AHRS

Interface Library

IXBLUE

DEEP INSIGHT. SHARPER SENSES.

Document Revision History

Edition	Date	Comments
A	01/2014	First Edition
B	03/2012	HEROT frame added HEHDT HEROT, IMU BINARY, IMU RAW DATA protocols added
C	10/2013	STOLT OFFSHORE, TSS1/DMS, DOLOG HRP protocols modified
D	06/2014	OCTANS NANO product added Quick guide to input protocols updated Quick guide to output protocols updated AHRS120, RDI SYNC, HEHDT HEROT, HETHS HEROT, POSTPROCESSING, MAHRS, TECHSAS protocols added Status description & NMEA frames updated
E	11/2014	Quick guide to input & output protocols updated Heart beat and alert management added NMEA frames updated ACK, ACN, ALF, ALR, ARC, PAHRS, PTNTHPR, PSXN19, TAH BIN protocols added
F	01/2015	Algorithm status updated NMEA RMC frame updated Quick guide to input protocols updated Quick guide to output protocols updated IFREMER VICTOR protocol added TMS CCV IMBAT AHRS protocol added
G	03/2015	New style guide updated to the document Quick guide to input & output protocols updated DCN Standard NAV 1 protocol updated, HBT and IXBLUE STANDARD BIN protocols added
H	09/2015	OCTANS STANDARD and HEAVE POSTPRO protocols updated. OCTANS algorithm status and system status updated. OCTANS system status 3 added. Web-based user interface status label added.
I	11/2015	Quick guide to output protocols updated. Seapath protocol added.
J	04/2016	Quick guide to output & input protocols updated. TAH BIN SMT protocol added. SEAPATH protocol updated.
K	02/2017	Quick guide to output & input protocols updated. Octans Subsea added. Ifremer Victor V3 & MINIFOG_OTG_MSG8 protocol added. TOKIMEC PTVF protocol updated.

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The **Warning** icon indicates that possible personal injury or death could result from failure to follow the provided recommendation.

Abbreviations and Acronyms

Abbreviations and acronyms are described in document *Inertial Products – Principle and Conventions (Ref.: MU-INS&AHRS-AN-003)*

Table of Contents

1 INTRODUCTION

This document provides information on the OCTANS interface library and the procedure for library protocol update. Depending on the OCTANS model and on the specifications of the connectors, some protocol interfaces are not relevant.

Additionally, this document provides a detailed description of OCTANS built-in test and OCTANS status word.

Unless duly specified in the protocol specification, definitions and conventions used for data input and output are standard OCTANS definitions and conventions such as described in *Inertial Products- Principle and Conventions (Ref.: MU-INS&AHRS-AN-003)*.

1.1 Conventions

1.1.1 EXPORT REGULATION LIMITATIONS

To comply with export regulations the iXBlue AHRS product range complies with the following limitations:

Table 1 - Saturation levels

Applicable to	OCTANS OCTANS SUBSEA	OCTANS NANO
Altitude (*)	4000 m	4000 m
Linear Speed (*)	41.66 m/s (150 km/h)	41.66 m/s (150 km/h)
Rotation Speed (*)	750°/s	250°/s
Acceleration (*)(**)	± 15 g	± 5 g

(*) Software limitation

(**) Hardware design limitation

Table 2 - Resolution limitations on output data

Applicable to	OCTANS OCTANS SUBSEA OCTANS NANO
Acceleration resolution (*)	1 mg
Rotation rates resolution (*)	3.6°/h

(*) Software limitation

(**) Hardware design limitation

To comply with French export regulations the inertial products delivered to some countries cannot output acceleration or rotation rate data and the post-processing protocol is not available. Please contact iXBlue for further details.

1.1.2 Reference Frame Notations

The following notations will be found in the protocol descriptions and are explained hereafter:

XV1, XV2, XV3: Vessel frame. XV1 (bow), XV2 (port), XV3 (up).

XVH1, XVH2, XVH3: Vessel Horizontal Frame. Vessel Frame compensated from roll and pitch.

X1, X2, X3: OCTANS Body frame. X1 (forward), X2 (left), X3(up). Refer to Principle and conventions document (Ref.: MU-INS&AHRS-AN-003) for convention description.

X1IMU, X2IMU, X3IMU: IMU reference frame or internal sensor bloc frame. X1IMU(forward), X2IMU(left), X3IMU(up).

XNorth, XEast, XUp: Local geographical frame.

Rotation rates convention:

XVI(I=1,2,3) rotation rate is positive when rotation vector is pointing in XVI(I=1,2,3) direction. "Cork screw" method defines the relation between rotation sign convention and displacement sign (i.e. turning clockwise, the screw move forward). The data is not compensated for earth rotation (15.04°/h).
Heading, Roll, Pitch rotation rate is different from XVI(I=1,2,3) rotation rate.

Acceleration convention:

XVI(I=1,2,3) acceleration is positive when acceleration vector is pointing in XVI(I=1,2,3) direction. Accelerations are compensated from gravity unless specified in the protocol (i.e.: CONTROL protocol).

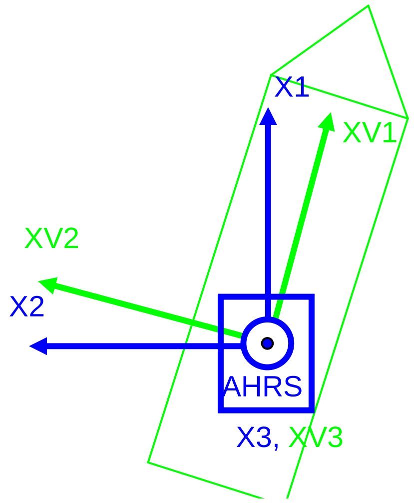

Figure 1 – Vessel and System reference frame

1.2 Firmware Restrictions

This document provides information on the AHRS interface library, giving the specifications on all standard protocols available on OCTANS running with firmware version higher than described in table below:

	FRMWCINT	Web-based MMI
OCTANS	4.16	5.76.3-1.125
OCTANS SUBSEA	4.20	5.76.3-1.125
OCTANS NANO	4.12	5.61-1.113

Refer to *Inertial Products - Web-based interface user guide (ref.: MU-INS-AN-021)* for the procedure to check the firmware version currently downloaded into your unit.

Contact iXBlue customer support (support@ixblue.com) to get the updated firmware version to be downloaded into your system.

2 OVERVIEW OF THE AHRS INTERFACE LIBRARY

2.1.1 DEFINITION OF THE AHRS INTERFACE LIBRARY

The AHRS Library is a set of interface protocols which are used to transfer data in and out of the AHRS through the different ports available (serial, Ethernet and pulse).

It is iXBlue's policy not to modify the specifications of the frame of existing protocols in order to maintain full compatibility of the AHRS units throughout the life of the product. Existing protocols are then updated without modification of the data frame.

OCTANS protocols are either:

- Hard-coded into OCTANS, and part of the OCTANS firmware version. In such case, existing protocols are updated and new protocols are added only when a new firmware version is released and downloaded into OCTANS. The specifications described in this document refer to firmware version or higher. All protocols related to serial or Ethernet inputs, pulse inputs and outputs are hard-coded, as well as a part of protocols for serial or Ethernet outputs. Hard-coded protocols that have been developed for specific customer are not documented in the standard Library documentation.
- Library protocols. These appear as text files which are stored into UDP Library folder on the CD-ROM provided with the product. It contains all the standard library protocols listed in Figure 2 - List of OCTANS updated standard library protocols available from the Library.

2.1.2 PROTOCOL LIBRARY UPGRADE

Figure 2 lists all the standard library protocols delivered by iXBlue. The protocol version is referenced by the index at the end of the protocol name. Updated or new protocols may be provided to you by the customer support as text files. Once the files are copied on the PC, these protocols are available for OCTANS serial interface configuration through the Web-Based User Interface. Refer to *Inertial Products - Web-based interface user guide (ref.: MU-INS-AN-021) to get details about how to configure the serial interface.*

2.1.3 Protocol Library Compatibility Issues

- For OCTANS product:

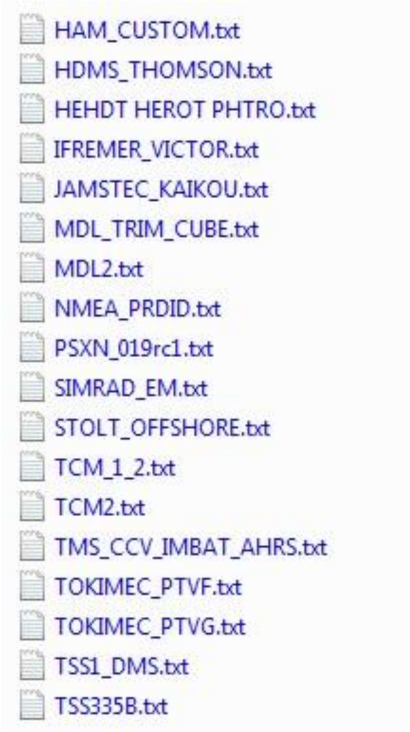

Figure 2 - List of OCTANS updated standard library protocols available from the Library

- For OCTANS NANO product:

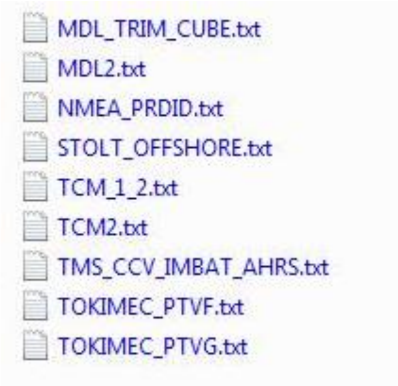

Figure 3 - List of OCTANS NANO updated standard library protocols available from the Library

2.2 OCTANS Status

2.2.1 STATUS OVERVIEW

OCTANS has built in tests at a low level of the hardware. These tests convert information translated into status information. The status information will help user to automatically check, in real time, for any malfunctioning, failure or degradation of the system. There is different status information:

- Sensor Status: (2 words of 32 bits)
  - Sensor Status 1: It corresponds to a low level sensor status word. Each flag is linked to sensors state (Optical source board , FOG sensors, accelerometers and temperature sensors).
  - Sensor Status 2: It corresponds to a high level sensor status. Each flag is a combination of specific sensor status 1 flags.
- Algorithms Status: (1 word of 32 bits)
  - Each flag of the algorithm status is set/unset by gyrocompass algorithm (algorithm state, external sensors, errors…)
- System Status: (3 words of 32 bits)
  - Each flag of the system status is linked to system state (input/output activity, sensor detection, system errors…)
- User Status: (1 word of 32 bits)
  - Each flag of the user status is a combination of flags from sensor, algorithm and/or system status.

The Figure 4 describes the previous description of status words.

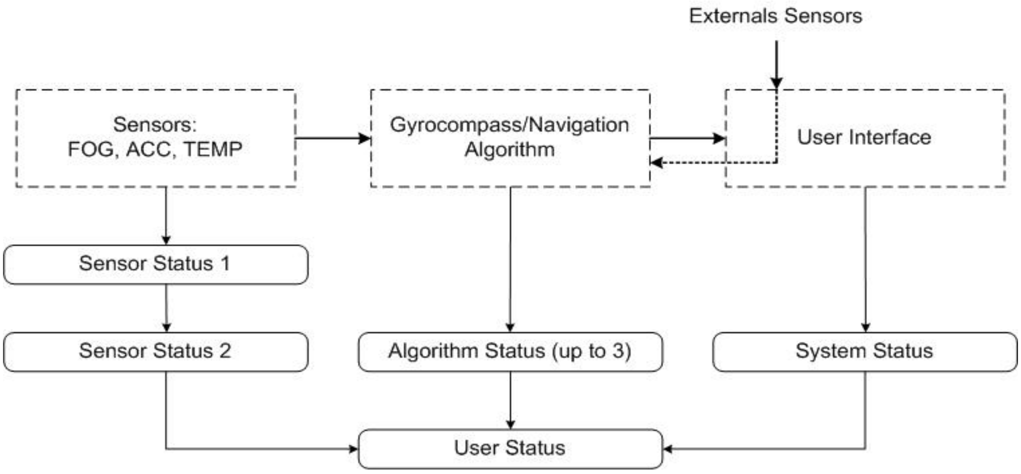

Figure 4 - Status information arborescence

2.2.2 OCTANS SENSOR STATUS 1 AND 2

Sensor status 1 corresponds to a low level sensor status. Each of sensor status 1 flag can trigger *"Degraded_Mode"* or *"Failure_Mode"* flags, visible in sensor status 2. Triggering thresholds corresponds to a number of successive occurrences (counted at sensor raw data frequency of 400Hz).

