850 - 160045

NMEA 0183 SENTENCES

This document describes the ASCII sentences used by the Kongsberg Simrad HiPAP/HPR systems. It is our intention that the sentences shall comply with the NMEA 0183 rules as specified in the note "Standard for interfacing Marine Electronic Devices NMEA 0183 Version 2.30".

The printouts, communication ports and baud rate are selected in the APOS dialogs/HSC 400 menus. The format described for the printouts is also used for internal storage of files.

Note ! *Both the APOS and the HSC 400 use the NMEA sentences. APOS supports more sentences than described in this document. The APOS On-line help contains an updated description of all sentences supported by the APOS.*

Document revision

	Documentation department		**Hardware/Software design**		**Project/Product Management**	
Rev	**Date**	**Sign**	**Date**	**Sign**	**Date**	**Sign**
A	16.10.95	-				
B	26.01.96		26.01.96		26.01.96	
C	03.06.98	GM	03.06.98	HPJ	03.06.98	JEF
D	10.10.01	GM	10.10.01	THG	10.10.01	JEF
E	12.12.02	GM	12.12.02	THG	12.12.02	JEF

Contents

Document History

(The information on this page is for internal use)

Rev.A	Original issue.
Rev.B	New software version 2.03 implemented where applicable. Refer to footnotes in the text for further information. The sentences implemented in the previous SW version are still compatible.
Rev.C	Minor changes to the layout. A new sentence, PSIMSNS, for sensor readings is added. The field definitions in the tables are corrected to be as described in version 2.20 of the NMEA 0183 standard. This is a change in the document, and not in the contents of the sentences sent from the HiPAP/HPR system. The document is made common for both the APOS and the HSC 400 operator stations.
Rev.D	New software version 3.5.2 implemented where applicable. General upgrading. Minor corrections in the text.
Rev.E	Implemented new telegram DR. Changed time description in GLL, VEP, SSB, SSD, SNS, LBM, GPS, LBP, LBR. Minor corrections in TDP and TDQ. Minor corrections in the text. Ref. EM 850-160045E.

1 INTRODUCTION

This is technical documentation that may be changed. Please contact Kongsberg Simrad before implementing the reception of sentences to assure that the note matches the SW version in the actual system to be interfaced. These html files for the APOS help system describe the NMEA sentences for the APOS. They are extended with new sentences as they are implemented in APOS. HSC 400 was the operator station used for the HiPAP/HPR systems before the APOS was released. The sentences implemented in HSC 400 are described in the note 160045/C in the operator manual.

Abbreviations

HPR	Hydroacoustic Positioning Reference system.
HiPAP	High Precision Acoustic Positioning
SSBL	Super Short Base Line
LBL	Long Base Line
HSC 400	HPR 400 System Controller, the “old” Operator Station
APOS	Acoustic Positioning Operator Station. It is the Kongsberg Simrad Operator Station for the HiPAP and HPR 400 transceivers.
rms	root mean square
TP	TransPonder

KS specific telegrams are made for standard positioning use:

SNS	Sensor values
SSB	SSBL position
SSD	Dual HiPAP SSBL measurement
LBP	LBL Position
LBM	LBL Measurement
LBR	LBL range
GPS	Global Positioning System
DR	Draft

KS specific telegrams are made for external control and access:

RCP	Remote Control Positioning
SVT	Sound Velocity

APOS

APOS is the Operator Station with the Windows Man Machine Interface. It replaces the older HSC 400, which will not be updated with new information.

Note ! *All NMEA sentences may not be implemented in the APOS.*

HPR 400 and HiPAP are two different types of transceivers. They may both be connected to either a HSC 400 or to an APOS Operator Station. In either case, the NMEA sentences are delivered by the Operator Station, and the format is independent of the physical units involved.

Files on the HSC 400 Operator Station

The NMEA sentences may be stored on files. When reading a file, the sentences on the file are interpreted regardless of the file name. When writing sentences to a file, the file name reflects the contents of the sentences. The file name convention consists of the following rules:

1. The files are stored on either the root of the diskette in A: or on the directory \HSC400\Data on the default drive. The default drive is the drive from which the HSC 400 program booted. That is normally the hard disk C:.
2. The file names are PSIMxxx, in which xxx is an index between 0 and 255. The index 000 is the one used for default parameters at power on.
3. The extension consists of three characters, which are the three last characters in the NMEA address of the sentences contained on the file.
4. It is possible to route printer output to files. The file name is as explained in 2. The extension is PRN.

Examples of file names are:

- The file **C:\HSC400\DATA\PSIM000.LBR** contains the seabed ranges between TPs. These ranges are the ones used by the HSC 400 at power on.
- The file **A:\PSIM100.LBL** contains locations saved on a diskette as data set number 100.
- The file **A:\PSIM002.PRN** contains printout routed to a file.

2 NMEA 0183 SENTENCES

The sentence format is set up in tables with one line for each field. The programs reading the sentences must be prepared to read any number of characters in each field as long as they comply with the NMEA standard.

The NMEA standard allows new data fields to be added after the last data field but before the checksum delimiter character "*". It has been done with the $--GLL sentence, which has got a Mode indicator field added after the Status field. Kongsberg Simrad has not added new data fields to the $PSIM sentences described in this on-line manual, and we intend not to do so with the sentences sent on serial lines and Ethernet to customer computers. We may, however, do it in the future with the $PSIM sentences defined for internal use.

The address field starts with PSIM, which is the proprietary code for Simrad Inc. Then three characters follows, this is the product identification within Kongsberg Simrad. In this note there is one chapter for each sentence. The chapter name starts with the three-characters product identification, and the list of contents may therefore be used as a list of the sentences.

The NMEA sentences may be stored on files. When reading a file, the sentences on the file are interpreted regardless of the file name. When writing sentences to a file, the file name should reflect the contents of the sentences.

The Geographical coordinates are always in the datum selected as the presentation datum and in the UTM zone selected. These parameters must be set correctly on the APOS.

SNS – Sensor values

The PSIMSNS sentence contains the sensor values read from the VRU, Gyro or attitude sensor. It is sent from the system when one of the following two events occur:

- The system has measured either a SSBL position or a LBL position. The sensor values in the sentence are the values read when the acoustic reply is received. The sensors are read by the transceiver doing the acoustic measurement. The SNS sentence is sent just before the sentence containing the SSBL or LBL position.
- No acoustic position is measured by the system for some time (ca 1 seconds for a HiPAP system and ca 5 seconds for a HPR400 system). Then the sensors are read periodically by the transceiver defined by the operator as the sensor source for the vessel.

If one or more of the sensor values are missing, the associated field(s) in the SNS sentence are empty. When the sentence is generated by an HPR 400 system, the Heave field is normally empty.

The format of the PSIMSNS sentence is:

Field	Name	Explanation
$	Start_character	
PSIMSNS	Address	Propr. Simrad address for sensor values.
,hhmmss.ss	Clock	The clock in hours minutes and seconds. The decimal fraction is optional.
,c--c	Pos_item	The position item to which the sentence is associated.
,xx	Transceiver	Transceiver number.
,xx	Transducer	Transducer number.
,x.x	Roll	The roll angle in degrees.
,x.x	Pitch	The pitch angle in degrees.
,x.x	Heave	The heave in metres.
,x.x	Heading	The heading in degrees. A value between 0 and 360.
,x	tag	Optional Tag field. It is used to + the SNS sentence to other sentence(s).
,x	Parameters	Describe parameters used in calculation.
,x.x	Time age	Time since the position was valid. Unit seconds.
,	Spare1	Empty field.

Field	Name	Explanation
,axx	Master Slave	Master Slave info plus APOS Identification number.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Pos_item The position item is either a transponder code or a LBL type.

When the SNS sentence is associated with a SSBL position, the Pos_item field contains the **Tp_code** as in the SSB sentence.

