SinoGNSS®
By ComNav Technology Ltd.

COMNAV OEM BOARD REFERENCE MANUAL

APPROVAL SHEET

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2.3	1) New version for K8 series boards. 2) Add definition for Galileo E6C 3) Modify SBASCONTROL command 4) update M911 messsage 5) Update GGA solution status 6) Update GPSEPHEM GPS ephemeris structure，delete RTCM0063 message。 7) Update PRN 8) Update BDS frequency 9) New added commands: a) APPSCENE b) KSXT c) GPNAV d) SCANSPECTRUM e) VECTORLENMODE f) HEADING2	2022/4/20
1.9	1) check errors and correcting 2) Supplement the direction Angle indication in GPNAV in 0	2020-04-16
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	l) QXWZSDKINFOB 2) Add following messages: a) Add theTable 5. GNSS Name and Corresponding PRN b) Add theTable 6. GNSS System c) Add theTable 9. DGNSS Type d) Add theTable 12. SET Type and Parameter e) Add theTable 15. Predefined Log Message f) Add notes to the form in NMEATALKER g) Add the parameters of the table in RTCMDATA1 h) Add the parameters of the table in GPSEPHEM i) Add the parameters of the table in INTERFACEMODE j) Add the parameters and notes of the table in RTKDYNAMICS k) Add the parameters of the table in RTKSOLUTION l) Add the examples of the table in UNDULATION m) Add the notes of the table in RANGECMP 3) Update definition of following commands: a) Modify the satellite channel number b) Modify the parameters of the table in IONUTC c) Modify the format and parameters in RTKQUALITY d) Adjust the time-delay default and maximum values in RTKFIXHOLDTIME e) Adjust the time-delay default values in RTKTIMEOUT 4) Change the contact information of the company 5) Adjust the document format of whole manual, check errors and correcting	
1.5	1) New SET commands: a) Set GPS L2 PRN code type setting in *3.2.32* b) Set GLONASS PRN code type setting on G1 and G2 frequency in *3.2.32* c) Set Auto sending raw data file in *3.2.32* d) Set external coordinates in *3.2.32* e) Set cyclesave switcher fileperiod sampleint eraseint in *3.2.32* f) Set stationmode mode portA portB interval in *3.2.32* g) Set EMMC ON/OFF in *3.2.32* h) Set projectiontype *param1* in *3.2.32* i) Set cp smoother on aa bb in *3.2.32*	2016-06-12

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	j) Set nmeamsgformat in *3.2.32* k) Set GLOPRBIAS gx p1 p2 ……p14\r\n in *3.2.32* l) Set GLOCHANPRBIAS gx chan p in *3.2.32* m) Set GLOPRBIAS DEFAULT in *3.2.32* 2) MARKCONTROL in*3.2.32 3.2.16* 3) MARKPOS in *4.2.4.1*, MARKTIME in *4.2.4.2* 4) Add NEMA data format in *3.2.11* 5) Change command “RTKDYNAMICS mode” in *3.2.21* 6) Add description of RTCM 1033 7) Change the PPS update rate to 10 Hz in *3.2.18* 8) Add DYNAMIC BASE and ROVER STATION SETTINGS 9) Add DYNAMIC BASE STATION SETTING 10) Add RTKQUALITY command in *3.2.32* 11) Add rtcm41 12) Add rtcm42 13) Add descriptions about GLORAWEPHEM in *4.2.1.6* 14) Delete the reply message in the example of SJ 15) Delete the reply message in the example of FX 16) Delete the reply message in the example of FC	
1.4	1) New added commands: a) HEADINGOFFSET in *3.2.10* b) RTKFIXHOLDTIME in *3.2.22* c) RTKSOURCE in *3.2.26* d) SBAS configuration: i. SBASCONTROL in *3.2.30* ii. SBASECUTOFF in *错误!未找到引用源。* iii. SBASTIMEOUT e) A few SET commands in *3.2.32* f) UNDULATION in *3.2.33* 2) Update definition of following commands: a) COM: Port ID in , Baud rate in . b) LOG: added keyword ‘offset’ in *3.2.14* *c)* LOCKOUT: d) *Table 5. GNSS Name and Corresponding PRN*	2015-9-25

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	e) LOCKOUTSYSTEM: f) *Table 6. GNSS System* g) MAGVAR in *3.2.15* h) RTKOBSMODE in *3.2.23* 3) Add *Table 19. Log* Trigger Types. Logs Supporting ONCHANGED and ONTRACKED 4) Updated log messages: a) Correct the message id of BD2RAWEPHEM from '413' to '412' in *4.2.1.4*. b) Append the message definition table for GPSEPHEM in *4.2.1.7*, which is also the definition of BD2EPHEM. c) RAWALM subframe description in *4.2.1.8* d) SATMSG in *4.2.7.3* e) REFSTATION in *4.2.8.1* f) Position or Velocity Type*Table* 26. Position or Velocity Type, 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 record: BINEX00DATA, BINEX0101DATA, BINEX0102DATA, BINEX0105DATA, BINEX7d00DATA, BINEX7e00DATA, BINEX7f05DATA ii. MARKPOS in *4.2.4.1*, MARKTIME in *4.2.4.2* iii. Meteorograph *4.2.5*: METEODATA, METEODATAEXT iv. M925 in *4.2.7.2*, PSRVEL in *4.2.5.6*, SATXYZ in *4.2.7.5* v. SBAS message: RAWSBASFRAME SBAS0, SBAS1, SBAS2, SBAS3, SBAS4, SBAS5, SBAS6, SBAS7, SBAS9, SBAS10, SBAS12, SBAS17, SBAS18, SBAS24, SBAS25, SBAS26, SBAS27, SBAS28 and SBAS63 b) International Standard messages: i. Self-defined NMEA 0183 Sentences: GPNAV in *0*, GPTRA in *0*, GPYBM in *0* ii. RTCM 3.x in :	

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	63 (Test Message, decoded BDS Ephemeris) MSM message: 1074 in *4.3.2.16*, 1084 in *4.3.2.17*, 1124 in *4.3.2.20* iii. BINEX Records: 0x00, 0x01-01, 0x01-02, 0x01-05, 0x7d-00, 0x7e-00, 0x7f-05 c) Other Message: i. Trimble: PTNL,AVR; PTNL,GGK in *4.4.1.2* ii. Command messages for weather instrument (meteorograph) control: ZZ11ASETDATE, ZZ11ASETTIME, ZZ11ASETID, ZZ11ASETAUTOSEND, ZZ11AREADDATE, ZZ11AREADTIME, ZZ11AREADID, ZZ11AREADAUTOSEND 6) Add ComNav binary command *RS*. 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” 4) Add or update following commands in *Chapter 3*: *a)* Update GNSS PRN in b) *Table 5.* GNSS Name and Corresponding PRN. c) Add command NMEATALKER in Section *3.2.17*. d) Add command RTKOBSMODE in Section *3.2.22*. e) Update description of RTKSOLUTION in Section *3.2.25*. *5)* Clarify the classifications of log messages in *0* and update 6) *Table 15. Predefined Log Message*. 7) Add following messages: a) Add GLOEPHEMERIS (B). b) Add GLORAWEPHEM (B). c) Add LOGLIST (A) in Section d) Update REFSTATION (A) to support ASCII output in Section *错误!未找到引用源。*.	2013-1-19

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	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. g) Add RTCM3.x Message 1012, 1019 and 102. h) Add JAVAD NAVPOS[NP] Message。 8) Adjust the document format of whole manual, check errors and correcting.	
1.2K	1) Add velocity type "DOPPLER_VELOCITY" in *Table* 26. Position or Velocity Type. 2) Add description of log message "BD2RAWALM". 3) Add description of log message "HEADING". 4) Update the description 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。 3) Rewording the description of the RTCM messages 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) 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).	2013-06-05
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.	2013-01-09

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1.2B	1) Add a serial log commands to check certain configurations or parameters, in section *4.4.2*.	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 *3.2.32*. 2) Add "SET PVTFREQ" command, in section *3.2.32*. 3) Add "SET RTKFREQ" command, in section *3.2.32*	2012-09-19
1.2A	1) Add "INTERFACEMODE" status in "SAVECONFIG" command 2) Add "CLOCKOFFSET" value in "SAVECONFIG" command; 3) Add notice of firmware updates; 4) Modify pin definition; 5) Add message "GPNTR", use command "LOG" to set output. 6) configure GNSS cards to work on Common-view time transfer mode is descripted. 7) Add message "GPHPR". 8) Add command "RTKREFMODE" in section *3.2.24*.	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" 7) Add command "RTKQUALITYLEVEL mode"	2012-07-01

TABLE OF CONTENTS

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: *sinognss.com* (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*).

