



**GPS/GLONASS/GALILEO/COMPASS
NV08C RECEIVERS**

**NMEA
PROTOCOL SPECIFICATION**

Version 1.4

Revision History

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1.0	Feb, 2011	First release of the document
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1.2	March, 2011	PASET and PKON1 examples edited
1.3	May, 2012	\$POTST test message added General editing
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1 NMEA Protocol Overview

Communication with NV08C series receivers by means of NMEA messages are based on NMEA 0183 Version 4.00 specification. The NMEA 0183 protocol specification for Interfacing Marine Electronic Devices may be obtained from <http://www.nmea.org>.

The NMEA 0183 Protocol is a simple, yet comprehensive ASCII protocol which defines both the communication interface and the data format. The protocol was originally established to enable marine navigation equipment to share information. Since it is a well-established industry standard, NMEA 0183 has also gained popularity for use in applications other than marine electronics. This document provides an overview of the NMEA 0183 messages and describes both the standard and proprietary messages offered by the NV08C receiver series.

1.1 Serial Communication Port

Data transfers are performed via a RS-232C (COM) serial interface. The default COM-port settings for NMEA 0183 data transmission over a bidirectional serial RS-232C port are shown in the [Table 1](#) below.

Table 1. Default COM-port settings for NMEA 0183 data transmissions

Start Bits	1
Data Bits	8
Parity	None (Disabled)
Flow control	None
Stop Bits	1

The transfer rate can be set in a range of 4,800 to 230,400 bits per second. By default the rate is set to 115,200 bits per second and can be changed by PIO configuration and/or by NMEA or BINR messages.

All transmitted data are represented by characters of the ASCII (ISO 8859-1) code.

The highest bit of the 8-bit sign is always transmitted as "0".

1.2 NMEA Protocol Messages Format

There are two major types of NMEA messages supported by the NMEA protocol: Approved (Standard) messages and Proprietary (Additional) messages. Standard messages are defined by the NMEA standard while Proprietary messages are set by GNSS receiver manufacturers and are based on NMEA standard regulations. Standard messages are sent by a navigation receiver by default or as a reply to a Query sentence (Q). Proprietary messages may be defined as incoming (Input), outgoing (Output) or both.

The following drawing shows the structure of a NMEA protocol message:

NMEA Message Frame					
\$	Address,		{<value>}	*<checksum>	<CR><LF>
	← Checksum range →				
Start character	Address field. Divided into 2 fields		Data fields	Checksum field	End sequence
	Talker ID	Message ID			
1 character	Only Digits and uppercase letters. Address field shall not be a null field		Length may vary	3 characters	2 characters
"\$" only (code 24h)	GP, GL, GN, GA or P for proprietary messages	See Messages Description below	Fields (even empty) are delimited by ",", (code 2Ch)	Starts with "*" (code 2Ah). 2 ASCII characters representing hex number for checksum. Checksum is exclusive OR of all characters between "\$" and "*"	<CR><LF> (codes 0Dh and 0Ah) only
EXAMPLE					
\$	GP	VTG,	089.0,T,,,15.2,N,,	*7F	<CR><LF>
\$GNGNS,122310.0,3722.425671,N,12258.856215,W,AA,15,0.9,1005.543,6.5,,*77<CR><LF>					

NMEA 0183 messages vary in length, but each message is limited to a maximum of 79 characters between the starting delimiter "\$" and the terminating sequence <CR><LF>.

Address Fields

The Address field is divided into 2 fields. The first field of standard (output) messages must be 2 characters representing Taker ID: "GP" for GPS, "GL" – GLONASS, "GA" – GALILEO and "GN" for combined navigation solution (if information of more than one satellite navigation system is used for data generation). The second field of standard (output) messages must be 3 characters representing Sentence ID. Please refer to messages Message Description for further information regarding Talker ID and Sentence ID.

The first character of the Address field of Proprietary messages should be the character "P" followed by Sentence ID.

The query message address field consists of five characters and is used for the purpose of requesting transmission of a specific message(s). The first two characters are the Talker Identifier of the device requesting data, the next two characters are the Talker ID of the device being addressed (navigation receiver) and the final character is the query character "Q".

Address field of the messages must contain only digits and uppercase letters and cannot be "null".

Data fields

A data field consists of a string of valid characters (or no characters - null field) between two delimiters ";". The string length may be fixed or variable. If a particular data field has zero length then only delimiter represents this field.

According to NMEA 0183 Latitude and Longitude are transmitted in the format Degrees, Minutes and (Decimal) Fractions of Minutes. Time is transmitted in the format Hours, Minutes, Seconds and (Decimal) Fractions of Seconds. Fractions are delimited by ".". Both fractions and delimiter "." are optional.

Some (defined) fields are specified to contain pre-defined constants, most often alphabetic characters. Such fields are indicated in the NMEA standard by the presence of one or more valid characters. Excluded from the list of allowable characters are the following characters that are used to indicate field types: "A", "a", "c", "hh", "hhmmss.ss", "llll.ll", "x", "yyyy.yy"

Table 2. Message Data Fields Description

Field Type	Symbol	Definition
Status	A	Field length is one character. Position Fix Flag. Please refer to the Message Description in Table 3 .
Latitude	llll.lll	Fixed/variable length field. Degrees,Minutes,Decimal Fraction of Minutes - 2 digits for Degrees, 2 digits for Minutes and a variable number of digits for Decimal Fraction of Minutes. Leading zeros always included for Degrees and Minutes to maintain fixed length of the Degrees and Minutes fields. The decimal point and associated decimal-fraction are optional if full resolution is not required.
Longitude	yyyyy.yyy	Fixed/variable length field. Degrees,Minutes,Decimal Fraction of Minutes - 3 digits for Degrees, 2 digits for Minutes and a variable number of digits for Decimal Fraction of Minutes. Leading zeros always included for Degrees and Minutes to maintain fixed length of the Degrees and Minutes fields. 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 Fraction of Seconds - 2 digits for Hours, 2 digits for Minutes, 2 digits for Seconds and a variable number of digits for Decimal Fraction of Seconds. Leading zeros always included for Hours, Minutes and Seconds to maintain fixed length of the fields. The decimal point and associated decimal-fraction are optional if full resolution is not required.

Field Type	Symbol	Definition
Numeric Value Fields		
Variable length number	x.x	Variable length field for integer or fractional numbers. Leading and trailing zeroes are optional. The decimal point and associated decimal-fraction are optional if full resolution is not required (for example: 73.00 = 73.0 = 073.0 = 73). The specific use of this formatter and restrictions (for example; integer, range) is defined in the sentence definition.
Fixed length number	xx	Fixed length numbers, only decimal characters allowed
Fixed HEX	hh	Fixed length hexadecimal numbers only, Most significant bit (MSB) on the left
Variable HEX	h--h	Variable length hexadecimal numbers only, MSB on the left
Field Type	Symbol	Definition
Information Fields		
Fixed Alphabetic	aa	Fixed length field of upper-case or lower-case alphabetic characters
Variable length text	c--c	Variable length field of valid characters
Fixed length text	cc	Fixed length field of valid characters

Note 1 – Spaces may only be used in variable text fields.

Note 2 – A negative sign "-" (HEX 2D) is the first character in a Field if the value is negative. When it used, then this increments the specified size of fixed length fields by one. The sign is omitted if the value is positive.

Note 3 – Fixed length field definitions show the actual number of characters. For example: a field defined to have a fixed length of 5 HEX characters is represented as hhhhh between delimiters in a sentence definition.

Checksum

A checksum field is required and shall be transmitted in all sentences. The checksum field is the last field in a sentence and follows the checksum delimiter character "*".

The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including ",", delimiters, between but not including the "\$" and the "*" delimiters. The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII characters (0-9, A-F (upper case)) for transmission. The most significant character is transmitted first.

