CASIC Multimode Satellite Navigation Receiver

Protocol specification

V4.2.0.3

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Document description		
file name	CASIC Multimode Satellite Navigation Receiver Protocol Specification	
Document summary	Describes the CASIC multi-mode satellite navigation receiver protocol specifications in detail, including the general standard NMEA0183 protocol Protocol, and a custom binary protocol.	
version number	V4.2.0.3	
date	2020.01.06	
new version update		
V3.7.0.1	2017.07.21	Modify the RXM-MEASX message to comply with the RINEX302 standard.
V3.8.0.1	2017.12.06	Expand the leap second information part (LPS) of the NMEA protocol; add NMEA-DHV Corresponding protocol with NMEA-UTC sentences.
V3.9.0.0	2017.12.20	Increase the support and content of NMEA-GST sentences.
V4.0.0.0	2017.12.26	Supplement the information content of NMEA-LPS. The content of some sentences is updated.
V4.1.0.0	2018.3.26	Revise the meaning of some signs of binary agreement content; revise some names.
V4.2.0.0	2018.11.14	Add the corresponding protocol of NMEA-INS sentence and NAV=IMUATT message.
V4.2.0.1	2018.11.22	Corrected typos.
V4.2.0.2	2019.05.14	Modify the NMEA-INS sentence, CFG-INS.
V4.2.0.3	2020.01.06	Add PCAS60 statement and modify PCAS03 statement.

1 NMEA protocol

1.1 NMEA protocol features

The CASIC receiver is compatible with the international standard NMEA0183 protocol, supports NMEA0183 version 4.1 by default, and is compatible with V2.3 And V3.X version, support the NMEA0183 V4.0 standard and the standard before V2.3 by sending commands.

Data is transmitted in a serial asynchronous manner. 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 used for data transmission

Baud rate (bps)	Support 4800, 9600, 19200, 38400, 57600, 115200
Data bit	8-bit
Stop bit	1 person
Check Digit	without

1.2 NMEA protocol framework

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

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

Based on the NMEA protocol framework, this receiver protocol specification adds custom sentences to control the receiver's Work mode, and query the product information of the receiver, 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. The transmitter identifiers 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	Correspondence 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	33~37	193~197	PRN-160

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 identifier. 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 BD, For GP, GL, GA, etc., if the satellites of multiple systems are used to obtain the position calculation, 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 the GLL, RMC and VTG statements is not output.

2) For the positioning quality (FS) item in the GGA sentence, 1 is used for both trajectory calculation and normal positioning.

It is estimated to be 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		
state	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 a decimal point with a 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	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 NMEA message overview

Page	Message name	Class/ID	describe
	NMEA standard message		Standard message
	GGA	0x4E 0x00	Receiver positioning data
	GLL	0x4E 0x01	Geographical Location-Latitude/Longitude
	GSA	0X4E 0x02	DOP and effective satellites
	GSV	0x4E 0x03	Visible satellite
	RMC	0x4E 0x04	Recommended minimum dedicated navigation data
	VTG	0x4E 0x05	Ground speed and heading
	GST	0x4E 0x07	Receiver pseudorange error statistics
	ZDA	0x4E 0x08	Time and date
	ANT	0x4E 0x11	Antenna status
	LPS	0x4E 0x12	Satellite system leap second correction information
	DHV	0x4E 0x13	Receiver speed information
	UTC	0x4E 0x16	Receiver status, leap second correction simplified information
	NMEA custom message		Custom message
	CAS00	-	Save configuration information
	CAS01	-	Communication protocol and serial port configuration information
	CAS02	-	Set targeting 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
	CAS12	-	Standby mode control
	CAS20	-	Online upgrade instructions

1.5 NMEA standard message

1.5.1 GGA

information	GGA
describe	Receiver time, location and positioning related data
type	Output
Format	$--GGA,UTCtime,lat,uLat,lon,uLon,FS,numSv,HDOP,msl,uMsl,sep,uSep,diffAg e,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	Numerical value	Indicates the current positioning quality (remark [1]), this field should not be empty
8	numSv	Numerical value	Number of satellites used for positioning, 00~24
9	HDOP	Numerical value	Horizontal factor of precision (HDOP)
10	msl	Numerical 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	Numerical value	The distance between the reference 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	Numerical value	Differentially corrected data age, this field is empty when DGPS is not used
15	diffSta	Numerical value	ID of the differential reference station
16	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
17	<CR><LF>	character	Carriage return and line feed

Remarks [1] Positioning quality mark

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

1.5.2 GLL

information	GLL
describe	Information such as latitude, longitude, positioning time and positioning status.
type	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.mmmm	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 (remarks [2]), only valid for NMEA 2.3 and above
9	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
10	<CR><LF>	character	Carriage return and line feed

Remarks [1] Data validity flag

Location quality mark	describe
A	Data is valid
V	Invalid data

Remarks [2] Positioning mode flag

Positioning mode flag	describe
A	Autonomous mode
E	Estimation mode (dead reckoning)
N	Invalid data
D	Differential mode
M	Not located, but there is an external input or a location saved in history

1.5.3 GSA

information	GSA
describe	Satellite number and DOP information used for positioning. Output GSA regardless of positioning or availability of 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.
type	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	number	Positioning status flag (remark [2])
4	{,SVID}	Numerical value	The number of the satellite used for positioning, this field displays a total of 12 available satellites No Fill in the space
5	PDOP	Numerical value	Position precision factor (PDOP)
6	HDOP	Numerical value	Horizontal factor of precision (HDOP)
7	VDOP	Numerical value	Vertical factor of precision (VDOP)
8	systemId	Numerical 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 * (not including $ and *) fruit
10	<CR><LF>	character	Carriage return and line feed

Remarks [1] Mode switching mode indication

Mode switch mode indication	describe
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	describe
1	Invalid targeting
2	2D positioning
3	3D positioning

Remarks [3] GNSS system ID

System ID	describe
1	GPS system
2	GLONASS system

1.5.4 GSV

information	GSV
describe	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.
type	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	$--GSV	String	Message ID, GSV 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	number	Current sentence number
4	numSv	Numerical value	Total number of visible satellites
5	{,SVID,ele, az,cn0}	Numerical value	as followed: Satellite number; Elevation angle, the value range is 0~90, the unit is degree; Azimuth angle, 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
6	signalId	Numerical 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 * (not including $ and *) fruit
8	<CR><LF>	character	Carriage return and line feed

1.5.5 RMC

information	RMC
describe	Recommended minimum positioning information
type	Output
Format	$--RMC,UTCtime,status,lat,uLat,lon,uLon,spd,cog,date,mv,mvE,mode*CS<C R><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	Numerical value	Speed over the ground, in knots
9	cog	Numerical value	True heading over ground, in degrees
10	date	ddmmyy	Date (dd is day, mm is month, yy is year)
11	mv	Numerical 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 *NMEA 2.3* and above are valid
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 * (not including $ and *) fruit
16	<CR><LF>	character	Carriage return and line feed

Remarks [1] Positioning mode flag

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

M	Not located, but there is an external input or a location saved in history

1.5.6 VTG

information	VTG
describe	Ground speed and ground heading information.
type	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	Numerical value	True north heading over Earth, in degrees
3	T	character	True north indicator, fixed as T
4	cogm	Numerical value	Heading to geomagnetic north, in degrees
5	M	character	Magnetic north indicator, fixed as M
6	sog	Numerical value	Speed over the ground, in knots
7	N	character	Speed unit knot, fixed as N
8	kph	Numerical 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 *NMEA 2.3* and above are valid
11	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *)
			fruit
12	<CR><LF>	character	Carriage return and line feed

Remarks [1] Positioning mode flag

Positioning mode flag	describe
A	Autonomous mode
E	Estimation mode (dead reckoning)
N	Invalid data
D	Differential mode
M	Not located, but there is an external input or a location saved in history

