User Manual

Version V2.6-20190510

Log & Command Reference

For Tersus BX GNSS OEM Boards

Sales & Technical Support:
sales@tersus-gnss.com & support@tersus-gnss.com
More details, please visit www.tersus-gnss.com

Table of Content

List of Tables

1. General Description

This log and command reference manual is for Tersus BX306, BX306Z, BX316, BX316R, BX316D and David GNSS RTK boards.

This document is the primary reference guide of commands and logs for customers.

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, abbreviation 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 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.

1.3 Binary Header for logs

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

Table 1 Binary header for logs

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 Lgth	Uchar	Length of the header	1
5	Message ID	Ushort	This is the Message ID number of the log, see section 1.5	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	See Table 2 GPS Reference Time Status	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

Table 2 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.

1.4 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.

Table 3 Command Response Meaning

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
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 over 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.

Failed to mount!	No SD card is installed.
Failed to unmount!	Fail to unmount when switch to SD/EMMC chip
Another download process must exit!	Only one process is allowed when downloading files from SD card / EMMC chip
Requested file does not exist!	No such file existed on the SD/EMMC chip
Need stop download file!	Some operation needs to stop during downloading.
Need close logfile!	No space on SD/EMMC for data collection
No change!	Switching fails between SD and EMMC chip.
Firmware not support it!	This input command is not supported by current firmware.
Action Failed (Reason:XXX)!	Some Action failed.

1.5 Message ID for logs

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

Table 4 Logs in Alphabetical Order

LOG	Description	Message ID
BDSEPHEMERIS	A single set of BDS ephemeris parameters	1696
BDSIONO	The ionosphere parameters transmitted by BeiDou satellites.	1590
BESTPOS	Best position data	42
BESTVEL	Velocity data	99
BESTXYZ	Cartesian coordinate position data	241
BSLNXYZ	RTK XYZ baseline	686
GPSEPHEM	GPS ephemeris data	7
GLOEPHEMERIS	GLONASS ephemeris data	723
HEADING	Heading information with the ALIGN feature	971
IONUTC	Ionospheric and UTC model information	8
MARTCOUNT	MARKCOUNT log contains the tick count for the event1 (MARK1COUNT) and event2 (MARK2COUNT) inputs.	1093/1094
MARKTIME	Time of mark1 input event	231
PASSCOM1	Pass-through log	233
PASSCOM2	Pass-through log	234
PASSUSB	Pass-through log	607
PSRDOP	DOP of SVs currently tracking	174
PSRXYZ	Pseudorange position and velocity.	243
RANGE	Satellite range information	43
RANGECMP	Compressed version of the RANGE log	140
REFSTATION	The ECEF Cartesian position of the base station	175

SATVIS	Satellite visibility	1043
THISANTENNA	Antenna type, ID and height	1421
TIME	Receiver time information	101
TRACKSTAT	Satellite tracking status	83
VERSION	Receiver hardware and software version numbers	37

2. Commands

2.1 Overview of Command System

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.
- The configuration of some commands, listed in the following table, can be shown with command 'log command', for example, you can input
  log ecutoff
  to show the ecutoff configuration.

dgpstxid
ecutoff
fix
interfacemode
logfile
posave
rtktimeout
rtksource
serialconfig
undulation

2.2 Command Reference

2.2.1 ANTENNAMODE

This command is used to configure which signals will be tracked by the primary and secondary antennas, respectively. It is valid only for the receivers supporting dual antennas, including BX316, BX316R and BX316D.

The command will not work immediately after it is inputted. Follow the following steps to make it works:

- Input ANTENNAMODE command to choose the mode.
- Input SAVECONFIG
- Power cycle the board or input RESET commands.

Table 5 ANTENNAMODE

Name			Value
Command			ANTENNAMODE option
Example			ANTENNAMODE DUALGPSBDS ANTENNAMODE 2
Function			Specify which signals will be tracked by two antennas.
Option	0	SINGLE (default)	Primary antenna tracks GPS L1/L2, GLONASS L1/L2, BDS B1/B2
	1	DUALGPSGLO	Primary antenna tracks GPS L1/L2, GLONASS L1/L2; secondary antenna tracks GPS L1, GLONASS L2 (BX316D secondary antenna tracks GPS L1, GLONASS L1).
	2	DUALGPSBDS	Primary antenna tracks GPS L1/L2, BDS B1/B2; secondary antenna tracks GPS L1, BDS B2 (BX316D secondary antenna tracks GPS L1, BDS B1).

2.2.2 ASSIGNALL

This command is used to override the automatic satellite/channel assignment and reacquisition processes. Generally, it is used to remove one or two systems from solution.

Table 6 ASSIGNALL

Name		Value
Command		ASSIGNALL system state
Example 1		ASSIGNALL GLONASS idle
Example 2		ASSIGNALL GLONASS auto
Parameter description	system	GPS/ GLONASS/ BDS
	state	IDLE: Set the system channel to not track any satellites
		AUTO: Set the system channel active (default)

After changing the assignment of satellite system, type SHOWCONFIG command (refer section 2.2.27) to display the current satellite system that

board receives. For example, it displays ‘assignall 0’ which means the board is receiving signals from GPS+GLONASS+BDS, other receiving mode is shown in the table below.

Table 7 ID for receiving mode

Value	Satellite System
0 (Default)	GPS+GLONASS+BDS
1	GPS
2	GLONASS
3	GPS+GLONASS
4	BDS
5	GPS+BDS
6	GLONASS+BDS
7	GPS+GLONASS+BDS

2.2.3 COM

This command is used to change the baud rate of the serial port to adapt its host device requirement.

Table 8 Configuring serial port baud rate

Name		Value
Command		COM [port] bps
Example		COM COM1 115200
Parameter description	PORT	COM1/ COM2
	Bps/ baud	9600/19200/38400/57600/115200/230400/460800/921600

2.2.4 DGPSTXID

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

Table 9 Sets DGPS station ID

Name		Value
Command		DGPSTXID type ID
Example 1		DGPSTXID rtcm 2
Example 2		DGPSTXID rtcmv3 any
Parameter description	mode	See Table 10 ID for corrections
	Base station ID	See Table 10 ID for corrections

Table 10 ID for corrections

Type	Valid values
auto	any
cmr	0---31 or any
rtcm	0---1023 or any
rtcmv3	0---4095 or any

2.2.5 DOWNLOADFILE

This command is used to download the file on the SD card or the EMMC chip to the computer. After the file is downloaded successfully, the file will be saved in the output directory of the Tersus GNSS Center software.

Table 11 DOWNLOADFILE

Name		Value
Command		DOWNLOADFILE filename [offset] [speed]
Example		DOWNLOADFILE 00002933.DAT 0 32000
Parameter description	offset	Download the file from the offset byte (0 if not specified). 0: download the file from the first byte.
	speed	Download speed, unit is byte/second (About 8KB if not specified). The recommendation： 1) Configure the communicate port to 460800 2) Speed is set to 32000, that is, 32KB/S.

See commands STORETYPE, LOGFILE, READFILELIST, GARBAGEFILE, STOPDOWNLOAD and UNLINKFILE for more.

2.2.6 ECUTOFF

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

Table 12 ECUTOFF

Name	Value
Command	ECUTOFF angle

Example		ECUTOFF 15.0
Parameter description	angle	Elevation cut-off angle, default is 5.0.

2.2.7 FIX

This command is used to fix position to the input values.
FIX POSITION should only be used for base station receivers. A station coordinate command is used to manage whether fix the station coordinate. For RTK, the coordinates should be fixed as known value when it serves as the base station. If the position is unknown, please refer to POSAVE command in page 24.

1) FIX POSITION
This command is to fix the coordinate of a base station.

Table 13 Fix the coordinate of the base station

Name		Value
Command		Fix position Lat Long Height
Example		Fix position 31.24523012 121.58922341 40.35
Parameter description	Lat	Latitude in degree (-90.0~90.0)
	Long	Longitude in degree (-180.0~180.0)
	Height	Mean sea level in meter.

Note:
1. The base coordinates are expressed in DEGREE and METER, the coordinates with the right units are necessary.
2. The height parameter is mean sea level which is different from ellipsoid height.
3. The detailed usage of FIX POSITION command refers to chapter 4 RTK Configuration Example.

2) FIX NONE
This command is for canceling fixed coordinate. 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.

2.2.8 FRESET

This command is used to clear all the data or part of the data which is stored in flash memory. Such data includes the almanac, ephemeris, and any user specific configurations. Options are used to choose which data will be reset.

Options are used for sophisticated customers; a general user can neglect all the options and just input FRESET to erase all the data or FRESET NOERASE to reboot the board.

Table 14 Reset to factory mode and freset options

Name		Value
Command		FRESET option
Example		freset bitmask11; reset the ephemeris, almanac and last position. All the data and configurations of the receiver will be erased.
option	NOERASE	No data is deleted, only reset the board.
	EPHEM	Only ephemeris is reset.
	ALMANAC	Only almanac is reset.
	UTC	Only the UTC time is reset.
	LAST_POSITION	Only the last position is reset.
	CONFIG	Only the receiver's configure is reset.
	FORMATEMMC	Format the internal EMMC chip. All the files on the EMMC chip will be erased.
	bitmaskX	bitmaskX can be used to reset two or more items above. X is the sum of the options' value, which is defined in Table 15.

Table 15 Value definition

EPHEM	1
ALMANAC	2
UTC	4
LAST_POSITION	8
CONFIG	16

2.2.9 GARBAGEFILE

When the internal EMMC chip or the external SD card is used for data collection, this command can be used to delete all the files saved some days ago when the free space reaches a threshold.