Table 3 – Low level sensor status 1 description

Bit	OCTANS NANO	OCTANS	OCTANS SUBSEA	Name	Appearance conditions	Status value	Sensor status 2 threshold	Degraded mode threshold	Failure mode threshold
0	✓	✓	✓	DATA_READY_ERR	Loss of sensors raw data (FOG or ACC)	0x00000001	1	N/A	3
1	N/A	✓	✓	SOURCE_POWER_CONTROL_ERR	FOG Optical source control power failure. Set when measured optical power <50% of set point (triggered by FOG Optical source board: bits 7 and 0 source status)	0x00000002	10	10	100
2	N/A	✓	✓	SOURCE_DIODE_ERR	FOG Optical source diode off (bit 11 source status +)	0x00000004	10	10	100
3	N/A	✓	✓	SOURCE_MODE_ERR	FOG Optical source not in power control mode (bit 8 source status)	0x00000008	10	10	100
4				ACC_X_SATURATION_ERR		0x00000010			
5	✓	✓	✓	ACC_Y_SATURATION_ERR	Accelerometer saturation (ADC saturation: OVF: bit 2 of ACC_n (n=X,Y,Z) status)	0x00000020	1	1	10
6				ACC_Z_SATURATION_ERR		0x00000040			
7				ACC_X_ACQ_ERR		0x00000080			
8	✓	✓	✓	ACC_Y_ACQ_ERR	Accelerometer acquisition error. (ADC incorrect frame: i.e: bit 3 ACC_n (n=X,Y,Z) status)	0x00000100	5	5	10
9				ACC_Z_ACQ_ERR		0x00000200			
10				FOG_X_SATURATION_ERR		0x00000400			
11	✓	✓	✓	FOG_Y_SATURATION_ERR	FOG saturation. (ADC saturation: OVF_CAN: bit 0 FOG_n (n=X,Y,Z) status)	0x00000800	100	100	1000
12				FOG_Z_SATURATION_ERR		0x00001000			
13				FOG_X_VPI_ERR		0x00002000			
14	✓	✓	✓	FOG_Y_VPI_ERR	VPI voltage control error. (VPI used to convert FOG phase shift to voltage and rotation: ERROR_VPI: bit 1 FOG_n (n=X,Y,Z) status)	0x00004000	1	N/A	1
15				FOG_Z_VPI_ERR		0x00008000			
16				FOG_X_LOW_POWER		0x00010000			
17	N/A	✓	N/A	FOG_Y_LOW_POWER	FOG low power. (LOW_POWER: bit 7 FOG_n (n=X,Y,Z) status)	0x00020000	10000	10000	N/A
18				FOG_Z_LOW_POWER		0x00040000			
19				FOG_X_ACQ_ERR		0x00080000			
20	✓	✓	✓	FOG_Y_ACQ_ERR	FOG frame acquisition error. (sensor board level: Framing FOG_n (n=X,Y,Z) byte)	0x00100000	1	1	10
21				FOG_Z_ACQ_ERR		0x00200000			
22				FOG_X_CRC_ERR		0x00400000			
23	✓	✓	✓	FOG_Y_CRC_ERR	FOG frame CRC error. (DSP board level: Check of CRC FOG_n (n=X,Y,Z) Data)	0x00800000	10	10	100
24				FOG_Z_CRC_ERR		0x01000000			

Bit	OCTANS NANO	OCTANS	OCTANS SUBSEA	Name	Appearance conditions	Status value	Sensor status 2 threshold	Degraded mode threshold	Failure mode threshold
25	✓	✓	✓	TEMP_ACQ_ERR	Temperature acquisition error (Optical source, ACC and FOG temperatures on sensor board)	0x02000000	1	1	N/A
26	✓	✓	✓	TEMP_THRESHOLD_ERR	TEMP_THRESHOLD_ERR will be set to 1, if any of the measured temperature (TACCx,y,z; TFOGx,y,z, TSource board) is greater than 90° or Tsensor board is greater than 115°C. In practice the Tsensor board will trigger the alarm first since temperature sensor is on an electronic component	0x04000000	1	1	N/A
27	✓	✓	✓	DTEMP_THRESHOLD_ERR	DTEMP_THRESHOLD_ERR will be set to 1 if any temperature variation is greater than 5°/minute.	0x08000000	1	1	N/A
28	✓	✓	✓	SENSOR_DATA_FIFO_WARNING	Sensor raw data FIFO half full	0x10000000	N/A	N/A	N/A
29	✓	✓	✓	SENSOR_DATA_FIFO_ERR	Sensor raw data FIFO full	0x20000000	1	N/A	1
30	N/A	✓	✓	SOURCE_POWER_ERR	Difference between measured source power and requested source power greater than 10% (Computed by DSP board)	0x40000000	100	100	1000
31	N/A	✓	✓	SOURCE_RECEPTION_ERR	Source data reception error (loss of source data, computed at DSP level)	0x80000000	100	N/A	100

Sensor status 2 corresponds to a high level sensor status. Each of the sensor status 2 flag is a combination (‘or’) of specific sensor status flag. *"Degraded_Mode"* or *"Failure_Mode"* flags are set if one the sensor status 1 flag counts respectively reaches degraded mode or failure mode threshold.

Status label are displayed on the web-based user interface with different colors:

- **Message in blue**: information message
- **Message in orange**: warning message
- **Message in red:** error message

Table 4 – High lever sensor status 2 description

Bit	OCTANS NANO	OCTANS OCTANS SUBSEA	Name	Status label displayed on the web-based user interface	Appearance conditions	Status value
0	✓	✓	FOG_X_ERR	**FOG X Error**	FOG_X_SATURATION_ERR (bit 10 Sensor Status 1) or FOG_X_ACQ_ERR (bit 19 Sensor Status 1) or FOG_X_CRC_ERR (bit 22 Sensor Status 1) or FOG_X_VPI_ERR (bit 13 Sensor Status 1) or FOG_X_LOW POWER (bit 16 Sensor Status 1)	0x00000001
1	✓	✓	FOG_Y_ERR	**FOG Y Error**	All Sensor Status 1 FOG_Y abnormalities (like FOG_X_ERR): (Bits 11, 20, 23, 14, 17 and 5 of Sensor Status 1).	0x00000002
2	✓	✓	FOG_Z_ERR	**FOG Z Error**	All Sensor Status 1 FOG_Z abnormalities (like FOG_X_ERR): (Bits 12, 21, 24, 15, 18 and 6 of Sensor Status 1).	0x00000004
3	N/A	✓	SOURCE_ERR	**Source error**	SOURCE_POWER_CONTROL_ERR (bit 1 Sensor Status 1) or SOURCE_DIODE_ERR (bit 2 Sensor Status 1)	0x00000008

Bit	OCTANS NANO	OCTANS OCTANS SUBSEA	Name	Status label displayed on the web-based user interface	Appearance conditions	Status value
					or SOURCE_MODE_ERR (bit 3 Sensor Status 1) or SOURCE_POWER__ERR (bit 30 Sensor Status 1) or SOURCE_RECEPTION _ERR (bit 31 Sensor Status 1)	
4	✓	✓	ACC_X_ERR	**Acc X Error**	ACC_X_SATURATION_ERR (bit 4 Sensor Status 1) or ACC_X_ACQ_ERR (bit 7 Sensor Status 1)	0x00000010
5	✓	✓	ACC_Y_ERR	**Acc Y Error**	All Sensor Status 1 ACC_Y abnormalities (like ACC_X_ERR): (Bits 5 and 8 of Sensor Status 1).	0x00000020
6	✓	✓	ACC_Z_ERR	**Acc Z Error**	All Sensor Status 1 ACC_Z abnormalities (like ACC_X_ERR): (Bits 6 and 9 of Sensor Status 1).	0x00000040
7	✓	✓	TEMP_ERR	**Temperature Alarm**	TEMP_ACQ_ERR (bit 25 Sensor Status 1) or TEMP_THRESHOLD_ERR (bit 26 Sensor Status 1) or DTEMP_THRESHOLD_ERR (bit 27 Sensor Status 1)	0x00000080
8	✓	✓	DSP_OVERLOAD	**DSP overload**	SENSOR_DATA_FIFO_WARNING (bit 28 Sensor Status 1) or SENSOR_DATA_FIFO_ERR (bit 29 Sensor Status 1)	0x00000100
9	N/A	✓	ERR_INIT_CAN_ACC_X	-	CAN_ACC_X Initialization Error	0x00000200
10	N/A	✓	ERR_INIT_CAN_ACC_Y	-	CAN_ACC_Y Initialization Error	0x00000400
11	N/A	✓	ERR_INIT_CAN_ACC_Z	-	CAN_ACC_Z Initialization Error	0x00000800
12-29	✓	✓	*Reserved*	-	-	-
30	✓	N/A	FAILURE_MODE	**Failure Mode**	See "*Low level Sensor Status 1 description*" table: Case numbers to trigger Degraded and Failure mode.	0x40000000
	N/A	✓	DEGRADED_MODE	**Degraded Mode**		
31	✓	N/A	DEGRADED_MODE	**Degraded Mode**		0x80000000
	N/A	✓	FAILURE_MODE	**Failure Mode**		

2.2.3 OCTANS ALGORITHM STATUS

OCTANS algorithm status consists of one status words. Each flag of the OCTANS algorithm status is set/unset by the gyrocompass algorithm.

Status label are displayed on the web-based user interface with different colors:

- **Message in blue**: information message
- **Message in orange**: warning message
- **Message in red:** error message

Table 5 –OCTANS Algorithm status description

Bit	OCTANS SUBSEA	OCTANS NANO	OCTANS	Name	Status label displayed on the web-based user interface	Appearance conditions	Status value
1	✓	✓	✓	ALIGNMENT	**Alignment**	Alignment mode (5 minutes from power on)	0x00000002
2	-	✓	✓	FINE ALIGNMENT		Fine Alignment completed	0x00000004
3-4	-	-	-	*Reserved*	-	-	-
5	✓	-	-	HEAVE_INITIALISATION	**Heave Init**	Heave filters initialization. Starts at power on and lasts less then 10 minutes.	0x00000020
6	-	-	-	Reserved	-	-	-
7	✓	✓	✓	MANUAL_LATITUDE	**Manual latitude**	Manual latitude used. Set when no external latitude received.	0x00000080
8	✓	✓	✓	MANUAL_SPEED	**Manual Speed**	Manual speed used. Set when no external speed received. Not set on OCTANS if position is received as speed is estimated in this case	0x00000100
9	-	-	-	LATITUDE_COMPUTATION	-	Automatic Latitude Computation	0x00000200
10-12	-	-	-	Reserved	-	-	-
13	-	✓	✓	MANUAL_LONGITUDE	**Manual longitude**	Manual Longitude Used	0x00002000
14	-	✓	✓	POLAR_VALIDITY	**Polar mode**	Output Polar Data validity	0x00004000
15	-	✓	✓	INCOMPATIBLE_FIRMWARES	**Incompatible firmwares**	Firmwares incompatible with Hardware (FOG, ACC or Algo type unset)	0x00008000
16-21	-	-	-	*Reserved*	-	-	-
22	✓	✓	✓	HEADING_ERR	**HRP not valid**	Set when gyrocompass algorithm does not converge (bad latitude input, speed input or sensor failure)	0x00400000
23	✓	✓	✓	ROLL_ERR	**-**		0x00800000
24	✓	✓	✓	PITCH_ERR	**-**		0x01000000
25-28	-	-	-	*Reserved*	-	-	-
29	-	✓	✓	SPEED SATURATION	**Speed exceeded**	Speed saturation	0x20000000
30-31	-	-	-	*Reserved*	-	-	-

2.2.4 OCTANS SYSTEM STATUS 1, 2 AND 3

$STSYS,STATUS is a 64 bits word, which acts as a built-in test and control of OCTANS at the system level. This System status is updated in real time and monitored through dedicated flags. It is dedicated to get information on status of serial input and output lines together with Ethernet activity. It also controls the detection of external sensors and system malfunction. Each flag is a bit which is set to "1" when flag is ON and set to "0" when flag is OFF.