1.5.7 ZDA

information	ZDA
describe	Time and date information.
type	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	Numerical value	Day, fixed two digits, value range 01~31
4	month	Numerical value	Month, fixed two digits, value range 01~12
5	year	Numerical value	Year, fixed four digits
6	ltzh	Numerical value	This time zone is hour, not supported, fixed as 00
7	ltzn	Numerical value	Minutes in this time zone, not supported, fixed as 00
8	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
9	<CR><LF>	character	Carriage return and line feed

1.5.8 TXT

product information

information	TXT
describe	product information
type	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	Numerical 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	Numerical value	Sentence number 01~99
4	zz	Numerical 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 * (not including $ and *) fruit
7	<CR><LF>	character	Carriage return and line feed

1.5.9 ANT

information	ANT
describe	Antenna status
type	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 the status of the antenna (short circuit)

Parameter Description

Field	name	Format	Parameter Description
1	$GPTXT	String	Message ID, TXT statement header
2	xx	Numerical 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 to display, and it is fixed to 01.
3	yy	Numerical value	The sentence number is 01~99, which is fixed to 01.
4	zz	Numerical value	Text identifier. It is fixed to 01.
5	info		Text message ANTENNA OPEN=antenna open ANTENNA OK=The antenna is good ANTENNA SHORT=Antenna short
6	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
7	<CR><LF>	character	Carriage return and line feed

1.5.10 DHV

information	DHV
describe	Receiver speed details
type	Output
Format	$--DHV,UTCtime,speed3D,spdX,spdY,spdZ,gdspd*CS<CR><LF>
Example	$GNDHV,021150.000,0.03,0.006,-0.042,-0.026,0.06*65

Parameter Description

Field	name	Format	Parameter Description
1	$--DHV	String	Message ID, DHV sentence header,'--' is the system identifier
2	UTCtime	hhmmss.sss	UTC time at the current moment
3	speed3D	Numerical value	Three-dimensional speed of the receiver, in m/s
4	spdX	Numerical value	Receiver ECEF-X axis direction speed, the unit is m/s
5	spdY	Numerical value	Receiver ECEF-Y axis direction speed, the unit is m/s
6	spdZ	Numerical value	Receiver ECEF-Z axis direction speed, the unit is m/s
7	gdspd	Numerical value	The speed of the receiver in the horizontal ground direction, the unit is m/s
8	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
9	<CR><LF>	character	Carriage return and line feed

1.5.11 LPS (only 5T support)

information	LPS (5T support only)
describe	Leap second information
type	Output
Format	$GPTXT,xx,yy,zz,LS=system,valid,utcLS,utcLSF,utcTOW,utcWNT,utcDN,utcWNF
	,utcA0,utcA1,leapDt,dateLsf,lsfExp,wnExp,wnExpNum*hh<CR><LF>
Example	$GNZDA,235402.000,31,12,2016,00,00*4E
	The current UTC time is December 31, 2016, 23:54:02
	$GPTXT,01,01,02,LS=0,3,17,18,61,138,7,137,0,0,358,311216,,,*64
	The leap second information of GPS is valid and used for time service. The current leap second and the leap second after the jump are not equal, and the leap second changes from 17 seconds to
	At 18 seconds, the leap second event occurred 358 seconds later (that is, 23:59:60 on December 31, 2016). current
	The GPS system of the receiver has no satellites that give warnings of abnormal UTC parameter information. No GPS week number exception is currently given
	Warning satellite.
	$GPTXT,01,01,02,LS=1,1,3,4,0,61,6,61,0,0,358,311216,,,*56
	Beidou's leap second information is valid and not used for time service. The current leap second is not equal to the leap second after the jump, and it jumps from 3 seconds to 4
	Seconds, the leap second event occurred 358 seconds later (that is, 23:59:60 on December 31, 2016). Notice:
	The leap seconds of GPS and Beidou are different because they have different time starting reference points. Current receiver Beidou series
	There are no satellites that give warnings about abnormal UTC parameter information. Currently, there is no satellite that gives an abnormal warning of the Beidou week number.

Parameter Description

Field	name	Format	Parameter Description
1	$GPTXT	String	Message ID, TXT statement header
2	xx	Numerical 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 to display, and it is fixed to 01.
3	yy	Numerical value	The sentence number is 01~99, which is fixed to 01.
4	zz	Numerical value	Text identifier. Fixed at 02.
5	LS=	String	Leap second message identifier, fixed character.
6	system	character	The system corresponding to the leap second information.
			0=GPS
			1=BDS (Beidou)
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 time service
			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	Numerical value	(Fields 8-15 are standard leap second 8 parameters, please refer to Beidou or
			GPS ICD document)
			The current leap second, in seconds, a positive number indicates that the satellite time is ahead of UTC

			time. Output when the leap second parameter is valid, otherwise it is empty.
9	utcLSF	Numerical value	The predicted leap second (after the occurrence of a leap second event), in seconds, a positive number table It shows that the satellite time is ahead of UTC time. Output when the leap second parameter is valid, Otherwise, it is empty.
10	utcTOW	Numerical value	The reference time for UTC correction parameters, within a week, the unit is 4096 seconds. Output when the leap second parameter is valid, otherwise it is empty.
11	utcWNT	Numerical value	The reference time of the UTC correction parameter, the number of weeks, the unit is week, modulo 256. Output when the leap second parameter is valid, otherwise it is empty.
12	utcDN	Numerical value	The time when the leap second occurred, the number of days in the week. For GPS systems, the valid range of this value is 1~7. For Beidou system, the valid range of this value is 1~6. 1 means the end of Sunday, 2 means the end of Monday, in order Push, 7 means the end of Saturday. Output when the leap second parameter is valid, otherwise it is empty.
13	utcWNF	Numerical value	The time when the leap second occurs, the number of weeks, the unit is week, mod 256. Leap second ginseng Output when the number is valid, otherwise it is empty.
14	utcA0	Numerical value	The time error between UTC time and satellite time (scale factor 2^-30), The unit is seconds. Output when the leap second parameter is valid, otherwise it is empty.
15	utcA1	Numerical value	The rate of change of the time error between UTC time and satellite time (scale factor 2^-50), the unit is second/second. Output when the leap second parameter is valid, otherwise Is empty.
16	leapDt	Numerical 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. The leap second parameter is valid and Output when there is a leap second change (utcLs≠utcLsf), otherwise it is empty.
17	dateLsf	ddmmyy	The date corresponding to the forecasted leap second occurrence time, in day/month/year format. Leap Output when the second parameter is valid and there is a leap second change (utcLs≠utcLsf), Otherwise, it is empty.
18	lsfExp	Hexadecimal value	The current satellite system's leap second correction time is abnormal. In 8-bit The hexadecimal value represents the relevant situation of the 32 satellites of the system. From From the lowest to the highest, the satellites are No. 1 to No. 32. 0=The leap second correction information of this satellite is not abnormal. 1=The leap second correction information of this satellite is abnormal. If the leap second occurrence time in the information is not the empirical time (June 30 or December 31), the receiver will give abnormal information, but will follow the changes The changed time is adjusted by leap second. Leap second parameter is valid and abnormal When output, otherwise it is empty.
19	wnExp	Hexadecimal value	The current satellite system time week number is abnormal alarm (year jump alarm). By 8 The hexadecimal value represents the relevant information of the system's 32 satellites. condition. From the lowest position to the highest position, the satellites are No. 1 to No. 32. 0=No abnormality in the number of weeks of the satellite, no alarm 1=The satellite week number is abnormal, and an alarm is given Output when there is an abnormality in the ephemeris time. Otherwise, it is empty.
20	wnExpNum value		The amplitude of the week number jump in the satellite message. The week number jumps forward relative to the normal value If it changes, the value is negative; otherwise, it is positive. The unit is the number of weeks. Ephemeris

