ORION 3.0

NMEA User Manual

CHANGE HISTORY

Date	Rev	Author	Status	Description of changes
2008-03-25	1.00	AM	Draft	Initial document version
2008-05-06	1.01	AM	Draft	Configuration sections are extended.
2008-07-17	1.02	AM	Draft	Position Pinning Configuration section is updated: zero values for position and velocity thresholds are described.
2008-08-21	1.03	AM	Draft	Position Pinning Configuration section is updated: more usage examples are added, Configuration Sections sections are updated: comment about error responses is added.
2008-08-21	1.04	AM	Draft	Position Pinning Configuration section is updated: pinning position update timeout and deep pinning mode delay are added.
2008-08-26	1.05	AM	Draft	Position Pinning Configuration section is updated: mistakes in examples are fixed
2008-08-27	1.06	AM	Draft	1. Added note about usage version string as Orion initialization complete signal. 2. AGPS custom protocol IDs described in Output Configuration section.
2008-09-02	1.07	AM	Draft	Font size is changed
2008-09-08	1.08	AM	Draft	”Reset configurations” is not supported for STOP command.
2008-09-19	1.09	AM	Draft	UBP mask description is added to the output configuration
2008-09-23	1.10	AM	Draft	Position Pinning Configuration command update. SLEEP command update. Algorithm Configuration command update. Version Number section update.

REFERENCES

[1] NMEA 0183 Standard For Interfacing Marine Electronic Devices (http://www.nmea.org)

[2] u-Map™ Application Note

[3] u-Nav Binary Protocol Specification for SDK Users, version 2.0

ABBREVIATIONS

Acronym	Description
AGPS	Assisted GPS
APP	Application Profile Subsystem
ASCII	American Standard Code for Information Interchange
bps	Bits Per Second
CRC	Cyclic Redundancy Check
FOM	Figure Of Merit

Acronym	Description
FSH	Flash memory
GMT	Greenwich Mean Time
GPS	Global Positioning System
HW	Hardware
ID	Identifier
LGF	Last Good Fix
LSE	Least Square Estimation
N/A	Not Applicable
NMEA	The National Marine Electronics Association
NVRAM	Non Volatile RAM
ORION	Atheros brand of GPS receivers
PVT	Position-Velocity-Time
RAIM	Receiver Autonomous Integrity Monitoring
RAM	Random Access Memory
RF	Radio Frequency
RTC	Real Time Clock
SA	Storage Agent Subsystem
SBAS	Satellite Based Augmentation System
SDK	Software Development Kit
TCXO	Temperature Controlled Crystal Oscillator
TOW	Time Of Week
UART	Universal Asynchronous Receiver / Transmitter
UBP	u-Nav Binary Protocol
UTC	Universal Time Coordinated
VSDSP	VLSI Solution DSP
WGS84	World Geodetic System reference frame for the earth, for use in geodesy and navigation

TABLE OF CONTENTS

1 OVERVIEW

This document describes the format and usage of the Atheros custom NMEA messages in the Orion navigation software. It also details the implementation specifics of standard NMEA output messages supported by Orion.

2 FORMAT

Atheros custom NMEA messages are structured according to the standard template of NMEA format. Every message starts with a dollar-sign '$'. After this prefix there will be an Atheros command prefix 'PUNV' (not registered) and a comma ',' . After the comma, there is the command field which is defined in section 3. The command field ends with an asterisk '*' and a two digit hexadecimal CRC checksum. The line is executed after <carriage return> <new line> character pair.

Example line: "***$PUNV,<command>*cc<carriage return><new line>***"

Please note all the NMEA messages, which do not start with dollar sign '$' will be ignored without any error response.

2.1 CRC Calculation

The CRC calculation is explained in the NMEA standard [1].

If the CRC is omitted or illegal, the message will be rejected. CRC value 'cc' (two lower case c-characters) will always be accepted.

2.2 Sentence Termination Delimiter

All sentences end with the sentence termination delimiter <carriage return><new line>. This combination is '\r\n' in C-language format and hexadecimal ASCII values are '$0D_h0A_h$'. Both characters have to be sent after CRC to execute the command.

3 CUSTOM NMEA SENTENCES

The command field starts the custom command. Atheros custom NMEA messages are defined below in Table 3-1.

Table 3-1 Atheros custom NMEA messages

Command / Response	In/Out	Description
ASSIST	In	UTC time assistance input message
CORR	In	u-Map assistance message
STORELGF	In	Force immediate LGF store operation
START	In	Request for immediate restart
SLEEP	In	Request to stop the navigation and enter to sleep mode
WAKEUP	In	Wake up from sleep
STOP	In	Request to stop the navigation
CONFIG	In	Request to configure configuration section
SET	In	Change configuration in RAM only
GETCONFIG	In	Request to read configure information of configuration section
VERSION	In	Alias to ***PUNV,GETCONFIG,09***
FOM	Out	Navigation quality indicator (figure-of-merit)
CFG_R	Out	Reply message for read configure information
CFG_S	Out	Reply message for write configure information
ERR	Out	Error message
OK	Out	Success message

If the NMEA string can be decoded to explicit command for the Orion system, the same message will be echoed back to sender.

3.1 Timing Limits

The current version of Orion will not operate properly if the user sends more than one custom NMEA message in a second.

3.2 Size Limits

According to the NMEA standard the maximum number of characters between the starting delimiter '$' or '!' and the terminating <CR><LF> should be 79, i.e. the maximum needed buffer size should be 82 for one sentence.

For the custom NMEA messages the maximum size of the input messages is 128 characters and for the output messages 200 characters.