Table 16 GARBAGEFILE

Name	Value
Command	garbagefile expiredday triggerquota
Example	garbagefile 2 1000
expiredday	An integer (unit is day), data collected before that time will be deleted.
triggerquota	When the free size (unit is MB) of the SD card or the EMMC chip is reached, some data will be deleted. Max is 10240, which is 10GB.

The example above means if the free space of the card reaches to 1000MB, then all the files saved two days ago will be deleted.

Please note, when the EMMC chip is used for data collection, up to 4GB storage is available to the users.

See commands STORETYPE, LOGFILE, DOWNLOAD, READFILELIST, STOPDOWNLOAD and UNLINKFILE for more.

2.2.10 GRADUALTRANSITION

The GRADUALTRANSITION function helps mitigate the discontinuities that often occur when a GNSS receiver changes positioning modes, or is in a position type with low precision.

Smooth transitions are very important for UAV and agricultural steering applications where sudden jumps may be problematic.

Table 17 Gradualtransition

Name		Value	
Command		gradualtransition mode time	
Example		gradualtransition no_transition gradualtransition owing_better 100	
Parameter description	Mode	DISABLE	gradualtransition is disable (default)
		NO_TRANSITION	The relative offset will be maintained, so there will be no discontinuity in the solution when the position type changes.
		TRANSITION	Transition at a user-configurable rate with the time parameter.
		OWING_BETTER	TRANSITION when changing from less accurate position type to more accurate type. NO_TRANSITION when changing from more

			accurate position type to a less accurate type.
	TIME	Only for TRANSITION and OWING_BETTER modes, valid range 1 - 1000, unit is second. The recommended value is 50.	

2.2.11 INTERFACEMODE

This command is used to configure the read and write mode of the port. The default is 'interfacemode auto auto on', the OEM board identifies commands and corrections format automatically. It is recommended not changing the default configuration.

Table 18 Configuring port mode

Name		Value
Command		Interfacemode port rxtype txtype response
Example		Interfacemode COM1 auto auto on
Parameter description	PORT	the serial port number of the board,COM1 and COM2
	RXTYPE	Receive interface mode (see Table 19)
	TXTYPE	Transmit interface mode (see Table 19)
	RESP	whether response commands

Table 19 Serial port mode

Mode	Description
Auto	Identify commands and corrections format automatically
RTCMV3	The port accepts/generates RTCM Version3.X corrections and commands
RTCMV2	The port accepts/generates RTCM Version2.X corrections and commands
CMR	The port accepts/generates CMR/CMR+ corrections and commands

2.2.12 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 1.

Table 20 Output logging configuration

Name	Value
Command	LOG [port] message [trigger [period]] [hold]
Example 1	LOG COM1 BESTPOSB ONTIME 1 HOLD The above example shows BESTPOS logging to com port 1 at 1 second intervals. The [hold] parameter is set so that logging is not disrupted by the UNLOGALL command.
Example 2	LOG COM2 VERSION ONCE NOHOLD

2.2.13 LOGFILE

This command is used to open and close a log file, saved on the external SD card or the internal EMMC chip.

Table 21 LOGFILE

Name		Value
Command		LOGFILE [switch]
Example		LOGFILE CLOSE
Switch	OPEN [filename]	Creates a file for saving loggings, file name is optional.
	CLOSE	Stop the file saving.
	AUTO	The file saving starts automatically after the board is power on.
	MANUAL (default)	The file saving will not start after the board is power on. 'logfile open' must be input to start file saving.

● If you want to save the loggings automatically after the board is power on, please follow:
Select where to save data with command STORETYPE.
Input all the loggings to be saved, for example, input *log file gpgga ontime 1* *log file passcom1b onnew* *log file rangeb ontime 1*
Input 'logfile auto'
Input 'saveconfig'
Then the file saving starts.
Input 'logfile manual' to stop the automatic file saving mode. Note: The file currently being recorded will be closed after power off, or can be manually closed by using 'logfile close'.

The last step is recommended although it is not mandatory. If power is off during the file saving, the data collected in the last second may not be saved.

● If you want to save the loggings manually after the board is power on, please follow:
Select where to save data with command STORETYPE.
Input all the loggings to be saved, for example, input *log file gpgga ontime 1* *log file passusbb onnew* *log file rangeb ontime 1*
Input 'saveconfig'
Input 'logfile open' when you want to start file saving.
Input 'logfile close' when file saving is completed.

If no file name is input, a name related to the board running time will be given.

See commands STORETYPE, DOWNLOAD, READFILELIST, GARBAGEFILE, STOPDOWNLOAD and UNLINKFILE for more.

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.

Table 22 MARKCONTROL

Name		Value	
Command		MARKCONTROL signal [switch[polarity[timebias [timeguard]]]]	
Example		MARKCONTROL MARK1 ENABLE POSITIVE 500 100	
Parameter description	signal	MARK1	This command is applied to Mark1.
	switch	ENABLE	Enables processing of the mark input signal (default).
		DISABLE	The mark input signal is ignored if DISABLE is selected.
	polarity	NEGATIVE	The polarity of the pulse is negative (default).
		POSITIVE	The polarity of the pulse is positive.
	timebias	An offset in ns, to be applied to the time the mark pulse is input. The range is -50000000 to 50000000.	
	timeguard	A time period in ms, during which no response to the input pulses. The range is 80 to 800.	

2.2.15 NMEATALKER

This command is for NMEA talker configuration.

Table 23 Change the NMEA talker ID

Name		Value	
Command		nmeatalker id	
Example		nmeatalker GP	
Parameter description	id	GP	All NMEA loggings will have a 'GP' talker solution, even when GLONASS/BDS satellites are used in solution. If there are GPS, GLONASS and BDS satellites in the solution, the talker ID will be GN. If there are only BDS satellites in the solution, the talker ID of this message is BD. If there are only GLONASS satellites in the solution, the talker ID of this message is GL.
		AUTO	default

2.2.16 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.

Table 24 PPSCONTROL

Name		Value	
Command		PPSCONTROL [switch [polarity [period [pulse width]]]]	
Example		PPSCONTROL enable negative 1000 2000	
Parameter 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 50,100,200,500, default=1000.	
	pulse width	Optional field to specify the pulse width of the PPS signal, unit is microseconds, default=1000.	

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.

Table 25 Implements base station position averaging

Name		Value	
Command		POSAVE state [maxtime [maxhstd [maxvstd]]] avemode	
Example		POSAVE ON 0.2 1 2 POSAVE ON 0.2 0.05 0.05 RTK	
Parameter 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 PVT result to get averaging position (default)
		RTK	Use RTK result to get averaging position according to the fixed solution in the specified period if OEM board receives differential corrections.

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

2.2.18 POSOFFSET

This command is to add an offset value to the computed solution, hence the customer can output a position with an offset to the antenna.

Table 26 POSOFFSET

Name		Value	
Command		POSOFFSET option [value1 value2 value3]	
Example		POSOFFSET XYZ 1 1 2	
Parameter description	Option	XYZ	The position offset (unit, meter) is in the XYZ direction.
		ENU	The position offset (unit, meter) is in the ENU direction.
		NONE	No position offset is added.
	Value1/2/3	Specify the values per field option	

2.2.19 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.

Table 27 PSRDIFFTIMEOUT

Name		Value
Command		PSRDIFFTIMEOUT delay
Example		PSRDIFFTIMEOUT 100
Parameter description	delay	The maximum age value of pseudorange differential data

2.2.20 READFILELIST

This command is used to show the files on the root directory of the SD card or the EMMC chip. The names and size of all the files will be output. The command can be input to show the status of the file whether logfile is in open or close status.

Table 28 READFILELIST

Name	Value
Command	READFILELIST
Example	READFILELIST

The output of the command is:
File_Number Name YYYY/MM/DD HH:MM size, the following is an example:

001 00002933.DAT 2018/01/29 03:43 1482351
002 00002940.DAT 2018/01/29 03:58 1973469
003 00002950.DAT 2018/01/29 04:03 2526363

See commands STORETYPE, LOGFILE, DOWNLOAD, STOPDOWNLOAD, GARBAGEFILE and UNLINKFILE for more.

2.2.21 RESET

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

Table 29 RESET

Name	Value
Command	RESET
Example	RESET

2.2.22 RTKCOMMAND

This command is used to reset the RTK filter or clear any set RTK parameters. The RESET command causes the RTK algorithm to undergo a complete reset.

Table 30 Sets the RTK correction source

Name		Value	
Command		RTKCOMMAND action [value]	
Example		RTKCOMMAND reset RTKCOMMAND minsatn x	
Parameter description	action	Reset	Reset RTK filter
		use_defaults	Reset to defaults

		minsatn	X The value of x is 0 or >=4 (when x=0, it restores to the default configuration, the minimum fixed satellite number is 4) It is considered to be fixed when the number of fixed satellites is greater than or equal to X.

2.2.23 RTKSOURCE

This command is used to set the RTK correction source, identify from which base station to accept RTK (RTCM, RTCMV3, and CMR) differential corrections.

Table 31 Sets the RTK correction source

Name		Value
Command		RTKSOURCE type [id]
Example		RTKSOURCE RTCMV3 6
Parameter description	type	See Table 10 ID for corrections
	id	See Table 10 ID for corrections or ANY

2.2.24 RTKTIMEOUT

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

Table 32 RTKTIMEOUT

Name		Value
Command		RTKTIMEOUT delay
Example		RTKTIMEOUT 60
Parameter description	delay	Maximum RTK data age (5 to 60). (unit second)

2.2.25 SAVECONFIG

This command is used to save current configurations to the flash memory. The saved configurations are still valid even if the board is rebooted.

Table 33 Save current configuration

Name	Value
Command	saveconfig
Example	saveconfig

2.2.26 SERIALCONFIG

This command is to configure serial port settings.