			It is output when there is an abnormality. Otherwise, it is empty.
twenty one	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *)

			fruit
twenty two	<CR><LF>	character	Carriage return and line feed

1.5.12 UTC (5T support only)

information	UTC (5T support only)
describe	Receiver status, leap second correction simplified information
type	Output
Format	$--UTC,UTCtime,lat,uLat,lon,uLon,FS,numSv,HDOP,hgt,uMsl,date,antSta,time Src,leapValid,dtLs,dtLsf,leapTime*CS<CR><LF>
Example	$GNUTC,235402.000,3200.00001,N,11900.00005,E,1,20,0.6,10.5,M,311216,0,0,1, 17,18,1216*3C

Parameter Description

Field	name	Format	Parameter Description
1	$--UTC	String	Message ID, UTC header
2	UTCtime	hhmmss	The UTC time of the current positioning, in the format of hour/minute/second.
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	Numerical value	Indicates the current positioning quality (remark [1]), this field should not be empty
8	numSv	Numerical value	Number of satellites used for positioning, 00~24
9	HDOP	Numerical value	Horizontal factor of precision (HDOP)
10	hgt	Numerical value	high
11	uMsl	character	Height unit, meter, fixed character M
12	date	ddmmyy	The current positioning date, in the format of day/month/year.
13	antSta	Numerical value	Antenna status: 0=Antenna is open 2=The antenna is normal 3=Antenna short circuit
14	timeSrc	Numerical value	Current timing source system: 0=GPS system 1=BDS system
15	leapValid	Numerical value	Leap second correction value validity flag: 0=No valid leap second value 1=Leap second value is valid
16	utcLs	Numerical value	Leap second correction value at the current moment
17	utcLsf	Numerical value	If there is a forecast leap second occurrence (in the leap second correction information, utcLs≠ utcLsf) , which means the new leap second correction value of the forecast. In the leap second event After birth, the value will continue to be output until it receives a correction without leap second forecast.

			Up to the information. If no leap second is predicted to occur (dtls in the received leap second correction information Equal to dtlsf), this field is empty
18	leapTime	mmyy	If there is a forecast leap second occurrence (in the leap second correction information, utcLs≠ utcLsf) , this field indicates the predicted time of occurrence of leap second. In leap second After the event occurs, the value will continue to be output until the leap second-free pre- So far as the revised information is reported. If there is no forecast leap second (dtls and dtlsf are equal), this field is empty. The format is month/year.
19	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
20	<CR><LF>	character	Carriage return and line feed

Remarks [1] Positioning quality mark

Location quality mark	describe
0	Targeting is unavailable or invalid
1	Standard positioning mode, effective positioning
6	Estimation mode

1.5.13 GST

information	GST
describe	Receiver pseudorange measurement accuracy details
type	Output
Format	$--GST,UTCtime,RMS,stdDevMaj,stdfDevMin,orientation,stdLat,stdLon,stdAlt* CS<CR><LF>
Example	$BDGST,081409.000,0.5,,,,0.2,0.1,0.4*5E

Parameter Description

Field	name	Format	Parameter Description
1	$--GST	String	Message ID, DHV sentence header,'--' is the system identifier
2	UTCtime	hhmmss.sss	UTC time at the current moment
3	RMS	Numerical value	The RMS value of the standard deviation of the pseudorange error of the receiver during the positioning process, in meters
4	stdDevMaj	Numerical value	The position standard deviation in the direction of the semi-major axis of the ellipse of the receiver, not supported
5	stdfDevMin value		The position standard deviation in the direction of the semi-minor axis of the receiver ellipse, not supported
6	orientation	Numerical value	The orientation of the semi-major axis of the ellipse of the receiver, not supported
7	stdLat	Numerical value	The standard deviation of the receiver's latitude error, in meters
8	stdLon	Numerical value	The standard deviation of the longitude error of the receiver, in meters
9	stdAlt	Numerical value	The standard deviation of the receiver height error, in meters
10	CS	Hexadecimal value	Checksum, XOR result of all characters between $ and * (excluding $ and *)
11	<CR><LF>	character	Carriage return and line feed

1.5.14 INS (only supported by 5S series)

information	INS (supported by 5S series only)
describe	Inertial Navigation System (INS) information
type	Output
Format	$GPTXT,xx,yy,zz,INS_INF=sensorID,attMode,status,sesorOK,RAM, ramStart*hh<CR><LF>
Example	$GPTXT,01,01,02,INS_INF=1,3,5,0,0,RAM,1*11 explain: k=1, current module sensor type 1; l=3, when installing the X-axis of the module package, only the left side of the vehicle needs to be considered; m=5, the module currently outputs RXM_SENSOR statements, each statement contains 5 groups of MEMS sampling data; n=0, the integrated navigation filter does not converge.

Parameter Description

Field	name	Format	Parameter Description
1	$GPTXT	String	Message ID, TXT statement header
2	xx	Numerical 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 to display, and it is fixed to 01.
3	yy	Numerical value	The sentence number is 01~99, which is fixed to 01.
4	zz	Numerical value	Text identifier.
5	INS_INF	String	Fixed as INS_INF, used for INS information flag.
6	sensorID	Numerical value	The sensor type used by the current module: 1 or 2.
7	attMode	Numerical value	Mode configuration of the relative installation attitude of the module relative to the vehicle, possible values Range: 0, 1, 2, 3. 0: The X axis of the module points to the front of the vehicle. 1: The X axis of the module points to the right of the vehicle. 2: The X axis of the module points to the rear of the vehicle. 3: The X axis of the module points to the left of the vehicle. 9: The relative attitude of the adaptive estimation module.
8	fs	Numerical value	Used only for output of internal MEMS raw data The number of samples in the RXM_SENSOR statement. Value range: 0, 1, 2, 5, 10, 25, 50. If m=0, it means that the RXM_SENSOR statement is not output; If m!=0, it means that the RXM_SENSOR statement is output once every second, A sentence contains m groups of MEMS sensor sampling data.
9	status	Numerical value	Used to display the convergence status of the integrated navigation filter, n=2 means received Converge.
10	sesorOK	Numerical value	-
11	RAM	String	Fixed as RAM

	ramStart	Numerical value	1: There is a backup power supply and the dead reckoning function is turned on immediately after power-on 0: There is a backup power supply and the dead reckoning function is turned off immediately after power-on

			Off by default
6	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *)
			fruit
7	<CR><LF>	character	Carriage return and line feed

1.6 NMEA custom message

1.6.1 CAS00

information	CAS00
describe	Save the current configuration information to FLASH, even if the receiver is completely powered off, the information in FLASH will not be lost.
type	enter
Format	$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 * (not including $ and *) fruit
3	<CR><LF>	character	Carriage return and line feed

1.6.2 CAS01

information	CAS01
describe	Set the baud rate of serial communication.
type	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	number	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 * (not including $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.3 CAS02

information	CAS02
describe	Set the positioning update rate.
type	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	Numerical 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, XOR result of all characters between $ and * (excluding $ and *)
4	<CR><LF>	character	Carriage return and line feed

1.6.4 CAS03

information	CAS03
describe	Set the NMEA sentence that requires output or stop output.
type	enter
Format	$PCAS03,nGGA,nGLL,nGSA,nGSV,nRMC,nVTG,nZDA,nANT,nDHV,nLPS,res1,r es2,nUTC,nGST,res3,res4,res5,nTIM*CS<CR><LF>
Example	$PCAS03,1,1,1,1,1,1,1,1,0,0,,,1,1,,,,1*33