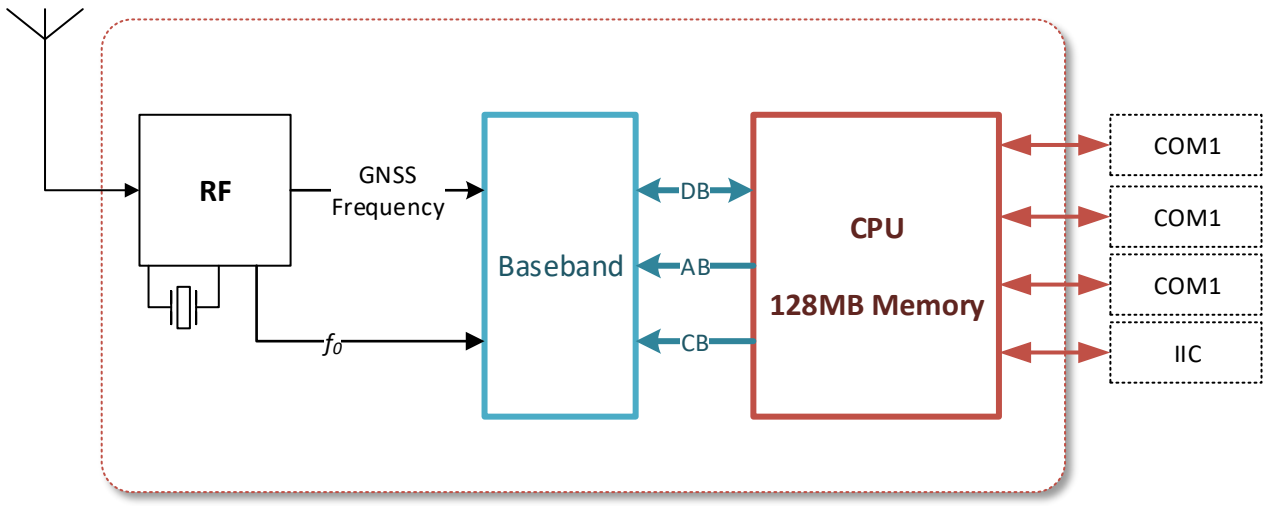


Figure 1. OEM Block Diagram

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

```
#HEADINGA,COM1,0,60.0,FINESTEERING,2034,301375.000,00000000,0
000,1114;SOL_COMPUTED,SINGLE,0.000000000,0.000000000,0.000000
000,0.000000000,180.000000000,90.000000000,"AAAA",18,18,18,18
,0,0,0,0*a3ac87f5
```

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.

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!"

3.2 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 (GPS:1~32,BDS:141~203,GLO:38~61,GAL:71~94, QZSS: 131-140)

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(-90~90 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 2.

baudrate valid value refer to Table 3. Default baudrate:115200.

Example

```
COM COM1 9600
```

Table 2.Port ID

PORT ID
COM1
COM2
COM3
USB
GPRS
COM4

Table 3. 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 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 (-90 ~ 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.

3.2.7 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
```

3.2.8 FRESET Reset to the factory default

Format

```
FRESET
```

Description

This command is used to restore factory settings, clear all message output and parameter settings, clear all saved satellite ephemeris and almanac, and the approximate coordinates of the receiver

Example

```
FRESET
```

3.2.9 FLYCONTROL Detect flying point in dual antenna mode

Format

```
FLYCONTROL <parameter1> < parameter2>
```

Description

This command is used to detect the flying point in dual antenna mode. When the error in the horizontal or vertical direction exceeds the threshold and the duration exceeds 2s, RTK will be automatically initialized to suppress continuous flying points.

Parameters

parameter1	threshold for horizontal, default value=18cm
parameter2	threshold for vertical, default value=30cm

Example

```
FLYCONTROL 18 30
```

3.2.10 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
```

3.2.11 INTERFACEMODE Set receive or transmit modes for ports

Format

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

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 4

input-mode refer to Tabble 4.

output-mode always be GENERIC mode, refer to Table 4

swith on/off

Example

```
INTERFACEMODE COM1 RTCMV3 RTCMV3
```

Table 4. 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
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

MODE NAME	DESCRIPTION	SUPPORT
GENERIC	No limit	Y
AUTO	RTCM, RTCMV3 and CMR are auto switched.	Y
COMPASS	ComNav commands and logs	Y
NEMA	NEMA correction	Y

3.2.12 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.

Parameters

prn PR number of satellite (refer to Table 5).

Example

```
LOCKOUT 10
```

Table 5. GNSS Name and Corresponding PRN

GNSS	PRN
GPS	1~32
GLONASS	38~61
GALILEO	71~203
BDS	141~177
QZSS	131~140

3.2.13 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 6

Example

```
LOCKOUTSYSTEM BD2
```

Table 6. GNSS System

GNSS SYSTEM
GPS
BD2
GLONASS
GALILEO
BD3
QZSS

3.2.14 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 15. Predefined Log Message ~

Table 18. Other Message. *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 19

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.

3.2.15 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 7

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 7. MAGVAR Type

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

3.2.16 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: A constant time bias in nanoseconds can be applied to each event pulse. Typically this is used to account for a transmission delay. Default=0.

Timegaurd: The time guard specifies the minimum number of milliseconds between pulses. This is used to coarsely filter the input pulses. Default=0.

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
```

3.2.17 MAXVECLENERR Set the directional flypoint detection threshold

Format

```
MAXVECLENERR <paramater>
```

Description

This instruction is used to set the threshold of baseline difference during flypoint detection in directional mode.That is, if the difference between the actual calculated baseline length and

the set baseline length is larger than the threshold value, it is considered to be a directional flying point.

Parameters

paramater *The threshold,*The unit is cm and the default value is 8 cm.

Example

```
MAXVECLENERR 12
```

3.2.18 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
```

3.2.19 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
```

3.2.20 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
```

3.2.21 APPSCENE Set application scene

Format

SET APPSCENE *<mode>*

Description

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

Parameters

mode survey/robot/car/air/space.

APPLICATION
Survey
Robot

Car
Air
Space

Example

```
SET APPSCENE SURVEY
```

3.2.22 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 200s and more than 5s, default value is 20s

Example

```
RTKFIXHOLDTIME 15
```

3.2.23 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 8. 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	Reserved
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.

3.2.24 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
```

3.2.25 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: Auto;

1: RTD;

2: Extra-wide;

3: Float;

Example

```
RTKSOLUTION 1
```

3.2.26 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 9. DGNSS Type. If ANY (Default) chosen, the receiver ignores the ID string. Specify a type when using base station IDs.

stn id Base station ID

Table 9. DGNSS Type

ID	TYPE STRING	DESCRIPTION
0	RTCM	RTCM ID: 0 <= RTCM station ID <=1023 or ANY
13	RTCMV3	RTCM Version 3.0 ID: 0 <= RTCMV3 station ID <=4095 or ANY

Example

```
RTKSOURCE AUTO ANY
RTKSOURCE RTCM ANY
// Specify the format before specifying base station ID
RTKSOURCE RTCMV3 5
RTKSOURCE RTCM 4
```

3.2.27 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 200s

Example

```
RTKTIMEOUT 30
```

3.2.28 RTKQUALITYLEVEL Set RTK quality level

Format

```
RTKQUALITYLEVEL <normal/quick/extra-safe>
```

Description

Use this command to select an RTK quality mode.

Parameters

normal/extra-safe/quick normal RTK/*extra-safe RTK*/quick RTK

Quick	Efficiency first, and the fixed rate of the fixed solution is guaranteed as far as possible.
Extra-safe	Quality first, ensuring the reliability of the fixed solution as much as possible.
Normal	*Equilibrium mode.*

Example

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

3.2.29 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 10.

Example

```
SAVECONFIG
```

Table 10. 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
OTHER CONFIGURATION	

3.2.30 SBASCONTROL Control the usage of SBAS corrections

Format

```
SET PVTOBSMODE SBAS

SET SBASSYS <SBASTYPE>
```

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

SBASTYPE refer to Table 11.

Table 11. SBASTYPE

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

```
SET PVTOBSMODE SBAS
SET SBASSYS MSAS
```

3.2.31 INSCONTROL Set onboard IMU

Format

```
INSCONTROL <switch>
```

Description

Use this command to enable/disable onboard IMU.

Parameters

Switch	*"enable"* active onboard IMU.
	"disbale" deactive onboard IMU.

Example

```
IMSCONTROL ENABLE
```

3.2.32 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 12. SET Type and Parameter*.

param refer to *Table 12. SET Type and Parameter*.

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

SET GPS OFF

SET SIGNAL L1CA/L2C/L2P/L5C/L1C ON/OFF

SET SIGNAL L2P OFF

SET SIGNAL B1C/B2a OFF
```

Table 12. 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 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 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:

SYNTAX	PARAMETER	DESCRIPTION
		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 PVTFREQ *Param1*	*Param1* is valid PVT frequency in Hz: 1, 2, 5(default), 10, 20.	ComNav board work in 5hz PVT in default setting, if a higher or lower 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	Notice: please keep RTK frequency is not higher than PVT frequency.

SYNTAX	PARAMETER	DESCRIPTION
	Hz: 1, 2, 5(default), 10.	
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 *3.2.23*.
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*

SYNTAX	PARAMETER	DESCRIPTION
		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 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 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”.	(1)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

SYNTAX	PARAMETER	DESCRIPTION
	PortB: set the communication port for sending differential messages from base station. The parameter is "com1", "com2", "com3". *Interval*: set the time interval for sending the differential messages. The parameter is float pointing.	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* *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*

SYNTAX	PARAMETER	DESCRIPTION
		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* *log gpgga ontime 0.2* *log gptra ontime 0.2* *for the slave station:* *set stationmode master com3 com3 0.2.*
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.
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.

