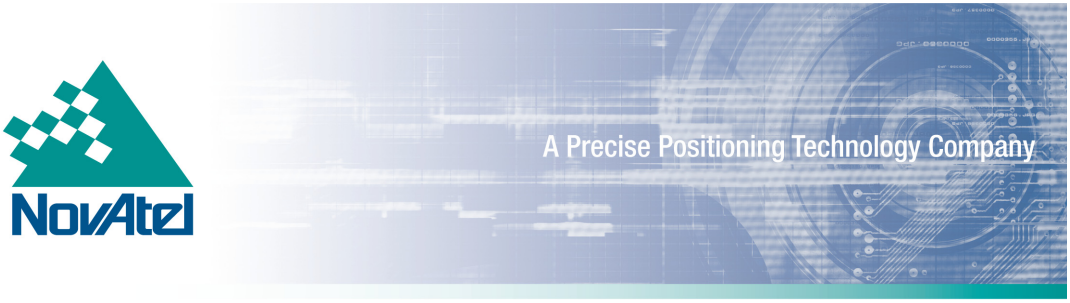

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OM-20000129 Rev 3 July 2012

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Customer Support

NovAtel Knowledge Base

If you have a technical issue, visit the NovAtel Support page at http://www.novatel.com/support/welcome-to-novatel-support/.Through the *Support* page, you can access Customer Support's Helpdesk and Solutions, find papers and tutorials or download current manuals.

Before Contacting Customer Support

Before you contact NovAtel Customer Support about a software problem, perform the following steps:

1. Log the following data to a file on your computer for 15 minutes:

   RXSTATUSB once
   RAWEPHEMB onchanged
   RANGEB ontime 1
   BESTPOSB ontime 1
   RXCONFIGA once
   VERSIONB once

2. Send the data file to NovAtel Customer Support: support@novatel.com
3. You can also issue a FRESET command to the receiver to clear any unknown settings.

> The FRESET command will erase all user settings. You should know your configuration and be able to reconfigure the receiver before you send the FRESET command.

If you are having a hardware problem, send a list of the troubleshooting steps taken and the results.

Contact Information

Use one of the following methods to contact NovAtel Customer Support:

Call the NovAtel Hotline at 1-800-NOVATEL (U.S. and Canada) or +1-403-295-4900 (international) (business hours 9 a.m. to 5 p.m. mountain time)	
Fax: +1-403-295-4901 E-mail: support@novatel.com Website: http://www.novatel.com	Write: NovAtel Inc. Customer Support Department 1120 - 68 Avenue NE Calgary, AB Canada, T2E 8S5

Foreword

About this Manual

Thank you for purchasing your NovAtel product. Your receiver includes companion documents to this manual with information on the hardware operation. Afterwards, this document will be your primary reference guide for commands and logs.

This manual describes each command and log the OEM6 family of receivers are capable of accepting or generating. Sufficient detail is provided so you can understand the purpose, syntax and structure of each command or log. You will also be able to effectively communicate with the receiver, enabling you to effectively use and write custom interfacing software for specific needs and applications.

Related Documents and Information

OEM6 products include the following:

- Satellite Based Augmentation System (SBAS) signal functionality
- Support for all current and upcoming GNSS constellations
- L-band capability including OmniSTAR
- National Marine Electronics Association (NMEA) standards, a protocol used by GNSS receivers to transmit data
- Differential Global Positioning System (DGPS)
- Real-Time Kinematic (RTK)

For more information on these components, please refer the Support page on our website at www.novatel.com. For introductory information on GNSS technology, refer to our *An Introduction to GNSS* book found at http://www.novatel.com/support/knowledge-and-learning/published-papers-and-documents/gnss-book/.

This manual does not address any of the receiver hardware attributes or installation information. Please consult the *OEM6 Family Installation and Operation User Manual* for information about these topics. Furthermore, should you encounter any functional, operational or interfacing difficulties with the receiver, consult the same manual for NovAtel warranty and support information.

Conventions

The following conventions are used in this manual:

	Denotes information to supplement or clarify the accompanying text.
	Caution that a certain action, operation or configuration may result in incorrect or improper use of the product.
	Warning that a certain action, operation or configuration may result in regulatory noncompliance, safety issues or equipment damage.

Log and command conventions include the following:

H	The letter H in the # *Bytes* or *Binary Offset* columns represents the header length for that log. The binary header is described in *Section 5.1 Log Header* on Page 74.
`0x`	A number following `0x` is a hexadecimal number.
`[ ]`	Parameters surrounded by [and] are optional in a command or are required for only some instances of the command depending on the values of other parameters.
< >	Text displayed between < and > indicates the entry of a keystroke in the case of the command or an automatic entry in the case of carriage return <CR> and line feed <LF> in data output.

In tables where no values are given, the fields are reserved for future use.

Command Defaults and Structure

- The factory defaults for commands are shown in *Section 2.4, Factory Defaults* on *page 57*. Each factory default is also shown after the syntax but before the example of each command description starting on *page 58*.
- The letter H in the Binary Byte or Binary Offset columns of the commands and logs tables represents the header length for that command or log, see *Section 1.1.3, Binary* on *page 23*.
- The number following 0x is a hexadecimal number.
- Default values shown in command tables indicate the assumed values when optional parameters have been omitted. Default values do not imply the factory default settings, see *"Factory Defaults" on page 57* for a list of factory default settings.
- Command descriptions' brackets, [ ], represent optional parameters.
- In tables where values are missing they are assumed to be reserved for future use.
- Status words in ASCII logs are output as hexadecimal numbers and must be converted to binary format (and in some cases then also to decimal). For an example of this type of conversion, please see the RANGE log, *Table 87* on *page 471*.
- Conversions and their binary or decimal results are always read from right to left. For a complete list of hexadecimal, binary and decimal equivalents, please refer to

the *Unit Conversion* information available on our website at: http://www.novatel.com/support/knowledge-and-learning/.

- ASCII log examples may be split over several lines for readability. In reality, only a single [CR][LF] pair is transmitted at the end of an ASCII log.

You can download the most up-to-date version of this manual along with any addendums from the http://www.novatel.com/support/knowledge-and-learning/ section of the NovAtel website at www.novatel.com.

Prerequisites

As this reference manual is focused on the OEM6 family commands and logging protocol, it is necessary to ensure the receiver has been properly installed and powered up according to the instructions outlined in the companion *OEM6 Family Installation and Operation User Manual* before proceeding.

Chapter 1 Message

1.1 Message Types

The receiver handles incoming and outgoing NovAtel data in three different message formats: Abbreviated ASCII, ASCII and binary. This allows for a great deal of versatility in the way the OEM6 family of receivers can be used. All NovAtel commands and logs can be entered, transmitted, output or received in any of the three formats. The receiver also supports RTCA, RTCMV3, RTCM, CMR, CMRPLUS and NMEA format messaging. For more information about message logs, refer to the contents of Chapters 2 and 3.

When entering an ASCII or abbreviated ASCII command to request an output log, the message type is indicated by the character appended to the end of the message name. 'A' indicates the message is ASCII and 'B' indicates binary. No character means the message is Abbreviated ASCII. When issuing binary commands, the output message type is dependent on the bit format in the message's binary header (refer to *Binary* on *page 23)*.

Table 1 below, describes the field types used in the description of messages.

Table 1: Field Types

Type	Binary Size (bytes)	Description
Char	1	The **char** type is an 8-bit integer in the range -128 to +127. This integer value may be the ASCII code corresponding to the specified character. In ASCII or Abbreviated ASCII this comes out as an actual character
UChar	1	The **uchar** type is an 8-bit unsigned integer. Values are in the range from +0 to +255. In ASCII or Abbreviated ASCII this comes out as a number
Short	2	The **short** type is 16-bit integer in the range -32768 to +32767
UShort	2	The same as short except it is not signed. Values are in the range from +0 to +65535
Long	4	The **long** type is 32-bit integer in the range -2147483648 to +2147483647
ULong	4	The same as long except it is not signed. Values are in the range from +0 to +4294967295
Double	8	The **double** type contains 64-bits: 1 for sign, 11 for the exponent and 52 for the mantissa. Its range is ±1.7E308 with at least 15 digits of precision. This is IEEE 754

Continued on next page

Type	Binary Size (bytes)	Description
Float	4	The **float** type contains 32-bits: 1 for the sign, 8 for the exponent and 23 for the mantissa. It's range is ±3.4E38 with at least 7 digits of precision. This is IEEE 754
Enum	4	A 4-byte enumerated type beginning at zero (an unsigned long). In binary, the enumerated value is output. In ASCII or Abbreviated ASCII, the enumeration label is spelled out
GPSec	4	This type has two separate formats dependant on whether you requested a binary or an ASCII format output. For binary, the output is in milliseconds and is a **long** type. For ASCII, the output is in seconds and is a **float** type
Hex	n	**Hex** is a packed, fixed length (n) array of bytes in binary but in ASCII or Abbreviated ASCII is converted into 2 character hexadecimal pairs
String	n	**String** is a variable length array of bytes that is null-terminated in the binary case and additional bytes of padding are added to maintain 4-byte alignment. The maximum byte length for each String field is shown in the row in the log or command tables

Table 2: Byte Arrangements

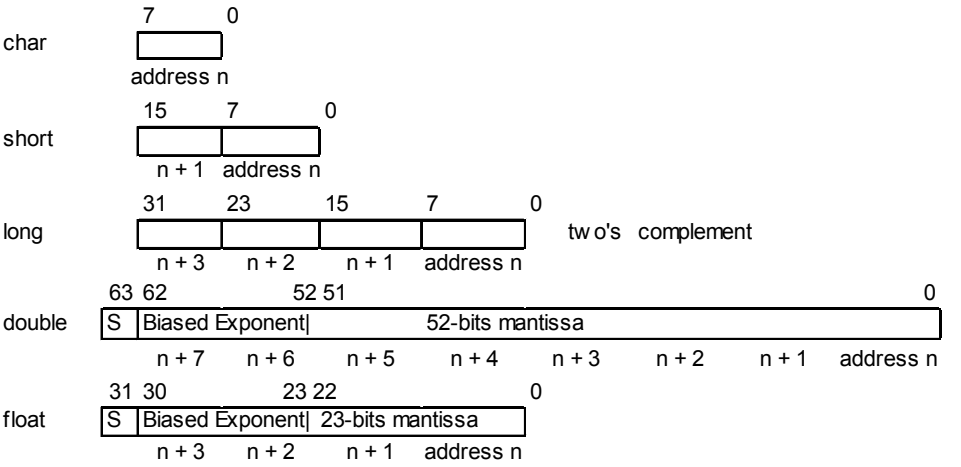


*Table 2*shows the arrangement of bytes, within each field type, when used by IBM PC computers. All data sent to or from the OEM6 family of receivers, however, is read least significant bit (LSB) first, opposite to what is shown in *Table 2*. Data is then stored in the receiver LSB first. For example, in char type data, the LSB is bit 0 and the most significant bit (MSB) is bit 7. See *Table 87, Channel Tracking Example* on *page 471* for a more detailed example.

1.1.1 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:
   - The first exception is the last header field which is followed by a ';' to denote the start of the data message.
   - The second exception 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.
   See *1.7, 32-Bit CRC* on *page 35* for the algorithm used to generate the CRC.
5. An ASCII string is one field and is surrounded by double quotation marks.
   For example:
   "ASCII string". If separators are surrounded by quotation marks then the string is still one field and the separator will be ignored (example, "xxx,xxx" is one field). Double quotation marks within a string are not allowed.
6. If the receiver detects an error parsing an input message, it returns an error response message. Please see *Chapter 4, Responses* on *page 598* for a list of response messages from the receiver.

Message Structure:

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

The ASCII message header structure is described in *Table 3* on the next page.

Table 3: ASCII Message Header Structure

Field #	Field Name	Field Type	Description	Ignored on Input
1	Sync	Char	**Sync** character. The ASCII message is always preceded by a single '#' symbol	N
2	Message	Char	The ASCII name of the log or command (lists are in *Table 10, page 44* and *Table 52, page 269*)	N
3	Port	Char	The name of the **port** from which the log was generated. The string is made up of the port name followed by an _x where x is a number from 1 to 31 denoting the virtual address of the port. If no virtual address is indicated, it is assumed to be address 0	Y
4	Sequence #	Long	Used for multiple related logs. It is a number that counts down from N-1 to 0, where 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0	N
5	% Idle Time	Float	The minimum percentage of time the processor is idle, between successive logs, with the same Message ID	Y
6	Time Status	Enum	The value indicates the quality of the GPS reference time (see *Table 8, GPS Reference Time Status* on *page 32*)	Y
7	Week	Ulong	GPS reference week number	Y
8	Seconds	GPSec	**Seconds** from the beginning of the GPS reference week; accurate to the millisecond level	Y
9	Receiver Status	Ulong	An eight digit hexadecimal number representing the status of various hardware and software components of the receiver, between successive logs, with the same Message ID (see *Table 99, Receiver Status* on *page 523*)	Y
10	Reserved	Ulong	Reserved for internal use.	Y
11	Receiver s/w Version	Ulong	A value (0 - 65535) representing the receiver software build number	Y
12	;	Char	The character indicates the end of the header	N

Example Log:

```
#RAWEPHEMA,COM1,0,35.0,SATTIME,1364,496230.000,00100000,97b7,2310;
30,1364,496800,8b0550a1892755100275e6a09382232523a9dc04ee6f794a0000090394ee,8b05
50a189aa6ff925386228f97eabf9c8047e34a70ec5a10e486e794a7a,8b0550a18a2effc2f80061c
2fffc267cd09f1d5034d3537affa28b6ff0eb*7a22f279
```

1.1.2 Abbreviated ASCII

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

Example Command:

```
log com1 loglist
```

Resultant Log:

```
<LOGLIST COM1 0 69.0 FINE 0 0.000 00240000 206d 0
<     4
<          COM1 RXSTATUSEVENTA ONNEW 0.000000 0.000000 NOHOLD
<          COM2 RXSTATUSEVENTA ONNEW 0.000000 0.000000 NOHOLD
<          COM3 RXSTATUSEVENTA ONNEW 0.000000 0.000000 NOHOLD
<          COM1 LOGLIST ONCE 0.000000 0.000000 NOHOLD
```

The array of 4 logs are offset from the left hand side and start with '<'.

1.1.3 Binary

Binary messages are strictly machine readable format. They are ideal for applications where the amount of data transmitted is fairly high. Due to the inherent compactness of binary as opposed to ASCII data, messages are much smaller. The smaller message size allows a larger amount of data to be transmitted and received by the receiver's communication ports. The structure of all binary messages follows the general conventions as noted here:

1. Basic format of:

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	4 bytes

2. The 3 Sync bytes will always be:

Byte	Hex	Decimal
First	AA	170
Second	44	68
Third	12	18

3. The CRC is a 32-bit CRC (see *1.7, 32-Bit CRC* on *page 35* for the CRC algorithm) performed on all data including the header.
4. The header is in the format shown in *Table 4, Binary Message Header Structure* on *page 24*.

Table 4: Binary Message Header Structure

Field #	Field Name	Field Type	Description	Binary Bytes	Binary Offset	Ignored on Input
1	Sync	Char	Hexadecimal 0xAA	1	0	N
2	Sync	Char	Hexadecimal 0x44	1	1	N
3	Sync	Char	Hexadecimal 0x12	1	2	N
4	Header Lgth	Uchar	Length of the header	1	3	N
5	Message ID	Ushort	This is the Message ID number of the log (see the log descriptions in *Table 54, OEM6 Logs in Numerical Order* on *page 282* for the Message ID values of individual logs)	2	4	N
6	Message Type	Char	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response bit (see *Section 1.2, page 29*) 0 = Original Message 1 = Response Message	1	6	N
7	Port Address	Uchar	See *Table* on *page 26* (decimal values >=32 may be used) (lower 8-bits only) [a]	1	7	N [b]
8	Message Length	Ushort	The length in bytes of the body of the message, not including the header nor the CRC	2	8	N
9	Sequence	Ushort	Used for multiple related logs. It is a number that counts down from N-1 to 0 where N is the number of related logs and 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0	2	10	N
10	Idle Time	Uchar	Time the processor is idle, in the last second between successive logs, with the same Message ID. Take the time (0 - 200) and divide by two to give the percentage of time (0 - 100%)	1	12	Y
11	Time Status	Enum	Indicates the quality of the GPS reference time (see *Table 8, GPS Reference Time Status* on *page 32*).	1 [c]	13	N [d]
12	Week	Ushort	GPS reference week number	2	14	N [d]

Field #	Field Name	Field Type	Description	Binary Bytes	Binary Offset	Ignored on Input
13	ms	GPSec	Milliseconds from the beginning of the GPS reference week	4	16	N [d]
14	Receiver Status	Ulong	32-bits representing the status of various hardware and software components of the receiver, between successive logs, with the same Message ID (see *Table 99, Receiver Status* on *page 523*)	4	20	Y
15	Reserved	Ushort	Reserved for internal use	2	24	Y
16	Receiver S/W Version	Ushort	A value (0 - 65535) representing the receiver software build number	2	26	Y

a. The 8-bit size means you will only see 0xA0 to 0xBF when the top bits are dropped from a port value greater than 8-bits. For example, ASCII port USB1 will be seen as 0xA0 in the binary output.

b. Recommended value is THISPORT (binary 192).

c. This ENUM is not 4-bytes long but, as indicated in the table, is only 1-byte.

d. These time fields are ignored if Field #11, Time Status, is invalid. In this case, the current receiver time is used. The recommended values for the three time fields are 0, 0, 0.

Table 5: Detailed Port Identifier

ASCII Port Name	Hex Port Value	Decimal Port Value [a]	Description
NO_PORTS	0	0	No ports specified
COM1_ALL	1	1	All virtual ports for COM1
COM2_ALL	2	2	All virtual ports for COM2
COM3_ALL	3	3	All virtual ports for COM3
THISPORT_ALL	6	6	All virtual ports for the current port
ALL_PORTS	8	8	All virtual ports for all ports
XCOM1_ALL	9	9	All virtual ports for XCOM1
XCOM2_ALL	10	10	All virtual ports for XCOM2
USB1_ALL	d	13	All virtual ports for USB1
USB2_ALL	e	14	All virtual ports for USB2
USB3_ALL	f	15	All virtual ports for USB3
AUX_ALL	10	16	All virtual ports for the AUX[b]
XCOM3_ALL	11	17	All virtual XCOM3
ICOM1_ALL	17	23	All virtual ports for ICOM1
ICOM2_ALL	18	24	All virtual ports for ICOM2
ICOM3_ALL	19	25	All virtual ports for ICOM3
NCOM1_ALL	1a	26	All virtual ports for NCOM1
NCOM2_ALL	1b	27	All virtual ports for NCOM2
NCOM3_ALL	1c	28	All virtual ports for NCOM3
COM1	20	32	COM1, virtual port 0
COM1_1	21	33	COM1, virtual port 1
. . .			
COM1_31	3f	63	COM1, virtual port 31
COM2	40	64	COM2, virtual port 0
. . .			
COM2_31	5f	95	COM2, virtual port 31
COM3	60	96	COM3, virtual port 0

Table 5: Detailed Port Identifier

ASCII Port Name	Hex Port Value	Decimal Port Value [a]	Description
. . .			
COM3_31	7f	127	COM3, virtual port 31
SPECIAL	a0	160	Unknown port, virtual port 0
. . .			
SPECIAL_31	bf	191	Unknown port, virtual port 31
THISPORT	c0	192	Current COM port, virtual port 0
. . .			
THISPORT_31	df	223	Current COM port, virtual port 31
XCOM1	1a0	416	XCOM1, virtual port 0
XCOM1_1	1a1	417	XCOM1, virtual port 1
. . .			
XCOM1_31	1bf	447	XCOM1, virtual port 31
XCOM2	2a0	672	XCOM2, virtual port 0
XCOM2_1	2a1	673	XCOM2, virtual port 1
. . .			
XCOM2_31	2bf	703	XCOM2, virtual port 31
USB1	5a0	1440	USB1, virtual port 0
USB1_1	5a1	1441	USB1, virtual port 1
. . .			
USB1_31	5bf	1471	USB1, virtual port 31
USB2	6a0	1696	USB2, virtual port 0
. . .			
USB2_31	6bf	1727	USB2, virtual port 31
USB3	7a0	1952	USB3, virtual port 0
. . .			
USB3_31	7bf	1983	USB port 3, virtual port 31
AUX	8a0	2208	AUX port, virtual port 0 [b]
. . .			
AUX_31	8bf	2239	AUX port, virtual port 31 [b]

Table 5: Detailed Port Identifier

ASCII Port Name	Hex Port Value	Decimal Port Value [a]	Description
XCOM3	9a0	2464	XCOM3, virtual port 0
. . .			
XCOM3_31	9bf	2495	XCOM3, virtual port 31
ICOM1	fa0	4000	ICOM1, virtual port 0
. . .			
ICOM1_31	fbf	4031	ICOM1, virtual port 31
ICOM2	10a0	4256	ICOM2, virtual port 0
. . .			
ICOM2_31	10bf	4287	ICOM2, virtual port 31
ICOM3	11a0	4512	ICOM3, virtual port 0
. . .			
ICOM3_31	11bf	4543	ICOM3, virtual port 31
NCOM1	12a0	4768	NCOM1, virtual port 0
. . .			
NCOM1_31	12bf	4799	NCOM1, virtual port 31
NCOM2	13a0	5024	NCOM2, virtual port 0
. . .			
NCOM2_31	13bf	5055	NCOM2, virtual port 31
NCOM3	14a0	5280	NCOM3, virtual port 0
. . .			
NCOM3_31	14bf	5311	NCOM3, virtual port 31

a. Decimal port values 0 through 16 are only available to the UNLOGALL command (refer to *page 260*) and cannot be used in the UNLOG command (refer to *page 258)* or in the binary message header (see *Table 4* on *page 24).*

b. The AUX port is only available on specific products.

COM1_ALL, COM2_ALL, COM3_ALL, THISPORT_ALL, ALL_PORTS, USB1_ALL, USB2_ALL, USB3_ALL, AUX_ALL, ICOM1_ALL, ICOM2_ALL, ICOM3_ALL, NCOM1_ALL, NCOM2_ALL, XCOM1_ALL, XCOM2_ALL, XCOM3_ALL and NCOM3_ALL are only valid for the UNLOGALL command.

1.2 Responses

By default, if you input a message you get back a response. If desired, the INTERFACEMODE command can be used to disable response messages (see *page 146*). The response will be in the exact format you entered the message (that is, binary input = binary response).

1.2.1 Abbreviated Response

Just the leading '<' followed by the response string, for example: <OK.

1.2.2 ASCII Response

Full header with the message name being identical except ending in an 'R' (for response). The body of the message consists of a 40 character string for the response string.
For example:

#BESTPOSR,COM1,0,67.0,FINE,1028,422060.400,00000000,a31b,0;"OK" *b867caad

1.2.3 Binary Response

Similar to an ASCII response except that it follows the binary protocols, see *Table 6, Binary Message Response Structure* on *page 30*.

Table 7, Binary Message Sequence on *page 31* is an example of the sequence for requesting and then receiving BESTPOSB. The example is in hex format. When you enter a hex command, you may need to add a ‘\x’ or ‘0x’ before each hex pair, depending on your code.
For example:

0xAA0x440x120x1C0x010x000x02 and so on).

Table 6: Binary Message Response Structure

	Field #	Field Name	Field Type	Description	Binary Bytes	Binary Offset
BINARY HEADER	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 number	2	4
	6	Message Type	Char	Bit 7 = Response Bit 1 = Response Message	1	6
	7	Port Address	Uchar	See *Table 5, Detailed Port Identifier* on *page 26*	1	7
	8	Message Length	Ushort	The length in bytes of the body of the message (not the CRC)	2	8
	9	Sequence	Ushort	Normally 0	2	10
	10	Idle Time	Uchar	Idle time	1	12
	11	Time Status	Enum	*Table 8, GPS Reference Time Status* on *page 32*	1 [a]	13
	12	Week	Ushort	GPS reference week number	2	14
	13	ms	GPSec	Milliseconds into GPS reference week	4	16
	14	Receiver Status	Ulong	*Table 99, Receiver Status* on *page 523*	4	20
	15	Reserved	Ushort	Reserved for internal use	2	24
	16	Receiver S/W Version	Ushort	Receiver software build number	2	26
ID	17	Response ID	Enum	The output format of the messages is dependent on the format of the input command. If the command is input as abbreviated ASCII, the output will be abbreviated ASCII. The same rule applies for both ASCII and binary formats (*Table 111, Response Messages* on *page 598*)	4	28
HEX	18	Response	Hex	String containing the ASCII response in hex coding to match the ID above (for example, 0x4F4B = OK)	variable	32

a. This ENUM is not 4-bytes long but as indicated in the table is only 1 byte.

Table 7: Binary Message Sequence

Direction	Sequence	Data
To Receiver	LOG Command Header	AA44121C 01000240 20000000 1D1D0000 29160000 00004C00 55525A80
	LOG Parameters	20000000 2A000000 02000000 00000000 0000F03F 00000000 00000000 00000000
	Checksum	2304B3F1
From Receiver	LOG Response Header	AA44121C 01008220 06000000 FFB4EE04 605A0513 00004C00 FFFF5A80
	Log Response Data	01000000 4F4B
	Checksum	DA8688EC
From Receiver	BESTPOSB Header	AA44121C 2A000220 48000000 90B49305 B0ABB912 00000000 4561BC0A
	BESTPOSB Data	00000000 10000000 1B0450B3 F28E4940 16FA6BBE 7C825CC0 0060769F 449F9040 A62A82C1 3D000000 125ACB3F CD9E983F DB664040 00303030 00000000 00000000 0B0B0000 00060003
	Checksum	42DC4C48

1.3 GLONASS Slot and Frequency Numbers

When a PRN in a log is in the range 38 to 61, then that PRN represents a GLONASS Slot where the Slot shown is the actual GLONASS Slot Number plus 37.

Similarly, the GLONASS Frequency shown in logs is the actual GLONASS Frequency plus 7.

For example:

```
#SATVISA,COM1,0,53.5,FINESTEERING,1363,234894.000,00000000,0947,2277;
TRUE,TRUE,46,
2,0,0,73.3,159.8,934.926,934.770,
...
43,8,0,-0.4,163.7,4528.085,4527.929,
...
3,0,0,-79.9,264.3,716.934,716.778*b94813d3
```

where 2 and 3 are GPS satellites and 43 is a GLONASS satellite. It's actual GLONASS Slot Number is 6. The SATVIS log shows 43 (6+ 37). It's actual GLONASS frequency is 1. The SATVIS log shows 8 (1+7). See also the SATVIS log on *page 531*.

Refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/ for more information.

1.4 GPS Reference Time Status

All reported receiver times are subject to a qualifying time status. The status indicates how well a time is known (see *Table 8*).

Table 8: GPS Reference Time Status

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

a. See also *Section 1.5, Message Time Stamps* on *page 34* and the *SETTIMEBASE* command on page *238*.

There are several distinct states the receiver goes through when CLOCKADJUST is enabled:

- UNKNOWN (initial state)
- COARSESTEERING (initial coarse time set)
- FINESTEERING (normal operating state)
- FINEBACKUPSTEERING (when the backup system is used for time)
- FREEWHEELING (when range bias becomes unknown)

and when the CLOCKADJUST is disabled:

- UNKNOWN (initial state)
- COARSE (initial coarse time set)
- FINE (normal operating state)

On start up and before any satellites are being tracked, the receiver can not possibly know the current time. As such, the receiver time starts counting at GPS reference week 0 and second 0.0. The time status flag is set to UNKNOWN.

If time is input to the receiver using the SETAPPROXTIME command (see *page 223*) or on receipt of an RTCAEPHEM message (see *page 500*) the time status will be APPROXIMATE.

After the first ephemeris is decoded, the receiver time is set to a resolution of ±10 milliseconds. This state is qualified by the COARSE or COARSESTEERING time status flag depending on the state of the CLOCKADJUST switch (for more information, refer to the CLOCKADJUST command on page 83).

Once a position is known and range biases are being calculated, the internal clock model will begin modeling the position range biases and the receiver clock offset.

Modelling will continue until the model is a good estimation of the actual receiver clock behavior. At this time, the receiver time will again be adjusted, this time to an accuracy of ±1 microsecond. This state is qualified by the FINE time status flag.

The final logical time status flag depends on whether CLOCKADJUST is enabled or not (see *page 83*). If CLOCKADJUST is disabled, the time status flag will never improve on FINE. The time will only be adjusted again to within ±1 microsecond if the range bias gets larger than ±250 milliseconds. If CLOCKADJUST is enabled, the time status flag is set to FINESTEERING and the receiver time is continuously updated (steered) to minimize the receiver range bias.

When the backup system is used, the time status is set to FINEBACKUPSTEERING. If, for some reason, the position is lost and the range bias cannot be calculated, the time status is degraded to FREEWHEELING.

1.5 Message Time Stamps

All NovAtel format messages generated by the OEM6 family of receivers have a GPS reference time stamp in their header. GPS reference time is referenced to UTC with zero point defined as midnight on the night of January 5, 1980. The time stamp consists of the number of weeks since that zero point and the number of seconds since the last week number change (0 to 604,799). GPS reference time differs from UTC time since leap seconds are occasionally inserted into UTC and GPS reference time is continuous. In addition, a small error (less than 1 microsecond) can exist in synchronization between UTC and GPS reference time. The TIME log reports both GNSS and UTC time and the offset between the two.

The data in synchronous logs (for example, RANGE, BESTPOS, TIME) are based on a periodic measurement of satellite pseudoranges. The time stamp on these logs is the receiver estimate of GPS reference time at the time of the measurement. When setting time in external equipment, a small synchronous log with a high baud rate will be accurate to a fraction of a second. A synchronous log with trigger ONTIME 1 can be used in conjunction with the 1PPS signal to provide relative accuracy better than 250 ns.

Other log types (asynchronous and polled) are triggered by an external event and the time in the header may not be synchronized to the current GPS reference time. Logs that contain satellite broadcast data (for example, ALMANAC, GPSEPHEM) have the transmit time of their last subframe in the header. In the header of differential time matched logs (for example, MATCHEDPOS) is the time of the matched reference and local observation that they are based on. Logs triggered by a mark event (for example, MARKEDPOS, MARKTIME) have the estimated GPS reference time of the mark event in their header. In the header of polled logs (for example, LOGLIST, PORTSTATS, VERSION) is the approximate GPS reference time when their data was generated. However, when asynchronous logs are triggered ONTIME, the time stamp will represent the time the log was generated and not the time given in the data.

1.6 Decoding of the GPS Reference Week Number

The GPS reference week number provided in the raw satellite data is the 10 least significant bits (or 8 least significant bits in the case of the almanac data) of the full week number. When the receiver processes the satellite data, the week number is decoded in the context of the current era and therefore is computed as the full week number starting from week 0 or January 6, 1980. Therefore, in all log headers and decoded week number fields, the full week number is given. Only in raw data, such as the *data* field of the RAWALM log or the *subframe* field of the RAWEPHEM log, will the week number remain as the 10 (or 8) least significant bits.

1.7 32-Bit CRC

The ASCII and Binary OEM6 family message formats all contain a 32-bit CRC for data verification. This allows the user to ensure the data received (or transmitted) is valid with a high level of certainty. This CRC can be generated using the following C algorithm:

```
#define CRC32_POLYNOMIAL   0xEDB88320L
/* --------------------------------------------------------------------------
Calculate a CRC value to be used by CRC calculation functions.
-------------------------------------------------------------------------- */
unsigned long CRC32Value(int i)
{
   int j;
   unsigned long ulCRC;
   ulCRC = i;
   for ( j = 8 ; j > 0; j-- )
   {
      if ( ulCRC & 1 )
         ulCRC = ( ulCRC >> 1 ) ^ CRC32_POLYNOMIAL;
      else
         ulCRC >>= 1;
   }
   return ulCRC;
}
/* --------------------------------------------------------------------------
Calculates the CRC-32 of a block of data all at once
-------------------------------------------------------------------------- */
unsigned long CalculateBlockCRC32(
   unsigned long ulCount,     /* Number of bytes in the data block */
   unsigned char *ucBuffer ) /* Data block */
{
   unsigned long ulTemp1;
   unsigned long ulTemp2;
   unsigned long ulCRC = 0;
  while ( ulCount-- != 0 )
   {
      ulTemp1 = ( ulCRC >> 8 ) & 0x00FFFFFFL;
      ulTemp2 = CRC32Value( ((int) ulCRC ^ *ucBuffer++ ) & 0xff );
      ulCRC = ulTemp1 ^ ulTemp2;
   }
   return( ulCRC );
}
```

The NMEA checksum is an XOR of all the bytes (including delimiters such as ',' but excluding the * and $) in the message output. It is therefore an 8-bit and not a 32-bit checksum.

Not all logs may be available. Every effort is made to ensure examples are correct, however, a checksum may be created for promptness in publication. In this case it will appear as '9999'.

Example:

BESTPOSA and BESTPOSB from an OEM6 family receiver.

ASCII:

```
#BESTPOSA,COM1,0,78.0,FINESTEERING,1427,325298.000,00000000,6145,2748;
SOL_COMPUTED,SINGLE,51.11678928753,-114.03886216575,1064.3470,-16.2708,
WGS84,2.3434,1.3043,4.7300,"",0.000,0.000,7,7,0,0,0,06,0,03*9c9a92bb
```

BINARY:

0xaa, 0x44, 0x12, 0x1c 0x2a, 0x00, 0x02, 0x20, 0x48, 0x00, 0x00, 0x00, 0x90, 0xb4, 0x93, 0x05, 0xb0, 0xab, 0xb9, 0x12, 0x00, 0x00, 0x00, 0x00, 0x45, 0x61, 0xbc, 0x0a, 0x00, 0x00, 0x00, 0x00, 0x10, 0x00, 0x00, 0x00, 0x1b, 0x04, 0x50, 0xb3, 0xf2, 0x8e, 0x49, 0x40, 0x16, 0xfa, 0x6b, 0xbe, 0x7c, 0x82, 0x5c, 0xc0, 0x00, 0x60, 0x76, 0x9f, 0x44, 0x9f, 0x90, 0x40, 0xa6, 0x2a, 0x82, 0xc1, 0x3d, 0x00, 0x00, 0x00, 0x12, 0x5a, 0xcb, 0x3f, 0xcd, 0x9e, 0x98, 0x3f, 0xdb, 0x66, 0x40, 0x40, 0x00, 0x30, 0x30, 0x30, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0b, 0x0b, 0x00, 0x00, 0x00, 0x06, 0x00, 0x03, 0x***42***, 0x***dc,*** 0x***4c,*** 0x***48***

Below is a demonstration of how to generate the CRC from both ASCII and BINARY messages using the function described above.

When you pass the data into the code that follows, exclude the checksum shown in ***bold italics*** above.

ASCII:

```
#include <iostream.h>
#include <string.h>
void  main()
{
char *i = ”BESTPOSA,COM2,0,77.5,FINESTEERING,1285,160578.000,00000020,5941,11
64;
SOL_COMPUTED,SINGLE,51.11640941570,-114.03830951024,1062.6963,-16.2712,
WGS84,1.6890,1.2564,2.7826,\"\",0.000,0.000,10,10,0,0,0,0,0,0";
unsigned long iLen = strlen(i);
unsigned long CRC = CalculateBlockCRC32(iLen, (unsigned char*)i);
cout << hex << CRC <<endl;
}
```

BINARY:

```
#include <iostream.h>
#include <string.h>
int main()
{
unsigned char buffer[] = {0xAA, 0x44, 0x12, 0x1C, 0x2A, 0x00, 0x02, 0x20,
0x48, 0x00, 0x00, 0x00, 0x90, 0xB4, 0x93, 0x05, 0xB0, 0xAB, 0xB9, 0x12, 0x00,
0x00, 0x00, 0x00, 0x45, 0x61, 0xBC, 0x0A, 0x00, 0x00, 0x00, 0x00, 0x10, 0x00,
0x00, 0x00, 0x1B, 0x04, 0x50, 0xB3, 0xF2, 0x8E, 0x49, 0x40, 0x16, 0xFA, 0x6B,
0xBE, 0x7C, 0x82, 0x5C, 0xC0, 0x00, 0x60, 0x76, 0x9F, 0x44, 0x9F, 0x90, 0x40,
0xA6, 0x2A, 0x82, 0xC1, 0x3D, 0x00, 0x00, 0x00, 0x12, 0x5A, 0xCB, 0x3F, 0xCD,
0x9E, 0x98, 0x3F, 0xDB, 0x66, 0x40, 0x40, 0x00, 0x30, 0x30, 0x30, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0B, 0x0B, 0x00, 0x00, 0x00, 0x06, 0x00,
0x03};
unsigned long crc = CalculateBlockCRC32(sizeof(buffer)buffer);
cout << hex << crc <<endl;
//Please note that this hex needs to be reversed due to Big Endian order where
the most significant value in the sequence is stored first (at the lowest
storage address). For example, the two bytes required for the hex number 4F52
is stored as 524F.
}
```

Chapter 2 Command

2.1 Command Formats

The receiver accepts commands in 3 formats as described in *Chapter 1*:

- Abbreviated ASCII
- ASCII
- Binary

Abbreviated ASCII is the easiest to use for your input. The other two formats include a CRC for error checking and are intended for use when interfacing with other electronic equipment.

The following are examples of the same command in each format:.

Abbreviated ASCII Example:

```
LOG COM1 BESTPOSB ONTIME 1[CR]
```

ASCII Example:

```
LOGA,COM2,0,66.0,UNKNOWN,0,15.917,004c0000,5255,32858;COM1,
BESTPOSB,ONTIME,1.000000,0.000000,NOHOLD*F95592DD[CR]
```

Binary Example:

```
AA44121C 01000240 20000000 1D1D0000 29160000 00004C00 55525A80
20000000 2A000000 02000000 00000000 0000F03F 00000000 00000000
00000000 2304B3F1
```

2.2 Command Settings

There are several ways to determine the current command settings of the receiver:

1. Request an RXCONFIG log, see *page 519*. This log provides a listing of all commands issued to the receiver and their parameter settings. It also provides the most complete information.
2. For some specific commands, logs are available to indicate all their parameter settings. The LOGLIST log, see *page 409*, shows all active logs in the receiver beginning with the LOG command. The COMCONFIG log, see *page 331*, shows both the COM and INTERFACEMODE commands parameter settings for all serial ports.
3. Request a log of the specific command of interest to show the parameters last entered for that command. The format of the log produced is exactly the same as the format of the specific command with updated header information.

Requesting a log for specific command is useful for most commands. For commands repeated with different parameters (for example, COM and LOG), only the most recent set of parameters used is shown. To view all sets of parameters, try method 1 or 2 above.

Abbreviated ASCII Example:

```
log fix
<FIX COM1 0 45.0 FINE 1114 151898.288 00200000 dbfd 33123
<     NONE -10000.00000000000 -10000.00000000000 -10000.0000
```

2.3 Commands by Function

Table 9: OEM6 Commands Sorted by Function

Clock Information Status and Time		
ADJUST1PPS	Adjusts the receiver clock	429
CLOCKADJUST	Enables clock adjustments	15
CLOCKCALIBRATE	Adjusts clock steering parameters	430
CLOCKOFFSET	Adjusts for delay in 1PPS output	596
EXTERNALCLOCK	Sets external clock parameters	230
SETAPPROXTIME	Sets an approximate GPS reference time	102
Communications, Control and Status		
APPLICATION	Starts/stops the application	413
ASSIGNLBAND	Sets L-band satellite communication parameters	729
ASSIGNLBAND2	Sets L-band satellite communication parameters	1200
COM	Sets COM port configuration	4
COMCONTROL	Controls the hardware control lines of the RS232 ports	431
DNSCONFIG	Configures DNS servers	1244
ECHO	Sets port echo	1247
ETHCONFIG	Configures Ethernet physical layer	1245
FREQUENCYOUT	Sets the output pulse train available on VARF	232
GENERATEDIFFCORRECTIONS	Sends differential corrections	1296
GENERATERTKCORRECTIONS	Sends RTK corrections	1260
ICOMCONFIG	Configures IP virtual COM port	1248
INTERFACEMODE	Sets interface type for a port, Receive (Rx)/Transmit (Tx)	3

Communications, Control and Status		
IPCONFIG	Configures network IP settings	1243
LOG	Requests a log	1
MARKCONTROL	Controls processing of the mark inputs	614
NTRIPCONFIG	Configures NTRIP	1249
NTRIPSOURCETABLE	Sets the NTRIPCASTER ENDPOINTS to be used for the SOURCETABLE log	1343
PPSCONTROL	Controls the PPS output	613
SEND	Sends ASCII message to a port	177
SENDHEX	Sends non-printable characters to a port	178
SERIALCONFIG	Configures serial port settings	1246
SETCANNAME	Sets the CAN name fields	1091
SOFTLOADCOMMIT	Commits to the soft load module	475
SOFTLOADDATA	Uploads data for soft load process	1218
SOFTLOADRESET	Restarts soft load process	476
SOFTLOADSETUP	Configures the soft load process	1219
SOFTLOADSREC	Configures the soft load process	477
TUNNELESCAPE	Breaks out of a tunnel	962
UNLOG	Removes a log from the logging control	36
UNLOGALL	Removes all logs from the logging control	38
Differential Rover/Base Station		
ALIGNAUTOMATION	Configures the ALIGN plug and play feature	1323
ANTENNAMODEL	Enters/changes rover antenna model	841
BASEANTENNAMODEL	Enters/changes base antenna model	870
DGPSEPHEMDELAY	Sets DGPS ephemeris delay	142
DGPSTXID	Sets DGPS station ID	144
FIXPOSDATUM	Sets a datum position.	761
GENERATEALIGNCORRECTIONS	Configures the ALIGN Master and starts sending out ALIGN RTCA corrections through the specified port	1349
HPSEED	Specifies the initial position for OmniSTAR HP/XP	782
HPSTATICINIT	Sets the static initialization of OmniSTAR HP/XP	780
MOVINGBASESTATION	Enables a moving base station	763
POSAVE	Implements base station position averaging	173
POSTIMEOUT	Sets the position time out	612
PSRDIFFSOURCE	Sets the pseudorange correction source	493

Differential Rover/Base Station		
PSRDIFFSOURCETIMEOUT	Sets duration after differential corrections switched from one source to another	1449
PSRDIFFTIMEOUT	Sets maximum age of differential data	1450
RTKANTENNA	Specifies L1 phase center (PC) or ARP and enables/ disables PC modeling	858
RTKCOMMAND	Resets the RTK filter or set the filter to default settings	97
RTKDYNAMICS	Sets up the RTK dynamics mode	183
RTKMATCHEDTIMEOUT	Sets the duration after matched RTK filter is reset	1447
RTKNETWORK	Specifies the RTK network mode	951
RTKQUALITYLEVEL	Chooses an RTK quality mode	844
RTKSOURCE	Sets the RTK correction source	494
RTKSOURCETIMEOUT	Sets duration after RTK corrections switched from one source to another	1445
RTKSVENTRIES	Sets the number of satellites in corrections	92
RTKTIMEOUT	Sets the maximum age of RTK data	910
SETBASERECEIVERTYPE	Specifies the base receiver type to aid GLONASS ambiguity fixing in RTK	1374
SETROVERID	Sets the Rover ID output in ROVERPOS, HEADING2, ALIGNBSLNXYZ and ALIGNBSLNENU logs	1135
SETRTCM16	Enters ASCII text for an RTCM data stream	131
SETRTCM36	Enters ASCII text with Russian characters	880
SETRTCMRXVERSION	Sets the expected RTCM message standard input	1216
SETRTCMTXVERSION	Sets the expected RTCM transmission standard input	1322
SBASTIMEOUT	Sets the amount of time the receiver remains in an SBAS position if it stops receiving SBAS corrections	1001
General Receiver Control		
ANTENNAPOWER	Controls power to Low Noise Amplifier (LNA) of an active antenna	98
AUTH	Adds the authorization code for a new model	49
FRESET	Resets the receiver to factory default	20
MODEL	Switches the receiver to an existing authorized model	22
NVMRESTORE	Restores NVM data after an NVM failure	197
PROFILE	Configures multiple profiles in the non-volatile memory	1411
RESET	Resets the hardware	18
SAVECONFIG	Saves the current configuration	19
SETTIMEBASE	Sets the primary and backup systems for time base	1237

General Receiver Control		
SETUTCLEAPSECONDS	Sets when future leap seconds take effect	1150
STATUSCONFIG	Configures various status mask fields in RXSTATUSEVENT log	95
Position, Parameters and Solution Filtering Control		
DATUM	Chooses a DATUM name type	160
DIFFCODEBIASCONTROL	Enables or disables satellite differential code biases	913
FIX	Constrains receiver height or position	44
GGAQUALITY	Customizes the GPGGA GPS quality indicator	691
HDTOUTTHRESHOLD	Controls the NMEA GPHDT log output	1062
HEADINGOFFSET	Adds specified offset to heading and pitch values	1082
IONOCONDITION	Sets ionospheric condition	1215
LOCALIZEDCORRECTIONDATUM	Sets a local datum	947
NMEATALKER	Sets the NMEA talker ID	861
OMNIUSEGLONASS	Enables/disables GLONASS in OmniStar	1199
PDPFILTER	Enables, disables or resets the Pseudorange/Delta-Phase (PDP) filter	424
PDPMODE	Selects the PDP mode and dynamics	970
RAIMMODE	Configures RAIM mode	1285
RTKELEVMASK	Sets the RTK elevation mask	91
SBASCONTROL	Sets SBAS test mode and PRN	652
SETAPPROXPOS	Sets an approximate position	377
SETBESTPOSCRITERIA	Sets selection criteria for BESTPOS	839
SETDIFFCODEBIASES	Sets satellite differential code biases	687
SETIONOTYPE	Sets the ionospheric corrections model	711
SETTROPOMODEL	Sets the troposphere model used to correct ranges in the PSRPOS and PDPPOS solutions	1434
UNDULATION	Sets ellipsoid-geoid separation	214
USERDATUM	Sets user customized datum	78
USEREXPDATUM	Sets custom expanded datum	783
UTMZONE	Sets UTM parameter	749
Satellite Tracking and Channel Control		
ASSIGN	Assigns individual satellite channel	27
ASSIGNALL	Assigns all satellite channels	28
CNOUPDATE	Sets the C/No update rate and resolution	849

Satellite Tracking and Channel Control		
DLLTIMECONST	Replaces the GLOCSMOOTH and CSMOOTH commands	1011
DYNAMICS	Adjusts the tracking state transition time-out	258
ECUTOFF	Sets the satellite tracking elevation cut-off	50
FORCEGLOL2CODE	Forces the receiver to track L2C or P-code	1217
FORCEGPSL2CODE	Forces the receiver to track L2C or P-code	796
GALECUTOFF	Sets the Galileo satellite elevation cut-off angle	1114
GLOECUTOFF	Sets the GLONASS satellite elevation cut-off angle	735
LOCKOUT	Prevents the receiver from using a satellite	137
LOCKOUTSYSTEM	Prevents the receiver from using a system	871
QZSSECUTOFF	Sets the elevation cut-off angle for QZSS satellites	1350
SBASECUTOFF	Sets the SBAS satellite elevation cut-off	1000
TRACKSV	Overrides the automatic satellite/channel assignment for all satellites with manual instructions	1326
UNASSIGN	Unassigns a previously ASSIGNed channel	29
UNASSIGNALL	Unassigns all previously ASSIGNed channels	30
UNLOCKOUT	Reinstates a satellite in the solution	138
UNLOCKOUTALL	Reinstates all previously locked out satellites	139
UNLOCKOUTSYSTEM	Reinstates in the solution computation a system previously locked out	908
Waypoint Navigation		
MAGVAR	Sets the magnetic variation correction	180
SETNAV	Sets waypoints	162

Table 10: OEM6 Commands in Alphabetical Order

OEM6 Commands in Alphabetical Order		
ASCII Name	**Description**	**Message ID**
ADJUST1PPS	Adjusts the receiver clock	429
ALIGNAUTOMATION	Configures the ALIGN plug and play feature	1323
ANTENNAMODEL	Enters/changes the rover antenna model	841
ANTENNAPOWER	Controls the power to Low Noise Amplifier (LNA) of an active antenna	98
APPLICATION	Starts/stops the application	413
ASSIGN	Assigns individual satellite channel	27
ASSIGNALL	Assigns all satellite channels	28
ASSIGNLBAND	Sets L-band satellite communication parameters	729
ASSIGNLBAND2	Sets L-band satellite communication parameters	1200
AUTH	Adds authorization code for new model	49
BASEANTENNAMODEL	Enters/changes base antenna model	870
CLOCKADJUST	Enables clock adjustments	15
CLOCKCALIBRATE	Adjusts clock steering parameters	430
CLOCKOFFSET	Adjusts for delay in 1PPS output	596
CNOUPDATE	Sets C/No update rate and resolution	849
COM	Sets COM port configuration	4
COMCONTROL	Controls the hardware control lines of the RS232 ports	431
DATUM	Chooses a DATUM name type	160
DGPSEPHEMDELAY	Sets DGPS ephemeris delay	142
DGPSTXID	Sets DGPS station ID	144

OEM6 Commands in Alphabetical Order		
ASCII Name	**Description**	**Message ID**
DIFFCODEBIASCONTROL	Enables or disable satellite differential code biases	913
DLLTIMECONST	Replaces the GLOCSMOOTH and CSMOOTH commands	1011
DNSCONFIG	Manually configures DNS servers	1244
DYNAMICS	Adjusts tracking state transition time-out	258
ECHO	Sets port echo	1247
ECUTOFF	Sets satellite tracking elevation cut-off	50
ETHCONFIG	Configures Ethernet physical layer	1245
EXTERNALCLOCK	Allows the OEM6 card to operate with an optional external oscillator	230
FIX	Constrains receiver height or position	44
FIXPOSDATUM	Sets the position in a specified datum	761
FORCEGLOL2CODE	Forces the receiver to track L2C or P-code	1217
FORCEGPSL2CODE	Forces the receiver to track L2C or P-code	796
FREQUENCYOUT	Sets the output pulse train available on VARF	232
FRESET	Resets the receiver to factory default	20
GALECUTOFF	Sets elevation cut-off angle for Galileo satellites	1114
GENERATEALIGNCORRECTIONS	Configures the ALIGN Master and starts sending out ALIGN RTCA corrections through the specified port	1349
GENERATEDIFFCORRECTIONS	Sends a preconfigured set of differential corrections	1296
GENERATERTKCORRECTIONS	Sends a preconfigured set of RTK corrections	1260
GGAQUALITY	Customizes the GPGGA GPS quality indicator	691

OEM6 Commands in Alphabetical Order		
ASCII Name	**Description**	**Message ID**
GLOECUTOFF	Sets the GLONASS satellite elevation cut-off angle	735
HDTOUTTHRESHOLD	Controls the NMEA GPHDT log output	1062
HEADINGOFFSET	Adds heading and pitch offset values	1082
HPSEED	Specifies the initial position for OmniSTAR HP/XP	782
HPSTATICINIT	Sets static initialization of OmniSTAR HP/XP	780
ICOMCONFIG	Configures IP virtual COM port	1248
INTERFACEMODE	Sets interface type for a port, Receive (Rx)/ Transmit (Tx)	3
IONOCONDITION	Sets ionospheric condition	1215
IPCONFIG	Configures network IP settings	1243
LOCALIZEDCORRECTIONDATUM	Sets a local datum	947
LOCKOUT	Prevents the receiver from using a satellite by specifying its PRN	137
LOCKOUTSYSTEM	Prevents the receiver from using a system	871
LOG	Requests a log	1
MAGVAR	Sets magnetic variation correction	180
MARKCONTROL	Controls processing of the mark inputs	614
MODEL	Switches receiver to a previously AUTHed model	22
MOVINGBASESTATION	Sets ability to use a moving base station	763
NMEATALKER	Sets the NMEA talker ID	861
NTRIPCONFIG	Configures NTRIP	1249
NTRIPSOURCETABLE	Sets the NTRIPCASTER ENDPOINTS used for the SOURCETABLE log	1343

OEM6 Commands in Alphabetical Order		
ASCII Name	**Description**	**Message ID**
NVMRESTORE	Restores NVM data after a failure in NVM	197
OMNIUSEGLONASS	Enables/disables GLONASS in OmniStar	1199
PDPFILTER	Enables, disables or resets the Pseudorange/ Delta-Phase (PDP) filter	424
PDPMODE	Selects the PDP mode and dynamics	970
POSAVE	Implements base station position averaging	173
POSTIMEOUT	Sets the position time out	612
PPSCONTROL	Controls the PPS output	613
PROFILE	Configures multiple profiles in the non-volatile memory	1411
PSRDIFFSOURCE	Sets the pseudorange correction source	493
PSRDIFFSOURCETIMEOUT	Sets duration after differential corrections switched from one source to another	1449
PSRDIFFTIMEOUT	Sets maximum age of differential data	1450
QZSSECUTOFF	Sets the elevation cut-off angle for QZSS satellites	1350
RAIMMODE	Configures RAIM mode	1285
RESET	Performs a hardware reset	18
RTKANTENNA	Specifies L1 phase center (PC) or ARP and enable/disable PC modeling	858
RTKCOMMAND	Resets the RTK filter or sets the filter to default settings	97
RTKDYNAMICS	Sets up the RTK dynamics mode	183
RTKELEVMASK	Sets the RTK elevation mask	91
RTKMATCHEDTIMEOUT	Sets the duration after matched RTK filter is reset	1447

OEM6 Commands in Alphabetical Order		
ASCII Name	**Description**	**Message ID**
RTKNETWORK	Specifies the RTK network mode	951
RTKQUALITYLEVEL	Chooses an RTK quality mode	844
RTKSOURCE	Sets the RTK correction source	494
RTKSOURCETIMEOUT	Sets duration after RTK corrections switched from one source to another	1445
RTKSVENTRIES	Sets number of satellites in corrections	92
RTKTIMEOUT	Sets maximum age of RTK data	910
SAVECONFIG	Saves current configuration	19
SBASCONTROL	Sets SBAS test mode and PRN	652
SBASECUTOFF	Sets SBAS satellite elevation cut-off	1000
SBASTIMEOUT	Sets the amount of time the receiver remains in an SBAS position if it stops receiving SBAS corrections	1001
SEND	Sends ASCII message to a port	177
SENDHEX	Sends non-printable characters to a port	178
SERIALCONFIG	Configures serial port settings	1246
SETAPPROXPOS	Sets an approximate position	377
SETAPPROXTIME	Sets an approximate GPS reference time	102
SETBASERECEIVERTYPE	Specifies the base receiver type to aid GLONASS ambiguity fixing in RTK	1374
SETBESTPOSCRITERIA	Selects criteria for BESTPOS	839
SETCANNAME	Sets the CAN name fields	1091
SETDIFFCODEBIASES	Sets satellite differential code biases	687
SETIONOTYPE	Sets the ionospheric corrections model	711
SETNAV	Sets waypoints	162

OEM6 Commands in Alphabetical Order		
ASCII Name	**Description**	**Message ID**
SETROVERID	Sets the Rover ID output in ROVERPOS, HEADING2, ALIGNBSLNXYZ and ALIGNBSLNENU logs	1135
SETRTCM16	Enters ASCII text for RTCM data stream	131
SETRTCM36	Enters ASCII text with Russian characters	880
SETRTCMRXVERSION	Sets the expected RTCM standard input	1216
SETRTCMTXVERSION	Sets the RTCM transmission standard	1322
SETTIMEBASE	Sets primary and backup systems for time base	1237
SETTROPOMODEL	Sets the troposphere model used to correct ranges n the PSRPOS and PDPPOS solutions	1434
SETUTCLEAPSECONDS	Sets when future leap seconds take effect	1150
SOFTLOADCOMMIT	Commits to the soft load module	475
SOFTLOADDATA	Uploads data for soft load	1218
SOFTLOADRESET	Restart soft load process	476
SOFTLOADSETUP	Configures the soft load process	1219
SOFTLOADSREC	Configures soft load process	477
STATUSCONFIG	Configures various status mask fields in RXSTATUSEVENT log	95
TRACKSV	Overrides the automatic satellite/channel assignment for all satellites with manual instructions	1326
TUNNELESCAPE	Breaks out of an established tunnel	962
UNASSIGN	Unassigns a previously ASSIGNed channel	29
UNASSIGNALL	Unassigns all previously ASSIGNed channels	30
UNDULATION	Sets ellipsoid-geoid separation	214
UNLOCKOUT	Reinstates a satellite in the solution	138

OEM6 Commands in Alphabetical Order		
ASCII Name	**Description**	**Message ID**
UNLOCKOUTALL	Reinstates all previously locked out satellites	139
UNLOCKOUTSYSTEM	Reinstates in the solution computation a system previously locked out	908
UNLOG	Removes a log from the logging control	36
UNLOGALL	Removes all logs from the logging control	38
USERDATUM	Sets user customized datum	78
USEREXPDATUM	Sets custom expanded datum	783
UTMZONE	Sets UTM parameters	749

Table 11: OEM6 Commands in Numerical Order

OEM6 Commands in Numerical Order		
Message ID	**ASCII Name**	**Description**
1	LOG	Requests a log
3	INTERFACEMODE	Sets interface type for a port, Receive (Rx)/ Transmit (Tx)
4	COM	Sets COM port configuration
15	CLOCKADJUST	Enables clock adjustments
18	RESET	Performs a hardware reset
19	SAVECONFIG	Saves current configuration
20	FRESET	Resets receiver to factory default
22	MODEL	Switches receiver to a previously AUTHed model
27	ASSIGN	Assigns individual satellite channel
28	ASSIGNALL	Assigns all satellite channels
29	UNASSIGN	Unassigns a previously ASSIGNed channel

OEM6 Commands in Numerical Order		
Message ID	**ASCII Name**	**Description**
30	UNASSIGNALL	Unassigns all previously ASSIGNed channels
36	UNLOG	Removes a log from the logging control
38	UNLOGALL	Removes all logs from the logging control
44	FIX	Constrains receiver height or position
49	AUTH	Adds authorization code for new model
50	ECUTOFF	Sets satellite tracking elevation cut-off
78	USERDATUM	Sets user customized datum
91	RTKELEVMASK	Sets the RTK elevation mask
92	RTKSVENTRIES	Sets number of satellites in corrections
95	STATUSCONFIG	Configures various status mask fields in RXSTATUSEVENT log
97	RTKCOMMAND	Resets the RTK filter or sets the filter to default settings
98	ANTENNAPOWER	Controls power to Low Noise Amplifier (LNA) of an active antenna
102	SETAPPROXTIME	Sets an approximate GPS reference time
131	SETRTCM16	Enters ASCII text for RTCM data stream
137	LOCKOUT	Prevents the receiver from using a satellite by specifying its PRN
138	UNLOCKOUT	Reinstates a satellite in the solution
139	UNLOCKOUTALL	Reinstates all previously locked out satellites
142	DGPSEPHEMDELAY	Sets DGPS ephemeris delay
144	DGPSTXID	Sets DGPS station ID
160	DATUM	Chooses a DATUM name type
162	SETNAV	Sets waypoints

OEM6 Commands in Numerical Order		
Message ID	**ASCII Name**	**Description**
173	POSAVE	Implements base station position averaging
177	SEND	Sends ASCII message to a port
178	SENDHEX	Sends non-printable characters to a port
180	MAGVAR	Sets magnetic variation correction
183	RTKDYNAMICS	Sets up the RTK dynamics mode
197	NVMRESTORE	Restores NVM data after a failure in NVM
214	UNDULATION	Sets ellipsoid-geoid separation
230	EXTERNALCLOCK	Allows the OEM6 card to operate with an optional external oscillator
232	FREQUENCYOUT	Sets the output pulse train available on VARF
258	DYNAMICS	Adjusts tracking state transition time-out
377	SETAPPROXPOS	Sets an approximate position
413	APPLICATION	Starts/stops the application
424	PDPFILTER	Enables, disables or resets the Pseudorange/ Delta-Phase (PDP) filter
429	ADJUST1PPS	Adjusts the receiver clock
430	CLOCKCALIBRATE	Adjusts clock steering parameters
431	COMCONTROL	Controls the hardware control lines of the RS232 ports
475	SOFTLOADCOMMIT	Commits to the soft load module
476	SOFTLOADRESET	Restart soft load process
477	SOFTLOADSREC	Configures soft load process
493	PSRDIFFSOURCE	Sets the pseudorange correction source
494	RTKSOURCE	Sets the RTK correction source
596	CLOCKOFFSET	Adjusts for delay in 1PPS output

OEM6 Commands in Numerical Order		
Message ID	**ASCII Name**	**Description**
612	POSTIMEOUT	Sets the position time out
613	PPSCONTROL	Controls the PPS output
614	MARKCONTROL	Controls processing of the mark inputs
687	SETDIFFCODEBIASES	Sets satellite differential code biases
652	SBASCONTROL	Sets SBAS test mode and PRN
691	GGAQUALITY	Customizes the GPGGA GPS quality indicator
711	SETIONOTYPE	Sets the ionospheric corrections model
729	ASSIGNLBAND	Sets L-band satellite communication parameters
735	GLOECUTOFF	Sets the GLONASS satellite elevation cut-off angle
749	UTMZONE	Sets UTM parameters
761	FIXPOSDATUM	Sets the position in a specified datum
763	MOVINGBASESTATION	Sets ability to use a moving base station
780	HPSTATICINIT	Sets static initialization of OmniSTAR HP/XP
782	HPSEED	Specifies the initial position for OmniSTAR HP/XP
783	USEREXPDATUM	Sets custom expanded datum
796	FORCEGPSL2CODE	Forces the receiver to track L2C or P-code
839	SETBESTPOSCRITERIA	Selects criteria for BESTPOS
841	ANTENNAMODEL	Enters/changes rover antenna model
844	RTKQUALITYLEVEL	Chooses an RTK quality mode
849	CNOUPDATE	Sets C/No update rate and resolution
858	RTKANTENNA	Specifies L1 phase center (PC) or ARP and enable/disable PC modeling
861	NMEATALKER	Sets the NMEA talker ID

OEM6 Commands in Numerical Order		
Message ID	**ASCII Name**	**Description**
870	BASEANTENNAMODEL	Enters/changes base antenna model
871	LOCKOUTSYSTEM	Prevents the receiver from using a system
880	SETRTCM36	Enters ASCII text with Russian characters
908	UNLOCKOUTSYSTEM	Reinstates in the solution computation a system previously locked out
910	RTKTIMEOUT	Sets maximum age of RTK data
913	DIFFCODEBIASCONTROL	Enables or disable satellite differential code biases
947	LOCALIZEDCORRECTION-DATUM	Sets a local datum
951	RTKNETWORK	Specifies the RTK network mode
962	TUNNELESCAPE	Breaks out of an established tunnel
970	PDPMODE	Selects the PDP mode and dynamics
1000	SBASECUTOFF	Sets SBAS satellite elevation cut-off
1001	SBASTIMEOUT	Sets the amount of time the receiver remains in an SBAS position if it stops receiving SBAS corrections
1011	DLLTIMECONST	Replaces the GLOCSMOOTH and CSMOOTH commands
1062	HDTOUTTHRESHOLD	Controls the NMEA GPHDT log output
1082	HEADINGOFFSET	Adds specified offset to heading and pitch values
1091	SETCANNAME	Sets the CAN name fields
1114	GALECUTOFF	Sets elevation cut-off angle for Galileo satellites
1135	SETROVERID	Sets the Rover ID output in ROVERPOS, HEADING2, ALIGNBSLNXYZ and ALIGNBSLNENU logs
1150	SETUTCLEAPSECONDS	Sets when future leap seconds take effect

OEM6 Commands in Numerical Order		
Message ID	**ASCII Name**	**Description**
1199	OMNIUSEGLONASS	Enables/disables GLONASS in OmniStar
1200	ASSIGNLBAND2	Sets L-band satellite communication parameters
1215	IONOCONDITION	Sets ionospheric condition
1216	SETRTCMRXVERSION	Sets the RTCM transmission standard
1217	FORCEGLOL2CODE	Forces the receiver to track L2C or P-code
1218	SOFTLOADDATA	Uploads data for soft load
1219	SOFTLOADSETUP	Configures the soft load process
1237	SETTIMEBASE	Sets primary and backup systems for time base
1243	IPCONFIG	Configures network IP settings
1244	DNSCONFIG	Manually configures DNS servers
1245	ETHCONFIG	Configures Ethernet physical layer
1246	SERIALCONFIG	Configures serial port settings
1247	ECHO	Sets port echo
1248	ICOMCONFIG	Configures IP virtual COM port
1249	NTRIPCONFIG	Configures NTRIP
1260	GENERATERTKCORRECTIONS	Sends a preconfigured set of RTK corrections
1285	RAIMMODE	Configures RAIM mode
1296	GENERATEDIFFCORRECTIONS	Sends a preconfigured set of differential corrections
1322	SETRTCMTXVERSION	Sets the expected RTCM transmission standard input
1323	ALIGNAUTOMATION	Configures the ALIGN plug and play feature
1326	TRACKSV	Overrides the automatic satellite/channel assignment for all satellites with manual instructions

OEM6 Commands in Numerical Order		
Message ID	**ASCII Name**	**Description**
1343	NTRIPSOURCETABLE	Sets the NTRIPCASTER ENDPOINTS to be used for the SOURCETABLE log
1349	GENERATEALIGNCORRECTIONS	Configures the ALIGN Master and start sending out ALIGN RTCA corrections through the specified port
1350	QZSSECUTOFF	Sets the elevation cut-off angle for QZSS satellites
1374	SETBASERECEIVERTYPE	Specifies the base receiver type to aid GLONASS ambiguity fixing in RTK
1411	PROFILE	Configures multiple profiles in the non-volatile memory
1434	SETTROPOMODEL	Sets the troposphere model used to correct ranges in the PSRPOS and PDPPOS solutions
1445	RTKSOURCETIMEOUT	Sets duration after RTK corrections switched from one source to another
1447	RTKMATCHEDTIMEOUT	Sets duration after which matched RTK filter is reset
1449	PSRDIFFSOURCETIMEOUT	Sets duration after differential corrections switched from one source to another
1450	PSRDIFFTIMEOUT	Sets maximum age of differential data

Ensure that all windows, other than the Console window, are closed in NovAtel's Connect user interface application before you issue the SAVECONFIG command.

FRESET STANDARD causes all previously stored user configurations saved to non-volatile memory to be erased (including Saved Config, Saved Almanac, Saved Ephemeris and L-band-related data, excluding subscription information).

2.4 Factory Defaults

When the receiver is first powered up or after a FRESET command (see *page 129*), all commands revert to their factory default settings. When you use a command without specifying its optional parameters, it may have a different command default than the factory default. The SAVECONFIG command (see *page 208*) can be used to save these defaults. Use the RXCONFIG log (see *page 519*) to reference any default command and log settings.

2.5 Command Reference

When you use a command without specifying its optional parameters, it may have a different command default than the factory default. Factory default settings for individual commands are stated in the following commands, organized alphabetically by command name.

2.5.1 ADJUST1PPS Adjusts the receiver clock

Use this command to adjust the receiver clock or as part of the procedure to transfer time between receivers. The number of pulses per second (PPS) is always set to 1 Hz with this command. It is typically used when the receiver is not adjusting its own clock and is using an external reference frequency.

To disable the automatic clock adjustment, refer to the CLOCKADJUST command on *page 83*. To configure the receiver to use an external reference oscillator, see the EXTERNALCLOCK command on *page 116*.

The ADJUST1PPS command can be used to:

1. Manually shift the phase of the clock
2. Adjust the phase of the clock so the output 1PPS signal matches an external signal
3. Set the receiver clock close to that of another GNSS receiver
4. Set the receiver clock exactly in phase of another GNSS receiver

1. The resolution of the clock synchronization is 50 ns.
2. To adjust the 1PPS output, when the receiver's internal clock is being used and the CLOCKADJUST command is enabled, use the CLOCKOFFSET command on *page 89*.
3. If the 1PPS rate is adjusted, the new rate does not start until the next second begins.

Figure 1 on *Page 58*shows the 1PPS alignment between a Fine and a Cold Clock receiver. See also the TIMESYNC log on *Figure 3.3.149* on *Page 590* and the *Transfer Time Between Receivers* section in the *OEM6 Family Installation and Operation User Manual*.

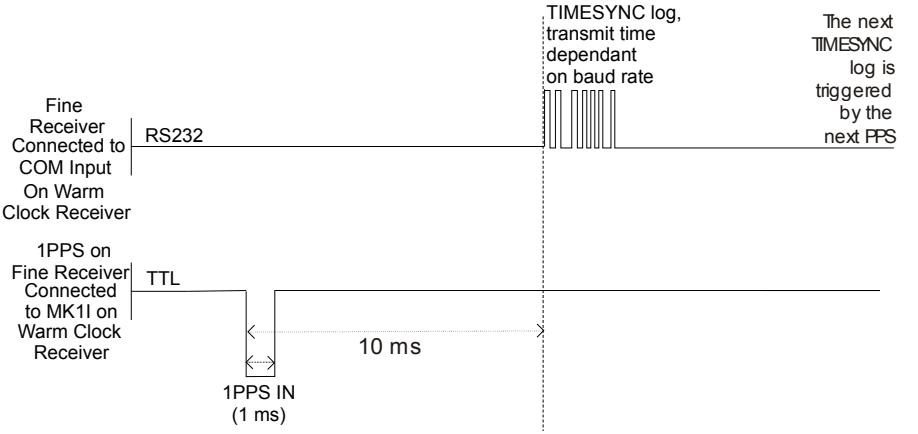


Figure 1: 1PPS Alignment

The 1PPS is obtained from different receivers in different ways. For more information about 1PPS alignment, refer to the OEM6 Installation and Operation Guide found on our website at http://www.novatel.com/support/firmware-software-and-manuals/.

Alternatively, the 1PPS signal can be set up to be output on the RTS signal of COM1, COM2 or COM3, or the DTR signal of COM2 using the COMCONTROL command, see *page 92*. The accuracy of the 1PPS is less using this method, but may be more convenient in some circumstances.

To find out the time of the last 1PPS output signal, use the TIMESYNCA/B output message, see *page 590*, which can be output serially on any available COM port, for example:

```
LOG COM1 TIMESYNCA ONTIME 1
```

Abbreviated ASCII Syntax: **Message ID: 429**

ADJUST1PPS mode [period] [offset]

Factory Default:

adjust1pps off

ASCII Example:

adjust1pps mark continuous 240

You can use the ADJUST1PPS command to synchronize two OEM6 cards in a primary/ secondary relationship to a common external clock.

At the Primary Receiver:

LOG COM2 TIMESYNCa ONTIME 1

clockadjust DISABLE

EXTERNALCLOCK OCXO (you can choose rubidium, cesium or user instead)

EXTERNALCLOCK FREQUENCY 10 (you can choose 5 instead)

At the Secondary Receiver:

interfacemode com2 novatel novatel

clockadjust disable

adjust1pps mark (or markwithtime or time depending on your connection, see *figure 2* on *page 61*)

externalclock ocxo (you can choose rubidium, cesium or user instead)

externalclock frequency 10 (you can choose 5 instead)

Connections:

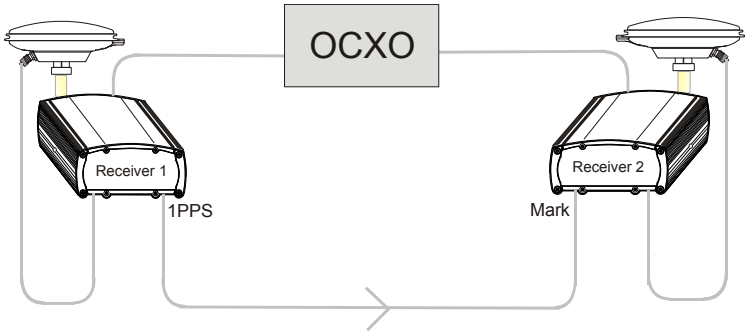
Null modem cable connected from Primary COM2 to Secondary COM2

OCXO signal sent through a splitter to feed both the Primary and Secondary external clock inputs

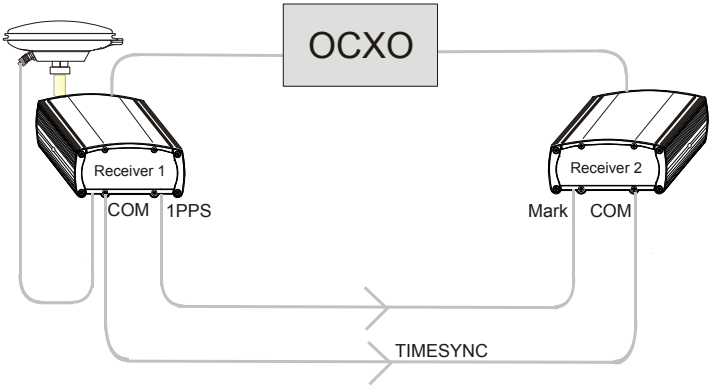
Primary 1PPS (pin# 2) connected to Secondary MKI (Mark Input, pin# 4)

Make to connect everything before you apply power. If power is applied and the OEM6 receivers have acquired satellites before the OCXO and/or 1PPS = MKI is set up, the times reported by the TIMESYNC logs still diverge. We noted that after the clock model was stabilized at state 0, the time difference between the Primary and Secondary reported by the TIMESYNC log was less than 10 ns.

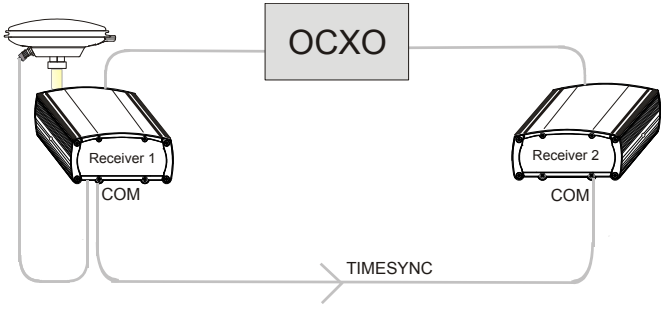
In *Figure 2* on *page 61*, the examples are for the transfer of time. If you need position, you must be tracking satellites and your receiver must have a valid almanac.



adjust1pps mark (if Receiver 2 is not in coarsetime, the input is ignored)



adjust1pps markwithtime (will get to finetime)



adjust1pps time (will only get to coarsetime)

Figure 2: ADJUST1PPS Connections[1]

1. These examples are for the transfer of time. If you need position, you must be tracking satellites and your receiver must have a valid almanac.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ADUST-1PPS header	-	-	This field contains the command name	-	H	0
2	mode	OFF	0	Disables ADJUST1PPS	Enum	4	H
		MANUAL	1	Immediately shifts the receivers time by the offset field in ns. The period field has no effect in this mode. This command does not affect the clock state			
		MARK[a]	2	Shifts the receiver time to align its 1PPS with the signal received in the MK1I port adjusted by the offset field in ns. The effective shift range is ± 0.5 s			
		MARKWITHTIME[b]	3	Shifts the receiver time to align its 1PPS with the signal received in the MK1I port adjusted by the offset field in ns, and sets the receiver TOW and week number, to that embedded in a received TIMESYNC log, see *page 590*. Also sets the receiver Time Status to that embedded in the TIMESYNC log, which must have arrived between 800 and 1000 ms prior to the MK1I event (presumably the 1PPS from the Primary), or it is rejected as an invalid message			
		TIME	4	If the receiver clock is not at least COARSE adjusted, this command enables the receiver to COARSE adjust its time upon receiving a valid TIMESYNC log in any of the ports. The clock state embedded in the TIMESYNC log must be at least FINE or FINESTEERING before it is considered. The receiver does not use the MK1I event in this mode			

3	period	ONCE	0	The time is synchronized only once (default). The ADJUST1PPS command must be reissued if another synchronization is required	Enum	4	H+4
		CONTINUOUS	1	The time is continuously monitored and the receiver clock is corrected if an offset of more than 50 ns is detected			
4	offset	-2147483648 to +2147483647		Allows the operator to shift the Secondary clock in 50 ns increments. In MANUAL mode, this command applies an immediate shift of this offset in ns to the receiver clock. In MARK and MARKWITHTIME mode, this offset shifts the receiver clock with respect to the time of arrival of the MK1I event. If this offset is zero, the Secondary aligns its 1PPS to that of the signal received in its MK1I port. For example, if this value was set to 50, then the Secondary would set its 1PPS 50 ns ahead of the input signal and if this value was set to -100 then the would set its clock to 100 ns behind the input signal. Typically, this offset is used to correct for cable delay of the 1PPS signal (default=0)	Long	4	H+8

a. Only the MK1I input can be used to synchronize the 1PPS signal. Synchronization cannot be done using the MK2I input offered on some receivers.

b. It is presumed that the TIMESYNC log, see *page 590*, was issued by a Primary GNSS receiver within 1000 ms but not less than 800 ms, of the last 1PPS event, see *Figure 1, 1PPS Alignment on Page 58*. Refer also to the *Transfer Time Between Receivers* section in the *OEM6 Family Installation and Operation User Manual*.

2.5.2 ALIGNAUTOMATION Configures ALIGN Plug-and-Play Feature

This command configures the ALIGN plug and play feature. Use this command to enable/disable the plug and play feature, to set the rover COM port to which master is connected, to set the baud rate for communication, to set the intended operation rate using this command and to enable/disable sending the HEADINGEXTB back to the Master receiver.

On issuing this command at ALIGN Rover, Rover will automatically sync with Master and configure it to send corrections at the specified baud rate and specified data rate.

This command should only be issued at ALIGN Rover.

Abbreviated ASCII Syntax: **Message ID: 1323**

alignautomation option [comport] [baudrate][datarate][headingextboption]

Factory Default:

alignautomation disable

Example:

alignautomation enable com2 230400 10 on

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ALIGNAUTOMATION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	option	ENABLE or DISABLE		Enable or disable the plug-and-play feature	ENUM	4	H
3	comport	COM1, COM2 or COM3		Rover COM port to which master is connected (default: COM2)	ENUM	4	H+4
4	baudrate	9600, 19200, 38400, 57600, 115200, 230400, 460800, or 921600		Intended baud rate for data transmission (default 230400)	ULONG	4	H+8
5	datarate	1, 2, 4, 5, 10 or 20 Hz		Rate at which heading output is required (default 10 Hz)	ULONG	4	H+12
6	headingextboption	ON or OFF		Enable or disable sending HEADINGEXTB back to the Master (default ON)	ENUM	4	H+16

2.5.3 ANTENNAMODEL Enters/changes rover antenna model

This command allows you to enter or change an antenna model for a rover receiver. Setting this value changes the appropriate field in RTCM23, RTCM1007 and RTCM1008 messages.You can set the antenna set up ID to any value from 0-255. See also BASEANTENNAMODEL, *page 81*, to set these parameters for the base and RTKANTENNA, *page 193*.

Phase center offsets are entered as northing, easting and up. The Phase Center Variation (PCV) entries follow the NGS standard and correspond to the phase elevation, at 5 degree increments, starting at 90 degrees and decreasing to 0. All units are in mm.

1. L1/L2 processing should include both L1 and L2 values or the resulting values might be incorrect. Since the phase measurement itself is corrected with the L1/L2 difference, failure to enter these values could result in bad position fixes.
2. For proper usage, the rover receiver needs to have both ANTENNAMODEL and BASEANTENNAMODEL data entered locally. Existing differential messaging standards do not include transmission of all data found in BASEANTENNAMODEL.
3. It is recommended that the ANTENNNAMODEL, BASEANTENNAMODEL and RTKANTENNA commands are used together and only used if complete antenna model information is available. These commands are best used in high precision static survey situations where antenna models are available for the base and rover receivers.

Abbreviated ASCII Syntax: **Message ID: 841**

ANTENNAMODEL name SN setupID type [L1 offset N] [L1 offset E] [L1 offset UP] [L1 var] [L2 offset N] [L2 offset E] [L2 offset UP] [L2 var]

Factory Default:

antennamodel none none 0 none

ASCII Example:

```
antennamodel 702gg nae07070025 3 user 3.0 -1.0 68.4 0.0 0.0
0.1 0.0 0.0 -0.2 -0.5 -0.8 -1.1 -1.3 -1.4 -1.7 -1.7 -1.8
-1.8 -1.4  -0.4 0.0 0.0 -0.6 -1.4 70.9 0.0 -0.9 -1.3 -1.5
-1.5 -1.5 -1.6 -1.7 -2.0 -2.2 -2.4 -2.7 -2.8 -2.9 -2.8 -2.7
-2.3 0.0 0.0
```

This example is using absolute calibration values from NGS for a NovAtel 702 Antenna.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ANTENNA-MODEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	name			Antenna name	String[32]	Vari-able [a]	H
3	SN			Antenna serial number	String[32]	Vari-able [a]	Variable
4	setupID			Setup identification - setting this value changes the appropriate field in RTCM23, RTCM1007 and RTCM1008 (starting on *page 502*)	Ulong	4	Variable
5	type[b]			Antenna model type None = No antenna 1 = User antenna	Enum	4	Variable
6	L1 offset N			L1 phase offsets northing (default = 0.0)	Double	8	Variable
7	L1 offset E			L1 phase offsets easting (default = 0.0)	Double	8	Variable
8	L1 offset UP			L1 phase offsets up (default = 0.0)	Double	8	Variable
9	L1 var			L1 phase center variations (default = 0.0 *for all 19*)	Double [19]	152	Variable
10	L2 offset N			L2 phase offsets northing (default = 0.0)	Double	8	Variable
11	L2 offset E			L2 phase offsets easting (default = 0.0)	Double	8	Variable
12	L2 offset UP			L2 phase offsets up (default = 0.0)	Double	8	Variable
13	L2 var			L2 phase center variations (default = 0.0 *for all 19*)	Double [19]	152	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

b. This should always be a user antenna when data is being entered manually for phase center offsets and/or phase center variation arrays.

2.5.4 ANTENNAPOWER Controls power to the antenna

This command enables or disables the supply of electrical power from the internal power source of the receiver to the Low Noise Amplifier (LNA) of an active antenna. Refer to the *OEM6 Family Installation and Operation User Manual* for further information about supplying power to the antenna.

There are several bits in the receiver status that pertain to the antenna (see *Table 99, Receiver Status* on *page 523*). These bits indicate whether the antenna is powered (internally or externally) and whether it is open circuited or short circuited.

On startup, the ANTENNAPOWER is set to ON.

Abbreviated ASCII Syntax: **Message ID: 98**

ANTENNAPOWER switch

Factory Default:

antennapower on

ASCII Examples:

antennapower on

antennapower off

antennapower on3v3

> For the OEM628 receiver, it is possible to supply power to the LNA of an active antenna either from the antenna port of the receiver itself or from an external source. The internal antenna power supply of the receiver can produce 5 VDC +/-5% at up to 100 mA. This meets the needs of any of NovAtel's dual-frequency GNSS antennas, so, in most cases, an additional LNA power supply is not required.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ANTENNAPOWER header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	OFF	0	Disables antenna power	Enum	4	H
		ON	1	Enables antenna power (5V)			
		ON3V3	2	Enables antenna power (3V)			

2.5.5 APPLICATION

This commands is used to start, stop or remove the application.

Abbreviated ASCII Syntax: **Message ID: 413**

APPLICATION

Factory Default:

application start

ASCII Examples:

application remove

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Application header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Start	STOP	0	Stops application	Enum	4	H
		START	1	Starts application			
		REMOVE	2	Removes application			
3	Parameter	0-		Sets application parameter (default=0)	Ulong	4	H+4
4	Priority	0-		Sets application priority (default=1)	Long	4	H+8
5	Stack size	0-		Sets application stack size (default=1000)	Long	4	H+12

2.5.6 ASSIGN Assigns a channel to a PRN

1. The ASSIGN command should only be used by advanced users.
2. Assigning a SV channel sets the forced assignment bit in the channel tracking status field which is reported in the RANGE and TRACKSTAT logs
3. Assigning a PRN to a SV channel does not remove the PRN from the search space of the automatic searcher; only the SV channel is removed (that is, the searcher may search and lock onto this PRN on another channel). The automatic searcher only searches for PRNs 1 to 32 for GPS channels, PRNs 38 to 61 for GLONASS (where available), PRNs 1-36 for Galileo (where available) and PRNs 120 to 138, 183-187 for SBAS channels.
4. GLONASS SVs cannot be assigned if there is no information on GLONASS frequencies and matching slot numbers.

This command may be used to aid in the initial acquisition of a satellite by allowing you to manually override the automatic satellite/channel assignment and reacquisition processes. The command specifies that the indicated tracking channel search, for a specified satellite, at a specified Doppler frequency, within a specified Doppler window.

The instruction remains in effect for the specified SV channel and PRN, even if the assigned satellite subsequently sets. If the satellite Doppler offset of the assigned SV channel exceeds that specified by the *window* parameter of the ASSIGN command, the satellite may never be acquired or reacquired. If a PRN has been assigned to a channel and the channel is currently tracking that satellite, when the channel is set to *AUTO* tracking, the channel immediately idles and returns to automatic mode.

To cancel the effects of *ASSIGN*, you must issue one of the following:

- The *ASSIGN* command with the *state* set to *AUTO*
- The *UNASSIGN* command (starting on *page 251*)
- The *UNASSIGNALL* command (starting on *page 252*)

These immediately return SV channel control to the automatic search engine.

Table 12: Channel State

Binary	ASCII	Description
0	IDLE	Set the SV channel to not track any satellites
1	ACTIVE[a]	Set the SV channel active (default)
2	AUTO	Tell the receiver to automatically assign PRN codes to channels

a. A PRN number is required when using the ACTIVE channel state in this command.

Abbreviated ASCII Syntax: **Message ID: 27**

ASSIGN channel [state] [prn [Doppler [Doppler window]]]

ASCII Example 1:

assign 0 active 29 0 2000

In example 1, the first SV channel is acquiring satellite PRN 29 in a range from -2000 Hz to 2000 Hz until the satellite signal is detected.

ASCII Example 2:

assign 11 28 -250 0

SV channel 11 is acquiring satellite PRN 28 at an offset of -250 Hz only.

ASCII Example 3:

assign 11 idle

SV channel 11 is idled and does not attempt to search for satellites.

OEM6 cards have 4 channels available for SBAS. They automatically use the healthy GEO satellites with the highest elevations. You can use the ASSIGN command to enter a GEO PRN manually.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ASSIGN header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively (see *1.1 Message Types* on *page 19)*	-	H	0
2	channel	0 to *n*, where *n* is the number of the last channel in the current channel configuration		Desired SV channel number where channel 0 is the first SV channel. The last channel depends on your model configuration	ULong	4	H
3	state	*These return SV channel control to the automatic search engine immediately (Table 12)*		Set the SV channel state	Enum	4	H+4
4	prn	GPS: 1-32 SBAS: 120-138, 183-187 GLONASS: see *1.3 GLONASS Slot and Frequency Numbers* on *page 31*. Galileo: 1-36 QZSS: 193-197		Optional satellite PRN code. If not included in the command line, the state parameter must be set to IDLE	Long	4	H+8
5	Doppler	-100 000 to 100 000 Hz		Current Doppler offset of the satellite Note: Satellite motion, receiver antenna motion and receiver clock frequency error must be included in the calculation of Doppler frequency (default = 0)	Long	4	H+12
6	Doppler window	0 to 10 000 Hz		Error or uncertainty in the Doppler estimate above. Note: This is a ± value. Example: 500 for ± 500 Hz (default = 4 500)	ULong	4	H+16

2.5.7 ASSIGNALL Assigns all channels to a PRN

The ASSIGNALL command should only be used by advanced users.

This command allows you to override the automatic satellite/channel assignment and reacquisition processes for all receiver channels with manual instructions.

Abbreviated ASCII Syntax: **Message ID: 28**

ASSIGNALL [system][state][prn [Doppler [Doppler window]]]

Table 13: Channel System

Binary	ASCII	Description
3	ALL	All systems
99	GPS	GPS system
100	SBAS	SBAS system
101	GLONASS	GLONASS system
102	GALILEO	GALILEO system
103	COMPASS	COMPASS system
104	QZSS	QZSS system

Only GLONASS satellites that are in the almanac are available to assign using a slot number in the ASSIGN command. The possible range is still 38 to 61.

ASCII Example 1:

ASSIGNALL GLONASS IDLE

In example 1, all GLONASS channels are idled out, essentially stopping the receiver from tracking GLONASS.

ASCII Example 2:

ASSIGNALL GLONASS AUTO

In example 2, all GLONASS channels are enabled in auto mode. This enables the receiver to automatically assign channels to track the available GLONASS satellites.

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This command is the same as ASSIGN except that it affects **all** SV channels.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ASSIGN-ALL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	system	See *Table 13, Channel System* on *page 72*		System that SV channel is tracking	Enum	4	H
3	state	These return SV channel control to the automatic search engine immediately (Table 12)		Set the SV channel state	Enum	4	H+4
4	prn	GPS: 1-32 SBAS: 120-138, 183-187 GLONASS: see *1.3 GLONASS Slot and Frequency Numbers* on *page 31*. Galileo: 1-36 QZSS: 193-197		Optional satellite PRN code. If not included in the command line, the state parameter must be set to idle	Long	4	H+8
5	Doppler	-100 000 to 100 000 Hz		Current Doppler offset of the satellite Note: Satellite motion, receiver antenna motion and receiver clock frequency error must be included in the calculation of Doppler frequency.(default = 0)	Long	4	H+12
6	Doppler window	0 to 10 000 Hz		Error or uncertainty in the Doppler estimate above.This is a ± value (for example, 500 for ± 500 Hz) (default =4500)	ULong	4	H+16

These command examples are only applicable to specific receiver models.

1. If you use the *system* field with this command and the receiver has no channels configured with that channel system, the command has no effect on the receiver's tracking state.

2.5.8 ASSIGNLBAND Sets L-band satellite communication parameters

This command enables a receiver channel to track the specified L-band signal at a specified frequency and baud rate.

In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR or use of other DGPS service is required. Contact NovAtel Inc. for more details.

Abbreviated ASCII Syntax: **Message ID: 729**

ASSIGNLBAND mode [freq] [baud]

Factory Default:

assignlband idle

ASCII Example:

assignlband omnistar 1536782 1200

Beam Frequencies

The OmniSTAR beam frequency chart can be found at http://www.omnistar.com.

For example: Use OmniSTAR VBS

assignlband omnistar <freq> 1200

psrdiffsource omnistar

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ASSIGNLBAND header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively (see *1.1 Message Types* on *page 19)*	-	H	0
2	mode	See *Table 14, Page 75*		Set the mode and enter specific frequency and baud rate values	Enum	4	H
3	freq[a]	1525000 to 1560000 or 1525000000 to 1560000000		L-band service beam frequency of satellite (Hz or kHz). See also *Beam Frequencies* on *page 74* (default = 1545000)	Ulong	4	H+4
4	baud	300, 600, 1200, 2400 or 4800		Data rate for communication with L-band satellite (default = 1200)	Ulong	4	H+8

a. The frequency assignment can be made in kHz or Hz. For example:
ASSIGNLBAND OMNISTAR 1557855000 1200
ASSIGNLBAND OMNISTAR 1557855 1200

Table 14: L-band Mode

Binary	ASCII	Description
0	Reserved	
1	OMNISTAR	When you select OmniSTAR, enter a dedicated frequency and baud rate
2	Reserved	
3	IDLE	When you select IDLE, the receiver is configured to stop tracking any L-band satellites. The 'freq' and 'baud' fields are optional so that you may select IDLE without specifying the other fields

Table 14: L-band Mode

Binary	ASCII	Description
4	OMNISTARAUTO	When you select OMNISTARAUTO, the receiver automatically selects the best OmniSTAR beam to track based on the receiver's position. This requires the receiver to have a downloaded satellite list from an OmniSTAR satellite. Therefore, a manual assignment is necessary the first time an OmniSTAR satellite is assigned on a new receiver. After collection, the satellite list is stored in NVM for subsequent auto assignments. Lists are considered valid for 6 months and are constantly updated while an OmniSTAR signal is tracking. If the receiver has a valid satellite list, it is reported in a status bit in the LBANDSTAT log, see *page 403* [a]
5	OMNISTARNARROW	When you select OMNISTARNARROW, enter a dedicated frequency and baud rate. For reacquisitions of the L-band signal, the receiver uses a 1500 Hz search window

a. The receiver will always track an available local beam over a global beam. The receiver constantly monitors the satellite list to ensure it is tracking the best one and automatically switches beams if it is not tracking the best one. You can view the satellite list by logging the OMNIVIS log, see *page 431*.