Parameter Description

Field	name	Format	Parameter Description
1	$PCAS03	String	Message ID, statement header
2	nGGA	Numerical value	GGA output frequency, sentence output frequency is based on the positioning update rate , N (0~9) means output once every n times of positioning, 0 means no output If the sentence is empty, the original configuration will be maintained.
3	nGLL	Numerical value	GLL output frequency, same as nGGA
4	nGSA	Numerical value	GSA output frequency, same as nGGA
5	nGSV	Numerical value	GSV output frequency, same as nGGA
6	nRMC	Numerical value	RMC output frequency, same as nGGA
7	nVTG	Numerical value	VTG output frequency, same as nGGA
8	nZDA	Numerical value	ZDA output frequency, same as nGGA
9	nANT	Numerical value	ANT output frequency, same as nGGA
10	nDHV	Numerical value	DHV output frequency, same as nGGA
11	nLPS	Numerical value	LPS output frequency, same as nGGA
12	res1	Numerical value	Reserve
13	res2	Numerical value	Reserve
14	nUTC	Numerical value	UTC output frequency, same as nGGA
15	nGST	Numerical value	GST output frequency, same as nGST
16	res3	Numerical value	Reserve
17	res4	Numerical value	Reserve
18	res5	Numerical value	Reserve
19	nTIM	Numerical value	TIM (PCAS60) output frequency, same as nGGA
20	CS	Hexadecimal value	Checksum, XOR result of all characters between $ and * (excluding $ and *)
twenty one	<CR><LF>	character	Carriage return and line feed

1.6.5 CAS04

information	CAS04
describe	Configure the working system.
type	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	number	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 * (not including $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.6 CAS05

information	CAS05
describe	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) .
type	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	number	NMEA protocol type selection (note [1])
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ 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
9	Compatible with single GPS NMEA0183 protocol, compatible with NMEA 2.2 version

1.6.7 CAS06

information	CAS06
describe	Query product information
type	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	number	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 multi-mode 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 * (not including $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.8 CAS10

information	CAS10
describe	Receiver restart
type	enter
Format	$PCAS10,rs*CS<CR><LF>
Example	$PCAS10,0*1C hot start
	$PCAS10,1*1D warm start
	$PCAS10,2*1E cold start
	$PCAS10,3*1F Factory start

Parameter Description

Field	name	Format	Parameter Description
1	$PCAS10	String	Message ID, statement header
2	rs	number	Start mode configuration. 0=hot start. Do not use initialization information, back up all in the storage 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 start. Clear all data in the memory and reset the receiver To the factory default configuration.
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.9 CAS12

information	CAS12
describe	Receiver standby mode control
	5L low-power module supports this command
type	enter
Format	$PCAS12,stdbysec*CS<CR><LF>
Example	$PCAS12,60*28 The receiver enters the standby mode and automatically powers on after 60 seconds

Parameter Description

Field	name	Format	Parameter Description
1	$PCAS12	String	Message ID, statement header
2	stdbysec	Numerical value	The time for the receiver to enter standby mode, the maximum is 65535 seconds
3	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
4	<CR><LF>	character	Carriage return and line feed

1.6.10 CAS20

information	CAS20
describe	Online upgrade instructions
type	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 * (not including $ and *) fruit
3	<CR><LF>	character	Carriage return and line feed

1.6.11 CAS15

information	CAS15
describe	Satellite system control commands, you can configure whether to receive any satellite in the system
	Subsequent versions of *V5200* support this command
type	enter
Format	$PCAS15,X,YYYYYYYY*CS<CR><LF>
Example	$PCAS15,2,FFFFFFFF*37, turn on Beidou satellites 1-32
	$PCAS15,2,FFFFFFE0*42, turn on Beidou's 6-32 satellite, and turn off Beidou 1-5
	$PCAS15,4,FFFF*31, turn on satellites 1-16 of SBAS, that is, PRN=120-135
	$PCAS15,5,1F*47, turn on the satellites 1-5 of QZSS, that is, PRN=193,194,195,199,197

Parameter Description

Field	name	Format	Parameter Description
1	$PCAS15	String	Message ID, statement header
2	SYS_ID	1 number	2=Beidou 1-32 satellite 3=Beidou 33-64 satellite 4=SBAS satellite (SBAS satellite No. 1-19, corresponding to PRN 120-138 No) 5=QZSS satellite (QZSS satellite 1-5, corresponding to PRN 193, No. 194, 195, 199, 197)
3	SV_MASK	1 to 8 hexadecimal Numerical value	Each hexadecimal character controls 4 satellites, the rightmost one controls 1-4 Satellite. Hexadecimal characters are converted to 4bit binary, each 1bit corresponds to 1 satellite Star, 1=receive the satellite; 0=prohibit. For example: 3FFFFFE0, which means satellites 31, 32, 1-5 are prohibited.
4	CS	Hexadecimal value	Checksum, the exclusive OR of all characters between $ and * (not including $ and *) fruit
5	<CR><LF>	character	Carriage return and line feed

1.6.12 CAS60

information	CAS60
describe	Receiver time information.

The subsequent version of *5T*- module *V5302* supports this command

type	Output
Format	$PCAS60,UTCtime,ddmmyyyy,wn,tow,timevalid,leaps,leapsValid*CS
Example	$PCAS60,091242.000,23122019,2085,119580,1,18,1*33
	$PCAS60,091222.000,23122019,,,0,,0*33
	$PCAS60,092011.000,23122019,2085,120029,1,,0*33

Parameter Description

Field	name	Format	Parameter Description
1	$PCAS60	String	Message ID
2	UTCtime	hhmmss.sss	UTC time at the current moment, if leaksValid is 0, then use Default leaks calculation
3	ddmmyyy y	Numerical value	Current day month year
4	wn	Numerical value	GPS system weeks
5	tow	Numerical value	GPS system in seconds
6	timeValid	Numerical value	Time validity (2/3/4/5 field), 1=valid, 0=invalid
7	leaps	Numerical value	The difference between GPS time and UTC time, leap seconds
8	leapsValid value		Leaps are valid, 1=valid, 0=invalid
9	CS	Hexadecimal value	Checksum, exclusive OR of all characters between $ and (excluding $ and) result
10		character	Carriage return and line feed

2 CASIC protocol

2.1 CASIC protocol features

The CASIC receiver uses 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 starting and delimiting 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 fields.

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, and 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 = (id << 24) + (class << 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 one received first is in the low order)
Accumulate.

2.3 CASIC type and number

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

name	type	describe
NAV	0x01	Navigation results: position, speed, time
TIM	0x02	Timing message: time pulse output, time mark result
RXM	0x03	The 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.
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: each type of consumer
The data in the message are 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
Single-precision and double-precision standard transmission.

abbreviation	type	Number of bytes	Remark
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	type	describe
	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 0x10	16+32*N	cycle	Pseudorange, carrier phase raw measurement information
	RXM-SVPOS	0x03 0x11	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	Query/Configure the working mode of UART
	CFG-MSG	0x06 0x01	0/4	Query/setting	Query/configuration information sending frequency
	CFG-RST	0x06 0x02	4	set up	Restart the receiver/clear the saved data structure
	CFG-TP	0x06 0x03	0/16	Query/setting	Query/configure the relevant parameters of the receiver PPS
	CFG-RATE	0x06 0x04	0/4	Query/setting	Query/Configure the navigation rate of the receiver
	CFG-CFG	0x06 0x05	4	set up	Clear, save and load configuration information
	CFG-TMODE	0x06 0x06	0/28	Query/setting	Query/Configure the PPS timing mode of the receiver
	CFG-NAVX	0x06 0x07	0/44	Query/setting	Query/professional configuration of navigation engine parameters
	CFG-GROUP	0x06 0x08	0/56	Query/setting	Query/configure GLONASS group delay parameters
	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 the ionospheric information of the BDS system.
	MSG-BDSEPH	0x08 0x02	92	cycle	The receiver outputs BDS system ephemeris information.
	MSG-GPSUTC	0x08 0x05	20	cycle	The receiver outputs GPS system UTC information.
	MSG-GPSION	0x08 0x06	16	cycle	The receiver outputs GPS system ionospheric 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 states of the hardware
	Class AID		AID auxiliary message	
AID-INI	0x0B 0x01	56	Query/enter	Auxiliary position, time, frequency, clock frequency deviation information
AID-HUI	0x0B 0x03	60	enter	Auxiliary health information, UTC parameters, ionospheric parameters