SYNTAX	PARAMETER	DESCRIPTION
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 gx p1 p2……p14	Gx: GLONASS frequency index, valid value=1, 2 P1: channel 1 frequency correction P14: +6 RF settings, unit is mm	Gx=1 rfer to G1 Gx=2 refer to 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 Set both corrections of G1 and G2 in all channels to be 0.
set relayrtcmv3 on/off comX	on/off:switch comX:serial port	Forwarding RTCMV3 differential data
set drtimeout XXX	GNSS+IMU Calculation Duration	Set the calculation time of the GNSS+IMU solution. After the satellite signal loses lock and exceeds the set threshold, the board will exit the combined solution.
set imuaxestype 1/2/3/4/5/6/7/8	1: The front of the OEM module faces up, the y-axis faces the front of the vehicle.	Set axes of OEM module

SYNTAX	PARAMETER	DESCRIPTION
	2: Axes 1 rotates 90 degrees counterclockwise horizontally. 3: Axes 1 rotates 180 degrees counterclockwise horizontally. 4: Axes 1 rotates 180 degrees counterclockwise horizontally. 5: The front of the K8 module faces down, the y-axis faces the front of the vehicle. 6: Axes 5 rotates 90 degrees counterclockwise horizontally. 7: Axes 5 rotates 180 degrees counterclockwise horizontally. 8: Axes 5 rotates 270 degrees counterclockwise horizontally.	
SET CWI AUTO Param1	Param1: 0: disable anti-jamming, default 1: active anti-jamming, channel 1 2: active anti-jamming, channel 2 3: active anti-jamming, channel 1 and 2	Setup anti-jamming mode as auto

<table>
<tr><th>SYNTAX</th><th>PARAMETER</th><th>DESCRIPTION</th></tr>
<tr><td>SET CWI MANUAL Param1 Param2 Param3</td><td>Param1:
Channel ID, refer to right table.
Param2:
0: CWI channel 1, default
1: CWI channel 2
Param3:
0: close, default
1: open</td><td>Setup anti-jamming mode as manual<table><tr><td>Channel id</td><td>frequency</td></tr><tr><td>0</td><td>L5/E5a/B2a</td></tr><tr><td>1</td><td>B2/E5b/B2b</td></tr><tr><td>2</td><td>B1</td></tr><tr><td>3</td><td>L1CA/E1C/B1C</td></tr><tr><td>4</td><td>G1</td></tr><tr><td>5</td><td>L2</td></tr><tr><td>6</td><td>G2</td></tr><tr><td>7</td><td>B3</td></tr><tr><td>8</td><td>L-Band</td></tr></table></td></tr>
<tr><td>SET AE Param1</td><td>Param1:
OFF: close AE
25M: 25M AE
100M: 100M AE, default</td><td>Setup AE</td></tr>
<tr><td>SET SIGNAL Param1 OFF</td><td>Param1:
GPS/GLO/GAL/BD2/BD3/SBAS
OFF: close</td><td>Close GPS/GLONASS/GALILEO/BD2/BD3/SBAS</td></tr>
<tr><td>SET SIGNAL Param1 ON/OFF</td><td>Param1:
L1CA/L2C/L2P/L5C/L1C；
B1I/B2I/B3I；
B1C/B2b/B2a/B2</td><td>Open/close GPS signal
Open/close BD2 signal
Open/close BD3 signal</td></tr>
</table>

SYNTAX	PARAMETER	DESCRIPTION
	E1C/E5b/E5a/E5/E6C； S1C/S5C； G1C/G2C/G3C； ON/OFF: open/close signal	Open/close Galileo signal Open/close SBAS signal Open/close Glonass signal
SET SIGNAL Param1 OFF	Param1: L2C、L2P、L5C、L1C； B2I、B3I； B1C、B2b、B2a、B2； E5b、E5a、E5、E6C； S5C； G2C、G3C； OFF: close the signal	 Close one GPS signal Close one BD2 signal Close one BD3 signal Close one Galileo signal Close one SBAS signal Close one Glonass signal
SET SIGNAL B1C/B2a OFF		Close BD3 signal

Table 13. 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 positioning mode automatically. The decimal number is:
<table>
<tr><th>Position status</th><th>latitude</th><th>longitude</th><th>height</th><th>Undulation</th><th>Differential delay</th></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>
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><th></th><th>latitude</th><th>longitude</th><th>height</th><th>Undulation</th><th>Differential delay</th></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>

3.2.33 VECTORLENMODE Baseline length mode

Format

```
VECTORLENMODE <para>
```

Description

If the baseline length in the scene is fixed, it is recommended to choose mode 2, which can reduce the flying point and improve the fixed rate.

If the baseline length in the scenario is not fixed, select mode 1 and the fixed rate will decrease to some extent.

Parameters

1: moving base mode, baseline length is not fixed;

2: moving base move, baseline length is fixed.

Example

```
VECTORLENMODE 1
```

3.2.34 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 14 Default value is 'EGM96'.

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

Table 14. 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

UNDULATION OSU89B

UNDULATION USER 10.000000000

UNDULATION table
```

3.2.35 SCANSPECTRUM Set Spectrum Sweep Parameters

Format 1

```
SCANSPECTRUM <center-freq> <scan-range> <scan-times>
```

Format 2

```
SCANSPECTRUM <mode>
```

Description

This command is used to setup spectrum sweep parameters.

Parameters

Center-freq: Set scan center frequency

Scan-range: set scan range

Scan-times: Set the number of scan points

Mode: L1/L2/L5, the center frequency is L1, L2, L5 frequency points, the scanning range is 8000KHz, and 200 points are scanned.

Example

```
SCANSPECTRUM 1575420 8000 200
```

3.2.36 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 5. GNSS Name and Corresponding PRN.

Example

```
UNLOCKOUT 10
```

3.2.37 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
```

3.2.38 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 6. GNSS System.

Example

```
UNLOCKOUTSYSTEM BD2
```

3.2.39 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 15. Predefined Log Message ~

Table 18. Other Message.

Example

```
UNLOG VERSIONB
```

3.2.40 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 2.

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 *3.2.14*.

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

FORMAT

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

Field#	Field Name	Field Type	Description	Binary Byte	Binary Offset
7	Reserved			1	7
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 15. Predefined Log Message

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION	REFER TO
1	71	BD2EPHEM	B	BD2 decoded ephemeris information	*4.2.1.1*
2	72	BD3EPHEM	B	BD3 decoded ephemeris information	*4.2.1.2*
3	741	BD2RAWALM	B	BD2 raw almanac	*4.2.1.3*
4	412	BD2RAWEPHEM	B	BD2 Raw ephemeris	*4.2.1.4*
5	42	BESTPOS	A, B	Best position data	*4.2.5.1*
6	99	BESTVEL	A,B, Abb	Best velocity data	*4.2.5.2*

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION	REFER TO
7	241	BESTXYZ	A, B	Position information in xyz.	*4.2.5.3*
8	317	COMCONFIG	A, B	COM configuration Information in ASCII Format	
9	792	GLORAWEPHEM	B	GLONASS raw ephemeris message.	*4.2.1.6*
10	71	GPSEPHEM	B	A single set of decoded GNSS ephemeris whose message ID is different from NovAtel® definition	*4.2.1.7*
11	1122	GALEPHEMERIS	B	Galileo ephemeris parameters	*4.2.1.8*
12	971	HEADING	A, B	Heading angle message	*4.2.3.1*
13	1335	HEADING2	A, B	Multi-rover heading information	*HEADING2*
14	8	IONUTC	A,B, Abb	Ionosphere and UTC parameters	*4.2.7.1*
15	5	LOGLIST	A	Log settings in each port.	*4.2.2.2*
16	925	M925	B	Extended Satellite Information	*4.2.7.2*
17	181	MARKPOS	A, B	Position at time of mark input event	*4.2.4.1*
18	231	MARKTIME	A, B	Time of mark input event	*4.2.4.2*
19	174	PSRDOP	B	DOP of SVs currently tracking	*4.2.5.4*
20	47	PSRPOS	A,B, Abb	Pseudorange Position	*4.2.5.5*
21	100	PSRVEL	A, B	Pseudorange Velocity	*4.2.5.6*
22	43	RANGE	A,B, Abb	Detailed range information	*4.2.6.1*
23	140	RANGECMP	A,B, Abb	Compressed version of the RANGE log	*4.2.6.2*
24	74	RAWALM	B	Raw almanac	*4.2.1.9*
25	41	RAWEPHEM	B	Raw ephemeris	*4.2.1.10*
26	175	REFSTATION	A, B	Base station Position	*4.2.8.1*
27	911	SATMSG	B	Satellite status (defined by ComNav)	*4.2.7.3*
28	48	SATVIS	B	Satellite visibility	*4.2.7.4*
29	270	SATXYZ	A, B	Satellite positions in ECEF Cartesian coordinates	*4.2.7.5*
30	101	TIME	B	Board time information	*4.2.9.1*
31	83	TRACKSTAT	B	Satellite tracking status	*4.2.2.3*
32	37	VERSION	A,B, Abb	Board software and hardware version	*4.2.2.4*