The OCTANS status word is coded with 16 hexadecimal characters in the "$STSYS,hhhhhhhh,llllllll" NMEA sentence. hhhhhhhh is the hexadecimal value of the first 32 Less Significant Bits (System Status 1). llllllll is the hexadecimal value of the 32 Most Significant Bits (System Status 2).

Status 3 is available through specific protocols (not OCTANS STANDARD) to remain consistency with the existing applications.

The hexadecimal coding hhhhhhhh of the 32 LSB of $STSYS is given in Table 6. Bits 0 to 3 correspond to the value of the weakest hexadecimal number, bits 4 to 7 correspond to the second weakest hexadecimal number and so on. The hexadecimal coding llllllll of the 32 MSB of $STSYS is given in Table 7. Bits 32 to 35 correspond to the value of the weakest hexadecimal number, bits 36 to 39 correspond to the second weakest hexadecimal number and so on.

When a status bit is set to 1, the corresponding message is displayed in the System Status area of the User Interface.

Status label are displayed on the web-based user interface with different colors:

- **Message in blue**: information message
- **Message in orange**: warning message
- **Message in red:** error message

Table 6 - OCTANS System status 1 description

Bit	OCTANS	OCTANS NANO	OCTANS SUBSEA	Appearance conditions	Status value
0	INPUT_R_ERR/ **Input R error**			Serial Port: Input port Framing Error (Baudrate, parity…). From repeater port R to port E.	0x00000001
1	Reserved		**Input A error**		0x00000002
2			**Input B error**		0x00000004
3			**Input C error**		0x00000008
4	INPUT_A_ERR/ **Input A error**		**Input D error**		0x00000010
5	INPUT_B_ERR/ **Input B error**		**Input E error**		0x00000020
6	INPUT_C_ERR/ **Input C error**	*Reserved*			0x00000040
7	INPUT_D_ERR/ **Input D error**	*Reserved*			0x00000080
8	INPUT_ PORT_R_ACTIVITY/**INPUT R**			Input port activity (RS or Ethernet) (set when received data, before input protocol decoding)	0x00000100
9	*Reserved*		INPUT_A_ACTIVITY / **Input A**		0x00000200
10			INPUT_B_ACTIVITY / **Input B**		0x00000400
11			INPUT_C_ACTIVITY / **Input C**		0x00000800
12	INPUT_A_ACTIVITY / **Input A**		INPUT_D_ACTIVITY / **Input D**		0x00001000
13	INPUT_B_ACTIVITY / **Input B**		INPUT_E_ACTIVITY / **Input E**		0x00002000
14	INPUT_C_ACTIVITY / **Input C**	*Reserved*			0x00004000
15	INPUT_D_ACTIVITY / / **Input D**	*Reserved*			0x00008000

Bit	OCTANS	OCTANS NANO	OCTANS SUBSEA	Appearance conditions	Status value
16	OUTPUT_R_FULL / **Output R full**			Output port full (RS or Ethernet) (too much data to transfer)	0x00010000
17	OUTPUT_A_FULL / **Output A full**				0x00020000
18	OUTPUT_B_FULL / **Output B full**				0x00040000
19	OUTPUT_C_FULL / **Output C full**				0x00080000
20	OUTPUT_D_FULL / **Output D full**				0x00100000
21	OUTPUT_E_FULL / **Output E full**				0x00200000
22	ETHERNET_PORT_FULL / **Ethernet output full**			Ethernet output full (common for all Ethernet output ports)	0x00400000
23	EXTERNAL_LAT_RECEIVED / **Lattitude received**			External latitude received (in GGA frame)	0x00800000
24	INTERNAL_TIME_USED **/ Internal time**			System uses internal time	0x01000000
25	EXTERNAL_TIME_SYNC / **External time sync.**			UTC Time received and used (ZDA or ZDA+PPS)	0x02000000
26	ETHERNET PORT ACTIVITY / -			Ethernet link reception (common for all Ethernet input ports)	0x04000000
27	PULSE_IN_A_ACTIVITY / **Pulse in A**	PULSE_IN_A_ACTIVITY / **Pulse in A**	PULSE_IN_A_ACTIVITY / **Pulse in A**	Input Pulse activity	0x08000000
28	PULSE_IN_B_ACTIVITY / **Pulse in B**	*Reserved*	PULSE_IN_B_ACTIVITY / **Pulse in B**		0x10000000
29	PULSE_IN_C_ACTIVITY / **Pulse in C**	*Reserved*	PULSE_IN_C_ACTIVITY / **Pulse in C**		0x20000000
30	PULSE_IN_D_ACTIVITY / **Pulse in D**	*Reserved*			0x40000000
31	EXTERNAL_TIME_RECEIVED / **External time reception**			External Time received	0x80000000

Table 7 - OCTANS System status 2 description

Bit	OCTANS OCTANS NANO OCTANS SUBSEA	Status label displayed on the web-based user interface	Appearance conditions	Status value
0 - 1	*Reserved*	-	-	-
2	GPS_DETECTED	**GPS reception**	GPS data detected	0x00000004
3 - 12	*Reserved*	-	-	-
13	EXTERNAL_LONGITUDE_USED	**Longitude received**	External Longitude Received	0x00002000
14-16	*Reserved*	-	-	-
17	EXTERNAL_SPEED_RECEIVED	**Speed received**	External Speed Received	0x00020000
18	DSP_INCOMPATIBILITY	**Incompatible DSP firmware**	DSP firmware and CINT firmware are not compatible	0x00040000
19 - 23	*Reserved*	-	-	-
24	INTERNAL_LOG	**Internal logging**	Internal Log in progress	0x0010000
25	*Reserved*	**Analog Outputs Failure**	SPI DACs Link Failure	0x0020000
26	*Reserved*	-	-	-
27	MPC_OVERLOAD	**Latency warning**	Interface board CPU overload (too much output protocols with too high output rates)	0x08000000
28	POWER_SUPPLY_FAILURE	**Power failure**	Unit power failure	0x10000000
29	Reserved	-	-	0x20000000
30	CONFIGURATION_SAVED	**Configuration saved**	Configuration saved after having been changed	0x40000000
31	*Reserved*	-	-	-

Table 8 - OCTANS System status 3 description

Bit	OCTANS OCTANS NANO OCTANS SUBSEA	Status label displayed on the web-based user interface	Appearance conditions	Status value
0-6	*Reserved*	-	*Reserved*	-
7	MANUAL SPEED DETECTED	**Manual speed**	Manual Speed Received	0x00000080
8-31	*Reserved*	-	*Reserved*	-

2.2.5 OCTANS USER STATUS

The OCTANS User Status is a 32 bits word which acts as a built-in test and control of the system. Different OCTANS modes as well as the optical and electrical sub-parts status are monitored in real time through dedicated flags. Each flag is a bit which is set to “1” when flag is ON and set to “0” when flag is OFF.

This status is generated for compatibility with OCTANS III status. Additional status bits specific to OCTANS surface can be found in system status described in next section.

The OCTANS status word coding is described in 2.2.1.

The OCTANS User status word is 32 bits long, coded with 8 hexadecimal characters in the “$PHINF,hhhhhhhh” NMEA sentence.

Table 9 - OCTANS User status description

Bit	OCTANS OCTANS SUBSEA	OCTANS NANO	Set when following bits are set	Status value
0	HEADING_NOT_VALID		HEADING_ERR (bit 22 Algo Status)	0x00000001
1	ROLL_NOT_VALID		ROLL_ERR (bit 23 Algo Status)	0x00000002
2	PITCH_NOT_VALID		PITCH_ERR (bit 24 Algo Status)	0x00000004
3	HEAVE_INIT	*Reserved*	HEAVE_INITIALISATION (bit 5 Algo Status)	0x00000008
4	*Reserved*		-	-
5	ALIGNEMENT		ALIGNEMENT (bit 1 Algo Status)	0x00000020
6	CONFIG_SAVED		CONFIGURATION_SAVED (bit 30 System Status 2)	0x00000040
7	DSP_OVERLOAD		DSP_OVERLOAD (bit 8 Sensor Status 2)	0x00000080
8	FOG_X1_ANOMALY		FOG_X_ERR (bit 0 Sensor Status 2)	0x00000100
9	FOG_X2_ANOMALY		FOG_Y_ERR (bit 1 Sensor Status 2)	0x00000200
10	FOG_X3_ANOMALY		FOG_Z_ERR (bit 2 Sensor Status 2)	0x00000400
11	FOG_ACQ_ERR		FOG_X_ERR (bit 0 Sensor Status 2) or FOG_Y_ERR (bit 1 Sensor Status 2) or FOG_Z_ERR (bit 2 Sensor Status 2)	0x00000800
12	ACC_X1_ANOMALY		ACC_X_ERR (bit 4 Sensor Status 2)	0x00001000
13	ACC_X2_ANOMALY		ACC_Y_ERR (bit 5 Sensor Status 2)	0x00002000
14	ACC_X3_ANOMALY		ACC_Z_ERR (bit 6 Sensor Status 2)	0x00004000
15	SENSOR_ERR		FOG_X_ERR (bit 0 Sensor Status 2) or FOG_Y_ERR (bit 1 Sensor Status 2) or FOG_Z_ERR (bit 2 Sensor Status 2) or ACC_X_ERR (bit 4 Sensor Status 2) or ACC_Y_ERR (bit 5 Sensor Status 2) or ACC_Z_ERR (bit 6 Sensor Status 2) or TEMP_ERR (bit 7 Sensor Status 2)	0x00008000
16	INPUT_A_ERR		INPUT_A_ERR (bit 4 System Status1) for OCTANS & OCTANS NANO INPUT_A_ERR (bit 1 System Status1) for OCTANS 3000	0x00010000
17	INPUT_B_ERR		INPUT_B_ERR (bit 5 System Status1) for OCTANS & OCTANS NANO INPUT_B_ERR (bit 2 System Status1) for OCTANS 3000	0x00020000
18	INPUT_R_ERR		INPUT_R_ERR (bit 0 System Status1)	0x00040000

Bit	OCTANS OCTANS SUBSEA	OCTANS NANO	Set when following bits are set	Status value
19	CPU_OVERLOAD		CINT_OVERLOAD (bit 27 System Status 2)	0x00080000
20	OUTPUT_A_FULL		OUTPUT_A_FULL (bit 17 System Status 1)	0x00100000
21	OUTPUT_B_FULL		OUTPUT_B_FULL (bit 18 System Status 1)	0x00200000
22	OUTPUT_C_FULL		OUTPUT_C_FULL (bit 19 System Status 1)	0x00400000
23	OUTPUT_R_FULL		OUTPUT_R_FULL (bit 16 System Status 1)	0x00800000
24	MANUAL_SPEED_USED		MANUAL_LATITUDE (bit 7 Algo Status)	0x01000000
25	MANUAL_LATITUDE_USED		MANUAL_SPEED (bit 8 Algo Status)	0x02000000
26	INTERNAL_TIME_USED		INTERNAL_TIME_USED (bit 24 System Status 1)	0x04000000
27	HRP_NOT_VALID		HEADING_ERR (bit 22 Algo Status) or ROLL_ERR (bit 23 Algo Status) or PITCH_ERR (bit 24 Algo Status)	0x08000000
28	TEMPERATURE_ERR		TEMP_ERR (bit 7 Sensor Status 2)	0x10000000
29	*Reserved*		-	-
30	DEGRADED_MODE		DEGRADED_MODE (bit 31 Sensor Status 2) for OCTANS and OCTANS 3000 DEGRADED_MODE (bit 30 Sensor Status 2) for OCTANS NANO or ALIGNEMENT (bit 1 Algo Status 1)	0x40000000
31	FAILURE_MODE		FAILURE_MODE (bit 30 Sensor Status 2) for OCTANS and OCTANS 3000 FAILURE_MODE (bit 31 Sensor Status 2) for OCTANS NANO	0x80000000

