COMNAV OEM BOARD REFERENCE MANUAL

APPROVAL SHEET

SUBSCRIPTION	SIGNATURE	DATE
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DOCUMENT NUMBER	CURRENT REVISION	RELEASE DATE
CNT-OEM-RM001	1.5	2016/6/12

REVISION HISTORY

REVISION	MODIFICATION	DATE
1.5	1) New SET commands: a) Set GPS L2 PRN code type setting in *3.2.38* b) Set GLONASS PRN code type setting on G1 and G2 frequency in *3.2.38* c) Set Auto sending raw data file in *3.2.38* d) Set external coordinates in *3.2.38* e) Set cyclesave switcher fileperiod sampleint eraseint in *3.2.38* f) Set stationmode mode portA portB interval in *3.2.38* g) Set EMMC ON/OFF in *3.2.38* h) Set projectiontype *param1* in *3.2.38* i) Set cp smoother on aa bb in *3.2.38* j) Set nmeamsgformat in *3.2.38* k) Set GLOPRBIAS gx p1 p2 ……p14\r\n in *3.2.38* l) Set GLOCHANPRBIAS gx chan p in *3.2.38* m) Set GLOPRBIAS DEFAULT in *3.2.38* 2) MARKCONTROL in*3.2.38 3.2.17* 3) MARKPOS in *4.2.5.1*, MARKTIME in *4.2.5.2* 4) Add NEMA data format in *3.2.12* 5) Change command “RTKDYNAMICS mode” in *3.2.25* 6) Add description of RTCM 1033 in *4.3.3.14* 7) Change the PPS update rate to 10 Hz in *3.2.19* 8) Add DYNAMIC BASE and ROVER STATION SETTINGS in *6.4* 9) Add DYNAMIC BASE STATION SETTING in *6.5* 10) Add RTKQUALITY command in *3.2.38* 11) Add rtcm41 in *4.3.2.6* 12) Add rtcm42 in *4.3.2.7* 13) Add descriptions about GLORAWEPHEM in *4.2.1.5* 14) Delete the reply message in the example of SJ in *A.2.3* 15) Delete the reply message in the example of FX in *A.2.10* 16) Delete the reply message in the example of FC in *A.2.5*	2016-06-12
1.4	1) New added commands: a) HEADINGOFFSET in *3.2.11*	2015-9-25

REVISION	MODIFICATION	DATE
	b) RTKFIXHOLDTIME in *3.2.27* c) RTKSOURCE in *3.2.31* d) SBAS configuration: i. SBASCONTROL in *3.2.35* ii. SBASECUTOFF in *3.2.36* iii. SBASTIMEOUT in *3.2.37* e) A few SET commands in *3.2.38* f) UNDULATION in *3.2.39* 2) Update definition of following commands: a) COM: Port ID in *Table 3*, Baud rate in *Table 4*. b) LOG: added keyword 'offset' in *3.2.15* c) LOCKOUT: *Table 6. GNSS Name and Corresponding PRN* d) LOCKOUTSYSTEM: *Table 7. GNSS System* e) MAGVAR in *3.2.16* f) RTKOBSMODE in *3.2.28* 3) Add *Table 24.* Logs Supporting ONCHANGED and ONTRACKED 4) Updated log messages: a) Correct the message id of BD2RAWEPHEM from '413' to '412' in *4.2.1.3*. b) Append the message definition table for GPSEPHEM in *4.2.1.6*, which is also the definition of BD2EPHEM. c) RAWALM subframe description in *4.2.1.7* d) SATMSG in *4.2.9.3* e) REFSTATION in *4.2.11.1* f) Position or Velocity Type in *Table 32*, which is used in BESTPOS, BESTVEL, BESTXYZ, PSRPOS, PSRVEL, PSRXYZ, HEADING and TRACKSTAT. 5) New added log messages: a) Predefined Log in *4.2*: i. BINEX records in *4.2.2*: BINEX00DATA, BINEX0101DATA, BINEX0102DATA, BINEX0105DATA, BINEX7d00DATA, BINEX7e00DATA, BINEX7f05DATA ii. MARKPOS in *4.2.5.1*, MARKTIME in *4.2.5.2* iii. Meteorograph *0*: METEODATA, METEODATAEXT iv. M925 in *4.2.9.2*, PSRVEL in *4.2.7.6*, PSRXYZ in *4.2.7.7*, SATXYZ in	

REVISION	MODIFICATION	DATE
	4.2.9.5 v. SBAS message: RAWSBASFRAME in *4.2.10.1*; SBAS0, SBAS1, SBAS2, SBAS3, SBAS4, SBAS5, SBAS6, SBAS7, SBAS9, SBAS10, SBAS12, SBAS17, SBAS18, SBAS24, SBAS25, SBAS26, SBAS27, SBAS28 and SBAS63 in *4.2.10*. b) International Standard messages: i. Self-defined NMEA 0183 Sentences: GPNAV in *4.3.1.2.8*, GPTRA in *4.3.1.2.14*, GPYBM in *4.3.1.2.16* ii. RTCM 3.x in : 63 (Test Message, decoded BDS Ephemeris) in *4.3.3.1* MSM message: 1074 in *4.3.3.16*, 1084 in *4.3.3.17*, 1124 in *4.3.3.18* 1003 in *4.3.3.3*, 1011 in *4.3.3.10* 4078 in *4.3.3.19* iii. BINEX Records in *4.3.4*: 0x00, 0x01-01, 0x01-02, 0x01-05, 0x7d-00, 0x7e-00, 0x7f-05 c) Other Message: i. Trimble: PTNL,AVR in *4.4.1.3*; PTNL,GGK in *4.4.1.4* ii. Command messages for weather instrument (meteorograph) control in *6.3*: ZZ11ASETDATE, ZZ11ASETTIME, ZZ11ASETID, ZZ11ASETAUTOSEND, ZZ11AREADDATE, ZZ11AREADTIME, ZZ11AREADID, ZZ11AREADAUTOSEND 6) Add ComNav binary command *RS* in *A.2.14*. 7) Adjust the document format of whole manual, check errors and correcting.	
1.3	2) Remove OEM Board Physical Information and Technical Specifications listed in Appendix A/B into corresponding Product Specification documents. Refer to: *CNT-OEM-PS001, K500_K501_K501G_K505 OEM Board Product Specification* *CNT-OEM-PS002, K502_K508_K528 OEM Board Product Specification* 3) Move “CHAPTER 4. BINARY COMMANDS AND LOGS” to *Appendix A. Binary Commands*. 4) Add or update following commands in *Chapter 3*:	2013-1-19

REVISION	MODIFICATION	DATE
	a) Update GNSS PRN in *Table 6*. b) Add command NMEATALKER in Section *3.2.17*. c) Add command RTKOBSMODE in Section *3.2.27*. d) Update description of RTKSOLUTION in Section *3.2.30*. 5) Clarify the classifications of log messages in *0* and update *Table 19. Predefined Log Message*. 6) Add following messages: a) Add GLOEPHEMERIS (B). b) Add GLORAWEPHEM (B). c) Add LOGLIST (A) in Section *0*. d) Update REFSTATION (A) to support ASCII output in Section *0*. e) Add GPRRS, GPSEH, GPURA, GPGRS, GPDRC, GPRSC, GPCLH, GPIDM, and GPPRR in Section *4.3.1*. f) Add RTCM2.x Message 1, 9 and 31 in Section *4.3.2*. g) Add RTCM3.x Message 1012, 1019 and 1020 in Section *4.3.3*. h) Add JAVAD NAVPOS[NP] Message in Section *4.4*. 7) Adjust the document format of whole manual, check errors and correcting.	
1.2K	1) Add velocity type “DOPPLER_VELOCITY” in *Table 32*. 2) Add description of log message “BD2RAWALM“ in Sec. *4.2.1.2*. 3) Add description of log message “HEADING“ in Sec. *4.2.3.2*. 4) Update the description in Sec. *6.3* to clarify the usage of “INTERFACEMODE”. 5) Fix cross reference errors on Solution Status, Position & Velocity type for BESTPOS, BESTVEL, BESTXYZ, PRSPOS and TRACKSTAT.	2013-07-05
1.2J	1) Correct the description of Field #5 and #6 of the log message GPNTR. 2) Update the Pin information of K502 and K508 OEM board in *Appendix B. Technical Specifications*. 3) Rewording the description of the RTCM messages from Sec *4.3.2.1* ~ Sec *4.3.3.1* to make them more clearly.	2013-06-21
1.2I	1) Adjust the document format of whole manual 2) Update the contact information of ComNav in Sec.*1.5*. 3) Error checking and correcting: a) Words and Phrases b) Cross References to Sections, Tables, or Figures (under way) c) Discrepant Description between Different Sections (under way)	2013-06-05

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	4) Description rewording or polishing of whole manual a) Change document name from "Compass OEM Board Reference Manual" to "***ComNav OEM Board Reference Manual***" 5) Release formal document number as ***CNT-OEM-RM001***, based on ComNav's document standardization system (Under Construction).	
1.2H	1) The Latest Card Firmware Version is 1.30D. 1.30D is not released, just in testing.	2013-05-22
1.2G	1) Add message "HEADINGB", "BESTXYZA".	2013-05-09
1.2E	1) Add message "RANGEB", "RTCMDATA1B", "RANGECMPL1B".	2013-01-25
1.2F	1) Add message "RTCM1002B", "RTCM1010B", "RANGEA", "RANGECMPA", "BESTVELA", "BESTVELB", "IONUTCA", "IONUTC", "IONUTCB".	2013-02-20
1.2D	1) Add K506 pin definition, in section *Appendix B. Technical Specifications*.	2013-01-09
1.2B	1) Add a serial log commands to check certain configurations or parameters, in section *4.4.3*.	2013-01-04
1.2A	1) Add "BD2 Elevation Mask Angle", "GLONASS Elevation Mask Angle" and "GALILEO Elevation Mask Angle", in section *2.3*.	2012-10-16
1.2A	1) Add "SET CPUFREQ" command, in section *3.2.35*. 2) Add "SET PVTFREQ" command, in section *3.2.35*. 3) Add "SET RTKFREQ" command, in section *3.2.35*	2012-09-19
1.2A	1) Add "INTERFACEMODE" status in "SAVECONFIG" command, in section *3.2.34*; 2) Add "CLOCKOFFSET" value in "SAVECONFIG" command, in section *3.2.34*; 3) Add notice of firmware updates, in *Appendix C. Firmware Updates*; 4) Modify pin definition, in *Appendix B. Technical Specifications* 5) Add message "GPNTR", use command "LOG" to set output. 6) Configure GNSS cards to work on Common-view time transfer mode is descripted in section *6.3*. 7) Add message "GPHPR" in section *4.3.1.2.6.* 8) Add command "RTKREFMODE" in section *3.2.29*.	2012-08-27
1.2	1) Add command "CLOCKOFFSET delay" 2) Add command "PPSCONTROL switch polarity period width" 3) Add message "GPCDT", use command "LOG" to set output 4) Add command "RTKSOLUTION mode" 5) Add command "RTKDYNAMICS mode" 6) Add command "RTKELEVMASK angle"	2012-07-01

REVISION	MODIFICATION	DATE
	7) Add command “RTKQUALITYLEVEL mode”	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1. PREFACE

This preface describes the versions of K-Series OEM board and the main contents of this manual, and lists the conventions and terminology which used.

- About this Manual
- Using this Manual
- Conventions
- Warranty Exclusions and Disclaimer
- Contact Us

1.1 INTRODUCTION

Welcome to ***ComNav OEM Board Reference Manual*** released by Compass Navigation (ComNav) Technology Ltd. The purpose of this manual is to describe the K-Series OEM board and provide guidelines for developers using ComNav command set. The precise details of each command, including syntax, reply and any restrictions on its use, are described in this reference manual.

This information is of primary importance for developers to effectively use and write custom interfacing software for specific needs and applications. And it's also useful for the technique supporters and compatible program developers.

In this manual, a considerable amount of generic information is also included about the hardware architecture and ComNav software applications, although this usually needs to be supplemented by detailed implementation-specific information from the technical reference manual of the device being used, such as *K-Series board User Guide*.

This manual assumes that you are familiar with the principles of the Global Navigation Satellite System (GNSS), and with the terminology used to discuss it. For example, you should understand some terms, such as elevation mask, single point positioning and Post Processing Kinematic (PPK).

This manual also assumes that you are familiar with Microsoft Windows and know how to use a mouse, select options from menus and dialogs, make selections from lists, and refer to online help.

1.2 USAGE OF THIS MANUAL

The information in this manual is organized into four parts, as listed below.

PART A – INTRODUCTION OF OEM BOARD

In Part A, we introduce the hardware architecture and working model of the ComNav OEM board. It contains following chapters:

Chapter 2. Overview of OEM Boards

To introduce the hardware architecture of the OEM boards using figures and tables. Also some typical boards are described in this chapter. The memory map and Board's working model are given in details. From this chapter, users can realize how the board works and how the flash memory is distributed.

PART B – COMMAND SET AND LOG MESSAGES

Part B describes the Command Set and Log Messages of ComNav Board, and it consists of Chapter 3 & 4:

Chapter 3. Compatible Commands

Chapter 3 gives the details of commands supported by ComNav board, including ComNav commands and NovAtel® compatible commands.

Chapter 4. Log Messages

All log messages produced ComNav OEM board are defined in Chapter 4.

PART C –OPERATION EXAMPLES

Part C provides some examples frequently used such as set-up a base station, log raw data and so on.

Chapter 5. Operations Frequently-Used

In Chapter 5, the operational commands of several frequently-used operations are presented in sequence.

Chapter 6. Application Cases

Three kinds of application cases are described in Chapter 6 to provide users with a wider application perspective.

PART D – BINARY COMMAND AND OEM BOARD PRODUCT SPECIFICATION

Appendix A. Binary Commands

Besides the commands listed in Chapter 3, ComNav also defined some commands for special function which are presented in Appendix A.

Appendix B. Technical Specifications

Appendix C. Firmware Updates

Appendix B and C of this manual deliver the product specifications of ComNav OEM Board, including Physical Information, Technical Specifications and Firmware Updates, respectively.

1.3 CONVENTIONS

This manual employs typographic and other conventions intended to improve its ease of use.

GENERAL TYPOGRAPHIC CONVENTIONS

typewriter	Is used in the main text, including command descriptions, source code examples, tables and lists, etc.
italic	Highlights important notes, introduces special technical terminology, and denotes the name of device, book, etc.
bold	Is used for emphasis in descriptive lists and elsewhere, where appropriate.
CAPITALS	Are used for a few terms which have specific technical meanings.

OTHER SIMPLE CONVENTIONS

The number following 0x is a hexadecimal number.

Command descriptions use the angle bracket symbols ‘<>‘ to represent obligatory parameters.

Command descriptions use the square brackets, [], to represent the optional parameters.

In tables where cells’ value are missing, these cells are assumed to be reserved for future use.

ICON DESCRIPTIONS

note box that contains important information you should pay attention to

usage box that contains additional information or examples to help you use your board

1.4 WARRANTY EXCLUSIONS AND DISCLAIMER

These warranties shall be applied only in the event and to the extent that the Products and Software are properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with ComNav's relevant operator's manual and specifications;

The Products and Software are not modified or misused. The preceding warranties shall not apply to, and ComNav shall not be responsible for defects or performance problems resulting from:

The combination or utilization of the Product or Software with hardware or software products, information, data, systems, interfacing or devices not made, supplied or specified by ComNav;

The operation of the Product or Software under any specification other than, or in addition to, ComNav's standard specifications for its products;

The unauthorized modification or use of the Product or Software;

Damage caused by accident, lightning or other electrical discharge, fresh or salt water immersion or spray;

Normal wear and tear on consumable parts (e.g., batteries);

ComNav does not warrant or guarantee the results obtained through the use of the Product.

1.5 CONTACT US

Due to the uncertainty in construction of BD2, some configurations and functions of terminal units should be modified in accordance with the development of BD2, and the reference manual should be updated at the same time, the latest version bulletin should be found in our website. If any issues are encountered, please contact us, and we are very pleased to help you to solve your problems. Because BD2 system is not totally completed yet, so some mistakes are unavoidable in the manual and relevant productions. Notice that, if these mistakes bring you inconvenience and losses, we can't afford the responsibilities.

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CHAPTER 2. OEM BOARD OVERVIEW

This chapter introduces the primary information of OEM cards. It contains:

- Product Summary
- Board Catalog
- Typical Board Introduction
- Memory Allocation Map

2.1 PRODUCT SUMMARY

2.1.1 The introduction to OEM board

OEM Board is the core product of ComNav. We offer a wide variety of boards for numerous precision farming applications. Our proprietary positioning technology provides users with high accuracy and a flexible solution for the most challenging applications and environments. Furthermore, OEM Boards are continually being updated with advancements in GPS correction sources and GNSS technology.

More information on ComNav products, please visit our website: *comnav.cn* (Chinese) or *comnavtech.com* (English).

2.1.2 ComNav GNSS Board

The ComNav GNSS board is used for a wide range of precise positioning and navigation applications. It offers centimeter-level accuracy based on RTK/OTF (Real-Time Kinematic/On-the-Fly) solutions and decimeter accuracy based on L1 C/A (Coarse/Acquisition) code phase solutions. Automatic initialization and switching between positioning modes allow for the best position solutions possible. Low latency and high update rates give the response time and accuracy required for precise dynamic applications.

Designed for reliable operation in all environments, ComNav boards provide a positioning interface to a PC, external processing device, or control system. The board can be controlled through a serial port or SPI or IIC or USB or CAN bus using a user interface. User interface lets you script the ComNav board operation with a single command. Alternatively, you can use ComNav Utilities, such as Compass Receiver Utility (CRU), to handle board configuration and controlling.

You can configure the ComNav board as an autonomous base station or as a rover board. Streamed outputs from the board provide detailed information, including the time, position, quality assurance (figure of merit) numbers, and the number of tracked satellites.

With the improvement of navigation technology, we keep modifying the architecture of ComNav board to meet latest industrial standards. In this section, hardware architectures will be described.

2.1.3 Preparing for the future

Some new Global Navigation Satellite Systems (GNSS) are under construction, such as Galileo system proposed by the European Union and the Beidou-2 System devised by China. ComNav fully supports this advancement in the GNSS market. We'll be sure to have Galileo compatible products available for our customers in the near future.

It is our goal to offer the most productive and competitive equipment that meet our customers' needs both now and in the future.

2.2 TYPICAL BOARDS

Following figure provides the block diagram of ComNav OEM boards, and more description on features, dimensions and pin definitions are documented in OEM board PS (refer to *Appendix B*).

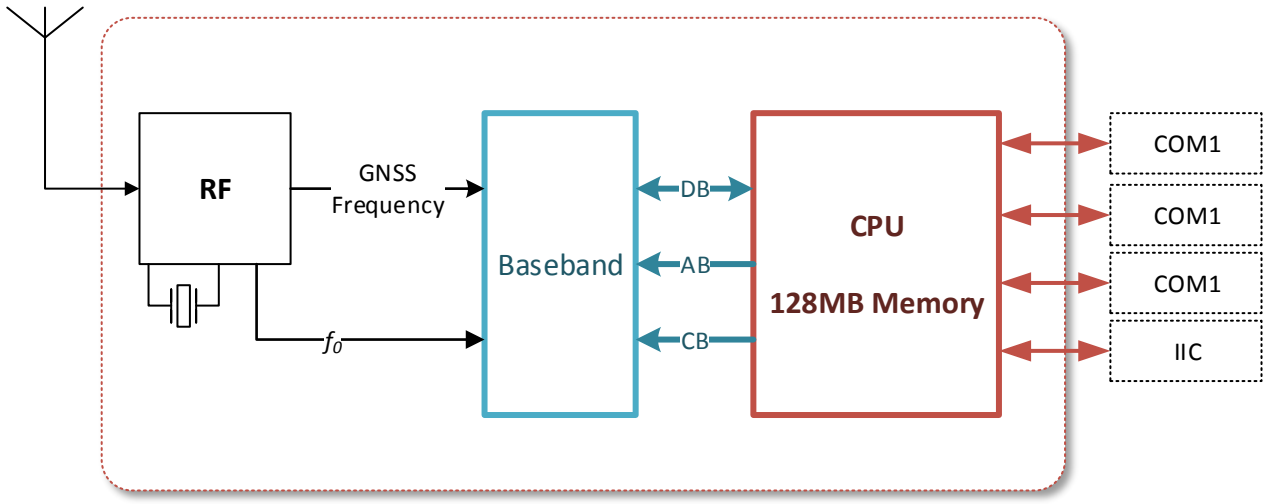


Figure 1. OEM Block Diagram

2.3 MEMORY ALLOCATION MAP

In this section, it's introduced that how board's memory is distributed. The first 128 bytes are used to restore the board's information, including revision information, register code and operating settings, etc.

Table 1. System Information Section

BYTE	DESCRIPTION	NOTE
0-31	Protocol Class, Board S/N, Date of production, Hardware Revision by a blank space.	For example: 1907 123456 2012-01-01 201
32-39	Registration Code, 8 bytes	
40~43	Reserved	
44	Additional symbol of Device type	
45	Internal Oscillator	
46~47	Reserved	
48	Static/Dynamic Flag	(0: static, 1: dynamic)
49	Reserved	
50	GPS Elevation Mask Angle	
51	Memory Size	(16–8M bytes; 32–16M bytes)
52 - 55	Firmware Revision, 4 bytes.	
56	BD2 Elevation Mask Angle	
57	GLONASS Elevation Mask Angle	
58	GALIEEO Elevation Mask Angle	
59 - 62	Reserved	
63	Differential Data Format	(CMR/CMR+/RTCM2/RTCM3/RTCA)
64 - 89	P/N Number, 16 bytes	
90-95	Reserved	
96	Coordinate settings of Base Station	
97 - 127	Reserved	

NOTE: Users can get S/N, P/N number and size information from the label on shell of board

CHAPTER 3. COMPATIBLE COMMANDS

Except for those commands handled by CPU, ComNav board also support GNSS board commands. This chapter introduces GNSS board commands, including ComNav Board Commands and NovAtel® Commands.

Along with the release of GPS board developed by ComNav itself, the board command packets are issued.

The syntax of ComNav board command is similar to that of NovAtel® OEM board. But there also exist a little difference. Here, we introduce ComNav board command packets, and NovAtel® OEM Board Commands will be summarized in next section.

3.1 COMMAND FORMATS

In the OEM card, we adopt GNSS card produced by other company, like NovAtel®. So the board not only supports ComNav commands, but the board commands as well.

3.1.1 Format

The OEM card handles incoming and outgoing data in three different message formats: Abbreviated ASCII, ASCII, and Binary. This allows for a great deal of versatility in the way the OEMV family boards can be used. All NovAtel® commands and logs can be entered, transmitted, output or received in any of the three formats. The board also supports RTCM2.X, RTCM3.X, RTCM, CMR, and NMEA format message.

ASCII

ASCII messages are readable by both the user and a computer. The structures of all ASCII messages follow the general conventions as noted here:

1) The lead code identifier for each record is '#'.

2) Each log or command is of variable length depending on amount of data and formats.

3) All data fields are delimited by a comma with two exceptions. **First exception** is the last header field which is followed by a ';' to denote the start of the data message. **Another one** is the last data field, which is followed by a * to indicate end of message data.

4) Each log ends with a hexadecimal number preceded by an asterisk and followed by a line termination using the carriage return and line feed characters, for example, *1234ABCD[CR][LF]. This value is a 32-bit CRC of all bytes in the log, excluding the'#' identifier and the asterisk preceding the four checksum digits.

Example

```
com com1,57600,n,8,1,n,off,on
```

Abbreviated ASCII

This message format is designed to make the entering and viewing of commands and logs by the user as simple as possible. The data is represented as simple ASCII characters separated by spaces or commas and arranged in an easy to understand fashion. There is also no 32-bit CRC for error detection because it is meant for viewing by the user.

Example Command

```
log version
```

Response Log

```
<VERSION COM1 0 60.0 UNKNOWN    0      0.000 00000000 0000 1114
<     1
<                 GPSCARD  "S2002"  "00902165        "  "CARD-501AA-22"
"1.10A-1.10A" "1.000" "2012/May/ 5" "18:18:52"
```

As you can see the array of 3 logs are offset from the left hand side and start with '<'.

Binary

The binary format is similar to that of ComNav format. See *Appendix A. Binary Commands*.

Command Format

```
Cmd param1 … paramN\r\n
```

The sending message is a simple ASCII string in which characters are separated by **spaces** and arranged in an easy to understand fashion. The first character is command name. And don't miss the tail, "\r\n".

Reply Message

Except LOG command, other command's response is:

```
If succeed:  "OK! \r\n Command Accepted!"
If failed:   "Error! \r\n Unidentifiable Command!"
```

3.1.2 Command List

Table 2. Command List

ID	COMMANDS	DESCRIPTIONS	REFER TO
1	ASSIGN	Assign individual satellite channel to a PRN	*3.2.1*
2	BD2ECUTOFF	Set BD2 satellite elevation cut-off	*3.2.2*
3	CLOCKOFFSET	Adjust for delay in 1 PPS output	*3.2.3*
4	COM	COM port configuration control	*3.2.4*
5	DGPSTXID	DGPS transmit ID	*3.2.5*
6	DYNAMICS	Tune receiver parameters	*3.2.6*
7	ECUTOFF	Set satellite elevation cutoff	*3.2.7*
8	ERASEFLASH	Erase all data restored in flash	*3.2.8*
9	FIX	Constrain fix height or position	*3.2.9*
10	FRESET	Reset and set configuration to factory setting	*3.2.10*
11	HEADINGOFFSET	Add heading and pitch offset values	*3.2.11*
12	INTERFACEMODE	Set receive or transmit modes for ports	*3.2.12*
13	LOCKOUT	Prevent the receiver from using a satellite by specifying its PRN	*3.2.13*
14	LOCKOUTSYSTEM	Prevent the receiver to using a system	*3.2.14*
15	LOG	Request a log message	*3.2.15*
16	MAGVAR	Set magnetic variation correction	*3.2.16*
17	NMEATALKER	NMEA message talker identifier control	*3.2.17*
18	PPSCONTROL	Control the PPS output style	*3.2.19*
19	PPMADJUST	Adjust clock-error	*3.2.20*
20	READFLASH	Read restored data in flash	*3.2.21*
21	REFAUTOSETUP	Ref-station auto setup	*3.2.22*
22	RESET	Perform a hardware reset	*3.2.23*
23	RTKCOMMAND	Reset or set the RTK filter to its defaults	*3.2.24*
24	RTKDYNAMICS	Set RTK dynamic mode	*3.2.25*
25	RTKELEVMASK	Set the RTK elevation mask angle	*3.2.26*
26	RTKFIXHOLDTIME	Set maximum age of RTK fixed data	*3.2.27*
27	RTKOBSMODE	Set the observation mode of rover receiver	*3.2.28*
28	RTKREFMODE	Set the RTK ref-station position mode	*3.2.29*
29	RTKSOLUTION	Set RTK solution mode	*3.2.30*
30	RTKSOURCE	Set RTK correction source	*3.2.31*
31	RTKTIMEOUT	Set maximum age of RTK data	*3.2.32*
32	RTKQUALITY	Set rtk quality level	*3.2.33*

ID	COMMANDS	DESCRIPTIONS	REFER TO
33	SAVECONFIG	Save current configuration in memory	*3.2.34*
34	SBASCONTROL	Enable or disable corrections of SBAS and PRN to be used	*3.2.35*
35	SBASECUTOFF	Set SBAS satellite elevation cut-off	*3.2.36*
36	SBASTIMEOUT	Set SBAS corrections time out	*3.2.37*
37	SET	Configure according settings	*3.2.38*
38	UNDULATION	Choose undulation	*3.2.39*
39	UNLOCKOUT	Reinstate a satellite in the solution computation	*3.2.40*
40	UNLOCKOUTALL	Reinstate all previous locked out satellites	*3.2.41*
41	UNLOCKOUTSYSTEM	Reinstate previously locked out system	*3.2.42*
42	UNLOG	Remove log from logging control	*3.2.43*
43	UNLOGALL	Remove all logs from logging control	*3.2.44*

3.2 COMMAND REFERENCE

3.2.1 ASSIGN Assign a channel to a PRN

Format

ASSIGN <*channel*> <*prn*>

Description

This command may be used to aid in the initial acquisition of a satellite by allowing you to override the automatic satellite/channel assignment and reacquisition processes with manual instructions. The command specifies that the indicated tracking channel search for a specified satellite.

Parameters

channel Channel number (0~11)

prn Satellite number (1~32)

Example

```
ASSIGN 2 19
```

The above example shows that channel 2 is acquiring satellite PRN 19.

3.2.2 BD2ECUTOFF Set BD2 satellite elevation cut-off

Format

```
BD2ECUTOFF <cutoff-angle>
```

Description

This command sets the elevation cut-off angle for tracked BD2 satellites.

Parameters

cutoff-angle the value of bd2 cutoff-angle(0~90 degrees)

Example

```
BD2ECUTOFF 10
```

3.2.3 CLOCKOFFSET Adjust for delay in 1 PPS output

Format

```
CLOCKOFFSET <delay>
```

Description

This command can be used to adjust PPS output delay in nanoseconds. In timing situations, the time delay is not a fix value attribute to two factors:

1. Signal path from the antenna to the RF, for example, using a cable with 10ns delay should import a 10ns extra delay in PPS output

2. A signal process path delay from the RF to the digital sections, in types of different circuit boards and signal processing method, a little different delay exists;

Major common delay has been compensated by default setting, but a residual delay should be adjusted by user according to different antenna and cables.

Parameters

delay a positive value indicates a delay output relative to current PPS, a negative value indicates a forward output.

Example

```
CLOCKOFFSET -200
```

The above command set a forward 200 nanoseconds PPS output relative to current output.

3.2.4 COM Set baud rate

Format

```
COM <port> <baudrate>
```

Description

This command permits you to set the baud rate of COM port.

Parameters

port refer to *Table 3*.

baudrate valid value refer to *Table 4*.

Example

```
COM COM1 9600
```

Table 3. Port ID

PORT ID
COM1
COM2
COM3
USB
GPRS
COM4

Table 4. Baud Rate

BAUDRATE	
1200	57600
4800	115200
9600	230400
19200	460800
38400	921600

3.2.5 DGPSTXID DGPS transmit ID

Format

```
DGPSTXID <type> <ID>
```

Description

This command sets the station ID value for the receiver when it is transmitting corrections. This allows for the easy identification of which base station was the source of the data.

For example, if you want to compare RTCM and RTCMV3 corrections, you would be easily able to identify their base stations by first setting their respective DGPSTXID values.

Parameter:

type differential data format such as RTCMV3

ID reference station ID

Example

```
DGPSTXID RTCMV3 10
```

This command set reference station ID as 10 in RTCMV3 format.

3.2.6 DYNAMICS Tune board parameters

Format

```
DYNAMICS <status>
```

Description

This command adjusts the board dynamics to that of your environment. It is used to optimally tune board parameters.

The DYNAMICS command should only be used by advanced users. The default of AIR should not be changed except under very specific conditions.

Parameters

<status>

AIR	**Board is in an aircraft or a land vehicle, for example a high speed train, with velocity greater than 110 km/h. This is also the most suitable dynamic for a jittery vehicle at any speed.**
LAND	Board is in a stable land vehicle with velocity less than 110 km/h
FOOT	Board is being carried by a person with velocity less than 11 km/h

Example

```
DYNAMICS FOOT
```

3.2.7 ECUTOFF Set satellite elevation cut-off angle

Format

```
ECUTOFF <cutoff-angle>
```

Description

This command sets the elevation cut-off angle for tracked satellites. The board does not start automatically searching for a satellite until it rises above the cut-off angle. Tracked satellites that fall below the cut-off angle are no longer tracked unless they were manually assigned (see *3.2.1* ASSIGN command).

Parameters

cutoff-angle the value of cut-off angle (0 ~ 90 degrees).

Example

```
ECUTOFF 10.0
```

This command permits a negative cut-off angle; it could be used in these situation:

1. The antenna is at a high altitude, and thus can look below the local horizon.

2. Satellites are visible below the horizon due to atmospheric refraction.

3.2.8 ERASEFLASH Erase files restored in flash

Format

```
ERASEFLASH
```

Description

The receiver erase all files which include GNSS observation and ephemeris restored in flash. If no corresponding software in your computer to erase these files, this command would be a good choice.

Example

```
ERASEFLASH
```

3.2.9 FIX Constrain to fixed height and position

Format

```
FIX POSITION <lat> <lon> <hgt>
```

Description

This command fixes three parameters of the board: latitude, longitude, height. For various applications, fixing these values can assist in improving acquisition times and accuracy of position or corrections.

Parameters

lat latitude (-90 to 90 degrees).

lon longitude in degrees. (-180 to 180 degrees)

hgt mean sea level (MSL) height (-1,000 to 20,000,000 m).

Example

```
FIX POSITION 30.0 150.0 50
```

3.2.10 FRESET Reset to the factory default

Format

```
FRESET
```

Description

This command clears data which is stored in non-volatile memory, and set the baud rate to 38400. No data log is outputted.

Example

```
FRESET
```

3.2.11 HEADINGOFFSET Add heading and pitch offset values

Format

```
HEADINGOFFSET <headingoffsetindeg> <pitchoffsetindeg>
```

Description

This command is used to add an offset in degree in the heading and pitch values of the HEADING, GPHDT, GPNAV, GPTRA, GPYBM and PTNL,AVR logs.

Both heading offset and pitch offset have the default values of 0 degree.

Parameters

Headingoffsetindeg -180.0 ~ +180.0, default value = 0.0

Pitchoffsetindeg -90.0 ~ +90.0, default value = 0.0

Example

```
HEADINGOFFSET 10 10
```

3.2.12 INTERFACEMODE Set receive or transmit modes for ports

Format

```
INTERFACEMODE <port> <input-mode> <output-mode>
```

Description

This command configures a port to detect data or output data in specified mode. **Currently output-mode is not affected by command and always in generic mode**.

Parameters

port refer to *Table 3*.

input-mode refer to *Table 5*.

output-mode always be GENERIC mode, refer to *Table 5*.

Example

```
INTERFACEMODE COM1 RTCMV3 RTCMV3
```

Table 5. INTERFACEMODE

MODE NAME	DESCRIPTION	SUPPORT
NONE	The port is disabled.	Y
NOVATEL	NovAtel® commands and logs	Y
RTCM	RTCM corrections	Y
RTCA	RTCA corrections	N
CMR	CMR corrections	Y
OMNISTAR	OMNISTAR corrections	N
IMU	IMU information	N

MODE NAME	DESCRIPTION	SUPPORT
RTCMNOCR	RTCM with no CR/LF	N
CDGPS	GPS *C code	N
TCOM1	Tune mode	N
TCOM2		
TCOM3		
TAUX		
RTCMV3	RTCMV3 corrections	Y
NOVATELBINARY	NovAtel® binary messages	Y
GENERIC	No limit	Y
AUTO	RTCM, RTCMV3 and CMR are auto switched.	Y
COMPASS	ComNav commands and logs	Y
NEMA	NEMA correction	Y

3.2.13 LOCKOUT Prevent the board from using a satellite

Format

```
LOCKOUT <prn>
```

Description

This command prevents the board from using a satellite by de-weighting its range in the solution computations. Note that the LOCKOUT command does not prevent the board from tracking an undesirable satellite. This command must be repeated for each satellite to be locked out.

See also the UNLOCKOUT.

Parameters

prn PR number of satellite (refer to *Table 6*).

Example

```
LOCKOUT 10
```

Table 6. GNSS Name and Corresponding PRN

GNSS	PRN
GPS	1~32
GLONASS	38~61
BD2	141~177
SBAS	120 ~ 138

3.2.14 LOCKOUTSYSTEM Prevent the receiver from using a system

Format

```
LOCKOUTSYSTEM <system>
```

Description

This command prevents the receiver from using satellites in the specified system in the solution computation.

Parameters

system the name of a specified GNSS system, refer to *Table 7*.

Example

```
LOCKOUTSYSTEM BD2
```

Table 7. GNSS System

GNSS SYSTEM
GPS
BD2
GLONASS
GALILEO
SBAS

3.2.15 LOG Request logs from board

Format

```
LOG <message-type> [type-trigger] [period] [offset]
```

Description

The board is capable of generating many different logs. Supported log messages are listed in *Table 19* ~ *Table 23*. *Chapter 4* will discuss the conventions and definitions on these messages.