Table 34 Configuring serial port settings

Name		Value
Command		SERIALCONFIG [port]baud[parity[databits[stopbits]]]
Example		serialconfig com1 9600 n 8 1
Parameter description	Port	COM1,COM2,USB
	Bps/ baud	9600/19200/38400/57600/115200/230400/460800/921600
	parity	See Table 34 Parity
	databits	7 or 8 (default = 8)
	stopbits	1 or 2 (default = 1)

Table 35 Parity

Binary	ASCII	Description
0	N	No parity (default)
1	E	Even parity
2	O	Odd parity

2.2.27 SHOWCONFIG

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

Table 36 SHOWCONFIG

Name	Value
Command	SHOWCONFIG
Example	SHOWCONFIG
Function	To show all the configurations of the receiver, including ports config, loglist and commands input, and etc.

2.2.28 STOPDOWNLOAD

With this command, users can stop downloading files from EMMC or SD card.

Table 37 STOPDWOWNLOAD

Name	Value
Command	STOPDOWNLOAD
Example	stopdownload

See commands STORETYPE, LOGFILE, DOWNLOAD, READFILELIST, GARBAGEFILE and UNLINKFILE for more.

2.2.29 STORETYPE

With this command, customers can use on-board EMMC chip for data collection, which bring convenience for data collection.

For BX316 and BX316R, data can be saved on the internal EMMC, as well as on the external SD card. The default configuration is the SD card. For other receivers, command STORETYPE must be input before data collection on EMMC chip.

Note: Use ‘logfile close’ before switching store type.

Table 38 STORETYPE

Name		Value	
Command		STORETYPE OPTION	
Example		Storetype eMMC	
Parameter description	OPTION	EMMC	Save data to the internal EMMC chip
		SD	Save data to the external SD card.

If the switch is successful, the receiver will response ‘OK’, otherwise, it will response ‘No change’.

See commands LOGFILE, DOWNLOAD, READFILELIST, STOPDOWNLOAD, GARBAGEFILE and UNLINKFILE for more.

2.2.30 THISANTENNAPCO

Use the THISANTENNAPCO command to set the Phase Center Offsets (PCO) for the given frequency of this receiver. The Offsets are defined as East, North and Up from the Antenna Reference Point to the Frequency Phase Center in millimeter. Currently only GPSL1 is supported for this command.

Table 39 THISANTENNAPCO

Name		Value
Command		THISANTENNAPCO GPSL1 [EAST OFFSET] [NORTH OFFSET] [UP OFFSET] or THISANTENNAPCO NONE
Example		THISANTENNAPCO GPSL1 1.99 0.61 65.64
Parameter description	East offset	NGS standard Phase Center East Offset in millimeters.
	North offset	NGS standard Phase Center North Offset in millimeters.
	Up offset	NGS standard Phase Center Up Offset in millimeters.

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.

Table 40 THISANTENNASET

Name		Value
Command		THISANTENNASET height X
Example		thisantennaset height 2.31
Parameter description	X	Valid value is 0 to 10, unit is meter.

2.2.32 THISANTENNATYPE

This command is used to set the antenna type of this receiver. 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 IGS website

(https://www.ngs.noaa.gov/ANTCAL/index.xhtml) to get the type and random names of the antenna.

Table 41 THISANTENNATYPE

Name		Value
Command		THISANTENNATYPE ANTENNATYPE [randomtype] [setupid] [serialno]
Example		thisantennatype trsax3702 none 0 015005171500000158
Parameter description	antennatype	Specify the antenna type, see Table 42 Antenna Type.
	randomtype	The antenna type in IGS website.
	setupid	The antenna random type in IGS website. 0: model for IGS.
	serialno	Default is the serial number of the antenna.

Table 42 Antenna Type

Value	Name
0	NONE
1	USER
2	TRSAX3702
3	TRSAX3703
4	TRSAX3705

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 1° by 1° spacing; the OSU89B table provides ellipsoid height at a 2° by 3° 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)

Table 43 Undulation

Name		Value	
Command		UNDULATION option [separation]	
Example		UNDULATION USER -1.006	
Parameter 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	It is required when USER option is selected.	

2.2.34 UNLINKFILE

This command is used to delete files on the EMMC chip or the SD card.

Table 44 UNLINKFILE

Name	Value
Command	UNLINKFILE filename
Example	unlinkfile 00002933.DAT

See commands STORETYPE, LOGFILE, DOWNLOAD, READFILELIST, STOPDOWNLOAD and GARBAGEFILE for more.

2.2.35 UNLOG

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

Table 45 Cancel a particular output

Name		Value
Command		Unlog port message
Example		Unlog COM1 GPGGA
Parameter description	port	COM1 / COM2
	message	NMEA message / rtcm message / observation message

2.2.36 UNLOGALL

This command is used to stop all output from specified serial port.

Table 46 UNLOGALL

Name		Value
Command		unlogall [port] [held]
Example		unlogall
Parameter description	port	COM1 / COM2
	held	Remove previously held logs

3. Logs

3.1 Log reference

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.

Table 47 AUTHLIST

Name	Value
Message ID	1348
Input	log authlist
Example	AUTHLIST COM1 0 0.0 UNKNOWN -1 0.000 00000000 0 20161214 s/n:008001171500000043 type:factory key: 313B7946A9159C6CD562984BCCF7ECC9D07648632E42900CD0F1 F5CBC7F96262E38DBBDC9FBF835142A47DDB37ACAD9514F723B 8C4CAC16AE61CF7D59A4E2178 status:valid level:4 expiredday:20180130 group:0 groupnum:0 expiredtime:0(day) from 0(second)
Function	Serial number and the current authcode.

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.	Char[]

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.

Table 48 BDSEPHEMERIS

Name	Value
Message ID	1696
Input	log bdsephemeris onchanged
Example	BDSEPHEMERIS COM1 0 0.0 FINESTEERING 1943 445511.000 00000000 407 20161214 171 587 1.00 0 7.80e-09 2.30e-09 6 442800 2.07488891e-04 -8.79385453e-12 -9.48676901e-20 7 442800,5282.596361 2.1449478809e-03 -2.358018891 3.9215919215e-09 2.9904806491e+00 -2.33 90842837e+00 -7.0638656669e-09 9.8075003362e-01 2.7715440174e-10 2.2682361305e-06 3.2796524465e-06 3.0654687500e+02 4.7078125000e+01 -4.2840838432e-08 -5.6810677052e-08
Function	Decoded BDS ephemeris.

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
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	Double	8	H+20

		the B1 signal (seconds)			
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	Ulong	4	H+40
10	a0	Constant term of clock correction polynomial (seconds)	Double	8	H+44
11	a1	Linear term of clock correction polynomial (seconds/ seconds)	Double	8	H+52
12	a2	Quadratic term of clock correction polynomial (seconds/ seconds^2)	Double	8	H+60
13	AODE	Age of data, ephemeris	Ulong	4	H+64
14	toe	Reference time of ephemeris parameters	Ulong	4	H+68
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
20	Ω0	Longitude of ascending node of orbital of plane computed according to reference time (radians)	Double	8	H+116
21	Ω dot	Rate of right ascension (radians/second)	Double	8	H+124
22	I0	Inclination angle at reference time (radians)	Double	8	H+132
23	IDOT	Rate of inclination angle (radians/second)	Double	8	H+140
24	cuc	Amplitude of cosine harmonic correction term to the argument of latitude (radians)	Double	8	H+148
25	cus	Amplitude of sine harmonic correction term to the argument of latitude (radians)	Double	8	H+156
26	crc	Amplitude of cosine harmonic correction term to the orbit radius (metres)	Double	8	H+164
27	crs	Amplitude of sine harmonic correction term to the orbit radius (metres)	Double	8	H+172
28	cic	Amplitude of cosine harmonic	Double	8	H+180

		correction term to the angle of inclination (radians)			
29	cis	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.

Table 49 BDSIONO

Name	Value
Message ID	1590
Input	log bdsionoa onchanged
Example	#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
Function	ionosphere parameter transmitted by Beidou satellites

ID	Field	Description	Type	Binary Bytes	Offset
1	BDSIONO header	Log header		H	0
2	ID	Transmitting satellite ID	Ulong	4	H
3	a0	Klobuchar cosine curve amplitude constant term (seconds)	Double	8	H+4
4	a1	Klobuchar cosine curve amplitude first-order term (seconds/π)	Double	8	H+12
5	a2	Klobuchar cosine curve amplitude second-order term (seconds/π2)	Double	8	H+20
6	a3	Klobuchar cosine curve amplitude third-order term (seconds/π3)	Double	8	H+28
7	b0	Klobuchar cosine curve period constant term (seconds)	Double	8	H+36
8	b1	Klobuchar cosine curve period first-order term (seconds/π)	Double	8	H+44
9	b2	Klobuchar cosine curve period second-order	Doubl	8	H+5

		term (seconds/π2)	e		2
10	b3	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.

Table 50 BESTPOS

Name	Value
Message ID	42
Input	log bestpos ontime 1
Example	BESTPOS COM1 0 0.0 FINESTEERING 1985 111380.000 00000000 122 20161214 SOL_COMPUTED SINGLE 31.19041832433 121.59320409832 29.2071 11.5177 WGS84 1.0093 1.0814 1.1129 "0000" 0.000 0.000 24 24 0 24 0 00 30 33
Function	Best position

ID	Field	Description	Type	Binary Bytes	Offset
1	BESTPOS header	Log header		H	0
2	sol stat	Solution status, see Table 51 Solution Status	Enum	4	H
3	pos type	Position type, see Table 52 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
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 54 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 53 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)	-	-	-

Table 51 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)
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

Table 52 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/AUTO command
8	DOPPLER_VELOCITY	Velocity computed using instantaneous Doppler
16	SINGLE	Single point position
17	PSRDIFF	Pseudorange differential solution
18	WAAS	Solution calculated using corrections from an WAAS
19	PROPAGATED	Propagated by a Kalman filter without new observations
34	NARROW_FLOAT	Floating narrow-lane ambiguity solution
48	L1_INT	Integer L1 ambiguity solution
50	NARROW_INT	Integer narrow-lane ambiguity solution

Table 53 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

Table 54 BESTPOS Galileo and BDS Signal-Used Mask

Bit	Mask	Description
0	0x01	Galileo E1 used in Solution
1 - 3	0x02 – 0x08	Reserved
4	0x10	BDS B1 used in Solution
5	0x20	BDS B2 used in Solution
6 - 7	0x40 – 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.

