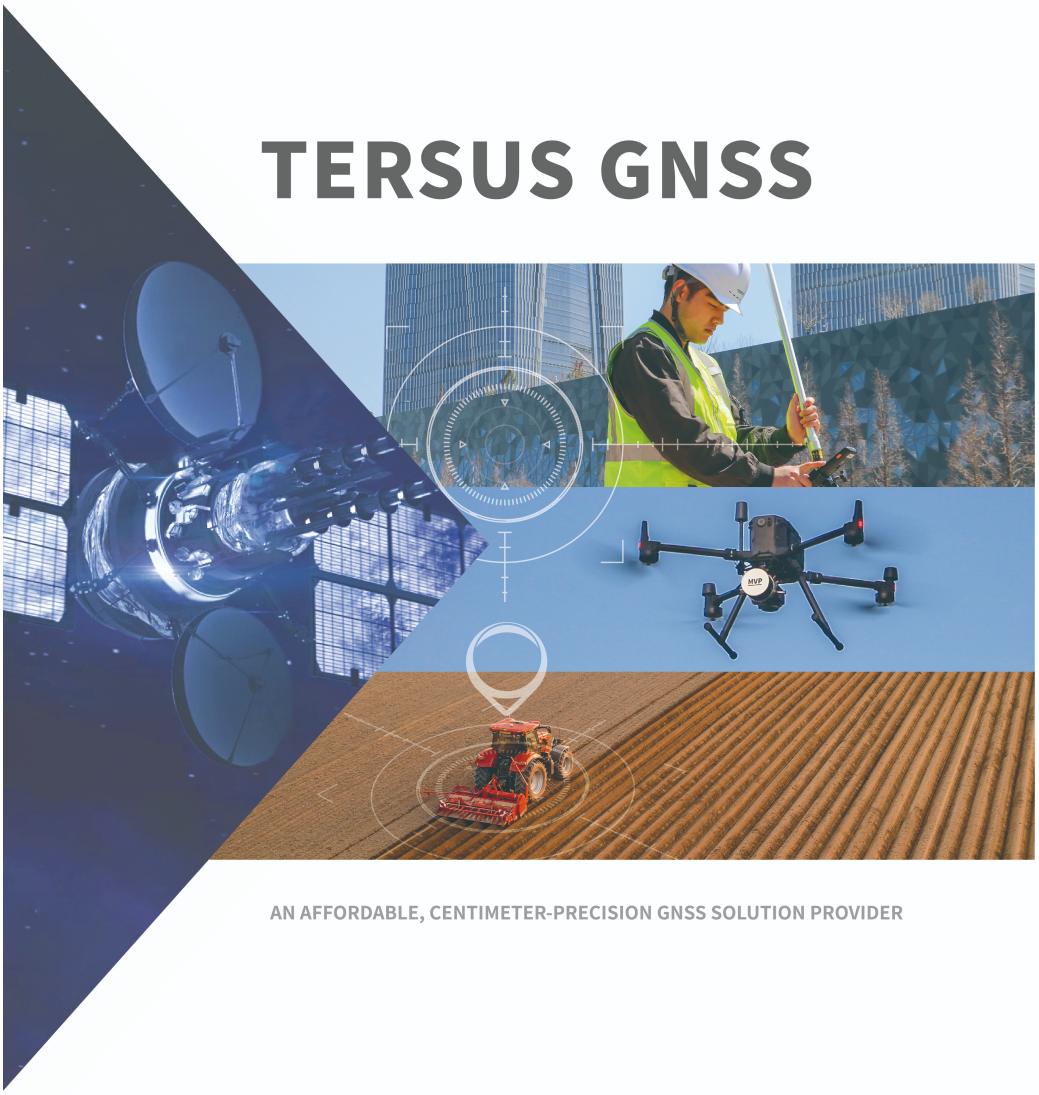
TERSUS GNSS



AN AFFORDABLE, CENTIMETER-PRECISION GNSS SOLUTION PROVIDER

Logs and Commands Reference for Tersus BX40&BX50

Version 2.4 - 20240912

Table of Content

1. General description

This logs and commands reference manual is for Tersus BX40, BX50 and PPP boards, providing reference guide of commands and logs to customers.

The firmware upgrade package of the **fw_only** can upgrade the PPP board and the BX40 board.

The firmware upgrade package of the **all_3706** is a large package with bit stream that needs to be filled for the first upgrade of the BX40 board.

The firmware upgrade package of the **all, without 3706** is a large package with bit stream that needs to be filled for the first upgrade of the PPP board.

1.1 General sentence format

All data is transmitted in the form of sentences. Only printable ASCII characters are allowed, plus CR (carriage return) and LF (line feed). Each sentence starts with a "$" sign and ends with CR>LF>.

Unless otherwise specified, all the loggings output support three formats: ASCII, abbreviated ASCII and binary formats.

Only input commands with ASCII formats (manually or with programming) are supported.

All the NMEA output loggings support ASCII format only.

1.2 Default baud rate

The default baud rate of COM1 is **115200** bps, and that of COM2 is **460800** bps.

1.3 Talker Sentences

The general format for a talker sentence is given below.

$ttsss, d1, d2 ...*xxCR>LF>

Each sentence begins with a '$' and ends with a carriage return/line feed sequence and cannot be longer than 80 characters of visible text (plus the line terminators). The data fields in a single line are separated by commas. If data for a field is not available, the field is omitted, but the delimiting commas are still there, with no space between them.

The data may vary in the amount of precision contained in the message. For example time might be indicated to decimal parts of a second or location may be shown with 3 or even 4 digits after the decimal point. Programs that read the data should only use the commas to determine the field boundaries and not depend on column positions.

1.4 ASCII header for logs

ASCII messages are readable by both the user and a computer. The structure of ASCII messages is as follows.

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

The following table gives the structure description about the ASCII header for all loggings.

Field	Field Name	Field Type	Description	Ignored on Input
1	Sync	Char	Sync character. The ASCII message is always preceded by a single '#' symbol	N
2	Message	Char	The ASCII name of the log or command	N
3	Port	Char	The name of the port from which the log was generated. The string is made up of the port name followed by an _x where x is a number from 1 to 31 denoting the virtual address of the port. If no virtual address is indicated, it is assumed to be address 0	Y
4	Sequence #	Long	Used for multiple related logs. It is a number that counts down from N-1 to 0, where 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0	N
5	% Idle Time	Float	The minimum percentage of time the processor is idle, calculated once per second	Y
6	Time Status	Enum	The value indicates the quality of the GPS refence time	Y
7	Week	Ulong	GPS reference week number	Y
8	Seconds	GPSec	Seconds from the beginning of the GPS reference week; accurate to the millisecond level	Y
9	Receiver Status	Ulong	Reserved to 0x00	Y
10	Reserved	Ulong	Reserved for internal use	Y
11	Receiver S/W Version	Ulong	Reserved to 0xbe0xa2	Y
12	;	Char	The character indicates the end of the header	N

1.5 Binary header for logs

The following table gives the structure description about the binary header for all loggings.

Field	Field Name	Field Type	Description	Binary Bytes
1	Sync	Char	Hexadecimal 0xAA	1
2	Sync	Char	Hexadecimal 0x44	1
3	Sync	Char	Hexadecimal 0x12	1
4	Header Length	Uchar	Length of the header	1
5	Message ID	Ushort	This is the Message ID number of the log.	2
6	Message Type	Char	Reserved to 0x02	1
7	Port Address	Uchar	COM1:32 COM2:33 USB:1440 FILE:8002	1
8	Message Length	Ushort	The length in bytes of the body of the message, not including the header nor the CRC	2
9	Sequence	Ushort	Reserved to 0x00	2
10	Idle Time	Uchar	Reserved to 0x00	1
11	Time Status	Enum	Indicates the quality of the GPS reference time	1
12	Week	Ushort	GPS reference week number	2
13	ms	GPSec	Milliseconds from the beginning of the GPS reference week	4
14	Receiver Status	Ulong	Reserved to 0x00	4
15	Reserved	Ushort	Reserved for internal use	2
16	Receiver S/W Version	Ushort	Reserved to 0xbe0xa2	2

1.5.1 GPS Reference Time Status

GPS Reference Time Status (Decimal)	GPS Reference Time Status (ASCII)	Description
20	UNKNOWN	Time validity is unknown
60	APPROXIMATE	Time is set approximately
80	COARSEADJUSTING	Time is approaching coarse precision
100	COARSE	This time is valid to coarse precision
120	COARSESTEERING	Time is coarse set and is being steered
130	FREEWHEELING	Position is lost and the range bias cannot be calculated
140	FINEADJUSTING	Time is adjusting to fine precision
160	FINE	Time has fine precision
170	FINEBACKUPSTEERING	Time is fine set and is being steered by the backup system
180	FINESTEERING	Time is fine set and is being steered
200	SATTIME	Time from satellite. Only used in logs containing satellite data such as ephemeris and almanac.

1.6 Command Response

The receiver is capable of outputting several ASCII format responses for various conditions. Most responses are error messages to indicate when something is not correct.

Response	Meaning
OK	Command was received correctly.
Invalid Message. Field = XXX	Field XXX of the input message is not correct.
Invalid Checksum	The checksum of the input message is not correct.
Message missing field	A field is missing from the input message.
Trigger XXX not valid for this log	Trigger type XXX is not valid for this type of log.
Parameter XXX is out of range	Field XXX of the input message is outside the acceptable limits.

Response	Meaning
Array size for field XXX exceeds max	Field XXX contains more array elements than allowed.
Invalid Param	An invalid value is input for field XXX.
Message is incorrect	The input message is incorrect.
Invalid baud rate	The baud rate is invalid.
The card is Group, please add the No. after group.	The parameters in the input license are not correct.
Invalid Authcode entered	The authcode entered is not valid
Need factory public key!	A factory public key is needed.
Trial lic have been used.	A trial license is expired.
Update denied (Trial Lic used time is more than purchased keys)	A trial license is denied.
Update denied (New Lic key Expired time is less than old Lic key)	A license is expired.
Firmware not support it!	This input command is not supported by current firmware.
Action Failed (Reason:XXX)!	Some Action failed.

1.7 Message ID for logs

Each log has a unique message ID, which is included in the output binary header.

Log	Description	Message ID
AUTHLIST	Serial number and the current authcode	1348
BDSEPHEMERIS	Decoded BDS ephemeris	1696
BDSIONO	Ionosphere parameter transmitted by Beidou satellites	1590
BESTPOS	Best position	42
BESTVEL	Best available velocity data	99
BESTXYZ	Best available Cartesian position and velocity	241
BESTXYZ2	An extension of BESTXYZ with extra fields related to delta-P	242
CMRGLOOBS	Output GLONASS observations in CMR format	104

Log	Description	Message ID
GALINAVEPHEMERIS	Decoded Galileo INAV ephemeris	1309
GLOEPHEMERIS	Decoded GLONASS ephemeris	723
GPGGA	GPS fix data and undulation	218
GPGLL	Geographic position	219
GPGSA	GPS DOP and active satellites	221
GPGST	Estimated error in position solution	222
GPGSV	GPS satellites in view	223
GPNTR	Detailed information between rover and base	209
GPRMC	GPS specific information	225
GPSEPHEM	Decoded GPS ephemeris	7
GPVTG	Track made good and ground speed	226
GPZDA	UTC time and date	227
IONUTC	Ionospheric and UTC data	8
LOGLIST	List of system logs	5
MARK1COUNT MARK2COUNT	Event mark tick count output	1093 1094
MARKTIME MARK2TIME	Time of mark input event	231 616
QZSSEPHEMERIS	Decoded QZSS ephemeris	1336
RANGE	Satellite range information	43
RANGECMP	Compressed version of the RANGE log	140
REFSTATION	Position of the base station in RTCM format	175
RTKSATINFO	Display RTK related satellite information	2006
RTKSATS	Display the information of satellites participating in RTK	1174
SATVIS	Satellite visibility	1043
SBASEPHEMERIS	Decoded SBAS ephemeris	601
TEMPSENSOR	Temperature of the CPU and baseband	30
THISANTENNA	Antenna information	1421
VERSION	Version information	37

2. Commands

2.1 Overview of Commands

Tersus GNSS systems allow users to modify its configuration with command systems. Here are some general remarks on this command system:

- All commands are not case-sensitive.
- All loggings related command must specify the port related. If the port is not specified, the command is applied to current port.
- If the commands are executed successfully, the board returns OK. Otherwise, it returns an error message.

2.2 Command Reference

2.2.1 ASSIGNALL

This command is used to inquire, close and start the current satellite system status, effective immediately.

Name	Value
Command	ASSIGNALL [sys] [status]
Description	sys: GPS, GLONASS, BDS, Galileo, QZSS， SBAS status: idle (set the system channel to not track any satellites), auto (set the system channel active)
Example	assignall GPS idle

2.2.2 ASSIGNFREQ

This command is used to inquire, close and start the specified frequency, effective after **SAVECONFIG** and **RESET**.

Name	Value
Command	ASSIGNFREQ [sys] [freq] [status]
Description	sys: GPS, GLONASS, BDS, Galileo, QZSS， SBAS freq: L1, L2, L5,B1I, B2I, B2a, B3I, E1, E5a, E5b, S1， and etc. status: idle (set the system channel to not track any satellites), auto (set the system channel active)
Example 1	assignfreq
Return	ASSIGNFREQ NONE IDLE

Name	Value
Example 2	assignfreq BDS B2a idle assignfreq sbas s1 idle
Return	OK < take effect after saveconfig and reset >

2.2.3 ASSIGNLBANDBEAM

This command is for manually setting the L-band reception frequency.

Name	Value
Command	ASSIGNLBANDBEAM Name Option
Description	Name: It should be a name from LBANDBEAMTABLE, ERTAP, ARTAP, SATAP, EATAP, OCTAP, IRTAP Option: Assignment option, it can be IDLE, AUTO, MANUAL. See table of L-Band Assignment Option
Example1	ASSIGNLBANDBEAM AMSAT MANUAL
Description	manually select AMSAT as L-Band data source
Example2	ASSIGNLBANDBEAM ALLSAT AUTO
Description	enable all L-band beams
Example3	ASSIGNLBANDBEAM ALLSAT IDLE
Description	disable all L-band beams

2.2.3.1 L-Band Assignment Option

Option	Description
IDLE	Idle all L-Band channels
AUTO	The receiver searches for multiple L-Band beams on the L-Band channels based on AUTO selection criteria. The receiver would track the L-Band beam when the elevation angle is positive
MANUAL	The receiver assigns the specified beam on the first L-Band channel and makes the other L-Band channels IDLE.

2.2.4 COM

This command is to set the baud rate of the communication serial port.

Name	Value
Command	COM [port] bps
Description	If port is not specified, it indicates the current serial port. port: COM1/COM2 bps: 9600/19200/38400/57600/115200/230400/460800/921600
Example	com com1 460800

2.2.5 DISKCONTROL FILE

This command is used to generate a new file when the board is constantly powered on.

Name	Value
Command1	diskcontrol FILE auto_newpart 1
Description	Automatically generate a new file every 1 hour
Command2	diskcontrol FILE auto_newpart 24
Description	Automatically generate a new file every 24 hours
Command3	diskcontrol FILE auto_newpart
Description	This command's function is equivalent to "diskcontrol FILE auto_newpart 24" Automatically generate a new file every 24 hours
Command4	diskcontrol FILE auto_newpart disable
Description	Cancel the function of automatically generating files

This command "diskcontrol FILE auto_newpart n" takes the UTC of the file system time as the hour/day boundary.

2.2.6 DISKCONTROL FILENAME

This command is used to define a new file name, effective after **SAVECONFIG** and **RESET**.

Name	Value
Command	DISKCONTROL FILENAME define
Description	Define: Custom file name The file name cannot exceed 31 digits in length The file name should not containing special characters like .\/?*:<>” The file name supports numbers and uppercase and lowercase letter

Name	Value
Command1	DISKCONTROL FILENAME Tersus DISKCONTROL FILE_NAME Tersus
Description	Create a new file named "Tersus"
Command2	DISKCONTROL
Description	Query the current file and file name

2.2.7 DiskTimeZone

This command is used to configure the file system time (the local time zone) and UTC deviation.

Name	Value
Command1	DiskTimeZone 8
Description	Configure the file system time to East 8
Command2	DiskTimeZone -1
Description	Configure the file system time to West 1
Command3	DiskTimeZone
Description	Query the deviation of the current file system time and UTC
Example	DiskTimeZone
Return	<UTC+8; <UTC-1; etc

2.2.8 DGPSTXID

This command is used to set the DGPS station ID value for the receiver when it is transmitting corrections.

Name	Value
Command	DGPSTXID type ID
Description	* mode: see table of ID for corrections * base station ID: see table of ID for corrections
Example 1	DGPSTXID rtcm 2
Example 2	DGPSTXID rtcmv3 any

2.2.8.1 ID for corrections

Type	Valid values
AUTO	any
CMR	0~31 or any
RTCM	0~1023 or any
RTCMV3	0~4095 or any

2.2.9 ECUTOFF

This command is to set the elevation cut-off angle (unit is degree) for RTK used satellites.

Name	Value
Command	ECUTOFF [sys][angle] ECUTOFF default or ECUTOFF reset ECUTOFF
Description	sys: ALL, GPS, GLO(GLONASS), BDS(BeiDou), GAL(Galileo), QZS (QZSS), SBAS angle: 0~90deg default or reset: set the elevation cut-off angle of all constellations to 1 degree ECUTOFF only is to inquire the elevation cut-off angle for each current system.
Example	ECUTOFF GPS 1.00deg GLO 1.00deg BDS 1.00deg GAL 1.00deg

2.2.10 FIX

This command is used to fix position to the input values.

2.2.10.1 FIX NONE

This command is to cancel the fixed coordinate of a base station.

When switching the role of the board from base station to rover station, removing the fixed coordinate is necessary. In this case, use this command to remove the fixed coordinate.

2.2.10.2 FIX POSITION

This command is to fix the coordinate of a base station.

Name	Value
Command	FIX POSITION LAT LON MSL

Name	Value
Description	LAT: Latitude in degree (-90.0~90.0) LON: Longitude in degree (-180.0~180.0) MSL: Mean sea level in meter.
Example	fix position 31.24523012 121.58922341 40.35

You can fix the position of the receiver using latitude, longitude and height in Mean Seal Level (MSL) or ellipsoidal parameters depending on the **UNDULATION** setting. The factory default for the UNDULATIONcommand setting is EGM96, where the height entered in the **FIX** command is set as MSL height. If you change the UNDULATION setting to USER 0, the height entered in the **FIX** command is set as ellipsoidal height.

The values entered into the fix position command should reflect the precise position of the base station antenna phase center.

2.2.10.2.1 FIX Parameters

ASCII Type Name	Parameter 1	Parameter 2	Parameter 3
AUTO	Not used	Not used	Not used
NONE	Not used	Not used	Not used
POSITION	Lat (-90 to 90 degrees) where a '-' sign denotes south and a '+' sign denotes north	Lon (-360 to 360 degrees) where a '-' sign denotes west and a '+' sign denotes east	Default MSL height (-1000 to 20000000m)

This FIX command is also used to inquire the fix status.
Input 'fix' in the text console window, the response is as blow:
FIX POSITION NONE //for a rover
FIX POSITION fix_mode B L H //for a base
The fix mode has following four statuses.