Parameters

type Choose the data types you want to generate.

trigger Choose log type triggers, refer to *Table 24*.

period The data for synchronous logs is generated on a regular schedule.

period specify the time interval.

offset Used for *period* (ONTIME trigger) in seconds.

To log data at 1 second, after every minute, set the period to 60 and the offset to 1. A valid value is any integer (whole number) smaller than the period. These decimal values, on their own, are also valid: 0.1, 0.2, 0.25 or 0.5, as well as any multiple of the maximum logging rate defined by the receiver model. Values less than 1ms will be considered an offset of 0 ms. The offset cannot be smaller than the minimum measurement period supported by the model.

Example

```
LOG VERSIONA
```

The above example shows the ASCII data of board version is logging to the appointed COM port.

3.2.16 MAGVAR Set a magnetic variation correction

Format

```
MAGVAR <type> [correction [std dev]]
```

Description

The receiver computes directions referenced to True North. Use this command (magnetic variation correction) if you intend to navigate in agreement with magnetic compass bearings. The receiver uses the magnetic variation correction 0 degree if you don’t set any magnetic correction.

Parameters

type 'AUTO' (default) or 'CORRECTION', refer to *Table 8. MAGVAR Type*.

correction As *type* equals to 'CORRECTION', magnitude of correction (±180 degrees)

std dev Standard deviation of correction (±180 degrees, default = 0)

Example

```
MAGVAR AUTO

MAGVAR CORRECTION 10 0
```

Table 8. MAGVAR Type

TYPE	DESCRIPTION
AUTO	Use IGRF corrections according to receiver position
CORRECTION	Use the value inputted

3.2.17 MARKCONTROL Mark message control

Format

```
MARKCONTROL signal switch [polarity] [timebias [timeguard]]
```

Description

The *signal* only supports the key words "mark1"; *switch* supports the key words "enable" and "disable"; *polarity* supports the key words "positive" and "negative", which separately represent "positive pulse" and "negative pulse"; *timebias* and *timeguard* parameters cannot be set by now.

The settings can be saved by *saveconfig* command and the markcontrol status can be checked by *log sysconfig* command.

Example

```
markcontrol mark1 enable negative 0 0
```

3.2.18 NMEATALKER NMEA message talker identifier control

Format

(1) Control

```
NMEATALKER (Sentence ID) (Talker ID)
```

Manipulate individual or all talker identifiers.

Sentence Identifier (ID): Please refer to column 2 of *Table 10*. At the moment, 26 sentence identifiers are available:

```
CDT, GGA, GGARTK, GLL, GRS, GSA, GST, GSV, HDT, HPR, NAV, NTR,    RMC, RRS,
SEH, TRP, URA, VTG, ZDA, DRC, RSC,    CLH, IDM, PRR, GTD, ALL
```

Among these 26 identifiers, the first 25 are sentence identifiers and the last one ('ALL') is used to fulfill the function of manipulating all the first 25 identifiers.

Talker Identifier (ID): Please refer to column 7 of *Table 10*. At the moment, 6 sentence identifiers are available:

```
GN, GP, BD, GL, GA, AUTO
```

Among these 6 identifiers, the first 5 are talker identifiers and the last one ('AUTO') is used to indicate that receiver will automatically choose a talker identifier according to constellation used in current estimates, during which talker identifiers are subject to command 'lockout' and 'unlockout'. In 'AUTO' mode, how receiver choose a talker identifier is subject to the principles shown in the following table:

Table 9. NMEATALKER Available Identifiers

CONSTELLATION USED IN SOLUTIONS	TALKER IDENTIFIERS
GPS	GP
BDS	BD
GLONASS	GL
GALILEO (NA)	GA
two or more constellations	GN

(2) Query

```
NMEATALKER LIST
```

List talker identifiers for all current NMEA messages.

(3) Reset

```
NMEATALKER RESET
```

Reset talker identifiers to factory defaults, as shown in *Figure 2*:

```
NMEATALKER Status:
-------------------------------------
NO|   Name : Mode   | Identifier
-------------------------------------
 1|    CDT : MANUAL| GP
 2|    GGA : MANUAL| GP
 3| GGARTK : MANUAL| GP
 4|    GLL : MANUAL| GP
 5|    GRS : AUTO   | [GN,GP,BD,GL,GA]
 6|    GSA : AUTO   | [GN,GP,BD,GL,GA]
 7|    GST : MANUAL| GP
 8|    GSV : AUTO   | [GN,GP,BD,GL,GA]
 9|    HDT : MANUAL| GP
10|    HPR : MANUAL| GP
11|    NAV : MANUAL| GP
12|    NTR : MANUAL| GP
13|    RMC : MANUAL| GP
14|    RRS : AUTO   | [GN,GP,BD,GL,GA]
15|    SEH : AUTO   | [GN,GP,BD,GL,GA]
16|    TRP : MANUAL| GP
17|    URA : AUTO   | [GN,GP,BD,GL,GA]
18|    VTG : MANUAL| GP
19|    ZDA : MANUAL| GP
20|    DRC : AUTO   | [GN,GP,BD,GL,GA]
21|    RSC : MANUAL| GP
22|    CLH : AUTO   | [GN,GP,BD,GL,GA]
23|    IDM : AUTO   | [GN,GP,BD,GL,GA]
24|    PRR : AUTO   | [GN,GP,BD,GL,GA]
25|    GTD : MANUAL| GP
```

Figure 2. Factory Defaults of NMEATALKER Identifiers

Description

Command is not case-sensitive and keywords are separated by space and each command is ended with a pair of Carriage Return (CR) and Line Feed (LF).

NMEATALKER commands only affect talker identifiers; LOG commands used to request a log is unaffected by NMEATALKER commands. Talker identifiers in LOG command remain 'GP':

```
LOG GP~~~ ONTIME 1
```

In AUTO mode, talker identifier changes subject to results of using LOCKOUT/UNLOCKOUT commands.

Summary on how to use NMEATALKER manipulating individual or all talker identifiers is presented in following table:

Table 10.NMEATALKER Commands and All Controlled NMEA Message Types

Commands	Sentence Identifiers	GPS	GLONASS	BDS	GNSS	Talker Identifiers (5 optional prefixes)	Message Output Types	Factory Defaults (Refer to *Figure 2*)	
NMEATALKER		AUTO				[GN,GP,BD,GL,GA]	Note	Current Mode Note	Talker Identifier
1	**CDT**	GPCDT	GLCDT	BDCDT	GNCDT	Prefix + CDT	Hybrid	M	GP
2	**GGA**	GPGGA	GLGGA	BDGGA	GNGGA	Prefix + GGA	Hybrid	M	GP
3	**GGARTK**	GPGGARTK	GLGGARTK	BDGGARTK	GNGGARTK	Prefix + GGARTK	Hybrid	M	GP
4	**GLL**	GPGLL	GLGLL	BDGLL	GNGLL	Prefix + GLL	Hybrid	M	GP
5	**GRS**	GPGRS	GLGRS	BDGLL		Prefix + GRS	By Group	A	[GN,GP,BD,GL,GA]
6	**GSA**	GPGSA	GLGSA	BDGSA		Prefix + GSA	By Group	A	[GN,GP,BD,GL,GA]
7	**GST**	GPGST	GLGST	BDGST	GNGST	Prefix + GST	Hybrid	M	GP
8	**GSV**	GPGSV	GLGSV	BDGSV		Prefix + GSV	By Group	A	[GN,GP,BD,GL,GA]
9	**HDT**	GPHDT	GLHDT	BDHDT	GNHDT	Prefix + HDT	Hybrid	M	GP
10	**HPR**	GPHPR	GLHPR	BDHPR	GNHPR	Prefix + HPR	Hybrid	M	GP
11	**NAV**	GPNAV	GLNAV	BDNAV	GNNAV	Prefix + NAV	Hybrid	M	GP
12	**NTR**	GPNTR	GLNTR	BDNTR	GNNTR	Prefix + NTR	Hybrid	M	GP
13	**RMC**	GPRMC	GLRMC	BDRMC	GNRMC	Prefix + RMC	Hybrid	M	GP
14	**RRS**	GPRRS	GLRRS	BDRRS		Prefix + RRS	By Group	A	[GN,GP,BD,GL,GA]
15	**SEH**	GPSEH	GLSEH	BDSEH		Prefix + SEH	By Group	A	[GN,GP,BD,GL,GA]
16	**TRP**	GPTRP	GLTRP	BDTRP	GNTRP	Prefix + TRP	Hybrid	M	GP
17	**URA**	GPURA	GLURA	BDURA		Prefix + URA	By Group	A	[GN,GP,BD,GL,GA]
18	**VTG**	GPVTG	GLVTG	BDVTG	GNVTG	Prefix + VTG	Hybrid	M	GP
19	**ZDA**	GPZDA	GLZDA	BDZDA	GNZDA	Prefix + ZDA	Hybrid	M	GP
20	**DRC**	GPDRC	GLDRC	BDDRC		Prefix + DRC	By Group	A	[GN,GP,BD,GL,GA]
21	**RSC**	GPRSC	GLRSC	BDRSC	GNRSC	Prefix + RSC	Hybrid	M	GP
22	**CLH**	GPCLH	GLCLH	BDCLH		Prefix + CLH	By Group	A	[GN,GP,BD,GL,GA]

Commands	Sentence Identifiers	GPS	GLONASS	BDS	GNSS	Talker Identifiers (5 optional prefixes)	Message Output Types	Factory Defaults (Refer to *Figure 2*)	
23	**IDM**	GPIDM	GLIDM	BDIDM		Prefix + IDM	By Group	A	[GN,GP,BD,GL,GA]
24	**PRR**	GPPRR	GLPRR	BDPRR		Prefix + PRR	By Group	A	[GN,GP,BD,GL,GA]
25	**GTD**	GPGTD	GLGTD	BDGTD		Prefix + GTD	Hybrid	M	GP
	ALL	applied to all sentence identifiers							
	GPTRA GPRMB GPGGALONG PTNLPJK	Currently Not Available Currently Not Available							Talker identifiers in these messages are not affected by nmeatalker commands

NOTE:

Column 8 'Message Output Type': Hybrid and By Group means NMEA message are serialized in two types: HYBRID and GROUP.

HYBRID: No matter how many constellations are used in PVT solution, receiver output contains only one message, whose PVT solution is a combined result of all the constellations available.

GROUP: In contrast to COMBINATION mode, each constellation has its own message.

Column 9 'Current Mode': A -- AUTO, M -- MANUAL. Manual and Auto means whether talker identifiers are specified manually or automatically.

Example

Table 11.Examples of NMEATALKER Commands and Outputs

COMMAND	SENTENCE IDENTIFIER	TALKER IDENTIFIER	OUTPUT	DESCRIPTION
NMEATALKER	ALL	AUTO		Auto mode. All talker identifiers are set automatically according to *Table 10*. (In contrast, in manual mode, all talker identifiers are set using appropriate commands). In auto mode, talker identifiers are controlled by the constellations used in PVT solution. If more than one constellation is used, talker identifier will be adjusted to 'GN' automatically.
NMEATALKER	ALL	GN	$GN…, …	Manual mode. All talker identifiers are set as 'GN', regardless of how many constellations are used in PVT solution.
NMEATALKER	ALL	GP	$GP…, …	Manual mode. All talker identifiers are set as 'GP', regardless of how many constellations are used in PVT solution.
NMEATALKER	GGA	BD	$BDGGA, …	Manual and hybrid mode. All talker identifiers are set as 'BD', regardless of how many constellations are used in PVT solution.
NMEATALKER	RMC	GP	$GPRMC, …	Manual and hybrid mode. All talker identifiers are set as 'GP', regardless of how many constellations are used in PVT solution.
NMEATALKER	GSV	GN	$GNGSV, … $GNGSV, … $GNGSV, …	Manual and Group mode. All talker identifiers are set as 'GN', and at each epoch three messages are given.
NMEATALKER	GLL	GL	$GLGLL, …	
NMEATALKER	LIST			LIST command, listing all possible combinations of sentence and talker identifiers. The result should look like *Figure 2* (Factory defaults).
NMEATALKER	RESET			RESET command, resetting talker identifiers to factory defaults, as shown in *Figure 2*.

3.2.19 PPSCONTROL Control the PPS output style

Format

PPSCONTROL *<switch><polarity><period><pulse-width>*

Description

This command can be used to set the polarity, period and pulse-width of PPS output. The PPS can't be disabled and the update rate can be up to 10 Hz.

Parameters

switch 'enable' or 'disable', the switch should be set to 'enable', and 'disable' is not allowed.

polarity 'positive' and 'negative', if 'positive', it should be a high level pulse, a low level pulse correspond to a 'negative' mode.

period in seconds, 'period' can't be configured, it is constantly 1 second temporary.

pulse-width in microseconds, pulse-width should be less than half of period.

Example

```
PPSCONTROL ENABLE POSITIVE 1 1000
```

3.2.20 PPMADJUST Adjust PPM or not

Format

PPMADJUST <status>

Description

This command is used to decide whether adjust the PPM or not.

Parameters

status ON (adjust) / OFF (don't adjust)

Example

```
PPMADJUST ON        //Adjust PPM.
PPMADJUST OFF       //Not adjust PPM.
```

3.2.21 READFLASH Read files from flash

Format

```
READFLASH
```

Description

The receiver reads all files which include GNSS observation and ephemeris restored in flash and output to current port. This command only be used in situation that you couldn't download the files using corresponding software.

Example

```
READFLASH
```

3.2.22 REFAUTOSETUP Set base station self-starting

Format

```
REFAUTOSETUP <status>
```

Description

This command is used to decide whether the base station self-starts or not. This command is defined by ComNav.

Parameters

status ON (self-start) / OFF (don't self-start)

Example

```
REFAUTOSETUP ON        //Self-start
REFAUTOSETUP OFF       //Don't self-start
```

3.2.23 RESET Perform a hardware reset

Format

```
RESET
```

Description

This command performs a hardware reset. Following a RESET command, the board initiates a cold-start boot up.

Example

```
RESET
```

3.2.24 RTKCOMMAND Reset or set the RTK filter to its defaults

Format

```
RTKCOMMAND <action>
```

Description

This command provides the ability to reset the RTK filter and clear any set RTK parameters. The RESET parameter causes the advance RTK algorithm to undergo a complete reset, forcing the system to restart the ambiguity resolution calculations.

Parameters

action RESET

Example

```
RTKCOMMAND RESET
```

3.2.25 RTKDYNAMICS Set RTK dynamic mode

Format

```
RTKDYNAMICS <mode>
```

Description

This command can be used to set dynamic mode. In different mode, RTK engine should treat the observation data in different style to promote the performance of RTK engine.

Parameters

mode static/foot/land/air.

Example

```
RTKDYNAMICS DYNAMIC
```

3.2.26 RTKELEVMASK Set the RTK elevation mask angle

Format

```
RTKELEVMASK <type> <angle>
```

Description

This command is used to set elevation mask angle of RTK engine. In some situations, observations of low-elevation satellites may influence the resolution process and result of RTK, so a higher mask angle should be a good choice to ensure a better performance of RTK engine.

Parameters

type 'AUTO' or 'USER'.

If 'auto' mode is set, RTK engine should set elevation mask automatically,

in 'user' mode, RTK engine should set elevation mask as user identified.

angle integer number. Angle should be more than 0 degree and less than 90 degree.

The default value is 0 degree.

Example

```
RTKELEVMASK user 10
```

3.2.27 RTKFIXHOLDTIME Set maximum age of RTK fixed data

Format

```
RTKFIXHOLDTIME <time-delay>
```

Description

This command is used to set the maximum age of RTK fixed data to use when operating as a rover station. RTK fixed data received that is older than the specified time is ignored.

Parameters

time-delay less than 99s and more than 5s, default value is 10s

Example

```
RTKFIXHOLDTIME 15
```

3.2.28 RTKOBSMODE Set the observation mode of rover receiver

Format

RTKOBSMODE <mode>

Description

This command is used to set the observation mode of rover receiver. In other words, using this command can set which frequency would be involved in the RTK computation of rover receiver.

Parameters

mode = 'AUTO': switch observation mode (RTK or RTD) automatically according to differential data type received by receiver

= Integer number (Manual Mode), its value can be one of the followings:

Table 12.RTKOBSMODE Manual Mode

MANUAL MODE	DESCRIPTION
0	Pseudoranges (PRs) and Carrier Phases (CPs) from GPS/BDS/GLONASS all frequencies involved; default mode. [Supporting RTCM 3.x PR&CPs correction related Message Types, RTCM 2.3 Message Types 18/19.]
1	PRs and CPs from GPS L1, BDS B1 and GLONASS G1C involved
2	Reserved
3	PRs from GPS L1 (currently supported), BDS B1 (currently NA) and GLONASS G1C (currently NA) involved; [Supporting RTCM 2.3 Message Type 1]
4	Single Positioning mode with improved postioning accuracy
5	PRs and CPs from GPS L1/L2 and BDS B1/B3.

1. RTCM 2.3 Message Type 3 is not affected by this command.

2. As for *manual mode 3*, this command takes higher priority of RTKSOLUTION, which means that:

As rover receiver is set a different observation mode with this command, it's not necessary to send a RTKSOLUTION command to change rover receiver's solution mode, for its solution mode will be adjusted automatically per its observation mode.

3.2.29 RTKREFMODE Set the RTK ref-station position mode

Format

```
RTKREFMODE <mode>
```

Description

This command is used to configure rover station to process position of reference station as moving base station RTK mode or fixed base station RTK.

Parameters

mode 0: fixed base station RTK; 1: moving base station RTK;

Example

```
RTKREFMODE 1
```

3.2.30 RTKSOLUTION Set RTK solution mode

Format

```
RTKSOLUTION <mode>
```

Description

This command provides a method to configure RTK resolution engine, which is used by Rover RTK receiver. In some situations, only RTD is needed to get a quicker initiation process and a not so accurate result, this command can be used to configure RTK engine to RTD mode.

Parameters

mode integer number, which could be one of the followings:

0: dual-frequency RTK (Default mode, Auto);

1: single-frequency RTD;

2: dual-frequency RTD;

3: triplex-frequency RTK;

4: triplex-frequency RTD;

5: L1/L2/B1/B3 RTK;

Example

```
RTKSOLUTION 1
```

3.2.31 RTKSOURCE Set RTK correction source

Format

```
RTKSOURCE <type> [stn id]
```

Description

This command is used to identify from which base station to accept RTK (RTCM, RTCMV3, RTCA, CMR and OmniSTAR (HP/XP)) differential corrections. This is useful when the receiver is receiving corrections from multiple base stations.

Parameters

type DGNSS type string name, default value is 'AUTO', refer to *Table 13*. If ANY (Default) chosen, the receiver ignores the ID string. Specify a type when using base station IDs.

stn id Base station ID

Table 13.DGNSS Type

ID	TYPE STRING	DESCRIPTION
0	RTCM	RTCM ID: 0 <= RTCM station ID <=1023 or ANY
1	RTCA	RTCA ID: A four character string containing only alpha (a-z) or numeric characters (0-9) or ANY
2	CMR	CMR ID: 0 <= CMR station ID <=31 or ANY
3	OMNISTAR	In the RTKSOURCE command, OMNISTAR enables OmniSTAR HP/XP (if allowed) and disables other RTK types. OmniSTAR HP/XP has its own filter, which computes corrections to within about 10 cm accuracy
4	Reserved	
5	SBAS	If SBAS is set in the RTKSOURCE command, it can not provide carrier phase positioning and returns an error
6	RTK	The correction type used is determined by the setting of the RTKSOURCE command
7,8,9	Reserved	
10	AUTO c d	In the RTKSOURCE command, AUTO means that both the RTK filter and the

ID	TYPE STRING	DESCRIPTION
		OmniSTAR HP/XP filter (if authorized) are enabled. The RTK filter selects the first received RTCM, RTCA, RTCMV3 or CMR message. The BESTPOS log selects the best solution between RTK and OmniSTAR HP/XP
11	NONE	Disables all differential correction types
12	Reserved	
13	RTCMV3	RTCM Version 3.0 ID: 0 <= RTCMV3 station ID <=4095 or ANY
14,15	Reserved	

Example

```
RTKSOURCE AUTO ANY

RTKSOURCE RTCM ANY

Notify: Specify the format before specifying base station ID

RTKSOURCE RTCMV3 5

RTKSOURCE RTCM 4
```

3.2.32 RTKTIMEOUT Set maximum age of RTK data

Format

```
RTKTIMEOUT <time-delay>
```

Description

This command is used to set the maximum age of RTK data to use when operating as a rover station. RTK data received that is older than the specified time is ignored.

Parameters

time-delay less than 200s, default 60s

Example

```
RTKTIMEOUT 30
```

3.2.33 RTKQUALITY Set RTK quality level

Format

```
RTKQUALITY <normal/quick>
```

Description

Use this command to select an RTK quality mode.

Parameters

normal/quick normal RTK/ quick RTK

Example

```
Rtkquality normal
Notice: for the geomatics application, the default setting: FFT+QUICK mode
For the attitude determination application, the setting: LAND+QUICK mode.
```

3.2.34 SAVECONFIG Save current configuration

Format

```
SAVECONFIG
```

Description

This command saves the user's present configuration, including the current log settings (type, whether output testing data, etc.), FIX settings, baud rate, and so on, refer to *Table 14*.

Example

```
SAVECONFIG
```

Table 14.Saved Configuration

CONFIGURATION	DESCRIPTION
LOG	All logs in all ports are saved
FIX	Just fix position is saved
COM	baud rates of all ports are saved
ECUTOFF	Cutoff-angles include BD2 are saved
PJKPARA	Six parameters of PJK are saved
PPSOFFSET	Configured offset is saved
INTERFACEMODE	Ports mode status of COM1, COM2 and COM3

3.2.35 SBASCONTROL Control the usage of SBAS corrections

Format

```
SBASCONTROL <switch> [system] [prn]
```

Description

This command is used to dictate how the receiver tracks and uses correction data from one of Satellite Based Augmentation Systems (SBAS). To enable the position solution corrections, issue the SBASCONTROL ENABLE command. The receiver does not, by default, attempt to track or use any SBAS signals satellites unless told to do so by the SBASCONTROL command.

When using the SBASCONTROL command to direct the receiver to use a specific correction type, the receiver begins to search for and track the relevant SBAS GEO PRNs for that correction type only.

The receiver can be forced to track a specific PRN using the ASSIGN command. The receiver can also be forced to use the corrections from a specific SBAS PRN using the SBASCONTROL command.

Tracked SBAS PRNs have been presented in log message GPGSV, SATMSG and RANGECMP.

Parameters

switch = 'ENABLE': Receiver uses the SBAS corrections it receives

= 'DISABLE' (Default): Receiver does not use the SBAS corrections it receives

system it's an optional parameter as *switch* equals to 'DISABLE', refer to *Table 15*.

Table 15.SBAS Systems

KEYWORD	ID	DESCRIPTION
NONE	0	Does not use any SBAS satellites
WAAS	3	Uses only WAAS satellites
EGNOS	4	Uses only EGNOS satellites
MSAS	5	Uses only MSAS satellites
GAGAN	6	Uses only GAGAN satellites

prn = 0: Receiver uses any PRN (default)

= 120-138: Receiver uses SBAS corrections only from this PRN

Example

```
SBASCONTROL ENABLE EGNOS

SBASCONTROL ENABLE MSAS 129
```

3.2.36 SBASECUTOFF Set SBAS satellite elevation cut-off

Format

```
SBASECUTOFF <angle>
```

Description

This command sets the elevation cut-off angle for SBAS satellites. The receiver does not start automatically searching for an SBAS satellite until it rises above the cut-off angle (when satellite position is known).

Parameters

angle ±90 degree, default value is -5 degree.

Example

```
SBASECUTOFF -5
```

3.2.37 SBASTIMEOUT Set SBAS corrections time out

Format

```
SBASTIMEOUT <mode> [time-out]
```

Description

This command is used to set the amount of time the receiver remains using the last effective SBAS corrections if it has been disabled to receive SBAS corrections.

Parameters

mode = AUTO (Default), Set the default value (180s) of time delay

= SET, Set the time delay in seconds

time-delay 120s ~ 200s, only as *mode* = 'SET', default value is 180s

Example

```
SBASTIMEOUT 150
```

3.2.38 SET Configure settings

Format

```
SET <type> <param1> <param2> …
```

Description

This command should be used to configure some special settings such as PJK parameters, debug information output, and so on.

Parameters

type refer to *Table 16*.

param refer to *Table 16*.

Example

```
SET DIFFMATCHMODE synch

SET STATIC on

SET PJKPARA 6378137.0 298.257223563 0 120 0 500000

SET WORKMODE timing

SET TIMINGREFXYZ -2844870.0 4662776.0 3282481.0

SET BD2PVTOBS B2I

SET CPUFREQ 624

SET PVTFREQ 5

SET RTKFREQ 5

SET GPSL2CODETYPE codetype

SET GLONASSCODETYPE codetype

SET AUTOSENDFILE switch period delay

SET EXTERNALCOORD ON

SET CYCLESAVE switcher fileperiod sampleint eraseint

SET STATIONMODE mode portA portB interval

SET EMMC ON/OFF

SET BD2PVTMAXAODC XX

SET BD2PVTMAXAODE XXSET PROJECTIONTYPE Param1
```

```
SET CP SMOOTHER aa bb

SET NMEAMSGFORMAT <KEYWORD>

SET GLOPRBIAS gx p1 p2 …… p14

SET GLOCHANPRBIAS gx chan p

SET BLOPRBIAS DEFAULT
```

Table 16.SET Type and Parameter

SYNTAX	PARAMETER	DESCRIPTION
SET DIFFMATCHMODE *Param1*	*Param1*: SYNCH or ASYNCH	Set RTK in synchronous mode or asynchronous mode
SET ATOM *Param1*	*Param1*: ON = Enable atom clock OFF = Disable atom clock	
SET ANTHIGH *Param1*	*Param1* is known antenna height of a receiver	
SET STATIC *Param1*	*Param1*: ON = start a static file collection OFF = end a static file collection	Start or end static data collection
SET PJKPARA *Param1 … Param6*	*Param1 … Param6*: A: the long axle of the earth 1/F: F is the Earth flat rate B0: reference latitude(in degree) L0: reference longitude(in degree) N0: reference north coordinate E0: reference east coordinate	Set PJK parameters in coordinate conversion. Their default settings are: A: 6378137.0; F: 1.0 / 298.257223563; B0: 0; L0: 120 / 180 * PI N0: 0 E0: 500000
SET TIMINGREFXYZ *Param1 … Param3*	*Param1 … Param3*: X (WGS84), Y (WGS84), Z (WGS84)	In timing mode, this command is used to set reference station coordinates as x, y and z in WGS84 coordination frame.
SET WORKMODE *Param1*	*Param1*: PVT or TIMING	Set receiver work-mode: PVT mode or Timing Mode. Following a

SYNTAX	PARAMETER	DESCRIPTION

		command set work-mode to timing mode, reference station coordinates should be set using command below. If switching work-mode from PVT to TIMING, two commands:
		`SET WORKMODE TIMING`
		`SET TIMINGREFXYZ X Y Z`
		should be needed. If switching work-mode from TIMING to PVT, only one command is needed:
		`SET WORKMODE PVT`

SET BD2PVTOBS *Param1*	*Param1*: B1I, B2I or B3I, AUTO	This command could be used to choose signal of BD2 in PVT computation. B1I/B2I/B3I: In PVT computation, observations, ephemeris and almanac are extracted from B1I, B2I or B3I. AUTO: In PVT computation, observations, ephemeris and almanac are extracted from one of signals B1I, B2I and B3I, according to the quantity of each singal's observables. The signal with more observables will be used in PVT computation firstly.
SET CPUFREQ *Param1*	*Param1* is valid CPU frequency in Hz: 208, 416(default), 624, 806.	This command could be used to set frequency of CPU core. In some cases high update rate observation, PVT or RTK is needed, the default CPU core frequency couldn't bear so huge calculation load, so a higher frequency is necessary, at the same time, it means more power cost.
SET PVTFREQ *Param1*	*Param1* is valid PVT frequency in	ComNav board work in 5hz PVT in default setting, if a higher or lower

SYNTAX	PARAMETER	DESCRIPTION
	Hz: 1, 2, 5(default), 10, 20.	PVT update frequency is needed, this command could configure the PVT update rate at most 20hz. But the calculation ability of CPU is not unlimited, in 5hz PVT, RTK could work on 5hz; if a 10hz PVT and 10hz RTK are needed at the same time, a higher CUP frequency at least 624Mhz is necessary.
SET RTKFREQ *Param1*	*Param1* is valid RTK frequency in Hz: 1, 2, 5(default), 10.	Notice: please keep RTK frequency is not higher than PVT frequency.
SET BASELINELENGTH *Param1*	*Param1* is a fixed baseline length of a rover (>0)	
SET MODIFYCPTOPR *Param1*	*Param1*: ON = to carry out the modulation OFF = no modulation (default)	Invoke a modulation manipulation on Carrier Phase, to make CP's values close to those of corresponding Pseudorange.
SET CPSMOOTHPR *Param1 [Param2] [Param3]*	*Param1*: smooth enable switch, ON/OFF *Param2*: smoothing time contant *Param3*: Tracking time threshhold	Param1: ON = enable Carrier Phase to smooth Pseudorange [Default] OFF = Disable Carrier Phase to smooth Pseudorange Valid range of Param2 is 10 ~ 200 seconds. Its default value is 50s. Valid range of Param3 is 0 ~ 60 seconds. Its default value is 15s. After one satellite was tracked for a time period (Param3), receiver starts to use Carrier Phase to smooth the satellite's PR.
SET RTKOBSMODE *Param1*	Param1 is RTK Obs mode	AUTO, MANUAL [Default] For more information on the mode, refer to *3.2.28 RTKOBSMODE Set the observation mode of rover receiver*

SYNTAX	PARAMETER	DESCRIPTION
SET VECTORLENGTH *Param1*	*Param1* is a vector length of a rover (>0)	
SET GPSL2CODETYPE *Param1*	*Param1* (*codetype*) is: pcode: P code ccode: C code auto: Track the L2C automatically	a) AUTO, MANUAL[Default] code type: Track L2C signal if this satellite has the L2C signals; track L2P if not. b) The setting status can be checked by the command: *log codetype* c) Example: set gpsl2codetype auto For the GPS L2 automatically choose the PRN code type to track.
SET GLONASSCODETYPE *Param1*	*Param1* (*codetype*) is: pcode: P code ccode: C code Auto: N/A	a) Default mode: pcode b) Example: set glonasscodetype ccode; In this command, the PRN tracking code type is: C code.
SET AUTOSENDFILE *switch period delay*	*switch: raw data file send switch.* *Period*: raw data file send period, the unit is (seconds). *Delay*: time delay of the raw data file sending out on time, and the	*Switch:* 1: open the sending file function 0: close the sending file function *period*: If the period is set with “3600”, it means the file is sent once every 3600s.

SYNTAX	PARAMETER	DESCRIPTION
	unit is in seconds.	*delay*: The time delay is set for leaving more time for the internet module connection. If the delay is set "15", it means the data file will be sent out 15 seconds delay after the sending period time. The parameters of this command can be saved by *saveconfig* command.
SET EXTERNALCOORD ON	Externalcoord: the external coordinates.	This function uses the external coordinates as base station position and send these coordinates for differential operation. This function can be inquired by the command *log sysconfig*, and can be saved by *saveconfig*.
SET CYCLESAVE *switcher fileperiod sampleint eraseint*	*switcher*: set the cycle saving. "ENABLE" is open, and "DISABLE" is close. *Fileperiod*: set the file saving period. The parameter is integer in unit of hour. *Sampleint*: set the file saving sampling interval. The parameter is integer in unit of second.	- This message settings can be saved by *saveconfig* and checked by *log sysconfig*. - the *switcher* corresponds to the "Data log" of the CRU; the "ENABLE" corresponds to the "AUTO"; "DISABLE" corresponds to the "MANUAL". The *Fileperiod* corresponds to the "Data Log Session" of CRU; The "sampleint" corresponds to the "sampleinterval" of CRU. - Using the *set cyclesave* command to set the cycle saving parameters means modifying the settings of the static file saving of the CRU. Same, using the CRU to modify the static file saving also means changing the cyclesave parameters. But the open and close of *cyclesave* can only be

SYNTAX	PARAMETER	DESCRIPTION
	Eraseint: set the file erasing time interval. The parameter is integer and the unit is seconds.	controlled by the input command.
SET STATIONMODE *mode portA portB interval*	*Mode:* set the station style, the parameter is string. “master” is the base station, “slave” is the rover station. *PortA*: set the communication port for receiving the differential data from the base station. The parameter is “com1”, “com2”, “com3”. *PortB*: set the communication port for sending differential messages from base station. The parameter is “com1”, “com2”, “com3”. *Interval*: set the time interval for	(2) example: set stationmode master com2 com3 0.2 In this command, the OEM board is set as master station. It receives the correction data from com2 and sending out the correction message to the rover station from com3; the message sending interval is 0.2 seconds. Additionally, after receiving the command as in the example, the OEM board will automatically check the current frequencies of the PVT and RTK according to the *interval* parameter. The frequencies will be tuned automatically if the PVT/RTK frequencies are lower than the message sending frequency. For example, assuming the PVT/RTK frequency is 5 Hz, while receiving the command “set stationmode master com2 com3 0.1”, the PVT/RTK frequencies are set with 10 Hz. However, the frequency of the CPU cannot be set automatically. If needed, please set manually. The command as former example will execute the following commands internally: *Set pvtfreq 5*

SYNTAX	PARAMETER	DESCRIPTION
	sending the differential messages. The parameter is float pointing.	*Set rtkfreq 5* *Interfacemode com2 auto auto on* *Interfacemode com3 auto auto on* *Log com3 rtcmcompassb ontime 0.2* (2) set stationmode slave com3 com3 0.2 In the above example, the OEM board is set as slave station, where the messages from the master are received from com3 and attitude results are sent back to com3. 0.2 is the interval time which is used to check if the PVT and RTK frequencies are under the requirement. The function is same as the master station. The above command is realized by the following commands: *set pvtfreq 5* *set rtkfreq 5* *interfacemode com3 auto auto on* *log com3 rtcmcompass3b ontime 0.2* *set diffmatchmode synch* *rtkrefmode* 1 The adding commands are used for the setting related to the attitude determination. For the requirement from the master station, it needs to be set additionally. For example, the command settings for a master station are as: *set stationmode master com2 com3 0.2*

SYNTAX	PARAMETER	DESCRIPTION
		log gpgga ontime 0.2 *log gptra ontime 0.2* *for the slave station:* *set stationmode master com3 com3 0.2.*
SET EMMC ON/OFF	ON: active the EMMC chip OFF: close the EMMC chip	For the K708 OEM board, the EMMC chip is not activated by default setting; if the chip is needed, I needs to be activated by the command. For everytime the EMMC is open/closed, it can be set effectively only after setting: *saveconfig* command. The EMMC status is finished during the initialization while starting the receiver. The EMMC status can be inquired by the *sysconfig* command.
SET BD2PVTMAXAODC XX	XX: is the AODC value	This command is used to set the AODC value for the Beidou PVT solution. The default value is: 1. It can be inquired and saved in the *sysconfig* command.
SET BD2PVTMAXAODE XX	XX: is the AODE value	This command is used to set the AODE value for the Beidou PVT solution. The default value is: 2. It can be inquired and saved in the *sysconfig* command.