Table 55 BESTVEL

Name	Value
Message ID	99
Input	log bestvel ontime 1
Example	BESTVEL COM1 0 0.0 FINESTEERING 1985 111487.000 00000000 122 20161214 SOL_COMPUTED SINGLE 0.000 0.0000 0.0024 0.000000 -0.0038 0.0
Function	Best available velocity data.

ID	Field	Description	Type	Binary Bytes	Offset
1	BESTVEL header	Log header		H	0
2	sol stat	Solution status, see Table 51 Solution Status	Enum	4	H
3	pos type	Position type, see Table 52 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
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.

Table 56 BESTXYZ

Name	Value
Message ID	241
Input	log bestxyz ontime 1
Example	BESTXYZ COM1 0 0.0 FINESTEERING 1985 111549.000 00000000 122 20161214 SOL_COMPUTED SINGLE -2860998.0551 4651722.7067 3283993.2404 1.1682 1.4465 1.2355 SOL_COMPUTED DOPPLER_VELOCITY -0.0041 -0.0029 0.0008 0.0080 0.0100 0.0085 "0000" 0 0.000 0.000 25 25 0 25 0 00 30 33
Function	Best available cartesian position and velocity

ID	Field	Description	Type	Binary Bytes	Offset
1	BESTXYZ header	Log header		H	0
2	P-sol status	Solution status, see Table 51 Solution Status	Enum	4	H
3	pos type	Position type, see Table 52 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 51 Solution Status	Enum	4	H+44
11	Vel type	Velocity type, see Table 52 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
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 54 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 53 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 BSLNXYZ

This log outputs the RTK quality baseline in ECEF system, The XYZ baselines are rotated relative to base position. This log is valid only when the receiver is in RTK or DGPS position. If the receiver is in single position, there will be no BSLNXYZ output.

Table 57 BSLNXYZ

Name	Value
Message ID	686
Input	log bslnxyz ontime 1
Example	BSLNXYZ COM1 0 0.0 FINESTEERING 1985 112320.000 00000000 122 20161214 SOL_COMPUTED NARROW_INT -0.2135 -0.6551 0.8910 0.0149 0.0203 0.0089 "0000" 25 22 22 22 0 00 30 33
Function	Best available cartesian position related to the base position.

ID	Field	Description	Type	Binary Bytes	Offset
1	BSLNXYZ header	Log header		H	0
2	sol status	Solution status, see Table 51 Solution Status	Enum	4	H

3	bsln type	Position type, see Table 52 Position or Velocity Type	Enum	4	H+4
4	B-X	X-axis offset (m)	Double	8	H+8
5	B-Y	Y-axis offset (m)	Double	8	H+16
6	B-Z	Z-axis offset (m)	Double	8	H+24
7	B-X σ	Standard deviation of B-X (m)	Float	4	H+32
8	B-Y σ	Standard deviation of B-Y (m)	Float	4	H+36
9	B-Z σ	Standard deviation of B-Z (m)	Float	4	H+40
10	stn ID	Base station identification	Char[4]	4	H+44
11	#SVs	Number of satellites tracked	Uchar	1	H+48
12	#solnSVs	Number of satellite vehicles in solution	Uchar	1	H+49
13	#ggL1	Number of GPS plus GLONASS plus BDS L1/B1 used in solution	Uchar	1	H+50
14	#solnMultiSVs	Number of satellites with L1/E1/B1 signals used in solution	Uchar	1	H+51
15	Reserved		Uchar	1	H+52
16	ext sol stat	Extended solution status	Hex	1	H+53
17	Galileo and BDS sig mask	Galileo and BDS signals used mask (see Table 54 BESTPOS Galileo and BDS Signal-Used Mask)	Hex	1	H+54
18	GPS and GLONASS sig mask	GPS and GLONASS signals used mask (see Table 53 BESTPOS GPS and GLONASS Signal-Used Mask)	Hex	1	H+55
19	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+60
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.8 CMROBS

A proprietary RTK data transmission standard from Trimble Navigation Ltd.

Table 58 CMROBS

Name	Value
Message ID	103
Command	LOG COM2 CMROBS ONTIME 1
Function	BASE Station Satellite Observation Information

3.1.9 CMRREF

A proprietary RTK data transmission standard from Trimble Navigation Ltd.

Table 59 CMRREF

Name	Value
Message ID	105
Command	LOG COM2 CMRREF ONTIME 10
Function	BASE Station Satellite Observation Information

3.1.10 CMRDESC

A proprietary RTK data transmission standard from Trimble Navigation Ltd.

Table 60 CMRDESC

Name	Value
Message ID	310
Command	LOG COM2 CMRDESC ONTIME 10
Function	BASE Station Satellite Observation Information

Example input:
Fix position xx.xxxxxxxx xxx.xxxxxxxx xxx.xxx
Log cmrobs ontime 1
Log cmrred ontime 10
Log cmrdesc ontime 5

3.1.11 CMRPLUS

A proprietary RTK data transmission standard from Trimble Navigation Ltd.

Table 61 CMRPLUS

Name	Value
Message ID	717
Command	LOG COM2 CMRPLUS ONTIME 1
Function	BASE Station Satellite Observation Information and Base Station Position

Example input:
Fix position xx.xxxxxxxx xxx.xxxxxxxx xxx.xxx
Log cmrplus ontime 1

3.1.12 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.

Table 62 GPGGA

Name	Value
Message ID	218
Input	log gpgga ontime 1
Example (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 (Combined GPS/GLONASS/BDS)	$GNGGA,075318.00,3111.4240602,N,12135.5915558,E,4,24,0.6,28.767,M,11.518,M,1.0,0000*60

Field	Structure	Description	Type	Example
1	$GPGGA	Log header		
2	utc	UTC time status of position (hours/minutes/seconds/decimal seconds)	hhmmss.ss	075318.00
3	lat	Latitude (DDmm.mm)	llll.ll	3111.4240602
4	lat dir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yy	12135.5915558
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	x	4

		4: RTK fixed ambiguity solution 5: RTK floating ambiguity solution 7: Manual input mode(fixed positon)		
8	sats	Number of satellites in use. May be different to the number in view	xx	24
9	hdop	Horizontal dilution of precision	x.x	0.6
10	alt	Antenna altitude above/below mean sea level	x.x	28.767
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	xxxx	0000
16	*xx	Checksum	*hh	
17	[CR][LF]	Sentence terminator	-	

3.1.13 GPGLL

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

Table 63 GPGLL

Name	Value
Message ID	219
Input	log gpgll ontime 1
Example (GPS only)	$GPGLL,3111.4253764,N,12135.5908779,E,015133.00,A,A*7C
Example (Combined GPS/GLONASS/BDS)	$GNGLL,3111.4253694,N,12135.5908841,E,015128.00,A,A*7C
Function	Geographic position

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
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	hhmmss.ss	015128.00

		(hours/minutes/seconds/decimal seconds)		
7	data status	Data status: A = Data valid, V = Data invalid	x	A
8	mode ind	Positioning system mode indicator, see Table 64 NMEA Positioning System Mode Indicator.	xx	A
9	*xx	Checksum	*hh	
10	[CR][LF]	Sentence terminator	-	

Table 64 NMEA Positioning System Mode Indicator

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

3.1.14 GPGRS (not support currently)

This log reports the range residuals. The residuals are re-computed after the position solution in the GPGGA message is computed.

Table 65 GPGRS

Name	Value
Message ID	220
Input	log gpgrs ontime 1
Example (GPS only)	$GPGRS,033854.00,1,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,,*47
Example (Combined GPS / GLONASS / BDS)	$GPGRS,033950.00,1,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,,*42 $GLGRS,033950.00,1,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,,,,*13 $BDGRS,033950.00,1,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,,*4B

Field	Structure	Description	Type	Example
1	$GPGRS	Log header		
2	utc	UTC time status of position (hours/minutes/seconds/decimal seconds)	hhmmss.ss	
3	mode	Mode 0= residuals were used to calculate the position given in the matching GGA line (apriori) (not used by OEM6 receivers) Mode 1= residuals were recomputed after the GGA position was computed (preferred	x	

		mode)		
4 - 15	res	Range residuals for satellites used in the navigation solution. Order matches order of PRN numbers in GPGSA	x.x,x.x,…	
16	*xx	Checksum	*hh	
17	[CR][LF]	Sentence terminator	-	

3.1.15 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.

Table 66 GPGSA

Name	Value
Message ID	221
Input	log gpgsa ontime 1
Example (GPS only)	$GPGSA,A,3,10,12,14,25,26,29,31,32,,,,,1.0,0.8,0.6*31
Example (Combined GPS/GLONASS/BDS)	$GNGSA,A,1,10,12,13,15,20,21,24,25,32,,,,1.2,0.6,1.0*2F $GNGSA,A,1,74,70,86,73,75,65,88,87,71,72,,,1.2,0.6,1.0*29 $GNGSA,A,1,161,162,163,164,166,167,168,169,170,173,174,,1.2,0.6,1.0*1F
Function	GPS DOP and active satellites

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 = 161 to 197	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	-	

3.1.16 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.