- PENDING: The receiver has not yet achieved the computed position status, and it cannot compare the difference between the entered base coordinates and the real position.
- SOL_COMPUTED: The difference between the entered coordinates and the measured receiver coordinates is less than 25m.
- INTEGRITY_WARNING: The difference between the entered coordinates and the measured receiver coordinates is approximately 25~50m.
- INVALID_FIX: The difference between the entered coordinates and the measured receiver coordinates is larger than 50m.

2.2.11 FRESET

This command is used to clear all the data and configurations of the board or receiver, and restart it.

Name	Value
Command	FRESET
Example	freset

2.2.12 INTERFACEMODE

This command is used to query the port settings and set the port.

Name	Value
Command	interfacemode [comid] rxtype txtype response
Description	**comi**: if port is not specified, it indicates the current serial port. **rxtype**: the receive data type, specifically auto, none, trcm and tersus. auto： receive all types of data, default none: not receiving any data rtcm: differential data, contains cmr, rtcm, rtcmv3 tersus: command in tersus format **txtype**: the transmission data type, currently not in effect **response**: return value, on is available, off is not available, and on is the default
Example1	INTERFACEMODE COM1
Description1	query the default settings of the COM1 port
Return1	INTERFACEMODE COM1 AUTO AUTO ON
Example2	INTERFACEMODE COM2 RTCM AUTO
Description2	Set the COM2 port to receive only differential data, except for the interfacemode command
Return2	OK

2.2.13 LOG

This command is to request logs from the receiver.

If the log is synchronous, the trigger is ONTIME; if it is asynchronous, the trigger is ONCHANGED. The unit of period is second.

The optional parameter [hold] prevents a log from being removed when the UNLOGALL command, with its defaults, is issued. To remove a log which was invoked using the [hold] parameter requires the specific use of the UNLOG command. To remove all logs that have the [hold] parameter, use the UNLOGALL command with the held field set to TRUE.

The [port] parameter is optional. If [port] is not specified, [port] is defaulted to the port that the command was received on.

Name	Value
Command	LOG [port] message [trigger [period [offset [hold]]]]
Example	LOG [port] COM1, COM2, file0, file in which, file0 indicates the inner folder of the flash drive which is used to store the inner debug information; file indicates the user folder of the flash drive which is used by the customer.

Binary format

ID	Field	Binary value	Description	Type	Binary bytes	Binary offset
1	LOG (binary) header	See table of Binary header for logs	This filed contains the message header	-	H	0
2	port	COM1, COM2, USB or FILE	Output port	Enum	4	H
3	message	Valid message ID	Message ID of log to output	Ushort	2	H+4
4	message type	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response Bit 0 = Original Message 1 = Response Message	Message type of log	Char	1	H+6
5	Reserved			Char	1	H+7

ID	Field	Binary value	Description	Type	Binary bytes	Binary offset
6	trigger	0 = ONNEW	Does not output current message but outputs when the message is updated (not necessarily changed)	Enum	4	H+8
		1 = ONCHANGED	Outputs the current message and then continues to output when the message is changed			
		2 = ONTIME	Output on a time interval			
		4 = ONCE	Output the current message. If no message is currently present, the next message is output when available			
7	period	Valid values for the high rate logging are 0.05, 0.1, and 0.2. For logging slower than 1 Hz any integer value is accepted.	Log period (for ONTIME trigger) in seconds	Double	8	H+12
8	hold	0 = NOHOLD	Allow log to be removed by the UNLOGALL command	Enum	4	H+28

ID	Field	Binary value	Description	Type	Binary bytes	Binary offset
		1 = HOLD	Prevent log from being removed by the default UNLOGALL command			

ASCII format

ID	Field	ASCII value	Description	Format
1	LOG (ASCII) header	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII or ASCII respectively	-
2	port	COM1, COM2, USB or FILE	Output port (default = THISPORT)	Enum
3	message	Any valid message name, with an optional A or B suffix	Message name of log to output	Char [ ]
4	trigger	ONNEW	Output when the message is updated (not necessarily changed)	Enum
		ONCHANGED	Output immediately and thereafter when the message is changed	
		ONTIME	Output on a time interval	
		ONCE	Output only the current message (default). If no message is currently is present, the next message is output when available.	
5	period	Valid values for the high rate logging are 0.05, 0.1, and 0.2. For logging slower than 1 Hz any integer value is accepted.	Log period (for ONTIME trigger) in seconds	Double

ID	Field	ASCII value	Description	Format
8	hold	NOHOLD	To be removed by the UNLOGALL command (default)	Enum
		HOLD	Prevent log from being removed by the default UNLOGALL command	

2.2.14 MARKCONTROL

This command is used to control the mark inputs. Using this command, the event mark inputs can be enabled or disabled, polarity can be positive or negative, and a time offset and guard against extraneous pulses are optional.

Name	Value
Command	MARKCONTROL signal [switch[polarity[timebias [timeguard]]]]
Description	* signal: eg. MARK1, the command is applied to Mark1. * switch: eg. ENABLE, enables processing of the mark input signal (default). eg. DISABLE, the mark input signal is ignored if DISABLE is selected. * polarity: eg. NEGATIVE, the polarity of the pulse is negative (default). eg. POSITIVE, the polarity of the pulse is positive. * timebias: An offset in nanoseconds, to be applied to the time the mark pulse is input. The range is -50000000 to 50000000. * timeguard: A time period in milliseconds, during which no response to the input pulses. The range is 80 to 800.
Example	MARKCONTROL mark1 enable positive 500 100

2.2.15 MAXRTKPPPAGE

This command is used for the application of the framework.

Name	Value
Command1	MAXRTKPPPAGE 0
Description	Indicates that there is a result of PPP, and the PPP framework is directly applied. MAXRTKPPPAGE 0 (default)
Command2	MAXRTKPPPAGE X(X>0 and X<255)
Description	When the differential time of RTK is greater than X, if there is a PPP fixed solution, the PPP fixed solution is transferred to the previous RTK positioning framework, and the coordinates of the PPP fixed solution are given. the range of [X] is [1-255]. 0 is invalid.

2.2.16 NMEATALKER

This command is used to alter the behavior of the NMEA talker ID. The talker is the first 2 characters after the $ sign in the log header of the NMEA logs. The logs affected by the NMEATALKER command are GPGLL, GPGSA, GPGST, GPGSV, GPRMC, and GPVTG.

When NMEATALKER is set to GP, the NMEA messages include information only about the GPS satellites that have a 'GP' talker solution, even when the receiver is tracking multi-constellation. When NMEATALKER is set to AUTO, the NMEA talker ID changes as per the constellations enabled on the receiver. When there is one constellation in the solution, the NMEA talker ID is output as: GP for GPS, GL for GLONASS, GA for Galileo, BD for BeiDou, and GS or SBAS. If more than one constellation is in th solution, the NMEA talker ID is output as GN with the exception of GPGSV.

Name	Value
Command	nmeatalker id
Example	nmeatalker GP
Default	NMEATALKER AUTO

2.2.17 POSAVE

This command implements position averaging for base stations. Position averaging continues for a specified number of hours or until the estimated averaged position error is within specified accuracy limits.

Averaging stops when the time limit, the horizontal standard deviation limit or the vertical standard deviation limit is achieved. When averaging is complete, the FIX POSITION command is automatically invoked.

If initiating differential logging, then issue the POSAVE command followed by the SAVECONFIG command, the receiver averages positions after every power on or reset. It then invokes the FIX POSITION command to enable it to output differential corrections. POSAVE OFF can be input to erase the saved POSAVE command.

The unit of parameter 'maxtime' is hour, and is meter for 'maxhstd' (desired horizontal standard deviation 0-100m) and 'maxvstd' (desired vertical standard deviation 0-100m). The minimal value of 'maxtime' is 0.01, that is, 36 seconds.

Name	Value
Command	POSAVE state [maxtime [maxhstd [maxvstd]]] avemode

Name	Value
Description	* state: ON (Implements position averaging for base stations.) OFF (Disable position averaging.) * maxtime: 0.01-100, amount of time that positions are to be averaged, unit is hour (default=0.0) * maxhstd: 0 - 100 m, Desired horizontal standard deviation (default = 0.0) * maxvstd: 0 - 100 m, Desired vertical standard deviation (default = 0.0) * avemode: - : Use single result to get averaging position (default) ; RTK: Use RTK result to get averaging position according to the fixed solution PPP:Use PPP result to get averaging position according to the fixed solution SPP: Use SPP result to get averaging position according to the fixed solution in the specified period if OEM board receives differential corrections.
Example	POSAVE on 0.2 1 2 POSAVE on 0.01 0.05 0.05 RTK POSAVE on 0.01 0.05 0.05 PPP POSAVE on 0.01 0.05 0.05 SPP

Type below command:
POSAVE
to check whether the current status of POSAVE is ON or OFF.

2.2.18 PPPSOURCE

This command is used to query and set the status of the tapsat and ntrip service.

Name	Value
Command	PPPSOURCE TapSat [enable/disable] Ntrip [disable/enable]
Description	enable or disable Tapsat satellite tracking (enable by default), disable or enable ntrip-TAP service (disable by default) when ntrip-TAP is enabled, Tapsat is disabled by default and TAP service can only be accessed through ntrip-TAP
Example1	pppsource ntrip enable com1
Description	This command is sent when the ntrip-TAP service needs to beactived
Return	No return printing
Example2	PPPSOURCE
Description	query the status of the Tapsat and ntrip service
Return	PPPSOURCE TapSat ENABLE Ntrip DISABLE

2.2.19 PPSCONTROL

This command is used to control the polarity, period and pulse width of the PPS output signal, the unit of period is millisecond, the unit of pulse width is microsecond.

Name	Value
Command	PPSCONTROL [switch [polarity [period [pulse width]]]]
Description	* switch: Enable: Enable the PPS (default) Disable: Disable the PPS * polarity: NEGATIVE: Set the polarity to negative level (default) POSITIVE: Set the polarity to positive level * period: Specify the period of the pulse, in millisecond, can be 50, 100, 125, 200, 250, 500, 1000, default=1000. * pulse width: Optional field to specify the pulse width of the PPS signal, unit is microseconds, default=1000.
Example	PPSCONTROL enable positive 1000 500000

2.2.20 PSRDIFFTIMEOUT

This command is used to set the maximum age of pseudorange differential correction data to use when operating as a rover station. Pseudorange differential correction data whose age is more than this value will not be used by the rover. The default delay is 180 seconds.

Name	Value
Command	PSRDIFFTIMOUT delay
Description	delay: the maximum age value of pseudorange differential data.
Example	psrdifftimeout 180

2.2.21 RESET

This command is to perform a software reset. No data saved in the flash memory (such as almanac and ephemeris dat, or the configuration) will be erased.

Name	Value
Command	RESET
Example	reset

2.2.22 RTKANTENNA

This command is to specify whether to use L1 phase center or Antenna Reference Point(ARP) positioning.

Name	Value
Command1	RTKANTENNA L1PC
Description	L1 phase center position reference（factory dafault）
Command2	RTKANTENNA ARP
Description	ARP position reference Configuring ARP will require configuring either THISANTENNATYPE or THISANTENNAPCO, otherwise it will not take effect

2.2.23 RTKQUALITYLEVEL

This command is to query RTK quality level or set RTK quality level. There are three levels as follows.
Rapid Fix: With it, you can get stable fixed solutions much faster. The fixed threshold is slightly lower, and so is the confidence of the results.
Extreme Reliable: The results are very reliable, but it may take some time to get fixed solutions, especially in a challenging environment. The fixed threshold is high, and so is the confidence of the results.
Balance: It is the default setting, and the effect is somewhere in between the above two modes.

Name	Value
Command	RTKQUALITYLEVEL [level0/level1/level2]
Description	level0: Rapid Fix, the receiver enters fixed priority mode to get a fixed solution faster. level1: Balance. level2: Extreme Reliable, the receiver is fixed with guaranteed accuracy.
Example	rtkqualitylevel (this query command will return a response of level0, levle1 or level2) rtkqualitylevel level0 (set quality level as Rapid Fix) rtkqualitylevel level1 (set quality level as Balance) rtkqualitylevel level2 (set quality level as Extreme Reliable)

2.2.24 RTKRESET

This command is to reset the RTK engine and cause the ExtremeRTK engine to undergo a complete reset, forcing the system to restart the ambiguity resolution calculations .

Name	Value
Command	RTKRESET
Example	rtkreset

2.2.25 RTKTIMEOUT

This command is to set the maximum age of RTK data to use when operating as a rover station.

Name	Value
Command	RTKTIMOUT delay
Description	delay: maximum RTK data age (5 to 300) (unit second).
Example1	rtktimeout 300
Example2	rtktimeout 60 (default)

2.2.26 SAVECONFIG

This command is used to save current configuration. The saved configurations are still valid even if the board or receiver is rebooted.

Name	Value
Command	SAVECONFIG
Example	saveconfig

2.2.27 SETSTREAMFROMVRS

This command is to label differential data from the Virtual Reference Station(VRS) results.

Name	Value
Command1	SetStreamFromVRS true
Description	Config VRS mode
Command2	SetStreamFromVRS false
Description	Cancel VRS mode

2.2.28 SETUSERLBANDBEAM

This command is used to customised L-Band satellites.

Name	Value
Command	setuserlbandbeam [name][frequency][baudrate][ScrambTableID]
Description	Customised L-Band satellites

2.2.29 SHOWCONFIG

This command is to show all the configurations of the receiver.

Name	Value
Command	SHOWCONFIG
Example	showconfig

2.2.30 THISANTENNAPCO

This command is used to set the Phase Center Offsets (PCO) for the given frequency.

Name	Value
Command	THISANTENNAPCO Frequency [NorthOffset] [EastOffset] [UpOffset]
Description	The offsets are defined as North, East, and Up from the Antenna Reference Point to the Frequency Phase Center in mm
Example	THISANTENNAPCO GPSL1 0.61 1.99 65.64

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	THISANTENNAPCO header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary	-	H	0
2	Frequency	See table Frequency Type	See table Frequency Type	The frequency for which the phase center offsets are valid	Enum	4	H

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
3	NorthOffset			NGS standard Phase Center North Offset (millimeters) Enter values as per the NGS standards and tables to define which direction is plus or minus	Double	8	H+4
4	EastOffset			NGS standard Phase Center East Offset (millimeters) Enter values as per the NGS standards and tables to define which direction is plus or minus	8	H+12	
5	UpOffset			NGS standard Phase Center Up Offset (millimeters) Enter values as per the NGS standards and tables to define which direction is plus or minus	8	H+20	

2.2.30.1 Ferquency Type

Value	Name	Description
0	GPSL1	GPS L1 frequency
1	GPSL2	GPS L2 frequency
2	GPSL5	GPS L5 frequency
3	GLOL1	GLONASS L1 frequency
4	GLOL2	GLONASS L2 frequency
5	BDSB1	BeiDou B1 frequency
6	BDSB2	BeiDou B2 frequency
7	BDSB2A	BeiDou B2A frequency
8	BDSB3	BeiDou B3 frequency
9	GALE1	Galileo E1 frequency
10	GALE5B	Galileo E5b frequency
11	GALE5A	Galileo E5a frequency

2.2.31 THISANTENNASET

This command is used to configure the height information of the antenna, which can be transmitted with RTCM1006 and CMRREF. This command is valid only for a base station.

Name	Value
Command	THISANTENNASET height X
Description	X: Valid value is 0 to 10, unit is meter.
Example	THISANTENNASET height 0.000000

2.2.32 THISANTENNATYPE

This command is used to set the antenna type of this receiver, effective after **SAVECONFIG** and **RESET**.
The antenna and random types are the IGS names for the antenna. If no user-defined antenna types are input, the antenna type broadcasted by Tersus receivers will be advnullantenna. This information will be broadcasted with RTCM1007, RTCM1008, RTCM1033 and CMRDES.

To set the antenna type, you have to go to NGS website (https://www.ngs.noaa.gov/ANTCAL/index.xhtml) to get the type and random names of the antenna.

Name	Value
Command	THISANTENNATYPE ANTENNATYPE [random type] [setup id] [serial no]
Description	* antenna type: specify the antenna type, see table of Antenna Type * random type: the antenna type in NGS website. * setup id: the antenna random type in NGS website. 0: model for NGS. * serial no: default is the serial number of the antenna
Example	THISANTENNATYPE ADVNULLANTENNA none 0

2.2.33 UNDULATION

This command allows users to enter a specific geoidal undulation value. Four options are provided in the option field: the EGM96 table provides ellipsoid heights at a 1degree by 1degree spacing; the OSU89B table provides ellipsoid height at a 2degrees by 3degrees spacing; GSIGEO2011 is the geoidal model for Japan; users can use the specific undulation value. The default is EGM96.

The relation between ellipsoid height and mean sea-level (MSL) height is:

h = H + N

N = geoid/ellipsoid separation or geoid undulation
H = mean sea-level height or geoid height (height above the geoid)
h = ellipsoidal height (height above ellipsoid)

Name	Value
Command	UNDULATION option [separation]
Description	option: * EGM96, default * OSU89B, use the OSU89B undulation table * GSIGEO2011, the model can be found in http://www.gsi.go.jp/buturisokuchi/geoid.html * USER, use the user specified undulation value separation: required when USER option is selected. If type undulation only, it is to inquire the geoidal undulation.
Example	undulation user -1.006

2.2.34 UNLOG

This command is to stop specified output, which is cancelling particular output.

Name	Value
Command	UNLOG port message
Description	* port: COM1 / COM2 / USB / FILE * message: NMEA message / rtcm message / observation message
Example	unlog com1 gpgga

2.2.35 UNLOGALL

This command is to stop all output from specified port.

Name	Value
Command	UNLOGALL [port] [held]
Description	* port: COM1 / COM2 / USB / FILE * held: FALSE: Does not remove logs with the HOLD parameter (default). TRUE: Remove previously held logs, even those with the HOLD parameter.
Example	unlogall

2.2.36 USERDATUM

This command is to set user customized ellopsoid and datum transformation.

Name	Value
Command	USERDATUM semimajor flattening dx dy dz rx ry rz scale [vx] [vy] [vz] USERDATUM CGCS2000 dx dy dz rx ry rz scale [vx] [vy] [vz]
Example 1	USERDATUM 6378137.0 298.257222101 0.0 0.0 0.0 0.0 0.0 0.0 0.0 USERDATUM CGCS2000 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Description	set ellopsoid and datum transformation
Example 2	USERDATUM
Description	query the currently set parameters
Example 3	USERDATUM OFF
Description	close the datum transformation

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header			USERDATUM header		H	0
2	Semimajor	6378137.0	6378137.0	Datum semimajor (meters) The only ellipsoid currently supported is CGCS2000(ITRF97). The value must be 6378137.0 or the setting is invalid. Subsequently expandable	Double	8	H
3	Flattening	298.257222101	298.257222101	Reciprocal flattening The only ellipsoid currently supported is CGCS2000(ITRF97). The value must be 298.257222101 or the setting is invalid. Subsequently expandable	Double	8	H+8
4	dx	±2000.0	±2000.0	Translation values(meters)	Double	8	H+16
5	dy	±2000.0	±2000.0	Translation values(meters)	Double	8	H+24
6	dz	±2000.0	±2000.0	Translation values(meters)	Double	8	H+32

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
7	rx	±10.0 radians	±10.0 radians	Datum rotation angles. A positive sign is for counter clockwise rotation and a negative sign is for clockwise rotation	Double	8	H+40
8	ry	±10.0 radians	±10.0 radians	Datum rotation angles. A positive sign is for counter clockwise rotation and a negative sign is for clockwise rotation	Double	8	H+48
9	rz	±10.0 radians	±10.0 radians	Datum rotation angles. A positive sign is for counter clockwise rotation and a negative sign is for clockwise rotation	Double	8	H+56
10	scale	±10.0 ppm	±10.0 ppm	Scale values is the difference in ppm	Double	8	H+64
11	vx			Velocity field in mm, or 0 if not entered			
12	vy			Velocity field in mm, or 0 if not entered			
13	vz			Velocity field in mm, or 0 if not entered			

3. Logs

3.1 Log reference

Logs are used to extract information from the board or receiver.