SYNTAX	PARAMETER	DESCRIPTION
SET PROJECTIONTYPE *Param1*	Param1 can be set with gauss and utm.	Gauss: means setting the projection type as Gauss-Boaga projection type. utm: universal transverse Mercator projection.
SET CP SMOOTHER ON aa bb	aa: smooth timing constant value from 10 ~ 200 bb: tracking time (second) since starting smoothing. The time is set from 0 ~ 60.	The parameter settings can be checked by the command: *log sysconfig* Defaul setting is: smoothing time aa is 50 and the tracking time bb 15 seconds.
Set nmeamsgformat<keyword>	Keyword: COMNAV, STANDARD, NORMAL, LONG.	*COMNAV*: default setting. Currently the OEM board outputs NMEA format message. *STANDARD*:se Standard NMEA0183 message format. Reference Table 17.
Set CLOPRBIAS gx p1 p2 …… p14	gx: GLONASS frequency index. The value can be set with 1 or 2. p1: the first channel frequency correction. p14: +6 RF channel settings in unit of mm.	gx = 1 means G1 gx = 2 means G2; example: set gloprbias 1 -700 -600 -500 -400 -300 -200 -100 0 100 200 300 400 500 600 set gloprbias 2 -700 -600 -500 -400 -300 -200 -100 0 100 200 300 400 500 600

SYNTAX	PARAMETER	DESCRIPTION
		Note: all 15 parameters should be set in the command.
Set GLOCHANPRBIAS gx chan p	gx: same as in above. chan: RF channel number. Value is from -7 ~ 6 with respect to the 14 channels of GLONASS. p: corrections as above.	Example: *Set glochanprbias 1 -6 300* The example means set the G1 frequency in -6 channel of GLONASS with 300mm.
Set GLOPRBIAS DEFAULT	N/A	Set both corrections of G1 and G2 in all channels to be 0.

Table 17.Description of NMEAMSGFORMAT keyword

<table>
<tr><td>COMNAV</td><td colspan="2">Default setting – NEMA message format for current OEM board output</td></tr>
<tr><td>STANDARD</td><td>Standard NMEA0183 message format</td><td>1. no position case: GGA, RMC, VTG, HDT corresponding data are not output, and the message only output comma.
2. this key word only influences the GPGGA data accuracy, where the data accuracy adjusts according to the
<table>
<tr><td>Position status</td><td>latitude</td><td>longitude</td><td>height</td><td>Undulation</td><td>Differential delay</td></tr>
<tr><td>Single positioning</td><td>4-bits</td><td>4-bits</td><td>2-bits</td><td>2-bits</td><td>N/A</td></tr>
<tr><td>Non-single positioning</td><td>7-bits</td><td>7-bits</td><td>4-bits</td><td>3-bits</td><td>Integer number with 2 digit(receiving differential data)</td></tr>
</table>
positioning mode automatically. The decimal number is:
Non-single positioning: RTD, SBAS, HDT manual setting or simulation input, etc.
3. when working in single positioning mode, the differential delay of GPGGA and station number are N/A.</td></tr>
<tr><td>NORMAL</td><td>NMEA message normal accuracy format</td><td>1. no position case: GGA, RMC, VTG, HDT corresponding data are not output but only comma.
2. this key word only influences the GPGGA data accuracy. The data output accuracy is fixed and the decimal part is defined as:</td></tr>
</table>

<table>
<tr>
<td>LONG</td>
<td>NMEA message high accuracy format</td>
<td>
<table>
<tr><td></td><td>latitude</td><td>longitude</td><td>height</td><td>Undulation</td><td>Differential delay</td></tr>
<tr><td>NORMAL</td><td>4-bits</td><td>4-bits</td><td>2-bits</td><td>2-bits</td><td>2 digits integer</td></tr>
<tr><td>LONG</td><td>7-bits</td><td>7-bits</td><td>4-bits</td><td>3-bits</td><td>xx.x (2 digits integer, 1 decimal)</td></tr>
</table>
Non-single positioning: RTD, SBAS, HDT manual setting or simulation input, etc.
3. when working in single positioning mode, the differential delay of GPGGA and station number are N/A.
4. for the LONG mode, undulation and its unit “M” are still reserved, and same as NovAtel GPGGALONG.
5. Reference: NovAtel OME6 Manual book, Table 106, Position Precision of NMEA Logs.
</td>
</tr>
</table>

3.2.39 UNDULATION Choose undulation

Format

```
UNDULATION <opt> [sep]
```

Description

This command permits user to either enter a specific geoidal undulation value. The undulation values reported in the position logs are in reference to the ellipsoid of the chosen datum.

Parameters

opt Geoidal height model option, refer to *Table 18*. Default value is 'EGM96'.

sep Undulation value required for the USER option, default value = 0.000.

Table 18.Geoidal Height (Undulation) Model

OPTION	ID	DESCRIPTION
TABLE	0	Use the internal undulation table (same as EGM96)
USER	1	Use the user specified undulation value
OSU89B	2	Use the OSU89B undulation table
EGM96	3	Use global geoidal height model EGM96 table

Example

```
UNDULATION EGM96 10.0
```

3.2.40 UNLOCKOUT Reinstate a satellite in the solution

Format

```
UNLOCKOUT <prn>
```

Description

This command allows a satellite which has been previously locked out (LOCKOUT command) to be reinstated in the solution computation. If more than one satellite is to be reinstated, this command must be reissued for each satellite reinstatement.

Parameters

prn PR number of satellite, refer to *Table 6*.

Example: `UNLOCKOUT 10`

3.2.41 UNLOCKOUTALL Reinstate a satellite in the solution

Format

```
UNLOCKOUTALL
```

Description

This command allows all satellites which have been previously locked out (LOCKOUT command) to be reinstated in the solution computation.

Example

```
UNLOCKOUTALL
```

3.2.42 UNLOCKOUTSYSTEM Reinstate previously locked out system

Format

```
UNLOCKOUTSYSTEM <system>
```

Description

This command allows a system which previously locked out to be reinstated in the solution computation.

Parameters

system the name of a specified GNSS system, refer to *Table 7*.

Example

```
UNLOCKOUTSYSTEM BD2
```

3.2.43 UNLOG Remove a log from logging control

Format

```
UNLOG <message-type>
```

Description

This command permits you to remove a specific log request from the system.

Parameters

message-type refer to *Table 19* ~ *Table 23*.

Example

```
UNLOG VERSIONB
```

3.2.44 UNLOGALL Remove all logs from logging control

Format

```
UNLOGALL <port>
```

Description

This command disables all logs on the port if port is specified, if no port is specified, all logs of all ports would be disabled.

Parameters

port refer to *Table 3*.

Example

```
UNLOGALL COM1

UNLOGALL
```

CHAPTER 4. LOG MESSAGES

Many different types of data can be logged using LOG command. This chapter covers all types of data logs supported by ComNav board.

4.1 CONVENTIONS

4.1.1 Command Format

Send

```
LOG <message-type> [trigger] [period] [offset]
```

Refer to Section *3.2.15*.

Reply

The format of reply message is Binary, which is quite different from sending message. The board also supports NMEA string.

4.1.2 Binary Message Layout and Header Definition

Header	Data	CRC

Header 3 Sync bytes plus 25 bytes of header information. The header length is variable as fields may be appended in the future. Always check the header length.

Data variable

CRC 32-bit CRC performed on all data including the header.

HEADER

Field#	Field Name	Field Type	Description	Binary Byte	Binary Offset
1	Sync	Char	Hexadecimal 0xAA.	1	0
2	Sync	Char	Hexadecimal 0x44.	1	1
3	Sync	Char	Hexadecimal 0x12.	1	2
4	Header Lgth	Uchar	Length of the header.	1	3
5	Message ID	Ushort	Message ID	2	4
6	Reserved			1	6
7	Reserved			1	7

Field#	Field Name	Field Type	Description	Binary Byte	Binary Offset
8	Message Length	Ushort	The length in bytes of the body of the message. This does not include the header nor the CRC.	2	8
9	Reserved			2	10
10	Reserved			1	12
11	Reserved			1	13
12	Week	Ushort	GPS week number.	2	14
13	ms	GPS time	Milliseconds from the beginning of the GPS week.	4	16
14	Reserved			4	20
15	Reserved	Ushort	Reserved for internal use.	2	24
16	Receiver S/W Version	Ushort	This is a value (0 - 65535) that represents the receiver software build number.	2	26

NOTE:

In current version, the length of header is always 28 bytes.

The length of data block is variable.

4.1.3 Log Message List

Currently supported messages are listed in alphabetical order below.

4.1.3.1 Predefined Log Message List

Table 19.Predefined Log Message

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION	REFER TO
1	71	BD2EPHEM	B	BD2 decoded ephemeris information	*4.2.1.1*
2	741	BD2RAWALM	B	BD2 raw almanac	*4.2.1.2*
3	412	BD2RAWEPHEM	B	BD2 Raw ephemeris	*4.2.1.3*
4	42	BESTPOS	A, B	Best position data	*4.2.7.1*
5	99	BESTVEL	A, B, Abb	Best velocity data	*4.2.7.2*
6	241	BESTXYZ	A, B	Position information in xyz.	*4.2.7.3*
7	110	BINEX00DATA	B	BINEX Record 0x00 encapsulated by Binary	*4.2.2.1*

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION	REFER TO
				header & CRC-32	
8	81	BINEX0101DATA	B	BINEX Record 0x01-01 encapsulated by Binary header & CRC-32	*4.2.2.2*
9	82	BINEX0102DATA	B	BINEX Record 0x01-02 encapsulated by Binary header & CRC-32	*4.2.2.3*
10	85	BINEX0105DATA	B	BINEX Record 0x01-05 encapsulated by Binary header & CRC-32	*4.2.2.4*
11	114	BINEX7D00DATA	B	BINEX Record 0x7d-00 encapsulated by Binary header & CRC-32	*4.2.2.5*
12	115	BINEX7E00DATA	B	BINEX Record 0x7e-00 encapsulated by Binary header & CRC-32	*4.2.2.6*
13	120	BINEX7F05DATA	B	BINEX Record 0x7f-05 encapsulated by Binary header & CRC-32	*4.2.2.7*
14	317	COMCONFIG	A, B	COM configuration Information in ASCII Format	*4.2.3.1*
15	723	GLOEPHEMERIS	B	Decoded GLONASS Ephemeris	*4.2.1.4*
16	792	GLORAWEPHEM	B	GLONASS raw ephemeris message.	*4.2.1.5*
17	712	GPSEPHEM	B	GPS decoded ephemeris information	*4.2.1.6*
18	971	HEADING	A, B	Heading angle message	*4.2.4.1*
19	8	IONUTC	A, B, Abb	Ionosphere and UTC parameters	*4.2.9.1*
20	5	LOGLIST	A	Log settings in each port.	*4.2.3.2*
21	925	M925	B	Extended Satellite Information	*4.2.9.2*
22	181	MARKPOS	A, B	Position at time of mark input event	*4.2.5.1*
23	231	MARKTIME	A, B	Time of mark input event	*4.2.5.2*
24	106	METEODATA	B	Basic Meteorograph Data Message	*4.2.6.1*
25	108	METEODATAEXT	B	Extended Meteorograph Data Message	*4.2.6.2*
26	174	PSRDOP	B	DOP of SVs currently tracking	*4.2.7.4*
27	47	PSRPOS	A, B, Abb	Pseudorange Position	*4.2.7.5*
28	100	PSRVEL	A, B	Pseudorange Velocity	*4.2.7.6*
29	243	PSRXYZ	A, B	Pseudorange Cartesian position and velocity	*4.2.7.7*
30	43	RANGE	A, B, Abb	Detailed range information	*4.2.8.1*

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION	REFER TO
31	140	RANGECMP	A, B, Abb	Compressed version of the RANGE log	*4.2.8.2*
32	74	RAWALM	B	Raw almanac	*4.2.1.7*
33	41	RAWEPHEM	B	Raw ephemeris	*4.2.1.8*
34	973	RAWSBASFRAME	A	Raw SBAS frame data	*4.2.10.1*
35	175	REFSTATION	A, B	Base station Position	*4.2.11.1*
36	396	RTCMDATA1	B	Pseudorange correction message	*4.2.8.3*
37	911	SATMSG	B	Satellite status (defined by ComNav)	*4.2.9.3*
38	48	SATVIS	B	Satellite visibility	*4.2.9.4*
39	270	SATXYZ	A, B	Satellite positions in ECEF Cartesian coordinates	*4.2.9.5*
40	976	SBAS0	A	Do Not Use for Safety Applications	*4.2.10.2*
41	977	SBAS1	A	PRN Mask Assignments	*4.2.10.3*
42	982	SBAS2	A	Fast Corrections	*4.2.10.4*
43	987	SBAS3	A		
44	992	SBAS4	A		
45	994	SBAS5	A		
46	995	SBAS6	A	Integrity Information	*4.2.10.5*
47	996	SBAS7	A	Fast Correction Degradation Factor	*4.2.10.6*
48	997	SBAS9	A	GEO Navigation Message	*4.2.10.7*
49	978	SBAS10	A	Degradation Factors	*4.2.10.8*
50	979	SBAS12	A	SBAS Network Time/UTC/GLO Time Offset Parameters Message	*4.2.10.9*
51	980	SBAS17	A	GEO Almanacs	*4.2.10.10*
52	981	SBAS18	A	Ionospheric Grid Point Masks	*4.2.10.11*
53	983	SBAS24	A	Mixed Fast Corrections/Long Term Satellite Error Corrections	*4.2.10.12*
54	984	SBAS25	A	Long Term Satellite Error Corrections	*4.2.10.13*
55	985	SBAS26	A	Ionospheric Delay Corrections	*4.2.10.14*
56	986	SBAS27	A	SBAS Service	*4.2.10.15*
57	975	SBAS28	A	Clock-Ephemeris Covariance Matrix Message	*4.2.10.16*
58	1003	SBAS63	A	Null Message	*4.2.10.17*
59	101	TIME	B	Board time information	*4.2.12.1*
60	83	TRACKSTAT	B	Satellite tracking status	*4.2.3.3*

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION	REFER TO
61	37	VERSION	A, B, Abb	Board software and hardware version	*4.2.3.4*

4.1.3.2 International Standard Message List

ComNav boards also support NMEA, RTCM 2.X, RTCM 3.X messages. Please reference the NMEA and RTCM protocol manual for details.

Table 20.NMEA Message

NO	ID	LOG MESSAGE	DESCRIPTION
Standard			
1	218	GPGGA	GPS Fix Data and Undulation
2	219	GPGLL	Latitude and Longitude of Present Vessel Position
3	221	GPGSA	GPS DOP and Active Satellites
4	222	GPGST	Only Dop Values are Valid Currently
5	223	GPGSV	GPS Satellites in View
6	228	GPHDT	Actual Vessel Heading in Degrees True
7	225	GPRMC	GPS Specific Information
8	226	GPVTG	The Track Made Good and Speed Relative to the Ground
9	227	GPZDA	UTC Time and Date
ComNav Proprietary			
1	211	GPCDT	Differential timing result
2	267	GPCLH	Constellation Health
3	265	GPDRC	Delta Range Correction
4	259	GPGGARTK	GPS Fix Data and Undulation
5	220	GPGRS	Pseudorange Residual
6	237	GPHPR	Parameters of Attitude Angles
7	268	GPIDM	Constellation Health
8	264	GPNAV	ComNav Navigation Information Message
9	209	GPNTR	Information about navigating to reference station.
10	271	GPPRR	Pseudorange and Range Rate Residual
11	263	GPRRS	Differential GPS and BDS Corrections
12	266	GPRSC	Reference Station Coordinates

NO	ID	LOG MESSAGE	DESCRIPTION
13	261	GPSEH	Satellite Health Indication
14	207	GPTRA	Heading, Pitch and Roll (reserved) Message
15	262	GPURA	Satellite User Range Accuracy (URA)
16	87	GPYBM	Position, Velocity,, Heading, Pitch and PJK information

Table 21.RTCM Message

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION
RTCM 2.X				
1	107	RTCM1	B	Pseudorange correction message in RTCM2.3
2	402	RTCM3	B	Type 3 Base Station Parameters
3	275	RTCM9	B	GPS Partical Correction Set
4	399	RTCM1819	B	Type18 and Type 19 Raw Measurements
5	864	RTCM31	B	Differential GLONASS Corrections
6		RTCM41	B	GNSS pseudorange corrections
7		RTCM42	B	General partial corrections
RTCM 3.X				
1	89	RTCM0063	B	BDS Ephemerides (a test message)
2	785	RTCM1002	B	Extended L1-Only GPS RTK Observables
3		RTCM1003	B	L1 and L2 GPS RTK Observables
4	787	RTCM1004	B	Extended L1/L2 GPS RTK Observables
5	788	RTCM1005	B	RTK Base Station ARP
6	789	RTCM1006	B	Base Station ARP with Height
7	856	RTCM1007	B	Extended Antenna Descriptor and Setup Information
8	857	RTCM1008	B	Extended Antenna Descriptor and Setup Information
9	898	RTCM1010	B	Extended L1-OnlyGLONASS RTK Observables
10		RTCM1011	B	GLONASS L1/L2 RTK
11	900	RTCM1012	B	Extended L1 & L2 GLONASS Observables
12	893	RTCM1019	B	GPS Ephemerides
13	895	RTCM1020	B	GLONASS Ephemerides
14	999	RTCM1033	B	Receiver and Antenna Descriptors
15	781	RTCM1104	B	Extended B1, B2 or B3 BD2 RTK Observables
16	624	RTCM1074	B	GPS MSM4 — Full PRs and Phase Ranges plus CNR

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION
17	644	RTCM1084	B	GLO MSM4 — Full PRs and Phase Ranges plus CNR
18	674	RTCM1124	B	BDS MSM4 — Full PRs and Phase Ranges plus CNR
19		RTCM4078	B	A RTCM 3.x Proprietary Message for ComNav

Table 22.BINEX Message

NO	RECORD	LOG MESSAGE	FORMAT	DESCRIPTION
Standard				
1	0x00	BINEX00	B	Site Metadata
2	0x01-01	BINEX0101	B	Decoded GPS Ephemeris
3	0x01-02	BINEX0102	B	Decoded GLONASS — FDMA Ephemeris
4	0x01-05	BINEX0105	B	Decoded Beidou-2/Compass Ephemeris
5	0x7d-00	BINEX7D00	B	Receiver Internal State
6	0x7e-00	BINEX7E00	B	Ancillary Site Data Prototyping
7	0x7f-05	BINEX7F05	B	GNSS Observable Prototyping
BINEX Records encapsulated by ComNav Binary Message Header and CRC-32				
1	0x00	BINEX00DATA	B	Refer to *4.2.2.1*
2	0x01-01	BINEX0101DATA	B	Refer to *4.2.2.2*
3	0x01-02	BINEX0102DATA	B	Refer to *4.2.2.3*
4	0x01-05	BINEX0105DATA	B	Refer to *4.2.2.4*
5	0x7d-00	BINEX7D00DATA	B	Refer to *4.2.2.5*
6	0x7e-00	BINEX7E00DATA	B	Refer to *4.2.2.6*
7	0x7f-05	BINEX7F05DATA	B	Refer to *4.2.2.7*

4.1.3.3 Other Message List

Table 23.Other Message

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION
Trimble Proprietary Messages				
1	390	CMROBS	B	Base station satellite observation information

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION
2	391	CMRREF	B	Base station position information
3	224	PTNLAVR	A	Time, yaw, tilt, range, mode, PDOP, and number of SVs for Moving Baseline RTK
4	76	PTNLGGK	A	Time, position, position type, and DOP values
5	229	PTNLPJK	A	PJK Position
JAVAD Proprietary Messages				
1	52	NAVPOS	A	[NP] Navigation Positon
Parameter Messages				
1	2001	BD2ECUTOFF		BD2 cutoff angle.
2	2002	ECUTOFF		GPS cutoff angle.
3	2017	GLOECUTOFF		GLONASS cutoff angle.
4	2018	MAGVAR		Magnetic variation correction.
5	2013	PJKPARA		PJK Parameters Used in PTNLPJK Message
6	2019	PVTFREQ		PVT frequency.
7	2003	REFMODE		Reference mode, auto-started, SPP or fixed position.
8	2022	REFPJKXYH		Ref-Station position in PJK mode.
9	2015	REGLIST		Registered functions list
10	2020	RTKFREQ		RTK frequency.
11	2008	RTKTIMEOUT		Time thresh of differential data could be used.
12	2021	SYSCONFIG		Main system configuration parameters.
Command Messages for Weather Instrument (Meteorograph)				
1	932	ZZ11ASETDATE	A	Set date of ZZ11A Meteorograph
2	933	ZZ11ASETTIME	A	Set time of ZZ11A Meteorograph
3	934	ZZ11ASETID	A	Set ID of ZZ11A Meteorograph
4	935	ZZ11ASETAUTOSEND	A	Set output period of ZZ11A Meteorograph
5	936	ZZ11AREADDATE	A	Read date from ZZ11A Meteorograph
6	937	ZZ11AREADTIME	A	Read time from ZZ11A Meteorograph
7	938	ZZ11AREADID	A	Read ID of ZZ11A Meteorograph
8	939	ZZ11AREADAUTOSEND	A	Read the output period of ZZ11A Meteorograph

4.1.4 Trigger Types

The receiver is capable of generating many different logs. These logs are divided into three types: synchronous, asynchronous, and polled.

☞ The data for synchronous logs is generated on a regular schedule.

☞ Asynchronous data is generated at irregular intervals. If asynchronous logs were collected on a regular schedule, they would not output the most current data as soon as it was available.

☞ The data in polled logs is generated on demand. An example would be RXCONFIG. It would be polled because it changes only when commanded to do so. Therefore, it would not make sense to log this kind of data ONCHANDED, or ONNEW.

The following table outlines the log types and the valid triggers to use:

Table 24.Log Trigger Types

TYPE	RECOMMENDED TRIGGER	ILLEGAL TRIGGER
Synch	ONTIME	ONNEW, ONCHANGED
Asynch	ONCHANGED	-
Polled	ONCE or ONTIME	ONNEW, ONCHANGED

Table 25.Logs Supporting ONCHANGED and ONTRACKED

NO	ID	LOG MESSAGE	REFER TO
1	8	IONUTC	*4.2.9.1*
2	41	RAWEPHEM	*4.2.1.8*
3	71	BD2EPHEM	*4.2.1.1*
4	79	BINEX0101	*4.3.4.2*
5	80	BINEX0102	*4.3.4.2*
6	84	BINEX0105	*4.3.4.2*
7	89	RTCM0063	*4.3.3.1*
8	90	RTCM4011	*NA*
9	104	RTCM4013	*NA*
10	175	REFSTATION	*4.2.11.1*
11	412	BD2RAWEPHEM	*4.2.1.3*
12	712	GPSEPHEM	*4.2.1.6*

13	723	GLOEPHEMERIS	*4.2.1.4*
14	792	GLORAWEPHEM	*4.2.1.5*
15	893	RTCM1019	*4.3.3.12*
16	895	RTCM1020	*4.3.3.13*

☞ ***NOTE for Table 25***

(1) Most log messages listed in this table are relevant to GNSS satellite almanacs or ephemeris.

(2) As for each log message listed in this table, if 'ONTIME' trigger is chosen for it, receiver/OEM board will output the message which only contains ONE satellite's data (e.g. one satellite ephemeris) for each sending.

(3) If ONCHANGED/ONTRACKED trigger is used, receiver/OEM board will output the message containing all valid satellites' data for the first time sending. After first sending, only those valid satellites data which have changed or just be tracked since last sending, will be output.

4.1.5 Examples

For example, if the receiver supports 5 Hz logging, the minimum logging period is 1/5 Hz or 0.2 s. The following are valid examples for a synchronous or asynchronous log, on a receiver that can log at rates up to 5 Hz:

```
log bestposb 0.2              [5 Hz]
log bestposb 0.5              [2 Hz]
log bestposb ontime 1         [1 Hz]
log bestposb ontime 2         [0.5 Hz]
log bestposb ontime 10        [0.1 Hz]
```

4.2 PREDEFINED LOG MESSAGES

4.2.1 Almanacs and Ephemeris

This section defines those log messages which contains raw or decoded almanacs and ephemeris of GNSS satellites.

Attention please, user can refer to Table 25. Logs Supporting ONCHANGED and ONTRACKED to get more information on how to properly use ONCHANGED/ONTRACKED trigger for almanacs and ephemeris log messages.

4.2.1.1 BD2EPHEM BD2 Ephemeris

Description

This message contains the BD2 ephemeris parameters.

Message ID	71
Recommended Input	*log bd2ephemb onchanged*
Supported Format	*binary*

Reply (Binary)

Refer to *4.2.1.6.*

4.2.1.2 BD2RAWALM Raw BD2 Almanac

Description

This message contains raw almanac sub frames received from BDS satellites.

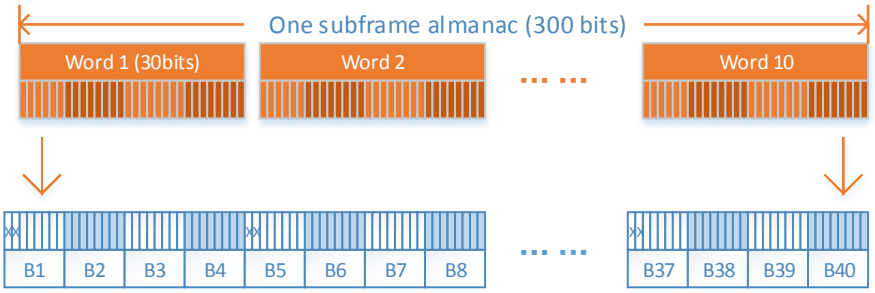
Message ID	741
Recommended Input	*log bd2rawalmb ontime 1*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BD2RAWALM header	Log header		H	0
2	ref week	Almanac reference week number	Ulong	4	H
3	ref secs	Almanac reference time (s)	Ulong	4	H+4
4	subframes	Number of subframes to follow	Ulong	4	H+8
5	svid	SV ID (satellite vehicle ID)	UShort	2	H+12
6	data	Subframe page data *Note*	Hex	40	H+14
7...	Next subframe offset = H + 12 + (subframe x 42)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 12 + (42

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
					x subframes)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

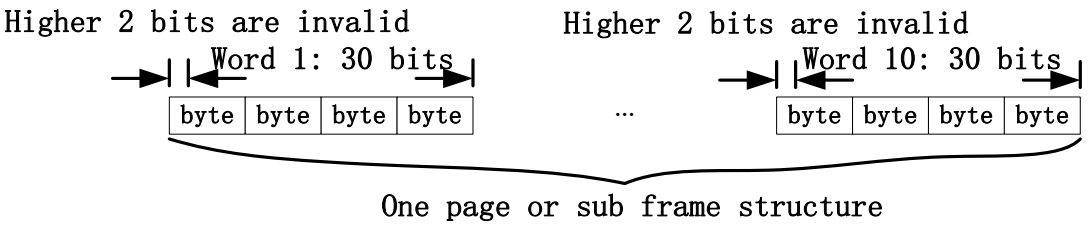
☞ ***Note.*** Length of one subframe almanac is 10 words (30 bits per word, MSB first). Subframe 4 Page 1~24 and Subframe 5 Page 1~6 contain 30 frames BDS satellites' almanac (Refer to Beidou-ICD-1.0 Table 5-11-1 and 5-11-2). One word (30 bits) is split into 4 bytes data (first two bits of 1st byte is unused), then one almanac subframe data is expressed in 40 bytes as following figures shows:



4.2.1.3 BD2RAWEPHEM Raw BD2 Ephemeris

Description

This log contains the raw ephemeris of BD2 satellites, and each raw ephemeris message is 400 bytes long. Each ephemeris page is 300 bits long, and the log contains all bits, although some bits are not used in current definition. For GEO satellites, ephemeris bits are all in sub frame 1, which is composed of 10 pages, each page is 10 words long and there are 30 bits in each word. Notice, just higher 150 valid bits are used in page, so all pages are needed to be decoded. For IGSO and MEO satellites, ephemeris bits are in sub frame 1, 2 and 3 and each sub frame is 10 words long and all 300 bits are valid, the other sub frames are invalid in the log. The page or sub frame structure in bytes arrays are showed in the below figure. If detailed information needed, please refer to BD2 ICD.



Message ID	412
Recommended Input	*log bd2rawephb onchanged*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BD2RAWEPHEM header	Log header		H	0
2	prn	Satellite PRN number	Ulong	4	H
3	ref week	Ephemeris reference week number	Ulong	4	H+4
4	ref secs	Ephemeris reference time (s)	Ulong	4	H+8
5	Subframe1 or page1	Sub-frame 1 or page1 data	Hex	40	H+12
6	subframe2 or page2	Sub-frame 2 or page2 data	Hex	40	H+52
…	…	…	…	…	…
7	Subframe10 or page 10	Sub-frame 10 or page10 data	Hex	40	H+372
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+412
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.1.4 GLOEPHEMERIS Decoded GLONASS Ephemeris

Description

This log contains GLONASS ephemeris information. GLONASS ephemerides are referenced to the PZ90.02 geodetic datum. No adjustment between the GPS and GLONASS reference frames are needed to perform PVT solution. Messages are grouped and transmitted. One message per satellite ID.

Message ID	723
Recommended Input	*log gloephemerisa onchanged*
Supported Format	*ASCII,binary*

Reply (Binary)

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	GLOEPHEMERIS header	Log header		H	0
2	sloto	Slot information offset - PRN identification (Slot + 37).	Ushort	2	H
3	freqo	Frequency channel offset 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				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 meters	Double	8	H+28
15	pos y	Y coordinate for satellite at reference time (PZ-90.02), in meters	Double	8	H+36
16	pos z	Z coordinate for satellite at reference time (PZ-90.02), in meters	Double	8	H+44
17	vel x	X coordinate for satellite velocity at reference time (PZ-90.02), in meters/s	Double	8	H+52
18	vel y	Y coordinate for satellite velocity at reference time	Double	8	H+60

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
		(PZ-90.02), in meters/s			
19	vel z	Z coordinate for satellite velocity at reference time (PZ-90.02), in meters/s	Double	8	H+68
20	LS acc x	X coordinate for lunisolar acceleration at reference time (PZ-90.02), in meters/s/s	Double	8	H+76
21	LS acc y	Y coordinate for lunisolar acceleration at reference time (PZ-90.02), in meters/s/s	Double	8	H+84
22	LS acc z	Z coordinate for lunisolar acceleration at reference time (PZ-90.02), in meters/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, refer to *Table 26*	Ulong	4	H+140
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+144
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 26.GLOEPHEMERIS Info Flags

NIBBLE#	BIT#	MASK	DESCRIPTION	RANGE VALUE
N0	0 (LSB)	0x00000001	P1 Flag: Time Interval between adjacent iIssue(fb) values	00: 0 minutes 01: 30 minutes 10: 45 minutes 11: 60 minutes
	1	0x00000002		
	2	0x00000004	P2 Flag: Oddness or Evenness of iIssue (fb) value	0 = Even, 1 = Odd
	3	0x00000008	P3 Flag: Number of Satellites with almanac	0 = Four, 1 = Five

NIBBLE#	BIT#	MASK	DESCRIPTION	RANGE VALUE
			information within current subframe	
N1 – N7	4 - 31	…	Reserved	

4.2.1.5 GLORAWEPHEM Raw GLONASS Ephemeris

Description

This log contains the raw ephemeris of GLONASS satellites.

Message ID	792
Recommended Input	*log glorawephemb onchanged*
Supported Format	*Binary*

Reply (Binary)

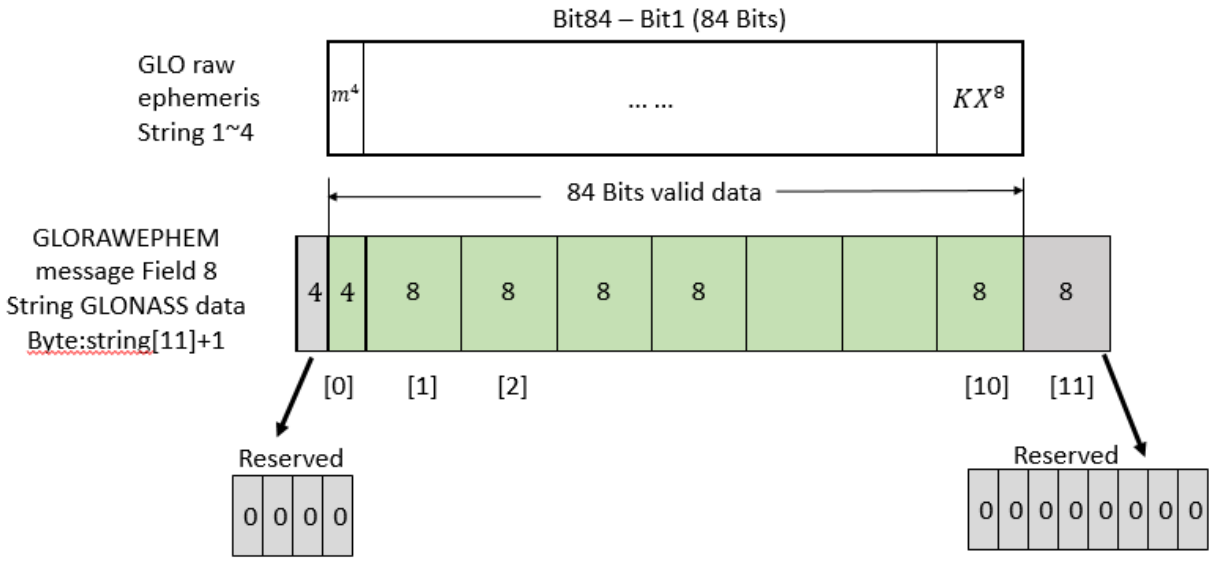
Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	GLORAWEPHEM header	Log header		H	0
2	sloto	Slot information offset - PRN identification (Slot + 37).	Ushort	2	H
3	freqo	Frequency channel offset in the range 0 to 20	Ushort	2	H+2
4	sigchan	Signal channel number	Ulong	4	H+4
5	week	GPS reference week, in weeks	GPSec	4	H+8
6	time	GPS reference time, in milliseconds (binarydata) or seconds (ASCII data)	Ulong	4	H+12
7	#recs	Number of records to follow	Ulong	4	H+16
8	string	GLONASS data string	Uchar[]	11	H+20
9	Reserved		Uchar	1	H+31
10…	Next record offset = H+20+(#recs x 12)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+20+(#recsx12)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Notice:

1. GLORAWEPH message includes four GLONASS raw ephemeris string, which is shown in the Figure 4.2a.

2. Each of the first four strings is from m4 to KX8 including 84-bits. The corresponding string is set with Bit84 ~ Bit1 from higher-order to lower-order bit.

3. According to the GLORAWEPHEM message, the 8th data field "string GLONASS data string" includes 88 bits of 11 bytes. The first 4-bits is 0000, and the left 84-bits are reserved to store the Bit84~Bit1 of one GLONASS raw ephemeris string. After the 11th byte, GLORAWEPHEM message is reserved with 1 byte as shown in the following figure.



4.2.1.6 GPSEPHEM GPS Ephemeris

Description

A single set of decoded GNSS ephemeris whose message ID is different from NovAtel® definition.

Message ID	712
Recommended Input	*log gpsephemb onchanged*
Supported Format	*binary*

Reply (Binary)

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SATMSG Header	Log Header		H	0

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
2	wSize	Struct size	unsigned short	2	H+0
3	blFlag	Eph valid flag	BYTE	1	H+2
4	bHealth	Satellite health flag	BYTE	1	H+3
5	ID	Satellite prn id (1~177), GPS: 1~32, BD2: 141~177	BYTE	1	H+4
6	bReserved	reserved	BYTE	1	H+5
7	uMsgID	ignored	unsigned short	2	H+6
8	m_wIdleTime	ignored	short	2	H+8
9	iodc	Issue of data clock	short	2	H+10
10	accuracy	Reference to URA in paga-84 of GPS ICD *IS-GPS-200-vD*	short	2	H+12
11	week	Gps week	unsigned short	2	H+14
12	iode	Issue of data	int	4	H+16
13	tow	time of eph be sent	int	4	H+20
14	toe	Eph time	double	8	H+24
15	toc	Time of clock-para	double	8	H+32
16	af2	Reference to paga-86 of GPS ICD *IS-GPS-200-vD*	double	8	H+40
17	af1		double	8	H+48
18	af0		double	8	H+56
19	Ms0	Mean Anomaly	double	8	H+64
20	deltan	Mean motion difference from computed value	double	8	H+72
21	es	Eccentricity	double	8	H+80
22	roota	square root	double	8	H+88
23	omega0	Longitude of ascending node of orbit plane at weekly epoch	double	8	H+96
24	i0	Inclination angle at ref. times.	double	8	H+104
25	ws	Argument of perigee	double	8	H+112
26	omegaot	Rate of right ascension	double	8	H+120
27	itoet	Rate of inclination angle	double	8	H+128
28	Cuc	Amplitude of the cosine harmonic correction term to the augument of latitude	double	8	H+136

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
29	Cus	Amplitude of the sine harmonic correction term to the augument of latitude	double	8	H+144
30	Crc	Amplitude of the cosine harmonic correction term to the orbit radius	double	8	H+152
31	Crs	Amplitude of the sine harmonic correction term to the orbit radius	double	8	H+160
32	Cic	Amplitude of the cosine harmonic correction term to the angle of inclination.	double	8	H+168
33	Cis	Amplitude of the sine harmonic correction term to the angle of inclination.	double	8	H+176
34	tgd	Reference to paga-90 of GPS ICD *IS-GPS-200-vD*	double	8	H+184
35	tgd2	Only used in BD2 satellite, refer to BD2-ICD.	double	8	H+192
36	CRC	32-bit CRC Code	Hex	4	H+200

4.2.1.7 RAWALM Raw Almanac Information

Description

This message contains raw almanac sub frames received from GPS satellite.