2.5.9 ASSIGNLBAND2 Sets L-band satellite communication parameters

This command enables a receiver channel to track the specified L-band signal at a specified frequency and baud rate as ASSIGNLBAND but you can also specify the OmniSTAR satellite service ID number. In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR or use of other DGPS service is required. Contact NovAtel Inc. for more details.

Abbreviated ASCII Syntax: **Message ID: 1200**

ASSIGNLBAND2 mode [freq] [baud] [id]

Factory Default:

assignlband2 idle

ASCII Example:

assignlband2 omnistar 1557855000 1200 c685

Beam Frequencies

Use OmniSTAR VBS

assignlband2 omnistar <freq> 1200

psrdiffsource omnistar

The OmniSTAR beam frequency chart can be found at http://www.omnistar.com.

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Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ASSIGNLBAND 2 header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively (see *1.1 Message Types* on *page 19)*	-	H	0
2	mode	See *Table 14*		Set the mode and enter specific frequency and baud rate values	Enum	4	H
3	freq[a]	1525000 to 1560000 or 1525000000 to 1560000000		L-band service beam frequency of satellite (Hz or kHz). See also *Beam Frequencies* on *page 74* (default = 1545000)	Ulong	4	H+4
4	baud	300, 600, 1200, 2400 or 4800		Data rate for communication with L-band satellite (default = 1200)	Ulong	4	H+8
5	ID	0x0, 0xC685, 0x2873 or 0xFCEE		OmniSTAR satellite service ID number (default=0x0)	Ulong	4	H+12

a. The frequency assignment can be made in kHz or Hz. For example:
ASSIGNLBAND2 OMNISTAR 1557855000 1200 c685
ASSIGNLBAND2 OMNISTAR 1557855 1200 c685

2.5.10 AUTH Adds authorization code for new model

This command is used to add or remove authorization codes from the receiver. Authorization codes are used to authorize models of software for a receiver. The receiver is capable of keeping track of 24 authorization codes at one time. The MODEL command (see *page 167*) can then be used to switch between authorized models. The VALIDMODELS log (see *page 594*) lists the current available models in the receiver. The AUTHCODES log (see *page 298*) lists all Authorization codes entered into the receiver. This simplifies the use of multiple software models on the same receiver.

If there is more than one valid model in the receiver, the receiver either uses the model of the last auth code entered via the AUTH command or the model that was selected by the MODEL command, whichever was done last. Adding an Authorization Code or Using the MODEL command would cause a reset automatically. Removing an Authorization Code would not cause a reset.

Removing an authorization code will cause the receiver to permanently lose this information.

Abbreviated ASCII Syntax: **Message ID: 49**

AUTH [state] part1 part2 part3 part4 part5 model [date]

Input Example:

auth add t48jf2,w25dbm,jh46bj,2wghmj,8jw5tw,g2sr0rccr,101114

When you want to easily upgrade your receiver without returning it to the factory, our unique field upgradeable feature allows you buy the equipment that you need today and upgrade without facing obsolescence.

When you are ready to upgrade from one model to another, call 1-800-NOVATEL to speak with our Customer Support/Sales Personnel, who can provide the authorization code that unlocks the additional features of your GNSS receiver. This procedure can be performed at your work site and takes only a few minutes.

Receiver models can also be downgraded. This is a two step handshaking process and is best performed in location with e-mail access.

Boot version OEM060200RB0000 introduces support for signature authorization codes in addition to standard authorization codes. Standard authorization codes are firmware specific meaning new codes are required if the receiver firmware is updated. Signature authorization codes will work with any firmware version that has been digitally signed by NovAtel removing the need for new codes after an upgrade. Digitally signed firmware files can be found on www.novatel.com. To update firmware on receivers with older boot versions, please contact NovAtel Customer Support.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	AUTH header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	state	REMOVE[a]	0	Remove the authcode from the system	Enum	4	H
		ADD	1	Add the authcode to the system (default)			
3	part1	6 character ASCII string		Authorization code section 1	String	16	H+4
4	part2	6 character ASCII string		Authorization code section 2	String	16	H+20
5	part3	6 character ASCII string		Authorization code section 3	String	16	H+36
6	part4	6 character ASCII string		Authorization code section 4	String	16	H+52
7	part5	6 character ASCII string		Authorization code section 5	String	16	H+68
8	model	Alpha numeric	Null terminated	Model name of the receiver	String [max. 16]	Variable [b]	Variable
9	date	Numeric	Null terminated	Expiry date entered as yymmdd in decimal	String [max 7]	Variable [a]	Variable

a. For this parameter, the Part1-Part5 fields can be entered as 0 0 0 0 0, and only the model name entered.

b. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

2.5.11 BASEANTENNAMODEL Enters/changes base antenna model

This command allows you to enter or change an antenna model for a base receiver. Setting this value changes the appropriate field in RTCM23, RTCM1007 and RTCM1008 messages.You can set the antenna set up ID to any value from 0-255. See also ANTENNAMODEL, *page 65*, to set these parameters at the rover and RTKANTENNA, *page 193*.

Phase center offsets are entered as northing, easting and up. The Phase Center Variation (PCV) entries follow the NGS standard and correspond to the phase elevation at 5 degree increments starting at 90 degrees and decreasing to 0. All units are in mm.

1. L1/L2 processing should include both L1 and L2 values or the resulting values might be incorrect. Since the phase measurement itself is corrected with the L1/L2 difference, failure to enter these values could result in bad position fixes.
2. It is recommended that the ANTENNNAMODEL, BASEANTENNAMODEL and RTKANTENNA commands are used together and only used if complete antenna model information is available. These commands are best used in high precision static survey situations where antenna models are available for the base and rover receivers.

Abbreviated ASCII Syntax: **Message ID: 870**

BASEANTENNAMODEL name SN setupID type [L1 offset N] [L1 offset E] [L1 offset UP] [L1 var] [L2 offset N] [L2 offset E] [L2 offset UP] [L2 var]

Factory Default:

baseantennamodel none none 0 none

ASCII Example:

baseantennamodel 702 nvh05410007 1 user

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	BASE-ANTENNA-MODEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	name			Antenna name	String[32]	Variable [a]	H
3	SN			Antenna serial number	String[32]	Variable [a]	Variable
4	setupID			Setup identification - setting this value changes the appropriate field in RTCM23, RTCM1007 and RTCM1008, see *550, 515* and *515* respectively	Ulong	4	Variable
5	type[b]			Antenna model type 0 = No antenna 1 = User antenna	Enum	4	Variable
6	L1 offset N			L1 phase offsets northing (default = 0.0)	Double	8	Variable
7	L1 offset E			L1 phase offsets easting (default = 0.0)	Double	8	Variable
8	L1 offset UP			L1 phase offsets up (default = 0.0)	Double	8	Variable
9	L1 var			L1 phase center variations (default = 0.0 *for all 19*)	Double [19]	152	Variable
10	L2 offset N			L2 phase offsets northing (default = 0.0)	Double	8	Variable
11	L2 offset E			L2 phase offsets easting (default = 0.0)	Double	8	Variable
12	L2 offset UP			L2 phase offsets up (default = 0.0)	Double	8	Variable
13	L2 var			L2 phase center variations (default = 0.0 *for all 19*)	Double [19]	152	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

b. This should always be a user antenna when data is being entered manually for phase center offsets and/or phase center variation arrays.

2.5.12 CLOCKADJUST Enables clock adjustments

All oscillators have some inherent drift. By default, the receiver attempts to steer the receiver's clock to accurately match GPS reference time. If for some reason this is not desired, this behavior can be disabled using the CLOCKADJUST command. The TIME log can then be used to monitor clock drift.

1. The CLOCKADJUST command should only be used by advanced users.
2. If the CLOCKADJUST command is ENABLED and the receiver is configured to use an external reference frequency (set in the EXTERNALCLOCK command, see *page 116*, for an external clock - TCXO, OCXO, RUBIDIUM, CESIUM, or USER), then the clock steering process takes over the VARF output pins and may conflict with a previously entered FREQUENCYOUT command, see *page 126*.
3. When using the EXTERNALCLOCK and CLOCKADJUST commands together, issue the EXTERNALCLOCK command first to avoid losing satellites.
4. When disabled, the range measurement bias errors continue to accumulate with clock drift.
5. Pseudorange, carrier phase and Doppler measurements may jump if the CLOCKADJUST mode is altered while the receiver is tracking.
6. When disabled, the time reported on all logs may be offset from GPS reference time. The 1PPS output may also be offset. The amount of this offset may be determined from the TIME log, see *page 587*.
7. A discussion on GPS reference time may be found in *Section 1.4 GPS Reference Time Status* on *page 32*.

Abbreviated ASCII Syntax: **Message ID: 15**

CLOCKADJUST switch

Factory Default:

clockadjust enable

ASCII Example:

clockadjust disable

The CLOCKADJUST command can be used to calibrate an internal oscillator. Disable the CLOCKADJUST mode in order find out what the actual drift is from the internal oscillator. Watch the CLOCKMODEL log to see the drift rate and adjust the oscillator until the drift stops.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	CLOCKADJUST header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	DISABLE	0	Disallow adjustment of internal clock	Enum	4	H
		ENABLE	1	Allow adjustment of internal clock			

2.5.13 CLOCKCALIBRATE Adjusts clock steering parameters

This command is used to adjust the control parameters of the clock steering loop. The receiver must be enabled for clock steering before these values can take effect. Refer to the CLOCKADJUST command, see *page 83*, to enable or disable this feature.

To disable the clock steering process, issue the CLOCKADJUST DISABLE command.

The current values used by the clock steering process are listed in the CLOCKSTEERING log, see *page 325*.

The values entered using the CLOCKCALIBRATE command are saved to non-volatile memory (NVM). To restore the values to their defaults, the FRESET CLKCALIBRATION command must be used. Issuing FRESET without the CLKCALIBRATION parameter will not clear the values (see *page 129* for more details).

Abbreviated ASCII Syntax: **Message ID: 430**

CLOCKCALIBRATE [mode][period] [width] [slope] [bandwidth]

ASCII Example:

clockcalibrate auto

The receiver by default steers its INTERNAL VCTCXO but can be commanded to control an EXTERNAL reference oscillator. Use the EXTERNALCLOCK command, see *page 116*, to configure the receiver to use an external reference oscillator. If the receiver is configured for an external reference oscillator and configured to adjust its clock, then the clock steering loop attempts to steer the external reference oscillator through the use of the VARF signal. Note that the clock steering control process conflicts with the manual FREQUENCYOUT command, see *page 126*. It is expected that the VARF signal is used to provide a stable reference voltage by the use of a filtered charge pump type circuit (not supplied).

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	CLOCKCALIBRATE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	SET	0	Sets the period, pulsewidth, slope and bandwidth values into NVM for the currently selected steered oscillator (INTERNAL or EXTERNAL)	Enum	4	H
		AUTO	1	Forces the receiver to do a clock steering calibration to measure the slope (change in clock drift rate with a 1 bit change in pulse width) and required pulsewidth to zero the clock drift rate. After the calibration, these values along with the period and bandwidth are entered into NVM and are then used from this point forward on the selected oscillator			
		OFF	2	Terminates a calibration process currently underway (default)			
3	period	0 to 262144		Signal period in 25 ns steps. Frequency Output = 40,000,000 / Period (default = 4400)	Ulong	4	H+4

Continued on next page

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
4	pulsewidth	The valid range for this parameter is 10% to 90% of the period		Sets the initial pulse width that should provide a near zero drift rate from the selected oscillator being steered. The valid range for this parameter is 10% to 90% of the period. The default value is 2200. If this value is not known, (in the case of a new external oscillator) then it should be set to ½ the period and the mode should be set to AUTO to force a calibration (default=2200)	Ulong	4	H+8
5	slope			This value should correspond to how much the clock drift changes with a 1 bit change in the pulsewidth m/s/bit. The default values for the slope used for the INTERNAL and EXTERNAL clocks is -2.0 and -0.01 respectively. If this value is not known, then its value should be set to 1.0 and the mode should be set to AUTO to force a calibration. Once the calibration process is complete and using a slope value of 1.0, the receiver should be recalibrated using the measured slope and pulsewidth values (see the CLOCKSTEERING log, on *page 325*). This process should be repeated until the measured slope value remains constant (less than a 5% change) (default=-2.0)	Float	4	H+12

Continued on next page

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
6	bandwidth			This is the value used to control the smoothness of the clock steering process. Smaller values result in slower and smoother changes to the receiver clock. Larger values result in faster responses to changes in oscillator frequency and faster start up clock pull in. The default values are 0.03 and 0.001 Hz respectively for the INTERNAL and EXTERNAL clocks (default=0.03)	Float	4	H+16

2.5.14 CLOCKOFFSET Adjusts for delay in 1PPS output

This command can be used to remove a delay in the PPS output. The PPS signal is delayed from the actual measurement time due to two major factors:

- A delay in the signal path from the antenna to the receiver
- An intrinsic delay through the RF and digital sections of the receiver

The second delay is automatically accounted for by the receiver using a nominal value determined for each receiver type. However, since the delay from the antenna to the receiver cannot be determined by the receiver, an adjustment cannot automatically be made. The CLOCKOFFSET command can be used to adjust for this delay.

Abbreviated ASCII Syntax: **Message ID: 596**

CLOCKOFFSET offset

Factory Default:

clockoffset 0

ASCII Example:

clockoffset -15

There may be small variances in the delays for each cable or card. The CLOCKOFFSET command can be used to characterize each setup. For example, for a cable with a delay of 10 ns, the offset can be set to -10 to remove the delay from the PPS output.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	CLOCKOFFSET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively (see *1.1 Message Types* on *page 19)*	-	H	0
2	offset	±200		Specifies the offset in nanoseconds	Long	4	H

2.5.15 CNOUPDATE Sets the C/No update rate and resolution

This command allows you to set the C/No update rate and resolution.

Abbreviated ASCII Syntax: **Message ID: 849**

CNOUPDATE rate

Factory Default:

cnoupdate default

ASCII Example (rover):

cnoupdate 20hz

Use the CNOUPDATE command for higher resolution C/No measurements, of the incoming GNSS signals, at a higher rate. By default, the C/No values are calculated at approximately 4 Hz but this command allows you to increase that rate to 20 Hz.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	CNO-UPDATE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	rate	DEFAULT	0	C/No update rate: 0 = Turn off C/No enhancement default = 4 Hz (4 bits/s) 1 = 20 Hz C/No updates (20 bits/s)	ENUM	4	H
		20 HZ	1				

2.5.16 COM Configures the COM port

The SERIALCONFIG command replaces this one, see *page 218*.

2.5.17 COMCONTROL Controls the RS232 hardware control lines

This command is used to control the hardware control lines of the RS232 ports. The TOGGLEPPS mode of this command is typically used to supply a timing signal to a host PC computer by using the RTS or DTR lines. The accuracy of controlling the COM control signals is better than 900 µs. The other modes are typically used to control custom peripheral devices. Also, it is possible to communicate with all three serial ports simultaneously using this command.

1. If handshaking is disabled, any of these modes can be used without affecting regular RS232 communications through the selected COM port. However, if handshaking is enabled, it may conflict with handshaking of the selected COM port, causing unexpected results.
2. The PULSEPPSLOW control type cannot be issued for a TX signal.
3. Only PULSEPPSHIGH, FORCEHIGH and FORCELOW control types can be used for a TX signal.

Abbreviated ASCII Syntax: **Message ID: 431**

COMCONTROL port signal control

Factory Default:

comcontrol com1 rts default

comcontrol com2 rts default

comcontrol com3 rts default

ASCII Example 1:

serialconfig com1 9600 n 8 1 n (to disable handshaking)

comcontrol com1 rts forcelow

comcontrol com2 dtr togglepps

ASCII Example 2:

comcontrol com1 rts togglepps

comcontrol com2 rts togglepps

comcontrol com3 rts togglepps

ASCII Example 3:

To set a break condition on AUX:

comcontrol aux tx forcelow

A break condition remains in effect until it is cleared.

To clear a break condition on AUX:

comcontrol com1 tx default

or

comcontrol com1 tx forcehigh

Table 15: Tx, DTR and RTS Availability

	Tx Available On:	DTR Available On:	RTS Available On:
OEM628	COM1 and COM2	N/A	COM1 and COM2

COM1 on the OEM628 is user configurable for RS-422. Refer to the *Technical Specifications* appendix and also the *Connecting Data Communication Equipment* section of the *OEM6 Family Installation and Operation User Manual*.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	COMCONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	port	COM1	1	RS232 port to control. Valid ports are COM1, COM2 and COM3	Enum	4	H
		COM2	2				
		COM3	3				
3	signal	RTS	0	COM signal to control. The controllable COM signals are RTS, DTR and TX. See also *Table 15, Tx, DTR and RTS Availability* on *page 93*	Enum	4	H+4
		DTR	1				
		TX	2				

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
4	control	DEFAULT	0	Disables this command and returns the COM signal to its default state	Enum	4	H+8
		FORCEHIGH	1	Immediately forces the signal high			
		FORCELOW	2	Immediately forces the signal low			
		TOGGLE	3	Immediately toggles the current sate of the signal			
		TOGGLEPPS	4	Toggles the state of the selected signal within 900 μs after each 1PPS event. The state change of the signal lags the 1PPS by an average value of 450 μs. The delay of each pulse varies by a uniformly random amount less than 900 μs			
		PULSEPPSLOW	5	Pulses the line low at a 1PPS event and to high 1 ms after it. Not for TX			
		PULSEPPSHIGH	6	Pulses the line high for 1 ms at the time of a 1PPS event			

2.5.18 DATUM Chooses a datum name type

This command permits you to select the geodetic datum for operation of the receiver. If not set, the factory default value is WGS84. See the USERDATUM command for user definable datums. The datum you select causes all position solutions to be based on that datum.

The transformation for the WGS84 to Local used in the OEM6 family is the Bursa-Wolf transformation or reverse Helmert transformation. In the Helmert transformation, the rotation of a point is counter clockwise around the axes. In the Bursa-Wolf transformation, the rotation of a point is clockwise. Therefore, the reverse Helmert transformation is the same as the Bursa-Wolf.

See *Table 16, Page 96* for a complete listing of all available predefined datums. The offsets in the table are from your local datum to WGS84.

Abbreviated ASCII Syntax: **Message ID: 160**

DATUM datum

Factory Default:

datum wgs84

ASCII Example:

datum csrs

Also, as an example, you can achieve spatial integrity with Government of Canada maps and surveys if the coordinates are output using the CSRS datum (Datum ID# 64).

Table 16, Page 96 contains the internal ellipsoid and transformation parameters used in the receiver. The values contained in these tables were derived from the following DMA reports:

1. TR 8350.2 Department of Defense World Geodetic System 1984 and Relationships with Local Geodetic Systems - Revised March 1, 1988.
2. TR 8350.2B Supplement to Department of Defense World Geodetic System 1984 Technical Report - Part II - Parameters, Formulas, and Graphics for the Practical Application of WGS84 - December 1, 1987.
3. TR 8350.2 Department of Defense World Geodetic System 1984 National Imagery and Mapping Agency Technical Report, Third Addition, Amendment 1 - January 3, 2000

By default, NovAtel receivers output positions in WGS84, with the following additional information to consider:

Single	Uses WGS84
SBAS	Corrects to WGS84
EGNOS	Corrects to International Terrestrial Reference System (ITRF) which is compatible with WGS84
OmniSTAR XP/HP	Corrects to ITRF which is compatible with WGS84
OmniSTAR VBS	Corrects to ITRF which is compatible with WGS84
PSRDIFF and RTK	Unknown, as the rover does not know how the user fixed the base position, but must be close to WGS84

Table 16: Reference Ellipsoid Constants

ELLIPSOID	ID CODE	a (metres)	1/f	f
Airy 1830	AW	6377563.396	299.3249646	0.00334085064038
Modified Airy	AM	6377340.189	299.3249646	0.00334085064038
Australian National	AN	6378160.0	298.25	0.00335289186924
Bessel 1841	BR	6377397.155	299.1528128	0.00334277318217
Clarke 1866	CC	6378206.4	294.9786982	0.00339007530409
Clarke 1880	CD	6378249.145	293.465	0.00340756137870
Everest (India 1830)	EA	6377276.345	300.8017	0.00332444929666
Everest (Brunei & E.Malaysia)	EB	6377298.556	300.8017	0.00332444929666
Everest (W.Malaysia & Singapore)	EE	6377304.063	300.8017	0.00332444929666
Geodetic Reference System 1980	RF	6378137.0	298.257222101	0.00335281068118
Helmert 1906	HE	6378200.0	298.30	0.00335232986926
Hough 1960	HO	6378270.0	297.00	0.00336700336700
International 1924	IN	6378388.0	297.00	0.00336700336700
Parameters of the Earth	PZ-90.02	6378136.0	298.26	0.00335280374302
South American 1969	SA	6378160.0	298.25	0.00335289186924
World Geodetic System 1972	WD	6378135.0	298.26	0.00335277945417
World Geodetic System 1984	WE	6378137.0	298.257223563	0.00335281066475

Table 17: Datum Transformation Parameters

Datum ID# [a]	NAME	DX [b]	DY [b]	DZ [b]	DATUM DESCRIPTION	ELLIPSOID
1	ADIND	-162	-12	206	This datum has been updated, see ID# 65 [c]	Clarke 1880
2	ARC50	-143	-90	-294	ARC 1950 (SW & SE Africa)	Clarke 1880
3	ARC60	-160	-8	-300	This datum has been updated, see ID# 66 [c]	Clarke 1880
4	AGD66	-133	-48	148	Australian Geodetic Datum 1966	Australian National
5	AGD84	-134	-48	149	Australian Geodetic Datum 1984	Australian National
6	BUKIT	-384	664	-48	Bukit Rimpah (Indonesia)	Bessel 1841
7	ASTRO	-104	-129	239	Camp Area Astro (Antarctica)	International 1924
8	CHATM	175	-38	113	Chatham 1971 (New Zealand)	International 1924
9	CARTH	-263	6	431	Carthage (Tunisia)	Clarke 1880
10	CAPE	-136	-108	-292	CAPE (South Africa)	Clarke 1880
11	DJAKA	-377	681	-50	Djakarta (Indonesia)	Bessel 1841
12	EGYPT	-130	110	-13	Old Egyptian	Helmert 1906
13	ED50	-87	-98	-121	European 1950	International 1924
14	ED79	-86	-98	-119	European 1979	International 1924
15	GUNSG	-403	684	41	G. Segara (Kalimantan - Indonesia)	Bessel 1841
16	GEO49	84	-22	209	Geodetic Datum 1949 (New Zealand)	International 1924
17	GRB36	375	-111	431	**Do not use.** Use ID# 76 instead. [d]	Airy 1830
18	GUAM	-100	-248	259	Guam 1963 (Guam Island)	Clarke 1866
19	HAWAII	89	-279	-183	**Do not use.** Use ID# 77 or ID# 81 instead. [d]	Clarke 1866

Table 17: Datum Transformation Parameters

Datum ID#	NAME	DX	DY	DZ	DATUM DESCRIPTION	ELLIPSOID
20	KAUAI	45	-290	-172	**Do not use.** Use ID# 78 or ID# 82 instead. [d]	Clarke 1866
21	MAUI	65	-290	-190	**Do not use.** Use ID# 79 or ID# 83 instead. [d]	Clarke 1866
22	OAHU	56	-284	-181	**Do not use.** Use ID# 80 or ID# 84 instead. [d]	Clarke 1866
23	HERAT	-333	-222	114	Herat North (Afghanistan)	International 1924
24	HJORS	-73	46	-86	Hjorsey 1955 (Iceland)	International 1924
25	HONGK	-156	-271	-189	Hong Kong 1963	International 1924
26	HUTZU	-634	-549	-201	This datum has been updated, see ID# 68 [c]	International 1924
27	INDIA	289	734	257	**Do not use.** Use ID# 69 or ID# 70 instead. [d]	Everest (EA)
28	IRE65	506	-122	611	**Do not use.** Use ID# 71 instead. [d]	Modified Airy
29	KERTA	-11	851	5	Kertau 1948 (West Malaysia and Singapore)	Everest (EE)
30	KANDA	-97	787	86	Kandawala (Sri Lanka)	Everest (EA)
31	LIBER	-90	40	88	Liberia 1964	Clarke 1880
32	LUZON	-133	-77	-51	**Do not use.** Use ID# 72 instead. [d]	Clarke 1866
33	MINDA	-133	-70	-72	This datum has been updated, see ID# 73 [c]	Clarke 1866
34	MERCH	31	146	47	Merchich (Morocco)	Clarke 1880
35	NAHR	-231	-196	482	This datum has been updated, see ID# 74 [c]	Clarke 1880
36	NAD83	0	0	0	N. American 1983 (Includes Areas 37-42)	GRS-80
37	CANADA	-10	158	187	N. American Canada 1927	Clarke 1866
38	ALASKA	-5	135	172	N. American Alaska 1927	Clarke 1866

Table 17: Datum Transformation Parameters

Datum ID#	NAME	DX	DY	DZ	DATUM DESCRIPTION	ELLIPSOID
39	NAD27	-8	160	176	N. American Conus 1927	Clarke 1866
40	CARIBB	-7	152	178	This datum has been updated, see ID# 75 [c]	Clarke 1866
41	MEXICO	-12	130	190	N. American Mexico	Clarke 1866
42	CAMER	0	125	194	N. American Central America	Clarke 1866
43	MINNA	-92	-93	122	Nigeria (Minna)	Clarke 1880
44	OMAN	-346	-1	224	Oman	Clarke 1880
45	PUERTO	11	72	-101	Puerto Rica and Virgin Islands	Clarke 1866
46	QORNO	164	138	-189	Qornoq (South Greenland)	International 1924
47	ROME	-255	-65	9	Rome 1940 Sardinia Island	International 1924
48	CHUA	-134	229	-29	South American Chua Astro (Paraguay)	International 1924
49	SAM56	-288	175	-376	South American (Provisional 1956)	International 1924
50	SAM69	-57	1	-41	South American 1969	S. American 1969
51	CAMPO	-148	136	90	S. American Campo Inchauspe (Argentina)	International 1924
52	SACOR	-206	172	-6	South American Corrego Alegre (Brazil)	International 1924
53	YACAR	-155	171	37	South American Yacare (Uruguay)	International 1924
54	TANAN	-189	-242	-91	Tananarive Observatory 1925 (Madagascar)	International 1924
55	TIMBA	-689	691	-46	This datum has been updated, see ID# 85 [c]	Everest (EB)
56	TOKYO	-128	481	664	This datum has been updated, see ID# 86 [c]	Bessel 1841
57	TRIST	-632	438	-609	Tristan Astro 1968 (Tristan du Cunha)	International 1924
58	VITI	51	391	-36	Viti Levu 1916 (Fiji Islands)	Clarke 1880

Table 17: Datum Transformation Parameters

Datum ID#	NAME	DX	DY	DZ	DATUM DESCRIPTION	ELLIPSOID
59	WAK60	101	52	-39	This datum has been updated, see ID# 67 [c]	Hough 1960
60	WGS72	0	0	4.5	World Geodetic System - 72	WGS72
61	WGS84	0	0	0	World Geodetic System - 84	WGS84
62	ZANDE	-265	120	-358	Zanderidj (Surinam)	International 1924
63	USER	0	0	0	User Defined Datum Defaults	User [a]
64	CSRS	Time-variable 7 parameter transformation				
65	ADIM	-166	-15	204	Adindan (Ethiopia, Mali, Senegal & Sudan) [c]	Clarke 1880
66	ARSM	-160	-6	-302	ARC 1960 (Kenya, Tanzania) [c]	Clarke 1880
67	ENW	102	52	-38	Wake-Eniwetok (Marshall Islands) [c]	Hough 1960
68	HTN	-637	-549	-203	Hu-Tzu-Shan (Taiwan) [c]	International 1924
69	INDB	282	726	254	Indian (Bangladesh) [d]	Everest (EA)
70	INDI	295	736	257	Indian (India, Nepal) [d]	Everest (EA)
71	IRL	506	-122	611	Ireland 1965 [d]	Modified Airy
72	LUZA	-133	-77	-51	Luzon (Philippines excluding Mindanoa Is.) [de]	Clarke 1866
73	LUZB	-133	-79	-72	Mindanoa Island [c]	Clarke 1866
74	NAHC	-243	-192	477	Nahrwan (Saudi Arabia) [c]	Clarke 1880
75	NASP	-3	142	183	N. American Caribbean [c]	Clarke 1866
76	OGBM	375	-111	431	Great Britain 1936 (Ordinance Survey) [d]	Airy 1830
77	OHAA	89	-279	-183	Hawaiian Hawaii [d]	Clarke 1866
78	OHAB	45	-290	-172	Hawaiian Kauai [d]	Clarke 1866

Table 17: Datum Transformation Parameters

Datum ID#	NAME	DX	DY	DZ	DATUM DESCRIPTION	ELLIPSOID
79	OHAC	65	-290	-190	Hawaiian Maui [d]	Clarke 1866
80	OHAD	58	-283	-182	Hawaiian Oahu [d]	Clarke 1866
81	OHIA	229	-222	-348	Hawaiian Hawaii [d]	International 1924
82	OHIB	185	-233	-337	Hawaiian Kauai [d]	International 1924
83	OHIC	205	-233	-355	Hawaiian Maui [d]	International 1924
84	OHID	198	-226	-347	Hawaiian Oahu [d]	International 1924
85	TIL	-679	669	-48	Timbalai (Brunei and East Malaysia) 1948 [c]	Everest (EB)
86	TOYM	-148	507	685	Tokyo (Japan, Korea and Okinawa) [c]	Bessel 1841

a. The default user datum is WGS84. See also the USERDATUM and USEREXPDATUM commands starting on *page 263*. The following logs report the datum used according to the OEM card Datum ID column: BESTPOS, BESTUTM, MATCHEDPOS and PSRPOS.

b. The DX, DY and DZ offsets are from your local datum to WGS84.

c. The updated datum have the new x, y and z translation values updated to the latest numbers. The old datum values can still be used for backwards compatibility.

d. Use the corrected datum only (with the higher ID#) as the old datum is incorrect.

e. The original LUZON values are the same as for LUZA but the original has an error in the code.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Datum Type	See *Table 17*		The datum to use	Enum	4	H

2.5.19 DGPSEPHEMDELAY Sets DGPS ephemeris delay

The DGPSEPHEMDELAY command is used to set the ephemeris delay when operating as a base station. The ephemeris delay sets a time value by which the base station continues to use the old ephemeris data. A delay of 120 to 300 seconds typically ensures that the rover stations have collected updated ephemeris. After the delay period is passed, the base station begins using new ephemeris data.

The factory default of 120 seconds matches the RTCM standard.

The RTCA Standard stipulates that a base station shall wait five minutes after receiving a new ephemeris before transmitting differential corrections to rover stations that are using the RTCA standard. This time interval ensures that the rover stations have received the new ephemeris and have computed differential positioning based upon the same ephemeris. Therefore, for RTCA base stations, the recommended ephemeris delay is 300 seconds.

Abbreviated ASCII Syntax: **Message ID: 142**

DGPSEPHEMDELAY delay

Factory Default:

dgpsephemdelay 120

ASCII Example (base):

dgpsephemdelay 120

When using differential corrections, the rover receiver must use the same set of broadcast ephemeris parameters as the base station generating the corrections. The Issue of Ephemeris Data (IODE) parameter is transmitted as part of the differential correction so that the rover can guarantee that its and the base station ephemerides match. The DGPSEPHEMDELAY parameter should be large enough to ensure that the base station is not using a new set of ephemerides that has not yet been received at the rover receiver.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DGPSEPHEMDELAY header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	delay	0 to 600 s		Minimum time delay before new ephemeris is used	ULong	4	H

2.5.20 DGPSTXID Sets DGPS station ID

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.

Abbreviated ASCII Syntax: **Message ID: 144**

DGPSTXID type ID

Factory Default:

dgpstxid auto "any"

ASCII Examples:

dgpstxid rtcm 2	- using an rtcm type and id
dgpstxid cmr 30	- using a cmr type and id
dgpstxid cmr "any"	- using the default cmr id
dgpstxid rtca d36d	- using an rtca type and id
dgpstxid rtcmv3 2050	- using an rtcmv3 type and id

2.5.21 DIFFCODEBIASCONTROL Enables or disables satellite differential code biases

The purpose of the differential code biases is to correct pseudorange errors that affect the L1/L2 ionospheric corrections. This command enables/disables the biases. A set of biases is included in the firmware and use of the biases is enabled by default. See also the SETDIFFCODEBIASES command on *page 228*.

Abbreviated ASCII Syntax: **Message ID: 913**

DIFFCODEBIASCONTROL switch

Factory Default:

diffcodebiascontrol enable

Example:

diffcodebiascontrol disable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DIFFCODE-BIAS-CONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Disable the differential code bias	Enum	4	H
		ENABLE	1	Enable the differential code bias			

2.5.22 DLLTIMECONST Sets carrier smoothing

This command replaces the GLOCSMOOTH and CSMOOTH commands. It sets the amount of carrier smoothing performed on the code measurements. An input value of 100 corresponds to approximately 100 seconds of smoothing. Upon issuing the command, the locktime (amount of continuous tracking in seconds) for all tracking satellites is reset to zero and each code smoothing filter is restarted. You must wait for at least the length of smoothing time for the new smoothing constant to take full effect. The optimum setting for this command depends on your application.

1. This command may not be suitable for every GNSS application.
2. When using DLLTIMECONST in differential mode with the same receivers, the same setting should be used at both the base and rover station. If the base and rover stations use different types of receivers, it is recommended that you use the command default value is at each receiver (DLLTIMECONST <signaltype> 100).
3. There are several considerations when using the DLLTIMECONST command:
   - The attenuation of low frequency noise (multipath) in pseudorange measurements
   - The effect of time constants on the correlation of phase and code observations
   - The rate of “pulling-in” of the code tracking loop (step response)
   - The effect of ionospheric divergence on carrier smoothed pseudorange (ramp response)

   The primary reason for applying carrier smoothing to the measured pseudoranges is to mitigate the high frequency noise inherent in all code measurements. Adding more carrier smoothing by increasing the DLLTIMECONST value filters out lower frequency noise, including some multipath frequencies.

There are also some adverse effects of higher DLLTIMECONST values on some performance aspects of the receiver. Specifically, the time constant of the tracking loop is directly proportional to the DLLTIMECONST value and affects the degree of dependence between the carrier phase and pseudorange information. Carrier phase smoothing of the code measurements (pseudoranges) is accomplished by introducing data from the carrier tracking loops into the code tracking system. Phase and code data, collected at a sampling rate greater than about 3 time constants of the loop, are correlated (the greater the sampling rate, the greater the correlation). This correlation is not relevant if only positions are logged from the receiver, but is an important consideration if the data is combined in some other process such as post-mission carrier smoothing. Also, a narrow bandwidth in a feedback loop impedes the ability of the loop to track step functions. Steps in the pseudorange are encountered during initial lock-on of the satellite and when working in an environment conducive to multipath. A low DLLTIMECONST value allows the receiver to effectively adapt to these situations.

Also, increased carrier smoothing may cause problems when satellite signals are strongly affected by the ionosphere. The rate of divergence between the pseudoranges and phase-derived ranges is greatest when a satellite is low in the sky since the GPS signal must travel through a much “thicker” ionosphere. The tracking error of the receiver is greatest at these times when a lot of carrier smoothing is implemented. In addition, changing periods of ionospheric activity (diurnal changes and the 11-year cycle) influences the impact of large DLLTIMECONST values. It is important to realize that the advantages of carrier smoothing do not come without some trade off in receiver performance. The factory default DLLTIMECONST value of 100 was selected as an optimal compromise of the above considerations. For the majority of applications, this default value should be appropriate. However, the flexibility exists to adjust the parameter for specific applications by users who are familiar with the consequences.

Abbreviated ASCII Syntax: **Message ID: 1011**

DLLTIMECONST signaltype timeconst

Factory Defaults:

dlltimeconst <signaltype>100

Example:

dlltimeconst gpsl2c 100

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DLLTIMECONST header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	signal type	See *Table 18*		Signal type	Enum	4	H
	time const			Time constant (sec)	Ulong	4	H+4

Table 18: Signal Type

Value (Binary)	Signal (ASCII)	Description
33	GPSL1CA	GPS L1 C/A-code
68	GPSL2Y	GPS L2 P(Y)-code
69	GPSL2C	GPS L2 C/A-code
70	GPSL2P	GPS L2 P-code
103	GPSL5	GPS L5
2177	GLOL1CA	GLONASS L1 C/A-code
2211	GLOL2CA	GLONASS L2 C/A-code
2212	GLOL2P	GLONASS L2 P-code
4129	SBASL1	SBAS L1
4194	SBASL5	SBAS L5
10433	GALE1	Galileo E1
10438	GALE1TEST	Galileo E1 test (GIOVE)
10466	GALE5A	Galileo E5A
10471	GALE5ATEST	Galileo E5A test (GIOVE)
10499	GALE5B	Galileo E5B
10504	GALE5BTEST	Galileo E5B test (GIOVE)
10532	GALALTBOC	Galileo ALT-BOC
10537	GALALTBOCTEST	Galileo ALT-BOC test (GIOVE)
14753	QZSSL1CA	QZSS L1 C/A-code
14787	QZSSL2C	QZSS L2 C/A-code
14820	QZSSL5	QZSS L5
16737	OMNISTAR	OMNIStar Service

2.5.23 DNSCONFIG Manually configures DNS servers

This command is part of the Ethernet set up. It configures the Domain Name Servers (DNS) so that host names can be used instead of IP addresses.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1244**

DNSCONFIG number_of_DNS_servers IP

Factory Default:

dnsconfig 0

ASCII Example:

DNSCONFIG 1 192.168.1.5

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	DNSCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	NumDNSServer	None	0	Number of DNS servers	Enum	4	H
		-	1				
3	IP address	xxx.xxx.xxx.xxx (10.0.0.2)		IP address of primary DNS server	String	16	H+4

2.5.24 DYNAMICS Tunes receiver parameters

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

The DYNAMICS command adjusts the Tracking State transition time out value of the receiver, see *Table 85, Tracking State* on *page 470*. When the receiver loses the position solution, see *Table 57, Solution Status* on *page 304*, it attempts to steer the tracking loops for fast reacquisition (5 s time-out by default). The DYNAMICS command allows you to adjust this time-out value, effectively increasing the steering time. The three states 0, 1 and 2 set the time-out to 5, 10 or 20 s respectively.

1. The DYNAMICS command should only be used by advanced users. The default of AUTO should **not** be changed except under very specific conditions.
2. The DYNAMICS command affects satellite reacquisition. The constraint of its filter with FOOT is very tight and is appropriate for a user on foot. A sudden tilted or up and down movement, for example while a tractor is moving slowly along a track, may trip the RTK filter to reset and cause the position to jump. AIR should be used in this case.

Abbreviated ASCII Syntax: **Message ID: 258**

DYNAMICS dynamics

Factory Default:

dynamics auto

Example:

dynamics foot

Table 19: User Dynamics

Binary	ASCII	Description
0	AIR	Receiver is in an aircraft or a land vehicle, for example a high speed train, with velocity greater than 110 km/h (30 m/s). This is also the most suitable dynamic for a jittery vehicle at any speed. See also *Note #2* above.
1	LAND	Receiver is in a stable land vehicle with velocity less than 110 km/h (30 m/s).
2	FOOT	Receiver is being carried by a person with velocity less than 11 km/h (3 m/s).
3	AUTO	Receiver monitors dynamics and adapts behavior accordingly

Qualifying North American Solar Challenge cars annually weave their way through 1000's of miles between the US and Canada. GNSS keeps them on track through many intersections on secondary highways and gives the Calgary team constant intelligence on the competition's every move. In this case, with average speeds of 46 miles/hour and at times a jittery vehicle, air is the most suitable dynamic.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DYNAMICS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	dynamics	See *Table 19*		Receiver dynamics based on your environment	Enum	4	H

2.5.25 ECHO Sets port echo

This command sets a port to echo.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1247**

ECHO [port] echo

Factory Default:

echo com1 off
echo com2 off
echo com3 off
echo aux off
echo usb1 off
echo usb2 off
echo usb3 off
echo icom1 off
echo icom2 off
echo icom3 off
echo ncom1 off
echo ncom2 off
echo ncom3 off

ASCII Example:

```
echo icom1 on
```

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	ECHO Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See Table 38[a]		Port to configure (default = THISPORT)	Enum	4	H
3	echo	OFF	0	Sets port echo to off	Enum	4	H+4
		ON	1	Sets port echo to on			

a. XCOM and NCOM ports are not supported.

2.5.26 ECUTOFF Sets satellite elevation cut-off for GPS Satellites

This command sets the elevation cut-off angle for tracked satellites. The receiver does not start automatically searching for a GPS satellite until it rises above the cut-off angle. Tracked satellites that fall below the cut-off angle are no longer tracked unless they are manually assigned (see the ASSIGN command *Section 2.5.6* on *page 69*).

In either case, satellites below the ECUTOFF angle are eliminated from the internal position and clock offset solution computations.

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

- The antenna is at a high altitude, and thus can look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

1. Care must be taken when using ECUTOFF because the signals from lower elevation satellites are traveling through more atmosphere and are therefore degraded. Use of satellites below 5 degrees is not recommended.
2. Use the GLOECUTOFF command (see *page 137*) to cut-off GLONASS satellites, the GALECUTOFF command (see *page 131*) for Galileo satellites and the SBASCUTOFF command (see *page 211*) for SBAS satellites.

Abbreviated ASCII Syntax: **Message ID: 50**

ECUTOFF angle

Factory Default:

ecutoff 5.0

ASCII Example:

ecutoff 10.0

A low elevation satellite is a satellite the receiver tracks "just" above the horizon. Generally, a satellite is considered low elevation if it is anywhere between 0 and 15 degrees above the horizon. Low elevation satellites are usually setting or rising.

There is no difference in the data transmitted from a low elevation satellite to that transmitted from a higher elevation satellite. However, differences in the signal path of a low elevation satellite make their use less desirable. Low elevation satellite signals are noisier due to the increased amount of atmosphere they must travel through. In addition, signals from low elevation satellites don't fit the assumption that a signal travels in air nearly the same as in a vacuum. As such, using low elevation satellites in the solution results in greater position inaccuracies.

The elevation cut-off angle is specified with ECUTOFF to ensure that noisy, low elevation satellite data below the cut-off is not used in computing a position. If post-processing data, it is still best to collect all data (even that below the cut-off angle). Experimenting with different cut-off angles can then be done to provide the best results. In cases where there are not enough satellites visible, a low elevation satellite may actually help in providing a useful solution.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	angle	±90.0 degrees		Elevation cut-off angle relative to horizon	Float	4	H

2.5.27 ETHCONFIG Configures Ethernet physical layer

Use this command to configure the Ethernet physical layer.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1245**

`ETHCONFIG` interface_name [speed] [duplex] [crossover] [power_mode]

Factory Default:

```
ethconfig etha auto auto auto powerdown
```

ASCII Example:

```
ethconfig etha 100 full mdix normal
```

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	ETHCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	interface	ETHA	2		Enum	4	H
3	speed	AUTO	1	Auto-negotiate speed (default)	Enum	4	H+4
		10	2	Force 10BaseT			
		100	3	Force 100BaseT			
4	duplex	AUTO	1	Auto-negotiate duplex (default)	Enum	4	H+8
		HALF	2	Force half duplex			
		FULL	3	Force full duplex			
5	crossover	AUTO	1	Auto-detect crossover (default)	Enum	4	H+12
		MDI	2	Force MDI (straight through)			
		MDIX	3	Force MDIX (crossover)			
6	power mode	AUTO	1	Energy detect mode (default)	Enum	4	H+16
		POWER DOWN	2	Soft power down mode			
		NORMAL	3	Normal mode			

2.5.28 EXTERNALCLOCK Sets external clock parameters

Overview

The EXTERNALCLOCK command allows the OEM6 card to operate with an optional external oscillator. You are able to optimally adjust the clock model parameters of these receivers for various types of external clocks.

1. This command affects the interpretation of the CLOCKMODEL log.
2. If the EXTERNALCLOCK command is enabled and set for an external clock (TCXO, OCXO, RUBIDIUM, CESIUM or USER) and the CLOCKADJUST command, see *page 83*, is ENABLED, then the clock steering process takes over the VARF output pins and may conflict with a previously entered FREQUENCYOUT command, see *page 126*. If clocksteering is not used with the external oscillator, the clocksteering process must be disabled by using the CLOCKADJUST DISABLE command.
3. When using the EXTERNALCLOCK and CLOCKADJUST commands together, issue the EXTERNALCLOCK command first to avoid losing satellites.

There are three steps involved in using an external oscillator:

1. Follow the procedure outlined in the *OEM6 Family Installation and Operation User Manual* to connect an external oscillator to your OEM6.
2. Using the EXTERNALCLOCK command, select a standard oscillator and its operating frequency.
3. Using the CLOCKADJUST command, disable the clocksteering process if external clocksteering is not used.

Theory

An unsteered oscillator can be approximated by a three-state clock model, with two states representing the range bias and range bias rate, and a third state assumed to be a Gauss-Markov (GM) process representing the range bias error generated from satellite clock dither. The third state is included because the Kalman filter assumes an (unmodeled) white input error. The significant correlated errors produced by satellite clock dither are obviously not white and the Markov process is an attempt to handle this kind of short term variation.

The internal units of the new clock model's three states (offset, drift and GM state) are metres, metres per second and metres. When scaled to time units for the output log, these become seconds, seconds per second and seconds, respectively. Note that the old units of the third clock state (drift rate) were metres per second per second.

The user has control over 3 process noise elements of the linear portion of the clock model. These are the h_0, h_{-1} and h_{-2} elements of the power law spectral density model used to describe the frequency noise characteristics of oscillators:

$$S_y(f) = \frac{h_{-2}}{f^2} + \frac{h_{-1}}{f} + h_0 + h_1 f + h_2 f^2$$

where *f* is the sampling frequency and $S_y(f)$ is the clock's power spectrum. Typically only h_0, h_{-1}, and h_{-2} affect the clock's Allan variance and the clock model's process noise elements.

Usage

Before you use an optional external oscillator, several clock model parameters must be set. There are default settings for a Voltage-Controlled Temperature-Compensated Crystal Oscillator (VCTCXO), ovenized crystal oscillator (OCXO), Rubidium and Cesium standard, which are given in *Table 20, Page 118*. You may alternatively choose to supply customized settings.

The EXTERNALCLOCK command determines whether the receiver uses its own internal temperature-compensated crystal oscillator or that of an external oscillator as a frequency reference. It also sets which clock model is used for an external oscillator.

To force the OEM6 to use the internal oscillator, use the EXTERNALCLOCK DISABLE command and physically disconnect the external oscillator input. Do not use the EXTERNALCLOCK OCXO, CESIUM, RUBIDIUM or USER parameters if there is no external oscillator connected to the OEM6.

Abbreviated ASCII Syntax: **Message ID: 230**

EXTERNALCLOCK clocktype [freq] [h_0[h_{-1}[h_{-2}]]]

Factory Default:

externalclock disable

ASCII Examples:

externalclock user 10mhz 1.0167e-23 6.87621e-25 8.1762e-26

externalclock tcxo 5mhz

Table 20: Clock Type

ASCII	Binary	Description
DISABLE	0	Turns the external clock input off, reverts back to the on-board VCTCXO
TCXO	1	Sets the predefined values for a VCTCXO
OCXO	2	Sets the predefined values for an OCXO
RUBIDIUM	3	Sets the predefined values for a rubidium oscillator
CESIUM	4	Sets the predefined values for a cesium oscillator
USER	5	Defines custom process noise elements

Table 21: Pre-Defined Values for Oscillators

Clock Type	h_0	h_{-1}	h_{-2}
VCTCXO	1.0 e-21	1.0 e-20	1.0 e-20
OCXO	2.51 e-26	2.51 e-23	2.51 e-22
Rubidium	1.0 e-23	1.0 e-22	1.3 e-26
Cesium	2.0 e-20	7.0 e-23	4.0 e-29

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	EXTERNALCLOCK header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	clocktype	See *Table 20, Page 118*		Clock type	Enum	4	H
3	freq	0 MHz	0	Optional frequency. If a value is not specified, the default is 5 MHz	Enum	4	H+4
		5 MHz	1				
		10 MHz	2				
4	h_0	1.0 e-35 to 1.0 e-18		Optional timing standards. These fields are only valid when the USER clocktype is selected. Do not use h values with VCTCXO, OCXO, CESIUM or RUBIDIUM clock types. The h values for these options are fixed, see *Table 21* (default=0.0)	Double	8	H+8
5	h_{-1}	1.0 e-35 to 1.0 e-18			Double	8	H+16
6	h_{-2}	1.0 e-35 to 1.0 e-18			Double	8	H+24

2.5.29 FIX Constrains to fixed height or position

This command fixes various parameters of the receiver such as height or position. For various applications, fixing these values can assist in improving acquisition times and accuracy of position or corrections. For example, fixing the position and height is a requirement for differential base stations as it provides a truth position to base the differential corrections from.

If you enter a FIXPOSDATUM command, see *page 123*, the FIX command is then issued internally with the FIXPOSDATUM command values translated to WGS84. It is the FIX command that appears in the RXCONFIG log. If the FIX or the FIXPOSDATUM command are used, their newest values overwrite the internal FIX values.

1. It is strongly recommended that the FIX POSITION entered be good to within a few metres. This level of accuracy can be obtained from a receiver using single point positioning once 5 or 6 satellites are being tracked.
2. FIX POSITION should only be used for base station receivers. Applying FIX POSITION to a rover, switches it from RT20 or RT2, mode to a fixed position mode. Applying FIX POSITION to the rover does not speed up ambiguity resolution.
3. Any setting other than FIX POSITION disables output of differential corrections unless the MOVINGBASESTATION command is set to ENABLE, see *page 168*.
4. You can fix the position of the receiver using latitude, longitude and height in Mean Sea Level (MSL) or ellipsoidal parameters depending on the UNDULATION setting. The factory default for the UNDULATION setting is TABLE, where the height entered in the FIX command is set as MSL height. If you change the UNDULATION setting to USER 0, the height entered in the FIX command is set as ellipsoidal height (*page 119)*.

Error checking is done on the entered fixed position. If less than 3 measurements are available, the solution status indicates PENDING. While the status is PENDING, the fixed position value is not used internally (for example, for updating the clock model or controlling the satellite signal search). Once 3 or more measurements are available, error checking is performed. If the error check passes, the solution status changes to SOL_COMPUTED and the fixed position is used internally. At the first level of error, when the fixed position is off by approximately 25-50 m, the output position log indicates INTEGRITY_WARNING in the solution status field but the fixed position value is still used internally. If the error reaches the second level, a few kilometers, the receiver does not use the fixed position at all and indicates INVALID_FIX in the solution status. Note that a fixed position obtained from the POSAVE (*page 179*) function is treated the same way in the error checking as one entered manually.

Abbreviated ASCII Syntax: **Message ID: 44**

FIX type [param1 [param2 [param3]]]

Factory Default:

fix none

ASCII Example:

fix height 4.567

In order to maximize accuracy of an RTK survey, you must fix the base station coordinates to their known position using the FIX [lat][lon][hgt] command. This ensures the accuracy of their corrections.

Table 22: FIX Parameters

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

a. For a discussion on height, refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

b. See also *Note #4* on *in the FIX Command*.

Table 23: Fix Types

ASCII Name	Binary Value	Description
NONE	0	Unfix. Clears any previous FIX commands.
AUTO	1	Configures the receiver to fix the height at the last calculated value if the number of satellites available is insufficient for a 3-D solution. This provides a 2-D solution. Height calculation resumes when the number of satellites available allows a 3-D solution.
HEIGHT	2	Configures the receiver in 2-D mode with its height constrained to a given value. This command is used mainly in marine applications where height in relation to mean sea level may be considered to be approximately constant. The height entered using this command is referenced to the mean sea level, see the BESTPOS log on *page 301* (is in metres). The receiver is capable of receiving and applying differential corrections from a base station while FIX HEIGHT is in effect. The FIX HEIGHT command overrides any previous FIX HEIGHT or FIX POSITION command. This command only affects pseudorange corrections and solutions.
POSITION	3	Configures the receiver with its position fixed. This command is used when it is necessary to generate differential corrections. For both pseudorange and differential corrections, this command must be properly initialized before the receiver can operate as a GNSS base station. Once initialized, the receiver computes differential corrections for each satellite being tracked. The computed differential corrections can then be output to rover stations by utilizing any of the following receiver differential corrections data log formats: RTCM, RTCMV3, RTCA or CMR. See the *OEM6 Family Installation and Operation User Manual* for information about using the receiver for differential applications. The values entered into the FIX POSITION command should reflect the precise position of the base station antenna phase center. Any errors in the FIX POSITION coordinates directly bias the corrections calculated by the base receiver. The receiver performs all internal computations based on WGS84 and the datum command is defaulted as such. The datum in which you choose to operate (by changing the DATUM command) is internally converted to and from WGS84. Therefore, all differential corrections are based on WGS84, regardless of your operating datum. The FIX POSITION command overrides any previous FIX HEIGHT or FIX POSITION command settings.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FIX header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	type	See *Table 23, Page 121*		Fix type	Enum	4	H
3	param1	See *Table 22, Page 120*		Parameter 1	Double	8	H + 4
4	param2			Parameter 2	Double	8	H + 12
5	param3			Parameter 3	Double	8	H + 20

2.5.30 FIXPOSDATUM Sets position in a specified datum

This command sets the position by referencing the position parameters through a specified datum. The position is transformed into the same datum as that in the receiver's current setting. The FIX command, see *page 119*, is then issued internally with the FIXPOSDATUM command values. It is the FIX command that appears in the RXCONFIG log. If the FIX or the FIXPOSDATUM command are used, their newest values overwrite the internal FIX values.

Abbreviated ASCII Syntax: **Message ID: 761**

FIXPOSDATUM datum lat lon height

Factory Default:

fixposdatum none

ASCII Example:

fixposdatum user 51.11633810554 -114.03839550586 1048.2343

You can use the FIXPOSDATUM command in a survey to fix the position with values from another known datum, rather than transforming them into WGS84.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FIXPOSDATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	datum	See *Table 16, Page 96*		Datum ID	Enum	4	H
3	lat	±90		Latitude (degrees)	Double	8	H + 4
4	lon	±360		Longitude (degrees)	Double	8	H + 12
5	height	-1000 to 20000000		Mean sea level (MSL) height (m) [a]	Double	8	H + 20

a. For a discussion on height, refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

2.5.31 FORCEGLOL2CODE Forces receiver to track GLONASS satellite L2 P or L2 C/A code

This command allows you to force the receiver to track GLONASS satellite L2 P-code or L2 C/A code.

Abbreviated ASCII Syntax: **Message ID: 1217**

FORCEGLOL2CODE L2type

Factory Default:

forceglol2code default

ASCII Example:

forceglol2code p

Table 24: GLONASS L2 Code Type

Binary	ASCII	Description
1	P	L2 P-code or L2 Precise code
2	C	L2 C/A code or L2 Coarse/ Acquisition code
3	DEFAULT	Set to channel default

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FORCEGLOL2-CODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	L2type	See *Table 25* above		GLONASS L2 code type	Enum	4	H

2.5.32 FORCEGPSL2CODE Forces receiver to track GPS satellite L2 P or L2C code

This command allows you to force the receiver to track L2 P-code or L2C code. AUTO tells the receiver to use L2C code type if available and L2 P-code if L2C code is not available.

Abbreviated ASCII Syntax: **Message ID: 796**

FORCEGPSL2CODE L2type

Factory Default:

forcegpsl2code default

ASCII Example:

forcegpsl2code p

Table 25: GPS L2 Code Type

Binary	ASCII	Description
0	AUTO	Receiver uses the best L2 code type available. For RTK positioning, AUTO changes the L2 code type being tracked to match the L2 code type found in the base station corrections to ensure the greatest number of satellites are used in the solution.
1	P	L2 P-code or L2 Precise code
2	C	L2C code or L2 Civilian code
3	DEFAULT	Set to channel default

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FORCEGPSL2-CODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	L2type	See *Table 25* above		GPS L2 code type	Enum	4	H

2.5.33 FREQUENCYOUT Sets output pulse train available on VARF

This command sets the output pulse train available on the Variable Frequency (VARF) pin. The output waveform is coherent with the 1PPS output, see the usage note and *Figure 3* below.

1. If the CLOCKADJUST command is ENABLED, see Table 2.5.12, Page 83, and the receiver is configured to use an external reference frequency (set in the EXTERNALCLOCK command, see Table 2.5.28, Page 116, for an external clock - TCXO, OCXO, RUBIDIUM, CESIUM, or USER), then the clock steering process takes over the VARF output pins and may conflict with a previously entered FREQUENCYOUT command.
2. Figure 3 shows how the chosen pulse width is frequency locked but not necessarily phase locked when using ENABLE option. To synchronize the phase, use ENABLESYNC option.

Abbreviated ASCII Syntax: **Message ID: 232**

FREQUENCYOUT [switch] [pulsewidth] [period]

Factory Default:

frequencyout disable

ASCII Example:

frequencyout enable 2 4

This example generates a 50% duty cycle 25 MHz square wave.

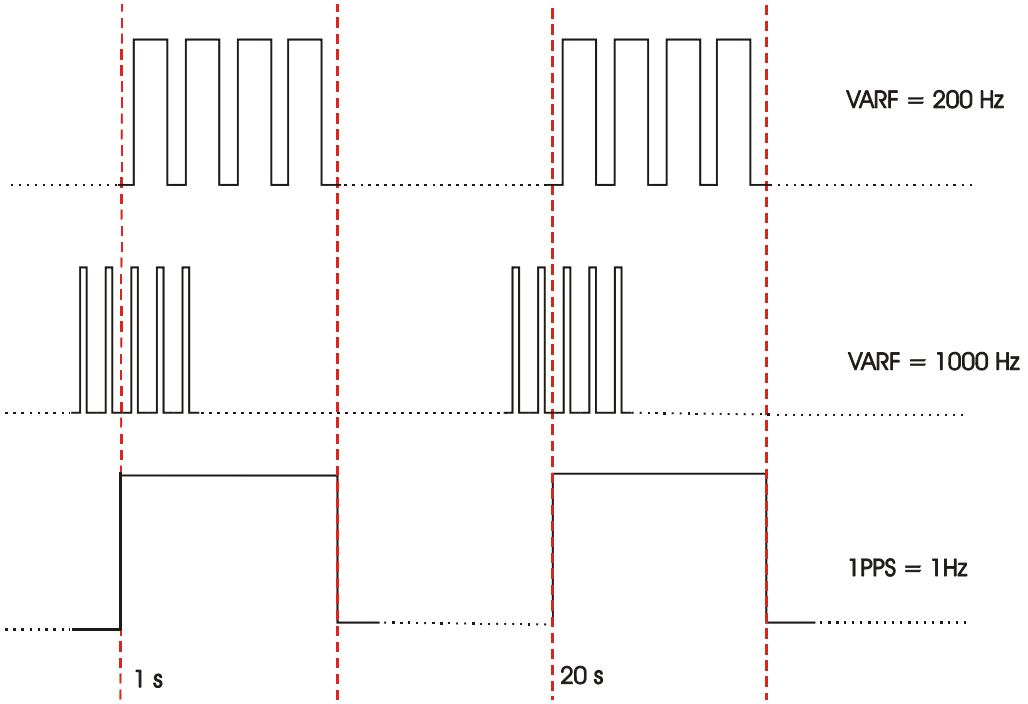


Figure 3: Pulse Width and 1PPS Coherency

When using ENABLE option, the VARF and 1PPS are not necessarily in phase as described in the diagram above. To align the phase of the VARF with the 1PPS, use the ENABLESYNC option and the VARF phase will be synchronized to the leading edge of the 1PPS pulse. Note that if the VARF and 1PPS frequencies are not even multiples of each other, this may cause the VARF to have a shorter cycle pulse prior to each 1PPS pulse. 1PPS is not affected.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FREQUENCYOUT header	ENABLE SYNC	12	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	DISABLE	0	Disable causes the output to be fixed low (default)	Enum	4	H
		ENABLE	1	Enables customized frequency output			
		ENABLE SYNC	2	Enable customized frequency output synchronized to PPS			
3	pulsewidth	(0 to 1073741823)		Number of 10 ns steps for which the output is high. Duty cycle = pulsewidth / period. If pulsewidth is greater than or equal to the period, the output is a high DC signal. If pulsewidth is 1/2 the period, then the output is a square wave (default = 0)	Ulong	4	H+4
4	period	(0 to 1073741823)		Signal period in 10 ns steps. Frequency Output = 100,000,000 / Period (default = 0)	Ulong	4	H+8

2.5.34 FRESET Clears selected data from NVM and reset

This command clears data which is stored in non-volatile memory. Such data includes the almanac, ephemeris, and any user specific configurations. The commands, ephemeris, almanac, and L-band related data, excluding the subscription information, can be cleared by using the STANDARD target. The model can only be cleared by using the MODEL target. The receiver is forced to hardware reset. In addition, values entered using the CLOCKCALIBRATE command can only be cleared by using the CLKCALIBRATION target.

FRESET STANDARD (which is also the default) causes any commands, ephemeris, GNSS and almanac data previously saved to NVM to be erased.

Abbreviated ASCII Syntax: **Message ID: 20**

FRESET [target]

Input Example:

freset command

If you are receiving no data or random data from your receiver, try the following before contacting NovAtel:

- Verify that the receiver is tracking satellites
- Check the integrity and connectivity of power and data cables
- Verify the baud rate settings of the receiver and terminal device (your PC, data logger or laptop)
- Switch COM ports

Issue a FRESET command

Table 26: FRESET Target

Binary	ASCII	Description
0	STANDARD	Resets commands, ephemeris and almanac (default). Also resets all L-band related data except for the subscription information
1	COMMAND	Resets the stored commands (saved configuration)
2	GPSALMANAC	Resets the stored GPS almanac
3	GPSEPHEM	Resets the stored GPS ephemeris
4	GLOEPHEM	Resets the stored GLONASS ephemeris
5	MODEL	Resets the currently selected model
11	CLKCALIBRATION	Resets the parameters entered using the CLOCKCALIBRATE command
20	SBASALMANAC	Resets the stored SBAS almanac
21	LAST_POSITION	Resets the position using the last stored position
31	GLOALMANAC	Resets the stored GLONASS almanac
52	PROFILEINFO	Resets the stored profile configurations

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FRESET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	target	See *Table 26*		What data is to be reset by the receiver (default=STANDARD)	Enum	4	H

2.5.35 GALECUTOFF Sets elevation cut-off angle for Galileo satellites

This command sets the elevation cut-off angle for tracked Galileo satellites. The receiver 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 the ASSIGN command starting on *page 69*).

In either case, satellites below the GALECUTOFF angle are eliminated from the internal position and clock offset solution computations. See also the ECUTOFF (*page 113*) and GLOECUTOFF (*page 137*) commands for more information about elevation cut-off commands.

This command permits a negative cut-off angle and can be used in the following situations:

- The antenna is at a high altitude and thus look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

1. Care must be taken when using GALECUTOFF because the signals from lower elevation satellites are traveling through more atmosphere and are therefore degraded. Use of satellites below 5 degrees is not recommended.
2. Use the ECUTOFF command (see*page 113*) to cut-off GPS satellites, the GLOECUTOFF command (see *page 137*) for GLONASS satellites and the SBASCUTOFF command (see *page 211*) for SBAS satellites.

Abbreviated ASCII Syntax: **Message ID: 1114**

GALECUTOFF angle

Factory Default:

galecutoff 5.0

ASCII Example:

galecutoff 10.0

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GALECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	angle	±90.0 degrees		Elevation cut-off angle relative to horizon	Float	4	H

2.5.36 GENERATEALIGNCORRECTIONS to Configure ALIGN Master

This command configures the ALIGN Master and starts sending out ALIGN RTCA corrections through the specified port. This command is equivalent to sending the following commands to the Master:

unlogall [port]

fix none

movingbasestation enable

interfacemode [port] novatel rtca

com [port] [baud] N 8 1 N OFF ON

log [port] rtcaobs3 ontime [rate = 1/ obsreqrate]

log [port] rtcarefext ontime [rate = 1/ refextreqrate]

Abbreviated ASCII Syntax: **Message ID: 1349**

generatealigncorrections port [baud] [obsreqrate] [refextreqrate

ASCII Example:

generatealigncorrections com2 230400 10 10]

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GENERATEALIGNCORRECTIONS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See Table 39		Port through which correction should be sent out	ENUM	4	H
3	baud	9600, 19200, 38400, 57600, 115200, 230400, 460800 or 921600		Communication baud rate	ULONG	4	H+4
4	obsreqrate	1, 2, 4, 5, 10 or 20		RTCAOBS3 data rate in Hz	ULONG	4	H+8
5	refextreqrate	0, 1, 2, 4, 5, 10 or 20		RTCAREFEXT data rate in Hz	ULONG	4	H+12

2.5.37 GENERATEDIFFCORRECTIONS Sends a preconfigured set of differential corrections

Configures the receiver to send a preconfigured set of differential corrections.

Abbreviated ASCII Syntax: **Message ID: 1296**

GENERATEDIFFCORRECTIONS mode port

ASCII Example:

generatediffcorrections rtcm com2

Preconfigured set of differential corrections sent when RTCM:

rtcm1 ontime 1
rtcm31 ontime 1
rtcm3 ontime 10

Preconfigured set of differential corrections sent when RTCA:

rtca1 ontime 1
rtcaref ontime 10

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GENERATEDIFFCORRECTIONS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	RTCM	2	Serial port interface mode identifier. See *Table 28, Serial Port Interface Modes* on *page 148*	Enum	4	H
		RTCA	3				
3	port	See *Table 39, COM Port Identifiers* on *page 220*		Port to configure	Enum	8	H+4

2.5.38 GENERATERTKCORRECTIONS Sends a preconfigured set of RTK corrections

Configures the receiver to send a preconfigured set of RTK corrections.

Abbreviated ASCII Syntax: **Message ID: 1260**

GENERATERTKCORRECTIONS mode port

ASCII Example:

generatertkcorrections rtcmv3 com2

Preconfigured set of differential corrections sent when RTCM**:**

rtcm1819 ontime 1
rtcm3 ontime 10
rtcm22 ontime 10
rtcm23 ontime 60
rtcm24 ontime 60

Preconfigured set of differential corrections sent when RTCMV3:

rtcm1004 ontime 1
rtcm1012 ontime 1
rtcm1006 ontime 10
rtcm1008 ontime 10
rtcm1033 ontime 10

Preconfigured set of differential corrections sent when RTCA:

rtcaobs2 ontime 1
rtcaref ontime 10

Preconfigured set of differential corrections sent When CMR:

cmrobs ontime 1
cmrgloobs ontime 1
cmrref ontime 10

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GENERATERTKCORRECTIONS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	RTCM	2	Serial port interface mode identifier. For more information, see *Table 28, Serial Port Interface Modes* on *page 148*	Enum	4	H
		RTCA	3				
		CMR	4				
		RTCMV3	14				
3	port	See *Table 39, COM Port Identifiers* on *page 220*		Port to configure	Enum	8	H+4

2.5.39 GGAQUALITY Customizes the GPGGA GPS quality indicator

This command allows you to customize the NMEA GPGGA GPS quality indicator. See also the GPGGA log on *page 362*.

Abbreviated ASCII Syntax: **Message ID: 691**

GGAQUALITY #entries [pos type1][qual1] [pos type2] [qual2]...

Input Example 1:

ggaquality 1 sbas 2

Makes the SBAS solution type show 2 as the quality indicator.

Input Example 2:

ggaquality 2 sbas 2 narrow_float 3

Makes the SBAS solution type show 2 and the NARROW_FLOAT solution type show 3, as their quality indicators.

Input Example 3:

ggaquality 0

Sets all the quality indicators back to the default.

Some solution types, see *Table 56, Position or Velocity Type* on *page 303*, store a quality indicator. For example, OmniSTAR_HP, OmniSTAR_XP and NARROW_FLOAT all share an indicator of 2. This command can be used to customize an application to have unique indicators for each solution type.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GGAQUALITY header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	#entries	0-20		The number of position types that are being re-mapped (20 max)	Ulong	4	H+4
3	pos type1	See *Table 56, Position or Velocity Type* on *page 303*		The 1st position type that is being remapped	Enum	4	H+8
4	qual1	*See page 362*		The number that appears in the GPGGA log for the 1st position type	Ulong	4	H+12
5	pos type2	See *Table 56, Position or Velocity Type* on *page 303*		The 2nd position type that is being remapped, if applicable	Enum	4	H+16
6	qual2	See *page 362*		The number that appears in the GPGGA log for the 2nd solution type, if applicable	Ulong	4	H+20
...	Next solution type and quality indicator set, if applicable				Variable		

2.5.40 GLOECUTOFF Sets GLONASS satellite elevation cut-off

This command sets the elevation cut-off angle for tracked GLONASS satellites. The receiver 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 the ASSIGN command starting on *page 69*).

In either case, satellites below the GLOECUTOFF angle are eliminated from the internal position and clock offset solution computations. See also the ECUTOFF (*page 113*) and SBASECUTOFF (*page 211*) commands for more information about elevation cut-off commands.

This command permits a negative cut-off angle and can be used in the following situations:

- The antenna is at a high altitude and can look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

1. Care must be taken when using GLOECUTOFF because the signals from lower elevation satellites are traveling through more atmosphere and are therefore degraded. Use of satellites below 5 degrees is not recommended.
2. Use the ECUTOFF command (see *page 113*) to cut-off GPS satellites, the GALECUTOFF command or Galileo satellites and the SBASCUTOFFcommand (see *page 211*) for SBAS satellites.

Abbreviated ASCII Syntax: **Message ID: 735**

GLOECUTOFF angle

Factory Default:

gloecutoff 5.0

ASCII Example:

gloecutoff 0

Refer to the GLONASS section in our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GLO-ECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	angle	±90.0 degrees		Elevation cut-off angle relative to horizon	Float	4	H

2.5.41 HDTOUTTHRESHOLD Controls GPHDT log output

This command controls the output of the NMEA GPHDT heading log, see *page 378*. It sets a heading standard deviation threshold. Only heading information with a standard deviation less than this threshold can be output into a GPHDT message.

Abbreviated ASCII Syntax: **Message ID: 1062**

HDTOUTTHRESHOLD thresh

Factory Default:

hdtoutthreshold 2.0

ASCII Example:

hdtoutthreshold 2.0

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HDTOUT-THRESHOLD header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	thresh	0.0 - 180.0		Heading standard deviation threshold (degrees)	Float	4	H

2.5.42 HEADINGOFFSET Adds heading and pitch offset values

Puts an offset in the heading and pitch values in output of the HEADING, HEADING2 and GPHDT logs. See pages *389*, *391* and *378* for more information.

Abbreviated ASCII Syntax: **Message ID: 1082**

HEADINGOFFSET headingoffsetindeg [pitchoffsetindeg]

Factory Default:

headingoffset 0 0

ASCII Example:

headingoffset 2 -1

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HEADING OFFSET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	headingoffsetindeg	-180.0 - 180.0		Offset added to heading output (degrees)	Float	4	H
3	pitchoffsetindeg	-90.0 - 90.0		Offset added to pitch output (degrees)	Float	4	H+4

2.5.43 HPSEED Specifies the initial OmniSTAR HP/XP position

This OmniSTAR HP/XP command allows you to specify the initial position for OmniSTAR HP/XP. It allows you to specify the datum and undulation for the position entered. Position is then transformed into the datum currently set in the receiver. You can use STORE or RESTORE as a variable.

The HPSEED command does not get saved when you use the SAVECONFIG command. Rather, if STORE is issued with the HPSEED command, it stores it in NVM. The RESTORE variable resends the stored HPSEED command.

Abbreviated ASCII Syntax: **Message ID: 782**

HPSEED mode [lat lon hgt latσ lonσ hgtσ [datum undulation]]

Factory Default:

hpseed reset

1. ASCII Examples:
   - To store the current HP/XP position so that it can be used as the seed in the future:

     HPSEED STORE
   - To use the stored HP/XP position as the seed:

     HPSEED RESTORE
   - To use a known position in the native datum of OmniSTAR HP/XP as the seed:

     HPSEED SET 51.11633810554 -114.03839550586 1048.2343 0.0086,0.0090,0.0191
   - To use a known position from a datum other than the native OmniSTAR HP/XP datum as the seed:

     HPSEED SET 51.11633810554 -114.03839550586 1048.2343 0.0086,0.0090,0.0191 CANADA EGM96
2. HP/XP seeding is restarting the HP/XP filter from known coordinates with a known accuracy as a starting point such that it is already converged. This is implemented by using the HPSEED command. There are two ways of using our implementation of HP/XP seeding:

Continued on next page

a. Seed HP/XP from a stored HP/XP position:

- When HP/XP is converged and the vehicle is stopped, enter HPSEED STORE to save the current HP/XP position to NVM.
- When the vehicle is restarted, enter HPSEED RESTORE to feed the previously known position into the HP/XP process so it can start from the previous accuracy.

b. Seed HP/XP from an externally generated known position and accuracy:

- Consider the case of survey customers who enter the known antenna location with HPSEED SET <latitude> <longitude> <msl height> <lat stdev> <long stdev> <height stdev>
- If the source of the position is in a different datum than the native datum of HP/XP, or if a different undulation has been used, the transformation can be specified after <height stdev> with <datum id> <undulation type>.

Note: Initial position estimate for HP/XP and fallback when HP/XP is lost:

When HP/XP starts up, it requests the current position to get itself started. In the startup time line implemented, this is the first valid position available when the task running HP/XP receives its first L-band data. This may or may not be a Virtual Base Station (VBS) position when VBS is also enabled. It depends on how things start up, for instance, whatever pseudorange filter position is available is used. If you want to hold off on HP/XP using the position estimate until you've confirmed that the VBS corrections have started and plenty of satellites are in the solution, start up with PSRDIFFSOURCE OMNISTAR and RTKSOURCE NONE, wait for the condition of the VBS position to be satisfactory and then set RTKSOURCE OMNISTAR as well. The HP/XP startup will be waiting until you set the RTKSOURCE. This may give some minor improvement to the convergence time of HP/XP.

This is somewhat related to the position falling back to VBS when HP/XP is lost. If both PSRDIFFSOURCE OMNISTAR and RTKSOURCE OMNISTAR is set, the BESTPOS log contains the best available of the two. There is normally an offset between the HP/XP solution and VBS.

Table 27: Seeding Mode

Binary Value	ASCII Mode Name	Description
0	RESET	Clear current seed and restart HP/XP [a]
1	SET	Specify a position and inject it into HP/XP as seed
2	STORE	Store current HP/XP position in NVM for use as a future seed [a]
3	RESTORE	Inject NVM-stored position into HP/XP as seed [a]

a. No further parameters are needed in the syntax.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HPSEED header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	See *Table 27, Page 142*		Seeding mode	Enum	4	H
3	lat	±90		Latitude (degrees)	Double	8	H+4
4	lon	±360		Longitude (degrees)	Double	8	H+12
5	hgt	-1000 to 20000000		Height above mean sea level (m)	Double	8	H+20
6	latσ			Latitude standard deviation (m)	Float	4	H+28
7	lonσ			Longitude standard deviation (m)	Float	4	H+32
8	hgtσ			Height standard deviation (m)	Float	4	H+36
9	datum	See Table 16, Page 96		Datum ID (default = WGS84)	Enum	4	H+40
10	undulation	see the UNDULATION command's *option* field values on *page 253*		Undulation type (default = TABLE)	Enum	4	H+44

2.5.44 HPSTATICINIT Sets OmniSTAR HP/XP static initialization

This command enables or disables static initialization of OmniSTAR HP/XP. If the OmniSTAR HP/XP process knows that the receiver is stationary, it can converge more quickly.

If the HP/XP filter perceives receiver motion, it may abort static initialization. See the Static Initialization Mode bit in the HP/XP Status field of the LBANDSTAT log, details starting on *page 403*, to confirm that static initialization is in progress.

Abbreviated ASCII Syntax: **Message ID: 780**

HPSTATICINIT switch

Factory Default:

hpstaticinit disable

ASCII Example:

hpstaticinit enable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HPSTATICINIT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	DISABLE	0	The receiver is not stationary	Enum	4	H
		ENABLE	1	The receiver is stationary			

2.5.45 ICOMCONFIG Configures IP virtual COM port

This command is used for Ethernet set up. It allows you to configure the transport/application layer of the configuration.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1248**

ICOMCONFIG [port] protocol [endpoint[bindinterface]]

Factory Default:

icomconfig icom1 tcp :3001

icomconfig icom2 tcp :3002

icomconfig icom3 tcp :3003

ASCII Example:

icomconfig icom1 tcp :2000 etha

Due to security concerns, the configuration ICOMCONFIG UDP :3000 and TCP should only be used by customers on a closed system, that is, board-to-board. NovAtel is not liable for any security breaches that may occur if not used on a closed system.

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	ICOMCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	THISPORT	6	Name of the port (default = THISPORT). For more information, see *Table 28* on *page 148*	Enum	4	H
		ICOM1	23				
		ICOM2	24				
		ICOM3	25				
3	protocol	DISABLE	1	Disable this service	Enum	4	H+4
		TCP	2	Use Raw TCP			
		UDP	3	Use Raw UDP			
4	endpoint	Host:Port For example: 10.0.3.1:8000 mybase.com:3000:2000		Endpoint to wait on, or to connect to where host is a host name or IP address and port is the TCP/uDP port number. If host is blank, act as a server	String	80	H+8
5	bindInterface	ALL (default)	1	All, or an interface that supports TCP/IP	Enum	4	H+88
		ETHA	2				

2.5.46 INTERFACEMODE Sets receive or transmit modes for ports

This command allows the user to specify what type of data a particular port on the receiver can transmit and receive. The receive type tells the receiver what type of data to accept on the specified port. The transmit type tells the receiver what kind of data it can generate. For example, you would set the receive type on a port to RTCA in order to accept RTCA differential corrections.

This command also acts as a collection response ether and can be used as a log.

It is also possible to disable or enable the generation or transmission of command responses for a particular port. Disabling of responses is important for applications where data is required in a specific form and the introduction of extra bytes may cause problems, for example RTCA, RTCM, RTCMV3 or CMR. Disabling a port prompt is also useful when the port is connected to a modem or other device that responds with data the receiver does not recognize.

For applications running in specific interface modes, see *Table 28* on *page 148*, please set the appropriate interface modes before send or receive corrections. It is important that a port's interface mode matches the data being received on that port. Mismatches between the interface mode and received data can result in CPU overloads.

When INTERFACEMODE *port* NONE NONE OFF is set, the specified port are disabled from interpreting any input or output data. Therefore, no commands or differential corrections are decoded by the specified port. When GENERIC is set for a port, it is also disabled but data can be passed through the disabled port and be output from an alternative port using the pass-through logs PASSCOM, PASSXCOM, PASSAUX and PASSUSB. See *Section 3.3.70* on *page 433* for details on these logs along with the *Operation* chapter in the *OEM6 Family Installation and Operation User Manual*, for information about pass-through logging. See also the COMCONFIG log on *page 331*.

If you intend to use the SERIALCONFIG command, ensure you do so before the INTERFACEMODE command on each port. The SERIALCONFIG command can remove the INTERFACEMODE command setting if the baud rate is changed after the interface mode is set. You can also turn break detection off using the SERIALCONFIG command, see *Section 2.5.92* on *page 218*, to stop the port from resetting because it is interpreting incoming bits as a break command.

OmniSTAR External Stream

This feature allows you to use OmniSTAR VBS, HP or XP when you are not tracking an L-band signal on the OEM6. This is useful on an L-band-capable receiver where the OmniSTAR signals are unavailable. There is an OmniSTAR option for the INTERFACEMODE command (OMNISTAR), see *Table 28* on *page 148*.

For example, set the incoming INTERFACEMODE command to OMNISTAR on COM2:

```
INTERFACEMODE COM2 OMNISTAR NONE
```

where COM2 is expecting raw OmniSTAR L-band data from an external source.

1. OMNISTAR is not a valid setting for an INTERFACEMODE output command.
2. Receiver data only comes from one port at a time.
3. When setting up a demodulator, use this command to output all raw L-band.

Abbreviated ASCII Syntax: **Message ID: 3**

INTERFACEMODE [port] rxtype txtype [responses]

Factory Default:

interfacemode com1 novatel novatel on
interfacemode com2 novatel novatel on
interfacemode com3 novatel novatel on
interfacemode aux novatel novatel on
interfacemode usb1 novatel novatel on
interfacemode usb2 novatel novatel on
interfacemode usb3 novatel novatel on
interfacemode xcom1 novatel novatel on
interfacemode xcom2 novatel novatel on
interfacemode xcom3 novatel novatel on
interfacemode icom1 novatel novatel on
interfacemode icom2 novatel novatel on
interfacemode icom3 novatel novatel on
interfacemode ncom1 rtcmv3 none off
interfacemode ncom2 rtcmv3 none off
interfacemode ncom3 rtcmv3 none off

ASCII Example 1:

interfacemode com1 rtca novatel on

ASCII Example 2:

interfacemode com2 mrtca none

Are NovAtel receivers compatible with others on the market?

All GNSS receivers output two solutions: position and time. The manner in which they output them makes each receiver unique. Most geodetic and survey grade receivers output the position in electronic form (typically RS-232), which makes them compatible with most computers and data loggers. All NovAtel receivers have this ability. However, each manufacturer has a unique way of formatting the messages. A NovAtel receiver is not directly compatible with a Trimble or Ashtech receiver (which are also incompatible with each other) unless everyone uses a generic data format.

But there are several generic data formats available. For position and navigation output there is the NMEA format. Real-time differential corrections use RTCM or RTCA format. Receiver code and phase data use RINEX format. NovAtel and all other major manufacturers support these formats and can work together using them.

You must understand your post-processing and real-time software requirements. Good software supports a generic standard while poor software locks you into one brand of GNSS equipment. For the most flexibility, insist on generic data format support for all hardware and software solutions

Table 28: Serial Port Interface Modes

Binary Value	ASCII Mode Name	Description
0	NONE	The port accepts/generates nothing. The port is disabled
1	NOVATEL	The port accepts/generates NovAtel commands and logs
2	RTCM	The port accepts/generates RTCM corrections
3	RTCA	The port accepts/generates RTCA corrections
4	CMR	The port accepts/generates CMR corrections
5	OMNISTAR	The port accepts OMNISTAR corrections, see also *OmniSTAR External Stream* on *page 146*
6-7	Reserved	
8	RTCMNOCR	RTCM with no CR/LF appended [a]
9	Reserved	

Table 28: Serial Port Interface Modes

Binary Value	ASCII Mode Name	Description
10	TCOM1	INTERFACEMODE tunnel modes. To configure a full duplex tunnel, configure the baud rate on each port. Once a tunnel is established, the baud rate does not change. Special characters, such as a BREAK condition, do not route across the tunnel transparently and the serial port is altered, see the SERIALCONFIG command on *page 218*. Only serial ports may be in a tunnel configuration: COM1, COM2, COM3 or AUX may be used. For example, configure a tunnel at 115200 bps between COM1 and AUX: COM AUX 115200 COM COM1 115200 INTERFACEMODE AUX TCOM1 NONE OFF INTERFACEMODE COM1 TAUX NONE OFF The tunnel is fully configured to receive/transmit at a baud rate of 115200 bps
11	TCOM2	
12	TCOM3	
13	TAUX [b]	
14	RTCMV3	The port accepts/generates RTCM Version 3.0 corrections
15	NOVATELBINARY	The port only accepts/generates binary messages. If an ASCII command is entered when the mode is set to binary only, the command is ignored. Only properly formatted binary messages are responded to and the response is a binary message
16-17	Reserved	
18	GENERIC	The port accepts/generates nothing. SEND/SENDHEX commands from another port generate data on this port. Any incoming data on this port can be seen with PASSCOM logs on another port, see *page 433*
19	Reserved	
20	MRTCA	The port accepts/generates Modified Radio Technical Commission for Aeronautics (MRTCA) corrections
21-26	Reserved	
27	AUTO	For autodetecting different RTK correction formats

a. An output interfacemode of RTCMNOCR is identical to RTCM but with the CR/LF appended. An input interfacemode of RTCMNOCR is identical to RTCM and functions with or without the CR/LF.

b. Only available on specific models.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	INTERFACEMODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See *Table 39* on *page 220*		Serial port identifier (default = THISPORT)	Enum	4	H
3	rxtype	See *Table 28* on *page 148*		Receive interface mode	Enum	4	H+4
4	txtype			Transmit interface mode	Enum	4	H+8
5	responses	OFF	0	Turn response generation off	Enum	4	H+12
		ON	1	Turn response generation on (default)			

2.5.47 IONOCONDITION Sets ionospheric condition

This command changes the level of ionosphere activity that is assumed by the RTK positioning algorithms.

Abbreviated ASCII Syntax: **Message ID: 1215**

IONOCONDITION mode

Factory Default:

ionocondition auto

ASCII Example:

ionocondition normal

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	IONOCONDITION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively		H	
2	mode	QUIET	0	Receiver assumes a low level of ionosphere activity	Enum	4	H
		NORMAL	1	Receiver assumes a medium level of ionosphere activity			
		DISTURBED	2	Receiver assumes a high level of ionosphere activity			
		AUTO	10	Receiver monitors the ionosphere activity and adapts behavior accordingly			

2.5.48 IPCONFIG Configures network IP settings

This command configures static/dynamic TCP/IP properties for the Ethernet connection.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1243**

`IPCONFIG` [interface_name] address_mode [ip_address [netmask [gateway]]]

Factory Default:

ipconfig etha dhcp

ASCII Examples:

ipconfig etha static 192.168.74.10 255.255.255.0 192.168.74.1

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	IPCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	interface name	ALL	1	Name of the Ethernet interface (default = ETHA)	Enum	4	H
		ETHA	2				
4	address mode	DHCP	1	Use Dynamic IP address	Enum	4	H+4
		STATIC	2	Use Static IP address			
5	IP address	xxx.xxx.xxx.xxx (For example: 10.0.0.2)		IP Address – decimal dot notation	String	16	H+8
6	netmask	xxx.xxx.xxx.xxx (For example: 255.255.255.0)		Netmask – decimal dot notation	String	16	H+24
7	gateway	xxx.xxx.xxx.xxx (For example: 10.0.0.1)		Gateway – decimal dot notation	String	16	H+40

2.5.49 LOCALIZEDCORRECTIONDATUM Sets a Local Datum

Use this command to select a localized correction datum before you use localized wide area corrections. The choices are World Geodetic System 84 (WGS84) and North American 1983 (NAD83) including Areas 37-42. The default is WGS84, however, when the receiver receives OmniSTAR data and you issue a LOCALIZEDCORRECTIONDATUM NAD83 command, it bases the localized wide area corrections on NAD83

RTCM corrections are always with respect to the datum selected at the base. For example, if you set the LOCALIZEDCORRECTIONDATUM to NAD83 at a base station, the datum of the positions produced at the rover receiver using these localized corrections will be NAD83. This is true even though the datum in the rover BESTPOS log shows WGS84.

Localized Wide Area Corrections Mode

The local wide area corrections enhancement allows a NovAtel receiver to receive OmniSTAR VBS corrections, compute an equivalent DGPS correction and then output it in RTCM format to any GNSS receiver. You can select to output corrections in the WGS84 or NAD83 datum.

Localized OmniSTAR corrections are available on products with L-band capability. Supported datums provide these corrections with WGS84 as the default.

This enhancement also uses the following logs:

RTCMOMNI1, see *page 502* and *OmniSTAR Local Wide Area Corrections on page 505*.

Use the SAVECONFIG command to save local wide area corrections interface settings.

Abbreviated ASCII Syntax: **Message ID: 947**

LOCALIZEDCORRECTIONDATUM type

ASCII Example:

localizedcorrectiondatum nad83

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	LOCALIZED-CORRECTION-DATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	type	WGS84	1	Localized correction datum type	Enum	4	H
		NAD83	2				

2.5.50 LOCKOUT Prevents the receiver from using a satellite

This command prevents the receiver from using a satellite in the solution computations.

1. The LOCKOUT command does not prevent the receiver from tracking an undesirable satellite.
2. LOCKOUT and UNLOCKOUT commands cannot be used with Galileo PRNs.

This command must be repeated for each satellite to be locked out. See also the UNLOCKOUT (*page 255*) and UNLOCKOUTALL (*page 256*) commands.

Abbreviated ASCII Syntax: **Message ID: 137**

LOCKOUT prn

Input Example:

lockout 8

The LOCKOUT command allows you to remove one or more satellites from the solution while leaving other satellites available.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	LOCKOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	prn	GPS: 1-32, 183-187 SBAS: 120-138 38-61 for GLONASS: see *Section 1.3* on *page 31* QZSS 193-197		qzss	Ulong	4	H

2.5.51 LOCKOUTSYSTEM Prevents the receiver from using a system

This command prevents the receiver from using satellites in a system in the solution computations.

The LOCKOUTSYSTEM command does not prevent the receiver from tracking an undesirable satellite.

This command must be repeated for each system to be locked out. See also the UNLOCKOUTSYSTEM on *page 257*and UNLOCKOUTALL on *page 256*.

Abbreviated ASCII Syntax: **Message ID: 871**

LOCKOUTSYSTEM system

Factory Defaults:

lockoutsystem glonass
lockoutsystem galileo
lockoutsystem sbas
lockoutsystem qzss

The LOCKOUTSYSTEM command allows you to remove one or more systems from the solution while leaving other systems available.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	LOCKOUT SYSTEM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	system	See Table 29		A single satellite system to be locked out	Enum	4	H

Table 29: Satellite System

Binary Value	ASCII Mode Name
0	GPS
1	GLONASS
2	SBAS
5	Galileo
7	QZSS

2.5.52 LOG Requests logs from the receiver

Many different types of data can be logged using several different methods of triggering the log events. Every log element can be directed to any combination of the three COM ports and three USB ports. The ONTIME trigger option requires the addition of the *period* parameter. See Chapter 3, Data Logs on page *267* for further information and a complete list of data log structures. The *LOG* command tables in this section show the binary format followed by the ASCII command format.

The optional parameter [hold] prevents a log from being removed when the UNLOGALL command, with its defaults, is issued. To remove a log which was invoked using the [hold] parameter requires the specific use of the UNLOG command, see *page 258*. To remove all logs that have the [hold] parameter, use the UNLOGALL command with the *held* field set to 1, see *page 260*.