2 NMEA Protocol Implementation

2.1 Data output cyclogram

Typically the receiver transmits messages each time it obtains the next navigation solution (each time new PVT is calculated). Data values of navigation solution corresponding to a time pulse N (see [Figure 1](#)) are sent in the *packet of messages N* approximately 100 ms after the time pulse. If a single output message is requested then the response message should appear in max 100 msec if no other messages are being transmitted at the same time.

If data output rate is set to 10 Hz then the data output starts in no later than 10 msec after the time pulse and extrapolation from the previous fix is used as current data.

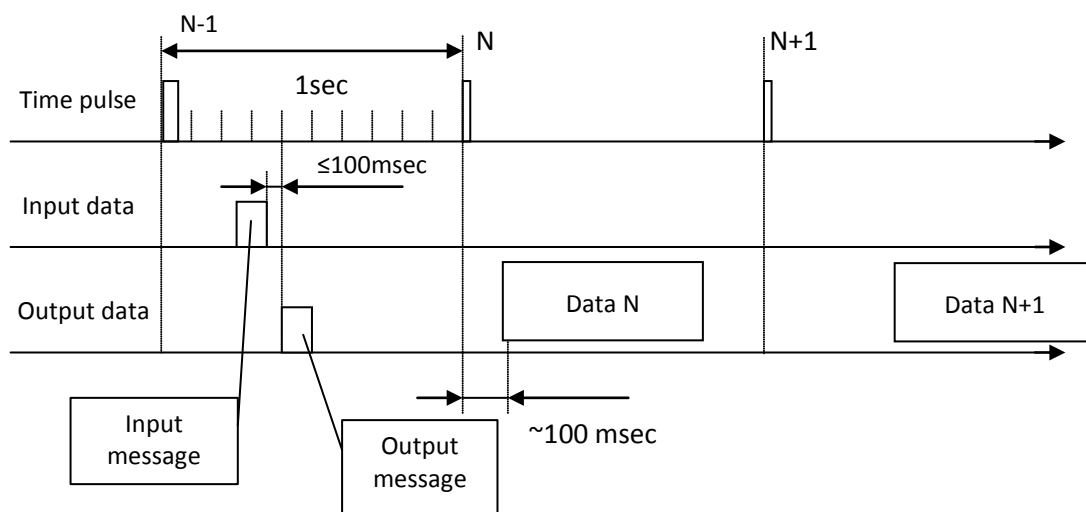


Figure 1. Data output cyclogram

The messages are transmitted in the same sequence as they were requested. The maximum number of output messages is 20. To avoid data omission the requested data rate shall match the communication channel and receiver capabilities.

If a port communication protocol change or rate change is requested (by a [PORZA – COM Port Setting](#) message) then a PORZA response message with new settings will be generated by a receiver. This PORZA response message has no priority and will be sent in the same order as the messages were requested. The receiver will change the settings within 100 msec after the PORZA output message is generated.

2.2 Geodetic Datum reference

The NV08C receiver provides data in a selected local Geodetic Datum. The following Geodetic Datums are available: WGS 84, PZ 90, SK 42, SK 95, PZ 90.02 as well as user defined geodetic datum. Information regarding the selected local geodetic datum and datum offset from a reference datum may be obtained using the NMEA DTM message. The reference datum is always WGS 84 and cannot be changed. Position in the local datum is offset from the position in the reference datum as shown in the following equation:

$$P_{\text{local datum}} = P_{\text{ref datum}} + \text{Offset}$$

Latitude and longitude offsets are always positive numbers while the altitude offset may be negative.

Position data in Gauss-Kruger rectangular projection are available in the PORZE message.

2.3 Talker ID

According to the NMEA 0183 protocol, the Talker ID serves to define the navigation system(s) used for the reported position coordinates. If only GPS, GLONASS, GALILEO etc. are used for the reported position solution the Talker ID is GP, GL, GA etc. and the errors pertain to the individual system. If satellites from multiple systems are used to obtain the reported position solution, the Talker ID is GN and the errors pertain to the combined solution.

To allow customers to use software developed for interfacing GPS-only receivers a Compatibility mode is included in the communication protocol. In this mode the Talker ID of GGA, RMC, DTM, GLL, VTG and ZDA messages is set to "GP" regardless of which system satellites are used for the reported position. The Compatibility mode may be enabled or disabled by using a PONME message.

2.4 Specific Output Data Attributes

The accuracy of output data (number of decimal digits after fixed point in fractional numbers) for Latitude, Longitude and Time can be set by using a PONME message.

If required a local time and date shift can be set by using the PKON1 message. If the time shift was preset then all messages (except of ZDA messages) transmit time and date calculated for the local time.

The local time shift and local datum must be set up individually for both the NMEA and BINR protocol, and for each of the receiver's communication ports.

The GGA message (Time, position and fix related data for a GPS receiver) transmits combined positioning data obtained by multiple navigation systems (GNSS), as opposed to the NMEA 0183 standard which specifies only GPS as a source for data calculation.

2.5 Navigation Receiver Default Settings

- Local geodetic datum – WGS 84
- Time – UTC
- Altitude – re: mean-sea-level (geoid)

2.6 Position Fix Flag

Position Fix Flag field Message Description for messages GLL, RMC, GGA, GSA, GNS, VTG is provided in [Table 3](#).

Table 3. Position Fix Flag fields

NMEA Message: Field	No position fix	No position fix. Estimated data only	2D position fix	3D position fix
GLL, RMC: Status	V	V	A	A
	A=Data Valid, V=Data Invalid (Navigation Receiver Warning)			
GGA: Quality Indicator	0	6	1 / 2	1 / 2
	0=Fix not available/invalid, 1=GPS SPS Mode, Fix valid, 2=Differential GPS, SPS Mode, Fix Valid, 6=Estimated (Dead Reckoning) Mode			
GSA: Nav Mode	1	1	2	3
	1=Fix Not available, 2=2D Fix, 3=3D Fix			
GLL, GNS, RMC, VTG: Mode Indicator	N	E	A / D	A / D
	N=No Fix, A=Autonomous GNSS Fix, D=Differential GNSS Fix, E=Estimated/Dead Reckoning Fix			

2.7 Supported NMEA Messages Overview

NMEA messages supported by NV08C series receivers are listed in [Table 4](#).

Table 4. Supported NMEA messages

Message ID	Reference	Message Description	Message Type
Standard (Approved messages)			
DTM	3.1	DTM – Datum Reference	Output
GBS	3.2	GBS – RAIM GNSS Satellite Fault Detection	Output
GGA	3.3	GGA – Global Positioning System Fix Data	Output
GLL	3.4	GLL – Geographic Position – Latitude/Longitude	Output
GNS	3.5	GNS – GNSS Fix Data	Output
GSA	3.6	GSA – GNSS DOP and Active Satellites	Output
GSV	3.7	GSV – GNSS Satellites In View	Output
RMC	3.8	RMC – Recommended Minimum Specific GNSS Data	Output
VTG	3.9	VTG – Course over Ground & Ground Speed	Output
ZDA	3.10	ZDA – Time & Date	Output
Q	3.11	Q – Query Message	Query
Proprietary messages			
ALVER	4.1	ALVER – Receiver and FW information	Output
PAMOD	4.2	PAMOD – Timing Mode Related Parameters	Output
PASET	4.3	PASET – Set of Timing Mode Parameters	Input
PKON1	4.4	PKON1 – Set of Receiver Configuration	Input
PNVTT	4.5	POTST – Test Results	Output
POCWT	4.6	POCWT – Tone Test Results	Output
POCWT	4.7	POCWT – Set Tone Test Parameters	Input
PONAV	4.8	PONAV – Navigation Solution Parameters	Input/Output
PONME	4.9	PONME – Set NMEA Communication Parameters	Input
POPPS	4.10	POPPS – Time Pulse Settings	Input/Output
POPWR	4.11	POPWR – Power Saving Mode	Input/Output
PORST	4.12	PORST – Force Receiver Reset	Input
PORZA	4.13	PORZA – COM Port Setting	Input/Output
PORZB	4.14	PORZB – Extended Query Message	Query
PORZD	4.15	PORZD – RMS Error of Coordinates	Output
PORZE	4.16	PORZE – Position in Gauss-Kruger Coordinate System	Output
PORZX	4.17	PORZX – Local datum, Satellite Constellations in use, Time Offset	Output