Message ID	74
Recommended Input	*log rawalmb*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	RAWALM header	Log header		H	0
2	ref week	Almanac reference week number	Ulong	4	H
3	ref secs	Almanac reference time (s)	Ulong	4	H+4
4	subframes	Number of subframes to follow	Ulong	4	H+8
5	svid	SV ID (satellite vehicle ID)	UShort	2	H+12
6	data	Subframe page data	Hex	30	H+14

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
7...	Next subframe offset = H + 12 + (subframe x 32)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 12 + (32 x subframes)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.1.8 RAWEPHEM Raw Ephemeris Information

Description

This message contains raw ephemeris information received from GPS satellite.

Message ID	41
Recommended Input	*log rawephemb onchanged*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	RAWEPHEM header	Log header		H	0
2	prn	Satellite PRN number	Ulong	4	H
3	ref week	Ephemeris reference week number	Ulong	4	H+4
4	ref secs	Ephemeris reference time (s)	Ulong	4	H+8
5	subframe1	Subframe 1 data, refer to following NOTE	Hex	30	H+12
6	subframe2	Subframe 2 data, refer to following NOTE	Hex	30	H+42
7	subframe3	Subframe 3 data, refer to following NOTE	Hex	30	H+72
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+102
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

☞ ***NOTE*. Subframe 1 ~ 3 data layout**

Subframe 1: GPS Ephemeris Word1 -Word10

Subframe 2: GPS Ephemeris Word11-Word20

Subframe 3: GPS Ephemeris Word21-Word30

Each Word has 24 bits data which take three bytes of subframe in order. Each subframe has 30 bytes to hold 10 GPS ephemeris words.

4.2.2 BINEX Records Data

This section presents log messages including BINEX record data encapsulated by ComNav binary message header and CRC-32. Those standard BINEX record messages are defined in Section *4.3.4*.

4.2.2.1 BINEX00DATA BINEX Record 0x00 Data

Description

This message outputs BINEX Record 0x00 data encapsulated by binary header and CRC-32.

Message ID	110
Recommended Input	*log binex00datab ontime 10*
Supported Format	*Binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BINEX00DATA header	Log header		H	0
2	Record 0x00	BINEX Record 0x00 data (L is record length)	BINEX	L	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + L
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.2.2 BINEX0101DATA BINEX Record 0x01-01 Data

Description

This message outputs BINEX Record 0x01-01 data encapsulated by binary header and CRC-32.

Message ID	81
Recommended Input	*log binex0101datab ontime 1*
Supported Format	*Binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BINEX0101DATA header	Log header		H	0
2	Record 0x01-01	BINEX Record 0x01-01 data (L is record length)	BINEX	L	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + L
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.2.3 BINEX0102DATA BINEX Record 0x01-02 Data

Description

This message outputs BINEX Record 0x01-02 data encapsulated by binary header and CRC-32.

Message ID	82
Recommended Input	*log binex0102datab ontime 1*
Supported Format	*Binary*

Reply (BINEX)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BINEX0102DATA header	Log header		H	0
2	Record 0x01-02	BINEX Record 0x01-02 data (L is record length)	BINEX	L	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + L
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.2.4 BINEX0105DATA BINEX Record 0x01-05 Data

Description

This message outputs BINEX Record 0x01-05 data encapsulated by binary header and CRC-32.

Message ID	85
Recommended Input	*log binex0105datab ontime 1*
Supported Format	*Binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BINEX0105DATA header	Log header		H	0
2	Record 0x01-05	BINEX Record 0x01-05 data (L is record length)	BINEX	L	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + L
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.2.5 BINEX7D00DATA BINEX Record 0x7d-00 Data

Description

This message outputs BINEX Record 0x7d-00 data encapsulated by binary header and CRC-32.

Message ID	114
Recommended Input	*log binex7d00datab ontime 1*
Supported Format	*Binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BINEX7D00DATA header	Log header		H	0
2	Record 0x7d-00	BINEX Record 0x7d-00 data (L is record length)	BINEX	L	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + L
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.2.6 BINEX7E00DATA BINEX Record 0x7e-00 Data

Description

This message outputs BINEX Record 0x7e-00 data encapsulated by binary header and CRC-32.

Message ID	115
Recommended Input	*log binex7e00datab ontime 1*
Supported Format	*Binary*

Reply (BINEX)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BINEX7E00DATA header	Log header		H	0
2	Record 0x7e-00	BINEX Record 0x7e-00 data (L is record length)	BINEX	L	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + L
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.2.7 BINEX7F05DATA BINEX Record 0x7f-05 Data

Description

This message outputs BINEX Record 0x7f-05 data encapsulated by binary header and CRC-32.

Message ID	120
Recommended Input	*log binex7f05datab ontime 1*
Supported Format	*Binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BINEX7F05DATA header	Log header		H	0
2	Record 0x7f-05	BINEX Record 0x7f-05 data (L is record length)	BINEX	L	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + L
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.3 Configuration and Status

4.2.3.1 COMCONFIG COM Port Configuration

Description

This message contains configurations of ports such as baud rate, COM ID and so on.

Message ID	37
Recommended Input	*log comconfigb*
Supported Format	*ASCII, binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	COMCONFIG header	Log header		H	0
2	#port	Number of ports with information to follow	Long	4	H
3	port	Serial port identifier	Enum	4	H+4
4	baud	Communication baud rate	Ulong	4	H+8
5	parity	Parity	Enum	4	H+12
6	databits	Number of data bits	Ulong	4	H+16
7	stopbits	Number of stop bits	Ulong	4	H+20
8	handshake	Handshaking	Enum	4	H+24
9	echo	When echo is on, the port is transmitting any input characters as they are received. 0 = OFF 1 = ON	Enum	4	H+28
10	breaks	Breaks are turned on or off 0 = OFF 1 = ON	Enum	4	H+32
11	rx type	The status of the receive interface mode	Enum	4	H+36
12	tx type	The status of the transmit interface mode	Enum	4	H+40
13	response	Responses are turned on or off 0 = OFF 1 = ON	Enum	4	H+44
14	next port offset = H + 4 + (#port x 44)				
15	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+(#port x44)
16	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.3.2 LOGLIST List all System Logs

Description

This log outputs a complete list of all log entries available in the system. The following tables show the binary and ASCII output.

Message ID	5
Recommended Input	*log loglista once*
Supported Format	*ASCII*

Reply (ASCII)

```
#LOGLISTA,COM1,0,60.0,FINESTEERING,1776,125044.700,00000000,0000,1114;
COM1,GPGGA,ABBASCII,ONTIME,1.000,
COM3,GPGSV,ABBASCII,ONTIME,5.000,
COM3,RTCM1019,BINARY,ONTRACKED,1.000,
```

Field#	Field Type	Data Description	Format
1	LOGLIST (ASCII) header	Log header	
2	#logs	Number of messages to follow, maximum = 64	Long
3	port	Output port see *Table 3. Port ID*	Enum
4	message	Message name of log	Char[]
5	message types	ASCII, ABBASCII, BINARY	Char[]
6	trigger	ONCHANGED, ONTIME, ONTRACKED	Enum
7	period	Log period for ONTIME	Double
	Next port		Enum
variable	xxxx	32-bit CRC [To be appended]	Hex
variable	[CR][LF]	Sentence terminator (ASCII only) [To be appended]	-

4.2.3.3 TRACKSTAT Tracking State

Description

This log provides channel tracking status information for each of the receiver parallel channels.

Message ID	83
Recommended Input	*log trackstatb ontime 1*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	TRACKSTAT header	Log header		H	0
2	sol status	Solution status (refer to *Table 31*)	Enum	4	H
3	pos type	Position type (refer to *Table 32*)	Enum	4	H+4
4	cutoff	Tracking elevation cut-off angle	Float	4	H+8
5	# chans	Number of hardware channels with information to follow	Long	4	H+12
6	PRN/slot	Satellite PRN number of range measurement (refer to *Table 6*)	Short	2	H+16
7	glofreq	Only used in GLONASS, null yet	Short	2	H+18
8	ch-tr-status	Channel tracking status (refer to *Table 36*)	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)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+16+ (#chans x 40)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.3.4 VERSION Version Information

Description

This log contains the version information of aboard.

Message ID	37
Recommended Input	*log version*
Supported Format	*ASCII, binary and abbreviated ASCII*

Reply (Abbreviated ASCII)

```
<VERSION COM1 0 60.0 UNKNOWN    0      0.000 00000000 0000 1114

<     1

<                  GPSCARD  "S2002"  "00902165          "  "CARD-501AA-22"
"1.10A-1.10A" "1.000" "2012/May/ 5" "18:18:52"
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	VERSION Header	Log Header		H	0
2	#comp	Number of components, value =1	Long	4	H
3	type	Component type, value = 0	Enum	4	H+4
4	model	Model Information (refer to *Figure 3*)	Char[]	16	H+8
5	PSN	Product serial number (refer to *Figure 4*)	Char[]	16	H+24
6	Hw version	Hardware version (refer to *Figure 5*)	Char[]	16	H+40
7	Sw version	Software version (refer to *Figure 6*)	Char[]	16	H+56
8	Boot version	Boot code version	Char[]	16	H+72
9	Comp date	Firmware compile date (refer to *Table 30*)	Char[]	12	H+88
10	Comp time	Firmware compile time (refer to *Table 30*)	Char[]	12	H+100
11	CRC	32-bit CRC	Hex	4	H+112

In *Figure 3*, each number denotes frequency No. in corresponding GNSS system; the first denotes GPS, GLONASS, GALILEO and BD2 in turns.

Figure 3. Model

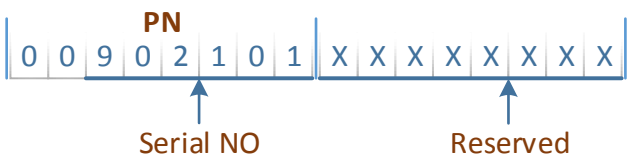


Figure 4. Product Serial No.

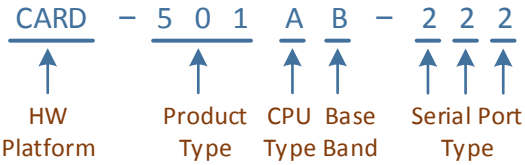


Figure 5. Hardware (HW) Version

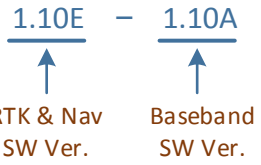


Figure 6. Software (SW) Version

Table 27.CPU Type

CPU FLAG	CPU MODEL
A	
B	
C	

Table 28.Base Band Type

FPGA FLAG	FPGA MODEL
A	
B	
C	
D	

Table 29.Serial Port Type

SERIAL PORT FLAG	PORT CONFIGURATION
2	RS232
4	RS422
T	LV TTL
X	Selectable configuration

Table 30.Compile Date and Time

YYYY/MM/DD	YYYY: Year MM: Month DD: Day
HH:MM:SS	HH: Hour MM: Minute SS: Second

4.2.4 Heading, Pitch and Roll Messages

4.2.4.1 HEADING Heading Information

Description

The heading is the angle from True North of the base to rover vector in a clockwise direction.

Message ID	971
Recommended Input	*log headingb onchanged*
Supported Format	*ASCII and Binary*

Reply

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	HEADING header	Log header		H	0
2	sol stat	Solution status, see *Table 31*	Enum	4	H
3	pos type	Position type, see *Table 32*	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	Pitch standard deviation in degrees	Float	4	H+28
10	stn ID	Station ID string	Char[4]	4	H+32
11	#SVs	Number of observations 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	Uchar	1	H+38
14	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+39
15	Reserved		Uchar	1	H+40
16	ext sol stat	Extended solution status (default: 0)	Uchar	1	H+41
17	Reserved		Uchar	1	H+42
18	sig mask	Signals used mask - if 0, signals used in solution are unknown. See *Table* 33.	Uchar	1	H+43
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.5 Mark Event Messages

4.2.5.1 MARKPOS Position at time of mark input event

Description

This log message contains the estimated position of the antenna when a pulse is detected at a mark input. It's generated when a pulse occurs on the event input from receiver EVENT interface.

Message ID	181
Recommended Input	*log markposa onnew*
Supported Format	*ASCII, Binary*

Reply

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	MARKPOS header	Log header		H	0
2	sol status	Solution status (refer to *Table 31*)	Enum	4	H
3	pos type	Position type (refer to *Table 32*)	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoids and the WGS84 ellipsoid (m)	Float	4	H+32
8	datum id#	Datum ID number	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	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 satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	Reserved		Uchar	1	H+66
18			Uchar	1	H+67
19			Uchar	1	H+68
20	ext sol stat	Extended solution status (default: 0)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown. See *Table 33*.	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.5.2 MARKTIME Time of mark input event

Description

This message includes the time of the leading edge of the detected mark input pulse. It's generated when a pulse occurs on the event input from receiver EVENT interface. The message setting can be saved in the *saveconfig*, and the message status can be checked by *log loglista*.

Message ID	231
Recommended Input	*log marktimea onnew*
Supported Format	*ASCII, Binary*

Reply

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	MARKTIME 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	Receiver clock offset, in seconds. 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+12
5	offset std	Standard deviation of receiver clock offset (s)	Double	8	H+20
6	utc offset	This field represents the offset of GPS reference time from UTC time (s), 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 (0 indicates that UTC time is unknown because there is no almanac available in order to acquire the UTC offset.)	Double	8	H+28
7	status	Clock model status, see *Table 47*	Enum	4	H+36

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.6 Meteorograph Data

This section presents a set of messages of meteorograph data from some weather instrument.

4.2.6.1 METEODATA Basic Meteorograph Data Message

Description

This log message contains the basic data information from ZZ11A Meteorograph, such as date, time, weather instrument ID, normal temperature, humidity and air pressure, etc.

Message ID	106
Recommended Input	*log meteodatab ontime 60*
Supported Format	*ASCII, Binary*

Reply (ASCII)

```
#METEODATAA,COM1,0,60.0,FINESTEERING,1856,352733.000,00000000,0000,111
4;TMQD,20150803,135200,00007,30.5,0,1006.0*2E682D01
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	METEODATA header	Log header		H	0
2	Data Indicator	1 = data per minute 2 = data per hour	UShort	2	H
3	Year, Month, Day	yyyymmdd, refer to NOTE after this table	ULong	4	H+2
4	Hour, Minute, Second	hhmmss (ss is reserved), refer to NOTE after this table	ULong	4	H+6
5	Sensor ID	Meteorograph Sensor ID: xxxxx	ULong	4	H+10
6	Temperature	±xxx.x (°C)	Float	4	H+14

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
7	Humidity	xxx (%RH)	UShort	2	H+18
8	Air Pressure	xxxx.x (hPa)	Float	4	H+20
9	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+24
10	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

NOTE:

```
Year      = (Ulong)( yyyymmdd / 10000)
Month     = (Ulong)((yyyymmdd - (Year * 10000)) / 100)
Day       = (Ulong)( yyyymmdd - (Year * 10000) - (Month * 100))

Hour      = (Ulong)( hhmmss / 10000)
Minutes   = (Ulong)((hhmmss - (Hour * 10000)) / 100)
Seconds   = (Ulong)( hhmmss - (Hour * 10000) - (Minutes * 100))
```

4.2.6.2 METEODATAEXT Extended Meteorograph Data Message

Description

This log message contains extended data information from ZZ11A Meteorograph, such as date, time, weather instrument ID, temperature (normal, maximum and minimum), humidity (normal, minimum), air pressure (normal, maximum and minimum), water pressure, dew-point temperature, battery voltage, mainboard temperature etc.

Message ID	108
Recommended Input	*log meteodataexta ontime 60*
Supported Format	*ASCII, Binary*

Reply (ASCII)

```
#METEODATAEXTA,COM1,0,60.0,FINESTEERING,1856,352733.000,00000000,0000,
1114;TMQD,20150803,135200,00007,30.5,31.1,130900,30.5,135100,0,0,13090
0,1006.0,1006.5,130900,1006.0,134800,0.0,0.0,12.0,32.6*3B1FCCAA
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	METEODATAEXT header	Log header		H	0

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
2	Data Indicator	1 = data per minute 2 = data per hour	UShort	2	H
3	Year, Month, Day	yyyymmdd, refer to the NOTE defined in *4.2.6.1*	ULong	4	H+2
4	Hour, Minute, Second	hhmmss (ss is reserved), refer to the NOTE defined in *4.2.6.1*	ULong	4	H+6
5	Sensor ID	Meteorograph Sensor ID: xxxxx	ULong	4	H+10
6	Temperature	±xxx.x (°C)	Float	4	H+14
7	Max Temp	±xxx.x (°C)	Float	4	H+18
8	Max Temp Time	hhmmss (ss is reserved)	ULong	4	H+22
9	Min Temp	±xxx.x (°C)	Float	4	H+26
10	Min Temp Time	hhmmss (ss is reserved)	ULong	4	H+30
11	Humidity	xxx (%RH)	UShort	2	H+34
12	Min Humidity	xxx (%RH)	UShort	2	H+36
13	Min Humidity Time	hhmmss (ss is reserved)	ULong	4	H+38
14	Air Pressure	xxxx.x (hPa)	Float	4	H+42
15	Max Air Pressure	xxxx.x (hPa)	Float	4	H+46
16	Max Air Pressure Time	hhmmss (ss is reserved)	ULong	4	H+50
17	Min Air Pressure	xxxx.x (hPa)	Float	4	H+54
18	Min Air Pressure Time	hhmmss (ss is reserved)	ULong	4	H+58
19	Water Pressure	xxx.x (hPa)	Float	4	H+62
20	Dew-point temperature	±xxx.x (°C)	Float	4	H+66
21	Battery Voltage	xx.x (V)	Float	4	H+70
22	Mainboard Temperature	xxx.x (°C)	Float	4	H+74
23	Reserved	Reserved		2	H+78
24	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+80
25	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.7 Position and Velocity Messages

Log messages mainly related to Position and velocity information are defined in this section.

4.2.7.1 BESTPOS Best Position

Description

This log contains the best available GNSS position (in meter) computed by the board. In addition, it reports several status indicators, including differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections. A differential age of 0 indicates that no differential correction was used.

Message ID	42
Recommended Input	*log bestposb ontime 1*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	Bestpos Header	Log Header		H	0
2	Sol stat	Solution status (refer to *Table 31*)	Enum	4	H
3	Pos type	Position type (refer to *Table 32*)	Enum	4	H+4
4	Lat	Latitude	Double	8	H+8
5	Lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	the ralationship between the geoid and the ellipsoid of the chosen datum	Float	4	H+32
8	Datum id#	Datum id number	Enum	4	H+36
9	Lat σ	Latitude standard deviation	Float	4	H+40
10	Lon σ	Longitude standard deviation	Float	4	H+44
11	Hgt σ	Height standard deviation	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 satellite tracked	UCHAR	1	H+64
16	#solnSVs	SV number used in solution	UCHAR	1	H+65
17	#ggL1	L1 number	UCHAR	1	H+66
18	#ggL1L2	L1 &L2 number	UCHAR	1	H+67
19	reserved	Reserved bytes	UCHAR	1	H+68
20	ext sol stat	Extended solution status	UCHAR	1	H+69
21	reserved	Reserved bytes	UCHAR	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution	UCHAR	1	H+71

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
		are unknown. See *Table* 3332.			
23	CRC	32-bit CRC Code	Hex	4	H+72

Table 31.Solution Status

SOLUTION STATUS		DESCRIPTION
(BINARY)	**(ASCII)**	
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
6	COLD_START	Not yet converged from cold start

Table 32.Position or Velocity Type

TYPE (BINARY)	TYPE (ASCII)	DESCRIPTION
0	NONE	No solution
1	FIXEDPOS	Position has been fixed by the FIX POSITION command
8	DOPPLER_VELOCITY *Note*	Velocity computed using instantaneous Doppler
16	SINGLE	Single point position
17	PSRDIFF	Pseudorange differential solution
18	SBAS	Solution calculated using corrections from an SBAS
34	NARROW_FLOAT	Floating narrow-lane ambiguity solution
49	WIDE_INT	Integer wide-lane ambiguity solution
50	NARROW_INT	Integer narrow-lane ambiguity solution
51	SUPER WIDE-LANE	Super wide-lane solution
69	PPP	Converged PPP solution

☞ ***Note*. Herein, the instantaneous doppler used for velocity computation comes directly from the tracking loop of OEM board, which means this doppler velocity has not nearly latency. In theory, its latency is smaller than the timing accuracy of OEM board.**

Table 33.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	BDS B1 used in Solution
4	0x10	GLONASS L1 used in Solution
5	0x20	GLONASS L2 used in Solution
6	0x40	BDS B2 used in Solution
7	0x80	BDS B3 used in Solution

4.2.7.2 BESTVEL Best Available Velocity Data

Description

This message contains the best available velocity information computed by the receiver. In addition, it reports a velocity status indicator, which is useful in indicating whether or not the corresponding data is valid. The velocity measurements sometimes have a latency associated with them. The time of validity is the time tag in the log minus the latency value.

Message ID	99
Recommended Input	*log bestvelb ontime 1*
Supported Format	*ASCII, Binary*

Direction of motion over ground in this log is derived from north speed and east speed, so the direction error is related to motion status. Higher speed means less direction error, and lower speed means more direction error. For example, in Doppler frequency velocity mode, we could assume a typical velocity error of 0.2m/s, and carrier velocity is 70km/hour, or 19.4m/s, the maximum direction error is:

```
Dir_error = arctan (0.2/19.4) = 0.59 degree.
```

Reply

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTVEL header	Log header		H	0
2	sol status	Solution status, see *Table 31*	Enum	4	H
3	vel type	Velocity type, see *Table 32*	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.	Float	4	H+8
5	age	Differential age in seconds	Float	4	H+12
6	hor spd	Horizontal speed over ground, in meters 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 meters 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)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.7.3 BESTXYZ Best Available Cartesian Position and Velocity

Description

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.

Message ID	241
Recommended Input	*log bestxyzb ontime 1*
Supported Format	*ASCII, Binary*

Reply

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 31*	Enum	4	H
3	pos type	Position type, see *Table 32*	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 31*	Enum	4	H+44
11	vel type	Velocity type, see *Table 32*	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 satellite vehicles tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	#ggL1	Number of GPS plus BDS L1 used in solution	Uchar	1	H+106
25	#ggL1L2	Number of GPS plus BDS L1 and L2 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	Reserved		Hex	1	H+110

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
29	sig mask	Signals used mask - if 0, signals used in solution are unknown. See *Table* 33	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.7.4 PSRDOP Pseudorange DOP

Description

The dilution of precision data is calculated using the geometry of only those satellites that are currently being tracked and used in the position solution by the board. This log is updated once every 60 seconds or whenever a change in the satellite constellation occurs. Therefore, the total number of data fields output by the log is variable and depends on the number of SVs that are being tracked.

Message ID	174
Recommended Input	*log psrdopb ontime 1*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	PSRDOP Header	Log Header		H	0
2	gdop	Geometric dilution of precision	Float	4	H
3	Pdop	Position dilution of precision	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	Float	4	H+16
7	Cutoff	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	Ulong	4	H+28
10	Next prn offset = H+28+(#prn*4)				

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
11	CRC	32-bit CRC	Hex	4	H+28+(#prn*4)

4.2.7.5 PSRPOS Pseudorange Position

Description

This message includes position calculated using pseudorange and other information such as differential age, station id and so on.

Message ID	*47*
Recommended Input	*log psrposb ontime 1*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	PSRPOS header	Log header		H	0
2	sol status	Solution status (refer to *Table 31*)	Enum	4	H
3	pos type	Position type (refer to *Table 32*)	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoids and the WGS84 ellipsoid (m)	Float	4	H+32
8	datum id#	Datum ID number	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	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 satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
17	Reserved		Uchar	1	H+66
18			Uchar	1	H+67
19			Uchar	1	H+68
20	ext sol stat	Extended solution status (default: 0)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown. See *Table 33*.	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.7.6 PSRVEL Pseudorange Velocity

Description

In the PSRVEL log the actual speed and direction of the receiver antenna over ground is provided. The velocity measurements sometimes have a latency associated with them. The time of validity is the time tag in the log minus the latency value.

Message ID	100
Recommended Input	*log psrvela ontime 1*
Supported Format	*ASCII, Binary*

Reply (ASCII)

```
#PSRVELA,COM1,0,60.0,FINESTEERING,1865,486344.000,00000000,0000,1114;S
OL_COMPUTED,DOPPLER_VELOCITY,0.000,0.000,0.0329,132.511867,0.0907,0.0*
e24644e1
```

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRVEL header	Log header		H	0
2	sol status	Solution status, see *Table 31*	Enum	4	H
3	vel type	Velocity type, see *Table 32*	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	Float	4	H+8

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
		give improved results.			
5	age	Differential age in seconds	Float	4	H+12
6	hor spd	Horizontal speed over ground, in meters 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 meters 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)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.7.7 PSRXYZ Pseudorange Cartesian Position and Velocity

Description

This message includes the receiver's pseudorange position and velocity in ECEF coordinates. The position and velocity status field's indicate whether or not the corresponding data is valid.

Message ID	243
Recommended Input	*log psrxyza ontime 1*
Supported Format	*ASCII, Binary*

Reply (ASCII)

```
#PSRXYZA,COM3,0,60.0,FINESTEERING,1865,486590.000,00000000,0000,1114;S
OL_COMPUTED,SINGLE,-2844802.6861,4662742.6630,3282473.3324,0.6379,1.28
53,0.6043,SOL_COMPUTED,DOPPLER_VELOCITY,0.0036,-0.0616,-0.0187,0.6379,
1.2853,0.6043,"",0.000,99.000,1.000,20,20,0,0,0,02,00,91*17626BB9
```

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 31*	Enum	4	H
3	pos type	Position type, see *Table 32*	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

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
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 31*	Enum	4	H+44
11	vel type	Velocity type, see *Table 32*	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 satellite vehicles tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	#ggL1	Number of GPS plus BDS L1 used in solution	Uchar	1	H+106
25	#ggL1L2	Number of GPS plus BDS L1 and L2 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	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown. See *Table* 33	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.8 Raw Observations and Corrections

This section presents a set of log messages which contain GNSS raw observables and corrections for RTK and Pseudorange differential positioning, generally broadcasted by reference station.

4.2.8.1 RANGE Detailed Observation Information

Description

This message includes detailed observation information such as pseudorange, carrier phase, Doppler, signal to noise ration and so on. At the same time, detailed channel states are involved.

Message ID	43
Recommended Input	*log rangeb ontime 1*
Supported Format	*Binary*

Reply

Field#	Field Type	Description	Format	Binary Byte	Binary Offset
1	RANGE header	Log header		H	0
2	# obs	Number of observations with information to follow a	Long	4	H
3	PRN/ slot	Satellite PRN number of range measurement (see *Table 35*)	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	# of seconds of continuous tracking (no cycle slipping)	Float	4	H+40
12	ch-tr-stat	Tracking status (see *Table 34*, Channel Tracking	ULong	4	H+44

Field#	Field Type	Description	Format	Binary Byte	Binary Offset
	us	Status)			
13...	Next PRN offset = H + 4 + (#obs x 44)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#obs x 44)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.8.2 RANGECMP Compressed Range Information

Description

This message contains the channel measurements for the currently tracked satellites.

Message ID	140
Recommended Input	*log rangecmpb ontime 1*
Supported Format	*binary*

Reply (Binary)

Table 34.Channel Tracking Status

DATA	BIT(S) FIRST TO LAST	LENGTH (BITS)	SCALE FACTOR	UNITS
Channel Tracking Status	0-31	32	See *Table 38*	-
Doppler Frequency	32-59	28	1/256	Hz
Pseudorange (PSR)	60-95	36	1/128	m
Accumulated Doppler Range (ADR)	96-127	32	1/256	cycles
StdDev-PSR	128-131	4		m
StdDev-ADR	132-135	4	(n + 1)/512	cycles
PRN/Slot	136-143	8	1 (See *Table 35*)	-
Lock Time	144-164	21 (maximum: 2,097,151)	1/32	s
C/No (valid range: 20-51 dB-Hz)	165-169	5	(20 + n)	dB-Hz
Reserved	170-191	22		

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	RANGECMP header	Log header		H	0
2	#obs	Number of satellite observations with information to follow.	Long	4	H
3	1st range record	Compressed range log in above format	Hex	24	H+4
4	Next rangecmp offset = H + 4 + (#obs x 24)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4 + (#obs x 24)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 35.PRN Definition in Binary Message

GNSS	PRN
GPS	1~32
GLONASS	38~61
SBAS	120~138
BD2	141~177

Table 36.Tracking State

STATE	DESCRIPTION	STATE	DESCRIPTION
0	Idle	7	Frequency-lock loop
2	Wide frequency band pull-in	9	Channel alignment
3	Narrow frequency band pull-in	10	Code search
4	Phase lock loop	11	Aided phase lock loop

Table 37.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

Table 38.Channel Tracking

NIBBLE #	BIT #	MASK	DESCRIPTION	RANGE VALUE
N0	0	0x00000001	Tracking state	Refer to *Table 36. Tracking State*
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010		
	5	0x00000020	SV channel number	Tracking channel ID
	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 known1 = Known
N3	12	0x00001000	Code locked flag	0 = Not locked 1 = Locked
	13	0x00002000	Correlator type	Refer to *Table 37*
	14	0x00004000		
	15	0x00008000		
N4	16	0x00010000	Satellite system	0 = GPS 1= GLONASS 2 = SBAS 3 = GALILEO 4 = BD2 5-6 = Reserved
	17	0x00020000		
	18	0x00040000		

NIBBLE #	BIT #	MASK	DESCRIPTION	RANGE VALUE
				7 = Other
	19	0x00080000	Reserved	
N5	20	0x00100000	Grouping	0 = Not grouped, 1 = Grouped
	21	0x00200000	Signal type	Dependent on satellite system above: GPS: 0 = L1 C/A 2 = L5 5 = L2 P 9 = L2 P codeless 17 = L2C GLONASS: 0 = L1 C/A 1 = L2 C/A 5 = L2 P BD2: 0 = L1 C/A 17 = L2 C/A 2 = L3 C/A SBAS: 0 = L1 C/A Other: 19 = OmniSTAR 23 = CDGPS
	22	0x00400000		
	23	0x00800000		
N6	24	0x01000000		
	25	0x02000000		
	26	0x04000000	Forward Error Correction	0 = Not FEC, 1 = FEC
	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

4.2.8.3 RTCMDATA1 Pseudorange Correction

Description

This message is used for pseudorange differential corrections, include all information of RTCM1 message of standard RTCM2.3.

Message ID	396
Recommended Input	*log rtcmdata1b ontime 1*
Supported Format	*binary*

Reply (Binary)

Field#	Field type	Data Description	Format	Binary Byte	Binary Offset
1	RTCMDATA1 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see REFSTATION.	Ulong	4	H+20
8	#prn	Number of PRNs with information to follow	Ulong	4	H+24
9	scale	Scale where 0 = 0.02 m and 0.002 m/s 1 = 0.32 m and 0.032 m/s	Ulong	4	H+28
10	UDRE	User differential range error	Ulong	4	H+32
11	PRN/slot	Satellite PRN number of range measurement (GPS: 1-32 and BD2: 141~177)	Ulong	4	H+36
12	psrcorr	Scaled pseudorange correction (meters)	Long	4	H+40
13	rate corr	Scaled range rate correction	Long	4	H+44
14	IOD	Issue of data	Long	4	H+48
15...	Next PRN offset = H+28 + (#prns x 24)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.9 Satellite Measurements

Log messages containing GNSS satellite measurements and information are defined in the following sections.

4.2.9.1 IONUTC Ionospheric and UTC Data

Description

The Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) are provided.

Message ID	8
Recommended Input	*log ionutcb onchanged*
Supported Format	*ASCII, Binary and Abb-ASCII*

Reply

Field#	Field Type	Data Description	Format	Binary Byte	Binary 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	deltat utc	Time difference	Ulong	4	H+104

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+108
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.9.2 M925 Extended Satellite Information

Description

This log provides extended information of satellites, like PRN numbers, elevation, azimuth, and some board's information, including signal strength and battery status.

For integrative receivers, much information should be collected from numbers of messages to display in screen or other media, so this message involved nearly all the information you need is strongly recommended.

It's an updating version of SATMSG, and could replace the latter.

Message ID	925
Recommended Input	*log m925b*
Supported Format	*binary*

Reply (Binary)

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	M925 Header1	Log Header, its length H = 28		H	0
2	M925 Header2 Length	Header2 Length = 64 (Ver: 0x03)	Byte	1	H
3	Sat Number	Satellite number	Byte	1	H+1
4	GPRS Str	GPRS signal strength: 4(type) - 4(strength)	Byte	1	H+2
5	Bluetooth Str	Bluetooth signal strength: 4(type) - 4(strength)	Byte	1	H+3
6	Battery Status	*Refer to following NOTE on Field#6, Battery Status (i.e. electric quantity), one byte*	Byte	1	H+4
7	Rcvr Temp	Receiver tempature, or other status parameters which might be sent with an interval, controlled by a flag	Byte	1	H+5
8	Fre Flag	Frequence Flag1, refer to *Table 39*	Byte	1	H+6
9	Fre Flag2	Frequence Flag2, refer to *Table 39*	Byte	1	H+7

10	Data-link status	Radio status: type, on-off, strength, TxD or RxD	Byte	1	H+8
11	Diff Data Type	Differential data type	Byte	1	H+9
12	Work Mode	Receiver work mode: fixed or movable ref station, rover reveiver or single positioning.	Byte	1	H+10
13	Fix Status	Position Type, refer to *Table 32*	Byte	1	H+11
14	Diff Age	Differential data age in second	Byte	1	H+12
15	PDOP	Scale factor: 0.1	Byte	1	H+13
16	RMS	Postiong Accuracy RMS, scale factor: 0.1	Byte	1	H+14
17	Reserved	-	Byte	1	H+15
18	Latitude	In degree	Double	8	H+16
19	Longitude	In degree	Double	8	H+24
20	Height	Ellipsoidal height of fix (antenna height above ellipsoid), in meter	Double	8	H+32
21	Undulation	Height undulation, in meter	Float	4	H+40
22	Covariance E	Postion Error Cov in East direction (m)	Float	4	H+44
23	Covariance N	Postion Error Cov in North direction (m)	Float	4	H+48
24	Covariance V	Postion Error Cov in Vertial direction (m)	Float	4	H+52
25	FreqHealth1	Signal Frequency Helth Flag 1, refer to *Table 40*	Byte	1	H+56
26	FreqHealth2	Signal Frequency Helth Flag 2, refer to *Table 41*	Byte	1	H+57
27	Use Sats	Satellite Number used in solution	Byte	1	H+58
28	Tracking Sats	Satellite Number continuously tracked	Byte	1	H+59
29	GPRS status	GPRS connection status, refer to *Table 42*	Byte	1	H+60
30	Reserved		Byte	1	H+61
31	Reserved		Byte	1	H+62
32	Reserved		Byte	1	H+63
33	PRN	Satellite ID (1~177), Refer to *Table 6*	Byte	1	H1 (= H+64)
34	Azimuth	Degree (°)	Short	2	H1+1
35	Elevation	Degree (°)	Byte	1	H1+3
36	L1 Status	Frequency status about L1, refer to *Table 44*	Byte	1	H1+4
37	L1 SNR	L1 signal noise ratio	Byte	1	H1+5
38	L1 RMS	L1 RMS	Byte	1	H1+6
39	L1 Lost	L1 track lost counter	Byte	1	H1+7

	Counter				
40	Next Fre Infor	May be L2 Infor, according to fre-flag		4	H1+8
41	Next Fre Infor	May be L5 infor, according to fre-flag		4	H1+12
42	Next Sat Offset: H1 + Sat × (4 + Fre No*4), where H1 = H+64 (Ver: 0x03)				
43	CRC	32-bit CRC Code	Hex	4	H1+ Sat×(4 + Fre No*4)

NOTE: Field#6, battery status (i.e. electric quantity), one byte

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0

BIT7: Battery #2

BIT6: Battery #1

BIT5-BIT0: Electric quantity of Battery #1 or Battery #2 which is subject to the value of BIT7 and BIT6. The battery electric quantity percent (0% ~ 100%) is represented by 64 numbers (0 ~ 63). An exception is that the number '0' represents the battery is not available or not mounted, since it's impossible a battery has a %0 electric quantity.

The electric quantity of Battery #1 and #2 is presented in each M925 and SATMSG log message alternately. If BIT7 is set as 1, the value of BIT5-BIT0 represents Battery #2's electric quantity, and a zero value of BIT5-BIT0 means that Battery #2 is not available. Similarly, if BIT6 is set as 1, the value of BIT5-BIT0 represents Battery #1's electric quantity, and a zero value of BIT5-BIT0 means that Battery #1 is not available. It's definitely impossible that both BIT7 and BIT6 are set to as 1 at the same time.

If Field#6 is extracted, battery electric quantity can be calculated as:

Battery electric quantity = Round up the value of ((Field#6 & 0x3F) × 101 / 0x40)

Attention please, once battery electric quantity decreases down to 10%, it would drop down steeply and a warning for changing a new battery is necessary.

Table 39.Frequency Flag (Version 3)

BIT	DESCRIPTION
BIT7	G2 information involved (GLONASS: G2)
BIT6	G1 information involved (GLONASS: G1)
BIT5	B3 information involved (BD2: B3)
BIT4	B2 information involved (BD2: B2)
BIT3	B1 information involved (BD2: B1)
BIT2	L5 information involved (GPS: L5)
BIT1	L2 information involved (GPS: L2)
BIT0	L1 information involved (GPS: L1)

Table 40.Frequency Health Flag 1

BIT	DESCRIPTION	VALUE
BIT7	GLONASS G2	0: healthy 1: unhealthy
BIT6	GLONASS G1	
BIT5	BDS B3	
BIT4	BDS B2	
BIT3	BDS B1	
BIT2	GPS L5	
BIT1	GPS L2	
BIT0	GPS L1	

Table 41.Frequency Health Flag 2

BIT	DESCRIPTION
BIT7	Reserved for future GNSS frequency
BIT6	
BIT5	
BIT4	
BIT3	
BIT2	
BIT1	
BIT0	

Table 42.GPRS Connection Status

BIT	DESCRIPTION	STATUS
BIT7	Reserved	
BIT6	Reserved	
BIT5	Reserved	
BIT4	Reserved	
BIT3	CORS Status	0: not connected; 1: connected
BIT2	Net Register Status	0: not registered; 1: registered
BIT1	SIM Card Status	0: not ready; 1: ready
BIT0	Module Status	0: not ready; 1: ready

4.2.9.3 SATMSG Satellite Information

Description

This log provides both the information of satellites, like PRN numbers, elevation, azimuth, and some board's information, including signal strength and battery status.

For integrative receivers, much information should be collected from numbers of messages to display in screen or other media, so this message involved nearly all the information you need is strongly recommended.

Message ID	911
Recommended Input	*log satmsgb*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SATMSG Header	Log Header		H	0
2	Sat Number	Satellite number	Byte	1	H
3	Version Number	From Version Number: 2, frequency flag and frequency status become effective	Byte	1	H+1
4	GPRS Str	GPRS signal strength	Byte	1	H+2
5	Bluetooth Str	Bluetooth signal strength	Byte	1	H+3
6	Battery Status	Refer to the *NOTE on Field#6, Battery Status*	Byte	1	H+4

		(i.e. electric quantity), one byte defined in *4.2.9.2 M925*			
7	Fre Flag	Frequency flag, refer to *Table 43. Frequency Flag (Version 2)*	Byte	1	H+5
8	PRN	Satellite ID (1~177), Refer to *Table 6*	Byte	1	H+6
9	Azimuth	Degree (°)	Short	2	H+7
10	Elevation	Degree (°)	Byte	1	H+9
11	L1 Status	Frequency status about L1, refer to *Table 44*	Byte	1	H+10
12	L1 SNR	L1 signal noise ratio	Byte	1	H+11
13	L1 RMS	L1 RMS	Byte	1	H+12
14	L1 Lost Counter	L1 track lost counter	Byte	1	H+13
15	Next Fre Infor	May be L2 Infor, according to fre-flag		4	H+14
16	Next Fre Infor	May be L5 infor, according to fre-flag		4	H+18
17	Next Sat Offset: H + 10 + Sat × (4 + Fre No*4)				
18	CRC	32-bit CRC Code	Hex	4	H+10+Sat × (4+ Fre No*4)

Table 43.Frequency Flag (Version 2)

BIT	DESCRIPTION
BIT7	Reserved
BIT6	Reserved
BIT5	Reserved
BIT4	Reserved
BIT3	Reserved
BIT2	L3 information involved (GPS: L5; BD2: B3)
BIT1	L2 information involved (GPS: L2; BD2: B2)
BIT0	L1 information involved (GPS: L1; BD2: B1)

Table 44.Frequency Status

BIT	DESCRIPTION	VALUE	
BIT7	In RTK calculation, if reference satellite	1: reference satellite	0: not
BIT6	Reserved		
BIT5	Reserved (Lockout status of the satellite)		
BIT4	In RTK calculation, if involved in combined ambiguity	1: used	0: not used
BIT3	In RTK calculation, if ambiguity fixed	1: used	0: not used
BIT2	In RTK calculation, if carrier-phase used	1: used	0: not used
BIT1	In RTK calculation, if pseudorange used	1: used	0: not used
BIT0	This frequency information if valid	1: valid	0: invalid

4.2.9.4 SATVIS Satellite Visibility

Description

This message contains satellite visibility information such as elevation and azimuth.

Message ID	48
Recommended Input	*log satvisb ontime 5*
Supported Format	*binary*

Reply (Binary)

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SATVIS Header	Log Header		H	0
2	Sat vis	Is satellite visibility valid: 0 = false, 1 = true	Enum	4	H
3	Comp alm	Complete GPS almanac used? 0=false, 1= true	Enum	4	H+4
4	#sat	Number of satellites	Ulong	4	H+8
5	PRN/slot	PRN of range measurement (GPS: 1-32)	Short	2	H+12
6	glofreq	Not used	Short	2	H+14
7	health	Satellite health	Ulong	4	H+16
8	Elev	Elevation (degrees)	Double	8	H+20
9	Az	Azimuth (degrees)	Double	8	H+28
10	True dop	Theoretical Doppler of satellite	Double	8	H+36
11	App dop	Apparent Doppler for this board	double	8	H+44

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
12	Next satellite offset = H+12+(#sat*40)				
13	CRC	32-bit CRC	Hex	4	H+12+(#sat*40)

4.2.9.5 SATXYZ Satellite Positions in ECEF Cartesian Coordinates

Description

This message contains the decoded healthy satellite information necessary to compute the solution: satellite coordinates (ECEF WGS84), satellite clock correction, ionospheric corrections and tropospheric corrections.

Message ID	270
Recommended Input	*log satxyzb ontime 5*
Supported Format	*ASCII, Binary*

Reply (ASCII)