3.1.1 AUTHLIST

This log contains the serial number of the board and the expired date of the current authcode. A new authcode must be input if the current authcode is expired, otherwise, the board cannot work.

This output of AUTHLIST can support ASCII or abbr. ASCII, binary format is not supported.

Name	Value
Message ID	1348
Input	log authlist
Function	Serial number and the current authcode
Example output	>AUTHLIST COM1 0 0.0 FINE 2273 370400.000 00000000 0 1 <s/n:034001222600000008 <tap-serial: 341008 <type:factory <key:2BBDE7E13DFA2236765D1A6EBE4F6A45CE413A2D24C5571E58E5ECC92C2CFF6BD97C5B395EE0D0769F1711FB70EA6E9E9331F3DE9B6F545D5374D917266E9E73 <status:valid level:4 expiredday:2099/12/31 group:0 groupnum:0 <l-band:subscripted mode:PPP-AR expiredday:2023/08/21

ID	Field	Description	Format
1	authlist header	Log header	
2	S/N	Serial number of the board	Char[]
3	Current authcode status	Current authcode and its status	

3.1.2 BDSEPHEMERIS

This log contains a single set of BDS ephemeris parameters with appropriate scaling applied. Multiple messages are transmitted, one for each SV ephemeris collected.

Name	Value
Message ID	1696
Input	log bdsephemerisa onchanged

Name	Value
Function	Decoded BDS ephemeris
Example output	<BDSEPHEMERIS,COM2,0,0.0,FINE,2124,182380.000,00000000,0,1; < 189 768 1.00 0 1.00e-10 1.00e-10 1 180000 2.87133618e-04 5.10969045e-12 0.00000000e+00 1 180000,5282.622843 2.2837857250e-04 2.019816654 3.6744387694e-09 8.0463641535e-01 2.2276588124e-01 -6.9845766499e-09 9.6570153515e-01 -3.3644258561e-10 -5.7970173657e-06 6.0047022998e-06 2.4534375000e+02 -1.1475000000e+02 7.9628080130e-08 4.0512531996e-08 <BDSEPHEMERIS,COM2,0,0.0,FINE,2124,182380.000,00000000,0,1; < 182 768 1.00 0 1.61e-08 1.61e-08 1 180000 -7.66918645e-04 -2.19024798e-12 0.00000000e+00 1 180000,5282.613285 5.8900180738e-04 0.215837253 4.0769555358e-09 -2.7151473990e-01 2.3346671123e+00 -6.9285028857e-09 9.6354019365e-01 2.4643883660e-10 -5.4249539971e-07 6.0130842030e-06 2.3973437500e+02 -1.3109375000e+01 1.9557774067e-08 -4.6566128731e-08 <BDSEPHEMERIS,COM2,0,0.0,FINE,2124,182380.000,00000000,0,1; < 181 768 1.00 0 1.45e-08 1.45e-08 1 180000 -6.82038488e-04 -6.72972789e-12 0.00000000e+00 1 180000,5282.616974 5.0850666594e-04 -0.581630548 4.0765983781e-09 -2.5616244601e-01 2.3347534113e+00 -6.9992201170e-09 9.6353069785e-01 2.4251010152e-10 -6.1932951212e-07 5.6340359151e-06 2.4340625000e+02 -1.3546875000e+01 -5.9604644775e-08 3.2596290112e-09 <BDSEPHEMERIS,COM2,0,0.0,FINE,2124,182380.000,00000000,0,1; < 180 768 1.00 0 2.31e-08 2.31e-08 1 180000 -8.46382114e-04 -5.47295542e-12 0.00000000e+00 1 180000,5282.615583 6.2100228388e-04 -0.391262484 4.1019565772e-09 1.8893138668e+00 2.3329209440e+00 -6.9085020526e-09 9.6424592727e-01 2.0679432810e-10 -7.9162418842e-07 6.0703605413e-06 2.3879687500e+02 -1.2593750000e+01 1.5832483768e-08 -5.5879354477e-09 <BDSEPHEMERIS,COM2,0,0.0,FINE,2124,182380.000,00000000,0,1; < 179 768 1.00 0 1.23e-08 1.23e-08 1 180000 5.54888393e-04 1.36388678e-11 0.00000000e+00 1 180000,5282.611227 6.0118071269e-04 -1.005527037 4.1151714134e-09 1.7396561521e+00 2.3323003947e+00 -6.8910013236e-09 9.6424734923e-01 2.2000916426e-10 -7.3900446296e-07 6.0973688960e-06 2.4101562500e+0

ID	Field	Description	Type	Binary Bytes	Offset
1	BDSEPHEMERIS header	Log header		H	0
2	satellite ID	ID/ranging code, start from 161	Ulong	4	H
3	Week	Week number	Ulong	4	H+4
4	URA	User range accuracy (metres). This is the evaluated URAI/URA lookup-table value.	Double	8	H+8

ID	Field	Description	Type	Binary Bytes	Offset
5	health 1	Autonomous satellite health flag. 0 means broadcasting satellite is good and 1 means not.	Ulong	4	H+16
6	tgd1	Equipment group delay differential for the B1 signal (seconds)	Double	8	H+20
7	tgd2	Equipment group delay differential for the B2 signal (seconds)	Double	8	H+28
8	AODC	Age of data, clock	Ulong	4	H+36
9	toc	Reference time of clock parameters (seconds)	Ulong	4	H+40
10	a_0	Constant term of clock correction polynomial (seconds)	Double	8	H+44
11	a_1	Linear term of clock correction polynomial (seconds/ seconds)	Double	8	H+52
12	a_2	Quadratic term of clock correction polynomial (seconds/ seconds^2)	Double	8	H+60
13	AODE	Age of data, ephemeris	Ulong	4	H+68
14	toe	Reference time of clock parameters	Ulong	4	H+72
15	RootA	Square root of semi-major axis (sqrt(metres))	Double	8	H+76
16	ecc	Eccentricity (sqrt(metres))	Double	8	H+84
17	ω	Argument of perigee	Double	8	H+92
18	ΔN	Mean motion difference from computed value (radians/ second)	Double	8	H+100
19	M0	Mean anomaly at reference time (radians)	Double	8	H+108

ID	Field	Description	Type	Binary Bytes	Offset
20	Ω0	Longitude of ascending node of orbital of plane computed according to reference time (radians)	Double	8	H+116
21	'Ω	Rate of right ascension (radians/second)	Double	8	H+124
22	i_0	Inclination angle at reference time (radians)	Double	8	H+132
23	IDOT	Rate of inclination angle (radians/second)	Double	8	H+140
24	c_{uc}	Amplitude of cosine harmonic correction term to the argument of latitude (radians)	Double	8	H+148
25	c_{us}	Amplitude of sine harmonic correction term to the argument of latitude (radians)	Double	8	H+156
26	c_{rc}	Amplitude of cosine harmonic correction term to the orbit radius (metres)	Double	8	H+164
27	c_{rs}	Amplitude of sine harmonic correction term to the orbit radius (metres)	Double	8	H+172
28	c_{ic}	Amplitude of cosine harmonic correction term to the angle of inclination (radians)	Double	8	H+180
29	c_{is}	Amplitude of sine harmonic correction term to the angle of inclination (radians)	Double	8	H+188
30	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+196
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.3 BDSIONO

This log contains the ionosphere parameters transmitted by BeiDou satellites.

Name	Value
Message ID	1590
Input	log bdsionoa onchanged
Function	Ionosphere parameter transmitted by Beidou satellites
Example output	#BDSIONOA,COM2,0,0.0,FINESTEERING,2024,356755.000,00000000,1025,20161214; 161, 8.381903171539307e-09,1.490116119384766e-07,-1.370906829833984e-06, 2.741813659667969e-06,1.064960000000000e+05,-3.112960000000000e+05, 7.864320000000000e+05,-6.553600000000000e+0

ID	Field	Description	Type	Binary Bytes	Offset
1	BDSIONO header	Log header		H	0
2	ID	Transmitting satellite ID	Ulong	4	H
3	α0	Klobuchar cosine curve amplitude constant term (seconds)	Double	8	H+4
4	α1	Klobuchar cosine curve amplitude first-order term (seconds/π)	Double	8	H+12
5	α2	Klobuchar cosine curve amplitude second-order term (seconds/π2)	Double	8	H+20
6	α3	Klobuchar cosine curve amplitude third-order term (seconds/π3)	Double	8	H+28
7	β0	Klobuchar cosine curve period constant term (seconds)	Double	8	H+36
8	β1	Klobuchar cosine curve period first-order term (seconds/π)	Double	8	H+44
9	β2	Klobuchar cosine curve period second-order term (seconds/π2)	Double	8	H+52
10	β3	Klobuchar cosine curve period third-order term (seconds/π3)	Double	8	H+60
11	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+68
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.4 BESTPOS

This log contains the best position solution computed by the receiver. It also reports several status indicators, including differential age. A differential age of 0 indicates that no differential correction was used.

Name	Value
Message ID	42
Input	log bestpos ontime 1
Function	Best position
Example output	>BESTPOS COM2 0 0.0 FINE 2148 206982.000 00000000 0 1 < SOL_COMPUTED,PPP_AR,31.19041508349,121.59319713961,29.1980 11.5176 WGS84 0.0034 0.0031 0.0068 "0000" 2.001 0.000 48 37 37 37 0 00 30 33

ID	Field	Description	Type	Binary Bytes	Offset
1	BESTPOS header	Log header		H	0
2	sol stat	Solution status, see table of Solution Status	Enum	4	H
3	pos type	Position type, see table of Position or Velocity Type	Enum	4	H+4
4	lat	Latitude (degrees)	Double	8	H+8
5	lon	Longitude (degrees)	Double	8	H+16
6	hgt	Height above mean sea level (meters)	Double	8	H+24
7	undulation	Undulation - the relationship between the geoid and the ellipsoid (m) of the chosen datum	Float	4	H+32
8	datum id#	Datum ID number	Enum	4	H+36
9	lat σ	Latitude standard deviation (m)	Float	4	H+40
10	lon σ	Longitude standard deviation (m)	Float	4	H+44
11	hgt σ	Height standard deviation (m)	Float	4	H+48
12	Stn id	Base station ID	Char[4]	4	H+52
13	diff_age	Differential age in seconds	Float	4	H+56

ID	Field	Description	Type	Binary Bytes	Offset
14	sol_age	Solution age in seconds	Float	4	H+60
15	#SVs	Number of satellites tracked	Uchar	1	H+64
16	#solnSVs	Number of satellites used in solution	Uchar	1	H+65
17	#solnL1SVs	Number of satellites with L1/E1/B1 signals used in solution	Uchar	1	H+66
18	#solnMultiSVs	Number of satellites with multi-frequency signals used in solution	Uchar	1	H+67
19	Reserved		Hex	1	H+68
20	ext sol stat	Extended solution status	Hex	1	H+69
21	Galileo and BDS sig mask	Galileo and BDS signals used mask (see Table of BESTPOS Galileo and BDS Signal-Used Mask)	Hex	1	H+70
22	GPS and GLONASS sig mask	GPS and GLONASS signals used mask (see table of BESTPOS GPS and GLONASS Signal-Used Mask)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.4.1 Solution Status

Binary	ASCII	Description
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
2	NO_CONVERGENCE	No convergence
3	SINGULARITY	Singularity at parameters matrix
4	COV_TRACE	Covariance trace exceeds maximum (trace > 1000 m)

Binary	ASCII	Description
5	TEST_DIST	Test distance exceeded (maximum of 3 rejections if distance >10 km)
6	COLD_START	Not yet converged from cold start
7	V_H_LIMIT	Height or velocity limits exceeded (in accordance with export licensing restrictions)
8	VARIANCE	Variance exceeds limits
9	RESIDUALS	Residuals are too large
11	SOL_STATUS_ INSUFFICIENT_OBS_RTK	Insufficient common observations for RTK
13	INTEGRITY_WARNING	Large residuals make position unreliable
18	PENDING	When a FIX POSITION command is entered, the receiver computes its own position and determines if the fixed position is valid
19	INVALID_FIX	The fixed position, entered using the **FIX position** command, is not valid
20	UNAUTHORIZED	Position type is unauthorized
21	Reserved	
22	INVALID_RATE	The selected logging rate is not supported for this solution type.

3.1.4.2 Position or Velocity Type

Binary	ASCII	Description
0	NONE	No solution
1	FIXEDPOS	Position has been fixed by the FIX POSITION command
2	FIXEDHEIGHT	Position has been fixed by the **FIX height** or **FIX auto** command
4	FLOATCONV	Solution from floating point carrier phase ambiguities
5	WIDELANE	Solution from wide-lane ambiguities
6	NARROWLANE	Solution from narrow-lane ambiguities
8	DOPPLER_VELOCITY	Velocity computed using instantaneous Doppler
16	SINGLE	Single point position
17	PSRDIFF	Pseudorange differential solution

Binary	ASCII	Description
18	WAAS	Solution calculated using corrections from an WAAS
19	PROPAGATED	Propagated by a Kalman filter without new observations
20-31	Reserved	
32	L1_FLOAT	Floating L1 ambiguity solution
33	IONOFREE_FLOAT	Floating ionospheric-free ambiguity solution
34	NARROW_FLOAT	Floating narrow-lane ambiguity solution
35-47	Reserved	
48	L1_INT	Integer L1 ambiguity solution
49	WIDE_INT	Integer wide-lane ambiguity solution
50	NARROW_INT	Integer narrow-lane ambiguity solution
68	PPP_CONVERGING	PPP_CONVERGING solution, PPP hasn't converged yet
69	PPP	PPP solution, PPP is converging
72	PPP_AR	PPP_AR solution, PPP fixed

3.1.4.3 BESTPOS GPS and GLONASS Signal-Used Mask

Bit	Mask	Description
0	0x01	GPS L1 used in Solution
1	0x02	GPS L2 used in Solution
2	0x04	GPS L5 used in Solution
3	0x08	Reserved
4	0x10	GLONASS L1 used in Solution
5	0x20	GLONASS L2 used in Solution
6-7	0x40-0x80	Reserved

3.1.4.4 BESTPOS Galileo and BDS Signal-Used Mask

Bit	Mask	Description
0	0x01	Galileo E1 used in Solution
1	0x02	Galileo E5a used in Solution
2	0x04	Galileo E5b used in Solution

Bit	Mask	Description
3	0x08	Reserved
4	0x10	BeiDou B1 used in Solution
5	0x20	BeiDou B2 used in Solution
6	0x40	BeiDou B3 used in Solution
7	0x80	Reserved

3.1.5 BESTVEL

This log contains the best available velocity information computed by the receiver. In addition, it reports a velocity status indicator, which is useful to indicate whether or not the corresponding data is valid.
Velocity calculations are computed from the Doppler measurements.

Name	Value
Message ID	99
Input	log bestvel ontime 1
Function	Best available velocity data
Example output	>BESTVEL COM1 0 0.0 FINE 2148 204787.000 00000000 0 1 < SOL_COMPUTED SINGLE 0.000 0.000 0.0025 0.000000 0.0081 0.0

ID	Field	Description	Type	Binary Bytes	Offset
1	BESTVEL header	Log header		H	0
2	sol stat	Solution status, see table of Solution Status	Enum	4	H
3	pos type	Position type, see table of Position or Velocity Type	Enum	4	H+4
4	latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results (s)	Float	4	H+8
5	age	Differential age in seconds	Float	4	H+12
6	hor spd	Horizontal speed over ground, in metres per second	Double	8	H+16

ID	Field	Description	Type	Binary Bytes	Offset
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	Double	8	H+32
9	Reserved		Float	4	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.6 BESTXYZ

This log contains the receiver's best available position and velocity in ECEF coordinates. The position and velocity status fields indicate whether or not the corresponding data is valid.
The velocity in this log is determined by the pseudorange filter. Velocities from the pseudorange filter are calculated from the Doppler.

Name	Value
Message ID	241
Input	log bestxyz ontime 1
Function	Best available Cartesian position and velocity
Example output	>BESTXYZ COM2 0 0.0 FINE 2148 207263.000 00000000 0 1 < SOL_COMPUTED NARROW_INT -2860997.8743 4651725.9285 3283991.5233 0.0039 0.0055 0.0042 SOL_COMPUTED SINGLE 0.0086 -0.0142 -0.0037 0.0051 0.0040 0.0096 "0000" 0 2.001 0.000 48 37 37 37 0 00 30 33

ID	Field	Description	Type	Binary Bytes	Offset
1	BESTXYZ header	Log header		H	0
2	P-sol status	Solution status, see table of Solution Status	Enum	4	H
3	pos type	Position type, see table of Position or Velocity Type	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8

ID	Field	Description	Type	Binary Bytes	Offset
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P-Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status, see table of Solution Status	Enum	4	H+44
11	Vel type	Velocity type, see table of Position or Velocity Type	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m/s)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m/s)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m/s)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m/s)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m/s)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m/s)	Float	4	H+84
18	stn ID	Base station identification	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#SVs	Number of satellites tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	#ggL1	Number of GPS plus GLONASS plus BDS L1/B1 used in solution	Uchar	1	H+106

ID	Field	Description	Type	Binary Bytes	Offset
25	#solnMultiSVs	Number of satellites with L1/E1/B1 signals used in solution	Uchar	1	H+107
26	Reserved		Char	1	H+108
27	ext sol stat	Extended solution status	Hex	1	H+109
28	Galileo and BDS sig mask	Galileo and BDS signals used mask (see table of BESTPOS Galileo and BDS Signal-Used Mask)	Hex	1	H+110
29	GPS and GLONASS sig mask	GPS and GLONASS signals used mask (see table of BESTPOS GPS and GLONASS Signal-Used Mask)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.7 BESTXYZ2

This log is an extension of BESTXYZ with extra fields related to delta-P. Delta-P is defined as position changes in ECEF coordinates during last interval time. Divide delta-P by time interval equals average velocity during last interval time.
Please note the difference with the fields related to V, which is instant velocity of current moment, calculated with doppler observations.