2.7 NAV (0x01)

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

2.7.1 NAV-STATUS (0x01 0x00)

information	NAV-STATUS				
describe	Receiver navigation status				
type	Cycle/query				
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	80	0x01 0x00	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	one Bit	describe
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	-	Message validity of the almanac and ephemeris of 32 GPS satellites Logo (Remark [3])
40	U1*24-		glnMsgFlag	-	24 GLONASS satellite almanacs and ephemeris messages Validity flag (remark [3])
64	U1*14-		bdsMsgFlag	-	Almanac and ephemeris telegram validity of 14 BDS satellites Logo (Remark [3])
78	U1		gpsUtcionFlag	-	GPS's UTC and ionospheric information's message validity mark Journal (Remarks [4])
79	U1	-	bdsUtcionFlag	-	BDS's UTC and ionospheric information's message validity standards Journal (Remarks [4])

Remark [1]: Positioning mark

Numerical value	describe
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

Numerical value	describe

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 message of the almanac, the lower 4 bits represent the validity flag of the message of the ephemeris

Numerical value	describe
0	Missing
1	Unhealthy
2	Expired
3	efficient

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

Numerical value	describe
0	Missing
1	Unhealthy
2	Expired
3	efficient

2.7.2 NAV-DOP (0x01 0x01)

information	NAV-DOP
describe	Positioning precision factor
type	Cycle/query

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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

describe PVT navigation information in ECEF coordinate system

type Cycle/query

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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	-	The total number of satellites involved 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	-	numSVGLN	-	Number of GLONASS satellites participating in the calculation
12	U2	-	res	-	Reserve
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	The Z coordinate in the ECEF coordinate system
48	R4	-	pAcc	M^2	Variance of 3D position estimation accuracy error
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	Variance of 3D velocity estimation accuracy error
68	R4	-	pDop	-	Location DOP

Remark [1]: Positioning mark

Numerical value	describe
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

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	describe
0	GPS time service, that is, the time of the week and the number of the week are the receiver's local time obtained from GPS satellites
1	BDS
2	GLONASS

Remark [4]: Multi-mode receiving mode

Bit	describe
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				
describe	Position and velocity information in the geodetic coordinate system				
type	Cycle/query				
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	80	0x01 0x03	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	runTime	ms	Running time from power-on/reset
4	U1	-	posValid	-	Positioning mark (refer to 2.7.3 Remarks [1])
5	U1		velValid	-	Speed flag (refer to 2.7.3 Remark [2])
6	U1	-	system	-	Receiver's multi-mode receive mode mask (Refer to 2.7.3 Remarks [4])
7	U1	-	numSV	-	The total number of satellites involved 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	-	numSVGLN	-	Number of GLONASS satellites participating in the calculation
11	U1	-	res	-	Reserve
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	Variance of horizontal position accuracy error
44	R4	-	vAcc	m^2	Variance of vertical position accuracy error
48	R4	-	velN	m/s	North speed in ENU coordinate system
52	R4	-	velE	m/s	East velocity 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 velocity
68	R4	-	heading	°	course
72	R4	-	sAcc	(m/s)^2	Variance of accuracy error of ground velocity
76	R4	-	cAcc	°^2	Variance of accuracy error of heading (variance of heading)

2.7.5 NAV-TIMEUTC (0x01 0x10)

information	NAV-TIMEUTC					
describe	UTC time information					
type	Cycle/query					
information structure	head	Length (bytes)	Identifier	Payload	Checksum	
	0xBA 0xCE	twenty four	0x01 0x10	See the table below	4 Bytes	

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	runTime	ms	Running time from power-on/reset
4	R4	$1/c_2$	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 within minutes (0~59)
twenty one	U1	-	valid	-	Time valid mark (remark [1])
twenty two	U1	-	timeSrc	-	Timing system logo (Note [2])
twenty three	U1	-	dateValid	-	Date valid mark (remark [3])

Remarks[1]: Time valid sign

Numerical value	describe
B0	Valid mark within UTC week, 0=invalid, 1=valid
B1	UTC week number valid flag, 0=invalid, 1=valid
B2	UTC leap second correction valid flag, 0=invalid, 1=valid

Remarks [2]: Timing system logo

Numerical value	describe
0	GPS timing
1	BDS timing
2	GLONASS timing

Remark [3]: Date valid mark

Numerical value	describe
0	Invalid date
1	External input date
2	Get date from satellite
3	Obtain reliable dates from multiple satellites

2.7.6 NAV-CLOCK (0x01 0x11)

information	NAV-CLOCK				
describe	Clock solving information				
type	Cycle/query				
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	64	0x01 0x11	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	runTime	ms	Running time from power-on/reset
4	R4	1/c	freqBias	-	Clock drift (clock frequency deviation)
8	R4	1/c^2	tAcc	s^2	Time accuracy (variance)
12	R4	1/c^2	fAcc	-	Frequency accuracy (variance)
Start of the repeated part (N=0 means GPS, 1 means BDS, 2 means GLONASS)					
16+16*N	R8	-	tow	ms	Time of the 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				
describe	GPS satellite information				
type	Cycle/query				
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	8+12*N	0x01 0x20	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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		Reserve
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 indication of 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 repetition					

Remark [1]: System type

Numerical value	describe
0	GPS
1	BDS
2	GLONASS

Remark [2]: Satellite status

Bit	describe
B0	1=Satellite participates in the calculation
B1-B3	Reserve
B4	1=Invalid satellite prediction information
B5	Reserve
B7:B6	00=reserved 01=The forecast information of the satellite is based on the almanac 10=reserved 11=The prediction information of the satellite is based on the ephemeris

Remark [3]: Quality indicator of signal measurement

quality	illustrate
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, which means the half-circle ambiguity is valid (inverted PI correction is valid)
BIT3	=1, which means that the half-cycle ambiguity is subtracted from the measured value of the carrier phase
BIT4	Reserve
BIT5	=1, which means the carrier frequency is valid
BIT6-BIT7	Reserve

2.7.8 NAV-BDSINFO (0x01 0x21)

information NAV-BDSINFO

describe BDS satellite information

type Cycle/query

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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		Reserve
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 repetition					

2.7.9 NAV-GLNINFO (0x01 0x22)

information	NAV-GLNINFO				
describe	GLONASS satellite information				
type	Cycle/query				
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	8+12*N	0x01 0x22	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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		Reserve
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 repetition					

2.7.10 NAV-IMUATT (0x01 0x06)

information	NAV-IMUATT				
describe	The posture of the IMU coordinate system relative to the local navigation coordinate system (NED)				
type	Cycle/query				
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	32	0x01 0x06	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	tow	s	Receiver GPS within weeks (note [1])
4	U2	-	weekNum	week	Receiver GPS week number (remark [1])
6	U1		flag	-	Posture available signs (remarks [2])
7	U1	-	res	-	Reserve
8	I4	1e-5	roll	deg	Roll angle
12	I4	1e-5	pitch	deg	Pitch angle
16	I4	1e-5	heading	deg	Heading
20	U4	1e-5	rollAcc	deg	Roll angle accuracy
twenty four	U4	1e-5	pitchAcc	deg	Pitch angle accuracy
28	U4	1e-5	headingAcc	deg	Heading angle accuracy

Remark [1]: Receiver GPS within weeks

rcvTow/wn Refer to the meaning of rcvTow/wn in RXM-MEASX.

Remark [2]: Posture available sign

flag 0x01-posture estimation is valid; 0xff posture estimation is invalid.

2.8 TIM (0x02)

2.8.1 TIM-TP (0x02 0x00)

Message name	TIM-TP				
describe	Timing pulse information				
type	Cycle/query				
Annotation information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	twenty four	0x02 0x00	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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	-	Reserve

Remark [1]: reference time of timing pulse

Value	describe
B3:B0	0: GPS time source 1: BDS time source 2: GLN time source
B7:B4	0: The time base is UTC 1: The time base is GNSS (refer to the value of B3:B0 for the specific system)

Remark [2]: UTC parameter valid flag

Value	describe
0	Missing
1	Reserve
2	Expired
3	efficient

2.9 RXM (0x03)

Measured value message.