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

1. The OEM6 family of receivers can handle 64 logs at a time. If you attempt to log more than 64 logs at a time, the receiver responds with an Insufficient Resources error.
2. Maximum flexibility for logging data is provided to the user by these logs. The user is cautioned, however, to recognize that each log requested requires additional CPU time and memory buffer space. Too many logs may result in lost data and degraded CPU performance. Receiver overload can be monitored using the idle-time field and buffer overload bits of the Receiver Status in any log header.
3. Polled log types do not allow fractional offsets or ONTIME rates faster than 1 Hz.
4. Use the ONNEW trigger with the MARKTIME, MARK2TIME, MARKPOS or MARK2POS logs.
5. Only the MARKPOS, MARK2POS, MARKTIME or MARK2TIME logs and ‘polled’ log types are generated, on the fly, at the exact time of the mark. Synchronous and asynchronous logs output the most recently available data.
6. If you do use the ONTIME trigger with asynchronous logs, the time stamp in the log does not necessarily represent the time the data was generated but rather the time when the log is transmitted.

Abbreviated ASCII Syntax: **Message ID: 1**

LOG [port] message [trigger [period [offset [hold]]]]

Factory Default:

log com1 rxstatuseventa onnew 0 0 hold

log com2 rxstatuseventa onnew 0 0 hold

log com3 rxstatuseventa onnew 0 0 hold

log aux rxstatuseventa onnew 0 0 hold

log usb1 rxstatuseventa onnew 0 0 hold

log usb2 rxstatuseventa onnew 0 0 hold

log usb3 rxstatuseventa onnew 0 0 hold

log icom1 rxstatuseventa onnew 0 0 hold

log icom2 rxstatuseventa onnew 0 0 hold

log icom3 rxstatuseventa onnew 0 0 hold

Abbreviated ASCII Example 1:

log com1 bestpos ontime 7 0.5 hold

The above example shows BESTPOS logging to COM port 1 at 7 second intervals and offset by 0.5 seconds (output at 0.5, 7.5, 14.5 seconds and so on). The [hold] parameter is set so that logging is not disrupted by the UNLOGALL command (*page 260*).

To send a log once, the trigger option can be ignored.

Abbreviated ASCII Example 2:

log com1 bestpos once 0.000000 0.000000 nohold

See *Section 2.1 Command Formats* on *page 38* for additional examples.

In NovAtel's Connect interface application there are two ways to initiate data logging to the receiver's serial ports. You can either enter the LOG command in the *Console* window or use the interface provided in the *Logging Control* window. Ensure the Power Settings on your PC are not set to go into Hibernate or Standby modes. Data is lost if one of these modes occurs during a logging session.

Field	Field Name	Binary Value	Description	Field Type	Binary Bytes	Binary Offset
1	LOG (binary) header	See *Table 4, Binary Message Header Structure* on *page 24*	This field contains the message header	-	H	0
2	port	See *Table 5*	Output port	Enum	4	H
3	message	Any valid message ID	Message ID of log to output	UShort	2	H+4
4	message type	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response Bit (*page 29*) 0 = Original Message 1 = Response Message	Message type of log	Char	1	H+6
5	Reserved			Char	1	H+7
6	trigger	0 = ONNEW	Does not output current message but outputs when the message is updated (not necessarily changed)	Enum	4	H+8
		1 = ONCHANGED	Outputs the current message and then continues to output when the message is changed			
		2 = ONTIME	Output on a time interval			
		3 = ONNEXT	Output only the next message			
		4 = ONCE	Output only the current message			
		5 = ONMARK	Output when a pulse is detected on the mark 1 input, MK1I [a] [b]			
7	period	Valid values for the high rate logging are 0.05, 0.1, 0.2, 0.25 and 0.5. For logging slower than 1Hz any integer value is accepted	Log period (for ONTIME trigger) in seconds [c]	Double	8	H+12

Continued on next page

Field	Field Name	Binary Value	Description	Field Type	Binary Bytes	Binary Offset
8	offset	A valid value is any integer smaller than the period. These decimal values, on their own, are also valid: 0.1, 0.2, 0.25 or 0.5	Offset for period (ONTIME trigger) in seconds. If you want to log data at 1 second, after every minute, set the period to 60 and the offset to 1	Double	8	H+20
9	hold	0 = NOHOLD	Allow log to be removed by the UNLOGALL command	Enum	4	H+28
		1 = HOLD	Prevent log from being removed by the default UNLOGALL command			

a. Refer to the *Technical Specifications* appendix in the *OEM6 Family Installation and Operation User Manual* for more details on the MK1I pin. ONMARK only applies to MK1I. Events on MK2I (if available) do not trigger logs when ONMARK is used. Use the ONNEW trigger with the MARKTIME, MARK2TIME, MARKPOS or MARK2POS logs.

b. Once the 1PPS signal has hit a rising edge, for both MARKPOS and MARKTIME logs, a resolution of both measurements is 49 ns. As for the ONMARK trigger for other logs that measure latency, for example RANGE and POSITION logs such as BESTPOS, it takes typically 20-30 ms (50 ms maximum) for the logs to output information from the 1PPS signal. Latency is the time between the reception of the 1PPS pulse and the first byte of the associated log. See also the MARKPOS and MARKTIME logs starting on *page 412*.

c. See *Appendix A* in the *OEM6 Family Installation and Operation User Manual* for the maximum raw measurement rate to calculate the minimum period. If the value entered is lower than the minimum measurement period, the value is ignored and the minimum period is used.

Field	Field Name	ASCII Value	Description	Field Type
1	LOG (ASCII) header	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII or ASCII respectively	-
2	port	*Abbreviated ASCII Syntax: Message ID: 1246* on *page 219*	Output port (default = THISPORT)	Enum
3	message	Any valid message name, with an optional A or B suffix	Message name of log to output	Char [ ]
4	trigger	ONNEW	Output when the message is updated (not necessarily changed)	Enum
		ONCHANGED	Output when the message is changed	
		ONTIME	Output on a time interval	
		ONNEXT	Output only the next message	
		ONCE	Output only the current message (default)	
		ONMARK	Output when a pulse is detected on the mark 1 input, MK1I [ab]	

Continued on next page

5	period	Any positive double value larger than the receiver's minimum raw measurement period	Log period (for ONTIME trigger) in seconds (default = 0) (see *Footnote c* on *page 160*)	Double
6	offset	Any positive double value smaller than the period	Offset for period (ONTIME trigger) in seconds. If you want to log data, at 1 second after every minute, set the period to 60 and the offset to 1 (default = 0)	Double
7	hold	NOHOLD	Allow log to be removed by the UNLOGALL command (default)	Enum
		HOLD	Prevent log from being removed by the UNLOGALL command	

a. Refer to the *Technical Specifications* appendix in the *OEM6 Family Installation and Operation User Manual* for more details on the MK1I pin. ONMARK only applies to MK1I. Events on MK2I (if available) do not trigger logs when ONMARK is used. Use the ONNEW trigger with the MARKTIME, MARK2TIME, MARKPOS or MARK2POS logs.

b. Once the 1PPS signal has hit a rising edge, for both MARKPOS and MARKTIME logs, a resolution of both measurements is 49 ns. As for the ONMARK trigger for other logs that measure latency, for example RANGE and POSITION logs such as BESTPOS, it takes typically 20-30 ms (50 ms maximum) for the logs to output information from the 1PPS signal. Latency is the time between the reception of the 1PPS pulse and the first byte of the associated log. See also the MARKPOS and MARKTIME logs starting on *page 412*.

2.5.53 MAGVAR Sets a magnetic variation correction

The receiver computes directions referenced to True North. Use MAGVAR (magnetic variation correction) if you intend to navigate in agreement with magnetic compass bearings. The correction value entered here causes the "bearing" field of the NAVIGATE log to report bearing in degrees Magnetic. The receiver computes the magnetic variation correction if you use the auto option. See *Figure 4, Illustration of Magnetic Variation and Correction on Page 163.*

The receiver calculates values of magnetic variation for given values of latitude, longitude and time using the International Geomagnetic Reference Field (IGRF) 2010 spherical harmonic coefficients and IGRF time corrections to the harmonic coefficients. The model is intended for use up to the year 2015. The receiver will compute for years beyond 2015 but accuracy may be reduced.

Abbreviated ASCII Syntax: **Message ID: 180**

MAGVAR type [correction] [std dev]

Factory Default:

magvar correction 0 0

ASCII Example 1:

magvar auto

ASCII Example 2:

magvar correction 15 0

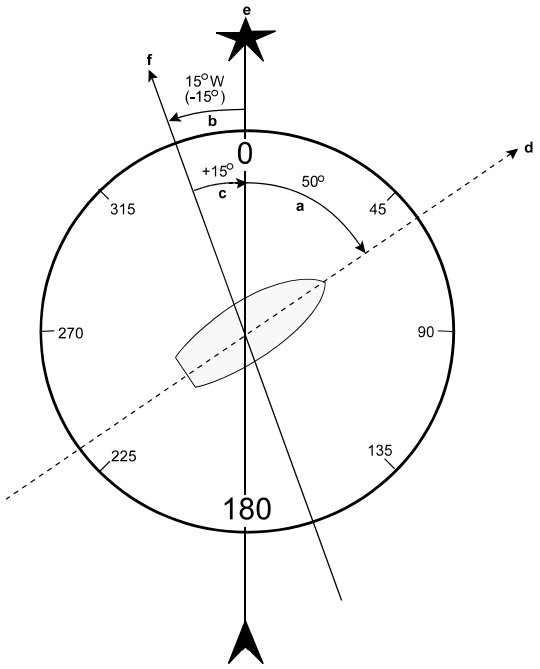


Figure 4: Illustration of Magnetic Variation and Correction

Reference	Description
a	True Bearing
b	Local Magnetic Variation
c	Local Magnetic Variation Correction (inverse of magnetic variation)
a + c	Magnetic Bearing
d	Heading: 50° True, 60° Magnetic
e	True North
f	Local Magnetic North

How does GNSS determine what Magnetic North is? Do the satellites transmit a database or some kind of look up chart to determine the declination for your given latitude and longitude? How accurate is it?

Magnetic North refers to the location of the Earth's Magnetic North Pole. Its position is constantly changing in various cycles over centuries, years and days. These rates of change vary and are not well understood. However, we are able to monitor these changes.

True North refers to the earth's celestial pole, that is, at 90° north latitude or the location where the lines of longitude converge. This position is always the same and does not vary.

The locations of these two poles do not coincide. Thus, a relationship is required between these two values for users to relate GNSS bearings to their compass bearings. This value is called the magnetic variation correction or declination.

GNSS does not determine where Magnetic North is nor do the satellites provide magnetic correction or declination values. However, OEM6 receivers store this information internally in look up tables so that when you specify that you want to navigate with respect to Magnetic North, this internal information is used. These values are also available from various information sources such as the United States Geological Survey (USGS). The USGS produces maps and has software which enables you to determine these correction values. By identifying your location (latitude and longitude), you can obtain the correction value. Refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning for USGS contact information.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	MAGVAR header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	type	AUTO	0	Use IGRF corrections	Enum	4	H
		CORRECTION	1	Use the correction supplied			
3	correction	± 180.0 degrees		Magnitude of correction (Required field if type = Correction)	Float	4	H+4
4	std_dev	± 180.0 degrees		Standard deviation of correction (default = 0)	Float	4	H+8

2.5.54 MARKCONTROL Controls processing of mark inputs

This command provides a means of controlling the processing of the mark 1 (MK1I) and mark 2 (MK2I) inputs for the OEM6. Using this command, the mark inputs can be enabled or disabled, polarity can be changed and a time offset and guard against extraneous pulses can be added.

The MARKPOS and MARKTIME logs to, have their outputs (and extrapolated time tags) pushed into the future (relative to the MKI event) by the amount entered into the time bias field. In almost all cases, this value is set to 0, which is also the default setting (*page 412* and *page 414*).

Abbreviated ASCII Syntax: **Message ID: 614**

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

Factory Default:

markcontrol mark1 disable

markcontrol mark2 disable

ASCII Example:

markcontrol mark1 enable negative 50 100

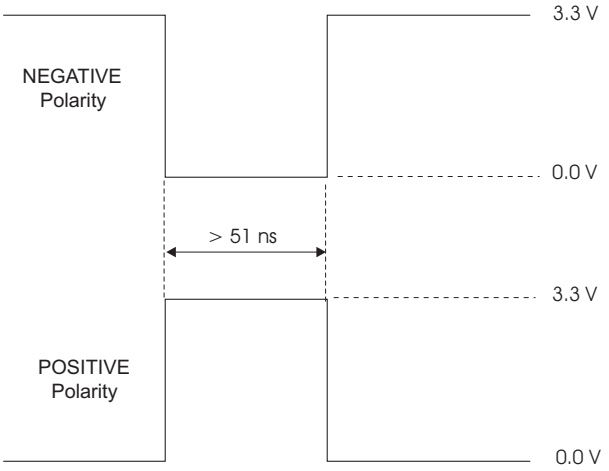


Figure 5: TTL Pulse Polarity

If you have a user point device, such as a video camera device, connect the device to the receiver's I/O port. Use a cable that is compatible to both the receiver and the device. A MARKIN pulse can be a trigger from the device to the receiver. See also the MARKPOS and MARKTIME logs (*page 412* and *page 414*).

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	MARKCONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	signal	MARK1	0	Specifies which mark input the command should be applied to. Set to MARK1 for the MK1I input and MARK2 for MK2I. Both mark inputs have 10 K pull-up resistors to 3.3 V and are leading edge triggered	Enum	4	H
		MARK2	1				
3	switch	DISABLE	0	Disables or enables processing of the mark input signal for the input specified. If DISABLE is selected, the mark input signal is ignored (default = ENABLE)	Enum	4	H+4
		ENABLE	1				
4	polarity	NEGATIVE	0	Optional field to specify the polarity of the pulse to be received on the mark input. See *Figure 5* on *Page 165* for more information (default= NEGATIVE)	Enum	4	H+8
		POSITIVE	1				
5	timebias	Any valid long value		Optional value to specify an offset, in nanoseconds, to be applied to the time the mark input pulse occurs (default =0)	Long	4	H+12
6	timeguard	Any valid ulong value larger than the receiver's minimum raw measurement period [a]		Optional field to specify a time period, in milliseconds, during which subsequent pulses after an initial pulse are ignored (default =0)	ULong	4	H+16

a. See *Appendix A* in the *OEM6 Family Installation and Operation User Manual* for the maximum raw measurement rate to determine the minimum period. If the value entered is lower than the minimum measurement period, the value is ignored and the minimum period is used.

2.5.55 MODEL Switches to a previously authorized model

This command is used to switch the receiver between models previously added with the AUTH command (*page 79*). When this command is issued, the receiver saves this model as the active model. The active model is now used on every subsequent start up. The MODEL command causes an automatic reset.

Use the VALIDMODELS log to output a list of available models for your receiver. The VALIDMODELS log is described on *page 594*. Use the VERSION log to output the active model, see *page 595*.

If you switch to an expired model, the receiver will reset and enter into an error state. You will need to switch to a valid model to continue.

Abbreviated ASCII Syntax: **Message ID: 22**

MODEL model

Input Example:

model d2lr0rccr

NovAtel receivers use the concept of models to enable different levels of functionality in the receiver firmware. For example, a receiver may be purchased with an L1 only enabled version of firmware and be easily upgraded at a later time to a more feature intensive model. All that is required to upgrade is an authorization code for the higher model and the AUTH command (see *page 79*). Reloading the firmware or returning the receiver for service to upgrade the model is not required. Upgrades are available from NovAtel Customer Support. Contact information is available on our website at www.novatel.com or on *page 15*.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	MODEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	model	Max 16 character null-terminated string (including the null)		Model name	String [max 16]	Variable[a]	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

2.5.56 MOVINGBASESTATION Enables the use of a moving base station

This command enables or disables a receiver from transmitting corrections without a fixed position.

The moving base function allows you to obtain a centimeter level xyz baseline estimate when the base station and possibly the rover are moving. It is very similar to normal RTK, that is, one base station and potentially more than one rover, depending on the data link. Communication with each receiver is done in the usual way (refer to *Transmitting and Receiving Corrections* section of the *Operation* chapter in the *OEM6 Family Installation and Operation User Manual*). The BSLNXYZ log is an asynchronous 'matched' log that can be logged with the onchanged trigger to provide an accurate baseline between the base and rover.

At the rover, it is recommended that you only use the PSRPOS log for position when in moving base station mode. PSRPOS has normal accuracy with good standard deviations. Other position logs, for example BESTPOS, can have error levels of 10's to 100's of metres and should be considered invalid. Also, the standard deviation in these logs does not correctly reflect the error level. Other rover position logs, where accuracy and standard deviations are affected by the moving base station mode, are BESTXYZ, GPGST, MARKPOS, MARK2POS, MATCHEDPOS, MATCHEDXYZ, RTKPOS and RTKXYZ.

The MOVINGBASESTATION command must be used to allow the base to transmit messages without a fixed position.

1. Use the PSRPOS position log at the rover. It provides the best accuracy and standard deviations when the MOVINGBASESTATION mode is enabled.
2. This command supports RTCM V2.3 messages (except RTCM2021), RTCM V3 operation and CMR GLONASS.
3. RTCA, RTCM1819 and RTCM V3 support includes GPS + GLONASS operation.
4. The MOVINGBASESTATION mode is functional if any of the following RTK message formats are in use: RTCAOBS, RTCAOBS2, CMROBS, RTCAREF or CMRREF.

Abbreviated ASCII Syntax: **Message ID: 763**

MOVINGBASESTATION switch

Factory Default:

movingbasestation disable

ASCII Example:

movingbasestation enable

1. Consider the case where there is a fixed base, an airplane flying with a moving base station near its front and a rover station at its tail end.
Corrections can be sent between the receivers in a ‘daisy chain’ effect, where the fixed base station sends corrections to the moving base station, which in turn can send corrections to the rover.

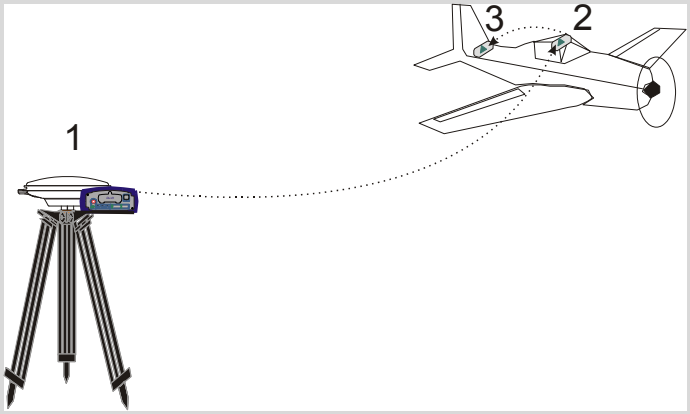


Figure 6: Moving Base Station ‘Daisy Chain’ Effect

Be cautious when using this method, as a check on the position type is only done at the fixed base station. Moving base stations will continue to operate under any conditions.

2. This command is useful for moving base stations doing RTK positioning at sea. A rover station is used to map out local areas (for marking shipping lanes, hydrographic surveying and so on), while the base station resides on the control ship. The control ship may not move much (parked at sea), but there is a certain amount of movement due to the fact that it is floating in the ocean. By using the MOVINGBASESTATION command, the control ship is able to use RT2-level RTK positioning and move to new survey sites.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	MOVING-BASESTATION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	DISABLE	0	Do not transmit corrections without a fixed position	Enum	4	H
		ENABLE	1	Transmit corrections without a fixed position			

2.5.57 NMEATALKER Sets the NMEA talker ID

This command allows you to alter the behavior of the NMEA talker ID. The talker is the first 2 characters after the $ sign in the log header of the GPGLL, GPGRS, GPGSA, GPGST, GPGSV, GPRMB, GPRMC, GPVTG and GPZDA log outputs.

The default GPS NMEA messages (`nmeatalker gp`) include specific information about only the GPS satellites that have a 'GP' talker solution, even when GLONASS satellites are present. The `nmeatalker auto` command changes this behavior so that the NMEA messages include all satellites in the solution and the talker ID changes according to those satellites.

If `nmeatalker` is set to `auto` and there are both GPS and GLONASS satellites in the solution, two sentences with the GN talker ID are output. The first sentence contains information about the GPS and the second sentence on the GLONASS satellites in the solution.

If `nmeatalker` is set to `auto` and there are only GLONASS satellites in the solution, the talker ID of this message is GL.

Abbreviated ASCII Syntax: **Message ID: 861**

NMEATALKER id

Factory Default:

nmeatalker gp

ASCII Example:

nmeatalker auto

The NMEATALKER command only affects NMEA logs that are capable of a GPS output. For example, GLMLA is a GLONASS-only log and the output will always use the GL talker. *Table 30, NMEA Talkers* on *page 171* shows the NMEA logs and whether they use GPS (GP), GLONASS (GL) or combined (GN) talkers with `nmeatalker auto`.

Table 30: NMEA Talkers

Log	Talker IDs
GLMLA	GL
GPALM	GP
GPGGA	GP
GPGLL	GP or GN
GPGRS	GP or GN
GPGSA	GP or GN
GPGST	GP or GN
GPGSV	GP and GL
GPRMB	GP or GN
GPRMC	GP or GN
GPVTG	GP or GN
GPZDA	GP

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	NMEA-TALKER header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	ID	GP	0	GPS only	Enum	4	H
		AUTO	1	GPS, GLONASS, combined			

2.5.58 NTRIPCONFIG Configures NTRIP

This command sets up and configures NTRIP communication.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID 1249**

ntripconfig port type [protocol [endpoint [mountpoint [username [password [bindinterface]]]]]]

Mountpoint, username and password are all set up on the caster.

Factory Default:

ntripconfig ncom1 disabled

ntripconfig ncom2 disabled

ntripconfig ncom3 disabled

ntripconfig ncomx disabled

ASCII Example:

ntripconfig ncom1 client v1 :2000 calg0

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	NTRIPCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	this port	6	Name of the port see Table 37, Page 210 (this port = default)	Enum	4	H
		ncom1	26				
		ncom2	27				
		ncom3	28				
3	type	DISABLE	1	NTRIP type (default DISABLE)	Enum	4	H+4
		Client	2				
		Server	3				
4	protocol	V1 (default)	1	Protocol	Enum	4	H+8
		V2	2				
4	endpoint	Max 80 character string		Endpoint to wait on or to connect to where host is a hostname or IP address and port is the TCP/UDP port number	String	80	H+12
5	mountpoint	Max 80 character string		Which mount point to use	String	80	H+92
6	user name	Max 30 character string		Login user name	String	30	H+172
7	password	Max 30 character string		Password	String	30	H+202
5	bindInterface	ALL (default)	1	All, or an interface that supports TCP/IP	Enum	4	H+232
		ETHA	2				

2.5.59 NTRIPSOURCETABLE Set NTRIPCASTER ENDPONTS

This command sets the NTRIPCASTER ENDPOINTS to be used for the SOURCETABLE log.

Abbreviated ASCII Syntax: **Message ID 1343**

ntripsourcetable endpoint

Factory Default:

none

ASCII Example:

ntripsourcetable hera.novatel.com:2101
ntripsourcetable 198.161.64.11:2101

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	NTRIPSOURCETABLE header	-		This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Endpoint	Max 80 character string		Endpoint, in format of host:port, to connect to where the host is a hostname or IP address and port is the TCP/IP port number	STRING	80	H
3	Reserved1	Reserved		Reserved	ULONG	4	H+80
4	Reserved2	Reserved		Reserved	ULONG	4	H+84

2.5.60 NVMRESTORE Restores NVM data after an NVM failure

This command restores non-volatile memory (NVM) data after a NVM Fail error. This failure is indicated by bit 13 of the receiver error word being set (see also *RXSTATUS page 521* and *RXSTATUSEVENT page 529*). If corrupt NVM data is detected, the receiver remains in the error state and continues to flash an error code on the Status LED until the NVMRESTORE command is issued (refer to the chapter on *Built-In Status Tests* in the *OEM6 Family Installation and Operation User Manual* for further explanation).

If you have more than one auth code and the saved model is lost, then the model may need to be entered using the MODEL command or it is automatically saved in NVM on the next start up. If the almanac was lost, a new almanac is automatically saved when the next complete almanac is received (after approximately 15 minutes of continuous tracking). If the user configuration was lost, it has to be reentered by the user. This could include communication port settings.

The factory default for the COM ports is 9600, n, 8, 1.

After entering the NVMRESTORE command and resetting the receiver, the communications link may have to be reestablished at a different baud rate from the previous connection.

Abbreviated ASCII Syntax: **Message ID: 197**

NVMRESTORE

The possibility of NVM failure is extremely remote, however, if it should occur it is likely that only a small part of the data is corrupt. This command is used to remove the corrupt data and restore the receiver to an operational state. The data lost could be the user configuration, almanac, model or other reserved information.

2.5.61 OMNIUSEGLONASS Enables/disables GLONASS in OmniStar

Abbreviated ASCII Syntax: **Message ID: 1199**

OMNIUSEGLONASS switch

Factory Default:

omniuseglonass disable

ASCII Example:

omniuseglonass enable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	OMNIUSEGLONASS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	DISABLE	0	Enables/disables GLONASS in OmniStar	Enum	4	H
		ENABLE	1				

2.5.62 PDPFILTER Enables, disables or resets the PDP filter

This command enables, disables or resets the Pseudorange/Delta-Phase (PDP) filter. The main advantages of the PDP implementation are:

- Smooths a jumpy position
- Bridges outages in satellite coverage (the solution is degraded from normal but there is at least a reasonable solution without gaps)

1. Enable the PDP filter to output the PDP solution in BESTPOS, BESTVEL and NMEA logs.
2. Refer to the *Operation* chapter of the OEM6 Installation and Operation Manual for a section on configuring your receiver for PDP or GL1DE® operation.

GL1DE Position Filter

GL1DE is a mode of the PDP[1] filter that optimizes the position for consistency over time rather than absolute accuracy. This is ideally in clear sky conditions where the user needs a tight, smooth and consistent output. The GL1DE filter works best with SBAS. The PDP filter is smoother than a least squares fit but is still noisy in places. The GL1DE filter produces a very smooth solution with consistent rather than absolute position accuracy. There should typically be less than 1 centimeter difference in error from epoch to epoch. GL1DE also works in single point, DGPS and OmniSTAR VBS modes. See also the PDPMODE command on *page 178* and the PDPPOS, PDPVEL and PDPXYZ logs starting on *page 439*.

Abbreviated ASCII Syntax: **Message ID: 424**

PDPFILTER switch

Factory Default:

pdpfilter disable

ASCII Example:

pdpfilter enable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PDPFILTER header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	DISABLE	0	Enable/disable/reset the PDP filter. A reset clears the filter memory so that the PDP filter can start over	Enum	4	H
		ENABLE	1				
		RESET	2				

1. Refer also to our application note APN=038 on *Pseudorange/Delta-Phase (PDP)*, available on our website at http://www.novatel.com/support/applicationnotes.htm.

2.5.63 PDPMODE Selects the PDP mode and dynamics

This command allows you to select the mode and dynamics of the PDP filter.

1. You must issue a PDPFILTER ENABLE command before the PDPMODE command. See also *Section 2.5.63 PDPMODE Selects the PDP mode and dynamics* on *page 178*.
2. It is recommended that the ionotype be left at "AUTO" when using either normal mode pdp or GL1DE.
See also SETIONOTYPE command on *page 229*.

Abbreviated ASCII Syntax: **Message ID: 970**

PDPMODE mode dynamics

Factory Default:

pdpmode normal auto

ASCII Example:

pdpmode relative dynamic

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PDPMODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	NORMAL	0	In relative mode, GL1DE performance is optimized to obtain a consistent error in latitude and longitude over time periods of 15 minutes or less, rather than to obtain the smallest absolute position error. See also *GL1DE Position Filter* on *page 177*	Enum	4	H
		RELATIVE	1				
3	dynamics	AUTO	0	Auto detect dynamics mode	Enum	4	H+4
		STATIC	1	Static mode			
		DYNAMIC	2	Dynamic mode			

2.5.64 POSAVE Implements base station position averaging

This command implements position averaging for base stations. Position averaging continues for a specified number of hours or until the estimated averaged position error is within specified accuracy limits. Averaging stops when the time limit or the horizontal standard deviation limit or the vertical standard deviation limit is achieved. When averaging is complete, the FIX POSITION command is automatically invoked.

If you initiate differential logging, then issue the POSAVE command followed by the SAVECONFIG command, the receiver averages positions after every power on or reset. It then invokes the FIX POSITION command to enable it to send differential corrections.

Abbreviated ASCII Syntax: **Message ID: 173**

POSAVE [state] maxtime [maxhstd [maxvstd]]

Factory Default:

posave off

ASCII Example 1:

posave on 24 1 2

ASCII Example 2:

posave off

The POSAVE command can be used to establish a new base station, in any form of survey or RTK data collection, by occupying a site and averaging the position until either a certain amount of time has passed or position accuracy has reached a user specified level. User specified requirements can be based on time or horizontal or vertical quality of precision.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	POSAVE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	state	ON	1	Enable or disable position averaging	Enum	4	H
		OFF	0				
3	maxtime	0.01 - 100 hours		Maximum amount of time that positions are to be averaged. Only becomes optional if: State = OFF	Float	4	H+4
4	maxhstd	0 - 100 m		Desired horizontal standard deviation (default = 0)	Float	4	H+8
5	maxvstd	0 - 100 m		Desired vertical standard deviation (default = 0)	Float	4	H+12

2.5.65 POSTIMEOUT Sets the position time out

This commands allows you to set the time out value for the position calculation in seconds.

In position logs, for example BESTPOS or PSRPOS, when the position time out expires, the *Position Type* field is set to NONE. Other field values in these logs remain populated with the last available position data. Also, the position is no longer used in conjunction with the almanac to determine what satellites are visible.

Abbreviated ASCII Syntax: **Message ID: 612**

POSTIMEOUT sec

Factory Default:

postimeout 600

ASCII Example:

postimeout 1200

When performing data collection in a highly dynamic environment (for example, urban canyons or in high speed operations), you can use POSTIMEOUT to prevent the receiver from using calculated positions that are too old. Use POSTIMEOUT to force the receiver position type to NONE. This ensures that the position information being used in BESTPOS or PSRPOS logs is based on a recent calculation. All position calculations are then recalculated using the most recent satellite information.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	POSTIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	sec	0-86400		Time out in seconds	Ulong	4	H

2.5.66 PPSCONTROL Controls the PPS output

This command provides a method for controlling the polarity, period and pulse width of the PPS output on the OEM6. You can also disable the PPS output using this command.

The leading edge of the 1PPS pulse is always the trigger/reference:

```
PPSCONTROL ENABLE NEGATIVE
```

generates a normally high, active low pulse with the falling edge as the reference, while:

```
PPSCONTROL ENABLE POSITIVE
```

generates a normally low, active high pulse with the rising edge as the reference.

The pulse width is user-adjustable. The adjustable pulse width feature generates these uses for the PPS signal:

- Supporting triggers/systems that need longer, or shorter, pulse widths than the default to register the pulse
- Enabling a type of GPIO line for manipulation of external hardware control lines

Abbreviated ASCII Syntax: **Message ID: 613**

PPSCONTROL [switch [polarity [period [pulse width]]]]

Factory Default:

ppscontrol enable negative 1.0 1000

ASCII Example:

ppscontrol enable positive 0.5 2000

This command is used to setup the PPS signal coming from the receiver. Suppose you wanted to take measurements such as temperature or pressure in synch with your GNSS data. The PPS signal can be used to trigger measurements in other devices.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PPSCONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	DISABLE	0	Disables or enables output of the PPS pulse (default =ENABLE)	Enum	4	H+4
		ENABLE	1				
3	polarity	NEGATIVE	0	Optional field to specify the polarity of the pulse to be generated on the PPS output. See *Figure 5* for more information (default= NEGATIVE)	Enum	4	H+8
		POSITIVE	1				
4	period	0.05, 0.1, 0.2, 0.25, 0.5, 1.0, 2.0, 3.0,...20.0		Optional field to specify the period of the pulse, in seconds (default=1.0)	Double	8	H+12
5	pulse width	Any positive value less than or equal to half the period		Optional field to specify the pulse width of the PPS signal in microseconds. This value should always be less than or equal to half the period (default=1000)	ULong	4	H+20

2.5.67 PROFILE Profile in Non-Volitile Memory (NVM)

This command allows user to configure multiple profiles in the NVM at receiver startup. The output is in the PROFILEINFO log. See also the FRESET command (*page 129*).

Abbreviated ASCII Syntax: **Message ID: 1411**

PROFILE Option Name [commands]

ASCII Examples:

```
PROFILE create Base
PROFILE createelement Base "log versiona"
PROFILE createelement Base "serialconfig com2 115200"
PROFILE createelement Base "log com2 rtca1 ontime 1"
PROFILE activate Base
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PROFILE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Option	refer to *Table 31, Page 183*		Profile options	Enum	4	H
3	Name			Profile name	String [Max 20]	variable[a]	variable
4	Command			Profile command	String [Max 150]	variable[a]	variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

Table 31: Profile Option

Binary	ASCII	Description
0	Reserved	
1	CREATE	Create a profile (default)
2	DELETE	Delete an existing profile
3	CREATEELEMENT	Create an element in an existing profile
4	DELETEELEMENT	Delete an existing element in an existing profile
5	ACTIVATE	Activate an existing profile
6	DEACTIVATE	Deactivate a running profile

Restrictions:
1. Only support up to 9 profiles.
2. Only support up to 20 commands per profile.
3. Only support up to 150 characters long for each command.
4. Only support up to 1500 characters for all commands in one profile.
5. If one of the profiles is activated, the SAVECONFIG functionality is disabled.
6. All profile data cleared from the NVM only by a FRESET or NVMCLEAR command.
7. The receiver shall reset after a profile is activated.

2.5.68 PSRDIFFSOURCE Sets the Pseudorange Correction Source

This command lets you identify from which base station to accept differential corrections. This is useful when the receiver is receiving corrections from multiple base stations. See also the RTKSOURCE command on *page 203*.

1. When a valid PSRDIFFSOURCE command is received, the current correction is removed immediately rather than in the time specified in PSRDIFFSOURCETIMEOUT (*page 187*).
2. To use L-band differential corrections, an L-band receiver and the OmniSTAR service or use of a DGPS service is required. Contact NovAtel for details.
3. For ALIGN users: the ALIGN rover will not use RTK corrections automatically to do PSRDIFF positioning, as ALIGN is commonly used with a moving base. If you have a static base and want a PSRDIFF position, at the ALIGN rover, set the PSRDIFFSOURCE RTK.

Abbreviated ASCII Syntax: **Message ID: 493**

PSRDIFFSOURCE type [id]

Factory Default:

psrdiffsource auto "any"

ASCII Examples:

1. Enable only SBAS:
   rtksource none
   psrdiffsource sbas
   sbascontrol enable auto
2. Enable OmniSTAR VBS, and HP or XP:
   rtksource omnistar
   psrdiffsource omnistar
3. Enable RTK and PSRDIFF from RTCM, with a fall-back to SBAS:
   rtksource rtcm any
   psrdiffsource rtcm any
   sbascontrol enable auto
4. Disable all corrections:
   rtksource none
   psrdiffsource none

Since several errors affecting signal transmission are nearly the same for two receivers near each other on the ground, a base at a known location can monitor the errors and generate corrections for the rover to use. This method is called Differential GPS and is used by surveyors to obtain submetre accuracy.

Major factors degrading GPS signals, which can be removed or reduced with differential methods, are atmospheric, satellite orbit errors and satellite clock errors. Errors not removed include receiver noise and multipath.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PSRDIFFSOURCE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	type	See *Table 33, Page 191*		ID Type. All types (except NONE) may revert to SBAS (if enabled) or SINGLE position types. See *Table 56, Page 303* [a]	Enum	4	H
3	Base station ID	Char [5] or ANY		ID string	Char[5]	8 [b]	H+4

a. If you choose ANY, the receiver ignores the ID string. Specify a Type when you are using base station IDs.

b. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment.

Table 32: DGPS Type

Binary	ASCII	Description
0	RTCM [d]	RTCM ID: 0 ≤ RTCM ID ≤ 1023 **or** ANY
1	RTCA [d]	RTCA ID: A four character string containing only alpha (a-z) or numeric characters (0-9) **or** ANY
2	CMR [da]	CMR ID: 0 ≤ CMR ID ≤ 31 **or** ANY
3	OMNISTAR [b d]	In the PSRDIFFSOURCE command, OMNISTAR enables OmniSTAR VBS and disables other DGPS types. OmniSTAR VBS produces RTCM-type corrections. In the RTKSOURCE command, OMNISTAR enables OmniSTAR HP/XP (if allowed) and disables other RTK types. OmniSTAR HP/XP has its own filter, which computes corrections in RTK float mode or within about 10 cm accuracy
Reserved		
5	SBAS [c d]	In the PSRDIFFSOURCE command, when enabled, SBAS such as WAAS, EGNOS and MSAS, forces the use of SBAS as the pseudorange differential source. SBAS is able to simultaneously track two SBAS satellites and incorporate the SBAS corrections into the position to generate differential quality position solutions. An SBAS-capable receiver permits anyone within the area of coverage to take advantage of its benefits. **If SBAS is set in the RTKSOURCE command, it can not provide carrier phase positioning and returns an error**
6	RTK[c]	In the PSRDIFFSOURCE command, RTK enables using RTK correction types for PSRDIFF positioning.The correction type used is determined by the setting of the RTKSOURCE command (*page 203*)
10	AUTO [c d]	In the PSRDIFFSOURCE command, AUTO means that if any correction format is received then it will be used. If multiple correction formats are available, then RTCM, RTCA and RTK will be preferred over OmniSTAR, which will be preferred over SBAS messages. If RTCM, RTCA and RTK are all available then the type of the first received message will be used. In the RTKSOURCE command, AUTO means that both the NovAtel RTK filter and the OmniSTAR HP/XP filter (if authorized) are enabled. The NovAtel RTK filter selects the first received RTCM, RTCA, RTCMV3 or CMR message. The BESTPOS log selects the best solution between NovAtel RTK and OmniSTAR HP/XP
11	NONE [c d]	Disables all differential correction types
12	Reserved	
13	RTCMV3 [ba]	RTCM Version 3.0 ID: 0 ≤ RTCMV3 ID ≤ 4095 **or** ANY

a. This cannot be used in the PSRDIFFSOURCE command.
b. Base station ID parameter is ignored.
c. Available only with the PSRDIFFSOURCE command (*page 184)*.
d. All PSRDIFFSOURCE entries fall back to SBAS (except NONE).

2.5.69 PSRDIFFSOURCETIMEOUT Sets PSRDIFF correction source timeout

When multiple differential correction sources are available, this command allows the user to set a time in seconds, that the receiver will wait before switching to another differential source, if corrections from the original source are lost.

It recommended that only one reference station's corrections are sent to the receiver at a time.

Abbreviated ASCII Syntax: **Message ID: 1449**

PSRDIFFSOURCETIMEOUT option [timeout]

ASCII Example:

psrdiffsourcetimeout auto (default 0 seconds)

psrdiffsourcetimeout set 180

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PSRDIFFSOURCETIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII ASCII or binary, respectively	-	H	0
2	option	AUTO or SET		Use AUTO or set the time	ENUM	4	H+4
3	timeout	0 to 3600 sec		Specify the time (default=0)	ULONG	4	H+8

2.5.70 PSRDIFFTIMEOUT Sets maximum age of differential data

This command is used to set the maximum age of pseudorange differential correction data to use when operating as a rover station. Received pseudorange differential correction data, older than the specified time, is ignored. This time out period also applies to differential corrections generated from RTK corrections.

The RTCA Standard for SCAT-I stipulates that the maximum age of differential correction messages cannot be greater than 22 seconds. Therefore, for RTCA rover users, the recommended PSRDIFF delay setting is 22.

Abbreviated ASCII Syntax: **Message ID: 1450**

PSRDIFFTIMEOUT delay

Factory Default:

psrdifftimeout 300

ASCII Example:

psrdifftimeout 60

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PRSDIFFTIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	delay	2 to 1000 s		Maximum pseudorange differential age	ULong	4	H

2.5.71 QZSSECUTOFF Sets QZSS Satellite Elevation Cutoff

This command sets the elevation cut-off angle for QZSS satellites. The receiver does not start automatically searching for a QZSS satellite until it rises above the cut-off angle. Tracked QZSS satellites that fall below the QZSSECUTOFF angle are no longer tracked unless they are manually assigned (see the ASSIGN command on *page 69*).

This command does not affect the tracking of GPS satellites. Similarly, the ECUTOFF command does not affect QZSS satellites.

Abbreviated ASCII Syntax: **Message ID: 1350**

QZSSECUTOFF angle

Factory Default:

qzssecutoff 5.0

ASCII Example

qzssecutoff 10.0

This command permits a negative cut-off angle and can be used in the following situations:

- The antenna is at a high altitude and can look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	angle	±90 degrees		Elevation cutoff angle relative to the horizon	FLOAT	4	H

2.5.72 RAIMMODE Configures RAIM mode

This command is used to configure RAIM operation. This command uses RTCA MOPS characteristics which defines the positioning accuracy requirements for airborne lateral navigation (LNAV) and vertical navigation (VNAV) at 3 stages of flight:

1. En route travel
2. Terminal (within range of air terminal)
3. Non-precision approach

In order to ensure that the required level of accuracy is available in these phases of flight, MOPS requires the computation of protection levels (HPL and VPL). MOPS has the following definitions that apply to NovAtel's RAIM feature:

Horizontal Protection Level (HPL) is a radius of the circle in the horizontal plane. Its center is at the true position, that describes the region, assured to contain the indicated horizontal position. It is the horizontal region where the missed alert and false alert requirements are met using autonomous fault detection.

Vertical Protection Level (VPL) is half the length of the segment on the vertical axis. Its center is at the true position, that describes the region, assured to contain the indicated vertical position when autonomous fault detection is used.

Horizontal Alert Limit (HAL) is a radius of the circle in the horizontal plane. Its center is at the true position, that describes the region, required to contain the indicated horizontal position with the required probability.

Vertical Alert Limit (VAL) is half the length of the segment on the vertical axis. Its center is at the true position, that describes the region, required to contain the indicated vertical position with certain probability.

Probability of False Alert (P_{fa}) is a false alert defined as the indication of a positioning failure, when a positioning failure has not occurred (as a result of false detection). A false alert would cause a navigation alert.

Detection strategy

NovAtel's RAIM detection strategy uses the weighted Least-Squares Detection (LSA) method. This method computes a solution using a LSA and is based on the sum of squares of weighted residuals. It is a comparison between a root sum of squares of residuals and a decision threshold to determine a pass/fail decision.

Isolation strategy

NovAtel RAIM uses the maximum residual method. Logically it is implemented as a second part of Fault Detection and Exclusion (FDE) algorithm for LSA detection method. Weighted LSA residuals are standardized individually and the largest residual is compared to a decision threshold. If it is more than the threshold, the observation corresponding to this residual is declared faulty.

Abbreviated ASCII Syntax: **Message ID: 1285**

RAIMMODE mode [hal [val [pfa]]]

Factory Default:

raimmode default

Input Example:

raimmode user 100 100 0.01

raimmode terminal

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	RAIMMODE Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	MODE	See Table 34, Page 196			-	4	H
3	HAL	5 ≤ HAL ≤ 9999.99		Horizontal akert limit (m) (Default = 0.0)	Double	8	H+4
4	VAL	5 ≤ VAL ≤ 9999.99		Vertical alert limit (m) (Default = 0.0)	Double	8	H+12
5	PFA	$(P_{fa})= 1e^{-7} \leq P_{fa} \leq 0.25$		Probability of false alert (Default = 0.0)	Double	8	H+20

Table 33: RAIM Mode Types

Binary	ASCII	Description
0	DISABLE	Do not do integrity monitoring of least squares solution
1	USER	User will specify alert limits and probability of false alert
2	DEFAULT	Use OEMV (NovAtel) RAIM (default)
3	APPROACH	Default numbers for non-precision approach navigation modes are used - HAL = 556 m (0.3 nm), VAL = 50 m for LNAV/VNAV
4	TERMINAL	Default numbers for terminal navigation mode are used - HAL = 1855 m (1 nm), no VAL requirement
5	ENROUTE	Default numbers for enroute navigation mode are used - HAL = 3710m (2 nm), no VAL requirement

2.5.73 RESET Performs a hardware reset

This command performs a hardware reset. Following a RESET command, the receiver initiates a cold start boot up. The receiver configuration reverts either to the factory default, if no user configuration was saved or the last SAVECONFIG settings. Refer to the FRESET and SAVECONFIG commands on *page 129* and *page 208*.

The optional delay field is used to set the number of seconds the receiver is to wait before resetting.

Abbreviated ASCII Syntax: **Message ID: 18**

RESET [delay]

Input Example

reset 120

1. The RESET command can be used to erase any unsaved changes to the receiver configuration.
2. Unlike the FRESET command, the RESET command does not erase data stored in the NVM, such as Almanac and Ephemeris data.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RESET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	delay			Seconds to wait before resetting (default = 0)	Ulong	4	H

2.5.74 RTKANTENNA Specifies L1 phase center (PC) or ARP and enables/disables PC modeling

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

You can also decide whether or not to apply phase center variation modeling. If there are any conditions that make a selected mode impossible, the solution status in the position logs indicate an error or warning.

L1 ARP offsets, L2 ARP offsets and phase center variation parameters can be entered using the ANTENNAMODEL and BASEANTENNAMODEL commands on *page 65* and *page 81*.

Error states occur if either the rover does not have the necessary antenna information entered or the base is not sending sufficient information to work in the requested mode. Some examples of these error conditions are:

- RTCM Types 23 and 24 messages are received from the base and no model is available for the specified base antenna
- Phase center modeling is requested but the base is only sending RTCM Types 3 and 22
- Position reference to the ARP is requested but no rover antenna model is available

Abbreviated ASCII Syntax: **Message ID: 858**

RTKANTENNA posref pcv

Factory Default:

rtkantenna unknown disable

ASCII Example:

rtkantenna arp enable

This command is used for high precision RTK positioning allowing application of antenna offset and phase center variation parameters.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKANTENNA header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	posref	L1PC	0	L1 phase center position reference	Enum	4	H
		ARP	1	ARP position reference			
		UNKNOWN	2	Unknown position reference			
3	pcv	DISABLE	0	Disable PCV modelling	Enum	4	H+4
		ENABLE	1	Enable PCV modelling			
4	Reserved				Bool	4	H+8
5	Reserved				Bool	4	H+12

2.5.75 RTKCOMMAND Resets or sets the RTK filter to default

This command is used to reset the RTK filter or 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. The USE_DEFAULTS action executes the following command: RTKDYNAMICS DYNAMIC.

Abbreviated ASCII Syntax: **Message ID: 97**

RTKCOMMAND action

Factory Default:

rtkcommand use_defaults

ASCII Example:

rtkcommand reset

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKCOMMAND header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	action	USE_DEFAULTS	0	Reset to defaults	Enum	4	H
		RESET	1	Reset RTK filter			

2.5.76 RTKDYNAMICS Sets the RTK dynamics mode

This command is used to specify how the receiver looks at the data. There are three modes: STATIC, DYNAMIC and AUTO. The STATIC mode forces the RTK software to treat the rover station as though it were stationary.

DYNAMIC mode forces the software to treat the receiver as though it were in motion. If the receiver is undergoing very slow, steady motion (<2.5 cm/s for more than 5 seconds), you should use DYNAMIC mode (as opposed to AUTO) to prevent inaccurate results and possible resets.

For reliable performance, the antenna should not move more than 1-2 cm when in STATIC mode.

Abbreviated ASCII Syntax: **Message ID: 183**

RTKDYNAMICS mode

Factory Default:

rtkdynamics dynamic

ASCII Example:

rtkdynamics static

Table 34: Dynamics Mode

ASCII	Binary	Description
AUTO	0	Automatically determines dynamics mode
STATIC	1	Static mode
DYNAMIC	2	Dynamic mode

Use the STATIC option to decrease the time required to fix ambiguities and reduce the amount of noise in the position solution. If you use STATIC mode when the antenna is not static, the receiver will have erroneous solutions and unnecessary RTK resets.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKDYNAMICS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	*Table 34, Page 196*		Set the dynamics mode	Enum	4	H

2.5.77 RTKELEVMASK Sets the RTK elevation mask

This command sets the elevation mask for generating RTK corrections at a base station. Any satellites below the elevation mask will not be included in the correction messages. Intended for RTCA, it works only with RTCAOBS, RTCAOBS2 or RTCAOBS3 *page 500*. This command is useful when the amount of bandwidth available for transmitting corrections is limited.

Abbreviated ASCII Syntax: **Message ID: 91**

RTKELEVMASK masktype [angle]

Factory Default:

rtkelevmask auto 0.0

ASCII Example:

rtkelevmask auto 2.0

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKELEVMASK header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	MaskType	0	AUTO	Type of elevation mask for RTK	Enum	4	0
		1	USER				
3	Angle			Elevation mask angle (default=-1.0)	Enum	4	H+4

2.5.78 RTKMATCHEDTIMEOUT Sets RTK filter reset time after corrections are lost

This command sets the length of time the receiver continues to use the last RTK correction data once the corrections stop. Once this time is reached, the RTK filter is reset.

Abbreviated ASCII Syntax: **Message ID: 1447**

RTKMATCHEDTIMEOUT timeout

ASCII Example:

rtkmatchedtimeout 180

Factory Default

rtkmatchedtimeout 300

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKMATCHEDTIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	timeout	1 to 3600 s		Time out period	Ulong	4	H+4

2.5.79 RTKNETWORK Specifies the RTK network mode

Network RTK uses permanent base station installations, allowing kinematic GNSS users to achieve centimetre accuracies, without the need of setting up a GNSS base station, at a known site. This command sets the RTK network mode for a specific network. For more details on Network RTK, refer to the application note APN-041available on our website.

http://www.novatel.com/support/applicationnotes.htm.

Abbreviated ASCII Syntax: **Message ID: 951**

RTKNETWORK mode [network#]

Factory Default:

rtknetwork auto

Input Example:

rtknetwork imax

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTK-NETWORK header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	*Table 35, Page 200*		RTK network mode. The factory default is auto where the receiver switches to the first available network RTK source	Enum	4	H
3	network#	4-24		Specify a number for the network (default = 0)	Ulong	4	H+4

Table 35: Network RTK Mode

Binary	ASCII	Description
0	DISABLE	Single reference station RTK mode. All received network RTK corrections are ignored.
1-4	Reserved	
5	VRS	The Virtual Reference Station (VRS) or Virtual Base Station (VBS) idea introduced by Trimble, is that a base station is artificially created in the vicinity of a rover receiver. All baseline length dependent errors, such as abnormal troposphere variation, ionospheric disturbances and orbital errors, are reduced for this VRS. The rover receiving VRS information has a lower level of these errors than a distant base station. The VRS is calculated for a position, supplied by the rover during communication start up, with networking software. The VRS position can change if the rover is far away from the initial point. The format for sending the rover's position is standard NMEA format. Most rovers receive VRS data, for a calculated base station, within a couple of metres away. The VRS approach requires bi-directional communication for supplying the rover's position to the networking software.
6	IMAX	The iMAX idea, introduced by Leica Geosystems, is that networking software corrections, based on the rover's position, are calculated as with VRS. However, instead of calculating the base station observations for the provided position or another position closer to the base station, original observation information is corrected with the calculated corrections and broadcast. VRS works so that although the rover is unaware of the errors the VRS is taking care of, there still might be ionospheric remains in the base station observations. iMAX provides actual base station position information. The rover may assume the base station is at a distance and open its settings for estimation of the remaining ionospheric residuals. The iMAX method may trigger the rover to open its settings further than required, since the networking software removes at least part of the ionospheric disturbances. However, compared to VRS above, this approach is safer since it notifies the rover when there might be baseline length dependent errors in the observation information. iMAX requires bi-directional communication to the networking software for supplying the base station observation information.
7	FKP	The FKP method delivers the information from a base station network to the rover. No precise knowledge of the rover's position is required for providing the correct information. The corrections are deployed as gradients to be used for interpolating to the rover's actual position.

Table 35: Network RTK Mode

Binary	ASCII	Description
8	MAX	The basic principle of the master-auxiliary concept is to provide, in compact form, as much of the information from the network and the errors it is observing to the rover as possible. With more information about the state and distribution of the dispersive and non-dispersive errors across the network, the rover is able to use more intelligent algorithms in the determination of its position solution. Each supplier of reference station software will have their own proprietary algorithms for modeling or estimating these error sources. The rover system can decide to use or to neglect the network RTK information, depending on its own firmware algorithm performance.
9	Reserved	
10	AUTO	Default value, assume single base. If network RTK corrections are detected then the receiver will switch to the appropriate mode. iMAX and VRS can only be detected using RTCMV3, however, it is not possible to distinguish between iMAX or VRS. If iMAX or VRS is detected, then iMAX will be assumed.

2.5.80 RTKQUALITYLEVEL Sets an RTK quality mode

Use this commands to select an RTK quality mode.

Abbreviated ASCII Syntax: **Message ID: 844**

RTKQUALITYLEVEL mode

Factory Default:

rtkqualitylevel normal

ASCII Example:

rtkqualitylevel extra_safe

Table 36: RTK Quality Mode

ASCII	Binary	Description
NORMAL	1	Normal RTK
EXTRA_SAFE	4	Extra Safe RTK

The EXTRA_SAFE command is needed in areas where the signal is partially blocked and the position solution in NORMAL mode shows NARROW_INT even though the real position solution is out by several metres. Using EXTRA_SAFE in these environments means the solution will be slower getting to NARROW_INT but it is less likely to be erroneous.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKQUALITY-LEVEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	See *Table 36, Page 202*		Set the RTK quality level mode	Enum	4	H

2.5.81 RTKSOURCE Sets the RTK correction source

This command lets you 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. See also the PSRDIFFSOURCE command on *page 184*.

To use OmniSTAR HP/XP differential corrections, a NovAtel receiver with L-band capability and a subscription to the OmniSTAR service are required. Contact NovAtel for details.

Abbreviated ASCII Syntax: **Message ID: 494**

RTKSOURCE type [id]

Factory Default:

rtksource auto "any"

ASCII Examples:

1. Specify the format before specifying the base station IDs:
   rtksource rtcmv3 5
   rtksource rtcm 6
2. Select only SBAS:
   rtksource none
   psrdiffsource sbas
   sbascontrol enable auto
3. Enable OmniSTAR HP and VBS:
   rtksource omnistar
   psrdiffsource omnistar
4. Enable RTK and PSRDIFF from RTCM, with a fall-back to SBAS:
   rtksource rtcm any
   psrdiffsource rtcm any
   sbascontrol enable auto

Consider an agricultural example where a farmer has their own RTCM base station set up but due to either obstructions or radio problems, occasionally experience a loss of corrections. By specifying a fall back to SBAS, the farmer could set up their receiver to use transmitted RTCM corrections when available but fall back to SBAS. Also, if they decided to get an OmniSTAR subscription, they could switch to the OmniSTAR corrections.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKSOURCE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	type	See *Table 32, Page 186*		ID Type [a]	Enum	4	H
3	Base station ID	Char [4] or ANY		ID string	Char[5]	8 [b]	H+4

a. If you choose ANY, the receiver ignores the ID string. Specify a type when you are using base station IDs.

b. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment.

2.5.82 RTKSOURCETIMEOUT Sets RTK correction source timeout

When multiple RTK correction sources are available, this command allows the user to set a time, in seconds, that the receiver will wait before switching to another RTK correction source if corrections from the original source are lost.

It recommended that only one reference station's corrections are sent to the receiver at a time.

Abbreviated ASCII Syntax: **Message ID: 1445**

RTKSOURCETIMEOUT option [timeout]

Factory Default:

rtksourcetimeout auto

ASCII Example:

rtksourcetimeout auto

rtksourcetimeout set 180

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKSOURCETIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	option	AUTO or SET		Use AUTO or set the time	ENUM	4	H+4
3	timeout	0 to 3600 s		Specify the time (default=0)	ULONG	4	H+8

2.5.83 RTKSVENTRIES Sets number of satellites in corrections

This command sets the number of satellites (at the highest elevation) that are transmitted in the RTK corrections from a base station receiver. Intended for RTCA, it works only with RTCAOBS, RTCAOBS2 or RTCAOBS3 (*page 500*). This is useful when the amount of bandwidth available for transmitting corrections is limited.

Abbreviated ASCII Syntax: **Message ID: 92**

RTKSVENTRIES number

Factory Default:

rtksventries 24

ASCII Example:

rtksventries 7

GPS devices have enabled many transit and fleet authorities to provide Automatic Vehicle Location (AVL). AVL systems track the position of individual vehicles and relay that data back to a remote dispatch location that can store or better utilize the information. Consider the implementation of an AVL system within a police department, to automatically log and keep track of the location of each cruiser. Typically a fleet uses a 9600 bps connection where AVL data is relayed back to headquarters. The limited bandwidth of the radio must be shared amongst the AVL and other systems in multiple cruisers.

When operating with a low baud rate radio transmitter (9600 or lower), especially over a long distance, the AVL system could limit the number of satellites for which corrections are sent using the RTKSVENTRIES command.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKSVENTRIES header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	number	4-24		The number of SVs to be transmitted in correction messages	ULong	4	H

2.5.84 RTKTIMEOUT Sets maximum age of RTK data

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.

Abbreviated ASCII Syntax: **Message ID: 910**

RTKTIMEOUT delay

Factory Default:

rtktimeout 60

ASCII Example (rover):

rtktimeout 20

See the DGPSEPHEMDELAY command on *page 102* to set the ephemeris changeover delay for base stations.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKTIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	delay	5 to 60 s		Maximum RTK data age	ULong	4	H

2.5.85 SAVECONFIG Save current configuration in NVM

This command saves the present configuration in Non-Volatile Memory (NVM). The configuration includes the current log settings, FIX settings, port configurations and so on. The output is in the RXCONFIG log, see *page 519*. See also the FRESET command, *page 129*.

If you are using this command in NovAtel's Connect, ensure that you have all windows other than the Console window closed. Otherwise, log commands used for the various windows are saved as well. This will result in unnecessary data being logged.

Abbreviated ASCII Syntax: **Message ID: 19**

SAVECONFIG

2.5.86 SBASCONTROL Sets SBAS test mode and PRN

This command allows you to dictate how the receiver tracks and uses correction data from Satellite Based Augmentation Systems (SBAS).

To enable the position solution corrections you must 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 in AUTO mode, if the receiver is outside the defined satellite system's corrections grid, it reverts to ANY mode and chooses a system based on other criteria.

Once tracking satellites from one system in ANY or AUTO mode, it does not track satellites from other systems. This is because systems such as WAAS, EGNOS and MSAS do not share broadcast information and have no way of knowing each other are there.

The "testmode" parameter in the example is to get around the test mode of these systems. EGNOS at one time used the IGNOREZERO test mode. At the time of printing, ZEROTOTWO is the correct setting for all SBAS, including EGNOS, running in test mode. On a simulator, you may want to leave this parameter off or specify NONE explicitly.

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

You can force the receiver to track a specific PRN using the ASSIGN command. You can force the receiver to use the corrections from a specific SBAS PRN using the SBASCONTROL command.

Disable stops the corrections from being used.

Depending on the PSRDIFFSOURCE setting, the receiver may automatically switch to using Pseudorange Differential (RTCM or RTCA) or OmniStar corrections, regardless of the current SBASCONTROL setting.

Abbreviated ASCII Syntax: **Message ID: 652**

SBASCONTROL switch [system] [prn] [testmode]

Factory Default:

sbascontrol disable

ASCII Example:

sbascontrol enable waas

NovAtel's OEM6 receivers work with SBAS systems including EGNOS (Europe), MSAS (Japan) and WAAS (North America).

Table 37: System Types

ASCII	Binary	Description
NONE	0	Does not use any SBAS satellites
AUTO	1	Automatically determines satellite system to use and prevents the receiver from using satellites outside of the service area (default)
ANY	2	Uses any and all SBAS satellites found
WAAS	3	Uses only WAAS satellites
EGNOS	4	Uses only EGNOS satellites
MSAS	5	Uses only MSAS satellites
GAGAN	6	Uses only GAGAN satellites
QZSS	7	Uses only QZSS SAIF signals

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SBASCONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	switch	DISABLE	0	Receiver does not use the SBAS corrections it receives (default)	Enum	4	H
		ENABLE	1	Receiver uses the SBAS corrections it receives			
3	system	See Table 37, Page 210		Choose the SBAS the receiver will use (default=auto)	Enum	4	H+4
4	prn	0		Receiver uses any PRN (default)	ULong	4	H+8
		120-138		Receiver uses SBAS corrections only from this PRN			
5	testmode	NONE	0	Receiver interprets Type 0 messages as they are intended (as do not use) (default)	Enum	4	H+12
		ZEROTOTWO	1	Receiver interprets Type 0 messages as Type 2 messages			
		IGNOREZERO	2	Receiver ignores the usual interpretation of Type 0 messages (as do not use) and continues			

2.5.87 SBASECUTOFF Sets SBAS satellite elevation cut-off

This command sets the elevation cut-off angle for SBAS satellites. The receiver does not start automatically searching for an SBAS satellite until it rises above the cut-off angle. Tracked SBAS satellites that fall below the SBASECUTOFF angle are no longer tracked unless they are manually assigned (see the ASSIGN command on *page 69*).

This command does not affect the tracking of GPS satellites. Similarly, the ECUTOFF command does not affect SBAS satellites.

Abbreviated ASCII Syntax: **Message ID: 1000**

SBASECUTOFF angle

Factory Default:

sbasecutoff -5.0

ASCII Example:

sbasecutoff 10.0

This command permits a negative cut-off angle and can be used in the following situations:

- The antenna is at a high altitude and can look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SBASECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	angle	±90.0 degrees		Elevation cut-off angle relative to horizon	Float	4	H

2.5.88 SBASTIMEOUT Sets the SBAS position time out

This command is used to set the amount of time the receiver remains in an SBAS position if it stops receiving SBAS corrections.

Abbreviated ASCII Syntax: **Message ID: 1001**

SBASTIMEOUT mode delay

Factory Default:

sbastimeout auto

ASCII Example:

sbastimeout set 100

When the time out mode is AUTO, the time out delay is 180 s.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SBASTIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	mode	See Table 38, Page 212 below		Time out mode	Enum	4	H
3	delay	2 to 1000 s		Maximum SBAS position age	Double	8	H+4
4	Reserved				Double	8	H+12

Table 38: SBAS Time Out Mode

Binary	ASCII	Description
0	Reserved	
1	AUTO	Set the default value (180 s)
2	SET	Set the delay in seconds

2.5.89 SELECTCHANCONFIG Sets the channel configuration

Some software models come with support for more than one channel configuration, which can be verified by logging CHANCONFIGLIST (see *page 320*). SELECTCHANCONFIG allows the user to pick a different channel configuration from the allowable set. If a different channel configuration from the current configuration is selected via the SELECTCHANCONFIG command, the receiver will reset and start back up with the new configuration. The *Set in Use* number in the CHANCONFIGLIST log should change as a result.

Abbreviated ASCII Syntax: **Message ID: 1149**

SELECTCHANCONFIG chanconfigsetting

Factory Default:

selectchanconfig 1

ASCII Example:

selectchanconfig 2

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
1	SELECTCHANCONFIG header	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	chanconfigsetting	Channel configuration to use	Ulong	4	H

Below is a use case example of CHANCONFIG command. Abbreviated ASCII commands and logs are used to better illustrate the example.

1.LOG VERSION to show the current model.

•GPSCARD "D2LR0RCCR" "BFN11230026" "OEM628-1.00" "OEM060200RN0000" "OEM060200RB0000" "2012/Mar/22" "10:51:30"

2.“D2L” prefix in the model indicates it is a GPS+GLONASS L1/L2 with SBAS and LBAND functionality.

3.LOG CHANCONFIGLIST to show what the channel configuration options are and which channel configuration set is being used.

•CHANCONFIGLIST COM1 0 84.5 FINESTEERING 1684 158935.214 00000020 d1c0 10526
1 2
4
16 GPSL1L2
4 SBASL1
14 GLOL1L2
1 LBAND
4
16 GPSL1L2PL2C
4 SBASL1
14 GLOL1L2PL2C
1 LBAND

4.There are two options given the model and the first channel configuration set is currently being used.

5.If the user would like to use the second channel configuration set which the receiver would explicitly tracks both L2P and L2C signals, SELECTCHANCONFIG 2 would be entered.

6.The receiver receives the command and reset. At the startup, the second channel configuration set is configured.

7.To double check, LOG CHANCONFIGLIST

•CHANCONFIGLIST COM1 0 84.5 FINESTEERING 1684 158935.214 00000020 d1c0 10526
2 2
4
16 GPSL1L2
4 SBASL1
14 GLOL1L2
1 LBAND
4
16 GPSL1L2PL2C
4 SBASL1
14 GLOL1L2PL2C
1 LBAND

8.To triple check, LOG TRACKSTAT to show all the configured channels.

2.5.90 SEND Sends an ASCII message to a COM port

This command is used to send ASCII printable data from any of the COM or USB ports to a specified communications port. This is a one time command, therefore the data message must be preceded by the SEND command and followed by <CR> each time you wish to send data. If the data string contains delimiters (that is, spaces, commas, tabs and so on), the entire string must be contained within double quotation marks. Carriage return and line feed characters (for example, 0x0D, 0x0A) are appended to the sent ASCII data.

Abbreviated ASCII Syntax: **Message ID: 177**

SEND port data

ASCII Example

send com1 “log com1 rtcaobs ontime 5”

Scenario: Assume you are operating receivers as base and rover stations. It could also be assumed that the base station is unattended but operational and you wish to control it from the rover station. From the rover station, you could establish the data link and command the base station receiver to send differential corrections.

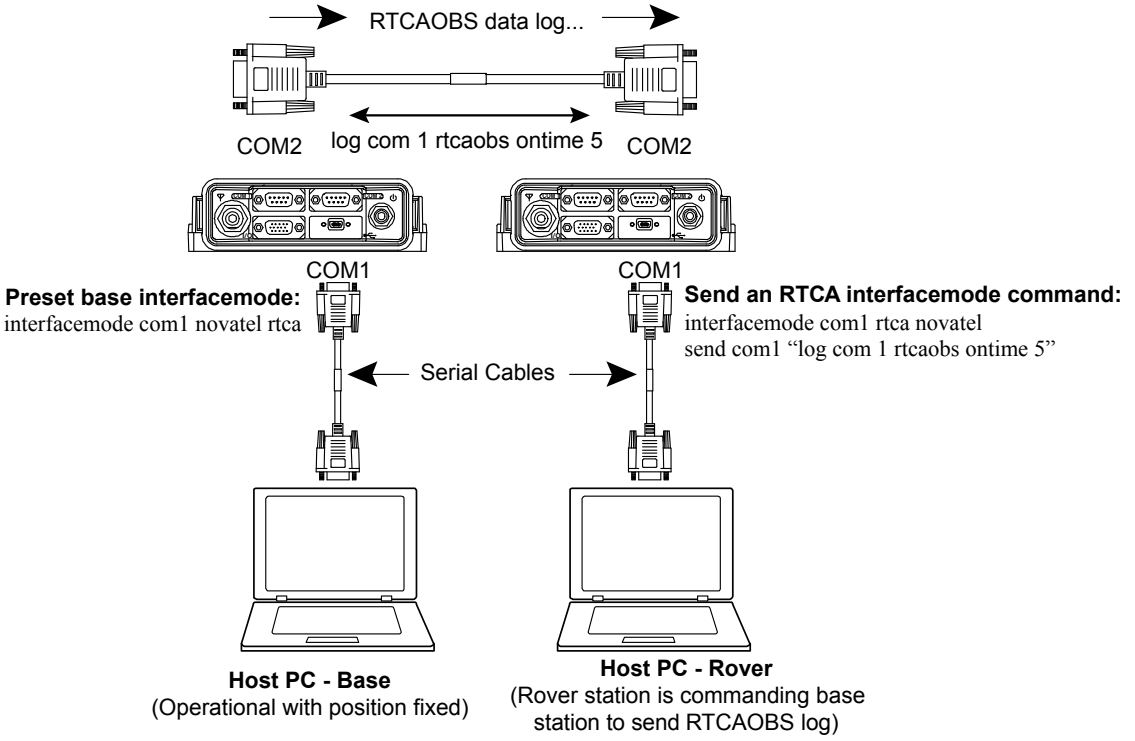


Figure 7: Using the SEND Command

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SEND header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See		Output port	Enum	4	H
3	message	Max 100 character string (99 typed visible chars and a null char added by the firmware automatically)		ASCII data to send	String [max 100]	Vari-able [a]	Vari-able

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

2.5.91 SENDHEX Send non-printable characters in hex pairs

This command is like the SEND command except it is used to send non-printable characters expressed as hexadecimal pairs. Carriage return and line feed characters (for example, 0x0D, 0x0A) will **not** be appended to the sent data and so must be explicitly added to the data if needed.

Abbreviated ASCII Syntax: **Message ID: 178**

SENDHEX port length data

Input Example:

sendhex com1 6 143ab5910d0a

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SENDHEX header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See *Table 39, Page 220*		Output port	Enum	4	H
3	length	0 - 700		Number of hex pairs	ULong	4	H+4
4	message	limited to a 700 maximum string (1400 pair hex) by command interpreter buffer even number of ASCII characters from set of 0-9, A-F no spaces are allowed between pairs of characters		Data	String [max 700]	Vari-able[a]	Vari-able

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

2.5.92 SERIALCONFIG Configures serial port settings

1. This replaces the COM command.
2. This command also acts as a collection response ether and can be used as a log.

This command permits you to configure the receiver's asynchronous serial port communications drivers.

The current SERIALCONFIG port configuration can be reset to its default state at any time by sending it two hardware break signals of 250 milliseconds each, spaced by fifteen hundred milliseconds (1.5 seconds) with a pause of at least 250 milliseconds following the second break. This will:

- Stop the logging of data on the current port (see UNLOGALL on *page 260)*
- Clear the transmit and receive buffers on the current port
- Return the current port to its default settings (see *Factory Defaults* on *page 57* for details)
- Set the interface mode to NovAtel for both input and output (see the INTERFACEMODE command on *page 146*)

See also *Factory Defaults* on *page 57* for a description of the factory defaults and the COMCONFIG log on *page 331*.

1. The COMCONTROL command, see *page 92*, may conflict with handshaking of the selected COM port. If handshaking is enabled, then unexpected results may occur.
2. Baud rates higher than 115,200 bps are not supported by standard PC hardware. Special PC hardware may be required for higher rates, including 230400 bps, 460800 bps and 921600 bps. Also, some PC's have trouble with baud rates beyond 57600 bps.Watch for situations where the COM ports of two receivers are connected together and the baud rates do not match. Data transmitted through a port operating at a slower baud rate may be misinterpreted as break signals by the receiving port if it is operating at a higher baud rate. This is because data transmitted at the lower baud rate is stretched relative to the higher baud rate. In this case, configure the receiving port to have break detection disabled using the SERIALCONFIG command.

Use the SERIALCONFIG command before using the INTERFACEMODE command on each port. Turn break detection off using the SERIALCONFIG command to stop the port from resetting because it is interpreting incoming bits as a break command.

Abbreviated ASCII Syntax: **Message ID: 1246**

SERIALCONFIG [port] baud [parity[databits[stopbits[handshaking[break]]]]]

Factory Defaults:

serialconfig com1 9600 n 8 1 n on

serialconfig com2 9600 n 8 1 n on

serialconfig com3 9600 n 8 1 n on

ASCII Example:

serialconfig com1 9600 n 8 1 n off

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	SERIALCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See Table 39, Page 220		Port to configure (default = THISPORT)	Enum	4	H
3	bps/baud	300, 600, 900, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800 and 921600		Communication baud rate (bps).	ULong	4	H+4
4	parity	See Table 40, Page 221		Parity	Enum	4	H+8
5	databits	7 or 8		Number of data bits (default = 8)	Ulong	4	H+12
6	stopbits	1 or 2		Number of stop bits (default = 1)	Ulong	4	H+16
7	handshake[a]	See Table 41, Page 221		Handshaking	Enum	4	H+20
8	break	OFF	0	Disable break detection	Enum	4	H+24
		ON	1	Enable break detection (default)			
		AUTO	2				
		DEFAULT	3				

a. The OEM6 AUX and COM3 ports do not support hardware handshaking. Only transmit and receive lines exist for these ports on the OEM6.

Table 39: COM Port Identifiers

Binary	ASCII	Description
1	COM1	COM port 1
2	COM2	COM port 2
3	COM3	COM port 3
6	THISPORT	The current COM port
8	ALL	All COM ports
9	XCOM1	Virtual COM1 port
10	XCOM2	Virtual COM2 port
13	USB1	USB port 1
14	USB2	USB port 2
15	USB3	USB port 3
16	AUX	AUX port
17	XCOM3	Virtual COM3 port
23	ICOM1	Virtual serial ports (over Ethernet)
24	ICOM2	
25	ICOM3	
26	NCOM1	NTRIP ports (over Ethernet)
27	NCOM2	
28	NCOM3	

Table 40: Parity

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

Table 41: Handshaking

Binary	ASCII	Description
0	N	No handshaking (default)
1	XON	XON/XOFF software handshaking
2	CTS	CTS/RTS hardware handshaking

2.5.93 SETAPPROXPOS Sets an approximate position

This command sets an approximate latitude, longitude and height in the receiver. Estimating these parameters, when used in conjunction with an approximate time (see the SETAPPROXTIME command on *page 223*), can improve satellite acquisition times and time to first fix (TTFF). For more information about TTFF and Satellite Acquisition, please refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

The horizontal position entered should be within 200 km of the actual receiver position. The approximate height is not critical and can normally be entered as zero. If the receiver cannot calculate a valid position within 2.5 minutes of entering an approximate position, the approximate position is ignored.

The approximate position is not visible in any position logs. It can be seen by issuing a SETAPPROXPOS log. See also the SATVIS log on *page 531*.

Abbreviated ASCII Syntax: **Message ID: 377**

SETAPPROXPOS lat lon height

Input Example:

setapproxpos 51.116 -114.038 0

For an example on the use of this command, please see the SETAPPROXTIME command on *page 223*.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETAPPROXPOS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Lat	± 90 degrees		Approximate latitude	Double	8	H
3	Lon	± 180 degrees		Approximate longitude	Double	8	H+8
4	Height	-1000 to +20000000 m		Approximate height	Double	8	H+16

2.5.94 SETAPPROXTIME Sets an approximate GPS reference time

This command sets an approximate time in the receiver. The receiver uses this time as a system time until a coarse time can be acquired. This can be used in conjunction with an approximate position (see the SETAPPROXPOS command on *page 222*) to improve time to first fix (TTFF). For more information TTFF and Satellite Acquisition, please refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

The time entered should be within 10 minutes of the actual GPS reference time.

If the week number entered does not match the broadcast week number, the receiver resets.

See also the SATVIS log on *page 531*.

Abbreviated ASCII Syntax: **Message ID: 102**

SETAPPROXTIME week sec

Input Example:

setapproxtime 1605 425384

Upon power up, the receiver does not know its position or time and therefore cannot use almanac information to aid satellite acquisition. You can set an approximate GPS reference time using the SETAPPROXTIME command or RTCAEPHEM message. The RTCAEPHEM message contains GPS reference week and seconds and the receiver uses that GPS reference time if the time is not yet known. Several logs provide base station coordinates and the receiver uses them as an approximate position allowing it to compute satellite visibility. Alternately, you can set an approximate position by using the SETAPPROXPOS command (*page 222*)).

Approximate time and position must be used in conjunction with a current almanac to aid satellite acquisition. See the table below for a summary of the OEM6 family commands and logs used to inject an approximated time or position into the receiver:

Approximate	Command	Log
Time	SETAPPROXTIME	RTCAEPHEM
Position	SETAPPROXPOS	RTCAREF *or* CMRREF *or* RTCM3

Base station aiding can help in these environments. A set of ephemerides can be injected into a rover station by broadcasting the RTCAEPHEM message from a base station. This is also useful in environments where there is frequent loss of lock. GPS ephemeris is three frames long within a sequence of five frames. Each frame requires 6 s of continuous lock to collect the ephemeris data. This gives a minimum of 18 s and a maximum of 36 s continuous lock time or when no recent ephemerides (new or stored) are available.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETAPPROXTIME header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	week	0-9999		GPS reference week number	Ulong	4	H
3	sec	0-604800		Number of seconds into GPS reference week	Double	8	H+4

2.5.95 SETBASERECEIVERTYPE Sets base receiver type

This command allows the user to specify the base receiver type to aid GLONASS ambiguity fixing in RTK. It can be used as a substitute for RTCM1033 messages that contains the information on the base receiver type. This command should be issued to the Rover. Using this allows the Rover receiver to fix the GLONASS ambiguities when using RTCM2.X and CMR corrections as well.

An incorrect base type setting can significantly impair ambiguity resolution.

Abbreviated ASCII Syntax: **Message ID: 1374**

setbasereceivertype base_type

Factory Default:

setbasereceivertype unknown

ASCII Example:

setbasereceivertype novatel

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SBASERECEIVERTYPE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	base type	unknown	0	Unknown Base	-	4	0
		novatel	1	NovAtel Base	-		
		trimble	2	Trimble Base	-		
		topcon	3	Topcon Base	-		
		magellan	4	Magellan Base	-		
		leica	5	Leica Base			

2.5.96 SETBESTPOSCRITERIA Sets selection criteria for BESTPOS

Use this command to set the criteria for the BESTPOS log. It allows you to choose between 2D and 3D standard deviation to obtain the best position from the BESTPOS log. It also allows you to specify the number of seconds to wait before changing the position type. This delay provides a single transition that ensures position types do not skip back and forth. See also BESTPOS on *page 301*.

Abbreviated ASCII Syntax: **Message ID: 839**

SETBESTPOSCRITERIA type delay

Factory Default:

setbestposcriteria pos3d 0

Input Example:

setbestposcriteria pos2d 5

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SET-BESTPOS-CRITERIA header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	type	See *Table 42, Page 226*		Select a 2D or 3D standard deviation type to obtain the best position from the BESTPOS log	Enum	4	H
3	delay	0 to 100 s		Set the number of seconds to wait before changing the position type	Ulong	4	4

Table 42: Selection Type

ASCII	Binary	Description
POS3D	0	3D standard deviation (default)
POS2D	1	2D standard deviation

2.5.97 SETCANNAME Sets the CAN name fields

This commands sets the CAN device name fields.

Abbreviated ASCII Syntax: **Message ID: 1091**

SETCANNAME

Input Example:

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETCANNAME header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	ManufacturerCode			CAN module's Manufacturer Code	ULong	4	H
3	IndustryGroup			Industry group number (default = 2)	ULong	4	H+4
4	DeviceClass			11783-5 Device class (default = 0)	ULong	4	H+8
5	DeviceClassInstance			11783-5 Device class instance (default = 0)	ULong	4	H+12
6	Function			11783-5 Function (default = 23)	ULong	4	H+16
7	FunctionInstance			11783-5 Function instance (default = 0)	ULong	4	H+20
8	ECUInstance			11783-5 ECU Instance (default = 0)	ULong	4	H+24
9	PreferredAddress			Device default address on start up (default=28)	ULong	4	H+28
10	Reserved				ULong	4	H+32

2.5.98 SETDIFFCODEBIASES Sets satellite differential code biases

> Changing the biases may negatively affect positioning accuracy. NovAtel recommends that only advanced users modify the biases.

Use this command to set the differential code biases that correct pseudorange errors affecting the L1/L2 ionospheric corrections. Bias values are restricted to between -3 ns and +3 ns. A set of biases is included in the firmware and use of the biases is enabled by default. See also the DIFFCODEBIASCONTROL command on *page 104*.

The receiver uses the C/A code on L1 and the P code on L2 to calculate a dual-frequency ionospheric correction. However, the GNSS clock corrections are broadcast as if the P codes on both L1 and L2 are used to calculate this correction. The biases account for the differences between the P and C/A codes on L1 and improve the estimate of the ionospheric correction.

The biases are calculated by the International GNSS Service (IGS). Calculation details, analysis and results are available at http://aiuws.unibe.ch/spec/dcb.php. The most recent 30 day average bias values can be downloaded from http://aiuws.unibe.ch/ionosphere/p1c1.dcb.

Abbreviated ASCII Syntax: **Message ID: 687**

SETDIFFCODEBIASES bias_type biases

Factory Default:

```
SETDIFFCODEBIASES GPS_C1P1 -0.004 -0.012 -0.595 1.123 1.885
0.116 1.356 -0.681 -0.093 -2.304 0.374 1.383 1.387 -0.037
1.711 -0.808 1.435 -0.379 -1.970 -1.454 -0.546 -2.386 0.694
-0.316 -0.589 0.663 -0.326 -0.355 1.911 -1.404 1.474 -1.252
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETDIFF-CODE-BIASES header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	bias_type	GPS_C1P1 (default)	0	Code pair to which biases refer	Enum	4	H
		GPS_C2P2	1				
3	biases	-		Array of 40 biases (ns)	Float[40]	160	4

2.5.99 SETIONOTYPE Enables ionospheric models

Use this command to set which ionospheric corrections model the receiver should use. If the selected model is not available, the receiver reverts to AUTO.

L1 only models automatically use SBAS ionospheric grid corrections, if available.

Abbreviated ASCII Syntax: **Message ID: 711**

SETIONOTYPE model

Factory Default:

setionotype auto

ASCII Example:

setionotype klobuchar

An ionotype of AUTO is recommended for PDP and GL1DE.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETIONO-TYPE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	model	See Table 43, Page 229		Choose an ionospheric corrections model	Enum	4	H

Table 43: Ionospheric Correction Models

ASCII	Binary	Description
NONE	0	Don't use ionosphere modelling
KLOBUCHAR	1	Use the Klobuchar model broadcast by GPS
GRID	2	Use the SBAS grid model
L1L2	3	Use the L1/L2 model
AUTO	4	Automatically determine the ionospheric model to use

2.5.100 SETNAV Sets start and destination waypoints

This command permits entry of one set of navigation waypoints (see Figure 8, Illustration of SETNAV Parameters on Page 230). The origin (FROM) and destination (TO) waypoint coordinates entered are considered on the ellipsoidal surface of the current datum (default WGS84). Once SETNAV has been set, you can monitor the navigation calculations and progress by observing the NAVIGATE log messages.

Track offset is the perpendicular distance from the great circle line drawn between the FROM lat-lon and TO lat-lon waypoints. It establishes the desired navigation path or track, that runs parallel to the great circle line, which now becomes the offset track, and is set by entering the track offset value in metres. A negative track offset value indicates that the offset track is to the left of the great circle line track. A positive track offset value (no sign required) indicates the offset track is to the right of the great circle line track (looking from origin to destination). See *Figure 8* on *Page 230* for clarification.

Abbreviated ASCII Syntax: **Message ID: 162**

SETNAV fromlat fromlon tolat tolon track offset from-point to-point

Factory Default:

setnav 90.0 0.0 90.0 0.0 0.0 from to

ASCII Example:

setnav 51.1516 -114.16263 51.16263 -114.1516 -125.23 from to

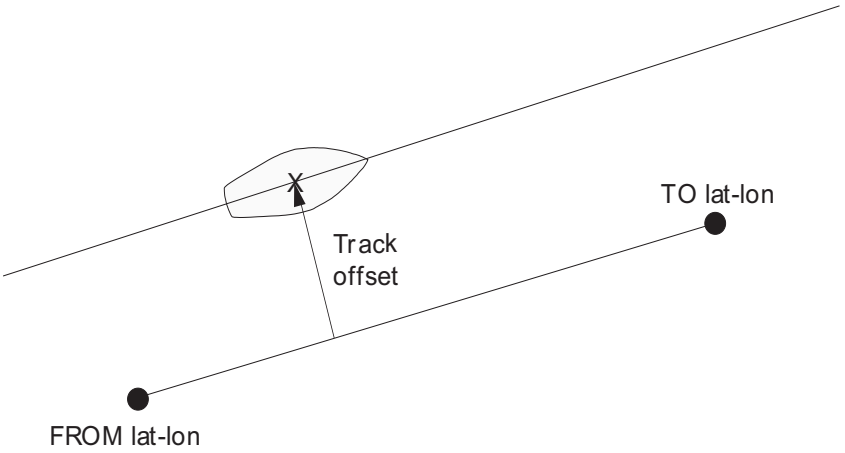


Figure 8: Illustration of SETNAV Parameters

Consider the case of setting waypoints in a deformation survey along a dam. The surveyor enters the From and To point locations, on either side of the dam. using the SETNAV command. They then use the NAVIGATE log messages to record progress and show where they are in relation to the *From* and *To* points.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETNAV header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	fromlat	± 90 degrees		Origin latitude in units of degrees/decimal degrees. A negative sign for South latitude. No sign for North latitude	Double	8	H
3	fromlon	± 180 degrees		Origin longitude in units of degrees/decimal degrees. A negative sign for West longitude. No sign for East longitude	Double	8	H+8
4	tolat	± 90 degrees		Destination latitude in units of degrees/decimal degrees	Double	8	H+16
5	tolon	± 180 degrees		Destination longitude in units of degrees/decimal degrees	Double	8	H+24
6	track offset	± 1000 km		Waypoint great circle line offset (in kilometres) establishes offset track. Positive indicates right of great circle line and negative indicates left of great circle line	Double	8	H+32
7	from-point	5 characters maximum		ASCII station name	String [max 5]	Variable [a]	Variable
8	to-point	5 characters maximum		ASCII station name	String [max 5]	Variable [a]	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

2.5.101 SETROVERID to Set ID for ALIGN rovers

This command sets the Rover ID output in ROVERPOS, HEADING2, ALIGNBSLNXYZ and ALIGNBSLNENU logs.

The default value for the ID is set using the last six characters of the receiver PSN Number. For example, if the receiver PSN number is DAB07170027, ID is set as R027, i.e., 17 is represented as R and last three characters are filled in as is.

It is not guaranteed that each receiver will have a unique auto-generated ID. Use this command to set the ID in case the auto-generated ID overlaps with other rovers. It is the user's responsibility to ensure each receiver ID is unique (if they own multiple receivers). If the ID overlaps, use this command to set the ID.

Abbreviated ASCII Syntax: **Message ID: 1135**

setroverid ROV1

Factory Default:

If the receiver PSN is: DAB07170027
setroverid R027

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETROVERID header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	ID	4 Character String e.g., ROV1		ID String	CHAR[4]	4	H

2.5.102 SETRTCM16 Enters ASCII text for RTCM data stream

The RTCM type 16 message allows ASCII text to be transferred from a GNSS base station to rover GNSS receivers. The SETRTCM16 command is used to define the ASCII text at the base station. The text defined by the SETRTCM16 command can be verified in the RXCONFIG log. Once the ASCII text is defined it can be broadcast periodically by the base station with the command "log <port> RTCM16 ONTIME <interval>". The received ASCII text can be displayed at the rover by logging RTCM16T.

This command limits the input message length to a maximum of 90 ASCII characters. If the message string contains any delimiters (that is, spaces, commas, tabs and so on) the entire string must be contained in double quotation marks.

Abbreviated ASCII Syntax: **Message ID: 131**

SETRTCM16 text

Input Example:

setrtcm16 “base station will shut down in 1 hour”

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETRTCM16 header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	text	Maximum 90 character string		The text string	String [max 90]	Variable[a]	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

2.5.103 SETRTCM36 Enters ASCII text with Russian characters

The RTCM Type 36 message is the GLONASS equivalent of the RTCM Type 16 message except that the RTCM36 message can contain characters from an extended character set including Russian characters. *Table 45, System used for timing* on *page 238* provides the standard decimal and hex codes to use when transmitting Cyrillic characters to provide Russian language messages. Codes from 0 to 127 correspond to standard ASCII codes.

To support the 8-bit character data in the ASCII version, 8-bit characters are represented as \xnn (or \dnnn) which are the hexadecimal (or decimal) values of the characters. A "\" is represented as "\\".

In the RTCM36T log, the ASCII output displays the 8-bit characters in the decimal \dnnn representation. However, in the SETRTCM36 command, you can enter the 8-bit characters using the \x or \d prefix.

This command limits the input message length to a maximum of 90 ASCII characters. If the message string contains any delimiters (that is, spaces, commas, tabs, and so on) the entire string must be contained in double quotation marks.

Abbreviated ASCII Syntax: **Message ID: 880**

SETRTCM36 extdtext

Input Example:

To set the message “QUICK ШТОРМ”, enter any of the following commands (color added or gray scale in printed versions to aid understanding):

setrtcm36 “quick \d166\d146\d174\d144\d140”

setrtcm36 “quick \xa6\x92\xae\x90\x8c ”

setrtcm36 “\x51\x55\x49\x43\x4b\x20\xa6\x92\xae\x90\x8c ”

setrtcm36 “\x51\x55\x49\x43\x4b\xa6\x92\xae\x90\x8c ”

Similarly, the corresponding RTCM36T message, see *page 502*, looks like:

#RTCM36TA,COM1,0,77.5,FINESTEERING,1399,237244.454,00000000,
2E54,35359;"QUICK \D166\D146\D174\D144\D140"*4AA7F340

Similar to the RTCM Type 16 message, the SETRTCM36 command is used to define the ASCII text at the base station and can be verified in the RXCONFIG log. Once the ASCII text is defined it can be broadcast periodically by the base station with the command, for example "log port RTCM36 ONTIME 10". The received ASCII text can be displayed at the rover by logging RTCM36T.

Table 44: Russian Alphabet Characters (Ch) in Decimal (Dec) and Hexadecimal (Hex)

Hex Code	Dec Code	Ch	Hex Code	Dec Code	Ch	Hex Code	Dec Code	Ch	Hex Code	Dec Code	Ch
80	128	А	90	144	Р	A0	160	а	B0	176	р
81	129	Б	91	145	С	A1	161	б	B1	177	с
82	130	В	92	146	Т	A2	162	в	B2	178	т
83	131	Г	93	147	У	A3	163	г	B3	179	у
84	132	Д	94	148	Ф	A4	164	д	B4	180	ф
85	133	Е	95	149	Х	A5	165	е	B5	181	х
86	134	Ж	96	150	Ц	A6	166	ж	B6	182	ц
87	135	З	97	151	Ч	A7	167	з	B7	183	ч
88	136	И	98	152	Ш	A8	168	и	B8	184	ш
89	137	Й	99	153	Щ	A9	169	й	B9	185	щ
8A	138	К	9A	154	Ъ	AA	170	к	BA	186	ъ
8B	139	Л	9B	155	Ы	AB	171	л	BB	187	ы
8C	140	М	9C	156	Ь	AC	172	м	BC	188	ь
8D	141	Н	9D	157	Э	AD	173	н	BD	189	э
8E	142	О	9E	158	Ю	AE	174	о	BE	190	ю
8F	143	П	9F	159	Я	AF	175	п	BF	191	я

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETRTCM36 header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	extdtext	Maximum 90 character string		The RTCM36 text string	String [max 90]	Variable[a]	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

2.5.104 SETRTCMRXVERSION Sets the RTCM message standard

This command sets RTCM corrections to RTCM 2.2 or 2.3 message standards.

For RTCM correction message types, see Table 28, Page 148.