Name	Value
Message ID	242
Input	log bestxyz2 ontime 1
Example output	>BESTXYZ2 COM2 0 0.0 FINE 2314 371728.000 00000000 0 1 < SOL_COMPUTED PPP_AR -2860998.4045 4651725.0645 3283992.2028 0.0105 0.0176 0.0122 SOL_COMPUTED SINGLE 0.0018 -0.0046 -0.0075 0.0032 0.0037 0.0036 VALID 0.0000 -0.0013 -0.0021 0.0018 0.0017 0.0017 "5002"6.000 1000 49 33 33 33 0 0 30 33

ID	Field	Description	Type	Binary Bytes	Offset
1	BESTXYZ2 header	Log header		H	0
2	P-sol status	Solution status, see table of Solution Status	Enum	4	H
3	pos type	Position type, see table of Position or Velocity Type	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P-Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status, see table of Solution Status	Enum	4	H+44
11	Vel type	Velocity type, see table of Position or Velocity Type	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m/s)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m/s)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m/s)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m/s)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m/s)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m/s)	Float	4	H+84
18	delta P-sol status	Position difference type 0: invalid; 1:valid	Enum	4	H+88
19	delta P-X	delta Position X-coordinate (m)	Double	8	H+92
20	delta P-Y	delta Position Y-coordinate (m)	Double	8	H+100

ID	Field	Description	Type	Binary Bytes	Offset
21	delta P-Z	delta Position Z-coordinate (m)	Double	8	H+108
22	delta P-X σ	Standard deviation of delta P-X (m)	Float	4	H+116
23	delta P-Y σ	Standard deviation of delta P-Y (m)	Float	4	H+120
24	delta P-Z σ	Standard deviation of delta P-Z (m)	Float	4	H+124
25	stn ID	Base station identification	Char[4]	4	H+128
26	Min_age	Differential age in seconds	Float	4	H+132
27	Interval	Time interval for delta position difference. Unit:ms	Short	2	H+136
28	#SVs	Number of satellites tracked	Uchar	1	H+138
29	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+139
30	#ggL1	Number of GPS plus GLONASS plus BDS L1/B1 used in solution	Uchar	1	H+140
31	#solnMultiSVs	Number of satellites with L1/E1/B1 signals used in solution	Uchar	1	H+141
32	Reserved		Char	1	H+142
33	Reserved		Char	1	H+143
34	Galileo and BDS sig mask	Galileo and BDS signals used mask (see table of BESTPOS Galileo and BDS Signal-Used Mask)	Hex	1	H+144
35	GPS and GLONASS sig mask	GPS and GLONASS signals used mask (see table of BESTPOS GPS and GLONASS Signal-Used Mask)	Hex	1	H+145
36	Reserved		Char	1	H+146
37	Reserved		Char	1	H+147

3.1.8 CMRGLOOBS

This log is to output GLONASS observations in CMR format.

Name	Value
Message ID	104
Input	log cmrgloobs ontime x
Function	Output GLONASS observations in CMR format
Example output	Input:log cmrgloobs ontime 1 <OK

3.1.9 GALINAVEPHEMERIS

This log contains the Galileo INAV ephemeris information. Multiple messages are transmitted, one for each SVID with date.

Name	Value
Message ID	1309
Input	log galinavephemeris onchanged
Function	Decoded Galileo INAV ephemeris

Name	Value
Example output	<GALINAVEEPHEMERIS,COM2,0,0.0,FINE,2124,181845.000,00000000,0,1; < 27 0 0 0 0 0 0 0 0 45 3 3 180600 180600 -2.168046802e+00 3.028697586e-09 3.497112775e-04 5.440618469e+03 9.803480310e-01 1.717928701e-10 -1.398325957e+00 -1.413054413e+00 -5.635591888e-09 6.575137377e-06 6.072223186e-06 2.183750000e+02 1.404062500e+02 -0.000000047 -1.676380634e-08 1.290835789e-04 -8.029133e-12 0.00000e+00 -4.657e-10 -4.657e-10 <GALINAVEEPHEMERIS,COM2,0,0.0,FINE,2124,181845.000,00000000,0,1; < 15 0 0 0 0 0 0 0 0 45 3 3 180600 180600 -2.287300915e+00 2.393671135e-09 1.627230085e-04 5.440601952e+03 9.925867174e-01 -5.964534161e-11 6.826605164e-01 -2.573989129e+00 -5.229860702e-09 -5.517154932e-06 9.732320905e-06 1.517187500e+02 -1.194062500e+02 -0.000000030 -1.322478056e-07 8.515709778e-04 -1.492140e-12 0.00000e+00 3.958e-09 4.424e-09 <GALINAVEEPHEMERIS,COM2,0,0.0,FINE,2124,181845.000,00000000,0,1; < 5 0 0 0 0 0 0 0 0 39 3 3 177000 177000 -5.082165411e-02 3.661938249e-09 1.060520299e-04 5.440614738e+03 9.544220140e-01 -1.507205638e-10 2.790713746e+00 4.792686342e-01 -5.760954253e-09 -1.773238182e-06 6.707385182e-06 1.973750000e+02 -3.606250000e+01 0.000000017 2.607703209e-08 -3.441217123e-04 3.112177e-12 0.00000e+00 1.397e-09 1.630e-09 <GALINAVEEPHEMERIS,COM2,0,0.0,FINE,2124,181845.000,00000000,0,1; < 3 0 0 0 0 0 0 0 0 39 3 3 177000 177000 -7.365141706e-01 3.668367088e-09 3.284568666e-04 5.440614939e+03 9.544082801e-01 -1.164334213e-10 2.790723801e+00 3.749178786e-01 -5.791312660e-09 -1.672655344e-06 6.521120667e-06 1.987812500e+02 -3.800000000e+01 0.000000024 -1.490116119e-08 -3.454764956e-04 -4.234835e-12 0.00000e+00 9.313e-10 1.164e-09

ID	Field	Description	Type	Binary Bytes	Offset
1	GALINAVEPHEMERIS header	Log header		H	0
2	SatId	Satellite identifier	Ulong	4	H
3	E5bHealth	E5b health status bits	Uchar	1	H+4
4	E5bDVS	E5b data validity status	Uchar	1	H+5
5	Reserved		Uchar	1	H+6
6	Reserved		Uchar	1	H+7
7	E1bHealth	E1b health status bits	Uchar	1	H+8
8	E1bDVS	E1b data validity status	Uchar	1	H+9
9	Reserved		Uchar	1	H+10

ID	Field	Description	Type	Binary Bytes	Offset
10	Reserved		Uchar	1	H+11
11	IODnav	Issue of data ephemeris	Ushort	2	H+12
12	SISA Index	Signal in space accuracy (unitless)	Uchar	1	H+14
13	INAV Source	Identifies the source signal: 0 = Unknown 1 = E1b 2 = E5b 3 = E1b and E5b	Uchar	1	H+15
14	T0e	Ephemeris reference time (s)	Ulong	4	H+16
15	T0c	Clock correction data reference time of week from the I/NAV message (s)	Ulong	4	H+20
16	M0	Mean anomaly at ref time (radians)	Double	8	H+24
17	DeltaN	Mean motion difference (radians/s)	Double	8	H+32
18	Ecc	Eccentricity (unitless)	Double	8	H+40
19	RootA	Square root of semi-major axis	Double	8	H+48
20	I0	Inclination angle at ref time (radians)	Double	8	H+56
21	IDot	Rate of inclination angle (radians/s)	Double	8	H+64
22	Omega0	Longitude of ascending node of orbital plane at weekly epoch (radians)	Double	8	H+72
23	Omega	Argument of perigee (radians)	Double	8	H+80
24	OmegaDot	Rate of right ascension (radians/s)	Double	8	H+88

ID	Field	Description	Type	Binary Bytes	Offset
25	Cuc	Amplitude of the cosine harmonic correction term to the argument of latitude (radians)	Double	8	H+96
26	Cus	Amplitude of the sine harmonic correction term to the argument of latitude (radians)	Double	8	H+104
27	Crc	Amplitude of the cosine harmonic correction term to the orbit radius (m)	Double	8	H+112
28	Crs	Amplitude of the sine harmonic correction term to the orbit radius (m)	Double	8	H+120
29	Cic	Amplitude of the cosine harmonic correction term to the angle of inclination (radians)	Double	8	H+128
30	Cis	Amplitude of the sine harmonic correction term to the angle of inclination (radians)	Double	8	H+136
31	Af0	SV clock bias correction coefficient from the I/NAV message (s)	Double	8	H+144
32	Af1	SV clock drift correction coefficient from the I/NAV message (s/s)	Double	8	H+152
33	Af2	SV clock drift rate correction coefficient from the I/NAV message (s/s^2)	Double	8	H+160
34	E1E5aBGD	E1, E5a broadcast group delay	Double	8	H+168
35	E1E5bBGD	E1, E5b broadcast group delay	Double	8	H+176
36	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+184

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

3.1.10 GLOEPHEMERIS

This log contains GLONASS ephemeris information. GLONASS ephemerides are referenced to the PZ90.02 geodetic datum. No adjustment between the GPS and GLONASS reference frames are made for positioning. Multiple messages are transmitted, one for each SVID with data.

Name	Value
Message ID	723
Input	log gloephemerisa onchanged
Function	Decoded GLONASS ephemeris
Example output	#GLOEPHEMERISA,COM2,0,0.0,FINE,2124,181879.000,00000000,0,1;61,9,1,0,2124, 182718000,10782,266,0,0,23,0,-1.9934690429687500e+07,1.1610552734375000e+07, 1.0871672363281250e+07,-1.3716983795166016e+03,5.9706020355224609e+02, -3.1588726043701172e+03,-9.3132257461547852e-07,-9.3132257461547852e-07, -1.8626451492309570e-06,-1.4165416359901428e-05,3.7252902984619141e-09, 9.0949470177292824e-13,19800,3,1,0,29*e5777c93 #GLOEPHEMERISA,COM2,0,0.0,FINE,2124,181879.000,00000000,0,1;60,10,1,0,2124, 182718000,10782,266,0,0,23,0,-2.4440876953125000e+07,6.9341806640625000e+06, -2.2388955078125000e+06,3.6651134490966797e+02,1.3733196258544922e+02, -3.5926914215087891e+03,-3.7252902984619141e-06,-9.3132257461547852e-07, -1.8626451492309570e-06,-3.3355038613080978e-04,7.4505805969238281e-09, 1.8189894035458565e-12,19800,3,3,0,29*b898d78d #GLOEPHEMERISA,COM2,0,0.0,FINE,2124,181879.000,00000000,0,1;54,11,1,0,2124, 182718000,10782,266,0,0,23,0,-4.2901030273437500e+06,1.2036435058593750e+07, 2.2072879882812500e+07,-2.8462810516357422e+03,1.0274372100830078e+03, -1.1181354522705078e+03,9.3132257461547852e-07,0.0000000000000000e+00, -1.8626451492309570e-06,-3.6012101918458939e-04,0.0000000000000000e+00, 2.7284841053187847e-12,19800,3,3,0,29*c8253b38 #GLOEPHEMERISA,COM2,0,0.0,FINE,2124,181879.000,00000000,0,1;40,12,1,0,2124, 182718000,10782,266,0,0,23,0,-2.1664648437500000e+06,2.4796314941406250e+07, -5.6641328125000000e+06,4.4937133789062500e+00,7.9598331451416016e+02, 3.4559640884399414e+03,-0.0000000000000000e+00,-9.3132257461547852e-07, 9.3132257461547852e-07,-2.2455118596553802e-05,-2.7939677238464355e-09, 9.0949470177292824e-13,19800,3,3,0,13*e31da8be #GLOEPHEMERISA,COM2,0,0.0,FINE,2124,181879.000,00000000,0,1;39,3,1,0,2124, 182718000,10782,266,0,0,23,0,-9.7864448242187500e+06,2.0540821777343750e+07, 1.1626337890625000e+07,4.6576309204101563e+02,-1.5216989517211914e+03, 3.0841417312622070e+03,0.0000000000000000e+00,-0.0000000000000000e+00, -9.3132257461547852e-07,-4.4665206223726273e-04,5.5879354476928711e- 09,1.8189894

ID	Field	Description	Type	Binary Bytes	Offset
1	GLOEPHEMERIS header	Log header		H	0
2	sloto	Slot information offset - PRN identification (Slot + 37). This is also called SLOTO in Connect	Ushort	2	H
3	freqo	Frequency channel offset for satellite in the range 0 to 20	Ushort	2	H+2
4	sat type	Satellite type where 0 = GLO_SAT 1 = GLO_SAT_M (M type) 2 = GLO_SAT_K (K type)	Uchar	1	H+4
5	Reserved			1	H+5
6	e week	Reference week of ephemeris (GPS reference time)	Ushort	2	H+6
7	e time	Reference time of ephemeris (GPS reference time) (ms)	Ulong	4	H+8
8	t offset	Integer seconds between GPS and GLONASS time. A positive value implies GLONASS is ahead of GPS reference time.	Ulong	4	H+12
9	Nt	Calendar number of day within 4 year interval starting at Jan 1 of a leap year	Ushort	2	H+16
10	Reserved			1	H+18
11	Reserved			1	H+19
12	issue	15 minute interval number corresponding to ephemeris reference time	Ulong	4	H+20
13	health	Ephemeris health where 0-3 = GOOD 4-15 = BAD	Ulong	4	H+24
14	pos x	X coordinate for satellite at reference time (PZ-90.02) (metres)	Double	8	H+28
15	pos y	Y coordinate for satellite at reference time (PZ-90.02) (metres)	Double	8	H+36

ID	Field	Description	Type	Binary Bytes	Offset
16	pos z	Z coordinate for satellite at reference time (PZ-90.02) (metres)	Double	8	H+44
17	vel x	X coordinate for satellite velocity at reference time (PZ-90.02) (metres/s)	Double	8	H+52
18	vel y	Y coordinate for satellite velocity at reference time (PZ-90.02) (metres/s)	Double	8	H+60
19	vel z	Z coordinate for satellite velocity at reference time (PZ-90.02), (metres/s)	Double	8	H+68
20	LS acc x	X coordinate for lunisolar acceleration at reference time (PZ-90.02), (metres/s/s)	Double	8	H+76
21	LS acc y	Y coordinate for lunisolar acceleration at reference time (PZ-90.02) (metres/s/s)	Double	8	H+84
22	LS acc z	Z coordinate for lunisolar acceleration at reference time (PZ-90.02) (metres/s/s)	Double	8	H+92
23	tau_n	Correction to the nth satellite time t_n relative to GLONASS time t_c (seconds)	Double	8	H+100
24	delta_tau_n	Time difference between navigation RF signal transmitted in L2 sub-band and navigation RF signal transmitted in L1 sub-band by nth satellite (seconds)	Double	8	H+108
25	gamma	Frequency correction (seconds/second)	Double	8	H+116
26	Tk	Time of frame start (since start of GLONASS day) (seconds)	Ulong	4	H+124
27	P	Technol.ogical parameter	Ulong	4	H+128
28	Ft	User range	Ulong	4	H+132
29	age	Age of data (days)	Ulong	4	H+136
30	Flags	Information flags	Ulong	4	H+140

ID	Field	Description	Type	Binary Bytes	Offset
31	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+144
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.10.1 GLONASS Ephemeris Flags Coding

Nibble Number	Bit	Description	Range Values	Hex Value
N0	0	P1 Flag - Time interval between adjacent iISSUE (fb) values	See table of P1 Flag Range Values	00000001
	1	P1 Flag - Time interval between adjacent iISSUE (fb) values	See table of P1 Flag Range Values	00000002
	2	P2 Flag - Oddness or Evenness of iISSUE (fb) value	0 = even 1 = odd	00000004
	3	P3 Flag - Number of satellites with almanac information within current subframe	0 = four 1 = five	00000008
N-1 through N-7	4 ... 31	Reserved		

3.1.10.2 P1 Flag Range Values

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

3.1.11 GPGGA

This log contains time, position and fix related data of the GNSS receiver. The GPGGA log outputs these messages without waiting for a valid almanac.

The NMEA (National Marine Electronics Association) has defined standards that specify how electronic equipment for marine users communicates. GNSS receivers are part of this standard and the NMEA has defined the format for several GNSS data logs，or known as 'sentences'. Each NMEA sentence begins with a '$' followed by the prefix 'GL' or 'GN' followed by a sequence of letters that define the type of information contained in the sentence. Data contained within the sentence is separated by commas and the sentence is terminated with a two digit checksum followed by a carriage return/line feed. Here is an example of a NMEA sentence describing time, position and fix related data.

Please refer to command NMEATALKER for more about the NMEA talker.

Name	Value
Message ID	218
Input	log gpgga ontime 1
Function	GPS fix data and undulation
Example output (GPS only)	$GPGGA,075255.00,3111.4240599,N,12135.5915584,E,4,10,0.6,28.774,M,11.518,M,1.0,0000*6A
Example output (Combined GPS/GLO/BDS)	$GNGGA,093508.00,3111.4243539,N,12135.5909066,E,4,38,0.5,28.781,M,11.518,M,2.0,0000*67
Example output (TAP)	$GNGGA,093508.00,3111.4243539,N,12135.5909066,E,4,38,0.5,28.781,M,11.518,M,2.0,5002*67

Field	Structure	Description	Type	Example
1	$GPGGA	Log header		
2	utc	UTC time status of position (hours/minutes/seconds/decimal seconds)	hhmmss.ss	064334.00
3	lat	Latitude (DDmm.mm)	llll.ll	3111.4245500
4	lat dir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yy	12135.5914008
6	lon dir	Longitude direction (E = East, W = West)	a	E
7	quality	0: Fix not available or invalid 1: Single point 2: Pseudorange differential 4: RTK fixed ambiguity solution 5: RTK floating ambiguity solution 7: Manual input mode(fixed position)	x	4

Field	Structure	Description	Type	Example
8	sats	Number of satellites in use. May be different to the number in view.	xx	54
9	hdop	Horizontal dilution of precision	x.x	0.5
10	alt	Antenna altitude above/below mean sea level	x.x	27.935
11	a-units	Units of antenna altitude (M = metres)	M	M
12	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid	x.x	11.518
13	u-units	Units of undulation (M = metres)	M	M
14	age	Age of correction data (in seconds)	xx	1.0
15	stn	ID Differential base station ID ID≤4095 represents RTK results ID=5000 represents PPP_CONVERGING results ID=5001 represents PPP results ID=5002 represents PPP_AR results	xxxx	0000
16	*xx	Checksum	*hh	
17	[CR][LF]	Sentence terminator	-	

3.1.12 GPGLL

This log contains latitude and longitude of present vessel position, time of position fix and status.

Name	Value
Message ID	219
Input	log gpgll ontime 1
Function	Geographic position
Example output (GPS only)	$GPGLL,3111.4253764,N,12135.5908779,E,015133.00,A,A*7C
Example output (Combined GPS/GLO/BDS)	$GNGLL,3111.4243534,N,12135.5909068,E,093548.00,A,D*7F

Field	Structure	Description	Type	Example
1	$GPGLL	Log header		
2	lat	Latitude (DDmm.mm)	llll.ll	3111.4253694
3	lat dir	Latitude direction (N = North, S = South)	a	N

Field	Structure	Description	Type	Example
4	lon	Longitude (DDDmm.mm)	yyyyy.yy	12135.5908841
5	lon dir	Longitude direction (E = East, W = West)	a	E
6	utc	UTC time status of position (hours/minutes/seconds/decimal seconds)	hhmmss.ss	015128.00
7	data status	Data status: A = Data valid, V = Data invalid	x	A
8	mode ind	Positioning system mode indicator, see below table for NMEA Positioning System Mode Indicator	xx	A
9	*xx	Checksum	*hh	
10	[CR][LF]	Sentence terminator	-	

3.1.12.1 NMEA Positioning System Mode Indicator

Mode	NMEA Positioning System Mode Indicator
A	Autonomous
D	Differential
E	Estimated (dead reckoning) mode
M	Manual input
N	Data not valid

3.1.13 GPGSA

This log contains GNSS receiver operating mode, satellites used for navigation and DOP values. The GPGSA log outputs these messages without waiting for a valid almanac.