Table 67 GPGST

Name	Value
Message ID	222
Input	log gpgst ontime 1
Example (GPS only)	$GPGST,083332.00,2.19,1.31,1.12,40.3633,1.20,1.23,1.32*47
Example (Combined GPS/GLONASS/BDS)	$GNGST,083448.00,2.11,0.01,0.01,29.5443,0.01,0.01,0.01*4C
Function	Pseudorange measurement noise statistics

Field	Structure	Description	Type	Example
1	$GPGST	Log header		
2	utc	UTC time status of position (hours/minutes/seconds/ decimal seconds)	hhmmss .ss	083448.00
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	2.11
4	smjr std	Standard deviation of semi-major axis of error ellipse (m)	x.x	0.01
5	smnr std	Standard deviation of semi-minor axis of error ellipse (m)	x.x	0.01
6	orient	Orientation of semi-major axis of error ellipse (degrees from true north)	x.x	29.5443
7	lat std	Standard deviation of latitude error (m)	x.x	0.01
8	lon std	Standard deviation of longitude error (m)	x.x	0.01
9	alt std	Standard deviation of altitude error (m)	x.x	0.01
10	*xx	Checksum	*hh	
11	[CR][LF]	Sentence terminator	-	

3.1.17 GPGSV

This log contains the number of GPS SVs in view, PRN numbers, elevation, azimuth and SNR value.

Table 68 GPGSV

Name	Value
Message ID	223
Input	log gpgsv ontime 1
Example (Combined GPS /GLONASS/ BDS)	$GPGSV,3,1,09,10,36,319,47,12,27,131,48,13,05,069,37,15,40,059,49*7A $GPGSV,3,2,09,20,66,320,48,21,41,230,48,24,65,044,52,25,13,168,38*76 $GPGSV,3,3,09,32,17,279,43*4C $GLGSV,3,1,10,74,69,117,55,70,02,109,27,86,01,211,41,73,36,039,52*61 $GLGSV,3,2,10,75,27,187,52,65,17,316,45,88,12,308,43,87,16,262,48*66 $GLGSV,3,3,10,71,40,076,53,72,49,358,52*60 $BDGSV,3,1,11,161,47,148,46,162,36,237,42,163,51,200,47,164,34,124,44*62 $BDGSV,3,2,11,166,63,359,46,167,32,172,43,168,20,196,40,169,48,309,46*6F $BDGSV,3,3,11,170,14,191,39,173,34,225,45,174,32,106,46*68
Function	Satellites in view

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 GLO = 65 to 96 (64+ GLONASS slot number) BDS = 161 to 197	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
variable	[CR][LF]	Sentence terminator	-	

3.1.18 GPHDT

This log contains actual vessel heading in degrees (from True North). See also a description of the HEADING log on page 58.

This log is only supported by BX316 and BX316D boards. Please ensure dual antennas mode is chosen before heading can be output, see command ANTENNAMODE in page 13 for more details.

Table 69 GPHDT

Name	Value
Message ID	1045
Input	log gphdt ontime 1
Example	$GNHDT,35.200,T*2B

Field	Structure	Description	Type	Example
1	$GPHDT	Log header		
2	heading	Heading in degrees	x.x	35.200
3	True	Degrees True	T	T
4	*xx	Checksum	*hh	*2B
5	[CR][LF]	Sentence terminator	-	

3.1.19 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.

Table 70 GPNTR

Name	Value
Message ID	209
Input	log gpntr ontime 1
Example	$GPNTR,024404.00,1,17253.242,+5210.449,-16447.587,-49.685,0004*40

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	-	

3.1.20 GPRMC

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

Table 71 GPRMC

Name	Value
Message ID	225
Input	log gprmc ontime 1
Example (GPS only)	$GPRMC,033255.00,A,3111.4246749,N,12135.5908896,E,0.065,0.0,070417,0.0,E,A*04
Example (Combined GPS/GLONASS/BDS)	$GNRMC,030840.40,A,3111.42520653,N,12135.59053522,E,0.038,138.4,280317,0.0,E,A*22
Function	GPS specific information

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)	LIII.II	3111.42520

				653
5	lat dir	Latitude direction: (N = North, S = South)	a	N
6	lon	Longitude (DDDmm.mm)	yyyyy.yy	12135.5905 3522
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 64 NMEA Positioning System Mode Indicator.	a	A
14	*xx	Checksum	*hh	*22
15	[CR][LF]	Sentence terminator	-	

3.1.21 GPVTG

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

Table 72 GPVTG

Name	Value
Message ID	226
Input	log gpvtg ontime 1
Example (GPS only)	$GPVTG,47.251,T,47.251,M,0.124,N,0.230,K,A*3B
Example (Combined GPS/GLONASS/BDS)	$GNVTG,56.703,T,56.703,M,0.068,N,0.127,K,A*37
Function	Track made good and ground speed

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 64 NMEA Positioning System Mode Indicator.	a	A

11	*xx	Checksum	*hh	*37
12	[CR][LF]	Sentence terminator	-	

3.1.22 GPZDA

The GPSZDA log outputs the UTC date and time.

Table 73 GPZDA

Name	Value
Message ID	227
Input	log gpzda ontime 1
Example	$GNZDA,053045.00,07,04,2017,,*78

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	*78
9	[CR][LF]	Sentence terminator	-	

3.1.23 GPSEPHEM

This log contains a single set of GPS ephemeris parameters. This command is used to log GPS broadcast ephemeris in ASCII format.

Table 74 GPSEPHEM

Name	Value
Message ID	7
Input	log gpsephem onchanged
Example	GPSEPHEM COM1 0 0.0 FINESTEERING 1943 445309.000 00000000 407 20161214 3 439200.0 0 30 30 1943 1943 446400.0 2.656135670e+07 4.344466679e-09 2.021661162e+00 5.580164725e-04 1.520378678e-01 -1.028180122e-06 1.158006489e-05 1.547500000e+02

	-1.865625000e+01 -3.352761269e-08 1.862645149e-09 9.600372875e-01 -4.928776732e-11 -4.734842780e-01 -7.874970881e-09 30 446400.0 1.862645149e-09 -1.05151e-04 1.13687e-12 0.00000e+00 TRUE 1.458500140e-04 1.0000000e+00

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	M0	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
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	I0	Inclination angle at reference time, radians	Double	8	H+128

22	IDOT	Rate of inclination angle, radians/second	Double	8	H+136
23	Ω0	Right ascension, radians	Double	8	H+144
24	Ω dot	Rate of right ascension, radians/second	Double	8	H+152
25	iodc	Issue of data clock	Ulong	4	H+160
26	toc	SV clock correction term, seconds	Double	8	H+164
27	tgd	Estimated group delay difference, seconds	Double	8	H+172
28	af0	Clock aging parameter, seconds (s)	Double	8	H+180
29	af1	Clock aging parameter, (s/s)	Double	8	H+188
30	af2	Clock aging parameter, (s/s/s)	Double	8	H+196
31	AS	Anti-spoofing on: 0 = FALSE 1 = TRUE	Double	8	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, 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.	Double	8	H+216
34	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+224
35	[CR][LF]	Sentence terminator (ASCII only)			

3.1.24 GLOEPHEMERIS

This log contains GLONASS ephemeris information.

Table 75 GLOEPHEMERIS

Name	Value
Message ID	723
Input	log gloephemeris onchanged
Example	GLOEPHEMERIS COM1 0 0.0 FINESTEERING 1943 445444.000 00000000 407 20161214 39 3 1 0 1943 445518000 10782 463 0 0 27 0 -1.3815634277343750e+07 1.9141996093750000e+07 -9.5697236328125000e+06 6.8848896026611328e+02 -1.1339406967163086e+03 -3.253355026245117 2e+03 9.3132257461547852e-07 3.7252902984619141e-06 0.0000000000000000e+00 -2.4393666535615921e-04 5.5879354476928711e-09 9.0949470177292824e-13 23400 1 0 0 13
Function	Decoded GLONASS ephemeris

ID	Field	Description	Type	Binary	Offset

				Bytes	
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) in 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), in metres	Double	8	H+28
15	pos y	Y coordinate for satellite at reference time (PZ-90.02), in metres	Double	8	H+36
16	pos z	Z coordinate for satellite at reference time (PZ-90.02), in metres	Double	8	H+44
17	vel x	X coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+52
18	vel y	Y coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+60
19	vel z	Z coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+68
20	LS acc x	X coordinate for lunisolar acceleration at	Double	8	H+76

		reference time (PZ90.02), in metres/s/s			
21	LS acc y	Y coordinate for lunisolar acceleration at reference time (PZ-90.02), in metres/s/s	Double	8	H+84
22	LS acc z	Z coordinate for lunisolar acceleration at reference time (PZ-90.02), in metres/s/s	Double	8	H+92
23	tau_n	Correction to the nth satellite time t_n relative to GLONASS time t_c, in 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, in seconds	Double	8	H+108
25	gamma	Frequency correction, in seconds/second	Double	8	H+116
26	Tk	Time of frame start (since start of GLONASS day), in seconds	Ulong	4	H+124
27	P	Technological parameter	Ulong	4	H+128
28	Ft	User range	Ulong	4	H+132
29	age	Age of data, in days	Ulong	4	H+136
30	Flags	Information flags,	Ulong	4	H+140
31	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+144
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.25 HEADING

This log contains the heading angle from True North of the base to rover vector in a clockwise direction. This log is only supported by BX316 and BX316D boards. Please ensure dual antennas mode is chosen before heading can be output, see command ANTENNAMODE in page 13 for more details.