Message ID	Reference	Message Description	Message Type
POSST	4.18	POSST – Additional Receiver Parameter Settings	Input/Output
POUTC	4.19	POUTC – LEAP SECOND in use, Expected UTC Correction and SW Sawtooth Correction Data	Output

3 Standard (Approved) Messages

3.1 DTM – Datum Reference

Message Description

The DTM message provides the current local geodetic datum and datum offsets from the reference datum. The reference Datum cannot be changed and is always WGS 84 for the NV08C receiver.

This message is used to define the datum, which position location and geographic locations in subsequent messages are referenced to.

Latitude and longitude offsets are positive numbers, while the altitude offset may be negative or positive.

Position in the local datum is offset from the position in the reference datum as shown in the following equation:

$$P_{\text{local datum}} = P_{\text{ref datum}} + \text{Offset}$$

For all datum the DTM message should be transmitted prior to any datum change and periodically at intervals of not greater than 30 seconds.

Message Format

\$ aa DTM ,ccc ,a ,x.x,a ,x.x,a ,x.x ,ccc *hh <CR><LF>

1 2 3 4 5 6 7 8 9 10 11

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID (see chapter 2.3)
3	DTM	Message ID
4	ccc	Local datum code W84 = WGS84, P90 = PZ-90, S42 = SK42, S95 = SK95, P92 = PZ-90.02, User defined = 999
5	a	Local datum subdivision code A, P = local datum #1 B = local datum #2 C = local datum #3 D = local datum #4 E = local datum #5
6	x.x,a	x.x: Latitude offset, minutes, a: N (North) or S (South)
7	x.x,a	x.x: Longitude offset, minutes, a: E (East) or W (West)
8	x.x	Altitude offset, metres

#	Field	Format
9	ccc	Reference datum code, W84 = WGS 84
10	*hh	Checksum indicator ("*", code 2Ah) and checksum
11	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

\$ GP DTM ,W84 , ,00.0000,S,00.0000,E,00.0,W84 *42 <CR><LF>

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

3.2 GBS – RAIM GNSS Satellite Fault Detection

Message Description

The GBS message provides results of the Receiver Autonomous Integrity Monitoring (RAIM) function. Given that the GNSS receiver is tracking sufficient satellites to perform integrity checks on the positioning quality of the position solution, a message is required in order to report the output of this process to other systems and advise the system user. With the RAIM function in the GNSS receiver, the receiver can isolate faults to individual satellites and not use these in its position and velocity calculations. Also, the GNSS receiver can still track the satellite(s) and easily judge when returned within tolerance. This message is used for reporting such RAIM information. To perform this integrity function, the GNSS receiver must have at least two observables in addition to the minimum required for navigation. Normally these observables take the form of additional redundant satellites.

If only GPS, GLONASS, etc. is used for the reported position solution the Talker ID is “GP”, “GL”, etc. and the errors pertain to the individual system. If satellites from multiple systems are used to obtain the reported position solution the Talker ID is “GN” and the errors pertain to the combined solution.

Message Format

\$ aa GBS, hhmmss.s-s, x.x, x.x, x.x, xx, x.x, x.x, x.x *hh <CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID “GN” = GNSS “GP” = GPS “GL” = GLONASS
3	GBS	Message ID
4	hhmmss.s-s	Time of the fix associated with this message
5	x.x	Latitude Error Estimation
6	x.x	Longitude Error Estimation
7	x.x	Altitude Error Estimation
8	xx	PRN of most likely failed and therefore excluded satellite
9	x.x	Probability of missed detection for most likely failed satellite. Not in use. The field is empty.
10	x.x	Excluded Measurement Error Estimate (m)
11	x.x	Standard deviation of position
12	*hh	Checksum indicator (“*”, code 2Ah) and checksum
13	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

\$ GN GBS, 152835.00, 3.4, 3.8, 7.8 , , , , *54 <CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13

3.3 GGA – Global Positioning System Fix Data

Message Description

The GGA message outputs time, position and fix related data. The fix is based on all available GNSS. This message is similar to the GNS – GNSS Fix Data GNS message.

Message Format

\$ aa GGA ,hhmmss.s-s, llll.l-l,a ,yyyyy.y-y,a ,x ,xx ,x.x ,x.x,M ,x.x,M ,x.x,xxxx *hh <CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID (see chapter 2.3)
3	GGA	Message ID
4	hhmmss.s-s	Time of position fix
5	llll.l-l,a	Latitude, a a: N (North) or S (South)
6	yyyyy.y-y,a	Longitude, a a: E (East) or W (West)
7	x	Position Fix Flag 0 = Fix not available or invalid 1 = Position fix valid, autonomous mode 2 = Position fix valid, Differential mode 6 = Estimated data (extrapolation, dead reckoning)
8	xx	Number of satellites used in calculation
9	x.x	Horizontal dilution of precision (HDOP)
10	x.x,M	Altitude re: mean-sea-level (geoid), metres
11	x.x,M	Geoidal separation, metres Geoidal Separation: the difference between the WGS 84 earth ellipsoid surface and mean-sea-level (geoid)surface, "- " = mean-sea-level surface below WGS 84 ellipsoid surface.
12	x.x	Age of Differential GNSS data. Time in seconds since last SC104 Type 1 or 9 update, null field when DGPS is not used.
13	xxxx	Differential reference station ID, 0000-1023. Null field when DGNSS is not used
14	*hh	Checksum indicator ("*", code 2Ah) and checksum
15	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Examples

When Talker ID is always "GP".

```
$ GP GGA ,152835.00 ,5554.0114,N ,03732.5007,E ,1 ,13 ,00.8 ,170.4,M ,14.5,M , , *5E <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----

When Talker ID depends on what systems are used to get navigation parameters:

GNSS fix:

```
$ GN GGA ,150947.00 ,5554.0083,N ,03732.502,E ,1 ,15 ,00.6 ,190.6,M ,14.5,M , , *78 <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----

GPS only fix:

```
$ GP GGA ,151114.00 ,5554.0093,N ,03732.5027,E ,1 ,11 ,00.7 ,196.4,M ,14.5,M , , *5E <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----

GLONASS only fix:

```
$ GL GGA ,150626.00 ,5554.0097,N ,03732.4979,E ,1 ,06 ,01.2 ,192.6,M ,14.5,M , , *46 <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----

3.4 GLL – Geographic Position – Latitude/Longitude

Message Description

The GLL message contains the latitude and longitude of the present position, the time of the position fix and the status.

Message Format

\$ aa GLL ,lll.l-l,a ,yyyyy.y-y,a ,hhmmss.s-s ,A ,a *hh <CR><LF>

1 2 3 4 5 6 7 8 9 10

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID (see 2.3)
3	GLL	Message ID
4	lll.l-l,a	Latitude,a a: N (North) or S (South)
5	yyyyy.y-y,a	Longitude,a a: E (East) or W (West)
6	hhmmss.s-s	Time of position fix
7	A	Status A = Data valid V = Data not valid
8	a	Mode Indicator. A = Autonomous mode D = Differential mode N = No Data available
9	*hh	Checksum indicator ("*", code 2Ah) and checksum
10	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

\$ GN GLL ,5554.0106,N,03732.5149,E,154101.00 ,A ,A *7D <CR><LF>

1 2 3 4 5 6 7 8 9 10

3.5 GNS – GNSS Fix Data

Message Description

The GNS message contains Time, Position Fix and related data for single or combined navigation satellite systems (GNSS).