2.2.6 OCTANS HIGH LEVEL STATUS

Table 10 - OCTANS User status description

Bit	OCTANS OCTANS NANO OCTANS SUBSEA	Set when following bits are set	Status value
0	SYSTEM OK	SYSTEM INIT (bit 1 HighLevel Status) NOT SET and SYSTEM ERROR (bit 2 HighLevel Status) NOT SET	0x00000001
1	SYSTEM INIT	ALIGNEMENT (bit 1 Algo Status) SET or HEAVE_INIT (bit 5 Algo Status) SET	0x00000002
2	SYSTEM ERROR	ELECTRONIC ERROR (bit 9 High Level Status) SET or SERIAL IN ERROR (bit 5 High Level Status) SET or SERIAL OUT ERROR (bit 7 High Level Status) SET or HEADING_ERR or ROLL_ERR or PITCH_ERR (bit 22 to 24Algo Status) SET	0x00000004
3	*Reserved*	-	-
4	SERIAL IN OK	SERIAL IN ERROR (bit 5 HighLevel Status) NOT SET	0x00000010
5	SERIAL IN ERROR	INPUT R,A,B,C,D or E ERR (bits 0 to 5 System Status 1) SET	0x00000020
6	SERIAL OUT OK	SERIAL OUT ERROR (bit 7 HighLevel Status) NOT SET	0x00000040
7	SERIAL OUT ERROR	OUTPUT R,A,B,C,D or E FULL (bits 16 to 20 System Status 1) SET	0x00000080
8	ELECTRONIC OK	ELECTRONIC ERROR (bit 9 HighLevel Status) NOT SET	0x00000100
9	ELECTRONIC ERROR	CPU ERROR (bit 15 HighLevel Status) SET or ACC ERROR (bit 13 HighLevel Status) SET or FOG ERROR (bit 11 HighLevel Status) SET	0x00000200
10	FOG OK	FOG ERROR (bit 11 HighLevel Status) NOT SET	0x00000400
11	FOG ERROR	FOG X,Y,or Z ERROR (bits 0,1,2 Sensor Status 2) SET	0x00000800
12	ACC OK	ACC ERROR (bit 13 HighLevel Status) NOT SET	0x00001000
13	ACC ERROR	ACC X,Y,Z ERROR (bit 4,5,6 Sensor Status 2) SET	0x00002000
14	CPU OK	CPU ERROR (bit 15 HighLevel Status) NOT SET	0x00004000
15	CPU ERROR	DSP OVERLOPAD (bit 8 Sensor Status 2) SET or CINT OVERLOAD (bit 27 System Status 2) SET	0x00008000
16-24	*Reserved*	-	-
24	TEMPERATURE OK	TEMP ERROR (bit 7 Sensor Status 2) NOT SET	0x01000000
25-31	*Reserved*	-	-

3 NMEA FRAMES

Each NMEA frame described below is formatted as follows:

$CCCCCCCC*hh<CR><LF>			
where:	**$**	'$' fix character	
	CCCCC	is the frame content	
	*****	'*' fix character	
	hh	is the NMEA 0183 (hexadecimal encoded XOR of all bytes excluding the starting character '$' and the stop one '*)	

3.1 Input NMEA Frame Definition

This section described all NMEA 0183 frames being common in several inputs protocols. Refer to the section 4.1 to know exactly which frames are decoded by the NMEA compatible protocols.

3.1.1 NON STANDARD NMEA FRAME

3.1.1.1 UTC Frame

UTC yy.mm.dd hh:mm:ss ab <CR><LF>		
Where	UTC	fixed text header
	yy.mm.dd	year month and date (USED)
	hh:mm:ss	UTC time not GPS time. (USED)
	a	Integer number representing the position-fix type: (cf. **Note 1**) (USED) 1 = time only 2 = 1D & time 3 = currently unused 4 = 2D & time 5 = 3D & time ? = no time
	b	Number of GPS satellites being tracked. (NOT USED) Note – If the receiver is not tracking satellites, the time tag is based on the receiver clock. In this case, a and b are represented by "??". The time readings from the receiver clock are less accurate than time readings determined from the satellite signals.

Note 1: If a=?, telegram is invalid. if a=1, 2, 3, 4, or 5, telegram is valid.

3.1.2 STANDARD NMEA TELEGRAMS

3.1.2.1 $--ACN Frame

This frame is the new version of alert command received from the Integrated Navigation System to modify an alert state. It complies with IEC 61924-2: 2012-12.

$--ACN,HHMMSS.SS,AAA,BBB,C,D,E*hh<CR><LF>		
HHMMSS.SS	Time of command	(NOT USED)
AAA	Manufacturer mnemonic	Must be empty
BBB	Alert identifier	Must be 240 for standard gyrocompass system fault alert
C	Alert instance	Must be set to 1
D	Alert command	Must be: 'A' to acknowledge the alert 'Q' to request/repeat the alert 'O' to request a responsibility transfer 'S' to silence the alert
E	Sentence status flag	Must be set to 'C'
hh	NMEA checksum	

3.1.2.2 $--ACK Frame

This frame is the old version of alert command received from the Integrated Navigation System to acknowledge an alert. It complies with standard IEC 61162-1 (2010-11).

$--ACK,AAA*hh<CR><LF>		
AAA	Alert identifier	Must be 240 for standard gyrocompass system fault alert
hh	NMEA checksum	

3.1.2.3 $--GGA Frame

$--GGA,hhmmss.ss,llmm.mm,a, LLLmm.mm,b,q,ss,y.y,x.x,M,g.g,M,a.a,zzzz*hh<CR><LF>	
hhmmss.ss	UTC of position (USED)
llmm.mm	Latitude in degrees (ll) and in minutes (mm.mm) (USED)
a	Hemisphere N: North S: South (USED)
LLLmm.mm	Longitude in degrees (LLL) and in minutes (mm.mm) (USED)
b	Longitude sign E: East W: West (USED)
q	GPS quality indicator 0 and ≥ 6 fix invalid 1=GPS SPS Mode, fix valid 2=Differential GPS, SPS Mode, fix valid 3= GPS PPS Mode, fix valid 4= RTK. Satellite system used in RTK mode with fixed integers 5= Float RTK. Satellite system used in RTK mode with floating integers (USED)
ss	Number of satellites. (**Note 1**) (USED)
y.y	Horizontal dilution of precision. (**Note 1**) (USED)
x.x	Antenna altitude (USED)
M	Units of antenna altitude (meters) (USED)
g.g	Geoidal separation. (USED)
M	Units of geoidal separation (meters)
a.a	Age of differential GPS data. (NOT USED)
zzzz	Differential reference station ID. (NOT USED)
hh	NMEA checksum

Note 1: Data read and transmitted to certain output telegrams (i.e: GPS LIKE). The data is not used by the algorithm.

3.1.2.4 $--GLL Frame

$--GLL,llmm.mm,a,LLLmm.mm,b,hhmmss.ss,S,M*hh<CR><LF>		
llmm.mm	Latitude in degrees (ll) and in minutes (mm.mm)	(USED)
a	ASCII 'N' for North, ASCII 'S' for South	(USED)
LLLmm.mm	Longitude in degrees (LLL) and in minutes (mm.mm)	(USED)
b	ASCII 'E' for East, ASCII 'W' for West	(USED)
hhmmss.ss	UTC time of position (**Note 1**)	(USED)
S	Status (**Note 2**): ASCII 'A' = data valid ASCII 'V' = data invalid Warning : Shall not be blank field	(USED)
M	Positioning system Mode indicator (**Note 2**) : ASCII 'A' = Autonomous mode ASCII 'D' = Differential mode ASCII 'E' = Estimated (dead reckoning) mode ASCII 'M' = Manual input mode ASCII 'S' = Simulator N= Data not valid Warning : Shall not be blank field	(USED)
hh	NMEA checksum	

Note 1: Time is used by algorithm in "INS algorithm based" products.

Note 2: For GLL or RMC telegram, the Mode indicator field supplements the status field. The status field shall be set to 'V' (data invalid) for all values of operating mode except for 'A' and 'D' (Autonomous and Differential).

3.1.2.5 $--GST Frame

$--GST,hhmmss.ss,x.x,. x.x,. x.x,. x.x,. x.x,. x.x,. x.x,*hh<CR><LF>		
hhmmss.ss	UTC time of the GGA fix associated with this sentence	(USED)
x.x	RMS value of the standard deviation on pseudo-ranges	(NOT USED)
x.x	Standard deviation of semi-major axis of error ellipse	(NOT USED)
x.x	Standard deviation of semi-minor axis of error ellipse	(NOT USED)
x.x	Orientation of semi-major axis of error ellipse	(NOT USED)
x.x	Standard deviation of latitude error, in meters	(USED)
x.x	Standard deviation of longitude error, in meters	(USED)

$--GST,hhmmss.ss,x.x,. x.x,. x.x,. x.x,. x.x,. x.x,. x.x,*hh<CR><LF>		
x.x	Standard deviation of altitude error, in meters	(USED)
hh	NMEA checksum	

3.1.2.6 $--RMC Frame

$--RMC,hhmmss.ss,S,llmm.mm,a,LLLmm.mm,b,x.x,x.x,ddmmyy,x.x,S,M*hh<CR><LF>		
S	Status : ASCII 'A' = data valid ASCII 'V' = data invalid Warning : Shall not be blank field	(USED)
llmm.mm	Latitude in degrees (ll) and in minutes (mm.mm)	(USED)
a	ASCII 'N' for North, ASCII 'S' for South	(USED)
LLLmm.mm	Longitude in degrees (LLL) and in minutes (mm.mm)	(USED)
b	ASCII 'E' for East, ASCII 'W' for West	(USED)
x.x	Speed over ground in knots (**Note 1**)	(USED)
x.x	Course over ground in degrees	(NOT USED)
ddmmyy	Date	(NOT USED)
x.x	Magnetic variation	(NOT USED)
S	Mode indicator : ASCII 'E' = Easterly variation substracts from True course ASCII 'W' = Westerly variation adds to true course	(NOT USED)
M	Positioning system Mode indicator (**Note 2**) : ASCII 'A' = Autonomous mode ASCII 'D' = Differential mode ASCII 'E' = Estimated (dead reckoning) mode ASCII 'M' = Manual input mode ASCII 'S' = Simulator N= Data not valid Warning : Shall not be blank field	(USED)
hh	NMEA checksum	

Note 1: Speed in RMC telegram is only used in "INS algorithm based" products and input to algorithm as EM LOCH data. If position is valid, speed is not taken into account by algorithm. If position is invalid speed is taken into account by algorithm. RMC telegram should be declared as position and speed input if both position and/or speed need to be used.

Note 2: For GLL or RMC telegram, the Mode indicator field supplements the status field. The status field shall be set to ‘V’ (data invalid) for all values of operating mode except for ‘A’ and ‘D’ (Autonomous and Differential).

3.1.2.7 $--VBW Frame

$--VBW,x.x,x.x,A,x.x,x.x,A,x.x,A,x.x,A*hh <CR><LF>		
x.x	Longitudinal DVL (XV1) water speed, in knots, ‘-‘ = astern.	(USED)
x.x	Transverse DVL (XV2) water speed, in knots, ‘-‘ = port.	(USED)
A	Status of DVL water speed, A=Data valid. V= data invalid	(USED)
x.x	Longitudinal DVL (XV1) ground speed, in knots, ‘-‘ = astern.	(USED)
x.x	Transverse DVL (XV2) ground speed, in knots, ‘-‘ = port.	(USED)
A	Status of DVL ground speed: A = data valid V = data invalid	(USED)
x.x	Stern transverse water speed in knots.	(NOT USED)
A	Status of stern water speed.	(NOT USED)
x.x	Stern transverse ground speed in knots.	(NOT USED)
A	Status of stern ground speed.	(NOT USED)
hh	NMEA checksum	

3.1.2.8 $--VHW Frame

$--VHW, x.x ,T, x.x ,M,x.x,N,x.x,K*hh<CR><LF>		
x.x	Heading, degrees true	(USED)
T	True	(USED)
x.x	Heading, degrees magnetic	(NOT USED)
M	Magnetic	(NOT USED)
x.x	Speed in knots	(USED)
N	Knots	(USED)
x.x	Speed in km/h	(NOT USED)
K	Kilometers/hour	(NOT USED)
hh	NMEA checksum	

3.1.2.9 $--VTG Frame

$--VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>		
x.x	Course over ground, degrees true	(USED)
T	True	(USED)
x.x	Course over ground, degrees magnetic	(NOT USED)
M	Magnetic	(NOT USED)
x.x	Speed over ground in knots	(USED)
N	Knots	(USED)
x.x	Speed over ground in Km/h	(NOT USED)
K	Km/h	(NOT USED)
a	Mode indicator A= Autonomous mode D= Differential mode E= Estimated (dead reckoning) mode M= Manual input mode N= Data not valid The positioning system mode indicator field should be a null field.	(USED if not a null field)
hh	NMEA checksum	

3.1.2.10 $--ZDA Frame

$--ZDA,hhmmss.ss,,,,, *hh <CR><LF>		
hhmmss.ss	UTC of the last PPS	(USED)
dd	UTC day	(USED)
mm	UTC month	(USED)
yyyy	UTC year	(USED)
hh	Local zone hour (**Note 1**)	(USED)
mm	Local zone minutes (**Note 1**)	(USED)
hh	NMEA checksum	

Note 1: Data read and transmitted to certain output telegrams (i.e: GPS LIKE). The data is not used by the algorithm.