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 16. 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	237	GPHPR	Parameters of Attitude Angles
2	209	GPNTR	Information about navigating to reference station.
3	207	GPTRA	Heading, Pitch and Roll (reserved) Message
4	87	GPYBM	Position, Velocity,, Heading, Pitch and PJK information
5	264	GPNAV	ComNav Navigation Information Message

Table 17. RTCM Message

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION
RTCM 3.X				
1	787	RTCM1004	B	Extended L1/L2 GPS RTK Observables
2	788	RTCM1005	B	RTK Base Station ARP
3	789	RTCM1006	B	Base Station ARP with Height
4	856	RTCM1007	B	Extended Antenna Descriptor and Setup Information
5	857	RTCM1008	B	Extended Antenna Descriptor and Setup Information
6	898	RTCM1010	B	Extended L1-OnlyGLONASS RTK Observables
7	900	RTCM1012	B	Extended L1 & L2 GLONASS Observables
8	893	RTCM1019	B	GPS Ephemerides
9	895	RTCM1020	B	GLONASS Ephemerides
10	999	RTCM1033	B	Receiver and Antenna Descriptors

11	781	RTCM1104	B	Extended B1, B2 or B3 BD2 RTK Observables
12	624	RTCM1074	B	GPS MSM4 — Full PRs and Phase Ranges plus CNR
13	644	RTCM1084	B	GLO MSM4 — Full PRs and Phase Ranges plus CNR
14	674	RTCM1124	B	BDS MSM4 — Full PRs and Phase Ranges plus CNR
15	684	RTCM1114	B	QZSS MSM4
16		RTCM4078	B	A RTCM 3.x Proprietary Message for ComNav

4.1.3.3 Other Message List

Table 18. Other Message

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION
Trimble Proprietary Messages				
1	224	PTNLAVR	A	Time, yaw, tilt, range, mode, PDOP, and number of SVs for Moving Baseline RTK
2	76	PTNLGGK	A	Time, position, position type, and DOP values
3	229	PTNLPJK	A	PJK Position
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.
KSXT Positioning and Heading Data				
1	230	KSXT		KSXT positioning and heading data
Frequency Spectrum Data				

NO	ID	LOG MESSAGE	FORMAT	DESCRIPTION
2	2260	frequency spectrum data		Frequency spectrum data

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 19. Log Trigger Types

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

Table 20. Logs Supporting ONCHANGED and ONTRACKED

NO	ID	LOG MESSAGE	REFER TO
1	8	IONUTC	*4.2.7.1*
2	41	RAWEPHEM	*4.2.1.10*
3	71	BD2EPHEM	*4.2.1.1*
4	175	REFSTATION	*4.2.8.1*
5	412	BD2RAWEPHEM	*4.2.1.4*
6	712	GPSEPHEM	*4.2.1.7*
7	723	GLOEPHEMERIS	*4.2.1.3*

8	792	GLORAWEPHEM	*4.2.1.6*
9	893	RTCM1019	*4.3.2.8*
10	895	RTCM1020	*4.3.2.9*
11	150	RTCM1042	*RTCM1042*
12	901	RTCM1044	*RTCM1044*
13	152	RTCM1045	*RTCM1045*
14	154	RTCM1046	*RTCM1046*

☞ ***NOTE for* Table 20*:***

(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*** 20. 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 *4.2.1.7.*

4.2.1.2 BD3EPHEM BD3 Ephemeris

Description

This message contains the BD3 ephemeris parameters.

Message ID	72
Recommended Input	*log bd3ephemb onchanged*
Supported Format	*binary*

Reply (Binary)

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	BD3EPHEMEM Header	Log Header	uchar	H	0
2	Prn	Satellite PRN number (1-63)	uchar	1	H
3	Valid	Ephemeris reception ID	uchar	1	H+1
4	sattype	Satellite Orbit Type 01 : GEO , 10 : IGOS , 11 : MEO	uchar	1	H+2

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
5	health	Satellite health indicator	uchar	1	H+3
6	URAI	User distance accuracy index	uchar	1	H+4
7	IODE	Issue of data	uchar	1	H+5
8	IODC	Issue of data clock	uchar	1	H+6
9	BRsv0	Reserved	uchar	1	H+7
10	SIF	Signal integrity identification (0 : normal state , 1 : abnormal state)	uchar	1	H+8
11	AIF	System warning sign (0 : This signal SISMAI is effective , 1 : This signal SISMAI is invalid)	uchar	1	H+9
12	BRsv1	Reserved	uchar	1	H+10
13	BRsv2	Reserved	uchar	1	H+11
14	BRsv3	Reserved	uchar	1	H+12
15	BRsv4	Reserved	uchar	1	H+13
16	BRsv5	Reserved	uchar	1	H+14
17	BRsv6	Reserved	uchar	1	H+15
18	toe	Eph time	uint	4	H+16
19	toc	Time of clock-para	uint	4	H+20
20	Delt_A	The deviation of the major axis at the reference time from the reference value	double	8	H+24
21	Dot_A	Rate of change of the major axis	double	8	H+32
22	Delt_n0	The difference between the average angular velocity of the satellite and the calculated value at the reference time	double	8	H+40
23	Dot_n0	The rate of change of the difference between the average angular velocity of the satellite and the calculated value at the reference time	double	8	H+48
24	M0	The Angle of the plane near the reference moment	double	8	H+56
25	e	Eccentricity ratio	double	8	H+64
26	w	Near-geocentric amplitude	double	8	H+72

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
27	Omega0	Longitude of ascending node of orbit plane at weekly epoch	double	8	H+80
28	i0	Inclination angle at ref. times.	double	8	H+88
29	Omega_dot	The rate of the right ascension	double	8	H+96
30	i_dot	The rate of the orbit inclination	double	8	H+104
31	Cuc	Amplitude of the cosine harmonic correction term to the augument of latitude	double	8	H+112
32	Cus	Amplitude of the sine harmonic correction term to the augument of latitude	double	8	H+120
33	Crc	Amplitude of the cosine harmonic correction term to the orbit radius	double	8	H+128
34	Crs	Amplitude of the sine harmonic correction term to the orbit radius	double	8	H+136
35	Cic	Amplitude of the cosine harmonic correction term to the angle of inclination.	double	8	H+144
36	Cis	Amplitude of the sine harmonic correction term to the angle of inclination.	double	8	H+152
37	a0	Deviation coefficient of satellite clock	double	8	H+160
38	a1	Drift coefficient of satellite clock	double	8	H+168
39	a2	Drift rate coefficient of satellite clock	double	8	H+176
40	tgdB1Cp	Group delay differential of the B1C pilot component	double	8	H+184
41	tgdB2ap	Group delay differential of the B2a pilot component	double	8	H+192
42	tgdB1Cd	Group delay differential between the B2C data and pilot components	double	8	H+200
43	CRC	32-bit CRC Code	Hex	4	H+208

4.2.1.3 BD2RAWALM Raw BD2 Almanac

Description

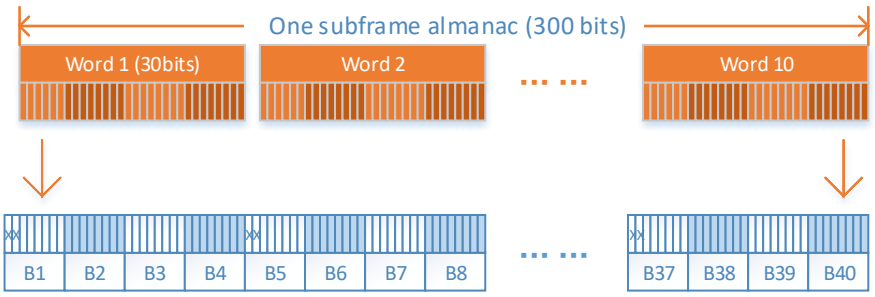
This message contains raw almanac sub frames received from BDS satellites.

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 * 42)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+(42 * subframes)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

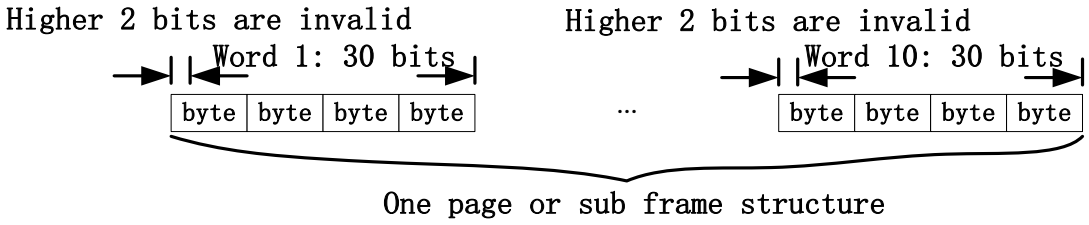
☞ ***Note*. Length of one subframe almanac is 10 words (30 bits per word, MSB first). Subframe 4 Page 1~24 and Subframe 5 Page 1~6 contain 30 frames BDS satellites' almanac (Refer to Beidou-ICD-1.0 table** 5-11-1 and 5-11-2). One word (30 bits) is **split into 4 bytes data (first two bits of 1st byte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



4.2.1.4 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)	-	-	-

4.2.1.5 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 gloephemerisb 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

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
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 (PZ-90.02), in meters/s	Double	8	H+60
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 18	Ulong	4	H+140
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+144