Abbreviated ASCII Syntax: **Message ID: 1216**

SETRTCMRXVERSION version

Factory Default:

setrtcmrxversion v23

Input Example:

setrtcmrxversion v23

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETRTCMRXVERSION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	version	v23	0	RTCM version 2.3	-	4	0
		v22	1	RTCM version 2.2	-		0

2.5.105 SETRTCMTXVERSION Sets the RTCM transmission standard

This command sets RTCM corrections to RTCM 2.2 or 2.3 transmission standards.

For RTCM correction message types, see Table 28, Page 148

Abbreviated ASCII Syntax: **Message ID: 1322**

SETRTCMTXVERSION version

Factory Default:

setrtcmtxversion v23

Input Example:

setrtcmtxversion v23

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETRTCMTXVERSION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	version	v23	0	RTCM version 2.3	-	4	0
		v22	1	RTCM version 2.2	-		0

2.5.106 SETTIMEBASE Sets primary and backup systems for time base

This command configures the primary and backup steering system(s) for timing. The primary system is the system that the receiver steers the clock to. Upon startup, the primary system must be present long enough to steer the clock to be valid once, otherwise, the backup system cannot be used. The backup system is used whenever the primary system is not present. When using GLONASS only positioning, the position solution will always be output in the PSRPOS log. GLONASS only positioning is not supported by the PDP filter or GL1DE.

Abbreviated ASCII Syntax: **Message ID: 1237**

SETTIMEBASE primarysystem number of backups [system[backupsystem timeout]]

Factory Default:

For GLONASS only receiver:

settimebase glonass 0

For GPS capable receiver:

settimebase gps 1 auto 0

Input Example:

settimebase gps 1 glonass 30

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETTIMEBASE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	primarysystem	*Table 45, Page 238*		The primary system for steering the receiver clock	Enum	4	H
3	number of backups	0, 1 or 2		The number of records to follow (see *Table 45, Page 238*)	Ulong	4	H+4
4	system	*Table 45, Page 238*		The system to be used for backup	Enum	4	H+8
5	backup system timeout	0 to +4294967295 (seconds)		Duration that the backup system is used to steer the clock. 0 means ongoing	Ulong	4	H+12

Table 45: System used for timing

Binary	ASCII
0	GPS
1	GLONASS
2	GALILEO

2.5.107 SETTROPOMODEL Sets Troposphere model

This command sets the troposphere model used to correct ranges used in the PSRPOS and PDPPOS solutions.

Abbreviate ASCII Syntax: **Message ID: 1434**

SETTROPOMODEL model

Factory Default:

settropomodel auto

Input Example:

settropomodel none

Disabling the troposphere model may negatively affect positioning accuracy. NovAtel recommends that only advanced users modify this setting.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETTROPOMODEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	model type	NONE	1	Do not apply any troposphere corrections	ENUM	4	0
		AUTO	2	Automatically use an appropriate model			

2.5.108 SETUTCLEAPSECONDS Sets future leap seconds

This command allows the user to force the UTC offset to be updated according to the input date.

Abbreviated ASCII Syntax: **Message ID: 1150**

SETUTCLEAPSECONDS seconds [futureweeknumber [futuredaynumber [futureseconds]]]

Factory Default:

setutcleapseconds: 15 = current seconds (current UTC offset), 1694 = Future week number, 7 = Future Day number, 16 = future seconds

Input Example:

setutcleapseconds 15 1694 7 16

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETUTCLEAPSECONDS header		-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Seconds[a]	0-			ULONG	4	0
3	Future week number	0-10000		GPS Week when future leap seconds will take effect (default = 1694)	ULONG	4	H+4
4	Future day number	1-7		Day of the week when future leap seconds will take effect (default = 7)	ULONG	4	H+8
5	Future seconds	0-		Future leap second offset takes place on the FutureWeekNumber for the FutureDayNumber (default = 16)	ULONG	4	H+12

a. This value is only be applied if the UTC status in the TIME log is not Valid.

2.5.109 SOFTLOADCOMMIT Commits to the softload module

This command completes the soft load process by writing the uploaded image to flash. Refer to *The OEM6 Installation and Operation Guide* found on our website at http://www.novatel.com/support/firmware-software-and-manuals/ for more information about the softload process.

Abbreviated ASCII Syntax: **Message ID: 475**

softloadcommit [source]

Input Example:

softloadcommit userapp

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADCOMMIT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Soft load source	COM	1	Source is from COM port (default)	Enum	4	0
		USERAPP	128	Source is a user application through API			

2.5.110 SOFTLOADDATA Uploads data for soft load

This command is used to upload data to the receiver for the soft load process. Refer to *The OEM6 Installation and Operation Guide* found on our website at http://www.novatel.com/support/firmware-software-and-manuals/ for more information about the softload process.

This command is only valid in binary mode.

Abbreviated ASCII Syntax: **Message ID: 1218**

Not applicable

Factory Default:

Not applicable

Input Example:

Not applicable

Field	Field Type	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADDATA header	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	offset	-	Block-based offset of the data	ULONG	4	0
3	data length	-	Number of bytes of data	ULONG	4	H
4	data	-	Incoming data	UCHAR	4096	H+4

2.5.111 SOFTLOADRESET Restarts soft load process

This command clears the upload buffer and restarts the soft load process. Refer to *The OEM6 Installation and Operation Guide* found on our website at http://www.novatel.com/support/firmware-software-and-manuals/ for more information about the softload process.

The command does not affect the flash and does not reset the receiver.

Abbreviated ASCII Syntax: **Message ID: 476**

softloadreset [source]

Input Example:

softloadreset

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADREST header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Soft load source	COM	1	Source is from COM port (default)	Enum	4	0
		USERAPP	128	Source is a user application through API			

2.5.112 SOFTLOADSETUP Configures the soft load process

Use this command to configure the soft load process. Refer to *The OEM6 Installation and Operation Guide* found on our website at http://www.novatel.com/support/firmware-software-and-manuals/ for more information about the softload process.

Abbreviated ASCII Syntax: **Message ID: 1219**

softloadsetup setuptype setupdata

Input Example:

softloadsetup datatype app

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADREST header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Setup type	See *Table 46, Page 244*		The type of setup command	Enum	4	0
3	Setup data	-	-	Setup data string. See Table 46 for details on this data. This data can be pulled from the S0 records of the hex file being loaded onto the receiver	String	512	H+4

Table 46: Available Set up Commands

Binary	ASCII	Description
1	Platform	Comma separated list of platforms supported by the data to be uploaded
2	Version	Version of the data to be uploaded
3	Datatype	Intended data block for the data to be uploaded
4	Authcode	PSN and AUTH code for the data to be uploaded. The format is: PSN:AuthCode. For example: BFN10260115:T48JF2,W25DBM,JH46BJ,2WGHMJ,8JW5TW,G2SR0RCCR,101114

2.5.113 SOFTLOADSREC Configures soft load process

Use this command to send S-Records to the receiver for the soft load process.

Abbreviated ASCII Syntax: **Message ID: 477**

softloadsrec s-record [source]

Input Example:

```
softloadsrec s30900283c10faa9f000ef
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADSREC header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	SREC	-		SREC data variable hex pairs - This data can be pulled from the firmware hex file	String	SREC_MAX_SERC+1	0
2	Soft load source	COM	1	Source is from COM port (default)	Enum	4	0
		USERAPP	128	Source is a user application through API			

2.5.114 STATUSCONFIG Configures RXSTATUSEVENT mask fields

This command is used to configure the various status mask fields in the RXSTATUSEVENT log, see *page 529*. These masks allow you to modify whether various status fields generate errors or event messages when they are set or cleared.

Receiver Errors automatically generate event messages. These event messages are output in RXSTATUSEVENT logs. It is also possible to have status conditions trigger event messages to be generated by the receiver. This is done by setting/clearing the appropriate bits in the event set/clear masks. The set mask tells the receiver to generate an event message when the bit becomes set. Likewise, the clear mask causes messages to be generated when a bit is cleared. If you wish to disable all these messages without changing the bits, simply UNLOG the RXSTATUSEVENT logs on the appropriate ports. Refer also to the *Built in Status Tests* chapter in the *OEM6 Family Installation and Operation User Manual*.

Abbreviated ASCII Syntax: **Message ID: 95**

STATUSCONFIG type word mask

Factory Default:

statusconfig priority status 0
statusconfig priority aux1 0x00000008
statusconfig priority aux2 0
statusconfig set status 0x00000000
statusconfig set aux1 0
statusconfig set aux2 0
statusconfig clear status 0x00000000
statusconfig clear aux1 0
statusconfig clear aux2 0

ASCII Example:

statusconfig set status 0028a51d

The receiver gives the user the ability to determine the importance of the status bits. In the case of the Receiver Status, setting a bit in the priority mask causes the condition to trigger an error. This causes the receiver to idle all channels, set the ERROR strobe line, flash an error code on the status LED, turn off the antenna (LNA power) and disable the RF hardware, the same as if a bit in the Receiver Error word is set. Setting a bit in an Auxiliary Status priority mask causes that condition to set the bit in the Receiver Status word corresponding to that Auxiliary Status.

Table 47: Mask Types

ASCII	Binary	Description
PRIORITY	0	Replace the Priority mask
SET	1	Replace the Set mask
CLEAR	2	Replace the Clear mask

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	STATUSCONFIG header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	type	See *Table 46, Page 244*		Type of mask to replace	Enum	4	H
3	word	STATUS	1	Receiver Status word	Enum	4	H+4
		AUX1	2	Auxiliary 1 Status word			
4	mask	8 digit hexadecimal		The hexadecimal bit mask	Ulong	4	H+8

2.5.115 TRACKSV Override automatic satellite assignment criteria

This command allows you to override the automatic satellite/channel assignment for all satellites with manual instructions.

Abbreviated ASCII Syntax: **Message ID 1326**

TRACKSV system ID condition

Factory Default:

the conditions for gps, glonass, galileo and qzss are default as goodhealth
the condition for sbas is default as anyhealth

Table 48: TrackSV Command System

Binary	ASCII
0	GPS
1	GLONASS
2	SBAS
5	GALILEO
7	QZSS

Table 49: TrackSV Command Condition

Binary	ASCII	Description
1	NEVER	Never track this satellite
2	GOODHEALTH	Track this satellite if the health is indicated as healthy in both the almanac and ephemeris
3	ANYHEALTH	Track this satellite no matter what the health is
4	ALWAYS	Always track this satellite

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	TRACKSV header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	System	see Table 48		System that SV channel is tracking	ENUM	4	H
3	SVID	GPS: 1-32 SBAS: 120-138, 183-187 GLONASS:1-24 (see *Section 1.3* on *page 31*) GALILEO: 1-36 QZSS: 193-197		Satellite ID number	ULONG	4	H+4
4	Condition	see Table 49		Tracking condition	ENUM	4	H+8

2.5.116 TUNNELESCAPE Breaks out of an established tunnel

The tunnel escape sequence feature allows you to break out of a tunnel between two ports by sending a predefined sequence of bytes through the tunnel in-line with the data stream. While the Bluetooth implementation on DL-V3 products utilizes the tunnel mode of OEM receivers, the tunnel escape sequence feature is applicable to any tunneling application.

Use the TUNNELESCAPE command to specify the tunnel escape sequence. The escape sequence is applied independently to all active tunnels. Use the SAVECONFIG command to save the escape sequence in case of a power cycle.

This command allows you to define an escape sequence that, when detected in a byte stream between any two COM (or AUX) ports, resets the interface mode to NOVATEL NOVATEL on those ports. The baud rate and other port parameters remain unaffected.

The TUNNELESCAPE command accepts three parameters. The first is the *switch* parameter with ENABLE or DISABLE options. The second is the *length* parameter. It is a number from 1 to 8 and must be present if the *switch* parameter is set to ENABLE. The third parameter, *esc seq*, consists of a series of pairs of digits representing hexadecimal numbers, where the number of pairs are equal to the value entered for the second parameter. The series of hexadecimal pairs of digits represent the escape sequence. The receiver detects a sequence in a tunnel exactly as it was entered.

For example, the command TUNNELESCAPE ENABLE 4 61626364 searches for the bytes representing “abcd” in a tunnel stream. TUNNELESCAPE ENABLE 3 AA4412 searches for the NovAtel binary log sync bytes.

You must first set up a tunnel. For example, create a tunnel between COM1 and COM2 by entering INTERFACEMODE COM1 TCOM2 NONE OFF. The commands can be entered in any order.

1. All bytes, leading up to and including the escape sequence, pass through the tunnel before it is reset. Therefore, the escape sequence is the last sequence of bytes that passes through the tunnel. Configure the receiver to detect and interpret the escape sequence. For example, use this information to reset equipment or perform a shutdown process.
2. The receiver detects the escape sequence in all active tunnels in any direction.
3. Create tunnels using the INTERFACEMODE command, see *page 146*.
4. SAVECONFIG WARNING: If you are using the SAVECONFIG command in NovAtel’s Connectt, ensure that you have all windows other than the *Console* window closed. Otherwise, Connect also saves log commands used for its various windows. This will result in unnecessary data being logged.

Abbreviated ASCII Syntax: **Message ID: 962**

TUNNELESCAPE switch length [esc seq]

Factory Default:

tunnelescape disable 0

ASCII Example:

tunnelescape enable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	TUNNEL-ESCAPE header	-	-	This field contains the command name	H	0	-
2	switch	DISABLE	0	Enable or disable the tunnel escape mode (default = DISABLE)	ENUM	4	H
		ENABLE	1				
3	length	0 to 8		Specifies the number of hex bytes to follow	ULONG	4	H+4
4	esc seq			Escape sequence where Hex pairs are entered without spaces, for example, AA4412	Uchar[8]	8	H+8

2.5.117 UNASSIGN Unassigns a previously assigned channel

This command cancels a previously issued ASSIGN command (*page 69*) and the SV channel reverts to automatic control (the same as ASSIGN AUTO).

Abbreviated ASCII Syntax: **Message ID: 29**

UNASSIGN channel

Input Example:

unassign 11

Issuing the UNASSIGN command to a channel that was not previously assigned by the ASSIGN command will have no effect.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNASSIGN header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	channel	0 to *n*, where *n* is the number of the last channel in the current channel configuration		Reset SV channel to automatic search and acquisition mode	ULong	4	H
3	state	*These return SV channel control to the automatic search engine immediately (see Table 12, Page 69)*		Set the SV channel state (currently ignored)	Enum	4	H+4

2.5.118 UNASSIGNALL Unassigns all previously assigned channels

This command cancels all previously issued ASSIGN commands (*page 69*) for all SV channels (same as ASSIGNALL AUTO). Tracking and control for each SV channel reverts to automatic mode. See ASSIGN AUTO for more details.

Abbreviated ASCII Syntax: **Message ID: 30**

UNASSIGNALL [system]

Input Example:

unassignall gps

Issuing the UNASSIGNALL command has no effect on channels that were not previously assigned using the ASSIGN command.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNASSIGNALL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	system	*[system][state][prn [Doppler [Doppler window]]]* See Table 13, Page 72		System that the SV channel is tracking (default=ALL)	Enum	4	H

2.5.119 UNDULATION Chooses undulation

This command permits you to either enter a specific geoidal undulation value. In the *option* field, the EGM96 table provides ellipsoid heights at a 0.25° by 0.25° spacing while the OSU89B is implemented at a 2° by 3° spacing. In areas of rapidly changing elevation, you could be operating somewhere within the 2° by 3° grid with an erroneous height. EGM96 provides a more accurate model of the ellipsoid which results in a denser grid of heights. It is also more accurate because the accuracy of the grid points themselves has also improved from OSU89B to EGM96. For example, the default grid (EGM96) is useful where there are underwater canyons, steep drop-offs or mountains.

The undulation values reported in the BESTPOS, BESTUTM, MARKPOS, MATCHEDPOS, OMNIHPPOS, PSRPOS and RTKPOS logs are in reference to the ellipsoid of the chosen datum.

Abbreviated ASCII Syntax: **Message ID: 214**

UNDULATION option [separation]

Factory Default:

undulation egm96

ASCII Example 1:

undulation osu89b

ASCII Example 2:

undulation user -5.599999905

Refer to the application note titled *Geoid Issue*, available on our website at http://www.novatel.com/support/applicationnotes.htm, for a description of the relationships in *Figure 9*.

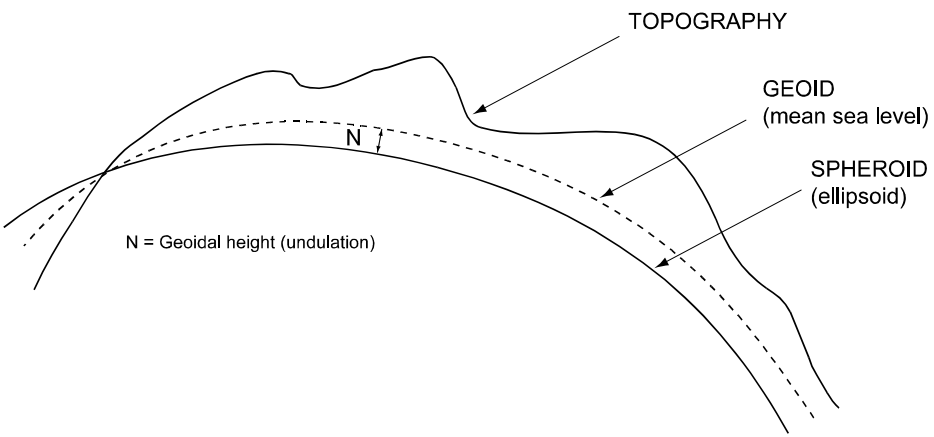


Figure 9: Illustration of Undulation

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNDULATION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	option	USER	1	Use the user specified undulation value	Enum	4	H
		OSU89B	2	Use the OSU89B undulation table			
		EGM96	3	Use global geoidal height model EGM96 table (default)			
3	separation	± 1000.0 m		The undulation value (required for the USER option)	Float	4	H+4

2.5.120 UNLOCKOUT Reinstates a satellite in the solution

This command allows a satellite which has been previously locked out (LOCKOUT command, *page 155*) 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.

Abbreviated ASCII Syntax: **Message ID: 138**

UNLOCKOUT prn

Input Example:

unlockout 8

The UNLOCKOUT command allows you to reinstate a satellite while leaving other locked out satellites unchanged.

This command cannot be used with Galileo PRNs.

s

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNLOCKOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	prn	GPS: 1-32 SBAS: 120-138, 183-187 GLONASS: see *1.3 GLONASS Slot and Frequency Numbers* on *page 31* QZSS 193-197		A single satellite PRN number to be reinstated	Ulong	4	H

2.5.121 UNLOCKOUTALL Reinstates all previously locked out satellites

This command allows all satellites which have been previously locked out (LOCKOUT (*page 155*) or LOCKOUTSTYSTEM (*page 156*) commands) to be reinstated in the solution computation.

Abbreviated ASCII Syntax: **Message ID: 139**

UNLOCKOUTALL

Input Example:

unlockoutall

2.5.122 UNLOCKOUTSYSTEM Reinstates previously locked out system

This command allows a system which has been previously locked out (refer to the LOCKOUTSYSTEM command, *page 156*) to be reinstated in the solution computation.

> If more than one system is to be reinstated, this command must be reissued for each system reinstatement.

Abbreviated ASCII Syntax: **Message ID: 908**

UNLOCKOUTSYSTEM system

Input Example:

unlockoutsystem glonass

> The UNLOCKOUTSYSTEM command allows you to reinstate a system while leaving other locked out systems unchanged.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNLOCKOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	system	See Table 29, Page 156		A single satellite system to be reinstated	Enum	4	H

2.5.123 UNLOG Removes a log from logging control

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

The [*port*] parameter is optional. If [*port*] is not specified, it is defaulted to the port on which the command was received. This feature eliminates the need for you to know which port you are communicating on if you want logs to be removed on the same port as this command.

Abbreviated ASCII Syntax: **Message ID: 36**

UNLOG [port] message

Input Example:

unlog com1 bestposa

unlog bestposa

The UNLOG command allows you to remove one or more logs while leaving other logs unchanged.

Field	Field Name	Binary Value	Description	Field Type	Binary Bytes	Binary Offset
1	UNLOG (binary) header	(See *Table 4, Page 24*)	This field contains the message header	-	H	0
2	port	See Table 5, Page 26 (decimal values greater than 16 may be used)	Port to which log is being sent (default = THISPORT)	Enum	4	H
3	message	Any valid message ID	Message ID of log to output	UShort	2	H+4
4	message type	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response Bit (*1.2 Responses* on *page 29*) 0 = Original Message 1 = Response Message	Message type of log	Char	1	H+6
5	Reserved			Char	1	H+7

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNLOG (ASCII) header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See Table 5, Page 26 (decimal values greater than 16 may be used)		Port to which log is being sent (default = THISPORT)	Enum	4	H
3	message	Message Name	N/A	Message Name of log to be disabled	Ulong	4	H+4

2.5.124 UNLOGALL Removes all logs from logging control

If [*port*] is specified this command disables all logs on the specified port only. All other ports are unaffected. If [*port*] is not specified this command defaults to the ALL_PORTS setting.

Abbreviated ASCII Syntax: **Message ID: 38**

UNLOGALL [port] [held]

Input Example:

unlogall com2_15

The UNLOGALL command allows you to remove all log requests currently in use.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNLOGALL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See Table 5, Page 26 (decimal values greater than 16 may be used)		Port to clear (default = ALL_PORTS)	Enum	4	H
3	held	FALSE	0	Does not remove logs with the HOLD parameter (default)	Enum	4	H+4
		TRUE	1	Removes previously held logs, even those with the HOLD parameter			

2.5.125 USERDATUM Sets user customized datum

This command permits entry of customized ellipsoidal datum parameters. This command is used in conjunction with the DATUM command, see *page 95*. If used, the command default setting for USERDATUM is WGS84.

When the USERDATUM command is entered, the USEREXPDATUM command, see *page 263*, is then issued internally with the USERDATUM command values. It is the USEREXPDATUM command that appears in the RXCONFIG log. If the USEREXPDATUM or the USERDATUM command are used, their newest values overwrite the internal USEREXPDATUM values.

The transformation for the WGS84 to Local used in the OEM6 family is the Bursa-Wolf transformation or reverse Helmert transformation. In the Helmert transformation, the rotation of a point is counter clockwise around the axes. In the Bursa-Wolf transformation, the rotation of a point is clockwise. Therefore, the reverse Helmert transformation is the same as the Bursa-Wolf.

Abbreviated ASCII Syntax: **Message ID: 78**

USERDATUM semimajor flattening dx dy dz rx ry rz scale

Factory Default:

userdatum 6378137.0 298.2572235628 0.0 0.0 0.0 0.0 0.0 0.0 0.0

ASCII Example:

userdatum 6378206.400 294.97869820000 -12.0000 147.0000 192.0000 0.0000 0.0000 0.0000 0.000000000

You can use the USERDATUM command in a survey to fix the position with values from another known datum so that the GNSS calculated positions are reported in the known datum rather than WGS84.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	USERDATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	semimajor	6300000.0 - 6400000.0 m		Datum Semi-major Axis (a) in metres	Double	8	H
3	flattening	290.0 - 305.0		Reciprocal Flattening, 1/f = a/(a-b)	Double	8	H+8
4	dx	± 2000.0		Datum offsets from local to WGS84. These are the translation values between the user datum and WGS84 (internal reference)	Double	8	H+16
5	dy	± 2000.0			Double	8	H+24
6	dz	± 2000.0			Double	8	H+32
7	rx	± 10.0 radians		Datum rotation angle about X, Y and Z. These values are the rotation from your local datum to WGS84. A positive sign is for counter clockwise rotation and a negative sign is for clockwise rotation	Double	8	H+40
8	ry	± 10.0 radians			Double	8	H+48
9	rz	± 10.0 radians			Double	8	H+56
10	scale	± 10.0 ppm		Scale value is the difference in ppm between the user datum and WGS84	Double	8	H+64

2.5.126 USEREXPDATUM Sets custom expanded datum

Like the USERDATUM command, this command allows you to enter customized ellipsoidal datum parameters. However, USEREXPDATUM literally means user expanded datum allowing you to enter additional datum information such as velocity offsets and time constraints. The 7 expanded parameters are rates of change of the initial 7 parameters. These rates of change affect the initial 7 parameters over time relative to the Reference Date provided by the user.

This command is used in conjunction with the DATUM command, see *page 95*. If you use this command without specifying any parameters, the command defaults to WGS84. If you enter a USERDATUM command, see *page 261*, the USEREXPDATUM command is then issued internally with the USERDATUM command values. It is the USEREXPDATUM command that appears in the RXCONFIG log. If the USEREXPDATUM or the USERDATUM command are used, their newest values overwrite the internal USEREXPDATUM values.

Abbreviated ASCII Syntax: **Message ID: 783**

USEREXPDATUM semimajor flattening dx dy dz rx ry rz scale xvel yvel zvel xrvel yrvel zrvel scalev refdate

Factory Default:

userexpdatum 6378137.0 298.25722356280 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

ASCII Example:

```
USEREXPDATUM 6378137.000 298.25722356280 0.000000000
0.000000000 0.000000000 0.00000000 0.000000000 0.000000000
0.000000000 0.000000000 0.000000000 0.000000000 0.0000
0.000000000 0.000000000 0.000000000 0.000000000
```

You can use the USEREXPDATUM command in a survey to fix the position with values from another known datum so that the GPS calculated positions are reported in the known datum rather than WGS84. For example, it is useful for places like Australia, where the continent is moving several centimetres a year relative to WGS84. With USEREXPDATUM you can also input the velocity of the movement to account for drift over the years.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	USEREXPDATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	semimajor	6300000.0 - 6400000.0 m		Datum semi-major axis (a) in metres	Double	8	H
3	flattening	290.0 - 305.0		Reciprocal Flattening, 1/f = a/(a-b)	Double	8	H+8
4	dx	± 2000.0 m		Datum offsets from local to WGS84. These are the translation values between the user datum and WGS84 (internal reference)	Double	8	H+16
5	dy	± 2000.0 m			Double	8	H+24
6	dz	± 2000.0 m			Double	8	H+32
7	rx	± 10.0 radians		Datum rotation angle about X, Y and Z. These values are the rotation from your local datum to WGS84. A positive sign is for counter clockwise rotation and a negative sign is for clockwise rotation	Double	8	H+40
8	ry	± 10.0 radians			Double	8	H+48
9	rz	± 10.0 radians			Double	8	H+56
10	scale	± 10.0 ppm		Scale value is the difference in ppm between the user datum and WGS84	Double	8	H+64
11	xvel	± 2000.0 m/yr		Velocity vector along X-axis	Double	8	H+72
12	yvel	± 2000.0 m/yr		Velocity vector along Y-axis	Double	8	H+80
13	zvel	± 2000.0 m/yr		Velocity vector along Z-axis	Double	8	H+88
14	xrvel	± 10.0 radians/yr		Change in the rotation about X over time	Double	8	H+96
15	yrvel	± 10.0 radians/yr		Change in the rotation about Y over time	Double	8	H+104
16	zrvel	± 10.0 radians/yr		Change in the rotation about Z over time	Double	8	H+112
17	scalev	± 10.0 ppm/yr		Change in scale from WGS84 over time	Double	8	H+120
18	refdate	0.0 year		Reference date of parameters Example: 2011.00 = Jan 1, 2011 2011.19 = Mar 11, 2011	Double	8	H+128

2.5.127 UTMZONE Sets UTM parameters

This command sets the UTM persistence, zone number or meridian. Please refer to http://earth-info.nga.mil/GandG/coordsys/grids/referencesys.html for more information and a world map of UTM zone numbers.

1. The latitude limits of the UTM System are 80°S to 84°N, so if your position is outside this range, the BESTUTM log outputs a northing, easting and height of 0.0, along with a zone letter of "*" and a zone number of 0, so that it is obvious that the data in the log is dummy data.
2. If the latitude band is X, then the Zone number should not be set to 32, 34 or 36. These zones were incorporated into other zone numbers and do not exist.

Abbreviated ASCII Syntax: **Message ID: 749**

UTMZONE command [parameter]

Factory Default:

utmzone auto 0

ASCII Example 1:

utmzone set 10

ASCII Example 2:

utmzone current

The UTM grid system is displayed on all National Topographic Series (NTS) of Canada maps and United States Geological Survey (USGS) maps. On USGS 7.5-minute quadrangle maps (1:24,000 scale), 15-minute quadrangle maps (1:50,000, 1:62,500, and standard-edition 1:63,360 scales) and Canadian 1:50,000 maps the UTM grid lines are drawn at intervals of 1,000 metres and are shown either with blue ticks at the edge of the map or by full blue grid lines. On USGS maps at 1:100,000 and 1:250,000 scale and Canadian 1:250,000 scale maps a full UTM grid is shown at intervals of 10,000 metres.

Table 50: UTM Zone Commands

Binary	ASCII	Description
0	AUTO	UTM zone default that automatically sets the central meridian and does not switch zones until it overlaps by the set persistence. This a spherical approximation to the earth unless you are at the equator (default = 0) (m)
1	CURRENT	Same as UTMZONE AUTO with infinite persistence of the current zone. The parameter field is not used
2	SET	Sets the central meridian based on the specified UTM zone. A zone includes its western boundary, but not its eastern boundary, Meridian. For example, zone 12 includes (108°W, 114°W) where 108° < longitude ≤ 114°
3	MERIDIAN	Sets the central meridian as specified in the parameter field. In BESTUTM, the zone number is output as 61 to indicate the manual setting (zones are set by pre-defined central meridians not user-set ones)

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UTMZONE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	command	See *Table 50, Page 266*			Enum	4	H
3	parameter				Enum	4	H+4

Chapter 3 Data Logs

3.1 Log Types

See the LOG command on *page 157*, for details about requesting logs.

The receiver is capable of generating three type of logs: synchronous, asynchronous and polled. The data for synchronous logs is generated on a regular schedule. In order to output the most current data as soon as it is available, asynchronous data is generated at irregular intervals. The data in polled logs is generated on demand. The following table outlines the log types and the valid triggers to use:

Table 51: Log Type Triggers

Type	Recommended Trigger	Illegal Trigger
Synch	ONTIME	ONNEW, ONCHANGED
Asynch	ONCHANGED or ONCE	-
Polled	ONCE or ONTIME [a]	ONNEW, ONCHANGED

a. Polled log types do not allow fractional offsets and cannot do ontime rates faster than 1 Hz.

See *Section 1.5, Message Time Stamps* on *page 34* for information about how the message time stamp is set for each type of log.

1. The OEM6 family of receivers can handle 64 logs at a time. If you attempt to log more than 64 logs at a time, the receiver responds with an Insufficient Resources error.
2. The following logs do not support the ONNEXT trigger: GPSEPHEM, RAWEPHEM, RAWGPSSUBFRAME, RAWSBASFRAME, RXSTATUSEVENT and SBAS9.
3. Asynchronous logs, such as MATCHEDPOS, should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may result in inaccurate time tags.
4. Use the ONNEW trigger with the MARKTIME or MARKPOS logs.
5. Before the output of fields for ASCII and binary logs, there is an ASCII or binary header respectively. See also *Table 3, ASCII Message Header Structure* on *page 22* and *Table 4, Binary Message Header Structure* on *page 24*. There is no header information before Abbreviated ASCII output, see *page 23*.

3.1.1 Log Type Examples

For polled logs, the receiver only supports an offset that is:

- smaller than the logging period
- an integer

The following are valid examples for a polled log:

```
log comconfig ontime 2 1
log portstats ontime 4 2
log version once
```

For polled logs, the following examples are invalid:

```
log comconfig ontime 1 2      [offset is larger than the logging period]
log comconfig ontime 4 1.5    [offset is not an integer]
```

For synchronous and asynchronous logs, the receiver supports any offset that is:

- smaller than the logging period
- a multiple of the minimum logging period

For example, if the receiver supports 20 Hz logging, the minimum logging period is 1/20 Hz or 0.05 s. The following are valid examples for a synchronous or asynchronous log, on a receiver that can log at rates up to 20 Hz:

```
log bestpos ontime 1                [1 Hz]
log bestpos ontime 1 0.1
log bestpos ontime 1 0.90
log avepos ontime 1 0.95
log avepos ontime 2                 [0.5 Hz]
log avepos ontime 2 1.35
log avepos ontime 2 1.75
```

For synchronous and asynchronous logs, the following examples are invalid:

```
log bestpos ontime 1 0.08   [offset is not a multiple of the minimum logging period]
log bestpos ontime 1 1.05   [offset is larger than the logging period]
```

3.2 Logs by Function

Table 52: OEM6 Logs By Function

LOGS	DESCRIPTIONS	TYPE
GENERAL RECEIVER CONTROL AND STATUS		
AUTHCODES	Contains all authorization codes (auth codes) entered into the system since the last complete firmware reload	Polled
APPLICATIONSTATUS	Provides application status information	Asynch
ETHSTATUS	Current Ethernet status	Asynch
HWMONITOR	Monitor hardware levels	Polled
IPSTATUS	Current network configuration status	Asynch
LOGLIST	List of system logs	Polled
PASSCOMx, PASSXCOMx, PASSICOMx, PASSNCOMx, PASSUSBx where x can be 1 or 2 or 3; PASSAUX, PASSETH1	Pass-through log that redirects data from one port to another port	Asynch
PASSTHROUGH	Outputs pass-through data from all receiver ports	Asynch
PORTSTATS	Displays port statistics	Polled
PROFILEINFO	Outputs a list of profiles	Polled
RTCAOBS3	Proprietary message that carries dual-frequency GPS and GLO measurements and is used in ALIGN. Also carries SBAS measurements if the Master receiver is single-frequency (L1-only) receiver to enable SBAS-ALIGN at the L1-only ALIGN Rover	Synch
RXCONFIG	Receiver configuration status	Polled
RXSTATUS	Self-test status	Asynch
RXSTATUSEVENT	Status event indicator	Asynch
SOURCETABLE	Outputs the NTRIP source table entries from the NTRIPCASTER set by the NTRIPSOURCETABLE command	Synch
VALIDMODELS	Model and expiry date information for receiver	Asynch
VERSION	Receiver hardware and software version numbers	Polled
POSITION, PARAMETERS AND SOLUTION FILTERING CONTROL		
ALIGNDOP	Outputs the DOP computed using the satellites used in solution	Asynch
ALIGNBSLNXYZ	Outputs the RTK quality XYZ baselines from ALIGN.	Asynch
ALIGNBSLNENU	Outputs the RTK quality ENU baselines from ALIGN. The XYZ baselines (output in ALIGNBSLNXYZ log) are rotated relative to master position (output in MASTERPOS) to compute ENU baselines	Asynch
AVEPOS	Position averaging log	Asynch

LOGS	DESCRIPTIONS	TYPE
POSITION, PARAMETERS AND SOLUTION FILTERING CONTROL		
BESTPOS [a]	Best position data	Synch
BESTUTM	Best available UTM data	Synch
BESTXYZ	Cartesian coordinates position data	Synch
BSLNXYZ	RTK XYZ baseline	Synch
DIFFCODEBIASES	Differential code biases being applied	Polled
GALIONO	Decoded Galileo ionospheric corrections	Asynch
GPGGA	NMEA, fix and position data	Synch
GPGGARTK	NMEA, global position system fix data	Synch
GPGLL	NMEA, position data	Synch
GPGRS	NMEA, range residuals	Synch
GPGSA	NMEA, DOP information	Synch
GPGST	NMEA, measurement noise statistics	Synch
GPHDT	NMEA, heading from True North	Asynch
HEADING	Heading information with the ALIGN feature	Asynch
HEADING2	Outputs same information as HEADING log with an additional Rover ID field	Asynch
HEADINGSATS	Outputs the satellite information from ALIGN filter	Asynch
IONUTC	Ionospheric and UTC model information	Asynch
MARKPOS, MARK2POS	Position at time of mark input event	Asynch
MARKTIME, MARK2TIME	Time of mark input event	Asynch
MASTERPOS	Displays the master position with the ALIGN feature	Asynch
MATCHEDPOS [a]	Computed position	Asynch
MATCHEDXYZ	Cartesian coordinates computed position data	Asynch
OMNIHPPOS	OmniSTAR HP/XP position data	Synch
PSRDOP	DOP of SVs currently tracking	Asynch
RAIMSTATUS	RAIM status	Synch
ROVERPOS	Displays the rover position with the ALIGN feature	Asynch
RTKDOP	Values from the RTK fast filter	Synch
RTKDOP2	Values from the RTK fast filter	Synch
RTKPOS [a]	RTK low latency position	Synch
RTKVEL [b]	RTK velocity	Synch
RTKVEL2 [b]	RTK velocity	Synch
RTKXYZ	RTK Cartesian coordinate position	Synch

a. The RTK system in the receiver provides two kinds of position solutions. The Matched RTK position is computed with buffered observations, so there is no error due to the extrapolation of base station measurements. This provides the highest accuracy solution possible at the expense of some latency which is affected primarily by the speed of the differential data link. The MATCHEDPOS log contains the matched RTK solution and can be generated for each processed set of base station observations.

   The Low-Latency RTK position is computed from the latest local observations and extrapolated base station observations. This supplies a valid RTK position with the lowest latency possible at the expense of some accuracy. The degradation in accuracy is reflected in the standard deviation and is summarized in our *An Introduction to GNSS* book, available through our website at www.novatel.com through *Support* | *Knowledge and Learning* > *Learn About GNSS* > *GNSS Book*. The amount of time that the base station observations are extrapolated is in the "differential age" field of the position log. The Low-Latency RTK system extrapolates for 60 seconds. The RTKPOS log contains the Low-Latency RTK position when valid, and an "invalid" status when a Low-Latency RTK solution could not be computed. The BESTPOS log contains either the low-latency RTK, OmniSTAR HP, XP or pseudorange-based position, whichever has the smallest standard deviation.

b. The RTK velocity is computed from successive Low-Latency RTK position solutions. The RTKVEL log contains the RTK velocity, when valid and outputs an 'invalid' status if a Low-Latency RTK velocity solution cannot be computed. The BESTVEL log contains the Low-Latency RTK velocity when the BESTPOS log contains the Low-Latency RTK position.

   In a BESTVEL, PSRVEL or RTKVEL log, the actual speed and direction of the receiver antenna over ground is provided. The receiver does not determine the direction a vessel, craft or vehicle is pointed (heading) but rather the direction of motion of the GNSS antenna relative to ground.

LOG	DESCRIPTION	TYPE
WAYPOINT NAVIGATION		
BESTPOS	Best position data	Synch
BESTVEL[a]	Velocity data	Synch
GPHDT	NMEA, heading from True North	Asynch
GPRMB	NMEA, waypoint status	Synch
GPRMC	NMEA, navigation information	Synch
GPVTG	NMEA, track made good and speed	Synch
NAVIGATE	Navigation waypoint status	Synch
OMNIHPPOS	OmniSTAR HPXP position data	Synch
PSRPOS	Pseudorange position	Synch
PSRVEL[a]	Pseudorange velocity	Synch
PSRXYZ	Pseudorange Cartesian coordinate position	Synch

a. In a BESTVEL, PSRVEL or RTKVEL log, the actual speed and direction of the receiver antenna over ground is provided. The receiver does not determine the direction a vessel, craft or vehicle is pointed (heading) but rather the direction of motion of the GNSS antenna relative to ground.

CLOCK INFORMATION, STATUS, AND TIME		
CLOCKMODEL	Range bias information	Synch
CLOCKSTEERING	Clock steering status	Asynch
GALCLOCK	Galileo time information	Asynch
GLOCLOCK	GLONASS clock information	Asynch
GPZDA	NMEA, UTC time and data	Synch
PSRTIME	Time offsets from the pseudorange filter	Synch
TIME	Receiver time information	Synch
TIMESYNC	Synchronize time between receivers	Synch
POST PROCESSING DATA		
GPSEPHEM	Decoded GPS ephemeris information	Asynch
IONUTC	Ionospheric and UTC model information	Asynch
RANGE	Satellite range information	Synch
RANGECMP	Compressed version of the RANGE log	Synch
RANGECMP2	RANGE data compressed to handle more channels and types	Synch
RANGEGPSL1	L1 version of the RANGE log	Synch
RAWEPHEM	Raw ephemeris	Asynch
TIME	Receiver clock offset information	Synch

LOG	DESCRIPTION	TYPE
SATELLITE TRACKING AND CHANNEL CONTROL		
ALMANAC	Current decoded almanac data	Asynch
BESTSATS	Satellites used in BESTPOS	Synch
CHANCONFIGLIST	Channel configuration list	Polled
GALALMANAC	Decoded Galileo almanac parameters from Galileo navigation messages	Asynch
GALEPHEMERIS	Galileo ephemeris information is available through the GALEPHEMERIS log	Asynch
GALFNAVRAWPAGE	Contains the raw Galileo F/Nav page data	Asynch
GALINAVRAWWORD	Contains the raw Galileo I/Nav word data	Asynch
GLMLA	NMEA GLONASS almanac data	Asynch
GLOALMANAC	GLONASS almanac data	Asynch
GLOEPHEMERIS	GLONASS ephemeris data	Asynch
GLORAWALM	Raw GLONASS almanac data	Asynch
GLORAWEPHEM	Raw GLONASS ephemeris data	Asynch

LOG	DESCRIPTION	TYPE
SATELLITE TRACKING AND CHANNEL CONTROL		
GLORAWFRAME	Raw GLONASS frame data	Asynch
GLORAWSTRING	Raw GLONASS string data	Asynch
GPALM	NMEA, almanac data	Asynch
GPGSA	NMEA, SV DOP information	Synch
GPGSV	NMEA, satellite-in-view information	Synch
GPSEPHEM	Decoded GPS ephemeris information	Asynch
MATCHEDSATS	Lists the used and unused satellites for the corresponding MATCHEDPOS solution	Asynch
OMNIHPSATS	Satellites used in the OMNIHPPOS solution	Synch
OMNIVIS	OmniSTAR satellite visibility list	Synch
QZSSALMANAC	Contains the decoded almanac parameters as received from the satellite with the parity information removed and appropriate scaling applied	Asynch
QZSSIONUTC	Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) for QZSS are provided	Asynch
QZSSRAWEPHEM	Contains the raw binary information for subframes one, two and three from the satellite with the parity information removed	Asynch
QZSSEPHEMERIS	Single set of QZSS ephemeris parameters	Asynch
QZSSRAWALMANAC	Contains the undecoded almanac subframes as received from the QZSS satellite	Asynch
QZSSRAWSUBFRAME	A raw QZSS subframe is 300 bits in total, includes the parity bits which are interspersed with the raw data ten times, in six bit chunks, for a total of 60 parity bits	Asynch
PDPSATS	Satellites used in PDPPOS solution	Synch
PSRDOP	DOP of SVs currently tracking	Asynch
PSRDOP2	Pseudorange Least Squares DOP	Asynch
RANGE	Satellite range information	Synch
RANGEGPSL1	L1 version of the RANGE log	Synch
RAWALM	Raw almanac	Asynch
RAWCNAVFRAME	Raw L2C frame data	Asynch
RAWEPHEM	Raw ephemeris	Asynch
RAWGPSSUBFRAME	Raw subframe data	Asynch
RAWGPSWORD	Raw navigation word	Asynch
RAWSBASFRAME	Raw SBAS frame data	Asynch
RTKSATS	Satellites used in RTKPOS solution	Synch

LOG	DESCRIPTION	TYPE
SATELLITE TRACKING AND CHANNEL CONTROL		
SATVIS	Satellite visibility	Synch
SATVIS2	Satellite visibility	Asynch
SATXYZ2	Combined with a RANGE log, contains the decoded satellite information necessary to compute the solution	Synch
SBAS0	Removes PRN from the solution	Asynch
SBAS1	PRN mask assignments	Asynch
SBAS2	Fast correction slots 0-12	Asynch
SBAS3	Fast correction slots 13-25	Asynch
SBAS4	Fast correction slots 26-38	Asynch
SBAS5	Fast correction slots 39-50	Asynch
SBAS6	Integrity message	Asynch
SBAS7	Fast correction degradation	Asynch
SBAS9	GEO navigation message	Asynch
SBAS10	Degradation factor	Asynch
SBAS12	SBAS network time and UTC	Asynch
SBAS17	GEO almanac message	Asynch
SBAS18	IGP mask	Asynch
SBAS24	Mixed fast/slow corrections	Asynch
SBAS25	Long-term slow satellite corrections	Asynch
SBAS26	Ionospheric delay corrections	Asynch
SBAS27	SBAS service message	Asynch
SBAS32	Fast correction slots 0-10	Asynch
SBAS33	Fast correction slots 11-21	Asynch
SBAS34	Fast correction slots 22-32	Asynch
SBAS35	Fast correction slots 39-50	Asynch
SBAS45	Slow corrections	Asynch
SBASALMANAC	A collection of all current SBAS almanacs decoded by the receiver	Asynch
SBASCORR	SBAS range corrections used	Synch
SOFTLOADSTATUS	Status of the soft load process	Asynch
TRACKSTAT	Satellite tracking status	Synch

DIFFERENTIAL BASE STATION		
ALMANAC	Current almanac information	Asynch
BESTPOS	Best position data	Synch
BESTVEL	Velocity data	Synch
BSLNXYZ	RTK XYZ baseline	Asynch
GPGGA	NMEA, position fix data	Synch
GPGGARTK	NMEA, global position system fix data	Synch
LBANDINFO	L-band configuration information	Asynch
LBANDSTAT	L-band status information	Asynch
MATCHEDPOS	Computed position – Time Matched	Asynch
OMNIHPPOS	OmniSTAR HP/XP position data	Synch
PSRPOS	Pseudorange position	Synch
PSRVEL	Pseudorange velocity	Synch
RANGE	Satellite range information	Synch
RANGECMP	Compressed version of the RANGE log	Synch
RAWLBANDFRAME	Raw L-band frame data	Asynch
RAWLBANDPACKET	Raw L-band data packet	Asynch
REFSTATION	Base station position and health	Asynch
REFSTATIONINFO	Reference station position and health	Asynch
RTCAOBS	Type 7 Base Station observations	Synch
RTCAOBS2	Type 7 Base Station observations 2	Synch
RTCAREF	Type 7 Base Station parameters	Synch
RTKPOS	RTK low latency position	Synch

RTCA, RTCM, RTCMV3 or CMR data logs, for example RTCM1001.

Table 53: OEM6 Logs in Alphabetical Order

DATA TYPE	MESSAGE ID	DESCRIPTION
ALIGNBSLNENU	1315	Outputs the RTK quality ENU baselines from ALIGN
ALIGNBSLNXYZ	1314	Outputs the RTK quality XYZ baselines from ALIGN
ALIGNDOP	1332	Outputs the DOP computed using the satellites used in solution
ALMANAC	73	Current almanac information
APPLICATIONSTATUS	520	Provides application status information
AUTHCODES	1348	Contains all authorization codes (auth codes) entered into the system since the last complete firmware reload
AVEPOS	172	Position averaging

Table 53: OEM6 Logs in Alphabetical Order

DATA TYPE	MESSAGE ID	DESCRIPTION
BESTPOS	42	Best position data
BESTSATS	1194	Satellites used in BESTPOS
BESTUTM	726	Best available UTM data
BESTVEL	99	Velocity data
BESTXYZ	241	Cartesian coordinate position data
BSLNXYZ	686	RTK XYZ baseline
CHANCONFIGLIST	1148	Channel configuration list
CLOCKMODEL	16	Current clock model matrices
CLOCKSTEERING	26	Clock steering status
DIFFCODEBIASES	914	Differential code biases being applied
ETHSTATUS	1288	Current Ethernet status
GALALMANAC	1120	Decoded Galileo almanac parameters from Galileo navigation messages
GALCLOCK	1121	Galileo time information
GALEPHEMERIS	1122	Galileo ephemeris information is available through the GALEPHEMERIS log
GALFNAVRAWPAGE	1413	Contains the raw Galileo F/Nav page data
GALINAVRAWWORD	1414	Contains the raw Galileo I/Nav word data
GALIONO	1127	Decoded Galileo ionospheric corrections
GLOALMANAC	718	GLONASS almanac data
GLOCLOCK	719	GLONASS clock information
GLOEPHEMERIS	723	GLONASS ephemeris data
GLORAWALM	720	Raw GLONASS almanac data
GLORAWEPHEM	792	Raw GLONASS ephemeris data
GLORAWFRAME	721	Raw GLONASS frame data
GLORAWSTRING	722	Raw GLONASS string data
GPSEPHEM	7	GPS ephemeris data
HEADING	971	Heading information with the ALIGN feature
HEADING2	1335	Outputs same information as HEADING log with an additional Rover ID field
HEADINGSATS	1316	Outputs the satellite information from ALIGN filter
HWMONITOR	963	Monitor hardware levels
IONUTC	8	Ionospheric and UTC model information
IPSTATUS	1289	Current network configuration status
LBANDINFO	730	L-band configuration information

Table 53: OEM6 Logs in Alphabetical Order

DATA TYPE	MESSAGE ID	DESCRIPTION
LBANDSTAT	731	L-band status information
LOGLIST	5	A list of system logs
MARKPOS, MARK2POS	181, 615	Position at time of mark input event
MARKTIME, MARK2TIME	231, 616	Time of mark input event
MASTERPOS	1051	Displays master position with the ALIGN feature
MATCHEDPOS	96	RTK Computed Position – Time Matched
MATCHEDSATS	1176	Lists the used and unused satellites for the corresponding MATCHEDPOS solution
MATCHEDXYZ	242	RTK Time Matched cartesian coordinate position data
NAVIGATE	161	Navigation waypoint status
OMNIHPPOS	495	OmniSTAR HP/XP position data
OMNIHPSATS	1197	Satellites used in the OMNIHPPOS solution
OMNIVIS	860	OmniSTAR satellite visibility list
PASSAUX, PASSCOM1, PASSCOM2, PASSCOM3, PASSETH1, PASSICOM1, PASSICOM2, PASSICOM3, PASSNCOM1, PASSNCOM2, PASSNCOM3, PASSUSB1, PASSUSB2, PASSUSB3, PASSXCOM1, PASSXCOM2, PASSXCOM3	690, 233, 234, 235, 1209, 1250, 1251, 1252, 1253, 1254, 1255, 607, 608, 609, 405, 406, 795	Pass-through logs
PASSTHROUGH	1342	Outputs pass-through data from all receiver ports
PDPPOS	469	PDP filter position
PDPSATS	1234	Satellites used in PDPPOS solution
PDPVEL	470	PDP filter velocity
PDPXYZ	471	PDP filter Cartesian position and velocity
PORTSTATS	72	COM or USB port statistics
PROFILEINFO	1412	Outputs a list of profiles
PSRDOP	174	DOP of SVs currently tracking
PSRDOP2	1163	Pseudorange Least Squares DOP
PSRPOS	47	Pseudorange position information
PSRTIME	881	Time offsets from the pseudorange filter
PSRVEL	100	Pseudorange velocity information

Table 53: OEM6 Logs in Alphabetical Order

DATA TYPE	MESSAGE ID	DESCRIPTION
PSRXYZ	243	Pseudorange Cartesian coordinate position information
QZSSALMANAC	1346	Contains the decoded almanac parameters as received from the satellite with the parity information removed and appropriate scaling applied
QZSSEPHEMERIS	1336	Single set of QZSS ephemeris parameters
QZSSIONUTC	1347	Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) for QZSS are provided
QZSSRAWALMANAC	1345	Contains the undecoded almanac subframes as received from the QZSS satellite
QZSSRAWEPHEM	1330	Contains the raw binary information for subframes one, two and three from the satellite with the parity information removed
QZSSRAWSUBFRAME	1331	A raw QZSS subframe is 300 bits in total, includes the parity bits which are interspersed with the raw data ten times, in six bit chunks, for a total of 60 parity bits
RAIMSTATUS	1286	RAIM status
RANGE	43	Satellite range information
RANGECMP	140	Compressed version of the RANGE log
RANGECMP2	1273	RANGE data compressed to handle more channels and types
RANGEGPSL1	631	L1 version of the RANGE log
RAWALM	74	Raw almanac
RAWCNAVFRAME	1066	Raw L2C frame data
RAWEPHEM	41	Raw ephemeris
RAWGPSSUBFRAME	25	Raw subframe data
RAWGPSWORD	407	Raw navigation word
RAWLBANDFRAME	732	Raw L-band frame data
RAWLBANDPACKET	733	Raw L-band data packet
RAWSBASFRAME	287	Raw SBAS frame data
REFSTATION	175	Base station position and health
REFSTATIONINFO	1325	Reference station position and health information
ROVERPOS	1052	Displays over position with the ALIGN feature
RTCAOBS3	1340	A NovAtel proprietary message that carries dual-frequency GPS and GLO measurements and is used in ALIGN. Also carries SBAS measurements if the Master receiver is single-frequency (L1-only) receiver to enable SBAS-ALIGN at the L1-only ALIGN Rover
RTKDOP	952	Values from the RTK fast filter

Table 53: OEM6 Logs in Alphabetical Order

DATA TYPE	MESSAGE ID	DESCRIPTION
RTKDOP2	1172	Values from the RTK fast filter
RTKPOS	141	RTK low latency position data
RTKSATS	1174	Satellites used in RTKPOS solution
RTKVEL	216	RTK velocity
RTKXYZ	244	RTK Cartesian coordinate position data
RXCONFIG	128	Receiver configuration status
RXSTATUS	93	Self-test status
RXSTATUSEVENT	94	Status event indicator
SATVIS	48	Satellite visibility
SATVIS2	1043	Satellite visibility
SATXYZ2	1451	Combined with a RANGE log, this data set contains the decoded satellite information necessary to compute the solution
SBAS0	976	Remove PRN from the solution
SBAS1	977	PRN mask assignments
SBAS2	982	Fast correction slots 0-12
SBAS3	987	Fast correction slots 13-25
SBAS4	992	Fast correction slots 26-38
SBAS5	994	Fast correction slots 39-50
SBAS6	995	Integrity message
SBAS7	996	Fast correction degradation
SBAS9	997	GEO navigation message
SBAS10	978	Degradation factor
SBAS12	979	SBAS network time and UTC
SBAS17	980	GEO almanac message
SBAS18	981	IGP mask
SBAS24	983	Mixed fast/slow corrections
SBAS25	984	Long term slow satellite corrections
SBAS26	985	Ionospheric delay corrections
SBAS27	986	SBAS service message
SBAS32	988	Fast correction slots 0-10
SBAS33	989	Fast correction slots 11-21
SBAS34	990	Fast correction slots 22-32
SBAS35	991	Fast correction slots 39-50
SBAS45	993	Slow corrections

Table 53: OEM6 Logs in Alphabetical Order

DATA TYPE	MESSAGE ID	DESCRIPTION
SBASALMANAC	1425	A collection of all current SBAS almanacs decoded by the receiver
SBASCORR	998	SBAS range corrections used
SOFTLOADSTATUS	1235	Describes the status of the SoftLoad process
SOURCETABLE	1344	Outputs the NTRIP source table entries from the NTRIPCASTER set by the NTRIPSOURCETABLE command
TIME	101	Receiver time information
TIMESYNC	492	Synchronize time between receivers
TRACKSTAT	83	Satellite tracking status
VALIDMODELS	206	Model and expiry date information for receiver
VERSION	37	Receiver hardware and software version numbers
CMR Format Logs [a]		
CMRDESC	310	Base station description information
CMRGLOOBS	882	CMR Type 3 GLONASS observations
CMROBS	103	Base station satellite observation information
CMRPLUS	717	Base station position information (low rate)
CMRREF	105	Base station position information
RTCA FORMAT LOGS [a]		
RTCA1	10	Type 1 Differential GPS corrections
RTCAEPHEM	347	Type 7 Ephemeris and time information
RTCAOBS	6	Type 7 Base Station observations
RTCAOBS2	805	Type 7 Base Station observations II
RTCAOBS3	1340	Proprietary message that carries dual-frequency GPS and GLO measurements and is used in ALIGN. Also carries SBAS measurements if the Master receiver is single-frequency (L1-only) receiver to enable SBAS-ALIGN at the L1-only ALIGN Rover
RTCAREF	11	Type 7 Base Station parameters
RTCM1	107	Type 1 Differential GPS corrections
RTCM3	117	Type 3 Base Station parameters
RTCM FORMAT LOGS [a]		
RTCM9	275	Type 9 Partial Differential GPS corrections
RTCM15	307	Type 15 Ionospheric corrections
RTCM16	129	Type16 Special message
RTCM16T	131	Type16T Special text message
RTCM1819	260	Type18 and Type 19 raw measurements

RTCM FORMAT LOGS [a]		
RTCM2021	374	Type 20 and Type 21 measurement corrections
RTCM22	118	Type 22 Extended Base Station parameters
RTCM23	665	Type 23 Antenna type definition
RTCM24	667	Type 24 Antenna Reference Point (ARP)
RTCM31	864	Type 31 Differential GLONASS corrections
RTCM32	873	Type 32 GLONASS Base Station parameters
RTCM36	875	Type 36 Special message
RTCM36T	877	Type 36T Special text message
RTCM59	116	Type 59N-0 NovAtel Proprietary: RT20 Differential
RTCM59GLO	903	NovAtel proprietary GLONASS differential
RTCMV3 FORMAT LOGS [a]		
RTCMOMNI1	957	RTCM1 from OmniSTAR
RTCM1001	772	L1-Only GPS RTK Observables
RTCM1002	774	Extended L1-Only GPS RTK Observables
RTCM1003	776	L1/L2 GPS RTK Observables
RTCM1004	770	Extended L1/L2 GPS RTK Observables
RTCM1005	765	RTK Base Station ARP
RTCM1006	768	RTK Base Station ARP with Antenna Height
RTCM1007	852	Extended Antenna Descriptor and Setup
RTCM1008	854	Extended Antenna Reference Station Description and serial number
RTCM1009	885	GLONASS L1-Only RTK
RTCM1010	887	Extended GLONASS L1-Only RTK
RTCM1011	889	GLONASS L1/L2 RTK
RTCM1012	891	Extended GLONASS L1/L2 RTK
RTCM1019	893	GPS Ephemerides
RTCM1020	895	GLONASS Ephemerides
RTCM1033	1097	Receiver and antenna descriptors
NMEA FORMAT DATA LOGS		
GLMLA	859	NMEA GLONASS almanac data
GPALM	217	Almanac Data
GPGGA	218	GPS Fix Data and undulation
GPGGALONG	521	GPS Fix Data, Extra Precision and undulation
GPGGARTK	259	GPS Fix Data with Extra Precision
GPGLL	219	Geographic Position - latitude/longitude
GPGRS	220	GPS Range Residuals for Each Satellite
GPGSA	221	GPS DOP and Active Satellites

NMEA FORMAT DATA LOGS		
GPGST	222	Pseudorange Measurement Noise Statistics
GPGSV	223	GPS Satellites in View
GPHDT	1045	Heading in Degrees True
GPRMB	224	Generic Navigation Information
GPRMC	225	GPS Specific Information
GPVTG	226	Track Made Good and Ground Speed
GPZDA	227	UTC Time and Date

a. CMR, RTCA, and RTCM logs may be logged with an A or B extension to give an ASCII or Binary output with a NovAtel header followed by Hex or Binary data respectively

Table 54: OEM6 Logs in Numerical Order

MESSAGE ID	DATA TYPE	DESCRIPTION
5	LOGLIST	A list of system logs
7	GPSEPHEM	GPS ephemeris data
8	IONUTC	Ionospheric and UTC model information
16	CLOCKMODEL	Current clock model matrices
25	RAWGPSSUBFRAME	Raw subframe data
26	CLOCKSTEERING	Clock steering status
37	VERSION	Receiver hardware and software version numbers
41	RAWEPHEM	Raw ephemeris
42	BESTPOS	Best position data
43	RANGE	Satellite range information
47	PSRPOS	Pseudorange position information
48	SATVIS	Satellite visibility
72	PORTSTATS	COM or USB port statistics
73	ALMANAC	Current almanac information
74	RAWALM	Raw almanac
83	TRACKSTAT	Satellite tracking status
93	RXSTATUS	Self-test status
94	RXSTATUSEVENT	Status event indicator
96	MATCHEDPOS	RTK Computed Position – Time Matched
99	BESTVEL	Velocity data
100	PSRVEL	Pseudorange velocity information
101	TIME	Receiver time information
128	RXCONFIG	Receiver configuration status

Table 54: OEM6 Logs in Numerical Order

MESSAGE ID	DATA TYPE	DESCRIPTION
140	RANGECMP	Compressed version of the RANGE log
141	RTKPOS	RTK low latency position data
161	NAVIGATE	Navigation waypoint status
172	AVEPOS	Position averaging
174	PSRDOP	DOP of SVs currently tracking
175	REFSTATION	Base station position and health
181	MARKPOS	Position at time of mark input event
206	VALIDMODELS	Model and expiry date information for receiver
216	RTKVEL	RTK velocity
231	MARKTIME	Time of mark input event
233, 234, 235	PASSCOM1, PASSCOM2, PASSCOM3	Pass-through logs
241	BESTXYZ	Cartesian coordinate position data
242	MATCHEDXYZ	RTK Time Matched cartesian coordinate position data
243	PSRXYZ	Pseudorange cartesian coordinate position information
244	RTKXYZ	RTK cartesian coordinate position data
287	RAWSBASFRAME	Raw SBAS frame data
405, 406	PASSXCOM1, PASSXCOM2	Pass-through logs
407	RAWGPSWORD	Raw navigation word
469	PDPPOS	PDP filter position
470	PDPVEL	PDP filter velocity
471	PDPXYZ	PDP filter Cartesian position and velocity
492	TIMESYNC	Synchronize time between receivers
495	OMNIHPPOS	OmniSTAR HP/XP position data
520	APPLICATIONSTATUS	Provides application status information
607, 608, 609	PASSUSB1, PASSUSB2, PASSUSB3	Pass-through logs (for receivers that support USB)
615	MARK2POS	Time of mark input event
616	MARK2TIME	Position at time of mark input event
631	RANGEGPSL1	L1 version of the RANGE log
686	BSLNXYZ	RTK XYZ baseline
690	PASSAUX	Pass-through log for AUX port
718	GLOALMANAC	GLONASS almanac data
719	GLOCLOCK	GLONASS clock information

Table 54: OEM6 Logs in Numerical Order

MESSAGE ID	DATA TYPE	DESCRIPTION
720	GLORAWALM	Raw GLONASS almanac data
721	GLORAWFRAME	Raw GLONASS frame data
722	GLORAWSTRING	Raw GLONASS string data
723	GLOEPHEMERIS	GLONASS ephemeris data
726	BESTUTM	Best available UTM data
730	LBANDINFO	L-band configuration information
731	LBANDSTAT	L-band status information
732	RAWLBANDFRAME	Raw L-band frame data
733	RAWLBANDPACKET	Raw L-band data packet
792	GLORAWEPHEM	Raw GLONASS ephemeris data
795	PASSXCOM3	Pass through log
860	OMNIVIS	OmniSTAR satellite visibility list
881	PSRTIME	Time offsets from the pseudorange filter
914	DIFFCODEBIASES	Differential code biases being applied
952	RTKDOP	Values from the RTK fast filter
963	HWMONITOR	Monitor Hardware Levels
971	HEADING	Heading information with the ALIGN feature
976	SBAS0	Remove PRN from the solution
977	SBAS1	PRN mask assignments
978	SBAS10	Degradation factor
979	SBAS12	SBAS network time and UTC
980	SBAS17	GEO almanac message
981	SBAS18	IGP mask
982	SBAS2	Fast correction slots 0-12
983	SBAS24	Mixed fast/slow corrections
984	SBAS25	Long term slow satellite corrections
985	SBAS26	Ionospheric delay corrections
986	SBAS27	SBAS service message
987	SBAS3	Fast correction slots 13-25
988	SBAS32	CDGPS Fast Corrections slots 0-10
989	SBAS33	CDGPS Fast Corrections slots 11-21
990	SBAS34	CDGPS Fast Corrections slots 22-32
991	SBAS35	CDGPS Fast Corrections slots 32-43

Table 54: OEM6 Logs in Numerical Order

MESSAGE ID	DATA TYPE	DESCRIPTION
992	SBAS4	Fast correction slots 26-38
993	SBAS45	CDGPS Slow Corrections
994	SBAS5	Fast corrections slots 39-50
995	SBAS6	Integrity Message
996	SBAS7	Fast Correction Degradation
997	SBAS9	Geo Nav Message
998	SBASCORR	SBAS range corrections used
1043	SATVIS2	Satellite visibility
1051	MASTERPOS	Displays the master position with the ALIGN feature
1052	ROVERPOS	Displays the rover position with the ALIGN feature
1066	RAWCNAVFRAME	Raw L2C frame data
1120	GALALMANAC	Decoded Galileo almanac parameters from Galileo navigation messages
1121	GALCLOCK	Galileo time information
1122	GALEPHEMERIS	Galileo ephemeris information is available through the GALEPHEMERIS log
1127	GALIONO	Decoded Galileo ionospheric corrections
1148	CHANCONFIGLIST	Channel configuration list
1162	PSRSATS	Satellites used in PSRPOS solution
1163	PSRDOP2	Pseudorange least squares DOP
1172	RTKDOP2	Values from the RTK Fast Filter
1174	RTKSATS	Satellites used in RTKPOS solution
1176	MATCHEDSATS	Lists the used and unused satellites for the corresponding MATCHEDPOS solution
1194	BESTSATS	Satellites used in BESTPOS
1197	OMNIHPSATS	Satellites used in the OMNIHPPOS solution
1209	PASSETH1	Pass through log
1234	PDPSATS	Satellites used in PDPPOS solution
1235	SOFTLOADSTATUS	Status of the soft load process
1250	PASSICOM1	Pass through log
1251	PASSICOM2	Pass through log
1252	PASSICOM3	Pass through log
1253	PASSNCOM1	Pass through log
1254	PASSNCOM2	Pass through log

Table 54: OEM6 Logs in Numerical Order

MESSAGE ID	DATA TYPE	DESCRIPTION
1255	PASSNCOM3	Pass through log
1273	RANGECMP2	RANGE data compressed to handle more channels and types
1286	RAIMSTATUS	RAIM status
1288	ETHSTATUS	Current Ethernet status
1289	IPSTATUS	Current network configuration status
1314	ALIGNBSLNXYZ	Outputs the RTK quality XYZ baselines from ALIGN
1315	ALIGNBSLNENU	Outputs the RTK quality ENU baselines from ALIGN
1316	HEADINGSATS	Outputs the satellite information from ALIGN filter
1325	REFSTATIONINFO	Reference station position and health information
1330	QZSSRAWEPHEM	Contains the raw binary information for subframes one, two and three from the satellite with the parity information removed
1331	QZSSRAWSUBFRAME	A raw QZSS subframe is 300 bits in total, includes the parity bits which are interspersed with the raw data ten times, in six bit chunks, for a total of 60 parity bits
1332	ALIGNDOP	Outputs the DOP computed using the satellites used in solution
1335	HEADING2	Outputs same information as HEADING log with an additional Rover ID field
1336	QZSSEPHEMERIS	Single set of QZSS ephemeris parameters
1340	RTCAOBS3	Proprietary message that carries dual-frequency GPS and GLO measurements and is used in ALIGN. Also carries SBAS measurements if the Master receiver is single-frequency (L1-only) receiver to enable SBAS-ALIGN at the L1-only ALIGN Rover
1342	PASSTHROUGH	Outputs pass-through data from all receiver ports
1344	SOURCETABLE	Outputs the NTRIP source table entries from the NTRIPCASTER set by the NTRIPSOURCETABLE command
1345	QZSSRAWALMANAC	Contains the undecoded almanac subframes as received from the QZSS satellite
1346	QZSSALMANAC	Contains the decoded almanac parameters as received from the satellite with the parity information removed and appropriate scaling applied
1347	QZSSIONUTC	Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) for QZSS are provided
1348	AUTHCODES	Contains all authorization codes (auth codes) entered into the system since the last complete firmware reload

Table 54: OEM6 Logs in Numerical Order

MESSAGE ID	DATA TYPE	DESCRIPTION
1412	PROFILEINFO	Outputs a list of Profiles
1413	GALFNAVRAWPAGE	Contains the raw Galileo F/Nav page data
1414	GALINAVRAWWORD	Contains the raw Galileo I/Nav word data
1425	SBASALMANAC	A collection of all current SBAS almanacs decoded by the receiver
1451	SATXYZ2	Combined with a RANGE log, this data set contains the decoded satellite information necessary to compute the solution
CMR FORMAT LOGS [a]		
103	CMROBS	Base station satellite observation information
105	CMRREF	Base station position information
310	CMRDESC	Base station description information
717	CMRPLUS	Base station position information (low rate)
882	CMRGLOOBS	CMR Type 3 GLONASS observations
RTCA FORMAT LOGS [a]		
6	RTCAOBS	Type 7 Base Station observations
10	RTCA1	Type 1 Differential GPS corrections
11	RTCAREF	Type 7 Base Station parameters
347	RTCAEPHEM	Type 7 Ephemeris and time information
805	RTCAOBS2	Type 7 Base Station observations 2
RTCM FORMAT LOGS [a]		
107	RTCM1	Type 1 Differential GPS corrections
116	RTCM59	Type 59N-0 NovAtel Proprietary: RT20 differential
117	RTCM3	Type 3 Base Station parameters
118	RTCM22	Type 22 Extended Base Station parameters
129	RTCM16	Type16 Special message
131	RTCM16T	Type16T Special text message
260	RTCM1819	Type18 and Type 19 raw measurements
275	RTCM9	Type 9 Partial Differential GPS Corrections
307	RTCM15	Type 15 Ionospheric Corrections
374	RTCM2021	Type 20 and Type 21 Measurement Corrections
665	RTCM23	Type 22 Extended Base Station parameters
667	RTCM24	Type 23 Antenna Type Definition
864	RTCM31	Type 31 Differential GLONASS Corrections
873	RTCM32	Type 32 GLONASS Base Station parameters

Table 54: OEM6 Logs in Numerical Order

MESSAGE ID	DATA TYPE	DESCRIPTION
RTCM FORMAT LOGS [a]		
875	RTCM36	Type 36 Special Message
RTCMV3 FORMAT LOGS [a]		
877	RTCM36T	Type 36T Special Text Message
903	RTCM59GLO	NovAtel proprietary GLONASS differential NovAtel
957	RTCMOMNI1	RTCM1 from OmniSTAR
765	RTCM1005	RTK Base Station ARP
768	RTCM1006	RTK Base Station ARP with Antenna Height
770	RTCM1004	Extended L1/L2 GPS RTK Observables
772	RTCM1001	L1-Only GPS RTK Observables
774	RTCM1002	Extended L1-Only GPS RTK Observables
776	RTCM1003	L1/L2 GPS RTK Observables
852	RTCM1007	Extended Antenna Descriptor and Setup
854	RTCM1008	Extended Antenna Reference Station Description and Serial Number
885	RTCM1009	GLONASS L1-Only RTK
887	RTCM1010	Extended GLONASS L1-Only RTK
889	RTCM1011	GLONASS L1/L2 RTK
891	RTCM1012	Extended GLONASS L1/L2 RTK
893	RTCM1019	GPS Ephemerides
895	RTCM1020	GLONASS Ephemerides
1097	RTCM1033	Receiver and antenna descriptors
NMEA FORMAT DATA LOGS		
217	GPALM	Almanac Data
218	GPGGA	GPS Fix Data and Undulation
219	GPGLL	Geographic Position - latitude/longitude
220	GPGRS	GPS Range Residuals for Each Satellite
221	GPGSA	GPS DOP and Active Satellites
222	GPGST	Pseudorange Measurement Noise Statistics
223	GPGSV	GPS Satellites in View
224	GPRMB	Generic Navigation Information
225	GPRMC	GPS Specific Information
226	GPVTG	Track Made Good and Ground Speed
227	GPZDA	UTC Time and Date

Table 54: OEM6 Logs in Numerical Order

MESSAGE ID	DATA TYPE	DESCRIPTION
259	GPGGARTK	GPS Fix Data with Extra Precision
521	GPGGALONG	GPS Fix Data, Extra Precision and Undulation
859	GLMLA	NMEA GLONASS Almanac Data
1045	GPHDT	Heading in Degrees True

a. CMR, RTCA, RTCM and RTCMV3 logs may be logged with an A or B extension to give an ASCII or Binary output with a NovAtel header followed by Hex or Binary data respectively.

3.3 Log Reference

3.3.1 ALIGNBSLNENU ENU Baselines using ALIGN

This log outputs the RTK quality ENU baselines from ALIGN. The XYZ baselines (output in ALIGNBSLNXYZ log) are rotated relative to master position (output in MASTERPOS) to compute ENU baselines.

Message ID: **1315 (ALIGNBSLNENU)**
Log Type: **Asynch**

Recommended Input:

log alignbslnenua onnew

ASCII Example:

#ALIGNBSLNENUA,COM1,0,29.0,FINESTEERING,1629,259250.000,00040000,100b,39448;SOL_COMPUTED,NARROW_INT,4.1586,-1.9197,-0.0037,0.0047,0.0050,0.0062,"0092","AAAA",22,16,16,16,0,01,0,33*11e1d4c0

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	ALIGNBSLNENU	Log Header		H	0
2	sol stat	Solution status, *see Table 57, Page 304*	ENUM	4	H
3	pos type	Position type, *see Table 56, Page 303*	ENUM	4	H+4
4	East	East Baseline (relative to master position) in metres	DOUBLE	8	H+14
5	North	North Baseline (relative to master position) in metres	DOUBLE	8	H+16
6	Up	Up Baseline (relative to master position) in metres	DOUBLE	8	H+24
7	East σ	East Baseline STD in metres	FLOAT	4	H+32
8	North σ	North Baseline STD in metres	FLOAT	4	H+36
9	Up σ	Up Baseline STD in metres	FLOAT	4	H+40
10	Rover id	Rover Receiver ID *Set using SETROVERID command on ROVER (page 232)* *e.g., setroverid RRRR*	CHAR[4]	4	H+44
11	Master id	Master Receiver ID *Set using DGPSTXID command on MASTER (page 103)* *Default: AAAA*	UCHAR	1	H+48
12	#SVs	Number of satellites tracked	UCHAR	1	H+52

Continued on next page

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
13	#solnSVs	Number of satellites in solution	UCHAR	1	H+53
14	#obs	Number of satellites above elevation mask angle	UCHAR	1	H+54
15	#multi	Number of satellites above elevation mask angle with L2	UCHAR	1	H+55
16	Reserved		UCHAR	1	H+44
17	ext sol stat	Extended solution status, *see Table 59, Page 305*	HEX	1	H+57
18	Reserved		HEX	1	H+46
19	sig mask	Signals used mask - if 0, signals used in solution are unknown, *see Table 57, Page 304*	HEX	1	H+59
20	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+60
21	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.2 ALIGNBSLNXYZ XYZ Baselines using ALIGN

This log outputs the RTK quality XYZ baselines from ALIGN.

Message ID: **1314 (ALIGNBSLNXYZ)**
Log Type: **Asynch**

Recommended Input:

log alignbslnxyza onnew

ASCII Example:

#ALIGNBSLNXYZA,COM1,0,29.0,FINESTEERING,1629,259250.000,00040000,9d28,39448;SOL_COMPUTED,NARROW_INT,3.1901,-3.0566,
1.2079,0.0050,0.0054,0.0056,"0092","AAAA",22,16,16,16,0,01,0,33*ac372198

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	ALIGNBSLNXYZ	Log Header		H	0
2	sol stat	Solution status, see Table 57, Page 304	ENUM	4	H
3	pos type	Position type, see Table 56, Page 303	ENUM	4	H+4
4	dX	X Baseline in metres	DOUBLE	8	H+8
5	dY	Y Baseline in metres	DOUBLE	8	H+16
6	dZ	Z Baseline in metres	DOUBLE	8	H+24
7	dX σ	X Baseline STD in metres	FLOAT	4	H+32
8	dY σ	Y Baseline STD in metres	FLOAT	4	H+36
9	dZ σ	Z Baseline STD in metres	FLOAT	4	H+40
10	Rover id	Rover Receiver ID *Set using SETROVERID command on ROVER (page 232)* *e.g. setroverid RRRR*	UCHAR[4]	4	H+44
11	Master id	MASTER RECEIVER ID *SET DGPSTXID COMMAND ON MASTER (page 103)* *DEFAULT: AAAA*	UCHAR[4]	1	H+48
12	#SVs	Number of satellites tracked	UCHAR	1	H+52
13	#solnSVs	Number of satellites in solution	UCHAR	1	H+53
14	#obs	Number of satellites above elevation mask angle	UCHAR	1	H+54
15	#multi	Number of satellites above elevation mask angle with L2	UCHAR	1	H+55

Continued on next page

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
16	Reserved		UCHAR	1	H+56
17	ext sol stat	Extended solution status, *see Table 59, Page 305*	Hex	1	H+57
18	Reserved		Hex	1	H+58
19	sig mask	Signals used mask - if 0, signals uded in solution are unknown, *see Table 57, Page 304*	Hex	1	H+59
20	xxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+60
21	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.3 ALIGNDOP Calculated DOP Values

This log outputs the DOP computed using the satellites used in heading solution. This log comes out at a default 1 Hz rate. Additional logs will come out in the middle of second if DOP changes and ALIGN is operating at >1 Hz.

Message ID: **1332**
Log Type: **Asynch**

Recommended Input:

log aligndopa onnew

ASCII Example:

#aligndopa,com1,0,22.5,finesteering,1629,259250.000,00040000,de2d,39448;1.6160,1.2400,0.6900,0.9920,0.7130,10.0,16,4,32,23,10,7,20,13,30,16,47,43,46,53,54,44,45*90a72971

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	ALIGNDOP	Log Header		H	0
2	GDOP	Geometric DOP	FLOAT	4	H
3	PDOP	Position DOP	FLOAT	4	H+4
4	HDOP	Horizontal DOP	FLOAT	4	H+8
5	HTDOP	Horizontal and time DOP	FLOAT	4	H+12
6	TDOP	Time DOP	FLOAT	4	H+16
7	Elev mask	Elevation mask angle	FLOAT	4	H+20
8	#sats	Number of satellites to follow	ULONG	4	H+24
9	sats	Satellites in use at time of calculation	ULONG [#sats]	4 x (#sats)	H+28
10	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	variable
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.4 ALMANAC Decoded GPS Almanac

This log contains the decoded almanac parameters from Subframe four and five, as received from the satellite, with the parity information removed and appropriate scaling applied. Multiple messages are transmitted, one for each SV almanac collected. For more information about almanac data, refer to the GPS SPS Signal Specification.

The OEM6 family of receivers automatically save almanacs in their Non-Volatile Memory (NVM), so creating an almanac boot file is not necessary.

Message ID: **73**
Log Type: **Asynch**

Recommended Input:

log almanaca onchanged

ASCII Example:

```
#ALMANACA,COM1,0,54.0,SATTIME,1364,409278.000,00000000,06de,2310;
29,
1,1364,589824.0,6.289482e-03,-7.55460039e-09,-2.2193421e+00,-1.7064776e+00,
-7.94268362e-01,4.00543213e-05,3.63797881e-12,1.45856541e-04,2.6560037e+07,
4.45154034e-02,1,0,0,FALSE,
2,1364,589824.0,9.173393e-03,-8.16033991e-09,1.9308788e+00,1.9904300e+00,
6.60915023e-01,-1.62124634e-05,0.00000000,1.45860023e-04,2.6559614e+07,
8.38895743e-03,1,0,0,FALSE,
3,1364,589824.0,7.894993e-03,-8.04604944e-09,7.95206128e-01,6.63875501e-01,
-2.00526792e-01,7.91549683e-05,3.63797881e-12,1.45858655e-04,2.6559780e+07,
-1.59210428e-02,1,0,0,TRUE,
...
28,1364,589824.0,1.113367e-02,-7.87461372e-09,-1.44364969e-01,-2.2781989e+00,
1.6546425e+00,3.24249268e-05,0.00000000,1.45859775e-04,2.6559644e+07,
1.80122900e-02,1,0,0,FALSE,
29,1364,589824.0,9.435177e-03,-7.57745849e-09,-2.2673888e+00,-9.56729511e-01,
1.1791713e+00,5.51223755e-04,1.09139364e-11,1.45855297e-04,2.6560188e+07,
4.36225787e-02,1,0,0,FALSE,
30,1364,589824.0,8.776665e-03,-8.09176563e-09,-1.97082451e-01,1.2960786e+00,
2.0072936e+00,2.76565552e-05,0.00000000,1.45849410e-04,2.6560903e+07,
2.14517626e-03,1,0,0,FALSE*de7a4e45
```

The speed at which the receiver locates and locks onto new satellites is improved if the receiver has approximate time and position, as well as an almanac. This allows the receiver to compute the elevation of each satellite so it can tell which satellites are visible and their Doppler offsets, improving Time to First Fix (TTFF).

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	ALMANAC header	Log header		H	0
2	#messages	The number of satellite PRN almanac messages to follow. Set to zero until almanac data is available	Long	4	H
3	PRN	Satellite PRN number for current message, dimensionless	Ulong	4	H+4
4	week	Almanac reference week (GPS reference week number)	Ulong	4	H+8
5	seconds	Almanac reference time, seconds into the week	Double	8	H+12
6	ecc	Eccentricity, dimensionless - defined for a conic section where e = 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse and e>1 is a hyperbola	Double	8	H+20
7	$\dot{\omega}$	Rate of right ascension, radians/ second	Double	8	H+28
8	ω_0	Right ascension, radians	Double	8	H+36
9	ω	Argument of perigee, radians - measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion	Double	8	H+44
10	M_o	Mean anomaly of reference time, radians	Double	8	H+52
11	a_{fo}	Clock aging parameter, seconds	Double	8	H+60
12	a_{f1}	Clock aging parameter, seconds/ second	Double	8	H+68
13	N	Corrected mean motion, radians/ second	Double	8	H+76
14	A	Semi-major axis, metres	Double	8	H+84
15	incl-angle	Angle of inclination relative to 0.3 π, radians	Double	8	H+92
16	SV config	Satellite configuration	Ulong	4	H+100
17	health-prn	SV health from Page 25 of subframe 4 or 5 (6 bits)	Ulong	4	H+104
18	health-alm	SV health from almanac (8 bits)	Ulong	4	H+108
19	antispoof	Anti-spoofing on? 0 = FALSE 1 = TRUE	Enum	4	H+112
20...	Next PRN offset = H + 4 + (#messages x 112)				
21	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4 + (112 x #messages)
22	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.5 APPLICATIONSTATUS Application status information

This log contains API status information.

Message ID: **520**
Log Type: **Asynch**

Recommended Input:

log applicationstatus once

ASCII Example:

#APPLICATIONSTATUSA,COM2,0,86.0,UNKNOWN,0,1.693,00040000,3314,6096;1,FALSE,00000000,00000000,"IndividualTest","1.00","2010/Sep/14","09:31:08"*e3667131

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	APIVersion	Version of the API header	ULONG	4	H
2	Running	TRUE if the application is running. FALSE otherwise	BOOL	4	H+4
3	BaseAddress	Base address of the loaded application	ULONG	4	H+8
4	Size	Size of the loaded application	ULONG	4	H+12
5	Name	Name of the loaded application	FixedChar Array[16]	16	H+16
6	Version	Version of the loaded application	FixedChar Array[16]	16	H+32
7	CompileDate	Compile data of the loaded application	FixedChar Array[12]	12	H+48
8	CompileTime	Compile time of the loaded application	FixedChar Array[12]	12	H+60

3.3.6 AUTHCODES

This log contains all authorization codes (auth codes) entered into the system since the last complete firmware reload. Signature authorization codes will be maintained through a Softload. The log also indicates the status of the firmware signature, if present. For more information about firmware signatures see the “Upgrading Using the AUTH Command” section of the Installation and Operation User Manual.

The following situations will cause an authorization code to be marked invalid. If you require new authorization codes, please contact NovAtel Customer Service.

- Authorization Code is for a different receiver
- Authorization Code is for a different firmware version
- Authorization Code has expired
- Authorization Code was entered incorrectly
- Authorization Code requires a firmware signature, but one is not present.

Message ID: **1348**
Log Type: **Polled**

Recommended Input:

log authcodesa once

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	AUTHCODES Signature Status	Status of the Firmware Signature 1 = NONE 2 = INVALID 3 = VALID	ENUM	4	H
2	Number of Auth Codes	# of Auth Codes to follow (max is 24)	ULONG	4	H+4
3	Auth code type	1=STANDARD 2=SIGNATURE	ENUM	4	H+8
4	Valid	TRUE if the Auth Code has been verified	BOOL	4	H+12
5	Auth Code String	ASCII String of the Auth Code	STRING	80	H+16
6	Next AuthCode offset =H+8 (#AuthCodes x 88)				
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.7 AVEPOS Position Averaging

When position averaging is underway, the various fields in the AVEPOS log contain the parameters being used in the position averaging process. *Table 55* below shows the possible position averaging status values seen in field #8 of the AVEPOS log table on the next page.

See the description of the POSAVE command on *page 179*. For general positioning information, refer also to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

1. All quantities are referenced to the geoid (average height above sea level), regardless of the use of the DATUM or USERDATUM commands, except for the height parameter (field #4 in the AVEPOS log table on the next page). The relation between the geoid and WGS84 ellipsoid is the geoidal undulation and can be obtained from the PSRPOS log, see *page 451*.
2. Asynchronous logs should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Message ID: **172**
Log Type: **Asynch**

Recommended Input:

```
log aveposa onchanged
```

ASCII Example:

```
#AVEPOSA,COM1,0,48.5,FINESTEERING,1364,492100.000,80000000,e3b4,2310;
51.11635589900,-114.03833558937,1062.216134356,1.7561,0.7856,1.7236,
INPROGRESS,2400,2*72a550c1
```

Table 55: Position Averaging Status

Binary	ASCII	Description
0	OFF	Receiver is not averaging
1	INPROGRESS	Averaging is in progress
2	COMPLETE	Averaging is complete

When a GNSS position is computed, there are four unknowns being solved: latitude, longitude, height and receiver clock offset (often just called time). The solutions for each of the four unknowns are correlated to satellite positions in a complex way. Since satellites are above the antenna (none are below) there is a geometric bias. Therefore, geometric biases are present in the solutions and affect the computation of height. These biases are called DOPs (Dilution Of Precision). Smaller biases are indicated by low DOP values. VDOP (Vertical DOP) pertains to height. Most of the time, VDOP is higher than HDOP (Horizontal DOP) and TDOP (Time DOP). Therefore, of the four unknowns, height is the most difficult to solve. Many GNSS receivers output the Standard Deviations (SD) of the latitude, longitude and height. Height often has a larger value than the other two.

Accuracy is based on statistics and reliability is measured in percent. When a receiver states it can measure height to one metre, this is an accuracy. Usually this is a one sigma value (one SD). A one sigma value for height has a reliability of 68%. In other words, the error is less than one metre 68% of the time. For a more realistic accuracy, double the one sigma value (one metre) and the result is 95% reliability (error is less than two metres 95% of the time). Generally, GNSS heights are 1.5 times poorer than horizontal positions. See also *page 374* for CEP and RMS definitions.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	AVEPOS header	Log header		H	0
2	lat	Average WGS84 latitude (degrees)	Double	8	H
3	lon	Average WGS84 longitude (degrees)	Double	8	H+8
4	ht	Average height above sea level (m)	Double	8	H+16
5	lat σ	Estimated average standard deviation of latitude solution element (m)	Float	4	H+24
6	lon σ	Estimated average standard deviation of longitude solution element (m)	Float	4	H+28
7	hgt σ	Estimated average standard deviation of height solution element (m)	Float	4	H+32
8	posave	Position averaging status (see *Table 55*)	Enum	4	H+36
9	ave time	Elapsed time of averaging (s)	Ulong	4	H+40
10	#samples	Number of samples in the average	Ulong	4	H+44
11	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.8 BESTPOS Best Position

This log contains the best available combined GNSS and Inertial Navigation System (INS), if available, position (in metres) computed by the receiver. 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.

With the system operating in an RTK mode, BESTPOS reflects the latest low-latency solution for up to 60 seconds after reception of the last base station observation. After this 60 second period, the position reverts to the best solution available and the degradation in accuracy is reflected in the standard deviation fields. If the system is not operating in RTK mode, pseudorange differential solutions continue for the time specified in the PSRDIFFTIMEOUT command, see *page 188*.

See also the table footnote for position logs on *page 271* as well as the MATCHEDPOS, PSRPOS and RTKPOS logs on *pages 416, 451* and *512*.

Message ID: **42**
Log Type: **Synch**

Recommended Input:

```
log bestposa ontime 1
```

See *Section 2.1, Command Formats* on *page 38* for more examples of log requests.

Different logging rates are possible with different engines. For example, RTK 100 Hz, LSQS 100 Hz, PDP 20Hz, HP/G2/XP 20Hz.

ASCII Example 1:

```
#BESTPOSA,COM1,0,83.5,FINESTEERING,1419,336148.000,00000040,6145,2724;
SOL_COMPUTED,SINGLE,51.11636418888,-114.03832502118,1064.9520,-16.2712,
WGS84,1.6961,1.3636,3.6449,"",0.000,0.000,8,8,8,8,0,0,0,06,0,03*6f63a93d
```

ASCII Example 2:

```
#BESTPOSA,COM1,0,78.5,FINESTEERING,1419,336208.000,00000040,6145,2724;
SOL_COMPUTED,NARROW_INT,51.11635910984,-114.03833105168,1063.8416,-16.2712,
WGS84,0.0135,0.0084,0.0172,"AAAA",1.000,0.000,8,8,8,8,0,01,0,03*3d9fbd48
```

Multi-frequency GNSS receivers offer two major advantages over single-frequency equipment:

1. Ionospheric errors, inherent in all GNSS observations, can be modelled and significantly reduced by combining satellite observations made on two different frequencies.
2. Observations on two frequencies allow for faster ambiguity resolution times.

In general, multi-frequency GNSS receivers provide a faster, more accurate and more reliable solution than single-frequency equipment. They do, however, cost significantly more and so it is important for potential GNSS buyers to carefully consider their current and future needs.

Table 56: Position or Velocity Type

Type (binary)	Type (ASCII)	Description
0	NONE	No solution
1	FIXEDPOS	Position has been fixed by the FIX POSITION command
2	FIXEDHEIGHT	Position has been fixed by the FIX HEIGHT/AUTO command
8	DOPPLER_VELOCITY	Velocity computed using instantaneous Doppler
16	SINGLE	Single point position
17	PSRDIFF	Pseudorange differential solution
18	SBAS	Solution calculated using corrections from an SBAS
19	PROPAGATED	Propagated by a Kalman filter without new observations
20	OMNISTAR [a]	OmniSTAR VBS position (L1 sub-metre)
32	L1_FLOAT	Floating L1 ambiguity solution
33	IONOFREE_FLOAT	Floating ionospheric-free ambiguity solution
34	NARROW_FLOAT	Floating narrow-lane ambiguity solution
48	L1_INT	Integer L1 ambiguity solution
50	NARROW_INT	Integer narrow-lane ambiguity solution
64	OMNISTAR_HP [a]	OmniSTAR HP position
65	OMNISTAR_XP [a]	OmniSTAR XP or OmniSTAR G2 (GPS+GLONASS) position

a. In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR or use of a DGPS service is required. Contact NovAtel for details.

Table 57: Solution Status

Solution Status		Description
(Binary)	(ASCII)	
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
2	NO_CONVERGENCE	No convergence
3	SINGULARITY	Singularity at parameters matrix
4	COV_TRACE	Covariance trace exceeds maximum (trace > 1000 m)
5	TEST_DIST	Test distance exceeded (maximum of 3 rejections if distance >10 km)
6	COLD_START	Not yet converged from cold start
7	V_H_LIMIT	Height or velocity limits exceeded (in accordance with export licensing restrictions)
8	VARIANCE	Variance exceeds limits
9	RESIDUALS	Residuals are too large
10	DELTA_POS	Delta position is too large
11	NEGATIVE_VAR	Negative variance
12	Reserved	
13	INTEGRITY_WARNING	Large residuals make position unreliable
18	PENDING	When a FIX POSITION command is entered, the receiver computes its own position and determines if the fixed position is valid [a]
19	INVALID_FIX	The fixed position, entered using the FIX POSITION command, is not valid
20	UNAUTHORIZED	Position type is unauthorized - HP or XP on a receiver not authorized for it

a. PENDING implies there are not enough satellites being tracked to verify if the FIX POSITION entered into the receiver is valid. Under normal conditions, you should only see PENDING for a few seconds on power up before the GNSS receiver has locked onto its first few satellites. If your antenna is obstructed (or not plugged in) and you have entered a FIX POSITION command, then you may see PENDING indefinitely.

Table 58: BESTPOS Signal-Used Mask

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

Table 59: Extended Solution Status

Bit	Mask	Description
0	0x01	If an RTK solution: AdVance solution has been verified If a PDP solution: solution is GL1DE
1-3	0x0E	Pseudorange Iono Correction 0 = Unknown[a] 1 = Klobuchar Broadcast 2 = SBAS Broadcast 3 = Multi-frequency Computed 4 = PSRDiff Correction 5 = NovAtel Blended Iono Value
4	0x10	Reserved
5	0x20	0 - No antenna warning 1 - Antenna information is missing See *Section 2.5.74* on *page 193*
6-7	0xC0	Reserved

a. Unknown can indicate that the Iono Correction type is None or that the default Klobuchar parameters are being used.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTPOS header	Log header		H	0
2	sol stat	Solution status, see *Table 57* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56* on *page 303*	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 geoid and the ellipsoid (m) of the chosen datum [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Table 16, Reference Ellipsoid Constants* on *page 96*)	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 satellites tracked	Uchar	1	H+64
16	#solnSVs	Number of satellites used in solution	Uchar	1	H+65
17	#solnL1SVs	Number of satellites with L1/E1 signals used in solution	Uchar	1	H+66
18	#solnMultiSVs	Number of satellites with multi-frequency signals used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84.

3.3.9 BESTSATS Satellites used in BESTPOS

This log lists the used and unused satellites for the corresponding BESTPOS solution. It also describes the signals of the used satellites or reasons for exclusions.

Message ID: **1194**
Log Type: **Synch**

Recommended Input:

log bestsats ontime 1

Abbriviated ASCII Example:

```
<BESTSATS COM1 0 80.0 FINESTEERING 1690 601528.000 00000008 be05 43488
<     20
<           GPS 11 GOOD 00000003
<           GPS 8 GOOD 00000003
...
<           GPS 1 GOOD 00000003
<           GPS 7 GOOD 00000003
<           SBAS 133 NODIFFCORR 00000000
<           SBAS 138 NODIFFCORR 00000000
<           SBAS 135 NODIFFCORR 00000000
<           GLONASS 10-7 GOOD 00000003
<           GLONASS 21+4 GOOD 00000003
...
<           GLONASS 12-1 GOOD 00000003
<           GLONASS 11 GOOD 00000003
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTSATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	System	See *Table 29* on *page 156*	Enum	4	H+4
4	Satellite ID	In binary logs, the satellite ID field is 4 bytes. The 2 lowest-order bytes, interpreted as a USHORT, are the system identifier: for instance, the PRN for GPS, or the slot for GLONASS. The 2 highest-order bytes are the frequency channel for GLONASS, interpreted as a SHORT and zero for all other systems. In ASCII and abbreviated ASCII logs, the satellite ID field is the system identifier. If the system is GLONASS and the frequency channel is not zero, then the signed channel is appended to the system identifier. For example, slot 13, frequency channel -2 is output as 13-2	Ulong	4	H+8
5	Status	Satellite status. See *Table 60*	Enum	4	H+16
6	Status mask	See *Table 61* on *page 309*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 60: Observation Status

ASCII	Binary	Description
0	GOOD	Observation is good
1	BADHEALTH	Bad satellite health in ephemeris
2	OLDEPHEMERIS	Ephemeris >3 hours old
6	ELEVATIONERROR	Satellite was below the elevation cutoff
7	MISCLOSURE	Estimated/actual gap too large
8	NODIFFCORR	No differential correction available
9	NOEPHEMERIS	No ephemeris available
10	INVALIDIODE	IODE used is invalid
11	LOCKEDOUT	Satellite has been locked out
12	LOWPOWER	Not enough signal power
13	OBSL2	Observation is on L2
15	UNKNOWN	Status is unknown
16	NOIONOCORR	No ionosphere delay correction was available
25	NOSIGNALMATCH	Signal type doesn't match
99	NA	Not applicable, no observations available
100	BAD_INTEGRITY	Observation was an outlier and was eliminated from the solution
101	LOSSOFLOCK	Lock broken
102	NOAMBIGUITY	No RTK ambiguity type resolved

Table 61: BESTSATS GPS Signal 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

Table 62: BESTSATS GLONASS Signal Mask

Bit	Mask	Description
0	0x01	GLONASS L1 used in Solution
1	0x02	GLONASS L2 used in Solution

Table 63: BESTSATS Galileo Signal Mask

Bit	Mask	Description
0	0x01	Galileo E1 used in Solution

3.3.10 BESTUTM Best Available UTM Data

This log contains the best available position computed by the receiver in UTM coordinates.