3.2 Output NMEA Frame Definition

This section described all NMEA 0183 frames being common in several outputs protocols. Refer to the section 4.4 to know exactly which frames are output by the NMEA compatible protocols.

3.2.1 NON STANDARD NMEA TELEGRAMS

3.2.1.1 $GPGGA Frame

$GPGGA,hhmmss.ss,LLII.IIIIIII,a,LLLII.IIIIIII,a,x,xx,x.xxx,x.xxx,M,x.xxx,M,x.xxx,xxxx*hh<CR><LF>		
hhmmss.ss	UTC time of position	
LLII.IIIIIII	Latitude in degrees (LL) and in minutes (II.IIIIIII)	
a	'N' for Northern hemisphere, 'S' for Southern hemisphere	
LLLII.IIIIIII	Longitude in deg (LLL) and in minutes (II.IIIIIII)	
a	'E' for East, 'W' for West	
x	GPS quality indicator	
xx	Number of satellites in use	**Note 1**
x.xxx	Horizontal dilution of precision (HDOP)	
x.xxx	Antenna altitude above mean sea level (geoid) (meters)	
M	Unit of antenna altitude (fixed character = 'M' for meters)	
x.xxx	Geoidal separation	**Note 1**
M	Unit of Geoidal separation (fixed character = 'M' for meters)	
x.xxx	Age of the differential GPS data	**Note 1**
xxxx	Differential reference station ID	**Note 1**
hh	NMEA checksum	

Note 1: Copy of last GPS values received. When no GPS has been received since power up, these fields are null except for number of satellites in use set to 3 by default.

3.2.1.2 $GPGLL Frame

$GPGLL,LLII.IIIIIII,a,LLLII.IIIIIII,a,hhmmss.ss,a,m*hh<CR><LF>		
LLII.IIIIIII	Latitude in degrees (LL) and in minutes (II.IIIIIII)	
a	'N' for Northern hemisphere, 'S' for Southern hemisphere	
LLLII.IIIIIII	Longitude in deg (LLL) and in minutes (II.IIIIIII)	
a	'E' for East, 'W' for West	
hhmmss.ss	UTC time of position	
a	Status 'A' for Data Valid, 'V' for Data Invalid	
m	Mode indicator 'A' , 'D' or 'E'	
hh	NMEA checksum	

3.2.1.3 $GPGST Frame

$GPGST,hhmmss.ss,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>		
hhmmss.ss	UTC Time	
x.x	RMS value of the standard deviation on pseudo-ranges	**Note 1**
x.x	Standard deviation of semi-major axis of error ellipse in meters	
x.x	Standard deviation of semi-minor axis of error ellipse in meters	
x.x	Orientation of semi-major axis of error ellipse	
x.x	Standard deviation of the error of Latitude in meters	
x.x	Standard deviation of the error of Longitude in meters	
x.x	Standard deviation of the error of Altitude	
hh	NMEA checksum	

Note 1: Copy of last GPS values received. When no GPS has been received since power up, these fields are null except for number of satellites in use set to 3 by default.

3.2.1.4 $GPVTG Frame

$GPVTG,x.xxx,T,x.xxx,M,x.xxx,N,x.xxx,K,a*hh<CR><LF>		
x.xxx	True course (deg)	
T	Fixed character = 'T'	
x.xxx	Magnetic course (deg)	
M	Fixed character = 'M'	
x.xxx	Speed (knots)	
N	Fixed character = 'N'	
x.xxx	Speed (km/h)	
K	Fixed character='K'	
a	Positioning system mode indicator 'A', 'D' or 'E'	
hh	NMEA checksum	

3.2.1.5 $GPZDA and $PHZDA Frame

"—" in the header is either GP or PH.

$--ZDA,hhmmss.ss,dd,mm,yyyy,hh,mm*hh<CR><LF>		
hhmmss.ss	UTC time of PHINS	
dd	UTC day	
mm	UTC month	
yyyy	UTC year	
hh	Local zone hours	**Note 1**
mm	Local zone minutes	**Note 1**
hh	NMEA checksum	

Note 1: Copy of last GPS values received. When no GPS has been received since power up, these fields are null except for number of satellites in use set to 3 by default.

3.2.1.6 $PHCMP Frame

$PHCMP,llll.ll,a,x.xx,N*hh<CR><LF>		
llll.ll	Latitude in degrees (two first l) and in minutes (four last l)	
a	‘N’ for Northern hemisphere and ‘S’ for Southern hemisphere	
x.xx	Speed Norm in knots	
N	Fixed character = ‘N’	
hh	NMEA checksum	

3.2.1.7 $PHHRP Frame

$PHHRP,sxx,d,hhhhhhhh*hh<CR><LF>		
s	+ for Clockwise - for Counter Clockwise	
xx	Number of heading turn since the last reset	
d	‘d’ fix character	
hhhhhhhh	User Status	Hexadecimal value
hh	NMEA checksum	

3.2.1.8 $PHINF Frame

$PHINF,hhhhhhhh*hh<CR><LF>		
hhhhhhhh	User Status	Hexadecimal value
hh	NMEA checksum	

3.2.1.9 $PHLIN Frame

$PHLIN,x.xxx,y.yyy,z.zzz*hh<CR><LF>		
x.xxx	surge in meters (signed)	
y.yyy	sway in meters (signed)	
z.zzz	Heave in meters (signed)	
hh	NMEA checksum	

3.2.1.10 $PHPOS Frame

$PHPOS,x.xxx,y.yyy,z.zzz,x.xxx,y.yyy,z.zzz *hh<CR><LF>		
x.xxx	Surge in m	With Selected Lever Arm
y.yyy	Sway in m	
z.zzz	Heave in m	
x.xxx	Surge in m	Without Lever Arm
y.yyy	Sway in m	
z.zzz	Heave in m	
hh	NMEA checksum	

3.2.1.11 $PHROT Frame

$PHROT,x.xxx,y.yyy,z.zzz*hh<CR><LF>		
x.xxx	Roll speed in °/s (signed)	
y.yyy	Pitch speed in °/s (signed)	
z.zzz	Heading speed in °/s (signed)	
hh	NMEA checksum	

3.2.1.12 $PHSPD Frame

$PHSPD,x.xxx,y.yyy,z.zzz*hh<CR><LF>		
x.xxx	Surge speed in m/s (signed)	
y.yyy	Sway speed in m/s (signed)	
z.zzz	Heave speed in m/s (signed	
hh	NMEA checksum	

3.2.1.13 $PHTRH Frame

$PHTRH,x.xx,a,y.yy,b,z.zz,c*hh<CR><LF>		
x.xx	Pitch in degrees	
a	'M' for bow up and 'P' for bow down	
y.yy	Roll in degrees	
b	'B' for port down and 'T' for port up	
z.zz	Heave absolute value in meters	
c	'O' if OCTANS goes up and 'U' if OCTANS goes down	
hh	NMEA checksum	

3.2.1.14 $PHTRO Frame

$PHTRO,x.xx,a,y.yy,b*hh<CR><LF>		
x.xx	Pitch in degrees	Pitch and Roll fields are empty if HRP_INVALID is set in user status
a	'M' for bow up and 'P' for bow down	
y.yy	Roll in degrees	
b	'B' for port down and 'T' for port up	
hh	NMEA checksum	

3.2.1.15 $PHVIT Frame

$PHVIT,x.xxx,y.yyy,z.zzz,x.xxx,y.yyy,z.zzz *hh<CR><LF>		
x.xxx	Surge speed in m/s	With Selected Lever Arm
y.yyy	Sway speed in m/s	
z.zzz	Heave speed in m/s	
x.xxx	Surge speed in m/s	Without Lever Arm
y.yyy	Sway speed in m/s	
z.zzz	Heave speed in m/s	
hh	NMEA checksum	

3.2.1.16 $STALG Frame

$STALG,aaaaaaaa,bbbbbbbb*hh<CR><LF>		
aaaaaaaa	Algorithm status 1	Hexadecimal value
bbbbbbbb	Algorithm status 2	
hh	NMEA checksum	

3.2.1.17 $STSOR Frame

$STSOR,aaaaaaaa,bbbbbbbb*hh<CR><LF>		
aaaaaaaa	Sensor status 1	Hexadecimal value
bbbbbbbb	Sensor status 2	
hh	NMEA checksum	

3.2.1.18 $STSYS Frame

$STSYS,aaaaaaaa,bbbbbbbb*hh<CR><LF>		
aaaaaaaa	System status 1	Hexadecimal value
bbbbbbbb	System status 2	
hh	NMEA checksum	

3.2.1.19 $TIME_ Frame

$TIME_,hhmmss.sss*hh<CR><LF>		
hh	Hours	System Time or UTC Time if time synchronized
mm	Minutes	
ss.sss	Seconds	
hh	NMEA checksum	

3.2.2 STANDARD NMEA TELEGRAMS

3.2.2.1 $HEALC Frame

This frame is sent to periodically report a list of active alerts.

Parameters GGG, HHH, J and K are not sent if no active alert (D=0).

It complies with standard IEC 61924-2 (Annex J and annex K).

$HEALC,A,B,C,D,GGG,HHH,J,K]*hh<CR><LF>		
A	Total number of ALF sentences	Fixed to 1
B	Sentence number	Fixed to 1
C	Sequential message identifier	Fixed to 1
D	Number of alert entries	0 if no active alert, 1 if one active alert
GGG	Manufacturer mnemonic	Empty (standardized alert identifier used)
HHH	Alert identifier	Fixed to 240 for a gyrocompass (**Note 1**)
J	Alert instance	Fixed to 1
K	Revision counter	Starts at 1 and is incremented up to 99 after each alert status change in ALF message. Resets to 1 after 99 is used.
hh	NMEA checksum	

Note 1: See IEC 61924-2, Annex J, §J.5, Table J.3.

3.2.2.2 $HEALR Frame

This frame is used for compatibility with old NMEA standard to inform on alert state. It is transmitted each time the alert status changes, or each 30 seconds to update the upper system with active alert list, even if no alert is present. It complies with standard IEC 61924-2 (Annex L).

$HEALR,HHMMSS.SS,XXX,A,B,C*hh<CR><LF>		
HHMMSS.SS	Time	Current time (UTC time if the system is synchronized in UTC, or internal time otherwise) in hour, minute and seconds.
XXX	Unique Alert Identifier	Fixed to 240 for a gyrocompass
A	Alert condition	‘A’ if alert condition is raised ‘V’ if alert condition is cleared
B	Alert acknowledge state	‘V’ if not acknowledged ‘A’ if acknowledged
C	Description text	“System fault”
hh	NMEA checksum	

3.2.2.3 $HEARC Frame

This frame is sent to refuse incoming bad formatted alert commands. It complies with standard It complies with standard IEC 61924-2 (Annex J and annex K).

