CASIC Multi-mode Satellite Navigation Receiver

Protocol Specification

V4.2.0.3
2020-01-06

Documentation	
Document NameCASIC Multimode Satellite Navigation Receiver Protocol Specification	
Document Summary: This document describes in detail the CASIC multi-mode satellite navigation receiver protocol specification, including the universal standard NMEA0183 protocol. protocol, and custom binary protocol.	
Version number V4.2.0.3	
Date	2020.01.06
Version Update	
V3.7.0.1	2017.07.21 Modified RXM-MEASX message to comply with RINEX302 standard.
V3.8.0.1	2017.12.06 Expanded the leap second information part (LPS) of the NMEA protocol; added NMEA-DHV and the corresponding protocol for NMEA-UTC sentences.
V3.9.0.0	2017.12.20 Added support and content for NMEA-GST sentences.
V4.0.0.0	2017.12.26 Added NMEA-LPS information content and updated some sentences.
V4.1.0.0	2018.3.26 Corrected the meaning of some binary protocol symbols and corrected some names.
V4.2.0.0	2018.11.14 Added NMEA-INS sentences and corresponding protocols of NAV=IMUATT message.
V4.2.0.1	2018.11.22 Corrected the typo.
V4.2.0.2	2019.05.14 Modified NMEA-INS sentences, CFG-INS.
V4.2.0.3	2020.01.06 Added PCAS60 statement and modified PCAS03 statement.

1 NMEA protocol

1.1 NMEA Protocol Characteristics

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 NMEA0183 V4.0 standard and standards before V2.3 by sending commands.

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

Data transmission method

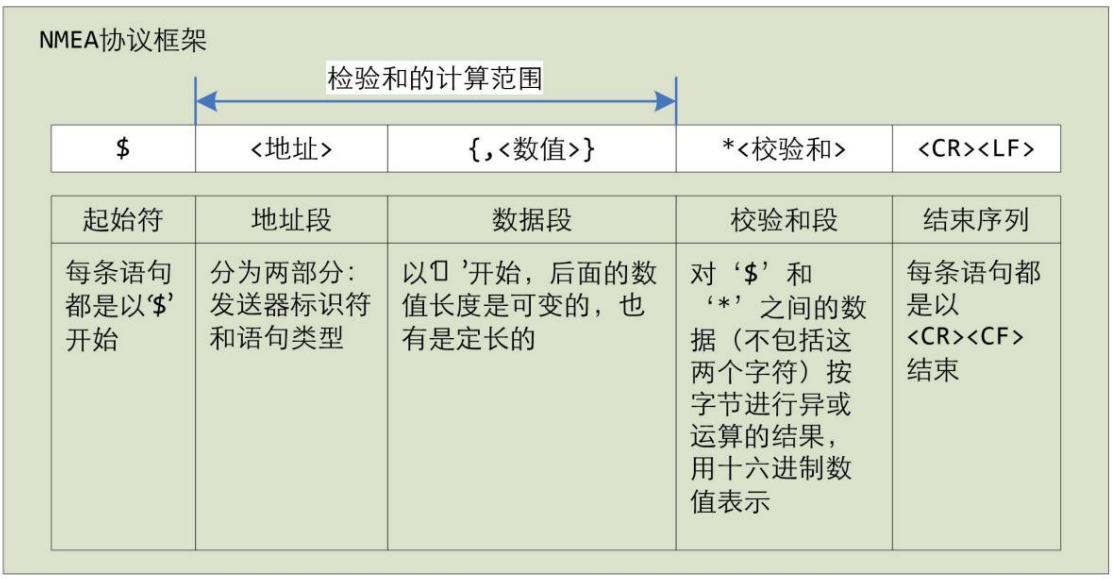
	Start bit D0 D1			D2 D3 D4 D5 D6 D7		Stop bit				

Parameters used for data transmission

Baud rate (bps) supports 4800, 9600, 19200, 38400, 57600, 115200	
Data bit	8-bit
Stop bit	1 bit
Parity bit	none

1.2 NMEA Protocol Framework

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



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

This receiver protocol specification adds custom statements based on the NMEA protocol framework to control the receiver. working mode, and query the receiver's product information, etc. The identifier of the custom statement is 'P'.

1.3 NMEA Identifiers and Field Types

1.3.1 Transmitter Identifier

NMEA sentences use transmitter identifiers to distinguish different GNSS modes. The transmitter identifiers are defined as follows:

Transmitter	Identifier
Beidou Navigation Satellite System	BD
(BDS) 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 NMEA	Satellite number identifier Satellite PRN number	Correspondence between satellite number 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

CASIC receivers support multiple NMEA data protocol formats. The differences between different protocols are reflected in the system identifier.

Newer versions of the protocol add some fields.

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

[1] Identifier: If only BD, GPS, GLONASS, Galileo and other satellites are used for position calculation, the transmission identifier is BD, GP, GL, GA, etc. If multiple systems of satellites are used to obtain position solutions, the transmission identifier is GN.

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

As mentioned in Section 1.1, the CASIC receiver supports three versions of the NMEA0183 protocol standard. These three standards are listed below:

The differences between them are as follows.

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

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

2) In the GGA statement, the position quality (FS) is set to 1 for both dead reckoning and normal positioning (in 2.3, the track

The calculation is set to 6).

NMEA 4.1 protocol adds some fields based on 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 NMEA sentence introduction in Section 1.5.

1.3.4 Field Type

Field Type	symbol	definition
Special Format Field		
state	A	Single character fields: A=Yes, the data is valid and the alarm flag is cleared; V = No, data is invalid, alarm flag is set.
latitude	ddmm.mmmm	Fixed/Variable Length Fields dd represents a fixed length of 2 degrees, and the mm before the decimal point represents Indicates a fixed length of 2, and the mmmm after the decimal point indicates Variable length decimal fraction.
longitude	dddmm.mmmm fixed/variable length field	ddd represents a fixed length of 3. mm before the decimal point indicates a fixed length of 2. The mmmm after the digit indicates a decimal point with a variable length.
time	hhmmss.sss	Fixed length field hh represents hours with a fixed length of 2, and mm represents a fixed length The ss before the decimal point indicates a fixed length of 2. Seconds. The sss after the decimal point indicates a fixed length of 3 fractional seconds.
Determine the		Some fields are defined for predefined constants.
field value field		
Variable	x.x	Variable length or floating point numeric fields
number fixed hexadecimal field hh___ Variable		Fixed-length hexadecimal number with the most significant digit on the left
hexadecimal field h--h Information field		Variable-length hexadecimal number with the most significant digit on the left
Fixed alphabetic field aa___ Fixed numeric		Fixed-length uppercase or lowercase alphabetic character field
field xx___ Variable text		Fixed-length numeric character field
	c--c	Variable length valid character field

1.4 NMEA Message Overview

Page message name		Class/ID	describe
NMEA standard messages			Standard Messages
	GGA	0x4E 0x00	Receiver positioning data
	GLL	0x4E 0x01	Geographic location - Latitude/Longitude
	GSA	0X4E 0x02	DOP and effective satellites
	GSV	0x4E 0x03	Visible satellites
	RMC	0x4E 0x04	Recommended minimum dedicated navigation data
	VTG	0x4E 0x05	Ground speed and heading
	GST	0x4E 0x07	Statistics of receiver pseudorange errors
	WHETHER	0x4E 0x08 0x4E	Time and Date
	ON	0x11	Antenna status
	LPS	0x4E 0x12 0x4E	Satellite system leap second correction information
	DHV	0x13	Receiver speed information
	UTC	0x4E 0x16	Receiver status, leap second correction simplified information
NMEA Custom Messages			Custom Message
	CAS00	·	Save configuration information
	CAS01	·	Communication protocol and serial port configuration information
	CAS02	·	Set the positioning update rate
	CAS03	·	Enable or disable output information and its frequency
	CAS04	·	Set the initialization system and number of channels
	CAS05	·	Set the transmitter identifier for NMEA sentences
	CAS06	·	Query module software and hardware information
	CAS10	·	Startup mode and auxiliary information configuration
	CAS12	·	Standby mode control
	CAS20	·	Online upgrade instructions

1.5 NMEA standard messages

1.5.1 GGA

InformationGGA			
Data describing the receiver's time, location, and positioning			
Type Output			
ÿÿ $--GGA,UTCtime,lat,uLat,lon,uLon,FS,numSv,HDOP,msl,uMsl,sep,uSep,diffAg e,diffSta*CS<CR><LF>			
Example$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 Current location UTC time	
3	years	ddmm.mmmm Latitude, the first two characters represent degrees, the following characters represent minutes	
4	uLat	character	Latitude direction: N-North, S-South
5	lon	dddmm.mmm m	Longitude, the first 3 characters represent degrees, the following characters represent minutes
6	uLon		Longitude direction: E-East, W-West
7	FS		Indicates the current positioning quality (Note [1]). This field should not be empty.
8	Character value numSv value		The number of satellites used for positioning, 00~24
9	HDOP numeric numeric character		Horizontal Dilution of Precision (HDOP)
10	msl	numeric	Altitude, that is, the height of the receiver antenna relative to the geoid
11	uMsl		Height unit, meter, fixed character M
12	sep		The distance between the reference ellipsoid and the geoid, "-" indicates the geoid The water level is below the reference ellipsoid
13	uSep character height unit, meter, fixed character M		
14	diffAge The data age of the numerical difference correction. This field is empty when DGPS is not used.		
15	diffSta Value Hexadecimal		The ID of the differential reference station
16	CS	checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
17	<CR><LF> characters		Carriage return and line feed
Note[1] Positioning quality mark			
Positioning quality mark		describe	
0		Location not available or invalid	
1		SPS positioning mode, positioning is effective	
6		Estimation Mode (Dead Reckoning) Only valid for NMEA 2.3 and above	

1.5.2 GLL

InformationGLL			
Describes information such as latitude, longitude, positioning time and positioning status.			
Type Output			
ÿÿ $--GLL,lat,uLat,lon,uLon, UTCtime,valid,mode*CS<CR><LF>			
Example$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	years	ddmm.mmmm Latitude, the first two characters represent degrees, the following characters represent minutes	
3	uLat	character	Latitude direction: N-North, S-South
4	lon	dddmm.mmm m	Longitude, the first 3 characters represent degrees, the following characters represent minutes
5	uLon		Longitude direction: E-East, W-West
6	UTCtime	Character hhmmss.sss Current location UTC time	
7	valid	Character Data Validity (Note [1])	
8	mode Character positioning mode (Note [2]), hexadecimal value checksum, XOR of all		Only NMEA and above versions are valid 2.3
9	CS	characters between $ and * (excluding $ and *) fruit	
10	<CR><LF> characters		Carriage return and line feed
Note [1] Data validity flag			
Positioning Quality Mark Description			
A		Data is valid	
V		Invalid data	
Note [2] Positioning mode flag			
Positioning mode flag		describe	
A		Autonomous Mode	
AND		Estimation Mode (Dead Reckoning)	
N		Invalid data	
D		Differential Mode	
M		Not located, but there is an external input or historically saved location	

1.5.3 GSA

Information GSA			
Describes the satellite number and DOP information used for positioning. Regardless of whether positioning or whether there are available satellites, GSA is output When the receiver is in multi-system joint operation, each system's available satellite corresponds to a GSA statement. Each GSA sentence contains the PDOP, HDOP, and VDOP based on the combined satellite system.			
Type Output			
ÿÿ $--GSA,smode,FS{,SVID},PDOP,HDOP,VDOP*CS<CR><LF>			
Example$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 smode character		Message ID, GSA statement header, '--' is the system identifier
2	number		Mode switching indication (Note [1])
3	FS		Positioning status flag (Note [2])
4	{,SVID} Value		The satellite number used for positioning. This field displays a total of 12 available satellites. If there are more than 12 pieces, only the first 12 pieces will be output. If there are less than 12 pieces, no Sufficient area filling
5	PDOP value		Position Dilution of Precision (PDOP)
6	HDOP value		Horizontal Dilution of Precision (HDOP)
7	VDOP value systemId value		Vertical Dilution of Precision (VDOP)
8			GNSS system ID number defined by NMEA (Note [3]) Only valid for NMEA 4.1 and above
9	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
10	<CR><LF> characters		Carriage return and line feed
Note [1] Mode switching indication			
Mode switching indication description			
M		Manual switch. Forced to 2D or 3D working mode	
A		Automatic switching. The receiver automatically switches between 2D/3D working modes	
Note [2] Positioning status flag			
Positioning status		describe	
1		Invalid targeting	
2		2D Positioning	
3		3D Positioning	
Note[3] GNSS system ID			
System ID		describe	
1		GPS system	
2		GLONASS system	
4		BDS System	