Name	Value
Message ID	221
Input	log gpgsa ontime 1
Function	GPS DOP and active satellites
Example output (GPS only)	$GPGSA,A,3,10,12,14,25,26,29,31,32,,,,,1.0,0.8,0.6*31
Example output (Combined GPS/GLO/BDS)	$GPGSA,A,3,1,3,7,8,14,17,19,21,22,28,30,,0.5,0.8,0.9*16 *$GLGSA,A,3,71,76,77,78,86,87,88,,,,,,0.5,0.8,0.9*0F* $BDGSA,A,3,1,2,3,4,7,8,10,13,14,27,28,30,0.5,0.8,0.9*0A *$GAGSA,A,3,13,15,21,27,30,,,,,,,0.5,0.8,0.9*08*

Field	Structure	Description	Type	Example
1	$GPGSA	Log header		
2	mode MA	A = Automatic 2D/3D M = Manual, forced to operate in 2D or 3D	M	A
3	mode 123	Mode: 1 = Fix not available; 2 = 2D; 3 = 3D	x	3
4~15	prn	PRN numbers of satellites used in solution (null for unused fields), total of 12 fields GPS = 1 to 32 GLO = 65 to 96 (64+GLONASS slot number) BDS = 1 to 46 GAL = 1 to 36	x.x,x.x,...	10,12,14,25, 26,29,31,32,,,,,
16	pdop	Position dilution of precision	x.x	1.0
17	hdop	Horizontal dilution of precision	x.x	0.8
18	vdop	Vertical dilution of precision	x.x	0.6
19	*xx	Checksum	*hh	
20	[CR][LF]	Sentence terminator	-	

3.1.14 GPGST

This log contains pseudorange measurement noise statistics are translated in the position domain in order to give statistical measures of the quality of the position solution.
This log reflects the accuracy of the solution type used in the **BESTPOS** log and **GPGGA** log, except for the RMS field. The RMS field, since it specifically relates to pseudorange inputs, does not represent carrier-phase based positions. Instead, it reflects the accuracy of the pseudorange position.
This log outputs these meassages withput waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Name	Value
Message ID	222
Input	log gpgst ontime 1
Function	estimated error in position solution
Example output (Multi-constellation)	$GNGST,063802.00,9.75,5.74,5.44,23.8992,5.6898,5.4921,5.6991*46

Name	Value
Example output (GPS only)	$GPGST,063656.00,18.45,10.77,10.52,10.1009,10.7656,10.5247,10.6685*5B

Field	Structure	Description	Symbol	Example
1	$GPGST	Log header		$GPGST
2	UTC	UTC time status of position (hours/minutes/seconds/decimal/seconds)	hhmmss.ss	063656.00
3	RMS	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudoranges and DGPS corrections	x.x	2.78
4	smjr std	Standard deviation of semi-major axis o error ellipse (m)	x.x	3.55
5	smnr std	Standard deviation of semi-minor axis of error ellipse (m)	x.x	1.88
6	orient	Orientation of semi-major axis of error ellipse (degrees from true north)	x.x	15.2525
7	lat std	Standard deviation of latitude error (m)	x.x	2.51
8	lon std	Standard deviation of longitude error (m)	x.x	1.94
9	alt std	Standard deviation of altitude error (m)	x.x	4.30
10	*xx	Checksum	*hh	*6E
11	[CR][LF]	Sentence terminator		[CR][LF]

3.1.15 GPGSV

This log contains the number of GPS SVs in view, PRN numbers, elevation, azimuth and SNR value. The total number of messages and the message number are included in each message.

Name	Value
Message ID	223
Input	log gpgsv ontime 1
Function	GPS satellites in view

Name	Value
Example output (Combined GPS/GLO/BDS)	log gpgsv <OK $GPGSV,3,1,11,02,23,277,39,03,21,041,35,04,20,088,37,05,02,216,32*72 *$GPGSV,3,2,11,06,53,308,44,09,23,127,38,12,07,324,34,17,70,045,44*72 $GPGSV,3,3,11,19,63,351,43,22,01,042,27,28,41,185,42*43 *$GLGSV,3,1,09,65,10,183,00,70,13,030,28,71,50,072,42,72,43,152,41*6B $GLGSV,3,2,09,76,21,227,40,77,26,284,29,85,12,085,34,86,44,036,00*62 *$GLGSV,3,3,09,87,26,316,40*57 $BDGSV,6,1,23,01,46,141,41,02,36,236,38,03,53,201,42,04,36,122,38*6C *$BDGSV,6,2,23,05,15,255,00,06,06,173,35,07,48,193,42,08,60,324,42*66 $BDGSV,6,3,23,10,58,231,42,13,47,285,43,16,03,177,00,19,45,175,45*61 *$BDGSV,6,4,23,20,57,083,47,22,01,203,00,26,11,291,38,29,64,026,00*6B $BDGSV,6,5,23,30,28,094,42,32,14,040,37,35,33,312,44,36,03,191,34*62 *$BDGSV,6,6,23,38,62,315,45,40,61,204,45,45,17,238,38*51 $GAGSV,3,1,09,04,31,150,38,11,43,307,39,12,52,035,39,19,34,080,35*6A *$GAGSV,3,2,09,24,40,226,42,25,32,293,40,31,12,180,00,33,13,076,33*63 $GAGSV,3,3,09,36,02,276,00*55 *$GSGSV,1,1,0,0,07*A

Field	Structure	Description	Type	Example
1	$GPGSV	Log header		
2	# msgs	Total number of messages (1-9)	x	3
3	msg #	Message number (1-9)	x	1
4	# sats	Total number of satellites in view. May be different than the number of satellites in use.	xx	09
5	prn	Satellite PRN number GPS = 1 to 32 SBAS = 33 to 64(add 87 for PRN#s) GLO = 65 to 96 (64+ GLONASS slot number) BDS = 1 to 46 GAL = 1 to 36	xx	10
6	elev	Elevation, degrees, 90 maximum	xx	36
7	azimuth	Azimuth, degrees True, 000 to 359	xxx	319
8	SNR	SNR (C/No) 00-99 dB, null when not tracking	xx	47
... ...	... ...	Next satellite PRN number, elev, azimuth, SNR, ... Last satellite PRN number, elev, azimuth, SNR,		
variable	*xx	Checksum	*hh	*61

Field	Structure	Description	Type	Example
variable	[CR][LF]	Sentence terminator	-	

3.1.16 GPNTR

This general-used NMEA message includes distance between reference station and the rover station, distance in east, north and up direction. This log is only valid when the receiver is working as a rover and its position type is RTK or DGPS.

Name	Value
Message ID	209
Input	log gpntr ontime 1
Function	Detailed information between rover and base
Example output	$GNNTR,093743.00,4,1.121,-0.922,-0.638,+0.020,"0000"*53

Field	Structure	Description	Type	Example
1	$GPNTR	Log header		
2	utc	UTC of time	hhmmss.ss	024404.00
3	pos status	0: Fix not available or invalid 1: Single point 2: Pseudorange differential 4: RTK fixed ambiguity solution 5: RTK floating ambiguity solution	x	4
4	distance	The distance between the rover and the base. (unit: meters)	dddd.ddd	17253.242
5	distance in north	Direction: +:North, -:South	dddd.ddd	+5210.449
6	distance in east	Direction: +:East, -:West	dddd.ddd	-16447.587
7	distance in vertical direction	Direction: +:Up, -:Down	dddd.ddd	-49.685
8	Station ID	0~1023, or ''(No ref-station)	x	0004
9	*xx	Checksum	*hh	*40
10	[CR][LF]	Sentence terminator	-	

3.1.17 GPRMC

This log contains time, date, position, track made good and speed data provided by the GPS navigation receiver.

Name	Value
Message ID	225
Input	log gprmc ontime 1
Function	GPS specific information
Example output (GPS only)	$GPRMC,033255.00,A,3111.4246749,N,12135.5908896,E,0.065,0.0,070417,0.0,E,A*04
Example output (Combined GPS/GLO/BDS)	$GNRMC,085903.00,A,3111.4247992,N,12135.5911079,E,0.022,0.0,090321,0.0,E,A*06

Field	Structure	Description	Type	Example
1	$GPRMC	Log header		
2	utc	UTC of position	hhmmss.ss	030840.40
3	pos status	Position status (A = data valid, V = data invalid)	A	A
4	lat	Latitude (DDmm.mm)	llll.ll	3111.4253694
5	lat dir	Latitude direction (N = North, S = South)	a	N
6	lon	Longitude (DDDmm.mm)	yyyyy.yy	12135.5908841
7	lon dir	Longitude direction (E = East, W = West)	a	E
8	speed Kn	Speed over ground, knots	x.x	0.038
9	track true	Track made good, degrees True	x.x	138.4
10	date	Date: dd/mm/yy	xxxxxx	280317
11	mag var	Magnetic variation, degrees	x.x	0.0
12	var dir	Magnetic variation direction E/W	a	E
13	mode ind	Positioning system mode indicator, see table for NMEA Positioning System Mode Indicator	xx	A
14	*xx	Checksum	*hh	*22
15	[CR][LF]	Sentence terminator	-	

3.1.18 GPSEPHEM

This log contains a single set of GPS ephemeris parameters.

Name	Value
Message ID	7
Input	log gpsephema onchanged
Function	Decoded GPS ephemeris.
Example output	<GPSEPHEM,COM2,0,0.0,FINE,2124,182393.000,00000000,0,1; < 25 180000.0 0 67 67 2124 2124 187200.0 2.656097136e+07 4.666265797e-09 2.128995928e+00 9.138991125e-03 9.319413431e-01 4.053115845e-06 4.878267646e-06 2.851875000e+02 8.087500000e+01 -1.657754183e-07 -1.955777407e-07 9.638315089e-01 1.303625730e-10 -1.155894216e+00 -8.208913363e-09 67 187200.0 5.587935448e-09 5.26025e-05 5.57066e-12 0.00000e+00 TRUE 1.458535096e-04 1.0000000e+00 <GPSEPHEM,COM2,0,0.0,FINE,2124,182393.000,00000000,0,1; < 19 180000.0 0 96 96 2124 2124 187200.0 2.656065063e+07 4.173745282e-09 2.135841615e+00 9.239178267e-03 1.721992851e+00 -4.319474101e-06 4.548579454e-06 2.993125000e+02 -8.156250000e+01 1.434236765e-07 -2.793967724e-08 9.821103807e-01 -4.200174954e-10 -5.382758796e-03 -8.014262398e-09 96 187200.0 -1.536682248e-08 -1.01670e-04 5.00222e-12 0.00000e+00 TRUE 1.458556588e-04 1.0000000e+00 <GPSEPHEM,COM2,0,0.0,FINE,2124,182393.000,00000000,0,1; < 17 180000.0 0 85 85 2124 2124 187200.0 2.656122022e+07 4.266606293e-09 -4.595014320e-01 1.343255513e-02 -1.636250153e+00 -3.570690751e-06 5.032867193e-06 2.974375000e+02 -6.950000000e+01 -1.322478056e-07 1.229345798e-07 9.838031290e-01 -2.946551307e-10 -5.081291464e-02 -8.398206962e-09 85 187200.0 -1.117587090e-08 3.29385e-04 5.45697e-12 0.00000e+00 TRUE 1.458510602e-04 1.0000000e+00 <GPSEPHEM,COM2,0,0.0,FINE,2124,182393.000,00000000,0,1; < 13 180000.0 0 121 121 2124 2124 187200.0 2.656046371e+07 4.570190367e-09 -1.003254407e+00 4.546834040e-03 1.046009399e+00 -9.797513485e-07 8.516013622e-06 2.197500000e+02 -2.096875000e+01 5.029141903e-08 5.401670933e-08 9.683512441e-01 -2.839403987e-10 -3.122247692e+00 -8.007476401e-09 121 187200.0 -1.117587090e-08 4.75659e-05 3.52429e-12 0.00000e+00 TRUE 1.458575950e-04 1.0000000e+00 <GPSEPHEM,COM2,0,0.0,FINE,2124,182393.000,00000000,0,1; < 12 180000.0 0 68 68 2124 2124 187200.0 2.655987402e+07 4.375539402e-09 2.381090104e+00 7.910413318e-03 1.166490060e+00 3.516674042e-06 4.481524229e-06 2.971250000

ID	Field	Description	Type	Binary Bytes	Offset
1	GPSEPHEM header	Log header		H	0
2	PRN	Satellite PRN number	Ulong	4	H
3	tow	Time stamp of subframe 1 (seconds)	Double	8	H+4
4	health	Health status - a 6-bit health code as defined in ICD-GPS-200	Ulong	4	H+12
5	IODE1	Issue of ephemeris data 1	Ulong	4	H+16
6	IODE2	Issue of ephemeris data 2	Ulong	4	H+20
7	week	toe week number (computed from Z count week)	Ulong	4	H+24
8	z week	Z count week number. This is the week number from subframe 1 of the ephemeris. The 'toe week' (field #7) is derived from this to account for rollover	Ulong	4	H+28
9	toe	Reference time for ephemeris, seconds	Double	8	H+32
10	A	Semi-major axis, metres	Double	8	H+40
11	ΔN	Mean motion difference, radians/second	Double	8	H+48
12	M_0	Mean anomaly of reference time, radians	Double	8	H+56
13	ecc	Eccentricity, dimensionless - quantity defined for a conic section where e= 0 is a circle, e = 1 is a parabola, 0e1 is an ellipse and e>1 is a hyperbola	Double	8	H+64
14	ω	Argument of perigee, radians - measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion	Double	8	H+72
15	cuc	Argument of latitude (amplitude of cosine, radians)	Double	8	H+80

ID	Field	Description	Type	Binary Bytes	Offset
16	cus	Argument of latitude (amplitude of sine, radians)	Double	8	H+88
17	crc	Orbit radius (amplitude of cosine, metres)	Double	8	H+96
18	crs	Orbit radius (amplitude of sine, metres)	Double	8	H+104
19	cic	Inclination (amplitude of cosine, radians)	Double	8	H+112
20	cis	Inclination (amplitude of sine, radians)	Double	8	H+120
21	l_0	Inclination angle at reference time, radians	Double	8	H+128
22	l^0	Rate of inclination angle, radians/second	Double	8	H+136
23	ω_o	Right ascension, radians	Double	8	H+144
24	ώ	Rate of right ascension, radians/second	Double	8	H+152
25	iodc	Issue of data clock	Ulong	8	H+160
26	toc	SV clock correction term, seconds	Double	4	H+164
27	tgd	Estimated group delay difference, seconds	Double	8	H+172
28	a_{f0}	Clock aging parameter, seconds (s)	Double	8	H+180
29	a_{f1}	Clock aging parameter, (s/s)	Double	8	H+188
30	a_{f2}	Clock aging parameter, (s/s/s)	Double	8	H+196
31	AS	Anti-spoofing on: 0 = FALSE 1 = TRUE	Bool	4	H+204
32	N	Corrected mean motion, radians/second Note: This field is computed by the receiver.	Double	8	H+208
33	URA	User Range Accuracy variance, m^2. The ICD specifies that the URA index transmitted in the ephemerides can be converted to a nominal standard deviation value using an algorithm listed there.	Double	8	H+216

ID	Field	Description	Type	Binary Bytes	Offset
34	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+224
35	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.19 GPVTG

This log contains the track made good and speed relative to the ground.

Name	Value
Message ID	226
Input	log gpvtg ontime 1
Function	Track made good and ground speed
Example output (GPS only)	$GPVTG,47.251,T,47.251,M,0.124,N,0.230,K,A*3B
Example output (Combined GPS/GLO/BDS)	$GNVTG,0.000,T,0.000,M,0.017,N,0.031,K,A*39

Field	Structure	Description	Type	Example
1	$GPVTG	Log header		
2	track true	Track made good, degrees True	x.x	56.703
3	True	Degrees True	T	T
4	track mag	Track made good, degrees Magnetic;	x.x	56.703
5	M	Magnetic track indicator	M	M
6	speed Kn	Speed over ground, knots	x.x	0.068
7	N	Nautical speed indicator (N = Knots)	N	N
8	speed Km	Speed, kilometres/hour	x.x	0.127
9	K	Speed indicator (K = km/hr)	K	K
10	mode ind	Positioning system mode indicator, see table for NMEA Positioning System Mode Indicator	xx	A
11	*xx	Checksum	*hh	*37
12	[CR][LF]	Sentence terminator	-	

3.1.20 GPZDA

The GPSZDA log outputs the UTC date and time.

Name	Value
Message ID	227
Input	log gpzda ontime 1
Funtion	UTC time and date
Example output	$GNZDA,090026.00,09,03,2021,,*7E

Field	Structure	Description	Type	Example
1	$GPZDA	Log header		
2	utc	UTC time status	hhmmss.ss	053045.00
3	day	Day, 01 to 31	xx	07
4	month	Month, 01 to 12	xx	04
5	year	Year	xxxx	2017
6	null	not available, always null	xx	
7	null	not available, always null	xx	
8	*xx	Checksum	*hh	*37
9	[CR][LF]	Sentence terminator	-	

3.1.21 IONUTC

This log contains the Ionospheric Model (ION) parameters and the Universal Time Coordinated (UTC) parameters.

Name	Value
Message ID	8
Input	log ionutc onchanged
Function	Ionospheric and UTC data
Example output	IONUTC COM1 0 0.0 FINESTEERING 1943 445738.000 00000000 407 20161214 1.117587089538574e-08 1.490116119384766e-08 -5.960464477539062e-08 -5.960464477539062e-08 8.806400000000000e+04 1.638400000000000e+04 -1.966080000000000e+05 -1.310720000000000e+05 152 1 5 2.7939677238464355e-09 2.664535259e-15 137 7 18 18 0

ID	Field	Description	Type	Binary Bytes	Offset
1	IONUTC header	Log header		H	0
2	a0	Alpha parameter constant term	Double	8	H
3	a1	Alpha parameter 1st order term	Double	8	H+8
4	a2	Alpha parameter 2nd order term	Double	8	H+16
5	a3	Alpha parameter 3rd order term	Double	8	H+24
6	b0	Beta parameter constant term	Double	8	H+32
7	b1	Beta parameter 1st order term	Double	8	H+40
8	b2	Beta parameter 2nd order term	Double	8	H+48
9	b3	Beta parameter 3rd order term	Double	8	H+56
10	utc wn	UTC reference week number	Ulong	4	H+64
11	tot	Reference time of UTC parameters	Ulong	4	H+68
12	A0	UTC constant term of polynomial	Double	8	H+72
13	A1	UTC 1st order term of polynomial	Double	8	H+80
14	wn lsf	Future week number	Ulong	4	H+88
15	dn	Day number (the range is 1 to 7 where Sunday = 1 and Saturday = 7)	Ulong	4	H+92
16	deltat ls	Delta time due to leap seconds	Long	4	H+96
17	deltat lsf	Future delta time due to leap seconds	Long	4	H+100
18	Reserved			4	H+104
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+108
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.22 LBANDBEAMTABLE

This log lists all available L-Band beams.

Name	Value
Input	log lbandbeamtable onchanged

Name	Value
Example output	<LBANDBEAMTABLE COM2 0 0.0 FINE 2327 354796.000 00000000 0 1 <6 < ERTAP 1545950000 2400 25.0 -14.1 273.4 < SATAP 1545815000 1200 -54.0 -62.7 351.5 < EATAP 1546230000 1200 25.0 -14.1 273.4 < OCTAP 1545875000 1200 144.0 46.4 141.3 < IRTAP 1546240000 1200 84.0 35.7 236.2 <ARTAP 1545245000 2400 -98.0 -47.2 58.1

ID	Field	Description
1	Name	The name of beam/tracking satellite
2	Frequency	Beam frequency (Hz)
3	Baud	Beam baud rate (bps)
4	Longitude	Transmitting satellite longitude in degrees
5	Elevation	Transmitting satellite elevation in degrees related to current receiver position
6	Azimuth	Transmitting satellite azimuth in degrees

3.1.23 LBANDTRACKSTAT

This log lists the current L-Band tracking status for the tracked L-Band beams.