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

Table 21. 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 information within current subframe	0 = Four, 1 = Five
N1 – N7	4 - 31	…	Reserved	

4.2.1.6 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

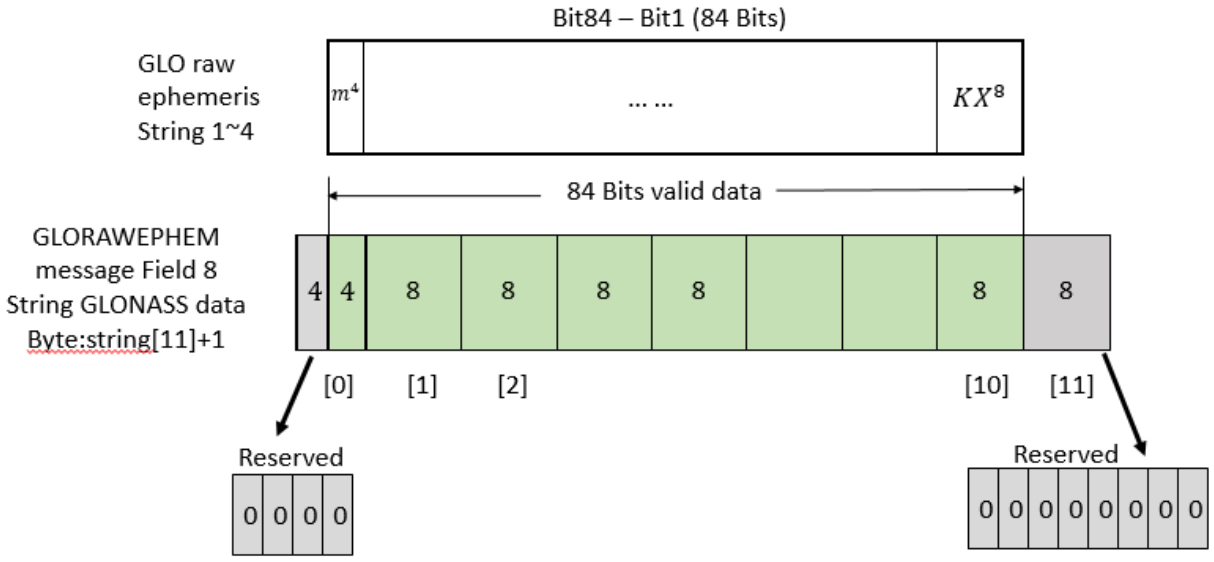
Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
6	time	GPS reference time, in milliseconds (binarydata) or seconds (ASCII data)	Ulong	4	H+12
7	#recs	Number of records to follow	Ulong	4	H+16
8	string	GLONASS data string	Uchar[]	11	H+20
9	Reserved		Uchar	1	H+31
10	Next record offset = 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 following figure.

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.



4.2.1.7 GPSEPHEM GPS Ephemeris

Description

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

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

Reply (Binary)

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	GPSEPHEMEMB/BD2EPHEMEM Header	Log Header		H	0
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 (1~203), GPS: 1~32, BDS: 141~203, Galileo: 71~106	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 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	Time drift (s)	double	8	H+40

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
17	af1	Time speed (s)	double	8	H+48
18	af0	Time offset (s)	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
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 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	tgd3	B1C pilot component (BD3 only)	double	8	H+200
37	tgd4	B1a pilot component (BD3 only)	double	8	H+208
38	tgd5	B2b full latency (BD3 only)	double	8	H+216
39	CRC	32-bit CRC Code	Hex	4	H+224

4.2.1.8 GALEPHEMERIS Galileo Ephemeris

Description

This message contains the Galileo ephemeris parameters.

Tips: Currently the onchanged mode is not supported, only the ontime mode is supported.

Message ID	*1122*
Recommended Input	*log galephemb ontime 60*
Supported Format	*binary*

Reply (Binary)

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
1	GALEPHEMERISB Header	Log Header		H	0
2	SatId	Satellite identifier（1-36）	Ulong	4	H
3	FNAVReceived	Indicates FNAV almanac data received 0: No F/NAV ephemeris has been received 1: F/NAV ephemeris data is received		4	H+4
4	INAVReceived	Indicates INAV almanac data received 0: No I/NAV ephemeris has been received 1: I/NAV ephemeris data is received	BOOL	4	H+8
5	E1BHealth	E1B health status bits (only valid if INAVReceived is TRUE)	Uchar	1	H+12
6	E5aHealth	E5a health status bits(only valid if FNAVReceived is TRUE)	Uchar	1	H+13
7	E1bHealth	E5b health status bits (only valid if INAVReceived is TRUE)	Uchar	1	H+14
8	E1BDVS	E1B data validity status (only valid if INAVReceived is TRUE)	Uchar	1	H+15
9	E5aDVS	E5a data validity status (only valid if FNAVReceived is TRUE)	Uchar	1	H+16
10	E5bDVS	E5b data validity status (only valid if	Uchar	1	H+17

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
		INAVReceived is TRUE)			
11	SISA	Signal inspace accuracy (unitless)	Uchar	1	H+18
12	Reserved		Uchar	1	H+19
13	IODNav	Issue of data ephemeris	Ulong	4	H+20
14	T0e	Ephemeris reference time (s)	Ulong	4	H+24
15	RootA	square root	Double	8	H+28
16	DeltaN	Mean motion difference from computed value	Double	8	H+36
17	M0	Mean anomaly at ref time (radians)	Double	8	H+44
18	Ecc	Eccentricity (dimensionless)	Double	8	H+52
19	Omega	Argument of perigee (radians)	Double	8	H+60
20	Cuc	Amplitude of the cosine harmonic correction term to the augument of latitude	Double	8	H+68
21	Cus	Amplitude of the sine harmonic correction term to the augument of latitude (radians)	Double	8	H+76
22	Crc	Amplitude of the cosine harmonic correction term to the orbit radius (m)	Double	8	H+84
23	Crs	Amplitude of the sine harmonic correction term to the orbit radius (m)	Double	8	H+92
24	Cic	Amplitude of the cosine harmonic correction term to the angle of inclination (radians)	Double	8	H+100
25	Cis	Amplitude of the sine harmonic correction term to the angle of inclination (radians)	Double	8	H+108
26	I0	Inclinationangle at ref time (radians)	Double	8	H+116
27	IDot	Rate of inclinationangle (radians/s)	Double	8	H+124
28	Omega0	Longitude of ascending node of orbital plane at weekly epoch(radians)	Double	8	H+132
29	OmegaDot	Rate of right ascension(radians/s)	Double		H+140

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
30	FNAVT0c	Clock difference parameter reference time(only valid if FNAV Received is TRUE)	Double	8	H+148
31	FNAVAf0	SV clock bias correctioncoefficient from the F/NAV message (s)	Ulong	4	H+152
32	FNAVAf1	SV clock drift correctioncoefficient from the F/NAV message (s/s)	Double	8	H+160
33	FNAVAf2	SV clock drift rate correctioncoefficient from the F/NAV message (s/s^2)	Double	8	H+168
34	INAVT0c	Clock difference parameter reference time(only valid if INAV Received is TRUE)	Double	8	H+176
35	INAVAf0	SV clock bias correctioncoefficient from the I/NAV message (s)	Double	8	H+180
36	INAVAf1	SV clock drift correctioncoefficient from the I/NAV message (s/s)	Double	8	H+188
37	INAVAf2	SV clock drift rate correctioncoefficient from the I/NAV message (s/s^2)	Double	8	H+196
38	E1E5aBGD	E1, E5a broadcast group delay	Double	8	H+204
39	E1E5bBGD	E1, E5b broadcast group delay(only valid if INAV Received is TRUE)	Double	8	H+212
40	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+220
41	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 22. Signal Type

ASCII	SIGNAL TYPE	DESCRIPTION
10433	GALE1	Galileo E1
10466	GALE5A	Galileo E5A
10499	GALE5B	Galileo E5B
10532	GALALTBOC	Galileo ALT-BOC
10565	GALE6C	Galileo E6C
10572	GALE6B	Galileo E6B

ASCII	SIGNAL TYPE	DESCRIPTION
14753	QZSS L1CA	QZSS L1 C/A -code
14760	QZSS L1Cp	QZSS L1C P-code
14787	QZSS L2CM	QZSS L2 C/A-code
14891	QZSS L6P	QZSS L6P

4.2.1.9 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
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)	-	-	-

4.2.1.10 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 Configuration and Status

4.2.2.1 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)	-	-	-

4.2.2.2 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 2.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
	xxxx	32-bit CRC	Hex
	[CR][LF]	Sentence terminator (ASCII only)	-

4.2.2.3 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 *Table25*)	Enum	4	H

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
3	pos type	Position type (refer to *Table26*)	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 5.)	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 29)	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)				
	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+16+ (#chans x 40)
	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.2.4 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 5*)	Char[]	16	H+8
5	PSN	Product serial number (refer to *Figure 6*.)	Char[]	16	H+24
6	Hw version	Hardware version (refer to *figure 7*)	Char[]	16	H+40
7	Sw version	Software *version* (refer to figure 8)	Char[]	16	H+56
8	Boot version	Boot code version	Char[]	16	H+72
9	Comp date	Firmware compile date (refer to table 24)	Char[]	12	H+88
10	Comp time	Firmware compile time (refer to table 24)	Char[]	12	H+100
11	CRC	32-bit CRC	Hex	4	H+112