1.5.4 GSV

InformationGSV	
Describes the satellite number of the visible satellite and its elevation angle, azimuth angle, carrier-to-noise ratio and other information. The number of parameter groups is variable, with a maximum of 4 groups and a minimum of 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 numMsg character		Message ID, GSV statement header, '--' is the system identifier
2			Each GSV sentence can output up to 4 visible satellite signals. Therefore, when the system has more than 4 visible satellites, more GSV statements.
3	msgNo number numSv value		Current statement number
4			Total number of visible satellites
5	{,SVID,ele, value az,cn0}		In order: Satellite number; Elevation angle, the value range is 0~90, the unit is degree; Azimuth, the value range is 0~359, the unit is degree; The carrier-to-noise ratio ranges from 0 to 99, and the unit is dB-Hz. The current satellite is tracked and the space is filled
6	signalId value		GNSS signal ID defined by NMEA (0 represents all signals) Only valid for NMEA 4.1 and above
7	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
8	<CR><LF> characters		Carriage return and line feed

1.5.5 RMC

InformationRMC	
Describes the 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 Current location UTC time	
3	status	String position valid flag.	V = Receiver warning, invalid data A=Data is valid
4	years	ddmm.mmmm Latitude, the first two characters represent degrees, the following characters represent minutes	
5	uLat	character	Latitude direction: N-North, S-South
6	lon	dddmm.mmm m	Longitude, the first 3 characters represent degrees, the following characters represent minutes
7	uLon		Longitude direction: E-East, W-West
8	spd		Ground speed, in knots
9	planted	Character value value	True heading over ground, in degrees
10	date	ddmmyy	Date (dd for day, mm for month, yy for year)
11	mv	numeric	Magnetic declination, in degrees. Fixed to be empty
12	mvE		Magnetic declination direction: E-East, W-West. Fixed to empty
13	character mode character		Positioning mode flag (Note [1]) only *NMEA 2.3* Valid for versions above
14	navStatus character		Navigation status indicator (V means the system does not output navigation status information) Only valid for NMEA 4.1 and above
15	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
16	<CR><LF> characters		Carriage return and line feed

Note [1] Positioning mode flag

Positioning mode flag	describe
A	Autonomous Mode
AND	Estimation Mode (Dead Reckoning)
N	Invalid data
D	Differential Mode
M	Not located, but there is an external input or historically saved location

1.5.6 VTG

Information VTG			
Describes the ground speed and ground heading information.			
Type Output			
ÿÿ $--VTG,cogt,T,cogm,M,sog,N,kph,K,mode*CS<CR><LF>			
Example$GPVTG,75.20,T,,M,0.009,N,0.017,K,A*02			
Parameter Description			
Field Name		Format	Parameter Description
1	$--VTG string cogt numeric character		Message ID, VTG statement header, '--' is the system identifier
2	cogm numeric character numeric		Course relative to true north, in degrees
3	T		True north indication, fixed at T
4	character numeric character mode		Heading relative to magnetic north, in degrees
5	M	character	Magnetic north indication, fixed at M
6	healthy		Ground speed, in knots
7	N		Speed unit is knot, fixed as N
8	kph		Ground speed in kilometers per hour
9	K		Speed unit, kilometers per hour, fixed as K
10			Positioning mode flag (Note [1]) only *NMEA 2.3* Valid for versions above
11	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
12	<CR><LF> Characters Note [1]		Carriage return and line feed
Positioning mode flag			
Positioning mode flag		describe	
A		Autonomous Mode	
AND		Estimation Mode (Dead Reckoning)	
N		Invalid data	
D		Differential Mode	
M		Not located, but there is an external input or historically saved location	

1.5.7 IF

Information ZDA			
Describes time and date information.			
Type Output			
ÿÿ $--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 is a numerical day, fixed two digits, ranging from 01 to 31		
4	month is a numerical month, fixed two digits, ranging from 01 to 12		
5	year	Value	Year, fixed four digits
6	ltz	value The hour in this time zone. Not supported, fixed as 00	
7	ltzn		Minutes in this time zone are not supported and are fixed at 00
8	CS	Numeric hexadecimal checksum, the XOR of all characters between $ and * (excluding $ and *) fruit	
9	<CR><LF> characters		Carriage return and line feed

1.5.8 TXT

Product Information

Information TXT	
Describe product information	
Type output, output once when starting up	
Format $GPTXT,xx,yy,zz,info*hh<CR><LF>	
Example $GPTXT,01,01,02,MA=CASIC*27	Indicates the manufacturer's name (CASIC) $GPTXT,01,01,02,IC=ATGB03+ATGR201*71 Indicates the model of the chip or chipset (baseband chip model ATGB03, RF 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 at this startup (GB indicates the dual-mode mode of GPS+BDS) $GPTXT,01,01,02,CI=00000000*7A Indicates the customer number (the customer number is 00000000)

Parameter Description

Field Name		Format	Parameter Description
1	$GPTXT string value		Message ID, TXT header
2	xx		The total number of sentences in the current message is 01~99. If a message is too long, Need to be divided into multiple pieces of information display
3	yy	Numerical	Statement number 01~99
4	zz	Numerical	Text qualifier. 00=error message; 01=Warning message; 02=Notification information; 07=User information.
5	info		Text information
6	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
7	<CR><LF> characters		Carriage return and line feed

1.5.9 ANT

InformationANT	
Describe the 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 antenna status (short circuit)	

Parameter Description

Field Name		Format	Parameter Description
1	$GPTXT string value		Message ID, TXT header
2	xx		The total number of sentences in the current message is 01~99. If a message is too long, Needs to be displayed as multiple pieces of information, fixed as 01.
3	yy	Numerical	Statement numbers are 01~99, fixed at 01.
4	zz	Numerical	Text identifier. Fixed to 01.
5	info		Text information ANTENNA OPEN=Antenna open ANTENNA OK=Antenna OK ANTENNA SHORT=Antenna short circuit
6	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
7	<CR><LF> characters		Carriage return and line feed

1.5.10 DHV

Information DHV			
Details describing the receiver's speed			
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 statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss Current UTC time	
3	speed3D value value		Receiver 3D velocity, in m/s
4	spdY	spdX	Receiver ECEF-X axis speed, in m/s
5	value spdZ value gdspd		Receiver ECEF-Y axis speed, in m/s
6	value		Receiver ECEF-Z axis speed, in m/s
7			Receiver horizontal ground speed, in m/s
8	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
9	<CR><LF> characters		Carriage return and line feed

1.5.11 LPS (supported only by 5T)

Information LPS (supported only by 5T)	
Describe leap second information	
Type Output	
value $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 23:54:02, December 31, 2016 $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 timing. The current leap second is not equal to the leap second after the jump. It jumps from 17 seconds to 18 seconds, the leap second event occurs 358 seconds later (that is, 23:59:60 on December 31, 2016). The receiver GPS system has no satellites that give UTC parameter information abnormality alarms. Currently, there is no GPS week number abnormality. Alerting 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 but not used for timing. The current leap second is not equal to the leap second after the jump. It jumps from 3 seconds to 4 seconds. The leap second event occurs 358 seconds later (that is, at 23:59:60 on December 31, 2016). Note: The leap seconds of GPS and BeiDou are different because their time starting reference points are different. There is no satellite that gives an abnormal UTC parameter information alarm. There is currently no satellite that gives an abnormal Beidou week number alarm.	

Parameter Description

Field Name		Format	Parameter Description
1	$GPTXT string value		Message ID, TXT header
2	xx		The total number of sentences in the current message is 01~99. If a message is too long, Needs to be displayed as multiple pieces of information, fixed as 01.
3	yy	Numeric	Statement numbers are 01~99, fixed at 01.
4	zz	numeric	Text identifier. Fixed to 02.
5	LS=	string	Leap second message identifier, fixed characters.
6	system character		The system corresponding to the leap second information. 0=GPS 1 = BDS (Beidou)
7	valid	character	Leap second information valid flag. When multiple satellite systems are jointly positioned, only One of these systems is used for timing (calibration of 1PPS and UTC time) 0 = Leap second information is invalid 1 = Leap second information is valid, but the system is not used for timing 2 = Leap second information is invalid, but the system is already used for timing 3 = Leap second information is valid and the system is already used for timing
8	utcLS	Numeric	(Fields 8-15 are standard leap second 8 parameters, see Beidou or ICD document for GPS) The current leap second, in seconds. A positive number means the satellite time is ahead of UTC. Time. Output if leap second parameter is valid, otherwise empty.
9	utcLSF value		The predicted leap second (after the leap second event occurs), in seconds, with positive numbers representing

			Indicates that the satellite time is ahead of UTC time. Output when the leap second parameter is valid. Otherwise empty.
10	utcTOW value		The reference time of the UTC correction parameter, in units of 4096 seconds within the week. Output if leap second parameter is valid, otherwise empty.
11	utcWNT value		The reference time of the UTC correction parameter, week number, unit is week, modulo 256. Output if leap second parameter is valid, otherwise empty.
12	utcDN value		The time and day of the week at which the leap second occurs. For the GPS system, the valid value range is 1~7. For the BeiDou system, the valid value range is 1 to 6. 1 means the end of Sunday, 2 means the end of Monday, and so on. Push, 7 means the end of Saturday. Output if leap second parameter is valid, otherwise empty.
13	utcWNF value		The time when a leap second occurs, the number of weeks, in units of weeks, modulo 256. Output if the number is valid, otherwise empty.
14	utcA0 value		The time error between UTC time and satellite time (proportional factor 2^-30), The unit is seconds. Output if leap second parameter is valid, otherwise empty.
15	utcA1	Numeric	The rate of change of the time error between UTC time and satellite time (proportional factor 2^-50), in seconds/second. Output when leap second parameter is valid, otherwise Is empty.
16	leapDt value		The time interval between the time when the leap second event occurs and the current UTC time A positive number indicates that the leap second event will occur in the future. The leap second parameter is valid and Output if there is a leap second change (utcLsÿutcLsf), otherwise empty.
17	dateLsf	ddmmyy	The date corresponding to the predicted leap second occurrence time, in day/month/year format. Output when the seconds parameter is valid and there is a leap second change (utcLsÿutcLsf). Otherwise empty.
18	lsfExp	Hexadecimal value of the leap second correction time abnormality alarm of the current satellite system.	The hexadecimal value represents the relevant information of the 32 satellites in the system. The lowest to highest bits are satellites 1 to 32. 0=There is no abnormality in the leap second correction information of this satellite. 1=The leap second correction information of this satellite is abnormal. If the leap second time in the information is not the empirical time (June 30 or December 31), the receiver will give an abnormal message, but will follow the change The leap second parameter is valid and there is an exception. Output if yes, otherwise empty.
19	wnExp	Hexadecimal value of the current satellite system time week abnormal alarm (year skip alarm).	The hexadecimal value of the bit represents the relevant information of the 32 satellites in the system. From the lowest to the highest, they are satellites 1 to 32. 0 = The satellite cycle is normal, no alarm 1 = The satellite's rotation 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 the time is changed, the value is negative; otherwise, it is positive. The unit is the number of weeks. Output when there is an exception in the time. Otherwise, it is empty.
21	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	

			fruit
22	<CR><LF> characters		Carriage return and line feed

1.5.12 UTC (supported only by 5T)

Information UTC (only supported by 5T)	
Describes the receiver status, leap second correction simplified information	
Type Output	
Type $--UTC,UTCtime,lat,uLat,lon,uLon,FS,numAnswer,HDOP,hgt,uMsl,date,antSta,time Src,leapValid,dtLs,dtLsf,leapTime*CS<CR><LF>	
Example$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 location in the format of hours/minutes/seconds.
3	years	ddmm.mmmm Latitude, the first two characters represent degrees, the following characters represent minutes	
4	uLat	Character	Latitude direction: N-North, S-South
5	lon	dddmm.mmmm m	Longitude, the first 3 characters represent degrees, the following characters represent minutes
6	uLon		Longitude direction: E-East, W-West
7	FS		Indicates the current positioning quality (Note [1]). This field should not be empty.
8	Character value numSv value		The number of satellites used for positioning, 00~24
9	HDOP value hgt value character		Horizontal Dilution of Precision (HDOP)
10	ddmmyy antSta value		high
11	uMsl		Height unit, meter, fixed character M
12	date		Current positioning date in the format of day/month/year.
13			Antenna Status: 0 = Antenna open circuit 2 = Antenna is normal 3 = Antenna short circuit
14	timeSrc value		Current timing source system: 0=GPS system 1=BDS system
15	leapValid value		Leap second correction value validity flag: 0 = No valid leap second value 1 = leap second value is valid
16	utcLs		The leap second correction value for the current time
17	ValueutcLsf Value		If a leap second is predicted to occur (utcLsÿ utcLsf), indicating the predicted new leap second correction value. After the leap second is generated, the value will continue to be output until a correction is received with no leap second forecast. Positive information so far. If an unforeseen leap second occurs (the received leap second correction information contains dtls