```
#SATXYZA,COM3,0,60.0,FINESTEERING,1865,474754.000,00000000,0000,1114;0
.0,22,

15,-15084222.3606,6578111.4367,20797324.0055,-82716.737,1.939505301,3.
250863906,0.000000000,0.000000000,

18,331939.5836,16396859.9411,21377137.9648,132303.811,2.181498551,3.18
3969806,0.000000000,0.000000000,

14,14332302.7311,22342874.5826,2543349.8588,8761.333,5.964851393,11.68
3728685,0.000000000,0.000000000,

20,-20937088.1269,13183406.6559,9607131.0245,108446.846,1.734673649,2.
886741179,0.000000000,0.000000000,

21,-561165.7287,24827903.5557,9661802.3609,-145528.329,2.153225620,3.0
19855033,0.000000000,0.000000000,

12,-21186097.7357,10768124.0658,-11738353.6757,100528.613,3.932592236,
11.646636609,0.000000000,0.000000000,

24,-14558949.4706,19131262.1052,11076165.7393,-1804.985,1.658385230,2.
465761340,0.000000000,0.000000000,

142,7261670.7669,41527286.5505,-117059.2936,-22006.452,6.492729818,4.4
53330966,0.000000000,0.000000000,
```

```
143,-14811002.3199,39447763.4671,-956706.2550,-25834.066,4.676105362,3
.131226458,0.000000000,0.000000000,

144,-39628887.7279,14486292.9577,-346788.5894,59380.037,5.782862006,4.
233089765,0.000000000,0.000000000,

145,21933086.9619,35994587.1747,-551147.5582,52360.344,10.164416051,9.
510727002,0.000000000,0.000000000,

146,-18423459.0520,21354484.3222,31373249.6331,-34315.885,3.442801813,
2.601635931,0.000000000,0.000000000,

147,-21638134.9976,36315776.2488,-1833791.2176,28313.409,4.622843134,3
.110330994,0.000000000,0.000000000,

149,-732990.3528,24461063.7700,34401050.0440,110974.229,3.870875851,3.
011551144,0.000000000,0.000000000,150,-11016086.5712,37999666.2144,-14
874307.5423,37494.950,7.398493056,4.994304421,0.000000000,0.000000000,

141,-32334540.2436,27078823.6741,-499709.4237,-56949.895,4.730575008,3
.259515751,0.000000000,0.000000000,

43,-1458650.9146,11004205.3443,22954676.5578,-22871.512,2.315825486,3.
515196014,0.000000000,0.000000000,

42,-19512711.3525,4690307.7077,15742060.7042,-2453.082,2.128749742,3.6
05844930,0.000000000,0.000000000,

53,-17722019.9252,17620756.8073,5323458.1164,-5538.798,1.813382812,2.7
96211254,0.000000000,0.000000000,

58,10706156.5231,22641811.6824,4741145.3140,-9878.178,4.497215083,6.81
0739645,0.000000000,0.000000000,

46,-9937718.8939,20466356.2848,-11454304.7735,-4963.400,4.041715928,7.
585728332,0.000000000,0.000000000,

52,-14342256.7827,2476448.5517,20935199.3460,-16602.556,2.329772824,4.
018819136,0.000000000,0.000000000*15FB91FA
```

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SATXYZ Header	Log Header		H	0
2	Reserved		Double	8	H
3	#sat	Number of satellites	Ulong	4	H+8
4	PRN/slot	PRN of range measurement, refer to *Table 6*	ULong	4	H+12
5	X	Satellite X co-ordinates (ECEF,m)	Double	8	H+16

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
6	Y	Satellite Y co-ordinates (ECEF,m)	Double	8	H+24
7	Z	Satellite Z co-ordinates (ECEF,m)	Double	8	H+32
8	clk corr	Satellite clock correction (m)	Double	8	H+40
9	iono delay	Ionosphere delay (m)	Double	8	H+48
10	tropo delay	Troposphere delay (m)	Double	8	H+56
11	Reserved1		Double	8	H+64
12	Reserved2		Double	8	H+72
13	Next satellite offset = H+12+(#sat*68)				
14	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+ (#sat*68)
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10 SBAS Message Types

This section presents the set of message types of SBAS per RTCA DO-229D.

4.2.10.1 RAWSBASFRAME Raw SBAS Information

Description

This message contains raw SBAS frame data of 226 bits, including 8-bit preamble, 6-bit message type and 212 bits of data but without a 24-bit CRC. Only frame data with a valid preamble and CRC are reported.

Message ID	973
Recommended Input	*log rawsbasframea ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#RAWSBASFRAMEA,COM1,0,60.0,FINESTEERING,1865,350002.000,00000000,0000,
1114;0,129,25,c666115ffb06e1381283067a05043c800000000000000000000000000
00,0*CA686A12
```

```
#RAWSBASFRAMEA,COM1,0,60.0,FINESTEERING,1865,350002.000,00000000,0000,
1114;0,137,25,c666115ff906c140140305fa84843c8000000000000000000000000000
00,0*AE57377C

#RAWSBASFRAMEA,COM1,0,60.0,FINESTEERING,1865,350003.000,00000000,0000,
1114;0,129,26,5369c407e1ef0ff883c5dc21e0cf047815c05e01f81bc43e1ef1d760
00,0*327DC1E6

#RAWSBASFRAMEA,COM1,0,60.0,FINESTEERING,1865,350003.000,00000000,0000,
1114;0,137,63,53fc000000000000000000000000000000000000000000000000000000
00,0*E9307D42
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	RAWEPHEM header	Log header		H	0
2	decode #	Frame decoder number	Ulong	4	H
3	PRN	SBAS satellite PRN number	Ulong	4	H+4
4	SBAS Msg id	SBAS message type (0 ~ 63)	Ulong	4	H+8
5	data	Raw SBAS frame data. There are 226 bits of data and 6 bits of padding	Hex[29]	32	H+12
6	chan	Signal channel number that the frame was decoded on	Ulong	4	H+44
7	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+48
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.2 SBAS0 Do Not Use for Safety Applications

Description

The first SBAS message type, Message Type 0, will be used primarily during system testing. The receipt of a Message Type 0 will result in the cessation of the use of any ranging data and all message types 1-7, 9-10, 18, 24-28 obtained from that SBAS signal (PRN code). Other message types may be retained, such as message type 17, for potential performance enhancements. In addition, that SBAS signal (PRN code) will be deselected for at least one minute.

While testing, WAAS will broadcast the contents of a type 2 message in each type 0 message. Other SBAS service providers may broadcast both Type 0 and Type 2 messages during testing. For users who do not require integrity (equipment under test or equipment used for non-safety applications), the message type 0 that is not empty may be used for ranging and corrections.

Message ID	*976*
Recommended Input	*log sbas0a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS0 header	Log header		H	0
2	PRN	SBAS SV PRN number	ULong	4	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.3 SBAS1 PRN Mask Assignments

Description

SBAS Message Type 1 givers the PRN Mask. It consists of 210 ordered slots, each of which indicates if data is provided for the corresponding satellite. The satellites for which corrections are provided are ordered from 1 to a maximum of 51, in order to decode Message Types 2 - 5, 6, 7, 24, 25 and 28.

Message ID	*977*
Recommended Input	*log sbas1a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS1A,COM1,0,60.0,FINESTEERING,1863,557215.000,00000000,0000,1114;12
9,7FFFFFFF00000000000000000000000808000000000000000000,0*F83CE234

#SBAS1A,COM1,0,60.0,FINESTEERING,1863,557239.000,00000000,0000,1114;13
7,7FFFFFFF00000000000000000000000808000000000000000000,0*5328422C
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS1 header	Log header		H	0
2	PRN	Source PRN of message	Ulong	4	H
3	mask	PRN bit mask [1-byte padding]	Uchar[27]	28	H+4
4	IODP	Issue of PRN mask data	Ulong	4	H+32
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 36

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.4 SBAS2 - 5 Fast Corrections

Description

SBAS Message Types 2 to 5 are broadcasted to provide fast corrections. Message Type 2 contains the data sets for the first 13 satellites designated in the PRN mask. Message Type 3 contains the data sets for satellites 14 - 26 designated in the PRN mask, etc., through Message Type 5, which contains the data sets for satellites 40 through 51 designated in the PRN mask. The last data set of Message Type 5 is not used due to the constraint that corrections can only be provided for 51 satellites.

Message ID	982, 987, 992, 994
Recommended Input	*log sbas2a ontime 1* *log sbas3a ontime 1* *log sbas4a ontime 1* *log sbas5a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS2A,COM1,0,60.0,FINESTEERING,1863,557234.000,00000000,0000,1114;12
9,0,0,-4,2047,2047,-2,2047,2047,2047,2047,2047,2047,2047,-4,2047,6,14,
14,6,14,14,14,14,14,14,14,6,14*D3CEE5E5

#SBAS2A,COM1,0,60.0,FINESTEERING,1863,557234.000,00000000,0000,1114;13
7,0,0,-1,2047,2047,1,2047,2047,2047,2047,2047,2047,2047,-2,2047,6,14,1
4,6,14,14,14,14,14,14,14,6,14*5BE2F027

#SBAS3A,COM1,0,60.0,FINESTEERING,1863,557236.000,00000000,0000,1114;12
9,1,0,-11,2047,2047,2047,2047,-1,35,2047,2047,-2,2047,2047,2047,7,14,1
4,14,14,6,10,14,14,10,14,14,14*E4E406B0

#SBAS3A,COM1,0,60.0,FINESTEERING,1863,557235.000,00000000,0000,1114;13
7,0,0,-8,2047,2047,2047,2047,4,45,2047,2047,14,2047,2047,2047,7,14,14,
14,14,6,10,14,14,10,14,14,14*198F75A3

#SBAS4A,COM1,0,60.0,FINESTEERING,1863,557235.000,00000000,0000,1114;12
9,1,0,-18,-2,0,2047,2047,16,3,2047,2047,2047,2047,2047,2047,14,7,6,14,
14,14,12,15,15,15,15,15,15*FFBFB51C
```

```
#SBAS4A,COM1,0,60.0,FINESTEERING,1863,557236.000,00000000,0000,1114;13
7,1,0,-15,0,3,2047,2047,16,18,2047,2047,2047,2047,2047,2047,14,7,6,14,
14,14,12,15,15,15,15,15,15*90EE6A
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS2~4 header	Log header		H	0
2	PRN	Source PRN of message	ULong	4	H
3	IODF	Issue of fast corrections data	Ulong	4	H+4
4	IODP	Issue of PRN mask data	Ulong	4	H+8
5 ~ 17	*PRC[i]*	*PRC[i]*: Fast corrections (-2048 to +2047) for the PRN in (SBAS2: i = 0- 12) (SBAS3: i = 13- 25) (SBAS4: i = 26- 38)	Long[13]	4 * 13	H+8+k*4 (k = 1 ~ 13)
18~30	*UDRE[i]*	*UDREi*: User differential range error indicator for the PRN in slot i (SBAS2: i = 0- 12) (SBAS3: i = 13- 25) (SBAS4: i = 26- 38)	Ulong[13]	4 * 13	H+60+k*4 (k = 1 ~ 13)
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 116
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS5 header	Log header		H	0
2	PRN	Source PRN of message	ULong	4	H
3	IODF	Issue of fast corrections data	Ulong	4	H+4
4	IODP	Issue of PRN mask data	Ulong	4	H+8
5 ~ 16	*PRC[i]*	*PRC[i]*: Fast corrections (-2048 to +2047) for the PRN in slot i (SBAS5: i = 39 - 50)	Long[12]	4 * 12	H+8+k*4 (k = 1 ~ 12)
17	*PRC Reserved*	Invalid, do not use	Long	4	H+60
18~29	*UDRE[i]*	*UDRE[i]*: User differential range error	Ulong[12]	4 * 12	H+60+k*4 (k = 1 ~ 12)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
		indicator for the PRN in slot i (SBAS5: i = 39- 50)			
30	*UDRE Reserved*	(Invalid, do not use)	Ulong	4	H+112
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 116
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.5 SBAS6 Integrity Information

Description

The integrity information is provided by Message Type 6, which allows the fast corrections of Message Type 2-5 and 24 to be updated infrequently, commensurate with the dynamics of the satellite clock errors. It can also be used to indicate an alert condition on multiple satellites.

Message ID	995
Recommended Input	*log sbas6a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS6 header	Log header		H	0
2	PRN	SBAS SV PRN number	ULong	4	H
3	IODF2	Issue of fast corrections data	Ulong	4	H+4
4	IODF3	Issue of fast corrections data	Ulong	4	H+8
5	IODF4	Issue of fast corrections data	Ulong	4	H+12
6	IODF5	Issue of fast corrections data	Ulong	4	H+16
7 ~ 57	*UDRE[i]*	*UDRE[i]*: User differential range error indicator for the PRN in slot I (i = 0 - 50)	Ulong[51]	4 * 51	H+16+(i+1)*4
58	UDRE Reserved	Invalid, do not use	Ulong	4	H+224
59	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4
60	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.6 SBAS7 Fast Correction Degradation Factor

Description

The Type 7 message of SBAS specifies the applicable IODP, system latency time (t_{lat}) and the fast correction degradation factor indicator (ai_i) for computing the degradation of fast and long term corrections.

Message ID	996
Recommended Input	*log sbas7a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS7A,COM1,0,60.0,FINESTEERING,1863,555697.000,00000000,0000,1114;12
9,1,0,0,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15
,15,15,15,15,15,15,15,15,15,15,15,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0*7825412F

#SBAS7A,COM1,0,60.0,FINESTEERING,1863,555714.000,00000000,0000,1114;13
7,1,0,0,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15
,15,15,15,15,15,15,15,15,15,15,15,15,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0*6D5BC66
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS7 header	Log header		H	0
2	PRN	SBAS SV PRN number	ULong	4	H
3	latency	System latency (s)	Ulong	4	H+4
4	IODP	Issue of PRN mask data	Ulong	4	H+8
5	spare bits	Unused spare bits	Ulong	4	H+12
6 ~ 56	*ai[i]*	*ai[i]*: Degradation factor indicator for the PRN in slot i (i = 0-50)	Ulong[51]	4 * 51	H+12+(i+1)*4
59	ai Reserved	Invalid, do not use	Ulong	4	H+220
59	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4
60	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.7 SBAS9 GEO Navigation Message

Description

The SBAS Type 9 GEO Navigation Message represents the position, velocity and acceleration of the geostationary satellite, in ECEF Coordinates, and its apparent clock time and frequency

offsets. Also included is the time of applicability (t_0) and an accuracy exponent (URA) representing the health of the GEO ranging signal. aGf_0 and aGf_1 will be an estimate of the time offset and drift with respect to SBAS Network Time. Their combined effect will be added to the estimate of the satellite's transmit time.

Message ID	997
Recommended Input	*log sbas9a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS9A,COM1,0,60.0,FINESTEERING,1863,555689.000,00000000,0000,1114;12
9,107,37312,14,-34558908.00,24173308.00,32571.6,0.112500,1.610000,0.69
6,0.0001000,0.0000625,-0.0001875,-2.579763532E-07,-3.092281986E-11*620
FBD67

#SBAS9A,COM1,0,60.0,FINESTEERING,1863,555689.000,00000000,0000,1114;13
7,7,37312,6,-34558924.00,24173288.00,32547.6,0.112500,1.610625,0.696,0
.0001000,0.0000625,-0.0001875,-1.182779670E-07,-3.001332516E-11*CD13FE
8D
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS9 header	Log header		H	0
2	PRN	Source PRN of message	Ulong	4	H
3	IOD	Issue of GEO navigation data	Ulong	4	H+4
4	t0	Time of applicability	Ulong	4	H+8
5	URA	URA value	Ulong	4	H+12
6	X	ECEF X coordinate (m)	Double	8	H+16
7	Y	ECEF Y coordinate (m)	Double	8	H+24
8	Z	ECEF Z coordinate (m)	Double	8	H+32
9	Xvel	X rate of change (m/s)	Double	8	H+40
10	Yvel	Y rate of change (m/s)	Double	8	H+48
11	Zvel	Z rate of change (m/s)	Double	8	H+56
12	Xaccel	X rate of rate change (m/s^2)	Double	8	H+64
13	Yaccel	Y rate of rate change (m/s^2)	Double	8	H+72
14	Zaccel	Z rate of rate change (m/s^2)	Double	8	H+80
15	af0	Time offset (s)	Double	8	H+88
16	af1	Time drift (s)	Double	8	H+96
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+104
18	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.8 SBAS10 Degradation Factors

Description

Message Type 10 provides the degradation factors. These factors are used as described in RTCA DO-229D.

Message ID	978
Recommended Input	*log sbas10a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS10A,COM1,0,60.0,FINESTEERING,1863,555743.000,00000000,0000,1114;1
29,1,38,76,256,152,100,311,83,256,6,228,300,0,0,0,0,000000000000000000
0000*AA059256

#SBAS10A,COM1,0,60.0,FINESTEERING,1863,555743.000,00000000,0000,1114;1
37,1,38,76,256,152,100,311,83,256,6,228,300,0,0,0,0,000000000000000000
0000*C3D6489E
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
1	SBAS10 header	Log header		H	0	-
2	PRN	Source PRN of message	ULong	4	H	-
3	B_{rcc}	Estimated noise and round off error parameter	Ulong	4	H+4	0.002
4	C_{ltc_lsb}	Maximum round off due to the least significant bit (lsb) of the orbital clock	Ulong	4	H+8	0.002
5	C_{ltc_vl}	Velocity error bound	Ulong	4	H+12	0.00005
6	I_{ltc_vl}	Update interval for v=1 long term	Ulong	4	H+16	-
7	C_{ltc_v0}	Bound on update delta	Ulong	4	H+20	0.002
8	I_{ltc_v1}	Minimum update interval v = 0	Ulong	4	H+24	-
9	C_{geo_lsb}	Maximum round off due to the lsb of the orbital clock	Ulong	4	H+28	0.0005
10	C_{geo_v}	Velocity error bound	Ulong	4	H+32	0.00005
11	I_{geo}	Update interval for GEO navigation message	Ulong	4	H+36	-
12	C_{er}	Degradation parameter	Ulong	4	H+40	0.5

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
13	C_{iono_step}	Bound on ionospheric grid delay difference	Ulong	4	H+44	0.001
14	I_{iono}	Minimum ionospheric update interval	Ulong	4	H+48	-
15	C_{iono_ramp}	Rate of ionospheric corrections change	Ulong	4	H+52	0.000005
16	RSS_{udre}	User differential range error flag	Ulong	4	H+56	-
17	RSS_{iono}	Root sum square flag	Ulong	4	H+60	-
18	$C_{covariance}$	Covariance	Ulong	4	H+64	0.1
19	Spare bits	Spare 88 bits, possibly GLONASS	Hex[11]	11	H+68	-
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72	
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	

4.2.10.9 SBAS12 SBAS Network Time/UTC/GLO Time Offset Parameters Message

Description

SBAS Message Type 12 will consist of a preamble, a message type identifier (= 12) followed by the UTC parameters, then followed by a flag to indicate the UTC time standard from which the offset is determined. The next item are the Time of Week (TOW) in seconds of the beginning of the message, followed by a GPS Week number (WN). The spare 75 bits possibly to be partially replaced with the difference between SBAS Network Time and GLONASS time.

Message ID	979
Recommended Input	*log sbas12a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS12 header	Log header		H	0
2	PRN	Source PRN of message	ULong	4	H
3	A_{1SNT}	Time drift (s/s)	Double	8	H+4
4	A_{0SNT}	Time offset (s)	Double	8	H+12
5	t_{0t}	Seconds into the week (s)	Ulong	4	H+20

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
6	WN_t	Week number	Ushort	2	H+24
7	dt_{LS}	Delta time due to leap seconds	Short	2	H+26
8	WN_{LSF}	Week number, leap second future	Ushort	2	H+28
9	DN	Day of the week (the range is 1 to 7 where Sunday = 1 and Saturday = 7)	Ushort	2	H+30
10	dt_{LSF}	Delta time, leap second future	Ushort	2	H+32
11	UTC ID	UTC Standard identifier	Ushort	2	H+34
12	GPS TOW	GPS reference time of the week	Ulong	4	H+36
13	GPS WN	GPS de-modulo week number	Ulong	4	H+40
14	GLO Indicator	Is GLONASS information present? 0 = FALSE, 1 = TRUE	Enum	4	H+44
15	Reserved	Reserved array of hexabytes for GLONASS time offset	Char[10]	10 + 2	H+48
16	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H +60
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.10 SBAS17 GEO Almanacs

Description

Almanacs for GEOs will be broadcast periodically to alert the user of their existence, location, the general service provided and health and status. Almanacs for three satellites will be broadcast in the GEOs Almanacs Message Type 17. These messages will be repeated to include all GEOs. Unused almanacs will have a PRN number of 0 and should be ignored.

Message ID	980
Recommended Input	*log sbas17a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS17 header	Log header		H	0
2	PRN	Source PRN of message	ULong	4	H
3	#ents	Number of almanac entries with	Ulong	4	H+4

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
		information to follow			
4	Data ID	Data ID type	Ushort	2	H+8
5	Entry PRN	PRN for this entry	Ushort	2	H+10
6	Health	Health bits	Ushort	4a	H+12
7	X	ECEF X coordinate (m)	Long	4	H+16
8	Y	ECEF Y coordinate (m)	Long	4	H+20
9	Z	ECEF Z coordinate (m)	Long	4	H+24
10	X vel	X rate of change (m/s)	Long	4	H+28
11	Y vel	Y rate of change (m/s)	Long	4	H+32
12	Z vel	Z rate of change (m/s)	Long	4	H+36
13 …	Next entry			H+8+(#ents x 32)	
4+#ents*9	t0	Time of day in secs (0 ~ 86336)	Ulong	4	H+8+ (#ents x32)
5+#ents*9	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+(#ents x32)
6+#ents*9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.11 SBAS18 Ionospheric Grid Point Masks

Description

The ionospheric delay corrections are broadcast in SBAS Message Type 18 as vertical delay estimates at specified ionospheric grid points (IGPs), applicable to a signal on L1. In order to facilitate flexibility in the location of these IGPs, a fixed definition of densely spaced IGP locations is used, resulting in a large number of possible IGPs. The predefined IGPs are contained in 11 bands (numbered 0 to 10). Bands 0-8 are vertical bands on a Mercator projection map, and bands 9-10 are horizontal bands on a Mercator projection map.

The density of these predefined IGPs, is dictated by the possible large variation in the ionosphere vertical delay during periods of high solar activity, especially at lower latitudes. Since it would be impossible to broadcast IGP delays for all possible locations, a mask is broadcast to define the IGP locations providing the most efficient model of the ionosphere at the time.

Message ID	981
Recommended Input	*log sbas18a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS18A,COM1,0,60.0,FINESTEERING,1863,555684.000,00000000,0000,1114;1
37,3,0,3,0003FFC180FFC0C03FF0001FF00007FC0000FC00003F00000000,0*3F6D65
94
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS18 header	Log header		H	0
2	PRN	Source PRN of message	ULong	4	H
3	#bands	Number of bands broadcast	Ulong	4	H+4
4	Band Num	Specific band number that identifies which of the 11 IGP bands the data belongs to	Ulong	4	H+8
5	IODI	Issue of ionospheric data	Ulong	4	H+12
6	IGP mask	IGP mask	Uchar[26]	26+2	H+16
7	spare bit	One spare bit	Ulong	4	H+44
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.12 SBAS24 Mixed Fast Corrections/Long Term Satellite Error Corrections

Description

This section presents the Type 24 Mixed Fast Correction/Long Term Satellite Error Corrections Message. The first half of the message consists of six fast data sets according to the PRN mask sequence, followed by the IODP, a Block ID indicating which corrections block is provided, and the IODF. The Block ID (0, 1, 2, 3) will indicate whether the Type 24 message contains the fast corrections associated with a Type 2, Type 3, Type 4, or Type 5 message, respectively. The left data fields are composed of a half message as described in Message Type 25.

Message ID	983
Recommended Input	*log sbas24a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
1	SBAS24 header	Log header		H	0	

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
2	PRN	Source PRN of message	ULong	4	H	-
3	PRC0	PRC[i]: Fast corrections (-2048 to +2047) for the PRN in slot I (i = 0-5)	Long	4	H+4	-
4	PRC1		Long	4	H+8	-
5	PRC2		Long	4	H+12	-
6	PRC3		Long	4	H+16	-
7	PRC4		Long	4	H+20	-
8	PRC5		Long	4	H+24	-
9	UDRE0	UDRE[i]: User differential range error indicator for the PRN in slot i (i = 0-5)	Ulong	4	H+28	-
10	UDRE1		Ulong	4	H+32	-
11	UDRE2		Ulong	4	H+36	-
12	UDRE3		Ulong	4	H+40	-
13	UDRE4		Ulong	4	H+44	-
14	UDRE5		Ulong	4	H+48	-
15	IODP	Issue of PRN mask data	Ulong	4	H+52	-
16	Block ID	Associated message type	Ulong	4	H+56	
17	IODF	Issue of fast corrections data	Ulong	4	H+60	-
18	spare	Spare value	Ulong	4	H+64	-
19	vel	Velocity code flag	Ulong	4	H+68	-
20	mask1	Index into PRN mask (Type 1)	Ulong	4	H+72	-
21	IODE1	Issue of ephemeris data	Ulong	4	H+76	-
22	dx1	Delta x (ECEF)	Long	4	H+80	0.125
23	dy1	Delta y (ECEF)	Long	4	H+84	0.125
24	dz1	Delta z (ECEF)	Long	4	H+88	0.125
25	da_{f0}	Delta af0 clock offset	Long	4	H+92	2^{-31}
26	mask2	Second index into PRN mask (Type 1)	Ulong	4	H+96	-
27	IODE2	Second issue of ephemeris data	Ulong	4	H+100	-
28	ddx	Delta delta x (ECEF)	Long	4	H+104	2^{-11}
29	ddy	Delta delta y (ECEF)	Long	4	H+108	2^{-11}
30	ddz	Delta delta z (ECEF)	Long	4	H+112	2^{-11}
31	da_{f1}	Delta af1 clock offset	Long	4	H+116	2^{-39}
32	t0	Applicable time of day	Ulong	4	H+120	16
33	IODP	Issue of PRN mask data	Ulong	4	H+124	-
34	corr spare	Spare value when velocity code is equal	Ulong	4	H+128	-

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
		to 0				
35	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H +132	
36	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	

4.2.10.13 SBAS25 Long Term Satellite Error Corrections

Description

SBAS Message Type 25 will be broadcast to provide error estimates for slow varying satellite ephemeris and clock errors with respect to WGS-84 ECEF coordinates. These corrections are estimated with respect to the GNSS broadcast clock and ephemeris parameters. These long-term corrections are not applied for SBAS satellites operated by that service provider. Instead, the Type 9 GEO Navigation Message will be updated as required to prevent slow varying GEO satellite errors.

Message ID	984
Recommended Input	*log sbas25a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS25A,COM1,0,60.0,FINESTEERING,1863,555690.000,00000000,0000,1114;1
29,1,4,66,-1,-30,-21,-26,0,0,1,0,0,0,2321,0,0,1,19,4,-26,9,3,-24,0,0,4
,-1,0,2,2321,0,0*45D51D97

#SBAS25A,COM1,0,60.0,FINESTEERING,1863,555690.000,00000000,0000,1114;1
37,1,4,66,1,-29,-19,-28,0,0,1,0,-1,0,2321,0,0,1,19,4,-32,6,5,-25,0,0,4
,-1,0,1,2321,0,0*D8356EA3
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
1	SBAS25 header	Log header		H	0	
2	PRN	Source PRN of message	ULong	4	H	
3	1st half vel	Velocity code flag (0 or 1)	Ulong	4	H+4	-
4	1st half mask1	Index into PRN mask (Type 1)	Ulong	4	H+8	-
5	1st half IODE1	Issue of ephemeris data	Ulong	4	H+12	-
6	1st half dx1	Delta x (ECEF)	Long	4	H+16	0.125

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
7	1st half dy1	Delta y (ECEF)	Long	4	H+20	0.125
8	1st half dz1	Delta z (ECEF)	Long	4	H+24	0.125
9	1st half a_{f0}	Delta af0 clock offset	Long	4	H+28	2^{-31}
10	1st half mask2	Second index into PRN mask (Type 1) Dummy value when vel code = 1	Ulong	4	H+32	-
11	1st half IODE2	Second issue of ephemeris data Dummy value when vel code = 1	Ulong	4	H+36	-
12	1st half ddx	Delta delta x (ECEF) when vel code = 1 Delta x (dx) when vel code = 0	Long	4	H+40	2^{-11}
13	1st half ddy	Delta delta y (ECEF) when vel code = 1 Delta y (dy) when vel code = 0	Long	4	H+44	2^{-11}
14	1st half ddz	Delta delta z (ECEF) when vel code = 1 Delta z (dz) when vel code = 0	Long	4	H+48	2^{-11}
15	1st half a_{f1}	Delta af1 clock offset when vel code = 1 Delta af0 clock offset when vel code = 0	Long	4	H+52	2^{-39}
16	1st half t0	Applicable time of day Dummy value when vel code = 0	Ulong	4	H+56	16
17	1st half IODP	Issue of PRN mask data	Ulong	4	H+60	-
18	1st half corr spare	Spare value when vel code = 0 Dummy value when vel code = 1	Ulong	4	H+64	-
19	2nd half vel	Velocity code flag (0 or 1)	Ulong	4	H+68	-
20	2nd half mask1	Index into PRN mask (Type 1)	Ulong	4	H+72	-
21	2nd half IODE1	Issue of ephemeris data	Ulong	4	H+76	-
22	2nd half dx1	Delta x (ECEF)	Long	4	H+80	0.125
23	2nd half dy1	Delta y (ECEF)	Long	4	H+84	0.125
24	2nd half dz1	Delta z (ECEF)	Long	4	H+88	0.125
25	2nd half a_{f0}	Delta af0 clock offset	Long	4	H+92	2^{-31}
26	2nd half mask2	Second index into PRN mask (Type 1) Dummy value when vel code = 1	Ulong	4	H+96	-
27	2nd half IODE2	Second issue of ephemeris data Dummy value when vel code = 1	Ulong	4	H+100	-
28	2nd half ddx	Delta delta x (ECEF) when vel code = 1 Delta x (dx) when vel code = 0	Long	4	H+104	2^{-11}

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
29	2nd half ddy	Delta delta y (ECEF) when vel code = 1 Delta y (dy) when vel code = 0	Long	4	H+108	2^{-11}
30	2nd half ddz	Delta delta z (ECEF) when vel code = 1 Delta z (dz) when vel code = 0	Long	4	H+112	2^{-11}
31	2nd half a_{f1}	Delta af1 clock offset when vel code = 1 Delta af0 clock offset when vel code = 0	Long	4	H+116	2^{-39}
32	2nd half t0	Applicable time of day Dummy value when vel code = 0	Ulong	4	H+120	16
33	2nd half IODP	Issue of PRN mask data	Ulong	4	H+124	-
34	2nd half corr spare	Spare value when vel code = 0 Dummy value when vel code = 1	Ulong	4	H+128	-
35	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H +132	
36	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	

4.2.10.14 SBAS26 Ionospheric Delay Corrections

Description

The SBAS Message Type 26 Ionospheric Delay Corrections Message provides the users with vertical delays (relative to a GPS L1 signal) and their accuracy at geographically defined IGPs identified by band number and IGP number. Each message contains a band number and a block ID that indicates the location of the IGPs in the respective band mask.

Message ID	985
Recommended Input	*log sbas26a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS26A,COM1,0,60.0,FINESTEERING,1863,555756.000,00000000,0000,1114;1
37,7,3,15,20,12,17,13,14,13,13,14,11,14,24,15,24,15,69,14,46,14,35,14,
24,12,19,12,16,12,14,13,12,13,3,0*A92A4AC3
```

```
#SBAS26A,COM1,0,60.0,FINESTEERING,1863,555762.000,00000000,0000,1114;1
29,0,0,15,21,15,11,15,16,15,10,15,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,3,0*33A69AE7
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset	Scale Factor
1	SBAS26 header	Log header		H	0	
2	PRN	Source PRN of message	ULong	4	H	
3	Band Num	Band number	Ulong	4	H+4	-
4	Block ID	Block ID	Ulong	4	H+8	-
5	#pts	Number of grid points with information to follow	Ulong	4	H+12	-
6	IGPvde	IGP vertical delay estimates	Ulong	4	H+16	0.125
7	GIVEI	Grid ionospheric vertical error indicator	Ulong	4	H+20	-
8…	Next #pts entry			H+16+ (#pts x 8)		-
6+(#ptsx2)	IODI	Issue of data - ionosphere	Ulong	4	H+16+(#ptsx8)	-
7+(#ptsx2)	spare	7 spare bits	Ulong	4	H+20+(#ptsx8)	-
8+(#ptsx2)	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4	-
9+(#ptsx2)	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

4.2.10.15 SBAS27 SBAS Service

Description

SBAS Type 27 messages may be transmitted to increase the σ_{UDRE} values in selected areas. Type 27 message parameters apply only to the service provider transmitting the message.

The Number of Service Messages parameter in each Type 27 message indicates the total number of unique Type 27 messages for the current Issue of Data, Service (IODS). Each unique message for that IODS includes a sequential Service Message Number. The IODS is incremented in all messages, each time that any parameter in any Type 27 message is changed.

Message ID	986
Recommended Input	*log sbas27a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS27 header	Log header		H	0
2	PRN	Source PRN of message	ULong	4	H
3	IODS	Issue of slow corrections data	Ulong	4	H+4
4	#messages	Low-by-one count of messages	Ulong	4	H+8
5	message Num	Low-by-one message number	Ulong	4	H+12
6	Priority code	Priority code	Ulong	4	H+16
7	dUDRE inside	Delta user differential range error - inside	Ulong	4	H+20
8	dUDRE outside	Delta user differential range error - outside	Ulong	4	H+24
9	#reg	Number of regions with information to follow	Ulong	4	H+28
10	lat1	Coordinate 1 latitude	Long	4	H+32
11	lon1	Coordinate 1 longitude	Long	4	H+36
12	lat2	Coordinate 2 latitude	Long	4	H+40
13	lon2	Coordinate 2 longitude	Long	4	H+44
14	shape	Shape where: 0 = triangle 1 = square	Ulong	4	H+48
15…	Next #reg entry			H+32+ (#reg x 20)	
10+(#regx5)	t0	Time of applicability	Ulong	4	H+32+ (#reg x 20)
11+(#regx5)	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4
12+(#regx5)	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.16 SBAS28 Clock-Ephemeris Covariance Matrix Message

Description

Message Type 28 may be broadcast to provide the relative covariance matrix for clock and ephemeris errors. This is an expansion of the information contained in the σ_{UDRE} in that it specifies the correction confidence as a function of user location. Message Type 28 provides increased availability inside the service volume and increased integrity outside.

Message ID	975
Recommended Input	*log sbas28a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS28A,COM1,0,60.0,FINESTEERING,1863,557256.000,00000000,0000,1114;1
29,1,2,12,1,390,370,217,16,94,143,20,864,1007,850,33,5,243,187,87,1,92
5,79,263,166,937,8*E60BB71E

#SBAS28A,COM1,0,60.0,FINESTEERING,1863,557256.000,00000000,0000,1114;1
37,1,2,12,1,393,370,218,16,94,145,20,864,1006,849,33,5,243,187,87,1,92
5,79,263,166,937,8*28785BD8
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS header	Log header		H	0
2	PRN	Source PRN of message	ULong	4	H
3	IODP	Issue of PRN mask data	ULong	4	H+4
4	#prn	Number of PRN with information to follow (0 ~ 2)	ULong	4	H+8
5	Mask1	Index into PRN mask (Type 1)	UShort	2	H+12
6	Scale exponent1	Scale exponent of 1st Satellite	UShort	2	H+14
7	E_11 (1st satellite)	$E_{1,1}$ of Cov Matrix E for 1st satellite	UShort	2	H+16
8	E_22 (1st satellite)	$E_{2,2}$ of Cov Matrix E for 1st satellite	UShort	2	H+18
9	E_33 (1st satellite)	$E_{3,3}$ of Cov Matrix E for 1st satellite	UShort	2	H+20
10	E_44 (1st satellite)	$E_{4,4}$ of Cov Matrix E for 1st satellite	UShort	2	H+22
11	E_12 (1st satellite)	$E_{1,2}$ of Cov Matrix E for 1st satellite	UShort	2	H+24
12	E_13 (1st satellite)	$E_{1,3}$ of Cov Matrix E for 1st satellite	UShort	2	H+26
13	E_14 (1st satellite)	$E_{1,4}$ of Cov Matrix E for 1st satellite	UShort	2	H+28
14	E_23 (1st satellite)	$E_{2,3}$ of Cov Matrix E for 1st satellite	UShort	2	H+30
15	E_24 (1st satellite)	$E_{2,4}$ of Cov Matrix E for 1st satellite	UShort	2	H+32
16	E_34 (1st satellite)	$E_{3,4}$ of Cov Matrix E for 1st satellite	UShort	2	H+34
17…	Next #prn entry			H+12+(#prn x 24)	
5+(#prnx12)	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+ (#prnx24)
6+(#prnx12)	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.10.17 SBAS63 Null Message

Description

The Null Message Type 63 is used as a filler message if no other message is available for broadcast for the one-second time slot.

Message ID	1003
Recommended Input	*log sbas63a ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
#SBAS63A,COM1,0,60.0,FINESTEERING,1863,557249.000,00000000,0000,1114;1
29*4438AB42

#SBAS63A,COM1,0,60.0,FINESTEERING,1863,557249.000,00000000,0000,1114;1
37*BA9BB704
```