$HEARC,HHMMSS.SS,AAA,BBB,C,D*hh<CR><LF>		
HHMMSS.SS	Time	Time of last alarm state change (UTC time if the system is synchronized in UTC, or internal time otherwise) in hour, minute and seconds.
AAA	Manufacturer mnemonic	Empty (standardized alert identifier used)
BBB	Alert identifier	Fixed to 240 for a gyrocompass (**Note 1**)
C	Alert instance	Repetition of received instance that was refused
D	Refused alert command	Repetition of received command character that was refused: ‘A’,’Q’, ‘O’, ‘S’ of ACN telegram.
hh	NMEA checksum	

Note 1: See IEC 61924-2, Annex J, §J.5, Table J.3.

3.2.2.4 $HEALF Frame

This frame is the new format for alert state reporting.

It is sent only when the alert status changes or on alert request from ACN telegram.

It complies with standard IEC 61924-2 (Annex J and annex K).

$HEALF,A,B,C,HHMMSS.SS,D,E,F,GGG,HHH,J,K,L,M--M*hh<CR><LF>		
A	Total number of ALF sentences	Fixed to 1
B	Sentence number	Fixed to 1
C	Sequential message identifier	Fixed to 1
HHMMSS.SS	Time	Time of last alert state change (UTC time if the system is synchronized in UTC, or internal time otherwise) in hour, minute and seconds.
D	Alert category	Fixed to 'B' for a gyrocompass
E	Alert priority	Fixed to 'W' for a gyrocompass
F	Alert state	'V' for active - unacknowledged 'S' for active – silenced 'A' for active – acknowledged 'O' for active – responsibility transferred 'U' for rectified – unacknowledged 'N' for normal – no alert active
GGG	Manufacturer mnemonic	Empty (standardized code)
HHH	Alert identifier	Fixed to 240 for a gyrocompass
J	Alert instance	Fixed to 1
K	Revision counter	Starts at 1 and is incremented up to 99 after each change of content of any field of the alert (i.e.: time, status). Resets to 1 after 99 is used.
L	Escalation counter	Starts at 0 and is incremented up to 9 each time the active-unacknowledged timer elapses. Resets to 1 after 9 is used.
M---M	Description text	Fixed to "System fault"
hh	NMEA checksum	

3.2.2.5 $HEHBT Frame

This frame is used to ensure that the link with other system is constant and not interrupted. It also provides system status.
It complies with IEC 61162-1 (2010-11).

$HEHBT,xx,s,x*hh<CR><LF>		
xx,	Sentence's output period in seconds	Fixed 30 seconds (**Note 1**)
a,	Status 'A' for "Equipment in normal operation" 'V' for "Equipement not in normal operation"	Set to 'V' when alert condition is raised Set to 'A' when alert condition is cleared
x,	Output counter cycling from 0 to 9	
hh	NMEA checksum	

Note 1: 30 s is based on the that any alert modification status should be reported at a period not exceeding 60 s (cf. IEC 61924-2, Annex J) and that ALC telegram must be updated and sent at least every 30 s (cf. IEC 61924-2, Annex K, §K.3). We take the smallest value here which is 30 s.

3.2.2.6 $HEHDT Frame

$HEHDT,x.x,T*hh<CR><LF>		
x.x	True heading in degrees. Empty if HRP INVALID is set in user status	**Note 1**
T	Fixed ASCII character 'T'	
hh	NMEA checksum	

Note 1: 2 digits after the decimal point in default mode.
5 digits after the decimal point in military mode.
Always 2 digits after the decimal point in case of udp library protocol

3.2.2.7 $HEROT Frame

$HEROT,x.x,S*hh<CR><LF>		
x.x	Heading rate of turn, in deg/mn Sign '–' when bow turns to port	**Note 1**
S	Status ASCII 'A' for data valid ASCII 'V' for data invalid	
hh	NMEA checksum	

Note 1: 2 digits after the decimal point in default mode. 5 digits after the decimal point in military mode. Always 2 digits after the decimal point in case of udp library protocol

3.2.2.8 $HETHS Frame

$HETHS,x.x,a*hh<CR><LF>		
x.x	True heading in degrees	**Note 1**
a	Mode indicator character	**Note 2**
hh	NMEA checksum	

Note 1: 2 digits after the decimal point in default mode
5 digits after the decimal point in military mode
Always 2 digits after the decimal point in case of udp library protocol

Note 2:

Mode indicator	Set condition	Output priority level
A = Autonomous	Default value	Low
E = Estimated (dead-reckoning)	N/A	N/A
M = Manual input	N/A	N/A
S = Simulator Mode	System status 2: SIMULATION_MODE	Medium
V = Data not valid	User status : HRP_INVALID	High

$HETHS,,V*hh<CR><LF>

3.2.2.9 $PHTRH Frame

$PHTRH,x.xx,a,y.yy,b,z.zz,c*hh<CR><LF>		
x.xx	Pitch in degrees	
a	'M' for bow up and 'P' for bow down	
y.yy	Roll in degrees	
b	'B' for port down and 'T' for port up	
z.zz	Heave absolute value in meters	
c	'U' if OCTANS goes up and 'O' if OCTANS goes down	
hh	NMEA checksum	

3.3 Checksum

An usual NMEA sentence is formatted as follows: $aaccc,c … c*hh<CR><LF>

"hh" is the checksum of the sentence, and allows for a control during data transmission, to check if there is any missing or corrupted field.

This checksum is the absolute value calculated by exclusive-O'Ring the 8 data bits (no start bits or stop bits) of each character in the sentence, but excluding "$" and "*".

The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII (0-9, A-F).

The most significant character is transmitted first.

The checksum field is required in all transmitted sentences.

4 DIGITAL INTERFACES

4.1 Heart beat management

The heart beat mechanism is used to monitor integrity of a connection between two systems over NMEA link.

The heart beat message is sent at fixed 30 second period. The status contained in the heartbeat message is set to “A” when the system is operating normally (Heading is valid), and to “V” when the system is not operating normally (i.e.: Heading invalid due to initial coarse alignment or when a sensor error is present).

The heart beat output is:

- not available on the repeater output port in serial and Ethernet
- available on any output port configured to output NMEA or text protocols (ASCII).

The heart beat management can be enabled port by port from the web-based user interface, refer to the “Web-based interface user guide” document (Ref. MU-INSIII-AN-021).

4.2 Alerts Management

Following the standard IEC 61924-2 (Marine navigation and radio-communication equipment and systems – Integrated Navigation Systems – Part 2: Modular structure for INS – Operational and performance requirements, methods of testing and required test results) two types of alert mechanism are now available:

- Old format: ALR/ACK alarm mechanism, see Figure 5 for the old alarm state diagram; Refer to NMEA frames definition to get more details about these messages.
  - ❑ The ALR message is sent each time the alarm status changes: activated, acknowledged or reset
  - ❑ The system decodes ACK messages to acknowledge change in current alert state. These changes are then reported in ALR telegram.
- New format: ALF/ALC/ARC new alarm mechanism, see Figure 6 for the new alarm state diagram. The system sends an ALF sentence each time the alarm internal state changes.

Refer to NMEA frames definition to get more details about these messages.

Both alarm mechanism are:

- available on all input ports including the repeater input port (serial and Ethernet), as long as the “ALERT IN” protocol is selected.
- not available on the repeater output port

Old and New format alert telegrams available on any output port configured to output NMEA or text protocols (ASCII).

The alarm and heart beat management telegrams can be configured port by port from the web-based user interface, refer to the “Web-based interface user guide” document (Ref. MU-INSIII-AN-021).

The alarms are only triggered when the system is in alignment or when a sensor error is present that produces invalid heading information.