Name	Value
Input	log lbandtrackstat ontime 1
Example output	<LBANDTRACKSTAT COM2 0 0.0 FINE 2328 204062.000 000000000 0 1 <2 <IRTAP 1546240000 1200 C685 0010 0 -215.6 54.24 5.03 0 0 1555 0.000122 <OCTAP 1545875000 1200 2873 0010 0 -62.8 45.17 180.00 0 6 1775 0.000854

|

ID	Field	Description	Format	Binary Bytes
1	Name	The name of beam/tracking satellite	Char	8
2	Frequency	Frequency assigned to this L-Band beam (Hz)	Int	4
3	Baud rate	Baud rate of assigned beam	Short	2

ID	Field	Description	Format	Binary Bytes
4	ID	Sevice ID of the assigned beam, heximal	Short	2
5	Reserved	Tracking status word(bit meaning not defined yet)	Short	2
6	Reserved	reserved	Short	2
7	Doppler	Signal doppler (Hz)	Float	4
8	C/No	Carrier to noise density (dB-Hz)	Float	4
9	Phase std.dev.	Phase tracking error standard deviation (cycles)	Float	4
10	Bad unique word bit	Bad unique word bit number of current frame	Short	2
11	Corrected Viterbi	Corrected viterbi symbols of current frame	Short	2
12	Received message number	Total received message number in bytes	Int	4
13	Bit error rate	Estimated pre-viterbi bit error rate	Float	4
				Total 44 bytes per satellite

3.1.24 LOGLIST

This log lists all the log information of current board configuration.

Name	Value
Message ID	5
Input	log loglist
Function	List of system logs
Example output	LOGLIST 3 COM1 GPGGA ONTIME 1.000000 NOHOLD COM1 RANGEB ONTIME 1.000000 NOHOLD FILE0 GPGGA ONTIME 1.000000 NOHOLD log loglist <OK

Field	Structure	Description	Format
1	$LOGLIST	Log header	
2	#logs	Number of messages to follow, maximum = 64	Long
3	port	Output port	Enum
4	message	Message name of log with no suffix for abbreviated ASCII, an A suffix for ASCII	Char[]
5	trigger	ONNEW ONCHANGED ONTIME ONNEXT ONCE	Enum
6	period	Log period for ONTIME	Double
7	offset	Offset for period (ONTIME trigger)	Double
8	hold	NOHOLD HOLD	Enum
9	Next port	offset = H + 4 + (#logs x 32)	
variable	*xxxx	32-bit CRC (ASCII only)	Hex
variable	[CR][LF]	Sentence terminator	-

3.1.25 MARKCOUNT

Markcount log contains the tick count for the event1 (MARK1COUNT) and event2 (MARK2COUNT) inputs.

Name	Value
Message ID	1093 (MARK1COUNT) 1094 (MARK2COUNT)
Input	log mark1count onnew
Function	Event mark tick count output
Example output	<MARK1COUNT COM1 0 0.0 FINESTEERING 2024 355077.000 00000000 1025 20161214 < 5203 23

ID	Field	Description	Type	Binary Bytes	Offset
1	MARK1COUNT, MARK2COUNT header	Log header		H	0
2	period	Delta time (milliseconds)	Ulong	4	H
3	count	Tick count	Ushort	2	H+4
4	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+6
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.26 MARKTIME

Marktime log contains the time of the leading edge of the detected mark input pulse. MARKTIME/MARK2TIME is generated when a pulse occurs on an event1 input or on an event2 input.

Name	Value
Message ID	231 (MARKTIME) 616 (MARK2TIME)
Input	log marktime onnew
Function	Time of mark input event
Example output	>MARK1TIME COM1 0 0.0 FINE 2148 195285.000 00000000 0 1 <2148 195285.500001 0 0.000000 "VALID"

ID	Field	Description	Type	Binary Bytes	Offset
1	MARKTIME MARK2TIME header	Log header		H	0
2	week	GPS reference week number	Long	4	H
3	seconds	Seconds into the week as measured from the receiver clock, coincident with the time of electrical closure on the Mark Input port	Double	8	H+4
4	offset	Reserved	Double	8	H+12
5	offset std	Reserved	Double	8	H+20

ID	Field	Description	Type	Binary Bytes	Offset
6	utc offset	Reserved	Double	8	H+28
7	status	Clock model status, see table of Clock Model Status	Enum	8	H+36
8	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+40
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.26.1 Clock Model Status

Clock Status (Binary)	Clock Status (ASCII)	Description
0	VALID	The clock model is valid
1	CONVERGING	The clock model is near validity
2	ITERATING	The clock model is iterating towards validity
3	INVALID	The clock model is not valid

3.1.27 QZSSEPHEMERIS

This log contains a single set of QZSS ephemeris parameters.

Name	Value
Message ID	1336
Input	log qzssephemerisa onchanged
Function	Decoded QZSS ephemeris

Name	Value
Example output	#QZSSEPHEMERISA,COM2,0,0.0,FINE,2124,181897.000,00000000,0,1;199,176400.0,0, 201,201,2124,2124,183600.0,4.216460315e+07,0.000000000e+00,-1.826075994e-01, 1.552912872e-04,-2.858734944e-01,-1.723691821e-05,6.157904863e-06,-1.816250000e+02, -5.263437500e+02,-6.277114153e-07,-1.709908247e-06,1.262834774e-03,0.000000000e+00, -2.775321572e+00,9.525396771e-10,969,183600.0,-6.053596735e-09,2.46800e-08, 0.00000e+00,0.00000e+00,TRUE,7.292003928e-05,7.8399997e+00*ca584e6a #QZSSEPHEMERISA,COM2,0,0.0,FINE,2124,181897.000,00000000,0,1;195,176400.0,0,201,201, 2124,2124,183600.0,4.216236492e+07,2.493318142e-09,-1.647788782e+00,7.435054053e-02, -1.575474218e+00,-1.803971827e-05,2.462416887e-06,2.218750000e+01,-5.524687500e+02, 1.862645149e-07,7.804483175e-07,7.128420422e-01,-2.632252501e-10,1.928157218e-01, -2.842261249e-09,969,183600.0,0.000000000e+00,-1.29966e-06,-3.41061e-13,0.00000e+00, TRUE,7.292833922e-05,7.8399997e+00*0cf20b0e #QZSSEPHEMERISA,COM2,0,0.0,FINE,2124,181897.000,00000000,0,1;194,176400.0,0,201, 201,2124,2124,183600.0,4.216759443e+07,2.295095600e-09,6.037301700e-02, 7.514375646e-02,-1.566695068e+00,1.788698137e-05,9.315088391e-06, -1.015937500e+02,5.050625000e+02,-3.837049007e-07,-5.774199963e-08, 7.470193766e-01,5.857386841e-11,-1.504496697e+00, -3.108343761e-09,969,183600.0,9.313225746e-10,-4.02378e-06,-5.68434e-13,0.00000e+00, TRUE,7.291457531e-05,7.8399997e+00*6e84162c #QZSSEPHEMERISA,COM2,0,0.0,FINE,2124,181897.000,00000000,0,1;193,176400.0,0,201,201, 2124,2124,183600.0,4.215812909e+07,2.845475668e-09,2.309820037e+00,7.445985300e-02, -1.567581920e+00,-4.140660167e-06,1.132488251e-06,1.151250000e+02,-1.330625000e+02, -1.607462764e-06,6.631016731e-07,7.282474429e-01,-4.850202030e-10,2.495740059e+00, -2.490818038e-09,969,183600.0,-5.587935448e-09,-3.45280e-04,2.84217e-12,0.00000e+00, TRUE,7.293968246e-05,7.8399997e+00*12d36911

ID	Field	Description	Type	Binary Bytes	Offset
1	QZSSEPHEMRIS header	Log header		H	0
2	PRN	Satellite PRN number	Ulong	4	H
3	tow	Time stamp of subframe 0 (s)	Double	8	H+4
4	health	Health status - a 6-bit health code as defined in QZSS Interface Specification	Ulong	4	H+12
5	IODE1	Issue of ephemeris data 1	Ulong	4	H+16
6	IODE2	Issue of ephemeris data 2	Ulong	4	H+20
7	week	GPS reference week number	Ulong	4	H+24
8	z week	Z count week number. This is the week number from subframe 1 of the ephemeris. The ‘toe week’ (field #7) is derived from this to account for rollover	Ulong	4	H+28
9	toe	Reference time for ephemeris (s)	Double	8	H+32

ID	Field	Description	Type	Binary Bytes	Offset
10	A	Semi-major axis (m)	Double	8	H+40
11	ΔN	Mean motion difference (radians/s)	Double	8	H+48
12	M_0	Mean anomaly of reference time (radius)	Double	8	H+56
13	ecc	Eccentricity (dimensionless) quantity defined for a conic section where e = 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse e>1 is a hyperbola	Double	8	H+64
14	ω	Argument of perigee (radians) measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion	Double	8	H+72
15	cuc	Argument of latitude (amplitude of cosine, radians)	Double	8	H+80
16	cus	Argument of latitude (amplitude of sine, radians)	Double	8	H+88
17	crc	Orbit radius (amplitude of cosine, metres)	Double	8	H+96
18	crs	Orbit radius (amplitude of sine, metres)	Double	8	H+104
19	cic	Inclination (amplitude of cosine, radians)	Double	8	H+112
20	cis	Inclination (amplitude of sine, radians)	Double	8	H+120
21	I_0	Inclination angle at reference time (radians)	Double	8	H+128
22	İ	Rate of inclination angle (radians/s)	Double	8	H+136
23	ω_0	Right ascension (radians)	Double	8	H+144
24	ώ	Rate of right ascension (radians/s)	Double	8	H+152

ID	Field	Description	Type	Binary Bytes	Offset
25	iodc	Issue of data clock	Ulong	4	H+160
26	toc	SV clock correction term (s)	Double	8	H+164
27	tgd	Estimated group delay difference (s)	Double	8	H+172
28	a_{fo}	Clock aging parameter (s)	Double	8	H+180
29	a_{f1}	Clock aging parameter (s/s)	Double	8	H+188
30	a_{f2}	Clock aging parameter (s/s/s)	Double	8	H+196
31	AS	Anti-spoofing on: 0= FALSE 1=TRUE	Enum	4	H+204
32	N	Corrected mean motion (radians/s)	Double	8	H+208
33	URA	User Range Accuracy variance, m2. The ICD specifies that the URA index transmitted in the ephemerides can be converted to a nominal standard deviation value using an algorithm listed there. We publish the square of the nominal value (variance)	Double	8	H+216
34	Fit Interval	Curve fit interval: 0 = Ephemeris data are effective for 2 hours 1 = Ephemeris data are effective for more than 2 hours	Uchar	1	H+224
35	Reserved		Uchar	1	H+225
36	Reserved		Uchar	1	H+226
37	Reserved		Uchar	1	H+227
38	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+228
39	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.28 RANGE

The RANGE log contains the raw measurements for the currently tracked satellites.
It is important to ensure that the receiver clock has been set. This can be monitored by the bits in the receiver status field of the log header. Large jumps in pseudorange as well as Accumulated Doppler Range(ADR) occur as the clock is being adjusted. If the ADR measurement is being used in precise phase processing, it is important not to use the ADR if the "parity known" flag, in the ch-tr-status field, is not set as there may exist a half(1/2) cycle ambiguity on the measurement. The tracking error estimate of the pesudorange and carrier phase (ADR) is the thermal noise of the receiver tracking loops only. It does not account for possible multipath errors or atmospheric delays.
If multiple signals are being tracked for a given PRN, an entry for each signal, with the same PRN, appears in the RANGE logs. As shown in Channel Tracking status , these entries can be differentiated by bits 21-25, which indicate the signal type of the observation.

Name	Value
Message ID	43
Input	log range
Function	Satellite range information

Name	Value
Example output	<RANGE,COM2,0,0.0,FINE,2120,284098.000,00000000,0,1; < 93 < 2 0 21520930.522 0.143 -113093242.889872 0.001 -1626.275 43.74 2175.000 08105da4 < 5 0 21119382.491 0.149 -110983093.691412 0.001 -1022.924 44.03 2190.986 18105e04 < 5 0 21119391.944 0.258 -85956733.939650 0.122 -797.221 24.34 0.000 02305207 < 6 0 24961847.148 0.197 -131175332.434482 0.002 -3209.396 34.35 2179.000 08105de4 < 7 0 25453069.246 0.195 -133756773.408787 0.002 -1637.760 34.50 1815.000 08105cc4 < 13 0 20088393.911 0.143 -105565220.797636 0.001 243.052 44.08 2175.000 08105d44 < 15 0 21021918.820 0.153 -110470931.840321 0.001 2153.119 42.64 2190.986 18105dc4 < 18 0 24440765.944 0.193 -128437096.257535 0.002 3331.655 34.57 1491.000 18105ca4 < 29 0 21832348.997 0.146 -114729762.244021 0.001 -124.302 44.05 2175.000 18105d64 < 30 0 23636964.668 0.177 -124213081.441245 0.002 -381.056 37.36 2115.000 18105ce4 < 30 0 23636968.475 0.710 -92756543.232112 0.007 -284.514 27.76 2111.560 01d05ce4 < 193 0 39158380.009 0.151 -205778670.672801 0.001 -442.780 42.32 2175.000 18155d84 < 193 0 39158379.669 0.251 -160347015.911948 0.005 -345.047 24.08 52.720 02355d84 < 193 0 39158382.993 1.300 -153665902.886862 0.003 -330.573 29.52 2175.000 01d55d84 < 194 0 37940473.123 0.174 -199378538.585529 0.002 295.701 37.11 2127.000 18155d04 < 195 0 36549502.314 0.156 -192068910.456557 0.002 -87.469 41.57 2190.986 18155e24 < 195 0 36549504.083 0.247 -149664089.021296 0.008 -68.246 26.59 2190.986 02355e24 < 195 0 36549505.924 0.460 -143428102.605478 0.007 -65.216 28.32 2190.986 01d55e24 < 199 0 36867592.178 0.174 -193740493.966059 0.002 -0.500 37.05 2140.000 08155d24 < 199 0 36867591.463 0.222 -150966612.774698 0.008 -0.434 26.74 2140.000 02355d24 < 199 0 36867595.234 0.670 -144676355.516890 0.003 -0.367 31.94 2140.000 01d55d24 < 59 4 20538311.865 0.301 -109634869.464781 0.003 -3196.818 39.26 2190.986 08115d44 < 46 5 23730638.157 0.320 -126720288.832168 0.002 2023.057 35.41 1172.000 18115c84

Name	Value
	< 38 8 21116085.583 0.298 -112877581.832005 0.002 1547.099 40.12 2102.000

ID	Field	Description	Type	Binary Bytes	Offset
1	RANGE header	Log header		H	0
2	#obs	Number of observations with information to follow (Satellite PRNs may have multiple lines of observations, one for each signal tracked)	Ulong	4	H
3	PRN/slot	Satellite PRN number of range measurement GPS: 1~32 GLONASS: 38~61 (slot, it's different from $GPGSV) BDS:1~63 GAL: 1~36 QZSS: 193~202 SBAS: 120~158	Ushort	2	H+4
4	glofreq	(GLONASS Frequency + 7)	Ushort	2	H+6
5	psr	Pseudorange measurement (m)	Double	8	H+8
6	psrstd	Pseudorange measurement standard deviation (m)	Float	4	H+16
7	adr	Carrier phase, in cycles (accumulated Doppler range)	Double	8	H+20
8	adrstd	Estimated carrier phase standard deviation (cycles)	Float	4	H+28
9	dopp	Instantaneous carrier Doppler frequency (Hz)	Float	4	H+32
10	C/No	Carrier to noise density ratio C/No =10[log10(S/N0)] (dB-Hz)	Float	4	H+36
11	locktime	Seconds of continuous tracking(no cycle slipping)	Float	4	H+40
12	ch-tr-status	Tracking status(see table of Channel Tracking status)	Float	4	H+44
13		Next PRN offset = H + 4 + (#obs x 44)			

ID	Field	Description	Type	Binary Bytes	Offset
14	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+4+ (#obs x44)
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.28.1 Channel Tracking status

Nibble	Bit	Mask	Description	Value
N0	0	0x00000001	Tracking state	See table of Tracking State
	1	0x00000002	Tracking state	
	2	0x00000004	Tracking state	
	3	0x00000008	Tracking state	
N1	4	0x00000010	SV channel number	(n-1) (0 = first, n = last) n depends on the receiver
	5	0x00000020	SV channel number	
	6	0x00000040	SV channel number	
	7	0x00000080	SV channel number	
N2	8	0x00000100	SV channel number	
	9	0x00000200	SV channel number	
	10	0x00000400	Phase lock flag	0 = Not locked, 1 = Locked
	11	0x00000800	Parity known flag	0 = Not known, 1 = Known
N3	12	0x00001000	Code locked flag	0 = Not locked, 1 = Locked
	13	0x00002000	Correlator type	0-7, see table of Correlator Type
	14	0x00004000	Correlator type	
	15	0x00008000	Correlator type	
N4	16	0x00010000	Satellite system	0 = GPS, 1 = GLONASS, 2 = SBAS, 3 = Galileo, 4 = BeiDou, 5 = QZSS, 6 = NavIC, 7 = Other

Nibble	Bit	Mask	Description	Value
	17	0x00020000	Satellite system	
	18	0x00040000	Satellite system	
	19	0x00080000	Antenna indicator	0 = data is from primary antenna 1 = data is from secondary antenna
N5	20	0x00100000	Grouping	0 = Not grouped, 1 = Grouped
	21	0x00200000	Signal type	GPS: 0=L1C/A, 9=L2P, 14=L5, 17=L2C GLONASS: 0=L1C/A, 1=L2C/A BDS: 0=B1, 1=B2, 2=B3, 9=B2a Galileo: 2=E1, 12=E5a, 17=E5b QZSS: 0=L1C/A, 14=L5, 17=L2C
	22	0x00400000	Signal type	
	23	0x00800000	Signal type	
N6	24	0x01000000	Signal type	
	25	0x02000000	Signal type	
	26	0x04000000	Reserved	
	27	0x08000000	Primary L1 channel	0 = Not primary, 1 = Primary
N7	28	0x10000000	Carrier phase measurement	0 = Half Cycle Not Added 1 = Half Cycle Added
	29	0x20000000	Digital filtering on signal	0 = No digital filter 1 = Digital filter
	30	0x40000000	PRN lock flag	0 = PRN Not Locked Out 1 = PRN Locked Out
	31	0x80000000	Channel assignment	0 = Automatic, 1 = Forced

3.1.28.2 Tracking State

State	Description
0	Idle
1	Sky Search
2	Wide frequency band pull-in
3	Narrow frequency band pull-in

State	Description
4	Phase lock loop
6	Channel steering
7	Frequency lock loop
9	Channel alignment
10	Code search
11	Aided phase lock loop
23	Side peak detection

3.1.28.3 Correlator Type

State	Description
0	N/A
1	Standard correlator: spacing = 1 chip
2	Narrow Correlator: spacing < 1 chip
3	Reserved
4	Pulse Aperture Correlator (PAC)
5	Narrow PAC
6	Reserved

3.1.29 RANGECMP

This log contains the RANGE data in a compressed format.