3.3 Format Description

3.3.1 ASSIST

With `ASSIST` command the user can inject time assistance into the navigation software. The format of `ASSIST` command is the following:

$PUNV,ASSIST,*hhmmss.ss,ddmmyycc**

hhmmss.ss is the UTC time: ***hh*** – hours (`00…23`), ***mm*** – minutes (`00…59`), ***ss.ss*** – seconds (`00.00…59.99`)

ddmmyy is the UTC date: ***dd*** – day (`01…31`), ***mm*** – month (`01…12`), ***yy*** – year (`00…99`)

$PUNV,ASSIST,*tow,wncc**

tow is time of the week in milliseconds (`0…604699999`) and ***wn*** is a week number (starting from January 6, 1980)

3.3.2 CORR

`CORR` command injects u-Map assistance information into the navigation software. Please find more information about u-Map feature from [2]. The format of `CORR` command is as follows:

$PUNV,CORR,*hhmmss.sss,llll.llll,N/S,yyyyy.yyyy,E/W,h,h,c,ccc**

hhmmss.sss is timestamp, which must match the NMEA timestamp from the message set that the correction applies to. The format is: ***hh*** – hours (`00…23`), ***mm*** – minutes (`00…59`), ***ss.sss*** – seconds (`00.000…59.999`)

llll.llll is snapped-to latitude. Degrees-minutes are in decimal format – 2 fixed digits of degrees (`00…90`), 2 fixed digits of minutes (`00…59`) and 4 fixed digits for decimal-fraction of minutes (`0000…9999`). Leading zeros always included for degrees and minutes to maintain fixed length. Trailing zeros always added for decimal-fraction of minutes to maintain fixed length.

N/S is latitude hemisphere: North (***N***) or South (***S***)

yyyyy.yyyy is snapped-to longitude. Degrees-minutes are in decimal format – 3 fixed digits of degrees (`000…180`), 2 fixed digits of minutes (`00…59`) and 4 fixed digits for decimal-fraction of minutes (`0000…9999`). Leading zeros always included for degrees and minutes to maintain fixed length. Trailing zeros always added for decimal-fraction of minutes to maintain fixed length.

E/W is longitude direction, which indicates the longitude direction: East (***E***) or West (***W***).

h.h is heading in degrees (optional). Variable length integer or floating point numeric field. The decimal point and associated decimal fraction are optional. A null field should be used to indicate that no heading assistance is provided.

c.c indicates the degree of confidence of the snapped-to position. Variable length integer or floating point numeric field. The decimal point and associated decimal fraction are optional.

3.3.3 STORELGF

With `STORELGF` command the user can force immediate LGF storage

$PUNV,STORELGF*23

3.3.4 START

With `START` command the user can restart the navigation and erase different kind of data at the same time.

$PUNV,START,*bitmaskcc**

bitmask is a hexadecimal number (without '`0x`' prefix) specifying the data to be erased

Table 3-2 Bitmasks

Bitmask	Description
0x001	Erase position from NVRAM, FSH and RAM
0x002	Erase accurate time, leave inaccurate time
0x004	Erase RTC time
0x008	Erase TCXO offset and drift values from NVRAM, FSH and RAM
0x010	Erase UTC parameters from FSH and RAM
0x020	Erase ionospheric correction parameters from FSH and RAM
0x040	Erase all almanacs from FSH and RAM
0x080	Erase NVRAM
0x100	Reset configurations from FSH and RAM (Output, Zone, Debug, Datum, VSDSP, pinning)
0x200	Erase all ephemerides from FSH and RAM
0x400	Erase all prehistory information collected so far in FSH and RAM

There is a number of predefined mnemonics to be used with the `START` command. When alias is used the command has the following form:

$PUNV,START,*aliascc**

alias is a mnemonic specifying the particular bitmask

Table 3-3 Aliases

Alias	Bitmask	Description
FACTORY	0xFFFF	Start-up with no prior information and reset configuration (FSH and RAM) to compiled–in factory defaults
ALL	0x02FF	Erase everything else except configurations
COLD	0x02F7	Retain TCXO and configurations
LGFCOLD	0x02F6	Retain TCXO, position and configurations
WARM	0x0202	Retain TCXO, position, RTC time and configurations
NOTIME	0x0004	Erase time, retain everything else
MEDIUM	0x0002	Erase time, but leave RTC
HOT	0x0000	Do not erase anything
AUTO	0x0000	Do not erase anything

START command in its simplest form is also supported:

$PUNV,START*71

, which just restarts navigation without erasing anything. So effectively it is equal to

$PUNV,START,HOT*0E

and

$PUNV,START,AUTO*52

and

$PUNV,START,0*6D

commands

3.3.5 SLEEP

With the SLEEP command the user can put the system into the sleep mode. The system stays in the sleep mode until it is forced to wake up or after specified timeout. The NMEA command for the sleep mode without timeout is

$PUNV,SLEEP,*bitmaskcc**

bitmask is a hexadecimal number (without '0x' prefix) specifying the data to be erased and has the same set of possible values as for START command described in 3.3.4

SLEEP command in its simplest form is also supported:

$PUNV,SLEEP*7E

, which effectively equals to

$PUNV,SLEEP,0*62

The NMEA command for sleep mode for a predefined time has the following form:

$PUNV,SLEEP,*hh*,*mm*,*sscc**

hh is hours (00…24)

mm is minutes (00…59)

ss is seconds (00…59).

The total sleeping time specified should be less than 90000 seconds.

3.3.6 WAKEUP

To wake up from sleep, send any kind of NMEA message to any UART port. The content of this message is disregarded by the system. After the wakeup from sleep, the system is always started in auto mode just like if `$PUNV,START,AUTO*52` command was sent. For distinctness sake the following command can be used

$PUNV,WAKEUP*2C

3.3.7 STOP

With `STOP` command the user can stop the navigation and erase different kind of data at the same time.