2.9.1 RXM-MEASX (0x03 0x10)

information	RXM-MEASX				
describe	Pseudorange, carrier phase raw measurement information				
type	Cycle/query				
Annotation					
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	16+32*N	0x03 0x10	See the table below	4 Bytes

Payload content:

character Offset	data type	Proportion Zoom	name	unit	describe
0	R8	-	rcvTow	s	Receiver GPS within weeks (note [1])
8	I2	-	wn	week	Receiver GPS weeks
10	I1	-	leapS	s	UTC leap second value (Note [2])
11	U1	-	numMeas	-	Number of measurement values, valid range 0~32
12	U1	-	recStat	-	Receiver status (remark [3])
13	U1	-	res1		Reserve
14	U1	-	res2	-	Reserve
15	U1	-	res3	-	Reserve
Start of repeated part (N=numMeas, valid range 0~32)					
16+32*N	R8	-	prMes	m	Pseudorange measurement value (unit: meter), for GLONASS inter-frequency deviation, receiver It is compensated by the built-in correction table.
24+32*N	R8	-	cpMes	cycles	Carrier phase measurement value (unit: week) (Remarks [4])
32+32*N	R4	-	doMes	Hz	Doppler measurement value (unit: Hz), close to The Doppler of the satellite is positive.
36+32*N	U1	-	gnssid	-	System type. 0=GPS, 1=BDS, 2=GLONASS
37+32*N	U1	-	svid	-	Satellite number
38+32*N	U1	-	res4	-	Reserve
39+32*N	U1	-	freqid	-	Frequency number (offset 8), only for GLONASS works. Valid value range [1,14], corresponding to frequency [-7,+6].
40+32*N	U2	-	locktime	ms	Carrier phase lock time, max 65535ms
42+32*N	U1	-	cn0	dB-Hz	Carrier to noise ratio
43+32*N	U1	-	res5	-	Reserve
44+32*N	U1	-	res6	-	Reserve
45+32*N	U1	-	res7	-	Reserve

46+32*N	U1	-	trkStat	-	Satellite tracking status (Note [5])
47+32*N	U1	-	res8	-	Reserve

End of repetition

Remark [1]: Receiver GPS within weeks

rcvTow	The receiver time should be aligned with the GPS time system as much as possible. RcvTow, receiving within a week of using the receiver Machine week number week, leap second value leapS can convert time to other time systems. More about not Please refer to the RINEX3 document for information on the simultaneous system. When the receiver works in single GLONASS mode, The UTC time can be obtained by subtracting the leap second value leapS from the receiver time directly, without considering recStat Whether the flag in is valid.

Remark [2]: UTC leap second value

leapS	The leap second value between GPS time and UTC time. This value is the latest value known to the receiver. recStat The flag in indicates whether the value is valid.

Remark [3]: Receiver status

recStat	illustrate
BIT0	=1, it means the leap second value leapS is valid (UTC correction parameter is valid).
BIT1	=1, it means that a clock rest has occurred, and the receiver time has a jump of an integer of milliseconds.

Remark [4]: Carrier phase measurement value

cpMes	Use an approximate value to initialize the initial full-cycle ambiguity of the carrier phase so that the carrier phase measurement value Close to the pseudorange measurement value. The clock reset mechanism acts on both the pseudorange measurement value and the load The measured value of wave phase complies with the regulations of RINEX3.

Remark [5]: Satellite tracking status

trkStat	illustrate
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, which means the half-circle ambiguity is valid (inverted PI correction is valid)
BIT3	=1, which means that the half-cycle ambiguity is subtracted from the measured value of the carrier phase

2.9.2 RXM-SVPOS (0x03 0x11)

information	RXM - SVPOS				
describe	Satellite location information				
type	Cycle/query				
Annotation					
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	16+48*N	0x03 0x11	See the table below	4 Bytes

Payload content:

character Offset	data type	Proportion Zoom	name	unit	describe
0	R8	-	rcvTow	s	Receiver GPS within weeks (Note [1])
8	I2	-	wn	week	Receiver GPS week number (remark [1])
10	U1	-	numMeas	-	Number of measurement values, valid range 0~32
11	U1	-	res1	-	Reserve
12	I4	-	res2	-	Reserve
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 efficient
58+48*N	U1	-	gnssid	-	System type, 0=GPS, 1=BDS, 2=GLONASS
59+48*N	U1	-	res3	-	Reserve
60+48*N	U4	-	res4	-	Reserve
End of repetition					

Remark [1]: Receiver GPS within weeks

rcvTow/wn Refer to the meaning of rcvTow/wn in RXM-MEASX.

2.9.3 RXM-SENSOR (0x03 0x07)

information	RXM - SENSOR				
describe	Sensor information				
type	Cycle/query				
Annotation					
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	16+16*N	0x03 0x11	See the table below	4 Bytes

Payload content:

character Offset	data type	Proportion Zoom	name	unit	describe
0	R8	-	rcvTow	s	Receiver GPS within weeks (Note [1])
8	I2	-	wn	week	Receiver GPS week number (remark [1])
10	I1	-	leapS	s	Leap second time in current GPS system
11	U1	-	numMeas	-	Number of measured values (Note [2])
12	U1	-	recStat	-	Receiver status
13	U1	-	timeSrc	-	0-GPS time; 1-BDS time
14	U1	-	rcvrId	-	0
15	U1	-	res	-	Reserve
Start of repeated part (N=numMeas, valid range: 1/2/5/10/25/50 several discrete values)					
16+16*N	I2	1g/16384	accX	m/s/s	Accelerometer X-axis measurement value (Note [3])
18+16*N	I2	1g/16384	accY	m/s/s	Accelerometer Y-axis measurement value
20+16*N	I2	1g/16384	accZ	m/s/s	Accelerometer Z axis measurement value
22+16*N	I2	250/32768	gyroX	deg/s	Gyro X-axis measurement value (Note [4])
24+16*N	I2	250/32768	gyroY	deg/s	Gyro Y-axis measurement value
26+16*N	I2	250/32768	gyroZ	deg/s	Gyro Z-axis measurement value
28+16*N	I2	1/326.8	temp	℃	Thermometer measurement
30+16*N	I2	-	res	-	Reserve
End of repetition					

Remark [1]: Receiver GPS within weeks

rcvTow/wn	Refer to the meaning of rcvTow/wn in RXM-MEASX.

Remark [2]: Measured value data

numMeas	Configured by the CFG-MSG statement, numMeas is related to the rate in CFG-MSG. CFG-MSG In the statement, rate=0, RXM_SENSOR statement is not output; rate is equal to 1/2/5/10/25/50 One of the discrete values, each sentence has numMeas = rate group MEMS sampling data; No Then, numMeas=50. If the RXM_SENSOR statement is output, it will be output once every second.

Remark [3]: Accelerometer

acc	The acceleration measurement range is -2g~+2g.

Remark [4]: Gyroscope

gyro	The range of the gyroscope is -250deg/s~+250deg/s.