See also the UTMZONE command on *page 265* and the BESTPOS log on *page 301*.

Message ID: **726**
Log Type: **Synch**

The latitude limits of the UTM System are 80°S to 84°N. If your position is outside this range, the BESTUTM log outputs a northing, easting and height of 0.0, along with a zone letter of '*'and a zone number of 0, so that it is obvious that the data in the log is unusable.

Recommended Input:

log bestutma ontime 1

ASCII Example:

```
#BESTUTMA,COM1,0,73.0,FINESTEERING,1419,336209.000,00000040,eb16,2724;
SOL_COMPUTED,NARROW_INT,11,U,5666936.4417,707279.3875,1063.8401,-16.2712,
WGS84,0.0135,0.0084,0.0173,"AAAA",1.000,0.000,8,8,8,8,0,01,0,03*a6d06321
```

Please refer to http://earth-info.nga.mil/GandG/coordsys/grids/referencesys.html for more information and a world map of UTM zone numbers.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTUTM header	Log header		H	0
2	sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+4
4	z#	Longitudinal zone number	Ulong	4	H+8
5	zletter	Latitudinal zone letter	Ulong	4	H+12
6	northing	Northing (m) where the origin is defined as the equator in the northern hemisphere and as a point 10000000 metres south of the equator in the southern hemisphere (that is, a 'false northing' of 10000000 m)	Double	8	H+16
7	easting	Easting (m) where the origin is 500000 m west of the central meridian of each longitudinal zone (that is, a 'false easting' of 500000 m)	Double	8	H+24
8	hgt	Height above mean sea level	Double	8	H+32
9	undulation	Undulation - the relationship between the geoid and the ellipsoid (m) of the chosen datum [a]	Float	4	H+40
10	datum id#	Datum ID number (see *Chapter 2, Table 16, Reference Ellipsoid Constants* on *page 96*)	Enum	4	H+44
11	N σ	Northing standard deviation	Float	4	H+48
12	E σ	Easting standard deviation	Float	4	H+52
13	hgt σ	Height standard deviation	Float	4	H+56
14	stn id	Base station ID	Char[4]	4	H+60
15	diff_age	Differential age in seconds	Float	4	H+64
16	sol_age	Solution age in seconds	Float	4	H+68
17	#SVs	Number of satellite vehicles tracked	Uchar	1	H+72
18	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+73
19	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+74
20	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+75
21	Reserved		Uchar	1	H+76
22	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+77
23	Reserved		Hex	1	H+78
24	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+79
25	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+80
26	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84.

3.3.11 BESTVEL Best Available Velocity Data

This log contains the best available velocity information computed by the receiver. In addition, it reports a velocity status indicator, which is useful to indicate whether or not the corresponding data is valid. 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. See also the table footnote for velocity logs on *page 271*.

The velocity type is from the same source tchosen for BESTPOS. So, if BESTPOS is from the pseudorange filter, the BESTVEL velocity type is the same as for PSRVEL, see *page 455*. If BESTPOS is from RTK, the BESTVEL velocity type is the same as for RTKVEL, see *515*. If BESTPOS is from PDP, the BESTVEL velocity type is the same as for PDPVEL, see *441*. If BESTPOS is from OMNIHPPOS, the BESTVEL velocity type is OMNISTAR_HP or OMNISTAR_XP.

The RTK, OmniSTAR HP and OmniSTAR XP velocities are computed from the average change in position over the time interval or the RTK Low Latency filter. As such, it is an average velocity based on the time difference between successive position computations and not an instantaneous velocity at the BESTVEL time tag. The velocity latency to be subtracted from the time tag is normally half the time between filter updates. Under default operation, the positioning filters are updated at a rate of 2 Hz. This average velocity translates into a velocity latency of 0.25 seconds.

To reduce the latency, increase the update rate of the positioning filter being used by requesting the BESTVEL or BESTPOS messages at a rate higher than 2 Hz. For example, a logging rate of 10 Hz would reduce the velocity latency to 0.05 seconds. For integration purposes, the velocity latency should be applied to the record time tag.

While the receiver is static, the velocity may jump several centimetres per second. If the velocity in the BESTVEL log comes from the pseudorange filter, it has been computed from instantaneous doppler measurements. You know that you have an instantaneous doppler velocity solution when you see PSRDIFF, WAAS, OMNISTAR or DOPPLER_VELOCITY in field #3 (*vel type*). The instantaneous doppler velocity has low latency and is not delta position dependent. If you change your velocity quickly, you can see this in the DOPPLER_VELOCITY solution. This instantaneous doppler velocity translates into a velocity latency of 0.15 seconds.

Message ID: **99**

Log Type: **Synch**

Recommended Input:

```
log bestvela ontime 1
```

ASCII Example:

```
#BESTVELA,COM1,0,61.0,FINESTEERING,1337,334167.000,00000000,827b,1984;
SOL_COMPUTED,PSRDIFF,0.250,4.000,0.0206,227.712486,0.0493,0.0*0e68bf05
```

Velocity (speed and direction) calculations are computed from either Doppler or carrier phase measurements rather than from pseudorange measurements. Typical speed accuracies are around 0.03m/s (0.07 mph, 0.06 knots).

Direction accuracy is derived as a function of the vehicle speed. A simple approach would be to assume a worst case 0.03 m/s cross-track velocity that would yield a direction error function something like:

$$d(\text{speed}) = \tan^{-1}(0.03/\text{speed})$$

For example, if you are flying in an airplane at a speed of 120 knots or 62 m/s, the approximate directional error will be:

$$\tan^{-1}(0.03/62) = 0.03 \text{ degrees}$$

Consider another example applicable to hiking at an average walking speed of 3 knots or 1.5 m/s. Using the same error function yields a direction error of about 1.15 degrees.

You can see from both examples that a faster vehicle speed allows for a more accurate heading indication. As the vehicle slows down, the velocity information becomes less and less accurate. If the vehicle is stopped, a GNSS receiver still outputs some kind of movement at speeds between 0 and 0.5 m/s in random and changing directions. This represents the random variation of the static position.

In a navigation capacity, the velocity information provided by your GNSS receiver is as, or more, accurate than that indicated by conventional instruments as long as the vehicle is moving at a reasonable rate of speed. It is important to set the GNSS measurement rate fast enough to keep up with all major changes of the vehicle's speed and direction. It is important to keep in mind that although the velocity vector is quite accurate in terms of heading and speed, the actual track of the vehicle might be skewed or offset from the true track by plus or minus 0 to 1.8 metres as per the standard positional errors.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTVEL header	Log header		H	0
2	sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	vel type	Velocity type, see *Table 56, Position or Velocity Type* on *page 303*	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 metres per second	Double	8	H+16
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	Double	8	H+32
9	Reserved		Float	4	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.12 BESTXYZ Best Available Cartesian Position and Velocity

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. See *Figure 10, page 317* for a definition of the ECEF coordinates.

See also the BESTPOS and BESTVEL logs on *pages 301 and 310* respectively.

These quantities are always referenced to the WGS84 ellipsoid, regardless of the use of the DATUM or USERDATUM commands.

Message ID: **241**
Log Type: **Synch**

Recommended Input:

log bestxyza ontime 1

ASCII Example:

```
#BESTXYZA,COM1,0,55.0,FINESTEERING,1419,340033.000,00000040,d821,2724;
SOL_COMPUTED,NARROW_INT,-1634531.5683,-3664618.0326,4942496.3270,
0.0099,0.0219,0.0115,SOL_COMPUTED,NARROW_INT,0.0011,-0.0049,-0.0001,
0.0199,0.0439,0.0230,"AAAA",0.250,1.000,0.000,12,11,11,11,0,01,0,33*e9eafeca
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P-Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H+44
11	vel type	Velocity type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m/s)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m/s)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m/s)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m/s)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m/s)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m/s)	Float	4	H+84
18	stn ID	Base station identification	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#SVs	Number of satellite vehicles tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+106
25	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+107
26	Reserved		Char	1	H+108
27	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+109
28	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

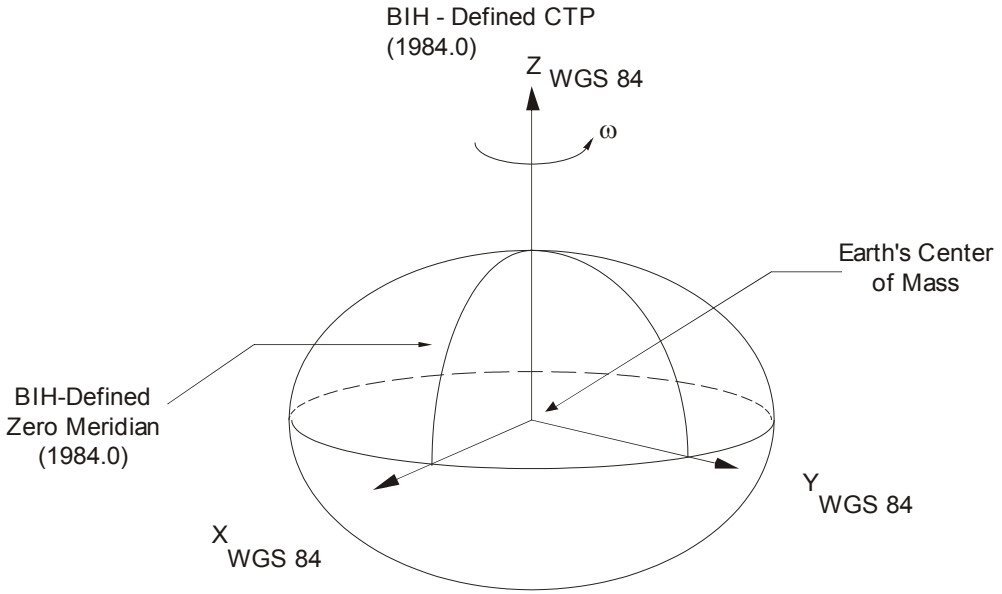
- Definitions - *

Origin = Earth's center of mass

Z-Axis = Parallel to the direction of the Conventional Terrestrial Pole (CTP) for polar motion, as defined by the Bureau International de l'Heure (BIH) on the basis of the coordinates adopted for the BIH stations.

X-Axis = Intersection of the WGS 84 Reference Meridian Plane and the plane of the CTP's Equator, the Reference Meridian being parallel to the Zero Meridian defined by the BIH on the basis of the coordinates adopted for the BIH stations.

Y-Axis = Completes a right-handed, earth-centered, earth-fixed (ECEF) orthogonal coordinate system, measured in the plane of the CTP Equator, 90° East of the X-Axis.



* Analogous to the BIH Defined Conventional Terrestrial System (CTS), or BTS, 1984.0.

Figure 10: The WGS84 ECEF Coordinate System

3.3.13 BSLNXYZ RTK XYZ Baseline

This log contains the receiver's RTK baseline in ECEF coordinates. The position status field indicates whether or not the corresponding data is valid. See *Figure 10, 317* for a definition of the ECEF coordinates.

The BSLNXYZ log comes from time-matched base and rover observations such as in the MATCHEDXYZ log on *page 421*.

Asynchronous logs, such as BSLNXYZ, should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Message ID: **686**

Log Type: **Asynch**

Recommended Input:

log bslnxyza onchanged

ASCII Example:

```
#BSLNXYZA,COM1,0,59.5,FINESTEERING,1419,340033.000,00000040,5b48,2724;
SOL_COMPUTED,NARROW_INT,0.0012,0.0002,-0.0004,0.0080,0.0160,0.0153,
"AAAA",12,12,12,12,0,01,0,33*1a8a1b65.
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BSLNXYZ header	Log header		H	0
2	sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	bsln type	Baseline type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+4
4	B-X	X-axis offset (m)	Double	8	H+8
5	B-Y	Y-axis offset (m)	Double	8	H+16
6	B-Z	Z-axis offset (m)	Double	8	H+24
7	B-X σ	Standard deviation of B-X (m)	Float	4	H+32
8	B-Y σ	Standard deviation of B-Y (m)	Float	4	H+36
9	B-Z σ	Standard deviation of B-Z (m)	Float	4	H+40
10	stn ID	Base station identification	Char[4]	4	H+44
11	#SVs	Number of satellite vehicles tracked	Uchar	1	H+48
12	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+49
13	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+50
14	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+51
15	Reserved		Uchar	1	H+52
16	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+53
17	Reserved		Hex	1	H+54
18	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+55
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+56
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.14 CHANCONFIGLIST Channel configuration list

This log provides the channel configuration list including the number of channels and signal types. If more than one channel configuration is available, then it can be switched using the SELECTCHANCONFIG command. For more information about the SELECTCHANCONFIG command, see page *213*.

Message ID: **1148**
Log Type: **Polled**

Recommended Input:

log chanconfiglista once

ASCII Example:

CHANCONFIGLIST COM1 0 94.0 FINESTEERING 1610 333241.675 00000000 D1C0 38637 1 2 2 16 GPSL1L2 4 SBASL1 2 16 GPSL1L2PL2C 4 SBASL1

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CHANCONFIGLIST header	Log header		H	0
2	SetInUse	Current channel configuration being used. For example, if SetInUse is 2 then the second channel configuration listed in this log is the current channel configuration	ULong	4	H
3	#chanconfigs	Number of channel configurations to follow	ULong	4	H+4
4	#signaltypes	Total number of signal types in this channel configuration	ULong	4	H+8
5	NumChans	Number of channels for individual signal type	ULong	4	H+12
6	SignalType	See *Table 64* on *page 321*	ULong	4	H+16
7..	Next chanconfig offset = H + 12+ 4* #signaltypes				
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+20
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 64: CHANCONFIGLIST Signal Type

Value	Name
0	GPSL1
1	GPSL1
4	SBASL1
5	GPSL5
6	GPSL1L2C
7	GPSL1L2AUTO
8	GLOL1L2
9	LBAND
10	GLOL1
11	GALE1
12	GALE5A
13	GALE5B
14	GALALTBOC
16	GPSL1L2PL2C
17	GPSL1L5
18	SBASL1L5
19	GPSL1L2PL2CL5
20	GPSL1L2PL5
21	GALE1E5AE5B
22	GALE1E5AE5BALTBOC
23	GALE1E5A
24	GLOL1L2C
25	GLOL1L2PL2C
26	QZSSL1CA
27	QZSSL1CAL2C
28	QZSSL1CAL2CL5
29	QZSSL1CAL5

3.3.15 CLOCKMODEL Current Clock Model Status

The CLOCKMODEL log contains the current clock model status of the receiver.

Monitoring the CLOCKMODEL log allows you to determine the error in your receiver reference oscillator as compared to the GNSS satellite reference.

All logs report GPS reference time not corrected for local receiver clock error. To derive the closest GPS reference time, subtract the clock offset from the GPS reference time reported. The clock offset can be calculated by dividing the value of the range bias given in field *6* of the CLOCKMODEL log by the speed of light (*c*).

The following symbols are used throughout this section:

B = range bias (m)

BR = range bias rate (m/s)

SAB = Gauss-Markov process representing range bias error due to satellite clock dither (m)

The standard clock model now used is as follows:

clock parameters array = [B BR SAB]

covariance matrix =

$$\begin{bmatrix} \sigma_B^2 & \sigma_B \sigma_{BR} & \sigma_B \sigma_{SAB} \\ \sigma_{BR} \sigma_B & \sigma_{BR}^2 & \sigma_{BR} \sigma_{SAB} \\ \sigma_{SAB} \sigma_B & \sigma_{SAB} \sigma_{BR} & \sigma_{SAB}^2 \end{bmatrix}$$

Table 65: Clock Model Status

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

Message ID: **16**
Log Type: **Synch**

Recommended Input:

log clockmodela ontime 1

ASCII Example:

```
#CLOCKMODELA,COM1,0,52.0,FINESTEERING,1364,489457.000,80000000,98f9,2310;
VALID,0,489457.000,489457.000,7.11142843e+00,6.110131956e-03,
-4.93391151e+00,3.02626565e+01,2.801659017e-02,-2.99281529e+01,
2.801659017e-02,2.895779736e-02,-1.040643538e-02,-2.99281529e+01,
-1.040643538e-02,3.07428979e+01,2.113,2.710235665e-02,FALSE*3d530b9a
```

The CLOCKMODEL log can be used to monitor the clock drift of an internal oscillator once the CLOCKADJUST mode has been disabled. Watch the CLOCKMODEL log to see the drift rate and adjust the oscillator until the drift stops.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CLOCKMODEL header	Log header		H	0
2	clock status	Clock model status as computed from current measurement data, see *Table 65, Clock Model Status* on *page 322*	Enum	4	H
3	reject	Number of rejected range bias measurements	Ulong	4	H+4
4	noise time	GPS reference time of last noise addition	GPSec	4	H+8
5	update time	GPS reference time of last update	GPSec	4	H+12
6	parameters	Clock correction parameters (a 1x3 array of length 3), listed left-to-right	Double	8	H+16
7				8	H+24
8				8	H+32
9	cov data	Covariance of the straight line fit (a 3x3 array of length 9), listed left-to-right by rows	Double	8	H+40
10				8	H+48
11				8	H+56
12				8	H+64
13				8	H+72
14				8	H+80
15				8	H+88
16				8	H+96
17				8	H+104
18	range bias	Last instantaneous measurement of the range bias (metres)	Double	8	H+112
19	range bias rate	Last instantaneous measurement of the range bias rate (m/s)	Double	8	H+120
20	change	Is there a change in the constellation? 0 = FALSE 1 = TRUE	Enum	4	H+128
21	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+132
22	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.16 CLOCKSTEERING Clock Steering Status

The CLOCKSTEERING log is used to monitor the current state of the clock steering process. All oscillators have some inherent drift. By default the receiver attempts to steer the receiver's clock to accurately match GPS reference time. If for some reason this is not desired, this behavior can be disabled using the CLOCKADJUST command, see *page 83*.

If the CLOCKADJUST command is ENABLED and the receiver is configured to use an external reference frequency (set in the EXTERNALCLOCK command, see *page 116*, for an external clock - TCXO, =OCXO, RUBIDIUM, CESIUM or USER), then the clock steering process takes over the VARF output pins and may conflict with a previously entered FREQUENCYOUT command, see *page 126*.

Message ID: **26**

Log Type: **Asynch**

Recommended Input:

log clocksteeringa onchanged

ASCII Example:

```
#CLOCKSTEERINGA,COM1,0,56.5,FINESTEERING,1337,394857.051,00000000,0f61,1984;
INTERNAL,SECOND_ORDER,4400,1707.554687500,0.029999999,-2.000000000,-0.224,
0.060*0e218bbc
```

To configure the receiver to use an external reference oscillator, see the EXTERNALCLOCK command on *page 116*.

Table 66: Clock Source

Binary	ASCII	Description
0	INTERNAL	The receiver is currently steering its internal VCTCXO using an internal VARF signal
1	EXTERNAL	The receiver is currently steering an external oscillator using the external VARF signal

Table 67: Steering State

Binary	ASCII	Description
0	FIRST_ORDER	Upon start-up, the clock steering task adjusts the VARF pulse width to reduce the receiver clock drift rate to below 1 ms using a 1st order control loop. This is the normal start-up state of the clock steering loop.
1	SECOND_ORDER	Once the receiver has reduced the clock drift to below 1 m/s, it enters a second order control loop and attempts to reduce the receiver clock offset to zero. This is the normal runtime state of the clock steering process.
2	CALIBRATE_HIGH [a]	This state corresponds to when the calibration process is measuring at the "High" pulse width setting.
3	CALIBRATE_LOW [a]	This state corresponds to when the calibration process is measuring at the "Low" pulse width setting.
4	CALIBRATE_CENTER [b]	This state corresponds to the "Center" calibration process. Once the center has been found, the modulus pulse width, center pulse width, loop bandwidth and measured slope values are saved in NVM and are used from now on for the currently selected oscillator (INTERNAL or EXTERNAL).

a. These states are only seen if you force the receiver to do a clock steering calibration using the CLOCKCALIBRATE command, see *page 85*. With the CLOCKCALIBRATE command, you can force the receiver to calibrate the slope and center pulse width of the currently selected oscillator, to steer. The receiver measures the drift rate at several "High" and "Low" pulse width settings.

b. After the receiver has measured the "High" and "Low" pulse width setting, the calibration process enters a "Center calibration" process where it attempts to find the pulse width required to zero the clock drift rate.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CLOCKSTEERING header	Log header		H	0
2	source	Clock source, see *Table 66, Clock Source* on *page 325*	Enum	4	H
3	steeringstate	Steering state, see *Table 67, Steering State* on *page 326*	Enum	4	H+4
4	period	Period of the FREQUENCYOUT signal used to control the oscillator, refer to the FREQUENCYOUT command. This value is set using the CLOCKCALIBRATE command	Ulong	4	H+8
5	pulsewidth	Current pulse width of the FREQUENCYOUT signal. The starting point for this value is set using the CLOCKCALIBRATE command. The clock steering loop continuously adjusts this value in an attempt to drive the receiver clock offset and drift terms to zero	Double	8	H+12
6	bandwidth	The current band width of the clock steering tracking loop in Hz. This value is set using the CLOCKCALIBRATE command	Double	8	H+20
7	slope	The current clock drift change in m/s/bit for a 1 LSB pulse width. This value is set using the CLOCKCALIBRATE command	Float	4	H+28
8	offset	The last valid receiver clock offset computed (m). It is the same as Field # 18 of the CLOCKMODEL log, see *page 318*	Double	8	H+32
9	driftrate	The last valid receiver clock drift rate received (m/s). It is the same as Field # 19 of the CLOCKMODEL log	Double	8	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.17 CMR Standard Logs

CMRDESC	**BASE STATION DESCRIPTION INFORMATION**
Message ID:	**310**
CMRGLOOBS	**CMR DATA GLONASS OBSERVATIONS (CMR TYPE 3 MESSAGE)**
Message ID:	**882**
CMROBS	**BASE STATION SATELLITE OBSERVATION INFORMATION**
Message ID:	**103**
CMRPLUS	**BASE STATION POSITION INFORMATION (LOW RATE)**
Message ID:	**717**
CMRREF	**BASE STATION POSITION INFORMATION**
Message ID:	**105**

The Compact Measurement Record (CMR) Format is a standard communications protocol used in Real-Time Kinematic (RTK) systems to transfer GNSS carrier phase and code observations from a base station to one or more rover stations.

1. The above messages can be logged with an A or B suffix for an ASCII or Binary output with a NovAtel header followed by Hex or Binary raw data respectively.
2. No guarantee is made that the OEM6 will meet its performance specifications if non-NovAtel equipment is used.
3. Trimble rovers must receive CMRDESC messages from a base.

The CMR message format was developed by Trimble Navigation Ltd. as a proprietary data transmission standard for use in RTK applications. In 1996, Trimble publicly disclosed this standard and allowed its use by all manufacturers in the GNSS industry[1].

The NovAtel implementation allows a NovAtel rover receiver to operate in RTK mode while receiving pseudorange and carrier phase data via CMR messages (version 3.0) from either a NovAtel or non-NovAtel base-station receiver. The NovAtel receiver can also transmit CMR messages (version 3.0). The station ID must be ≤ 31 when transmitting CMR corrections. The CMRPLUS output message distributes the base station information over 14 updates (see *page 328*).

The maximum message lengths of the four CMR messages are as follows:

CMROBS = 6 *(frame)* + 6 *(header)* + (14*L1 channels) + (14*L2 channels) = (222 bytes max.)

CMRREF = 6 *(frame)* + 6 *(header)* + 19 = (31 bytes)

CMRDESC = 6 (*frame*) + 6 (*header*) + (variable: 26 to 75) = (38 bytes minimum; 87 bytes max.)

CMRPLUS = 6 (*frame*) + 3 (*header*) + 7 = (16 bytes)

1. Talbot, N.C. (1996) “Compact Data Transmission Standard for High-Precision GPS”. ION GPS-96 Conference Proceedings, Kansas, MO, Sept. 1996, Vol. I, pp. 861-871.

CMR Type 3 RTK Formats

NovAtel CMR Type 3 messages are CMR Type 3 messages as defined by Leica and Topcon.

CMR Type 3 format messages are for GLONASS CMR observations. The CMRGLOOBS log is similar to the existing CMROBS log. See also *CMR Standard Logs* starting on *page 328*.

CMR Type 3 message types (CMRGLOOBS) have their Z count stamped to GLONASS UTC time instead of GPS reference time (the *epoch* field in the CMR Header part of the message).

When you use CMRGLOOBS in conjunction with CMRREF and CMROBS, you can perform GPS + GLONASS RTK positioning (provided you have a GLONASS-capable receiver model).

CMR Type 3 Example Setup

In the example below, apply *Steps #1* and *#2* to the base and *Step #3* to the rover.

1. Use the INTERFACEMODE command to set up the base port's receive mode as NONE and transmit mode as CMR:

```
interfacemode com2 none cmr
```

2. Log out CMRREF, CMROBS and CMRGLOOBS [1] messages:

```
log com2 CMRREF ontime 10
log com2 CMROBS ontime 1
log com2 CMRGLOOBS ontime 1
log com2 CMRDDESC ontime 10
```

We recommend that you log CMROBS and CMRGLOOBS messages out at the same rate.

3. Set up the rover receiver to use incoming CMR messages by setting the rover port's receive mode as CMR and the transmit mode as NONE:

```
interfacemode com2 CMR none
```

Using AdVance RTK with CMR Format Messages

To enable receiving CMR messages, follow these steps:

1. Issue the SERIALCONFIGcommand, see *page 218*, to the rover receiver to set its serial port parameters to the proper bit rate parity and so on.
2. Issue the "INTERFACEMODE COMn CMR" command to the rover receiver, where "COMn" refers to the communication port that is connected to the data link. See also *page 146*.

1. These correspond to reference station data, GPS observations and GLONASS observations respectively.

To send CMR messages, periodically transmit the three following CMR messages at the base station:

- A CMROBS message that contains base station satellite observation information. It should be sent once every 1 or 2 seconds.
- A CMRREF message that contains base station position information. It should be sent once every 10 seconds. Also, the rover receiver automatically sets an approximate position from this message if it does not already have a position. Therefore, this message can be used in conjunction with an approximate time to improve Time to First Fix (TTFF). For more information about TTFF, refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.
- A CMRDESC message that contains base station description information. It should be sent once every 10 seconds and be interlinked with the CMRREF message.

Assuming that the base station is transmitting valid data, your rover receiver begins to operate in AdVance RTK mode.

1. For CMR, the station ID must be less than 31 (refer to the DGPSTXID and RTKSOURCE commands on *pages 103* and *203* respectively).
2. CMRDESC is logged with an offset of 5 to allow interleaving with CMRREF. Note that Trimble rovers must receive CMRDESC messages from a base.
3. NovAtel CMR Type 2 messages are for compatibility only. Type 2 provides a reference station description message that is required by some manufacturers' rovers before CMR messages are used. When received, a Type 2 message is discarded. For transmission, all fields are permanently set as follows:

Record Length	=	33 bytes
Short Station ID	=	"cref"
COGO Code	=	""
Long Station ID	=	"UNKNOWN"

Example Input:

```
interfacemode com2 none CMR
fix position 51.116372360734  -114.038308797   1047.575
log com2 cmrobs ontime 1
log com2 cmrref ontime 10
log com2 cmrdesc ontime 10 5
log com2 cmrgloobs ontime 1
```

3.3.18 COMCONFIG

This has been replaced with SERIALCONFIG. See page *218* for more information.

3.3.19 DIFFCODEBIASES Differential code biases being applied

This log outputs the differential code biases that are being applied to the L1/L2 ionospheric corrections.

Message ID: **914**
Log Type: **Polled**

Recommended Input:

log diffcodebiases once

ASCII example:

```
#DIFFCODEBIASESA,COM1,0,61.5,UNKNOWN,0,4294967.295,004c0000,15ba,35548;
1,GPS_C1P1,-0.472,-0.006,-0.482,1.154,-1.153,0.250,-1.319,-0.535,0.119,
-1.945,0.522,1.425,1.489,0.090,0.000,-0.727,1.361,-0.416,-2.066,-1.347,
-0.380,0.543,0.414,-0.172,0.394,0.923,-0.422,-0.326,0.481,1.937,1.753,
-1.088,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000*417eef8e0
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	DIFFCODE-BIASES header	Log header		H	0
2	#bias_sets	Number of sets of bias code arrays	Long	4	H
3	bias_type	Bias type (there is currently only one type): 0 = GPS_C1P1	Enum	4	H+4
4	bias_array	Array of 40 biases (ns)	Float[40]	160	H+8
5	next bias_sets offset = H + 4 + (#bias_sets x 164)				
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#bias_sets x 164)
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.20 ETHSTATUS Current Ethernet status

This log provides the current status of the Ethernet ports.

Message ID: **1288**
Log Type: **Async**

Recommended Input:

```
log ethstatusa once
```

ASCII Example:

```
#ethstatusa,com1,0,89.5,finesteering,1609,500138.174,00000000,e89d,6259;1,etha,"00-21-66-00-05-a2",100_full*98d86b04
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	ETHSTATUS Header	Log header	-	H	0
2	#of interfaces	Number of records to follow	Ulong	4	H
3	interface	Name of the Ethernet interface (e.g., ETHA)	Enum	4	H+4
4	MAC address	This is an identifier assigned to your network adapters or network interface card	String	18	H+8
5	interface configuration	Current connectivity, speed and duplex settings of the Ethernet interface	Enum	4	H+26
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.21 GALALMANAC Decoded Galileo Almanac

This log contains the decoded Galileo almanac parameters from Galileo navigation messages.

> This log is not finalized and is subject to change.

Message ID: 1120

Log Type: Asynch

Recommended Input:

log galalmanaca onchanged

ASCII Example:

```
#GALALMANACA,COM1,0,86.0,SATTIME,1687,97061.000,00000020,131f,10636;12,FALSE,
TRUE,3,0,3,0,8,662,0.000,0.000427246,0.000000000,-1.622568178,-
1.188643363,2.904976117,0.000000000,0.000000000,0.029296875,-
0.021475731*ae4cb6ad
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	GALALMANAC header	Log header		H	0
2	SatId	Satellite ID	ULONG	4	H
3	FNAVReceived	Indicates FNAV almanac data received	BOOL	4	H+4
4	INAVReceived	Indicates INAV almanac data 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	E5bHealth	E5b health status bits (only valid if INAVReceived is TRUE)	UCHAR	1	H+14
8	Reserved1		UCHAR	1	H+15
9	IODa	Almanac issue of data	ULONG	4	H+16
10	Weeks	Almanac reference week	ULONG	4	H+20
11	Seconds	Almanac reference time of week	ULONG	4	H+24
12	Ecc	Eccentricity	DOUBLE	8	H+28
13	OmegaDot	Rate of right ascension	DOUBLE	8	H+36
14	Omega0	Right ascension	DOUBLE	8	H+44
15	Omega	Argument of perigee	DOUBLE	8	H+52

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
16	M0	Mean anomaly at ref time	DOUBLE	8	H+60
17	Af0	Satellite clock correction bias	DOUBLE	8	H+68
18	Af1	Satellite clock correction linear	DOUBLE	8	H+76
19	DeltaRootA	Difference with respect to the square root of the nominal semi-major axis	DOUBLE	8	H+84
20	DeltaI	Inclination at reference time relative to I0 = 56 deg	DOUBLE	8	H+92
21	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+100
22	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.22 GALCLOCK Galileo Clock Information

This log contains the Galileo time information.

> This log is not finalized and is subject to change.

Message ID: 1121

Log Type: Asynch

Recommended Input:

log galclocka onchanged

ASCII Example:

```
#GALCLOCKA,COM1,0,80.0,SATTIME,1697,258218.000,00440008,c6cf,43378;0.00000000
0,0.000000000,0,172800,161,159,2,0,0.000000000,0.000000000,172800,33*de47eaa6
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	GALCLOCK header	Log header		H	0
2	A0	Constant term of polynomial	DOUBLE	8	H
3	A1	1st order term of polynomial	DOUBLE	8	H+8
4	DeltaTls	Leap second count before leap second adjustment	LONG	4	H+16
5	Tot	UTC data reference time of week (seconds)	ULONG	4	H+20
6	WNt	UTC data reference week number	ULONG	4	H+24
7	WNlsf	Week number of leap second adjustment	ULONG	4	H+28
8	DN	Day number at the end of which a leap second adjustment becomes effective	ULONG	4	H+32
9	DeltaTlsf	Leap second count after leap second adjustment	LONG	4	H+36
10	A0g	Constant term of the polynomial describing the difference between Galileo and GPS time	DOUBLE	8	H+40
11	A1g	Rate of change of offset the offset between Galileo and GPS time	DOUBLE	8	H+48
12	T0g	Reference time for GGTO data	ULONG	4	H+56
13	WN0g	Week number of GGTO reference	ULONG	4	H+60
14	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+64
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.23 GALEPHEMERIS Decoded Galileo Ephemeris

This log contains Galileo ephemeris information.

> This log is not finalized and is subject to change.

Message ID: 1122

Log Type: Asynch

Recommended Input:

log galephemerisa onchanged

ASCII Example:

```
#GALEPHEMERISA,COM1,1,85.0,SATTIME,1686,508885.000,00000020,ddc6,10636;11,FAL
SE,TRUE,3,0,3,1,0,1,25,0,389,0,5440.605978012,3.546933458e-
09,1.894459743,0.000357608,-
0.880788993,0.000000000,0.000000000,0.000000000,0.000000000,0.000000000,0.000
000000,0.954963899,-4.143029717e-10,-1.620531946,-5.825956960e-
09,0,0.000000000,0.000000000,0.000000000,0,0.000000000,0.000000000,0.00000000
0,0.000000000,0.000000000*9b04af0f
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	GALEPHEMERIS header	Log header		H	0
2	SatId	Satellite ID	ULONG	4	H
3	FNAVReceived	Indicates FNAV ephemeris data received	BOOL	4	H+4
4	INAVReceived	Indicates INAV ephemeris data 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	E5bHealth	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 INAVReceived is TRUE)	UCHAR	1	H+17
11	SISA	Signal in space accuracy	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

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
15	RootA	Square root of semi-major axis	DOUBLE	8	H+28
16	DeltaN	Mean motion difference (radians/s)	DOUBLE	8	H+36
17	M0	Mean anomaly at ref time (radians)	DOUBLE	8	H+44
18	Ecc	Eccentricity (unitless)	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 argument of latitude (radians)	DOUBLE	8	H+68
21	Cus	Amplitude of the sine harmonic correction term to the argument 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	Inclination angle at ref time (radians)	DOUBLE	8	H+116
27	IDot	Rate of inclination angle (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	8	H+140
30	FNAVT0c	Clock correction data reference time of week from the F/NAV message (s). Only valid if FNAVReceived is TRUE	ULONG	4	H+148
31	FNAVAf0	SV clock bias correction coefficient from the F/NAV message (s). Only valid if FNAVReceived is TRUE	DOUBLE	8	H+152
32	FNAVAf1	SV clock drift correction coefficient from the F/NAV message (s/s). Only valid if FNAVReceived is TRUE	DOUBLE	8	H+160
33	FNAVAf2	SV clock drift rate correction coefficient from the F/NAV message (s/s^2). Only valid if FNAVReceived is TRUE	DOUBLE	8	H+168
34	INAVT0c	Clock correction data reference time of week from the I/NAV message (s). Only valid if INAVReceived is TRUE	ULONG	4	H+176
35	INAVAf0	SV clock bias correction coefficient from the I/NAV message (s). Only valid if INAVReceived is TRUE	DOUBLE	8	H+180

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
36	INAVAf1	SV clock drift correction coefficient from the I/NAV message (s/s). Only valid if INAVReceived is TRUE	DOUBLE	8	H+188
37	INAVAf2	SV clock drift rate correction coefficient from the I/NAV message (s/s^2). Only valid if INAVReceived is TRUE	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 INAVReceived 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)	-	-	-

3.3.24 GALFNAVRAWPAGE Raw Galileo F/NAV page data

This log contains the raw Galileo F/Nav page data.

> This log is not finalized and is subject to change.

Message ID: 1413

Log Type: Asynch

Recommended Input:

log galfnavrawpagea onchanged

ASCII Example:

```
#GALFNAVRAWPAGEA,USB3,0,85.0,SATTIME,1680,434410.000,00000008,d4fb,43274;56,1
1,0b818df50ad5ffc151001baffdaa04d5dae655e17affc8a41a83aa*5955b14d
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	GALFNAVRAWPAGE header	Log header		H	0
2	SigChanNum	Signal channel providing the data	ULONG	4	H
3	SatId	SVID of transmitting satellite	ULONG	4	H+4
4	RawFrameData	Raw F/NAV page (214 bits). Does not include CRC or Tail bits	UCHAR	27	H+8
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+35
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.25 GALINAVRAWWORD Raw Galileo I/NAV word data

This log contains the raw Galileo I/Nav word data.

> This log is not finalized and is subject to change.

Message ID: 1414
Log Type: Asynch

Recommended Input:

log galinavrawworda onchanged

ASCII Example:

```
#GALINAVRAWWORDA,USB3,0,84.5,SATTIME,1680,434401.000,00000008,884b,43274;55,1
1,GALE1,0b81e655e17a26eb5237d7d20088ffc9*dcb4bedb
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	GALINAVRAWWORD header	Log header		H	0
2	SigChanNum	Signal channel providing data	ULONG	4	H
3	SatId	SVID of transmitting satellite	ULONG	4	H+4
4	SignalType	Signal Type as defined in Table 18, Page 108	ENUM	4	H+8
5	RawFrameData	Raw I/NAV word (128 bits)	UCHAR	16	H+12
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+28
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.26 GALIONO Decoded Galileo Ionospheric Corrections

This log contains the decoded Galileo ionospheric corrections.

> This log is not finalized and is subject to change.

Message ID: 1127

Log Type: Asynch

Recommended Input:

log galionoa onchanged

ASCII Example:

```
#GALIONOA,COM1,0,84.0,SATTIME,1686,503485.000,00000020,d22e,10636;100.000000
00,0.000000000,0.000000000,0,0,0,0,0*5215b367
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	GALIONO header	Log header		H	0
2	Ai0	Effective ionisation level 1st order parameter (sfu)	DOUBLE	8	H
3	Ai1	Effective ionisation level 2st order parameter (sfu/degree)	DOUBLE	8	H+8
4	Ai2	Effective ionisation level 3st order parameter (sfu/degree^2)	DOUBLE	8	H+16
5	SF1	Ionospheric disturbance flag for region 1	UCHAR	1	H+24
6	SF2	Ionospheric disturbance flag for region 2	UCHAR	1	H+25
7	SF3	Ionospheric disturbance flag for region 3	UCHAR	1	H+26
8	SF4	Ionospheric disturbance for flag region 4	UCHAR	1	H+27
9	SF5	Ionospheric disturbance for flag region 5	UCHAR	1	H+28
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+29
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.27 GLMLA NMEA GLONASS Almanac Data

This log outputs almanac data for GLONASS satellites. Multiple sentences are transmitted, one for each satellite.

GLONASS satellites:

GLO PRN# $_{\text{NovAtel}}$ = GLO PRN# $_{\text{NMEA}}$ - 24

Slot# $_{\text{To match NovAtel format logs or GLONASS status website}}$ = GLO PRN# $_{\text{NMEA}}$ -24 -37

Message ID: **859**
Log Type: **Asynch**

Recommended Input:

log glmlaa onchanged

ASCII Example:

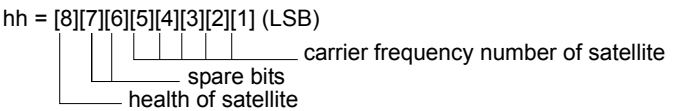
```
$GLMLA,16,01,65,1176,07,0496,4c,5ff2,8000,34c05e,0e93e8,04b029,001fa2,099,213*68
$GLMLA,16,02,66,1176,01,12e3,4c,42cc,8000,34c08e,10fae9,02f48c,00224e,099,003*64
$GLMLA,16,03,67,1176,8c,08f6,4a,ef4d,8000,34c051,13897b,00d063,001b09,099,000*63
$GLMLA,16,04,68,1176,06,116b,48,3a00,8000,34c09d,02151f,0e49e8,00226e,099,222*63
$GLMLA,16,05,70,1176,01,140f,49,45c4,8000,34c0bc,076637,0a3e40,002214,099,036*37
$GLMLA,16,06,71,1176,05,0306,4c,5133,8000,34c025,09bda7,085d84,001f83,099,21d*6E
$GLMLA,16,07,72,1176,06,01b1,4c,4c19,8000,34c021,0c35a0,067db8,001fca,099,047*3D
$GLMLA,16,08,74,1176,84,076b,45,7995,8000,34c07b,104b6d,0e1557,002a38,099,040*35
$GLMLA,16,09,78,1176,84,066c,46,78cf,8000,34c07b,0663f0,1a6239,0029df,099,030*38
$GLMLA,16,10,79,1176,80,0afc,45,8506,8000,34c057,08de48,1c44ca,0029d7,099,000*6B
$GLMLA,16,11,82,1176,8a,12d3,0f,e75d,8000,34be85,10aea6,1781b7,00235a,099,207*6E
$GLMLA,16,12,83,1176,03,0866,0f,6c08,8000,34c009,11f32e,18839d,002b22,099,214*36
$GLMLA,16,13,85,1176,88,01a6,0d,9dc9,8000,34bff8,031887,02da1e,002838,099,242*6D
$GLMLA,16,14,86,1176,8a,00e1,0e,4b15,8000,34c016,058181,010433,0027f0,099,227*6F
$GLMLA,16,15,87,1176,03,0383,0f,824c,8000,34bfda,081864,1104ea,002b04,099,00c*60
$GLMLA,16,16,88,1176,02,0821,0f,8ac8,8000,34c05b,0a8510,12dcb6,002b6f,099,020*3F
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

Field	Structure	Field Description	Symbol	Example
1	$GLMLA	Log header		$GLMLA
2	#alm	Number of NMEA almanac messages in the set	x.x	16
3	alm#	Current message number	x.x	13
4	slot	Slot number for satellite (65-96) [a]	xx	85
5	N	Calendar day count within the four year period from the last leap year	x.x	1176
6	hlth & freq	Health and frequency for satellite [b]	hh	88
7	ecc	Eccentricity [c]	hhhh	01a6
8	ΔTdot	Rate of change of orbital period (s/orbital period^2) [c]	hh	0d
9	ω	Argument of perigee (PZ-90.02), in radians [c]	hhhh	9dc9
10	τ_{16MSB}	Clock offset, in seconds [c]	hhhh	8000
11	ΔT	Correction to the mean value of the Draconian period (s/orbital period) [c]	hhhhhh	34bff8
12	tλ	GLONASS Time of ascending node equator crossing, in seconds [c]	hhhhhhh	031887
13	λ	Longitude of ascending node equator crossing (PZ-90.02), in radians [c]	hhhhhhh	02da1e
14	Δi	Correction to nominal inclination, in radians [c]	hhhhhhh	002838
15	τ_{12LSB}	Clock offset, in seconds [c]	hhh	099
16	t	Coarse value of the time scale shift [c]	hhh	242
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	*6D
18	[CR][LF]	Sentence terminator (ASCII only)	-	[CR][LF]

a. The NMEA GLONASS PRN numbers are 64 plus the GLONASS slot number. Current slot numbers are 1 to 24 which give the range 65 to 88. PRN numbers 89 to 96 are available if slot numbers above 24 are allocated to on-orbit spares.

b. Health and carrier frequency numbers are represented in this 2-character Hex field as:



c. The LSB of the Hex data field corresponds to the LSB of the word indicated in the Table 4.3 of the GLONASS Interface Control Document, 1995. If the number of available bits in the Hex field is greater than the word, the MSB (upper bits) are unused and filled with zeroes.

3.3.28 GLOALMANAC Decoded GLONASS Almanac

The GLONASS almanac reference time and week are in GPS reference time coordinates. GLONASS ephemeris information is available through the GLMLA log (*page 343*).

Nominal orbit parameters of the GLONASS satellites are as follows:

- Draconian period - 11 hours 15 minutes 44 seconds (see fields 14 and 15 in the following table)
- Orbit altitude - 19100 km
- Inclination - 64.8 (see field 11)
- Eccentricity - 0 (see field 12)

Message ID: **718**
Log Type: **Asynch**

Recommended Input:

log gloalmanaca onchanged

ASCII Example:

```
#GLOALMANACA,COM1,0,52.5,SATTIME,1364,410744.000,00000000,ba83,2310;
24,
1364,336832.625,1,2,0,0,2018.625000000,-2.775537500,0.028834045,0.001000404,
2.355427500,-2656.076171875,0.000000000,0.000091553,
1364,341828.437,2,1,0,0,7014.437500000,-3.122226146,0.030814438,0.004598618,
1.650371580,-2656.160156250,0.000061035,0.000095367,
1364,347002.500,3,12,0,0,12188.500000000,2.747629236,0.025376596,0.002099991,
-2.659059822,-2656.076171875,-0.000061035,-0.000198364,
1364,351887.125,4,6,0,0,17073.125000000,2.427596502,0.030895332,0.004215240,
1.438586358,-2656.167968750,-0.000061035,0.000007629,
.
.
.
1364,364031.187,23,11,0,1,29217.187500000,0.564055522,0.030242192,
0.001178741,2.505278248,-2655.957031250,0.000366211,0.000019073,
1364,334814.000,24,3,0,1,0.000000000,0.000000000,0.000000000,0.000000000,
0.000000000,0.000000000,0.000000000,0.000000000*4dc981c7
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLOALMANAC header	Log header		H	0
2	#recs	The number of GLONASS almanac records to follow. Set to zero until almanac data is available	Long	4	H
3	week	GPS reference week, in weeks	Ulong	4	H+4
4	time	GPS reference time, in milliseconds (binary data) or seconds (ASCII data)	GPSec	4	H+8
5	slot	Slot number for satellite, ordinal	Uchar	1	H+12
6	frequency	Frequency for satellite, ordinal (frequency channels are in the range -7 to +6)	Char	1	H+13
7	sat type	Satellite type where 0 = GLO_SAT 1 = GLO_SAT_M (M type) 2 = GLO_SAT_K (K type)	Uchar	1	H+14
8	health	Almanac health where 0 = GOOD 1 = BAD	Uchar	1	H+15
9	TlambdaN	GLONASS Time of ascending node equator crossing, in seconds	Double	8	H+16
10	lambdaN	Longitude of ascending node equator crossing (PZ-90.02), in radians	Double	8	H+24
11	deltaI	Correction to nominal inclination, in radians	Double	8	H+32
12	ecc	Eccentricity	Double	8	H+40
13	ArgPerig	Argument of perigee (PZ-90.02), in radians	Double	8	H+48
14	deltaT	Correction to the mean value of the Draconian period (s/orbital period)	Double	8	H+56
15	deltaTD	Rate of change of orbital period (s/orbital period^2)	Double	8	H+64
16	tau	Clock offset, in seconds	Double	8	H+72
17...	Next message offset = H + 4 + (#recs x 76)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4 + (76 x #recs)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.29 GLOCLOCK GLONASS Clock Information

This log contains the time difference information between GPS and GLONASS time as well as status flags. The status flags are used to indicate the type of time processing used in the least squares adjustment. GPS and GLONASS time are both based on the Universal Time Coordinated (UTC) time scale with some adjustments. GPS reference time is continuous and does not include any of the leap second adjustments to UTC applied since 1980. The result is that GPS reference time currently leads UTC time by 15 seconds.

GLONASS time applies leap seconds but is also three hours ahead to represent Moscow time. The nominal offset between GPS and GLONASS time is therefore due to the three hour offset minus the leap second offset. As well as the nominal offset, there is a residual offset on the order of nanoseconds which must be estimated in the least squares adjustment. The GLONASS-M satellites broadcasts this difference in the navigation message.

This log also contains information from the GLONASS navigation data relating GLONASS time to UTC.

Message ID: **719**
Log Type: **Asynch**

Recommended Input:

log gloclocka onchanged

ASCII Example:

```
#GLOCLOCKA,COM1,0,54.5,SATTIME,1364,411884.000,00000000,1d44,2310;
0,0.000000000,0.000000000,0,0,-0.000000275,792,-0.000001207,
0.000000000,0.000000000,0*437e9afaf
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLOCLOCK header	Log header		H	0
2	Reserved		Ulong	4	H
3			Double	8	H+4
4			Double	8	H+12
5	sat type	Satellite type where 0 = GLO_SAT 1 = GLO_SAT_M (M type) 2 = GLO_SAT_K (K type)	Uchar	1	H+20
6	N^4	Four-year interval number starting from 1996	Uchar	1 [a]	H+21 [a]
7	τ_{GPS}	Correction to GPS time relative to GLONASS time	Double	8	H+24
8	N^A	GLONASS calendar day number within a four year period beginning since the leap year, in days	Ushort	2 [a]	H+32 [a]
9	τ_C	GLONASS time scale correction to UTC(SU) given at beginning of day N4, in seconds	Double	8	H+36
10	b1	Beta parameter 1st order term	Double	8	H+44
11	b2	Beta parameter 2nd order term	Double	8	H+52
12	Kp	Kp provides notification of the next expected leap second. For more information, see *Table 68*	Uchar	1	H+60
13	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+61
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional bytes of padding are added to maintain 4-byte alignment.

Table 68: Kp UTC Leap Second Descriptions

Kp	Information on UTC Leap Second[a]
00	No UTC update for this quarter
01	UTC update of plus 1 second at the end of current quarter
11	UTC update of minus 1 second at end of current quarter

a. Based on GLONASS ICD version 5.1, 2008.

3.3.30 GLOEPHEMERIS Decoded GLONASS Ephemeris

This log contains GLONASS ephemeris information. GLONASS ephemerides are referenced to the PZ90.02 geodetic datum. No adjustment between the GPS and GLONASS reference frames are made for positioning.

Message ID: **723**
Log Type: **Asynch**

Recommended Input:

log gloephemerisa onchanged

Example:

```
#GLOEPHEMERISA,COM1,3,49.0,SATTIME,1364,413624.000,00000000,6b64,2310;
43,8,1,0,1364,413114000,10786,792,0,0,87,0,9.0260864257812500e+06,
-6.1145468750000000e+06,2.2926090820312500e+07,1.4208841323852539e+03,
2.8421249389648438e+03,1.9398689270019531e+02,0.0000000000000000,
-2.7939677238464355e-06,-2.7939677238464355e-06,2.1240487694740295e-04,
-1.396983862e-08,-3.6379788070917129e-12,78810,3,15,0,12*a02ce18b
#GLOEPHEMERISA,COM1,2,49.0,SATTIME,1364,413626.000,00000000,6b64,2310;
44,11,1,0,1364,413116000,10784,792,0,0,87,13,-1.2882617187500000e+06,
-1.9318657714843750e+07,1.6598909179687500e+07,9.5813846588134766e+02,
2.0675134658813477e+03,2.4769935607910156e+03,2.7939677238464355e-06,
-3.7252902984619141e-06,-1.8626451492309570e-06,6.4836814999580383e-05,
-4.656612873e-09,3.6379788070917129e-12,78810,3,15,3,28*e2d5ef15
#GLOEPHEMERISA,COM1,1,49.0,SATTIME,1364,413624.000,00000000,6b64,2310;
45,13,0,0,1364,413114000,10786,0,0,0,87,0,-1.1672664062500000e+07,
-2.2678505371093750e+07,4.8702343750000000e+05,-1.1733341217041016e+02,
1.3844585418701172e+02,3.5714883804321289e+03,2.7939677238464355e-06,
-2.7939677238464355e-06,0.0000000000000000,-4.5316293835639954e-05,
5.587935448e-09,-2.3646862246096134e-11,78810,0,0,0,8*c15abfeb
#GLOEPHEMERISA,COM1,0,49.0,SATTIME,1364,413624.000,00000000,6b64,2310;
59,17,0,0,1364,413114000,10786,0,0,0,87,0,-2.3824853515625000e+05,
-1.6590188964843750e+07,1.9363733398437500e+07,1.3517074584960938e+03,
-2.2859592437744141e+03,-1.9414072036743164e+03,1.8626451492309570e-06,
-3.7252902984619141e-06,-1.8626451492309570e-06,7.9257417449264526e-05,
4.656612873e-09,2.7284841053187847e-12,78810,0,0,0,12*ed7675f5
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS > GNSS Book*.

Table 69: GLONASS Ephemeris Flags Coding

N 0 <- <- Nibble Number							
4	3	2	1	0	Bit	Description	Range Values	Hex Value
				lsb = 0	0	P1 FLAG - TIME INTERVAL BETWEEN ADJACENT iSSUE(tb) VALUES	See Table below (*Table 70*)	00000001
					1			00000002
					2	P2 FLAG - ODDNESS OR EVENNESS OF iSSUE(tb) VALUE	0 = even, 1 = odd	00000004
					3	P3 FLAG - NUMBER OF SATELLITES WITH ALMANAC INFORMATION WITHIN CURRENT SUBFRAME	0 = four, 1 = five	00000008
					4 : 31	RESERVED (N-1 through N-7)		

Table 70: *Bits 0 - 1: P1 Flag Range Values*

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

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLO-EPHEMERIS header	Log header		H	0
2	sloto	Slot information offset - PRN identification (Slot + 37). This is also called SLOTO in Connectt	Ushort	2	H
3	freqo	Frequency channel offset for satellite in the range 0 to 20	Ushort	2	H+2
4	sat type	Satellite type where 0 = GLO_SAT 1 = GLO_SAT_M (M type) 2 = GLO_SAT_K (K type)	Uchar	1	H+4
5	Reserved			1	H+5
6	e week	Reference week of ephemeris (GPS reference time)	Ushort	2	H+6
7	e time	Reference time of ephemeris (GPS reference time) in ms	Ulong	4	H+8
8	t offset	Integer seconds between GPS and GLONASS time. A positive value implies GLONASS is ahead of GPS reference time.	Ulong	4	H+12
9	Nt	Calendar number of day within 4 year interval starting at Jan 1 of a leap year	Ushort	2	H+16
10	Reserved			1	H+18
11				1	H+19
12	issue	15 minute interval number corresponding to ephemeris reference time	Ulong	4	H+20
13	health	Ephemeris health where 0-3 = GOOD 4-15 = BAD	Ulong	4	H+24
14	pos x	X coordinate for satellite at reference time (PZ-90.02), in metres	Double	8	H+28
15	pos y	Y coordinate for satellite at reference time (PZ-90.02), in metres	Double	8	H+36
16	pos z	Z coordinate for satellite at reference time (PZ-90.02), in metres	Double	8	H+44
17	vel x	X coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+52
18	vel y	Y coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+60
19	vel z	Z coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+68
20	LS acc x	X coordinate for lunisolar acceleration at reference time (PZ-90.02), in metres/s/s	Double	8	H+76
21	LS acc y	Y coordinate for lunisolar acceleration at reference time (PZ-90.02), in metres/s/s	Double	8	H+84

Continued on next page

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
22	LS acc z	Z coordinate for lunisolar acceleration at reference time (PZ-90.02), in metres/s/s	Double	8	H+92
23	tau_n	Correction to the nth satellite time t_n relative to GLONASS time t_c, in seconds	Double	8	H+100
24	delta_tau_n	Time difference between navigation RF signal transmitted in L2 sub-band and navigation RF signal transmitted in L1 sub-band by nth satellite, in seconds	Double	8	H+108
25	gamma	Frequency correction, in seconds/second	Double	8	H+116
26	Tk	Time of frame start (since start of GLONASS day), in seconds	Ulong	4	H+124
27	P	Technological parameter	Ulong	4	H+128
28	Ft	User range	Ulong	4	H+132
29	age	Age of data, in days	Ulong	4	H+136
30	Flags	Information flags, see *Table 69, GLONASS Ephemeris Flags Coding* on *page 350*	Ulong	4	H+140
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+144
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.31 GLORAWALM Raw GLONASS Almanac Data

This log contains the raw almanac subframes as received from the GLONASS satellite.

Message ID: **720**
Log Type: **Asynch**

Recommended Input:

log glorawalma onchanged

Example:

```
#GLORAWALMA,COM1,0,44.5,SATTIME,1364,419924.000,00000000,77bb,2310;
1364,419954.069,54,
0563100000a4000000006f,0,
0681063c457a12cc0419be,0,
075ff807e2a69804e0040b,0,
0882067fcd80141692d6f2,0,
09433e1b6676980a40429b,0,
0a838d1bfcb4108b089a8c,0,
0bec572f9c869804f05882,0,
.
.
.
06950201e02e13d3819564,0,
07939a4a16fe97fe814ad0,0,
08960561cecc13b0014613,0,
09469a5d70c69802819466,0,
0a170165bed413b704d416,0,
0b661372213697fd41965a,0,
0c18000000000000000006,0,
0d00000000000000000652,0,
0e00000000000000000d0,0*b516623b
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLORAWALM header	Log header		H	0
2	week	GPS reference week, in weeks	Ulong	4	H
3	time	GPS reference time, in milliseconds (binary data) or seconds (ASCII data)	GPSec	4	H+4
4	#recs	Number of records to follow	Ulong	4	H+8
5	string	GLONASS data string	String	11	H+12
6	Reserved		Uchar	1	H+23
7...	Next record offset = H+ (#recs x 24)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H (#recs x 24)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.32 GLORAWEPHEM Raw GLONASS Ephemeris Data

This log contains the raw ephemeris frame data as received from the GLONASS satellite.

Message ID: **792**
Log Type: **Asynch**

Recommended Input:

log glorawephema onchanged

Example:

```
#GLORAWEPHEMA,COM1,3,47.0,SATTIME,1340,398653.000,00000000,332d,2020;
38,9,0,1340,398653.080,4,
0148d88460fc115dbdaf78,0,0218e0033667aec83af2a5,0,
038000b9031e14439c75ee,0,0404f22660000000000065,0*17f3dd17
…
#GLORAWEPHEMA,COM1,0,47.0,SATTIME,1340,398653.000,00000000,332d,2020;
41,13,0,1340,398653.078,4,
0108d812532805bfa1cd2c,0,0208e0a36e8e0952b111da,0,
03c02023b68c9a32410958,0,0401fda44000000000002a,0*0b237405
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

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

3.3.33 GLORAWFRAME Raw GLONASS Frame Data

This log contains the raw GLONASS frame data as received from the GLONASS satellite.

Message ID: **721**
Log Type: **Asynch**

Recommended Input:

log glorawframea onchanged

Example:

```
#GLORAWFRAMEA,COM1,19,53.0,SATTIME,1340,398773.000,00000000,8792,2020;
3,39,8,1340,398773.067,44,44,15,
0148dc0b67e9184664cb35,0,
0218e09dc8a3ae8c6ba18d,0,
…
0f00000000000000000000,0*11169f9e
…
#GLORAWFRAMEA,COM1,0,53.0,SATTIME,1340,398713.000,00000000,8792,2020;
1,41,13,1340,398713.077,36,36,15,
0108da12532805bfa1cded,0,
0208e0a36e8e0952b111da,0,
03c02023b68c9a32410958,0,
…
0f6efb59474697fd72c4e2,0*0a6267c8
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLORAWFRAME header	Log header		H	0
2	frame#	Frame number	Ulong	4	H
3	sloto	Slot information offset - PRN identification (Slot + 37). Ephemeris relates to this slot and is also called SLOTO in CDU.	Ushort	2	H+4
4	freqo	Frequency channel offset in the range 0 to 20	Ushort	2	H+6
5	week	GPS Week, in weeks	Ulong	4	H+8
6	time	GPS Time, in milliseconds (binary data) or seconds (ASCII data)	GPSec	4	H+12
7	frame decode	Frame decoder number	Ulong	4	H+16
8	sigchan	Signal channel number	Ulong	4	H+20
9	#recs	Number of records to follow	Ulong	4	H+24
10	string	GLONASS data string	String	11	H+28
11	Reserved		Uchar	1	H+39
12...	Next record offset = H+ (#recs x 40)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + (#recs x 40)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.34 GLORAWSTRING Raw GLONASS String

This log contains the raw string data as received from the GLONASS satellite.

Message ID: **722**
Log Type: **Asynch**

Recommended Input:

log glorawstringa onchanged

Example:

```
#GLORAWSTRINGA,COM1,0,51.0,SATTIME,1340,399113.000,00000000,50ac,2020;
4,6,06100000000000000004f,0*5b215fb2
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLORAWSTRING header	Log header		H	0
2	slot	Slot identification	Uchar	2	H
3	freq	Frequency channel (frequency channels are in the range -7 to +13)	Char	2	H+2
4	string	GLONASS data string	Uchar [string size] [a]	variable	H+4
5	Reserved		Uchar	1	variable
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	(H +4 + string size +1)
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

3.3.35 GPALM Almanac Data

This log outputs raw almanac data for each GPS satellite PRN contained in the broadcast message. A separate record is logged for each PRN, up to a maximum of 32 records. GPALM outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. UTC time is then set to VALID. It takes a minimum of 12.5 minutes to collect a complete almanac following receiver boot-up. In the case of a GLONASS capable receiver, the UTC offset can be determined once the GLONASS ephemeris is decoded, which takes about 50 seconds. If an almanac was stored in NVM, the stored values are reported in the GPALM log once time is set on the receiver.

To obtain copies of ICD-GPS-200, seen in the GPALM table footnotes, refer to ARINC in the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/. Refer also to NMEA contact information there.

Message ID: **217**

Log Type: **Asynch**

Recommended Input:

log gpalm onchanged

Example:

```
$GPALM,28,01,01,1337,00,305a,90,1b9d,fd5b,a10ce9,ba0a5e,2f48f1,cccb76,006,001
*27
$GPALM,28,02,02,1337,00,4aa6,90,0720,fd50,a10c5a,4dc146,d89bab,0790b6,fe4,000
*70
.
.
.
$GPALM,28,24,26,1337,00,878c,90,1d32,fd5c,a10c90,1db6b6,2eb7f5,ce95c8,00d,000
*23
$GPALM,28,25,27,1337,00,9cde,90,07f2,fd54,a10da5,adc097,562da3,6488dd,00e,000
*2F
$GPALM,28,26,28,1337,00,5509,90,0b7c,fd59,a10cc4,a1d262,83e2c0,3003bd,02d,000
*78
$GPALM,28,27,29,1337,00,47f7,90,1b20,fd58,a10ce0,d40a0b,2d570e,221641,122,006
*7D
$GPALM,28,28,30,1337,00,4490,90,0112,fd4a,a10cc1,33d10a,81dfc5,3bdb0f,178,004
*28
```

See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPALM	Log header		$GPALM
2	# msg	Total number of messages logged. Set to zero until almanac data is available	x.x	17
3	msg #	Current message number	x.x	17
4	PRN	Satellite PRN number: GPS = 1 to 32	xx	28
5	GPS wk	GPS reference week number [a]	x.x	653
6	SV hlth	SV health, bits 17-24 of each almanac page [b]	hh	00
7	ecc	e, eccentricity [c d]	hhhh	3EAF
8	alm ref time	to a almanac reference time [c]	hh	87
9	incl angle	$(sigma)_i$, inclination angle [c]	hhhh	OD68
10	omegadot	OMEGADOT, rate of right ascension [c]	hhhh	FD30
11	rt axis	$(A)^{1/2}$, root of semi-major axis [c]	hhhhhh	A10CAB
12	omega	omega, argument of perigee [c e]	hhhhhh	6EE732
13	long asc node	$(OMEGA)_o$,longitude of ascension node [c]	hhhhhh	525880
14	M_o	Mo, mean anomaly [c]	hhhhhh	6DC5A8
15	a_{f0}	af0, clock parameter [c]	hhh	009
16	a_{f1}	af1, clock parameter [c]	hhh	005
17	*xx	Checksum	*hh	*37
18	[CR][LF]	Sentence terminator		[CR][LF]

a Variable length integer, 4-digits maximum from (2) most significant binary bits of Subframe 1, Word 3 reference Table 20-I, ICD-GPS-200, Rev. B, and (8) least significant bits from subframe 5, page 25, word 3 reference Table 20-I, ICD-GPS-200.

b Reference paragraph 20.3.3.5.1.3, Table 20-VII and Table 20-VIII, ICD-GPS-200, Rev. B.

c Reference Table 20-VI, ICD-GPS-200, Rev. B for scaling factors and units.

d A quantity defined for a conic section where e= 0 is a circle, e = 1 is an ellipse, 0<e<1 is a parabola and e>1 is a hyperbola.

e A measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion.

3.3.36 GPGGA GPS Fix Data and Undulation

This log contains time, position and fix related data of the GNSS receiver. For greater precision but with loss of the undulation fields, use the GPGGARTK log (see *page 364*). See also *Table 71, Position Precision of NMEA Logs* on *page 368*.

The GPGGA log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **218**
Log Type **Synch**

Recommended Input:

log gpgga ontime 1

Example:

```
$GPGGA,134658.00,5106.9792,N,11402.3003,W,2,09,1.0,1048.47,M,-16.27,M,
08,AAAA*60
```

The NMEA (National Marine Electronics Association) has defined standards that specify how electronic equipment for marine users communicate. GNSS receivers are part of this standard and the NMEA has defined the format for several GNSS data logs otherwise known as 'sentences'.

Each NMEA sentence begins with a '$' followed by the prefix 'GL' or ‘GN’followed by a sequence of letters that define the type of information contained in the sentence. Data contained within the sentence is separated by commas and the sentence is terminated with a two digit checksum followed by a carriage return/line feed. Here is an example of a NMEA sentence describing time, position and fix related data:

$GPGGA,134658.00,5106.9792,N,11402.3003,W,2,09,1.0,1048.47,M
,
-16.27,M,08,AAAA*60

The GPGGA sentence shown above and other NMEA logs are output the same no matter what GNSS receiver is used, providing a standard way to communicate and process GNSS information. For more information about NMEA, see the NMEATALKER command on page *170*.

Field	Structure	Field Description	Symbol	Example
1	$GPGGA	Log header		$GPGGA
2	utc	UTC time status of position (hours/minutes/ seconds/ decimal seconds)	hhmmss.ss	202134.00
3	lat	Latitude (DDmm.mm)	llll.ll	5106.9847
4	lat dir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.2986
6	lon dir	Longitude direction (E = East, W = West)	a	W
7	GPS qual	GPS Quality indicator 0 = fix not available or invalid 1 = GPS fix 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS, 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 = Simulator mode 9 = WAAS [a]	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 = metres)	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 = metres)	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	*(empty when no differential data is present)*
16	*xx	Checksum	*hh	*48
17	[CR][LF]	Sentence terminator		[CR][LF]

a. An indicator of 9 has been temporarily set for WAAS (NMEA standard for WAAS not decided yet). This indicator can be customized using the GGAQUALITY command.

b. The maximum age reported here is limited to 99 seconds.

3.3.37 GPGGALONG Fix Data, Extra Precision and Undulation

This log contains, time, position, undulation and fix related data of the GNSS receiver. This is output as a GPGGA log but the GPGGALONG log differs from the normal GPGGA log by its extra precision. See also *Table 71, Position Precision of NMEA Logs* on *page 368*.

The GPGGALONG log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **521**
Log Type: **Synch**

Recommended Input:

log gpggalong ontime 1

Example 1:

```
$GPGGA,181126.00,5106.9802863,N,11402.3037304,W,7,11,0.9,1048.234,M,
-16.27,M,,*51
```

Example 2:

```
$GPGGA,134658.00,5106.9802863,N,11402.3037304,W,2,09,1.0,1048.234,M,
-16.27,M,08,AAAA
```

See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGGA-LONG	Log header		$GPGGA
2	utc	UTC time status of position (hours/minutes/ seconds/ decimal seconds)	hhmmss.ss	202126.00
3	lat	Latitude (DDmm.mm)	llll.ll	5106.9847029
4	lat dir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.2986286
6	lon dir	Longitude direction (E = East, W = West)	a	W
7	GPS qual	GPS Quality indicator 0 = fix not available or invalid 1 = GPS fix 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS 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 = Simulator mode 9 = WAAS [a]	x	1
8	# sats	Number of satellites in use (00-12). 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 msl	x.x	1062.376
11	units	Units of antenna altitude (M = metres)	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 = metres)	M	M
14	age	Age of Differential GPS data (in seconds) [b]	xx	10 *(empty when no differential data is present)*
15	stn ID	Differential base station ID, 0000-1023	xxxx	AAAA *(empty when no differential data is present)*
16	*xx	Checksum	*hh	*48
17	[CR][LF]	Sentence terminator		[CR][LF]

a. An indicator of 9 has been temporarily set for WAAS (NMEA standard for WAAS is not decided yet).

b. The maximum age reported here is limited to 99 seconds.

3.3.38 GPGGARTK Global Position System Fix Data

This log contains time, position and fix-related data of the GNSS receiver. This is output as a GPGGA log but the GPGGARTK log differs from the normal GPGGA log by its extra precision. In order for the position to be output with this extra precision, the undulation fields are unavailable (see the GPGGA log on *page 362*). See also *Table 71, Position Precision of NMEA Logs* on *page 368*.

The GPGGARTK log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **259**
Log Type: **Synch**

Recommended Input:

log gpggartk ontime 1

Example:

```
$GPGGA,135324.00,5106.9791988,N,11402.3002127,W,2,09,1.0,1047.606,M,,,04,AAAA
*1C
```

The GPGGARTK log is ideal for RTK positioning applications where millimeter level position precision is required. See also the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGGA	Log header		$GPGGA
2	utc	UTC time status of position (hours/minutes/ seconds/ decimal seconds)	hhmmss.ss	220147.50
3	lat	Latitude (DDmm.mm)	llll.ll	5106.7194489
4	lat dir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.3589020
6	lon dir	Longitude direction (E = East, W = West)	a	W
7	GPS qual	GPS Quality indicator 0 = fix not available or invalid 1 = GPS fix 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS 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 = Simulator mode 9 = WAAS [a]	x	1
8	# sats	Number of satellites in use. May be different to the number in view	xx	08
9	hdop	Horizontal dilution of precision	x.x	0.9
10	alt	Antenna altitude above/below mean sea level	x.x	1080.406
11	units	Units of antenna altitude (M = metres)	M	M
12	null	(This field not available on OEM6 family receivers)		*(empty when no differential data is present)*
13	null	(This field not available on OEM6 family receivers)		
14	age	Age of Differential GPS data (in seconds) [b]	xx	
15	stn ID	Differential base station ID, 0000-1023	xxxx	
16	*xx	Checksum	*hh	*48
17	[CR][LF]	Sentence terminator		[CR][LF]

a. An indicator of 9 has been temporarily set for WAAS. The NMEA standard for WAAS has not been decided yet.

b. The maximum age reported here is limited to 99 seconds.

3.3.39 GPGLL Geographic Position

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

Table 71 compares the position precision of selected NMEA logs.

The GPGLL log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only) or GN (satellites from both systems).

Message ID: **219**
Log Type: **Synch**

Recommended Input:

```
log gpgll ontime 1
```

Example 1 (GPS only):

```
$GPGLL,5107.0013414,N,11402.3279144,W,205412.00,A,A*73
```

Example 2 (Combined GPS and GLONASS):

```
$GNGLL,5107.0014143,N,11402.3278489,W,205122.00,A,A*6E
```

Table 71: Position Precision of NMEA Logs

NMEA Log	Latitude (# of decimal places)	Longitude (# of decimal places)	Altitude (# of decimal places)
GPGGA	4	4	2
GPGGALONG	7	7	3
GPGGARTK	7	7	3
GPGLL	7	7	N/A
GPRMC	7	7	N/A

See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Example
1	$GPGLL	Log header	$GPGLL
2	lat	Latitude (DDmm.mm)	5106.7198674
3	lat dir	Latitude direction (N = North, S = South)	N
4	lon	Longitude (DDDmm.mm)	11402.3587526
5	lon dir	Longitude direction (E = East, W = West)	W
6	utc	UTC time status of position (hours/minutes/seconds/ decimal seconds)	220152.50
7	data status	Data status: A = Data valid, V = Data invalid	A
8	mode ind	Positioning system mode indicator, see *Table 72* on *page 379*	A
9	*xx	Checksum	*1B
10	[CR][LF]	Sentence terminator	[CR][LF]

3.3.40 GPGRS GPS Range Residuals for Each Satellite

Range residuals can be computed in two ways, and this log reports those residuals. Under mode 0, residuals output in this log are used to update the position solution output in the GPGGA message. Under mode 1, the residuals are recomputed after the position solution in the GPGGA message is computed. The receiver computes range residuals in mode 1. An integrity process using GPGRS would also require GPGGA (for position fix data), GPGSA (for DOP figures) and GPGSV (for PRN numbers) for comparative purposes.

The GPGRS log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

1. If the range residual exceeds ± 99.9, then the decimal part is dropped. Maximum value for this field is ± 999. The sign of the range residual is determined by the order of parameters used in the calculation as follows:
   - range residual = calculated range - measured range
2. If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only) or GN (satellites from both systems).
3. There is no residual information available from the OmniSTAR HP/XP service, so the GPGRS contains the pseudorange position values when using it. For the OmniSTAR VBS service, residual information is available.

Message ID: **220**
Log Type: **Synch**

Recommended Input:

```
log gpgrs ontime 1
```

Example 1 (GPS only):

```
$GPGRS,142406.00,1,-1.1,-0.1,1.7,1.2,-2.0,-0.5,1.2,-1.2,-0.1,,,*67
```

Example 2 (Combined GPS and GLONASS):

```
$GNGRS,143209.00,1,-0.2,-0.5,2.2,1.3,-2.0,-1.3,1.3,-0.4,-1.2,-0.2,,*72
$GNGRS,143209.00,1,1.3,-6.7,,,,,,,,,*73
```

See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGRS	Log header		$GPGRS
2	utc	UTC time status of position (hours/ minutes/seconds/decimal seconds)	hhmmss.ss	192911.0
3	mode	Mode 0=residuals were used to calculate the position given in the matching GGA line (apriori) (not used by OEM6 receivers) Mode 1=residuals were recomputed after the GGA position was computed (preferred mode)	x	1
4 - 15	res	Range residuals for satellites used in the navigation solution. Order matches order of PRN numbers in GPGSA	x.x,x.x,.....	-13.8,-1.9,11.4,-33.6,0.9,6.9,-12.6,0.3,0.6,-22.3
16	*xx	Checksum	*hh	*65
17	[CR][LF]	Sentence terminator		[CR][LF]

3.3.41 GPGSA GPS DOP and Active Satellites

This log contains GNSS receiver operating mode, satellites used for navigation and DOP values.

The GPGSA log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

1. If the DOP values exceed 9999.0 or there is an insufficient number of satellites to calculate a DOP value, 9999.0 is reported for PDOP and HDOP. VDOP is reported as 0.0 in this case.
2. If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).

Message ID: **221**
Log Type: **Synch**

Recommended Input:

```
log gpgsa ontime 1
```

Example 1 (GPS only):

```
$GPGSA,M,3,17,02,30,04,05,10,09,06,31,12,,,1.2,0.8,0.9*35
```

Example 2 (Combined GPS and GLONASS):

```
$GNGSA,M,3,17,02,30,04,05,10,09,06,31,12,,,1.2,0.8,0.9*2B
$GNGSA,M,3,87,70,,,,,,,,,,,1.2,0.8,0.9*2A
```

The DOPs provide a simple characterization of the user satellite geometry. DOP is related to the volume formed by the intersection points of the user satellite vectors, with the unit sphere centered on the user. Larger volumes give smaller DOPs. Lower DOP values generally represent better position accuracy. The role of DOP in GNSS positioning is often misunderstood. A lower DOP value does not automatically mean a low position error. The quality of a GNSS derived position estimate depends upon both the measurement geometry as represented by DOP values and range errors caused by signal strength, ionospheric effects, multipath and so on.
Also see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGSA	Log header		$GPGSA
2	mode MA	A = Automatic 2D/3D M = Manual, forced to operate in 2D or 3D	M	M
3	mode 123	Mode: 1 = Fix not available; 2 = 2D; 3 = 3D	x	3
4 - 15	prn	PRN numbers of satellites used in solution (null for unused fields), total of 12 fields GPS = 1 to 32 SBAS = 33 to 64 (add 87 for PRN number) GLO = 65 to 96 [a]	xx,xx,.....	18,03,13, 25,16, 24,12, 20,,,,
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]

a. The NMEA GLONASS PRN numbers are 64 plus the GLONASS slot number. Current slot numbers are 1 to 24 which give the range 65 to 88. PRN numbers 89 to 96 are available if slot numbers above 24 are allocated to on-orbit spares.

3.3.42 GPGST Pseudorange Measurement Noise Statistics

This log contains pseudorange measurement noise statistics are translated in the position domain in order to give statistical measures of the quality of the position solution.

This log reflects the accuracy of the solution type used in the BESTPOS (*page 301*) and GPGGA (*page 362)*, except for the RMS field. The RMS field, since it specifically relates to pseudorange inputs, does not represent carrier-phase based positions. Instead it reflects the accuracy of the pseudorange position which is given in the PSRPOS log, see *page 451*.

The GPGST log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).

Message ID: **222**

Log Type: **Synch**

Recommended Input:

```
log gpgst ontime 1
```

Example 1 (GPS only):

```
$GPGST,141451.00,1.18,0.00,0.00,0.0000,0.00,0.00,0.00*6B
```

Example 2 (Combined GPS and GLONASS):

```
$GNGST,143333.00,7.38,1.49,1.30,68.1409,1.47,1.33,2.07*4A
```

1. See the GPGGA usage box that applies to all NMEA logs on *page 362*.
2. Accuracy is based on statistics, reliability is measured in percent. When a receiver can measure height to one metre, this is an accuracy. Usually this is a one sigma value (one SD). A one sigma value for height has a reliability of 68%, that is, the error is less than one metre 68% of the time. For a more realistic accuracy, double the one sigma value (1 m) and the result is 95% reliability (error is less than 2 m 95% of the time). Generally, GNSS heights are 1.5 times poorer than horizontal positions.
   As examples of statistics, the GPGST message and NovAtel performance specifications use Root Mean Square (RMS). Specifications may be quoted in CEP:
   - RMS - root mean square (a probability level of 68%)
   - CEP - circular error probable (the radius of a circle such that 50% of a set of events occur inside the boundary)

Field	Structure	Field Description	Symbol	Example
1	$GPGST	Log header		$GPGST
2	utc	UTC time status of position (hours/minutes/seconds/ decimal seconds)	hhmmss.ss	173653.00
3	rms	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudoranges and DGPS corrections	x.x	2.73
4	smjr std	Standard deviation of semi-major axis of error ellipse (m)	x.x	2.55
5	smnr std	Standard deviation of semi-minor axis of error ellipse (m)	x.x	1.88
6	orient	Orientation of semi-major axis of error ellipse (degrees from true north)	x.x	15.2525
7	lat std	Standard deviation of latitude error (m)	x.x	2.51
8	lon std	Standard deviation of longitude error (m)	x.x	1.94
9	alt std	Standard deviation of altitude error (m)	x.x	4.30
10	*xx	Checksum	*hh	*6E
11	[CR][LF]	Sentence terminator		[CR][LF]

3.3.43 GPGSV GPS Satellites in View

This log contains t number of SVs in view, PRN numbers, elevation, azimuth and SNR value. Four satellites maximum per message. When required, additional satellite data sent in 2 or more messages (a maximum of 9). The total number of messages being transmitted and the current message being transmitted are indicated in the first two fields.

The GPGSV log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

1. Satellite information may require the transmission of multiple messages. The first field specifies the total number of messages, minimum value 1. The second field identifies the order of this message (message number), minimum value 1.
2. If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only) or GL (GLONASS satellites only) or GN (satellites from both systems).
3. A variable number of 'PRN-Elevation-Azimuth-SNR' sets are allowed up to a maximum of four sets per message. Null fields are not required for unused sets when less than four sets are transmitted.

Message ID: **223**
Log Type: **Synch**

Recommended Input:

```
log gpgsv ontime 1
```

Example (Including GPS and GLONASS sentences):

```
$GPGSV,3,1,11,18,87,050,48,22,56,250,49,21,55,122,49,03,40,284,47*78
$GPGSV,3,2,11,19,25,314,42,26,24,044,42,24,16,118,43,29,15,039,42*7E
$GPGSV,3,3,11,09,15,107,44,14,11,196,41,07,03,173,*4D
$GLGSV,2,1,06,65,64,037,41,66,53,269,43,88,39,200,44,74,25,051,*64
$GLGSV,2,2,06,72,16,063,35,67,01,253,*66
```

The GPGSV log can be used to determine which satellites are currently available to the receiver. Comparing the information from this log to that in the GPGSA log shows you if the receiver is tracking all available satellites.

See also the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field 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 (see also the GPSGSA log on *page 362*)	xx	09
5	prn	Satellite PRN number GPS = 1 to 32 SBAS = 33 to 64 (add 87 for PRN#s) GLO = 65 to 96 [a]	xx	03
6	elev	Elevation, degrees, 90 maximum	xx	51
7	azimuth	Azimuth, degrees True, 000 to 359	xxx	140
8	SNR	SNR (C/No) 00-99 dB, null when not tracking	xx	42
... ...	... ...	Next satellite PRN number, elev, azimuth, SNR, ... Last satellite PRN number, elev, azimuth, SNR,		
variable	*xx	Checksum	*hh	*72
variable	[CR][LF]	Sentence terminator		[CR][LF]

a. The NMEA GLONASS PRN numbers are 64 plus the GLONASS slot number. Current slot numbers are 1 to 24 which give the range 65 to 88. PRN numbers 89 to 96 are available if slot numbers above 24 are allocated to on-orbit spares.

3.3.44 GPHDT NMEA Heading Log

This log contains actual vessel heading in degrees True (from True North). See also a description of heading on *page 389*. You can also set a standard deviation threshold for this log, see *page 138*.

You must have an ALIGN capable receiver to use this log.

1. If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only) or GN (satellites from both systems).
2. Asynchronous logs, such as GPHDT, should only be logged ONCHANGED otherwise the most current data is not available or included in the output. An example of this occurrence is in the ONTIME trigger. If this trigger is not logged ONCHANGED, it may cause inaccurate time tags.

Message ID: **1045**
Log Type: **Asynch**

Recommended Input:

log gphdt onchanged

Example 1 (GPS only):

```
$GPHDT,75.5664,T*36
```

Example 2 (Combined GPS and GLONASS):

```
$GNHDT,75.5554,T*45
```

Field	Structure	Field Description	Symbol	Example
1	$GPHDT	Log header		$GPHDT
2	heading	Heading in degrees	x.x	75.5554
3	True	Degrees True	T	T
4	*xx	Checksum	*hh	*36
5	[CR][LF]	Sentence terminator		[CR][LF]

3.3.45 GPRMB Navigation Information

This log contains navigation data from present position to a destination waypoint. The destination is set active by the receiver SETNAV command (*page 230*).

The GPRMB log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **224**
Log Type: **Synch**

Recommended Input:

log gprmb ontime 1

Example 1 (GPS only):

```
$GPRMB,A,5.14,L,FROM,TO,5109.7578000,N,11409.0960000,W,5.1,303.0,-0.0,V,A*6F
```

Example 2 (Combined GPS and GLONASS):

```
$GNRMB,A,5.14,L,FROM,TO,5109.7578000,N,11409.0960000,W,5.1,303.0,-0.0,V,A*71
```

1. If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only) or GN (satellites from both systems).
2. See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Table 72: NMEA Positioning System Mode Indicator

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

Field	Structure	Field Description	Symbol	Example
1	$GPRMB	Log header		$GPRMB
2	data status	Data status: A = data valid; V = navigation receiver warning	A	A
3	xtrack	Cross track error [a]	x.x	5.14
4	dir	Direction to steer to get back on track (L/R) [b]	a	L
5	origin ID	Origin waypoint ID [c]	c--c	FROM
6	dest ID	Destination waypoint ID [C]	c--c	TO
7	dest lat	Destination waypoint latitude (DDmm.mm [c]	llll.ll	5109.7578000
8	lat dir	Latitude direction (N = North, S = South) [c]	a	N
9	dest lon	Destination waypoint longitude (DDDmm.mm) [c]	yyyyy.yy	11409.0960000
10	lon dir	Longitude direction (E = East, W = West) [c]	a	W
11	range	Range to destination, nautical miles [d]	x.x	5.1
12	bearing	Bearing to destination, degrees True	x.x	303.0
13	vel	Destination closing velocity, knots	x.x	-0.0
14	arr status	Arrival status: A = perpendicular passed V = destination not reached or passed	A	V
15	mode ind	Positioning system mode indicator, see *Table 72* on *page 379*	a	A
16	*xx	Checksum	*hh	*6F
17	[CR][LF]	Sentence terminator		[CR][LF]

a. - If cross track error exceeds 9.99 NM, display 9.99
   - Represents track error from intended course
   - One nautical mile = 1,852 metres

b. Direction to steer is based on the sign of the crosstrack error, that is, L = xtrack error (+); R = xtrack error (-).

c. Fields 5, 6, 7, 8, 9, and 10 are tagged from the SETNAV command, see *page 230*.

d. If range to destination exceeds 999.9 NM, display 999.9.

3.3.46 GPRMC GPS Specific Information

This log contains time, date, position, track made good and speed data provided by the GPS navigation receiver. RMC and RMB are the recommended minimum navigation data to be provided by a GNSS receiver.

A comparison of the position precision between this log and other selected NMEA logs can be seen in *Table 71, Position Precision of NMEA Logs* on *page 368*.

The GPRMC log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only) or GN (satellites from both systems).

Message ID: **225**

Log Type: **Synch**

Recommended Input:

log gprmc ontime 1

Example 1 (GPS):

```
$GPRMC,144326.00,A,5107.0017737,N,11402.3291611,W,0.080,323.3,210307,0.0,E,A*
20
```

Example 2 (Combined GPS and GLONASS):

```
$GNRMC,143909.00,A,5107.0020216,N,11402.3294835,W,0.036,348.3,210307,0.0,E,A*
31
```

See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPRMC	Log header		$GPRMC
2	utc	UTC of position	hhmmss.ss	144326.00
3	pos status	Position status: A = data valid, V = data invalid	A	A
4	lat	Latitude (DDmm.mm)	llll.ll	5107.0017737
5	lat dir	Latitude direction N = North, S = South	a	N
6	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.3291611
7	lon dir	Longitude direction E = East, W = West	a	W
8	speed Kn	Speed over ground, knots	x.x	0.080
9	track true	Track made good, degrees True	x.x	323.3
10	date	Date: dd/mm/yy	xxxxxx	210307
11	mag var	Magnetic variation, degrees [a]	x.x	0.0
12	var dir	Magnetic variation direction E/W [b]	a	E
13	mode ind	Positioning system mode indicator, see *Table 72* on *page 379*	a	A
14	*xx	Checksum	*hh	*20
15	[CR][LF]	Sentence terminator		[CR][LF]

a. Note that this field is the actual magnetic variation and will always be positive. The direction of the magnetic variation is always positive.

b. Easterly variation (E) subtracts from True course and Westerly variation (W) adds to True course.