***Figure 5*. Model**

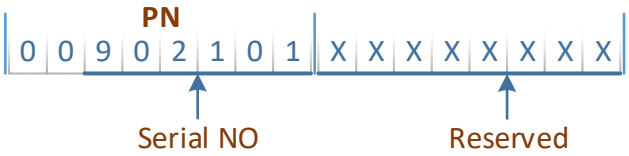


***Figure 6*. Product Serial No.**

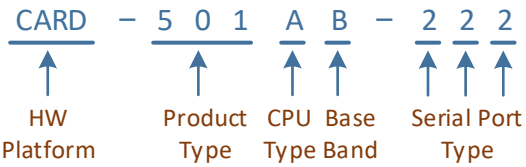


***Figure 5*. Model**

***Figure 7*. Hardware (HW) Version**

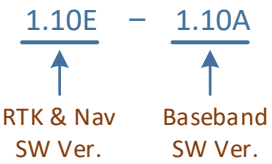


***Figure 8*. Software (SW) Version**

Table 23. Serial Port Type

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

Table 24. Compile Date and Time

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

4.2.3 Heading, Pitch and Roll Messages

4.2.3.1 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 headinga ontime 1*
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 *Table25*	Enum	4	H
3	pos type	Position type, see *Table26*	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	Uchar	1	H+43

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
		are unknown. See *Table27*			
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.3.2 HEADING2 Multi-rover Heading Information

Description

This message contains the heading information between the base station and the rover station, and is often used in dual board heading RTK. This message command is similar to the HEADING message, but has an additional rover ID field. HEADING2 refers to the heading between the dual antenna receiver's master antenna (Master ANT) and the base station's GNSS antenna.

Message ID	*1335*
Recommended Input	*log heading2a ontime 1*
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 *Table25*	Enum	4	H
3	pos type	Position type, see *Table26*	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	pitch std	Pitch standard deviation in degrees	Float	4	H+28
10	rover stn ID	Base station ID string	Char[4]	4	H+32
11	Master stn ID	Master station ID string	Char[4]	4	H+36
12	#SVs	Number of observations tracked	Uchar	1	H+40
13	#solnSVs	Number of satellites in solution	Uchar	1	H+41

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
14	#obs	Number of satellites above the elevation mask	Uchar	1	H+42
15	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+43
16	Reserved		Uchar	1	H+44
17	ext sol stat	Extended solution status (default: 0)	Uchar	1	H+45
18	Reserved		Uchar	1	H+46
19	sig mask	Signals used mask - if 0, signals used in solution are unknown. See *Table27*	Uchar	1	H+47
20	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
21	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.4 Mark Event Messages

4.2.4.1 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 *Table25*)	Enum	4	H
3	pos type	Position type (refer to *Table26)*	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
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 *Table27*	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.4.2 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 *Table35*.	Enum	4	H+36
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+40
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.5 Position and Velocity Messages

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

4.2.5.1 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 *Table25*)	Enum	4	H
3	Pos type	Position type (refer to *Table26*)	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 *Table27*			
23	CRC	32-bit CRC Code	Hex	4	H+72

Table 25. 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
19	INVALID_FIX	The fixed position, entered using the FIX positioncommand, is not valid

Table 26. 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
35	FIX_DERIVATION	Derivation 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
64	OMNISTAR_HP	Positioning solution
65	OMNISTAR_XP	Positioning solution
68	PPP_CONVERGING	Converging TerraStar-C, TerraStar-C PRO or TerraStar-X solution
69	PPP	Converged PPP solution

70	OPERATIONAL	Solution accuracy is within UA Loperational limit
71	WARNING	Solution accuracy is outside UAL operational limit but within warning limit
72	OUT_OF_BOUNDS	Solution accuracy is outside UAL limits

☞ ***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 27. 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

4.2.5.2 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 *Table25*	Enum	4	H
3	vel type	Velocity type, see *Table26*	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)	-	-	-

4.2.5.3 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 *Table25*	Enum	4	H
3	pos type	Position type, see *Table26*	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 *Table25*	Enum	4	H+44
11	vel type	Velocity type, see *Table26*	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

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
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 *Table27*	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.5.4 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

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

4.2.5.5 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 *Table25*)	Enum	4	H
3	pos type	Position type (refer to *Table26*)	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

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
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 *Table27*.	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.5.6 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;SOL_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 *Table25*	Enum	4	H
3	vel type	Velocity type, see *Table26*	Enum	4	H+4
4	latency	A measure of the latency in the velocity time tag in	Float	4	H+8

Field#	Field Type	Data Description	Format	Binary Bytes	Binary Offset
		seconds. It should be subtracted from the time to 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

4.2.6 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.

4.2.6.1 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

Field#	Field Type	Description	Format	Binary Byte	Binary Offset
3	PRN/ slot	Satellite PRN number of range measurement	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-status	Tracking status (see table 29)	ULong	4	H+44
13	Next PRN offset = H + 4 + (#obs x 44)				
	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#obs x 44)
	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.6.2 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)

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

Field#	Field Type	Description	Format	Binary Byte	Binary Offset
	header				
2	# obs	Number of observations with information	Ulong	4	H
3	1st range record	Compressed message format see Annotation a (RANGECMP only)	Hex	4	H+4
4	Next PRN offset = H + 4 + (#obs x 44)				
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#obs x 24)
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Annotation:

a. Compressed Message Format

DATA	BIT(S) FIRST TO LAST	LENGTH (BITS)	SCALE FACTOR	UNITS
Channel Tracking Status	0-31	32	See table 29	-
Doppler Frequency	32-59	28	1/256	Hz
Pseudorange (PSR)	60-95	36	1/128	m
Accumulated Doppler Range (ADR)[a]	96-127	32	1/256	cycles
StdDev-PSR	128-131	4	See Annotation [c]	m
StdDev-ADR	132-135	4	(n + 1)/512	cycles
PRN/Slot[c]	136-143	8	1 (See Table 28)	-
Lock Time[d]	144-164	21 (maximum: 2,097,151)	1/32	s
C/No[e] **(valid range: 20-51 dB-Hz)**	165-169	5	(20 + n)	dB-Hz
Reserved	170-191	22		

☞ ***b.*** ADR (Accumulated Doppler Range) is calculated as follows:

ADR_ROLLS = (RANGECMP_PSR / WAVELENGTH + RANGECMP_ADR) / MAX_VALUE
Round to the closest integer
IF (ADR_ROLLS ⩽ 0)
ADR_ROLLS = ADR_ROLLS - 0.5
ELSE

ADR_ROLLS = ADR_ROLLS + 0.5

At this point integerise ADR_ROLLS

CORRECTED_ADR = RANGECMP_ADR (MAX_VALUE*ADR_ROLLS)

ADR has units of cycles,MAX_VALUE= 8388608

GPS L1:WAVELENGTH = 0.1902936727984

GPS L2:WAVELENGTH = 0.2442102134246

GLONASS satellites emit L1and L2 carrier waves at a satellite-specific frequency, refer to the GLONASS section of AnIntroductionto GNSS available on our website

☞

c. StdDev-PSR Values

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

☞ ***d.***Number of seconds of continuous tracking (no cycle slipping) This field is constrained to a maximum value of 2,097,151which represents a lock time of 65535.96875s (2097151/32).

☞ ***e.***Carrier to noise density ratio The C/No is constrained to a value between 20-51dB-Hz. Thus, if it is reported that C/No = 20dB-Hz, the actual value could be less. Likewise, if it is reported that C/No = 51, the true value could be greater.

Table 28. PRN Definition in Binary Message

GNSS	PRN	OFFSET
GPS	1~32	0
GLONASS	38~61	37
SBAS	120~138	0
BD2	141~177	140
Galileo	1~36	0
QZSS	131~140	-62

Table 29. 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 30. 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 31. Channel Tracking

NIBBLE #	BIT #	MASK	DESCRIPTION	RANGE VALUE
N0	0	0x00000001	Tracking state	Refer to Table 29
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010		

NIBBLE #	BIT #	MASK	DESCRIPTION	RANGE VALUE
	5	0x00000020	SV channel number	0-n (0 means first, n means last) The value of n depends on the receiver
	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	0-7, refer to Table 30
	14	0x00004000		
	15	0x00008000		
N4	16	0x00010000	Satellite system	0 = GPS 1= GLONASS 2 = SBAS 3 = GALILEO 4 = BD2 5-6 = Reserved 7 = Other
	17	0x00020000		
	18	0x00040000		
	19	0x00080000	Reserved	
N5	20	0x00100000	Grouping	0 = Not grouped, 1 = Grouped
	21	0x00200000	Signal type	Dependent on satellite system above: GPS: 1= L1 C/A 2= L5 5= L2 P 9= L2 P codeless 14= L5Q 17 = L2C GLONASS:
	0	0x00400000		
	1	0x00800000		
N6	2	0x01000000		
	3	0x02000000		