If the data is calculated from multiple satellite systems in differential mode then several GNS messages are generated. The first message with Talker ID “GN” will be followed by separate messages with Talker ID “GP”, “GL” etc. to report the data calculated from the individual systems.

Only one GNS message is generated in differential mode with SBAS.

Message Format

\$ aa GNS ,hhmmss.s-s,IIII.I-I,a,yyyyy.y-y,a,c-c,xx,x.x,x.x,x.x,x.x,x.x *hh <CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID “GN” = GNSS mode “GP” = GPS only mode “GL” = GLONASS only mode
3	GNS	Message ID
4	Hhmmss.s-s	Time of position fix
5	IIII.I-I,a	Latitude,a a: N = North or S = South
6	yyyyy.y-y,a	Longitude,a a: E = East or W = West
7	c-c	Mode indicator. 2 characters in the current FW release: the first – for GPS, the second - for GLONASS: N = No fix. Satellite system not used in position fix, or fix not valid A = Autonomous. Satellite system used in non-differential mode in position fix D = Differential. Satellite system used in differential mode in position fix E = Estimated (or dead reckoning)
8	xx	Total number of satellites in use, 00-99
9	x.x	Horizontal dilution of precision (HDOP)
10	x.x	Antenna altitude, metres, re: mean-sea-level (geoid)
11	x.x	Geoidal separation, metres
12	x.x	Age of differential data. The field contains valid data only in differential mode with RTCM, otherwise it's empty.
13	xxxx	Differential reference station ID. The field contains valid data only in differential mode with RTCM, otherwise it remains empty

#	Field	Format
14	*hh	Checksum indicator ("*", code 2Ah) and checksum
15	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

Autonomous mode GNSS:

```
$ GN GNS ,122310.0 ,3722.425671,N ,12258.856215,W ,AA ,15 ,0.9 ,1005.543 ,6.5 , , *77 <CR><LF>
```

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Differential mode, GPS only:

```
$ GP GNS ,122310.0 ,3722.425671,N ,12258.856215,W ,DN ,8 ,0.9 ,1005.543 ,6.5 ,10.5 ,1001 *45 <CR><LF>
```

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Differential mode, GNSS:

```
$ GN GNS ,122310.0 ,3722.425671,N ,12258.856215,W ,DD ,15 ,0.9 ,1005.543 ,6.5 , , *77 <CR><LF>
```

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

```
$ GP GNS ,122310.0 , , , ,8 , , , ,10.5 ,1001 *72 <CR><LF>
```

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

```
$ GL GNS ,122310.0 , , , ,7 , , , ,8.5 ,1001 *58 <CR><LF>
```

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

3.6 GSA – GNSS DOP and Active Satellites

Message Description

The GSA message contains the GNSS receiver's operating mode, satellites used for calculation of the PVT data transmitted by the GGA message and DOP values.

The GPS satellites are identified by their PRN, which range from 1 to 32. The WAAS system has numbers 33 to 64 to identify its satellites. The numbers 65 to 95 are used for GLONASS satellites (64 + satellite slot number).

Message Format

```
$ aa GSA ,a ,x ,xx,...,xx ,x.x ,x.x ,x.x *hh <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID "GN" = GNSS mode "GP" = GPS only mode "GL" = GLONASS only mode
3	GSA	Message ID
4	a	Mode: M = Manual, forced to operate in 3D mode A = Automatic switching between 2D and 3D modes
5	x	Current Mode: 1 = Fix not available 2 = 2D mode 3 = 3D mode
6	xx,...,xx	ID numbers of satellites used in solution - GPS from 1 to 32. - WAAS from 33 to 64. - GLONASS from 65 to 96.
7	x.x	Position dilution of precision (PDOP)
8	x.x	Horizontal dilution of precision (HDOP)
9	x.x	Vertical dilution of precision (VDOP)
10	*hh	Checksum indicator ("*", code 2Ah) and checksum
11	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Examples

GNSS mode:

```
$ GN GSA ,A ,3 ,23,13,20,30,11,17,25,04,24,31,32 , ,01.0,00.8 *25 <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

```
$ GN GSA ,A ,3 ,82,75,66,76,77,84,83,,,,,01.0,00.5,00.8 *1E <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

GPS only:

```
$ GN GSA ,A ,3 ,16,23,13,20,30,11,25,04,24,31,32 ,01.2,00.7,01.0 *36 <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

GLONASS only:

```
$ GL GSA ,A ,3 ,66,75,76,77,78,83,84,,,,,01.8,00.9,01.5 *11 <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

3.7 GSV – GNSS Satellites In View

Message Description

The GSV message identifies the number of satellites (SV) in view, satellites' PRN numbers, elevation, azimuth and SNR value. One GSV message may contain data for one to four satellites. If more than 4 satellites are in view then additional GSV messages will be generated. Total number of messages being transmitted and the number of the current message are indicated in the first two fields of the message.

If multiple GPS, GLONASS, etc. satellites are in view, then separate GSV messages with Talker ID GP for GPS satellites in view, GL for GLONASS and GA for GALILEO satellites will be generated.

The GN Talker ID should not be used with this message.

NOTE – The current version of NMEA 0183 standard doesn't specify GALILEO and GIOVE satellites PRN. Therefore in this protocol release PRN for GIOVE-A and GIOVE-B set temporally to 201 and 202. The GALILEO PRN assignment will be updated once NMEA 0183 standard specifies these numbers.

Message Format

```
$ aa GSV ,x ,x ,xx ,xx ,xx ,xxx ,xx ,xx...,xx *hh <CR><LF>
```

1 2 3 4 5 6 7 8 9 10 11 12 13

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID "GP" = GPS satellites "GL" = GLONASS satellites "GA" = GALILEO and GIOVE satellites
3	GSV	Message ID
4	x	Total number of messages, 1 to 9
5	x	Message number, 1 to 9
6	xx	Total number of satellites in view
7	xx (xxx for GALILEO)	Satellite PRN number
8	xx	Elevation, degrees, 90° maximum
9	xxx	Azimuth, degrees True, 000° to 359°
10	xx	SNR 00-99 dBHz, null or blank when no tracking
11	xx,...,xx	PRN, elevation, azimuth and SNR for 2nd, 3rd and 4th SV
12	*hh	Checksum indicator ("*", code 2Ah) and checksum
13	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Examples

Data transmission for GPS + GLONASS + SBAS + GIOVE fix:

\$ GP GSV ,3 ,1 ,12 ,11 ,52 ,219 ,48 ,12,09,021,40,14,34,057,47,17,25,306,45 *72 <CR><LF>

1	2	3	4	5	6	7	8	9	10	11	12	13
---	---	---	---	---	---	---	---	---	----	----	----	----

\$ GP GSV ,3 ,2 ,12 ,20 ,46 ,274 ,48 ,23,14,223,45,24,67,214,49,31,35,123,48 *75 <CR><LF>

1	2	3	4	5	6	7	8	9	10	11	12	13
---	---	---	---	---	---	---	---	---	----	----	----	----

\$ GP GSV ,3 ,3 ,12 ,32 ,78 ,266 ,51 ,33,11,238,39,37,15,197,37,39,25,195,00 *7A <CR><LF>

1	2	3	4	5	6	7	8	9	10	11	12	13
---	---	---	---	---	---	---	---	---	----	----	----	----

\$ GL GSV ,2 ,1 ,07 ,65 ,36 ,079 ,51 ,66,77,331,53,74,15,014,42,75,41,067,49 *65 <CR><LF>

1	2	3	4	5	6	7	8	9	10	11	12	13
---	---	---	---	---	---	---	---	---	----	----	----	----

\$ GL GSV ,2 ,2 ,07 ,76 ,24 ,132 ,50 ,50,82,41,296,48,83,13,346,43 *78 <CR><LF>

1	2	3	4	5	6	7	8	9	10	11	12	13
---	---	---	---	---	---	---	---	---	----	----	----	----

\$ GA GSV ,1 ,1 ,02 ,201 ,14 ,335 ,35 ,202,-47,131,00 *42 <CR><LF>

1	2	3	4	5	6	7	8	9	10	11	12	13
---	---	---	---	---	---	---	---	---	----	----	----	----

3.8 RMC – Recommended Minimum Specific GNSS Data

Message Description

The RMC message contains the time, date, position, course and speed data provided by the GNSS navigation receiver. A checksum is mandatory for this message and the transmission interval may not exceed 2 seconds. All data fields must be provided unless the data is temporarily unavailable. Null fields may be used when data is temporarily unavailable.

Message Format