When the SNS sentence is associated with a LBL position, the Pos_item field contains the **Type** as in the LBP sentence.

When the SNS sentence is not associated with any position measured by the system, the Pos_item field is empty.

Transceiver It contains the number of the transceiver on which the sensor readings are performed.

The transceiver numbering starts at 1.

Transducer When the SNS sentence is associated with an acoustic position, the Transducer field contains the number (1 to 4) of the transducer doing the measurement. Otherwise the Transducer field is empty.

Roll, Pitch Unit degrees. The angles are around zero, that is, both positive and negative values are allowed.

Positive roll means that the starboard side is down.

Positive pitch means that the bow is up.

Heave Unit meters. Normally empty.

Heading Unit degrees 0 to 360. It is the value of the gyro at measurement time.

Tag A decimal digit, which is used to link this sentence to other sentence, otherwise the field is empty. First used in connection with PSIMPOP sentence.

Parameters A hexadecimal digit with bit coding used to describe parameters used in calculation for "Pos_item". All 0 means no relevant positioning.

Bit 0-1 Type of positioning. 0 means no positioning, 1 means SSBL, 2 means LBL, 3 means special positioning.

Bit 2-3 Deskew. 0 means deskew OFF, 1 means deskew Vessel, 2 means deskew Transponder.

Bit 4 Fixed/Mobile flag. 0 means Fixed, 1 means Mobile (SSBL positioning choice).

	Bit 5 Time in UTC. 1 = True.
	Bit 6 Sound Velocity profile used. 1 = True.
	Bit 7 Time Synced. 1 = True tells that one of the APOS, operator stations are synced against an external clock.
Time Age	Time from valid position time (i.e. time in the sentence) to generation of this NMEA sentence. Unit seconds.
Master Slave	This field describe if the operator station is Master or it is Slave, and it also give an identification of the operator station. The first character is either 'M' for Master or 'S' for Slave. Then a digit is following, where 121 indicates OS1, 122 indicates OS2 etc. The reason to the information is for redundancy, you may set all operator stations to send information to a specific receiver. The receiver will then get the measurements even if one of the operator stations go down. With this information it is possible to avoid double use of the same measurements.

SSB - SSBL position

The PSIMSSB sentence contains the position of a SSBL TP. It is sent after each HiPAP/SSBL measurement when so requested at the APOS. The operator may define various parameters for the printout.

The format of the PSIMSSB sentence is:

Field	Name	Explanation
$	Start_character	
PSIMSSB	Address	Propr. Simrad address for SSBL sentence.
,hhmmss.ss	Time	Empty or Time of reception.
,cc	Tp_code	Examples: B01, B33, B47.
,A	Status	A for OK and V for not OK.
,cc__	Error_code	Empty or a three-character error code.
,a	Coordinate_system	C for Cartesian, P for polar, U for UTM coordinates.
,a	Orientation	H for vessel head up, N for north, E for East.
,a	SW_ filter	M means Measured, F Filtered, P Predicted.
,x.x	X_coordinate	See separate explanation below.
,x.x	Y_coordinate	See separate explanation below.
,x.x	Depth	Depth in metres.
,x.x	Expected_accuracy	The expected accuracy of the position.
,a	Additional_info	N for none, C compass, I inclinometer, D depth, T time.
,x.x	First_add_value	Empty, Tp compass or Tp x inclination.
,x.x	Second_add_value	Empty or Tp y inclination.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Address field

It is PSIMSSB telling that it is a proprietary Kongsberg Simrad sentence containing a SSBL measurement.

Tp_code	The Tp_code field contains the three-character ASCII code of the transponder for which the sentence contains a measurement. The characters are the same as the ones used on the Operator Station and in the operator manual.
Status	The status field is "A" when position is OK, "and V" when the position is not OK or missing. The Error_code field contains in both case further description.
Error Code	The error code field contains a three-character error code. The possible codes are as shown in the table below:

Code	Explanation	Implication	Status Field
NRy	No reply is received.	No position is calculated	V
AmX	Ambiguity error in the X direction.	No position is calculated.	V
AmY	Ambiguity error in the Y direction.	No position is calculated.	V
Rej	The position is measured OK, but rejected by the SW filter in either the transceiver or in the HSC 400.		A
Mi2	The second pulse of the Tp reply is missing.	Both Additional_info fields are empty. Status Field is V if sensor type is Depth.	A/V
Mi3	The third pulse of the Tp reply is missing.	Additional_info field nr 2 is empty.	A
Pre	No position is measured. The position is predicted by the Kalman filter in the HSC 400.		A
VRU	The VRU connected to the system has reported error.	Position not calculated with correct roll&pitch.	V
GYR	The gyro connected to the system has reported error.	Position not calculated with correct heading.	V
ATT	Attitude sensor (VRU or Gyro) connected to the system has reported error.	Position not calculated with correct heading, roll and pitch.	V
ExD	External depth used in calculation of position.	Position OK.	A
ExM	External depth wanted but not received.	Position are calculated without locked depth.	V
???	The system has reported an unknown error.		V

When no position is calculated, the position fields X_coordinate, Y_coordinate and Depth are all empty. When the Status field is A, the measured position is OK but the Error_code field may still describe error in the measurement.

X_coordinate, Y_coordinate, Co-ordinate system, Orientation

The contents of the X_coordinate and the Y coordinate fields are controlled by the settings in the APOS Configure dialog. The Coordinate_system and Orientation fields should be used to decode the X_ and Y_coordinate fields as shown in the table.

APOS settings	**PSIMSSB fields**		**PSIMSSB coordinates of transponder position**	
CO-ORD	Coordinate system	Orientation	X_coordinate	Y_coordinate
Polar	P	H	Horizontal range	Bearing in degrees
Cartesian X/Y	C	H	Starboard	Forwards
Cartesian N/E	C	N	North	East
Cartesian E/N	C	E	East	North
UTM N/E	U	N	Northings	Eastings
UTM E/N	U	E	Eastings	Northings

Explanation of the fields in the sentence

The **Polar** and **Cartesian X/Y** coordinates are the position of the transponder relative to the vessel. They are in metres, except the **Bearing,** which is an angle between 0 to 360 degrees. The **Eastings** and the **Northings** are the UTM coordinates of the transponder.

Expected_accuracy The expected accuracy of the position is based on the covariance data calculated for each position. It is equal to the statistical sum of the Major and Minor semiaxes of the error ellipse displayed around the position.

Additional_info Either used for sensor values or for travel time from transponder to transducer. See below for actual values.

Additional_info	First value	Second value	Description
C	Bearing		Bearing in degrees.
I	X inclination	Y inclination	Inclination values in degrees, also used for diffinclination.
D	Depth		Depth [m]
T	Time		Time from transponder to transducer. Unit seconds.
N			Empty fields, used when transponder in beacon mode.

Examples

- **Different Tp codes**

B01, B55, B12 and B87 are active.

The Cartesian coordinates are:
B01 in (Fwd 50 m, Stb 100 m, Depth 48.5 m). Std_dev is 0.0 m.
B55 in (Fwd 50 m, Stb –100 m, Depth 25.8 m). Std_dev is 0.0 m.
B12 in (Fwd –50 m, Stb –100 m, Depth 0.9 m). Std_dev is 2.70 m.
B87 in (Fwd –50 m, Stb 100 m, Depth 9999.99 m). Std_dev is 2.70 m.