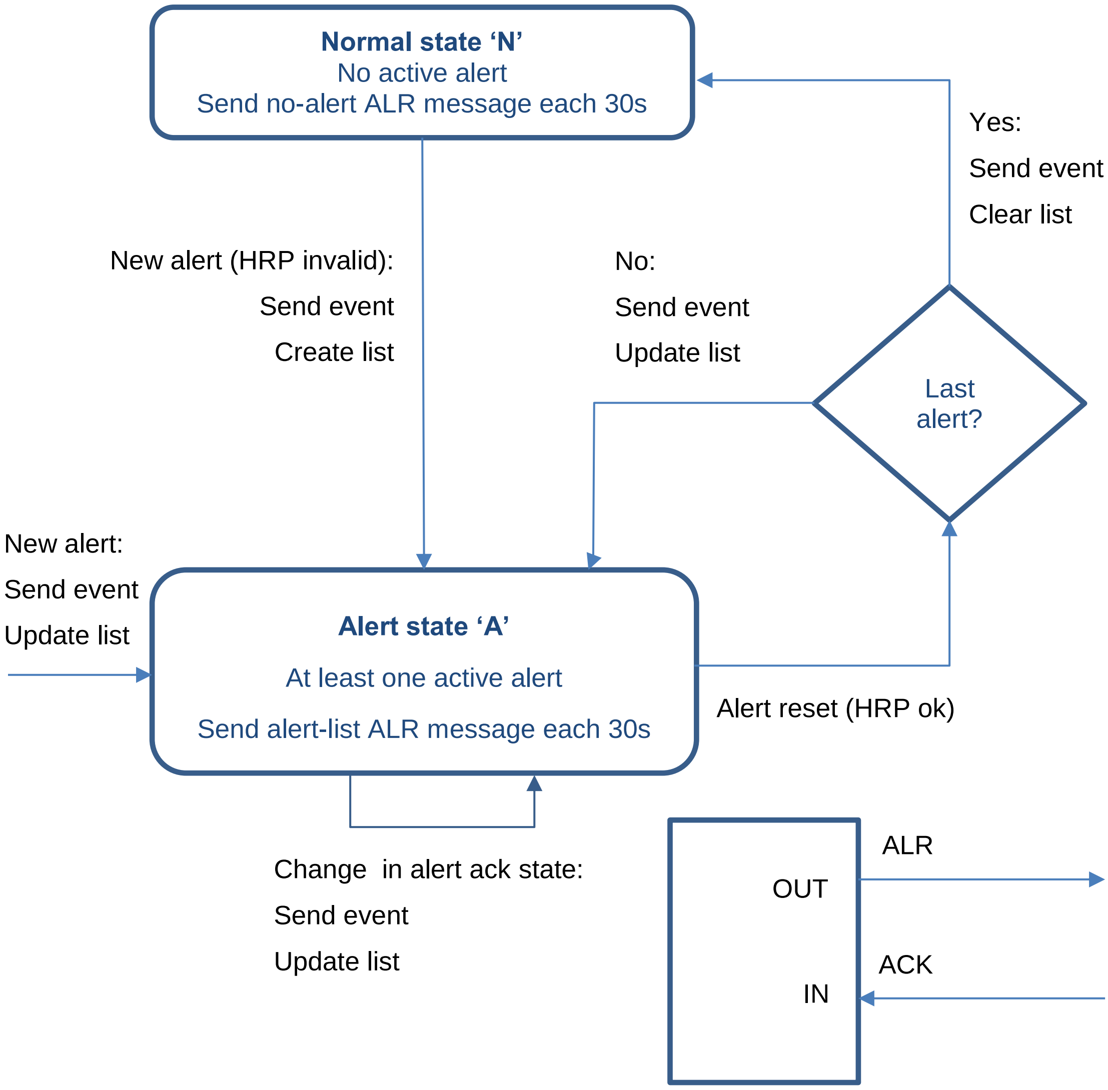

Figure 5 – Old alarm state diagram

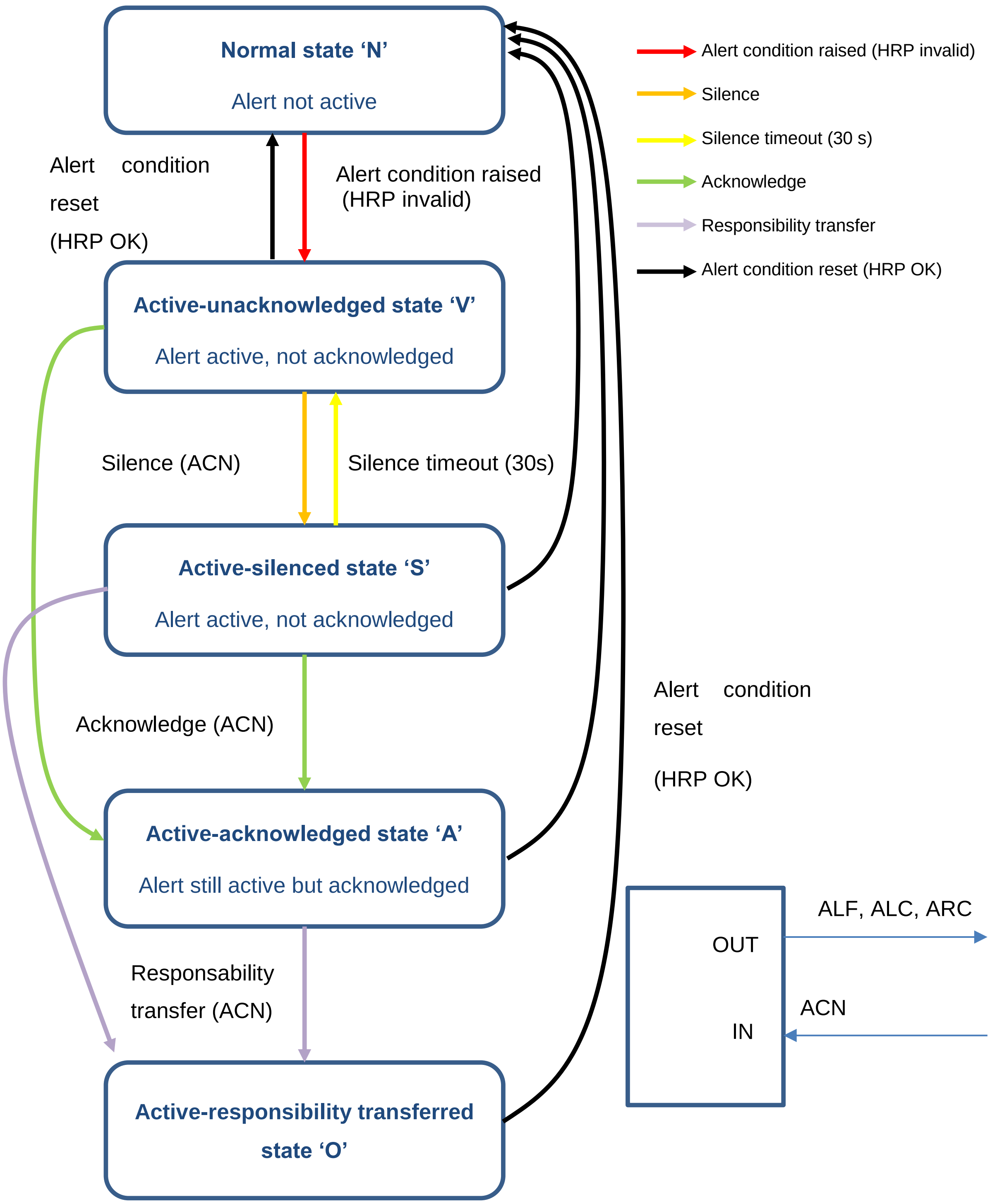

Figure 6 – New alarm state diagram

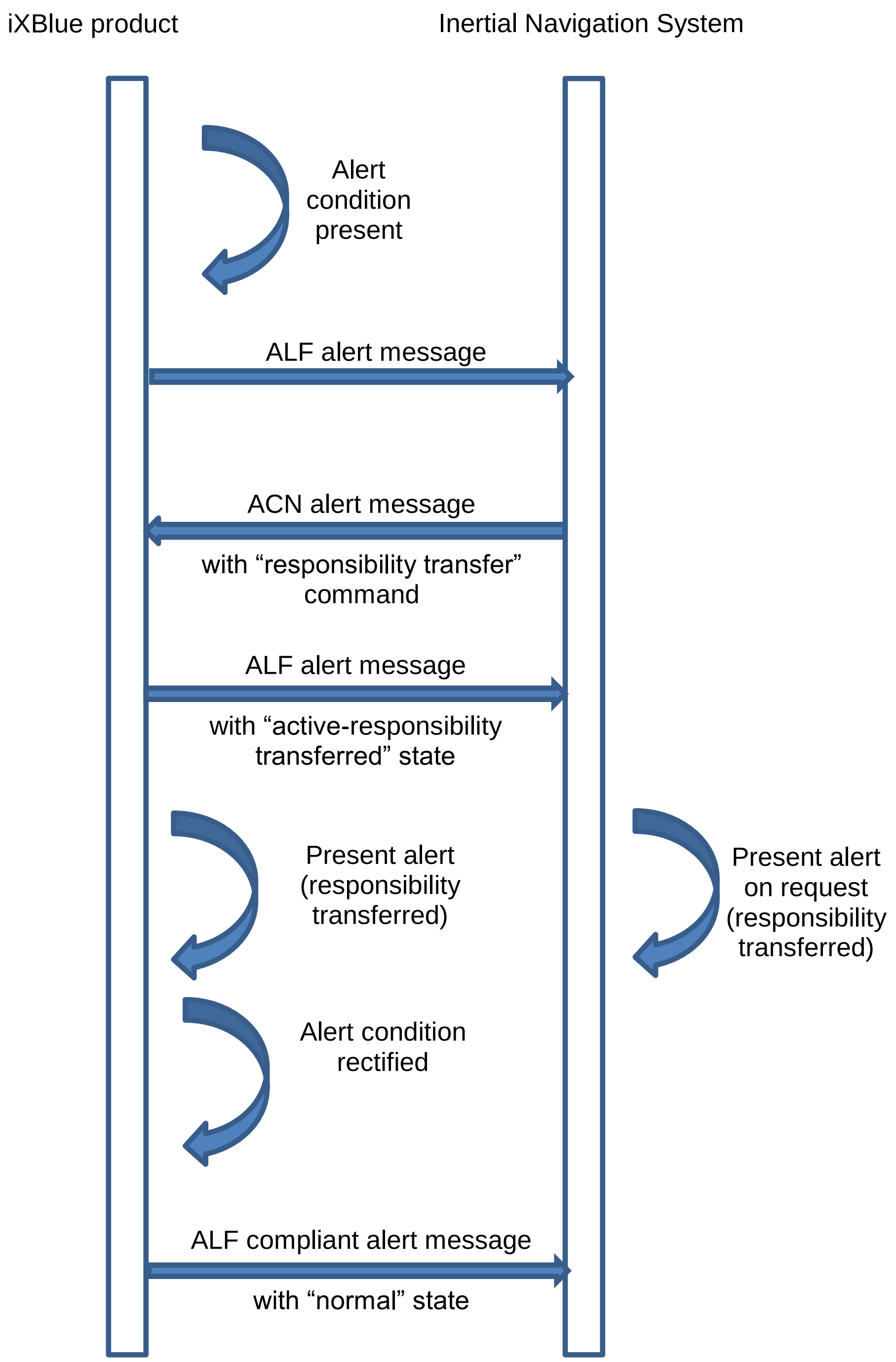

Figure 7 - Alert communication showing priority reduction (new alarm state)

4.3 Input Protocols

The OCTANS serial input protocols are used to enter data from external sensors (vessel speed and latitude, date and time) into OCTANS. All OCTANS serial input protocols are hard-coded into OCTANS. They are listed by their name when configuring the input serial port with the WEB-based User Interface.

A list of all available input protocols is given below. The specifications for each serial input protocol are given in the following pages.

4.3.1 QUICK GUIDE TO INPUT PROTOCOLS

PROTOCOLS	Hard Coded															
						NMEA STANDARD										
	DCN STD LOCH	DCN STD NAV 1	IXBLUE STD BIN v2	IXBLUE STD BIN V3	MINIFOG_GPS_MSG	ACK	ACN	GGA	GLL	GST	RMC	UTC	VBW	VHW	ZDA	VTG
PRODUCTS	Check if the protocol is available for your product															
OCTANS V / OCTANS 3000	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OCTANS NANO					✓			✓	✓		✓	✓	✓	✓	✓	
PARAMETER																
UTC TIME			X	X				X	X		X	X			X	X
POSITION UTC TIME STAMP								X	X							
POSITION LATITUDE		X	X	X	X			X	X		X					
POSITION LONGITUDE			X	X	X			X	X		X					
POSITION QUALITY INDICATOR								X								
POSITION X,Y SD										X						
ALERT MANAGEMENT(*)						X	X	X	X	X	X	X	X	X	X	X
SPEED	X	X	X	X							X		X	X		X
NMEA 0183 STANDARD						X	X	X	X	X	X	X	X	X	X	X
BINARY	X	X	X	X												
ASCII					X	X	X	X	X	X	X	X	X	X	X	X

(*) Can receive and manage ALERT ACK or ACN messages if this protocol is selected

4.3.2 DETAILED SPECIFICATIONS FOR INPUT PROTOCOLS

DCN Std Loch

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Binary protocol (Spec DCN n° 19188 LSM/NAV Rev 1 March 90)
- Data received: EM LOG data
- Data frame:

The frame contains 3 bytes in binary format without header and “end of frame” fields.

It is advisable to use the Timeout to synchronize the frames.

Important

Protocol is received at 600 bps, which may not be standard in all systems..

Message <F0><F1><F2>				
Field 0	Byte 0	Status byte	Bit 7: Operational (0:Yes, 1: No) Bit 6: Damage (0:No, 1: Yes) Bit 5: Simulation mode (0:No, 1: Yes) Bit 4: Test (0:No, 1: Yes) Bit 3: Reserved Bit 2: Reserved Bit 1: Reserved Bit 0: Reserved	(USED) (USED) (USED) (USED) (NOT USED) (NOT USED) (NOT USED) (NOT USED)
Field 1	Byte 1	Loch speed MSB	Bit 7: Sign (0:Positive, 1: Negative) Bit 6: MSB = 30 knots ……. Bit 0	(USED)
Field 2	Byte 2	Loch speed LSB	Bit 7 ……. Bit 0	(USED)

Notes

- The Data is not two complemented; Bit 7 of Byte 1 is the sign and (Byte 1, Bit 6) to (Byte 0, Bit 0) is the absolute value of the log data.
- The input data is declared valid by OCTANS algorithm only if all Bits 4 to 7 equal 0.
- Each byte is sent LSBit first. For data coded on several bytes, the bytes are sent MSByte first.

DCN Standard Nav 1

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: DCN Nav protocol 100m network (Spec DCN N°19187 LS/NAV Jun96)
- Data received: Latitude, Speed
- Data frame:

The frame contains 27 bytes in binary format.

Message <F0><F1>…<F18>			
Field 0	Bytes 0 to 2	Header	Byte 0: 27 Byte 1: Unused
Field 1	Byte 3	Status	Bit 7: Operational (0:Yes, 1:No)
Field 2	Bytes 4 to 7	Hour	Unused
Field 3	Byte 8	Aging	Unused
Field 4	Bytes 9 to 11	Heading	Unused
Field 5	Bytes 12 to 13	Relative Roll	Unused
Field 6	Bytes 14 to 16	Pitch	Unused
Field 7	Bytes 17 to 19	Latitude	24bits Two complement (+90° to -90°)
Field 8	Bytes 20 to 22	Longitude	Unused
Field 9	Bytes 23 to 24	North Speed	16 bits Two complement (+120m/s to -120m/s)
Field 10	Bytes 25 to 26	West Speed	Unused

IXBLUE STANDARD BIN V2, V3

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

To get details on this protocol, refer to IXBLUE STANDARD BIN V2, V3 description.

MINIFOG GPS MSG

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Binary protocol
- Data received: Latitude, longitude
- Data frame:

MiniFOG_GPS_MSG (Geographical Position Message)			Comments
Header	Byte 1	Value : 'G'	Delimiter to identify the start of message
Whole Latitude	Byte 2 to 3	Value : In degrees, range in [0°:90°]	Whole latitude provided by an external GPS sensor, in WGS84, LSB = 1°
Decimal Latitude	Byte 4 to 9	Value : In degrees, range in [0°:1°[	Decimal latitude provided by an external GPS sensor, in WGS84, LSB = 0.000001°
Latitude direction	Byte 10	Value : 'N' or 'S'	North or South latitude direction
Whole Longitude	Byte 11 to 13	Value : In degrees, range in [0°:180°]	Whole longitude provided by an external GPS sensor, in WGS84, LSB = 1°
Decimal Longitude	Byte 14 to 19	Value : In degrees, range in [0°:1°[	Decimal longitude provided by an external GPS sensor, in WGS84, LSB = 0.000001°
Longitude direction	Byte 20	Value : 'E' or 'W'	East or West longitude direction
End point	Byte 21	Value : <CR>	Carriage return
	Byte 22	Value : <LF>	Line feed

Example:

A packet reading "***G57279167N002256944W<cr><lf>"***

Will be ***Latitude*** 57°16'45"N and ***Longitude*** 2°15'25W.