```
$ aa RMC,hhmmss.s-s,A,lll.l-l,a,yyyyy.y-y,a,x.x,x.x,xxxxxx,x.x,a,a*hh<CR><LF>
```

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID (see 2.3)
3	RMC	Message ID
4	hhmmss.s-s	Time of position fix
5	A	Status A = Data valid V = Data not valid
6	lll.l-l,a	Latitude, a a: N (North) or S (South)
7	yyyyy.y-y,a	Longitude, a a: E (East) or W (West)
8	x.x	Speed over Ground (SoG), knots
9	x.x	Course over Ground (CoG), degrees True
10	xxxxxx	Date: ddmmyy (day/month/year)
11	x.x,a	Magnetic variation (in degrees), a a: E (East) or W (West) Note – The field is empty in the current protocol release.
12	a	Mode Indicator A = Autonomous mode D = Differential mode E = Estimated (dead reckoning) mode N = Data not valid
13	*hh	Checksum indicator ("*", code 2Ah) and checksum
14	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

```
$ GP RMC,054100.00,A,5552.9539,N,03727.3206,E,40.13,087.9,250211,,A*5C<CR><LF>
```

1 2 3 4 5 6 7 8 9 10 11 12 13 14

3.9 VTG – Course over Ground & Ground Speed

Message Description

The VTG message provides actual course (CoG) and speed (SoG) relative to the ground.

Message Format

\$ aa VTG ,x.x,T ,x.x,M ,x.x,N ,x.x,K ,a *hh <CR><LF>

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID (see 2.3)
3	VTG	Message ID
4	x.x,T	Course over Ground (CoG), degrees True
5	x.x,M	Course over Ground (CoG), degrees Magnetic Note – The field is empty in the current protocol release.
6	x.x,N	Speed over Ground (SoG), knots
7	x.x,K	Speed over Ground (SoG), km/hr
8	a	Mode Indicator: A = Autonomous mode D = Differential mode N = Data not valid
9	*hh	Checksum indicator ("*", code 2Ah) and checksum
10	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

\$ GP VTG ,089.0,T ,, ,15.2,N ,, ,A *12 <CR><LF>

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

3.10 ZDA – Time & Date

Message Description

The ZDA message provides UTC, day, month, year and local time zone.

The Local time zone is presented by the number of hours and minutes that have to be added to local time in order to get the UTC time. Local zone is generally negative for East longitudes with local exceptions near the International Date Line.

Message Format

\$ aa ZDA ,hhmmss.s-s ,xx ,xx ,xxxx ,xx ,xx *hh <CR><LF>

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker ID (see 2.3)
3	ZDA	Message ID
4	hhmmss.s-s	Time
5	xx	Day, 01 to 31
6	xx	Month, 01 to 12
7	xxxx	Year
8	xx	Local zone hours, 00 to ±13 hrs
9	xx	Local zone minutes, 00 to +59
10	*hh	Checksum indicator ("*", code 2Ah) and checksum
11	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Examples

At Chatham Is., New Zealand at 12:30 (noon) local time on June 10, 1995:

\$ GP ZDA ,234500 ,09 ,06 ,1995 ,-12 ,45 *6C <CR><LF>

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

In the Cook Islands at 15:00 local time on June 10, 1995:

\$ GP ZDA ,013000 ,11 ,06 ,1995 ,10 ,30 *4A <CR><LF>

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

3.11 Q – Query Message

Message Description

The Q message is a query for a required standard (approved) or proprietary NMEA message.

Message Format

```
$ aa aa Q ,c-c[,c-c, ...] *hh <CR><LF>
```

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	aa	Talker Identifier of the device requesting data, might be any
3	aa	Talker ID (must be always "GP")
4	Q	Message ID
5	c-c	ID of the requested NMEA message. For the standard messages - three characters of the message address (see NMEA message structure in Protocol Overview); for proprietary message – all 5 characters of the address.
6	*hh	Checksum indicator ("*", code 2Ah) and checksum
7	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

```
$ XX GP Q ,GGA *2B <CR><LF>
```

1	2	3	4	5	6	7
---	---	---	---	---	---	---

4 Propriety Messages

4.1 ALVER – Receiver and FW information

Message Description

The ALVER message provides information on the manufacturer, receiver and FW version.

Message Format

\$ ALVER ,c-c ,c-c ,xxxx *hh <CR><LF>

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	ALVER	Address field
3	c-c	Manufacturer's ID, text field
4	c-c	Device ID, text field
5	xxxx	FW version
6	*hh	Checksum indicator ("*", code 2Ah) and checksum
7	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

\$ ALVER ,NVS ,CSM23 ,0206 *73 <CR><LF>

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Request message:

\$POVER*5E<CR><LF>

4.2 PAMOD – Timing Mode Related Parameters

Message Description

The PAMOD message provides timing mode related parameters.

Message Format

```
$ PAMOD ,x ,xx ,lll.l-l,a ,yyyyy.y-y,a ,x.x *hh <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PAMOD	Address field
3	x	Mode: 0 – Navigation 1 – Timing mode with fixed coordinates 2 – Timing mode at the stage of position averaging
4	xx	averaging time, minutes
5	lll.l-l,a	Latitude,a a: N = North or S = South
6	yyyyy.y-y,a	Longitude;a a: E (East) or W (West)
7	x.x	Altitude, re: mean-sea-level (geoid), metres
8	*hh	Checksum indicator ("*", code 2Ah) and checksum
9	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

```
$ PAMOD ,0 ,0720 ,0000.0000,N ,0000.0000,E ,-18.0 *4F <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

4.3 PASET – Set of Timing Mode Parameters

Message Description

The PASET message sets the receiver's operation mode, averaging time and fixed position coordinates.

Message Format

```
$ PASET ,x ,xxxx ,lll.l-l,a ,yyyyy.y-y,a ,x.x *hh <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PASET	Address field
3	x	Mode: 0 – Navigation 1 – Timing mode with fixed coordinates 2 – Timing mode with preliminary position averaging
4	xxxx	Averaging time (20...1140), minutes
5	lll.l-l,a	Latitude,a a: N (North) or S (South)
6	yyyyy.y-y,a	Longitude,a a: E (East) or W (West)
7	x.x	Altitude, re: mean-sea-level (geoid), metres
8	*hh	Checksum indicator ("*", code 2Ah) and checksum
9	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

Mode 0: Navigation mode:

```
$ PASET,0,0,0000.00,N,00000.00,E,0.0 *6A <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Response: \$PAMOD,0,0020,0000.0000,N,00000.0000,E,000.0*5C <CR><LF>

Mode 1: Timing mode with fixed coordinates:

```
$ PASET,1,0,3722.42561,N,12258.85614,W,1347.0 *4A <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Response: \$PAMOD,1,0020,3722.4256,N,12258.8560,W,1347.0*78<CR><LF>

Mode 2: Timing mode with preliminary position averaging

```
$ PASET,2,60,0000.00,N,00000.00,E,0.0 *5E <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Response: \$PAMOD,2,0060,0000.0000,N,00000.0000,E,000.0*5A<CR><LF>

4.4 PKON1 – Set of Receiver Configuration

Message Description

The PKON1 message sets the Local Datum, active satellite system(s) and local time offset.

Message Format

```
$ PKON1 ,x ,x ,c-c,c-c ,xxxx, a *hh <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PKON1	Address field
3	x	Current Local Datum
4	x	Current active satellite system(s): 0 = GNSS 1 = GPS 2 = GLONASS 10 = GNSS+SBAS 11 = GPS+SBAS
5	c-c,c-c	Reserved fields
6	xxxx	Local time offset, hours, minutes
7	a	Sign of local time offset (A = "+", V = "-")
8	*hh	Checksum indicator ("*", code 2Ah) and checksum
9	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

1. Set GPS+GLONASS as current active satellite systems:

```
$ PKON1 ,0 ,0 ,, ,0000 ,A *6A <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

2. Set GPS only as current active satellite system:

```
$ PKON1 ,0 ,1 ,, ,0000 ,A *6B <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

3. Set GLONASS only as current active satellite system:

```
$ PKON1 ,0 ,2 ,, ,0000 ,A *68 <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

4.5 POTST – Test Results

Message Description

The POTST message contains information about internal test results. The message is transmitted once the receiver starts and can be requested by a Q query message or [PORZB – Extended Query Message](#). Message request ID is **TST**.

Note: This message is supported starting from NV08C FW v02.04.

Message Format

```
$ POTST,sx,cx [,sx,cx...] *hh <CR><LF>
```

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	POTST	Address field
3	sx	Test name: ID – device ID ANT – antenna test RFG – GPS RF-chain test RFR – GLONASS RF-chain test
4	cx	Test result: ID: device ID, 10 decimal digits ANT: 0 – active antenna is connected, 1 – no antenna, 2 – short circuit RFG, RFR: 0 – normal operation, other values – an error in the block Note: correct ANT test result is provided only in case of antenna supplying from NV08C device. In case of external antenna power supply ANT test always shows 1 (no antenna).
5	[,sx,cx...]	[,sx,cx] fields are repeated for all the test listed in row #3
6	*hh	Checksum indicator ("*", code 2Ah) and checksum
7	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Examples

```
$ POTST,ID,0268435534,ANT,0,RFG,0,RFR,0 *33 <CR><LF>
```

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Test results request

```
$ GPGPQ,TST *2E <CR><LF>
```

1	2	3	4	5
---	---	---	---	---

4.6 POCWT – Tone Test Results

Message Description

The POCWT output message provides receiver RF front end Tone Test results: SNR and Doppler frequency for harmonic signal at input. The Tone Test parameters shall be specified in the [POCWT – Set Tone Test Parameters](#) request message.

Message Format

\$ POCWT ,x.x ,xx ,x.x ,x.x ,xx ,x.x *hh <CR><LF>

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	POCWT	Address field
3	x.x	GLONASS test frequency, MHz
4	xx	GLONASS test SNR, dBHz
5	x.x	GLONASS test Doppler frequency, Hz
6	x.x	GPS test frequency, MHz (the field is empty if GPS test is off)
7	xx	GPS test SNR, dBHz (the field is empty if GPS test is off)
8	x.x	GPS test Doppler frequency, Hz (the field is empty if GPS test is off)
9	*hh	Checksum indicator ("*", code 2Ah) and checksum
10	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

\$ POCWT ,1602.0000 ,00 ,04995.4 ,1575.4200 ,00 ,01299.4 *58 <CR><LF>

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

4.7 POCWT – Set Tone Test Parameters

Message Description

The POCWT input message controls tone test parameters: GPS or GLONASS channel to be tested and GLONASS frequency to be tested. When the GPS channel is tested a tone signal of 1575.42 MHz is applied to the receiver RF input. For GLONASS the tone signal frequency is $1602 + X \cdot 0.5265$ MHz, $X = -7$ to $+6$, where X is the GLONASS's satellite slot number.

As a reply to this message the receiver will switch to the Tone Test mode and transmit the results of the test in the POCWT output message (see chapter [4.6 POCWT – Tone Test Results](#)).

Message Format

```
$ POCWT ,x ,x *hh <CR><LF>
```

1	2	3	4	5	6
---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	POCWT	Address field
3	x	Switch Off the Entire Test /GLONASS test frequency 0 = Test Off (both GPS and GLONASS) 1...15 = X+8 (GLONASS carrier frequency slot number) Note: GLONASS test cannot be switched off. Setting of this parameter to 0 switches off of the entire test
4	x	GPS Test On/Off 0 = GPS test Off 1 = GPS test ON
5	*hh	Checksum indicator ("*", code 2Ah) and checksum
6	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

```
$ POCWT ,8 ,1 *56 <CR><LF>
```

1	2	3	4	5	6
---	---	---	---	---	---

Test switching off:

```
$ POCWT ,0 ,1 *5E <CR><LF>
```

1	2	3	4	5	6
---	---	---	---	---	---

4.8 PONA V – Navigation Solution Parameters

Message Description

The PONA V message sets and confirms the navigation solution's parameters: DGNSS mode settings, min satellite elevation angle, PVT update rate, min SNR and position filter settings.

Message Format

NOTE – Format of INPUT and OUTPUT PONA V messages is the same.

```
$ PONA V ,x ,xx ,xx ,xx ,xxx *hh <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PONA V	Address field
3	x	DGNSS mode settings: 0 – RTCM SC-104 differential corrections only 1 – SBAS differential corrections only 2 – No differential corrections allowed 3 – Both RTCM SC-104 and SBAS differential corrections allowed
4	xx	Min elevation angle of satellites to be used in navigation calculations, degrees (in range from 00 to 90)
5	xx	PVT update rate, Hz. Permitted values: 1, 2, 5, and 10. Note: This parameter doesn't set the data output rate of the messages. Refer to message 4.14 (PORZB – Extended Query Message) , parameter 4).
6	xx	Min SNR of satellites to be used in navigation calculations, dBHz
7	xxx	Position filter settings – 0 to 100. 0 = the filter is Off
8	*hh	Checksum indicator ("*", code 2Ah) and checksum
9	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

```
$ PONA V ,3 ,05 ,01 ,12 ,30 *5D <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Response: \$PONA V,3,05,01,12,30*5D<CR><LF>

4.9 PONME – Set NMEA Communication Parameters

Message Description

The PONME message sets the NMEA communication parameters: time and position output resolution, Talker ID compatibility mode.

Message Format

\$ PONME, x, x [,x] [,x] *hh <CR><LF>

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PONME	Address field
3	x	Number of digits in fractional part of time output, permitted values 0 to 6
4	x	Number of digits in fractional part of position output, permitted values 1 to 6
5	x	Set compatibility mode for Talker ID (see Chapter 2.3): 0 – Talker ID for GGA, RMC, DTM, GLL, VTG, ZDA always “GP” 1 – Compatibility mode Off. Talker ID as per messages Message Description Note – The field is optional and can be omitted
6	x	Checksum On/Off 0 – Checksum On (by default) 1 – Checksum Off (not recommended) Note – The field is optional and can be omitted
7	*hh	Checksum indicator (“*”, code 2Ah) and checksum
8	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

\$ PONME,2,4,1 *42 <CR><LF>

4.10 POPPS – Time Pulse Settings

Message Description

The POPPS message sets and confirms the Time pulse parameters.

Message Format

NOTE – Format of INPUT and OUTPUT POPPS messages is the same.