The NMEA sentences are:

```
$PSIMSSB,,B01,A,,P,H,M,111.80,63.43,48.50,0.00,N,,*5E
$PSIMSSB,,B55,A,,P,H,M,111.80,296.57,25.80,0.00,N,,*64
$PSIMSSB,,B12,A,,P,H,M,111.80,243.43,0.90,2.70,N,,*59
$PSIMSSB,,B87,A,,P,H,M,111.80,116.57,9999.99,2.70,N,,*6A
```

- **Different statuses**

B36 is active with the following statuses:

ok	
No Reply	NRy
Ambiguity x	AmX
Ambiguity y	AmY
Reply rejected	Rej
Compass tp with missing 2. Pulse	Mi2
Inclinometer tp with missing 3. Pulse	Mi3

The NMEA sentences are:

```
$PSIMSSB,,B36,A,,P,H,M,100.00,0.00,200.00,2.70,N,,*5E
$PSIMSSB,,B36,V,NRy,P,H,M,,,,2.70,N,,*31
$PSIMSSB,,B36,V,AmX,P,H,M,,,,2.70,N,,*20
$PSIMSSB,,B36,V,AmY,P,H,M,,,,2.70,N,,*21
$PSIMSSB,,B36,V,Rej,P,H,M,100.00,0.00,200.00,2.70,N,,*14
$PSIMSSB,,B36,V,Mi2,P,H,M,100.00,0.00,200.00,2.70,N,,*5F
$PSIMSSB,,B36,V,Mi3,P,H,M,100.00,0.00,200.00,2.70,N,,*5E
```

- **Inclinometer Tp with ok reply**

B24 is active as inclinometer transponder with great values. The cartesian position:

(8765.43 m, -5678,34 m, 2345.78 m) is used. The inclinometer angles (-128,45, -135.98) degrees are used. The Std_dev is also -128.45 m.

The NMEA sentence is:

$PSIMSSB,,B24,A,,P,H,M,10443.96,122.94,2345.78,-128.45,I,-128.45,-135.98*49

- **Compass Tp with ok reply**

B82 is active as a compass tp. The Cartesian position (0, -200 m, 23 m) is used. The compass angle 200.98 degrees is used. The Std_dev is also 200.98 m.

The NMEA sentence is:

$PSIMSSB,,B82,A,,P,H,M,200.00,180.00,23.00,200.98,C,200.98,*7E

SSD - Dual HiPAP SSBL measurement

The PSIMSSD sentence contains the measured position of a SSBL TP done on either Master HiPAP or Slave HiPAP. It is sent two times for each measurement, one for the Master HiPAP and one for the Slave HiPAP. The PSIMSSB sentence is sent in addition, containing the combined position of the master and the slave. Following will be the normal sequence of telegrams for a Dual HiPAP position: PSIMSSD (Master HiPAP), PSIMSSD (Slave HiPAP), PSIMSNS, PSIMSSB.

The format of the PSIMSSD sentence is:

Field	Name	Explanation
$	Start character	
PSIMSSD	Address	The address for the dual HiPAP/SSBL sentence.
,hhmmss.ss	Time	The real time of the measurement. Given as hour, minutes and seconds. The time format is either local time or UTC time, depending on the selection in the menu.
,cc__	Tp_code	Examples: B01, B33, B47.
,A	Status	A for OK and V for not OK.
,cc	Error code	Empty or a three-character error code.
,M	Master	M = Master, S = Slave.
,x.x	North coordinate	Local North coordinate in meter.
,x.x	East coordinate	Local East coordinate in meter.
,x.x	Depth	Depth in meters.
,x.x	Expected accuracy	The expected accuracy of the position.
,x.x	Roll	The roll angle in degrees at measurement time.
,x.x	Pitch	The pitch angle in degrees at measurement time.
,x.x	Heave	The heave in meters.
,x.x	Heading	The heading in degrees at measurement time. A value between 0 and 360.
,	Empty	Reserved for future use.
,	Empty	Reserved for future use.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

The fields in the sentence

Address

The Address field is PSIMSSD telling that it is a proprietary SIMRAD sentence containing a SSBL measurement done on a Dual HiPAP system.

Tp_code The Tp_code field contains the three-character ASCII code of the transponder for which the sentence contains a measurement. The characters are the same as the ones used on the Operator Station and in the operator manual.

Status When the Status field is A, the measured position is OK and the Error_code field is empty.

The status field is V when the measurement is not OK. Then the Error_code field contains a three-character error code. When no position is calculated, the position fields North, East and Depth are all empty.

The possible codes are as set up as follows:

Code	Explanation	Implication
NRy	No reply is received.	No position is calculated.

Master

Dual HiPAP measurement is done by two HiPAPs. The Master sends the interrogation pulse to the transponder, the Master then measure the range between the Master transducer and the transponder both ways. The Slave will measure the range from the Master transducer to the transponder and from the transponder to the Slave transducer. Both measurements are compensated to the vessels CG (Center of Gravity) before output in this sentence.

Expected_accuracy	The expected accuracy of the position is based on the covariance data calculated for each position. It is equal to the statistical sum of the Major and Minor semiaxies of the error ellipse displayed around the position.
Roll, Pitch	Unit degrees. The angles are around zero, that is, both positive and negative values are allowed. Positive roll means that the starboard side is down. Positive pitch means that the bow is up.
Heave	Unit meters. Normally empty.
Heading	Unit degrees 0 to 360. It is the value of the gyro at measurement time.

LBP - LBL Position

The PSIMLBP sentence contains a position measured by LBL. It is sent from the APOS after each LBL position calculation when so requested in the Configure dialog. The operator may define various parameters for the printout.

The format of the PSIMLBP sentence is:

Field	Name	Explanation
$	Start_character	
PSIMLBP	Address	The address for LBL Position.
,hhmmss.ss	Time	The real time of the measurement. Given as hour, minutes and seconds. The time format is either local time or UTC time, depending on the selection in the menu.
,c--c	Tp_array	The Tp array for which the origin is valid.
,a	Type	The type of the item positioned.
,A	Status	The status of the position. A is OK.
,a_	Coordinates	See separate description below.
,x.x	X_coordinate	See separate description below.
,x.x	Y_coordinate	See separate description below.
,x.x	Depth	The depth of the position.
,x.x	Major	The major axis of the error ellipse.
,x.x	Minor	The minor axis of the error ellipse.
,x.x	Direction	The direction of the major axis in the error ellipse.
,x.x	Res_rms	The rms value of the normalised residuals.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Type

The Type field is Ve when the position is for the vessel. It is R1 to R4 for ROV 1 to ROV 4. It is T1 to T4 for TPs being positioned in LBL mode using the TP range feature of the TP.

Status

The Status field is A when the measurements are OK. The possible statuses are as shown below:

A	OK
RES	The residuals of the measurement are too large.
NVC	The position calculation does not converge in the vertical direction. It may happen when positioning items in the same depth as the seabed TPs.
NOC	The position calculation does not converge in the horizontal direction.
FER	Too few replies are received to calculate a position.
CER	Computational error when calculating the position.
NGl	No Geographic position, i.e. Origin defined in geographic coordinates.
???	Another error condition.

X_coordinate, Y_coordinate, Coordinate_system

The contents of the X_coordinate and the Y_coordinate fields are controlled by the settings in the Configure dialog.

The Coordinate_system field should be used to decode the X_ and Y_coordinate fields as shown in the table below.

APOS Configure Setting	**Coordinate system**	**X_coordinate**	**Y_coordinate**
Cartesian N/E	C	North	East
Cartesian E/N	L	East	North
UTM N/E	U	Northings	Eastings
UTM E/N	E	Eastings	Northings

The **Cartesian** coordinates are the position of the vessel or ROV in meters relative to the origin of the TP array. The **Eastings** and **Northings** are the UTM coordinates of the vessel or the ROV.

Res_rms	The field contains the root mean square of the normalised residuals of the measurements. A normalised residual is the residual divided with the expected accuracy of the measurement. An rms value less than 1 indicates that the measurements tend to be more accurate than expected. When the few measurements (less than 6) contribute in the calculation, the residuals tend to be lower than when many measurements contribute. Then the rms value of the residuals will be lower, too. When only 3 measurements contribute, the residuals will be zero. The error ellipse, however, will be greater when few measurements contribute than when many do. Therefore both the rms of the residuals, and the error ellipse, must be regarded when deciding the quality of the position.