$PUNV,STOP,*bitmaskcc**

bitmask is a hexadecimal number (without '`0x`' prefix) specifying the data to be erased. It has the same set of possible values as for `START` command described in 3.3.4. The exception is "Reset Configurations from FSH and RAM", which should not be used with `STOP` command.

There is a number of predefined mnemonics to be used with the `STOP` command. When alias is used the command has the following form:

$PUNV,STOP,*aliascc**

alias is a mnemonic specifying the particular bitmask. It has the same set of possible values as for `START` command described in 3.3.4. The only exceptions are `FACTORY`, `HOT` and `AUTO` aliases, which are not supported for `STOP` command.

`STOP` command in its simplest form is also supported:

$PUNV,STOP*29

, which just stops navigation without erasing anything. So effectively it is equal to

$PUNV,STOP,0*35

Please note that the confirmation for `STOP` command will be echoed only after the system has stopped. Until that Orion will produce navigation data.

3.3.8 CONFIG

With `CONFIG` command the user can change the configuration of the system. The configuration takes effect immediately and it is also stored in non-volatile media. The format of `CONFIG` command is the following:

$PUNV,CONFIG,*section ID*,*Various number of comma separated fields**cc**

section ID is a decimal number specifying the section ID. It is 2 fixed decimal digits and leading zeros are mandatory.

Reply to this command is `CFG_S` sentence described in 3.3.14

3.3.9 SET

With `SET` command the user can change the configuration of the system. The configuration takes effect immediately, but the new configuration is not stored in non-volatile media. The format of `SET` command is the following:

$PUNV,SET,*section ID*,*Various number of comma separated fields**cc**

section ID is a decimal number specifying the section ID. It is two fixed decimal digits and leading zeros are mandatory.

3.3.10 GETCONFIG

By `GETCONFIG` command the user can read the configuration of the system. The format of this message is as follows:

$PUNV,GETCONFIG,*section ID**cc**

section ID is a decimal number specifying the section ID. It is two fixed decimal digits and leading zeros are mandatory.

Reply to this command is `CFG_R` sentence described in 3.3.13

3.3.11 VERSION

By `VERSION` command the user can read version number string. The format of this message is as follows:

$PUNV,VERSION*6B

The reply to this command is `CFG_R` sentence described in 3.3.13

This command is an alias to the command

$PUNV,GETCONFIG,09*48

3.3.12 FOM

This message is navigation (PVT) quality indicator, i.e. figure-of-merit. It has the following format:

$PUNV,FOM,*fomcc**

fom a floating point number (`.000....999`).

Please see section 3.4.1 describing the way how this message can be enabled.

3.3.13 CFG_R

`CFG_R` sentence is a reply message for request of reading configuration. This NMEA message contains all configuration information about the selected section.

$PUNV,CFG_R,*section ID,Comma separated list of parameters in selected sectioncc**

section ID is a decimal number specifying the section ID. It is two fixed decimal digits with leading zeros if necessary.

3.3.14 CFG_S

`CFG_S` sentence is a reply message for request of changing configuration by ***$PUNV,CONFIG*** command. The format of the message is as follows.

$PUNV,CFG_S,*section IDcc**

section ID is a decimal number specifying the modified section ID. It is two fixed decimal digits with leading zeros if necessary.

This reply message is sent when configuration data is already successfully stored into non-volatile memory (flash).

3.3.15 ERR

`ERR` is a reply message of an error in the system. The format of the message is as follows:

$PUNV,ERR,*ID,error,datacc**

ID is the ID of subsystem, which detected the error. Two decimal digits with leading zero if necessary.

error is the subsystem specific error number. Five decimal digits with leading zero if necessary.

data is the error specific optional data. Five decimal digits with leading zero if necessary.

This document describes only those error codes that occur with NMEA commands.

Table 3-4. Error codes

ID	Subsystem	error	data	Description
5	NMEA	1	0	Illegal command form
5	NMEA	2	0	Illegal command prefix
5	NMEA	3	0	Illegal command
5	NMEA	4	0	Illegal section ID
5	NMEA	5	0	Illegal parameter
5	NMEA	6	0	Illegal CRC
5	NMEA	7	0	Illegal message
6	Application	0	File ID	Invalid data
6	Application	1	0	Invalid command
6	Application	2	0	Permission denied (Read only data)
6	Application	3	0	Invalid section ID
6	Application	4	0	Invalid file ID (Message from storage agent (SA))
6	Application	5	0	Invalid return value

Examples of error messages:

Illegal CRC:

$PUNV,ERR,05,00006,00000*5B

Illegal command:

$PUNV,ERR,05,00003,00000*5E

3.3.16 OK

OK is an acknowledgement message, which is sent as reply of successful execution of command, sent via different protocol. Currently OK is sent to confirm successful execution of commands sent via AGPS protocol. The format of the message is as follows:

$PUNV,OK,*ID*,*message IDcc**

ID is the ID of responding navigation subsystem. Two decimal digits with leading zero if necessary.

message ID is the ID of successfully executed command. Five decimal digits with leading zeros if necessary.

3.4 Configuration Sections

3.4.1 Output Configuration

Output configuration is used to configure input/output protocol.