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	SBAS63 header	Log header		H	0
2	PRN	Source PRN of message	ULong	4	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.11 Station Information

4.2.11.1 REFSTATION Base Station Position and Health

Description

This message includes base station position and health information received from differential messages.

Message ID	175
Recommended Input	*log refstationb onchanged*
Supported Format	*ASCII, Binary*

Reply (ASCII)

```
#REFSTATIONA,COM1,0,60.0,UNKNOWN,1776,107978.450,00000000,0000,1114;00
000000,0.000,0.000,0.000,0,0,"0000"*b7e5bd12
```

Table 45.Base Station Status

BIT #	MASK	DESCRIPTION	BIT = 0	BIT = 1
0	0x00000001	Validity of the base station.	Valid	Invalid

Table 46.Base Station Type

BASE STATION TYPE (BINARY)	DESCRIPTION (ASCII)	
0	NONE	Base station is not used
1	RTCM	Base station is RTCM
2	RTCA	Base station is RTCA
3	CMR	Base station is CMR
4	RTCMV3	Base station is RTCMV3

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	REFSTATION header	Log header		H	0
2	status	Status of the base station information (refer to ***Table 45***)	ULong	4	H
3	X	ECEF X value	Double	8	H+4
4	Y	ECEF Y value	Double	8	H+12
5	Z	ECEF Z value	Double	8	H+20
6	health	Base station health(0: Health OK)	Ulong	4	H+28
7	stn type	Base station type (refer to ***Table*** 46)	Enum	4	H+32
8	stn ID	Base station ID	Char[5]	8a	H+36
9	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
10	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.12 Time Messages

4.2.12.1 TIME Time Data

Description

This log provides several time related pieces of information including board clock offset and UTC time and offset. It can also be used to determine any offset in the PPS signal relative to GPS time.

Message ID	101
Recommended Input	*log timeb ontime 1*
Supported Format	*binary*

Reply (Binary)

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	TIME Header	Log Header		H	0
2	Clock status	Clock model status, refer to *Table 47*	Enum	4	H
3	Offset	Board clock offset	Double	8	H+4
4	Offset std	Board clock offset standard deviation.	Double	8	H+12
5	Utc offset	The offset of GPS time from UTC time	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	Utcms	UTC millisecond (0-60999)	Ulong	4	H+36
12	Utc status	UTC status: 0 = Invalid, 1 = Valid, 2 = Warning	Enum	4	H+40
13	CRC	32-bit CRC	Hex	4	H+44

Table 47.Clock Model Status

VALUE	CLOCK STATUS	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
4	ERROR	Clock model error

4.3 INTERNATIONAL STANDARD MESSAGES

4.3.1 NMEA sentences

4.3.1.1 Standard NMEA sentences

4.3.1.1.1 GPGGA GNSS Fix Data

Description

This message is a standard NMEA log, but a little different from the standard one in position precision. The position precision of this log is the same as GPGGARTK, in order to be used in greater conditions. The header of GPGGA is always “GP” regardless if other GNSS information involved in solution computation.

Message ID	218
Recommended Input	*log gpgga ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$GPGGA,024941.00,3110.4693903,N,12123.2621695,E,1,16,0.6,57.0924,M,0.0
00,M,99,AAAA*55
```

Field#	Structure	Description	Symbol	Example
1	$GPGGA	Log header		$GPGGA
2	utc	UTC time of position (hours/minutes/seconds/ decimal seconds)	hhmmss.ss	202134.00
3	lat	Latitude (DDmm.mm)	llll.lllllll	3110.4693903
4	latdir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yyyyyyy	121232621695
6	londir	Longitude direction (E = East, W = West)	a	W
7	GPS qual	GPS Quality indicator 0 = fix not available or invalid 1 = GPS fix 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS, or CDGPS 4 = RTK fixed ambiguity solution (RT2)	x	1

Field#	Structure	Description	Symbol	Example
		5 = RTK floating ambiguity solution (RT20), OmniSTAR HP or OmniSTAR XP 6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 =Super wide-lane mode 9 = SBAS		
8	# sats	Number of satellites in use. May be different to the number in view	xx	10
9	hdop	Horizontal dilution of precision	x.x	1.0
10	alt	Antenna altitude above/below mean sea level	x.x	1062.22
11	a-units	Units of antenna altitude (M = meters)	M	M
12	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid	x.x	-16.271
13	u-units	Units of undulation (M = meters)	M	M
14	age	Age of Differential GPS data (in seconds) b	xx	(empty when no differential data is present)
15	stn ID	Differential base station ID, 0000-1023	xxxx	
16	*xx	Checksum	*hh	*48
17	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.1.2 GPGLL Geographic Position

Description

This message is a standard NMEA log, include information such as time, latitude, longitude and so on. Be different from GPGGA, if BD2or other GNSS information is involved in, the header of GLL would become “GN” instead of “GP” which is outputted in only GPS information used in solution computation. If only BD2 information is used, header becomes “BD”.

Message ID	219
Recommended Input	*log gpgll ontime 1*
Supported Format	*ASCII*

Reply (ASCII) GPS and BD2

```
$GNGLL,3110.4702936,N,12123.2629222,E,031449.00,A,A*7C
```

Reply (ASCII) GPS only

```
$GPGLL,3110.4705303,N,12123.2635741,E,031544.00,A,A*68
```

Reply (ASCII) BD2 only

```
$BDGLL,3110.4685408,N,12123.2615164,E,031628.00,A,A*76
```

Field#	Structure	Description	Format	Example
1	$GPGLL	Log header		$GPGLL
2	lat	Latitude (DDmm.mm)	llll.lllllll	3110.4702936
3	latdir	Latitude direction (N = North, S = South)	a	N
4	lon	Longitude (DDDmm.mm)	yyyyy.yyyyyyy	12123.2629222
5	londir	Longitude direction (E = East, W = West)	a	W
6	utc	UTC time of position (hours/minutes/ seconds/decimal seconds)	hhmmss.ss	220152.50
7	data status	Data status: A = Data valid, V = Data invalid	A	A
8	mode ind	Positioning system mode indicator	a	A
9	*xx	Checksum	*hh	*1B
10	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.1.3 GPGSA GNSS DOP and Available Satellite

Description

This message contains available satellites used in solution computation and DOP values.

Message ID	221
Recommended Input	*log gpgsa ontime 1*
Supported Format	*ASCII*

Reply (ASCII) GPS and BD2

```
$GNGSA,M,3,25,14,15,18,31,27,09,21,22,12,,,0.8,0.6,0.5*2A
$GNGSA,M,3,141,143,144,146,147,148,149,150,,,,,0.8,0.6,0.5*2C
```

Reply (ASCII) GPS only

```
$GPGSA,M,3,25,14,15,18,31,27,09,21,22,12,,,1.5,0.9,1.3*30
```

Reply (ASCII) BD2 only

```
$BDGSA,M,3,141,143,144,146,147,148,149,150,,,,,2.7,1.7,2.2*2B
```

Field#	Structure	Description	Symbol	Example
1	$GPGSA	Log header		$GPGSA
2	mode MA	A = Automatic 2D/3D M = Manual, forced to operate in 2D or 3D	M	M
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 SBAS = 33 to 64 (add 87 for PRN number) GLO = 65 to 96 BD2 =141 to 177	xx,xx,.....	25,14, 15,18, 31,27, 09,21, 22,12,,,,
16	pdop	Position dilution of precision	x.x	1.5
17	hdop	Horizontal dilution of precision	x.x	0.9
18	vdop	Vertical dilution of precision	x.x	1.2
19	*xx	Checksum	*hh	*3F
20	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.1.4 GPGST Pseudorange Measurement Noise Statistics

Description

This message is a standard NMEA log. Pay attention to that rms, smjrstd, smnrstd and orient values are absent in the message currently.

Message ID	222
Recommended Input	*log gpgst ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

Field#	Structure	Description	Symbol	Example
1	$GPGST	Log header		$GPGST
2	utc	UTC time of position (hours/minutes/seconds/ decimal	hhmmss.ss	173653.00

Field#	Structure	Description	Symbol	Example
		seconds)		
3	rms	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudorange and DGPS corrections.	x.x	
4	smjrstd	Standard deviation of semi-major axis of error ellipse (m)	x.x	
5	smnrstd	Standard deviation of semi-minor axis of error ellipse (m)	x.x	
6	orient	Orientation of semi-major axis of error ellipse (degrees from true north)	x.x	
7	latstd	Standard deviation of latitude error (m)	x.x	2.51
8	lonstd	Standard deviation of longitude error (m)	x.x	1.94
9	alt std	Standard deviation of altitude error (m)	x.x	4.30
10	*xx	Checksum	*hh	*6E
11	[CR][LF]	Sentence terminator		[CR][LF]

Reply (ASCII) GPS and BD2

```
$GNGST,035330.00,,,,,0.22,2.37,1.44,*54
```

Reply (ASCII) GPS only

```
$GPGST,035330.00,,,,,0.22,2.37,1.44,*54
```

Reply (ASCII) BD2 only

```
$BDGST,035330.00,,,,,0.22,2.37,1.44,*54
```

4.3.1.1.5 GPGSV GNSS Satellites in View

Description

This is a standard NMEA message which includes PRN numbers, elevation, azimuth, and SNR values of satellites in view. Messages of GPS satellites use header “GP” and BD2 use “BD”.

Message ID	223
Recommended Input	*log gpgsv ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$GPGSV,3,1,09,14,67,095,51,31,55,331,50,25,38,041,50,22,25,188,46*70
```

```
$GPGSV,3,2,09,30,43,228,49,29,29,096,47,32,29,303,45,16,17,219,43*7B

$GPGSV,3,3,09,20,07,318,41,,,,,,,,,,,,*4A

$BDGSV,2,1,08,141,49,145,47,143,36,237,45,144,34,122,45,146,13,196,39*
6E

$BDGSV,2,2,08,147,63,004,50,148,39,173,45,149,25,222,42,150,51,324,46*
6D
```

Field#	Structure	Description	Symbol	Example
1	$GPGSV	Log header		$GPGSV
2	# msgs	Total number of messages (1-9)	x	3
3	msg #	Message number (1-9)	x	1
4	# sats	Total number of satellites in view. May be different than the number of satellites in use	xx	09
5	prn	Satellite PRN number GPS = 1 to 32 SBAS = 33 to 64 (add 87 for PRN#s) GLO = 65 to 96 BD2 = 141~177	xx	03
6	elev	Elevation, degrees, 90 maximum	xx	51
7	azimuth	Azimuth, degrees True, 000 to 359	xxx	140
8	SNR	SNR (C/No) 00-99 dB, null when not tracking	xx	42
… … …	… … …	Next satellite PRN number, elev, azimuth, SNR, … Last satellite PRN number, elev, azimuth, SNR,		
variable	*xx	Checksum	*hh	*72
variable	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.1.6 GPHDT Vessel Heading

Description

This message is a standard log which includes actual vessel heading for True North in degrees.

Message ID	228
Recommended Input	*log gphdt ontime 1*
Supported Format	*ASCII*

Reply (ASCII) GPS and BD2

```
$GNHDT,89.2769,T*20
```

Reply (ASCII) GPS

```
$GPHDT,154.6566,T*06
```

Reply (ASCII) BD2

```
$BDHDT,47.8506,T*2C
```

Field#	Structure	Description	Symbol	Example
1	$GPHDT	Log header		$GPHDT
2	heading	Heading in degrees	x.x	89.2769
3	True	Degrees True	T	T
4	*xx	Checksum	*hh	*36
5	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.1.7 GPRMC GNSS Specification Information

Description

This is a standard NMEA message which includes time, date, speed and true heading.

Message ID	225
Recommended Input	*log gprmc ontime 1*
Supported Format	*ASCII*

Reply (ASCII) GPS and BD2

```
$GNRMC,065029.00,A,3110.4722495,N,12123.2644026,E,0.456,330.1,050512,-0.0,W,A*12
```

Reply (ASCII) GPS

```
$GPRMC,065141.00,A,3110.4723882,N,12123.2636328,E,0.657,140.7,050512,-0.0,W,A*00
```

Reply (ASCII) BD2

```
$BDRMC,064944.00,A,3110.4700351,N,12123.2651820,E,0.862,89.6,050512,-0.0,W,A*26
```

Field#	Structure	Description	Symbol	Example
1	$GPRMC	Log header		$GPRMC
2	utc	UTC of position	hhmmss.ss	065029.00
3	pos status	Position status: A = data valid, V = data invalid	A	A
4	lat	Latitude (DDmm.mm)	llll.ll	3110.4722495
5	latdir	Latitude direction: N = North, S = South	a	N
6	lon	Longitude (DDDmm.mm)	yyyyy.yy	12123.2644026
7	londir	Longitude direction: E = East, W = West	a	E
8	speed Kn	Speed over ground, knots	x.x	0.456
9	track true	Track made good, degrees True	x.x	330.1
10	date	Date: dd/mm/yy	xxxxxx	050512
11	mag var	Magnetic variation, degrees	x.x	0.0
12	vardir	Magnetic variation direction E/W	a	W
13	mode ind	Positioning system mode indicator	a	A
14	*xx	Checksum	*hh	*12
15	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.1.8 GPVTG Track Make Good and Ground Speed

Description

This is a standard NMEA message which includes make good and ground speed.

Message ID	226
Recommended Input	*log gpvtg ontime 1*
Supported Format	*ASCII*

Reply (ASCII) GPS and BD2

```
$GNVTG,304.723,T,304.723,M,0.365,N,0.677,K,A*3B
```

Reply (ASCII) GPS only

```
$GPVTG,213.710,T,213.710,M,0.304,N,0.563,K,A*24
```

Reply (ASCII) BD2 only

```
$BDVTG,29.710,T,29.710,M,0.836,N,1.548,K,A*37
```

Field#	Structure	Description	Symbol	Example
1	$GPVTG	Log header		$GPVTG
2	track true	Track made good, degrees True	x.x	213.710
3	T	True track indicator	T	T
4	track mag	Track made good, degrees Magnetic; Track mag = Track true + (MAGVAR correction)	x.x	213.710
5	M	Magnetic track indicator	M	M
6	speed Kn	Speed over ground, knots	x.x	0.304
7	N	Nautical speed indicator (N = Knots)	N	N
8	speed Km	Speed, kilometers/hour	x.x	0.563
9	K	Speed indicator (K = km/hr)	K	K
10	mode ind	Positioning system mode indicator	a	A
11	*xx	Checksum	*hh	*24
12	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.1.9 GPZDA UTC Time and Date

Description

This message is a standard NMEA log which includes UTC time and date.

Message ID	276
Recommended Input	*log gpzda ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$GPZDA,071642.00,05,05,2012,,*61
```

Field#	Structure	Description	Symbol	Example
1	$GPZDA	Log header		$GPZDA
2	utc	UTC time	hhmmss.ss	071642.000

Field#	Structure	Description	Symbol	Example
3	day	Day, 01 to 31	xx	05
4	month	Month, 01 to 12	xx	05
5	year	Year	xxxx	2012
6	null	Local zone description - not available	xx	(empty when no data is present)
7	null	Local zone minutes description - not available	xx	
8	*xx	Checksum	*hh	*6F
9	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.2 ComNav Proprietary NMEA sentences

4.3.1.2.1 GPCDT Time Difference between Ref PPS and Rover PPS

Description

This message is a self-defined log to indicate the time difference between reference PPS and rover PPS. GPS, BD2, GLONASS and GALILEO systems' information are all included in this message, if valid flag is 1, the corresponding data is valid, and otherwise the data should be ignored. **This log is only valid in rover's RTD mode**.

Message ID	211
Recommended Input	*log gpcdt ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

Field#	Structure	Description	Format	Example
1	$GPCDT	Log header		$GPCDT
2	UTC Time	UTC time of position (hours/minutes/seconds/ decimal seconds)	hhmmss.ss	202134.00
3	GPS information	Difference between base station and rover station, in nanoseconds.	xx.x	3.2
4	GPS valid	Valid flag	x	1
5	BD2 information	Difference between base station and rover station, in nanoseconds.	xx.x	5.1
6	BD2 valid	Valid flag	x	1
7	GLONASS information	Difference between base station and rover station, in nanoseconds.	xx.x	0.0

Field#	Structure	Description	Format	Example
8	GLONASS valid	Valid flag	x	0
9	GALILEO information	Difference between base station and rover station, in nanoseconds.	xx.x	0.0
10	GALILEO valid	Valid flag	x	0
11	*xx	Checksum	*hh	*1B
12	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.2.2 GPCLH Constellation Health

Description

Each field is defined as it appears in RTCM2.3 #5 and data fields are serialized as standard RTCM2.3, without application of scaling factor. Each message consists 3 satellites and comma will be used as place holder if the last message contains less than 3 satellites.

Message ID	267
Recommended Input	*log gpclh ontime 1*
Supported Format	*ASCII*

Sentence Header:

```
$GPIDM,Msg NO (total number of sentences in this message),Msg ID(Message ID),Station ID,M-Z Counter,Sequence NO,Data Word Length,Station Health,
```

Sentence Fields:

```
SatID#1(int),IODL(int),Data Health(int),SNR(int),Health Enable(int),New Data(int),Loss of Satellite Warning(int),Time to Unhealthy(int),

SatID#2(int),IODL(int),Data Health(int),SNR(int),Health Enable(int),New Data(int),Loss of Satellite Warning(int),Time to Unhealthy(int),

SatID#3(int),IODL(int),Data Health(int),SNR(int),Health Enable(int),New Data(int),Loss of Satellite Warning(int),Time to Unhealthy(int)*CC
```

Example

```
$GPCLH,3,1,4,5553,0,7,0,12,0,0,25,0,0,0,0,22,0,0,26,0,0,0,0,14,0,0,23,0,0,0,0*7F

$GPCLH,3,2,4,5553,0,7,0,25,0,0,22,0,0,0,0,31,0,0,18,0,0,0,0,24,0,0,20,0,0,0,0*70

$GPCLH,3,3,4,5553,0,7,0,18,0,0,24,0,0,0,0,,,,,,,,,,,,,,,*76
```

```
$BDCLH,4,1,4,5553,0,10,0,141,0,1,21,0,0,0,0,142,0,0,17,0,0,0,0,143,0,0
,23,0,0,0,0*6B

$BDCLH,4,2,4,5553,0,10,0,144,0,0,20,0,0,0,0,146,0,0,23,0,0,0,0,147,0,0
,25,0,0,0,0*6C

$BDCLH,4,3,4,5553,0,10,0,149,0,0,25,0,0,0,0,150,0,0,20,0,0,0,0,153,0,0
,22,0,0,0,0*63

$BDCLH,4,4,4,5553,0,10,0,145,0,0,11,0,0,0,0,,,,,,,,,,,,,,,*6E
```

☞ ***Note.*** In current version, among such fields as SatID, IODL, Data Health, SNR, Health Enable, New Data, Loss of Satellite Warning, Time to Unhealthy, only these four are valid: SatID, IODL, Data Health and SNR

4.3.1.2.3 GPDRC Delta Range Correction

Description

Each field is defined as it appears in RTCM2.3 #2 and data fields are serialized as standard RTCM2.3, without application of scaling factor. Each message consists 3 satellites and comma will be used as place holder if the last message contains less than 3 satellites.

Message ID	265
Recommended Input	*log gpdrc ontime 1*
Supported Format	*ASCII*

Sentence Header:

```
$GPDRC,Msg NO (total number of sentences in this message),Msg ID(Message
ID),Station ID,M-Z Counter,Sequence NO,Data Word Length,Station Health,
```

Sentence Fields:

```
SatID#1(int),SF(int),UDRE(int),Delta PRC(int),Delta RRC(int),IOD(int),

SatID#2(int),SF(int),UDRE(int),Delta PRC(int),Delta RRC(int),IOD(int),

SatID#3(int),SF(int),UDRE(int),Delta PRC(int),Delta RRC(int),IOD(int)

*CC
```

Example

```
$GPDRC,4,1,4,2020,6,20,0,23,0,0,1256,0,0,3,0,0,457,1,0,27,0,0,522,255,
0*6C

$GPDRC,4,2,4,2020,6,20,0,19,0,0,277,1,0,13,0,0,633,1,0,16,0,0,692,255,
0*6E

$GPDRC,4,3,4,2020,6,20,0,7,0,0,245,1,0,8,0,0,756,254,0,9,0,0,793,254,0
*54

$GPDRC,4,4,4,2020,6,20,0,11,0,0,345,1,0,6,0,0,651,1,0,1,0,0,484,1,0*60

$BDDRC,3,1,4,2020,6,12,0,141,0,0,582,1,0,142,0,0,529,0,0,143,0,0,476,0
,0*4C

$BDDRC,3,2,4,2020,6,12,0,144,0,0,822,0,0,147,0,0,461,0,0,148,0,0,386,2
55,0*45

$BDDRC,3,3,4,2020,6,12,0,150,0,0,324,0,0,,,,,,,,,,,*4F
```

4.3.1.2.4 GPGGARTK GNSS Fix Data

Description

This message is the same as GPGGA; refer to GPGGA information in this document.

Message ID	259
Recommended Input	*log gpggartk ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$GPGGA,024941.00,3110.4693903,N,12123.2621695,E,1,16,0.6,57.0924,M,0.0
00,M,99,AAAA*55
```

4.3.1.2.5 GPGRS Pseudorange Residual

Description

Message ID	220
Recommended Input	*log gpgrs ontime 1*
Supported Format	*ASCII*

Reply

```
$GPGRS,hhmmss.ss,a,b.b,b.b,b.b,b.b,b.b,b.b,b.b,b.b,b.b,b.b,b.b,b.b,b.b*61
```

a: mode. 0: pseudorange residual is used in position estimation; 1: pseudorange residual is computed after position estimation;

b.b: pseudorange residual, corresponding to SV number in GPGSA;

Example

```
$GPGRS,033944.00,0,1.80,0.23,-0.37,0.56,-2.57,2.11,-0.84,-0.93,,,*61
$BDGRS,033944.00,0,0.40,1.17,0.69,-1.24,1.32,0.83,-0.39,-2.07,-0.71,,*6C
```

4.3.1.2.6 GPHPR Parameters of Attitude Angles

Description

This message is a non-standard message, which includes heading, pitch or roll angle of carrier on which two antennas are placed on.

Message ID	237
Recommended Input	*log gphpr ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$GPHPR,070901.00,090.10,000.20,000.00,4,14,1.00,0004*42
```

Field#	Structure	Description	Symbol	Example
1	$GPHPR	Log header		$GPHPR
2	utc	UTC time	hhmmss.ss	070901.00
3	heading	Heading, 0~360 degree	hhh.hh	090.10
4	pitch	Pitch, -90~90 degree	ppp.pp	000.20
5	roll	Roll, -90~90 degree	rrr.rr	000.00
6	QF	GPS Quality indicator 0 = fix not available or invalid 1 = GPS fix 2 = C/A differential 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution	q	4

Field#	Structure	Description	Symbol	Example
		6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 =Super wide-lane mode 9 = SBAS		
7	sat No.	satellite number	n	14
8	age	differential age	dd.dd	1.00
9	stn ID	reference station ID	xxxx	0004
10	*xx	Checksum	*hh	*42
11	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.2.7 GPIDM Ionospheric Delay Message

Description

Each field is defined as it appears in RTCM2.3 #15 and data fields are serialized as standard RTCM2.3, without application of scaling factor. Each message consists 3 satellites and comma will be used as place holder if the last message contains less than 3 satellites.

Message ID	268
Recommended Input	*log gpidm ontime 1*
Supported Format	*ASCII*

Sentence Header:

```
$GPIDM,Msg NO (total number of sentences in this message),Msg ID(Message ID),Station ID,M-Z Counter,Sequence NO,Data Word Length,Station Health,
```

Sentence Fields:

```
SysID(GPS: 0, GLO: 1, BDS: 2),SatID#1(int),Iono Delay(int),Iono Change Rate(int),
SysID(GPS: 0, GLO: 1, BDS: 2),SatID#2(int),Iono Delay(int),Iono Change Rate(int),
SysID(GPS: 0, GLO: 1, BDS: 2),SatID#3(int),Iono Delay(int),Iono Change Rate(int)*CC
```

Example

```
$GPIDM,4,1,4,2353,7,18,0,0,23,1211,0,0,3,457,0,0,27,753,0*70
```

```
$GPIDM,4,2,4,2353,7,18,0,0,19,0,0,0,13,1036,0,0,16,593,0*46
$GPIDM,4,3,4,2353,7,18,0,0,7,173,0,0,8,686,0,0,9,778,0*42
$GPIDM,4,4,4,2353,7,18,0,0,11,245,0,0,6,781,0,0,1,1402,0*4B
$BDIDM,3,1,4,2353,7,11,0,2,141,1068,0,2,142,1564,0,2,143,1569,0*69
$BDIDM,3,2,4,2353,7,11,0,2,144,1702,0,2,147,1489,0,2,148,1477,0*66
$BDIDM,3,3,4,2353,7,11,0,2,150,1918,0,,,,,,,,*69
```

☞ ***Note.*** In current version, among such fields as 'SatID,Iono Delay,Iono Change Rate', only two are valid: SatID and Iono Delay.

4.3.1.2.8 GPNAV ComNav Navigation Information Message

Description

This message is a non-standard message, which includes position, velocity, position and tracking information, and also heading, pitch and roll (reserved) angles output while dual antennas are used.

Message ID	264
Recommended Input	*log gpnav ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$GPNAV,20151003,123707.00,17,3,,31.17432494563,121.38795557054,41.7907
,10.7811,176.628,0.000,0.000,,0.000,-0.002,-0.010,0.002,1,NN,7,0.000,8
,5,9,,,8,5,9,,,,,,,*6F
```

Field#	Structure	Description	Symbol	Example
1	$GPNAV			$GPNAV
2	Date	Date: year, month, day	yyyymmdd	20141110
3	UTC Time	UTC Time: hour minute second	hhmmss.ss	072033.00
4	GPS leap second	GPS vs UTC, empty as invalid	x	16
5	BDS leap	BDS vs UTC, empty as invalid	x	2

Field#	Structure	Description	Symbol	Example
	second			
6	Reserved	leap second (XXX vs UTC)	x	XX
7	Latitude	WGS84, Latitude, in degree; +: north, -: south	.xxxxxxxxxxx	39.97577397443
8	Longitude	WGS84, Longitude, in degrees; +: east, -: west	.xxxxxxxxxxx	116.36426309103
9	Altitude	height above sea level (WGS84), (m)	.xxxx	69.4144
10	separation	Geoidal separation (m)	.xxxx	-9.5116
11	Tracking angle	0~360 degree, tracking angle, same as GPRMC	.xxx	354.549
12	Heading	Heading, The angle between true North and Heading (from true north to heading clockwise), 0~360 deg	.xxx	42.916
13	Pitch	Pitch, positive from horizontal surface to zenith, negative from horizontal surface to downword, -90~90 deg	.xxx	58.991
14	Roll	-90~90 deg, empty as invalid [Reserved]	.xxx	
15	Ve	Velocity North (m/s)	.xxx	-0.001
16	Vn	Velocity East (m/s)	.xxx	0.012
17	Vu	Velocity down (m/s)	.xxx	0.055
18	Vg	Velocity Ground (m/s)	.xxx	0.012
19	Status1	receiver RTK positioning quality indicator: 0 = fix not available or invalid 1 = GNSS fix 2 = C/A differential 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution 6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 =Super wide-lane mode 9 = SBAS	x	4
20	Status2	Heading solution indicator (Master receiver + Slave receiver): NV, VN, NN, VV	XX	NV
21	System Mask	GNSS systems used in solution GPS: 1(0x01, 00000001), GLO: 2(0x02,	x	5

Field#	Structure	Description	Symbol	Example
		00000010) BDS: 4(0x04, 00000100), GAL: 8(0x08, 00001000) GPS+GLO: 3 (0x01 + 0x02 = 0x03, 00000011) GPS+BDS: 5 (0x01 + 0x04 = 0x05, 00000101) GPS+GAL: 9 (0x01 + 0x08 = 0x09, 00001001) GLO+BDS: 6 (0x02 + 0x04 = 0x06, 00000110) GPS+GLO+BDS: 7 (0x01 + 0x02 + 0x04= 0x07, 00000111) GPS+GLO+BDS+GAL: 15 (0x01 + 0x02 + 0x04 + 0x08 = 0x0F, 00001111)		
22	Baseline	Baseline length (m)	.xxx	3.898
23-27	#SV Used	Satellite Number used from GPS/GLONASS/BDS/XXX/XXX	x,x,x,,	5,6,8, ,
28-32	#SV Tracked	Satellite Number tracked from GPS/GLONASS/BDS/XXX/XXX	x,x,x,,	5,6,8,,
33	Reserved			
34	Reserved			
35	Reserved			
36	Reserved			
37	*xx	Checksum	*hh	
38	[CR][LF]	Sentence terminator		

4.3.1.2.9 GPNTR Information on How to navigate to Reference Station

Description

This self-defined NMEA message includes distance between reference station and rover station, distance in east, distance in north, and in vertical dimension.