LBM - LBL Measurement

The PSIMLBM sentence contains roll, pitch, course, depth and range measurements as the basis for position calculation. The sentence is sent after each LBL measurement when so requested in the APOS Configure dialog. The operator may define various parameters for the printout in that menu.

The format of the PSIMLBM sentence is:

Field	Name	Explanation
$	Start_character	
PSIMLBM	Address	The address for LBL Measurement.
,hhmmss.ss	Time	The real time of the measurement. Given as hour, minutes and seconds. The time format is either local time or UTC time, depending on the selection in the menu.
,c--c	Tp_array	The Tp array in which the measurements are done.
,xx	Td_id	The identification of the TD on which the reply is received.
,x.x	Roll	The roll angle when receiving the measurements.
,x.x	Pitch	The pitch angle when receiving the measurements.
,x.x	Course	The course when receiving the measurements.
,x.x	Depth	Fixed depth or depth received from a depth sensor. Empty when no depth is available.
,x.x	Range_1	Range measured to the first location in array. Empty when no range measured.
,x.x	Range_2	Range to loc 2 or empty.
,x.x	Range_3	Range to loc 3 or empty.
,x.x	Range_4	Range to loc 4 or empty.
,x.x	Range_5	Range to loc 5 or empty.
,x.x	Range_6	Range to loc 6 or empty.
,x.x	Range_7	Range to loc 7 or empty.
,x.x	Range_8	Range to loc 8 or empty.
,a	Unit	M when the ranges are in meters. S when the ranges are in seconds.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Td_id	The Td_id defines the TD in use for the reception of the replies. 0 to 3 are used for TP range positioning tag 1 to 4. 8 to 11 are used for the TDs connected to Transceiver 1, 12 to 15 for the TDs connected to Transceiver 2, and so on. The TD on the vessel has an offset to the CG to which all positions refer. The Roll, Pitch and course values in the sentence are used to transfer the TD offset vector to geographical coordinates before being added to the position of the TDs.
Range_x	The ranges to the seabed TPs 1 to 8 are in either meters or seconds. The field is empty when no range is measured. The unit Meter or Second is given by the Unit field. When the ranges are in seconds, they refer to the one way propagation time of the sound. When in meters, they are compensated for the sound velocity profile used.

LBL - LBL Location

The PSIMLBL sentence contains coordinates of the LBL locations on the seabed. It is used both for input to and output. The sentences may be on a file for input to either the initial or calibrated coordinates of the locations. The sentences for the locations are sent from the APOS on the operator's request.

The format of the PSIMLBL sentence is:

Field	Name	Explanation
$	Start_character	
PSIMLBL	Address	The address for LBL Location.
,aa	Type	C when calibrated, I when initial coordinates.
,aa_	Coordinates	L when the coordinates are in local coordinates. U when the coordinates are in UTM. O when the coordinates are in UTM and define the UTM centre to be used.
,x	Location_no	Location number 1 to 99.
,x	Serial_no	The serial number of the TP at the location.
,x.x	North	North coordinate.
,x.x	East	East coordinate.
,x.x	Depth	Depth.
,x.x	Major	The Major axis of the one sigma error ellipse.
,x.x	Minor	The Minor axis of the one sigma error ellipse.
,x.x	Direction	The direction of the major axis.
,x.x	Depth_std_dev	The one sigma standard deviation in depth.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

The location coordinates may be entered in either UTM coordinates or in local coordinates.

When the locations are entered in UTM coordinates a UTM centre must have been specified beforehand. That is done either in the menu or in the file containing the LBL locations. Then the Coordinates field is O, causing the North and East to be interpreted as UTM coordinates and used as the UTM centre for the locations. The other fields may be empty when the Coordinates field is O, but they need not be. In the latter case the UTM centre is in the location. In the printouts, the UTM centre is printed with the other fields empty.

The distance from the UTM centre to the locations should be less than 15 km to avoid calculation noise when converting between global and local coordinates.

LBR - LBL Range

The PSIMLBR sentence contains information about a range measured between two locations on the seabed for calibration purpose. It is used both output from the APOS.

The format of the PSIMLBR sentence is:

Field	Name	Explanation
$	Start_character	
PSIMLBR	Address	The address for LBL Range.
,yymmddhhmm	Date_time	Date and time of measurement.
,A	Status	A when in use, V when excluded, S when sum element.
,c--c	Tp_array	The Tp array in which the measurement is done.
,x	Master	Master Location.
,x	Slave	Slave Location.
,x.x	Propagation_time	The one way propagation time [s] of the sound.
,x.x	Range	The range [m].
,x	No_measures	The number of measurements.
,x.x	Std_dev	The standard deviation of the range.
,x.x	Residual	The residual of the range.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Date_time The Date_time field contains two digits each for the year, month, day, hour and minute when the measurement was performed. It is empty when there is no information about when the measurement was done.

An example of a legal value is 9411071309, meaning 13:09 at 11 November 1994.

Status The Status field is A when the sentence contains a measurement used in the calibration and V when it contains a measurement excluded from the calibration. It is S when the sentence is a statistical sum of measured ranges. Each baselength may be measured many times in the same direction. Before used in the calibration calculation, these measurements are combined into one mean value and one standard deviation. Such sentences have the status S. They have an empty Propagation_time field.

Tp_array The Tp array tells in which array the measurement is performed. The

	field may be empty when the information is irrelevant.
Propagation_time	The Propagation field may be empty. Then the range is treated as fixed, and it may not be recalculated with a new sound velocity profile later. When the range is measured by the HPR system, the propagation field contains the time measured.
Residual	The residual field is empty when no calibration calculation is performed with the range measured. Otherwise it contains the residual last calculated. The field may be empty.

GPS - Global Positioning System

The HPR system may receive __GGA and __GLL NMEA 0183 position sentences from a GPS receiver. They are in the datum defined as the input datum on the APOS, and they normally give the position of the GPS antenna. This position may be transmitted as a PSIMGPS sentence. Then the position is in the Presentation datum defined on the APOS, and it is the position of the vessel reference point, i.e. the antenna offset is taken into account.

The values transmitted in the PSIMGPS sentence are the same as those displayed on the APOS screen when so requested.

The format of the PSIMGPS sentence is:

Field	**Name**	**Explanation**
$	Start_character	
PSIMGPS	Address	The address for GPS position
,yymmddhhmmss.ss	Date Time	The date and time received in the sentence from the GPS receiver. If time on whole seconds, the parts of seconds are not included. The time format is either local time or UTC time, depending on the selection in the menu.
,a_	Utm_Geo	The field is U if the position is in UTM coordinates and it is G if the position is in geographical coordinates.
,x.x	North	The North coordinate.
,a_	N_S	N telling that previous field is North and S telling it is South.
,x.x	East	The East coordinate.
,E	E_W	E telling that previous field is East and W telling it is west.
*hh	Checksum	Checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Utm_Geo When the Utm_Geo field is equal to U, the North and East fields contain the position in meters with one digit after the point. The N_S field is always N and the E_W field is always E for UTM coordinates. When the Utm_Geo field is equal to G, the North field is the latitude and the East field is the longitude. The two first digits of the latitude and the three first digits of the longitude are the degrees, the next two digits are the minutes. Then follows a point and four digits telling the decimal fraction of minutes.

DR Draft

The PSIMDR sentence contains information about the draft used by APOS, which may be used in calculation of SSBL positions with locked depth and in LBL/MuLBL calculation.

The draft is the depth of the keel referred to the surface. Before the draft will be used by APOS we need an input of the distance from reference point (normally CG - Center of Gravity) to keel.