			Equal to dtlsf), this field is empty
18	leapTime mmyy		If a leap second is predicted to occur (utcLsÿ utcLsf), which indicates the predicted time of the leap second. After the event occurs, the value will continue to be output until a non-leap second prediction is received. Until the revised information is reported. If there is no leap second forecast (the received leap second correction information contains dtls and dtlsf), this field is empty. The format is month/year.
19	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
20	<CR><LF> characters		Carriage return and line feed

Note[1] Positioning quality mark	
Positioning quality mark	describe
0	Location not available or invalid
1	Standard positioning mode, positioning is effective
6	Estimation Mode

1.5.13 GST

Information GST	
Describes the measurement accuracy details of the receiver pseudorange	
Type Output	
ÿÿ $--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 statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss Current UTC time	
3	RMS	The RMS value of the standard deviation of the receiver pseudorange error during numerical positioning, in meters	
4	stdDevMaj The standard deviation of the position of the numerical receiver ellipse in the direction of the semi-major axis. Not supported		
5	stdfDevMin The position standard deviation of the semi-minor axis of the numerical receiver ellipse. Not supported		
6	orientation The orientation of the semi-major axis of the numerical receiver ellipse. Not supported		
7	stdLat The standard deviation of the receiver's latitude error, in meters		
8	stdLon is the standard deviation of the receiver longitude error, in meters		
9	stdAlt	Standard deviation of the numerical receiver altitude error, in meters	
10	CS	Hexadecimal checksum, XOR result of all characters between $ and * (excluding $ and *)	
11	<CR><LF> characters		Carriage return and line feed

1.5.14 INS (supported by 5S series only)

Information INS (supported only by 5S series)	
Describes 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, the module package X-axis needs to be installed only on the left side of the vehicle; m=5, the module currently outputs RXM_SENSOR statements, each of which contains 5 sets of MEMS sampling data; n=0, the integrated navigation filter has not converged.	

Parameter Description

Field Name		Format	Parameter Description
1	$GPTXT string value		Message ID, TXT header
2	xx		The total number of sentences in the current message is 01~99. If a message is too long, Needs to be displayed as multiple pieces of information, fixed as 01.
3	yy	Numerical	Statement numbers are 01~99, fixed at 01.
4	zz	Numerical	Text qualifier.
5	INS_INF string		Fixed to INS_INF, for INS information flag.
6	sensorID valueattMode value		The sensor type used by the current module: 1 or 2.
7			The module's relative installation posture to the vehicle. Possible values Range: 0, 1, 2, 3. 0: The module's X axis points to the front of the vehicle. 1: The module's X axis points to the right of the vehicle. 2: The module's X axis points to the rear of the vehicle. 3: The module's X axis points to the left of the vehicle. 9: Adaptive estimation module relative pose.
8	fs	Numeric	Used only to output internal MEMS raw data The number of samples in the RXM_SENSOR statement. Value range: 0, 1, 2ÿ5ÿ10ÿ25ÿ50ÿ 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 per second. One statement contains m groups of MEMS sensor sampling data.
9	status	Numeric	Used to display the convergence status of the integrated navigation filter. n=2 means convergence Contain.
10	sesorOK value		-
11	RAM	String	Fixed to RAM
	ramStart value		1: Dead reckoning is enabled immediately after powering on with backup power 0: Dead reckoning is disabled immediately upon power-up with backup power

			Default off
6	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
7	<CR><LF> characters		Carriage return and line feed

1.6 NMEA Custom Messages

1.6.1 CAS00

Information CAS00			
Description Save the current configuration information to FLASH. Even if the receiver is completely powered off, the information in FLASH will not be lost.			
Type Input			
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 checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
3	<CR><LF> characters		Carriage return and line feed

1.6.2 CAS01

Information CAS01			
Description Set the serial communication baud rate.			
Type Input			
Format $PCAS01,br*CS<CR><LF>			
Example $PCAS01,1*1D			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS01 string number		Message ID, sentence header
2	br		Baud rate configuration. 0=4800bps 1=9600bps 2=19200bps 3=38400bps 4=57600bps 5=115200bps
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
4	<CR><LF> characters		Carriage return and line feed

1.6.3 CAS02

Information CAS02			
Description Sets the positioning update rate.			
Type Input			
Format $PCAS02,fixInt*CS<CR><LF>			
Example $PCAS02,1000*2E			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS02 string value		Message ID, sentence header
2	fixInt		Positioning update interval, in ms. 1000 = Update rate is 1Hz, outputting 1 positioning point per second 500 = Update rate 2Hz, output 2 positioning points per second 250 = Update rate is 4 Hz, outputting 4 positioning points per second 200 = Update rate is 5 Hz, output 5 positioning points per second 100 = Update rate is 10 Hz, outputting 10 positioning points per second
3	CS	Hexadecimal checksum, XOR result of all characters between $ and * (excluding $ and *)	
4	<CR><LF> characters		Carriage return and line feed

1.6.4 CAS03

Information CAS03	
Description Sets the NMEA sentence that requests output or stops output.	
Type Input	
ÿÿ $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 nGGA value		Message ID, sentence header
2			GGA output frequency, statement output frequency is based on positioning update rate n (0~9) means output once every n positioning times, 0 means no output If this statement is left blank, the original configuration will be retained.
3	nGLL	value	GLL output frequency, same as nGGA
4	nGSA	value	GSA output frequency, same as nGGA
5	nGSV	value	GSV output frequency, same as nGGA
6	nRMC value value value value		RMC output frequency, same as nGGA
7	nVTG	value	VTG output frequency, same as nGGA
8	nZDA	value	ZDA output frequency, same as nGGA
9	nANT	value	ANT output frequency, same as nGGA
10	nDHV	value	DHV output frequency, same as nGGA
11	nLPS	value	LPS output frequency, same as nGGA
12	res1	value	reserve
13	res2	value	reserve
14	nUTC	value	UTC output frequency, same as nGGA
15	nGST	value	GST output frequency, same as nGST
16	res3	value	reserve
17	res4	value	reserve
18	res5	value	reserve
19	nTIM	value	TIM (PCAS60) output frequency, same as nGGA
20	CS	value Hexadecimal value	checksum, XOR result of all characters between $ and * (excluding $ and *)
21	<CR><LF> characters		Carriage return and line feed

1.6.5 CAS04

Information CAS04			
Describes configuring a working system.			
Type Input			
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 mode number		Message ID, sentence header
2			Working system configuration. For specific product models, the following parts are supported Configuration. 1=GPS 2=BDS 3=GPS+BDS 4=GLONASS 5=GPS+GLONASS 6=BDS+GLONASS 7=GPS+BDS+GLONASS
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
4	<CR><LF> characters		Carriage return and line feed

1.6.6 CAS05

Information CAS05			
Description Set NMEA protocol type selection. There are many protocol types for multi-mode navigation receivers, and the data protocol standards are also More, this receiver product can support multiple protocol types input (Optional configuration)»			
Format $PCAS05,ver*CS<CR><LF>			
Example $PCAS05,1*19			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS05 string mode number		Message ID, sentence header
2			NMEA protocol type selection (Note [1])
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
4	<CR><LF> characters		Carriage return and line feed
Note [1] NMEA protocol type selection			
2	Compatible with NMEA 4.1 and above		
5	Compatible with BDS/GPS dual-mode protocol of China Transportation Information Center, compatible with NMEA 2.3 and above, compatible with NMEA4.0 Protocol		
9	Compatible with single GPS NMEA0183 protocol, compatible with NMEA 2.2 version		

1.6.7 CAS06

Information CAS06	
Description Query product information	
Type Input	
Format $PCAS06,info*CS<CR><LF>	
Example $PCAS06,0*1B	

Parameter Description

Field Name		Format	Parameter Description
1	$PCAS06 string number		Message ID, sentence header
2	info		Query the product information type. For information content, refer to 1.5.8. 0=Query the 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 checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
4	<CR><LF> characters		Carriage return and line feed

1.6.8 CAS10

Information CAS10			
Description Receiver Restart			
Type Input			
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 number		Message ID, sentence header
2	rs		Boot mode configuration. 0 = Warm start. No initialization information is used, and all The data is valid. 1 = Warm start. Do not use initialization information and clear ephemeris. 2 = Cold start. No initialization information is used, and all the All data except configuration. 3 = Factory Reset. Clear all data in the memory and reset the receiver. to the factory default configuration.
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
4	<CR><LF> characters		Carriage return and line feed

1.6.9 CAS12

Information CAS12			
Describe the receiver standby mode control 5L The low power module supports this command			
Type Input			
Format $PCAS12,stdbysec*CS<CR><LF>			
Example: $PCAS12,60*28 The receiver enters standby mode and automatically powers on after 60 seconds.			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS12 string stdbysec value		Message ID, sentence header
2			The time the receiver enters standby mode, maximum 65535 seconds
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
4	<CR><LF> characters		Carriage return and line feed

1.6.10 CAS20

Information CAS20			
Describe online upgrade instructions			
Type Input			
Format $PCAS20*CS<CR><LF>			
Example $PCAS20*03			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS20 string		Message ID, sentence header
2	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
3	<CR><LF> characters		Carriage return and line feed

1.6.11 CAS15

Information CAS15	
Describes the satellite system control instructions, which can configure whether to receive any satellite in the system V5200 Subsequent versions support this command	
Type Input	
ÿÿ $PCAS15,X,YYYYYYYY*CS<CR><LF>	
Example: $PCAS15,2,FFFFFFFF*37, turn on Beidou satellites 1-32 $PCAS15,2,FFFFFFE0*42, turn on BeiDou satellites 6-32 and turn off BeiDou satellites 1-5 $PCAS15,4,FFFF*31, turn on SBAS satellites 1-16, i.e. PRN=120-135 $PCAS15,5,1F*47, turn on QZSS satellites 1-5, i.e. PRN=193, 194, 195, 199, 197	

Parameter Description

Field Name		Format	Parameter Description
1	$PCAS15 string		Message ID, sentence header
2	SYS_ID 1 number		2 = BeiDou 1-32 satellites 3 = BeiDou 33-64 satellites 4 = SBAS satellite (SBAS satellites 1-19, corresponding to PRN 120-138 Number) 5 = QZSS satellite (QZSS satellites 1-5, corresponding to PRN 193, 194, 195, 199, 197)
3	SV_MASK 1 to 8 hexadecimal	Numeric	Each hexadecimal character controls 4 satellites, the rightmost one controls 1-4 Satellite No. Hexadecimal characters are converted to 4-bit binary, with each bit corresponding to one satellite. Satellite, 1 = receive the satellite; 0 = disable. For example: 3FFFFFE0 means prohibiting satellites 31, 32, 1-5.
4	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
5	<CR><LF> characters		Carriage return and line feed

1.6.12 CAS60

Information CAS60	
Describes the receiver time information. 5T-V5202 modules Subsequent versions support 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 The current UTC time. If leapsValid is 0, then Default leaps calculation	
3	ddmmyyy and	Numeric	Current date, month, and year
4	wn	Numeric	GPS system week number
5	tow	Numeric	GPS system week second
6	timeValid value		Time validity (2/3/4/5 fields), 1=valid, 0=invalid
7	leaps value		The difference between GPS time and UTC time, the number of leap seconds
8	leapsValid value		Leap seconds validity, 1=valid, 0=invalid
9	CS	Hexadecimal checksum, $ and result Between (excluding $ and) XOR of all characters	
10		character	Carriage return and line feed

2 CASIC Protocol

2.1 CASIC Protocol Features

CASIC receiver uses a custom standard interface protocol (CSIP, CASIC Standard Interface Protocol)
Send data to the host 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 Class	Message Number	Payload	Checksum
0xBA,0xCE	Short Integer 2 bytes	Bytes 1	1 Bytes < 2k bytes	Unsigned	Unsigned integer 4 bytes

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

Four hexadecimal characters serve as the message start delimiter (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)

It occupies one byte and indicates the basic subset to which the current message belongs.