The current output configuration can be read in the system with the following command:

$PUNV,GETCONFIG,00*41

The answer is as follows:

$PUNV,CFG_R,00,*CM-OutCM-In*,0,1000,*UART*,*NMEA_MASKcc**

The configuration command template for output configuration is as follows:

$PUNV,CONFIG,00,*CM-OutCM-In*,0,1000,*UART*,*NMEA_MASK/UBP_MASKcc**

or

$PUNV,SET,00,*CM-OutCM-In*,0,1000,*UART*,*NMEA_MASK/UBP_MASKcc**

Table 3-5 Output configuration

Name	Format	Valid values	Default value	Description
CM-In	Two hexadecimal digits	00 – NMEA 01 – UBP 04 – AGPS 3GPP 05 – AGPS 3GPP2 09 – AGPS custom 10 – User specific	00 - NMEA	Input communication protocol
CM-Out	Two hexadecimal digits	00 – NMEA 01 – UBP 04 – AGPS 3GPP 05 – AGPS 3GPP2 09 – AGPS custom 10 – User specific	00- NMEA	Output communication protocol
UART	Decimal	300,1200,2400,4800, 9600,14400,19200, 28800,57600,115200	4800	UART communication speed (bps)
NMEA_MASK	Three hexadecimal digits	001 – GGA 002 – GLL 004 – GSA 008 – GSV 010 – RMC 020 – VTG 040 – ZDA 080 – DTM 100 - FOM	01D	NMEA mask. It is a hexadecimal number that enables selected output NMEA messages. Different combinations of the outputting messages can be selected by calculating the final hexadecimal number after adding all wanted hexadecimal masks together.

UBP_MASK	List of three hexadecimal digits separated by commas	Please see [3] for possible UBP messages' ID codes	N/A	Comma separated list of hexadecimal UBP message IDs, which are sent out by UART. The maximum number of IDs in the list is limited by the maximum size of custom NMEA sentence, which is 128 characters.

Note! If the user changes the input communication protocol to other than NMEA, then to return to NMEA as an input protocol the new protocol specific command should be used.

Please note that there is no comma or space between CM-Out and CM-In fields.

The application profile subsystem will check the maximum length of the NMEA messages when changing output section. For example, if the speed is set to 4800 bps, the output protocol is NMEA and the selected NMEA messages will take bandwidth more than 450 characters per second, the application profile subsystem will produce an error message and reject the changes.

In case of successful execution of

$PUNV,CONFIG,00,*CM-OutCM-In*,0,1000,*UART,NMEA_MASK/UBP_MASKcc**

command the receiver sends confirmation in a following form:

$PUNV,CFG_S,00*53

In case of failure of execution of `GETCONFIG`, `CONFIG` or `SET` command the receiver sends `ERR` reply message. Please see ERR section for details.

Examples:

To produce all other messages but `DTM` and `FOM` at the speed of 115200 bps:

$PUNV,CONFIG,00,0000,0,1000,115200,7F*cc

To disable the default NMEA messages:

$PUNV,CONFIG,00,0000,0,1000,4800,0*cc

3.4.2 Time Zone Configuration

Time Zone configuration is used to configure user localization data.

The current configuration can be read in the system by the following command:

$PUNV,GETCONFIG,03*42

The answer is as follows:

$PUNV,CFG_R,03,*HZ,MZcc**

The configuration command template for the Time Zone configuration is

$PUNV,CONFIG,03,*HZ*,*MZcc**

or

$PUNV,SET,03,*HZ*,*MZcc**

Table 3-6 Time zone configuration

Name	Format	Valid values	Default value	Description
HZ	Decimal	`-11,-10,-9,...,12` `999` (not set)	`999`	Hour zone. It is an amount of full hour difference from the GMT.
MZ	Decimal	`0,15,30,45` `999` (not set)	`999`	Minute zone. It is an amount of extra minutes over the full hours.

In case of successful execution of

$PUNV,CONFIG,03,*HZ*,*MZcc**

command the receiver sends confirmation in a following form:

$PUNV,CFG_S,03*50

In case of failure of execution of `GETCONFIG`, `CONFIG` or `SET` command the receiver sends `ERR` reply message. Please see ERR section for details.

Examples:

To set the `-8` hour time zone:

$PUNV,CONFIG,03,-8,0*31

3.4.3 Version Number

Version configuration is used to deliver system version numbers. If output protocol is NMEA, then version numbers message is also reported after power-on, any commanded start command described in 3.3.4 section and after exiting sleep mode. In this case version numbers message is used for notification that Orion's initialization sequence is complete and it is ready to accept commands.

The version numbers can be read by using the following command:

$PUNV,GETCONFIG,09*48

The answer is as follows:

$PUNV,CFG_R,09,*Orion*,*UBP*,*BB*,*Flash*,*RF-IC*,*RF-mode*,*DeviceID*,*TCXO-PPB*,*TCXO-Freqcc**

Orion is the Orion version string

UBP is the UBP version number

BB is the baseband type

Flash is the flash type

DeviceID is the device identifier (hexadecimal number)

RF-IC, ***RF-mode*** and ***RF-CS*** are the RF type (these can be written by the user)

TCXO-PPB is the TCXO uncertainty (this can be written by the user)

TCXO-Freq is the TCXO frequency (this can be written by the user)

In case of failure of execution of this command the receiver sends `ERR` reply message. Please see ERR section for details.

3.4.4 Algorithm Configuration

Algorithm configuration is used to deliver configurable algorithm information to navigation core.

The current algorithm configuration can be read in the system with the following command:

$PUNV,GETCONFIG,11*41

The answer is as follows:

$PUNV,CFG_R,11,*Sbas*,*Prefilter*,*RaimMode*,*NavMode*,*Postfilter*,*MinEleSoft*,*MinEleHard*,*AltAiding*,*AltAidingValue*,*Environment*,*IntervalEphe*,*IntevalAlm*,*IntervalIono*,*MeasPseVar*,*MeasDopVar*,*ProcessSpVar*,*ProcessSgVar*,*ProcessSfVarcc**

The configuration command template for algorithm configuration is as follows:

$PUNV,CONFIG,11,*Sbas*,*Prefilter*,*RaimMode*,*NavMode*,*Postfilter*,*MinEleSoft*,*MinEleHard*,*AltAiding*,*AltAidingValue*,*Environment*,*IntervalEphe*,*IntevalAlm*,*IntervalIono*,*MeasPseVar*,*MeasDopVar*,*ProcessSpVar*,*ProcessSgVar*,*ProcessSfVarcc**

or

$PUNV,SET,11,*Sbas*,*Prefilter*,*RaimMode*,*NavMode*,*Postfilter*,*MinEleSoft*,*MinEleHard*,*AltAiding*,*AltAidingValue*,*Environment*,*IntervalEphe*,*IntevalAlm*,*IntervalIono*,*MeasPseVar*,*MeasDopVar*,*ProcessSpVar*,*ProcessSgVar*,*ProcessSfVarcc**