The format of the PSIMDR sentence is:

Field	Name	Explanation
$	Start character	
PSIMDR	Address	The address.
,x.x	Bow draft	Bow draft with unit meters.
,A	Status bow draft	A when draft is OK, V when not valid.
,x.x	Aft draft	Aft draft with unit meters.
,A	Status aft draft	A when draft is OK, V when not valid.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

3 LBL GEOGRAPHICAL CALIBRATION SENTENCES

The LBL geographical calibration is the process of deciding the latitude and longitude of the origin of a LBL array, and the rotation of the local co-ordinate system relative to the geographical north. It is explained in more detail in the APOS help.

This section contains the NMEA sentences describing both the result of the LBL geographical calibration and the measurements that are the basis for the calculation.

LBG - LBL Geographical calibration

The PSIMLBG sentence contains information about a position pair used for Geographical Calibration. The PSIMLBG sentences are sent from the APOS on the operator's request.

The format of the PSIMLBG sentence is:

Field	Name	Explanation
$	Start_character	
PSIMLBG	Address	Address for LBL Geographical calibration.
,yymmddhhmm	Date_time	Time of measurement.
,A	Status	A when position pair is in use, V when excluded
,a	UTM_or_rad	U for UTM coordinates, r for radians.
,c--c	Tp_array	The Tp array for which the origin is valid.
,x.x	Geographical_north	The Geographical North coordinate of GPS position.
,x.x	Geographical_east	The Geographical East coordinate of GPS position.
,x.x	LBL_north	The Local North coordinate of LBL measure.
,x.x	LBL_east	The Local East coordinate of LBL measure
,x.x	Dist_residual	The distance residual.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Geographical_north, Geographical_east These fields contain the position of the vessel read from the dGPS receiver. The position is offset to the reference point of the vessel.

LBL_north, LBL_east These fields contain the position of the vessel calculated based on the ranges to the seabed TPs. The position is offset to the reference point of the vessel. These coordinates are in the local coordinate system.

Dist_residual The Dist_residual field is updated when a geographical calibration is performed. It contains the horizontal difference in meters between the local LBL position and the geographical position, transformed to local coordinates.

LGQ - LBL Geographical Calibration Quality

The PSIMLGQ sentence contains information about the QA data of a position pair used for Geographical Calibration. The QA data are the elements in the Covariance matrixes of the Geographical position and of the local position. The PSIMLGQ sentences always follow the PSIMLBG sentences when transmitted from the APOS system. For each position pair there is one PSIMLBG sentence and one PSIMLGQ sentence.

The format of the PSIMLGQ sentence is:

Field	Name	Explanation
$	Start character	
PSIMLGQ	Address	Address for LBL Geographical Calibration QA.
,yymmddhhmm	Date time	Time of measurement.
,x.x	Geographical_north_var	The variance in the geographical north direction of the geographical position.
,x.x	Geographical_east_var	The variance in the geographical east direction of the geographical position.
,x.x	Geographical_covar	The covariance between north and east of the geographical position.
,x.x	LBL_north_var	The variance in the local north direction of the LBL position.
,x.x	LBL_east_var	The variance in the local east direction of the LBL position.
,x.x	LBL_covar	The covariance between north and east of the LBL position.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

The geographical variances

These fields contain the variance of the dGPS position in the north and east direction, and the co-variance between north and east. The variance is the square of the expected 1-sigma accuracy. The values are calculated based on the input from the dGPS receiver.

The LBL variances

These fields contain the variance of the LBL position in the north and east direction, and the co-variance between north and east. The variance is the square of the expected 1-sigma accuracy, which correspond to the error ellipse drawn on the APOS display.

LBO - LBL Origin

The PSIMLBO sentence contains information about the origin used for a Tp array. It is sent on the operator's request.

The format of the PSIMLBO sentence is:

Field	Name	Explanation
$	Start_character	
PSIMLBO	Address	The address for LBL Origin.
,c--c	Tp_array	The Tp array for which the origin is valid.
,a	UTM_or_rad	U for UTM coordinates, r for radians.
,x.x	Origin_north	The North coordinate or the latitude of the origin.
,x.x	Origin_east	The East coordinate or the longitude of the origin.
,x.x	Rotation	The rotation of the local north axis relative to geographical north.
,x.x	Rms_residual	Empty or the rms value of the distance residuals of the global calibration.
,x.x	Max_residual	The max residual value of the global calibration.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

UTM_or_rad The field UTM_or_rad is either U or r. When U, the Origin_north and _east fields are in UTM coordinates in meters and the Direction is in degrees. When r, the Origin_north, _east and Direction fields are all in radians.

Tp_array The origin read by the HSC 400 in a PSIMLBO sentence is used for the array specified in the Tp_array field. An empty field is interpreted as zero. Zero means the origin of the Super array.

Rotation The Rotation field may be empty. Then it is interpreted as zero when the UTM_or_rad field is r, and as the angle from Geographical north to UTM north when the UTM_or_rad field is U.

Rms_residual, Max_residual The Rms_residual and the Max_residual fields are the quality parameters of the origin coordinates deriving from the global calibration. The values are in meters. The fields are empty when the origin is inserted by an operator.

LOQ - LBL Origin Quality

The PSIMLOQ sentence contains information about quality the origin. It always follow a PSIMLBO sentence when sent from the APOS.

The format of the PSIMLOQ sentence is:

Field	Name	Explanation
$	Start_character	
PSIMLOQ	Address	The address for LBL Origin QA data.
,c--c	Tp_array	The TP array for which the QA data is valid.
,a_	UTM_or_rad	m for error ellipse meter and degrees values r for covariance matrix values in radians.
,x.x	Major or Lat_var	Major semi-axis of the origin error ellipse or covariance data.
,x.x	Minor or Lon_var	Minor semi-axis of the origin error ellipse or covariance data.
,x.x	Direction or Rot_var	The direction of the Major semi-axis of the origin error ellipse, or covariance data.
,x.x	Rot_stddev or Lat_lon_covar	Empty or covariance data.
,x.x	Empty or Lat_rot_covar	Empty or covariance data.
,x.x	Empty or Lon_rot_covar	Empty or covariance data.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

UTM_or_rad The UTM_or_rad field is either m or r. When m, the QA data for the origin are printed as error ellipse data in meters and degrees. These data are the error ellipse semiaxes, the direction of the major semi-axis relative to the geographical north, and the stddev of the rotation of the coordinate system.

When the UTM_or_rad field is r, the QA data are printed as covariance data in radians squared. The explanation of the covariance fields are shown in the list below.

Covariance matrix element	Explanation
Lat_var	The variance of the origin in the latitude (i.e. north) direction.
Lon_var	The variance of the origin in the longitude (i.e. east) direction.
Rot_var	The variance of the rotation of the axes.
Lat_lon_covar	The covariance between the latitude and the longitude.
Lat_rot_covar	The covariance between the Latitude and the rotation.
Lon_ro_covar	The covariance between the Longitude and the rotation.

4 LBL RUN TIME CALIBRATION SENTENCES

The LBL Run Time calibration is the process of deciding the positions of the transponders in the LBL array based on the LBL measurements when positioning in the array.

The operator can save the LBL measurements that are logged for a calibration to a file. This section explains the NMEA sentences that are written to the file.

The PSIMLBP and the PSIMLBL sentences are used in addition to the sentences explained in this section. PsimLBP contains the position of the vessel as calculated during the logging. There is one sentence for each measurement set. The PSIMLBL sentence contains the position of the transponder location.

RCT - Run Time Calibration Tx

The PSIMRCT sentence contains the position of the transducer relative to the vessel reference point when the LBL interrogation was done. It also contains the depth of the reference point, if known.