Field 4: Message ID (id)

The message class is followed by a one-byte message number.

Field 5: Payload

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

Field 6: Checksum (ckSum)

The checksum is the word-by-word (1 word consists of 4
bytes) and occupies 4 bytes.

The calculation of the checksum 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, payload contains all the information of field 5. During the calculation process, firstly, the part from field 2 to field 4 is
Assemble (4 bytes form a word), and then put the data in field 5 in groups of 4 bytes (the first received is in the low order)
To add up.

2.3 CASIC Type and Number

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

Name Type Description	
NAV 0x01 Navigation result: position, speed, time	
TIM	0x02 Timing message: time pulse output, time stamp result
RXM 0x03 Measurement information output by the receiver (pseudorange, carrier phase, etc.)	
ACK 0x05	ACK/NAK message: response message to CFG message
CFG 0x06 Input 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 message: ephemeris, almanac and other A-GPS data

2.4 CASIC Payload Definition Rules

2.4.1 Data Encapsulation

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

The data in the message is closely arranged, with 2-byte values placed at offset addresses that are multiples of 2 and 4-byte values placed at offset addresses that are multiples 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-PPSÿ

2.4.3 Data Types

Unless otherwise specified, all multi-character values are in little-endian format. All floating-point values are in IEEE 754 format.

Single and double precision standard transfers.

Abbreviated type U1	Bytes Notes	
unsigned char	1	
I1 signed char	1	Complement
U2 unsigned short integer I2 signed	2	
short integer U4 unsigned long	2	Complement
integer I4 signed long integer	4	
IEEE754 single precision	4	Complement
R4	4	
R8	IEEE754 double precision	8

2.5 CASIC Message Interaction

Defines the mechanism for input and output of receiver messages. When the receiver receives a CFG type message, it needs to The receiver responds with an ACK-ACK or ACK-NACK message to check whether the message is processed correctly.
CFG message, the sender shall not send a second CFG message. The receiver does not need to reply to other messages received.

2.6 CASIC Message Overview

Page message name	Class/ID	Length	Type	Description
Class NAV				NAV Navigation Results
	NAV-STATUS	0x01 0x00	80	Periodic receiver navigation status
	NAV-DOP	0x01 0x01	28	Cyclic geometric dilution of precision
	NAV-SOL	0x01 0x02	72	Cycle-simplified PVT navigation information
	NAV-PV	0x01 0x03	80	Periodic position and velocity information
	NAV-TIMEUTC	0x01 0x10	24	cycle UTC time information
	NAV-CLOCK	0x01 0x11	64	Periodic clock resolution information
	NAV-GPSINFO	0x01 0x20	8+12*N	cycle GPS satellite information
	NAV-BDSINFO	0x01 0x21	8+12*N	cycles BDS satellite information
	NAV-GLNINFO	0x01 0x22	8+12*N	cycles GLONASS satellite information
Class TIM				TIM Time Message
	TIM-TP	0x02 0x00	24	Periodic timing pulse information
Class RXM				RXM Receiver measurement information
	RXM-MEASX	0x03 0x10	16+32*N	periodic pseudorange, carrier phase raw measurement information
	RXM-SVPOS	0x03 0x11	16+48*N	period satellite position information
Class ACK				ACK/NACK Message
	ACK-NACK	0x05 0x00	4	The reply message indicates that the message was not received correctly.
	ACK-ACK	0x05 0x01	4	The reply message indicates that the message has been received correctly.
Class CFG				CFG Input configuration message
	CFG-PRT	0x06 0x00	0/8	Query/Set Query/Configure the UART working mode
	CFG-MSG	0x06 0x01	0/4	Query/Set query/configure information sending frequency
	CFG-RST	0x06 0x02	4	Set to restart the receiver/clear the saved data structure
	CFG-TP	0x06 0x03	0/16	Query/Set Query/Configure the receiver PPS related parameters
	CFG-RATE	0x06 0x04	0/4	Query/Set Query/Configure the navigation speed of the receiver
	CFG-CFG	0x06 0x05	4	Set up clearing, saving, and loading of configuration information
	CFG-TMODE	0x06 0x06	0/28	Query/Set Query/Configure the receiver PPS timing mode
	CFG-NAVX	0x06 0x07	0/44	Query/Set Query/Professional Configuration Navigation Engine Parameters
	CFG-GROUP	0x06 0x08	0/56	Query/SetQuery/Configure GLONASS group delay parameters
Class MSG				MSG Receiver satellite message information
	MSG-BDSUTC	0x08 0x00	20	The receiver periodically outputs the BDS system UTC information.
	MSG-BDSION	0x08 0x01	16	The periodic receiver outputs the BDS system ionospheric information.
	MSG-BDSEPH	0x08 0x02	92	The receiver periodically outputs BDS system ephemeris information.
	MSG-GPSUTC	0x08 0x05	20	The receiver periodically outputs the GPS system UTC information.
	MSG-GPSION	0x08 0x06	16	The periodic receiver outputs GPS system ionospheric information.
	MSG-GPSEPH	0x08 0x07	72	The receiver periodically outputs GPS system ephemeris information.
	MSG-GLNEPH	0x08 0x08	68	The receiver periodically outputs the GLN system ephemeris information.
Class MON				MON Monitoring Messages
	MY-VER	0x0A 0x04	64	Respond to query output version information

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

2.7 NAVÿ0x01ÿ

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

2.7.1 NAV-STATUSÿ0x01 0x00ÿ

Information NAV-STATUS					
Describes the receiver navigation status					
Type Cycle/Query					
information	head	Length (bytes) Identifier 0x01 0x00 See		Payload Checksum	
structure	0xBA 0xCE	80	the table below 4 Bytes		

Payload Content					
character Offset	data type	Proportion Zoom	name	one Bit	describe
0	U4	-	runTime	ms Run time from power on/reset	
4	U2	-	fixInterval	ms positioning interval	
6	U1	-	posValid	- Positioning mark (Note [1])	
7	U1	-	wellValid	- Speed sign (Note [2])	
8	U1*32 -		gpsMsgFlag	-	Validity of almanac and ephemeris messages for 32 GPS satellites Flag (Note [3])
40	U1*24 -		glnMsgFlag	-	Almanac and ephemeris messages from 24 GLONASS satellites Validity flag (Note [3])
64	U1*14 -		bdsMsgFlag	-	Validity of almanac and ephemeris messages for 14 BDS satellites Flag (Note [3])
78	U1		gpsUtcionFlag -		GPS UTC and ionospheric information message validity mark Zhi (Note [4])
79	U1	-	bdsUtcionFlag -		BDS UTC and ionospheric information message validity mark Zhi (Note [4])

Note[1]: Positioning mark	
Numerical description	
0 Invalid positioning	
1	External input position
2	Rough estimate of location
3	Keep the last positioning position
4	Dead Reckoning
5	Fast mode positioning
6	2D Positioning
7	3D Positioning
8	GNSS+DR integrated navigation

Note [2]: Speed sign	
Numerical description	
0	Invalid speed

1	External input speed
2	Rough estimate of speed
3	Keep the last speed
4	Speed deduction
5	Fast mode speed
6	2D Speed
7	3D Speed
8	Speed of GNSS+DR integrated navigation
Note [3]: Message validity flag The upper 4 bits represent the validity flag of the almanac message, and the lower 4 bits represent the validity flag of the ephemeris message.	
Numerical description	
0 Missing	
1	Unhealthy
2	Expired
3	efficient
Note [4]: Message validity flag The upper 4 bits indicate the validity flag of the UTC parameter message, and the lower 4 bits indicate the validity flag of the ionospheric parameter message.	
Numerical description	
0 Missing	
1	Unhealthy
2	Expired
3	efficient

2.7.2 NAV-DOPÿ0x01 0x01ÿ

Information NAV-DOP					
Describe the Dilution of Precision					
Type Cycle/Query					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	28	0x01 0x01	See the table below	4 Bytes

Payload content				
character Offset	data type	Proportion Zoom	name	Unit Description
0	U4		runtime	ms Run time from power on/reset
4	R4		pDop	- Position DOP
8	R4		hDop	- Horizontal DOP
12	R4		vDop	- Vertical DOP
16	R4		nDop	- Northbound DOP
20	R4		eDop	- Eastbound DOP
24	R4		tDop	- Time DOP

2.7.3 NAV-SOLÿ0x01 0x02ÿ

Information NAV-SOL					
Describes PVT navigation information in the ECEF coordinate system					
Type Cycle/Query					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	72	0x01 0x02	See the table below 4	Bytes

Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4		runTime	ms	Running time from power on/reset
4	U1		posValid		Positioning mark (Note [1])
5	U1		velValid timeSrc		Speed sign (Note [2])
6	U1				Time source (Note [3])
7	U1		system		The receiver's multimode receive mode mask (Note [4])
8	U1		numSV		The total number of satellites involved in the solution
9	U1		numSVGPS -		The number of GPS satellites involved in the solution
10	U1		numSVBDS -		Number of BDS satellites involved in the solution
11	U1		numSVGLN -		Number of GLONASS satellites involved in the solution
12	U2		res		reserve
14	U2		week		Week
16	R8		tow	s	Weekly time
24	R8		ecefX	m	X coordinate in ECEF coordinate system
32	R8		ecefY	m	Y coordinate in ECEF coordinate system
40	R8		ecefZ	m	Z coordinate in ECEF coordinate system
48	R4		pAcc	M^2	Variance of the estimated accuracy error of the 3D position
52	R4		ecefVX	m/s	X velocity in ECEF coordinate system
56	R4		ecefVY	m/s	Y velocity in ECEF coordinate system
60	R4		ecefVZ	m/s	Z velocity in ECEF coordinate system
64	R4		sAcc	(m/s)^2	Variance of the estimated accuracy error of the 3D velocity
68	R4		pDop		Position DOP

Note[1]: Positioning mark	
Numerical description	
0	Invalid targeting
1	External input position
2	Rough estimate of location
3	Keep the last positioning position
4	Dead Reckoning
5	Fast mode positioning
6	2D Positioning
7	3D Positioning
8	GNSS+DR integrated navigation

Note [2]: Speed sign	
Numerical description	

0	Invalid speed
1	External input speed
2	Rough estimate of speed
3	Keep the last speed
4	Speed deduction
5	Fast mode speed
6	2D Speed
7	3D Speed
8	Speed of GNSS+DR integrated navigation
Note [3]: Time source	
Time source description	
0	GPS timing, that is, the time of week and day of the week are the local time of the receiver obtained from the GPS satellites
1	BDS
2	GLONASS
Note [4]: Multi-mode receiving mode	
Bit Description	
B0	1 = GPS satellites are used for positioning
B1	1=BDS satellite is used for positioning
B2	1 = GLONASS satellites are used for positioning