NIBBLE #	BIT #	MASK	DESCRIPTION	RANGE VALUE
				0= L1 C/A 1= L2 C/A 5= L2 P Galileo: 1=E1B 2+E1C 7=E6C 12=E5a Q 17=E5b Q 20=AltBOC Q BDS: 0= B1 C/A 17= B2 C/A 2= B3 C/A 8= B1C 12= B2a 17= B2b QZSS: 0= L1 C/A 14= L5Q 17 = L2C SBAS: 0 = L1 C/A 6=L5I Other: 19 = OmniSTAR
	4	0x04000000	Forward Error Correction	0 = Not FEC, 1 = FEC
	5	0x08000000	Primary L1 channel	0 = Not primary, 1 = Primary
N7	6	0x10000000	Carrier phase measurement	0 = Half Cycle Not Added, 1 = Half Cycle Added
	7	0x20000000	Reserved	
	8	0x40000000	PRN lock flag	0 = PRN Not Locked Out 1 = PRN locked Out

NIBBLE #	BIT #	MASK	DESCRIPTION	RANGE VALUE
	9	0x80000000	Channel assignment	0 = Automatic, 1 = Forced

4.2.7 Satellite Measurements

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

4.2.7.1 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 =	Ulong	4	H+92

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
		1 and Saturday = 7)			
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
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+(#prn*44)
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

4.2.7.2 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: 0x13)	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	Byte	1	H+5

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
		which might be sent with an interval, controlled by a flag			
8	Fre Flag	Frequence Flag1, refer to Table 32	Byte	1	H+6
9	Fre Flag2	**Frequence Flag2, refer to Table 33Table 32. Frequency Flag (Version 4)**	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 *26***	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* 33. Frequency Health Flag 1	Byte	1	H+56
26	FreqHealth2	Signal Frequency Helth Flag 2, refer to *Table 34.* Frequency Health Flag 2	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

Field #	Field Type	Data Description	Format	Binary Byte	Binary Offset
29	GPRS status	GPRS connection status, refer to *Table* 35. GPRS Connection Status	Byte	1	H+60
30	Reserved		Byte	1	H+61
31	Reserved		Byte	1	H+62
32	Reserved		Byte	1	H+63
33	Reserved	24 bytes reserved			H+64
34	PRN	Satellite ID, Refer to Table 5	Byte	1	H1(= H+88)
35	Azimuth	Degree (°)	Short	2	H1+1
36	Elevation	Degree (°)	Byte	1	H1+3
37	L1 Status	Frequency status about L1, refer to Table	Byte	1	H1+4
38	L1 SNR	L1 signal noise ratio	Byte	1	H1+5
39	L1 RMS	L1 RMS	Byte	1	H1+6
40	L1 Lost Counter	L1 track lost counter	Byte	1	H1+7
41	Next Fre Infor	May be L2 Infor, according to fre-flag		4	H1+8
42	Next Fre Infor	May be L5 infor, according to fre-flag		4	H1+12
43	Next Sat Offset: H1 + Sat × (4 + Fre No*4), where H1 = H+64 (Ver: 0x03)				
44	CRC	32-bit CRC Code	Hex	4	H1+Sat ×(4+Fr eNo*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 32. Frequency Flag (Version 4)

BIT	DESCRIPTION
BIT7	Reserved
BIT6	Reserved
BIT5	Reserved
BIT4	B2A
BIT3	B1C
BIT2	L5 /B3I/G3/E5a
BIT1	L2 /B2I/G2/E5b
BIT0	L1 /B1I/G1/E1

Table 33. 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	

BIT	DESCRIPTION	VALUE
BIT2	GPS L5	
BIT1	GPS L2	
BIT0	GPS L1	

Table 34. Frequency Health Flag 2

BIT	DESCRIPTION	VALUE
BIT7	QZSS Q3	
BIT6	QZSS Q2	
BIT5	QZSS Q3	
BIT4	BD3 B2A	0: healthy
BIT3	BD3 B1C	1: unhealthy
BIT2	Galileo E3	
BIT1	Galileo E2	
BIT0	Galileo E1	

Table 35. 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

4.2.7.3 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: 8, 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 (i.e. electric quantity), one byte* defined in *4.2.7.2 M925*	Byte	1	H+4
7	Fre Flag	Frequency flag, refer to Table 36	Byte	1	H+5
8	PRN	Satellite ID (1~177), Refer to Table 5	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 37	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 + 6 + Sat × (4 + Fre No*4)				
18	CRC	32-bit CRC Code	Hex	4	H+10+Sat*

Field#	Field Type	Data Description	Format	Binary Byte	Binary Offset
					(4+FreNo* 4)

Table 36. 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 37. 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

4.2.7.4 SATVIS Satellite Visibility

This message contains satellite visibility information such as Mask angle 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
12	Next satellite offset = H+12+(#sat*40)				
13	CRC	32-bit CRC	Hex	4	H+12+(#sat*40)

4.2.7.5 SATXYZ Satellite Positions in ECEF Cartesian Coordinates

Description

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

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	Reserved	Double	8	H
3	#sat	Number of satellites	Ulong	4	H+8
4	PRN/slot	PRN of range measurement, refer to Table 5	ULong	4	H+12
5	X	Satellite X co-ordinates (ECEF,m)	Double	8	H+16
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	Reserved	Double	8	H+64
12	Reserved2	Reserved	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)	-	-	-

4.2.8 Station Information

4.2.8.1 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
```

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 toTable 38)	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 39)	Enum	4	H+32
8	stn ID	Base station ID	Char[5]	8[a]	H+36
9	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
10	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In binary format messages, add an extra 3 bytes of padding to keep 8 bytes aligned.

Table 38. Base Station Status

Bit #	Mask	Description	Bit = 0	Bit = 1
0	0x00000001	Validity of the base station.	Valid	Invalid

Table 39. Base Station Type

Base Station Type (Binary)	(ASCII)	Description
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

4.2.9 Time Messages

4.2.9.1 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 40.	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 40. 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

Field#	Structure	Description	Symbol	Example
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) 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	x	1
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)

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

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) BDS 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, refer to table 5.	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 seconds)	hhmmss.ss	173653.00

Field#	Structure	Description	Symbol	Example
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 BDS

```
$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) BDS 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, refer to table 5.	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
9	… … …	Next satellite PRN number, elev, azimuth, SNR, ... Last satellite PRN number, elev, azimuth, SNR,		
10	*xx	Checksum	*hh	*72
11	[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 BDS

```
$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) BDS

```
$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:	a	N

Field#	Structure	Description	Symbol	Example
		N = North, S = South		
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 track 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

Field#	Structure	Description	Symbol	Example
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
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 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 6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 =Super wide-lane mode 9 = SBAS	q	4
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]

4.3.1.2.2 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]

4.3.1.2.3 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	l	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

Field#	Structure	Description	Symbol	Example
10	*xx	Checksum	*hh	*12
11	[CR][LF]	Sentence terminator		[CR][LF]

4.3.1.2.4 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,+121.398934274,15.286,346.84
0,1.290,0.000,-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
3	utc	UTC time	HHMMSS.SS
4	Lat	Latitude, in degrees	+: north, -: south; ddd.mmmmmmmmmmm
5	Lon	Longitude, in degrees	+: east, -: west; ddd.mmmmmmmmmmm
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)

Field#	Structure	Description	Format
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
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	Station ID	reference station id	0000
22	Baseline length	distance between master station and slave station (baseline length between two antennas)	.xxx (m)
23	solution sv	number of satellites that anticipate in calculation of slave station	
24	rolling	Only supported by board and overall units which contain inertial module	.xxx (deg)
25	*xx	Checksum	*hh
26	[CR][LF]	Sentence terminator	

4.3.1.2.5 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 second	BDS vs UTC, empty as invalid	x	2
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,	.xxx	58.991

Field#	Structure	Description	Symbol	Example
		negative from horizontal surface to downword, -90~90 deg		
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 Universe (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 (The first letter is the master station and the second is the slave station. The two states are not left blank whether the message is output from the master station or from the slave station. V: Valid, N: Not Valid): NV, VN, NN, VV	XX	NV
21	System Mask	GNSS systems used in solution GPS: 1(0x01, 00000001), GLO: 2(0x02, 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 +	x	5

Field#	Structure	Description	Symbol	Example
		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		

4.3.2 RTCM 3.X message

4.3.2.1 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.

4.3.2.2 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.

4.3.2.3 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.

4.3.2.4 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.

4.3.2.5 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.

4.3.2.6 RTCM1010 Extended L1-Only GLONASS Observations

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.

4.3.2.7 RTCM1012 Extended L1 & L2 GLONASS Observations

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.

4.3.2.8 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.

4.3.2.9 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.

4.3.2.10 RTCM1042 BDS Ephemerides

Description

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

Message ID	150
Recommended Input	*log rtcm1042b ontime 5*
Supported Format	*Binary*

Reply (Binary)

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

4.3.2.11 RTCM1044 QZSS Ephemerides

Description

This message is a standard log of RTCM3 which contains QZSS satellite ephemeris information.

Message ID	*901*
Recommended Input	*log rtcm1044b ontime 5*
Supported Format	*Binary*

Reply (Binary)

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

4.3.2.12 RTCM1045 Galileo F/NAV Ephemerides

Description

This message is a standard log of RTCM3 which contains Galileo F/NAV satellite ephemeris information.