Table 76 HEADING

Name	Value
Message ID	971
Input	log heading ontime 1
Example	HEADING,COM2,0,0.0,FINESTEERING,1966,206193.000,00000000,912,20161214;SOL_COMPUTED NARROW_INT 1.051362872 297.221923828 -6.983160973 0.0,0.015089260 0.010237807 "0000" 15 15 15 15 00 23 30 03

ID	Field	Description	Type	Binary Bytes	Offset
1	HEADING header	Log header		H	0
2	sol stat	Solution status, see Table 51	Enum	4	H

		Solution Status			
3	pos type	Position type, see Table 52 Position or Velocity Type	Enum	4	H+4
4	length	Baseline length (0 to 3000 m).	Float	4	H+8
5	heading	Heading in degrees (0 to 360.0 degrees)	Float	4	H+12
6	pitch	Pitch (± 90 degrees)	Float	4	H+16
7	Reserved		Float	4	H+20
8	hdg std dev	Heading standard deviation in degrees	Float	4	H+24
9	ptch std dev	Pitch standard deviation in degrees	Float	4	H+28
10	stn ID	Station ID string	Char[4]	4	H+32
11	#SVs	Number of satellites tracked	Uchar	1	H+36
12	#solnSVs	Number of satellites in solution	Uchar	1	H+37
13	#obs	Number of satellites above the elevation mask angle	Uchar	1	H+38
14	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+39
15	sol source	Solution source	Hex	1	H+40
16	ext sol stat	Extended solution status	Hex	1	H+41
17	Galileo and BDS sig mask	Galileo and BDS signals used mask (see Table 54 BESTPOS Galileo and BDS Signal-Used Mask)	Hex	1	H+42
18	GPS and GLONASS sig mask	GPS and GLONASS signals used mask (see Table 53 BESTPOS GPS and GLONASS Signal-Used Mask)	Hex	1	H+43
19	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+44
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.26 IONUTC

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

Table 77 IONUTC

Name	Value
Message ID	8
Input	log ionutc onchanged
Example	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
Function	Ionospheric and UTC data.

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)	Ulong	4	H+108
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.27 LOGLIST

This command lists all the output messages. The output of LOGLIST can support ASCII or abbr. ASCII, binary format is not supported.

Table 78 Check logged message types

Name	Value
Message ID	5
Input	Log loglist once
Example	LOGLIST COM1 0 0.0 FINESTEERING 1943 452446.000 00000000 407 20161214 0003

	COM2 GPGGA ONTIME 1.000000 NOHOLD COM2 GPGSV ONTIME 1.000000 NOHOLD COM2 RANGEB ONTIME 1.000000 NOHOLD
Function	Check output loggings.

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 ONMARK	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	-

3.1.28 MARKCOUNT

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

Table 79 MARKCOUNT

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

ID	Field	Description	Type	Binary Bytes	Offset
1	MARK1COUNT, MARK2COUNT header	Log header		H	0
2	Period	Delta time (microseconds)	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)			

3.1.29 MARKPOS (not support currently)

MARKPOS log contains the estimated position of the antenna when a pulse is detected at a mark input. MARK1POS/MARK2POS is generated when a pulse occurs on an event1 input or an event2 input.

Table 80 MARKPOS

Name	Value
Message ID	181 (MARK1POS) 615 (MARK2POS)
Input	log markpos onnew
Example	TBD
Function	Event mark position output

3.1.30 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.

Table 81 MARKTIME

Name	Value
Message ID	231 (MARKTIME) 616 (MARK2TIME)
Input	log marktime onnew
Example	<MARKTIME COM1 0 0.0 FINESTEERING 2024 356393.000 00000000 1025 20161214 < 2024 356393.979340 0 0.000000 0.000000 "VALID"
Function	Event mark Time output

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
6	utc offset	Reserved	Double	8	H+28
7	status	Clock model status, see Table 98 Clock Model Status	Enum	4	H+36
8	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+40
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.31 PASSCOMid/PASSUSB

The pass-through logging enables the receiver to redirect any ASCII or binary data, input at a specified port, to any specified receiver port. It allows the receiver to perform bi-directional communications with other devices such as a modem, terminal or another receiver.

This log can be used at the rover side to save the corrections from the base.

Table 82 PASSCOMx

Name	Value
Message ID	PASSCOM1 233 PASSCOM2 234 PASSCOMUSB 607
Input	log passcom1 onnew log passusb onnew
Example	PASSCOM1 COM2 0 0.0 FINESTEERING 1986 184820.000 00000000 130 20161214 173 \xd3\x00\xa7F@\x00,\x0f\xa9\xc0\x00\xe4\x00\x00\x00\x00\x00\x00\x02\x00\x00\x7f\xff\xfb\xdb\xfb\xdc+\xd3\xec3\xe4\x14\x1f\x8e\xa6\xe2\x1c\xa8\xf9mz\xa3\xaf\xc5\x84\x9a\xac0\xd7\xdc\x1b\xab\xe1\xe7\xb3\x9b\xe3\x9d\x

	c6\xd2s\xe6\xe4\xf7\xfb\xc7\xeb\xf7\x12\x1d\xfe\xf9\xd0s4d\x9a\xc7\xfb\xe7\x97\xd3Xf\x02akB}k\x8b\xf4\xaa\xc0v\x04\xc1\xc4\x91\xc0\x00\x00\x0a\xf67\xceE?!V\xff\xb2\x17\xfdt\xa7\xcaO_/}\xf9\xadU\xe5\xdf\xef\x90\xf1\xfe;z\xfe\x16}\xf8\x0f\xb7\xff\xff\xf8G\xff\xff\xff\xff\xff\xf8\x00\x00_\…
Function	Pass the received data from a port

ID	Field	Description	Type	Binary Bytes	Offset
1	PASSCOM header	Log header		H	0
2	#bytes	Number of bytes to follow	Ulong	4	H
3	data	Message data	Char[80]	80	H+4
4	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+4+(#bytes)
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.32 PSRDOP

The DOP (Dilution Of Precision) value is calculated using the geometry of only those satellites currently being tracked and used in the position solution. This log is updated once every 60 seconds.

Table 83 PSRDOP

Name	Value
Message ID	174
Input	log psrdop ontime 60
Example	PSRDOP COM2 0 0.0 FINESTEERING 2024 303657.000 00000000 1024 20161214 1.1655 1.1057 0.6674 0.7625 0.3686 5.0000 28 3 10 12 14 16 22 25 26 29 31 32 66 77 76 75 65 85 67 72 161 162 163 164 166 167 169 170 171
Function	Pseudorange DOP

ID	Field	Description	Type	Binary Bytes	Offset
1	PSRDOP	Log header		H	0
2	gdop	Geometric dilution of precision - assumes 3D position and receiver clock	Float	4	H

		offset (all 4 parameters) are unknown			
3	pdop	Position dilution of precision - assumes 3D position is unknown and receiver clock offset is known	Float	4	H+4
4	hdop	Horizontal dilution of precision.	Float	4	H+8
5	htdop	Horizontal position and time dilution of precision.	Float	4	H+12
6	tdop	Time dilution of precision - assumes 3D position is known and only the receiver clock offset is unknown	Float	4	H+16
7	cutoff	GPS elevation cut-off angle	Float	4	H+20
8	#PRN	Number of satellites PRNs to follow	Long	4	H+24
9	PRN	PRN of SV PRN tracking, null field until position solution available	Ulong	4	H+28
10	Next PRN offset = H+28+(#prn x 4)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+28+ (#prn x 4)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.1.33 PSRXYZ

This log contains the receiver's pseudorange position and velocity in ECEF coordinates. The position and velocity status fields indicate whether or not the corresponding data is valid.

The velocity status indicates varying degrees of velocity quality. To ensure healthy velocity, the velocity sol status must also be checked. If the sol-status is non-zero, the velocity is likely invalid. It should be noted that the receiver does not determine the direction a vessel, craft or vehicle is pointed (heading) but rather the direction of the motion of the GNSS antenna relative to the ground.

The latency of the instantaneous Doppler velocity is always 0.15 seconds. The latency represents an estimate of the delay caused by the tracking loops under acceleration of approximately 1G. For most users, the latency can be assumed to be zero (instantaneous velocity).

Table 84 PSRXYZ

Name	Value
Message ID	243
Input	log psrxyz ontime 1

Example	log psrxyz <PSRXYZ COM1 0 0.0 FINESTEERING 1998 358131.000 00000000 426 20161214 <SOL_COMPUTED SINGLE -2860997.9647 4651722.2910 3283992.5529 1.0115 1.3640 1.1226 SOL_COMPUTED SINGLE -0.0114 0.0193 0.0072 0.0076 0.0102 0.0083 "" 0.000 0.000 0.000 27 26 0 0 0 0 48 51
Function	Pseudorange position and velocity.

ID	Field	Description	Type	Binary Bytes	Offset
1	PSRXYZ header	Log Header		H	0
2	P-sol status	Solution status, see Table 51 Solution Status	Enum	4	H
3	pos type	Position type, see Table 52 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 51 Solution Status	Enum	4	H+44
11	vel type	Velocity type, see Table 52 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 ID	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	Reserved		Uchar	1	H+106
25			Uchar	1	H+107
26			Uchar	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 54 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 53 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)	-	-	-

3.1.34 RANGE

The RANGE log contains the raw measurements for the currently tracked satellites.