3.3.47 GPSEPHEM Decoded GPS Ephemerides

This log contains a single set of GPS ephemeris parameters.

Message ID: 7
Log Type: Asynch

Recommended Input:

log gpsephema onchanged

ASCII Example:

```
#GPSEPHEMA,COM1,12,59.0,SATTIME,1337,397560.000,00000000,9145,1984;
3,397560.0,0,99,99,1337,1337,403184.0,2.656004220e+07,4.971635660e-09,
-2.752651501e+00,7.1111434372e-03,6.0071892571e-01,2.428889275e-06,
1.024827361e-05,1.64250000e+02,4.81562500e+01,1.117587090e-08,
-7.078051567e-08,9.2668266314e-01,-1.385772009e-10,-2.098534041e+00,
-8.08319384e-09,99,403184.0,-4.190951586e-09,2.88095e-05,3.06954e-12,
0.00000,TRUE,1.458614684e-04,4.00000000e+00*0f875b12
#GPSEPHEMA,COM1,11,59.0,SATTIME,1337,397560.000,00000000,9145,1984;
25,397560.0,0,184,184,1337,1337,403200.0,2.656128681e+07,4.897346851e-09,
1.905797220e+00,1.1981436634e-02,-1.440195331e+00,-1.084059477e-06,
6.748363376e-06,2.37812500e+02,-1.74687500e+01,1.825392246e-07,
-1.210719347e-07,9.5008501632e-01,2.171519024e-10,2.086083072e+00,
-8.06140722e-09,184,403200.0,-7.450580597e-09,1.01652e-04,9.09495e-13,
0.00000,TRUE,1.458511425e-04,4.00000000e+00*18080b24
.
.
.
#GPSEPHEMA,COM1,0,59.0,SATTIME,1337,397560.000,00000000,9145,1984;
1,397560.0,0,224,224,1337,1337,403200.0,2.656022490e+07,3.881233098e-09,
2.938005195e+00,5.8911956148e-03,-1.716723741e+00,-2.723187208e-06,
9.417533875e-06,2.08687500e+02,-5.25625000e+01,9.126961231e-08,
-7.636845112e-08,9.8482911735e-01,1.325055194e-10,1.162012787e+00,
-7.64138972e-09,480,403200.0,-3.259629011e-09,5.06872e-06,2.04636e-12,
0.00000,TRUE,1.458588731e-04,4.00000000e+00*97058299
```

The GPSEPHEM log can be used to monitor changes in the orbits of GPS satellites.

Table 73: URA Variance

Index Value (m)	A: Standard Deviations (m)	Variance: A^2 (m^2)
0	2.0	4
1	2.8	7.84
2	4.0	16
3	5.7	32.49
4	8	56
5	11.3	127.69
6	16.0	256
7	32.0	1024
8	64.0	4096
9	128.0	16384
10	256.0	65536
11	512.0	262144
12	1024.0	1048576
13	2048.0	4194304
14	4096.0	16777216
15	8192.0	67108864

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GPSEPHEM header	Log header		H	0
2	PRN	Satellite PRN number	Ulong	4	H
3	tow	Time stamp of subframe 0 (seconds)	Double	8	H+4
4	health	Health status - a 6-bit health code as defined in ICD-GPS-200 [a]	Ulong	4	H+12
5	IODE1	Issue of ephemeris data 1	Ulong	4	H+16
6	IODE2	Issue of ephemeris data 2	Ulong	4	H+20
7	week	GPS reference week number	Ulong	4	H+24
8	z week	Z count week number. This is the week number from subframe 1 of the ephemeris. The 'toe week' (field #7) is derived from this to account for rollover	Ulong	4	H+28
9	toe	Reference time for ephemeris, seconds	Double	8	H+32
10	A	Semi-major axis, metres	Double	8	H+40
11	ΔN	Mean motion difference, radians/second	Double	8	H+48
12	M_0	Mean anomaly of reference time, radians	Double	8	H+56
13	ecc	Eccentricity, dimensionless - quantity defined for a conic section where e= 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse and e>1 is a hyperbola	Double	8	H+64
14	ω	Argument of perigee, radians - measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion	Double	8	H+72
15	cuc	Argument of latitude (amplitude of cosine, radians)	Double	8	H+80
16	cus	Argument of latitude (amplitude of sine, radians)	Double	8	H+88
17	crc	Orbit radius (amplitude of cosine, metres)	Double	8	H+96
18	crs	Orbit radius (amplitude of sine, metres)	Double	8	H+104
19	cic	Inclination (amplitude of cosine, radians)	Double	8	H+112
20	cis	Inclination (amplitude of sine, radians)	Double	8	H+120
21	I_0	Inclination angle at reference time, radians	Double	8	H+128
22	$\overset{\circ}{I}$	Rate of inclination angle, radians/second	Double	8	H+136
23	ω_0	Right ascension, radians	Double	8	H+144
24	$\overset{\circ}{\omega}$	Rate of right ascension, radians/second	Double	8	H+152
25	iodc	Issue of data clock	Ulong	4	H+160
26	toc	SV clock correction term, seconds	Double	8	H+164
27	tgd	Estimated group delay difference, seconds	Double	8	H+172
28	a_{f0}	Clock aging parameter, seconds (s)	Double	8	H+180

Continued on next page

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
29	a_{f1}	Clock aging parameter, (s/s)	Double	8	H+188
30	a_{f2}	Clock aging parameter, (s/s/s)	Double	8	H+196
31	AS	Anti-spoofing on:0 = FALSE 1 = TRUE	Enum	4	H+204
32	N	Corrected mean motion, radians/second	Double	8	H+208
33	URA	User Range Accuracy variance, m^2. The ICD [a] specifies that the URA index transmitted in the ephemerides can be converted to a nominal standard deviation value using an algorithm listed there. We publish the square of the nominal value (variance). The correspondence between the original URA index and the value output is shown in *Table 73*	Double	8	H+216
34	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+224
35	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. To obtain copies of ICD-GPS-200, refer to ARINC in the *Standards and References* page of our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS*.

3.3.48 GPVTG Track Made Good And Ground Speed

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

The GPVTG log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **226**
Log Type: **Synch**

Recommended Input:

log gpvtg ontime 1

Example 1 (GPS only):

```
$GPVTG,172.516,T,155.295,M,0.049,N,0.090,K,D*2B
```

Example 2 (Combined GPS and GLONASS):

```
$GNVTG,134.395,T,134.395,M,0.019,N,0.035,K,A*33
```

If the NMEATALKER command, see *page 170*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only) or GN (satellites from both systems).

See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPVTG	Log header		$GPVTG
2	track true	Track made good, degrees True	x.x	24.168
3	T	True track indicator	T	T
4	track mag	Track made good, degrees Magnetic; Track mag = Track true + (MAGVAR correction) See the *MAGVAR* command, *page 162*	x.x	24.168
5	M	Magnetic track indicator	M	M
6	speed Kn	Speed over ground, knots	x.x	0.4220347
7	N	Nautical speed indicator (N = Knots)	N	N
8	speed Km	Speed, kilometres/hour	x.x	0.781608
9	K	Speed indicator (K = km/hr)	K	K
10	mode ind	Positioning system mode indicator, see *Table 72 on page 379*	a	A
11	*xx	Checksum	*hh	*7A
12	[CR][LF]	Sentence terminator		[CR][LF]

3.3.49 GPZDA UTC Time and Date

The GPZDA log outputs these messages without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be one hundred percent accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **227**

Log Type: **Synch**

Recommended Input:

```
log gpzda ontime 1
```

Example:

```
$GPZDA,143042.00,25,08,2005,,*6E
```

See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPZDA	Log header		$GPZDA
2	utc	UTC time status	hhmmss.ss	220238.00
3	day	Day, 01 to 31	xx	15
4	month	Month, 01 to 12	xx	07
5	year	Year	xxxx	1992
6	null	Local zone description - not available	xx	*(empty when no data is present)*
7	null	Local zone minutes description - not available [a]	xx	*(empty when no data is present)*
8	*xx	Checksum	*hh	*6F
9	[CR][LF]	Sentence terminator		[CR][LF]

a. Local time zones are not supported by OEM6 family receivers. Fields 6 and 7 are always null.

3.3.50 HEADING Heading Information

The heading is the angle from True North of the base to rover vector in a clockwise direction. This log can be output at both Master and Rover ends.

You must have an ALIGN capable receiver to use this log.

Asynchronous logs, such as HEADING, should only be logged ONCHANGED or ONNEW otherwise the most current data is not available or included in the output. An example of this occurrence is in the ONTIME trigger. If this trigger is not loggged ONCHANGED, it may cause inaccurate time tags.

The HEADING log is dictated by the output frequency of the master receiver sending out RTCAOBS2 or RTCAOBS3 messages. For the OEM628, HEADING now supports 20 Hz output rate. Ensure sufficient radio bandwidth is available between the ALIGN Master and the ALIGN Rover.

Message ID: **971**
Log Type: **Asynch**

Recommended Input:

log headinga onchanged

ASCII Example:

```
#HEADINGA,COM1,0,77.0,FINESTEERING,1481,418557.000,00000000,3663,36137;
SOL_COMPUTED,L1_INT,5.913998127,75.566444397,-0.152066842,0.0,0.104981117,
0.222061798,"AAAA",13,10,10,0,0,00,0,11*481a5bab
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	HEADING header	Log header		H	0
2	sol stat	Solution status, see *Table 57* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56* on *page 303*	Enum	4	H+4
4	length	Baseline length (0 to 3000 m)[a] For Z ALIGN Rovers, this field outputs decimal portion of the baseline	Float	4	H+8
5	heading	Heading in degrees (0 to 360.0 degrees)	Float	4	H+12
6	pitch	Pitch (±90 degrees)	Float	4	H+16
7	Reserved		Float	4	H+20
8	hdg std dev	Heading standard deviation in degrees	Float	4	H+24
9	ptch std dev	Pitch standard deviation in degrees	Float	4	H+28
10	stn ID	Station ID string	Char[4]	4	H+32
11	#SVs	Number of 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 angle	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 (see *Table 59, Extended Solution Status* on *page 305*)	Uchar	1	H+41
17	Reserved		Uchar	1	H+42
18	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Uchar	1	H+43
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. This is only true for L1 GPS + GLONASS Heading. If the user has a dual-frequency heading model, traditional RTK baseline lengths apply.

3.3.51 HEADING2 Heading information with multiple rovers

The heading is the angle from True North of the base to rover vector in a clockwise direction. This log is similar to the Heading log with additional rover ID field. This log can be output at both Master and Rover ends.

You must have an ALIGN capable receiver to use this log.

Asynchronous logs, such as HEADING and HEADING2, should only be logged ONCHANGED or ONNEW otherwise the most current data is not available or included in the output. An example of this occurrence is in the ONTIME trigger. If this trigger is not logged ONCHANGED, it may cause inaccurate time tags.

The HEADING2 log is dictated by the output frequency of the master receiver sending out RTCAOBS2 or RTCAOBS3 messages. For the OEM628, HEADING2 now supports 20 Hz output rate. Ensure sufficient radio bandwidth is available between the ALIGN Master and the ALIGN Rover.

Message ID: **1335**
Log Type: **Asynch**

Recommended Input:

log heading2a onnew

ASCII Example:

```
#HEADING2A,COM1,0,39.5,FINESTEERING,1622,422892.200,00040000,f9bf,6521;SOL_
COMPUTED,NARROW_INT,0.927607417,178.347869873,-
1.303741455,0.0,0.261901051,0.391376048,"R222","AAAA",18,17,17,16,0,01,0,33
*7be836f6
```

Field #	Field type	Field Description	Binary Format	Binary Bytes	Binary Offset
1	HEADING2	Log header		H	0
2	sol stat	Solution status, see *Table 57* on *page 304*	ENUM	4	H
3	pos type	Position type, see *Table 56* on *page 303*	ENUM	4	H+4
4	length	Baseline length in metres For Z ALIGN Rovers, this field outputs decimal portion of the baseline	FLOAT	4	H+8
5	heading	Heading in degrees (0° to 359.999°)	FLOAT	4	H+12
6	pitch	Pitch (±90 degrees)	FLOAT	4	H+16
7	Reserved		FLOAT	4	H+32
8	hdg std dev	Heading standard deviation in degrees	FLOAT	4	H+24
9	ptch std dev	Pitch standard deviation in degrees	FLOAT	4	H+28
10	rover stn ID	Rover Receiver ID *Set using SETROVERID command on ROVER e.g. setroverid RRRR (page 232)*	CHAR[4]	4	H+32
11	Master stn ID	Master Receiver ID *Set using DGPSTXID command on MASTER Default: AAAA (page 103)*	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
14	#obs	Number of satellites above the elevation mask angle	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 (see *Table 59, Extended Solution Status* on *page 305*)	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 *Table 58* on *page 305*)	UCHAR	1	H+47
20	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+48
21	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.52 HEADINGSATS Satellite used in heading solution

This log provides information on the satellites that are used in a heading solution.

Message ID: **1316**
Log Type: **Asynch**

Recommended Input:

log headingsatsa onnew

ASCII Example:

```
#HEADINGSATSA,COM1,0,26.0,FINESTEERING,1625,344654.600,00000008,f5b0,6569;1
7,GPS,31,GOOD,00000003,GPS,23,GOOD,00000003,GPS,30,GOOD,00000003,GPS,16,GOO
D,00000003,GPS,20,GOOD,00000003,GPS,25,GOOD,00000003,GPS,4,GOOD,00000003,GP
S,24,GOOD,00000003,GPS,11,GOOD,00000003,GPS,32,GOOD,00000003,GPS,14,GOOD,00
000003,GLONASS,20+2,GOOD,00000003,GLONASS,14-7,GOOD,00000001,GLONASS,2-
4,GOOD,00000003,GLONASS,13-2,GOOD,00000003,GLONASS,12-
1,GOOD,00000003,GLONASS,19+3,GOOD,00000001*15ec53a6
```

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	HEADINGSATS	Log header		H	0
2	#entries	Number of records to follow	ULONG	4	H
3	System	see *Table 29, Satellite System* on *page 156*	ENUM	4	H+4
4	Satellite ID	Satellite identities	ULONG	4	H+8
5	Status	see *Table 60, Observation Status* on *page 308*	ENUM	4	H+12
6	Status Mask	see *Table 61, BESTSATS GPS Signal Mask* on *page 309*	HEX	4	H+16
10	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+20
11	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.53 HWMONITOR Monitor Hardware Levels

This log allows the user to monitor temperature, antenna current and voltages.

Message ID: **963**
Log Type: **Polled**

Recommended Input:

log hwmonitora ontime 10

ASCII Example:

```
#HWMONITORA,COM1,0,83.0,FINESTEERING,1681,319572.841,00000020,52db,10526;
10,
43.312500000,100,0.000000000,200,3.207038403,300,1.881818175,400,2.787878752,
500,5.085718632,600,0.000000000,700,1.200586438,800,1.313000917,900,1.8166177
27,a00*fe36fddc
```

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	HWMONITOR header	Log Header		H	0
2	# measurements	Number of measurements to follow	ULong	4	H
3	reading	Temperature, antenna current or voltage reading Units: Degree Celsius for Temperature Amps for Antenna Current Volts for Voltage	Float	4	H+4
4	status	See *Table 74*	HexULong	4	H+8
5...	Next reading offset = H + 4 + (# measurements x 8)				
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+(# measurements x 8)
7	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

Table 74: HWMONITOR Status Table

Bits	Description
0-7	Boundary Limit Status (Binary): 0 = Value falls within acceptable bounds 1 = Value is under the lower warning limit 2 = Value is under the lower error limit 3 = Value is over the upper warning limit 4 = Value is over the upper error limit
8-15	Reading Type (Binary): 0 = Reserved 1 = Temperature 2 = Antenna Current 3 = MID3V3 Voltage 4 = VNIOL Voltage 5 = VNIOH Voltage 6 = Supply Voltage 7 = Antenna Current Voltage 8 = MINOS Core Voltage 9 = VCC Core Voltage 10 = VCC Mem Voltage 11 = Atlas Voltage

3.3.54 IONUTC Ionospheric and UTC Data

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

Message ID: **8**
Log Type: **Asynch**

Recommended Input:

log ionutca onchanged

ASCII Example:

```
#IONUTCA,COM1,0,58.5,FINESTEERING,1337,397740.107,00000000,ec21,1984;
1.210719347000122e-08,2.235174179077148e-08,-5.960464477539062e-08,
-1.192092895507812e-07,1.003520000000000e+05,1.146880000000000e+05,
-6.553600000000000e+04,-3.276800000000000e+05,1337,589824,
-1.210719347000122e-08,-3.907985047e-14,1355,7,13,14,0*c1dfd456
```

The Receiver-Independent Exchange (RINEX1[a]) format is a broadly accepted, receiver independent format for storing GPS data. It features a non-proprietary ASCII file format that can be used to combine or process data generated by receivers made by different manufacturers.

Use the NovAtel's Convert4 utility to produce RINEX files from NovAtel receiver data files. For the best results, the NovAtel receiver input data file should contain the logs as specified in the *PC Software and Firmware* chapter of the *OEM6 Family Installation and Operation User Manual* including IONUTC.

a. Refer to the U.S. National Geodetic Survey website at:

http://www.ngs.noaa.gov/CORS/Rinex2.html

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

3.3.55 IPSTATUS Current network configuration status

This log provides the configuration of IP address, netmask, gateway and a list of DNS servers currently in use.

Message ID: **1289**

Log Type: **Asynch**

Recommended Input:

log ipstatus a once

ASCII Example:

#ipstatusa,com1,0,90.5,finesteering,1609,500464.121,00000000,7fe2,6259;1,etha,"10.4
.44.131","255.255.255.0","10.4.44.1",1,"198.161.72.85"*ec22236c

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	IPSTATUS Header	Log header	-	H	0
2	IP status	Number of records to follow	Ulong	4	H
3	interface	ETHA	Enum	4	H+4
4	IP address	IP Address - decimal dot notation	String	16	H+8
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+34
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.56 LBANDINFO L-band Configuration Information

This log outputs configuration information for an L-band service.

In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR service or use of a DGPS service is required. Contact NovAtel for details through our website at www.novatel.com through *Support* or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **730**
Log Type: **Asynch**

Recommended Input:

log lbandinfoa ontime 1

ASCII Example 1 (OmniSTAR HP):

```
#LBANDINFOA,COM2,0,81.5,FINESTEERING,1295,152639.184,00000240,c51d,34461;
1547547,4800,c685,0,762640,EXPIRED,0,0,FIXEDTIME,1199,259199,0*8cc5e573
```

Table 75: L-band Subscription Type

Binary	ASCII	Description
0	EXPIRED	The L-band subscription has expired or does not exist
1	FIXEDTIME	The L-band subscription expires at a fixed date and time
2	COUNTDOWN	The L-band subscription expires after the specified amount of running time
3	COUNTDOWNOVERRUN	The COUNTDOWN subscription has expired but has entered a brief grace period. Resubscribe immediately
16	UNKNOWN	Unknown subscription

What is the real accuracy of the Coast Guard's DGPS as compared to the commercial DGPS? The Coast Guard claims a 10 metre accuracy for their DGPS. Some commercial DGPS vendors offer 5 m (or better) accuracy. Are the commercial vendors really supplying something more accurate than the Coast Guard signal?

The real accuracy of the Coast Guard's DGPS signal is likely better than 10 metres. However, there are a number of factors involved in determining the accuracy of a DGPS system. These include:

- proximity to the base station which is transmitting DGPS corrections
- the GNSS receiver used by the Coast Guard
- the GNSS receiver used by the commercial DGPS services
- the GNSS receiver and the statistical qualifier used in conjunction with the stated accuracy

If you were to compare the Coast Guard and commercial DGPS services under the same situations, for example, a base to user proximity of 1 km and stated accuracy at 2 drms (95% confidence), you would probably find the Coast Guard's DGPS is at least equivalent to, if not better than, commercial DGPS services.

Also of note, the Coast Guard's DPGS service is available to all users (marine, land and air), similar to a public utility, without charge. In addition, the Coast Guard's service acts as an integrity monitor, which provides an independent check of each GPS satellite's signal and reports whether it is good or bad. Commercial DGPS vendors usually have a monthly or yearly subscription fee.

All of the previous discussions have been dealing with code data. Some commercial DGPS services are now providing high accuracy carrier-phase data along with code data. With this type of data, depending on your equipment, you will be able to achieve decimetre and even centimetre level accuracies.

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	LBANDINFO header	Log header		H	0
2	freq	Selected frequency for L-band service (Hz or kHz, depending on how the frequency was specified in the ASSIGNLBAND or ASSIGNLBAND2 command)	Ulong	4	H
3	baud	Communication baud rate from L-band satellite	Ulong	4	H+4
4	ID	L-band signal service ID	Ushort	2	H+8
5	Reserved		Ushort	2	H+10
6	OSN	L-band serial number	Ulong	4	H+12
7	vbs sub	L-band VBS subscription type (see *Table 75* on *page 399*)	Enum	4	H+16
8	vbs exp week	GPS reference week number of L-band VBS expiration date [a]	Ulong	4	H+20
9	vbs exp secs	Number of seconds into the GPS reference week of L-band VBS expiration date [a]	Ulong	4	H+24
10	hp sub	OmniSTAR HP or XP subscription type (see *Table 75* on *page 399*)	Enum	4	H+28
11	hp exp week	GPS reference week number of OmniSTAR HP or XP expiration date [a]	Ulong	4	H+32
12	hp exp secs	Number of seconds into the GPS reference week of OmniSTAR HP or XP expiration date [a]	Ulong	4	H+36
13	hp sub mode	HP or XP subscription mode if the subscription is valid. Refer to *Table 76* on *page 402*	Hex	4	H+40
14	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. If the subscription type is COUNTDOWN, see Field #7 above, the expiration week and expiration seconds into the GPS reference week contain the amount of running time remaining in the subscription.

If the subscription type is COUNTDOWNOVERRUN, the expiration week and expiration seconds into GPS reference week count the amount of the overrun time.

Table 76: HP Subscription Mode

Bit Number	Mask	Description[a]	Value
0	0x00000001	XP	1=subscribed
1	0x00000002	HP	1=subscribed
2	0x00000004	G2	1=subscribed
3-7	0x000000f8	Reserved	
9	0x00000100	GPS measurements	1=enabled
10	0x00000200	GLONASS measurements	1=enabled

a. All other bits are reserved.

3.3.57 LBANDSTAT L-band Status Information

This log outputs status information for a standard L-band, OmniSTAR XP (Extra Precision) or OmniSTAR HP (High Performance) service.

In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR service or use of a DGPS, service is required. Contact NovAtel for details, through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **731**

Log Type: **Asynch**

Recommended Input:

log lbandstata ontime 1

ASCII Example:

```
#LBANDSTATA,COM1,0,73.5,FINESTEERING,1314,494510.000,00000000,c797,1846;
1551488896,43.19,62.3,0.00,0082,0000,7235,11,0,0000,0001,7762,04000000,0
*93f7d2af
```

In binary, the receiver outputs 48 bytes without the checksum when the LBANDSTATB log is requested.

Table 77: L-band Signal Tracking Status

Nibble #	Bit #	Mask	Description	Range Value
N0	0	0x0001	Tracking State	0 = Searching, 1 = Pull-in, 2 = Tracking, 3 = Idle
	1	0x0002		
	2	0x0004	Reserved	
	3	0x0008		
N1	4	0x0010		
	5	0x0020		
	6	0x0040	Bit Timing Lock	0 = Not Locked, 1 = Locked
	7	0x0080	Phase Locked	0 = Not Locked, 1 = Locked
N2	8	0x0100	DC Offset Unlocked	0 = Good, 1 = Warning
	9	0x0200	AGC Unlocked	0 = Good, 1 = Warning
	10	0x0400	Reserved	
	11	0x0800		
N3	12	0x1000		
	13	0x2000		
	14	0x4000		
	15	0x8000	Error	0 = Good, 1 = Error

Table 78: OmniSTAR VBS Status Word

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Subscription Expired [a]	False	True
	1	0x00000002	Out of Region [a]	False	True
	2	0x00000004	Wet Error [a]	False	True
	3	0x00000008	Link Error [a]	False	True
N1	4	0x00000010	No Remote Sites	False	True
	5	0x00000020	No Almanac	False	True
	6	0x00000040	No Position	False	True
	7	0x00000080	No Time	False	True
N2-N4	8-19	Reserved			
N5	20				
	21				
	22				
	23	0x00800000	Wet Warning [a]	False	True
N6	24-27	Reserved			
N7	28				
	29				
	30				
	31	0x80000000	Updating Data	False	True

a. Contact OmniSTAR for subscription support. All other status values are updated by collecting OmniSTAR data for 20-35 minutes.

Table 79: OmniSTAR HP/XP Additional Status Word

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x0001	Solution not fully converged	False	True
	1	0x0002	OmniStar satellite list available	False	True
	2	0x0004	Reserved		
	3	0x0008			
N1	4	0x0010	HP not authorized [a]	Authorized	Unauthorized
	5	0x0020	XP not authorized [a]	Authorized	Unauthorized
	6	0x0040	Reserved		
	7	0x0080			
N2	8	0x0100			
	9	0x0200			
	10	0x0400			
	11	0x0800			
N3	12	0x1000			
	13	0x2000			
	14	0x4000			
	15	0x8000			

a. This authorization is related to the receiver model and not the OmniStar subscription. To view OmniSTAR subscription information use the LBANDINFO log, see *page 399*.

Table 80: OmniSTAR HP/XP Status Word

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Subscription Expired [a]	False	True
	1	0x00000002	Out of Region [a]	False	True
	2	0x00000004	Wet Error [a]	False	True
	3	0x00000008	Link Error [a]	False	True
N1	4	0x00000010	No Measurements	False	True
	5	0x00000020	No Ephemeris	False	True
	6	0x00000040	No Initial Position	False	True
	7	0x00000080	No Time Set	False	True
N2	8	0x00000100	Velocity Error	False	True
	9	0x00000200	No base stations	False	True
	10	0x00000400	No Mapping Message	False	True
	11	0x00000800	Altitude Error	False	True
N3-N5	12-23	Reserved			
N6	24-25				
	26	0x04000000	Static Initialization Mode	False	True
	27	Reserved			
N7	28-30				
	31	0x80000000	Updating Data	False	True

a. Contact OmniSTAR for subscription support. All other status values are updated by collecting the OmniSTAR data for 20-35 minutes.

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	LBANDSTAT header	Log header		H	0
2	freq	Measured frequency of L-band signal (Hz)	Ulong	4	H
3	C/No	Carrier to noise density ratio C/No = $10[\log_{10}(S/N_0)]$ (dB-Hz)	Float	4	H+4
4	locktime	Number of seconds of continuous tracking (no cycle slipping)	Float	4	H+8
5	Reserved		Float	4	H+12
6	tracking	Tracking status of L-band signal (see *Table 77* on *page 404*)	Hex	2	H+16
7	Reserved		Hex	2	H+18
8	#bytes	Number of bytes fed to the standard process	Ulong	4	H+20
9	#good dgps	Number of standard updates	Ulong	4	H+24
10	#bad data	Number of missing standard updates	Ulong	4	H+28
11	Reserved (the *hp status 1* field is obsolete and has been replaced by the longer OmniSTAR HP Status field. The shorter legacy status here is maintained for backward compatibility)		Hex	2	H+32
12	hp status 2	Additional status pertaining to the HP or XP process (see *Table 79* on *page 406*)	Hex	2	H+34
13	#bytes hp	Number of bytes fed to the HP or XP process	Ulong	4	H+36
14	hp status	Status from the HP or XP process (see *Table 80* on *page 407*)	Hex	4	H+40
15	VBS status	Status word for OmniSTAR (see *Table 78* on *page 405*)	Hex	4	H+44
16	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.58 LOGLIST List of System Logs

This log outputs a list of log entries in the system. The following tables show the binary ASCII output. See also the RXCONFIG log on *page 519* for a list of current command settings.

Message ID: **5**
Log Type: **Polled**

Recommended Input:

log loglista once

ASCII Example:

```
#LOGLISTA,COM1,0,60.5,FINESTEERING,1337,398279.996,00000000,c00c,1984; 8,
COM1,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
COM2,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
COM3,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
USB1,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
USB2,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
USB3,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
COM1,BESTPOSA,ONTIME,10.000000,0.000000,NOHOLD,
COM1,LOGLISTA,ONCE,0.000000,0.000000,NOHOLD*5b29eed3
```

Do not use undocumented logs or commands! Doing so may produce errors and void your warranty.

Before contacting NovAtel Customer Support regarding software concerns, please do the following:

1. Issue a FRESET command
2. Log the following data to a file on your PC/laptop for 30 minutes:
   RXSTATUSB once
   RAWEPHEMB onchanged
   RANGEB ontime 1
   BESTPOSB ontime 1
   RXCONFIGA once
   VERSIONB once
3. Send the file containing the logs to NovAtel Customer Support, using the support@novatel.com e-mail address.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	LOGLIST (binary) header	Log header		H	0
2	#logs	Number of messages to follow, maximum = 64	Long	4	H
3	port	Output port, see *Table 5, Page 26*	Enum	4	H+4
4	message	Message ID of log	Ushort	2	H+8
5	message type	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response Bit (see *Section 1.2, Responses* on *page 29*) 0 = Original Message 1 = Response Message	Char	1	H+10
6	Reserved		Char	3[a]	H+11
7	trigger	0 = ONNEW 1 = ONCHANGED 2 = ONTIME 3 = ONNEXT 4 = ONCE 5 = ONMARK	Enum	4	H+14
8	period	Log period for ONTIME	Double	8	H+18
9	offset	Offset for period (ONTIME trigger)	Double	8	H+26
10	hold	0 = NOHOLD 1 = HOLD	Enum	4	H+32
11...	Next log offset = H + 4 + (#logs x 32)				
variable	xxxx	32-bit CRC	Hex	4	H+4+(#logs x 32)

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment.

Field #	Field type	Data Description	Format
1	LOGLIST (ASCII) header	Log header	
2	#port	Number of messages to follow, maximum = 64	Long
3	port	Output port, see *Table 5, Page 26*	Enum
4	message	Message name of log with no suffix for abbreviated ascii, an A suffix for ascii and a B suffix for binary.	Char [ ]
5	trigger	ONNEW ONCHANGED ONTIME ONNEXT ONCE ONMARK	Enum
6	period	Log period for ONTIME	Double
7	offset	Offset for period (ONTIME trigger)	Double
8	hold	NOHOLD HOLD	Enum
9...	Next port		
variable	xxxx	32-bit CRC	Hex
variable	[CR][LF]	Sentence terminator	-

3.3.59 MARKPOS, MARK2POS Position at Time of Mark Input Event

This log contains the estimated position of the antenna when a pulse is detected at a mark input. MARKPOS is a result of a pulse on the MK1I input and MARK2POS is generated when a pulse occurs on a MK2I input. Refer to the *Technical Specifications* appendix in the *OEM6 Family Installation and Operation User Manual* for mark input pulse specifications and the location of the mark input pins.

The position at the mark input pulse is extrapolated using the last valid position and velocities. The latched time of mark impulse is in GPS reference weeks and seconds into the week. The resolution of the latched time is 10 ns. See also the notes on MARKPOS in the MARKTIME log on *page 414*.

Message ID: **181 (MARKPOS)** and **615 (MARK2POS)**
Log Type: **Asynch**

Recommended Input:

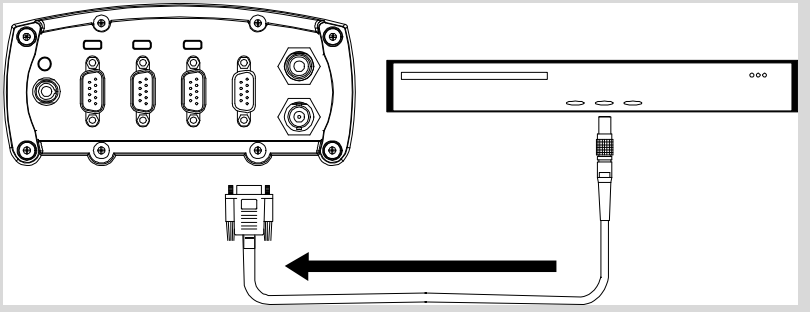
```
log markposa onnew
```

Use the ONNEW trigger with the MARKTIME or MARKPOS logs.

Abbreviated ASCII Example:

```
SOL_COMPUTED,NARROW_INT,51.11637234389,-114.03824932277,1063.8475,-16.2713,
WGS84,0.0095,0.0078,0.0257,"AAAA",1.000,0.000,17,10,10,9,0,1,0,03
```

Consider the case where you have a user point device such as video equipment. Connectt the device to the receiver's I/O port using a cable that is compatible to both the receiver and the device. Refer to your device's documentation for information about connectors and cables. The arrow along the cable in the figure below indicates a MARKIN pulse, from the user device on the right to the receiver I/O port.



Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MARKPOS/ MARK2POS header	Log header		H	0
2	sol status	Solution status (see *Table 57* on *page 304*)	Enum	4	H
3	pos type	Position type (see *Table 56* on *page 303*)	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 geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Chapter 2, Table 16, Reference Ellipsoid Constants* on *page 96*)	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	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84.

3.3.60 MARKTIME, MARK2TIME Time of Mark Input Event

This log contains the time of the leading edge of the detected mark input pulse. MARKTIME gives the time when a pulse occurs on the MK1I input and MARK2POS is generated when a pulse occurs on a MK2I input. Refer to the *Technical Specifications* appendix in the *OEM6 Family Installation and Operation User Manual* for mark input pulse specifications and the location of the mark input pins. The resolution of this measurement is 10 ns.

1. Use the ONNEW trigger with this or the MARKPOS logs.
2. Only the MARKPOS logs, the MARKTIME logs and 'polled' log types are generated 'on the fly' at the exact time of the mark. Synchronous and asynchronous logs output the most recently available data.

Message ID: **231 (MARKTIME) and 616 (MARK2TIME)**
Log Type: **Asynch**

Recommended Input:

log marktimea onnew

Example:

```
#MARKTIMEA,COM1,0,77.5,FINESTEERING,1358,422621.000,00000000,292e,2214;
1358,422621.000000500,-1.398163614e-08,7.812745577e-08,-14.000000002,
VALID*d8502226
```

These logs allow you to measure the time when events are occurring in other devices (such as a video recorder). See also the MARKCONTROL command on *page 165*.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MARKTIME/ MARK2TIME header	Log header		H	0
2	week	GPS reference week number	Long	4	H
3	seconds	Seconds into the week as measured from the receiver clock, coincident with the time of electrical closure on the Mark Input port	Double	8	H+4
4	offset	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, 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[a]	Double	8	H+28
7	status	Clock model status, see *Table 65, Clock Model Status* on *page 322*	Enum	4	H+36
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+40
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. 0 indicates that UTC time is unknown because there is no almanac available in order to acquire the UTC offset.

3.3.61 MASTERPOS Master Position using ALIGN

ALIGN generates distance and bearing information between a Master and Rover receiver. This log outputs the position information of the master when using the ALIGN feature. This log can be output from both Y and Z ALIGN models and can be output at both Master and Rover ends.

You must have an ALIGN capable receiver to use this log.

1. ALIGN is useful for obtaining the relative directional heading of a vessel/body, separation heading between two vessels/bodies or heading information with moving base and pointing applications.
2. The log can be output at both Y and Z model Rover if it is receiving the RTCAREFEXT message from the Master. The log can be output at any Master if Master is receiving HEADINGEXTB from the Rover.
3. MASTERPOS logging is dictated by the output frequency of the RTCAREFEXT output frequency.

Message ID: **1051 (MASTERPOS)**
Log Type: **Asynch**

Recommended Input:

log masterposa onchanged

Example 1:

```
#MASTERPOSA,COM1,0,21.5,FINESTEERING,1544,340322.000,00000008,5009,4655;
SOL_COMPUTED,NARROW_INT,51.11604599076,-114.03855412002,1055.7756,
16.9000,WGS84,0.0090,0.0086,0.0143,"AAAA",0.0,0.0,13,13,13,12,0,0,0,0*a72e8d3
f
```

Asynchronous logs, such as MASTERPOS, should only be logged ONCHANGED or ONNEW otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Field #	Field Type	Field Description	Binary Format	Binary Bytes	Binary Offset
1	MASTERPOS header	Log Header		H	0
2	sol stat	Solution Status, see *Table 57* on *page 304*	Enum	4	H
3	pos type	Position Type see *Table 56* on *page 303*	Enum	4	H+4
4	lat	Master WGS84 Latitude in degrees	Double	8	H+8
5	long	Master WGS84 Longitude in degrees	Double	8	H+16
6	hgt	Master MSL Height in metres	Double	8	H+24
7	undulation	Undulation in metres	Float	4	H+32
8	datum id#	WGS84 (default)	Enum	4	H+36
9	lat σ	Latitude Std in metres	Float	4	H+40
10	long σ	Longitude Std in metres	Float	4	H+44
11	hgt σ	Height Std in metres	Float	4	H+48
12	stn id	Receiver ID can be set using the DGPSTXID command, see *page 103*	Char[4]	4	H+52
13	Reserved		Float	4	H+56
14			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	#obs	Number of satellites above elevation mask angle	Uchar	1	H+66
18	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20			Uchar	1	H+69
21			Uchar	1	H+70
22			Uchar	1	H+71
23	xxxx		HEX	1	H+72
24	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.62 MATCHEDPOS Matched RTK Position

This log represents positions that have been computed from time matched base and rover observations. There is no base extrapolation error on these positions because they are based on buffered measurements, that is, they lag real time by some amount depending on the latency of the data link. If the rover receiver has not been enabled to accept RTK differential data or is not actually receiving data leading to a valid solution, this is shown in fields #2 (*sol status*) and #3 (*pos type*).

This log provides the best accuracy in static operation. For lower latency in kinematic operation, see the RTKPOS (*page 512*) or BESTPOS (*page 301*) logs. The data in the logs changes only when a base observation (RTCM, RTCMV3, RTCA, CMRPLUS or CMR) changes.

A good message trigger for this log is ONCHANGED. Then, only positions related to unique base station messages are produced and the existence of this log indicates a successful link to the base.

Asynchronous logs, such as MATCHEDPOS, should only be logged ONCHANGED otherwise the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Message ID: **96**
Log Type: **Asynch**

Recommended Input:

log matchedposa onchanged

ASCII Example:

```
#MATCHEDPOSA,COM1,0,63.0,FINESTEERING,1419,340034.000,00000040,2f06,2724;
SOL_COMPUTED,NARROW_INT,51.11635908660,-114.03833102484,1063.8400,-16.2712,
WGS84,0.0140,0.0075,0.0174,"AAAA",0.000,0.000,12,12,12,12,0,01,0,33*feac3a3a
```

Measurement precision is different from the position computation precision. Measurement precision is a value that shows how accurately the actual code or carrier phase is measured by the GNSS receiver. Position precision is a value that shows the accuracy of the position computation made from the code and/or carrier phase measurements. The P-code L2 measurement precision is not as good as the C/A measurement precision because the NovAtel GNSS receiver is a civilian grade GPS device and does not have direct access to the decrypted military L2 P(Y) code. This means that NovAtel's semi-codeless P-code L2 measurements are noisier than the civilian band C/A code measurements. Refer to the *OEM6 Installation and Operation Manual* for the technical specification of the OEM6 card.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MATCHED-POS header	Log header		H	0
2	sol status	Solution status (see *Table 57* on *page 304*)	Enum	4	H
3	pos type	Position type (see *Table 56* on *page 303*)	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 geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Table 17* on *page 97*)	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	Reserved		Float	4	H+56
14			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	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84.

3.3.63 MATCHEDSATS Satellites used in MATCHEDPOS solution

This log lists the used and unused satellites for the corresponding MATCHEDPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1176**
Log Type: **Asynch**

Recommended Input:

log matchedsats onchanged

Abbreviated ASCII Example:

```
<MATCHEDSATS COM1 0 80.0 FINESTEERING 1690 601976.000 00000008 b555 43488
<     20
<          GPS 11 GOOD 00000003
<          GPS 8 GOOD 00000003
...
<          GPS 1 GOOD 00000003
<          GPS 7 GOOD 00000003
<          SBAS 133 NODIFFCORR 00000000
<          SBAS 138 NODIFFCORR 00000000
<          SBAS 135 NODIFFCORR 00000000
<          GLONASS 10-7 GOOD 00000003
<          GLONASS 21+4 GOOD 00000003
...
<          GLONASS 12-1 GOOD 00000003
<     GLONASS 11 GOOD 00000003
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MATCHED SATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 156*	Enum	4	H+4
4	Satellite ID	Satellite identifier see *page Table 62* on *page 309*	Ulong	4	H+8
5	Status	Satellite status. See *Table 60* on *page 308*	Enum	4	H+16
6	Status mask	See *Table 61* on *page 309*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.64 MATCHEDXYZ Matched RTK Cartesian Position

This log contains the receiver's matched position in ECEF coordinates. It represents positions that have been computed from time matched base and rover observations. There is no base station extrapolation error on these positions because they are based on buffered measurements, that is, they lag real time, by some amount, depending on the latency of the data link. If the rover receiver has not been enabled to accept RTK differential data or is not actually receiving data leading to a valid solution, this is reflected by the code shown in field #2 (solution status) and #3 (position type). See *Figure 10, page 317* for a definition of the ECEF coordinates.

This log provides the best accuracy in static operation. For lower latency in kinematic operation, see the BESTXYZ or RTKXYZ logs on *pages 315* and *517* respectively. The data in the logs changes only when a base observation (RTCM, RTCMV3, RTCA or CMR) changes.

The time stamp in the header is the time of the matched observations that the computed position is based on and not the current time.

Message ID: **242**
Log Type: **Asynch**

Recommended Input:

log matchedxyza onchanged

Asynchronous logs, such as MATCHEDXYZ, should only be logged ONCHANGED otherwise the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

ASCII Example:

```
#MATCHEDXYZA,COM1,0,62.5,FINESTEERING,1419,340035.000,00000040,b8ed,2724;
SOL_COMPUTED,NARROW_INT,-1634531.5703,-3664618.0321,4942496.3280,0.0080,
0.0159,0.0154,"AAAA",12,12,12,12,0,01,0,33*e4b84015
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MATCHEDXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56, Position or Velocity Type* on *page 303*	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
18	stn ID	Base station ID	Char[4]	4	H+44
22	#SVs	Number of satellite vehicles tracked	Uchar	1	H+48
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+49
24	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+50
25	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+51
26	Reserved		Char	1	H+52
27	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+53
28	Reserved		Hex	1	H+54
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+55
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+56
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.65 NAVIGATE User Navigation Data

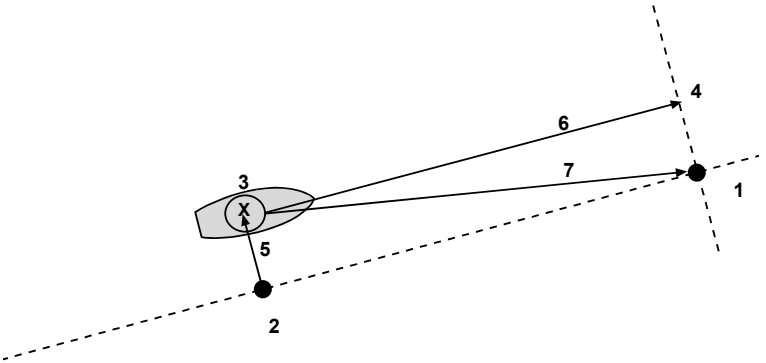
This log reports the status of the waypoint navigation progress. It is used in conjunction with the SETNAV command, see *page 230*.

See *Figure 11, below,* for an illustration of navigation parameters.

> The SETNAV command must be enabled before valid data will be reported from this log.

Message ID: **161**

Log Type: **Synch**



Reference	Description
1	TO lat-lon
2	X-Track perpendicular reference point
3	Current GPS position
4	A-Track perpendicular reference point
5	X-Track (cross track)
6	A-Track (along track)
7	Distance and bearing from 3 to 1

Figure 11: Navigation parameters

Table 81: Navigation Data Type

Navigation Data Type Binary	Navigation Data Type ASCII	Description
0	GOOD	Navigation is good
1	NOVELOCITY	Navigation has no velocity
2	BADNAV	Navigation calculation failed for an unknown reason
3	FROM_TO_SAME	“From” is too close to “To” for computation
4	TOO_CLOSE_TO_TO	Position is too close to “To” for computation
5	ANTIPODAL_WAYPTS	Waypoints are antipodal on surface

Recommended Input:

log navigatea ontime 1

ASCII Example:

```
#NAVIGATEA,COM1,0,56.0,FINESTEERING,1337,399190.000,00000000,aece,1984;
SOL_COMPUTED,PSRDIFF,SOL_COMPUTED,GOOD,9453.6278,303.066741,133.7313,
9577.9118,1338,349427.562*643cd4e2
```

Use the NAVIGATE log in conjunction with the SETNAV command to tell you where you currently are with relation to known To and From points. You can find a specific latitude, longitude or height knowing from where you started. For example, a backpacker could use these two commands to program a user supplied graphical display, on a digital GPS compass, to show their progress as they follow a defined route.

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	NAVIGATE header	Log header		H	0
2	sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+4
4	vel type	Velocity type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+8
5	nav type	Navigation data type (see *Table 81, Navigation Data Type* on *page 423*)	Enum	4	H+12
6	distance	Straight line horizontal distance from current position to the destination waypoint, in metres (see *Figure 11* on *page 423).* This value is positive when approaching the waypoint and becomes negative on passing the waypoint	Double	8	H+16
7	bearing	Direction from the current position to the destination waypoint, in degrees, with respect to True North (or magnetic if corrected for magnetic variation by MAGVAR command)	Double	8	H+24
8	along track	Horizontal track distance from the current position to the closest point on the waypoint arrival perpendicular; expressed in metres. This value is positive when approaching the waypoint and becomes negative on passing the waypoint	Double	8	H+32
9	xtrack	The horizontal distance (perpendicular track error), from the vessel's present position to the closest point on the great circle line, that joins the FROM and TO waypoints. If a "track offset" has been entered in the SETNAV command, xtrack is the perpendicular error from the "offset track". Xtrack is expressed in metres. Positive values indicate the current position is right of the Track, while negative offset values indicate left	Double	8	H+40
10	eta week	Estimated GPS reference week number at time of arrival at the "TO" waypoint, along track arrival perpendicular based on current position and speed, in units of GPS reference weeks. If the receiving antenna is moving at a speed of less than 0.1 m/s ,in the direction of the destination, the value in this field is "9999"	Ulong	4	H+48
11	eta secs	Estimated GPS seconds into week at time of arrival at destination waypoint along track arrival perpendicular, based on current position and speed, in units of GPS seconds into the week. If the receiving antenna is moving at a speed of less than 0.1 m/s in the direction of the destination, the value in this field is "0.000"	Double	8	H+52
12	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+60
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.66 NMEA Standard Logs

This log contains NMEA logs.

GLMLA	**GLONASS ALMANAC DATA**
GPALM	**ALMANAC DATA**
GPGGA	**GLOBAL POSITION SYSTEM FIX DATA AND UNDULATION**
GPGGALONG	**GPS FIX DATA, EXTRA PRECISION AND UNDULATION**
GPGGARTK	**GPS FIX DATA**
GPGLL	**GEOGRAPHIC POSITION**
GPGRS	**GPS RANGE RESIDUALS FOR EACH SATELLITE**
GPGSA	**GPS DOP AN ACTIVE SATELLITES**
GPGST	**PSEUDORANGE MEASUREMENT NOISE STATISTICS**
GPGSV	**GPS SATELLITES IN VIEW**
GPHDT	**NMEA HEADING LOG (ALIGN)**
GPRMB	**NAVIGATION INFORMATION**
GPRMC	**GPS SPECIFIC INFORMATION**
GPVTG	**TRACK MADE GOOD AND GROUND SPEED**
GPZDA	**UTC TIME AND DATE**

The NMEA log structures follow format standards as adopted by the National Marine Electronics Association. The reference document used is "Standard For Interfacing Marine Electronic Devices NMEA 0183 Version 3.01". For further information, refer to the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/. The following table contains excerpts from Table 6 of the NMEA Standard which defines the variables for the NMEA logs. The actual format for each parameter is indicated after the description.

See the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field Type	Symbol	Definition
Special Format Fields		
Status	A	Single character field: A = Yes, Data Valid, Warning Flag Clear V = No, Data Invalid, Warning Flag Set
Latitude	llll.ll	Fixed/Variable length field: degrees|minutes.decimal - 2 fixed digits of degrees, 2 fixed digits of mins and a variable number of digits for decimal-fraction of mins. Leading zeros always included for degrees and mins to maintain fixed length. The decimal point and associated decimal-fraction are optional if full resolution is not required
Longitude	yyyyy.yy	Fixed/Variable length field: degrees|minutes.decimal - 3 fixed digits of degrees, 2 fixed digits of mins and a variable number of digits for decimal-fraction of mins. Leading zeros always included for degrees and mins to maintain fixed length. The decimal point and associated decimal-fraction are optional if full resolution is not required
Time	hhmmss.ss	Fixed/Variable length field: hours|minutes|seconds.decimal - 2 fixed digits of hours, 2 fixed digits of mins, 2 fixed digits of seconds and variable number of digits for decimal-fraction of seconds. Leading zeros always included for hours, mins and seconds to maintain fixed length. The decimal point and associated decimal-fraction are optional if full resolution is not required.
Defined field		Some fields are specified to contain predefined constants, most often alpha characters. Such a field is indicated in this standard by the presence of one or more valid characters. Excluded from the list of allowable characters are the following which are used to indicate field types within this standard: "A", "a", "c", "hh", "hhmmss.ss", "llll.ll", "x", "yyyyy.yy"
Numeric Value Fields		
Variable numbers	x.x	Variable length integer or floating numeric field. Optional leading and trailing zeros. The decimal point and associated decimal-fraction are optional if full resolution is not required (example: 73.10 = 73.1 = 073.1 = 73)
Fixed HEX	hh___	Fixed length HEX numbers only, MSB on the left
Information Fields		
Variable text	c--c	Variable length valid character field
Fixed alpha	aa___	Fixed length field of uppercase or lowercase alpha characters
Fixed	xx___	Fixed length field of numeric characters
Fixed text	cc___	Fixed length field of valid characters

NOTES:

1. Spaces may only be used in variable text fields.
2. A negative sign "-" (HEX 2D) is the first character in a Field if the value is negative. The sign is omitted if the value is positive.
3. All data fields are delimited by a comma (,).
4. Null fields are indicated by no data between two commas (,,). Null fields indicate invalid data or no data available.
5. The NMEA Standard requires that message length be limited to 82 characters.

3.3.67 OMNIHPPOS OmniSTAR HP/XP Position

This log utputs L-band Extra Performance (XP) or High Performance (HP) position information.

In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR service is required. Contact NovAtel for details, through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **495**

Log Type: **Synch**

Recommended Input:

log omnihpposa ontime 1

ASCII Example:

```
#OMNIHPPOSA,COM1,0,67.5,FINESTEERING,1419,320435.000,00000000,808d,2724;
SOL_COMPUTED,OMNISTAR_HP,51.11635489609,-114.03819540112,1063.8314,-16.2713,
WGS84,0.1258,0.2135,0.2342,"1000",8.000,0.000,13,10,10,10,0,00,0,03*e8510806
```

OmniSTAR HP/XP service is particularly useful for agricultural machine guidance and many surveying tasks. It operates in real time, and without the need for local Base Stations or telemetry links. It usually has a 2-sigma Horizontal RMS (68%) = 10 cm for HP and 15 cm for XP.

.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	OMNIHPPOS header	Log header		H	0
2	sol status	Solution status, see *Table 57* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56* on *page 303*	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 geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Chapter 2, Table 16, Reference Ellipsoid Constants* on *page 96*)	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	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84.

3.3.68 OMNIHPSATS Satellites used in the OMNIHPPOS solution

This log lists the used and unused satellites for the corresponding OMNIHPPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1197**
Log Type: **Synch**

Recommended Input:

log omnihpsatsa ontime 1

ASCII Example:

```
#OMNIHPSATSA,COM2,0,85.0,FINESTEERING,1610,241351.000,00000000,2577,6293;17,G
PS,17,GOOD,00000003,GPS,2,GOOD,00000003,GPS,10,GOOD,00000003,GPS,4,GOOD,00000
003,GPS,29,GOOD,00000003,GPS,5,NOTUSED,00000000,GPS,25,GOOD,00000003,GPS,9,GO
OD,00000003,GPS,12,GOOD,00000003,GLONASS,15,NOTUSED,00000000,GLONASS,2-4,
NOTUSED,00000000,GLONASS,18-3,NOTUSED,00000000,GLONASS,9-2,NOTUSED,
00000000,GLONASS,1+1,NOTUSED,00000000,GLONASS,17+4,NOTUSED,00000000,GLONASS,1
6-1,NOTUSED,00000000,GLONASS,19+3,NOTUSED,00000000*F9EB4605
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	OMNIHPS ATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 156*.	Enum	4	H+4
4	Satellite ID	Satellite idendifier see *Table 62* on *page 309*	Ulong	4	H+8
5	Status	Satellite status. See *Table 60* on *page 308*	Enum	4	H+16
6	Status mask	See *Table 61* on *page 309*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.69 OMNIVIS Omnistar Satellite Visibility List

This log contains OmniSTAR satellite and visibility information.

For local OmniSTAR beams, the satellite with the smallest local ellipsoid distance is the best one to use. For global beams, the satellite with the highest elevation is the best one.

Message ID: **860**
Log Type: **Synch**

Recommended Input:

```
log omnivisa ontime 1
#OMNIVISA,COM1,0,60.5,FINESTEERING,1419,396070.000,00000020,0041,2710;
TRUE,8,
10,0,"MSVW_",0,0.000,1536782000,1200,c685,-1.16,-90.00,
11,0,"MSVC_",0,0.000,1534741000,1200,c685,8.28,-90.00,
12,0,"MSVE_",0,0.000,1530359000,1200,c685,22.97,-90.00,
8,0,"AMSAT",0,0.000,1535137500,1200,c685,34.87,31.09,
7,0,"EASAT",0,0.000,1535152500,1200,c685,91.01,-41.76,
3,0,"AFSAT",0,0.000,1535080000,1200,c685,110.73,-41.76,
4,0,"APSAT",0,0.000,1535137500,1200,2873,185.25,-40.66,
13,0,"OCSAT",0,0.000,1535185000,1200,2873,235.91,-18.57*b35c9cdf
```

ASCII Example 2:

```
#OMNIVISA,COM1,0,62.5,FINESTEERING,1419,334202.000,00000020,0041,2710;
FALSE,0*9e0f9078
```

Local Beams: When the value is negative, the user is inside the local beam footprint and a signal should be available. Beams with small positive values may be available but their availability is not guaranteed.

Global Beams: Any beams above 0 degrees are visible, however the tracking may be marginal for elevations less than 10 degrees.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	OMNIVIS header	Log header		H	0
2	valid	Is the list of satellites valid? 0 = FALSE 1 = TRUE	Bool	4	H
3	#recs	Number of records to follow	Ulong	4	H+4
4	link ID	Satellite link ID	Uchar	1	H+8
5	app flag	Time of applicability flag: 0 = Valid Now 1 = Invalid 2 = Valid Until 3 = Valid After 4-7 = Reserved	Uchar	1	H+9
6	sat name	Satellite name	String	6	H+10
7	app week	Time of applicability week	Ulong	4	H+16
8	app sec	Time of applicability (s into the week)	GPSec	4	H+20
9	freq	Satellite broadcast frequency (Hz)	Ulong	4	H+28
10	bit rate	Satellite data bit rate	Ushort	2	H+32
11	service id	Satellite service ID	Hex	2	H+34
12	ellip dist	Local ellipsoid distance parameter	Float	4	H+36
13	global elev	Global beam elevation (degrees)	Float	4	H+40
14	Next satellite offset = H + 8 + (#recs x 32)				
15	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+8+ (#recs x 32)
16	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.70 PASSCOM, PASSXCOM, PASSAUX, PASSUSB, PASSETH1, PASSICOM, PASSNCOM Redirects Data

The pass-through logging feature enables the receiver to redirect any ASCII or binary data, input at a specified port, to any specified receiver port. It allows the receiver to perform bi-directional communications with other devices such as a modem, terminal or another receiver. See also the *INTERFACEMODE* command on *page 146*.

There are many pass through logs: PASSCOM1, PASSCOM2, PASSCOM3, PASSXCOM1, PASSXCOM2, PASSXCOM3, PASSAUX, PASSETH1, PASSICOM1, PASSICOM2, PASSICOM3, PASSNCOM1, PASSNCOM2, PASSNCOM3 allow for redirection of data that is arriving at COM1, COM2, COM3, virtual COM1, virtual COM2 or AUX. The AUX port is available on some products. PASSUSB1, PASSUSB2, PASSUSB3 are only available on receivers supporting USB and can be used to redirect data from USB1, USB2 or USB3. PASSETH1 is only available on receivers supporting Ethernet and can be used to redirect data from ETH1.

A pass through log is initiated the same as any other log, that is, LOG [to-port] [data-type] [trigger]. However, pass-through can be more clearly specified as: LOG [to-port] [from-port-AB] [onchanged]. Now, the [from-port-AB] field designates the port which accepts data (that is, COM1, COM2, COM3, AUX, USB1, USB2 or USB3) as well as the format in which the data is logged by the [to-port] (A for ASCII or B for Binary).

When the [from-port-AB] field is suffixed with an [A], all data received by that port is redirected to the [to-port] in ASCII format and logs according to standard NovAtel ASCII format. Therefore, all incoming ASCII data is redirected and output as ASCII data. However, any binary data received is converted to a form of ASCII hexadecimal before it is logged.

When the [from-port-AB] field is suffixed with a [B], all data received by that port is redirected to the [to-port] exactly as it is received. The log header and time tag adhere to standard NovAtel Binary format followed by the pass through data as it was received (ASCII or binary).

Pass through logs are best utilized by setting the [trigger] field as onchanged or onnew.

If the data being injected is ASCII, then the data is grouped together with the following rules:

- blocks of 80 characters
- any block of characters ending in a <CR>
- any block of characters ending in a <LF>
- any block remaining in the receiver code when a timeout occurs (100 ms)

If the data being injected is binary or the port INTERFACEMODE mode is set to GENERIC, then the data is grouped as follows:

- blocks of 80 bytes
- any block remaining in the receiver code when a timeout occurs (100 ms)

If a binary value is encountered in an ASCII output, then the byte is output as a hexadecimal byte preceded by a backslash and an x. For example 0A is output as \x0A. An actual '\' in the data is output as \\. The output counts as one pass through byte although it is four characters.

The first character of each pass-through record is time tagged in GPS reference weeks and seconds.

PASSCOM1 Message ID:233

PASSCOM2 Message ID:234

PASSCOM3 Message ID:235

PASSXCOM1 Message ID: 405

PASSXCOM2 Message ID: 406

PASSXCOM3 Message ID: 795

PASSUSB1 Message ID: 607

PASSUSB2 Message ID: 608

PASSUSB3 Message ID: 609

PASSAUX Message ID: 690

PASSETH1 Message ID: 1209

PASSICOM1 Message ID: 1250

PASSICOM2 Message ID: 1251

PASSICOM3 Message ID: 1252

PASSNCOM1 Message ID: 1253

PASSNCOM2 Message ID: 1254

PASSNCOM3 Message ID: 1255

Log Type: Asynch

Recommended Input:

log passcom1a onchanged

Asynchronous logs should only be logged ONCHANGED otherwise the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

ASCII Example 1:

```
#PASSCOM2A,COM1,0,59.5,FINESTEERING,1337,400920.135,00000000,2b46,1984;
80,#BESTPOSA,COM3,0,80.0,FINESTEERING,1337,400920.000,00000000,4ca6,1899;
SOL_COMPUT*f9dfab46
#PASSCOM2A,COM1,0,64.0,FINESTEERING,1337,400920.201,00000000,2b46,1984;
80,ED,SINGLE,51.11636326036,-114.03824210485,1062.6015,-16.2713,WGS84,
1.8963,1.0674*807fd3ca
#PASSCOM2A,COM1,0,53.5,FINESTEERING,1337,400920.856,00000000,2b46,1984;
49,,2.2862,"",0.000,0.000,9,9,0,0,0,0,0,0*20b24878\x0d\x0a*3eef4220
#PASSCOM1A,COM1,0,53.5,FINESTEERING,1337,400922.463,00000000,13ff,1984;
17,unlog passcom2a\x0d\x0a*ef8d2508
```

ASCII Example 2:

```
#PASSCOM2A,COM1,0,53.0,FINESTEERING,1337,400040.151,00000000,2b46,1984;
80,\x99A\x10\x04\x07yN &\xc6\xea\xf10\x00\x01\xde\x00\x00\x10\xfe\xbf\xfe1\
xfe\x9c\xf4\x03\xe2\xef\x9f\x1f\xf3\xff\xd6\xff\xc3_A~z \xaa\xfe\xbf\xf9\
xd3\xf8\xd4\xf4-\xe8kHo\xe2\x00>\xe0QOC>\xc3\x9c\x11\xff\x7f\xf4\xa1\xf3t\
xf4'\xf4xvo\xe6\x00\x9d*dcd2e989
```

In the example, note that '~' is a printable character.

For example, you could connect two OEM6 family receivers together via their COM1 ports such as in the figure below (a rover station to base station scenario). If the rover station is logging BESTPOSA data to the base station, it is possible to use the pass through logs to pass through the received BESTPOSA data to a disk file (let's call it diskfile.log) at the base station host PC hard disk.

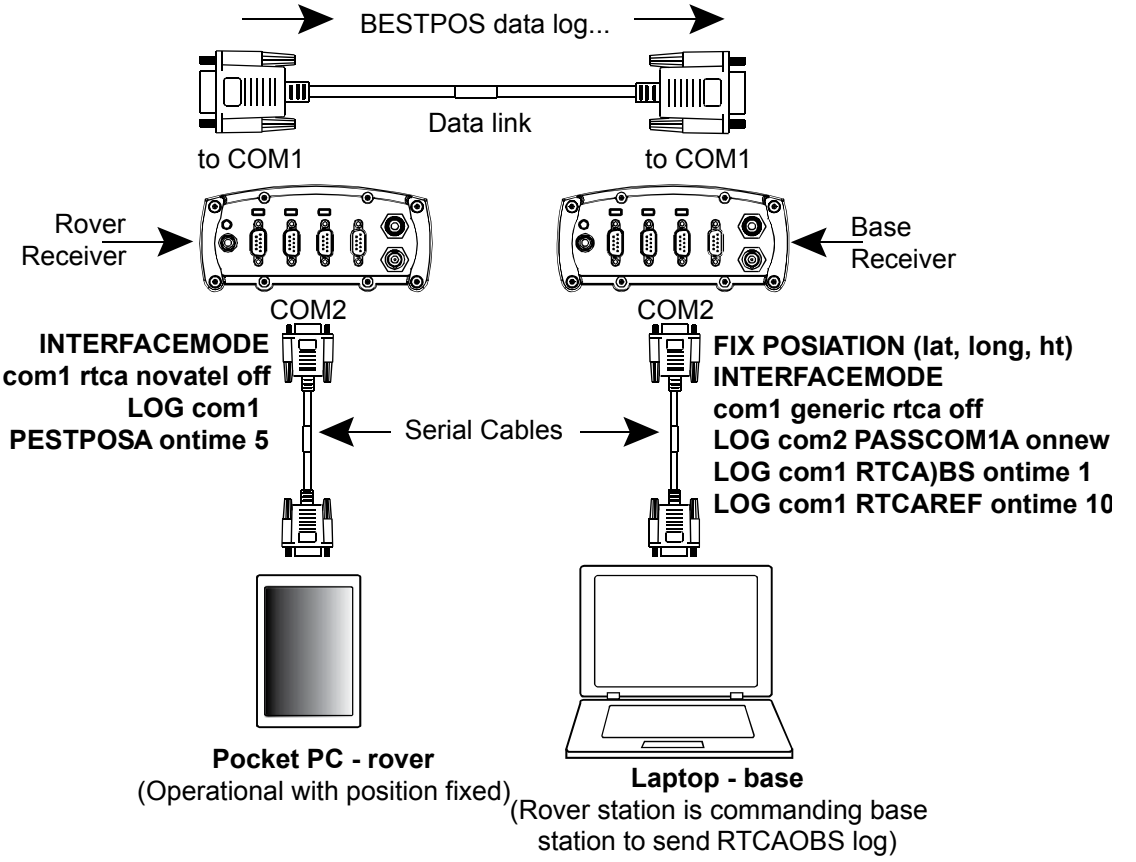


Figure 12: Pass Through Log Data

Under default conditions ,the two receivers "*chatter"* back and forth with the *Invalid Command Option* message (due to the command interpreter in each receiver not recognizing the command prompts of the other receiver). The*chattering* in turn causes the accepting receiver to transmit new pass through logs with the response data from the other receiver. To avoid the chattering problem, use the INTERFACEMODE command on the accepting port to disable error reporting from the receiving port command interpreter.

If the accepting port's error reporting is disabled by INTERFACEMODE, the BESTPOSA data record passes through and creates two records.

The reason that two records are logged from the accepting receiver is the first record was initiated by receipt of the BESTPOSA first terminator <CR>. The second record followed in response to the BESTPOSA second terminator <LF>.

Note the time interval between the first character received and the terminating <LF> can be calculated by differencing the two GPS REFERENCE TIME tags. This pass through feature is useful for time tagging the arrival of external messages. These messages can be any user related data. If you are using this feature for tagging external events, it is recommended that the rover receiver be disabled from interpreting commands so the receiver does not respond to the messages, using the INTERFACEMODE command, see *page 146*.

If the BESTPOSB binary log data is input to the accepting port (log com2 passcom1a onchanged), the BESTPOSB binary data at the accepting port is converted to a variation of ASCII hexadecimal before it is passed through to COM2 port for logging.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PASSCOM header	Log header		H	0
2	#bytes	Number of bytes to follow	Ulong	4	H
3	data	Message data	Char [80]	80	H+4
4	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+8+(#bytes)
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.71 PASSTHROUGH Redirected Data from All Ports

This log outputs pass through data from all receiver ports. The behavior is the same as the port specific pass though logs described in *Section 3.3.70* on *page 433*.

Message ID: **1342**

Log Type: **Asynch**

Recommended Input:

```
log passthrougha onchanged
```

ASCII Example:

```
#PASSTHROUGHA,COM1,0,73.0,FINESTEERING,1625,165965.067,00040008,5fa3,39275;US
B1,80,i\xd3\x00\x87>\xb0\x00'\x91\xb3"\xa0D?\xaa\xb2\x00\x07op\x18@\x05\xe9\x
d4\x08\xe7\x03\x7f\xfd\x18{\x80w\xff\xf2N_cy\x11\x80\x0bC\xdc\x01@\x00\xdfr\x
b1`\x873\xff\x81]\x7f\xe3\xff\xea\x83v\x08M\xd8?\xfcr\xf7\x01\x18\x00\x17\x1d
2\xd1\xd1b\x00*5cb8bd9a
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PASSTHROUGH header	Log header		H	0
2	Port	See *Table 39, COM Port Identifiers* on *page 220 in Chapter 2* of this manual	Enum	4	H
3	#bytes	Number of bytes to follow	ULONG	80	H+4
4	data	Message data	CHAR[80]	80	H+8
10	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+8+#+bytes
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.72 PDPPOS PDP filter position

The PDPPOS log contains the pseudorange position computed by the receiver with the PDP filter enabled. See also the PDPFILTER command on *page 177*.

Message ID: **469**

Log Type: **Synch**

Recommended Input:

```
log pdpposa ontime 1
```

ASCII Example:

```
#PDPPOSA,COM1,0,75.5,FINESTEERING,1431,494991.000,00040000,a210,35548;
SOL_COMPUTED,SINGLE,51.11635010310,-114.03832575772,1065.5019,-16.9000,
WGS84,4.7976,2.0897,5.3062,"",0.000,0.000,8,8,0,0,0,0,0,0*3cbfa646
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PDPPOS header	Log header		H	0
2	sol status	Solution status	Enum	4	H
3	pos type	Position type	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 geoid and the WGS84 ellipsoid (m) [a]	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	#sats	Number of satellite vehicles tracked	Uchar	1	H+64
16	#sats soln	Number of satellites in the 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 (see *Table 59* on *page 305*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84.

3.3.73 PDPSATS Satellites used in PDPPOS solution

This log lists the used and unused satellites for the corresponding PDPPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1234**
Log Type: **Synch**

Recommended Input:

log pdpsatsa ontime 1

Abbreviated ASCII Example:

```
<PDPSATS COM1 0 80.0 FINESTEERING 1690 603073.000 00000008 be33 43488
<     21
<          GPS 11 GOOD 00000001
<          GPS 27 GOOD 00000001
...
<          GPS 1 GOOD 00000001
<          GPS 7 GOOD 00000001
<          SBAS 133 NOTUSED 00000000
<          SBAS 138 NOTUSED 00000000
<          SBAS 135 NOTUSED 00000000
<          GLONASS 10-7 GOOD 00000001
<          GLONASS 21+4 GOOD 00000001
...
<          GLONASS 12-1 GOOD 00000001
<          GLONASS 11 GOOD 00000001
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PDPSATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 156*	Enum	4	H+4
4	Satellite ID	Satellite identifier. See *Table 62* on *page 309*	Ulong	4	H+8
5	Status	Satellite status. See *Table 60* on *page 308*	Enum	4	H+16
6	Status mask	See *Table 61* on *page 309*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.74 PDPVEL PDP filter velocity

The PDPVEL log contains the pseudorange velocity computed by the receiver with the PDP filter enabled. See also the PDPFILTER command on *page 177*.

Message ID: **470**
Log Type: **Synch**

Recommended Input:

log pdpvela ontime 1

ASCII Example:

```
#PDPVELA,COM1,0,75.0,FINESTEERING,1430,505990.000,00000000,b886,2859;
SOL_COMPUTED,SINGLE,0.150,0.000,27.4126,179.424617,-0.5521,0.0*7746b0fe
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PDPVEL header	Log header		H	0
2	sol status	Solution status	Enum	4	H
3	vel type	Velocity type	Enum	4	H+4
4	latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results	Float	4	H+8
5	age	Differential age in seconds	Float	4	H+12
6	hor spd	Horizontal speed over ground, in metres per second	Double	8	H+16
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	height	Height in metres 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)	-	-	-

3.3.75 PDPXYZ PDP filter Cartesian position and velocity

The PDPXYZ log contains the Cartesian position in X, Y and Z coordinates as computed by the receiver with the PDP filter enabled. See also the PDPFILTER command on *page 177*.

Message ID: **471**
Log Type: **Synch**

Recommended Input:

```
log pdpxyza ontime 1
```

ASCII Example:

```
#PDPXYZA,COM1,0,75.5,FINESTEERING,1431,494991.000,00040000,33ce,35548;
SOL_COMPUTED,SINGLE,-1634531.8128,-3664619.4862,4942496.5025,2.9036,
6.1657,3.0153,SOL_COMPUTED,SINGLE,-2.5588e-308,-3.1719e-308,3.9151e-308,
0.0100,0.0100,0.0100,"",0.150,0.000,0.000,8,8,0,0,0,0,0,0*a20dbd4f
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PDPXYZ header	Log header		H	0
2	P-sol status	Solution status	Enum	4	H
3	pos type	Position type	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P- Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status	Enum	4	H+44
11	vel type	Velocity type	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m)	Float	4	H+84
18	stn ID	Base station ID	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#sats	Number of satellite vehicles tracked	Uchar	1	H+104
23	#sats soln	Number of satellite vehicles used in solution	Uchar	1	H+105
24	Reserved		Uchar	1	H+106
25			Uchar	1	H+107
26			Uchar	1	H+108
27	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+109
28	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.76 PORTSTATS Port Statistics

This log conveys various status parameters of the receiver's communication ports. The receiver maintains a running count of a variety of status indicators of the data link. This log outputs a report of those indicators.

Message ID: **72**
Log Type: **Polled**

Recommended Input:

log portstatsa once

ASCII example:

```
#PORTSTATSA,COM1,0,89.0,FINESTEERING,1609,500694.175,00000000,a872,6259;15,CO
M1,313,3477,313,0,755,0,0,0,0,COM2,0,6,0,0,6,0,0,0,0,COM3,0,6,0,0,6,0,0,0,0,U
SB1,0,0,0,0,0,0,0,0,0,USB2,0,0,0,0,0,0,0,0,0,USB3,0,0,0,0,0,0,0,0,0,XCOM1,0,7
,0,0,0,0,0,0,0,XCOM2,0,7,0,0,0,0,0,0,0,XCOM3,0,7,0,0,0,0,0,0,0,ICOM1,0,0,0,0,
0,0,0,0,0,ICOM2,0,0,0,0,0,0,0,0,0,ICOM3,0,0,0,0,0,0,0,0,0,NCOM1,0,0,0,0,0,0,0
,0,0,NCOM2,0,0,0,0,0,0,0,0,0,NCOM3,0,0,0,0,0,0,0,0,0*8f33f6ef
```

Parity and framing errors occur for COM ports if poor transmission lines are encountered or if there is an incompatibility in the data protocol. If errors occur, you may need to confirm the bit rate, number of data bits, number of stop bits and parity of both the transmit and receiving ends. Characters may be dropped when the CPU is overloaded.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PORTSTATS header	Log header		H	0
2	#port	Number of ports with information to follow	Long	4	H
3	port	Port identifier, see *Table 5, Page 26*	Enum	4	H+4
4	rx chars	Total number of characters received through this port	Ulong	4	H+8
5	tx chars	Total number of characters transmitted through this port	Ulong	4	H+12
6	acc rx chars	Total number of accepted characters received through this port	Ulong	4	H+16
7	dropped rx chars	Number of software overruns in receive	Ulong	4	H+20
8	interrupts	Number of interrupts on this port	Ulong	4	H+24
9	breaks	Number of breaks (only for serial ports)	Ulong	4	H+28
10	par err	Number of parity errors (only for serial ports)	Ulong	4	H+32
11	fram err	Number of framing errors (only for serial ports)	Ulong	4	H+36
12	rx overruns	Number of hardware overruns in receive	Ulong	4	H+40
13	Next port offset = H + 4 + (#port x 40)				
14	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#port x 40)
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.77 PROFILEINFO Profile Information in NVM

This log outputs a list of Profiles in the system.

Message ID: 1412
Type: Polled

Recommended Input:

log profileinfoa onchanged

ASCII Examples:

```
#PROFILEINFOA,COM1,0,84.0,UNKNOWN,0,17539.339,004c0020,ae3a,10526;
"BASE",0,2,
"LOG VERSION",
"SERIALCONFIG COM2 230400"*0ad5cda5
```

Field	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	PROFILEINFO header		-	H	0
2	Name	Profile Name	String[Max 20]	variable[a]	variable
3	Status Word	Status Word, *Table 82* below	ULONG	4	variable
4	# of Commands	# of Commands	ULONG	4	variable
4	Command #1	Profile command	String[Max 150]	variable[a]	variable
5 …	Command #2	Profile Command	String[Max 150]	variable[a]	variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

If the input command has an optional port input, COM1 is assumed as the input.
For example, if <Profile Createelement Testing "log versiona"> is entered, defaults as "Log COM1 Versiona".
If you want to log version on COM2, then <Profile Createelement Testing "Log Com2 versiona"> command has to be entered.

Table 82: Status Word

Bit #	MASK	Description
0	0x00000001	Activate Flag (0 – Deactivate (default), 1 –Activate)
1 – 3	0x0000000E	Reserved
4	0x00000010	Command 1 validation Flag (0 – Valid (default), 1 – Invalid)
5	0x00000020	Command 2 validation Flag
6	0x00000040	Command 3 validation Flag
7	0x00000080	Command 4 validation Flag
8	0x00000100	Command 5 validation Flag
9	0x00000200	Command 6 validation Flag
10	0x00000400	Command 7 validation Flag
11	0x00000800	Command 8 validation Flag
12	0x00001000	Command 9 validation Flag
13	0x00002000	Command 10 validation Flag
14	0x00004000	Command 11 validation Flag
15	0x00008000	Command 12 validation Flag
16	0x00010000	Command 13 validation Flag
17	0x00020000	Command 14 validation Flag
18	0x00040000	Command 15 validation Flag
19	0x00080000	Command 16 validation Flag
20	0x00100000	Command 17 validation Flag
21	0x00200000	Command 18 validation Flag
22	0x00400000	Command 19 validation Flag
23	0x00800000	Command 20 validation Flag
24 - 31	0xFF000000	Reserved

3.3.78 PSRDOP Pseudorange DOP

The dilution of precision data is calculated using the geometry of only those satellites currently being tracked and used in the position solution by the receiver. 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 being tracked.

1. If a satellite is locked out using the LOCKOUT command, it will still show in the PRN list but it will be significantly deweighted in the DOP calculation.
2. The vertical dilution of precision can be calculated by:
   $vdop = \sqrt{pdop^2 - hdop^2}$

Message ID: 174
Log Type: Asynch

Recommended Input:

log psrdopa onchanged

ASCII Example:

```
#PSRDOPA,COM1,0,56.5,FINESTEERING,1337,403100.000,00000000,768f,1984;
1.9695,1.7613,1.0630,1.3808,0.8812,5.0,10,14,22,25,1,24,11,5,20,30,7*106de10a
```

When operating in differential mode, you require at least four common satellites at the base and rover. The number of common satellites being tracked at large distances is less than at short distances. This is important because the accuracy of GPS and DGPS positions depend a great deal on how many satellites are being used in the solution (redundancy) and the geometry of the satellites being used (DOP). DOP stands for Dilution Of Precision and refers to the geometry of the satellites. A good DOP occurs when the satellites being tracked and used are evenly distributed throughout the sky. A bad DOP occurs when the satellites being tracked and used are not evenly distributed throughout the sky or grouped together in one part of the sky.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRDOP header	Log header		H	0
2	gdop	Geometric dilution of precision - assumes 3D position and receiver clock offset (all 4 parameters) are unknown	Float	4	H
3	pdop	Position dilution of precision - assumes 3D position is unknown and receiver clock offset is known	Float	4	H+4
4	hdop	Horizontal dilution of precision.	Float	4	H+8
5	htdop	Horizontal position and time dilution of precision.	Float	4	H+12
6	tdop	Time dilution of precision - assumes 3D position is known and only the receiver clock offset is unknown	Float	4	H+16
7	cutoff	Elevation cut-off angle	Float	4	H+20
8	#PRN	Number of satellites PRNs to follow	Long	4	H+24
9	PRN	PRN of SV PRN tracking, null field until position solution available	Ulong	4	H+28
10...	Next PRN offset = H + 28 + (#prn x 4)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+28+ (#prn x 4)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.79 PSRDOP2 Pseudorange DOP

This log is similar to the PSRDOP log but contains the per system Time Dilution of Precision (TDOP).

Message ID: 1163
Log Type: Asynch

Recommended Input:

log psrdop2a onchanged

ASCII Example:

```
#PSRDOP2A,COM1,0,89.5,FINESTEERING,1613,164820.000,00000008,0802,39031;1.6740
,1.3010,0.6900,1.1030,2,GPS,0.6890,GLONASS,0.7980*5dd123d0.
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRDOP2 header	Log header		H	0
2	GDOP	Geometric dilution of precision - assumes 3D position and receiver clock offset (all 4 parameters) are unknown	Float	4	H
3	PDOP	Position dilution of precision - assumes 3D position is unknown and receiver clock offset is known	Float	4	H+4
4	HDOP	Horizontal dilution of precision	Float	4	H+8
5	VDOP	Vertical dilution of precision	Float	4	H+12
6	#systems	Number of systems	ULong	4	H+16
6	system	See *Table 29* on *page 156*	Enum	4	H+20
8	TDOP	Time dilution of precision	Long	4	H+24
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+28+
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.80 PSRPOS Pseudorange Position

This log contains the pseudorange position (in metres) computed by the receiver, along with three status flags. In addition, it reports other status indicators, including differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections.

Message ID: **47**
Log Type: **Synch**

Recommended Input:

log psrposa ontime 1

ASCII Example:

```
#PSRPOSA,COM1,0,58.5,FINESTEERING,1419,340037.000,00000040,6326,2724;
SOL_COMPUTED,SINGLE,51.11636177893,-114.03832396506,1062.5470,-16.2712,
WGS84,1.8532,1.4199,3.3168,"",0.000,0.000,12,12,0,0,0,06,0,33*d200a78c
```

There are variations of DGPS which can easily be perceived as using only one receiver. For example, the US Coast Guard operates a differential correction service which broadcasts GPS differential corrections over marine radio beacons. As a user, all you need is a marine beacon receiver and a GNSS receiver to achieve positioning accuracy of less than 1 metre. In this case, the Coast Guard owns and operates the base receiver at known coordinates. Other examples of users appearing to use only one GNSS receiver include FM radio station correction services, privately owned radio transmitters and corrections carried by communication satellites. Some of the radio receivers have built-in GNSS receivers and combined antennas, so they even appear to look as one self contained unit.

The major factors degrading GPS signals which can be removed or reduced with differential methods are the atmosphere, ionosphere, satellite orbit errors, and satellite clock errors. Some errors which are not removed include receiver noise and multipath.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRPOS header	Log header		H	0
2	sol status	Solution status (see *Table 57, Solution Status* on *page 304*)	Enum	4	H
3	pos type	Position type (see *Table 56, Position or Velocity Type* on *page 303*)	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 geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Table 16, Reference Ellipsoid Constants* on *page 96*)	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 (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84.

3.3.81 PSRSATS Satellites used in PSRPOS solution

This log lists the used and unused satellites for the corresponding PSRPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: 1162
Log Type: Synch

Recommended Input:

log psrsats ontime 1

Abbreviated ASCII Example:

```
<PSRSATS COM1 0 80.0 FINESTEERING 1690 601477.000 00000008 fea4 43488
<     20
<          GPS 11 GOOD 00000003
<          GPS 8 GOOD 00000003
...
<          GPS 1 GOOD 00000003
<          GPS 7 GOOD 00000003
<          SBAS 133 LOCKEDOUT 00000000
<          SBAS 138 LOCKEDOUT 00000000
<          SBAS 135 LOCKEDOUT 00000000
<          GLONASS 10-7 GOOD 00000003
<          GLONASS 21+4 GOOD 00000003
...
<          GLONASS 12-1 GOOD 00000003
<          GLONASS 11 GOOD 00000003
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRSATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 156*	Enum	4	H+4
4	Satellite ID	Satellite identifier. See *Table 62* on *page 309*	Ulong	4	H+8
5	Status	Satellite status. See *Table 60* on *page 308*	Enum	4	H+12
6	Status mask	See *Table 61* on *page 309*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.82 PSRTIME Time Offsets from the Pseudorange Filter

This log contains the instantaneous receiver clock offsets calculated in the pseudorange filter for each GNSS used in the solution.

Message ID: **881**
Log Type: **Synch**

Recommended Input:

log psrtimea ontime 1

ASCII Example:

```
#PSRTIMEA,COM1,0,62.5,FINESTEERING,1423,231836.000,00000000,462f,35520;
2,
GPS,-1.2631e-09,7.1562e-09,
GLONASS,-7.0099e-07,2.4243e-08*40aa2af1
```

Uses for this log include the following:

1. Estimating the difference between GPS and GLONASS satellite system times.
2. Estimating the difference between UTC and GLONASS system time.

.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRTIME header	Log header		H	0
2	#recs	Number of records to follow	Ulong	4	H
3	system	Navigation System 0 = GPS 1 = GLONASS	Enum	4	H+4
4	offset	GNSS time offset from the pseudorange filter	Double	8	H+8
5	offset stdv	Time offset standard deviation	Double	8	H+12
variable	Next binary offset = H+4+(#recs x 20)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.83 PSRVEL Pseudorange Velocity

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. See also the table footnote for velocity logs on *page 271*.

The velocity in the PSRVEL log is determined by the pseudorange filter. Velocities from the pseudorange filter are calculated from the Doppler.

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

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

Message ID: **100**
Log Type: **Synch**

Recommended Input:

log psrvela ontime 1

ASCII Example:

```
#PSRVELA,COM1,0,52.5,FINESTEERING,1337,403362.000,00000000,658b,1984;
SOL_COMPUTED,PSRDIFF,0.250,9.000,0.0698,26.582692,0.0172,0.0*a94e5d48
```

Consider the case where vehicles are leaving a control center. The control center's coordinates are known but the vehicles are on the move. Using the control center's position as a reference, the vehicles are able to report where they are with PSRPOS and their speed and direction with PSRVEL at any time.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRVEL header	Log header		H	0
2	sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	vel type	Velocity type, see *Table 56, Position or Velocity Type* on *page 303*	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 metres per second	Double	8	H+16
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	Double	8	H+32
9	Reserved		Float	4	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.84 PSRXYZ Pseudorange Cartesian Position and Velocity

This log contains the receiver's pseudorange position and velocity in ECEF coordinates. The position and velocity status field's indicate whether or not the corresponding data is valid. See *Figure 10, page 317* for a definition of the ECEF coordinates.

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

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

Message ID: **243**
Log Type: **Synch**

Recommended Input:

log psrxyza ontime 1

ASCII Example:

```
#PSRXYZA,COM1,0,58.5,FINESTEERING,1419,340038.000,00000040,4a28,2724;
SOL_COMPUTED,SINGLE,-1634530.7002,-3664617.2823,4942495.5175,1.7971,
2.3694,2.7582,SOL_COMPUTED,DOPPLER_VELOCITY,0.0028,0.0231,-0.0120,
0.2148,0.2832,0.3297,"",0.150,0.000,0.000,12,12,0,0,0,06,0,33*4fdbcdb1
```

The instantaneous Doppler is the measured Doppler frequency which consists of the satellite's motion relative to the receiver (Satellite Doppler + User Doppler) and the clock (local oscillator) drift.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P- Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H+44
11	vel type	Velocity type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m)	Float	4	H+84
18	stn ID	Base station ID	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#SVs	Number of satellite vehicles tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	Reserved		Char	1	H+106
25			Char	1	H+107
26			Char	1	H+108
27	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+109
28	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.85 QZSSALMANAC Decoded QZSS Almanac Parameters

This log contains the decoded almanac parameters as received from the satellite with the parity information removed and appropriate scaling applied. Multiple messages are transmitted, one for each SV almanac collected. For more information about almanac data, refer to the QZSS Interface Specification.

Message ID: 1346

Log Type: Asynch

Recommended Input:

log qzssalmanaca onchanged

ASCII Examples:

```
#QZSSALMANACA,COM1,0,89.5,SATTIME,1642,148584.000,00000008,67d2,39655;
1,
193,1642,208896.0,7.587582e-02,-2.94869425e-09,-1.4441238e+00,-
1.5737385e+00,1.7932513e+00,0.00000000,0.00000000,7.29336435e-
05,4.2159360e+07,7.11809030e-01,7,7*fb648921
```

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSALMANAC Header	Log header		H	0
2	#messages	Number of satellite PRN almanac messages to follow. Set to zero until almanac data is available	ULONG	4	H
3	PRN	Satellite PRN number for current message (dimensionless)	ULONG	4	H+4
4	week	Almanac reference week	ULONG	4	H+8
5	seconds	Almanac reference time (s)	DOUBLE	8	H+12
6	ecc	Eccentricity (dimensionless) defined for a conic section where e = 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse and e>1 is a hyperbola	DOUBLE	8	H+20
7	ώ	Rate of right ascension (radians/s)	DOUBLE	8	H+28
8	ω_0	Right, ascension (radians)	DOUBLE	8	H+36
9	ω	Argument of perigee (radians) measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion	DOUBLE	8	H+44
10	M_0	Mean anomaly of reference time (radians)	DOUBLE	8	H+52
11	a_{f0}	Clock aging parameter (s)	DOUBLE	8	H+60
12	a_{f1}	Clock aging parameter (s/s)	DOUBLE	8	H+68

Continued on next page

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
13	N	Corrected mean motion (radians/s)	DOUBLE	8	H+76
14	A	Semi-major axis (m)	DOUBLE	8	H+84
15	inclination angle	Angle of inclination	DOUBLE	8	H+92
16	health-prn	SV health from Page 25 of subframe 4 or 5 (6 bits)	ULONG	4	H+100
17	health-alm	SV health from almanac (8 bits)	ULONG	4	H+104
18	Next PRN offset = H+4+(#messages x 104)				
19	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+4+(104x#messages)
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.86 QZSSEPHEMERIS Decoded QZSS Parameters

This log contains a single set of QZSS ephemeris parameters.

Message ID: 1336

Log Type: Asynch

Recommended Input:

log qzssephemerisa onchanged

ASCII Examples:

```
#QZSSEPHEMERISA,COM1,0,93.5,SATTIME,1642,153690.000,00000008,1e9d,39655;
193,153690.000000000,7,201,201,1642,1642,154800.000000000,4.216030971806980e+07,2.11
5802417e-09,-2.152109479,0.075863329,-1.573817810,-0.000007546,0.000009645,-
177.375000000,-219.875000000,-0.000000797,-0.000002151,0.711859299,-2.978695503e-
10,-1.443966112,-1.636139580e-09,713,154800.000000000,-5.122274160e-09,-
0.000000163,1.250555215e-
12,0.000000000,FALSE,0.000072933,4.000000000,0,0,0,0*fbb52c7f
```

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

Continued on next page

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
16	cus	Argument of latitude (amplitude of sine, radians)	DOUBLE	8	H+88
17	crc	Orbit radius (amplitude of cosine, metres)	DOUBLE	8	H+96
18	crs	Orbit radius (amplitude of sine, metres)	DOUBLE	8	H+104
19	cic	Inclination (amplitude of cosine, radians)	DOUBLE	8	H+112
20	cis	Inclination (amplitude of sine, radians)	DOUBLE	8	H+120
21	I_0	Inclination angle at reference time (radians)	DOUBLE	8	H+128
22	$\dot{I}$	Rate of inclination angle (radians/s)	DOUBLE	8	H+136
23	ω_0	Right ascension (radians)	DOUBLE	8	H+144
24	$\dot{\omega}$	Rate of right ascension (radians/s)	DOUBLE	8	H+152
25	iodc	Issue of data clock	ULONG	8	H+160
26	toc	SV clock correction term s()	DOUBLE	8	H+164
27	tgd	Estimated group delay difference (s)	DOUBLE	8	H+172
28	a_{fo}	Clock aging parameter (s)	DOUBLE	8	H+180
29	a_{f1}	Clock aging parameter (s/s)	DOUBLE	8	H+188
30	a_{r2}	Clock aging parameter (s/s/s)	BOOL	4	H+196
31	AS	Anti-spoofing on: 0= FALSE 1=TRUE	ENUM	4	H+204
32	N	Corrected mean motion (radians/s)	DOUBLE	8	H+208
33	URA	User Range Accuracy variance, m2. The ICD specifies that the URA index transmitted in the ephemerides can be converted to a nominal standard deviation value using an algorithm listed there. We publish the square of the nominal value (variance)	DOUBLE	8	H+216
34	Fit Interval	Curve fit interval: 0 = Ephemeris data are effective for 2 hours 1 = Ephemeris data are effective for more than 2 hours	UCHAR	1	H+224
35	Reserved		UCHAR	1	H+225
36	Reserved		UCHAR	1	H+226
37	Reserved		UCHAR	1	H+227
38	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+228
39	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.87 QZSSRAWALMANAC Raw QZSS almanac data

This log contains the undecoded almanac subframes as received from the QZSS satellite.

Message ID: 1345

Log Type: Asynch

Recommended Input:

log qzssrawalmanaca onchanged

ASCII Examples:

```
ASCII Example:

#QZSSRAWALMANACA,COM1,0,93.5,SATTIME,1642,153300.000,00480008,64c4,39655;
1642,208896.000,7,
1,8b000031c390c1820e33d007fefe07cae831c5293ebfe15049104a000001,
51,8b000031c613f3336a1fffffffffffffffffffffffffffffffff000000,
49,8b000031cd90f14e6a7cf3cf1cf1cf3cf3c73cf1cf1cf3cf3cf3cf000002,
50,8b000031ce14f24e6a0cf3cf1df1cfffffffffffffffffffffff000002,
56,8b000031d511f80ff70003292ef496000006ffffffa4b6a0fe8040f0002,
52,8b000031e692f4a00a0fff83f060f2080180082082082082082002080381,
53,8b000031e717f5808208208208208208208208208208208208208208208080*ca4596f9
```

The OEM6 family of receivers automatically saves almanacs in their Non-Volatile Memory (NVM), therefore creating an almanac boot file is not necessary.

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSRAWALMANAC 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)[a]	ULONG	2	H+12
6	data	Subframe page data	HEX	30	H+14
7	Next subframe offset = H+12+(subframe x32)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+12+(32 x subframes)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. A value between 1 and 32 for the SV ID indicates the PRN of the satellite. Any other values indicate the page ID. SV ID 1 to 5 corresponds to QZSS PRN 193 to 197. Refer to QZSS Interface Specification for more details.

3.3.88 QZSSIONUTC QZSS ionospheric and time information

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

Message ID: 1347

Log Type: Asynch

Recommended Input:

log qzssionutca onchanged

ASCII Examples:

```
#QZSSIONUTCA,COM1,0,94.0,FINESTEERING,1642,153300.565,00480008,158b,39655;
1.396983861923218e-08,-6.705522537231444e-8,0.000000000000000e+000,1.7881393432

61719e-07,8.396800000000000e+04,7.536640000000000e+05,-7.864320000000000e+05,-
6.946816000000000e+06,1642,307200,-5.5879354476928711e-09,5.329070518e-
15,1768,4,15,15,0*0204eec1
```

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSIONUTC 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+28
7	b1	Beta parameter 1st order term	DOUBLE	8	H+36
8	b2	Beta parameter 2nd order term	DOUBLE	8	H+44
9	b3	Beta parameter 3rd order term	DOUBLE	8	H+52
10	utc wn	UTC reference week number	ULONG	4	H+60
11	tot	Reference time of UTC parameters	ULONG	4	H+64
12	A0	UTC constant term of polynomial	DOUBLE	8	H+68
13	A1	UTC 1st order term of polynomial	DOUBLE	8	H+76
14	wn lsf	Future week number	ULONG	4	H+84
15	dn	Day number (the range is 1 to 7 where Sunday=1 and Saturday=7)	ULONG	4	H+88
16	deltat ls	Delta time due to leap seconds	LONG	4	H+92
17	deltat lsf	Future delta time due to leap seconds	LONG	4	H+96
18	delta utc	Time difference	ULONG	4	H+100
19	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+108
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.89 QZSSRAWEPHEM QZSS Raw ephemeris Information

This log contains the raw binary information for subframes one, two and three from the satellite with the parity information removed. Each subframe is 240 bits long (10 words - 24 bits each) and the log contains a total 720 bits (90 bytes) of information (240 bits x 3 subframes). This information is preceded by the PRN number of the satellite from which it originated. This message is not generated unless all 10 words from all 3 frames have passed parity.

Message ID: 1330
Log Type: Asynch

Recommended Input:

log qzssrawsubframea onnew

ASCII Examples:

```
#QZSSRAWEPHEMA,COM1,0,84.5,SATTIME,1642,230580.000,00000008,2f9e,39
655;193,1642,234000,8b00004b0f879aa01c800000000000000000000f6df392
1fe0005fffdbd,8b00004b1009dfd2bb1ec493a98277e8fd26d924d5062dcae8f5b
739210e,8b00004b108ffe5bc52864ae00591d003b8b02b6bfe13f3affe2afdff1e
7*d2bd151e
```

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSRAWEPHEM Header	Log header		H	0
2	PRN	Satellite PRN number	ULONG	4	H
3	subfr id	Subframe ID	ULONG	4	H+4
4	data	Raw subframe data	HEX [30]	32[a]	H+8
5	chan	Signal channel number that the frame was decoded on	ULONG	4	H+40
6	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+44
7	[CR][LF]	Sentence terminator	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment.

3.3.90 QZSSRAWSUBFRAME Raw QZSS Subframe Data

This log contains the raw QZSS subframe data.

A raw QZSS subframe is 300 bits in total, 10 words of 30 bits each. This includes the parity 6 bits at the end of each word, for a total of 60 parity bits. Note that in Field #5, the 'data' field below, we have stripped out these 60 parity bits and only the raw subframe data remains, for a total of 240 bits. There are two bytes added onto the end of this 30 byte packed binary array to pad out the entire data structure to 32 bytes in order to maintain 4 byte alignment.

Message ID: 1331
Log Type: Asynch

Recommended Input:

log qzssrawephema onnew

ASCII Examples:

```
#QZSSRAWSUBFRAMEA,COM1,0,85.5,SATTIME,1642,230604.000,00000008,e56b,39655;193,5,8b00
004b11970637984efbf7fd4d0fa10ca49631ace140740a08fe0dfd43,65*6a7b9123
```

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSRAWSUBFRAME 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	HEX	30	H+12
6	subframe2	Subframe 2 data	HEX	30	H+42
7	subframe3	Subframe 3 data	HEX	30	H+72
8	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+102
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.91 RAIMSTATUS RAIM status

This log provides information on RAIM status. See *Section 2.5.72, RAIMMODE Configures RAIM mode* starting on *page 190*.

Message ID: 1286
Log Type: Synch

Recommended Input:

log raimstatusa ontime 1

ASCII Examples:

```
#RAIMSTATUSA,COM1,0,93.5,FINESTEERING,1595,387671.500,00000008,bf2d,5968;DEFA
ULT,PASS,NOT_AVAILABLE,0.000,NOT_AVAILABLE,0.000,0*96a129ee
```

```
#RAIMSTATUSA,COM1,0,95.5,FINESTEERING,1595,387672.000,00000008,bf2d,5968;APPR
OACH,PASS,PASS,17.037,PASS,25.543,0*2a53f2b9
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	RAIMSTATUS Header	Log header	-	H	0
2	RAIM Mode	RAIM mode, see *Table 33* on *page 191*	enum	4	H
3	Integrity status	Integrity Status, see *Table 83* on *page 468*	enum	4	H+4
4	HPL status	Horizontal protection level status, see *Table 84* on *page 468*	enum	4	H+8
5	HPL	Horizontal protection level	double	8	H+12
6	VPL status	Vertical protection level status, see *Table 84* on *page 468*	enum	4	H+20
7	VPL	Vertical protection level	double	8	H+24
8	Num of SVs	Number of excluded satellites	ulong	4	H+32
9	System	Satellite system	enum	4	H+36
10	Satellite ID	In binary logs, the satellite ID field is 4 bytes. The 2 lowest order bytes, interpreted as a USHORT, are the system identifier. For instance, the PRN for GPS or the slot for GLONASS. The 2 highest-order bytes are the frequency channel for GLONASS, interpreted as a SHORT and zero for all other systems. In ASCII and abbreviated ASCII logs, the satellite ID field is the system identifier. If the system is GLONASS and the frequency channel is not zero, then the signed channel is appended to the system identifier. For example, slot 13, frequency channel -2 is output as 13-2	ulong	4	H+40
…	….	Next excluded satellite system	….	….	
…	….	Next excluded satellite ID	….	….	
	xxxx	32-bit CRC (ASCII and Binary only)	hex	4	
	[CR][LF]	Sentence terminator (ASCII only)			

Table 83: Integrity Status

Binary	ASCII	Description
0	NOT_AVAILABLE	RAIM is unavailable because either there is no solution or because the solution is unique, that is, there is no redundancy
1	PASS	RAIM succeeded. Either there were no bad observations or the bad observations were successfully removed from the solution
2	FAIL	RAIM detected a failure and was unable to isolate the bad observations

Table 84: PL Status

Binary	ASCII	Description
0	NOT_AVAILABLE	When RAIM is not available for example, after issuing a FRESET command or when there are not enough satellites tracked to produce the required redundant observations
1	PASS	Current protection levels are below alert limits, meaning positioning accuracy requirements are fulfilled HPL < HAL VPL < VAL
2	ALERT	Current protection levels are above alert limits, meaning required positioning accuracy cannot be guaranteed by RAIM algorithm HPL ≥ HAL VPL ≥ VAL

3.3.92 RANGE Satellite Range Information

RANGE contains the channel measurements for the currently tracked satellites. When using this log, please keep in mind the constraints noted along with the description.