Name	Value
Message ID	140
Input	log rangecmp ontime 10
Function	Compressed version of the RANGE log

Name	Value
Example output	>RANGECMP COM1 0 0.0 FINE 2148 205310.000 00000000 0 1 < 132 < 845c1018221e002034e26609babef7520301bd4f60030000 < 845c30027c1700e048e26609cecf063003019c4fc0030000 < 845cd001931600b03ee2660929dd5b630201ea4fe0030000 ..... < 445d5308c217fb1f1016fc0a4468cc48031e405440030000 < 445d3302733dfcff2616fc0a06979c78031e4f54e0030000 < 445d9301eb55fc4f3216fc0a6d92981c021e9c5380030000

ID	Field	Description	Type	Binary Bytes	Offset
1	RANGECMP header	Log header		H	0
2	#obs	Number of satellite observations with information to follow	Ulong	4	H
3	1st range record	Compressed range log in format of table of Range Record Format	Hex	24	H+4
4		Next rangecmp offset = H+4+ (#obs x 24)			
5	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+4+ (#obs x24)
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.29.1Range Record Format (RANGECMP only)

Data	Description	Bits first to last	Length(bits)	Scale Factor	Units
Channel Tracking Status	Channel tracking status word	0-31	32	See table of Channel Tracking status	-
Doppler Frequency	Instantaneous carrier Doppler frequency	32-59	28	1/256	Hz

Data	Description	Bits first to last	Length(bits)	Scale Factor	Units
Pseudorange (PSR)	Pseudorange measurement	60-95	36	1/128	m
ADR	Accumulated Doppler Range	96-127	32	1/256	cycles
StdDev-PSR	Pseudorange measurement standard deviation	128-131	4	See table of StdDev-PSR Values	m
StdDev-ADR	ADR measurement standard deviation	132-135	4	(n+1)/512	cycles
PRN/Slot		136-143	8	1	-
Lock Time	Number of seconds of continuous tracking (no cycle slipping)	144-164	21	1/32	s
C/No	Carrier to noise density ratio	165-169	5	(20+n)	dB-Hz
GLONASS Frequency number	GLONASS Frequency number	170-175	n+7	1	
Reserved		176-191	16		

ADR (Accumulated Doppler Range) is calculated as follows:
ADR_ROLLS = (RANGECMP_PSR /WAVELENGTH + RANGECMP_ADR) /MAX_VALUE
Round to the closest integer
IF (ADR_ROLLS ≤ 0)
    ADR_ROLLS = ADR_ROLLS - 0.5
ELSE
    ADR_ROLLS = ADR_ROLLS + 0.5
At this point integerise ADR_ROLLS CORRECTED_ADR = RANGECMP_ADR - (MAX_VALUE*ADR_ROLLS)
where
 ADR has units of cycles
 WAVELENGTH = 0.1902936727984 for GPS L1
 WAVELENGTH = 0.2442102134246 for GPS L2
 MAX_VALUE = 8388608

Note: GLONASS satellites emit L1 and L2 carrier waves at a satellite-specific frequency, refer to the GLONASS section of An Introduction to GNSS.

3.1.29.2 StdDev-PSR Values

Code	StdDev-PSR (m)
0	0.050
1	0.075
2	0.113
3	0.169
4	0.253
5	0.380
6	0.570
7	0.854
8	1.281
9	2.375
10	4.750
11	9.500
12	19.000
13	38.000
14	76.000
15	152.000

3.1.30 REFSTATION

This log contains the ECEF Cartesian position of the base station as received through the RTCM, RTCMV3 or CMR messages. It also features a time tag, the health status of the base station and the station ID. This information is set at the base station using the FIX command and the DGPSTXID command.

The base station health, Field #6, may be one of 8 values (0 to 7). Values 0 through 5 indicate the scale factor that is multiplied with the satellite UDRE one-sigma differential error values. Below are values 0 to 5 and their corresponding UDRE scale factors:

0: 1 (Health OK) 0.75 2: 0.5 3: 0.3 4: 0.2 5: 0.1

The base station health field only applies to RTCM base stations. A value of 6 means the base station transmission is not monitored and a value of 7 means that the base station is not working.

Name	Value
Message ID	175
Input	log refstation ontime 30
Function	Position of the base station in RTCM format.
Example output	>REFSTATION COM2 0 0.0 FINE 2148 207681.000 00000000 0 1 < 00000000 -2860998.161 4651725.179 3283992.301 0 RTCMV3 "0"

ID	Field	Description	Type	Binary Bytes	Offset
1	RANGECMP header	Log header		H	0
2	status	Status of the base station information 0x00000001 Invalid 0x00000000 Valid	Ulong	4	H
3	x	ECEF X value (m)	Double	8	H+4
4	y	ECEF Y value (m)	Double	8	H+12
5	z	ECEF Z value (m)	Double	8	H+20
6	health	Base station health, see the description at the start of this section	Ulong	4	H+28
7	stn type	Station type, see table of Station Type	Enum	4	H+32
8	stn ID	Base station ID	Char[5]	8	H+36
9	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+44
10	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.30.1 Station Type

Base Station Type Binary	Base station type ASCII	Description
0	NONE	Base station is not used
1	RTCM	Base station is RTCM
3	CMR	Base station is CMR

Base Station Type Binary	Base station type ASCII	Description
4	RTCMV3	Base station is RTCMV3

3.1.31 RTCM Messages

RTCM 2.X and RTCM 3.X standard are supported , which is used to deliver the base station information to user side. RTCM defines a set of message types to deliver different information. The detailed usage of RTCM messages refers to RTK Configuration Example.

3.1.31.1 RTCM2 Messages

Here is a list of RTCM2 message types supported by BX40C. More details of RTCM2.protocols refers to the official document (RTCM10402.3 recommended standards for differential GNSS (Global Navigation Satellite Systems) service version 2.3)

Message Type	Flag	Description
3	B/R	GPS Reference Station Parameter(X, Y,Z coordinates in ECEF coordinate system)
18	B/R	Uncorrected Carrier phase measurements
19	B/R	Uncorrected pseudorange measurements
22	B	Extended Base Station
24	R	Reference Station Antenna Reference Point Parameter(X, Y, Z Coordinates in ECEF coordinate system) with antenna height , which is more precise than message type 3

B in *Flag* filed means the message is supported by a base, R means the message is supported by a rover, R/B means the message is supported both by a base and a rover.

3.1.31.2 RTCMv3 Messages

RTCMv3 logs are implementations of the messages described by the RTCM SC-104 committee's "Differential GNSS (Global Navigation Satellite Systems) Services – Version 3" standard. These messages are primarily intended to support RTK operations.
The RTCMv3 logs can be divided into several categories that are described below. An RTK base station must minimally transmit one or more observable message, together with one or more station and antenna message.

3.1.31.2.1 Legacy Observable Messages

The legacy observable messages contain GPS and GLONASS code and phase observables. The extended messages additionally contain the C/N0.

Log Name	Description
RTCM1001	GPS L1-only observables, basic
RTCM1002	GPS L1-only observables, extended
RTCM1003	GPS L1/L2 basic observables, basic
RTCM1004	GPS L1/L2 basic observables, extended
RTCM1009	GLONASS L1-only observables, basic
RTCM1010	GLONASS L1-only observables, extended
RTCM1011	GLONASS L1/L2 basic observables, basic
RTCM1012	GLONASS L1/L2 basic observables,extended

3.1.31.2.2 MSM Observable Messages

The Multiple Signal Messages (MSM) are observable messages for all current GNSS systems. They provide a standardized framework for message content and are designed to support future systems and signals.
** Sending legacy (1001-1004 and 1009-1012) and MSM messages in the same stream can cause problems for remote RTK users and is not recommended.**
Each GNSS system has a set of seven MSM types numbered from 1 to 7. The MSM type for each GNSS system provides the same generic information. Generally, as the MSM number increases, more information is available in the messages. For example, MSM1 for each GNSS system provides the code measurements for the system, while MSM3 provides both the code and phase.The information encoded in each MSM variant is described in Table below.
For RTK operations, MSM3 is minimally recommended.

Message	Description
MSM1	Provides the code measurements.
MSM2	Provides the phase measurements
MSM3	Provides the data from MSM1(code) and MSM2(phase) in a single message
MSM4	Provides all the data from MSM3(code and phase) and adds the CNR measurements
MSM5	Provides all the data from MSM4(code, phase and CNR) and adds the doppler measurements
MSM6	Provides the same information as MSM4, but has extended resolution on the measurements

Message	Description
MSM7	Provides the same information as MSM5, but has extended resolution on the measurements

MSM Log Names

Message	GPS	GLONASS	Galileo	QZSS	BeiDou
MSM1	RTCM1071	RTCM1081	RTCM1091	RTCM1111	RTCM1121
MSM2	RTCM1072	RTCM1082	RTCM1092	RTCM1112	RTCM1122
MSM3	RTCM1073	RTCM1083	RTCM1093	RTCM1113	RTCM1123
MSM4	RTCM1074	RTCM1084	RTCM1094	RTCM1114	RTCM1124
MSM5	RTCM1075	RTCM1085	RTCM1095	RTCM1115	RTCM1125
MSM6	RTCM1076	RTCM1086	RTCM1096	RTCM1116	RTCM1126
MSM7	RTCM1077	RTCM1087	RTCM1097	RTCM1117	RTCM1127

3.1.31.2.3 Station and Antenna Messages

The station and antenna messages provide the base station's coordinates and hardware. Remote RTK users require this information so that they can position themselves relative to a base station.

Log Name	RTCM Message Type	Description
RTCM1005	1005	Stationary RTK Base Station Antenne Reference Point(ARP)
RTCM1006	1006	Stationary RTK Base Station ARP with Antenna Height
RTCM1007	1007	Extended Antenna Descriptor and Setup Information
RTCM1008	1008	Extended Antenna Reference Station Description and Serial Number
RTCM1033	1033	Receiver and antenna descriptors

Message Type 1005 provides the Earth-Centered, Earth-Fixed (ECEF) coordinates of the Antenna Reference Point (ARP). The ARP is an explicit physical point on the antenna, typically the center of its base. It is related to the antenna phase center from where the measurements are emitted via the Phase Center Offsets (PCOs). The PCOs can be set using the **THISANTENNATYPE** command . If the PCOs are not set, then the coordinates transmitted by Message types 1005 and 1006 will be those that the receiver is fixed to by the **FIX** command.

Message Type 1006 is the same as 1005 but additionally provides the antenna height. This value is always set to zero by the receiver firmware.

Message Type 1007 provides the base station antenna type. Conventionally, the antenna name from the International GNSS Service (IGS) is used. The antenna name can be set using the THISANTENNATYPE command.

Message Type 1008 is the same as 1007 but additionally provides the antenna serial number. The serial number is always set to null by the receiver firmware.

Message Type 1033, like message types 1007 and 1008, also provides the antenna information. Message type 1033 additionally provides the receiver type and firmware version. The primary use of this information is to more-easily enable RTK rovers to fix their GLONASS ambiguities. This information is filled automatically and appropriately by the receiver firmware.

For a receiver operating as an RTK base station, the recommended messages to transmit are 1006 and 1033. With these messages remote RTK users have all the information describing the base station.

3.1.31.2.4 Ephemeris Messages

The ephemeris messages listed in Table below provide the satellite ephemerides. For RTK operations, this information is optional, as RTK rovers will be downloading their own ephemerides directly from the satellites.
There are two messages for each ephemeris type. For the messages logged ONTIME (e.g. LOG RTCM1019 ONTIME 10), a single satellite's ephemeris is output at each ONTIME interval. The ephemerides will be cycled through in numerical order. For the messages logged ONCHANGED(e.g. LOG RTCM1019ASYNC ONCHANGED), new or changed ephemerides will be output as soon as they are available.

Log Name	RTCM Message Type	Descripton
RTCM1019	1019	GPS Ephemerides, logged ONTIME
RTCM1019ASYNC	1019	GPS Ephemerides, logged ONCHANGED
RTCM1020	1020	GLONASS Ephemerides, logged ONTIME
RTCM1020ASYNC	1020	GLONASS Ephemerides, logged ONCHANGED
RTCM1042	1042	BeiDou Ephemerides, logged ONTIME
RTCM1042ASYNC	1042	BeiDou Ephemerides, logged ONCHANGED
RTCM1044	1044	QZSS Ephemerides, logged ONTIME
RTCM1044ASYNC	1044	QZSS Ephemerides, logged ONCHANGED
RTCM1045	1045	Galileo F/NAV Ephemerides, logged ONTIME
RTCM1045ASYNC	1045	Galileo F/NAV Ephemerides, logged ONCHANGED
RTCM1046	1046	Galileo I/NAV Ephemerides, logged ONTIME
RTCM1046ASYNC	1046	Galileo I/NAV Ephemerides, logged ONCHANGED

Below is a list of RTCM3 message types that supported by BX40C. B in flag filed means the message is supported by a base, R means the message is supported by a rover, R/B means the message is supported both by a base and a rover.

Message Type	Flag	Description
1001	B	L1 only GPS RTK observables
1002	R/B	Extended L1-only GPS RTK observables
1003	B	L1&L2 GPS RTK observables
1004	R/B	Extended L1&L2 GPS RTK observables
1005	R/B	Stationary RTK Reference Station ARP
1006	R/B	Stationary RTK Reference Station ARP with Antenna Height
1007	B	Extended Antenna Descriptor and Setup
1008	B	Extended Antenna Reference Station Description and serial number
1009	B	L1 only GLONASS RTK observables
1010	R/B	Extended L1-only GLONASS RTK observables
1011	B	L1&L2 GLONASS RTK observables
1012	R/B	Extended L1&L2 GLONASS RTK observables
1019	R	GPS Ephemerides
1020	R	GLONASS Ephemerides
1033	B	Receiver and antenna descriptors
1042	R	BDS Ephemerides
1071	B	GPS MSM1, GPS Code Measurements
1072	B	GPS MSM2, GPS Phase Measurements
1073	B	GPS MSM3, GPS Code and Phase Measurements
1074	R/B	GPS MSM4, GPS Code, Phase and CNR Measurements
1075	R/B	GPS MSM5, GPS Code, Phase, CNR and Doppler Measurements
1076	R/B	GPS MSM6, Extended GPS Code, Phase and CNR Measurements
1077	R/B	GPS MSM7, Extended GPS Code, Phase, CNR and Doppler Measurements
1081	B	GLONASS MSM1, GLONASS Code Measurements
1082	B	GLONASS MSM2, GLONASS Phase Measurements

Message Type	Flag	Description
1083	B	GLONASS MSM3, GLONASS Code and Phase Measurements
1084	R/B	GLONASS MSM4, GLONASS Code, Phase and CNR Measurements
1085	R/B	GLONASS MSM5, GLONASS Code, Phase, CNR and Doppler Measurements
1086	R/B	GLONASS MSM6, Extended GLONASS Code, Phase and CNR Measurements
1087	R/B	GLONASS MSM7, Extended GLONASS Code, Phase, CNR and Doppler Measurements
1121	B	Beidou MSM1, BeiDou Code Measurements
1122	B	Beidou MSM2, BeiDou Phase Measurements
1123	B	Beidou MSM3, BeiDou Code and Phase Measurements
1124	R/B	Beidou MSM4, BeiDou Code, Phase and CNR Measurements
1125	R/B	Beidou MSM5, BeiDou Code, Phase, CNR and Doppler Measurements
1126	R/B	Beidou MSM6, Extended BeiDou Code, Phase and CNR Measurements
1127	R/B	Beidou MSM7, Extended BeiDou Code, Phase, CNR and Doppler Measurements
1230	R/B	GLONASS bias information message

3.1.32 RTK Configuration Example

Example of RTK Configuration (RTCMv3 Base Mode):
UNLOGALL //remove all logs
UNDULATION USER 0.0 //Set user specified undulation value for ellipsoid height (optional)
FIX POSITION B L H //B: latitude (degree), L: longitude (degree), H: ellipsoid height (m)
or POSAVE ON 0.02 //Turn on position average for 0.02 hour (72s)
LOG COM2 RTCM1074 ONTIME 1 //output GPS observations
LOG COM2 RTCM1084 ONTIME 1 //output GLONASS observations
LOG COM2 RTCM1094 ONTIME 1 //output Galileo observations
LOG COM2 RTCM1114 ONTIME 1 //output QZSS observations
LOG COM2 RTCM1124 ONTIME 1 //output BeiDou observations
LOG COM2 RTCM1006 ONTIME 10 //output the base coordinate
LOG COM2 RTCM1033 ONTIME 10 //output antenna, receiver information
LOG COM2 RTCM1230 ONTIME 10 //output GLONASS bias information
SAVECONFIG //save configuration

Example of RTK Configuration (RTCM2 Base Mode):
UNLOGALL //remove all logs
UNDULATION USER 0.0 //Set user specified undulation value for ellipsoid height (optional)
FIX POSITION B L H //B: latitude (degree), L: longitude (degree), H: ellipsoid height (m)
or POSAVE ON 0.02 //Turn on position average for 0.02 hour (72s)
LOG COM2 RTCM1819 ONTIME 1 //output Carrier phase & pseudorange measurements
LOG COM2 RTCM3 ONTIME 10 //output GPS Reference Station Parameter
SAVECONFIG //save configuration

Below commands output ephemerides, not default configuration:
LOG COM2 RTCM1019 ONTIME 5 //GPS ephemerides
LOG COM2 RTCM1020 ONTIME 5 //GLONASS ephemerides
LOG COM2 RTCM1042 ONTIME 5 //BeiDou ephemerides
LOG COM2 RTCM1044 ONTIME 5 //QZSS ephemerides
LOG COM2 RTCM1046 ONTIME 5 //Galileo ephemerides

Example of RTK Configuration (Rover Mode):
FIX NONE //cancel the fixed coordinate of a base station
LOG COM1 GPGGA ONTIME 1 //output GPGGA message
SAVECONFIG //save configuration

Note:

1. Broadcast RTCM messages only after FIX POSITION command.
2. For the FIX POSITIONcommand, if the input coordinates and actual coordinates differ by more than 30m in one direction, it will stop broadcasting RTCM messages although the RTCM logs are input.

3.1.33 RTKSATINFO

This log is to display RTK related satellite information.

Name	Value
Message ID	2006
Input	log rtksatinfo ontime 1
Function	Display RTK related satellite information.
Example output	#RTKSATINFOA,COM2,0,0.0,FINE,2110,376347.000,00000000,0,1; NARROW_INT,45,12,6,20,7,11,5,18,6,11,11,4,4,18,18,6,6*4b92e576

ID	Field	Description	Type	Binary Bytes	Offset
1	RTKSATINFO header	Log header		H	0

ID	Field	Description	Type	Binary Bytes	Offset
2	pos type	Position type, see table of Position or Velocity Type	Enum	4	H
3	#base sat	Number of satellites for base	Uchar	1	H+4
4	#gq	Number of GPS+QZSS satellites for base	Uchar	1	H+5
5	#glo	Number of GLONASS satellites for base	Uchar	1	H+6
6	#bds	Number of BDS satellites for base	Uchar	1	H+7
7	#gal	Number of Galileo satellites for base	Uchar	1	H+8
8	#gq_wl	Number of fixed GPS+QZSS satellites in wide-lane ambiguity solution	Uchar	1	H+9
9	#glo_wl	Number of fixed GLONASS satellites in wide-lane ambiguity solution	Uchar	1	H+10
10	#bds_wl	Number of fixed BDS satellites in wide-lane ambiguity solution	Uchar	1	H+11
11	#gal_wl	Number of fixed Galileo satellites in wide-lane ambiguity solution	Uchar	1	H+12
12	#gqL1	Number of fixed GPS+QZSS L1 satellites	Uchar	1	H+13
13	#gqL2	Number of fixed GPS+QZSS L2 satellites	Uchar	1	H+14
14	#gloL1	Number of fixed GLONASS L1 satellites	Uchar	1	H+15
15	#gloL2	Number of fixed GLONASS L2 satellites	Uchar	1	H+16
16	#bdsB1	Number of fixed BDS B1 satellites	Uchar	1	H+17
17	#bdsB23	Number of fixed BDS B2/B3 satellites	Uchar	1	H+18
18	#galE1	Number of fixed Galileo E1 satellites	Uchar	1	H+19

ID	Field	Description	Type	Binary Bytes	Offset
19	#galE5b	Number of fixed Galileo E5b satellites	Uchar	1	H+20
20	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+21
21	[CR][LF]	Sentence terminator (ASCII only)	-		

3.1.34 RTKSATS

This log is to display the information of satellites participating in RTK.