2.7.4 NAV-PVÿ0x01 0x03ÿ

Information NAV-PV					
Describe the position and velocity information in the geodetic coordinate system					
Type Cycle/Query					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE 80 Payload content		0x01 0x03	See the table below 4	Bytes

character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4	-	runTime	ms	Running time from power on/reset
4	U1	-	posValid	-	Positioning mark (refer to 2.7.3 Note [1])
5	U1		wellValid	-	Speed mark (refer to 2.7.3 Note [2])
6	U1	-	system	-	The receiver's multimode receive mode mask (See 2.7.3 Note [4])
7	U1	-	numSV	-	The total number of satellites involved in the solution
8	U1	-	numSVGPS -		The number of GPS satellites involved in the solution
9	U1	-	numSVBDS -		Number of BDS satellites involved in the solution
10	U1	-	numSVGLN -		Number of GLONASS satellites involved in the solution
11	U1	-	res	-	reserve
12	R4	-	pDop lon	-	Position DOP
16	R8	-		°	longitude
24	R8	-	years	°	latitude
32	R4	-	height	m	Geodetic height (referenced to the ellipsoid)
36	R4	-	sepGeoid m hAcc		Height anomaly (the difference between earth height and sea level)
40	R4	-		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 velocity in ENU coordinate system
52	R4	-	very	m/s	Eastward velocity in ENU coordinate system
56	R4	-	very very	m/s	Celestial velocity in ENU coordinate system
60	R4	-	speed3D	m/s	3D Speed
64	R4	-	speed2D heading	m/s	2D Ground Speed
68	R4	-	sAcc	°	course
72	R4	-		(m/s)^2 Variance of the accuracy error of ground speed	
76	R4	-	cAcc	°^2 Variance of heading accuracy error (variance of heading)	

2.7.5 NAV-TIMEUTCÿ0x01 0x10ÿ

INFORMATION NAV-TIMEUTC					
Describe UTC time information					
Type Cycle/Query					
information	head	Length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	24	0x01 0x10 See the table below 4 Bytes		

Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
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 to 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 ÿ(1~12)	
17	U1	-	day	day	UTC day of the month (1 to 31)
18	U1	-	hour	hour	UTC hour of the day (0~23)
19	U1	-	min	min	UTC time and minutes (0~59)
20	U1	-	sec	s	UTC minutes and seconds (0~59)
21	U1	-	valid	-	Time validity flag (Note [1])
22	U1	-	timeSrc	-	Timing system flag (Note [2])
23	U1	-	dateValid -		Date validity flag (Note [3])

Note [1]: Time validity flag	
Numerical description	
B0	UTC week validity flag, 0 = invalid, 1 = valid
B1	UTC week number validity flag, 0 = invalid, 1 = valid
B2	UTC leap second correction validity flag, 0 = invalid, 1 = valid

Note[2]: Timing system flag	
Numerical description	
0	GPS Timing
1	BDS Timing
2	GLONASS timing

Note [3]: Date validity flag	
Numerical description	
0	Invalid date
1	External input date
2	Get date from satellite
3	Get reliable dates from multiple satellites

2.7.6 NAV-CLOCKÿ0x01 0x11ÿ

Information NAV-CLOCK					
Describe clock solution information					
Type Cycle/Query					
information	head	Length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	64	0x01 0x11 See the table below 4 Bytes		

Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4	-	runTime ms Run time from power on/reset		
4	R4	1/c 1/	freqBias Clock drift (clock frequency deviation)		
8	R4	c^2 tAcc 1/c^2 fAcc Start	s^2 time precision (variance)		
12	R4	of the repeated part (N=0	-	Frequency accuracy (variance)	
for GPS, 1 for BDS, 2 for GLONASS)					
16+16*N R8		-	tow	ms Week time	
24+16*N R4		-	dtUtc	s	The fractional seconds of the difference between satellite time and UTC time
28+16*N U2		-	wn	-	Week
30+16*N I1		-	leapS	-	UTC leap second, the integral of the difference between satellite time and UTC time Seconds part
31+16*N U1		-	valid	-	Time validity flag
The repetition part ends. The maximum value of N is (SYSTEM_ALL-1). In the current version, its value is 2.					

2.7.7 NAV-GPSINFOÿ0x01 0x20ÿ

InformationNAV-GPSINFO					
Describe GPS satellite information					
Type Cycle/Query					
information	head	Length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	8+12*N	0x01 0x20 See the table below 4 Bytes		

Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4	-	runTime	-	Running time from power on/reset
4	U1	-	numViewSv	-	The number of visible satellites, effective range 0~32
5	U1	-	numFixSv	-	Number of satellites used for positioning
6	U1		system	-	System Type (Note [1])
7	U1	-	res		reserve
Repeating part starts (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	Channel Number
9+12*N	U1	-	sweat	-	Satellite number
10+12*N	U1	-	flags	-	Satellite status mask (Note [2])
11+12*N	U1	-	quality	-	Quality indicator of signal measurement (Note [3])
12+12*N	U1	-	CN0	dB-Hz Signal-to-Noise Ratio	
13+12*N	I1	-	pupil	°	Satellite elevation angle (-90~90)
14+12*N	I2	-	azim	°	Satellite azimuth (0~360)
16+12*N	R4	-	prRes	m Pseudorange residual	
End of repeat section					

Note[1]: System type	
Numeric	describe
0	GPS
1	BDS
2	GLONASS

Note [2]: Satellite status	
Bit	describe
B0	1 = Satellite participates in the solution
B1-B3	reserve
B4	1=Satellite forecast information is invalid
B5	reserve
B7:B6	00 = Reserved 01=Satellite prediction information based on the almanac 10 = Reserved 11 = Satellite prediction information based on ephemeris

Note [3]: Quality indication of signal measurement	
quality	
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, indicating that the half-cycle ambiguity is valid (inverse PI correction is valid)
BIT3	= 1, indicating that the half-cycle ambiguity is subtracted from the carrier phase measurement
BIT4	reserve
BIT5	=1, indicating that the carrier frequency is valid
BIT6-BIT7	reserve

2.7.8 NAV-BDSINFOÿ0x01 0x21ÿ

Information NAV-BDSINFO					
Describe BDS satellite information					
Type Cycle/Query					
information	head	Length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	8+12*N	0x01 0x21 See the table below	4 Bytes	
Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4	-	runTime	-	Running time from power on/reset
4	U1	-	numViewSv numFixSv	-	The number of visible satellites, effective range 0~32
5	U1	-		-	Number of satellites used for positioning
6	U1	-	system	-	System type (refer to 2.7.7 Note [1])
7	U1	-	res		reserve
Repeating part starts (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	Channel Number
9+12*N	U1	-	sweat	-	Satellite number
10+12*N	U1	-	flags	-	Satellite status mask (refer to 2.7.7 Note [2])
11+12*N	U1	-	quality	-	Signal measurement quality indication (refer to 2.7.7 Note [3])
12+12*N	U1	-	CN0	dB-Hz Signal-to-Noise Ratio	
13+12*N	I1	-	pupil	°	Satellite elevation angle (-90~90)
14+12*N	I2	-	azim	°	Satellite azimuth (0~360)
16+12*N	R4	-	prRes	m Pseudorange residual	
End of repeat section					

2.7.9 NAV-GLNINFOÿ0x01 0x22ÿ

Information NAV-GLNINFO					
Describe GLONASS satellite information					
Type Cycle/Query					
information	head	Length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	8+12*N	0x01 0x22 See the table below 4 Bytes		
Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4	-	runTime	-	Running time from power on/reset
4	U1	-	numViewSv	-	The number of visible satellites, effective range 0~32
5	U1	-	numFixSv	-	Number of satellites used for positioning
6	U1	-	system	-	System type (refer to 2.7.7 Note [1])
7	U1	-	res		reserve
Repeating part starts (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	Channel Number
9+12*N	U1	-	sweat	-	Satellite number
10+12*N	U1	-	flags	-	Satellite status mask (refer to 2.7.7 Note [2])
11+12*N	U1	-	quality	-	Signal measurement quality indication (refer to 2.7.7 Note [3])
12+12*N	U1	-	CN0	dB-Hz Signal-to-Noise Ratio	
13+12*N	I1	-	pupil	°	Satellite elevation angle (-90~90)
14+12*N	I2	-	azim	°	Satellite azimuth (0~360)
16+12*N	R4	-	prRes	m Pseudorange residual	
End of repeat section					

2.7.10 NAV-IMUATTÿ0x01 0x06ÿ

Information NAV-IMUATT					
Describes the attitude of the IMU coordinate system relative to the local navigation coordinate system (NED)					
Type Cycle/Query					
information	head		Length (bytes) Identifier		Payload Checksum
structure	0xBA 0xCE 32 Payload			0x01 0x06	See the table below 4 Bytes
content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4	-	tow	s	Receiver GPS time of week (Note [1])
4	U2	-	weekNum	week	Receiver GPS week number (Note [1])
6	U1		flag	-	Attitude available flag (Note [2])
7	U1	-	res	-	reserve
8	I4	1e-5 roll		deg Roll angle	
12	I4	1e-5 pitch 1e-5		deg Pitch angle	
16	I4	heading 1e-5 rollAcc		deg Heading angle	
20	U4			deg Roll angle accuracy	
24	U4	1e-5 pitchAcc deg Pitch angle accuracy			
28	U4	1e-5 headingAcc deg heading angle accuracy			
Note[1]: Receiver GPS time of week					
rcvTow/wn Refer to the meaning of rcvTow/wn in RXM-MEASX.					
Note [2]: Attitude available flag					
flag	0x01-attitude estimation is valid; 0xff-attitude estimation is invalid.				

2.8 TIMÿ0x02ÿ

2.8.1 TIM-TPÿ0x02 0x00ÿ

Message NameTIM-TP					
Describe timing pulse information					
Type Cycle/Query					
Notes					
information		Length (bytes) Identifier Payload Checksum			
Header Structure	0xBA 0xCE Payload	24 0x02 0x00 See the table below 4 Bytes			
content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4	-	runTime	ms Run time from power on/reset	
4	R4	-	qErr	s	The time quantization error corresponding to the next time pulse
8	R8	-	tow	s	The time of week corresponding to the next time pulse
16	U2	-	wn	-	The week number corresponding to the next time pulse
18	U1	-	refTime	-	Reference time (Note [1])
19	U1	-	utcValid	-	Valid flag (Note [2])
20	U4	-	res	-	reserve

Note[1]: Timing pulse reference time	
Value Description	
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 (for specific system, refer to B3:B0 values)

Note [2]: UTC parameter valid flag	
Value Description	
0 Missing	
1	reserve
2	Expired
3	efficient

2.9 RXMÿ0x03ÿ

Measured value message.

2.9.1 RXM-MEASXÿ0x03 0x10ÿ

Information RXM-MEASX					
Describes the original measurement information of pseudorange and carrier phase					
Type Cycle/Query					
Notes					
information	head	Length (bytes) Identifier 0x03 0x10 See the		Payload Checksum	
structure	0xBA 0xCE	16+32*N	table below 4 Bytes		
Payload contents:					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	R8	·	rcvTow	s	Receiver GPS time of week (Note [1])
8	I2	·	wn	week	Receiver GPS week number
10	I1	·	leapS	s	UTC leap second value (Note [2])
11	U1	·	numMeas	·	Number of measured values, valid range 0~32
12	U1	·	recStat	·	Receiver status (Note [3])
13	U1	·	res1		reserve
14	U1	·	res2	·	reserve
15 res3 Repeating part starts (N=numMeas, valid range 0~32)	U1			·	reserve
16+32*N	R8	·	Through the	m	Pseudorange measurement value (unit: meter), for GLONASS inter-frequency deviation, receiver Compensation is done via built-in correction tables.
24+32*N	R8	·	cpMes	cycles	Carrier phase measurement value (unit: cycle) (Note [4])
32+32*N	R4	·	council	Hz	Doppler measurement value (unit: Hz), close to The satellite Doppler is positive.
36+32*N	U1	·	gnss	·	System type. 0=GPS , 1=BDS , 2=GLONASS
37+32*N	U1	·	sweat	·	Satellite number
38+32*N	U1	·	res4	·	reserve
39+32*N	U1	·	freqid	·	Frequency number (offset 8), only for GLONASS is valid. Valid value range [1,14], corresponding to the frequency [-7,+6].
40+32*N	U2	·	locktime	ms	Carrier phase lock time, maximum 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 res8		Satellite tracking status (Note [5])
47+32*N	U1				reserve
End of repeat section					
Note[1]: Receiver GPS time of week					
rcvTow	The receiver time is aligned with the GPS time system as closely as possible. Use the receiver's internal time rcvTow, receiving The machine week number week and leap second value leapS can be used to convert time to other time systems. More about For more information about the time system, please refer to the RINEX3 documentation. When the receiver is operating in single GLONASS mode, The UTC time can be obtained by subtracting the leap second value leapS from the receiver time without considering recStat Whether the flag bit in is valid.				
Note[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 bit in indicates whether the value is valid.				
Note [3]: Receiver status					
recStat Description					
BIT0	=1, indicating that the leap second value leapS is valid (UTC correction parameters are valid).				
BIT1	=1, indicating that a clock reset (clock rest) occurs, and the receiver time jumps by an integer number of milliseconds.				
Note [4]: Carrier phase measurement value					
cpMes	Initialize the initial integer ambiguity of the carrier phase using an approximate value so that the carrier phase measurement The clock reset mechanism acts on both the pseudorange measurement and the carrier. Wave phase measurement value, in accordance with RINEX3 regulations.				
Note [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, indicating that the half-cycle ambiguity is valid (inverse PI correction is valid)				
BIT3	= 1, indicating that the half-cycle ambiguity is subtracted from the carrier phase measurement				