The format of the PSIMRCT sentence is:

Field	Name	Explanation
$	Start character	
PSIMRCT	Address	The address for Run Time calibration Tx.
,	Spare	Reserved for Transceiver number.
,	Spare	Reserved for Transducer number.
,x.x	Td North	The Td-er North co-ordinate relative to the vessel reference point. [m].
,x.x	Td East	The Td-er East --- " ---
,x.x	Td Down	The Td-er Down --- " ---
,x.x	Reference Depth	The depth of the vessel reference point. [m]. Empty when the depth is not known.
,x.x	Reference Depth 1 Sigma	The 1-sigma uncertainty of the reference point depth [m]. Empty if the Reference depth field is empty.
,	Spare	
,	Spare	
,	Spare	
*hh	Checksum	Empty or checksum
CRLF	Termination	

Explanation of the fields in the sentence

Transducer North, East and Down coordinates

The position of the transducer when doing the LBL interrogation. It is the transducer-offset vector compensated for the vessel attitude when doing the Tx.

Reference depth

The depth of the vessel reference point is used in the LBL calculation when it is known. It is either the depth as derived from the transducer installation parameters, a manually inserted depth or the depth value read from a depth sensor (when the "vessel" is an ROV). The field is empty if the depth is not known.

The 1-sigma field contains the uncertainty of the depth in the previous field.

RCM - Run Time Calibration Measurements

The PSIMRCM sentence contains the LBL measurements done on a transducer towards one transponder location.

The format of the PSIMRCM sentence is:

Field	Name	Explanation
$	Start character	
PSIMRCM	Address	The address for Run Time Calibration Measurements.
,xx	Transceiver	Rx Transceiver number.
,xx__	Transducer	Rx Transducer number.
,xx__	Location	Location index, a number between 0 and 7.
,x.x	Td_North	The Td-er North coordinate relative to the vessel reference point. [m].
,x.x	Td_East	The Td-er East --- " ---
,x.x	Td_Down	The Td-er Down --- " ---
,x.x	Range	The V range from the Tx transducer to the transponder and back to the Rx transducer.
,x.x	Range 1-Sigma	The 1-sigma uncertainty of the V range.
,x.x	Sinus_North	Sinus of the North angle from the Rx Td-er to the transponder.
,x.x	Sinus_North 1-sigma	The 1-sigma uncertainty of the sinus North angle.
,x.x	Sinus_East	Sinus of the East angle from the Rx Td-er to the transponder.
,x.x	Sinus_East 1-sigma	The 1-sigma uncertainty of the sinus East angle.
,	Spare	
,	Spare	
,	Spare	
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Rx Transducer North, East and Down coordinates

The position of the transducer when receiving the LBL measurement. It is the transducer-offset vector compensated for the vessel attitude when receiving the reply.

Range, sinus to North and sinus to East

The LBL range and direction measurements towards the transponder. If a measurement is not done, the field is empty.

The 1-sigma fields contain the uncertainty of the field before. Empty if the field before is empty.

5 EXTERNAL CONTROL AND ACCESS SENTENCES

This section describes the sentences that allow other computers (i.e. external equipment as seen from the APOS) to control functions in the APOS and to access some internal data.

The sentences are often defined for special projects, and then implemented as a part of the system because they are useful for other projects/users too.

RCP - Remote Control Positioning

The PSIMRCP sentence contains information about how to activate and deactivate positioning from external equipment. The sentences for the remote control positioning are received on one of the APOS operator station.

The format of the PSIMRCP sentence is:

Field	Name	Explanation
$	Start character	
PSIMRCP	Address	The address for remote control operation.
,aa_	Type	"S" indicates standard SSBL
,aa_	Status	"A" indicates activate , "D" indicates deactivate, "R" indicates deactivate and remove any definitions, "S" indicates deactivating all of 'Type', no Tp_code necessary.
,x.x	Int_interval	Interrogation interval [s], 0.0 indicates fast as possible.
,cc__	Tp_code	Transponder channel. Examples: B01, B33, B47.
,	Spare1	
,	Spare2	
,	Spare3	
,	Spare4	
*hh	Checksum	Empty or checksum.
CRLF	Termination	

When receiving a PSIMRCP sentence the APOS checks if the transponder channel already is defined for SSBL-positioning, if so it will activate/deactivate any positioning for the found object with the existing parameters (except "Int_interval"). If the channel don't exist and "activate" is wanted, a new standard SSBL positioning object will be created with the APOS default values as parameters (transducer, max range, power etc).

Status "R" will remove the existing SSBL object from APOS, while status "D" will just deactivate the positioning and keep the parameters. "S" will deactivate all existing object of "Type", type would normally be SSBL.

SVT - Sound Velocity

The PSIMSVT sentence contains information about the sound velocity used by APOS in calculation of positions for HPR4xx and HiPAP. Since a sound profile could consist of many hundreds of points, many telegrams may be sent. The sentences for the sound velocity are sent on the operator's request and when any changes.

The format of the PSIMSVT sentence is:

Field	Name	Explanation
$	Start character	
PSIMSVT	Address	The address for sound velocity.
,aa_	Description	"P" indicates profile used. "M" for manual parameters. "R" indicates request for data.
,x	TotalPoints	Total number of points in the sound profile.
,x	Index	The index for the first point in this telegram A range from 0 to (TotalPoints -1) .
,x.x	Depth1	Depth for the next sound velocity [m].
,x.x	Sv1	Sound velocity for the previous depth [m/s].
,x.x	Depth2	Depth for the next sound velocity [m].
,x.x	Sv2	Sound velocity for the previous depth [m/s].
,x.x	Depth3	Depth for the next sound velocity [m].
,x.x	Sv3	Sound velocity for the previous depth [m/s].
,x.x	Depth4	Depth for the next sound velocity [m].
,x.x	Sv4	Sound velocity for the previous depth [m/s].
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Empty field for not existing data (especially for the last telegram).

If manual parameters selected then the first sound velocity will be transducer sound velocity, the second will be mean sound velocity and the third will be seabed sound velocity. All depths to be ignored.

All points with increasing depths.

If description is "R" the telegram is an input to APOS, and the telegram is a request to APOS to send it's sound velocity data.

6 TRANSDUCER ALIGNMENT SENTENCES

This section describes the sentences that are defined for the transducer alignment function in the APOS.

Some sentences are stored on the file when the measurements are saved. They contain the necessary information about what is measured, and a file with these measurements can be read by APOS to retrieve the measurements for post-processing.

Other sentences are stored on file when the results are saved. They contain the information about the results. A file with these measurements can be read by programs like Excel and MatLab to analyze and to document the results.

Sentences with the measurements

When the measurements for a transducer alignment are saved to a file, the following sentences are used:

- The $INZDA sentence. It is described in the NMEA standard from the "National Marine Electronics Association". It is the first sentence on the file. It tells the date of the measurements. The clock is stored in the PSIMSNS sentences for each measurement, but the date is missing in the PSIMSNS sentence.
- The PSIMSNS sentence. There is one sentence for each sentence. It contains the clock (timestamp) of the measurements and the Roll, Pitch, Heading when the HiPAP / SSBL measurement was done. It is the same sentence as used for other purposes too.
- The PSIMPPQ sentence. There is one sentence for each sentence. It contains the expected accuracy with which the measurement is done.
- The PSIMPOP sentence. There is one sentence for each measurement. It contains the measurement itself, i.e. the position of the vessel as measured by the dGPS and the position of the transponder relative to the transducer as measured by the HiPAP / SSBL system.

  Each measurement is described by three sentences. The are linked together by having the same tag number. The sentences with the same tag number are stored in sequence, with the PSIMPOP sentence as the last one.

Sentences with the results

When the results from a transducer alignment are saved to a file, the following sentences are used.

- The PSIMTDP sentence. One sentence with the installation parameters and one sentence with the calculated parameters are saved.
- The PSIMTDQ sentence. One sentence with the expected 1-sigma accuracy of the parameters that are calculated.
- The PSIMTPP sentence. There will be 2 sentence for each measured position pair, one with the UTM position of the transponder as measured with the installation parameters, and one with the UTM position after compensated with the calculated parameters. It will also be one sentence with the Boxed-in UTM position of the transponder.
- The PSIMTPQ sentence. There will be one sentence with the expected 1-sigma accuracy of the boxed-in transponder position.
- The PSIMVEP sentence. There will be one sentence with the vessel position for each position pair.