Table 3-7 Algorithm configuration

Name	Format	Valid values	Default value	Description
Sbas	Decimal number	`0,1`	`1`	SBAS master control: `0` - SBAS is switched off, `1` - SBAS is switched on.
Prefilter	Hexadecimal number	`0,1`	`1`	Pre-filter selection: `0` – no pre-filter `1` – carrier smooth

Name	Format	Valid values	Default value	Description
RaimMode	Hexadecimal number	Bit-field of 1,2,4,8,10,20,40,80,100,200,400	7FF	RAIM mode: 0x001 – code phase 0x002 - TOW 0x004 – elevation 0x008 – Doppler difference 0x010 – pseudo range in range 0x020 – pseudo range differ 0x040 – pseudo range change 0x080 – gross pseudo range 0x100 – gross Doppler 0x200 – gross correlation 0x400 - power
NavMode	Decimal number	1,2,3	2	Navigation mode: 1 - Least square estimation (LSE) 2 - weighted LSE 3 - Kalman
Postfilter	Hexadecimal number	Bit-field of 1,2,4,8,10	1F	Post-filter selection: 0x01 – position filter 0x02 – velocity filter 0x04 – altitude filter 0x08 – clock filter 0x10 – heading filter
MinEleSoft	Decimal number	0…45	5	Minimum soft elevation angle for used satellites (in degrees)
MinEleHard	Decimal number	0…45	2	Minimum hard elevation angle for used satellites (in degrees)
AltAiding	Decimal number	0,1	0	Altitude aiding: 0 – use altitude aiding value 1 – do not use altitude aiding value
AltAidingValue	Decimal number	≤20000	0	Altitude aiding value in respect to geoid (in meters)
Environment	Decimal number	0,1,2	0	Measurement qualification parameter: 0 – open sky 1 – urban canyon 2 – indoor
IntervalEphe	Decimal number	0,1,2	1	Ephemeris store interval: 0 – do not store 1 – when new available 2 – only by external command
IntervalAlm	Decimal number	0,1,2	1	Almanac store interval: 0 – do not store 1 – when new available 2 – only by external command
IntervalIono	Decimal number	0,1,2	1	UTC & Ionospheric data store interval: 0 – do not store 1 – when new available 2 – only by external command
MeasPseVar	Decimal with fractional part	Any	9.0	Measurement covariance for pseudo range
MeasDopVar	Decimal with fractional part	Any	1.0	Measurement covariance
ProcessSpVar	Decimal with fractional part	Any	0.5	Process covariance

Name	Format	Valid values	Default value	Description
ProcessSgVar	Decimal with fractional part	Any	`0.01`	Process covariance
ProcessSfVar	Decimal with fractional part	Any	`0.01`	Process covariance

In case of successful execution of

$PUNV,CONFIG,11,*Sbas*,*Prefilter*,*RaimMode*,*NavMode*,*Postfilter*,*MinEleSoft*,*MinEleHard*,*AltAiding*,*AltAidingValue*,*Environment*,*IntervalEphe*,*IntevalAlm*,*IntervalIono*,*MeasPseVar*,*MeasDopVar*,*ProcessSpVar*,*ProcessSgVar*,*ProcessSfVarcc**

command the receiver sends confirmation in a following form:

$PUNV,CFG_S,11*53

In case of failure of execution of `GETCONFIG`, `CONFIG` or `SET` command the receiver sends `ERR` reply message. Please see ERR section for details.

3.4.5 SBAS Configuration

SBAS configuration is used to configure SBAS functionality.

The current SBAS configuration can be read in the system with the following command:

$PUNV,GETCONFIG,11*41

Please see section 3.4.4 describing the response to this command.

SBAS functionality can be switched on or off by following command

$PUNV,CONFIG,SBAS,*Statuscc**

or

$PUNV,SET,SBAS,*Statuscc**

Table 3-8 SBAS configuration

Name	Format	Valid values	Default value	Description
Status	String	`ON`, `OFF`	`ON`	SBAS status: `ON` – SBAS is switched on, `OFF`- SBAS is switched off.

In case of successful execution of

$PUNV,CONFIG,SBAS,*Statuscc**

command, the receiver sends confirmation in a following form:

$PUNV,CFG_S,11*53

In case of failure of execution of GETCONFIG, CONFIG or SET command the receiver sends ERR reply message. Please see ERR section for details.

3.4.6 Datum Configuration

Datum configuration is used to select the output datum.

The current configuration can be read in the system by the following command:

$PUNV,GETCONFIG,13*43

The answer is as follows:

$PUNV,CFG_R,13,*Dx*,*Dy*,*Dz*,*Da*,*Df*,*Name*,*Idcc**

The configuration command template for custom datum is as follows:

$PUNV,CONFIG,13,*Dx*,*Dy*,*Dz*,*Da*,*Df*,*Namecc**

or

$PUNV,SET,13,*Dx*,*Dy*,*Dz*,*Da*,*Df*,*Namecc**

To select one of the predefined data, the syntax is as follows:

$PUNV,CONFIG,16,*Idcc**

or

$PUNV,SET,16,*Idcc**

Table 3-9 Datum configuration

Name	Format	Valid values	Default value	Description
Dx	Decimal	$-2^{15}-1 \ldots 2^{15}-1$	0	Datum centre X shift in respect to WGS84 ellipsoid (in meters).
Dy	Decimal	$-2^{15}-1 \ldots 2^{15}-1$	0	Datum centre Y shift in respect to WGS84 ellipsoid (in meters).
Dz	Decimal	$-2^{15}-1 \ldots 2^{15}-1$	0	Datum centre Z shift in respect to WGS84 ellipsoid (in meters).
Da	Decimal with fractional part	>0	6378137	Datum semi-major axis (in meters).
Df	Fractional decimal	0…1	0.003352810664	Flattening of datum.
Name	String up to 8 characters long	Please see Appendix A - Datum codes for possible datum names.	WGS84	The name of the selected datum.
Id	Decimal	Please see Appendix A - Datum codes for possible ID numbers.	1	Identifier of a pre-defined datum.