2.9.2 RXM-SVPOSÿ0x03 0x11ÿ

Information RXM-SVPOS					
Describe satellite position information					
Type Cycle/Query					
Notes					
information	head	Length (bytes) Identifier Payload Checksum			
structure	0xBA 0xCE	16+48*N	0x03 0x11 See the table below 4 Bytes		
Payload content:					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	R8	·	rcvTow	s	Receiver GPS time of week (Note [1])
8	I2	·	wn	week	Receiver GPS week number (Note [1])
10	U1	·	numMeas	·	Number of measured values, valid range 0~32
11	U1	·	res1	·	reserve
12	res2	Repeating part starts (N=numMeas, valid range		·	reserve
0~32)					
16+48*N	R8	·	x	m	Satellite coordinates
24+48*N	R8	·	and	m	Satellite coordinates
32+48*N	R8	·	With	m	Satellite coordinates
40+48*N	R4	·	svdt	m	Satellite clock error
44+48*N	R4	·	svdf	m/s	Satellite frequency deviation
48+48*N	R4	·	tropDelay	m	Tropospheric delay
52+48*N	R4	·	ionoDelay svid	m	ionospheric delay
56+48*N	U1	·		·	Satellite number
57+48*N	U1	·	glnFreqid	·	Frequency number (offset 8) for GLONASS efficient
58+48*N	U1	·	gnss	·	System Type , 0=GPS , 1=BDS , 2=GLONASS
59+48*N	U1	·	res3	·	reserve
60+48*N	U4	·	res4	·	reserve
Repeating part ends					
Note[1]: Receiver GPS time of week					
rcvTow/wn Refer to the meaning of rcvTow/wn in RXM-MEASX.					

2.9.3 RXM-SENSORÿ0x03 0x07ÿ

Information RXM- SENSOR					
Describe sensor information					
Type Cycle/Query					
Notes					
information	head	Length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	16+16*N	0x03 0x11 See the table below	4 Bytes	

Payload contents:					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	R8	·	rcvTow	s	Receiver GPS time of week (Note [1])
8	I2	·	wn	week	Receiver GPS week number (Note [1])
10	I1	·	leapS	s	Current GPS system time leap second time
11	U1	·	numMeas	·	Number of measurements (Note [2])
12	U1	·	recStat	·	Receiver Status
13	U1	·	timeSrc	·	0-GPS time; 1-BDS time
14	U1	·	rcvrId	·	0
15	U1	·	res	·	reserve
Repeating part starts (N=numMeas, valid range: 1/2/5/10/25/50 discrete values)					
16+16*N I2		1g/16384 accX	1g/16384 accY	m/s/s	Accelerometer X-axis measurement value (Note [3])
18+16*N I2		1g/16384 accZ	250/32768	m/s/s	Accelerometer Y-axis measurement value
20+16*N I2		gyroX 250/32768	gyroY	m/s/s	Accelerometer Z-axis measurement value
22+16*N I2		250/32768 gyroZ	1/326.8 temp	deg/s	Gyroscope X-axis measurement value (Note [4])
24+16*N I2				deg/s	Gyroscope Y-axis measurement value
26+16*N I2				deg/s	Gyroscope Z-axis measurement value
28+16*N I2				oC	Thermometer measurement
30+16*N I2		·	res	·	reserve
End of repeat section					

Note[1]: Receiver GPS time of week	
rcvTow/wn	Refer to the meaning of rcvTow/wn in RXM-MEASX.

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

Note [3]: Accelerometer	
acc	The accelerometer range is -2g~+2g.

Note [4]: Gyroscope	
gyro	The gyroscope range is -250deg/s~+250deg/s.

2.10 ACKÿ0x05ÿ

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

2.10.1 ACK-NACKÿ0x05 0x00ÿ

Information ACK-NACK					
Description Response to information that was not received correctly					
Type Answer					
Notes					
information structure	head	Length (bytes) Identifier 0x05 0x00 See		Payload Checksum	
	0xBA 0xCE	4	the table below 4 Bytes		
Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U1		clsID	- Type of information not received correctly	
1	U1		msgID	- Number of messages that were not received correctly	
2	U2		res	- reserve	

2.10.2 ACK-ACKÿ0x05 0x01ÿ

Information ACK-ACK					
Describes the response to the correct received information					
Type Answer					
Notes					
information structure	head	Length (bytes) Identifier Payload Checksum			
	0xBA 0xCE	4	0x05 0x01 See the table below 4 Bytes		
Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U1		clsID	- Correct type of information received	
1	U1		msgID	- Number of the correct received message	
2	U2		res	- reserve	

2.11 CFGÿ0x06ÿ

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

2.11.1 CFG-PRTÿ0x06 0x00ÿ

Message CFG-PRT					
Description query UART working mode, including UART0, UART1 two statements, the current UART statement finally output					
Type query					
Notes					
information	head	Length (bytes) 0	Identifier	Payload Checksum	
structure	0xBA 0xCE		0x06 0x00	0	4 Bytes

Message CFG-PRT					
Description Set the UART working mode					
Type Setting/Response Query					
Notes					
information		Length (bytes) 8	Identifier Payload Checksum		
structure	Header 0xBA 0xCE		0x06 0x00 See the table below 4 Bytes		
Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U1		portID		Port identifier (0 and 1 correspond to UART0 and UART1, 0xFF indicates the currently connected UART)
1	U1		protoMask -		Protocol control mask, each port can support several protocols at the same time When the corresponding bit is equal to 1, the protocol is enabled (Note [1])
2	U2		mode Bit mask of UART operating mode (Note [2])		
4	U4		baudRate bps baud rate		

Note [1]: Protocol Control Mask	
Bit Description	
B0 1=Binary protocol input	
B1	1 = Text protocol input
B4	1 = binary protocol output
B5	1=Text protocol output

Note [2]: UART operating mode bit mask		
Bit value description		
[7:6]	00	5bits
	01	6bits
	10	7bits
	11	8bits
[11:9]	10x	No verification
	001	Odd Parity

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

2.11.2 CFG-MSGÿ0x06 0x01ÿ

InformationCFG-MSG					
Description Query all information sending frequency					
Type query					
Notes					
information structure	Header 0xBA 0xCE	Length (bytes) Identifier 0 0x06 0x01		Payload Checksum 0	4 Bytes

InformationCFG-MSG					
DescriptionSet the frequency of sending information					
Type Settings					
Notes					
information structure	Header 0xBA 0xCE	Length (bytes) Identifier 0x06 0x01 See 4	the table below 4 Bytes	Payload Checksum	

Payload Content				
character Offset	data type	Proportion Zoom	name	Unit Description
0	U1		clsID	- Information type
1	U1		msgID	- Message number
2	U2		rate	- Frequency of message sending (Note [1])

Note[1]: Frequency of message sending	
Numerical description	
0 No output	
1	Output once for each positioning
2	Position twice, output once
N	N positionings, one output; In particular, when clsID=0x03, msgID=0x07, rate indicates the configured RXM_SENSOR information The number of samples per second of the sensor output.
0xFFFF	Output immediately once, and only once, equivalent to query output

2.11.3 CFG-RSTÿ0x06 0x02ÿ

Message Name	CFG-RST				
Describes restarting the receiver/clearing saved data structures					
Type Settings					
Notes					
information		Length (bytes) Identifier 4 0x06		Payload Checksum	
Header Structure	0xBA 0xCE Payload	0x02 See the table below 4 Bytes			

content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U2	-	navBbrMask -		Clears the battery-backed RAM. If a bit in the mask is set to 1, then clear the data represented by this bit (Note [1])
2	U1	-	resetMode	-	Reset method (Note [2])
3	U1	-	startMode	-	Startup method (Note [3])

Note [1]: Clear field	
Bit Description	
B0 Ephemeris	
B1	Almanac
B2	Health Information
B3	Ionospheric parameters
B4	Receiver positioning information
B5	Clock drift (clock frequency deviation)
B6	Crystal oscillator parameters
B7	UTC correction parameters
B8	RTC
B9	Configuration Information

Note [2]: Reset method	
Numerical description	
0	Immediate hardware reset (via WATCHDOG)
1	Controlled software reset
2	Controlled software reset (GPS only)
4	Hardware reset after shutdown (implemented by WATCHDOG)

Note [3]: Startup method	
Numerical description	
0	Hot Start
1	Warm start
2	Cold Start
3	Factory start

2.11.4 CFG-TPÿ0x06 0x03ÿ

Information CFG-TP					
Description Query time pulse parameters					
Type query					
Notes					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x03	0	4 Bytes

Information CFG-TP					
Description Read/set time pulse parameters					
Type Read/Set					
Notes					
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 Description
0	U4	·	interval	us The 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 (Note [3])
11	U1	·	timeSource	· Time source (Note [4])
12	R4	·	userDelay	s User time delay

Note [1]: Pulse enable flag

Value Description	
0	Turn off pulse
1	Enable pulse
2	The pulse is enabled and continuously output. When normal positioning is not possible, the pulse update rate is automatically maintained.
3	Output pulses when positioning normally, no pulses when the receiver cannot position normally

Note [2]: Pulse polarity configuration

0 Rising edge	
1	Falling edge

Note[3]: Reference time

0	UTC time
1	Satellite time

Note[4]: Satellite time source

Numerical description	
0 Force single GPS timing	
1	Mandatory single BDS timing
2	Mandatory single GLN timing
3	reserve

4	Main BDS, automatically switch to other timing systems when BDS is unavailable
5	Mainly use GPS, automatically switch to other timing systems when GPS is unavailable
6	Mainly use GLN, when GLN is unavailable, it can automatically switch to other timing systems
7	reserve
other	Automatic timing system selection

2.11.5 CFG-RATEÿ0x06 0x04ÿ

Message Name	CFG-RATE				
Describe the query positioning time interval					
Type query					
Notes	The receiver supports different navigation rates (the default rate is one update per second). The navigation rate directly affects the power consumption. The faster the rate, the greater the CPU and communication burden				
information structure		Length (bytes) Identifier Header		Payload Checksum	
	0xBA 0xCE	0	0x06 0x04	0	4 Bytes

Message Name	CFG-RATE				
Description	Set the positioning time interval				
Type Settings					
Notes	The receiver supports different navigation rates (the default rate is one update per second). The navigation rate directly affects the power consumption. The faster the rate, the greater the CPU and communication burden				
information structure	Header Length (Bytes) Identifier Payload Checksum				
	0xBA 0xCE	4	0x06 0x04 See the table below 4 Bytes		

Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U2		interval	ms	The time interval between two positioning
2	U2		res		reserve

2.11.6 CFG-CFGÿ0x06 0x05ÿ

Information CFG - CFG						
Describes clearing, saving, and loading configuration information						
Type Command						
Notes						
information		Length (bytes) Identifier Payload Checksum				
Header Structure	0xBA 0xCE Payload	4 0x06 0x05 See the table below 4 Bytes				
content						
character Offset	data type	Proportion Zoom	name	Unit Description		
0	U2		mask		Configuration information mask (Note [1])	
2	U1		mode	- Operation mode for configuration information (Note [2])		
3	U1		res	- reserve		

Note [1]: Configuration information mask	
Bit Description	
B0	IO port configuration information (CFG-PRT)
B1	Message Configuration (CFG-MSG)
B2	INF Message Configuration (CFG-INF)
B3	Navigation configuration (CFG-RATE, CFG-TMODE)
B4	Time Pulse Configuration (CFG-TP)
B5	Group delay (CFG-GROUP)