The tag number in the sentences are used to link together the sentences for the same position pair.

POP - Position Pair for Transducer alignment

The PSIMPOP sentence contains the dGPS and the HiPAP / SSBL measurements of a position pair used for Transducer Alignment. The sentence is used for storage on file when the operator saves the measurements done for a Transducer alignment.

The format of the PSIMPOP sentence is:

Field	Name	Explanation
$	Start_character	
PSIMPOP	Address	The address for Position Pair.
,cc__	Tp_code	The channel number of the transponder. An example is B25.
,A	Status	A for OK and V for not OK.
,xx	Tag	Tag number, linking this sentence to the PSIMSNS and the PSIMPOP sentences.
,a	UTM_or_rad	U for UTM coordinates, r for radians.
,	Spare 1	
,	Spare2	
,x.x	Geographical_North	The Geographical North co-ordinate of the vessel GPS antenna as measured by the dGPS receiver.
,x.x	Geographical_East	The East co-ordinate -- " --.
,x.x	SSBL_Fwd	The Forward co-ordinate of the transponder position relative to the transducer, as measured with the HiPAP/SSBL system.
,x.x	SSBL_Stb	The Starboard co-ordinate -- " --
,x.x	SSBL_Down	The Depth co-ordinate --"--
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

The positions in this sentence are as measured at the GPS antenna and at the HPR/HiPAP transducer before applying offsets, inclinations and roll pitch compensation. The positions are valid at the same time. The timetag and the attitude values are in the PSIMSNS sentence before this sentence.

UTM_or_rad This field defines the denomination of the geographical coordinates.

When it is r, the position is in radians in the WGS 84 datum. This is the only denomination implemented so far.

Geographical North and East

These coordinates give the position of the vessel GPS antenna.

SSBL Fwd, Stb and Down

These coordinates are the position of the transponder relative to the transducer. The coordinates are in the transducer co-ordinate system, i.e. they are as measured by the transceiver before the roll pitch compensation and before the compensation with the transducer inclinations and offsets.

PPQ - Position Pair Quality

The PSIMPPQ sentence contains information about the quality of a position pair used for Transducer Alignment. The sentence is used for storage on file when the operator saves the measurements done for a Transducer alignment.

The format of the PSIMPPQ sentence is:

Field	Name	Explanation
$	Start_character	
PSIMPPQ	Address	Address for Position Pair Quality.
,cc__	Tp_code	The channel number of the transponder. An example is B25.
,xx	Tag	Tag number, linking this sentence to the PSIMSNS and the PSIMPOP sentences.
,	HiPAP_signal	Signal level as reported by HiPAP
,	HiPAP_noise	Noise level as reported by HiPAP
,x.x	North_var	The variance in the North direction.
,x.x	East_var	The variance in the East direction.
,x.x	Depth_var	The variance in the Depth direction.
,x.x	North_East_covar	The co-variance between the North and the East coordinates.
,x.x	North_Depth_covar	The co-variance between the North and the Depth coordinates.
,x.x	East_Depth_covar	The co-variance between the East and the Depth coordinates.
*hh	Checksum	Empty or checksum
CRLF	Termination	

Explanation of the fields in the sentence

The variance and the co-variance fields are with denomination meter square. The variance fields give the square of the expected accuracy of the transponder position in latitude, longitude and depth. It is the sum of the corresponding values for the dGPS measurement and the HiPAP / SSBL measurement.

The six variance and co-variance fields are derived directly from the co-variance matrix in APOS, which is used to weight the measurement in the calculations.

TDP - Transducer Parameters for Transducer alignment

The PSIMTDP sentence contains the transducer parameters. The sentence is used for storage on file when the operator saves the results from a Transducer alignment.

Note ! *The VRU and Gyro rotation field are added in APOS version 5.6.0 in November 2001.*

The format of the PSIMTDP sentence is:

Field	Name	Explanation
$	Start character	
PSIMTDP	Address	The address for Transducer Parameters.
,xx	Transceiver	Transceiver number.
,xx	Transducer	Transducer number and type.
,c--c	Contents	The contents of the sentence. Initial, Calculated.
,x.x	Fwd offset	The Forward offset of the transducer. [m].
,x.x	Stb offset	The Starboard --- " ---
,x.x	Down offset	The Down --- " --- . Empty when the sentence contains calculated offset.
,x.x	Roll inclination	The roll inclination of transducer. [degrees]
,x.x	Pitch inclination	The pitch -- " --.
,x.x	Gear inclination	The gear -- " -- If the transducer is of the mechanical tracking type, the field contains the rotation (synchro offset) of the transducer.
,x.x	Transducer sound velocity	The transducer sound velocity.
,x.x	Mean sound velocity	The mean sound velocity.
,x.x	VRU rotation	The rotation of the VRU relative to the Gyro.
,x.x	Gyro rotation	The rotation of the Gyro relative to the vessel centre-line.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Transducer

The transducer field contains the transducer number in the least significant digit and the transducer type in the next digit. The code for the type is the same as the code used in the binary position telegrams.

Example

Transducer field equal to 91 means transducer number 1 and transducer type 9 which is HiPAP 500.

Contents

The sentence contains one of the two possible sets of parameters.

1. I for initial. The sentence contains the installation parameters of the transducer and the sound velocities as set on the APOS.
2. C for calculated. The sentence contains the parameters as calculated by the transducer alignment function. The fields of the parameters not calculated are empty.

GPA - GPS antenna offset Parameters for Transducer alignment

The PSIMGPA sentence contains the GPS antenna parameters. The sentence is used for storage on file when the operator saves the measurements and the results from a Transducer alignment.

The format of the PSIMGPA sentence is:

Field	Name	Explanation
$	Start_character	
PSIMGPA	Address	The address for GPS Antenna.
,x.x	Installed_Fwd_offset	The Forward offset of the GPS antenna. [m], as it was used during the logging of the measurements.
,x.x	Installed_Stb_offset	The Starboard --- " ---
,x.x	Installed_Height_offset	The Height --- " ---
,x.x	Installed_RollPitch	Y or y if the GPS antenna was Roll/Pitch corrected during the post-processing. Empty or anything else if it was not.
,	Spare	Spare.
,x.x	Correct_Fwd_offset	The Forward offset of the GPS antenna, [m], as it was used during the postprocessing.
,x.x	Correct_Stb_offset	The Starboard --- " ---
,x.x	Correct_Height_offset	The Height --- " ---
,x.x	Correct_RollPitch	Y or y if the GPS antenna was Roll/Pitch corrected during the post-processing. Empty or anything else if it was not.
,	Spare	Spare.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

The sentence has two sets of parameters.

The first set is for the antenna offset as it was installed and used during the logging of the measurements. Their names have the prefix Installed.

The next set is for the antenna offset as it was used during the calculation (post-processing) of the measurements. They are assumed to be the correct ones, and their names therefore have the prefix Correct. They are normally the same as the Installed_ values. If one or more of the three Correct_ offset fields are empty, the correct antenna offset is the same as the installed antenna offset. If the Correct_RollPitch field is empty, the value is the same as the Installed_RollPitch.

TDQ - Transducer Parameters quality

The PSIMTDQ sentence contains the expected 1-sigma accuracy of the parameters calculated for the transducer alignment. The sentence is used for storage on file when the operator saves the results from a Transducer alignment.