In case of successful execution of

$PUNV,CONFIG,13,*Dx*,*Dy*,*Dz*,*Da*,*Df*,*Namecc**

and

$PUNV,CONFIG,16,*Idcc**

commands the receiver sends confirmation in a following form:

$PUNV,CFG_S,13*51

In case of failure of execution of `GETCONFIG`, `CONFIG` or `SET` command the receiver sends `ERR` reply message. Please see ERR section for details.

Examples:

Default settings:

$PUNV,CONFIG,16,1*0D

3.4.7 Position Pinning Configuration

Position pinning configuration is for static case parameter configuration.

The current configuration can be read in the system by the following command:

$PUNV,GETCONFIG,17*47

The answer is as follows:

$PUNV,CFG_R,17,*Position threshold*,*Velocity threshold*,*Position update timeout*,*Deep mode delay*,*2D reacquisition 2D all 2D cold* *cc

The configuration command template for control configuration is as follows:

$PUNV,CONFIG,17,*Position threshold*,*Velocity threshold*, *Position update timeout*,*Deep mode delay*,*2D reacquisition 2D all 2D coldcc**

or

$PUNV,SET,17,*Position threshold*,*Velocity threshold*,*2D reacquisition 2D all 2D coldcc**

Table 3-10 Position pinning parameters

Name	Format	Valid values	Default value	Description
Position threshold	Decimal with fractional part	≥0	50	The threshold value for position jump. Position pinning will be disabled if this value is reached (in meters). Zero values for position and velocity thresholds effectively mean that position pinning is disabled.

Name	Format	Valid values	Default value	Description
Velocity threshold	Decimal with fractional part	≥0	1	The threshold value for velocity calculation. Position pinning will be disabled if this value is reached (in meters per second). Zero values for position and velocity thresholds effectively mean that position pinning is disabled.
Position update timeout	Decimal	>0	120	In position pinning mode, pinned position is updated based on this timeout (in seconds).
Deep mode delay	Decimal	≥0	600	When in position pinning mode, deep pinning mode is activated after this delay (in seconds). If 0, then deep pinning mode is disabled.
2D reacquisition	Hexadecimal	0,1	0	Indicates if 2D start-up mode is enabled in reacquisition: 0 – disabled, 1 – enabled. Please see usage examples below.
2D all	Hexadecimal	0,1	0	Indicates if 2D start-up mode is enabled in all start modes except COLD start: 0 – disabled, 1 – enabled. Please see usage examples below.
2D cold	Hexadecimal	0,1	0	Indicates if 2D start-up mode is enabled in COLD start: 0 – disabled, 1 – enabled. Please see usage examples below.

In case of successful execution of

$PUNV,CONFIG,17,*Position threshold*,*Velocity threshold*, *Position update timeout*,*Deep mode delay*,*2D reacquisition* *2D all* *2D coldcc**

command the receiver sends confirmation in a following form:

$PUNV,CFG_S,17*55

In case of failure of execution of GETCONFIG, CONFIG or SET command the receiver sends ERR reply message. Please see ERR section for details.

Examples:

Default settings:

$PUNV,CONFIG,17,50,1,120,600,0*cc

Default settings plus enabling 2D start-up mode for reacquisition only:

$PUNV,CONFIG,17,50,1,120,600,4*cc

Default settings plus enabling 2D start-up mode for all start modes only, except COLD start:

$PUNV,CONFIG,17,50,1,120,600,2*cc

Default settings plus enabling 2D start-up mode for cold start mode only:

$PUNV,CONFIG,17,50,1,120,600,1*cc

Default settings plus enabling 2D start-up mode for all cases:

$PUNV,CONFIG,17,50,1,120,600,7*cc

4 STANDARD NMEA SENTENCES

Orion supports the following standard NMEA messages: `DTM`, `GGA`, `GLL`, `GSA`, `GSV`, `RMC`, `VTG` and `ZDA`.

The following format conventions have been used, in accordance with the NMEA standard:

- When a null field is used to indicate unavailability of data, also the field for the unit of measure is formatted as a null field
- Three digits are always used for decimal-fraction of seconds in UTC time
- Four digits are always used for decimal-fraction of minutes in latitude and longitude
- `DTM`: Six digits are always used for decimal-fraction of latitude and longitude offsets. Two digits are always used for decimal-fraction of altitude offset.
- `GGA`: UTC field starts from zero time and changes to measured time when measurement is available (a debugging feature). The number of satellites is always reported with two digits with leading zero when necessary.
- `GLL`: UTC time field as in `GGA`
- `GSA`: satellite ID numbers are in range `0-99`. They are always reported with two digits with leading zero when necessary
- `GSV`: no implementation-specifics
- `RMC`: UTC time field as in `GGA`, course and speed over ground as in `VTG`
- `VTG`: course over ground is reported with `0.1` degree precision, speed over ground is reported with `0.1` unit precision for both knots and km/h fields. In case of speed equals zero, the heading is reported as null.
- `ZDA`: Local zone hours are always presented as the user has configured them. The default configuration is `0`. The hour zone is reported always by two digits (with

leading zero when necessary), and with leading minus sign when necessary. Local zone minutes are always presented with two digits (with leading zero when necessary). UTC time field as in GGA.