2.10 ACK (0x05)

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

2.10.1 ACK-NACK (0x05 0x00)

information	ACK-NACK					
describe	Responding to a message that was incorrectly received					
type	Reply					
Annotation						
information	head		Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE		4	0x05 0x00	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U1	-	clsID	-	Type of incorrectly received information
1	U1	-	msgID	-	The number of the message received incorrectly
2	U2	-	res	-	Reserve

2.10.2 ACK-ACK (0x05 0x01)

information	ACK-ACK					
describe	Respond to the information received correctly					
type	Reply					
Annotation						
information	head		Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE		4	0x05 0x01	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U1	-	clsID	-	Types of information received correctly
1	U1	-	msgID	-	The number of the correct received message
2	U2	-	res	-	Reserve

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)

information	CFG-PRT
describe	Query the working mode of UART, including two sentences UART0 and UART1. The current UART sentence will be output at the end
type	Inquire

Annotation

information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x00	0	4 Bytes

information	CFG-PRT
describe	Set the working mode of UART
type	Setting/response to query

Annotation

information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	8	0x06 0x00	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U1	-	portID	-	Port identification symbols (0 and 1 correspond to UART0 and UART1, 0xFF means the currently connected UART)
1	U1	-	protoMask	-	Protocol control mask, each port can support several protocols at the same time Discussion. Enable the protocol 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	describe
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	describe
[7:6]	00	5bits
	01	6bits
	10	7bits
	11	8bits
[11:9]	10x	No verification

	001	Odd parity

	000	Even parity
	x1x	Reserve
[13:12]	00	A stop bit
	01	1.5 stop bits
	10	Two stop bits
	11	Reserve

2.11.2 CFG-MSG (0x06 0x01)

information	CFG-MSG
describe	Check the frequency of sending all messages
type	Inquire

Annotation

information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x01	0	4 Bytes

information	CFG-MSG
describe	Set the frequency of sending messages
type	set up

Annotation

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U1	-	clsID	-	Information type
1	U1	-	msgID	-	Message number
2	U2	-	rate	-	Information sending frequency (remark [1])

Remark [1]: Frequency of sending information

Numerical value	describe
0	No output
1	Every time you locate, output once
2	Position twice, output once
N	N times of positioning, output once; In particular, when clsID=0x03, msgID=0x07, rate represents the configured RXM_SENSOR information The number of samples per second that the sensor outputs.
0xFFFF	Immediately output once, and only once, which is equivalent to query output

2.11.3 CFG-RST (0x06 0x02)

Message name CFG-RST

describe Restart the receiver/clear the saved data structure

type set up

Annotation

information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x02	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U2	-	navBbrMask	-	Clear battery-powered RAM. If a bit of the mask is set to 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 the field

Bit	describe
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

Numerical value	describe
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)

Remark [3]: Startup method

Numerical value	describe
0	Hot Start
1	Warm start
2	Cold start
3	Factory boot

2.11.4 CFG-TP (0x06 0x03)

information	CFG-TP				
describe	Query time pulse parameters				
type	Inquire				
Annotation					
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x03	0	4 Bytes

information	CFG-TP				
describe	Read/set time pulse parameters				
type	Read/set				
Annotation					
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	16	0x06 0x03	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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 (remarks [4)
12	R4	-	userDelay	s	User time delay

Remark [1]: Pulse enable flag

Value	describe
0	Off pulse
1	Enable pulse
2	The pulse is enabled and output continuously. When it cannot be positioned normally, the pulse update rate is automatically maintained
3	Output pulse during normal positioning, and no pulse when the receiver cannot be positioned normally

Remark [2]: Pulse polarity configuration

0	Rising edge
1	Falling edge

Remark [3]: Reference time

0	UTC time
1	Satellite time

Remark [4]: Satellite time source

Numerical value	describe
0	Mandatory single GPS time service
1	Mandatory single BDS timing
2	Mandatory single GLN timing
3	Reserve

4	Main BDS, when BDS is unavailable, 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 systems
7	Reserve
other	Automatic selection of timing system

2.11.5 CFG-RATE (0x06 0x04)

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

Message name	CFG-RATE				
describe	Set positioning interval				
type	set up				
Annotation	The receiver supports different navigation rates (the default rate is one update per second). The navigation rate will directly affect the power consumption, The faster the speed, the greater the burden on the CPU and communication				
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x04	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U2	-	interval	ms	Time interval between two positioning
2	U2	-	res	-	Reserve

2.11.6 CFG-CFG (0x06 0x05)

information	CFG- CFG				
describe	Clear, save and load configuration information				
type	Order				
Annotation					
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x05	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U2	-	mask	-	Mask of configuration information (Note [1])
2	U1	-	mode	-	Operation mode for configuration information (Note [2])
3	U1	-	res	-	Reserve

Remark [1]: Configure information mask

Bit	describe
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

Numerical value	describe
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
describe	Query timing mode
type	Inquire

Annotation

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

information	CFG-TMODE
describe	Read/set time service mode
type	Read/set

Annotation

information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	40	0x06 0x06	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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

Numerical value	describe
0	Autonomous positioning and simultaneous timing
1	After autonomously positioning for a period of time to obtain the user's position with sufficient accuracy, only use all available satellites to calculate the User clock parameters for time service. In this mode, when the user's position is fixed, a single satellite time service 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

2.11.8 CFG-NAVX (0x06 0x07)

Message name	CFG-NAVX				
describe	Query the professional configuration of the navigation engine				
type	Inquire				
Annotation	Query navigation related parameters				
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x07	0	4 Bytes

Message name	CFG-NAVX				
describe	Navigation engine professional configuration				
type	set up				
Annotation	Configure navigation related parameters				
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	44	0x06 0x07	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
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	-	Reserve
10	U1		iniFix3D		Initial positioning must be 3D positioning mark (0/1)
11	I1	-	minElev	°	Minimum elevation angle of GNSS satellite used 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	describe
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	Reserve
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

model	describe
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

model	describe
0	Reserve
1	2D positioning
2	3D positioning
3	2D/3D positioning automatic switching

Remark [4]: Navigation system enable

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

2.11.9 CFG-GROUP (0x06 0x08)

Message name	CFG-GROUP				
describe	Query the group delay of GLONASS				
type	Inquire				
Annotation					
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x08	0	4 Bytes

Message name	CFG-GROUP				
describe	Configure GLONASS group delay				
type	set up				
Annotation					
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	56	0x06 0x08	See the table below	4 Bytes

Payload content

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

2.11.10 CFG-INS (0x06 0x10)

Message name	CFG-INS				
describe	Query INS installation mode				
type	Inquire				
Annotation					
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	0	0x06 0x10	0	4 Bytes

Message name	CFG-INS				
describe	Configure INS installation mode				
type	set up				
Annotation					
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	4	0x06 0x10	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U2	-	attMode	-	The relative installation attitude mode of the module relative to the vehicle Configuration, possible value range: 0, 1, 2, 3. 0: The X axis of the module points to the front of the vehicle. 1: The X axis of the module points to the right of the vehicle. 2: The X axis of the module points to the rear of the vehicle. 3: The X axis of the module points to the left of the vehicle. 9: The relative attitude of the adaptive estimation module. The default is 9.
2	U2		ramStart	-	1: The dead reckoning function is enabled immediately after the backup power is turned on start 0: The dead reckoning function is off immediately after the backup power is turned on close Off by default

2.12 MSG (0x08)

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

2.12.1 MSG-BDSUTC (0x08 0x00)

information	MSG-BDSUTC				
describe	BDS fixed-point UTC data (synchronized parameters with UTC time)				
type	cycle				
Annotation					
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	20	0x08 0x00	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	res1	-	Reserve
4	I4	2^{-30}	a0UTC	s	BDT clock difference relative 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 A positive number
13	I1	-	dtlsf	s	After the new leap second takes effect, the cumulative leap second change of BDT relative to UTC A positive number
14	U1	-	res2	-	Reserve
15	U1	-	res3	-	Reserve
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	-	Reserve

Remark [1]: Information available sign

Numerical value	illustrate
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.12.2 MSG-BDSION (0x08 0x01)

information MSG-BDSION

describe BDS8 parameter fixed-point ionospheric data

type cycle

Annotation

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	res1	-	Reserve
4	I1	2^{-30}	alpha0	s	Ionospheric parameters
5	I1	2^{-27}	alpha1		Ionospheric parameters
6	I1	2^{-24}	alpha2		Ionospheric parameters
7	I1	2^{-24}	alpha3		Ionospheric parameters
8	I1	2^{11}	beta0	s	Ionospheric parameters
9	I1	2^{14}	beta1		Ionospheric parameters
10	I1	2^{16}	beta2		Ionospheric parameters
11	I1	2^{16}	beta3		Ionospheric parameters
12	U1	-	valid	-	Information available sign (remark [1])
13	U1	-	res2	-	Reserve
14	U2	-	res3	-	Reserve