```
$ POPPS ,x ,x ,x ,x ,xxxx ,c-c ,c-c *hh <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	POPPS	Address field
3	x	Time pulse type: P – software-synchronized Time pulse (see parameter #5) A – hardware-synchronized Time pulse (aligned to internal timescale)
4	x	SW defined Time pulse parameters: I – interval Time pulse. Time pulse generated at PVT update rate S – 1PPS time pulse. One pulse per second is generated
5	x	1PPS Time pulse reference: U – UTC S – UTC(SU) G – GLONASS time N – GPS time This field is applicable for 1PPS Time pulse only.
6	x	Internal receiver timescale adjustment: 1 – On (By default). Internal receiver timescale is adjusted once the offset to UTC is higher than 1 millisecond 0 – Off (Not recommended).
7	xxxx	SW defined Time pulse duration, microsecond. 1 to 1000 microseconds
8	x	PPS validity control. Allows PPS signal output only in case of valid navigation and availability of UTC parameters transmitted in navigation frame. E – enabled, D – disabled.
9	xxxx	Delay in antenna cable, nanoseconds
10	*hh	Checksum indicator ("*", code 2Ah) and checksum
11	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

NOTE – If a parameter setting is not be changed by the POPPS message then the corresponding field should be left empty. When settings are changed a reply POPPS message is generated.

Example

```
$ POPPS ,P ,S ,U ,1 ,1000 , , *06 <CR><LF>
```

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

Response: \$POPSS,P,S,U,1,1000,,*06<CR><LF>

4.11 POPWR – Power Saving Mode

Message Description

The POPWR message switches the receiver to low power mode (Sleep mode).

A response message is not provided. After receiving the POPWR message, the receiver is switched to Sleep mode and waits for a command to wake up.

The receiver will wake up by receiving any command, but the received command will not be decoded. Therefore sending a one byte command is sufficient to wake up the receiver.

Sending messages to the receiver is only possible after returning the receiver to operational mode (0.5 second minimum after sending a waking up command).

Message Format

\$POPWR,1111*66<CR><LF>

4.12 PORST – Force Receiver Reset

Message Description

The PORST message forces the receiver to reset.

Message Format

```
$ PORST,x*hh<CR><LF>
```

1	2	3	4	5
---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PORST	Address field
3	x	Reset type: F – Factory restart + Cold Start. W – Keep settings and Warm restart
4	*hh	Checksum indicator ("*", code 2Ah) and checksum
5	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

1. Cold Start with return to factory settings

```
$ PORST,F*20<CR><LF>
```

1	2	3	4	5
---	---	---	---	---

2. Warm Start:

```
$ PORST,W*31<CR><LF>
```

1	2	3	4	5
---	---	---	---	---

4.13 PORZA – COM Port Setting

Message Description

The PORZA message contains the receiver COM port settings: protocol NMEA/BINR and baud rate. As a reply to PORZA message the receiver sends the PORZA reply message with new COM port settings and then switches to the new settings.

Message Format

NOTE – Format of INPUT and OUTPUT PORZA messages is the same.

```
$ PORZA ,x ,x ,x *hh <CR><LF>
```

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PORZA	Address field
3	x	COM port number to be set: 0 – current port 1 – COM1 (UART A) 2 – COM2 (UART B)
4	x	Port baud rate, in bauds from 4,800 to 230,400
5	x	Protocol type: 0 – disable 1 – NMEA 0183 2 – RTCM-104 differential corrections reception 3 – BINR 4 – BINR2
6	*hh	Checksum indicator (“*”, code 2Ah) and checksum
7	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

```
$ PORZA ,1 ,115200 ,1 *7D <CR><LF>
```

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Response: \$PORZA,1,115200,1*7D<CR><LF>

4.14 PORZB – Extended Query Message

Message Description

The PORZB message sets a list of transmitted messages and output rates for the messages, or clears the earlier preset list.

Message Format

Message Format to clear the list of transmitted messages:

\$ PORZB *hh <CR><LF>

Message Format to add messages to be transmitted to the list:

\$ PORZB ,c-c ,x [,c-c,x...] *hh <CR><LF>

1 2 3 4 5 6 7

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PORZB	Address field
3	c-c	Addresses of the required messages (3 last characters for standard messages and all address field characters or 3 last characters for proprietary messages)
4	x	Message output rate in PVT update intervals Note: PVT update interval (in sec) is a value opposite to PVT update rate (in Hz) (see Message 4.8 PONA V – Navigation Solution Parameters Parameter 5) Setting the output rate to 1 will request messages to output every time a new PVT is calculated. Setting the output rate to N will request messages to output one time after N times of PVT calculation.
5	[,c-c,x...]	When several messages are to be added to the list then the Fields 3 and 4 should be set for each of requested messages
6	*hh	Checksum indicator ("*", code 2Ah) and checksum
7	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

1. Delete all messages from the output list:

\$PORZB*55<CR><LF>

2. Set output rate of RMC messages to 1 and GSV messages to 5 (GSV messages will be transmitted every fifth PVT calculation):

\$ PORZB ,RMC,1 ,GSV,5 *4F <CR><LF>

1 2 3 4 5 6 7

4.15 PORZD – RMS Error of Coordinates

Message Description

The PORZD message contains coordinates validity data and estimation of plane coordinates RMS (root mean square) value.

Message Format

```
$ PORZD ,A ,xxx.x *hh <CR><LF>
```

1	2	3	4	5	6
---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PORZD	Address field
3	A	Status: A=Data Valid V=Data Invalid
4	xxx.x	RMS error of plane coordinates
5	*hh	Checksum indicator ("*", code 2Ah) and checksum
6	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

1. Data is valid

```
$ PORZD ,A ,003.3 *3C <CR><LF>
```

1	2	3	4	5	6
---	---	---	---	---	---

2. Data is invalid

```
$ PORZD ,V ,999.9 *2B <CR><LF>
```

1	2	3	4	5	6
---	---	---	---	---	---

4.16 PORZE – Position in Gauss-Kruger Coordinate System

Message Description

The PORZE message outputs the recommended minimum of GPS and GLONASS data: time, date, coordinates, course, speed and receiver ID. Position coordinates are converted to Gauss-Kruger rectangular projections.

Message Format

\$ PORZE ,hhmmss.ss ,A ,x.x ,a ,x.x ,a ,x.x ,x.x ,xxxxxx ,cccc *hh <CR><LF>

1	2	3	4	5	6	7	8	9	10	11	12	13	14
---	---	---	---	---	---	---	---	---	----	----	----	----	----

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PORZE	Address field
3	hhmmss.ss	Time of Position Fix
4	A	Status: A=Data Valid V=Data Invalid
5	x.x	Coordinate X, metres
6	a	Reserved field. Must be left empty.
7	x.x	Coordinate Y + 500,000 + (Time zone number x 1,000,000), metres Example: If 6417534.2 is output, then Time zone number = 6, Y = 417534.2 – 500000 = – 82465.8 m.
8	a	Reserved field
9	x.x	Speed over the ground (SOG) in knots
10	x.x	Course over the ground (COG) in degrees
11	xxxxxx	Date: dd/mm/yy (day/month/year)
12	cccc	Receiver ID
13	*hh	Checksum indicator ("*", code 2Ah) and checksum
14	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

\$ PORZE ,082557.00 ,V ,6198571.5 , ,07408934.2 , ,00.00 ,000.0 ,090513 ,CSM23 *42 <CR><LF>

1	2	3	4	5	6	7	8	9	10	11	12	13	14
---	---	---	---	---	---	---	---	---	----	----	----	----	----

4.17 PORZX – Local datum, Satellite Constellations in use, Time Offset

Message Description

The PORZX message contains Local datum, satellite constellations in use and time offset data.