Note ! *The accuracy of the VRU and Gyro rotation field are added in APOS version 5.6.0 in November 2001.*

The format of the PSIMTDQ sentence is:

Field	Name	Explanation
$	Start character	
PSIMTDQ	Address	The address for Transducer Parameters quality.
,xx	Transceiver	Transceiver number.
,xx	Transducer	Transducer number.
,c--c	Contents	The contents of the sentence. It is always C for calculated.
,x.x	Accuracy Fwd offset	The accuracy of the calculated forward offset. [m].
,x.x	Accuracy Stb offset	The same for the starboard offset.
,x.x	Accuracy Roll Inclination	The accuracy of the calculated roll inclination. [degrees]
,x.x	Accuracy Pitch inclination	The same for the pitch inclination.
,x.x	Accuracy Gear inclination	The same for the pitch inclination. If the transducer is of the mechanical tracking type, the field contains the accuracy of the rotation (synchro offset) of the transducer.
,x.x	Accuracy Transducer sound velocity	Accuracy of the transducer sound velocity.
,x.x	Accuracy Mean sound velocity	Accuracy of the mean sound velocity.
,x.x	Accuracy VRU rotation	Accuracy of the rotation of the VRU relative to the Gyro.
,	Reserved for accuracy Gyro rotation	Reserved for future use.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

The fields of the parameters not calculated are empty.

The accuracy of the parameters are the expected 1-sigma accuracy as calculated by the transducer alignment function. It is calculated based on our knowledge about the accuracy of the measurements in the position pairs, the number of position pairs used in the calculation, and the geometry between the vessel positions and the seabed transponder.

The 1-sigma uncertainty value decreases when the number of measurements increases. That is correct when the errors on the measurements are random, which is assumed by the alignment function. In real life, however, there will also be some systematic errors. The contribution from the systematic errors is not reduced as the number of measurements increase. Please have this in mind when looking at the calculated 1-sigma errors. They may be unrealistic small when there are many measurements.

TPP - Transponder Position for Transducer alignment

The PSIMTPP sentence contains the geographical position of a transponder. The sentence is used for storage on file when the operator saves the results from a Transducer alignment.

The format of the PSIMTPP sentence is:

Field	Name	Explanation
$	Start_character	
PSIMTPP	Address	The address for Transponder Position.
,cc__	Tp_code	The channel number of the transponder. An example is B25.
,c--c	Contents	The contents of the sentence. Measured, Compensated, Boxed-in.
,A	Status	A for OK and V for not OK (Excluded.)
,xx	Tag	Tag number, linking this sentence to the PSIMSNS and the PSIMPOP sentences.
,a_	UTM_or_rad	U for UTM coordinates, r for radians.
,	Spare 1	
,	Spare2	
,x.x	Geographical_North	The Geographical North co-ordinate of the transponder.
,x.x	Geographical_East	The East co-ordinate -- " --
,x.x	Depth	The depth of the transponder.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Contents

The sentence contains one of the following three possible three positions of the transponder.

1. M for measured. The position is as measured with the original transducer installation parameters.
2. C for compensated. The position is compensated with the Transducer alignment parameters and sound velocities that are calculated.
3. B for Boxed in position. The position is the result of the Box-in. The Tag field is empty.

Tag

The tag is the measurement number. It is used to link this sentence to the other sentences on the file.

UTM_or_rad	This field defines the denomination of the geographical coordinates. When it is U, the position is in UTM coordinates in the APOS presentation datum. This is the only denomination implemented so far.

Geographical North, East and Depth

These coordinates give the position of the transponder. It is the sum of the dGPS position and position measured by the HiPAP/HPR system.

TPQ - Transponder Quality

The PSIMTPQ sentence contains the statistical quality data for a boxed-in transponder position as calculated by the Transducer Alignment function. The sentence is used for storage on file when the operator saves the results.

The format of the PSIMTPQ sentence is:

Field	Name	Explanation
$	Start character	
PSIMTPQ	Address	The address for Transponder quality.
,cc__	Tp_code	The channel number of the transponder. An example is B25.
,c--c	Contents	The contents of the sentence. It is always Boxed-in.
,	Spare 1	
,	Spare2	
,x.x	Major	The major semi-axis in the error ellipse for the transponder position. [m].
,x.x	Minor	The Minor semi-axis -- " --
,x.x	Direction	The direction of the major semi-axis relative to north. [degrees]
,x.x	Depth accuracy	The expected 1-sigma accuracy of the transponder depth.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Contents

It is always B for boxed in.

VEP - Vessel Position for Transducer alignment

The PSIMVEP sentence contains the position of the vessel as measured by the dGPS when doing measurements for Transducer Alignment. The sentence is used for storage on file when the operator saves the results from a Transducer alignment.

The format of the PSIMVEP sentence is:

Field	Name	Explanation
$	Start_character	
PSIMVEP	Address	The address for vessel position.
,hhmmss.ss	Time	The real time of the measurement. Given as hour, minutes and seconds. The time format is UTC time.
,A	Status	A for OK and V for not OK.
,xx	Tag	Tag number, linking this sentence to the PSIMTPP sentence.
,a	UTM_or_rad	U for UTM coordinates, r for radians.
,	Spare 1	
,	Spare2	
,x.x	Geographical_North	The Geographical North co-ordinate of the vessel reference point as measured by the dGPS receiver.
,x.x	Geographical_East	The East co-ordinate -- " --
,x.x	Heading	The heading of the vessel.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Explanation of the fields in the sentence

Tag

The tag is the measurement number. It is used to link this sentence to the other sentences on the file.

UTM_or_rad This field defines the denomination of the geographical coordinates. When it is U, the position is in UTM coordinates in the APOS presentation datum. This is the only denomination implemented so far.

Geographical North and East

These coordinates give the position of the vessel reference point. The position is measured by the dGPS receiver, and offset from the GPS antenna to the vessel reference point.

7 NMEA 0183 STANDARD SENTENCES

This section describes some of the standard NMEA 0183 sentences that are used by the APOS. The use may need more explanation than in the document written by the NMEA 0183 Standards Committee.

Most of the standard NMEA 0183 sentences used by the APOS are not described in this section, because they are used as described in the document written by the NMEA 0183 Standards Committee.

GLL - Geographic position Latitude Longitude

When the $__GLL sentence is received by the APOS, it is interpreted as described in the document written by the NMEA 0183 Standards Committee. I.e. the latitude and the longitude is the position of the vessel. It is normally received from a GPS receiver.

The $__GLL sentence may also be transmitted from the APOS. Then it contains the position of a SSBL transponder in latitude longitude. The format of the sentence is the same as described in the document written by the NMEA 0183 Standards Committee.

This section describes the $__GLL sentence transmitted by the APOS.

There is no information about the transponder code in the sentence. It is therefore recommended to log the PSIMSSB sentence together with the INGLL sentence. The PSIMSSB sentence gives you the transponder code and other status information. The timestamp of the PSIMSSB and the INGLL sentence are the same, enabling you to match the two sentences describing the same position.

The format of the INGLL sentence is:

Field	Name	Explanation
$	Start_character	
INGLL	Address	The address
,llll.ll	Latitude	Latitude of transponder. The format is DegreesMinutes.Decimalfractionofminute. Two digits for the degrees, two digits for the minutes. The number of digits for the fractional part of the minutes is optional.
,a	N/S	N when north, S when south.
,yyyyy.yy	Longitude	Longitude of transponder. The format is the same as for the latitude, except that 3 digits are used for the degrees.
,a	E/W	E when east, W when west.
,hhmmss.ss	Time	The time in hours minutes and seconds. The decimal fraction is optional. The time format is either local time or UTC time, depending on the selection in the menu.
,A	Status	A when position is OK, V when not valid.
,a	Mode indicator	It is always D. This field is optional, see below.
*hh	Checksum	Empty or checksum.
CRLF	Termination	

Mode indicator

The Mode indicator field is a new data field in the sentence, and it is defined in the NMEA standard V2.30. Some customers have coded the reception of the sentence before this field was added, and they reject the sentence when the field is present. We have therefore made this field optional. Ask Kongsberg Simrad how to add or remove this data field.

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