Note [2]: Operation mode	
Numeric	describe
0	Clear Permanent Configuration
1	Save the current configuration to permanent configuration
2	Load the permanent configuration into the current configuration

2.11.7 CFG-TMODEÿ0x06 0x06ÿ

Information	CFG-TMODE				
Describe the query timing mode					
Type query					
Notes					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x06	0	4 Bytes

Information	CFG-TMODE				
Description	Read/set timing mode				
Type	Read/Set				
Notes					
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	Description
0	U4		mode		Timing 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	3D variance of the m^2 position	
32	U4		svinMinDur	s	When the timing mode is 1, the minimum measurement time interval
36	R4		pigVarLimit	m^2 When the timing mode is 1, the positioning error limit	

Note[1]: Timing mode	
Numerical description	
0	Autonomous positioning and timing
1	After autonomous positioning has been performed for a period of time to obtain a user position with sufficient accuracy, the user can calculate the user position using only all available satellites. In this mode, when the user position is fixed, single satellite timing can be achieved.
2	The user enters the current location and only uses all available satellites to calculate the user clock parameters for timing. Single-satellite timing can be achieved

2.11.8 CFG-NAVXÿ0x06 0x07ÿ

Message NameCFG-NAVX					
Description query navigation engine professional configuration					
Type query					
Annotation query navigation related parameters					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x07	0	4 Bytes

Message NameCFG-NAVX					
Describe the professional configuration of the navigation engine					
Type Settings					
Annotation configuration navigation related parameters					
information		Length (bytes) Identifier Payload Checksum			
Header Structure	0xBA 0xCE 44 0x06 0x07 See the	table below 4 Bytes			

Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4		mask		Parameter mask, only the corresponding bit mask is set to 1, parameter Applies only when set (Note [1])
4	U1		dyModel fixMode		Dynamic mode (Note [2])
5	U1		minSVs		Positioning mode (Note [3])
6	U1				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 flag (0/1)
11	I1		minStudent	°	Minimum elevation angle of GNSS satellites 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 rollover number
16	R4		fixedAlt	m	Fixed height for 2D positioning
20	R4		fixedAltVar	m^2	Fixed height error during 2D positioning
24	R4		pDop tDop		Position DOP Maximum
28	R4		pAcc tAcc		Time DOP maximum
32	R4			m^2	Maximum position accuracy
36	R4			m^2	maximum time precision
40	R4		staticHoldTh	m/s	Standstill threshold

Note [1]: Parameter mask	
Bit Description	
B0	Apply dynamic mode settings
B1	Apply positioning mode settings
B2	Apply the maximum/minimum number of navigation satellites settings
B3	Apply minimum signal-to-noise ratio setting

B4	reserve
B5	Apply initial positioning 3D settings
B6	Apply minimum elevation setting
B7	Apply DR Limit Settings
B8	Application Navigation System Enablement
B9	Apply GPS week rollover settings
B10	Apply Height Assist
B11	Applying location DOP limits
B12	Applying time DOP limits
B13	Apply static hold settings
Note [2]: Dynamic mode	
Mode Description	
0	Portable Mode
[1] Still mode	
2	Walking Mode
3	Car Mode
4	Sailing Mode
5	Flight mode acceleration < 1g
6	Flight mode acceleration <2g
7	Flight mode acceleration <4g
Note [3]: Positioning mode	
Mode Description	
0	reserve
[1]	2D Positioning
2	3D Positioning
3	2D/3D positioning automatic switching
Note [4]: Navigation system enabled	
Bit Description	
B0	1=GPS
B1	1=BDS
B2	1=GLONASS

2.11.9 CFG-GROUPÿ0x06 0x08ÿ

Message NameCFG-GROUP					
Describes querying GLONASS group delay					
Type query					
Notes					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x08	0	4 Bytes

Message NameCFG-GROUP					
Describes the configuration of GLONASS group delay					
Type Settings					
Notes					
information		Length (bytes) Identifier	Payload Checksum		
Header Structure	0xBA 0xCE	56	0x06 0x08 See the table below	4 Bytes	

Payload content

character Offset	data type	Proportion Zoom	name	Unit	Description
0	R4[14]		groupDealy m		The group delay corresponding to each frequency of GLONASS, Use distance to represent (group delay time multiplied by the speed of light to get Distance to

2.11.10 CFG-INSÿ0x06 0x10ÿ

Message NameCFG-INS					
Description Query INS installation mode					
Type query					
Notes					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x10	0	4 Bytes

Message NameCFG-INS					
Describe configuration INS installation mode					
Type Settings					
Notes					
information		Length (bytes) Identifier Payload Checksum			
Header Structure	0xBA 0xCE	4 0x06 0x10 See the table below 4 Bytes			

Payload content

character Offset	data type	Proportion Zoom	name	Unit Description	
0	U2		attMode		The module's relative installation attitude to the vehicle Configuration, possible value range: 0, 1, 2, 3. 0: The module's X axis points to the front of the vehicle. 1: The module's X axis points to the right of the vehicle. 2: The module's X axis points to the rear of the vehicle. 3: The module's X axis points to the left of the vehicle. 9: Adaptive estimation module relative pose. The default is 9. 1:
2	U2		ramStart		The dead reckoning function starts immediately after the backup power is turned on. start 0: Dead reckoning function is turned off immediately after backup power is turned on close Default off

2.12 MSGÿ0x08ÿ

Receiver navigation message, message class is 0x08.

2.12.1 MSG-BDSUTCÿ0x08 0x00ÿ

Information	MSG-BDSUTC				
Describe BDS fixed-point UTC data (synchronized with UTC time parameters)					
Type Cycle					
Notes					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE 20		0x08 0x00	See the table below 4	Bytes
Payload Content					
character Offset	data type	Proportion Zoom	name	Unit	Description
0	U4	-	res1	- reserve	
4	I4	2^{-30}	a0UTC	s	BDT clock difference with respect to UTC
8	I4	2^{-50}	a1UTC	s/s	BDT clock speed relative to UTC
12	I1	-	dtls	s	Before the new leap second takes effect, the cumulative leap second change of BDT relative to UTC is Positive
13	I1	-	dtlsf	s	After the new leap second takes effect, the accumulated leap seconds of BDT relative to UTC will change to Positive
14	U1	-	res2	- reserve	
15	U1	-	res3	- reserve	
16	U1	-	wnlsf	wee k	Week number when the new leap second takes effect
17	U1	-	dn	day	The day of the week on which the new leap second takes effect
18	U1	-	valid	-	Information available flag (Note [1])
19	U1	-	res4	- reserve	

Note [1]: Information available flag

Numerical	Description
0	Invalid
1	Unhealthy
2	Expired
3	efficient

2.12.2 MSG-BDSIONÿ0x08 0x01ÿ

Information	MSG-BDSION				
Describe	BDS8 parameter fixed-point ionospheric data				
Type Cycle					
Notes					
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	Description
0	U4	·	res1	·	reserve
4	I1	2^{-30}	alpha0	s	Ionospheric parameters
5	I1	2^{-27}	alpha1	$\frac{s}{\pi}$	Ionospheric parameters
6	I1	2^{-24}	alpha2	$\frac{s}{\pi^2}$	Ionospheric parameters
7	I1	2^{-24}	alpha3	$\frac{s}{\pi^3}$	Ionospheric parameters
8	I1	2^{11}	beta0	s	Ionospheric parameters
9	I1	2^{14}	beta1	$\frac{s}{\pi}$	Ionospheric parameters
10	I1	2^{16}	beta2	$\frac{s}{\pi^2}$	Ionospheric parameters
11	I1	2^{16}	beta3	$\frac{s}{\pi^3}$	Ionospheric parameters
12	U1	·	valid	·	Information available flag (Note [1])
13	U1	·	res2	·	reserve
14	U2	·	res3	·	reserve

Note [1]: Information available flag	
Numerical Description	
0	Invalid
1	Unhealthy
2	Expired
3	efficient

2.12.3 MSG-BDSEPHÿ0x08 0x02ÿ

InformationMSG-BDSEPH					
Describe BDS ephemeris					
Type Cycle					
Notes					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	92	0x08 0x02 See the table below 4 Bytes		

Payload Content					
character Offset	data type	Proportion Zoom	Name Unit Description		
0	U4	·	res1	·	reserve
4	U4	2^{-19}	sqra	m1/2Square root of the semi-major axis of the satellite orbit	
8	U4	2^{-33}	is	·	Satellite orbit eccentricity
12	I4	2^{-31}	ω	π	Argument of perigee
16	I4	2^{-31}	M0 i0	π	Mean anomaly at reference time
20	I4	2^{-31}		π	Orbital inclination at reference time
24	I4	2^{-31}	Ω_0	π	Right ascension of the ascending node calculated at the reference time
28	I4	2^{-43}	$\dot{\Omega}$	$\frac{\pi}{s}$	Rate of change of right ascension of ascending node
32	I2	2^{-43}	Δn	$\frac{\pi}{s}$	The difference between the satellite's average velocity and the calculated value
34	I2	2^{-43}	TIME	$\frac{\pi}{s}$	Orbital inclination rate
36	I4	2^{-31}	cuc	rad Amplitude of the cosine harmonic correction term for the latitude argument	
40	I4	2^{-31}	cus	rad Amplitude of the sine harmonic correction term for latitude argument	
44	I4	2^{-6}	crc	m Amplitude of the cosine harmonic correction term of the orbital radius	
48	I4	2^{-6}	crs	m Amplitude of the sinusoidal harmonic correction term for orbital radius	
52	I4	2^{-31}	cic	rad Amplitude of the cosine harmonic correction term for orbital inclination	
56	I4	2^{-31}	cis	rad Amplitude of the sinusoidal harmonic correction for orbital inclination	
60	U4	2^{3}	then	s	Ephemeris reference time
64	U2	·	will do	·	The whole week number of the reference time
66	U2	·	res2	·	reserve
68	U4	2^{3}	toc	s	Reference time for clock error parameters 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 On-board equipment delay difference	
84	U1	·	iodc	·	Clock Data Age
85	U1	·	iodine	·	Ephemeris data age
86	U1	·	the water	·	User distance accuracy
87	U1	·	health	·	Satellite Autonomous Health Identification
88	U1	·	sweat	·	Satellite number
89	U1	·	valid	·	Information available flag (Note [1])

90	U2		res3		reserve

Note [1]: Information available flag

Numerical Description
0 Invalid
1. Unhealthy
2 Expired
3 Valid

2.12.4 MSG-GPSUTCÿ0x08 0x05ÿ

Message MSG-GPSUTC						
Describes GPS fixed point UTC data (synchronized with UTC time parameters)						
Type Cycle						
Notes						
information	head		Length (bytes) Identifier 0x08 0x05 See the		Payload Checksum	
structure	0xBA 0xCE		20	table below 4 Bytes		
Payload Content						
character Offset	data type	Proportion Zoom	name	Unit Description		
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 change of BDT relative to UTC is Leap second correction	
13	I1	-	dtlsf	s	After the new leap second takes effect, the cumulative change of BDT relative to UTC is Leap second correction	
14	U1	2^{12}	to	s	UTC data reference time	
15	U1	-	wnt	week UTC reference week number		
16	U1	-	wnlsf	week The number of the week in which the new leap second takes effect		
17	U1	-	dn	day The day of the week on which the new leap second takes effect		
18	U1	-	valid	-	Information available flag (Note [1])	
19	U1	-	res2	-	reserve	
Note [1]: Information available flag						
The value	illustrate					
0 is invalid.						
1	Unhealthy					
2	Expired					
3	efficient					

2.12.5 MSG-GPSIONÿ0x08 0x06ÿ

InformationMSG-GPSION					
Describing GPS ionospheric data					
Type Cycle					
Notes					
information	head	Length (bytes) Identifier 0x08 0x06 See the		Payload Checksum	
structure	0xBA 0xCE	16	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	$\frac{s}{\pi}$	Ionospheric parameters
6	I1	2^{-24}	alpha2	$\frac{s}{\pi^2}$	Ionospheric parameters
7	I1	2^{-24}	alpha3	$\frac{s}{\pi^3}$	Ionospheric parameters
8	I1	2^{11}	beta0	s	Ionospheric parameters
9	I1	2^{14}	beta1	$\frac{s}{\pi}$	Ionospheric parameters
10	I1	2^{16}	beta2	$\frac{s}{\pi^2}$	Ionospheric parameters
11	I1	2^{16}	beta3	$\frac{s}{\pi^3}$	Ionospheric parameters
12	U1	·	valid	·	Information available flag (Note [1])
13	U1	·	res2	·	reserve
14	U2	·	res3	·	reserve