Message ID	*152*
Recommended Input	*log rtcm1045b ontime 5*
Supported Format	*Binary*

Reply (Binary)

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

4.3.2.13 RTCM1046 Galileo I./NAV Ephemerides

Description

This message is a standard log of RTCM3 which contains GLONASS satellite ephemeris information.

Message ID	*154*
Recommended Input	*log rtcm1046b ontime 5*
Supported Format	*Binary*

Reply (Binary)

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

4.3.2.14 RTCM1033 Receiver and antenna information

Description

This message is a standard log of RTCM3 which contains receiver and antenna information.

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.

4.3.2.15 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.

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.

Table41. BD2 RTK Message

Message Type	Message Contents	ID
Observations	BD2 B1/B2/B3 observables	1104

Table 42. BD2 RTK Message Data Field

DF #	DF Name	DF Range	DF Resolution	Data Type	DF Notes
DF001	Reserved				

DF #	DF Name	DF Range	DF Resolution	Data Type	DF Notes
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	BD2 B1/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 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

DF #	DF Name	DF Range	DF Resolution	Data Type	DF Notes
					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

The 1104 message supports single-frequency, dual-frequency and triple-frequency RTK operation.

Table 43. 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 44. 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 45. 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

4.3.2.16 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.

4.3.2.17 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.

4.3.2.18 RTCM1094 Galileo 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 Galileo signals.

Message ID	*654*
Recommended Input	*log rtcm1094b ontime 1*
Supported Format	*binary*

Reply (Binary)

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

4.3.2.19 RTCM1114 QZSS 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 QZSS signals.

Message ID	*684*
Recommended Input	*log rtcm1114b ontime 1*
Supported Format	*binary*

Reply (Binary)

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

4.3.2.20 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.

4.3.2.21 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*

4.4 OTHER MESSAGES

4.4.1 TRIMBLE sentences

4.4.1.1 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 12 9.

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
```

4.4.1.2 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 12.

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
```

4.4.1.3 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 toTable 12)

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 Parameter Messages

Description

Some log commands are designed for requesting and checking system configuration parameters, such as cut-angle, reference mode and so on.

Key words listed in

Table 18. Other **Message***6* could be added after key word 'log' to request the corresponding parameters.

4.4.2.1 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 toTable 12.

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
```

4.4.3 KSXT positioning and heading Messages

Description

This message includes GNSS receiver information such as time, location, positioning and heading.

Message ID	*230*
Recommended Input	*log ksxt ontime 1*
Supported Format	*ASCII*

Reply (ASCII)

```
$KSXT,20210906104914.00,121.29239578,31.34996850,33.3672,276.66,43.34,
83.17,0.102,0.00,1,3,39,42,,,,0.101,0.012,0.143,95,94,*21
```

Field#	Structure	Description	Format	Demonstration
1	$KSXT	Log header		$KSXT
2	utc	UTC time	yyyy/mm/dd/hh/mm/ss	20210906104914.00
3	Lon	Longitude, in degrees, keep 8 significant digits after the decimal point	xxx.xxxxxxxx	121.29239578
4	Lat	Latitude, in degrees, keep 8 significant digits after the decimal point	xx.xxxxxxxx	31.3499685 0
5	Height	Altitude of fix, keep 4 significant digits after the decimal point	xx.xxxx	33.3672
6	Heading	Azimuth, The angle between true North and Heading (from true north to heading clockwise), keep 2 significant digits after the decimal point	0~360 degree .xx (deg)	276.66
7	Pitch	Pitch, positive from horizontal surface to zenith, negative from horizontal surface to downword	-90~90 degree .xx (deg)	43.44
8	Track true	True north track angle, keep 2 significant digits after the decimal point	0~360 degree .xx (deg)	83.17
9	Vel	Velocity, keep 3 significant digits after the decimal point	.xxx(km/h)	0.102
10	Roll	Roll angle, keep 3 significant digits after the decimal point	-90~90 degree .xx (deg)	1.12
11	Position qual	Receiver RTK positioning quality indicator: 0 = fix not available or invalid 1 = GNSS fix 2 = RTK float 4 = RTK fixed ambiguity solution	x	1
12	Heading qual	Receiver RTK heading and pitch quality indicator: 0 = fix not available or invalid	x	1

Field#	Structure	Description	Format	Demonstration
		1 = GNSS fix 2 = RTK float 4 = RTK fixed ambiguity solution		
13	#SsolnSVs	Number of satellites that anticipate in calculation of slave station	x	28
14	#MsolnSVs	Number of satellites that anticipate in calculation of master station	x	28
15	Pos East	East position coordinates: the east position in the geographic coordinate system with the base station as the origin, keep 3 significant digits after the decimal point	.xxx (m)	
16	Pos North	North position coordinates: the north position in the geographic coordinate system with the base station as the origin, keep 3 significant digits after the decimal point	.xxx (m)	
17	Pos up	Zenithal position coordinates: the zenithal position in the geographic coordinate system with the base station as the origin, keep 3 significant digits after the decimal point	.xxx (m)	
18	Vel E	Easting Velocity: Easting velocity in geographic coordinate system, keep 3 significant digits after the decimal point	.xxx (m/s)	
19	Vel N	Northing Velocity: Northing velocity in geographic coordinate system, keep 3 significant digits after the decimal point	.xxx (m/s)	
20	Vel Z	Zenithal velocity: the zenithal velocity in the geographic coordinate system, keep 3 significant digits after the decimal point	.xxx (m/s)	

Field#	Structure	Description	Format	Demonstration
21	M SNR	The current carrier-to-noise ratio value of the master antenna	95~100: Excellent 90~94: Good 85~89: Moderate 80~84: Fair <80: Poor	Data quality metrics for the master antenna
22	S SNR	The current carrier-to-noise ratio value of the slave antenna	95~100: Excellent 90~94: Good 85~89: Moderate 80~84: Fair <80: Poor	Data quality metrics for the slave antenna
23	*xx	Checksum	*hh	*21
24	[CR][LF]	Sentence terminator	-	[CR][LF]

4.4.4 Spectrum Messages

Description

This message includes spectrum information.

Message ID	*2260*
Recommended Input	*log spectrum ontime 1*
Supported Format	*Binary*

Reply

ID	**Field**	Description	Symbol	Byte number	Example
1	Header	Log header		H	0
2	CentFreq	Scan center frequency,khz	int	4	H
3	ScanRange	Scan range	int	4	H+4
4	ScanTimes	Scan point number N, less than 200	int	4	H+8
5	ScanStart	Scan start frequency, khz	int	4	H+12
6	ScanSample	Step length of the scan result, khz	int	4	H+16
7	ScanRatio	N, Scan point number	Ushort	2*N	H+20
8	CRC	32 bit CRC check	Hex	4	H+20+2*N

CHAPTER 5. COMMON CONFIGURATION

5.1 COM BAUD RATE CONFIGURATION

Command 1: com port baudrate

Note：

Com type: COM1/COM2/BLUETOOTH/GPRS，the default is COM1

Baud rate: 4800/9600(BLUETOOTH 9600)/19200/38400/57600/115200， the default is Com1

5.2 STOP ALL THE OUTPUT

Command1: unlogall

Note:

Stop all the output

Modify the dynamic correction data format

5.3 ACTIVATE 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

Note:

port type：COM1/COM2/COM3/BLUETOOTH

ONTIME Z： MAX = 10HZ， normally is 0.5/1/5/10/15/30/60 s

5.4 ACTIVATE BASE

Command1: Log port obsdata ontime x

Command2: Log port refdata ontime x

Command3: Fix position / Refautosetup on

Command4: Saveconfig

Note:

Com type: COM1/COM2/COM3， current default port

ONTIME X： MAX = 5HZ， normally is 0.2/1/5/10/15/30/60 s

Observation data type: RTCM1074B /RTCM1124B

BASE data type: RTCM1005B

5.4.1 RTCM 3.X

Output the RTCM 3.X data of Base to Com 2:

Command1: LOG COM2 RTCM1124B ONTIME 1

Command2: LOG COM2 RTCM1074B ONTIME 1

(Output message 1124 and 1074 to com2 per second)

Command3: LOG COM2 RTCM1005B ONTIME 5

(Output 1005 message to com 2 every five-second)

Command4: FIX AUTO

(Fix the Base coordinate automatically)

Command5: SAVECONFIG

(Save all the configuration)

Description:

Same as the above case, the configuration command of base rtcm3 is as follows:

Message type	**Command**	Description
Recommend command	interfacemode com2 none rtcm	COM configuration
	fix position 30.123 121.456 50.789	Set the base coordinates
	log com2 rtcm1005b ontime 10	Output the position information
	log com2 rtcm1124b ontime 1	Output the BDS observation data
	log com2 rtcm1074b ontime 1	Output the GPS observation data

APPENDIX A. TECHNICAL SPECIFICATION

Please refer to <K8 Series OEM Board specification> in ComNav official website (www.comnavtech.com)

APPENDIX B. FIRMWARE UPDATE

We will release the firmware in our official website after fully test, you can download and update the firmware to optimize the performance.

Note:

You should wait about 3 seconds to fully complete the update configuration after it prompt a completed in the update tool. And after that, you can close the power and restart the board to use the new firmware! You can send command “log version” to check the current firmware.