Message Format

```
$ PORZX ,x ,x ,c-c,c-c ,xxxx ,a *hh <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	PORZX	Address field
3	x	Current Local Datum 0= current datum is WGS 84; reference ellipsoid WGS 84 1= current datum is PZ 90; reference ellipsoid PZ 90 2= current datum is S 42 (Pulkovo 1942); reference Krasovsky ellipsoid 3= current datum is S 95 (Pulkovo 1995); reference Krasovsky ellipsoid 4= current datum is PZ 90.02; reference ellipsoid PZ 90.02 249, 255 = user defined datum #1 250 = user defined datum #2 251 = user defined datum #3 252 = user defined datum #4 253 = user defined datum #5
4	x	Satellite constellations in use: 0 = GNSS 1 = GPS 2 = GLONASS
5	c-c,c-c	Reserved fields
6	xxxx	Local time offset, hours, minutes
7	a	Sign of local time offset: A = + V = –
8	*hh	Checksum indicator (“*”, code 2Ah) and checksum
9	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

```
$ PORZX ,000 ,0 ,, ,0000 ,A *0E <CR><LF>
```

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

4.18 POSST – Additional Receiver Parameter Settings

Message Description

The POSST message sets additional receiver parameters.

NOTE – This message is supported beginning with firmware v0206 and onward.

Message Format

NOTE – The format of the Input and Output POSST messages are the same.

```
$ POSST,ccc,x,x,x*hh<CR><LF>
```

1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	POSST	Address field
3	ccc	The group name of the additional parameters Only "PVT" is currently supported
4	x	Reserved. Can be blank or zero.
5	x	RAIM enabled/disabled 1 – RAIM & FDE enabled, 0 – RAIM disabled Can be left blank
6	x	2D-mode disabled/enabled 1 – 2D-mode disabled, 0 – 2D-mode enabled Can be left blank or skipped
7	*hh	Checksum indicator ("*", code 2Ah) and checksum
8	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Examples

RAIM disabling:

```
$ POSST,PVT,,0*05<CR><LF>
```

1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---

Response: \$POSST,PVT,0,0,1*28

RAIM enabling:

```
$ POSST,PVT,,1*04<CR><LF>
```

1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---

Response: \$POSST,PVT,0,1,1*29

4.19 POUTC – LEAP SECOND in use, Expected UTC Correction and SW Sawtooth Correction Data

Message Description

The POUTC message provides information regarding the LEAP SECOND currently in use, expected UTC correction and SW Sawtooth correction data.

NOTE – This message is supported beginning with firmware v0206 and onward.

Message Format

```
$ POUTC, hhmmss, xxxxxx, x, x, x, x *hh <CR><LF>
```

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

Message Fields

#	Field	Format
1	\$	Start character (Code 24h)
2	POUTC	Address field
3	hhmmss	Current UTC Time
4	xxxxxx	Current Date: ddmmyy (day/month/year)
5	x	LEAP SECONDS currently in use Blank when data is not available
6	x	Expected LEAP SECOND correction decoded from GPS data frame: 0 – no correction expected 1 – expected LEAP SECOND correction +1 -1 – expected LEAP SECOND correction -1 Blank when data is not available Note: flag changes from nonzero to zero value immediately after a UTC correction.
7	x	Expected LEAP SECOND correction decoded from GLONASS data frame (KP flag): 0 – no correction expected 1 – expected LEAP SECOND correction +1 -1 – expected LEAP SECOND correction -1 Blank when data is not available Note: flag is changed from nonzero to zero value after GLONASS navigation frame update
8	x	The shift of the PPS rising edge relative to the true UTC position, nanoseconds Note: A negative value indicates that the UTC second event occurred before the PPS rising edge. Note: These parameters can be used for SW Sawtooth correction. Refer to example in Figure 2 and Figure 3 below.
9	*hh	Checksum indicator ("*", code 2Ah) and checksum
10	<CR><LF>	End of message indicator (codes 0Dh and 0Ah)

Example

Output message:

\$ POUTC ,072543 ,090512 ,15 ,1 ,1 -12 *7F <CR><LF>

1

2

3

4

5

6

7

8

9

10

Request of \$POUTC message with 1Hz rate:

\$PORZB,UTC,1*26

Table 5. Example of expected LEAP SECONDS, and GPS and GLONASS flags state during UTC correction on June 30, 2012

Date & Time		\$POUTC NMEA message fields				
Date	Time	UTC Time	Date	LEAP SECOND	GPS flag	GLONASS flag
...						
June 30, 2012	23:59:57	235957	300612	15	1	1
June 30, 2012	23:59:58	235958	300612	15	1	1
June 30, 2012	23:59:59	235959	300612	15	1	1
June 30, 2012	23:59:60	235960	300612	15	1	1
July 1, 2012	00:00:00	000000	010712	16	0	1
July 1, 2012	00:00:01	000001	010712	16	0	1
...						

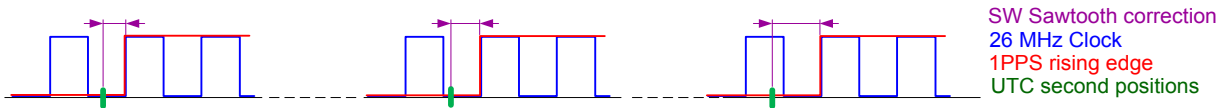


Figure 2. PPS edge position vs reference CLOCK and UTC

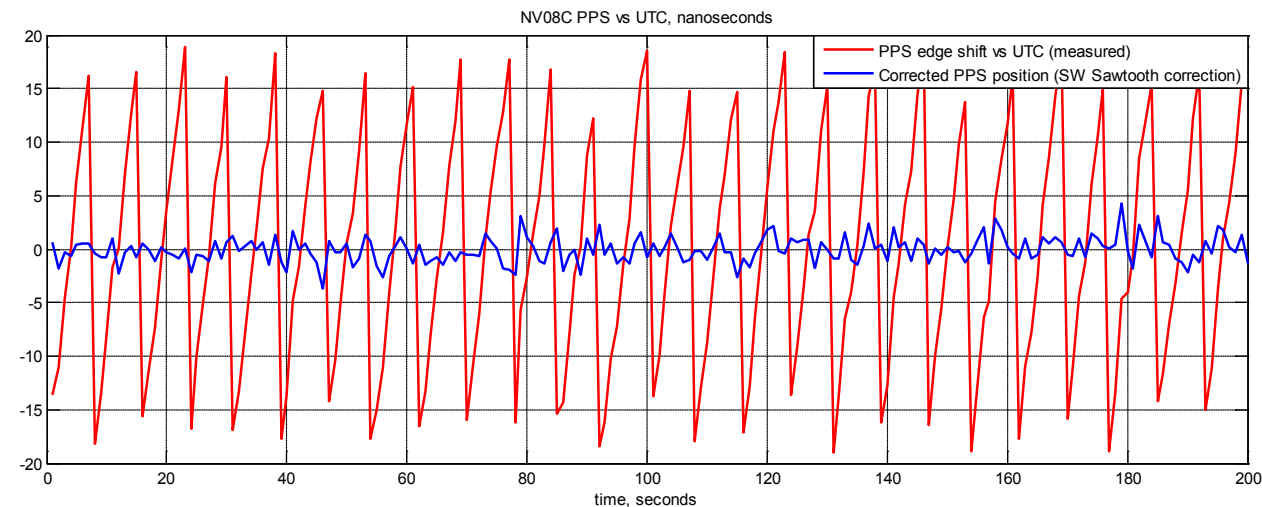


Figure 3. PPS jitter and accuracy with and without SW Sawtooth correction