Message ID	209
Recommended Input	*Log gpntr ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$GPNTR,024404.00,1,17253.242,+5210.449,-16447.587,-49.685,0004*40
```

Field#	Structure	Description	Symbol	Example
1	$GPNTR	Log header		$GPNTR
2	utc	UTC of position	hhmmss.ss	024404.00
3	pos status	GPS Quality indicator 0 = fix not available or invalid 1 = Single point position 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS, or CDGPS 4 = RTK fixed ambiguity solution (RT2) 5 = RTK floating ambiguity solution (RT20), OmniSTAR HP or OmniSTAR XP 6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 =Super wide-lane mode 9 = SBAS	I	1
4	distance	In 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 AAAA(No ref-station)	I	0004
9	*xx	Checksum	*hh	*12
10	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.2.10 GPPRR Pseudorange and Range Rate Residual

Description

Each field is defined as it appears in RTCM2.3 #19. Each message consists 3 satellites and comma will be used as place holder if the last message contains less than 3 satellites.

Message ID	271
Recommended Input	*log gpprr ontime 1*
Supported Format	*ASCII*

Sentence Header:

$GPPRR,Rsim ID(19),Msg Total Num(total number of sentences in this message),Msg ID(Message ID),Utc Time(double, rounded to the nearest tenth),

Sentence Fields:

SatID#1(int),Pr Res(double, rounded to the nearest hundredth),Rr Res(double, rounded to the nearest hundredth), Cr QI(double, rounded to the nearest hundredth),Pr V Est(double, rounded to the nearest hundredth), Cr Age(double, rounded to the nearest tenth),

SatID#2(int),Pr Res(double, rounded to the nearest hundredth),Rr Res(double, rounded to the nearest hundredth),Cr QI(double, rounded to the nearest hundredth),Pr V Est(double, rounded to the nearest hundredth), Cr Age(double, rounded to the nearest tenth),

SatID#3(int),Pr Res(double, rounded to the nearest hundredth),Rr Res(double, rounded to the nearest hundredth),Cr QI(double, rounded to the nearest hundredth),Pr V Est(double, rounded to the nearest hundredth), Cr Age(double, rounded to the nearest tenth)*CC

Example

```
$GPPRR,19,4,1,022537.0,3,-0.51,0.00,0.00,0.00,0.0,27,-0.65,0.00,0.00,0
.00,0.0,19,1.46,0.00,0.00,0.00,0.0*41

$GPPRR,19,4,2,022537.0,13,0.62,0.00,0.00,0.00,0.0,16,-1.35,0.00,0.00,0
.00,0.0,7,2.78,0.00,0.00,0.00,0.0*69

$GPPRR,19,4,3,022537.0,8,1.22,0.00,0.00,0.00,0.0,9,-0.77,0.00,0.00,0.0
0,0.0,11,1.12,0.00,0.00,0.00,0.0*56

$GPPRR,19,4,4,022537.0,6,-0.05,0.00,0.00,0.00,0.0,1,-3.86,0.00,0.00,0.
00,0.0,,,,,,*5F

$BDPRR,19,3,1,022537.0,141,0.00,0.00,0.00,0.00,0.0,142,0.00,0.00,0.00,
0.00,0.0,143,0.00,0.00,0.00,0.00,0.0*58

$BDPRR,19,3,2,022537.0,144,0.00,0.00,0.00,0.00,0.0,147,0.00,0.00,0.00,
0.00,0.0,148,0.00,0.00,0.00,0.00,0.0*50

$BDPRR,19,3,3,022537.0,150,0.00,0.00,0.00,0.00,0.0,,,,,,,,,,,,*5B
```

☞ ***Note.*** Among such fields as 'SatID, Pr Res, Rr Res, Cr QI, Pr V Est, Cr Age', only two are valid now: SatID and Pr Res.

4.3.1.2.11 GPRRS Differential GPS and BDS Corrections

Description

Message ID	263
Recommended Input	*log gprrs ontime 1*
Supported Format	*ASCII*

Reply

```
$GPRRS,hhmmss.ss,a,b,x,c,d.d,e.e,f.f,g.g,h.h,i,c,d.d,e.e,f.f,g.g,h.h,i
,c,d.d,e.e,f.f,g.g,h.h,i*CC
```

a: total number of messages;

b: message number;

x: number of satellites in this constellation;

c: PRN number;

d.d: PRC;

e.e: RRC;

f.f: PR Acceleration;

g.g: UDRE;

h.h: Z-Counter;

i: IOD;

Example

```
$GPRRS,033944.00,2,1,18,-12.1,0.0,0.0,1.3,435.6,102,9,-11.5,0.0,0.0,1.
1,435.6,3,21,-10.1,0.0,0.0,1.2,435.6,52*CC

$GPRRS,033944.00,2,2,24,-10.2,0.0,0.0,1.5,435.6,97*CC

$BDRRS,033944.00,2,1,1,-12.3,0.0,0.0,1.9,435.6,1,2,-11.9,0.0,0.0,2.1,4
35.6,1,3,-12.0,0.0,0.0,2.2,435.6,1*CC

$BDRRS,033944.00,2,2,4,-10.9,0.0,0.0,2.1,435.6,1,5,-13.9,0.0,0.0,2.3,4
35.6,1,5,-11.5,0.0,0.0,2.2,435.6,1*CC
```

4.3.1.2.12 GPRSC Reference Station Coordinates

Description

Each field is defined as it appears in RTCM2.3 #3 and data fields are serialized as standard RTCM2.3, without application of scaling factor. Each message contains one sentence.

Message ID	266
Recommended Input	*log gprsc ontime 1*
Supported Format	*ASCII*

Sentence:

```
$GPRSC,Station ID,M-Z Counter,Sequence NO,Data Word Length,Station Health,x(int),y(int),z(int)*CC
```

Example

```
$GPRSC,4,2145,2,4,0,-284479926,466274235,-284479926*64
```

4.3.1.2.13 GPSEH Satellite Health Indication

Description

Message ID	261
Recommended Input	*log gpseh ontime 1*
Supported Format	*ASCII*

Reply

```
$GPSEH,hhmmss.ss,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h,h*CC
```

h: SV health, based on similar information in extracted ephemeris. 0 for ‘Health’ and 1 for ‘Unhealth’. SV whose health status is available will have the corresponding bit set as 1 for 0. If its health is unknown, the position will be held but not set.

For example, in the first sentence, GPS prn 5,6,7,9,10,16,17,18,19,20 is set ‘health’ while all the others’ health status is unknown.

Example

```
$GPSEH,092055.20,,,,,,,,,,,0,,0,,,,0,,,,0,,0,0,,,,,,0,*72
$BDSEH,092055.20,,0,0,0,,0,0,,0,0,,,,,,,,,,,,,,,,,,,,,,,,,,,*4F
$GLSEH,092055.20,0,0,0,,,,,,,,0,0,,,,,,,,,,*6E
```

4.3.1.2.14 GPTRA Heading, Pitch and Roll (reserved) Message

Description

This self-defined NMEA message includes heading, pitch and roll (reserved) angles of the baseline vector between two antennas, as which are used with dual GNSS RF input receiver for attitude determination.

Message ID	207
Recommended Input	*Log gptra ontime 1*
Supported Format	*ASCII*

Sentence (ASCII)

```
$GPTRA,hhmmss.ss,hhh.hh,ppp.pp,rrr.rr,l,n,dd.dd,xxxx*CC<CR><LF>
```

Example

```
$GPTRA,063027.30,101.78,071.19,-00.00,4,10,0.00,0004*51
```

Field#	Structure	Description	Symbol	Example
1	$GPTRA	Log header		$GPTRA
2	utc	UTC of position	hhmmss.ss	063027.30
3	heading	0 ~ 360 degree	hhh.hh	101.78
4	pitch	-90 ~ 90 degree	ppp.pp	071.19
5	roll	[Reserved]	rrr.rr	-00.00
6	sol status	solution indicator 0 = fix not available or invalid 1 = Single point position 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS, or CDGPS 4 = RTK fixed ambiguity solution (RT2) 5 = RTK floating ambiguity solution (RT20), OmniSTAR HP or OmniSTAR XP	I	4
7	# sats	Number of satellites in use. May be different to the number in view	n	10
8	age	Age of Differential GPS data (in seconds)	dd.dd	0.00
9	stn ID	Differential base station ID, 0000-1023	xxxx	0004
10	*xx	Checksum	*hh	*12
11	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.2.15 GPURA Satellite User Range Accuracy (URA)

Description

Message ID	262
Recommended Input	*log gpura ontime 1*
Supported Format	*ASCII*

Reply

```
$GPURA,hhmmss.ss,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u,u*CC
```

u: URA. SV whose URA is available will have the corresponding bit set as appropriate level. If its URA is unavailable, the position will be held but not set. For example, in the first sentence, GPS prn 1,5,7,8,12,13,14,27 is set 1,2,2,3,3,4,2,2 respectively while all the others' URA is unknown.

Example

```
$GPURA,033944.00,1,,,,2,,2,3,,,,3,4,2,,,,,,,,,,,,2,,,,,*CC
$BDURA,033944.00,1,2,2,2,2,2,2,3,3,4,2,3,4,2,,,,,,,,,,,,,,,,,,,,,,,,*CC
```

4.3.1.2.16 GPYBM Position, Velocity, Heading, Pitch and PJK information

Description

This message is a non-standard message, which includes position, velocity, PJK information, and also heading and pitch angles output as dual antennas are used.

Message ID	87
Recommended Input	*log gpybm ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$GPYBM,SN00520429,070326.00,+31.170243388,+121.398934274,15.286,346.840,1.290,0.000,-0.002,0.003,0.002,3449917.897,538032.213,-451.861,1088.741,4,4,12,1,,,,*4B
```

Field#	Structure	Description	Format
1	$GPYBM	Log header	
2	Serial NO.	Serial Number of OEM board	SNxxxxxxxx, x = 0 ~ 9

Field#	Structure	Description	Format
3	utc	UTC time	HHMMSS.SS
4	Lat	Latitude, in degrees	+: north, -: south; ddd.mmmmmmmmmm
5	Lon	Longitude, in degrees	+: east, -: west; ddd.mmmmmmmmmm
6	ElpHeight	Ellipsoidal height of fix (antenna height above ellipsoid)	.xxx (m)
7	Heading	Heading, The angle between true North and Heading (from true north to heading clockwise)	0~360 degree .xxx (deg)
8	Pitch	Pitch, positive from horizontal surface to zenith, negative from horizontal surface to downword	-90~90 degree .xxx (deg)
9	Vel N	Velocity North	.xxx (m/s)
10	Vel E	Velocity East	.xxx (m/s)
11	Vel D	Velocity down	.xxx (m/s)
12	Vel G	Velocity Ground	.xxx (m/s)
13	Coordinate Northing	refer to PTNL,PJK	.xxx (m)
14	Coordinate Easting	refer to PTNL,PJK	.xxx (m)
15	North Distance	Distance to Ref station in North direction, refer to GPNTR	+: north, -: south; .xxx (m)
16	East Distance	Distance to Ref station in East direction, refer to GPNTR	+: east, -: west; .xxx (m)
17	Position Indicator	receiver RTK positioning quality indicator: 0 = fix not available or invalid 1 = GNSS fix 2 = C/A differential 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution 6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 =Super wide-lane mode 9 = SBAS	x

Field#	Structure	Description	Format
18	Attitude Indicator	receiver RTK heading and pitch quality indicator, refer to GPTRA, PTNL,AVR	x
19	Sat NO Used	satellite number used in solution	xx
20	Diff Age	differential age	xx
21	reserved1	reserved field 1	
22	reserved2	reserved field 2	
23	reserved3	reserved field 3	
24	reserved4	reserved field 4	
25	*xx	Checksum	
	[CR][LF]	Sentence terminator	

4.3.2 RTCM 2.X messages

4.3.2.1 RTCM1 Differential GPS Corrections

Description

This message is a standard log of RTCM2.X which contains differential GPS corrections. It contains satellite ID, pseudorange correction, range rate correction and Issue of Data (IOD), for all satellites in view of the reference station.

Message ID	107
Recommended Input	*log rtcm1b ontime 1*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 2.X documents.

4.3.2.2 RTCM3 Base Station Information

Description

This message is a standard log of RTCM2.X which contains base station parameters.

Message ID	402
Recommended Input	*log rtcm3b ontime 5*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 2.X documents.

4.3.2.3 RTCM9 GPS Partial Correction Set

Description

This message is a standard log of RTCM2.X which serves the same purpose as the Type 1 Message of RTCM2.X, in that it contains the primary differential GPS corrections. Each message contains the corrections for only three satellites.

Message ID	275
Recommended Input	*log rtcm9b ontime 1*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 2.X documents.

4.3.2.4 RTCM1819 Raw Measurement

Description

This message is a standard log of RTCM2.X which contains GPS dual frequency observables.

Message ID	399
Recommended Input	*log rtcm1819b ontime 1*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 2.X documents.

4.3.2.5 RTCM31 Differential GLONASS Corrections

Description

This message is a standard log of RTCM2.X which contains differential GLONASS corrections. It contains satellite ID, pseudorange correction, range rate correction and time of day, for all satellites in view of the reference station.

Message ID	864
Recommended Input	*log rtcm31b ontime 1*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 2.X documents.

4.3.2.6 RTCM41 Pseudorange observable Corrections

Description

This message is a standard log of RTCM2.X which contains pseudorange observable corrections. RTCM41 message contains the correction data of all satellites of the constellation. The message contains the satellite *gnssID*: “rtcm41gps”, “rtcm41bds” and “rtcm41glo”; logging *data rate (Hz)*; for all satellites in view of the reference station. No “A” or “B” need to be added to the command.

For the different GNSS systems, the log messages are shown in following tables separately.

a) GPS system

Message ID	124
Recommended Input	*log rtcm41gps ontime 1*
Supported Format	*binary*

b) GLONASS system

Message ID	125
Recommended Input	*log rtcm41glo ontime 1*
Supported Format	*binary*

c) BeiDou system

Message ID	126
Recommended Input	*log rtcm41bds ontime 1*
Supported Format	*binary*

In above example, the logging information is the GPS pseudorange observable corrections and the logging data rate is 1 Hz.

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 2.X documents.

4.3.2.7 RTCM42 General Partial Corrections

Description

This message is a standard log of RTCM2.X which contains pseudorange observable corrections. RTCM42 message contains the main GNSS corrections. However, RTCM42 does not need all satellites and the corrections are logged at different time. The reference station needs more stable clock because the clock drift is not modeled. The logging message contains the RTCM42 and satellite *gnssID*: “rtcm42gps”, “rtcm42bds” and “rtcm42glo”; logging *data rate (Hz)*; for all satellites in view of the reference station. No “A” or “B” need to be added to the command.

a) GPS system

Message ID	127
Recommended Input	*log rtcm42gps ontime 1*
Supported Format	*binary*

b) GLONASS system

Message ID	130
Recommended Input	*log rtcm42glo ontime 1*
Supported Format	*binary*

c) BeiDou system

Message ID	132
Recommended Input	*log rtcm42bds ontime 1*
Supported Format	*binary*

In above messages, the logging information is the GPS/GLONASS/BDS pseudorange observable corrections and the logging data rate is 1 Hz.

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 2.X documents.

4.3.3 RTCM 3.X messages

4.3.3.1 RTCM0063 BDS Ephemeris (A Test Message)

Description

This message is a test log of RTCM3.x which contains BDS satellite ephemeris information.

Message ID	89
Recommended Input	*log rtcm0063b ontime 1*
Supported Format	*Binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.2 RTCM1002 Extended L1 GPS Observables

Description

This message is a standard log of RTCM3 which contains extended L1 GPS observables of reference station.

Message ID	785
Recommended Input	*log rtcm1002b ontime 1*
Supported Format	*Binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.3 RTCM1003 L1 and L2 GPS RTK Observables

Description

RTCM1003 includes GPS L1 and L2 RTK observables. ComNav receivers support to decode RTCM1003 data and use it for RTK computation. But RTCM1003 log message output is not supported currently.

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.4 RTCM1004 Extended L1/L2 GPS Observables

Description

This message is a standard log of RTCM3 which contains extended L1 and L2 GPS observables of reference station.

Message ID	787
Recommended Input	*log rtcm1004b ontime 1*
Supported Format	*Binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.5 RTCM1005 Base Station Position

Description

This message is a standard log of RTCM3 which includes position information of reference station.

Message ID	788
Recommended Input	*log rtcm1005b ontime 5*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.6 RTCM1006 Base Station Position and Antenna Height

Description

This message is a standard log of RTCM3 which includes position information and antenna height of reference station.

Message ID	789
Recommended Input	*log rtcm1006b ontime 5*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.7 RTCM1007 Extended Information about Base Station

Description

This message is a standard log of RTCM3 which includes position, antenna height and descriptions of reference station.

Message ID	856
Recommended Input	*log rtcm1007b ontime 5*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.8 RTCM1008 Extended Information about Base Station

Description

This message is a standard log of RTCM3 which includes position, antenna height and descriptions of reference station.

Message ID	857
Recommended Input	*log rtcm1008b ontime 5*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.9 RTCM1010 Extended L1-Only GLONASS Observables

Description

This message is a standard log of RTCM3 which contains extended L1 GLONASS observables of reference station.

Message ID	898
Recommended Input	*log rtcm1010b ontime 1*
Supported Format	*Binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.10 RTCM1011 GLONASS L1/L2 RTK

Description

RTCM1011 includes GLONASS L1 and L2 RTK observables. ComNav receivers support to decode RTCM1011 data and use it for RTK computation. But RTCM1011 log message output is not supported currently.

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.11 RTCM1012 Extended L1 & L2 GLONASS Observables

Description

This message is a standard log of RTCM3 which contains extended L1 & L2 GLONASS observables of reference station. It supports dual-frequency RTK operation, and includes an indication of the satellite carrier-to-noise (CNR) as measured by the reference station.

Message ID	900
Recommended Input	*log rtcm1012b ontime 1*
Supported Format	*Binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.12 RTCM1019 GPS Ephemerides

Description

This message is a standard log of RTCM3 which contains GPS satellite ephemeris information.

Message ID	893
Recommended Input	*log rtcm1019b ontime 5*
Supported Format	*Binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.13 RTCM1020 GLONASS Ephemerides

Description

This message is a standard log of RTCM3 which contains GLONASS satellite ephemeris information.

Message ID	895
Recommended Input	*log rtcm1020b ontime 5*
Supported Format	*Binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.14 RTCM1033 Extended Information about Base Station

Description

This message is a standard log of RTCM3 which includes position, antenna height and descriptions of reference station. In order to enhance the compatibility, the rover needs to

receive the RTCM1033 message from the base station to identify the station type and the GLONASS freq-bias; the message 1033 is combined with message 1005/1006 or RTCMCOMPASSB; once one of these messages is ouput, the message 1033 outputs automatically.

Note: the station type in the message is ***SINOGNSS***.

Message ID	999
Recommended Input	*log rtcm1033b ontime 5*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.15 RTCM1104 BD2 RTK Message

Description

Because no available message could be applied to involve BD2 observables in RTCM3, a non-standard message is defined for currently applications. The message might be disabled if a standard RTCM3 message which includes BD2 observables is published. Just like messages about GPS RTK, a similar message style is adopted to encode information of BD2 satellites, as descript in *Table 48* to

Table 52.

Message ID	781
Recommended Input	*log rtcm1104b ontime 1*
Supported Format	*binary*

Reply (Binary)

Each frequency of BD2 is independent of the others, so an indicator should be defined to reflect which frequency is involved. Be different from standard RTCM3 message header, an additional 3 bits are added to descript the involved frequency, refer to the last content-line in *Table 50*.

Table 48.BD2 RTK Message

MESSAGE TYPE	MESSAGE CONTENTS	ID
Observations	BD2 B1/B2/B3 observables	1104

Table 49.BD2 RTK Message Data Field

DF #	DF Name	DF Range	DF Resolution	Data Type	DF Notes
DF001	Reserved				
DF002	Message Number	0-4095		uint12	
DF003	Reference Station ID	0-4095		uint12	
DF004	BD2 Epoch Time(TOW)	0-604,799,999 ms	1 ms	uint30	
DF005	Synchronous GNSS Message Flag			bit(1)	
DF006	No. of BD2 Satellite Signals Processed	0-31		uint5	The Number of BD2 Satellite Signals Processed refers to the number of satellites in the message. It does not necessarily equal the number of satellites visible to the Reference Station.
DF007	BD2 Divergence-free Smoothing Indicator			bit(1)	
DF008	Smoothing Interval			bit(3)	
DF009	BD2B1/B2/B3 Indicator			bit(3)	Indicator CombineB1B2B3 B1=0 No B1 Observations B2=0 No B1 Observations B3=0 No B1 Observations
DF010	BD2 Satellite ID	0-63		uint6	
DF011	BD2 Code Indicator			bit(2)	0= C/A
DF012	BD2 Pseudorange	0-299,792.46 m	0.02 m	uint24	The BD2 B1/B2/B3 Pseudorange field provides the raw pseudorange measurement at the reference station in meters, modulo one light-millisecond (299,792.458 meters). The BD2

DF #	DF Name	DF Range	DF Resolution	Data Type	DF Notes
					B1/B2/B3 pseudorange measurement is reconstructed by the user receiver from the B1/B2/B3pseudorange field by: (BD2 B1/B2/B3 pseudorange measurement) = (BD2 B1/B2/B3 pseudorange field) modulo (299,792.458 m) + integer as determined from the user receiver's estimate of the reference station range, or as provided by the extended data set. If DF013 is set to 80000h, this field does not represent a valid BD2 B1/B2/B3 pseudorange.
DF013	BD2 B1/B2/B3 Phase Range –B1/B2/B3 Pseudorange	± 262.1435 m	0.0005 m	int20	
DF014	BD2 B1/B2/B3 Time Indicator			uint7	
DF015	BD2 Integer B1/B2/B3 Pseudorange Modulus Ambiguity		299,792.458 m	uint8	The BD2 Integer B1/B2/B3 Pseudorange Modulus Ambiguity represents the integer number of full pseudorange modulus divisions (299,792.458m) of the raw B1/B2/B3 pseudorange measurement.
DF016	BD2 B1/B2/B3 CNR		0.25 dB-Hz	uint8	
DF017	BD2 BLOCK				Refer to *Table 52*

The Type 1104 Message supports single-frequency, dual-frequency and triple-frequency RTK operation. The frequency number included in each satellite is referred to DF009.

Table 50.Contents of BD2 RTK Message Header

DATA FIELD	DF NUMBER	DATA TYPE	BIT NO.
Message Number (e.g.,"1001"= 0011 1110 1001)	DF002	Uint12	12
Reference Station ID	DF003	uint12	12
BD2 Epoch Time (TOW)	DF004	Uint30	30
Synchronous GNSS Flag	DF005	bit(1)	1
No. of BD2 Satellite Signals Processed	DF006	uint5	5
BD2 Divergence-free Smoothing Indicator	DF007	bit(1)	1
BD2 Smoothing Interval	DF008	bit(3)	3
BD2 B1/B2/B3 Indicator	DF009	bit(3)	3
TOTAL			**67**

Table 51.Contents of the Satellite-Specific Portion, Each Satellite

DATA FIELD	DF NUMBER	DATA TYPE	NO. OF BITS
BD2 Satellite ID	DF010	Uint6	6
BD2 Block(according to DF009)	DF017		69
BD2 Block(according to DF009)	DF017		69
BD2 Block(according to DF009)	DF017		69
TOTAL			**6+69*n**

Table 52.DF017 (BD2 Block)-Frequency Contents of BD2 Satellite

DATA FIELD	DF NUMBER	DATA TYPE	BIT NO.
BD2 Code Indicator	DF011	bit(2)	2
BD2 Pseudorange	DF012	uint24	24
BD2 Phase Range – Pseudorange	DF013	int20	20
BD2 Lock time Indicator	DF014	uint7	7
BD2 Integer Pseudorange Modulus Ambiguity	DF015	uint8	8
BD2 CNR	DF016	uint8	8
TOTAL			**69**

4.3.3.16 RTCM1074 GPS MSM4 — Full PRs and Phase Ranges plus CNR

Description

This message is a standard log of RTCM 3.x MSM4 (Multiple Signal Message) which includes full pseudoranges, phase ranges and CNR (carrier-no-noise ratio) for GPS signals.

Message ID	624
Recommended Input	*log rtcm1074b ontime 1*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.17 RTCM1084 GLONASS MSM4 — Full PRs and Phase Ranges plus CNR

Description

This message is a standard log of RTCM 3.x MSM4 (Multiple Signal Message) which includes full pseudoranges, phase ranges and CNR (carrier-no-noise ratio) for GLONASS signals.

Message ID	644
Recommended Input	*log rtcm1084b ontime 1*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.18 RTCM1124 BDS MSM4 — Full PRs and Phase Ranges plus CNR

Description

This message is a standard log of RTCM 3.x MSM4 (Multiple Signal Message) which includes full pseudoranges, phase ranges and CNR (carrier-no-noise ratio) for BDS signals.

Message ID	674
Recommended Input	*log rtcm1124b ontime 1*
Supported Format	*binary*

Reply (Binary)

If detailed information about this message is needed, please refer to standard RTCM SC104 3.X document.

4.3.3.19 RTCM4078 ComNav Proprietary Message

Description

This message is a RTCM 3.X proprietary message of ComNav Technology Ltd, which is assigned by RTCM SC-104. RTCM4078 would be defined for miscellaneous applications by ComNav or ComNav's customers.

If someone or some organization would like to share its sub-messages, please contract ComNav for more information.

Message ID	xxx
Recommended Input	*log rtcm4078smXXXXb ontime 1*
Supported Format	*binary*

4.3.4 BINEX (BINary EXchange Format)

BINEX, for "BINary EXchange", is an operational binary format standard for GNSS research and operational purposes. The format has been designed to grow and allow encapsulation of any data or metadata allowed in the common ASCII exchange formats such as RINEX, IONEX, SP3, SINEX, and so on, including GNSS-related data and metadata as encountered.

4.3.4.1 Record 0x00 Site Metadata

Description

BINEX record 0x00 will (eventually) encapsulate all pertinent information (i.e. metadata) about the *site*, *monument*, *marker*, *reference point*, and *equipment setup* for the collection of GPS, GLONASS, SBAS, and other GNSS type data and other possible site-related information like meteorological, geophysical, etc. equipment.

Log message BINEX00 will output standard BINEX record including all possible 0x00 fields. The values of BINEX 0x00 fields could be set by command 'SET SITEMETADATA' defined in *Table 16*.

Message ID	77
Recommended Input	*log binex00b ontime 10*
Supported Format	*Binary*

Reply (BINEX)

For more information on BINEX records, please refer to the website *binex.unavco.org*.

4.3.4.2 Record 0x01 GNSS Navigation Information

Description

Each BINEX record 0x01 holds GNSS navigation information for a specific satellite. The format depends on the specific subrecord value. Depending on the subrecord, the navigation information may correspond to the binary broadcast message, a decoded version of the message analogous to what would appear in a RINEX NAV file, or other orbit formats such as SP3, and so on.

Subrecord 0x01: 0x01-01 — Decoded GPS Ephemeris

Subrecord 0x02: 0x01-02 — Decoded GLONASS — FDMA Ephemeris

Subrecord 0x05: 0x01-05 — Decoded Beidou-2/Compass Ephemeris

Message ID	79, 80, 84
Recommended Input	*log binex0101b onchanged*
	log binex0102b onchanged
	log binex0105b onchanged
Supported Format	*Binary*

Reply (BINEX)

For more information on BINEX records, please refer to the website *binex.unavco.org*.

4.3.4.3 Record 0x7d Receiver Internal State

Description

BINEX Record 0x7d serves as a test bed for working out the details of ways of storing receiver internal state variables, including, for example, internal temperature.

Subrecord 0x00: 0x7d-00

This subrecord is being developed for receiver internal state variables, e.g. internal temperature, power, and so on.

Message ID	112
Recommended Input	*log binex7d00b ontime 1*
Supported Format	*Binary*

Reply (BINEX)

For more information on BINEX records, please refer to the website *binex.unavco.org*.

4.3.4.4 Record 0x7e Ancillary Site Data Prototyping

Description

BINEX Record 0x7e serves as a test bed for working out the details of new ways of storing ancillary site data, including, for example, site meteorological (MET) data.

Subrecord 0x00: 0x7e-00

This subrecord is being developed for hold ancillary site data, e.g. site meteorological data (pressure, temperature, humidity, etc.), local geophysical data (tilt, strain, etc.), and so on.

Message ID	113
Recommended Input	*log binex7e00b ontime 5*
Supported Format	*binary*

Reply (BINEX)

For more information on BINEX records, please refer to the website *binex.unavco.org*.

4.3.4.5 Record 0x7f GNSS Observable Prototyping

Description

BINEX Record 0x7f serves as a test bed for working out the details of new ways of storing GNSS observables for new records.

Subrecord 0x05: 0x7f-05

Subrecord 0x05 can be used for other receiver data, as long as the following requirements are met:

- the time resolution for each time tag is to the millisecond, sufficient to store the time tags for receivers nominally collecting data at integer second values.
- epoch-by-epoch data is needed (RINEX model)
- the number of satellites being tracked is 1-64
- the GNSS satellite being tracked can be GPS, GLONASS (FDMA-broadcasting), SBAS, QZSS as a separate constellation, Galileo, Compass although other possible constellations could be accommodated in the future up to a maximum of 16 systems.
- the satellite number, i.e. the PRN # for all except GLONASS-FDMA and the slot # for GLONASS-FDMA, is 1-255
- 10-bit signal-to-noise values in units of 0.1 dBHz with a range of 0 — 102.1 dBHz
- other observables desired to be stored are some combination of:
    - pseudorange to 0.001 meter resolution (= RINEX pseudorange resolution)
    - phase to 0.02 mm resolution (~ 10x RINEX phase resolution)

- Doppler to 1/256 Hz resolution (~ 1/4 RINEX doppler resolution)

Message ID	86
Recommended Input	*log binex7f05b ontime 1*
Supported Format	*binary*

Reply (BINEX)

For more information on BINEX records, please refer to the website *binex.unavco.org*.

4.4 OTHER LOG MESSAGES

4.4.1 Trimble Proprietary Messages

4.4.1.1 CMROBS Base Station Satellite Observation

Description

This message is a standard log defined by Trimble Navigation Ltd. to transfer pseudorange and carrier-phase information for high-precision GPS, refer to corresponding document.

Message ID	390
Recommended Input	*log cmrobsb ontime 1*
Supported Format	*binary*

Reply (Binary)

Refer to corresponding document.

4.4.1.2 CMRREF Base Station Position

Description

This message is a standard log defined by Trimble Navigation Ltd. to transfer base station position.

Message ID	391
Recommended Input	*log cmrrefb ontime 5*
Supported Format	*binary*

Reply (Binary)

Refer to corresponding document.

4.4.1.3 PTNL,AVR Time, yaw, tilt, range, mode, PDOP, and number of SVs for Moving Baseline RTK

Description

This message is a standard log defined by Trimble Navigation Ltd. to output time, yaw, tilt, range, mode, PDOP, and number of SVs for moving baseline RTK. For more details, please refer to Trimble's document.

The output of yaw and tilt values is under the control of command 'SET RECEIVERROLE' defined in *Table 16*.