Note [1]: Information available flag	
Numerical Description	
0 Invalid	
1	Unhealthy
2	Expired
3	efficient

2.12.6 MSG-GPSEPHÿ0x08 0x07ÿ

Information RXM-GPSEPH						
Describing GPS ephemeris						
Type Cycle						
Notes						
information	head	Length (bytes) Identifier 0x08 0x07 See the		Payload Checksum		
structure	0xBA 0xCE	72		table below 4 Bytes		
Payload Content						
character Offset	data type	Proportion Zoom	Name Unit Description			
0	U4	·	res1	·	reserve	
4	U4	2^{-19}	sqra	m1/2Square root of the semi-major axis of the satellite orbit		
8	U4	2^{-33}	is	·	Satellite orbit eccentricity	
12	I4	2^{-31}	ω	π	Argument of perigee	
16	I4	2^{-31}	M0 i0	π	Mean anomaly at reference time	
20	I4	2^{-31}		π	Orbital inclination at reference time	
24	I4	2^{-31}	Ω_0	π	Right ascension of the ascending node calculated at the reference time	
28	I4	2^{-43}	$\dot{\Omega}$	$\frac{\pi}{s}$	Rate of change of right ascension of ascending node	
32	I2	2^{-43}	Δn	$\frac{\pi}{s}$	The difference between the satellite's average velocity and the calculated value	
34	I2	2^{-43}	TIME	$\frac{\pi}{s}$	Orbital inclination rate	
36	I2	2^{-29}	cuc rad Amplitude of the cosine harmonic correction for the latitude argument			
38	I2	2^{-29}	cus	rad Amplitude of the sine harmonic correction term for latitude argument		
40	I2	2^{-5}	crc	m Amplitude of the cosine harmonic correction term of the orbital radius		
42	I2	2^{-5}	crs	m Amplitude of the sinusoidal harmonic correction term for orbital radius		
44	I2	2^{-29}	cic	rad Amplitude of the cosine harmonic correction term for orbital inclination		
46	I2	2^{-29}	cis	rad Amplitude of the sinusoidal harmonic correction for orbital inclination		
48	U2	2^{4}	then	s	Ephemeris reference time	
50	U2	·	will -		The whole week number of the reference time	
52	U4	2^{4}	toc	s	Reference time for clock error parameters 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	On-board equipment delay	
64	U2	·	iodc -		Clock Data Age	
66	U1	·	the water	·	User distance accuracy	
67	U1	·	health -		Satellite Autonomous Health Identification	
68	U1	·	sweat	·	Satellite number	
69	U1	·	valid	·	Information available flag (Note [1])	
70	U2	·	res2	·	reserve	
Note [1]: Information available flag						

Value	illustrate
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.12.7 MSG-GLNEPHÿ0x08 0x08ÿ

Information RXM-GLNEPH					
Describe GLONASS ephemeris					
Type Cycle					
Notes					
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 Description		
0	U4	-	res1	-	reserve
4	I4	2^{-30}	year	s	Correction value of the nth satellite relative to GLONASS time
8	I4	2^{-11}	x	km	Satellite position coordinates in the PZ-90 coordinate system
12	I4	2^{-11}	and	km	Satellite position coordinates in the PZ-90 coordinate system
16	I4	2^{-11}	with	km	Satellite position coordinates in the PZ-90 coordinate system
20	I4	2^{-20}	dx	km/s Satellite speed in PZ-90 coordinate system	
24	I4	2^{-20}	you	km/s Satellite speed in PZ-90 coordinate system	
28	I4	2^{-20}	d	km/s Satellite speed in PZ-90 coordinate system	
32	I4	2^{-31}	taoc	s	GLONASS time relative to UTC time scale correction
36	I4	2^{-30}	taoGPS day Correction from GLONASS time to GPS time		
40	I2	2^{-40}	gamman -		Relative deviation of satellite predicted carrier frequency
42	U2	-	tk	-	The time of the day in the current frame, a total of 12 bits
44	U2	-	nt	day The current date starting 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}	yes	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}	year	s	The propagation time difference between the L2 signal and the L1 signal of the nth satellite
50	U1	-	bn	-	Health Sign
51	U1	900	tb	s The time of day at the current time (based on UTC+3)	
52	U1	-	M	-	GLONASS satellite categories
53	U1	-	P	- Control some technical parameters	
54	U1	-	ft	-	Prediction accuracy of satellite pseudorange
55	U1	-	in	day Satellite ephemeris age	
56	U1	-	p1	-	Almanac information update time flag
57	U1	-	p2	-	tb Parity flag

58	U1		p3		The almanac delivered in the current frame contains the number of satellites
59	U1		p4		Ephemeris data update flag: 1 means updated
60	U1		ln		Satellite Health Indicator (GLONASS-M satellites)
61	U1		n4		Time count (starting from 1996, four-year cycle)
62	U1		sweat		Satellite number
63	U1		nl		Frequency number
64	U1		valid		Information available flag (Note [1])
65	U1		res2		reserve
66	U2		res3		reserve

Note [1]: Information available flag

Numerical Description	
0	invalid
1	Unhealthy
2	Expired
3	efficient

2.13 MONÿ0x0Aÿ

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

2.13.1 MON-VERÿ0x0A 0x04ÿ

Information MON-VER					
Describe version information					
Type Response Query					
Notes					
information	head	Length (bytes) Identifier 0x0A		Payload Checksum	
structure	0xBA 0xCE	64	0x04 See the table below 4 Bytes		
Payload contents:					
character Offset	data type	Proportion Zoom	name	Unit Description	
0	CH[32] -		swVersion	- Software version string	
32	CH[32] -		hwVersion	- Hardware version string	

2.13.2 MON-HWÿ0x0A 0x09ÿ

Information MON-HW					
Describe the hardware status					
Type Cycle/Query					
Annotate various hardware configuration states, including antenna status, IO port status, noise level, AGC information, etc.					
information	head	Length (bytes) Identifier		Payload Checksum	
structure	0xBA 0xCE	56	0x0A 0x09 See the table below 4 Bytes		

Payload content:

character Offset	data type	Proportion Zoom	name	Unit Description	
0	U4	·	noisePerMs0	·	DIF0 Noise power of intermediate frequency data
4	U4	·	noisePerMs1	·	DIF1 Noise power of intermediate frequency data
8	U4	·	noisePerMs2	·	DIF2 Noise power of intermediate frequency data
12	U2	·	agcData0 agcData1	·	DIF0 The number of 1s in the amplitude bit of the intermediate frequency data
14	U2	·	agcData2	·	DIF1 The number of 1s in the amplitude bit of the intermediate frequency data
16	U2	·		·	DIF2 The number of 1s in the amplitude bit of the intermediate frequency data
18	U2	·	res	- reserve	
20	U1	·	antStatus	·	Antenna status (Note [1])
21	U1	·	res	- reserve	
22	U1	·	res	- reserve	
23	U1	·	res	- reserve	
24	U4[8] 2^24 jamming Note[1]: Antenna status			- Center frequency of the interfering signal (normalized)	

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

2.14 AIDÿ0x0Bÿÿ

Auxiliary information, such as receiver initial position, time, etc.

2.14.1 AID-INIÿ0x0B 0x01ÿ

Information AID-INI					
Describe auxiliary position, time, frequency, clock deviation information					
Type query/input					
Annotation configuration navigation related parameters					
information		Length (bytes) Identifier Payload Checksum			
Header 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 the ECEF coordinate system: If it is ECEF coordinate system, the unit is m; If latitude, the unit is degrees.
8	R8		ecefYOrLon m or 1°		Y coordinate or longitude in the ECEF coordinate system: If it is ECEF coordinate system, the unit is m; If longitude, the unit is degrees.
16	R8		ecefZOrAlt m		Y coordinate or height in the ECEF coordinate system
24	R8		tow	s	GPS time of week
32	R4	300	freqBias	ppm	Clock frequency drift. Example: FreqBias=300, indicates the crystal frequency deviation 1ppmÿ FreqBias=-150, indicates the crystal frequency deviation -0.5ppmÿ
36	R4		pAcc	m^2	Variance of the 3D position estimation error
40	R4 C^2 tAcc			s^2	The variance of the estimated error in time. Example: tAcc=9, indicating 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. Example: fAcc=900, which means the time error is sqrt(fAcc)/300=30/300=0.1ppm
48	U4		res		reserve
52	U2		wn		GPS week number
54	U1		timeSource		Time Source
55	U1		flags		Flags mask (Note [1])

Note[1]: Flag mask	
Bit Description	
B0	1=Position is valid
B1	1=Time is valid
B2	1 = Clock frequency drift data is valid

B3	reserve
B4	1 = Clock frequency data is valid
B5	1=position is in LLA format
B6	1=Invalid height
B7	reserve

2.14.2 AID-HUIÿ0x0B 0x03ÿ

InformationAID-HUI					
Describes auxiliary health information, UTC parameters, ionospheric parameters					
Type Input					
Annotation configuration navigation related parameters					
structure		Length (bytes) Identifier Message		Payload Checksum	
	Header 0xBA 0xCE	60 0x0B 0x03 See the table below 4 Bytes			
Payload Content					
character Offset	data type	Proportion Zoom	name	Unit Description	
4	U4	·	HeaGps	·	GPS satellite health information (Note [1])
8	U4	·	HeaBds	·	BDS satellite health information (Note [1])
12	U4	·	HeaGln	·	GLONASS satellite health information (Note [1])
16	I4	2^{-30}	utcGpsA0 s utcGpsA1 s/ss		UTC parameter A0, the clock difference of GPS time relative to UTC
20	I4	2^{-50}	New leap second before GPS		UTC parameter A1, GPS time relative to UTC
24	I1	·	utcGpsLS	time relative to UTC	
25	I1	·	utcGpsLSF s The new leap second after GPS time relative to UTC		
26	U1	·	utcGpsTow s		Reference weekday time for GPS UTC parameters
27	U1	·	utcGpsWNT week GPS UTC parameter reference week number		
28	U1	·	utcGpsWNF week GPS new leap second takes effect on the week		
29	U1	·	utcGpsDN day		Days of the week when the new GPS leap second takes effect
30	I2	·	Res Reserved	·	
32	I4	2^{-30}	utcBdsA0	s	UTC parameter A0, the clock difference of BDS time relative to UTC
36	I4	2^{-50}	utcBdsA1	s/ss	UTC parameter A1, BDS time relative to UTC
40	I1	·	utcBdsLS	The leap second before the new leap second BDS time relative to UTC	
41	I1	·	utcBdsLSF	s The leap second after the new leap second BDS time relative to UTC	
42	U1	·	utcBdsTow s		Reference weekday time for BDS UTC parameters
43	U1	·	utcBdsWNT week The reference week number of the UTC parameter of the BDS		
44	U1	·	utcBdsWNF week BDS The week number when the new leap second takes effect		
45	U1	·	utcBdsDN BDS The day of the week when the new leap second takes effect		
46	I2	·	Res	·	reserve
48	I1	2^{-30}	clawA0	s/p	Klobuchar model parameter alpha0
49	I1	2^{-27}	joint A1	s/p^{1}	Klobuchar model parameter alpha1
50	I1	2^{-24}	klobA2	s/p^{2}	Klobuchar model parameter alpha2
51	I1	2^{-24}	klobA3	s/p^{3}	Klobuchar model parameter alpha3
52	I1	2^{11}	clawB0	s/p	Klobuchar model parameter beta0
53	I1	2^{14}	clawB1	s/p^{1}	Klobuchar model parameter beta1
54	I1	2^{16}	clawB2	s/p^{2}	Klobuchar model parameter beta2
55	I1	2^{16}	klobB3	s/p^{3}	Klobuchar model parameter beta3
56	U4	·	flags	·	Valid flag mask (Note [2])
Note [1]: B0 represents satellite No. 1, and so on. The corresponding bit equals 0, indicating that the satellite is healthy.					
Note [2]: Valid flag					
Bit Description					

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