It is important to ensure that the receiver clock has been set. This can be monitored by the bits in the *Receiver Status* field of the log header. Large jumps in pseudorange as well as Accumulated Doppler Range (ADR) occur as the clock is being adjusted. If the ADR measurement is being used in precise phase processing, it is important not to use the ADR if the "parity known" flag, in the *ch-tr-status* field, is not set as there may exist a half (1/2) cycle ambiguity on the measurement. The tracking error estimate of the pseudorange and carrier phase (ADR) is the thermal noise of the receiver tracking loops only. It does not account for possible multipath errors or atmospheric delays.

If both the L1 and L2 signals are being tracked for a given PRN, two entries with the same PRN appear in the range logs. As shown in *Table 88, Channel Tracking Status* on *page 471*, these entries can be differentiated by bit 20, which is set if there are multiple observables for a given PRN and bits 21-22, which denotes whether the observation is for L1 or L2. This is to aid in parsing the data.

Message ID: **43**
Log Type: **Synch**

Recommended Input:

log rangea ontime 30

ASCII Example:

```
#RANGEA,COM1,0,63.5,FINESTEERING,1429,226979.000,00000000,5103,2748;
26,
6,0,23359924.081,0.078,-122757217.106875,0.015,-3538.602,43.3,19967.080,
08109c04,
6,0,23359926.375,0.167,-95654966.812027,0.019,-2757.355,36.7,19960.461,
01309c0b,
21,0,20200269.147,0.038,-106153137.954409,0.008,-86.289,49.5,13397.470,
08109c44,
21,0,20200268.815,0.056,-82716721.366921,0.008,-67.242,46.1,13391.980,
01309c4b,
16,0,23945650.428,0.091,-125835245.287192,0.024,-2385.422,41.9,10864.640,
08109c64,
16,0,23945651.399,0.148,-98053428.283142,0.028,-1858.773,37.7,10859.980,
01309c6b,
.
.
.
44,12,19388129.378,0.335,-103786179.553598,0.012,975.676,36.6,3726.656,
18119e24,
44,12,19388136.659,0.167,-80722615.862096,0.000,758.859,42.7,3714.860,
10b19e2b,
43,8,20375687.399,0.253,-108919708.904476,0.012,-2781.090,39.1,10629.934,
18119e84,
43,8,20375689.555,0.177,-84715349.232514,0.000,-2163.074,42.2,10619.916,
10b19e8b*fd2d3125
```

Consider the case where you have a computer to record data at a fixed location, and another laptop in the field also recording data as you travel. Can you take the difference between the recorded location and the known location of the fixed point and use that as an error correction for the recorded data in the field?

The simple answer is yes. You can take the difference between recorded position and known location and apply this as a position correction to your field data. Then, what is the difference between pseudorange and position differencing?

The correct and more standard way of computing this correction is to compute the range error to each GNSS satellite being tracked at your fixed location and to apply these range corrections to the observations at your mobile station.

The position corrections method is seldom used in industry. The drawback of this method is that computed corrections vary depending on the location of the fixed station. The geometry is not accounted for between the fixed station and the tracked satellites. Also, position corrections at the fixed site are computed with a certain group of satellites while the field station is tracking a different group of satellites. In general, when the position correction method is used, the farther the fixed and field stations are apart, the less accurate the solution.

The range corrections method is more commonly used in the industry. The advantage of using this method is that it provides consistent range corrections and hence field positions, regardless of the location of your fixed station. You are only able to obtain a "good" differential position if both the fixed and field stations are tracking the same four satellites at a minimum.

DGPS refers to using 1 base receiver, at a known location, and 1 or more rover receivers at unknown locations. As the position of the base is accurately known, we can determine the error present in GNSS at any given instant by either of the two methods previously described. We counter the bias effects present in GNSS including: ionospheric, tropospheric, ephemeris, receiver and satellite clock errors. You could choose either method depending on your application and the accuracy required.

Table 85: Tracking State

State	Description	State	Description
0	Idle	6	Channel steering
1	Sky Search	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 86: 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 87: Channel Tracking Example

	N7				N6				N5				N4				N3				N2				N1				N0			
0x	0				8				1				0				9				C				0				4			
Bit #	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary[a]	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0
Data	Chan. Assignment	Reserved (R)			Primary L1	R	Signal Type					Grouping	R	Satellite System			Correlator Spacing			Code locked flag	Parity flag	Phase lock flag	Channel Number					Tracking State			
Value	Automatic				Primary		L1 C/A					Grouped		GPS			PAC			Locked	Known	Locked	Channel 0					L1 Phase Lock Loop			

a.For a complete list of hexadecimal and binary equivalents please refer to the Unit Conversions page on our website at www.novatel.com through *Support | Knowledge and Learning*.

Table 88: Channel Tracking Status

Nibble #	Bit #	Mask	Description	Range Value
N0	0	0x00000001	Tracking state	0-11, see *Table 85, Tracking State* on *page 470*
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010		
	5	0x00000020	SV channel number	0-n (0 = first, n = last) n depends on the receiver
	6	0x00000040		
	7	0x00000080		
	8	0x00000100		
	9	0x00000200		
	10	0x00000400	Phase lock flag	0 = Not locked, 1 = Locked
	11	0x00000800	Parity known flag	0 = Not known, 1 = Known

Continued on next page

Nibble #	Bit #	Mask	Description	Range Value
N3	12	0x00001000	Code locked flag	0 = Not locked, 1 = Locked
	13	0x00002000	Correlator type	0-7, see *Table 86, Correlator Type* on *page 471*
	14	0x00004000		
	15	0x00008000		
N4	16	0x00010000	Satellite system	0 = GPS 1= GLONASS 2 = SBAS 3 = Galileo 4 = Reserved 5 = QZSS 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: 0 = L1 C/A 5 = L2 P 9 = L2 P codeless 14= L5 Q 17 = L2 C GLONASS: 0 = L1 C/A 1 = L2 C/A 5 = L2 P Galileo: 1= E1B 2 = E1C 12 = E5a Q 17 = E5b Q 20 = AltBOC Q QZSS: 14 = L5Q 0 = L1 C/A 17 = L2C SBAS: 0 = L1 C/A 6 = L5I Other: 19 = OmniSTAR
	22	0x00400000		
	23	0x00800000		
N6	24	0x01000000		
	25	0x02000000		
	26	0x04000000	Forward Error Correction	0 = Not FEC, 1 = FEC
	27	0x08000000	Primary L1 channel	0 = Not primary, 1 = Primary
N7	28	0x10000000	Carrier phase measurement [a]	0 = Half Cycle Not Added 1 = Half Cycle Added
	29	Reserved		
	30	0x40000000	PRN lock flag [b]	0 = PRN Not Locked Out
	31	0x80000000	Channel assignment	0 = Automatic, 1 = Forced

a. This bit is zero until the parity is known and the parity known flag (bit 11) is set to 1.

b. A PRN can be locked out using the LOCKOUT command, see also *page 155*.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RANGE header	Log header		H	0
2	# obs	Number of observations with information to follow [a]	Long	4	H
3	PRN/ slot	Satellite PRN number of range measurement (GPS: 1 to 32, SBAS: 120 to 138 or 183-187, GLONASS: 38 to 61 (see *Section 1.3* on *page 31*) and Galileo: 1 to 36, QZSS: 193-197	UShort	2	H+4
4	glofreq	(GLONASS Frequency + 7), see *Section 1.3* on *page 31*	UShort	2	H+6
5	psr	Pseudorange measurement (m)	Double	8	H+8
6	psr std	Pseudorange measurement standard deviation (m)	Float	4	H+16
7	adr	Carrier phase, in cycles (accumulated Doppler range)	Double	8	H+20
8	adr std	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 $C/No = 10[\log_{10}(S/N_0)]$ (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 *88, Channel Tracking Status* on *page 471* and the example in *Table 87*)	ULong	4	H+44
13...	Next PRN offset = H + 4 + (#obs x 44)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#obs x 44)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Satellite PRNs may have two lines of observations, one for the L1 frequency and the other for L2.

3.3.93 RANGECMP Compressed Version of the RANGE Log

This log contains the RANGE data in a compressed format.

Message ID: **140**
Log Type: **Synch**

Recommended Input:

log rangecmpa ontime 10

Example:

```
#RANGECMPA,COM1,0,63.5,FINESTEERING,1429,226780.000,00000000,9691,2748;
26,
049c10081857f2df1f4a130ba2888eb9600603a709030000,
0b9c3001225bf58f334a130bb1e2bed473062fa609020000,
449c1008340400e0aaa9a109a7535bac2015cf71c6030000,
4b9c300145030010a6a9a10959c2f09120151f7166030000,
...
0b9d301113c8ffefc284000c6ea051dbf3089da1a0010000,
249d1018c6b7f67fa228820af2e5e39830180ae1a8030000,
2b9d301165c4f8ffb228820a500a089f31185fe0a8020000,
449d1018be18f41f2aacad0a1a934efc40074ecf88030000,
4b9d301182b9f69f38acad0a3e3ac28841079fcb88020000,
849d101817a1f95f16d7af0a69fbe1fa401d3fd064030000,
8b9d30112909fb2f20d7af0a9f24a687521ddece64020000,
249e1118af4e0470f66d4309a0a631cd642cf5b821320000,
2b9eb110a55903502f6e4309ee28d1ad032c7cb7e1320000,
849e1118b878f54f4ed2aa098c35558a532bde1765220000,
8b9eb110abcff71f5ed2aa09cb6ad0f9032b9d16c5220000*0eeead18
```

Consider the case where commercial vehicles are leaving a control center. The control center's coordinates are known but the vehicles are on the move. Using the control center's position as a reference, the vehicles are able to report where they are at any time. Post-processed information gives more accurate comparisons.

Post-processing can provide post mission position and velocity using raw GNSS collected from the vehicles. The logs necessary for post-processing include:

RANGECMPB ONTIME 1

RAWEPHEMB ONNEW

This is an example of data collection for post-processing. OEM6 based output is compatible with post-processing software from the Waypoint Products Group, NovAtel Inc. Refer to our website at www.novatel.com for more details.

Table 89: Range Record Format (RANGECMP only)

Data	Bit(s) first to last	Length (bits)	Scale Factor	Units
Channel Tracking Status	0-31	32	see *Table 88* on *page 471*	-
Doppler Frequency	32-59	28	1/256	Hz
Pseudorange (PSR)	60-95	36	1/128	m
ADR [a]	96-127	32	1/256	cycles
StdDev-PSR	128-131	4	See note[b]	m
StdDev-ADR	132-135	4	(n + 1)/512	cycles
PRN/Slot [c]	136-143	8	1	-
Lock Time [d]	144-164	21	1/32	s
C/No [e]	165-169	5	(20 + n)	dB-Hz
Reserved	170-191	22		

a. ADR (Accumulated Doppler Range) is calculated as follows:

ADR_ROLLS = (RANGECMP_PSR / WAVELENGTH + RANGECMP_ADR) / MAX_VALUE
Round to the closest integer
IF (ADR_ROLLS ≤ 0)
    ADR_ROLLS = ADR_ROLLS - 0.5
ELSE
    ADR_ROLLS = ADR_ROLLS + 0.5
At this point integerise ADR_ROLLS
CORRECTED_ADR = RANGECMP_ADR - (MAX_VALUE*ADR_ROLLS)
where
ADR has units of cycles
WAVELENGTH = 0.1902936727984 for GPS L1 ***Note:*** *GLONASS satellites emit L1 and L2 carrier waves at*
WAVELENGTH = 0.2442102134246 for GPS L2 *a satellite-specific frequency, refer to the GNSS Reference Book for more on GLONASS frequencies.*
MAX_VALUE = 8388608

b.

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

c. GPS: 1 to 32, SBAS: 120 to 138 or 183-187, Galileo: 1 to 36, QZSS: 193-197, and GLONASS: 38 to 61, see *Section 1.3* on *page 31*.

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

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

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	RANGECMP header	Log header		H	0
2	#obs	Number of satellite observations with information to follow	Long	4	H
3	1st range record	Compressed range log in format of *Table 89* on *page 475*	Hex	24	H+4
4	Next rangecmp offset = H + 4 + (#obs x 24)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4 + (#obs x 24)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.94 RANGECMP2 Compressed Version of the RANGE log

This log contains the RANGE data in a compressed format to handle more channels and different channel types than the RANGECMP log.

Recommended Input: **Message ID: 1273**

log rangecmp2a ontime 10 **Log Type: Synch**

Example:

```
#RANGECMP2A,COM1,0,84.5,FINESTEERING,1681,163457.000,00000020,1fe3,10526;
634,
000d00f4fddf05920620e1ffff2979e806e81301c8ffe4ffff03106b5a50a902c8ff01100054f
6bd05410720e1ffff2996ea0e90fb01e2ffe4ffff030e0d65681603e3ff020400acdcd605c403
20e1ffff697b080e9859801300e4ffff4310c94fb8c70114000317002c554685260520e1ffff2
95f4412b0ad03c4ffe4ffff03d5a60d18c705c4ff0401008452b08583f92fe1ffff2998ac6530
2c800000e4ffff03f32edf784b0000000520000c8500056cfd2fe1ffff295fa40dd04a822300e
4ffff03b8242a58f8022300061f00c0081385effb2fe1ffff295fc408a83884f8ffe4ffff03b8
861608c286f8ff081e008cb25105970520e1ffff295c2604989483ceffe4ffff03f2862f48900
6cfff0914003027e204930020e1ffff695e4407188602ddffe4ffff43b8241480c903ddff0a0e
0050e3e305d3f92fe1ffff2979c89c506d800700e4ffff030f4bdd603a8006000b1900d8f3cc8
543fb2fe1ffff297a280950f2002500e4ffff03f1286880e80225001401183 41c0f0581f92fe1
ffff299d4404d02401f2ffe4ffff03920c2f900d82faff160d158cfa6b85400820e1ffff69baa
600b83d02d9ffe4ffff03734a4380ea04ceff170b178874ef0409fa2fe1ffff299d6409d01904
e6ffe4ffff0374ea31304d87daff180213c8039884fd0020e1ffff697fe401007082d4ffe4fff
f033b0616688084c4ff19131a5cdc9585f9fe2fe1ffff69b8c80e08e5800200e4ffff0357c830
a8d001ebff1b0c16a45ca384c80220e1ffff697f6401888a04efffe4ffff033a463d605e88020
01c031c905434051d0720e1ffff299cc60b18e881f3ffe4ffff0339462d38e182fbff231050f0
5e6406b9fd1fe6ffff6998080f1013801300*61b80516
```

Field #	Field Type	Description	Format	Binary Bytes	Binary Offset
1	RANGECMP2 header	Log Header		H	0
2	# bytes	Number of bytes in the compressed binary range data[a]	UChar	4	H
3	RangeData	Compressed binary range data in the format of [b] *Table 90, Satellite Block of the Range Record Format (RANGECMP2 only)* on *page 478* and *Table 91, Signal Block of the Range Record Format (RANGECMP2 only)* on *page 478*	UChar	#bytes	H+4
4	xxxx	32-bit CRC (ASCII and binary only)	Hex	4	H+4+(# bytes)
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Maximum is 2880 bytes.

b. The compressed binary range data is organized into satellite blocks, one for each satellite. Each satellite block is followed by a variable number of signal blocks corresponding to the same satellite. For example, a Satellite Block for GPS PRN 17 may be followed by two Signal Blocks for the L1 C/A and L2C signals.

Table 90: Satellite Block of the Range Record Format (RANGECMP2 only)

Data	Description	Bit(s) first to last	Length (bits)	Scale Factor	Units
SV Channel Number	Receiver SC channel number	0-7	8	-	-
Satellite Identifier	Satellite identifier specific to the satellite system: GPS: 1-32 SBAS: 120-138, 183-187 Galileo: 1-36 QZSS: 193-197 GLONASS: 1-24	8-15	8	-	-
GLONASS Frequency Identifier	GLONASS frequency channel offset by +7	16-19	4	(7+Ch#)	-
Satellite System Identifier	Defined in Table 29, Page 156	20-24	5	-	Enum
Reserved		25	1	-	-
Pseudorange Base	Pseudorange base value to be combined with PSR Diff and Phaserange Diff in each following Signal Block	26-54	29	1	m
Doppler Base	Doppler base value to be combined with the Scaled Doppler Diff value in each following Signal Block	55-75	21	1	Hz
Number of Signal Blocks	The number of Signal Blocks to follow this Satellite Block. See *Table 91* for Signal Block definition	76-79	4	-	-

Table 91: Signal Block of the Range Record Format (RANGECMP2 only)

Data	Description	Bit(s) first to last	Length (bits)	Scale Factor	Units
Signal Type	Defined in *Table 95, Signal Type (only in RANGECMP2)* on *page 481*	0-4	5	-	Enum
Phase Lock	Phase Lock: 0 = Not locked, 1 = Locked Parity Known: 0 = Not known, 1 = Known Code Lock: 0 = Not locked, 1 = Locked	5	1	-	BOOL
Parity Known		6	1	-	BOOL
Code Lock		7	1	-	BOOL
Locktime	Time of continuous tracking with no cycle slips. The locktime value saturates at a maximum of 131071ms	8-24	17	1	ms

Data	Description	Bit(s) first to last	Length (bits)	Scale Factor	Units
Correlator Type	Correlator type: (see Table 86, Page 471) Primary signal: 0 = Not primary, 1 = Primary Carrier phase measurement: 0 = Half cycle not added, 1 = Half cycle added	25-28	4	-	Enum
Primary Signal		29	1	-	BOOL
Carrier Phase Measurement		30	1	-	BOOL
Reserved		31	1	-	-
C/No	Carrier to Noise density ratio	32-36	5	(20 + n)	dB-Hz
StdDev PSR	Pseudorange Standard Deviation (defined *Table 92, Std Dev PSR Scaling* on *page 479*)	37-40	4	Bit Field in *Table 92*	-
StdDev ADR	Carrier-Phase Standard Deviation (defined *Table 93, Std Dev ADR Scaling* on *page 480*)	41-44	4	Bit Field in *Table 93*	-
PSR Diff	Pseudorange Diff to be combined with Pseudorange base i.e., PSR = PSRBase + PSRDiff/128	45-58	14	1/128	m (unsigned)
Phaserange Diff	Phaserange Diff to be combined with Pseudorange Base i.e., ADR = PSRBase + PhaserangeDiff/204	59-78	20	1/2048	m (unsigned)
Scaled Doppler Diff	Doppler Diff to be combined with Doppler Base. Note that all Doppler values are scaled to the L1/E1 equivalent value. (refer to *Table 94, L1/E1 Scaling* on *page 480*) i.e., Doppler = (DopplerBase + ScaledDopplerDiff/256)/ L1ScaleFactor	79-95	17	1/256	Hz (signed)

Table 92: Std Dev PSR Scaling

PSR Std Dev Bit Field Value	Represented Std Dev (m)		PSR Std Dev Bit Field Value	Represented Std Dev (m)
0	0.02		8	0.491
1	0.03		9	0.732
2	0.045		10	1.092
3	0.066		11	1.629
4	0.099		12	2.43
5	0.148		13	3.625
6	0.22		14	5.409
7	0.329		15	>5.409

Table 93: Std Dev ADR Scaling

ADR Std Dev Bit Field Value	Represented Std Dev (cycles)		ADR Std Dev Bit Field Value	Represented Std Dev (Cycles)
0	0.00391		8	0.03933
1	0.00521		9	0.05249
2	0.00696		10	0.07006
3	0.00929		11	0.09350
4	0.01239		12	0.12480
5	0.01654		13	0.16656
6	0.02208		14	0.22230
7	0.02947		15	>0.22230

Table 94: L1/E1 Scaling

Satellite System	Signal Type	L1/E1 Scale Factor
GPS	L1CA	1.0
	L2Y	154/120
	L2C	154/120
	L5Q	154/115
GLONASS	L1CA	1.0
	L2CA	9/7
	L2P	9/7
SBAS	L1CA	1.0
	L5I	154/115
Galileo	E1	1.0
	E5A	154/115
	E5B	154/118
QZSS	L1CA	1.0
	L2C	154/120
	L5Q	154/115
LBAND	OMNISTAR	1.0

Table 95: Signal Type (only in RANGECMP2)

Satellite System	Signal Type	Value
GPS	L1CA	1
	L2Y	4
	L2C	5
	L5Q	7
GLONASS	L1CA	1
	L2CA	3
	L2P	4
SBAS	L1CA	1
	L5I	2
Galileo	E1	1
	E5A	2
	E5B	3
QZSS	L1CA	1
	L2C	3
	L5Q	4
LBAND	OMNISTAR	1

3.3.95 RANGEGPSL1 L1 Version of the RANGE Log

This log is identical to the RANGE log, see *page 469,* except that it only includes L1 GPS observations.

Message ID: **631**
Log Type: **Synch**

Recommended Input:

log rangegpsl1a ontime 30

ASCII Example:

```
#RANGEGPSL1A,COM1,0,57.0,FINESTEERING,1337,404766.000,00000000,5862,1984;
10,
14,0,21773427.400,0.037,-114420590.433332,0.006,-2408.171,49.9,14963.280,
18109c04,
22,0,24822942.668,0.045,-130445851.055756,0.009,-3440.031,48.0,22312.971,
08109c24,
25,0,20831000.299,0.033,-109468139.214586,0.006,1096.876,50.7,7887.840,
08109c44,
1,0,20401022.863,0.032,-107208568.887106,0.006,-429.690,51.1,10791.500,
18109c64,
24,0,23988223.932,0.074,-126058964.619453,0.013,2519.418,43.8,493.550,
18109c84,
11,0,22154466.593,0.043,-116423014.826717,0.007,-1661.273,48.4,11020.952,
08109ca4,
5,0,24322401.516,0.067,-127815012.260616,0.012,-1363.596,44.6,6360.282,
18109cc4,
20,0,22294469.347,0.043,-117158267.467388,0.008,2896.813,48.5,4635.968,
08109ce4,
30,0,23267589.649,0.051,-122271969.418761,0.009,822.194,47.0,4542.270,
08109d04,
23,0,24975654.673,0.058,-131247903.805678,0.009,3395.097,45.9,406.762,
18109d24*be4b7d70
```

Since the RANGEGPSL1 log includes only L1 GPS observations, it is smaller in size than the RANGE log which contain entries for both L1 and L2. Use the RANGEGPSL1 log when data throughput is limited and you are only interested in GPS L1 range data. For L1 only models, RANGE and RANGEGPSL1 logs are identical.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RANGEGPSL1 header	Log header		H	0
2	# obs	Number of L1 observations with information to follow	Long	4	H
3	PRN	Satellite PRN number of range measurement (GPS: 1 to 32)	UShort	2	H+4
4	Reserved		UShort	2	H+6
5	psr	Pseudorange measurement (m)	Double	8	H+8
6	psr std	Pseudorange measurement standard deviation (m)	Float	4	H+16
7	adr	Carrier phase, in cycles (accumulated Doppler range)	Double	8	H+20
8	adr std	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 = $10[\log_{10}(S/N_0)]$ (dB-Hz)	Float	4	H+36
11	locktime	Number of seconds of continuous tracking (no cycle slipping)	Float	4	H+40
12	ch-tr-status	Tracking status (see *Table 88, Page 471*)	ULong	4	H+44
13...	Next PRN offset = H + 4 + (#obs x 44)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#obs x 44)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.96 RAWALM Raw Almanac Data

This log contains the undecoded almanac subframes as received from the satellite. For more information about Almanac data, refer to the *Introduction to GNSS* book, available through our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS > GNSS Book*.

Message ID: **74**
Log Type: **Asynch**

Recommended Input:

log rawalma onchanged

ASCII Example:

```
#RAWALMA,COM1,0,56.0,SATTIME,1337,405078.000,00000000,cc1b,1984;
1337,589824.000,43,
3,8b04e4839f35433a5590f5aefd3900a10c9aaa6f40187925e50b9f03003f,
27,8b04e483a1325b9cde9007f2fd5300a10da5562da3adc0966488dd01001a,
4,8b04e483a1b44439979006e2fd4f00a10d15d96b3b021e6c6c5f23feff3c,
28,8b04e483a3b05c5509900b7cfd5800a10cc483e2bfa1d2613003bd050017,
5,8b04e483a43745351c90fcb0fd4500a10d8a800f0328067e5df8b6100031,
57,8b04e483a6337964e036d74017509f38e13112df8dd92d040605eeaaaaaa,
6,8b04e483a6b54633e390fa8bfd3f00a10d4facbc80b322528f62146800ba,
29,8b04e483a8b05d47f7901b20fd5700a10ce02d570ed40a0a2216412400cb,
7,8b04e483a935476dee90fb94fd4300a10d93aba327b7794ae853c02700ba,
.
.
.
1,8b04e483d8b641305a901b9dfd5a00a10ce92f48f1ba0a5dcccb7500003b,
25,8b04e483dab25962259004fcfd4c00a10dc154eee5c555d7a2a5010d000d,
2,8b04e483db37424aa6900720fd4f00a10c5ad89baa4dc1460790b6fc000f,
26,8b04e483dd305a878c901d32fd5b00a10c902eb7f51db6b6ce95c701fff4*83cae97a
```

The OEM6 family of receivers automatically saves almanacs in their Non-Volatile Memory (NVM), therefore creating an almanac boot file is not necessary.

Field #	Field type	Data Description	Format	Binary Bytes	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)	GPSec	4	H+4
4	subframes	Number of subframes to follow	Ulong	4	H+8
5	svid	SV ID (satellite vehicle ID) [a]	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)	-	-	-

a. A value between 1 and 32 for the SV ID indicates the PRN of the satellite. Any other values indicate the page ID. See section 20.3.3.5.1.1, *Data ID and SV ID*, of ICD-GPS-200C for more details. To obtain copies of ICD-GPS-200, see ARINC in the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/.

3.3.97 RAWCNAVFRAME Raw CNAV frame data

This log provides raw frame data from signals which contain the CNAV message (L2C, L5).

Message ID: **1066**
Log Type: **Asynch**

Recommended Input:

log rawcnavframea onnew

ASCII Example:

```
#RAWCNAVFRAMEA,COM1,88,84.0,SATTIME,1693,242208.000,00000020,ee56,10585;50,19
3,11,8b04b4ed919863a6671f473a31412695eff3c026c0209ff07d601f775fefe1ff98780000
0000*cc38fb17
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWCNAVFRAME header	Log header		H	0
2	sigchannum	Signal cannel providing the bits	Ulong	4	H
3	PRN	Satellite PRN number	Ulong	4	H+4
4	frameId	frame ID	Ulong	4	H+8
5	data	Raw frame data	Hex[38]	38	H+12
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.98 RAWEPHEM Raw Ephemeris

This log contains the raw binary information for subframes one, two and three from the satellite with the parity information removed. Each subframe is 240 bits long (10 words - 24 bits each) and the log contains a total 720 bits (90 bytes) of information (240 bits x 3 subframes). This information is preceded by the PRN number of the satellite from which it originated. This message is not generated unless all 10 words from all 3 frames have passed parity.

Ephemeris data whose Time Of Ephemeris(TOE) is older than six hours is not shown.

Message ID: 41
Log Type: Asynch

Recommended Input:

log rawephema onnew

ASCII Example:

```
#RAWEPHEMA,COM1,15,60.5,FINESTEERING,1337,405297.175,00000000,97b7,1984;
3,1337,403184,8b04e4818da44e50007b0d9c05ee664ffbfe695df763626f00001b03c6b3,
8b04e4818e2b63060536608fd8cdaa051803a41261157ea10d2610626f3d,
8b04e4818ead0006aa7f7ef8ffda25c1a69a14881879b9c6ffa79863f9f2*0bb16ac3
.
.
.
#RAWEPHEMA,COM1,0,60.5,SATTIME,1337,405390.000,00000000,97b7,1984;
1,1337,410400,8b04e483f7244e50011d7a6105ee664ffbfe695df9e1643200001200aa92,
8b04e483f7a9e1faab2b16a27c7d41fb5c0304794811f7a10d40b564327e,
8b04e483f82c00252f57a782001b282027a31c0fba0fc525ffac84e10a06*c5834a5b
```

A way to use only one receiver and achieve better than 1 metre accuracy is to use precise orbit and clock files. Three types of GPS ephemeris, clock and earth orientation solutions are compiled by an elaborate network of GNSS receivers around the world all monitoring the satellite characteristics. IGS rapid orbit data is processed to produce files that correct the satellite clock and orbit parameters. Since there is extensive processing involved, these files are available on a delayed schedule from the US National Geodetic Survey at: www.ngs.noaa.gov/orbits

Precise ephemeris files are available today to correct GPS data which was collected a few days ago. All you need is one GNSS receiver and a computer to process on. Replace the ephemeris data with the precise ephemeris data and post-process to correct range values.

Field #	Field type	Data Description	Format	Binary Bytes	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	Hex	30	H+12
6	subframe2	Subframe 2 data	Hex	30	H+42
7	subframe3	Subframe 3 data	Hex	30	H+72
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+102
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.99 RAWGPSSUBFRAME Raw Subframe Data

This log contains the raw GPS subframe data.

A raw GPS subframe is 300 bits in total. This includes the parity bits which are interspersed with the raw data ten times in six bit chunks, for a total of 60 parity bits. Note Field #5, below, we have stripped out these 60 parity bits, and only the raw subframe data remains, for a total of 240 bits.

Message ID: **25**
Log Type: **Asynch**

Recommended Input:

log rawgpssubframea onnew

ASCII Example:

```
#RAWGPSSUBFRAMEA,COM1,59,62.5,SATTIME,1337,405348.000,00000000,f690,1984;2,22
,4,8b04e483f3b17ee037a3732fe0fc8ccf074303ebdf2f6505f5aaaaaaaaa9,2*41e768e4
...
#RAWGPSSUBFRAMEA,COM1,35,62.5,SATTIME,1337,405576.000,00000000,f690,1984;4,25
,2,8b04e48406a8b9fe8b364d786ee827ff2f062258840ea4a10e20b964327e,4*52d460a7
...
#RAWGPSSUBFRAMEA,COM1,0,62.5,SATTIME,1337,400632.000,00000000,f690,1984;20,9,
3,8b04e4826aadff3557257871000a26fc34a31d7a300bede5ffa3de7e06af,20*55d16a4a
```

The RAWGPSSUBFRAME log can be used to receive the data bits with the parity bits stripped out. Alternately, you can use the RAWGPSWORD log to receive the parity bits in addition to the data bits.

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWGPSSUBFRAME header	Log header		H	0
2	decode #	Frame decoder number	Ulong	4	H
3	PRN	Satellite PRN number	Ulong	4	H+4
4	subfr id	Subframe ID	Ulong	4	H+8
5	data	Raw subframe data	Hex[30]	32[a]	H+12
6	chan	Signal channel number that the frame was decoded on	Ulong	4	H+44
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment.

3.3.100 RAWGPSWORD Raw Navigation Word

This message contains the framed raw navigation words. Each log contains a new 30 bit navigation word (in the least significant 30 bits), plus the last 2 bits of the previous word (in the most significant 2 bits). The 30 bit navigation word contains 24 bits of data plus 6 bits of parity. The GPS reference time stamp in the log header is the time the first bit of the 30 bit navigation word was received. Only navigation data that has passed parity checking appears in this log. One log appears for each PRN being tracked every 0.6 seconds if logged ONNEW or ONCHANGED.

Message ID: **407**
Log Type: **Asynch**

Recommended Input:

log rawgpsworda onnew

ASCII Example:

```
#RAWGPSWORDA,COM1,0,58.5,FINESTEERING,1337,405704.473,00000000,9b16,1984;
14,7ff9f5dc*8e7b8721
...
#RAWGPSWORDA,COM1,0,57.0,FINESTEERING,1337,405783.068,00000000,9b16,1984;
1,93feff8a*6dd62c81
...
#RAWGPSWORDA,COM1,0,55.5,FINESTEERING,1337,405784.882,00000000,9b16,1984;
5,fffff8ce*a948b4de
```

The RAWGPSWORD log can be used to receive the parity bits in addition to the data bits. Alternately, you can use the RAWGPSSUBFRAME log which already has the parity bits stripped out

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWGPSWORD header	Log header		H	0
2	PRN	Satellite PRN number	Ulong	4	H
3	nav word	Raw navigation word	Ulong	4	H+4
4	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+8
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.101 RAWLBANDFRAME Raw L-band Frame Data

This log contains the raw L-band frame data. The RAWLBANDPACKET is output for OmniSTAR tracking.

1. In addition to a NovAtel receiver with L-band capability, use of a DGPS service is required. Contact NovAtel for details through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.
2. Please use the RAWLBANDPACKET log for raw OmniSTAR frame data, see *page 493*.

Message ID: **732**
Log Type: **Asynch**

Recommended Input:

log rawlbandframea onnew

ASCII Example:

```
#RAWLBANDFRAMEA,COM2,0,73.5,FINESTEERING,1295,152802.068,00000040,4f80,34461;
9,1a1e,600,f6,00,62,35,c8,cd,34,e7,6a,a1,37,44,8f,a8,24,71,90,d0,5f,94,2d,94,
3c,74,9c,f0,12,a3,4c,a7,30,aa,b6,2e,27,dd,dc,24,ba,d3,76,8d,76,d9,e7,83,1a,c8
,81,b0,62,1c,69,88,23,70,2a,06,c0,fc,f8,80,2c,72,f1,2e,6b,c2,5b,ec,03,70,d3,f
3,fe,ef,37,3d,17,37,1b,cf,be,af,d1,02,15,96,d1,f6,58,56,ac,bd,a3,11,12,d0,3d,
11,27,8a,87,28,0c,0f,52,70,b3,2f,0c,0c,62,2d,b8,69,6c,52,10,df,7d,bb,08,d6,ca
,a9,5e,77,66,96,c2,a0,63,3b,98,34,bc,d5,47,64,e0,00,37,10,4a,f7,c1,b6,83,8f,0
6,94,21,ff,b4,27,15,b0,60,40,02,b4,af,9c,9d,c2,d4,ea,95,68,86,0f,0a,9d,2d,36,
52,68,65,b8,a2,0b,00,21,80,64,8a,72,ff,59,b7,79,b9,49,fd,f5,3c,48,1c,2f,77,f1
,b2,9e,58,0a,81,05,1f,00,7b,00,1e,68,c9,a3,12,56,b8,2a,32,df,d9,ea,03,9b,16,c
6,17,2f,33,b3,5f,c4,f9,d2,97,75,64,06,52,a1,b2,3a,4b,69,e7,eb,0f,97,d3,e6,bf,
de,af,37,c6,10,13,9b,dc,c9,e3,22,80,78,3f,78,90,d5,9f,d3,5f,af,1f,7a,75,ef,77
,8e,de,ac,00,32,2e,79,fb,3f,65,f3,4f,28,77,b4,6d,f2,6f,31,24,b2,40,76,37,27,b
c,95,33,15,01,76,d5,f1,c4,75,16,e6,c6,ab,f2,fe,34,d9,c3,55,85,61,49,e6,a4,4e,
8b,2a,60,57,8a,e5,77,02,fc,9c,7d,d4,40,4c,1d,11,3c,9b,8e,c3,73,d3,3c,0d,ff,18
.
.
.
,7a,21,05,cb,12,f6,dd,c3,df,69,62,f5,70*3791693b
```

The data signal is structured to perform well in difficult or foliated conditions, so the service is available consistently more and has a higher degree of service reliability.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWLBANDFRAME header	Log header		H	0
2	frame#	Frame number (maximum = 9)	Ushort	2	H+2
3	channelcode	10-bit channel code word	Ushort	2	H+4
4	data	Raw L-band frame data	Uchar[1200]	1200	H+6
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+1206
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.102 RAWLBANDPACKET Raw L-band Data Packet

This log contains the raw L-band packet data. The RAWLBANDPACKET log is only output for OmniSTAR tracking.

In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR service is required. Contact NovAtel for details through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **733**

Log Type: **Asynch**

Recommended Input:

log rawlbandpacketa onnew

ASCII Example:

```
#RAWLBANDPACKETA,COM2,0,77.0,FINESTEERING,1295,238642.610,01000040,c5b1,34461
;9,07,de,3a,f9,df,30,7b,0d,cb*7e5205a8
```

OmniSTAR currently has several high-powered satellites in use around the world. They provide coverage for most of the Earth's land areas. Subscriptions are sold by geographic area. Any regional OmniSTAR service center can sell and activate subscriptions for any area. They may be arranged prior to travelling to a new area, or after arrival. Contact OmniSTAR at www.omnistar.com for further details.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWLBANDPACKET header	Log header		H	0
2	#recs	Number of records to follow	Ulong	4	H
3	data	Raw L-band data packet	Uchar[128]	128	H +4
4	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+128
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.103 RAWSBASFRAME Raw SBAS Frame Data

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

Message ID: **973**
Log Type: **Asynch**

Recommended Input:

log rawsbasframea onnew

ASCII Example:

```
#RAWSBASFRAMEA,COM1,0,91.0,SATTIME,1610,341534.000,00000000,58e4,38637;32,
133,4,c6115ffc00000c009ffc07004c089ffdffdffdffdfff957bbb6bfffc0,32*5afc5f95
#RAWSBASFRAMEA,COM1,0,91.0,SATTIME,1610,341535.000,00000000,58e4,38637;32,133,2,
53084007ff9fffffc03002c0000f0009ffc004005ffd6b961e39b9fb80,32*db5dfa62
#RAWSBASFRAMEA,COM1,0,91.0,SATTIME,1610,341535.000,00000000,58e4,38637;35,135,2,
53084007ff9fffffc03002c0000f0009ffc004005ffd6b961e39b9fb80,35*b72ff2a0
...
#RAWSBASFRAMEA,COM1,0,90.0,SATTIME,1610,341539.000,00000000,58e4,38637;34,138,3
,9a0c4000009ffc009ffdffc007fb9ffdffc0000040315b9bb96fb95680,34*cb050361
```

The RAWSBASFRAME log output contains all the raw data required for an application to compute its own SBAS correction parameters.

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

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignmen

3.3.104 REFSTATION Base station position and health

This log contains the ECEF Cartesian position of the base station as received through the RTCM, RTCMV3, RTCA or CMR message. It also features a time tag, the health status of the base station and the station ID. This information is set at the base station using the FIXPOSITION command and the DGPSTXID command. See *Figure 10, page 317* for a definition of the ECEF coordinates.

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

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

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

Message ID: **175**

Log Type: **Asynch**

Recommended Input:

log refstationa onchanged

ASCII Example:

```
#REFSTATIONA,COM1,0,66.5,FINESTEERING,1364,490401.124,80000000,4e46,2310;
00000000,-1634532.443,-3664608.907,4942482.713,0,RTCA,"AAAA"*1e2a0508
```

Table 96: Base Station Status

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

Table 97: 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

The REFSTATION log can be used for checking the operational status of a remotely located base station. You can verify that the base station is operating properly without travelling to it. This is especially useful for RTK work on long baselines.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	REFSTATION header	Log header		H	0
2	status	Status of the base station information (see *Table 96* below)	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, see the 2nd paragraph on the previous page	Ulong	4	H+28
7	stn type	Station type (see *Table 97, Station Type* on *page 495*)	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 the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment.

3.3.105 REFSTATIONINFO Base Station Position Information

This is extended version of REFSTATION log with latitude, longitude and ellipsoidal height of the base station in WGS84. In addition to the base station position, ARP height, antenna model name and antenna serial number are available if provided by the base station only through RTCMV3.

Message ID: **1325**
Log Type: **Asynch**

Recommended Input:

log refstationinfoa onchanged

ARP, Antenna model and Antenna serial number are set at the base station using BASEANTENNAMODEL command (*page 65*).

For example: baseantennamodel 702GG NVH05410007 1 user 0 0 1234

ASCII Example:

#REFSTATIONINFOA,USB1,0,89.5,EXACT,0,0.000,00000040,d38f,6782;51.116375174,-114.038254922,1048.502830628,WGS84,1.234,0,RTCMV3,"0","702GG","NVH05410007"*bedf8ece

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	REFSTATIONINFO header	Log header	H	0	
2	latitude	Latitude	Double	8	H
3	longitude	Longitude	Double	8	H+8
4	height	Ellipsoidal Height	Double	8	H+16
5	datum	Datum ID number (WGS84)	Enum	4	H+24
6	ARP height	Base Antenna ARP	FLOAT	4	H+28
7	health	Base Station Health, see REFSTATION (*page 495*)	Ulong	4	H+32
8	Ref Stn Type	Base Station Type, see REFSTATION (*page 495*)	Enum	4	H+36
9	stn ID	Base Station ID	Char[5]	8[a]	H+40
10	Ant Model	Base Antenna Model Name	Char[32]	32	H+48
11	Ant Serial	Base Antenna Serial Number	Char[32]	32	H+80
12	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment.

3.3.106 ROVERPOS Position using ALIGN

ALIGN generates distance and bearing information between a master and rover receiver. This log outputs the position information of the rover when using the ALIGN feature. This log can only be output from a Y ALIGN model and can be output at both Master and Rover ends.

You must have an ALIGN capable receiver to use this log.

1. ALIGN is useful for obtaining the relative directional heading of a vessel/body, separation heading between two vessels/bodies, or heading information with moving base and pointing applications.
2. The log can be output at the Y model Rover only if it is receiving the RTCAREFEXT message from the Master. The log can be output at any Master if the Master is receiving HEADINGEXTB from the Rover.
3. ROVERPOS is dependent on the output frequency of the RTCAREFEXT message from the master to the rover.

Message ID: **1052**
Log Type: **Asynch**

Recommended Input:

log roverposa onchanged

Example 1:

```
#ROVERPOSA,COM1,0,21.5,FINESTEERING,1544,340322.000,00000008,7453,4655;
SOL_COMPUTED,NARROW_INT,51.11605565964,-114.03854655975,1055.8559,-
16.9000,WGS84,0.0130,0.0122,0.0206,"RRRR",0.0,0.0,13,12,12,11,0,0,0,0*635b3a1
c
```

Asynchronous logs, such as ROVERPOS, should only be logged ONCHANGED or ONNEW otherwise the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Field #	Field Type	Field Description	Binary Format	Binary Bytes	Binary Offset
1	ROVERPOS header	Log Header		H	0
2	sol stat	Solution Status, see *Table 57* on *page 304*	Enum	4	H
3	pos type	Position Type see *Table 56* on *page 303*	Enum	4	H+4
4	lat	Rover WGS84 Latitude in degrees	Double	8	H+8
5	long	Rover WGS84 Longitude in degrees	Double	8	H+16
6	hgt	Rover MSL Height in metres	Double	8	H+24
7	undulation	Undulation in metres	Float	4	H+32
8	datum id#	WGS84 (default)	Enum	4	H+36
9	lat σ	Latitude Std in metres	Float	4	H+40
10	long σ	Longitude Std in metres	Float	4	H+44
11	hgt σ	Height Std in metres	Float	4	H+48
12	stn id	Receive ID (currently, “RRRR”)	Char[4]	4	H+52
13	Reserved		Float	4	H+56
14			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	#obs	Number of satellites above elevation mask angle	Uchar	1	H+66
18	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20			Uchar	1	H+69
21			Uchar	1	H+70
22			Uchar	1	H+71
23	xxxx		HEX	1	H+72
24	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.107 RTCA Standard Logs

RTCA1 **DIFFERENTIAL GPS CORRECTIONS**
MESSAGE ID: **10**

RTCAEPHEM **EPHEMERIS AND TIME INFORMATION**
MESSAGE ID: **347**

RTCAOBS **BASE STATION OBSERVATIONS*2***
MESSAGE ID: **6**

RTCAOBS2 **BASE STATION OBSERVATIONS**
MESSAGE ID: **805**

RTCAREF **BASE STATION PARAMETERS**
MESSAGE ID: **11**

RTCAREFEXT **EXTENDED BASE STATION PARAMETERS FOR ALIGN**
MESSAGE ID: **1049**

RTCAOBS3 **BASE STATION OBSERVATION FOR ALIGN**
MESSAGE ID: **1340**

1. The above messages can be logged with an A or B suffix for an ASCII or binary output with a NovAtel header followed by Hex or binary raw data respectively.
2. When you plan to send both RTCAOBS2 and RTCAOBS messages, ensure you send the RTCAOBS2 message before RTCAOBS.

The RTCA (Radio Technical Commission for Aviation Services) Standard is being designed to support Differential Global Navigation Satellite System (DGNSS) Special Category I (SCAT-I) precision instrument approaches. The RTCA Standard is in a preliminary state. Described below is NovAtel's current support for this standard. It is based on "Minimum Aviation System Performance Standards DGNSS Instrument Approach System: Special Category I (SCAT-I)".[1]

NovAtel has defined six proprietary RTCA Standard Type 7 binary format messages, RTCAOBS, RTCAOBS2, RTCAREF, RTCAEPHEM, RTCAREFEXT and RTCAOBS3 for base station transmissions. RTCAOBS3 and RTCAREFEXT are defined specifically for use in ALIGN. These can be used with either single- or dual-frequency NovAtel receivers. The RTCA message format out performs the RTCM format in the following ways, among others:

- a more efficient data structure (lower overhead)
- better error detection
- allowance for a longer message, if necessary

RTCAREF and RTCAOBS, respectively, correspond to the RTCM Type 3 and Type 59 logs used in single-frequency-only measurements. Both are NovAtel proprietary RTCA Standard Type 7 messages with an 'N' primary sub-label.

Refer to the *Receiving and Transmitting Corrections* section in the *OEM6 Installation and Operation Manual* for more information about using these message formats for differential operation.

Input Example

```
interfacemode com2 none RTCA
fix position 51.1136 -114.0435 1059.4
log com2 rtcaobs2 ontime 1
log com2 rtcaobs ontime 1
log com2 rtcaref ontime 10
log com2 rtca1 ontime 5
log com2 rtcaephem ontime 10 1
log com2 rtcarefext ontime 1
log com2 rtcaobs3 ontime 1
```

1.For further information about RTCA Standard messages, refer to:
Minimum Aviation System Performance Standards - DGNSS Instrument Approach System: Special Category I (SCAT-I), Document No. RTCA/DO-217 (April 19,1995); Appx A, Pg 21

3.3.108 RTCM Standard Logs

RTCM1 **DIFFERENTIAL GPS CORRECTIONS**
Message ID: **107**

RTCM3 **BASE STATION PARAMETERS**
Message ID: **117**

RTCM9 **PARTIAL DIFFERENTIAL GPS CORRECTIONS**
Message ID: **275**

RTCM15 **IONOSPHERIC CORRECTIONS**
Message ID: **307**

RTCM16 **SPECIAL MESSAGE**
Message ID: **129**

RTCM16T **SPECIAL TEXT MESSAGE,** see also *page 234*
Message ID: **131**

RTCM1819 **RAW MEASUREMENTS**
Message ID: **260**

RTCM2021 **MEASUREMENT CORRECTIONS**
Message ID: **374**

RTCM22 **EXTENDED BASE STATION**
Message ID: **118**

RTCM23 **ANTENNA TYPE DEFINITION**
Message ID: **665**

RTCM24 **ANTENNA REFERENCE POINT (ARP)**
Message ID: **667**

RTCM31 **DIFFERENTIAL GLONASS**
Message ID: **864**

RTCM32 **GLONASS BASE PARAMETERS**
Message ID: **873**

RTCM36 **SPECIAL EXTENDED MESSAGE**
Message ID: **875**

RTCM36T **SPECIAL EXTENDED MESSAGE,** see also *page 234*
Message ID: **877**

RTCM59 **TYPE 59N-0 PROPRIETARY DIFFERENTIAL**
Message ID: **116**

RTCM59GLO **PROPRIETARY GLONASS DIFFERENTIAL**
Message ID: **903**

RTCMOMNI1 **RTCM1 FROM OMNISTAR VBS**
Message ID: **957**

1. The RTCM messages can be logged with an A or B suffix for an ASCII or binary output with a NovAtel header followed by Hex or binary raw data respectively.
2. Combinations of integer offsets and fractional offsets are not supported for RTCM logs. See also the LOG command starting on *page 157* for more details on offsets.

The Radio Technical Commission for Maritime Services (RTCM) was established to facilitate the establishment of various radio navigation standards, which includes recommended GNSS differential standard formats. Refer to the *Receiving and Transmitting Corrections* section in the *OEM6 Installation and Operation Manual* for more information about using these message formats for differential operation.

The standards recommended by the RTCM Special Committee 104, Differential GPS Service (RTCM SC-104,Washington, D.C.), have been adopted by NovAtel for implementation into the receiver. Because the receiver is capable of utilizing RTCM formats, it can easily be integrated into positioning systems around the globe.

As it is beyond the scope of this manual to provide indepth descriptions of the RTCM data formats, it is recommended that anyone requiring explicit descriptions should obtain a copy of the published RTCM specifications.

RTCM SC-104[1] Type 3 and 59 messages can be used for base station transmissions in differential systems. However, since these messages do not include information about the L2 component of the GPS signal, they cannot be used with RT-2 positioning. Regardless of whether single or dual-frequency receivers are used, the RT-20 positioning algorithm is used. This is for a system in which both the base and rover stations utilize NovAtel receivers.

Note that the error detection capability of an RTCM format message is less than that of an RTCA-format message. The communications equipment used may have an error detection capability of it's own to supplement the RTCM message which induces higher overhead. Consult the radio vendor's documentation for further information.

If RTCM format messaging is being used, the optional *station id* field that is entered using the DGPSTXID command can be any number within the range of 0 - 1023 (for example, 119). The representation in the log message is identical to what was entered.

The NovAtel logs which implement the RTCM Standard Format for Type 1, 3, 9, 16, 18, 19, 22, 23, 24, 31, 32 and 36 messages are known as the RTCM1, RTCM3, RTCM9, RTCM16, RTCM1819, RTCM22, RTCM23, RTCM24, RTCM31, RTCM32 and RTCM36 logs, respectively, while Type 59N-0 messages are listed in the RTCM59 log.

1. For further information about RTCM SC-104 messages, you may wish to refer to:

   RTCM Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 2.3 at http://www.rtcm.org/overview.php.

All receiver RTCM standard format logs adhere to the structure recommended by RTCM SC-104. Thus, all RTCM message are composed of 30 bit words. Each word contains 24 data bits and 6 parity bits. All RTCM messages contain a 2 word header followed by 0 to 31 data words for a maximum of 33 words (990 bits) per message.

Message Frame Header	Data	Bits
Word 1	Message frame preamble for synchronization	8
	Frame/message type ID	6
	Base station ID	10
	Parity	6
Word 2	Modified z-count (time tag)	13
	Sequence number	3
	Length of message frame	5
	Base health	3
	Parity	6

Version 3.0, also developed by the RTCM SC-104, consists primarily of messages designed to support Real-Time Kinematic (RTK) operations. It provides messages that support GPS and GLONASS RTK operations, including code and carrier phase observables, antenna parameters, and ancillary system parameters. Version 3.1 adds RTCM messages containing transformation data and information about Coordinate Reference Systems.[1]

The remainder of this section provides further information concerning receiver commands and logs that utilize the RTCM data formats.

Example Input:

```
interfacemode com2 none RTCM
fix position 51.1136 -114.0435 1059.4
log com2 rtcm3 ontime 10
log com2 rtcm22 ontime 10 1
log com2 rtcm1819 ontime 1
log com2 rtcm31 ontime 2
log com2 rtcm32 ontime 2
log com2 rtcm1 ontime 5
```

1. For further information about RTCM SC-104 messages, refer to:

   RTCM Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3.0 and Version 3.1 at http://www.rtcm.org/overview.php.

OmniSTAR Local Wide Area Corrections

RTCM Type 1 messages are generated from OmniSTAR Virtual Base Station (VBS) corrections.

The positioning performance using OmniSTAR local wide area corrections meets the standard OmniSTAR VBS code differential performance specifications.

Unless otherwise noted, values in the RTCM Type 1 messages are unchanged from what is provided by the VBS library (for example, RRC, UDRE, station ID) apart from necessary unit scaling. An RTCM1 message is generated and output each time the VBS library provides updated corrections (about every 6 s). The receiver no longer outputs corrections when the L-band signal is lost and the VBS library stops generating corrections. The output is for the same set of satellites provided by the VBS library (above 5° elevation at the current position).

Enable the output of OmniSTAR VBS corrections in RTCM messages by using the following commands:

INTERFACEMODE COM2 NOVATEL RTCM OFF

ASSIGNLBAND OMNISTAR <frequency> <bps> or ASSIGNLBAND OMNISTARAUTO

PSRDIFFSOURCE OMNISTAR

LOG COM2 RTCMOMNI1 ONCHANGED

The RTCMOMNI1 log is asynchronous.

The OmniSTAR RTCM model outputs RTCM corrections at a rate of up to 0.2 Hz. This new model does not include position or raw measurement output.

3.3.109 RTCMV3 RTCMV3 Standard Logs

RTCM1001 **L1-ONLY GPS RTK OBSERVABLES**
Message ID: 772

RTCM1002 **EXTENDED L1-ONLY GPS RTK OBSERVABLES**
Message ID: 774

RTCM1003 **L1 AND L2 GPS RTK OBSERVABLES**
Message ID: 776

RTCM1004 **EXTENDED L1 AND L2 GPS RTK OBSERVABLES**
Message ID: 770

RTCM1005 **STATIONARY RTK BASE STATION ANTENNA REFERENCE POINT (ARP)**
Message ID: 765

RTCM1006 **STATIONARY RTK BASE STATION ARP WITH ANTENNA HEIGHT**
Message ID: 768

RTCM1007 **EXTENDED ANTENNA DESCRIPTOR AND SETUP INFORMATION**
Message ID: 852

RTCM1008 **EXTENDED ANTENNA REFERENCE STATION DESCRIPTION AND SERIAL NUMBER**
Message ID: 854

RTCM1009 **GLONASS L1-ONLY RTK**
Message ID: 885

RTCM1010 **EXTENDED GLONASS L1-ONLY RTK**
Message ID: 887

RTCM1011 **GLONASS L1/L2 RTK**
Message ID: 889

RTCM1012 **EXTENDED GLONASS L1/L2 RTK**
Message ID: 891

RTCM1019 **GPS EPHEMERIDES**
Message ID: 893

RTCM1020 **GLONASS EPHEMERIDES**
Message ID: 895

RTCM1033 **RECEIVER AND ANTENNA DESCRIPTORS**

Message ID: 1097

1. At the base station, choose to send either an RTCM1005 or RTCM1006 message to the rover station. Then select one of the observable messages (RTCM1001, RTCM1002, RTCM1003 or RTCM1004) to send from the base.
2. RTCM1007 and RTCM1008 data is set using the BASEANTENNAMODEL command, see *page 81*. If you have set a base station ID, it is detected and set. Other values are also taken from a previously entered BASEANTENNA-MODEL command.
3. In order to set up logging of RTCM1007 or RTCM1008 data, it is recommended to first use the INTERFACEMODE command to set the interface mode of the port transmitting RTCMV3 messages to RTCMV3, see *page 146*. Providing the base has a fixed position, see FIX on *page 119* or is configured as a moving base station (refer to *Section 2.5.56* on *page 168*) and its BASEANTENNAMODEL command set, you can log out RTCM1007 messages.
4. The RTCM messages can be logged with an A or B suffix for an ASCII or binary output with a NovAtel header followed by Hex or binary raw data respectively.

RTCM SC-104 is a more efficient alternative to the documents entitled "RTCM Recommended Standards for Differential NAVSTAR GPS Service, Version 2.x". Version 3.0, consists primarily of messages designed to support RTK operations. The reason for this emphasis is that RTK operation involves broadcasting a lot of information and thus benefits the most from a more efficient data format.

The RTCM SC-104 standards have been adopted by NovAtel for implementation into the receiver. The receiver can easily be integrated into positioning systems around the globe because it is capable of utilizing RTCM Version 3.0 formats.

The initial Version 3.0 document describes messages and techniques for supporting GPS. The format accommodates modifications to these systems (for example, new signals) and to new satellite systems that are under development. In addition, augmentation systems that utilize geostationary satellites, with transponders operating in the same frequency bands, are now in the implementation stages. Generically ,they are called Satellite-Based Augmentation Systems (SBAS) and are designed to be interoperable (for example WAAS, EGNOS, MSAS).

Message types contained in the current Version 3.0 standard have been structured in different groups. Transmit at least one message type from each of Groups 1 to 3:

Group 1 - Observations:

RTCM1001	L1-Only GPS RTK
RTCM1002	Extended L1 Only GPS RTK
RTCM1003	L1 And L2 GPS RTK
RTCM1004	Extended L1and L2 GPS RTK
RTCM1009	L1-Only GLONASS RTK
RTCM1010	Extended L1 Only GLONASS RTK
RTCM1011	L1/L2 GLONASS RTK

RTCM1012 Extended L1/L2 GLONASS RTK

Group 2 - Base Station Coordinates:

RTCM1005 RTK Base Antenna Reference Point (ARP)
RTCM1006 RTK Base ARP with Antenna Height

Group 3 - Antenna Description:

RTCM1007 Extended Antenna Descriptor and Setup Information
RTCM1008 Extended Antenna Reference Station Description and Serial Number

Group 4 - Auxiliary Operation Information:

RTCM1019 GPS Ephemerides
RTCM1020 GLONASS Ephemerides
RTCM1033 Receiver and Antenna Descriptors

Example Input:

```
interfacemode com2 none RTCMV3
fix position 51.1136 -114.0435 1059.4
baseantennamodel 702 NVH05410007 1 user
log com2 rtcm1005 ontime 3
log com2 rtcm1002 ontime 5
log com2 rtcm1006 ontime 1
log com2 rtcm1007 ontime 10
log com2 rtcm1008 ontime 10
```

RTCM1001-RTCM1004GPS RTK Observables

RTCM1001, RTCM1002, RTCM1003 and RTCM1004 are GPS RTK messages, which are based on raw data. From this data, valid RINEX files can be obtained. As a result, this set of messages offers a high level of interoperability and compatibility with standard surveying practices. Refer also to the *PC Software and Firmware* section of the *OEM6 Installation and Operation Manual* for details on the logs that Convert4 converts to RINEX.

The Type 1001 Message supports single-frequency RTK operation. It does not include an indication of the satellite Carrier-to-Noise (C/No) as measured by the base station.

The Type 1002 Message supports single-frequency RTK operation and includes an indication of the satellite C/No as measured by the base station. Since the C/No does not usually change from measurement to measurement, this message type can be mixed with the Type 1001 and is used primarily when a satellite C/No changes, thus saving broadcast link throughput.

The Type 1003 Message supports dual-frequency RTK operation, but does not include an indication of the satellite C/No as measured by the base station.

The Type 1004 Message supports dual-frequency RTK operation, and includes an indication of the satellite C/No as measured by the base station. Since the C/No does not usually change from measurement to measurement, this message type can be mixed with the Type 1003 and is used only when a satellite C/No changes, thus saving broadcast link throughput.

RTCM1005 & RTCM1006 RTK Base Antenna Reference Point (ARP)

Message Type 1005 provides the Earth-Centered, Earth-Fixed (ECEF) coordinates of the ARP for a stationary base station. No antenna height is provided.

Message Type 1006 provides all the same information as Message Type 1005 and also provides the height of the ARP.

These messages are designed for GPS operation and are equally applicable to future satellite systems. System identification bits are reserved for them.

Message Types 1005 and 1006 avoid any phase center problems by utilizing the ARP, which is used throughout the International GPS Service (IGS). They contain the coordinates of the installed antenna's ARP in ECEF coordinates; datum definitions are not yet supported. The coordinates always refer to a physical point on the antenna, typically the bottom of the antenna mounting surface.

RTCM1007 & RTCM1008 Extended Antenna Descriptions

Message Type 1007 provides an ASCII descriptor of the base station antenna. The International GPS Service (IGS) Central Bureau convention is used most of the time, since it is universally accessible.

Message Type 1008 provides the same information, plus the antenna serial number, which removes any ambiguity about the model number or production run.

IGS limits the number of characters to 20. The antenna setup ID is a parameter for use by the service provider to indicate the particular base station-antenna combination. "0" for this value means that the values of a standard model type calibration should be used. The antenna serial number is the individual antenna serial number as issued by the manufacturer of the antenna.

RTCM1009-RTCM1012 GLONASS RTK Observables

Message Types 1009 through 1012 provide the contents of the GLONASS RTK messages, which are based on raw data. You can obtain complete RINEX files from this data. This set of messages offers a high level of interoperability and compatibility with standard surveying practices. When using these messages, you should also use an ARP message (Type 1005 or 1006) and an Antenna Descriptor message (Type 1007 or 1008). If the time tags of the GPS and GLONASS RTK data are synchronized, the Synchronized GNSS flag can be used to connect the entire RTK data block.

RTCM1019-RTCM1020 GPS and GLONASS Ephemerides

Message Type 1019 contains GPS satellite ephemeris information. Message Type 1020 contains GLONASS ephemeris information. These messages can be broadcast in the event that an anomaly in ephemeris data is detected, requiring the base station to use corrections from previously good satellite ephemeris data. This allows user equipment just entering the differential system to use corrections broadcast from that ephemeris. Broadcast this message (Type 1019 or 1020) every 2 minutes until the satellite broadcast is corrected or until the satellite drops below the coverage area of the base station.

These messages can also be used to assist receivers to quickly acquire satellites. For example, if you access a wireless service with this message, it can utilize the ephemeris information immediately rather than waiting for a satellite to be acquired and the almanac data processed.

3.3.110 RTKDOP DOP Values from the RTK Fast Filter

This log contains the DOP values calculated by the RTK fast filter.

The RTKDOP log contains single-point DOPs, calculated using only the satellites used in the fast RTK solution, that is, those used for the RTKPOS position. Calculation of the RTK DOPs are limited to once a second.

The calculation of the RTK DOP is different than that for the pseudorange DOP. In the pseudorange filter, new DOPs are calculated every 60s or when the satellites used in the solution change. The RTK DOP is calculated at the rate requested and regardless of a change in satellites. However, the DOP is only calculated when the RTKDOP log is requested.

Message ID: **952**

Log Type: **Synch**

Recommended Input:

log rtkdopa ontime 10

ASCII Example:

```
#RTKDOPA,COM1,0,60.0,FINESTEERING,1449,446982.000,00000008,b42b,3044;2.3386,
1.9856,0.9407,1.5528,1.2355,10.0,11,21,58,6,7,10,16,18,24,26,29,41*85f8338b
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKDOP header	Log header		H	0
2	GDOP	Geometric DOP	Float	4	H
3	PDOP	Position DOP	Float	4	H+4
4	HDOP	Horizontal DOP	Float	4	H+8
5	HTDOP	Horizontal and Time DOP	Float	4	H+12
6	TDOP	Time DOP	Float	4	H+16
7	elev mask	Elevation mask angle	Float	4	H+20
8	#sats	Number of satellites to follow	Ulong	4	H+24
9	sats	Satellites in use at time of calculation	Ulong[#sats]	4x(#sats)	H+28
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.111 RTKDOP2 DOP Values from the RTK Low Latency Filter

This log is similar to the RTKDOP log, but contains the per-system TDOPs.

Message ID: **1172**
Log Type: **Synch**

Recommended Input:

log rtkdop2a ontime 10

ASCII Example:

```
#RTKDOP2A,COM1,0,80.0,FINESTEERING,1690,601478.000,00000008,ab50,43488;1.5000
,1.1850,0.6580,0.9850,2,GPS,0.6530,GLONASS,0.6490*c5f1a25f
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKDOP2 header	Log header		H	0
2	GDOP	Geometric DOP	Float	4	H
3	PDOP	Position DOP	Float	4	H+4
4	HDOP	Horizontal DOP	Float	4	H+8
5	VDOP	Vertical DOP	Float	4	H+12
6	TDOP	Time dilution of precision - assumes 3-D position is known and only the receiver clock offset is unknown	ULong	4	H+16
6	system	See *Table 29* on *page 156*	Enum	4	H+20
8	dop	Dilution of precision	Long	4	H+24
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.112 RTKPOS RTK Low Latency Position Data

This log contains the low latency RTK position computed by the receiver, along with two status flags. In addition, it reports other status indicators, including differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections. This log is recommended for kinematic operation. Better accuracy can be obtained in static operation with the MATCHEDPOS log (*page 418*).

With the system operating in an RTK mode, this log reflects if the solution is a good RTK low latency solution (from extrapolated base station measurements) or invalid. A valid RTK low latency solution is computed for up to 60 seconds after reception of the last base station observation. The degradation in accuracy, due to differential age, is reflected in the standard deviation fields, and is summarized in the Standards and Reference page available on our website at http://www.novatel.com/support/knowledge-and-learning/. See also the PSRDIFFTIMEOUT command on *page 188*.

Message ID: **141**

Log Type: **Synch**

Recommended Input:

log rtkposa ontime 1

ASCII Example:

```
#RTKPOSA,COM1,0,54.5,FINESTEERING,1419,340040.000,00000040,176e,2724;
SOL_COMPUTED,NARROW_INT,51.11635911294,-114.03833103654,1063.8336,-16.2712,
WGS84,0.0179,0.0096,0.0174,"AAAA",1.000,0.000,12,11,11,11,0,01,0,33*0adb3e47
```

Consider the case of a racing car, on a closed circuit, requiring RTK operation. In this situation, you would have to send live data to the pits using a radio link.

RTK operation enables live centimeter level position accuracy. When answers are required in the field, the base station must transmit information to the rover in real-time. For RTK operation, extra equipment such as radios are required to transmit and receive this information. The base station has a corresponding base radio and the rover station has a corresponding rover radio.

Post-processing can provide post-mission position and velocity data using raw GNSS data collected from the car. The logs necessary for post-processing include:

RANGECMPB ONTIME 1
RAWEPHEMB ONNEW

These are examples of data collection for post-processing, and real-time operation. OEM6-based output is compatible with post-processing software from the NovAtel's Waypoint Products Group or refer to our website at www.novatel.com.. for more details.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKPOS header	Log header		H	0
2	sol status	Solution status (see *Table 57* on *page 304*)	Enum	4	H
3	pos type	Position type (see *Table 56* on *page 303*)	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 geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Table 16, Reference Ellipsoid Constants* on *page 96*)	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	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84.

3.3.113 RTKSATS Satellites used in RTKPOS solution

This log lists the used and unused satellites for the corresponding RTKPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1174**
Log Type: **Synch**

Recommended Input:

log rtksats ontime 1

Abbreviated ASCII Example:

```
<RTKSATS COM1 0 80.0 FINESTEERING 1690 601976.000 00000008 95e7 43488
<     20
<          GPS 11 GOOD 00000003
<          GPS 8 GOOD 00000003
...
<          GPS 1 GOOD 00000003
<          GPS 7 GOOD 00000003
<          SBAS 133 NODIFFCORR 00000000
<          SBAS 138 NODIFFCORR 00000000
<          SBAS 135 NODIFFCORR 00000000
<          GLONASS 10-7 GOOD 00000003
<          GLONASS 21+4 GOOD 00000003
...
<          GLONASS 12-1 GOOD 00000003
<          GLONASS 11 GOOD 00000003
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKSATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 156*	Enum	4	H+4
4	Satellite ID	Satellite identifiers. See *page Table 63* on *page 309*	Ulong	4	H+8
5	Status	Satellite status. See *Table 60* on *page 308*	Enum	4	H+16
6	Status mask	See *Table 61* on *page 309*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.114 RTKVEL RTK Velocity

This log contains the RTK velocity information computed by the receiver. In addition, it reports a velocity status indicator is useful in indicating whether or not the corresponding data is valid and differential age is useful in predicting anomalous behavior brought about by outages in differential corrections. 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. See also the table footnote for velocity logs on page 271.

Velocities from the RTK filter are calculated from the delta-position. In RTKVEL, the velocity type is the same as the position type.

With the system operating in an RTK mode, this log reflects if the solution is a good RTK low latency solution (from extrapolated base station measurements) or invalid. A valid RTK low latency solution is computed for up to 60 seconds after reception of the last base station observation.

The velocity is computed from consecutive RTK low latency updates. As such, it is an average velocity based on the time difference between successive position computations and not an instantaneous velocity at the RTKVEL time tag. The velocity latency to be subtracted from the time tag is normally half the time between filter updates. Under default operation, the RTK low latency filter is updated at a rate of 2 Hz. This translates into a velocity latency of 0.25 seconds. The latency can be reduced by increasing the update rate of the RTK low latency filter by requesting the BESTVEL, RTKVEL, BESTPOS or RTKPOS messages at a rate higher than 2 Hz. For example, a logging rate of 10 Hz would reduce the velocity latency to 0.05 seconds. For integration purposes, the velocity latency should be applied to the record time tag.

Message ID: **216**
Log Type: **Synch**

Recommended Input:

```
log rtkvela ontime 1
```

ASCII Example:

```
#RTKVELA,COM1,0,43.5,FINESTEERING,1364,496137.000,00100000,71e2,2310;
SOL_COMPUTED,NARROW_INT,0.250,1.000,0.0027,207.645811,0.0104,0.0*f551cc42
```

Consider the case of an unmanned aircraft. A differential base station must send data to the remote aircraft. In this type of application, the aircraft's radio may pass differential data, for example RTKVEL, to the positioning system so it can process it and generate precise position information for the flight controls.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKVEL header	Log header		H	0
2	sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	vel type	Velocity type, see *Table 56, Position or Velocity Type* on *page 303*	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 metres per second	Double	8	H+16
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	Double	8	H+32
9	Reserved		Float	4	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.115 RTKXYZ RTK Cartesian Position and Velocity

This log contains the receiver's low latency position and velocity in ECEF coordinates. The position and velocity status fields indicate whether or not the corresponding data is valid. See Figure 10, page 317 for a definition of the ECEF coordinates.

The velocity measurements have a latency associated with them. The time of validity is the time tag in the log minus the latency value.

With the system operating in an RTK mode, this log reflects if the solution is a good RTK low latency solution (from extrapolated base station measurements) or invalid. A valid RTK low latency solution is computed for up to 60 seconds after reception of the last base station observation. The degradation in accuracy due to differential age is reflected in the standard deviation fields, and is summarized in the Standards and Reference page on our website at http://www.novatel.com/support/knowledge-and-learning/. See also the PSRDIFFTIMEOUT command on *page 188*.

The velocity is computed from consecutive RTK low latency updates. As such, it is an average velocity based on the time difference between successive position computations and not an instantaneous velocity at the RTKVEL time tag. The velocity latency to be subtracted from the time tag is normally half the time between filter updates. Under default operation, the RTK low latency filter is updated at a rate of 2 Hz. This translates into a velocity latency of 0.25 seconds. The latency can be reduced by increasing the update rate of the RTK low latency filter by requesting the BESTXYZ message at a rate higher than 2 Hz. For example, a logging rate of 10 Hz would reduce the velocity latency to 0.05 seconds. For integration purposes, the velocity latency should be applied to the record time tag.

See also the BESTXYZ and MATCHEDXYZ logs, on *pages 315* and *421*.