Message ID	224
Recommended Input	*log ptnlavr ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$PTNL,AVR,095548.82,+0.0000,Yaw,+0.0000,Tilt,,,0.000,1,1.4,20*3E
```

4.4.1.4 PTNL,GGK Time, position, position type, and DOP values

Description

This message is a standard log defined by Trimble Navigation Ltd. to output time, position, position type and DOP values. For more details, please refer to Trimble's document.

The type of height value in PTNL,GGK message can be configured using command 'SET PTNLGGKHEIGHT' as defined in *Table 16*.

Message ID	76
Recommended Input	*log ptnlggk ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$PTNL,GGK,090845.00,092815,3110.45948454,N,12123.27659269,E,1,21,0.7,E
HT54.187,M*42
```

4.4.1.5 PTNL,PJK Local Coordinates Calculated in Specified Parameters

Description

This message is used to make local measurement in specified PJK parameters configured by user such as A0, F, N0, E0, B0, L0. (Refer to *Table 16*)

Message ID	229
Recommended Input	*log ptnlpjk ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$PTNL,PJK,090856.00,050712,+3451152.262,N,+632295.897,E,1,13,0.9,EHT+5
8.181,M*7D
```

4.4.2 JAVAD Proprietary Messages

4.4.2.1 NAVPOS [NP] Navigation Position

Description

This message is a standard log defined by JAVAD GNSS, including the receiver's navigational and positioning parameters. The number of BDS satellites used in position computation are appended after the number of GLONASS satellites by ComNav Tech, to support BDS. For more information, please refer to JAVAD GREIS.

Message ID	52
Recommended Input	*log navpos ontime 1*
Supported Format	*ASCII*

Reply (Binary)

```
NP0B6,NAVPOS,V,091255.00,0,AA,{08,05,09},W84,N31o10'27.579537",E121o23
'16.579926",+00053.7719,V,+010.7811,0.68,1.06,0.544,0.737,0.1486,-0.69
91,217.703,N,217.703,0.046,0.063,100.00,999,@28
```

4.4.3 Parameter Messages

Description

Some log commands are designed for requesting and checking system configuration parameters, such as cut-angle, reference mode and so on. To set up a reference station, a group of logs are needed, some examples are demonstrated in *Chapter 5*.

Key words listed in *Table 23. Other Message* could be added after key word ‘log’ to request the corresponding parameters.

4.4.3.1 PJKPARA Parameters Used in Message PTNLPJK

Description

This message is used to check the six parameters used in PTNLPJK message; for detailed information and definition please refer to *Table 16.SET Type and Parameter*.

Message ID	2013
Recommended Input	*log pjkpara*
Supported Format	*ASCII*

Reply (ASCII)

```
A:6378137.000, 1/F:298.257, B0:0.000000deg, L0:120.000000, N0:0.000,
E0:500000.000
```

4.4.4 Command Messages for Weather Instrument (Meteorograph)

Description

These command messages are used to set parameters of ZZ11A Meteorograph, and read information from it.

Setting command messages are as follows:

ZZ11ASETDATE *Set date of ZZ11A Meteorograph*

ZZ11ASETTIME *Set time of ZZ11A Meteorograph*

ZZ11ASETID *Set ID of ZZ11A Meteorograph*

ZZ11ASETAUTOSEND *Set output period of ZZ11A Meteorograph*

Message ID	932, 933, 934, 935
Recommended Input	*log zz11asetdate* *log zz11asettime* *log zz11asetid* *log zz11asetautosend*
Supported Format	*ASCII*

Reading command messages are as follows:

ZZ11AREADDATE *Read date from ZZ11A Meteorograph*

ZZ11AREADTIME *Read time from ZZ11A Meteorograph*

ZZ11AREADID *Read ID of ZZ11A Meteorograph*

ZZ11AREADAUTOSEND Read the output period of ZZ11A Meteorograph

Message ID	936, 937, 938, 939
Recommended Input	*log zz11areaddate* *log zz11areadtime* *log zz11areadid* *log zz11areadautosend*
Supported Format	*ASCII*

Reply (ASCII)

Setting command messages:

```
DATA 2015-09-28 0xCA 0x0D 0x0A

TIME 10:06:40 0xC9 0x0D 0x0A

ID 00004 0xE6 0x0D 0x0A

AUTOSEND 10 0xCD 0x0D 0x0A
```

CHAPTER 5. FREQUENTLY-USED CONFIG PROCEDURES

5.1 SET BAUDRATE OF COM PORT

```
Command 1: com port baudrate
```

NOTICE:

- ☞ PORT TYPE: COM1/COM2/BLUETOOTH/GPRS DEFAULT COM1
- ☞ BAUDRATE: 4800/9600(BLUETOOTH 9600)/19200/38400/57600/115200 (COM1 DEFAULT)

5.2 STOP ALL OUTPUT

```
Command1: unlogall
```

NOTICE:

Shut down all data output

Change dynamic differential data format

5.3 LOG RAW DATA

```
Command1: ecutoff y
Command2: log port rangecmpb ontime z
Command3: log port rawephemb onchanged
Command3: log port bd2rawephemb onchanged
Command4: log port rawalmb onchanged
```

NOTICE:

PORT TYPE: COM1/COM2/COM3/BLUETOOTH DEFAULT CURRENT PORT

ONTIME Z: MAX = 2HZ NORMAL 0.5/1/5/10/15/30/60 S

5.4 START BASE STATION

```
Command1: Log port obsdata ontime x
Command2: Log port refdata ontime x
```

```
Command3: Fix position / Refautosetup on
Command4: Saveconfig
```

NOTICE:

- ☞ PORT TYPE: COM1/COM2/BLUETOOTH/GPRS DEFAULT CURRENT PORT
- ☞ ONTIME X: MAX = 5HZ NORMAL 0.2/1/5/10/15/30/60 S
- ☞ OBSDATA TYPE: RTCM1819B/ RTCM1004B /RTCM1104B /CMROBSB
- ☞ REFDATA TYPE: RTCM3B /RTCM1005B /CMRREFB

5.4.1 RTCM 2.X

Set up reference station in RTCM2 format, outputted from COM1

```
Command1: LOG COM1 RTCM3B ONTIME 5
```

Message 3 outputted from COM1 every 5 second

```
Command2: LOG COM1 RTCM1819B ONTIME 1
```

Message 1819 outputted from COM1 every 1 second

```
Command3: FIX AUTO
```

Fix reference station coordinates in auto mode

```
Command3: FIX POSITION 30.0 150.0 50
```

Fix reference station coordinates in manual mode

```
Command4: SAVECONFIG
```

Save configurations in flash

Description

Just like above example, the way to set up a RTCM2 base station is as below.

LOG TYPE	SYNCH	NOTE
Recommended Input	interfacemode com2 none rtcm	Configure port
	fix position 30.123 121.456 50.789	Identify station position
	log com2 rtcm3b ontime 10	Set position message
	log com2 rtcm1819b ontime 1	Set observables message

5.4.2 RTCM 3.X

Description

Because BD2 differential messages are not involved in RTCMV3 official documents, we define message: 1104 to encode BD2 observations currently.

BD2 differential data not defined in RTCMV3 official documents, so message 1104 may be updated or disabled in the future.

LOG TYPE	SYNCH	NOTE
Recommended	interfacemode com2 none rtcm	Configure port
Input	fix position 30.123 121.456 50.789	Identify station position
	log com2 rtcm1005b ontime 10	Set position message
	log com2 rtcm1104b ontime 1	Set BD2 observables message
	log com2 rtcm1004b ontime 1	Set GPS observables message

Set up reference station in RTCMV3 format, outputted from COM2

```
Command1: LOG COM2 RTCM1004B ONTIME 1
```

Message 1004 outputted from COM2 every 1 second

```
Command2: LOG COM2 RTCM1005B ONTIME 5
```

Message1005 outputted from COM2 every 5 second

```
Command3: FIX AUTO
```

Fix reference station coordinates in auto mode

```
Command4: SAVECONFIG
```

Save configurations in flash

Set up reference station in RTCMV3 using BD2 observations

```
Command1: LOG COM3 RTCM1104B ONTIME 1
```

Message 1104 outputted from COM3 every 1 second

```
Command2: LOG COM3 RTCM1005B ONTIME 5
```

Message 1105 outputted from COM3 every 5 second

```
Command3: REFAUTOSETUP ON
```

Fix reference station coordinates in auto mode

```
Command4: SAVECONFIG
```

Save configurations in flash

5.4.3 CMR

Set up reference station in CMR format, outputted from current port

```
Command1: LOG CMRREFB ONTIME 5
```

Message cmrrefb outputted from current port every 5 second

```
Command2: LOG CMROBSB ONTIME 1
```

Message cmrobsb outputted form current port every 1 second

```
Command3: FIX AUTO
```

Fix reference station coordinates in auto mode

```
Command4: SAVECONFIG
```

Save configurations in flash

Description

The published CMR messages are only about GPS, so currently we could not broadcast BD2 information in CMR format. An example is given below to show how to setup a CMR base station.

LOG TYPE	SYNCH	NOTE
Recommended Input	interfacemode com2 none cmr	Configure port
	fix position 30.123 121.456 50.789	Identify station position
	log com2 cmrrefb ontime 10	Set position message
	log com2 cmrobsb ontime 1	Set observables message

CHAPTER 6. APP CASES & RECOMMENDED CONFIGS

In some applications, a group of commands should be input to configure GNSS cards; this is a tough problem for some users to configure GNSS boards correctly. This chapter introduces these scenes and explains these commands and functions in detail.

6.1 VEHICLE APPLICATION

6.1.1 Precise Positioning for Land Vehicle

RTK configurations for vehicle positioning will be presented in this section.

6.1.2 Vehicle Attitude Determination

In vehicle attitude determination, a normal base station (B0), a main rover station (R1) and a vice-rover station (R2) are involved. B0 is a fixed base station, it broadcasts differential messages to R1. Using B0's differential messages, R1 make a normal RTK calculation, at the same time, R1 sends differential messages to R2, and so R1 is a normal rover station and a moving base station. R2 is a vice rover station. Notice, the base station coordinates in R1's differential messages are changeable, not as B0's.

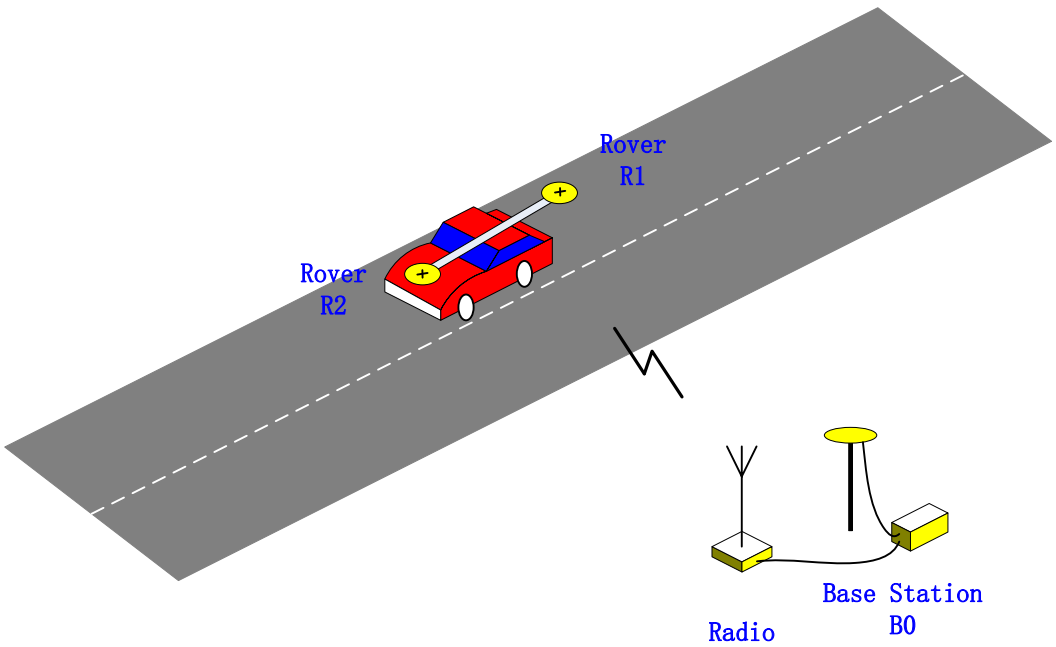


Figure 7. Attitude Determination System

6.2 TIMING

In PVT mode, the precision of PPS is about 20ns. A typical figure is shown below. If higher precision is needed, please contact us.

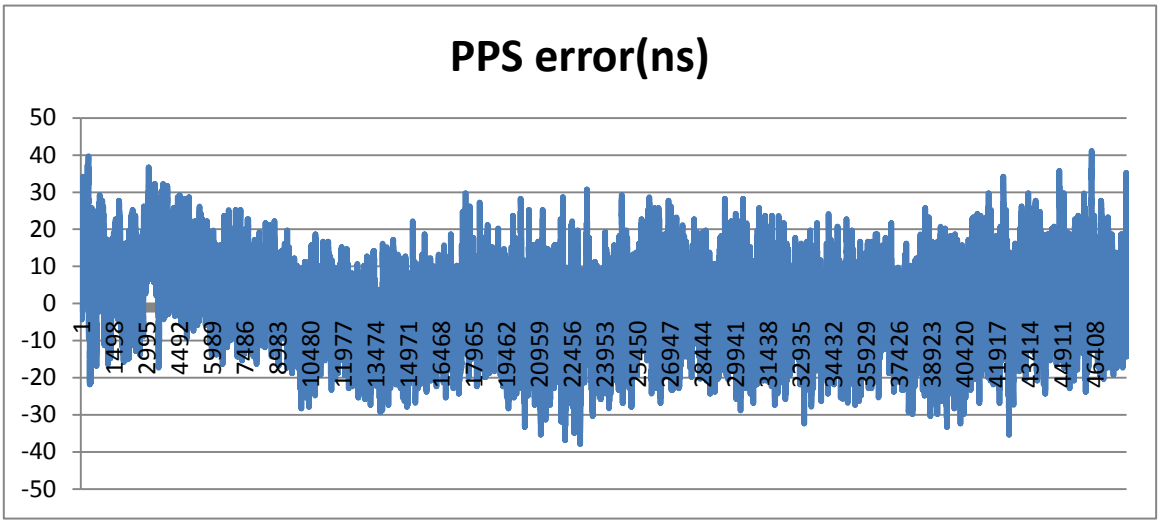


Figure 8. PPS error

6.3 COMMON-VIEW TIME TRANSFER MODE AND SETTING

NOTICE:

Not all kinds of GNSS cards support the common-view time transfer mode, the detailed information about this is needed, please contact with ComNav Technology Ltd.

Setup reference station:

```
Command1: log com2 rtcmcompassb ontime 1

Command2: fix auto
```

Command 1 configures com2 to output message “rtcmcompassb”, which is a self-defined message including position, observations and some hardware information of reference station.

Command 2 configures reference to work on auto-setup mode.

Setup rover station:

```
Command1: interfacemode com2 auto generic on

Command2: set diffmatchmode 100

Command3: rtksolution 1

Command4: log gpcdt ontime 1
```

Command 1 configures com2 to work on auto input mode to confirm differential message type automatically. Currently, the output mode is always 'GENERIC' (refer to Sec. *3.2.11*)

Command 2 configures GNSS cards to work on synchronous mode.

Command 3 configures GNSS cards to work on RTD mode.

Command 4 configures GNSS cards to output message "gpcdt".

If all the settings are configured correctly, the GNSS board who works as a rover station should output message "gpcdt" to indicate the PPS time difference between reference station and rover station. Just like below:

```
$GNCDT,063631.00,1.9,1,-12.5,1,0.0,0,0.0,0*4A
```

If message "gpgga" is logged, the time-lag should be 0, and position status flag should be 2, just like below:

```
$GPGGA,063631.00,3110.4709438,N,12123.2629884,E,2,12,1.6,59.3650,M,0.0
00,M,00,0004*5C
```

6.4 DYNAMIC BASE AND ROVER STATION SETTING – ENABLES THE *USE OF DYNAMIC BASE AND ROVER STATIONS*

NOTICE:

The base and rover station are both in dynamic mode. If the detailed information about this is needed, please contact with ComNav Technology Ltd.

By the dynamic base and rover settings, you can obtain a centimeter-level xyz baseline estimate, and the base station and possibly the rover are dynamic. Unlike the normal RTK application dynamic base station receives the OmniStar corrections for positioning and broadcasts these corrections to the possibly dynamic rover stations. As shown in Figure 9, only one OmniStar is fixed on the dynamic base carrier, and other possibly dynamic rovers can also receive the corrections to enhance the positioning performance. By using this working mode, only one OmniStar is arranged on the dynamic base station. Additionally, the dynamic base station is allowed to transmit the messages without a fixed position.

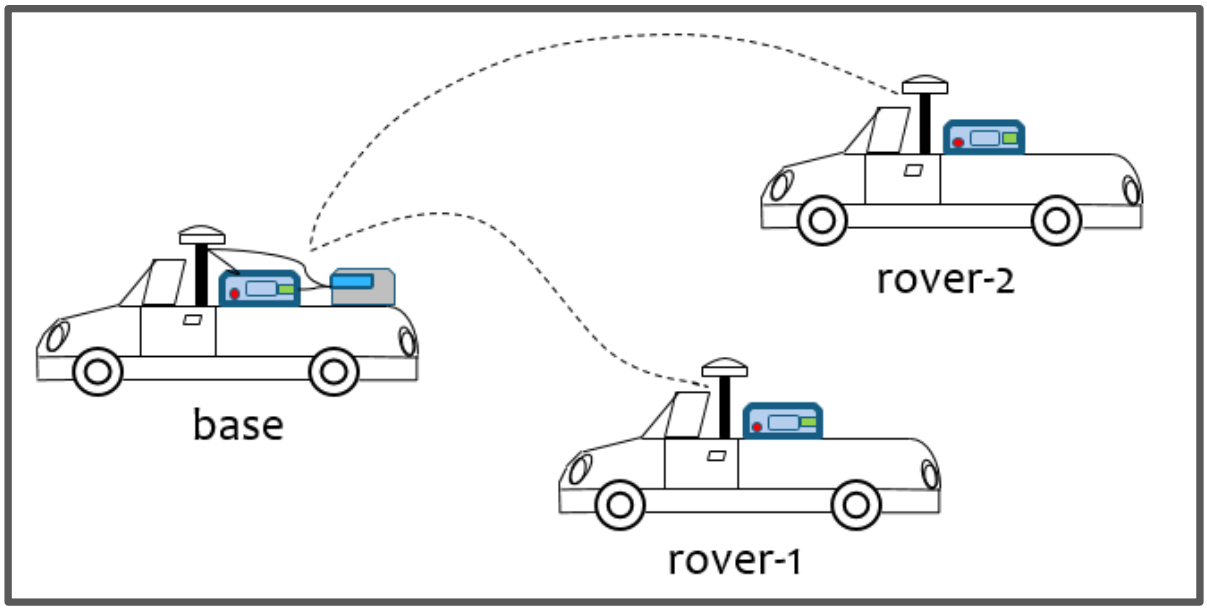


Figure 9 Dynamic Base Station

For the dynamic base and rover station application, the mode settings can be setup in the following steps.

Setup dynamic base station:

1. The dynamic base station is set to receive data in NMEA format:

   `Command1: interfacemode com2 nmea general on`

   Function: set com2 for receiving the NMEA format data.

2. Set the reference station with the external coordinates:

   `Command2: set external coord on`

   Function: use the external coordinates as reference station coordinates for broadcasting.

3. Setup reference station:

   Suggest to use the differential message in Sino data format.

   `Command3: log com3 rtcmcompassb ontime 1`

   `Command4: log com3 rtcmextcoormesb onnew`

Step: Setup the rover station:

Set the differential com and reference station solution mode.

`Command1: interfacemode com2 auto auto on`

`Command2: rtkrefmode 1`

`Command3: set diffmatchmode asynch`

RTK works in asynchronous mode and real time position output with no time delay.

6.5 DYNAMIC BASE STATION

NOTICE:

The base station is in dynamic mode. If the detailed information about this is needed, please contact with ComNav Technology Ltd.

In this application case, two OEM boards with two antennae are used and one of the OEM boards is used for the dynamic base station and the other one is applied as a rover station.

The settings are used to enable or disable a receiver from working with a dynamic base station. In this case, both of the dynamic base and rover stations are fixed on the vehicle where the rover station is static with respect to the dynamic base station.

The dynamic base station is similar to the normal RTK which can provide centimeter-level accuracy position. Corrections can be sent between the dynamic base and rover receivers, where the dynamic base receives the corrections from the fixed base station, which in turn can send corrections to the rover. In addition, the dynamic base station transmits the carrier phase and pseudorange observations to the rover station for attitude determination. The commands of this application must be used to allow the base to transmit messages without a fixed position.

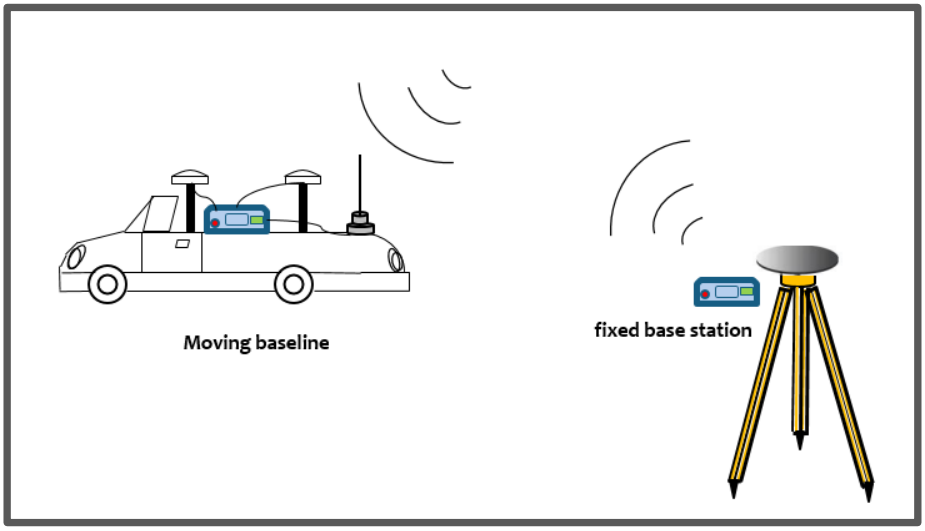


Figure 10 Dynamic Base and relative static rover stations

To setup the dynamic and rover station, the following log messages are recommended to be used when in

Setup dynamic base station:

```
Command1: Interfacemode com2 auto auto on
Command2: Interfacemode com3 auto auto on
Command3: log com3 rtcmcompassb ontime 1
Command4: log com1 gpgga ontime 1
Command5: log com1 heading ontime 1
```

Setup rover station:

```
Command1: interfacemode com3 auto auto on
Command2: Log com3 headingp ontime 1
Command3: rtkrefmode 1
Command4: saveconfig
```

This set of commands allow the base to do the RTK positioning with the fixed station and also display the attitude information to the user. The rover station is used for attitude determination computation and send the results back to the dynamic base station.

APPENDIX A. BINARY COMMANDS

This chapter describes the syntax and usage of board commands defined by ComNav.

A.1 COMMAND FORMATS

A.1.1 ComNav Command Formats

$	$	Cmd	Direct	Len	Data	Cksum	\r	\n

Table 53.Description of Parameters

ITEM	LENGTH	DESCRIPTION
$$	2 bytes	Prompt
Cmd	2 bytes	Command Code
Direct*	1 byte	ID of Source device and Target device
Len*	1 bytes (2 bytes before Ver5.0)	Length of Data
Data	N bytes	Data
Cksum*	1 byte	Checksum
\r\n	2 bytes	Carriage return and line feed. Tail of Command

NOTE:

*** Direct**

The high 4 bits is id of source device, and the low 4 bits is id of target device. All IDs are listed in *Table 55*. For example:

```
@=0x18
```

Where source device id =0001 (PC/PDA COM Port), destination device id=1000 (Data controller).

*** Len**

Only the low 6 bits are used to store the length of data package (exclude prompt '$$' and tail '\r\n').

*** Cksum**

From the first byte of *Cmd* block to the last byte of *Data* block, perform XOR operation one byte by one byte. And the result is checksum.

C++ example:

```
BYTE strStream[MAX_SUM];
BYTE bSum=0;
For(int i=2; i<num; i++)    bSum ^= strStream[i];
```

A.1.2 Error Message List

The board is capable of outputting several responses for various conditions. Most of these responses are error messages to indicate where something is incorrect.

The output format of the messages is dependent on the format of the input command. The responses are always packaged in **ST** message.

Table 54.Response Messages

MESSAGES	DESCRIPTION
Checksum Error	The checksum byte you send is wrong.
No Field	The command you send doesn't exist!
Command Invalid!	The command you call is not available at current condition

A.1.3 Examples of Error Messages

Checksum Error

Description

If you sent a command string with a wrong checksum byte, the response would hint you, Checksum Error.

Send (Hex)

```
24 24 53 49 18 00 03 0d 0a
```

The checksum byte (0x03) is wrong. It should be 0x02.

Reply (Hex)

```
24 24 53 54 81 13 5b 43 68 65 63 6b 20 53 75 6d 20 45 72 72 6f 72 5d 0d
0a 40 0d 0a
```

Checksum Error

No Field

Description

If you sent a command that doesn't exist, the board would reply with a message "No Field".

Send (Hex)

```
24 24 53 53 18 00 18 0d 0a
```

Send "SS" (this command doesn't exist).

Reply (Hex)

```
24 24 53 54 81 0a 4e 6f 20 46 69 65 6c 64 0d 0a c8 0d 0a
```

ST "No Field"

Command Invalid

Description

If you sent a command that is invalid in current condition, the board would reply with a message “Command Invalid”.

Send (Hex)

```
24 24 52 52 18 0018 0d 0a
```

Send “RR” command which is only valid in B20 board.

Reply (Hex)

```
24 24 53 54 81 12 43 4f 4d 4d 41 4e 44 20 49 4e 56 41 4c 49 44 21 0d 0a
84 0d 0a
```

Command Invalid!

A.1.4 Device ID List

ComNav defined a set of id codes for specifying device. These id codes are mainly used in command sentences as a parameter. All of them are listed in the following table.

Table 55.Device ID

CODE (BINARY)	DESCRIPTION

A.2 BINARY COMMON COMMANDS

ComNav common commands, defined by ComNav itself, are sent from remote device to the board to execute operations or to request data reports from boards. All kinds of boards produced by ComNav acknowledge these commands. It does this by sending a corresponding report packet.

This section provides details for each command including their syntax and function, which enables user calling them correctly.

NOTE:

Please pay attention to the **case sensitivity** of command name. For example, the **WC**

command is a totally different command from **Wc**. So are the FS & Fs, SD & Sd.

Some abbreviated terms:

- dir: Direct byte includes the source device id and the target device id
- cksum: Checksum
- Send len : The length of data in send messages
- Reply len: The length of data in reply messages.

3. The reply messages are returned if the command is called correctly. As for the returned error messages, see *A.1.2*.

COMNAV COMMAND LIST

Table 56.Command List

COMMAND	DESCRIPTION
System Command	
SD	Detect the power supply
SG	Shut down board
SI	Request System Information
SJ	Write system information
SR	Request board's working status
SZ	Perform a flash self-examination
File Operation Command	
FC	Erase files
FM	Request the file catalog
FS	Delete a file
FT	Cancel reading file
FW	Read a file
FX	Write point name and antenna height
Memory Operation Command	
MK	Clear one or N memory blocks
Other Operation	
RB	Insert info into data file.
RY	Set differential data format

COMMAND	DESCRIPTION
RS	Indicate the radio signal strength

*** Reserved command** -- these commands are reserved for future. The board could recognize these requests, but would reply without any data.

A.2.1 SG Shut down board

The ***SG*** command is used to shut down the board.

Send

$$	SG	dir		0x01	flag	cksum	\r\n

Reply

$$	ST	dir	0x15	hint	cksum	\r\n

Parameter

Send len = 0x01; reply len = 0x15 (21 bytes)

<*flag*> 1 byte

0	Request to shut down
1	Reply to shut down
2	turn off radio
3	turn on radio
4	Restore the main power

NOTE: 2,3 AND 4 WERE ADDED IN VER5.3.

<*hint*> string

Once closing board successfully, PC/PDA would receive a response “Close the board!”.

The process of shut down is:

Command Style

1. PC/PDA send command SG with parameter 0 to board’s master CPU.
2. Master CPU transmits the command to slave CPU.

3. Slave CPU reply SG command with parameter 1, then shut down the device.

Button Style

1. Master/Slave CPU find the power button is pressed. Then it will inform another CPU by sending command SG with parameter 0.

2. Slave CPU shut down the device.

Example

Send (Hex)

```
24 24 53 47 18 01 000d0d 0a
```

Reply (Hex)

```
24 24 53 54 81 15 43 6c 6f 73 65 20 74 68 65 20 72 65 63 65 69 76 65 72
21 0d 0a 83 0d 0a
```

```
Close the board!\r\n
```

A.2.2 SI Request System Information

The ***SI*** command request board to output all of its system information. You could find the details of system information in Section *2.3*.

Format

$$	SI	dir	0x00	cksum	\r\n

Reply

Package 1

$$	SI	dir	0x37	Info1	cksum	\r\n

Package 2

$$	SI	dir	0x37	Info2	cksum	\r\n

Package 3

$$	SI	dir	0x12	Info3	cksum	\r\n

Parameter

Send len = 0x00; Reply len = 0x37+0x37+0x12 = 0x80 (128 bytes)

<*info*> 128 bytes the system information, see *Table 1*.

Example

Request system information.

Send (Hex)

```
24 24 53 49 18 00 02 0d 0a
```

Reply (Hex)

Package 1:

```
24 24 53 49 81 37 31 39 30 38 20 30 35 32 30 35 33 20 32 30 30 39 2d 31
31 2d 31 32 ffffffffffffffffffff 00 00 38 7b 39 aa 81 7f 00 ff 00 00 00
ffffffff 05 0d 21 37 2e 31 75 0d 0a
```

Package 2:

```
24 24 53 49 81 37 41 ff ff ff 01 00 01 03 00 30 37 30 39 30 32 32 36
ffffffffffffffffffffffffffffffffffff     01     01     fffffff     00
ffffffffffffffffffffffff e6 0d 0a
```

Package 3:

```
24 24 53 49 81 12 ffff 31 31 39 30 38 33 33 34 35 31 fffffffffff 88 0d
0a
```

A.2.3 SJ Write system information

The ***SJ*** command writes system information to board's memory. Please be cautious to calling this command. The board could not work correctly if you wrote improper data in the improper address. You could find the details of system information in Section *2.3*.

NOTE: THE FIRST 32 BYTES COULD NOT BE MODIFIED.

Send

$$	SJ	dir	N+1	begin	data	cksum	\r\n

Reply

$$	SJ	dir	0x00	cksum	\r\n

Parameter

Send len = N+2; Reply len = 0x00

<*begin*> 1 byte the first address, value>31.

<*data*> N bytes data you write

Example

Send (Hex)

```
24 24 53 4a 18 02 32 0a 3b 0d 0a
```

Change the value of Elevation Mask Angle (byte #50) to 0x0a.

A.2.4 SR Request board's status

The ***SR*** command requests two types of status.

Type1 Get Working status

Send

$$	SR	dir	0x00	cksum	\r\n

Reply

Package 1

$$	ST	dir	0x22	status	cksum	\r\n

Package 2

$$	SR	dir	0x00	cksum	\r\n

Parameter

Send len = 0x00; Reply len = 0x22 (34 bytes)

<*status*> string The string describes the working status.

Example

Send (Hex)

```
24 24 53 52 18 00 19 0d 0a
```

Reply (Hex)

Package 1:

```
24 24 53 54 81 22 57 6f 72 6b 4d 6f 64 65 20 3d 20 31 2c 20 45 6d 70 74
79 20 42 6c 6f 63 6b 20 3d 20 46 46 30 3b 0d 0a ab 0d 0a
```

The status string is “WorkMode 1, empty block = FF0;”.

Package 2

```
24 24 53 52 81 00 80 0d 0a
```

Type2 Get Expire status

Send

$$	SR	dir	0x01	flag	cksum	\r\n

Reply

$$	SR	dir	0x22	status	cksum	\r\n

Parameter

Send len = 0x01; Reply len = 0x18 (24 bytes)

<*flag*> byte0—to judge if it has expired; 1—to get the expire date

<*status*> string If you send with flag=0, the response is expired status (0—not expire, 1--expired).Else if you send with flag=1, the response is the expired date.

Example 1

Send (Hex)

```
24 24 53 52 18 01 00 18 0d 0a
```

To judge if it’s out of date

Reply (Hex)

```
24 24 53 52 81 11 45 78 70 69 72 65 64 20 73 74 61 74 75 73 3a 20 30 d8
0d 0a
```

Expired status: 0

Example 2

Send (Hex)

```
24 24 53 52 18 01 01 19 0d 0a    //Get expire date
```

Reply (Hex)

```
24 24 53 52 81 18 45 78 70 69 72 65 64 20 64 61 74 65 3a 20 32 30 31 33
2d 30 37 2d 32 33 e7 0d 0a
```

Expired date: 2013-07-23

A.2.5 FC Erase a file

The ***FC*** command is used to erase a file. The file erased can't be restored.

Send

$$	FC	dir	0x04	file id	cksum	\r\n

Reply

$$	FC	dir	0x00	cksum	\r\n

Parameter

<*file id*> DWORD, 4 bytes. Id of the file to be erased

Example

Send (Hex)

```
24 24 46 43 18 04 00 02 14 55 5a 0d 0a
```

A.2.6 FM Request the File Catalog

The ***FM*** command requests board to send the file catalog.

Send

$$	FM	dir	0x00	cksum	\r\n

Reply

Package 1

$$	FM	dir	0x37	catalog	cksum	\r\n

Package 2 …… Package N

Parameter

Send len = 0x00; Reply len = N

<catalog> BYTE The file catalog. The length of each file is 16 bytes, and the first four bytes is file id.

Example

Send (Hex)

```
24 24 46 4d 18 00 13 0d 0a
```

Reply (Hex)

Package 1

```
24 24 46 4d 81 37 2a 39 e1 8d 40 ff 0b 00 ae 18 00 00 ffffffff 3c 39 e1
8d 40 35 33 36 32 4a 00 00 39 00 00 00 2a 39 e1 8d 7a ff 1f 00 b2 18 00
00 ffffffff 3c 39 e1 8d 7a 35 33 c2 0d 0a
```

Package2…..Package N

Analyze

File 1: **2a 39 e1 8d** 40 ff 0b 00 ae 18 00 00 ffffffff

File 2: **3c 39 e1 8d** 40 35 33 36 32 4a 00 00 39 00 00 00

File 3: **2a 39 e1 8d** 7a ff 1f 00 b2 18 00 00 ffffffff

……

A.2.7 FS Delete a file

The ***FS*** command is used to delete a file. FS command is different from FC that it only set the deleted flag of a file instead of erasing the file from memory. Not available in board of R series.

Send

$$	FS	dir	0x04	file id	cksum	\r\n

Reply

$$	FS	dir	N	data	cksum	\r\n

Parameter

<*file id*> DWORD file id

Example

Send (Hex)

24 24 46 53 18 04 **2a 39 e1 8d**76 0d 0a

Reply (Hex)

```
24 24 46 53 81 00 94 0d 0a
```

A.2.8 FT Exit file-read mode

The ***FT*** command is used to exit the file-read mode.

Send

$$	FT	dir	0x00	cksum	\r\n

Reply

$$	FS	dir	0x00	cksum	\r\n

Example

Send (Hex)

```
24 24 46 54 18 00 0a 0d 0a
```

Reply (Hex)

```
24 24 46 54 81 00 93 0d 0a
```

A.2.9 FW Read a file

The ***FW*** command is used to enter file-read mode. And there is no response for this command.

Send

$$	FW	dir	0x04	fileid	cksum	\r\n

Reply

$$	FW	dir	0x00	cksum	\r\n

Parameter

<*FileId*> DWORD

It's the id of file to be read. Please note that this id must can be found in the file catalog, or this command would fail. See command ***FM*** about outputting file catalog.

Example

Send (Hex)

```
24 24 46 57 18 042a 39 e1 8d 72 0d 0a
```

Reply (Hex)

```
No response!
```

A.2.10 FX Write point name and antenna height

The ***FX*** command is used to write the point name and antenna height.

Send

$$	FX	dir	0x07	ant	ptname	cksum	\r\n

Reply

$$	FX	dir	0x00	cksum	\r\n

Parameter

<*ptname*> string, 5 bytes survey point's name. It's a part of file name.

<*ant*> short Antenna height.

Example

Send (Hex)

```
24 24 46 58 18 0701 01 31 32 33 34 35 3c 0d 0a
```

A.2.11 MK Clear one or N memory blocks

The ***MK*** command is used to clear several flash blocks. If succeed, board would reply with the cleared block's id. Not available in board of R series.

Send

$$	MK	dir	0x03	Block id	Block num	cksum	\r\n

Reply

$$	MK	dir	0x02	Last block	cksum	\r\n

Parameter

Send len = 0x03; Reply len = 0x02

<*Block id*> 2 bytes the first block's id. (0-1023)

<*block num*> 1 byte The number of blocks you will clear

<last block> 1 byte id of the last block you clear.

Example

Clear block 1.

Send (Hex)

```
24 24 4d 4b 18 03 00 01 01 1d 0d 0a
```

Reply (Hex)

```
24 24 4d 4b 81 02 00 01 84 0d 0a
```

A.2.12 RB Insert info into data file

Users could insert some test info into the data file by sending ***RB*** command. Not available in board of R series.

Send

$$	RB	dir	N	Data	cksum	\r\n

Reply

$$	RB	dir	0x00	cksum	\r\n

Parameter

<*data*> string The data you write to board.

Example

Send (Hex)

```
24 24 52 42 18 0d 74 65 73 74 64 61 74 61 31 32 33 34 35 32 0d 0a
Write "testdata12345"
```

Reply (Hex)

```
24 24 52 42 81 00 91 0d 0a
```

A.2.13 RY Set differential data format

The ***RY*** command is used to set the format of differential data and the output port.

Send

$$	RY	dir	0x02	interface	format	cksum	\r\n

Reply

$$	RY	dir	0x00	cksum	\r\n

Parameter

<interface> 1 byte the output port of differential data

0	Board's COM1
1	Board's COM2
2	

<format> 1 byte the format of differential data

0	CMR
1	CMR+
2	RTCM2.0
3	RTCM3.0

Example

Send CMR data to board's COM1.

Send (Hex)

```
24 24 52 59 18 02 00 00 11 0d 0a
```

Reply (Hex)

```
24 24 52 59 81 00 8a 0d 0a
```

A.2.14 RS Indicate the radio signal strength

The ***RS*** command is used to indicate the radio signal strength.

Send

$$	RS	dir	len	level	cksum	\r\n

No Reply

Parameter

Send dir = 0xb8; Send len = 0x01 (1 byte).

<*level*> 1 byte

0	No signal
1~7	Signal Strength Level
8~15	invalid

Example

Send(Hex):

```
24 24 52 53 b8 01 00 b8 0d 0a
```

APPENDIX B. TECHNICAL SPECIFICATIONS

Please refer to ComNav OEM Board Product Specifications:

CNT-OEM-PS001, K500_K501_K501G_K505 OEM Board Product Specification

CNT-OEM-PS002, K502_K508_K528 OEM Board Product Specification

APPENDIX C. FIRMWARE UPDATES

Firmware updates are released on our website after they become available; user could download the newest firmware updates and keep your GNSS cards have a better performance.

NOTICE:

When process of firmware updates is completed, external three seconds should be waited to make sure the GNSS cards accomplish all the internal reconfigurations. Three seconds later, you could turn off the power and restart the GNSS cards to enjoy your new firmware! To confirm firmware have been updated successfully, command “log version” could be used to check the firmware information.