1	-	utcGpsWNT	week	GPS UTC parameter reference week number
28	U1	-	utcGpsWNF	week	GPS new jump second effective week day
29	U1	-	utcGpsDN	day	The number of days of the week when the new GPS seconds are effective
30	I2	-	Res	-	Keep
32	I4	2^{-30}	utcBdsA0	s	UTC parameter A0, the clock difference of BDS relative to UTC
36	I4	2^{-50}	utcBdsA1	s/s	UTC parameter A1, the clock speed of BDS relative to UTC
40	I1	-	utcBdsLS	s	The jump second of BDS relative to UTC before the new jump second
41	I1	-	utcBdsLSF	s	The jump second of BDS relative to UTC after the new jump second
42	U1	-	utcBdsTow	s	Reference time of the week for UTC parameters of BDS
43	U1	-	utcBdsWNT	week	BDS UTC parameter reference week number
44	U1	-	utcBdsWNF	week	The week number of the new jumping second
45	U1	-	utcBdsDN	day	The number of days in the week when the new BDS jump second takes effect
46	I2	-	Res	-	Keep
48	I1	2^{-30}	klobA0	s/π	Klobuchar model parameter alpha0
49	I1	2^{-27}	klobA1	s/π_1	Klobuchar model parameter alpha1
50	I1	2^{-24}	klobA2	s/π_2	Klobuchar model parameter alpha2
51	I1	2^{-24}	klobA3	s/π_3	Klobuchar model parameter alpha3
52	I1	2^{11}	klobB0	s/π	Klobuchar model parameter beta0
53	I1	2^{14}	klobB1	s/π_1	Klobuchar model parameter beta1
54	I1	2^{16}	klobB2	s/π_2	Klobuchar model parameters beta2
55	I1	2^{16}	klobB3	s/π_3	Klobuchar model parameters beta3
56	U4	-	flags	-	Valid flag mask (remark [2])

Remarks [1]: B0 means satellite number 1, and so on, the corresponding bit is equal to 0, which means the satellite is healthy.

Remarks [2]: valid flag

Bit	description
B0	Health information is valid
B1	UTC parameters are valid

B2	Ionospheric parameters are valid