Remark [1]: Information available sign

Numerical value	illustrate
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.12.3 MSG-BDSEPH (0x08 0x02)

information	MSG-BDSEPH				
describe	BDS Ephemeris				
type	cycle				
Annotation					
information structure	head	Length (bytes)	Identifier	Payload	Checksum
	0xBA 0xCE	92	0x08 0x02	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	res1	-	Reserve
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}			Argument of Perigee
16	I4	2^{-31}	M_0		Mean anomaly of reference time
20	I4	2^{-31}	i_0		Orbital inclination at reference time
twenty four	I4	2^{-31}	$_0$		Ascension of ascending node calculated by reference time
28	I4	2^{-43}			Ascension change rate of ascending node
32	I2	2^{-43}			The difference between the average speed of the satellite and the calculated value
34	I2	2^{-43}	IDOT		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 the orbital radius and the amplitude of the correction term
48	I4	2^{-6}	crs	m	The sine harmonic of the orbital 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	-	Reserve
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	-	Reserve

Remark [1]: Information available sign

Numerical value	illustrate
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.12.4 MSG-GPSUTC (0x08 0x05)

information	MSG-GPSUTC
describe	GPS fixed-point UTC data (synchronized parameters with UTC time)
type	cycle

Annotation

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	res1	-	Reserve
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	-	Reserve

Remark [1]: Information available sign

Numerical value	illustrate
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.12.5 MSG-GPSION (0x08 0x06)

information	MSG-GPSION				
describe	GPS ionospheric data				
type	cycle				
Annotation					

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	res1	-	Reserve
4	I1	2^{-30}	alpha0	s	Ionospheric parameters
5	I1	2^{-27}	alpha1		Ionospheric parameters
6	I1	2^{-24}	alpha2		Ionospheric parameters
7	I1	2^{-24}	alpha3		Ionospheric parameters
8	I1	2^{11}	beta0	s	Ionospheric parameters
9	I1	2^{14}	beta1		Ionospheric parameters
10	I1	2^{16}	beta2		Ionospheric parameters
11	I1	2^{16}	beta3		Ionospheric parameters
12	U1	-	valid	-	Information available sign (remark [1])
13	U1	-	res2	-	Reserve
14	U2	-	res3	-	Reserve

Remark [1]: Information available sign

Numerical value	illustrate
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.12.6 MSG-GPSEPH (0x08 0x07)

information RXM-GPSEPH

describe GPS ephemeris

type cycle

Annotation

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	res1	-	Reserve
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}			Argument of Perigee
16	I4	2^{-31}	M_0		Mean anomaly of reference time
20	I4	2^{-31}	i_0		Orbital inclination at reference time
twenty four	I4	2^{-31}	$_0$		Ascension of ascending node calculated by reference time
28	I4	2^{-43}			Ascension change rate of ascending node
32	I2	2^{-43}			The difference between the average speed of the satellite and the calculated value
34	I2	2^{-43}	IDOT		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 the orbital radius and the amplitude of the correction term
42	I2	2^{-5}	crs	m	The sine harmonic of the orbital 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	-	Reserve

Remark [1]: Information available sign

Numerical value	illustrate
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.12.7 MSG-GLNEPH (0x08 0x08)

information	RXM-GLNEPH
describe	GLONASS Ephemeris
type	cycle

Annotation

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	U4	-	res1	-	Reserve
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	-	Technical parameters of the control part
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	-	Reserve
66	U2	-	res3	-	Reserve

Remark [1]: Information available sign

Numerical value	illustrate
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.13 MON (0x0A)

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

2.13.1 MON-VER (0x0A 0x04)

information MON-VER

describe Version Information

type Respond to queries

Annotation

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

Payload content:

character Offset	data type	Proportion Zoom	name	unit	describe
0	CH[32]	-	swVersion	-	Software version string
32	CH[32]	-	hwVersion	-	Hardware version string

2.13.2 MON-HW (0x0A 0x09)

information MON-HW

describe Hardware status

type Cycle/query

Annotation Various configuration status of the hardware, including antenna status, IO port status, noise level, AGC information, etc.

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

Payload content:

character Offset	data type	Proportion Zoom	name	unit	describe
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	-	Reserve
20	U1	-	antStatus	-	Antenna status (remark [1])
twenty one	U1	-	res	-	Reserve
twenty two	U1	-	res	-	Reserve
twenty three	U1	-	res	-	Reserve
twenty four	U4[8]	2^24	jamming	-	Center frequency of interference signal (normalized)

Remark [1]: Antenna status

Numerical value	describe
0	Initialization process
1	Unknown status
2	normal
3	Short circuit
4	open circuit

2.14 AID (0x0B)

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

2.14.1 AID-INI (0x0B 0x01)

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

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
0	R8	-	ecefXOrLat	m or 1°	X coordinate or latitude in ECEF coordinate system: If it is the ECEF coordinate system, the unit is m; If it is latitude, the unit is degrees.
8	R8	-	ecefYOrLon	m or 1°	Y coordinate or longitude in ECEF coordinate system: If it is the ECEF coordinate system, the unit is m; If it is longitude, the unit is degrees.
16	R8	-	ecefZOrAlt	m	Y coordinate or height in ECEF coordinate system
twenty four	R8	-	tow	s	GPS time of the week
32	R4	300	freqBias	ppm	The clock frequency drifts. For example: FreqBias=300, which means crystal frequency deviation 1ppm; FreqBias=-150, which means crystal frequency deviation -0.5ppm;
36	R4	-	pAcc	m^2	Variance of the estimation error of the 3D position
40	R4	C^2	tAcc	s^2	The variance of the estimated error of time. For example: tAcc=9, which means the time error is sqrt(tAcc)/C=3/3e8=10ns
44	R4	300^2 fAcc		ppm^2	The variance of the clock frequency drift error. For example: fAcc=900, which means the time error is sqrt(fAcc)/300=30/300=0.1ppm
48	U4	-	res	-	Reserve
52	U2	-	wn	-	GPS weekday
54	U1	-	timeSource	-	Time source
55	U1	-	flags	-	Logo mask (remark [1])

Remark [1]: Logo mask

Bit	describe
B0	1=Position valid
B1	1=Time is valid
B2	1=The clock frequency drift data is valid

B3	Reserve
B4	1=The clock frequency data is valid
B5	1=Location is in LLA format
B6	1=Invalid height
B7	Reserve

2.14.2 AID-HUI (0x0B 0x03)

information	AID-HUI				
describe	Auxiliary health information, UTC parameters, ionospheric parameters				
type	enter				
Annotation	Configure navigation related parameters				
information	head	Length (bytes)	Identifier	Payload	Checksum
structure	0xBA 0xCE	60	0x0B 0x03	See the table below	4 Bytes

Payload content

character Offset	data type	Proportion Zoom	name	unit	describe
4	U4	-	HeaGps	-	Health information of GPS satellites (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 leap second
25	I1	-	utcGpsLSF	s	GPS time relative to UTC after the new leap second
26	U1	-	utcGpsTow	s	Reference time of the week for GPS UTC parameters
27	U1	-	utcGpsWNT	week	Reference week number of GPS UTC parameters
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 second jump takes effect
30	I2	-	Res	-	Reserve
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	Reference week number of UTC parameter of BDS
44	U1	-	utcBdsWNF	week	BDS new jump second effective weekday
45	U1	-	utcBdsDN	day	The number of days of the week when the new BDS jump second takes effect
46	I2	-	Res	-	Reserve
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	describe

B0	Health information is valid
B1	UTC parameters are valid
B2	Ionospheric parameters are valid