Table 85 RANGE

Name	Value
Message ID	43
Input	log range ontime 30
Example	<RANGE COM2 0 0.0 FINESTEERING 2024 303911.000 00000000 1024 20161214 51 14 0 20707203.440 0.200 -108817083.714634 0.001 1225.620 48.02 315.000 08105c24 14 0 20707200.228 0.230 -84792521.870671 0.006 954.994 41.07 312.960 01305c24 3 0 25089866.639 0.420 -131848133.382192 0.002 2728.897 39.29 293.000 18105c44 3 0 25089866.353 1.040 -102738807.923658 0.003 2126.382 37.71 293.000 02305c44 16 0 24456190.201 1.130 -128518151.219625 0.003 3856.135 34.08 310.000 18105c64 16 0 24456187.382 1.230 -100143996.521147 0.080 3004.305 18.03 2.000 11305c64 29 0 22990211.959 0.250 -120814377.490722 0.001 1745.164 44.48 314.000 08105c84 29 0 22990210.833 0.460 -94141066.181478 0.003 1360.009 41.04 314.000 02305c84 32 0 20465359.808 0.120 -107546190.116127 0.001 -302.762 50.75 305.000 18105ca4 32 0 20465359.486 0.240 -83802225.291461 0.001 -235.859 48.61 305.000 02305ca4 22 0 24121108.814 0.260 -126757279.012694 0.003 1777.271 38.00 314.000 08105cc4 22 0 24121104.226 0.480 -98771882.857880 0.007 1384.817 29.59 314.000 01305cc4 25 0 22075440.467 0.200 -116007219.837851 0.001 -2793.002 45.59 312.000 08105ce4 25 0 22075440.503 0.380 -90395236.251358 0.002 -2176.357 44.27 312.800 02305ce4 26 0 21957606.361 0.190 -115387997.528224 0.001 2810.708 47.06 311.000 08105d04

	26 0 21957607.166 0.330 -89912730.019941 0.002 2190.184 45.11 311.000 02305d04 10 0 23003265.495 0.280 -120882971.179500 0.002 -3441.319 43.14 323.996 08105d24 10 0 23003264.834 0.430 -94194522.346570 0.002 -2681.524 41.50 321.000 02305d24 31 0 21005491.396 0.120 -110384600.079048 0.001 467.494 51.44 316.000 18105d44 31 0 21005489.019 0.280 -86013961.163456 0.001 364.262 45.50 315.960 02305d44 40 12 23409859.635 0.290 -125314828.375159 0.001 4110.890 48.05 315.000 08115c04 40 12 23409860.891 0.770 -97467070.615725 0.002 3197.407 42.75 315.000 00315c04 58 11 23978799.721 0.430 -128315389.824759 0.001 1883.275 46.48 289.000 18115c44 58 11 23978800.069 1.170 -99800856.468269 0.004 1464.892 37.78 289.000 10315c44 50 5 22101318.615 0.310 -118019801.700207 0.002 2221.005 45.49 315.000 08115ca4 50 5 22101318.469 0.720 -91793176.245068 0.003 1727.470 43.06 315.000 00315ca4 49 6 19864366.845 0.210 -106111878.126011 0.001 -986.654 53.78 315.000 08115cc4 48 7 21804702.375 0.190 -116517716.065903 0.001 -2922.796 51.12 315.000 08115ce4 48 7 21804700.679 0.330 -90624879.558410 0.002 -2273.285 46.97 315.000 10315ce4 38 8 20485495.205 0.190 -109506715.934763 0.001 -3174.064 51.62 315.000 08115d04 38 8 20485496.581 0.390 -85171886.769226 0.002 -2468.632 44.64 315.000 00315d04 39 3 19555266.334 0.220 -104350639.564642 0.001 1549.866 56.08 315.000 18115d44 39 3 19555265.216 0.320 -81161602.112651 0.001 1205.501 50.41 313.000 00315d44 161 0 37267802.697 0.170 -194063225.095872 0.002 36.298 45.91 326.038 18145c04 161 0 37267790.457 0.190 -150061947.818652 0.002 28.139 49.00 326.038 00345c04 162 0 38166472.148 0.450 -198742832.006870 0.007 -29.657 41.60 326.038 18145c24 162 0 38166462.534 0.170 -153680527.014936 0.003 -22.932 46.64 326.038 00345c24 163 0 37043693.341 0.250 -192896230.398385 0.002 26.455 45.56 326.038 08145c44 163 0 37043685.014 0.160 -149159566.707166 0.003 20.467 47.80 326.038 10345c44 164 0 38209343.351 0.270 -198966073.738365 0.004 15.989 43.32 326.038 18145c64 164 0 38209334.184 0.290 -153853153.106594 0.004 12.359 45.33 326.038 00345c64 166 0 35740040.966 0.140 -186107768.287787 0.001 -45.565 46.76 326.038 18145ca4 166 0 35740032.371 0.120 -143910297.641445 0.001 -35.167 49.22 326.038 10345ca4 167 0 36321694.191 0.120 -189136591.017722 0.001 121.887 47.47 326.038 08145cc4 167 0 36321684.685 0.080 -146252372.425793 0.001 94.222 50.71 326.038 00345cc4 169 0 36120176.947 0.170 -188087236.973659 0.001 501.965 45.48 326.038 18145d04 169 0 36120170.782 0.100 -145440958.014472 0.001 388.101 50.25 326.038 10345d04 170 0 37542850.472 0.130 -195495470.464445 0.002 409.240 45.22 326.038 18145d24 170 0 37542844.289 0.180 -151169476.678971 0.001 316.570 47.30 326.038 00345d24 171 0 25898938.328 0.400 -134862568.555169 0.002 1027.639 38.74 301.000 18145d44 171 0 25898934.933 0.160 -104284271.056566 0.002 794.612 47.56 303.000 00345d44
Function	Satellite range information.

ID	Field	Description	Type	Binary Bytes	Offset
1	Range Header	Log Header		H	0
2	#obs	Number of observations with information to follow	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:161~197	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 86 Channel Tracking status)	Float	4	H+44
13	Next PRN offset = H + 4 + (#obs x 44)				
14	xxxx	32-bit crc(ASCII and Binary only)	Ulong	4	H+4+ (#obs x 44)
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 86 Channel Tracking status

Nibble	Bit	Mask	Description	Value
N0	0	0x00000001	Tracking state	See Table 87 Tracking State
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010	SV channel number	(n-1) (0 = first, n = last) n depends on the receiver
	5	0x00000020		
	6	0x00000040		
	7	0x00000080		

N2	8	0x00000100		
	9	0x00000200		
	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	See Table 88 Correlator Type
	14	0x00004000		
	15	0x00008000		
N4	16	0x00010000	Satellite system	0 = GPS 1 = GLONASS 4 = BEIDOU
	17	0x00020000		
	18	0x00040000		
	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: GLONASS: 0 = L1C/A 0 = L1 C/A 5 = L2P 1 = L2 C/A 9 = L2P codeless 5 = L2P 14 = L5 Q 17 = L2C BDS: 0 = B1 with D1 data 1 = B2 with D1 data 4 = B1 with D2 data 5 = B2 with D2 data
	22	0x00400000		
	23	0x00800000		
N6	24	0x01000000		
	25	0x02000000		
	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	Reserved	
	30	0x40000000	PRN lock flag	0 = PRN Not Locked Out 1 = PRN Locked Out
	31	0x80000000	Channel assignment	0 = Automatic 1 = Forced

Table 87 Tracking State

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

6	Channel steering
7	Frequency lock loop
9	Channel alignment
10	Code search
11	Aided phase lock loop

Table 88 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)
5-6	Reserved

3.1.35 RANGECMP

This log contains the RANGE data in a compressed format.

Table 89 RANGECMP

Name	Value
Message ID	140
Input	log rangecmp ontime 10
Example	RANGECMP COM2 0 88.000000 FINE 1981 98177.400000 00000000 52825548 18 45 241c10088f81f8efff09cd0a8be4b3e760051904a0030000 8b1c30014e29fa7fee09cd0a4e1db4f87005330320030000 … 641d040846e2ff5f91f8201348fd858c80a55a0260020000 601cb402e0e7ffef83f820131c0ceae180a5060380020000
Function	Compressed version of the RANGE log.

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 90 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 x 24)
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 90 Range Record Format

Data	Bits first to last	Length(bits)	Scale Factory	Units
Channel Tracking Status	0-31	32	See Table 86 Channel Tracking status	-
Doppler Frequency	32-59	28	1/256	hz
Pseudorange (PSR)	60-95	36	1/128	m
ADR	96-127	32	1/256	cycles
StdDev-PSR(1)	128-131	4	See (2)	m
StdDev-ADR	132-135	4	(n+1)/512	cycles
PRN/Slot(3)	136-143	8	1	-
Lock Time(4)	144-164	21	1/32	s
C/No(5)	165-169	5	(20+n)	dB-Hz
Reserved	170-191	22		

1. 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.

2. 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. GPS: 1 to 32, GLONASS: 38 to 61 and BDS: 161-197.

4. The Lock Time field of the RANGECMP log is constrained to a maximum value of 2,097,151 which represents a lock time of 65535.96875 s (2097151 ¸ 32).

5. C/No is constrained to a value between 20-51 dB-Hz. Thus, if it is reported that C/No = 20 dB-Hz, the actual value could be less. Likewise, if it is reported that C/No = 51, the true value could be greater.

3.1.36 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.

Table 91 REFSTATION

Name	Value
Message ID	175
Input	log refstation ontime 30
Example	<REFSTATION COM2 0 0.0 FINESTEERING 1997 444040.000 00000000

	420 20161214 < 00000000 -2860998.905 4651725.628 3283991.059 0 RTCMV3 "0"
Function	Position of the base station in RTCM format.

ID	Field	Description	Type	Binary Bytes	Offset
1	REFSTATION 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 2nd paragraph in 3.1.36.	Ulong	4	H+28
7	stn type	Station type, see Table 92	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)	-	-	-

Table 92 Station Type

Base Station type		Description
Binary	ASCII	
0	NONE	Base station is not used
1	RTCM	Base station is RTCM
3	CMR	Base station is CMR
4	RTCMV3	Base station is RTCMV3

3.1.37 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 chapter 4 RTK Configuration Example.

3.1.37.1 RTCM2 messages

Below is a list of RTCM version 2.x message types supported by Precis products.