Message ID: **244**
Log Type: **Synch**

Recommended Input:

```
log rtkxyza ontime 1
```

ASCII Example:

```
#RTKXYZA,COM1,0,56.0,FINESTEERING,1419,340041.000,00000040,3d88,2724;
SOL_COMPUTED,NARROW_INT,-1634531.5666,-3664618.0291,4942496.3230,0.0099,
0.0219,0.0115,SOL_COMPUTED,NARROW_INT,0.0030,0.0003,-0.0016,0.0198,0.0438,
0.0230,"AAAA",0.250,1.000,0.000,12,11,11,11,0,01,0,33*0497d146
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H
3	pos type	Position type, see *Table 56, Position or Velocity Type* on *page 303*	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P-Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status, see *Table 57, Solution Status* on *page 304*	Enum	4	H+44
11	vel type	Velocity type, see *Table 56* on *page 303*	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m)	Float	4	H+84
18	stn ID	Base station identification	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#SVs	Number of satellite vehicles tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+106
25	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+107
26	Reserved		Char	1	H+108
27	ext sol stat	Extended solution status (see *Table 59, Extended Solution Status* on *page 305*)	Hex	1	H+109
28	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 58* on *page 305*)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.116 RXCONFIG Receiver Configuration

This log is used to output a list of all current command settings. When requested, an RXCONFIG log is output for each setting. See also the LOGLIST log on *page 409* for a list of currently active logs.

Message ID: **128**
Log Type: **Polled**

Recommended Input:

log rxconfiga once

ASCII Example[1]:

```
#RXCONFIGA,COM1,71,47.5,APPROXIMATE,1337,333963.260,00000000,f702,1984;
#ADJUST1PPSA,COM1,71,47.5,APPROXIMATE,1337,333963.260,00000000,f702,1984;
OFF,ONCE,0*ba85a20b*91f89b07
#RXCONFIGA,COM1,70,47.5,APPROXIMATE,1337,333963.398,00000000,f702,1984;
#ANTENNAPOWERA,COM1,70,47.5,APPROXIMATE,1337,333963.398,00000000,f702,1984;
ON*d12f6135*8f8741be
#RXCONFIGA,COM1,69,47.5,APPROXIMATE,1337,333963.455,00000000,f702,1984;
#CLOCKADJUSTA,COM1,69,47.5,APPROXIMATE,1337,333963.455,00000000,f702,1984;
ENABLE*0af36d92*b13280f2
...
#RXCONFIGA,COM1,7,47.5,APPROXIMATE,1337,333966.781,00000000,f702,1984;
#STATUSCONFIGA,COM1,7,47.5,APPROXIMATE,1337,333966.781,00000000,f702,1984;
CLEAR,AUX2,0*a6141e28*d0bba9f2
#RXCONFIGA,COM1,2,47.5,APPROXIMATE,1337,333967.002,00000000,f702,1984;
#SBASECUTOFFA,COM1,2,47.5,APPROXIMATE,1337,333967.002,00000000,f702,1984;
-5.000000000*b9b11096*2e8b77cf
#RXCONFIGA,COM1,1,47.5,FINESTEERING,1337,398382.787,00000000,f702,1984;
#LOGA,COM1,1,47.5,FINESTEERING,1337,398382.787,00000000,f702,1984;
COM1,MARKPOSA,ONNEW,0.000000,0.000000,NOHOLD*a739272d*6692c084
#RXCONFIGA,COM1,0,47.5,FINESTEERING,1337,400416.370,00000000,f702,1984;
#LOGA,COM1,0,47.5,FINESTEERING,1337,400416.370,00000000,f702,1984;
COM2,PASSCOM2A,ONCHANGED,0.000000,0.000000,NOHOLD*55fc0c62*17086d18
```

Do not use undocumented commands or logs! Doing so may produce errors and void your warranty.

1. The embedded CRCs are flipped to make the embedded messages recognizable to the receiver. For example, consider the first embedded message above.

   91f89b07: 10010001111110001001101100000111

   11100000110110010001111110001001:e0d91f89

   The CRC is really e0d91f89.

The RXCONFIG log can be used to ensure your receiver is correctly setup for your application.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RXCONFIG header	Log header	-	H	0
2	e header	Embedded header	-	h	H
3	e msg	Embedded message	Varied	a	H + h
4	e xxxx	Embedded (inverted) 32-bit CRC (ASCII and Binary only). The embedded CRC is inverted so that the receiver does not recognize the embedded messages as messages to be output but continues with the RXCONFIG message. If you wish to use the messages output from the RXCONFIG log, simply flip the embedded CRC around for individual messages	Long	4	H+ h + a
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+ h + a + 4
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.117 RXSTATUS Receiver Status

This log conveys various status parameters of the GNSS receiver system. These include the Receiver Status and Error words which contain several flags specifying status and error conditions. If an error occurs (shown in the Receiver Error word), the receiver idles all channels, turns off the antenna and disables the RF hardware as these conditions are considered to be fatal errors. The log contains a variable number of status words to allow for maximum flexibility and future expansion.

The receiver gives the user the ability to determine the importance of the status bits. In the case of the Receiver Status, setting a bit in the priority mask causes the condition to trigger an error. This causes the receiver to idle all channels, turn off the antenna and disable the RF hardware, the same as if a bit in the Receiver Error word is set. Setting a bit in an Auxiliary Status priority mask causes that condition to set the bit in the Receiver Status word corresponding to that Auxiliary Status. See also the STATUSCONFIG command on *page 246*.

1. Field #4, the receiver status word as represented in *Table 99*, is also in Field #8 of the header. See the *ASCII Example* below and *Table 99* on *page 523* for clarification.
2. Refer also to the chapter on *Built-In Status Tests* in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **93**
Log Type: **Asynch**

Recommended Input:

log rxstatusa onchanged

ASCII Example:

```
#RXSTATUSA,COM1,0,43.5,FINESTEERING,1337,407250.846,00000000,643c,1984;
00000000,4,00000000,00000000,00000000,00000000,00000083,00000008,00000000,
00000000,00000000,00000000,00000000,00000000,00000000,00000000,00000000,
00000000*ba27dfae
```

Receiver errors automatically generate event messages. These event messages are output in RXSTATUSEVENT logs. It is also possible to have status conditions trigger event messages to be generated by the receiver. This is done by setting/clearing the appropriate bits in the event set/clear masks. The set mask tells the receiver to generate an event message when the bit becomes set. Likewise, the clear mask causes messages to be generated when a bit is cleared. See the STATUSCONFIG command on *page 246* for details.

If you wish to disable all these messages without changing the bits, simply UNLOG the RXSTATUSEVENT logs on the appropriate ports. See also the UNLOG command on *page 258*.

.

Table 98: Receiver Error

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Dynamic Random Access Memory (DRAM) status [a]	OK	Error
	1	0x00000002	Invalid firmware	OK	Error
	2	0x00000004	ROM status	OK	Error
	3	0x00000008	Reserved		
N1	4	0x00000010	Electronic Serial Number (ESN) access status	OK	Error
	5	0x00000020	Authorization code status	OK	Error
	6	0x00000040	Reserved		
	7	0x00000080	Supply voltage status	OK	Error
N2	8	0x00000100	Reserved		
	9	0x00000200	Temperature status (as compared against acceptable limits)	OK	Error
	10	0x00000400	MINOS status	OK	Error
	11	0x00000800	PLL RF1 hardware status - L1	OK	Error
N3	12	0x00001000	PLL RF2 hardware status - L2	OK	Error
	13	0x00002000	Reserved		
	14	0x00004000	Reserved		
	15	0x00008000	NVM status	OK	Error
N4	16	0x00010000	Software resource limit	OK	Error
	17	0x00020000	Model not valid for this receiver	OK	Error
	18	0x00040000	Reserved		
	19	0x00080000			

Continued on next page

Table 98: Receiver Error

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N5	20	0x00100000	Remote loading has begun	No	Yes
	21	0x00200000	Export restriction	OK	Error
	22	0x00400000	Safe Mode	OK	Error
	23	0x00800000	Reserved		
N6	24	0x01000000			
	25	0x02000000			
	26	0x04000000			
	27	0x08000000			
N7	28	0x10000000			
	29	0x20000000			
	30	0x40000000			
	31	0x80000000	Component hardware failure	OK	Error

a. RAM failure on an OEM6 card may also be indicated by a flashing red LED.

Table 99: Receiver Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Error flag, see *Table 98, Receiver Error* on *page 522*	No error	Error
	1	0x00000002	Temperature status	Within specifications	Warning
	2	0x00000004	Voltage supply status	OK	Warning
	3	0x00000008	Antenna power status See *ANTENNAPOWER* on *Page 67*	Powered	Not powered
N1	4	0x00000010	LNA Failure		
	5	0x00000020	Antenna open flag [a]	OK	Open
	6	0x00000040	Antenna shorted flag [a]	OK	Shorted
	7	0x00000080	CPU overload flag [a]	No overload	Overload

Continued on next page

Table 99: Receiver Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N2	8	0x00000100	COM1 buffer overrun flag	No overrun	Overrun
	9	0x00000200	COM2 buffer overrun flag	No overrun	Overrun
	10	0x00000400	COM3 buffer overrun flag	No overrun	Overrun
	11	0x00000800	Link overrun flag [b]	No overrun	Overrun
N3	12	0x00001000	Reserved		
	13	0x00002000	Aux transmit overrun flag	No overrun	Overrun
	14	0x00004000	AGC out of range[c]		
	15	0x00008000	Reserved		
N4	16	0x00010000	Reserved for SPAN		
	17	0x00020000	Reserved		
	18	0x00040000	Almanac flag/UTC known	Valid	Invalid
	19	0x00080000	Position solution flag	Valid	Invalid
N5	20	0x00100000	Position fixed flag, see *FIX* on *page 119*	Not fixed	Fixed
	21	0x00200000	Clock steering status	Enabled	Disabled
	22	0x00400000	Clock model flag	Valid	Invalid
	23	0x00800000	External oscillator locked flag	Unlocked	Locked
N6	24	0x01000000	Software resource	OK	Warning
	25	0x02000000	Reserved		
	26	0x04000000			
	27	0x08000000			
N7	28	0x10000000			
	29	0x20000000	Auxiliary 3 status event flag	No event	Event
	30	0x40000000	Auxiliary 2 status event flag	No event	Event
	31	0x80000000	Auxiliary 1 status event flag	No event	Event

a. This flag is only available on certain products.

b. This flag indicates if any of the USB, ICOM, NCOM or XCOM ports are overrun. See the auxiliary status word for the specific port for which the buffer is overrun.

c. The AGC out of range (Bit 14) flag indicates if any of the RF AGCs are out of the range as indicated in *Table 100, Auxiliary 1 Status* on *page 525*.

Table 100: Auxiliary 1 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Reserved		
	1	0x00000002			
	2	0x00000004			
	3	0x00000008	Position averaging	Off	On
N1	4	0x00000010	Reserved		
	5	0x00000020			
	6	0x00000040			
	7	0x00000080	USB connection status	Connected	Not connected
N2	8	0x00000100	USB1 buffer overrun flag	No overrun	Overrun
	9	0x00000200	USB2 buffer overrun flag	No overrun	Overrun
	10	0x00000400	USB3 buffer overrun flag	No overrun	Overrun
	11	0x00000800	Reserved		
N3	12	0x00001000	Profile Activation Bit = 0 (Ok) Bit = 1 (Error)		
	13	0x00002000	Reserved		
	14	0x00004000	RF1 AGC out of range		
	15	0x00008000	RF2 AGC out of range		
N4	16	0x00010000	RF3 AGC out of range		
	17	0x00020000	Reserved		
	18	0x00040000	Ethernet not connected		
	19	0x00080000	ICOM1 buffer overrun flag		

Continued on next page

Table 100: Auxiliary 1 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N5	20	0x00100000	ICOM2 buffer overrun flag		
	21	0x00200000	ICOM3 buffer overrun flag		
	22	0x00400000	NCOM1 buffer overrun flag		
	23	0x00800000	NCOM2 buffer overrun flag		
N6	24	0x01000000	NCOM3 buffer overrun flag		
	25	0x02000000	XCOM1 buffer overrun flag		
	26	0x04000000	XCOM2 buffer overrun flag		
	27	0x08000000	XCOM3 buffer overrun flag		
N7	28	0x10000000	Reserved		
	29	0x20000000	Reserved		
	30	0x40000000	Reserved		
	31	0x80000000	Reserved		

Table 101: Auxiliary 2 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x0000001	Reserved		

Table 102: Auxiliary 3 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x0000001	Reserved		

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RXSTATUS header	Log header		H	0
2	error	Receiver error (see *Table 98, Receiver Error* on *page 522*). A value of zero indicates no errors	ULong	4	H
3	# stats	Number of status codes (including Receiver Status)	ULong	4	H+4
4	rxstat	Receiver status word (see *Table 99, Receiver Status* on *page 523*)	ULong	4	H+8
5	rxstat pri	Receiver status priority mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+12
6	rxstat set	Receiver status event set mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+16
7	rxstat clear	Receiver status event clear mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+20
8	aux1stat	Auxiliary 1 status word (see *Table 100, Auxiliary 1 Status* on *page 525*)	ULong	4	H+24
9	aux1stat pri	Auxiliary 1 status priority mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+28
10	aux1stat set	Auxiliary 1 status event set mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+32
11	aux1stat clear	Auxiliary 1 status event clear mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+36
12	aux2stat	Auxiliary 2 status word (see *Table 101, Auxiliary 2 Status* on *page 526*)	ULong	4	H+40
13	aux2stat pri	Auxiliary 2 status priority mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+44
14	aux2stat set	Auxiliary 2 status event set mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+48
15	aux2stat clear	Auxiliary 2 status event clear mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+52
16	aux3stat	Auxiliary 3 status word (see *Table 102, Auxiliary 3 Status* on *page 526*)	ULong	4	H+56
17	aux3stat pri	Auxiliary 3 status priority mask, which can be set using the STATUSCONFIG command (see *page 246)*	ULong	4	H+60

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
18	aux3stat set	Auxiliary 3 status event set mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+64
19	aux3stat clear	Auxiliary 3 status event clear mask, which can be set using the STATUSCONFIG command (*page 246)*	ULong	4	H+68
20...	Next status code offset = H + 8 + (# stats x 16)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+8+(#stats x 64)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.118 RXSTATUSEVENT Status Event Indicator

This log is used to output event messages as indicated in the RXSTATUS log. An event message is automatically generated for all receiver errors, which are indicated in the receiver error word. In addition, event messages can be generated when other conditions, which are indicated in the receiver status and auxiliary status words, are met. Whether or not an event message is generated under these conditions is specified using the STATUSCONFIG command (detailed starting on *page 246)*.

On start-up, the receiver is set to log the RXSTATUSEVENTA log ONNEW on all ports. You can remove this message by using the UNLOG command, see *page 258*.

See also the chapter on *Built-In Status Tests* in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **94**
Log Type: **Asynch**

Recommended Input:

log rxstatuseventa onchanged

ASCII Example 1:

```
#RXSTATUSEVENTA,COM1,0,17.0,FREEWHEELING,1337,408334.510,00480000,b967,1984;
STATUS,19,SET,"No Valid Position Calculated"*6de945ad
```

ASCII Example 2:

```
#RXSTATUSEVENTA,COM1,0,41.0,FINESTEERING,1337,408832.031,01000400,b967,1984;
STATUS,10,SET,"COM3 Transmit Buffer Overrun"*5b5682a9
```

When a fatal event occurs (for example, in the event of a receiver hardware failure), a bit is set in the receiver error word, part of the RXSTATUS log (*page 521*) to indicate the cause of the problem. Bit 0 is set in the receiver status word to show that an error occurred, the error strobe is driven high and the LED flashes red and yellow showing an error code. An RXSTATUSEVENT log is generated on all ports to show the cause of the error. Receiver tracking is disabled at this point but command and log processing continues to allow you to diagnose the error. Even if the source of the error is corrected at this point, the receiver must be reset to resume normal operation.

Table 103: Status Word

Word (binary)	Word (ASCII)	Description
0	ERROR	Receiver Error word, see *Table 98* on *page 522*
1	STATUS	Receiver Status word, see *Table 99* on *page 523*
2	AUX1	Auxiliary 1 Status word, see *Table* on *page 522*
3	AUX2	Auxiliary 2 Status word see *Table 101* on *page 526*
4	AUX3	Auxiliary 3 Status word see *Table 102* on *page 526*

Table 104: Event Type

Event (binary)	Event (ASCII)	Description
0	CLEAR	Bit was cleared
1	SET	Bit was set

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RXSTATUSEVENT header	Log header		H	0
2	word	The status word that generated the event message (see *Table 103,* above)	Enum	4	H
3	bit position	Location of the bit in the status word (see*Table 99, Receiver Status* on *page 523* or the *Auxiliary Status* tables on *page 522*)	Ulong	4	H+4
4	event	Event type (see *Table 104* above)	Enum	4	H+8
3	description	This is a text description of the event or error	Char[32]	32	H+12
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.119 SATVIS Satellite Visibility

This log contains satellite visibility log with additional satellite information.

1. The SATVIS log is meant to provide a brief overview. The satellite positions and velocities used in the computation of this log are based on Almanac orbital parameters, not the higher precision Ephemeris parameters.
2. In the SATVIS log output there may be double satellite number entries. These are GLONASS antipodal satellites in the same orbit plane separated by 180 degrees latitude. For further information on GLONASS refer to *An Introduction to GNSS*, available through our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS > GNSS Book*.

Message ID: **48**
Log Type: **Synch**

Recommended Input:

log satvis ontime 60

Abbreviated ASCII Example:

```
<SATVIS COM1 0 80.0 FINESTEERING 1690 601512.000 00000008 0947 43488
<     TRUE FALSE 41
<          8 0 0 79.4 110.9 -398.990 -399.008
<          48 7 0 75.0 43.1 -175.600 -175.618
<          28 0 0 65.5 259.2 1199.421 1199.403
<          58 11 0 57.3 137.9 2065.393 2065.375
...
<          61 9 0 -59.4 224.2 1621.608 1621.590
<          54 11 0 -69.7 319.4 -1316.707 -1316.726
<          52 7 0 -80.8 189.5 -227.007 -227.025
```

Consider sky visibility at each of the base and rover receivers in a differential setup. The accuracy and reliability of differential messages is proportional to the number of common satellites that are visible at the base and rover. Therefore, if the sky visibility at either station is poor, you might consider increasing the occupation times. This condition is best measured by monitoring the number of visible satellites during data collection along with the PDOP value (a value less than 3 is ideal). Also, the location and number of satellites in the sky is constantly changing. As a result, some periods in the day are slightly better for data collection than others. Use the SATVIS log to monitor satellite visibility. The PSRDOP log, see *page 448*, can be used to monitor the PDOP values.

Site conditions surrounding the station that may affect satellite visibility and can generate noise in the data are water bodies, buildings, trees and nearby vehicles.

Field #	Field type	Data Description	Format	Binary Bytes	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	Was complete GPS almanac used? 0 = FALSE 1 = TRUE	Enum	4	H+4
4	#sat	Number of satellites with data to follow	Ulong	4	H+8
5	PRN/slot	Satellite PRN number of range measurement (GPS: 1-32 and SBAS: 120 to 138 or 183 to 187. For GLONASS, see *Section 1.3* on *page 31*)	Short	2	H+12
6	glofreq	(GLONASS Frequency + 7), see *Section 1.3* on *page 31*	Short	2	H+14
7	health	Satellite health [a]	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 - the expected Doppler frequency based on a satellite's motion relative to the receiver. It is computed using the satellite's coordinates and velocity along with the receiver's coordinates and velocity (Hz)	Double	8	H+36
11	app dop	Apparent Doppler for this receiver - the same as Theoretical Doppler above but with clock drift correction added (Hz)	Double	8	H+44
12	Next satellite offset = H + 12 + (#sat x 40)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+ (#sat x 40)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Satellite health values may be found in ICD-GPS-200. To obtain copies of ICD-GPS-200, refer to ARINC in the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/.

3.3.120 SATVIS2 Satellite Visibility

This log contains satellite visibility log with additional satellite and satellite system information.

1. The SATVIS2 log is meant to provide a brief overview. The satellite positions and velocities used in the computation of this log are based on Almanac orbital parameters, not the higher precision Ephemeris parameters.
2. In the SATVIS2 log output there may be double satellite number entries. These are GLONASS antipodal satellites in the same orbit plane separated by 180 degrees latitude. Refer also to the *GLONASS* chapter of the *An Introduction to GNSS Book*, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

Message ID: **1043**

Log Type: **Asynch**

Recommended Input:

log satvis2a onchanged

ASCII Example:

```
#SATVIS2A,COM2,3,90.5,FINESTEERING,1610,244590.000,00000000,a867,6293;GPS,
TRUE,TRUE,31,2,0,70.2,76.8,-815.364,-815.747,12,0,61.3,192.3,-1708.957,-
1709.339,25,0,57.8,282.3,984.112,983.729,10,0,42.4,99.7,957.491,957.108,4,0,3
3.6,60.3,-3112.510,-3112.892,29,0,29.6,282.7,2874.294,2873.912,5,0,
28.2,154.7,3305.821,3305.439,30,0,23.2,312.7,3227.645,3227.262,31,0,14.4,325.
4,1177.840,1177.457,23,0,4.8,26.3,570.313,569.930,13,0,2.8,54.4,2118.874,2118
.492,9,0,-3.3,204.6,-3695.150,-3695.532,17,0,-10.1,99.7,-3286.706,-
3287.089,21,0,-10.2,233.4,3183.252,3182.869,27,0,-11.7,194.3,-2856.249,-
2856.632,14,0,-19.0,280.9,-2767.366,-2767.749,20,0,-19.1,11.3,-3534.725,-
3535.108,26,0,-24.7,154.6,2016.654,2016.271,15,0,-
27.7,184.5,757.297,756.914,32,0,-30.3,353.9,-3096.307,-3096.689,16,0,-
31.3,330.6,3336.083,3335.701,18,0,-38.7,217.8,1888.025,1887.643,28,0,-
41.7,134.6,-2764.977,-2765.360,7,0,-44.5,72.9,1911.461,1911.078,8,0,-
49.2,107.9,346.080,345.697,11,0,-53.9,60.8,-2100.073,-2100.455,22,0,-
54.8,250.0,424.266,423.883,6,0,-55.7,281.7,1899.454,1899.072,3,0,-
67.4,285.8,1549.628,1549.246,24,0,-71.1,35.5,-1105.593,-1105.976,19,0,-
86.8,213.2,206.102,205.720*4c9815ef
```

Consider sky visibility at each of the base and rover receivers in a differential setup. The accuracy and reliability of differential messages is proportional to the number of common satellites that are visible at the base and rover. Therefore, if the sky visibility at either station is poor, you might consider increasing the occupation times. This condition is best measured by monitoring the number of visible satellites during data collection along with the PDOP value (a value less than 3 is ideal). Also, the location and number of satellites in the sky is constantly changing. As a result, some periods in the day are slightly better for data collection than others. Use the SATVIS2 log to monitor satellite visibility. The PSRDOP log, see *page 448*, can be used to monitor the PDOP values.

Site conditions surrounding the station that may affect satellite visibility and can generate noise in the data are water bodies, buildings, trees and nearby vehicles.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SATVIS2 header	Log header		H	0
2	Satellite System	GNSS satellite system identifier. See *Table 29* on *page 156*	Enum	4	H
3	sat vis	Is satellite visibility valid? 0 = FALSE 1 = TRUE	Enum	4	H+4
4	comp alm	Was complete GNSS almanac used? 0 = FALSE 1 = TRUE	Enum	4	H+8
5	#sat	Number of satellites with data to follow	Ulong	4	H+12
6	Satellite ID	In binary logs, the satellite ID field is 4 bytes. The 2 lowest order bytes, interpreted as a USHORT, are the system identifier: for instance, the PRN for GPS or the slot for GLONASS. The 2 highest-order bytes are the frequency channel for GLONASS, interpreted as a SHORT and zero for all other systems. In ASCII and abbreviated ASCII logs, the satellite ID field is the system identifier. If the system is GLONASS and the frequency channel is not zero, then the signed channel is appended to the system identifier. For example, slot 13, frequency channel -2 is output as 13-2	Ulong	4	H+16
7	health	7 Satellite health [a]	Ulong	4	H+20
8	elev	Elevation (degrees)	Double	8	H+24
9	az	Azimuth (degrees)	Double	8	H+32
10	true dop	Theoretical Doppler of satellite - the expected Doppler frequency based on a satellite's motion relative to the receiver. It is computed using the satellite's coordinates and velocity along with the receiver's coordinates and velocity (Hz)	Double	8	H+40
11	app dop	Apparent Doppler for this receiver - the same as Theoretical Doppler above but with clock drift correction added (Hz)	Double	8	H+48
12	Next satellite offset = H + 16 + (#sat x 40)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+16+ (#sat x 40)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Satellite health values may be found in ICD-GPS-200. To obtain copies of ICD-GPS-200, refer to ARINC in the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/.

3.3.121 SATXYZ2 Satellite Positions in ECEF Cartesian Coordinates

When combined with a RANGE log, this data set contains the decoded satellite information necessary to compute the solution: satellite coordinates (ECEF WGS84), satellite clock correction, ionospheric corrections and tropospheric corrections. See the calculation examples in the usage box below. Only those satellites used in the corresponding PSRPOS solution are reported here. See also *Figure 10* on *page 317*.

Message ID: **1451**
Log Type: **Synch**

Recommended Input:

log satxyz2 ontime 1

Abbreviated ASCII Example:

```
<SATXYZ2 COM1 0 83.5 FINESTEERING 1686 489605.000 00000040 7513 43391
< 18
<   GPS 1 -15502299.3828 1012325.6443 21538404.8435 76246.262 6.990 3.395 0.0 0.0
<   GPS 19 -25806091.5135 -6923139.1454 1709844.1975 -78547.421 5.734 9.238 0.0 0.0
<   GPS 12 20368857.0090 -5772890.2153 15912912.0724 20118.104 2.415 12.239 0.0 0.0
...
<   GLONASS 23+3 -22246787.0962 -4287240.2873 11721201.0046 -116210.453 6.928 4.205
0.0 0.0
<   GLONASS 7+5 4586441.8834 -14896106.2729 20222034.1193 -6061.174 1.636 2.529 0.0
0.0
<   GLONASS 8+6 -12121452.4145 -4467306.1322 21995556.9720 -7165.609 0.350 2.586 0.0
0.0
```

The OEM6 family use positive numbers for ionospheric and tropospheric corrections. A positive clock offset indicates the clock is running ahead of the reference time. Positive ionospheric and tropospheric corrections are added to the geometric ranges or subtracted from the measured pseudoranges. For example:

P = p + pd + c(dT - dt) + d(ion) + d(trop) + Ep

is equivalent to

P - c(dT - dt) - d(ion) - d(trop) = p + pd + Ep

where

P = measured pseudorange
p = geometric range
pd = orbit error
dt = satellite clock offset
dT = receiver clock offset
d (ion) = ionospheric delay
d (trop) = tropospheric delay
c = speed of light
Ep = noise and multipath

Field #	Field Type	Description	Format	Binary Bytes	Binary Offset
1	SATXYZ2 header	Log header		H	0
2	#sat	Number of satellites to follow	Ulong	4	H
3	System	Satellite system (*page 248*)	Enum	4	H+4
4	Satellite ID	Satellite ID: see tables on *Table 61* on *page 309*	Simple	4	H+8
5	X	Satellite X co-ordinates (ECEF,m)	Double	8	H+12
6	Y	Satellite Y co-ordinates (ECEF,m)	Double	8	H+20
7	Z	Satellite Z co-ordinates (ECEF,m)	Double	8	H+28
8	clk corr	Satellite clock correction (m)	Double	8	H+36
9	iono delay	Ionosphere delay (m)	Double	8	H+44
10	tropo delay	Troposphere delay (m)	Double	8	H+52
11		Reserved	Double	8	H+60
12		Reserved	Double	8	H+68
13		Next satellite offset = H + 4 + (#sat x 72)			
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4 + (#sat x 72)
variable	[CR][LF]	Sentence terminator (ASCII only)			

3.3.122 SBAS0 Do Not Use for Safety Applications

This message tells you, that the GEO transmitting SBAS corrections is operating in test mode, and should not be used for safety applications for a period of time outlined in the SBAS signal specification.

> The GEO transmitting SBAS corrections is operating in test mode, and should not be used for safety-of-life applications.

See how the SBAS0 message relates to the SBAS testing modes in the SBASCONTROL command on *page 209*.

Message ID: **976**
Log Type: **Asynch**

Recommended Input:

log SBAS0a onchanged

ASCII Example:

```
#SBAS0A,COM1,0,68.5,SATTIME,1093,161299.000,00040020,7d6a,209;122*e9a5ab08
```

> Although the SBAS was designed for aviation users, it now supports a wide variety of non-aviation uses including agriculture, surveying, recreation, and surface transportation.

.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS0 header	Log header		H	0
2	prn	Source PRN message - also PRN not to use	Ulong	4	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.123 SBAS1 PRN Mask Assignments

The PRN mask is given in SBAS1. The transition of the PRN mask to a new one (which will be infrequent) is controlled with the 2-bit IODP, which sequences to a number between 0 and 3. The same IODP appears in the applicable SBAS2, SBAS3, SBAS4, SBAS5, SBAS7, SBAS24 and SBAS25 messages (SBAS32, SBAS33, SBAS34, SBAS35 and SBAS45). This transition would probably only occur when a new satellite is launched or when a satellite fails and is taken out of service permanently. A degraded satellite may be flagged as a don't use satellite temporarily.

Message ID: 977
Log Type: Asynch

Recommended Input:

log SBAS1a onchanged

ASCII Example:

```
#SBAS1A,COM1,0,24.5,SATTIME,1337,415802.000,00000000,5955,1984;
134,ffeffffe00000000000000000000004004000000000000000000,2*3633cf7b
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS1 message can be logged to view the data breakdown of SBAS frame 1 which contains information about the PRN mask assignment.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	mask	PRN bit mask	Uchar[27]	28 [a]	H+4
4	iodp	Issue of PRN mask data	Ulong	4	H+32
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+36
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 1 byte of padding is added to maintain 4-byte alignment.

3.3.124 SBAS2 Fast Correction Slots 0-12

SBAS2 are fast corrections for slots 0-12 in the mask of SBAS1. This message may or may not come when SBAS is in testing mode (see the SBASCONTROL command on *page 209* for details).

Message ID: **982**
Log Type: **Asynch**

Recommended Input:

log SBAS2a onchanged

ASCII Example:

```
#SBAS2A,COM1,0,29.0,SATTIME,1337,415925.000,00000000,e194,1984;
134,2,2,3,-3,5,1,2047,-2,2047,2047,2047,2047,2047,-3,2,5,11,7,
8,14,8,14,14,14,14,14,6,12*8d8d2e1c
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS2 message can be logged to view the data breakdown of SBAS frame 2 which contains information about fast correction slots 0-12.

Table 105: Evaluation of UDREI

UDREI [a]	UDRE metres	σ^2 i.udre metres^2
0	0.75	0.0520
1	1.0	0.0924
2	1.25	0.1444
3	1.75	0.2830
4	2.25	0.4678
5	3.0	0.8315
6	3.75	1.2992
7	4.5	1.8709
8	5.25	2.5465
9	6.0	3.3260
10	7.5	5.1968
11	15.0	20.7870
12	50.0	230.9661
13	150.0	2078.695
14	Not Monitored	Not Monitored
15	Do Not Use	Do Not Use

a. The σ^2UDRE broadcast in SBAS2, SBAS3, SBAS4, SBAS5, SBAS6 and SBAS24 applies at a time prior to or at the time of applicability of the associated corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS2 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf	Issue of fast corrections data	Ulong	4	H+4	-
4	iodp	Issue of PRN mask data	Ulong	4	H+8	-
5	prc0	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 0-12)	Long	4	H+12	-
6	prc1		Long	4	H+16	-
7	prc2		Long	4	H+20	-
8	prc3		Long	4	H+24	-
9	prc4		Long	4	H+28	-
10	prc5		Long	4	H+32	-
11	prc6		Long	4	H+36	-
12	prc7		Long	4	H+40	-
13	prc8		Long	4	H+44	-
14	prc9		Long	4	H+48	-
15	prc10		Long	4	H+52	-
16	prc11		Long	4	H+56	-
17	prc12		Long	4	H+60	-
18	udre0	udre(i): User differential range error indicator for the prn in slot i (i = 0-12)	Ulong	4	H+64	See *Table 105, Evaluation of UDREI* on *page 540*
19	udre1		Ulong	4	H+68	
20	udre2		Ulong	4	H+72	
21	udre3		Ulong	4	H+76	
22	udre4		Ulong	4	H+80	
23	udre5		Ulong	4	H+84	
24	udre6		Ulong	4	H+88	
25	udre7		Ulong	4	H+92	
26	udre8		Ulong	4	H+96	
27	udre9		Ulong	4	H+100	
28	udre10		Ulong	4	H+104	
29	udre11		Ulong	4	H+108	
30	udre12		Ulong	4	H+112	
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+116	-
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.125 SBAS3 Fast Corrections Slots 13-25

SBAS3 are fast corrections for slots 13-25 in the mask of SBAS1. Only applies to SBAS2.

Message ID: **987**
Log Type: **Asynch**

Recommended Input:

log SBAS3a onchanged

ASCII Example:

```
#SBAS3A,COM1,0,17.0,SATTIME,1337,415990.000,00000000,bff5,1984;
134,1,2,2047,0,2047,2047,-21,-4,2047,2047,-1,0,2,2047,6,14,5,
14,14,11,5,14,14,5,7,5,14,8*a25aebc5
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS3 message can be logged to view the data breakdown of SBAS frame 3 which contains information about fast correction slots 13-25.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS3 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf	Issue of fast corrections data	Ulong	4	H+4	-
4	iodp	Issue of PRN mask data	Ulong	4	H+8	-
5	prc13	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 13-25)	Long	4	H+12	-
6	prc14		Long	4	H+16	-
7	prc15		Long	4	H+20	-
8	prc16		Long	4	H+24	-
9	prc17		Long	4	H+28	-
10	prc18		Long	4	H+32	-
11	prc19		Long	4	H+36	-
12	prc20		Long	4	H+40	-
13	prc21		Long	4	H+44	-
14	prc22		Long	4	H+48	-
15	prc23		Long	4	H+52	-
16	prc24		Long	4	H+56	-
17	prc25		Long	4	H+60	-
18	udre13	udre(i): User differential range error indicator for the prn in slot i (i = 13-25)	Ulong	4	H+64	See *Table 105, Evaluation of UDREI* on *page 540*
19	udre14		Ulong	4	H+68	
20	udre15		Ulong	4	H+72	
21	udre16		Ulong	4	H+76	
22	udre17		Ulong	4	H+80	
23	udre18		Ulong	4	H+84	
24	udre19		Ulong	4	H+88	
25	udre20		Ulong	4	H+92	
26	udre21		Ulong	4	H+96	
27	udre22		Ulong	4	H+100	
28	udre23		Ulong	4	H+104	
29	udre24		Ulong	4	H+108	
30	udre25		Ulong	4	H+112	
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+116	-
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.126 SBAS4 Fast Correction Slots 26-38

SBAS4 are fast corrections for slots 26-38 in the mask of SBAS1. Only applies to SBAS2.

Message ID: **992**
Log Type: **Asynch**

Recommended Input:

log SBAS4a onchanged

ASCII Example:

```
#SBAS4A,COM1,0,58.0,SATTIME,1093,163399.000,00000020,b4b0,209;
122,0,3,2047,3,-1,2047,2047,2047,-3,-1,5,3,3,
2047,2,14,3,3,14,14,14,6,3,4,5,4,14,3*2e0894b1
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS4 message can be logged to view the data breakdown of SBAS frame 4 which contains information about fast correction slots 26-38.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS4 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf	Issue of fast corrections data	Ulong	4	H+4	-
4	iodp	Issue of PRN mask data	Ulong	4	H+8	-
5	prc26	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 26-38)	Long	4	H+12	-
6	prc27		Long	4	H+16	-
7	prc28		Long	4	H+20	-
8	prc29		Long	4	H+24	-
9	prc30		Long	4	H+28	-
10	prc31		Long	4	H+32	-
11	prc32		Long	4	H+36	-
12	prc33		Long	4	H+40	-
13	prc34		Long	4	H+44	-
14	prc35		Long	4	H+48	-
15	prc36		Long	4	H+52	-
16	prc37		Long	4	H+56	-
17	prc38		Long	4	H+60	-
18	udre26	udre(i): User differential range error indicator for the prn in slot i (i = 26-38)	Ulong	4	H+64	See *Table 105, Evaluation of UDREI* on *page 540*
19	udre27		Ulong	4	H+68	
20	udre28		Ulong	4	H+72	
21	udre29		Ulong	4	H+76	
22	udre30		Ulong	4	H+80	
23	udre31		Ulong	4	H+84	
24	udre32		Ulong	4	H+88	
25	udre33		Ulong	4	H+92	
26	udre34		Ulong	4	H+96	
27	udre35		Ulong	4	H+100	
28	udre36		Ulong	4	H+104	
29	udre37		Ulong	4	H+108	
30	udre38		Ulong	4	H+112	
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+116	-
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.127 SBAS5 Fast Correction Slots 39-50

SBAS5 are fast corrections for slots 39-50 in the mask of SBAS1. Only applies to SBAS 2.

Message ID: **994**
Log Type: **Asynch**

Recommended Input:

log SBAS5a onchanged

ASCII Example:

```
#SBAS5A,COM1,0,72.5,SATTIME,1093,161480.000,00040020,31d4,209;122,1,3,
-7,2047,2047,2047,-4,2047,2047,2047,9,2047,2047,-3,-2,11,14,14,14,4,14,14,14,
5,14,14,4,2*2bf0109b
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS5 message can be logged to view the data breakdown of SBAS frame 5 which contains information about fast correction slots 39-50.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS5 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf	Issue of fast corrections data	Ulong	4	H+4	-
4	iodp	Issue of PRN mask data	Ulong	4	H+8	-
5	prc39	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 39-50)	Long	4	H+12	-
6	prc40		Long	4	H+16	-
7	prc41		Long	4	H+20	-
8	prc42		Long	4	H+24	-
9	prc43		Long	4	H+28	-
10	prc44		Long	4	H+32	-
11	prc45		Long	4	H+36	-
12	prc46		Long	4	H+40	-
13	prc47		Long	4	H+44	-
14	prc48		Long	4	H+48	-
15	prc49		Long	4	H+52	-
16	prc50		Long	4	H+56	-
17	prc51 (Invalid, do not use)		Long	4	H+60	-
18	udre39	udre(i): User differential range error indicator for the prn in slot i (i = 39-50)	Ulong	4	H+64	See *Table 105, Evaluation of UDREI* on *page 540*
19	udre40		Ulong	4	H+68	
20	udre41		Ulong	4	H+72	
21	udre42		Ulong	4	H+76	
22	udre43		Ulong	4	H+80	
23	udre44		Ulong	4	H+84	
24	udre45		Ulong	4	H+88	
25	udre46		Ulong	4	H+92	
26	udre47		Ulong	4	H+96	
27	udre48		Ulong	4	H+100	
28	udre49		Ulong	4	H+104	
29	udre50		Ulong	4	H+108	
30	udre51 (Invalid, do not use)		Ulong	4	H+112	
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+116	-
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.128 SBAS6 Integrity Message

SBAS6 is the integrity information message. Each message includes an IODF for each fast corrections message. The σ^2_{UDRE} information for each block of satellites applies to the fast corrections with the corresponding IODF.

Message ID: **995**
Log Type: **Asynch**

Recommended Input:

log SBAS6a onchanged

ASCII Example:

```
#SBAS6A,COM1,0,57.5,SATTIME,1093,273317.000,00000020,526a,209;
122,3,3,3,3,9,14,14,2,3,10,2,14,14,3,14,14,5,14,14,7,14,14,14,14,14,14,3,3,
14,14,14,14,3,15,11,11,15,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*925a2a9b
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS6 message can be logged to view the data breakdown of SBAS frame 6 which contains information about the integrity message.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS6 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf2	Issue of fast corrections data	Ulong	4	H+4	-
4	iodf3	Issue of fast corrections data	Ulong	4	H+8	-
5	iodf4	Issue of fast corrections data	Ulong	4	H+12	-
6	iodf5	Issue of fast corrections data	Ulong	4	H+16	-
7	udre0	udre(i): User differential range error indicator for the prn in slot i (i = 0-50)	Ulong	4	H+20	See *Table 105, Evaluation of UDREI* on *page 540*
8	udre1		Ulong	4	H+24	
9	udre2		Ulong	4	H+28	
10	udre3		Ulong	4	H+32	
11	udre4		Ulong	4	H+36	
12	udre5		Ulong	4	H+40	
13	udre6		Ulong	4	H+44	
14	udre7		Ulong	4	H+48	
15	udre8		Ulong	4	H+52	
16	udre9		Ulong	4	H+56	
17	udre10		Ulong	4	H+60	
18	udre11		Ulong	4	H+64	
19	udre12		Ulong	4	H+68	
20	udre13		Ulong	4	H+72	
21	udre14		Ulong	4	H+76	
22	udre15		Ulong	4	H+80	
23	udre16		Ulong	4	H+84	
24	udre17		Ulong	4	H+88	
25	udre18	udre(i): User differential range error indicator for the prn in slot i (i = 0-50)	Ulong	4	H+92	See *Table 105, Evaluation of UDREI* on *page 540*
26	udre19		Ulong	4	H+96	
27	udre20		Ulong	4	H+100	
28	udre21		Ulong	4	H+104	
29	udre22		Ulong	4	H+108	
30	udre23		Ulong	4	H+112	
31	udre24		Ulong	4	H+116	

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
32	udre25		Ulong	4	H+120	
33	udre26		Ulong	4	H+124	
34	udre27		Ulong	4	H+128	
35	udre28		Ulong	4	H+132	
36	udre29		Ulong	4	H+136	
37	udre30		Ulong	4	H+140	
38	udre31		Ulong	4	H+144	
39	udre32		Ulong	4	H+148	
40	udre33		Ulong	4	H+152	
41	udre34		Ulong	4	H+156	
42	udre35		Ulong	4	H+160	
43	udre36		Ulong	4	H+164	
44	udre37		Ulong	4	H+168	
45	udre38		Ulong	4	H+172	
46	udre39		Ulong	4	H+176	
47	udre40		Ulong	4	H+180	
48	udre41		Ulong	4	H+184	
49	udre42		Ulong	4	H+188	
50	udre43		Ulong	4	H+192	
51	udre44		Ulong	4	H+196	
52	udre45		Ulong	4	H+200	
53	udre46	udre(i): User differential range error indicator for the prn in slot i (i = 0-50)	Ulong	4	H+204	See *Table 105, Evaluation of UDREI* on *page 540*
54	udre47		Ulong	4	H+208	
55	udre48		Ulong	4	H+212	
56	udre49		Ulong	4	H+216	
58	udre50		Ulong	4	H+220	
58	udre51 (Invalid, do not use)		Ulong	4	H+224	
59	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+228	-
60	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.129 SBAS7 Fast Correction Degradation

The SBAS7 message specifies the applicable IODP, system latency time and fast degradation factor indicator for computing the degradation of fast and long term corrections.

Message ID: **996**
Log Type: **Asynch**

Recommended Input:

log SBAS7a onchanged

ASCII Example:

```
#SBAS7A,COM1,0,36.5,SATTIME,1337,416367.000,00000000,12e3,1984;
122,1,2,0,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,
15,15,15,15,15,15,15,15,15,15,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*827a7364
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS7 message can be logged to view the data breakdown of SBAS frame 7 which contains information about fast correction degradation.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS7 header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	latency	System latency	Ulong	4	H+4
4	iodp	Issue of PRN mask data	Ulong	4	H+8
5	spare bits	Unused spare bits	Ulong	4	H+12
6	al(0)	al(i): Degradation factor indicator for the prn in slot i (i = 0-50)	Ulong	4	H+16
7	al(1)		Ulong	4	H+20
8	al(2)		Ulong	4	H+24
9	al(3)		Ulong	4	H+28
10	al(4)		Ulong	4	H+32
11	al(5)		Ulong	4	H+36
12	al(6)		Ulong	4	H+40
13	al(7)		Ulong	4	H+44
14	al(8)		Ulong	4	H+48
15	al(9)		Ulong	4	H+52
16	al(10)		Ulong	4	H+56
17	al(11)		Ulong	4	H+60
18	al(12)		Ulong	4	H+64
19	al(13)		Ulong	4	H+68
20	al(14)		Ulong	4	H+72
21	al(15)		Ulong	4	H+76
22	al(16)		Ulong	4	H+80
23	al(17)		Ulong	4	H+84
24	al(18)		Ulong	4	H+88
25	al(19)		Ulong	4	H+92
26	al(20)		Ulong	4	H+96
27	al(21)	al(i): Degradation factor indicator for the prn in slot i (i = 0-50)	Ulong	4	H+100
28	al(22)		Ulong	4	H+104
29	al(23)		Ulong	4	H+108
30	al(24)		Ulong	4	H+112
31	al(25)		Ulong	4	H+116
32	al(26)		Ulong	4	H+120
33	al(27)		Ulong	4	H+124
34	al(28)		Ulong	4	H+128

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
35	al(29)		Ulong	4	H+132
36	al(30)		Ulong	4	H+136
37	al(31)		Ulong	4	H+140
38	al(32)		Ulong	4	H+144
39	al(33)		Ulong	4	H+148
40	al(34)		Ulong	4	H+152
41	al(35)		Ulong	4	H+156
42	al(36)		Ulong	4	H+160
43	al(37)		Ulong	4	H+164
44	al(38)		Ulong	4	H+168
45	al(39)		Ulong	4	H+172
46	al(40)		Ulong	4	H+176
47	al(41)		Ulong	4	H+180
48	al(42)		Ulong	4	H+184
49	al(43)		Ulong	4	H+188
50	al(44)		Ulong	4	H+192
51	al(45)		Ulong	4	H+196
52	al(46)		Ulong	4	H+200
53	al(47)		Ulong	4	H+204
54	al(48)		Ulong	4	H+208
55	al(49)	al(i):	Ulong	4	H+212
56	al(50)	Degradation factor indicator for the prn in slot i (i = 0-50)	Ulong	4	H+216
57	al(51) (Invalid, do not use)		Ulong	4	H+220
58	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+224
59	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.130 SBAS9 GEO Navigation Message

SBAS9 provides the GEO navigation message representing the position, velocity and acceleration of the geostationary satellite, in ECEF coordinates and its apparent clock time and frequency offsets.

Also included is the time of applicability, an Issue of Data (IOD) and an accuracy exponent (URA) representing the estimated accuracy of the message. The time offset and time drift are with respect to SBAS Network Time. Their combined effect is added to the estimate of the satellite's transmit time.

Message ID: **997**
Log Type: **Asynch**

Recommended Input:

log SBAS9a onchanged

ASCII Example:

```
#SBAS9A,COM1,0,38.0,SATTIME,1337,416426.000,00000000,b580,1984;
122,175,70848,2,24802064.1600,-34087313.9200,-33823.2000,
1.591250000,0.107500000,0.6080000,-0.0000750,-0.0001125,
0.000187500,-2.235174179e-08,9.094947018e-12*636051d2
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS9 message can be logged to view the data breakdown of SBAS frame 9 which contains the GEO navigation message.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS9 header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	iodn	Issue of GEO navigation data	Ulong	4	H+4
4	t_0	Time of applicability	Ulong	4	H+8
5	ura	URA value	Ulong	4	H+12
6	x	ECEF x coordinate	Double	8	H+16
7	y	ECEF y coordinate	Double	8	H+24
8	z	ECEF z coordinate	Double	8	H+32
9	xvel	X rate of change	Double	8	H+40
10	yvel	Y rate of change	Double	8	H+48
11	zvel	Z rate of change	Double	8	H+56
12	xaccel	X rate of rate change	Double	8	H+64
13	yaccel	Y rate of rate change	Double	8	H+72
14	zaccel	Z rate of rate change	Double	8	H+80
15	a_{f0}	Time offset	Double	8	H+88
16	a_{f1}	Time drift	Double	8	H+96
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+104
18	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.131 SBAS10 Degradation Factor

The fast corrections, long term corrections and ionospheric corrections are all provided in the SBAS10 message.

Message ID: **978**
Log Type: **Asynch**

Recommended Input:

log SBAS10a onchanged

ASCII Example:

```
#SBAS10A,COM1,0,35.5,SATTIME,1337,416469.000,00000000,c305,1984;
122,54,38,76,256,152,100,311,83,256,6,0,300,292,0,1,
00000000000000000000*8884d248
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS10 message can be logged to view the data breakdown of SBAS frame 10 which contains information about degradation factors.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS10 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	b_{rcc}	Estimated noise and round off error parameter	Ulong	4	H+4	0.002
4	c_{ltc_lsb}	Maximum round off due to the least significant bit (lsb) of the orbital clock	Ulong	4	H+8	0.002
5	c_{ltc_vl}	Velocity error bound	Ulong	4	H+12	0.00005
6	i_{ltc_vl}	Update interval for v=1 long term	Ulong	4	H+16	-
7	c_{ltc_v0}	Bound on update delta	Ulong	4	H+20	0.002
8	i_{ltc_v1}	Minimum update interval v = 0	Ulong	4	H+24	-
9	c_{geo_lsb}	Maximum round off due to the lsb of the orbital clock	Ulong	4	H+28	0.0005
10	c_{geo_v}	Velocity error bound	Ulong	4	H+32	0.00005
11	i_{geo}	Update interval for GEO navigation message	Ulong	4	H+36	-
12	c_{er}	Degradation parameter	Ulong	4	H+40	0.5
13	c_{iono_step}	Bound on ionospheric grid delay difference	Ulong	4	H+44	0.001
14	i_{iono}	Minimum ionospheric update interval	Ulong	4	H+48	-
15	c_{iono_ramp}	Rate of ionospheric corrections change	Ulong	4	H+52	0.000005
16	rss_{udre}	User differential range error flag	Ulong	4	H+56	-
17	rss_{iono}	Root sum square flag	Ulong	4	H+60	-
18	spare bits	Spare 88 bits, possibly GLONASS	Ulong	4	H+64	-
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+68	-
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.132 SBAS12 SBAS Network Time and UTC

SBAS12 contains information bits for the UTC parameters and UTC time standard from which an offset is determined. The UTC parameters correlate UTC time with the SBAS network time rather than with GPS reference time.

Message ID: **979**
Log Type: **Asynch**

Recommended Input:

log SBAS12a onchanged

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS12 message can be logged to view the data breakdown of SBAS frame 12 which contains information about time parameters.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS12 header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	A_1	Time drift (s/s)	Double	8	H+4
4	A_0	Time offset (s)	Double	8	H+12
5	seconds	Seconds into the week (s)	Ulong	4	H+20
6	week	Week number	Ushort	4	H+24
7	dt_{ls}	Delta time due to leap seconds	Short	2	H+28
8	wn_{lsf}	Week number, leap second future	Ushort	2	H+30
9	dn	Day of the week (the range is 1 to 7 where Sunday = 1 and Saturday = 7)	Ushort	2	H+32
10	dt_{lsf}	Delta time, leap second future	Short	2	H+34
11	utc id	UTC type identifier	Ushort	2	H+36
12	gpstow	GPS reference time of the week	Ulong	2	H+38
13	gpswn	GPS de-modulo week number	Ulong	2	H+40
14	glo indicator	Is GLONASS information present? 0 = FALSE 1 = TRUE	Enum	4	H+42
15	Reserved array of hexabytes for GLONASS		Char[10]	12[a]	H+46
16	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+58
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment.

3.3.133 SBAS17 GEO Almanac Message

Almanacs for all GEOs are broadcast periodically to alert you of their existence, location, the general service provided, status and health.

Unused almanacs have a PRN number of 0 and should be ignored, see *ASCII Example* below.

Message ID: **980**
Log Type: **Asynch**

Recommended Input:

log SBAS17a onchanged

ASCII Example:

```
#SBAS17A,COM1,0,84.5,SATTIME,1610,514149.000,00000000,896c,39061;135,3,
0,135,0,-11536200,-40536600,-260000,0,0,0,0,138,0,-12521600,-40258400,
0,0,0,0,0,133,0,-5551000,-41774200,-1248000,0,0,120,
82112*2be5146f
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS17 message can be logged to view the data breakdown of SBAS frame 17 which contains GEO almanacs.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS17 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	#ents	Number of almanac entries with information to follow	Ulong	4	H+4	-
4	data id	Data ID type	Ushort	2	H+8	-
5	entry prn	PRN for this entry	Ushort	2	H+10	-
6	health	Health bits	Ushort	4[a]	H+12	-
7	x	ECEF x coordinate	Long	4	H+16	-
8	y	ECEF y coordinate	Long	4	H+20	-
9	z	ECEF z coordinate	Long	4	H+24	-
10	x vel	X rate of change	Long	4	H+28	-
11	y vel	Y rate of change	Long	4	H+32	-
12	z vel	Z rate of change	Long	4	H+36	-
13...	Next entry = H+8 + (#ents x 32)					-
variable	t0	Time of day in seconds (0 to 86336)	Ulong	4	H+8+ (#ents x 32)	64
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+ (#ents x 32)	-
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

a. In the binary log case, an additional 2 bytes of padding is added to maintain 4-byte alignment.

3.3.134 SBAS18 IGP Mask

The ionospheric delay corrections are broadcast as vertical delay estimates, at specified ionospheric grid points (IGPs), applicable to a signal on L1. The predefined IGPs are contained in 11 bands (numbered 0 to 10). Bands 0-8 are vertical bands on a Mercator projection map and bands 9-10 are horizontal bands on a Mercator projection map. Since it is impossible to broadcast IGP delays for all possible locations, a mask is broadcast to define the IGP locations providing the most efficient model of the ionosphere at the time.

Message ID: **981**
Log Type: **Asynch**

Recommended Input:

log SBAS18a onchanged

ASCII Example:

```
#SBAS18A,COM1,0,33.0,SATTIME,1337,417074.000,00000000,f2c0,1984;
122,4,2,2,0000ffc0007fc0003ff0000ff80007fe0007fe0003ff0000ff80,0*b1ed353e
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS18 message can be logged to view the data breakdown of SBAS frame 18 which contains information about ionospheric grid points.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS18 header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	#bands	Number of bands broadcast	Ulong	4	H+4
4	band num	Specific band number that identifies which of the 11 IGP bands the data belongs to	Ulong	4	H+8
5	iodi	Issue of ionospheric data	Ulong	4	H+12
6	igp mask	IGP mask	Uchar[26]	28[a]	H+16
7	spare bit	One spare bit	Ulong	4	H+44
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment.

3.3.135 SBAS24 Mixed Fast/Slow Corrections

If there are 6 or fewer satellites in a block, they may be placed in this mixed correction message. There is a fast data set for each satellite and a UDRE indicator. Each message also contains an IODP indicating the associated PRN mask.

The fast correction (PRC) has a valid range of -2048 to +2047. If the range is exceeded a don't use indication is inserted into the user differential range error indicator (UDREI) field, see *Table 105* on *page 540*. You should ignore extra data sets not represented in the PRN mask.

The time of applicability (T0) of the PRC is the start of the epoch of the WNT second that is coincident with the transmission at the GEO satellite of the first bit of the message block.

Message ID: **983**
Log Type: **Asynch**

Recommended Input:

log SBAS24a onchanged

ASCII Example:

```
#SBAS24A,COM1,0,34.0,SATTIME,1337,417108.000,00000000,0a33,1984;
134,2047,2047,2047,2047,-1,-2,14,14,14,14,11,14,2,2,0,0,1,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0*76ff954b
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS24 message can be logged to view the data breakdown of SBAS frame 24 which contains mixed fast/slow corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS24 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	prc0	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 0-5)	Long	4	H+4	-
4	prc1		Long	4	H+8	-
5	prc2		Long	4	H+12	-
6	prc3		Long	4	H+16	-
7	prc4		Long	4	H+20	-
8	prc5		Long	4	H+24	-
9	udre0	udre(i): User differential range error indicator for the prn in slot i (i = 0-5)	Ulong	4	H+28	See *Table 105* on *page 540*
10	udre1		Ulong	4	H+.32	
11	udre2		Ulong	4	H+36	
12	udre3		Ulong	4	H+40	
13	udre4		Ulong	4	H+44	
14	udre5		Ulong	4	H+48	
15	iodp	Issue of PRN mask data	Ulong	4	H+52	-
16	block id	Associated message type	Ulong	4	H+56	
17	iodf	Issue of fast corrections data	Ulong	4	H+60	-
18	spare	Spare value	Ulong	4	H+64	-
19	vel	Velocity code flag	Ulong	4	H+68	-
20	mask1	Index into PRN mask (Type 1)	Ulong	4	H+72	-
21	iode1	Issue of ephemeris data	Ulong	4	H+76	-
22	dx1	Delta x (ECEF)	Long	4	H+80	0.125
23	dy1	Delta y (ECEF)	Long	4	H+84	0.125
24	dz1	Delta z (ECEF)	Long	4	H+88	0.125
25	da^{f0}	Delta a^{f0} clock offset	Long	4	H+92	2^{-31}
26	mask2	Second index into PRN mask (Type 1)	Ulong	4	H+96	-
27	iode2	Second issue of ephemeris data	Ulong	4	H+100	-
28	ddx	Delta delta x (ECEF)	Long	4	H+104	2^{-11}
29	ddy	Delta delta y (ECEF)	Long	4	H+108	2^{-11}
30	ddz	Delta delta z (ECEF)	Long	4	H+112	2^{-11}
31	da^{f1}	Delta a^{f1} clock offset	Long	4	H+116	2^{-39}
32	t_0	Applicable time of day	Ulong	4	H+120	16
33	iodp	Issue of PRN mask data	Ulong	4	H+124	-
34	corr spare	Spare value when velocity code is equal to 0	Ulong	4	H+128	-
35	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+132	-
36	[CR][LF]	Sentence terminator (ASCII only)	-	-	H+136	-

3.3.136 SBAS25 Long-Term Slow Satellite Corrections

SBAS25 provides error estimates for slow varying satellite ephemeris and clock errors with respect to WGS-84 ECEF coordinates.

Message ID: **984**
Log Type: **Asynch**

Recommended Input:

log SBAS25a onchanged

ASCII Example:

```
#SBAS25A,COM1,0,37.5,SATTIME,1337,417193.000,00000000,b8ff,1984;
134,1,19,25,-1,-3,0,-15,0,0,0,1,-1,-2,4465,2,0,1,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0*81685317
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS25 message can be logged to view the data breakdown of SBAS frame 25 which contains long term slow satellite corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS25 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	1st half vel	Velocity code flag (0 or 1)	Ulong	4	H+4	-
4	1st half mask1	Index into PRN mask (Type 1)	Ulong	4	H+8	-
5	1st half iode1	Issue of ephemeris data	Ulong	4	H+12	-
6	1st half dx1	Delta x (ECEF)	Long	4	H+16	0.125
7	1st half dy1	Delta y (ECEF)	Long	4	H+20	0.125
8	1st half dz1	Delta z (ECEF)	Long	4	H+24	0.125
9	1st half a^{f0}	Delta a^{f0} clock offset	Long	4	H+28	2^{-31}
10	1st half mask2	Second index into PRN mask (Type 1) Dummy value when velocity code = 1	Ulong	4	H+32	-
11	1st half iode2	Second issue of ephemeris data Dummy value when velocity code = 1	Ulong	4	H+36	-
12	1st half ddx	Delta delta x (ECEF) when velocity code = 1 Delta x (dx) when velocity code = 0	Long	4	H+40	2^{-11}
13	1st half ddy	Delta delta y (ECEF) when velocity code = 1 Delta y (dy) when velocity code = 0	Long	4	H+44	2^{-11}
14	1st half ddz	Delta delta z (ECEF) when velocity code = 1 Delta z (dz) when velocity code = 0	Long	4	H+48	2^{-11}
15	1st half a^{f1}	Delta a^{f1} clock offset when velocity code = 1 Delta a^{f0} clock offset when velocity code = 0	Long	4	H+52	2^{-39}
16	1st half t_0	Applicable time of day Dummy value when velocity code = 0	Ulong	4	H+56	16
17	1st half iodp	Issue of PRN mask data	Ulong	4	H+60	-
18	1st half corr spare	Spare value when velocity code = 0 Dummy value when velocity code = 1	Ulong	4	H+64	-
19	2nd half vel	Velocity code flag (0 or 1)	Ulong	4	H+68	-
20	2nd half mask1	Index into PRN mask (Type 1)	Ulong	4	H+72	-
21	2nd half iode1	Issue of ephemeris data	Ulong	4	H+76	-
22	2nd half dx1	Delta x (ECEF)	Long	4	H+80	0.125

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
23	2nd half dy1	Delta y (ECEF)	Long	4	H+84	0.125
24	2nd half dz1	Delta z (ECEF)	Long	4	H+88	0.125
25	2nd half a^{f0}	Delta a^{f0} clock offset	Long	4	H+92	2^{-31}
26	2nd half mask2	Second index into PRN mask (Type 1) Dummy value when velocity code = 1	Ulong	4	H+96	-
27	2nd half iode2	Second issue of ephemeris data Dummy value when velocity code = 1	Ulong	4	H+100	-
28	2nd half ddx	Delta delta x (ECEF) when velocity code = 1 Delta x (dx) when velocity code = 0	Long	4	H+104	2^{-11}
29	2nd half ddy	Delta delta y (ECEF) when velocity code = 1 Delta y (dy) when velocity code = 0	Long	4	H+108	2^{-11}
30	2nd half ddz	Delta delta z (ECEF) when velocity code = 1 Delta z (dz) when velocity code = 0	Long	4	H+112	2^{-11}
31	2nd half a^{f1}	Delta a^{f1} clock offset when velocity code = 1 Delta a^{f0} clock offset when velocity code = 0	Long	4	H+116	2^{-39}
32	2nd half t_0	Applicable time of day Dummy value when velocity code = 0	Ulong	4	H+120	16
33	2nd half iodp	Issue of PRN mask data	Ulong	4	H+124	-
34	2nd half corr spare	Spare value when velocity code = 0 Dummy value when velocity code = 1	Ulong	4	H+128	-
35	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+132	-
36	[CR][LF]	Sentence terminator (ASCII only)	-	-	H+136	-

3.3.137 SBAS26 Ionospheric Delay Corrections

SBAS26 provides vertical delays (relative to an L1 signal) and their accuracy at geographically defined IGPs identified by the BAND NUMBER and IGP number. Each message contains a band number and a block ID, which indicates the location of the IGPs in the respective band mask.

Message ID: 985
Log Type: Asynch

Recommended Input:

log SBAS26a onchanged

ASCII Example:

```
#SBAS26A,COM1,0,38.0,SATTIME,1337,417243.000,00000000,ec70,1984;
134,1,2,15,27,11,25,11,23,11,19,11,16,11,16,12,15,13,16,13,29,14,
30,13,27,11,27,11,24,11,19,11,16,12,2,0*3b6d6806
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS26 message can be logged to view the data breakdown of SBAS frame 26 which contains ionospheric delay corrections

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS26 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	band num	Band number	Ulong	4	H+4	-
4	block id	Block ID	Ulong	4	H+8	-
5	#pts	Number of grid points with information to follow	Ulong	4	H+12	-
6	igp_{vde}	IGP vertical delay estimates	Ulong	4	H+16	0.125
7	givei	Grid ionospheric vertical error indicator	Ulong	4	H+20	-
8...	Next #pts entry = H + 16 + (#pts x 8)					
variable	iodi	Issue of data - ionosphere	Ulong	4	H+16+ (#pts x 8)	
variable	spare	7 spare bits	Ulong	4	H+20+ (#pts x 8)	-
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+24+ (#pts x 8)	-
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.138 SBAS27 SBAS Service Message

SBAS27 messages apply only to the service provider transmitting the message. The number of service messages indicates the total number of unique SBAS27 messages for the current IODS. Each unique message for that IODS includes a sequential message number. The IODS is incremented in all messages, each time that any parameter in any SBAS27 message is changed.

Message ID: **986**

Log Type: **Asynch**

Recommended Input:

log SBAS27a onchanged.

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS27 message can be logged to view the data breakdown of SBAS frame 27 which contains information about SBAS service messages.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS27 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	iods	Issue of slow corrections data	Ulong	4	H+4	-
4	#messages	Low-by-one count of messages	Ulong	4	H+8	-
5	message num	Low-by-one message number	Ulong	4	H+12	-
6	priority code	Priority code	Ulong	4	H+16	-
7	dudre inside	Delta user differential range error - inside	Ulong	4	H+20	-
8	dudre outside	Delta user differential range error -outside	Ulong	4	H+24	-
9...	#reg	Number of regions with information to follow	Ulong	4	H+28	-
variable	lat1	Coordinate 1 latitude	Long	4	H+32	-
variable	lon1	Coordinate 1 longitude	Long	4	H+36	-
variable	lat2	Coordinate 2 latitude	Long	4	H+40	-
variable	lon2	Coordinate 2 longitude	Long	4	H+44	-
variable	shape	Shape where: 0 = triangle 1 = square	Ulong	4	H+48	-
variable	Next #reg entry = H + 32 + (#reg x 20)					
variable	t_0	Time of applicability	Ulong	4	H+32+ (#reg x 20)	16
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+36+ (#reg x 20)	-
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.139 SBAS32 Fast Correction Slots 0-10

SBAS32 are fast corrections for slots 0-10 in the mask of SBAS1, see *page 538*.

Message ID: **988**
Log Type: **Asynch**

Recommended Input:

log SBAS32a onchanged

ASCII Example:

```
#SBAS32A,COM2,0,70.5,FINE,1295,153284.000,00000240,18e9,34461;209,0,0,
-8097,0,0,0,0,-947,0,-2128,0,2570,14,0,14,14,14,14,0,14,0,14,0*58778ae5
```

Table 106: Evaluation of UDREI

UDREI	UDRE metres
0	0.01
1	0.02
2	0.03
3	0.05
4	0.10
5	0.15
6	0.20
7	0.25
8	0.30
9	0.35
10	0.40
11	0.45
12	0.50
13	0.60
14	Not Monitored
15	Do Not Use

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS32 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodp	Issue of PRN mask data	Ulong	4	H+4	-
4	prc0	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 0-10)	Long	4	H+8	-
5	prc1		Long	4	H+12	-
6	prc2		Long	4	H+16	-
7	prc3		Long	4	H+20	-
8	prc4		Long	4	H+24	-
9	prc5		Long	4	H+28	-
10	prc6		Long	4	H+32	-
11	prc7		Long	4	H+36	-
12	prc8		Long	4	H+40	-
13	prc9		Long	4	H+44	-
14	prc10		Long	4	H+48	-
15	udre0	udre(i): User differential range error indicator for the prn in slot i (i = 0-10)	Ulong	4	H+52	See *Table 106, Evaluation of UDREI* on *page 569*
16	udre1		Ulong	4	H+56	
17	udre2		Ulong	4	H+60	
18	udre3		Ulong	4	H+64	
19	udre4		Ulong	4	H+68	
20	udre5		Ulong	4	H+72	
21	udre6		Ulong	4	H+76	
22	udre7		Ulong	4	H+80	
23	udre8		Ulong	4	H+84	
24	udre9		Ulong	4	H+88	
25	udre10		Ulong	4	H+92	
26	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+96	-
27	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.140 SBAS33 Fast Correction Slots 11-21

SBAS33 are fast corrections for slots 11-21.

Message ID: **989**

Log Type: **Asynch**

Recommended Input:

log SBAS33a onchanged

ASCII Example:

```
#SBAS33A,COM2,0,47.5,FINE,1295,158666.000,01000240,b23e,34461;209,0,0,
-3343,0,0,0,-533,0,0,0,0,0,14,0,14,14,14,0,14,14,14,14,14*6d890f5f
```

Each raw mask frame gives data for a specific frame decoder number. The SBAS33 message can be logged to view the data breakdown of SBAS frame 33 which contains information about correction slots 11-21.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS33 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodp	Issue of PRN mask data	Ulong	4	H+4	-
4	prc11	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 11-21)	Long	4	H+8	-
5	prc12		Long	4	H+12	-
6	prc13		Long	4	H+16	-
7	prc14		Long	4	H+20	-
8	prc15		Long	4	H+24	-
9	prc16		Long	4	H+28	-
10	prc17		Long	4	H+32	-
11	prc18		Long	4	H+36	-
12	prc19		Long	4	H+40	-
13	prc20		Long	4	H+44	-
14	prc21		Long	4	H+48	-
15	udre11	udre(i): User differential range error indicator for the prn in slot i (i = 11-21)	Ulong	4	H+52	See *Table 106, Evaluation of UDREI* on *page 569*
16	udre12		Ulong	4	H+56	
17	udre13		Ulong	4	H+60	
18	udre14		Ulong	4	H+64	
19	udre15		Ulong	4	H+68	
20	udre16		Ulong	4	H+72	
21	udre17		Ulong	4	H+76	
22	udre18		Ulong	4	H+80	
23	udre19		Ulong	4	H+84	
24	udre20		Ulong	4	H+88	
25	udre21		Ulong	4	H+92	
26	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+96	-
27	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.141 SBAS34 Fast Correction Slots 22-32

SBAS34 are fast corrections for slots 22-32 in the mask of SBAS1, see *page 538*.

Message ID: **990**
Log Type: **Asynch**

Recommended Input:

log SBAS34a onchanged

ASCII Example:

```
#SBAS34A,COM2,0,73.0,FINE,1295,226542.000,00000040,1be8,34461;209,0,5879,0,0,
0,0,2687,0,10922,10922,10922,10922,0,14,14,14,14,0,14,15,15,15,15*3aeb74be
```

Each raw mask frame gives data for a specific frame decoder number. The SBAS34 message can be logged to view the data breakdown of SBAS frame 34 which contains information about fast correction slots 22-32.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS34 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodp	Issue of PRN mask data	Ulong	4	H+4	-
4	prc22	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 22-32)	Long	4	H+8	-
5	prc23		Long	4	H+12	-
6	prc24		Long	4	H+16	-
7	prc25		Long	4	H+20	-
8	prc26		Long	4	H+24	-
9	prc27		Long	4	H+28	-
10	prc28		Long	4	H+32	-
11	prc29		Long	4	H+36	-
12	prc30		Long	4	H+40	-
13	prc31		Long	4	H+44	-
14	prc32		Long	4	H+48	-
15	udre22	udre(i): User differential range error indicator for the prn in slot i (i = 22-32)	Ulong	4	H+52	See *Table 106, Evaluation of UDREI* on *page 569*
16	udre23		Ulong	4	H+56	
17	udre24		Ulong	4	H+60	
18	udre25		Ulong	4	H+64	
19	udre26		Ulong	4	H+68	
20	udre27		Ulong	4	H+72	
21	udre28		Ulong	4	H+76	
22	udre29		Ulong	4	H+80	
23	udre30		Ulong	4	H+84	
24	udre31		Ulong	4	H+88	
25	udre32		Ulong	4	H+92	
26	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+96	-
27	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.142 SBAS35 Fast Correction Slots 33-43

SBAS35 are fast corrections for slots 33-43 in the mask of SBAS1, see *page 538*.

Message ID: **991**
Log Type: **Asynch**

Recommended Input:

log SBAS35a onchanged

ASCII Example:

Each raw mask frame gives data for a specific frame decoder number. The SBAS35 message can be logged to view the data breakdown of SBAS frame 35 which contains information about fast correction slots 33-43.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS35 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodp	Issue of PRN mask data	Ulong	4	H+4	-
4	prc33	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 33-43)	Long	4	H+8	-
5	prc34		Long	4	H+12	-
6	prc35		Long	4	H+16	-
7	prc36		Long	4	H+20	-
8	prc37		Long	4	H+24	-
9	prc38		Long	4	H+28	-
10	prc39		Long	4	H+32	-
11	prc40		Long	4	H+36	-
12	prc41		Long	4	H+40	-
13	prc42		Long	4	H+44	-
14	prc43		Long	4	H+48	-
15	udre33	udre(i): User differential range error indicator for the prn in slot i (i = 33-43)	Ulong	4	H+52	See *Table 106, Evaluation of UDREI* on *page 569*
16	udre34		Ulong	4	H+56	
17	udre35		Ulong	4	H+60	
18	udre36		Ulong	4	H+64	
19	udre37		Ulong	4	H+68	
20	udre38		Ulong	4	H+72	
21	udre39		Ulong	4	H+76	
22	udre40		Ulong	4	H+80	
23	udre41		Ulong	4	H+84	
24	udre42		Ulong	4	H+88	
25	udre43		Ulong	4	H+92	
26	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+96	-
27	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.143 SBAS45 Slow Corrections

Each SBAS45 message contains a 2-bit IODP indicating the associated PRN mask.

The time of applicability (T0) of the PRC is the start of the epoch of the WNT second that is coincident with the transmission at the satellite of the first bit of the message block.

Message ID: **993**
Log Type: **Asynch**

Recommended Input:

log SBAS45a onchanged

ASCII Example:

```
#SBAS45A,COM2,0,73.0,FINE,1295,228498.000,00000040,c730,34461;209,23,32,197,
-116,206,-1,-6,-3,-5546,3488,25,148,262,-312,867,4,3,0,2513,3488,0*02d6e0d5
```

Each raw mask frame gives data for a specific frame decoder number. The SBAS45 message can be logged to view the data breakdown of SBAS frame 45 which contains information about slow corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS45 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	mask1	Index into PRN mask (Type 1)	Ulong	4	H+4	-
4	iode1	Issue of ephemeris data	Ulong	4	H+8	-
5	dx1	Delta x (ECEF)	Long	4	H+12	0.125
6	dy1	Delta y (ECEF)	Long	4	H+16	0.125
7	dz1	Delta z (ECEF)	Long	4	H+20	0.125
8	ddx	Delta delta x (ECEF)	Long	4	H+24	2^{-11}
9	ddy	Delta delta y (ECEF)	Long	4	H+28	2^{-11}
10	ddz	Delta delta z (ECEF)	Long	4	H+32	2^{-11}
11	$da^{f0}1$	Delta a^{f0} clock offset	Long	4	H+36	2^{-31}
12	$t_0 1$	Applicable time of day	Ulong	4	H+40	16
13	mask2	Second index into PRN mask (Type 1)	Ulong	4	H+44	-
14	iode2	Second issue of ephemeris data	Ulong	4	H+48	-
15	dx1	Delta x (ECEF)	Long	4	H+52	0.125
16	dy1	Delta y (ECEF)	Long	4	H+56	0.125
17	dz1	Delta z (ECEF)	Long	4	H+60	0.125
18	ddx	Delta delta x (ECEF)	Long	4	H+64	2^{-11}
19	ddy	Delta delta y (ECEF)	Long	4	H+68	2^{-11}
20	ddz	Delta delta z (ECEF)	Long	4	H+72	2^{-11}
21	$da^{f0}2$	Delta a^{f0} clock offset	Long	4	H+76	2^{-31}
22	$t_0 2$	Applicable time of day	Ulong	4	H+80	16
23	iodp	Issue of PRN mask data	Ulong	4	H+84	-
24	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+88	-
25	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.144 SBASALMANAC SBAS Almanac Collection

This log contains a collection of all current SBAS almanacs that have been decoded by the receiver and may contain almanac data for multiple PRNs. The SBASALMANAC log is populated by the Geo Almanac Message Type 17 and is also available in the SBAS17 log. These PRNs are broken out into individual SBAS almanac entries for this message and output individually. If multiple SBAS subsystems (e.g., WAAS, EGNOS, GAGAN, MSAS) are tracked, this message will include almanac data collected from each with the subsystem identified in each message entry. The almanac data contains all of the information required to compute the satellite position as well as health and status information.

Message ID: **1425**
Log Type: **Asynch**

Recommended Input:

Log SBASALMANACA onchanged

ASCII Example:

```
#SBASALMANACA,COM1,2,80.0,SATTIME,1672,411186.000,00000020,84d8,43119;133,WAAS,65600,0,0,-5571800,-41758600,-1456000,0,0,120*22da17e8
#SBASALMANACA,COM1,1,80.0,SATTIME,1672,411186.000,00000020,84d8,43119;135,WAAS,65600,0,0,-28758600,-30825600,0,0,0,0*dd122ca1
#SBASALMANACA,COM1,0,80.0,SATTIME,1672,411186.000,00000020,84d8,43119;138,WAAS,65600,0,0,-12547600,-40248000,0,0,0,0*89c6c51c
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	Header	Log header		H	0
2	ID	Satellite ID	ULONG	4	H
3	Variant	System variant. See table below	ENUM	4	H + 4
4	Time	Time of day (s)	ULONG	4	H + 8
5	Data ID	Data identification	USHORT	2	H + 12
6	Health	Satellite health	USHORT	2	H + 14
7	X	ECEF X coordinate (m)	LONG	4	H + 16
8	Y	ECEF Y coordinate (m)	LONG	4	H + 20
9	Z	ECEF Z coordinate (m)	LONG	4	H + 24
10	X Velocity	X rate of change (m/s)	LONG	4	H + 28
11	Y Velocity	Y rate of change (m/s)	LONG	4	H + 32
12	Z Velocity	Z rate of change (m/s)	LONG	4	H + 36
13	CRC	32-bit CRC (ASCII and binary only)	HEX	4	H + 40
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 107: SBAS Subsystem Types

ASCII	Binary	Description
NONE	0	No system
UNKNOWN	1	Unknown system
WAAS	2	WAAS system
EGNOS	3	EGNOS system
MSAS	4	MSAS system
GAGAN	5	GAGAN system

3.3.145 SBASCORR SBAS Range Corrections Used

The information is updated with each pseudorange position calculation. It has an entry for each tracked satellite. Satellites that are not included in an SBAS corrected solution have 0.0 in both the correction and ‘corr stdv’ fields.

The correction is the combined fast and slow corrections and is to be added to the pseudorange. Ionospheric and tropospheric corrections are not included and should be applied separately.

Message ID: **998**
Log Type: **Synch**

Recommended Input:

log SBAScorra ontime 1

ASCII Example:

```
#SBASCORRA,COM1,0,40.5,FINESTEERING,1337,417485.000,01000000,3b3b,1984;
20,
3,101,0.0000,0.0000,3,0,0.0000,0.0000,
2,133,0.0000,0.0000,2,0,0.0000,0.0000,
23,48,0.0000,0.0000,23,0,0.0000,0.0000,
4,55,0.0000,0.0000,4,0,0.0000,0.0000,
16,197,0.0000,0.0000,16,0,0.0000,0.0000,
20,25,0.0000,0.0000,20,0,0.0000,0.0000,
27,26,0.0000,0.0000,27,0,0.0000,0.0000,
25,186,0.0000,0.0000,25,0,0.0000,0.0000,
13,85,0.0000,0.0000,13,0,0.0000,0.0000,
122,0,0.0000,0.0000,134,0,0.0000,0.0000*0af4c14d
```

The SBAS pseudorange corrections can be added to the raw pseudorange for a more accurate solution in applications that compute their own solutions.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBASCORR header	Log header		H	0
2	#sat	Number of satellites with information to follow	Ulong	4	H
3	prn	Satellite PRN	Ulong	4	H+4
4	iode	Issue of ephemeris data for which the corrections apply	Ulong	4	H+8
5	corr	SBAS pseudorange correction (m)	Float	4	H+12
6	corr stdv	Standard deviation of pseudorange correction (m)	Float	4	H+16
7...	Next sat entry = H+4 + (#sat x 16)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#sat x 16)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.146 SOFTLOADSTATUS Status of the soft load process

This log describes the status of the SoftLoad process.

Message ID: 1235
Log Type: Asynch

Recommended Input:

log softloadstatusa once

ASCII Example:

```
#SOFTLOADSTATUSA,COM1,0,97.5,UNKNOWN,0,0.113,004c0001,2d64,10481;NOT_STARTED*
827fdc04
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	SOFTLOADSTATUS Header	Log header	-	H	0
2	status	Status of the soft load process see the following table	Enum	4	H
	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	
	[CR][LF]	Sentence terminator (ASCII only)			

Value	Name	Description
1	NOT_STARTED	SoftLoad process has not begun
2	READY_FOR_SETUP	Softload process is ready to receive setup information in the form of SOFTLOADSETUP commands or SOFTLOADSREC commands with S0 records
3	READY_FOR_DATA	Softload process is ready to receive data in the form of SOFTLOADDATA commands or SOFTLOADSREC commands with S3 records. Once all data has been sent, send the SOFTLOADCOMMIT command
4	DATA_VERIFIED	SoftLoad data has passed CRC. This status occurs after a SOFTLOADCOMMIT command
5	WRITING_FLASH	SoftLoad data is being writing to flash. This status occurs after a SOFTLOADCOMMIT command. During a firmware upload, the receiver may remain in this state for 45 seconds or longer
6	WROTE_FLASH	SoftLoad data has been written to flash
7	WROTE_AUTHCODE	The embedded AuthCode was successfully written

Continued on next page

Value	Name	Description
8	COMPLETE	Softload process has completed. The next step is to send the RESET command to reset the receiver
9	VERIFYING_DATA	SoftLoad is verifying the downloaded image
17	RESET_ERROR	Error reseting SoftLoad
18	BAD_SRECORD	A bad S Record was received
19	BAD_PLATFORM	This data cannot be loaded onto this platform
20	BAD_MODULE	This module cannot be loaded with SoftLoad.
21	BAD_AUTHCODE	Bad AuthCode received for this PSN
22	NOT_READY_FOR_SETUP	A SOFTLOADSETUP command was entered before a SOFTLOADRESET or after a SOFTLOADDATA command
23	NO_MODULE	No data module was entered before a SOFTLOADDATA command was received
24	NO_PLATFORM	No platform was entered before a SOFTLOADDATA command was received
25	NOT_READY_FOR_DATA	A SOFTLOADDATA command was received but the receiver was not ready for it
26	MODULE_MISMATCH	The SoftLoad data module was changed in the middle of loading
27	OUT_OF_MEMORY	SoftLoad has run out of RAM to store the incoming data
28	DATA_OVERLAP	SoftLoad data has overlapped
29	BAD_IMAGE_CRC	CRC of the downloaded image has failed
30	IMAGE_OVERSIZE	The downloaded image is too big for the intended data module
31	AUTHCODE_WRITE_ERROR	An error occurred when writing the embedded AuthCode to flash
32	BAD_FLASH_ERASE	Erasing of the flash failed
33	BAD_FLASH_WRITE	Writing to the flash failed

Status values >= 17 (RESET_ERROR) indicate that an error has occurred during the loading process. Status < 17 (RESET_ERROR) are part of normal SoftLoad operation.

3.3.147 SOURCETABLE NTRIP Source table entries

This log outputs the NTRIP SOURCETABLE entries from the NTRIPCASTER set by the NTRIPSOURCETABLE command. The entry data field in the first entry is always the header of the retrieved SOURCETABLE The entry data field in the last entry is always a string "ENDSOURCETABLE" which indicates the end of the source table. Entries in between these fields are the real SOURCETABLE entries.

Message ID: **1344**
Log Type: **Synch**

Recommended Input:

log sourcetablea once

ASCII Example:

#SOURCETABLEA,ICOM1,7,70.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","HTTP/1.1 200 OK;Ntrip-Version: Ntrip/2.0;Ntrip-Flags: st_filter,st_auth,st_match,st_strict,rtsp,plain_rtp;Server: NTRIP Caster/2.0.15;Date: Mon, 27 Jun 2011 17:47:23 GMT;Connection: close;Content-Type: gnss/sourcetable;Content-Length: 671"*6d385807

#SOURCETABLEA,ICOM1,6,70.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","CAS;hera.novatel.ca;80,2101;NovAtel;NovAtel;0;CAN;51;-115;http://www.novatel.com"*d5dcf61b

#SOURCETABLEA,ICOM1,5,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","NET;GREF;NovAtel;B;N;http://novatel.com;none;novatel.com;none"*e1abe7ef

#SOURCETABLEA,ICOM1,4,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","STR;novatel_rtcmv3;novatel rtcmv3;RTCM 3.0;1004(1),1006(1),1012(1),1033(1);2;GPS+GLO;NovAtel;CAN;51;-15;0;1;NovAtel OEM628;none;B;N;9600;Test"*59cd860f

#SOURCETABLEA,ICOM1,3,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","STR;novatel_rtcm;novatel rtcm;RTCM;1(1),3(10),31(1),32(10);2;GPS+GLO;NovAtel;CAN;51;-15;0;1;NovAtel OEM628;none;B;N;9600;Test"*3a8dc2ff

#SOURCETABLEA,ICOM1,2,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","STR;novatel_rtcaobs2;novatel rtcaobs2;RTCA; rtcaref(10), rtcaobs2(1);2;GPS+GLO;NovAtel;CAN;51;-15;0;1;NovAtel OEM628;none;B;N;9600;Test"*7078fa36

#SOURCETABLEA,ICOM1,1,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","STR;ipg;ipg test;unknown;unknown;2;unknown;NovAtel;CAN;51;-115;0;1;NovAtel OEM628;none;B;N;1200;Test"*e0f2cf39

#SOURCETABLEA,ICOM1,0,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","ENDSOURCETABLE"*2c5015c9

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	SOURCETABLE	Log header		H	0
2	endpoint	NTRIPCASTER Endpoint	String with varied length up to 80 bytes	a	H
3	Reserved1	reserved	ULONG	4	H+a
4	Reserved2	reserved	ULONG	4	H+a+4
5	Entry data	Source table entry data	String with varied length up to 512 bytes	b	H+a+8
6	xxxx	32-bit CRC (ASCII and binary only)	Hex	4	H+a+b+8
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.148 TIME Time Data

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

To find any offset in the PPS signal, log the TIME log 'ontime' at the same rate as the PPS output. For example, if the PPS output is configured to output at a rate of 0.5 seconds, see the PPSCONTROL command on *page 181*, log the TIME log 'ontime 0.5' as follows:

```
log time ontime 0.5
```

The TIME log offset field can then be used to determine any offset in PPS output relative to GPS reference time.

Message ID: **101**

Log Type: **Synch**

Recommended Input:

log timea ontime 1

ASCII Example:

```
#TIMEA,COM1,0,50.5,FINESTEERING,1337,410010.000,00000000,9924,1984;
VALID,1.953377165e-09,7.481712815e-08,-12.99999999492,2005,8,25,17,
53,17000,VALID*e2fc088c
```

1. Consider the case where you used the ADJUST1PPS command, see *page 58*, to synchronize two receivers in a primary/secondary relationship to a common external clock. You can use the TIME log after the clock model has stabilized at state 0, to monitor the time difference between the Primary and Secondary receivers.

2. The header of the TIME log gives you the GPS reference time (the week number since January 5th, 1980) and the seconds into that week. The TIME log outputs the UTC offset (offset of GPS reference time from UTC time) and the receiver clock offset from GPS reference time.

   If you want the UTC time in weeks and seconds, take the week number from the header. Then take the seconds into that week, also from the header, and add the correction to the seconds using the 2 offsets. Ensure not to go negative or rollover (go over the total number of seconds, 604800, in a week. In the case of rollover, add a week and the left over seconds become the seconds into this new week. If negative, subtract a week and the remainder from the seconds of that week.

   For example:

   TIME COM1 0 73.5 FINESTEERING 1432 235661.000 00000000 9924 2616

   `VALID` -0.000000351 0.000000214 -14.00000000106 2007 6 19 17 27 27000 `VALID`

   From the time information above:

   GPS reference time = 1432 (GPS reference week), 235661.000 (GPS seconds) from the header.

   From the UTC offset row in the TIME log description on *page 589*:

   UTC time = GPS reference time + offset + UTC offset

   UTC time

   = week 1432, 235661.000 s - 0.000000351 (offset) - 14.00000000106 (UTC offset)
   = week 1432, seconds 235646.99999964794

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	TIME header	Log header		H	0
2	clock status	Clock model status (not including current measurement data), see *Table 65* on *page 322*	Enum	4	H
3	offset	Receiver clock offset, in seconds from GPS reference time. A positive offset implies that the receiver clock is ahead of GPS reference time. To derive GPS reference time, use the following formula: GPS reference time = receiver time - offset	Double	8	H+4
4	offset std	Receiver clock offset standard deviation	Double	8	H+12
5	utc offset	The offset of GPS reference time from UTC time, computed using almanac parameters. UTC time is GPS reference time plus the current UTC offset plus the receiver clock offset: UTC time = GPS reference time + offset + UTC offset	Double	8	H+20
6	utc year	UTC year	Ulong	4	H+28
7	utc month	UTC month (0-12) [a]	Uchar	1	H+32
8	utc day	UTC day (0-31) [a]	Uchar	1	H+33
9	utc hour	UTC hour (0-23)	Uchar	1	H+34
10	utc min	UTC minute (0-59)	Uchar	1	H+35
11	utc ms	UTC millisecond (0-60999) [b]	Ulong	4	H+36
12	utc status	UTC status 0 = Invalid 1 = Valid 2 = Warning[c]	Enum	4	H+40
13	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. If UTC time is unknown, the values for month and day are 0.

b. Maximum of 60999 when leap second is applied.

c. Indicates that the leap seconds value is used as a default due to the lack of an almanac.

3.3.149 TIMESYNC Synchronize Time Between GNSS receivers

The TIMESYNC log is used in conjunction with the ADJUST1PPS command, see *page 58*, to synchronize the time between GNSS receivers.

Refer also to the *Transfer Time Between Receivers* section in the *OEM6 Family Installation and Operation User Manual.*

Message ID: **492**
Log Type: **Synch**

Recommended Input:

log timesynca ontime 1

ASCII Example:

```
#TIMESYNCA,COM1,0,46.0,FINESTEERING,1337,410095.000,00000000,bd3f,1984;
1337,410095000,FINESTEERING*aa2025db
```

The time data embedded in this log represents the time of the most recent 1PPS signal. The receiver issues this log from a communications port within 200 ms of the last 1PPS event. The 200 ms value is a "worst case scenario." See *Figure 1, 1PPS Alignment* on *page 58* for an illustration.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	TIMESYNC header	Log header		H	0
2	week	GPS reference week number	Ulong	4	H
3	ms	Number of milliseconds into the GPS reference week	Ulong	4	H+4
4	time status	GPS reference time Status, see *Table 8, GPS Reference Time Status* on *page 32*	Enum	4	H+8
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.150 TRACKSTAT Tracking Status

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

If both the L1 and L2 signals are being tracked for a given PRN, two entries with the same PRN appear in the tracking status log. As shown in *Table 88, Channel Tracking Status* on *page 471* these entries can be differentiated by bit 20, which is set if there are multiple observables for a given PRN, and bits 21-22, which denote whether the observation is for L1 or L2. This is to aid in parsing the data.

Message ID: **83**
Log Type: **Synch**

Recommended Input:

log trackstata ontime 1

ASCII Example:

```
#TRACKSTATA,COM1,0,49.5,FINESTEERING,1337,410139.000,00000000,457c,1984;
SOL_COMPUTED,PSRDIFF,5.0,30,
1,0,18109c04,21836080.582,-2241.711,50.087,1158.652,0.722,GOOD,0.973,
1,0,11309c0b,21836083.168,-1746.788,42.616,1141.780,0.000,OBSL2,0.000,
30,0,18109c24,24248449.644,-2588.133,45.237,939.380,-0.493,GOOD,0.519,
30,0,11309c2b,24248452.842,-2016.730,38.934,939.370,0.000,OBSL2,0.000,
...
14,0,18109da4,24747286.206,-3236.906,46.650,1121.760,-0.609,GOOD,0.514,
14,0,11309dab,24747288.764,-2522.270,35.557,1116.380,0.000,OBSL2,0.000,
0,0,0c0221c0,0.000,0.000,0.047,0.000,0.000,NA,0.000,
0,0,0c0221e0,0.000,0.000,0.047,0.000,0.000,NA,0.000*255a732e
```

L-band and HP/XP requires the following minimum number of satellites for the following operations:

- single point = 4 GPS satellites
- RTK, including HP/XP = 5 GPS satellites

Extra satellites provide additional redundancy, which is good to have. Note that the default cut-off angle is 5 degrees and single point positioning utilizes all available GPS satellites in the position solution.

RTK solutions, including HP/XP, only use GPS satellites that are above the RTK elevation angle (usually 12.5 degrees). So, although there could be more than 5 GPS satellites in view, if there are not at least 5 GPS satellites above 12.5 degrees then an RTK solution may not be possible.

Table 108: Range Reject Code

Reject Code (binary)	Reject Code (ASCII)	Description
0	GOOD	Observation is good
1	BADHEALTH	Bad satellite health is indicated by ephemeris data
2	OLDEPHEMERIS	Old ephemeris due to not being updated during the last 3 hours
3	ECCENTRICANOMALY	Eccentric anomaly error during computation of the satellite's position
4	TRUEANOMALY	True anomaly error during computation of the satellite's position
5	SATCOORDINATE-ERROR	Satellite coordinate error during computation of the satellite's position
6	ELEVATIONERROR	Elevation error due to the satellite being below the cut-off angle
7	MISCLOSURE	Misclosure too large due to excessive gap between estimated and actual positions
8	NODIFFCORR	No compatible differential correction is available for this particular satellite
9	NOEPHEMERIS	Ephemeris data for this satellite has not yet been received
10	INVALIDIODE	Invalid IODE (Issue Of Data Ephemeris) due to mismatch between differential stations
11	LOCKEDOUT	Locked out: satellite is excluded by the user (LOCKOUT command)
12	LOWPOWER	Low power: satellite is rejected due to low carrier/noise ratio
13	OBSL2	L2 observation is ignored and not used in the pseudorange solution
16	NOIONOCORR	No compatible ionospheric correction is available for this particular satellite
17	NOTUSED	Observation is ignored and not used in the solution
99	NA	No observation (a reject code is not applicable)
100	BAD_INTEGRITY	The integrity of the pseudorange is bad

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	TRACKSTAT header	Log header		H	0
2	sol status	Solution status (see *Table 57, Solution Status* on *page 304*)	Enum	4	H
3	pos type	Position type (see *Table 56, Position or Velocity Type* on *page 303*)	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 (GPS: 1 to 32, SBAS: 120 to 138 or 183 to187, QZSS: 193-197 and Galileo: 1 to 36. For GLONASS, see *Section 1.3* on *page 31*)	Short	2	H+16
7	glofreq	(GLONASS Frequency + 7), see *Section 1.3* on *page 31*	Short	2	H+18
8	ch-tr-status	Channel tracking status (see *Table 88, Channel Tracking Status* on *page 471*)	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 (see *Table 108, Range Reject Code* on *page 592*)	Enum	4	H+48
15	psr weight	Pseudorange filter weighting	Float	4	H+52
16...	Next PRN offset = H + 16 + (#chans x 40)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+16+ (#chans x 40)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.151 VALIDMODELS Valid Model Information

This log gives a list of valid authorized models available and expiry date information.

If a model has no expiry date, it reports the year, month and day fields as 0, 0 and 0 respectively.

Message ID: **206**
Log Type: **Asynch**

Recommended Input:

log validmodelsa once

ASCII Example:

```
#VALIDMODELSA,COM1,0,92.0,FINESTEERING,1610,499139.682,00000000,342f,6293;1,"
D2LR0RCCR",0,0,0*d0580c1b
```

Use the VALIDMODELS log to output a list of available models for the receiver. You can use the AUTH command, see *page 79*, to add a model and the MODEL command, see *page 167*, to change the currently active model. See the VERSION log on *page 595* for the currently active model

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	VALIDMODELS header	Log header		H	0
2	#mod	Number of models with information to follow	Ulong	4	H
3	model	Model name	String [Max16]	Variable[a]	Variable
4	expyear	Expiry year	Ulong	4	Variable Max:H+20
5	expmonth	Expiry month	Ulong	4	Variable Max: H+24
6	expday	Expiry day	Ulong	4	Variable: Max: H+28
7...	Next model offset = H + 4 + (#mods x variable [max:28])				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	Variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

3.3.152 VERSION Version Information

This log contains the version information for all components of a system. When using a standard receiver, there is only one component in the log.

A component may be hardware (for example, a receiver or data collector) or firmware in the form of applications or data (for example, data blocks for height models or user applications). See *Table 110, VERSION Log: Field Formats* on *page 596* for details on the format of key fields.

See also the VALIDMODELS log on *page 594*.

Message ID: **37**
Log Type: **Polled**

Recommended Input:

log versiona once

ASCII Example:

```
#VERSIONA,COM1,0,89.0,FINESTEERING,1610,504872.194,00000000,3681,6293;1,GPSCA
RD,"D2LR0RCCR","BFN10260022","OEM628-.00","OEM060000RN0000",
"OEM060000SB0002","2010/Nov/05","16:11:18"*
```

1. There is no need for an extra OmniSTAR Interface Board (I-Board) on L-band capable OEM6 receivers. If you have an OmniSTAR subscription and the receiver is tracking an OmniSTAR satellite, the OmniSTAR serial number can be found in the LBANDINFO log, see *page 399*.
2. The VERSION log is a useful log as a first communication with your receiver. Once connected, using NovAtel's Connectt or HyperTerminal, log VERSION and check that the output makes sense. Also, ensure that you have the receiver components you expected.

Table 109: Component Types

Binary	ASCII	Description
0	UNKNOWN	Unknown component
1	GPSCARD	OEM6 family component
2	CONTROLLER	Data collector
3	ENCLOSURE	OEM card enclosure
4-7	Reserved OmniSTAR CAN[a] interface board	
981073920 (0x3A7A0000)	DB_HEIGHTMODEL	Height/track model data
981073921 (0x3A7A0001)	DB_USERAPP	User application firmware
981073925 (0x3A7A0005)	DB_USERAPPAUTO	Auto-starting user application firmware

a. Please refer to the Acronyms page on our website at http://www.novatel.com/support/knowledge-and-learning/.

Table 110: VERSION Log: Field Formats

Field Type	Field Format (ASCII)	Description
hw version	P-RS-CCC	P = hardware platform (for example, OEM628) R = hardware revision (for example, 6.00) S = processor revision (for example, A) [a] CCC = COM port configuration (for example, 22T) [b]
sw version, boot version		
comp date	YYYY/MM/DD	YYYY = year MM = month DD = day (1 - 31)
comp time	HH:MM:SS	HH = hour MM = minutes SS = seconds

a. This field may be empty if the revision is not stamped onto the processor.

b. One character for each of the COM ports 1, 2, and 3. Characters are: 2 for RS-232, 4 for RS-422, T for LV-TTL, and X for user-selectable (valid for COM1 of certain products). Therefore, the example is for a receiver that uses RS-232 for COM 1 and COM 2 and LV-TTL for COM 3.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	VERSION header	Log header		H	0
2	# comp	Number of components (cards, and so on)	Long	4	H
3	type	Component type (see *Table 109, Component Types* on *page 596*)	Enum	4	H+4
4	model	OEM6 firmware model number e.g., G1SBOGTTO indicates the receiver's current model functionality	Char[16]	16	H+8
5	psn	Product serial number	Char[16]	16	H+24
6	hw version	Hardware version, see *Table 110, VERSION Log: Field Formats* on *page 596*	Char[16]	16	H+40
7	sw version	Firmware software version, see *Table 110*	Char[16]	16	H+56
8	boot version	Boot code version, see *Table 110*	Char[16]	16	H+72
9	comp date	Firmware compile date, see *Table 110*	Char[12]	12	H+88
10	comp time	Firmware compile time, see *Table 110*	Char[12]	12	H+100
11...	Next component offset = H + 4 + (#comp x 108)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#comp x 108)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Chapter 4 Response

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

The output format of the messages is dependent on the format of the input command. If the command is input as abbreviated ASCII, the output will be abbreviated ASCII. The same rule applies for both ASCII and binary formats.

Table 111: Response Messages

ASCII Message	Binary Message ID	Meaning
OK	1	Command was received correctly
REQUESTED LOG DOES NOT EXIST	2	The log requested does not exist
NOT ENOUGH RESOURCES IN SYSTEM	3	The request has exceeded a limit (for example, the maximum number of logs are being generated)
DATA PACKET DOESN'T VERIFY	4	Data packet is not verified
COMMAND FAILED ON RECEIVER	5	Command did not succeed in accomplishing requested task
INVALID MESSAGE ID	6	The input message ID is not valid
INVALID MESSAGE. FIELD = *X*	7	Field *x* of the input message is not correct
INVALID CHECKSUM	8	The checksum of the input message is not correct. Only applies to ASCII and binary format messages.
MESSAGE MISSING FIELD	9	A field is missing from the input message
ARRAY SIZE FOR FIELD *X* EXCEEDS MAX	10	Field *x* contains more array elements than allowed
PARAMETER *X* IS OUT OF RANGE	11	Field *x* of the input message is outside the acceptable limits
TRIGGER *X* NOT VALID FOR THIS LOG	14	Trigger type *x* is not valid for this type of log
AUTHCODE TABLE FULL - RELOAD SOFTWARE	15	Too many authcodes are stored in the receiver. The receiver firmware must be reloaded
INVALID DATE FORMAT	16	This error is related to the inputting of authcodes. Indicates the date attached to the code is not valid
INVALID AUTHCODE ENTERED	17	The authcode entered is not valid
NO MATCHING MODEL TO REMOVE	18	The model requested for removal does not exist
NOT VALID AUTH CODE FOR THAT MODEL	19	The model attached to the authcode is not valid

Table 111: Response Messages

CHANNEL IS INVALID	20	The selected channel is invalid
REQUESTED RATE IS INVALID	21	The requested rate is invalid
WORD HAS NO MASK FOR THIS TYPE	22	The word has no mask for this type of log
CHANNELS LOCKED DUE TO ERROR	23	Channels are locked due to error
INJECTED TIME INVALID	24	Injected time is invalid
COM PORT NOT SUPPORTED	25	The COM or USB port is not supported
MESSAGE IS INCORRECT	26	The message is invalid
INVALID PRN	27	The PRN is invalid
PRN NOT LOCKED OUT	28	The PRN is not locked out
PRN LOCKOUT LIST IS FULL	29	PRN lockout list is full
PRN ALREADY LOCKED OUT	30	The PRN is already locked out
MESSAGE TIMED OUT	31	Message timed out
UNKNOWN COM PORT REQUESTED	33	Unknown COM or USB port requested
HEX STRING NOT FORMATTED CORRECTLY	34	Hex string not formatted correctly
INVALID BAUD RATE	35	The baud rate is invalid
MESSAGE IS INVALID FOR THIS MODEL	36	Message is invalid for this model of receiver
COMMAND ONLY VALID IF IN NVM FAIL MODE	40	Command is only valid if NVM is in fail mode
INVALID OFFSET	41	The offset is invalid
MAXIMUM NUMBER OF USER MESSAGES REACHED	78	Maximum number of user messages has been reached
GPS PRECISE TIME IS ALREADY KNOWN	84	GPS precise time is already known

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week number 361

X

xyz coordinates 315, 457, 495

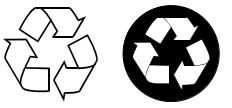
Y

year 589, 596

Z

Z count 329
zone number, UTM 265

Recyclable



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