Name	Value
Message ID	1174
Input	log rtksats ontime 1
Function	Display the information of satellites participating in RTK.

Name	Value
Example output	<RTKSATS,COM2,0,0.0,FINE,2117,110668.000,00000000,0,1; < 46 < GPS 2 GOOD 00000003 < GPS 5 GOOD 00000003 < GPS 6 GOOD 00000003 < GPS 7 GOOD 00000003 < GPS 9 GOOD 00000003 < GPS 12 GOOD 00000003 < GPS 13 GOOD 00000003 < GPS 15 GOOD 00000003 < GPS 17 GOOD 00000003 < GPS 19 GOOD 00000003 < GPS 25 GOOD 00000003 < GPS 29 GOOD 00000003 < GPS 30 GOOD 00000003 < GLONASS 1+1 GOOD 00000003 < GLONASS 7+5 GOOD 00000003 < GLONASS 8+6 GOOD 00000003 < GLONASS 23+3 GOOD 00000003 < GLONASS 24+2 GOOD 00000003 < BEIDOU 1 GOOD 00000005 < BEIDOU 2 GOOD 00000005 < BEIDOU 3 GOOD 00000005 < BEIDOU 4 GOOD 00000005 < BEIDOU 6 GOOD 00000005 < BEIDOU 7 GOOD 00000005 < BEIDOU 8 GOOD 00000005 < BEIDOU 9 GOOD 00000005 < BEIDOU 10 GOOD 00000005 < BEIDOU 11 GOOD 00000005 < BEIDOU 12 GOOD 00000005 < BEIDOU 13 GOOD 00000005 < BEIDOU 16 GOOD 00000005 < BEIDOU 21 GOOD 00000005 < BEIDOU 22 GOOD 00000005 < BEIDOU 34 GOOD 00000005 < BEIDOU 35 GOOD 00000005 < BEIDOU 38 GOOD 00000005 < BEIDOU 39 GOOD 00000005 < BEIDOU 40 GOOD 00000005 < Galileo 3 GOOD 00000005 < Galileo 5 GOOD 00000005 < Galileo 8 GOOD 00000005 < Galileo 13 GOOD 00000005 < Galileo 15 GOOD 00000005 < QZSS 193 GOOD 00000003 < QZSS 195 GOOD 00000003

ID	Field	Description	Type	Binary Bytes	Offset
1	RTKSATS header	Log header		H	0
2	# entries	Number of records to follow	Ulong	4	H
3	Satellite system	GNSS satellite system. 0: GPS 1: GLONASS 2: SBAS 5: Galieo 6: BeiDou 7: QZSS	Enum	4	H+4
4	Satellite ID	In binary logs, the satellite ID field is 4 bytes. The 2 lowest order bytes, interpreted as a USHORT, are the system identifier: for instance, the PRN for GPS or the slot for GLONASS. The 2 highest-order bytes are the frequency channel for GLONASS, interpreted as a SHORT and zero for all other systems. In ASCII and abbreviated ASCII logs, the satellite ID field is the system identifier. If the system is GLONASS and the frequency channel is not zero, then the signed channel is appended to the system identifier. For example, slot 13, frequency channel -2 is output as 13-2	Ulong	4	H+8
5	Status	Satellite status. *GOOD*: observation is good. The satellites are actually participating in RTK calculation under RTK fixed, float and pseudo-range differential state. *NOTUSED*: observation was not used in the RTK solution.	Enum	4	H+12
6	Signal mask	See table of Signal Mask below.	Hex	4	H+16
7		Next satellite offset = H+4+(#sat x 16)			
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+(#sat x16)
9	[CR][LF]	Sentence terminator (ASCII only)	-		

3.1.34.1 Signal Mask

Satellite System	Bit	Mask	Description
GPS	0	0x01	GPS L1 used in Solution
	1	0x02	GPS L2 used in Solution
	2	0x04	GPS L5 used in Solution
GLONASS	0	0x01	GLONASS L1 used in Solution
	1	0x02	GLONASS L2 used in Solution
	2	0x04	GLONASS L3 used in Solution
BeiDou	0	0x01	BeiDou B1 used in Solution
	1	0x02	BeiDou B2 used in Solution
	2	0X04	BeiDou B3 used in Solution
Galileo	0	0x01	Galileo E1 used in Solution
	1	0x02	Galileo E5A used in Solution
	2	0x04	Galileo E5B used in Solution
	3	0x08	Galileo ALTBOC used in Solution
QZSS	0	0x01	GPS L1 used in Solution
	1	0x02	GPS L2 used in Solution
	2	0x04	GPS L5 used in Solution

3.1.35 SATSINFO

This command contains all the satellite information tracked by the BX40C GNSS board, including the total number of satellites, PRN, altitude angle, azimuth angle, and SNR.

Name	Value
Message ID	20021
Input	log SATSINFOA ontime1 log SATSINFOB ontime 1

Output：

#SATSINFOA,COM2,0,0.0,FINE,2299,269823.000,00000000,0,1;31,3,0,0,0,23,GPS,4,316,30,3,44,0,42,17,44,14,GPS,16,263,58,2,46,0,42,9,GPS,26,343,69,3,48,0,48,17,51,14,GPS,28,77,45,3,44,0,46,17,48,14,GPS,31,37,61,2,46,0,46,17,GLONASS,41,213,52,2,54,0,51,1,GLONASS,42,303,47,2,54,0,50,1,GLONASS,51,24,40,2,53,0,50,1,GLONASS,52,308,43,2,52,0,49,1,BEIDOU,1,141,44,3,44,0,47,1,44,2,BEIDOU,2,236,35,3,39,0,46,1,42,2,BEIDOU,3,200,50,3,44,0,47,1,45,2,BEIDOU,4,124,33,3,40,0,44,1,43,2,BEIDOU,6,357,68,3,46,0,49,1,47,2,BEIDOU,7,205,48,3,43,0,48,1,46,2,BEIDOU,9,329,55,3,44,0,48,1,45,2,BEIDO

U,10,210,37,3,42,0,44,1,43,2,BEIDOU,16,4,68,3,49,0,49,1,47,2,BEIDOU,19,247,45,3,48,0,48,9,50,2,BEIDOU,27,105,33,3,43,0,41,9,44,2,BEIDOU,36,292,37,3,46,0,45,9,48,2,BEIDOU,39,42,72,3,50,0,50,9,51,2,BEIDOU,40,188,55,3,47,0,48,9,50,2,BEIDOU,46,10,59,3,49,0,49,9,51,2,GALILEO,4,160,46,3,44,2,50,17,47,12,GALILEO,9,279,72,3,48,2,52,17,50,12,GALILEO,24,255,42,3,45,2,49,17,46,12,GALILEO,31,356,69,3,47,2,52,17,49,12,QZSS,194,66,72,3,45,0,50,17,51,14,QZSS,196,185,38,3,42,0,44,17,46,14,QZSS,199,169,53,3,39,0,48,17,50,14*90674f00

ID	Field	Description	Type	Binary Bytes	Offset
1	Satsinfo header			H	0
2	Sat number	Total number of satellites currently tracked	Byte	1	H
3	Version number	Current Version:3	Byte	1	H+1
4	Reserved		Byte	1	H+2
5	Reserved		Byte	1	H+3
6	Reserved		Byte	1	H+4
7	Frq flag	Frequency identification. See table Frq flag	Byte	1	H+5
8	Sys status	System identification. See table Sys status	Byte	1	H+6
9	PRN	PRN numbers of satellites	Byte	1	H+7
10	Azimuth	Azimuth，degree	Short	2	H+8
11	Elevation	Elevation，degree	Byte	1	H+10
12	Freq No	Number of current PRN satellites containning frequency	Byte	1	H+11
13	SNR	SNR	Byte	1	H+12
14	Freq status	Freq status. See table Freq status	Byte	1	H+13
15	Next Frq info	Next frequency information of satellite (if available)			
16	Next satellite offset=H+6+sat*(6+freq No*2)				
17	xxxx	32-bit CRC checksum（ASCII and Binary only）	Hex	4	H+6+sat*(6+freq No*2)
18	[CR][LF]	Sentence terminator（ASCII only）			

3.1.35.1 Frq flag

Bit	Description	Value
Bit 7	Reserved	0
Bit 6	Reserved	0
Bit 5	BDS B2b, GPS L2P	0：not contained；1：contained
Bit 4	BDS B2a, GLO G3, GAL E6	0：not contained；1：contained
Bit 3	BDS B1C, GPS L1C	0：not contained；1：contained
Bit 2	GPS L5, BDS B3I, GAL E5a, IRNSS L5	0：not contained；1：contained
Bit 1	GPS L2C, GLO L2, BDS B2I, GAL E5b	0：not contained；1：contained
Bit 0	GPS L1C/A, GLO L1, BDS B1I, GAL E1	0：not contained；1：contained

3.1.35.2 Sys status

Sys status
0=GPS
1=GLONASS
2=SBAS
3=Galileo
4=BeiDou
5=QZSS
6=NavIC
7=Other

3.1.35.3 Freq status

Freq status	Value
GPS	0=L1C/A 5=L2P 9=L2P(Y), semicodeless 14=L5(Q) 16=L1C(P) 17=L2C(M)

Freq status	Value
GLONASS	0=L1C/A 1=L2C/A 5=L2P 6=L3(Q)
BeiDou	0=B1(I) with D1 data 1=B2(I) with D1 data 2=B3(I) with D1 data 4=B1(I) with D2 data 5=B2(I) with D2 data 6=B3(I) with D2 data 7=B1C(P) 9=B2a(P)
Galileo	2=E1(C) 6=E6B 7=E6C 12=E5a(Q) 17=E5b(Q) 20=E5AltBOC(Q)
QZSS	0=L1C/A 14=L5(Q) 16=L1C(P) 17=L2C(M) 27=L6P
SBAS	0=L1C/A 6=L5(I)
NavIC	0=L5 SPS
Other	19=L-Band

3.1.36 SATVIS

This log contains satellite visibility data for all available constellations with additional satellite information.

Name	Value
Message ID	1043
Input	log satvis ontime 60
Function	Satellite visibility

Name	Value
Example output	>SATVIS COM1 3 0.0 FINE 2148 205469.000 00000000 0 1 < GPS TRUE TRUE 11 < 1 0 0 83.8 88.7 -78.391 -581.900 ..... < 30 0 0 47.6 268.6 -120.701 -624.210 >SATVIS COM1 2 0.0 FINE 2148 205469.000 00000000 0 1 < GLONASS TRUE TRUE 5 < 12-1 0 69.3 161.5 -1583.918 -2095.743 ..... < 24+2 0 21.5 242.1 2717.593 2205.229 >SATVIS COM1 1 0.0 FINE 2148 205469.000 00000000 0 1 < BEIDOU TRUE TRUE 22 < 1 0 0 46.4 140.4 2.855 -496.077 ..... < 46 0 0 46.1 304.8 1575.863 1076.932 >SATVIS COM1 0 0.0 FINE 2148 205469.000 00000000 0 1 < GALILEO TRUE TRUE 6 < 2 0 0 8.6 134.8 -2620.974 -3124.483 ..... < 30 0 0 58.0 128.1 -1310.233 -1813.742 >SATVIS COM1 -1 0.0 FINE 2148 205469.000 00000000 0 1 < QZSS TRUE TRUE 4 < 193 0 0 11.4 153.1 254.282 -249.227 ... < 199 0 0 53.3 169.6 -2.660 -506.169 >SATVIS COM1 -1 0.0 FINE 2148 205469.000 00000000 0 1 < SBAS TRUE TRUE 7 < 122 0 0 46.7 142.0 0.081 0.000 ... < 144 0 0 32.43 239.7 39.170 0.000

ID	Field	Description	Type	Binary Bytes	Offset
1	SATVIS header	Log header		H	0
2	Satellite System	GNSS satellite system identifier. 0: GPS 1: GLONASS 2: SBAS 5: Galieo 6: BeiDou 7: QZSS	Enum	4	H
3	sat vis	Is satellite visibility valid? 0 = FALSE 1 = TRUE	Enum	4	H+4

ID	Field	Description	Type	Binary Bytes	Offset
4	almanac flag	Was complete GNSS almanac used? 0 = FALSE 1 = TRUE	Enum	4	H+8
5	#sat	Number of satellites with data to follow	Ulong	4	H+12
6	Satellite ID	In binary logs, the satellite ID field is 4 bytes. The 2 lowest order bytes, interpreted as a USHORT, are the system identifier: for instance, the PRN for GPS or the slot for GLONASS. The 2 highest-order bytes are the frequency channel for GLONASS, interpreted as a SHORT and zero for all other systems. In ASCII and abbreviated ASCII logs, the satellite ID field is the system identifier. If the system is GLONASS and the frequency channel is not zero, then the signed channel is appended to the system identifier. For example, slot 13, frequency channel -2 is output as 13-2	Ulong	4	H+16
7	health	Satellite health	Ulong	4	H+20
8	elev	Elevation (degrees)	Double	8	H+24
9	az	Azimuth (degrees)	Double	8	H+32
10	true Doppler	Theoretical Doppler of satellite - the expected Doppler frequency based on a satellite's motion relative to the receiver. It is computed using the satellite's coordinates and velocity along with the receiver's coordinates and velocity (Hz)	Double	8	H+40
11	apparent Doppler	Apparent Doppler for this receiver - the same as Theoretical Doppler above but with clock drift correction added (Hz)	Double	8	H+48
12		Next satellite offset = H + 16 + (#sat x 40)			
13	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+16+ (#sat x40)

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

3.1.37 SBASEPHEMERIS

This log is to record the ephemeris of SBAS satellite.

Name	Value
Message ID	601
Input	log sbasephemeris onchanged

ID	Field	Description	Type	Binary Bytes	Offset
1	sbasephemeris	Log header		H	0
2	svid	Start from 1	Uchar	1	H
3	IODN	Issue of Data Navigation	Uchar	1	H+1
4	URA	Accuracy code (URA, meters)	Uchar	1	H+2
5	SecOfDay	Scale 16s	Ushort	2	H+3
6	Rev		Ushort	2	H+5
7	X	Unit:m	Double	8	H+7
8	Y		Double	8	H+15
9	Z		Double	8	H+23
10	VX	Rate-of-Position change, m/s	Float	4	H+27
11	VY		Float	4	H+31
12	VZ		Float	4	H+35
13	AX	Acceleration, m/s^2	Float	4	H+39
14	AY		Float	4	H+43
15	AZ		Float	4	H+47
16	Af0	Clock parameter	Float	4	H+51
17	Af1		Float	4	H+55

ID	Field	Description	Type	Binary Bytes	Offset
18	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+59
19	[CR][LF]	Sentence terminator (ASCII only)			

3.1.38 TEMPSENSOR

This log is to query the temperature of the CPU and baseband.

Name	Value
Message ID	30
Input	log tempsensor
Function	Temperature of the CPU and baseband
Example output	<TEMPSENSOR COM2 0 0.0 FINE 2134 289622.000 00000000 0 1 < 69.21 80.84

ID	Field	Description	Type	Binary Bytes	Offset
1	TEMPSENSOR header	Log header		H	0
2	CPU temperature	CPU temperature	Float	4	H
3	baseband temperature	baseband temperature	Float	4	H+4
4	reserved		Float	4	H+8
5	reserved		Float	4	H+12
6	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+16
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.39 THISANTENNA

This log contains the information about the antenna, which is input with commands **THISANTENNASET** and **THISANTENNATYPE**.

This logging can be used at the base side to broadcast RTCM messages. And the binary logging information can be output in Tersus RINEX converter software.

Name	Value
Message ID	1421
Input	log thisantenna log thisantenna ontime 10
Function	Antenna information
Example output	<THISANTENNA COM1 0 0.0 FINE 2134 442706.000 00000000 0 1 < ADVNULLANTENNA NONE 0 0.000000

ID	Field	Description	Type	Binary Bytes	Offset
1	THISANTENNA header	Log header		H	0
2	Antenna type and Radome type	Antenna model type and Radome type	Enum	4	H
3	Antenna setup id	Setup identification	Ulong	4	H+4
4	Antenna height	Antenna ARP (m)	Float	4	H+8
5	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+12
6	[CR][LF]	Sentence terminator (ASCII only)	-		

3.1.39.1 Antenna Type

Value	Name
0	NONE
1	USER
2	TRSAX3702
3	TRSAX3703
4	TRSAX3705
5	TRSOSCAREU
6	TRSAX4E02

3.1.40 VERSION

This log is used to display the firmware version information of the current board of receiver. It also shows the current board type.

Name	Value
Message ID	37
Input	log version
Function	Version information
Example output1	#VERSIONA,COM2,0,0.0,FINE,2134,452555.000,00000000,0,1;1, GPSCARD,BX40C,037001203200000133,0371001029993, 1.0.886_debug,,Dec 4 2020,13:36:37*4ba3ea96
Example output2	>VERSION,COM1,0,0.0,FINE,2283,462603.000,00000000,0,1 <1 <GPSCARD,BX40C-TAP,034001232800000101,0341001021000 1.0.1546_debug Sep 15 2023,16:46:20

ID	Field	Description	Type	Binary Bytes	Offset
1	VERSION header	Log header		H	0
2	# comp	Number of components	Long	4	H
3	type	Component type(currently,GPSCARD card only)	Enum	4	H+4
4	model	firmware model number(currently,BX40C only)	Char[16]	16	H+8
5	psn	Product serial number	Char[20]	20	H+24
6	hw version	Hardware version	Char[16]	16	H+44
7	sw version	Firmware version	Char[16]	32	H+60
8	boot version		Char[16]	16	H+92
9	comp date	Month Day Year, Example: Dec 4 2020	Char[12]	12	H+108
10	comp time	HH:MM:SS, Example:13:36:37	Char[12]	12	H+120
11	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+132
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4. Terminology

Abbreviation	Definition
ASCII	American Standard Code for Information Interchange
BDS	BeiDou Navigation Satellite System
CMR	Compact Measurement Record
ECEF	Earth Center Earth Fixed
GLONASS	GLObal NAvigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
MSL	Mean Sea Level
NMEA	National Marine Electronics Association
PPS	Pulse Per Second
RINEX	Receiver Independent Exchange format
RMS	Root Mean Square
RTCM	Radio Technical Commission for Maritime Services
RTK	Real-Time Kinematic
WGS84	World Geodetic System 1984