Table 93 Collection of supported RTCM2 message

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

3.1.37.2 RTCM3 messages

Below is a list of RTCM3 message types that supported by Precis products. 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.

Table 94 Collection of supported RTCM3.2 message types

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
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

3.1.38 SATVIS

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

Table 95 SATVIS

Name	Value
Message ID	1043
Input	log satvis ontime 60
Example	log satvis

	SATVIS COM1 2 0.0 FINESTEERING 1943 446505.000 00000000 407 20161214 GPS TRUE TRUE 11 3 0 18.9 302.8 1007.386 1743.990 … 32 0 52.0 137.4 -2125.748 -1389.144 GLONASS TRUE TRUE 10 14-7 0 38.4 294.9 975.846 1724.878 … 4+6 0 40.7 312.3 2035.114 2784.146 BEIDOU TRUE TRUE 10 161 0 49.6 146.3 28.225 758.133 … 171 0 10.7 46.0 -1152.683 -422.776
Function	Satellite visibility.

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 6 = BDS	Enum	4	H
3	sat vis	Is satellite visibility valid? 0 = FALSE 1 = TRUE	Enum	4	H+4
4	comp alm	Was complete GPS almanac used? 0 = FALSE 1 = TRUE	Enum	4	H+8
5	#sat	Number of satellites with data to follow	Ulong	4	H+12
6	PRN/slot	Satellite PRN number of range measurement: GPS: 1-32 GLONASS: 1~24 BDS:161~197	Ushort	2	H+14
7	glofreq	(GLONASS Frequency + 7)	Short	2	H+16
8	health	Satellite health	Ulong	4	H+20
9	elev	Elevation (degrees)	Double	8	H+24
10	az	Azimuth (degrees)	Double	8	H+32
11	true dop	Theoretical Doppler of satellite – the expected Doppler frequency based on a satellite's	Double	8	H+40

		motion relative to the receiver. It is computed using the satellite's coordinates and velocity along with the receiver's coordinates and velocity (Hz)			
12	app dop	Apparent Doppler for this receiver – the same as Theoretical Doppler above but with clock drift correction added (Hz)	Double	8	H+48
13	Next satellite offset = H + 16 + (#sat x 40)				
14	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+12+ (#sat x 40)
15	[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.

Table 96 THISANTENNA

Name	Value
Message ID	1421
Input	log thisantenna log thisantennab ontime 10
Example	<THISANTENNA COM2 0 0.0 FINESTEERING 1997 445768.000 00000000 420 20161214 < trsax3702 none 0 2.310000
Function	Antenna information.

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)	-	-	-

3.1.40 TIME

This log provides several time related pieces of information including UTC time.

Table 97 TIME

Name	Value
Message ID	101
Input	log time ontime 1
Example	TIME COM1 0 0.0 FINESTEERING 1943 446734.000 00000000 407 20161214 VALID 0 0 0 2018 1 24 2 58 0 VALID
Function	Receiver time information

ID	Field	Description	Type	Binary Bytes	Offset
1	TIME header	Log header		H	0
2	clock status	Clock model status (not including current measurement data), see Table 98 Clock Model Status	Enum	4	H
3	offset	Receiver clock offset, in seconds from GPS reference time. A positive offset implies that the receiver clock is ahead of GPS reference time. To derive GPS reference time, use the following formula: GPS reference time = receiver time - offset	Double	8	H+4
4	offset std	Receiver clock offset standard deviation (s)	Double	8	H+12
5	utc offset	The offset of GPS reference time from UTC time, computed using almanac parameters. UTC time is GPS reference time plus the current UTC offset plus the receiver clock offset: UTC time = GPS reference time + offset + UTC offset	Double	8	H+20
6	utc year	UTC year	Ulong	4	H+28
7	utc month	UTC month (0-12)	Uchar	1	H+32

8	utc day	UTC day (0-31)	Uchar	1	H+33
9	utc hour	UTC hour (0-23)	Uchar	1	H+34
10	utc min	UTC minute (0-59)	Uchar	1	H+35
11	utc ms	UTC millisecond (0-60999)	Uchar	4	H+36
12	utc status	UTC status 0 = Invalid 1 = Valid 2 = Warning	Enum	4	H+40
13	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+44
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 98 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

3.1.41 TRACKSTAT

The TRACKSTAT log contains an entry for each channel. If there are multiple signal channels for one satellite (for example L1, L2 P(Y), L2C, and L5 for GPS), there will be multiple entries for that satellite. The signal type can be determined from the channel tracking status word.

Table 99 TRACKSTAT

Name	Value
Message ID	83
Input	log trackstat ontime 1
Example	log TRACKSTAT TRACKSTAT COM1 0 0.0 FINESTEERING 1943 447377.000 00000000 407 20161214 SOL_COMPUTED SINGLE 0.0 60 31 0 08105c00 20985668.535 360.714 51.56 3868.998 0.000 UNKNOW 0.000 31 0 01305c00 20985667.785 281.019 46.28 3868.998 0.000 UNKNOW 0.000 … 170 0 00345d20 37200720.664 529.217 46.07 3896.998 0.000 UNKNOW 0.000
Function	Tracking status.

ID	Field	Description	Type	Binary Bytes	Offset
1	TRACKSTAT header	Log header		H	0
2	sol stat	Solution status, see Table 51 Solution Status	Enum	4	H
3	pos type	Position type, see Table 52 Position or Velocity Type	Enum	4	H+4
4	cutoff	GPS tracking elevation cut-off angle	Float	4	H+8
5	# chans	Number of hardware channels with information to follow	Ulong	4	H+12
6	PRN/slot	Satellite PRN number of range measurement GPS: 1 to 32, QZSS: 193-197, Galileo: 1 to 36, GLONASS: 38~61 BDS:161~197	Short	2	H+16
7	glofreq	(GLONASS Frequency + 7)	Short	2	H+18
8	ch-tr-status	Channel tracking status (see Table 86 Channel Tracking status)	Ulong	4	H+20
9	psr	Pseudorange (m) - if this field is zero but the channel tracking status in the previous field indicates that the card is phase locked and code locked, the pseudorange has not been calculated yet	Double	8	H+24
10	Doppler	Doppler frequency (Hz)	Float	4	H+32
11	C/No	Carrier to noise density ratio (dB-Hz)	Float	4	H+36
12	locktime	Number of seconds of continuous tracking (no cycle slips)	Float	4	H+40
13	psr res	Pseudorange residual from pseudorange filter (m)	Float	4	H+44
14	reject	Range reject code from pseudorange filter.	Enum	4	H+48
15	psr weight	Pseudorange filter weighting	Float	4	H+52
16	Next PRN offset = H+16+(#chans x 40)				
17	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+16 (#chans x 40)
18	[CR][LF]	Sentence terminator (ASCII only) - -	-	-	-

3.1.42 VERSION

This command is used to display the version information of the current board.

Table 100 Display version information

Name	Value
Message ID	37
Input	Log version
Function	Version Information
Example	VERSION COM1 0 0.0 UNKNOWN -1 0.000 00000000 0 20161214 BX306 G2SB2G2 008001181300000026 0020 20161123 3.0 Mar 16 2018 00:39:52

ID	Field	Description	Type	Binary Bytes	Offset
1	VERSION header	Log header		H	0
2	# comp	Number of components (cards, and so on)		4	H
3	product name	OEM board name	Char[8]	8	H+4
4	model	Receiver's model	Char[12]	12	H+12
5	psn	Product serial number	Char[24]	24	H+24
6	sw version	Firmware software version	Char[8]	8	H+48
7	reserved			16	H+56
8	boot version	Boot code version	Char[16]	16	H+72
9	comp date	Firmware compile date	Char[12]	12	H+88
10	comp time	Firmware compile time,	Char[12]	12	H+100
11	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+104
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4. RTK Configuration Example

Example of RTK configuration (base mode):

```
FIX POSITION 31.000302123 114.289244543 26.130
ECUTOFF 15.0                                    (optional)
INTERFACEMODE COM2 AUTO AUTO ON                 (optional)
LOG COM2 RTCM1074 ONTIME 1
LOG COM2 RTCM1084 ONTIME 1
LOG COM2 RTCM1124 ONTIME 1
LOG COM2 RTCM1005 ONTIME 10
LOG COM2 RTCM1033 ONTIME 10
LOG COM2 RTCM1230 ONTIME 5
SAVECONFIG
```

Note: 1. Broadcast RTCM messages only after FIX POSITION command.
2. For the FIX POSITION command, 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.

Example of RTK configuration (rover mode):

```
FIX NONE
INTERFACEMODE COM2 AUTO AUTO ON
LOG COM1 GPGGA ONTIME 1
SAVECONFIG
```

5. Terminology

Table 101 List of terminology

Abbreviation	Definition
ASCII	American Standard Code for Information Interchange
CMR	Compact Measurement Record
DC	Direct Current
ESD	Electro Static Discharge
ECEF	Earth Center Earth Fixed
GLONASS	GLObal NAvigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IF	Intermediate Frequency
IMU	Inertial Measurement Unit
IO	Input/Output
LED	Light Emitting Diode
LNA	Low Noise Amplifier
MPU	Micro Processing Unit
NMEA	National Marine Electronics Association
PC	Personal Computer
PPS	Pulse Per Second
RF	Radio Frequency
RINEX	Receiver Independent Exchange format
RMS	Root Mean Squares
RTK	Real-Time Kinematic
RTCM	Radio Technical Commission for Maritime Services
SMA	Sub-Miniature-A interface
TBD	To Be Defined
TTFF	Time to First Fix
TTL	Transistor-Transistor Logic level
UART	Universal Asynchronous Receiver/Transmitter
UAV	Unmanned Aerial Vehicle
USB	Universal Serial BUS
WGS84	World Geodetic System 1984