5 APPENDIX A - DATUM CODES

ID NMBR	NAME	Region of use
0	"000"	User defined
1	"WGS84"	Global
2	"ADI-M"	Ethiopia; Sudan
3	"ADI-E"	Burkina Faso
4	"ADI-F"	Cameroon
5	"ADI-A"	Ethiopia
6	"ADI-C"	Mali
7	"ADI-D"	Senegal
8	"ADI-B"	Sudan
9	"AFG"	Somalia
10	"AIN-A"	Bahrain
11	"AIN-B"	Saudi Arabia
12	"AMA"	American Samoa Islands
13	"ANO"	Cocos Islands
14	"AIA"	Antigua (Leeward Islands)
15	"ARF-A"	Botswana
16	"ARF-H"	Burundi
17	"ARF-B"	Lesotho
18	"ARF-C"	Malawi
19	"ARF-M"	MEAN FOR Botswana; Lesotho; Malawi; Swaziland; Zaire; Zambia; Zimbabwe
20	"ARF-D"	Swaziland
21	"ARF-E"	Zaire
22	"ARF-F"	Zambia
23	"ARF-G"	Zimbabwe
24	"ARS-M"	MEAN FOR Kenya; Tanzania
25	ARS-A	Kenya
26	"ARS-B"	Tanzania
27	"ASC"	Ascension Island
28	"ATF"	Iwo Jima
29	"SHB"	St Helena Island
30	"TRN"	Tern Island
31	"ASQ"	Marcus Island

ID NMBR	NAME	Region of use
32	"AUA"	Australia; Tasmania
33	"AUG"	Australia; Tasmania
34	"PHA"	Djibouti
35	"IBE"	Efate & Erromango Islands
36	"BER"	Bermuda
37	"BID"	Guinea-Bissau
38	"BOO"	Colombia
39	"BUR"	Indonesia (Bangka & Belitung Ids)
40	"CAZ"	Antarctica (McMurdo Camp Area)
41	"CAI"	Argentina
42	"CAO"	Phoenix Islands
43	"CAP"	South Africa
44	"CAC"	Bahamas; Florida
45	"CGE"	Tunisia
46	"CHI"	New Zealand (Chatham Island)
47	"CHU"	Paraguay
48	"COA"	Brazil
49	"DAL"	Guinea
50	"DID"	Deception Island; Antarctica
51	"BAT"	Indonesia (Sumatra)
52	"GIZ"	New Georgia Islands (Gizo Island)
53	"EAS"	Easter Island
54	"EST"	Estonia
55	"EUR-E"	Cyprus
56	"EUR-F"	Egypt
57	"EUR-G"	England; Channel Islands; Scotland; Shetland Islands
58	"EUR-K"	England; Ireland; Scotland; Shetland Islands
59	"EUR-C"	Finland; Norway
60	"EUR-B"	Greece
61	"EUR-H"	Iran
62	"EUR-I"	Italy (Sardinia)
63	"EUR-J"	Italy (Sicily)
64	"EUR-L"	Malta
65	"EUR-M"	MEAN FOR Austria; Belgium; Denmark; Finland; France; W Germany; Gibraltar; Greece; Italy; Luxembourg; Netherlands; Norway; Portugal; Spain; Sweden; Switzerland
66	"EUR-A"	MEAN FOR Austria; Denmark; France; W Germany; Netherlands; Switzerland
67	"EUR-S"	MEAN FOR Iraq; Israel; Jordan; Lebanon; Kuwait; Saudi Arabia; Syria

ID NMBR	NAME	Region of use
68	"EUR-D"	Portugal; Spain
69	"EUR-T"	Tunisia
70	"EUS"	MEAN FOR Austria; Finland; Netherlands; Norway; Spain; Sweden; Switzerland
71	"FOT"	Nevis; St. Kitts (Leeward Islands)
72	"GAA"	Republic of Maldives
73	"GEO"	New Zealand
74	"GRA"	Azores (Faial; Graciosa; Pico; Sao Jorge; Terceira)
75	"GUA"	Guam
76	"GSE"	Indonesia (Kalimantan)
77	"DOB"	Guadalcanal Island
78	"HEN"	Afghanistan
79	"HER"	Croatia -Serbia, Bosnia-Herzegovina
80	"HJO"	Iceland
81	"HKD"	Hong Kong
82	"HTN"	Taiwan
83	"IND-B"	Bangladesh
84	"IND-I"	India; Nepal
85	"IND-P"	Pakistan
86	"INF-A"	Thailand
87	"ING-B"	Vietnam (Con Son Island)
88	"ING-A"	Vietnam (Near 16øN)
89	"INH-A1"	Thailand
90	"IDN"	Indonesia
91	"IRL"	Ireland
92	"ISG"	South Georgia Islands
93	"IST"	Diego Garcia
94	"JOH"	Johnston Island
95	"KAN"	Sri Lanka
96	"KEG"	Kerguelen Island
97	"KEA"	West Malaysia & Singapore
98	"KUS"	Caroline Islands
99	"KGS"	South Korea
100	"LCF"	Cayman Brac Island
101	"LEH"	Ghana
102	"LIB"	Liberia
103	"LUZ-A"	Philippines (Excluding Mindanao)
104	"LUZ-B"	Philippines (Mindanao)
105	"MPO"	Gabon
106	"MIK"	Mahe Island

ID NMBR	NAME	Region of use
107	"MAS"	Ethiopia (Eritrea)
108	"MER"	Morocco
109	"MID"	Midway Islands
110	"MIN-A"	Cameroon
111	"MIN-B"	Nigeria
112	"ASM"	Montserrat (Leeward Islands)
113	"NAH-A"	Oman (Masirah Island)
114	"NAH-C"	Saudi Arabia
115	"NAH-B"	United Arab Emirates
116	"NAP"	Trinidad & Tobago
117	"NAS-D"	Alaska (Excluding Aleutian Ids)
118	"NAS-V"	Alaska (Aleutian Ids East of 180øW)
119	"NAS-W"	Alaska (Aleutian Ids West of 180øW)
120	"NAS-Q"	Bahamas (Except San Salvador Id)
121	"NAS-R"	Bahamas (San Salvador Island)
122	"NAS-F"	Canada (Alberta; British Columbia)
123	"NAS-H"	Canada (Manitoba; Ontario)
124	"NAS-G"	Canada (New Brunswick; Newfoundland; Nova Scotia; Quebec)
125	"NAS-I"	Canada (Northwest Territories; Saskatchewan)
126	"NAS-J"	Canada (Yukon)
127	"NAS-O"	Canal Zone
128	"NAS-T"	Cuba
129	"NAS-U"	Greenland (Hayes Peninsula)
130	"NAS-P"	MEAN FOR Antigua; Barbados; Barbuda; Caicos Islands; Cuba; Dominican Republic; Grand Cayman; Jamaica; Turks Islands
131	"NAS-N"	MEAN FOR Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua
132	"NAS-E"	MEAN FOR Canada
133	"NAS-C"	MEAN FOR CONUS
134	"NAS-A"	MEAN FOR CONUS (East of Mississippi; River Including Louisiana; Missouri; Minnesota)
135	"NAS-B"	MEAN FOR CONUS (West of Mississippi; River Excluding Louisiana; Minnesota; Missouri)
136	"NAS-L"	Mexico
137	"NAR-A"	Alaska (Excluding Aleutian Ids)
138	"NAR-E"	Aleutian Ids
139	"NAR-B"	Canada
140	"NAR-C"	CONUS
141	"NAR-H"	Hawaii
142	"NAR-D"	Mexico; Central America

ID NMBR	NAME	Region of use
143	"NSD"	Algeria
144	"FLO"	Azores (Corvo & Flores Islands)
145	"OEG"	Egypt
146	"OHA-A"	Hawaii
147	"OHA-B"	Kauai
148	"OHA-C"	Maui
149	"OHA-M"	MEAN FOR Hawaii; Kauai; Maui; Oahu
150	"OHA-D"	Oahu
151	"FAH"	Oman
152	"OGB-A"	England
153	"OGB-B"	England; Isle of Man; Wales
154	"OGB-M"	MEAN FOR England; Isle of Man; Scotland; Shetland Islands; Wales
155	"OGB-C"	Scotland; Shetland Islands
156	"OGB-D"	Wales
157	"PLN"	Canary Islands
158	"PIT"	Pitcairn Island
159	"PTB"	MEAN FOR Burkina Faso & Niger
160	"PTN"	Congo
161	"POS"	Porto Santo; Madeira Islands
162	"PRP-A"	Bolivia
163	"PRP-B"	Chile (Northern; Near 19øS)
164	"PRP-C"	Chile (Southern; Near 43øS)
165	"PRP-D"	Colombia
166	"PRP-E"	Ecuador
167	"PRP-F"	Guyana
168	"PRP-M"	MEAN FOR Bolivia; Chile; Colombia; Ecuador; Guyana; Peru; Venezuela
169	"PRP-G"	Peru
170	"PRP-H"	Venezuela
171	"HIT"	Chile (Near 53øS) (Hito XVIII)
172	"PUR"	Puerto Rico; Virgin Islands
173	"PUK"	Russia
174	"QAT"	Qatar
175	"QUO"	Greenland (South)
176	"REU"	Mascarene Islands
177	"EUR-I"	Italy (Sardinia)
178	"SPK-A"	Hungary
179	"SPK-B"	Poland
180	"SPK-C"	Czechoslovakia
181	"SPK-D"	Latvia
182	"SPK-E"	Kazakhstan

ID NMBR	NAME	Region of use
183	"SPK-F"	Albania
184	"SPK-G"	Romania
185	"CCD"	Czechoslovakia (Prior 1 JAN 1993)
186	"SAE"	Espirito Santo Island
187	"SAO"	Azores (Sao Miguel; Santa Maria Ids)
188	"SAP"	East Falkland Island
189	"SCK"	Namibia
190	"SGM"	Salvage Islands
191	"SRL"	Sierra Leone
192	"SAN-A"	Argentina
193	"SAN-B"	Bolivia
194	"SAN-C"	Brazil
195	"SAN-D"	Chile
196	"SAN-E"	Colombia
197	"SAN-F"	Ecuador
198	"SAN-J"	Ecuador (Baltra; Galapagos)
199	"SAN-G"	Guyana
200	"SAN-M"	MEAN FOR Argentina; Bolivia; Brazil; Chile; Colombia; Ecuador; Guyana; Paraguay; Peru; Trinidad & Tobago; Venezuela
201	"SAN-H"	Paraguay
202	"SAN-I"	Peru
203	"SAN-K"	Trinidad & Tobago
204	"SAN-L"	Venezuela
205	"SOA"	Singapore
206	"TAN"	Madagascar
207	"TIL"	Brunei; E. Malaysia (Sabah Sarawak)
208	"TOY-A"	Japan
209	"TOY-M"	MEAN FOR Japan; South Korea; Okinawa
210	"TOY-C"	Okinawa
211	"TOY-B"	South Korea
212	"TDC"	Tristan da Cunha
213	"MVS"	Fiji (Viti Levu Island)
214	"VOR"	Algeria
215	"WAK"	Wake Atoll
216	"ENW"	Marshall Islands
217	"WGS72"	Global Definition
218	"YAC"	Uruguay
219	"ZAN"	Suriname
220	–	Reserved
221	"KKJ"	Finland