NMEA –ACK

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data frame: it is composed of
  - $--ACK frame see section 3.1.2.2

NMEA –ACN

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data frame: it is composed of
  - $--ACN frame see section 3.1.1

NMEA –GGA

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: Time, latitude, longitude, GPS quality indicator
- Data frame: it is composed of
  - $--GGA frame see section 3.1.2.3

NMEA –GLL

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: Latitude, longitude, UTC, status
- Data frame: it is composed of
  - $--GLL frame see section 3.1.2.4

NMEA –GST

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: UTC, standard deviation
- Data frame: it is composed of
  - $--GST frame see section 3.1.2.5.

NMEA –RMC

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: Status, latitude, longitude, speed, magnetic variation
- Data frame: it is composed of
  - $--RMC frame see section 3.1.2.6

NMEA –UTC

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: UTC, date, position fix type
- Data frame: it is composed of
  - $--UTC frame see section 3.1.1.1

NMEA –VBW

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: Longitudinal DVL, transverse DVL, stern and transverse water speed
- Data frame: it is composed of
  - $--VBW frame see section 3.1.2.7

NMEA –VHW

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: Heading, speed
- Data frame: it is composed of
  - $--VHW frame see section 3.1.2.8

NMEA –VTG

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: Course over ground, speed, mode indicator
- Data frame: it is composed of
  - $--VTG frame see section 3.1.2.9

NMEA –ZDA

This protocol is not available for all products.

Refer to the tables of the section 4.3.1 to know if this protocol is available for your product.

- Standard: Input NMEA 0183
- Data received: Date and time
- Data frame: it is composed of

  $--ZDA frame see section 3.1.2.10

4.4 Output Protocols

The OCTANS output protocols are used to output OCTANS data to external systems. A part of the OCTANS output protocols are hard-coded into OCTANS, and others are of library protocol type.

Hard-coded protocols are listed by their name when configuring the output port with the Web MMI, library protocols are configured by selecting them “From the library” in the MMI and then select the appropriate file on the installation CDROM.

A list of all available standard output protocols is given in the following page. It allows for a quick search of the most appropriate serial output protocol depending on requirement.

The specifications for each output protocol are given in the following pages. Unless duly specified in the protocol specification, standard OCTANS conventions are used for data output (refer to “Principles & Conventions” document (ref.: MU-INS&AHRS-AN-003) for detail on OCTANS conventions).

Information supplied by protocols is valid for the monitoring point described:

- By its lever arm to OCTANS center of measurement (refer to “Principles & Conventions” document (ref.: MU-INS&AHRS-AN-003) for the Lever Arm definition).
- By the misalignment angles to OCTANS reference frame – i.e. in the vessel reference frame.

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4.4.1 Quick Guide to Output Protocols

Please use the table below to quickly select the output protocol that best suits your application.

PROTOCOLS	HARD CODED																																										
	AHRS120	AMS	ANSCHUTZ STD 20	ATLAS FANSWEEP 20	B&A CUSTOM 1	B&A CUSTOM 2	DCN STD NAV 1	DCN STD NAV 10	DOLOG HRP	GYROCOMPAS 1	GYROCOMPAS 2	HEAVE POSTPRO	HEHDT	HEHDT FIXED	HEHDT HEROT	HETHS HEROT	IG03	IMU BINARY	IMU RAW DATA	IXBLUE STD BIN V2	IXBLUE STD BIN V3	IXSEA ICCB1	IXSEA TAH	MAHRS	MINIFOG_OTG_MSG8	MOTION SENSOR 1	MOTION SENSOR 2	MOTION SENSOR 3	MOTION SENSOR 4	OCTANS STANDARD	PAHRS	POS MV GROUP 111	POSTPROCESSING	PTNTHPR	PSXN 019	SEAPATH	SEATEX DHEAVE	SHINKAI 6500 HDT	TAH BIN	TAH BIN SMT	TECHSAS	TMS CCV IMBAT AHRS	TUS
PRODUCTS	Check if the protocol is available for your product																																										
OCTANS / OCTANS 3000	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
OCTANS NANO		✓			✓	✓			✓	✓			✓	✓	✓	✓	✓			✓					✓					✓			✓	✓							✓	✓	
PARAMETERS																																											
POLAR HEADING																															X												
HEADING	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X			X		X		X	X	X	X	X	X
ROLL		X		X	X	X	X	X	X	X	X						X			X	X	X	X	X	X	X	X	X	X	X	X			X	X	X		X	X	X	X	X	X
PITCH		X		X	X	X	X	X	X	X	X						X			X	X	X	X	X	X	X	X	X	X	X	X			X	X	X		X	X	X	X	X	X
HEADING SD																																											
ROLL SD																																											
PITCH SD																																											
DELAYED HEAVE												X								X	X											X					X						
HEAVE WITH LVA				X	X	X	X	X			X	X								X	X		X	X		X	X	X	X			X			X	X		X	X	X		X	
SURGE WITH LVA						X						X								X	X		X	X		X	X	X	X										X	X			
SWAY WITH LVA						X						X								X	X		X	X		X	X	X	X										X	X			
HEAVE WITHOUT LVA																				X	X		X						X														
SURGE WITHOUT LVA																													X														
SWAY WITHOUT LVA																													X														
HEAVE INFO (Mode,Period,Amp)												X																															
HEAVE SPEED						X														X	X		X				X	X	X	X									X	X			X
SURGE SPEED						X														X	X		X				X	X	X	X									X	X			X
SWAY SPEED						X														X	X		X				X	X	X	X									X	X			X
HSS SPEED WITHOUT LVA																													X														
NORTH or SOUTH SPEED																																				X							
EAST or WEST SPEED																																				X							
VERTICAL SPEED																																				X							
ACCELERATION XV3												X								X	X																					X	X
ACCELERATION XV1												X								X	X																					X	X
ACCELERATION XV2												X								X	X																					X	X
ROLL RATE						X			X											X	X				X						X					X			X			X	X
PITCH RATE						X			X											X	X				X						X					X			X			X	X
HEADING RATE			X			X			X						X	X				X	X		X		X						X					X			X			X	X
POLAR HEADING RATE																															X												
ROLL RATE smoothed																																								X			
PITCH RATE smoothed																																								X			
HEADING RATE smoothed																																								X			
DATE OF DATA																				X	X																						
TIME STAMP OF DATA												X								X	X		X									X			X	X	X		X	X	X		
LATITUDE (*)		X					X										X			X	X									X						X							
LONGITUDE (*)							X													X	X															X							

HARD CODED

PROTOCOLS	AHRS120	AMS	ANSCHUTZ STD 20	ATLAS FANSWEEP 20	B&A CUSTOM 1	B&A CUSTOM 2	DCN STD NAV 1	DCN STD NAV 10	DOLOG HRP	GYROCOMPAS 1	GYROCOMPAS 2	HEAVE POSTPRO	HEHDT	HEHDT FIXED	HEHDT HEROT
ALTITUDE (*)															
VESSEL SPEED (*)							X								
N TURNS SINCE RESET					X	X									
DATE and TIME (**)					X	X				X	X		X	X	X
IMU DATAS (ACC,ROT,TEMP)															
OCT SYSTEM STATUS															
OCT ALGO STATUS															
OCT USER STATUS										X	X				
OCT SENSOR STATUS															
OTHER STATUS		X	X	X			X	X	X			X			
CHECKSUM					X	X			X	X	X		X	X	X
NMEA 0183					X	X				X	X		X	X	X
BINARY			X	X			X	X	X			X			
ASCII	X	X			X	X				X	X		X	X	X

PROTOCOLS	HETHS HEROT	IG03	IMU BINARY	IMU RAW DATA	IXBLUE STD BIN V2	IXBLUE STD BIN V3	IXSEA ICCB1	IXSEA TAH	MAHRS	MINIFOG_OTG_MSG8	MOTION SENSOR 1	MOTION SENSOR 2	MOTION SENSOR 3	MOTION SENSOR 4	OCTANS STANDARD
ALTITUDE (*)															
VESSEL SPEED (*)					X	X	X		X						
N TURNS SINCE RESET															
DATE and TIME (**)	X								X		X	X	X	X	X
IMU DATAS (ACC,ROT,TEMP)			X	X											
OCT SYSTEM STATUS					X	X									X
OCT ALGO STATUS					X	X			X						X
OCT USER STATUS					X	X					X	X	X	X	X
OCT SENSOR STATUS			X	X	X	X									X
OTHER STATUS		X					X			X					X
CHECKSUM	X				X	X	X	X			X	X	X	X	X
NMEA 0183	X							X			X	X	X	X	X
BINARY			X	X	X	X	X								
ASCII	X	X						X	X	X	X	X	X	X	X

PROTOCOLS	PAHRS	POS MV GROUP 111	POSTPROCESSING	PTNTHPR	PSXN 019	SEAPATH	SEATEX DHEAVE	SHINKAI 6500 HDT	TAH BIN	TAH BIN SMT	TECHSAS	TMS CCV IMBAT AHRS	TUS
ALTITUDE (*)						X							
VESSEL SPEED (*)													
N TURNS SINCE RESET													
DATE and TIME (**)													
IMU DATAS (ACC,ROT,TEMP)													
OCT SYSTEM STATUS	X												
OCT ALGO STATUS													
OCT USER STATUS									X	X			X
OCT SENSOR STATUS													
OTHER STATUS		X		X	X	X	X				X	X	
CHECKSUM	X	X		X	X	X	X	X	X	X			
NMEA 0183	X				X								
BINARY		X	X			X	X	X	X	X		X	X
ASCII	X			X	X						X		

(*) copy of manual or GPS input latitude, longitude and altitude or speed input
(**) if ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages

PROTOCOLS	UDP																	
	HAM CUSTOM	HDMS THOMSON	IFREMER VICTOR	IFREMER VICTOR V3	JAMSTEC/KAIKOU	MDL (trim cube)	MDL 2	NMEA PRDID	PSXN 019	SIMRAD EM	STOLT OFFSHORE	TCM 1/2	TCM 2	TMS CCV IMBAT AHRS	TOKIMEC PTVF	TOKIMEC PTVG	TSS1/DMS	TSS335B
PRODUCTS	**Check if the protocol is available for your product**																	
OCTANS / OCTANS 3000	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OCTANS NANO				✓		✓	✓	✓			✓	✓	✓	✓	✓	✓		
PARAMETERS																		
HEADING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
ROLL	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PITCH	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HEAVE WITH LVA	X	X	X	X	X				X	X				X			X	X
ACCELERATION XV3	X		X	X	X									X			X	X
ACCELERATION XV1			X	X	X									X				
ACCELERATION XV2			X	X	X									X				
ACCELERATION XV1 XV2	X																X	X
ROLL RATE			X	X	X						X			X	X			
PITCH RATE			X	X	X						X			X	X			
HEADING RATE			X	X	X				X		X			X	X			
TIME STAMP OF DATA									X									
DATE and TIME (**)								X			X				x	x		
OCT USER STATUS	X																	
OTHER STATUS					X		X		X	X				X	X		X	X
CHECKSUM									X									
NMEA 0183	X							X	X		X				X	X		
BINARY		X	X	X	X					X				X				
ASCII	X					X	X	X	X		X	X	X		X	X	X	X

(**) if ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages

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4.4.2 DETAILED SPECIFICATIONS FOR OUTPUT PROTOCOLS

AHRS 120

This protocol is not available for all products.
Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard ASCII output data format.

:D0xxx*<CR><LF>		
:D0	Hex 3A 44 30 – Start of sentence	
xxx	Hexadecimal representation of the decimal heading angle. Range [000 to FFF]	The heading angle is coded as an unsigned 12 bits integer , LSB = 180°/2^{11} **Note 1**
*<CR><LF>	Hex 2A 0D 0A – End of sentence	

Note 1:

123.4 degrees on the compass becomes 123.4 * 2^{11}/180 = 1404.01 decimal value.
This decimal value, converted into its hexadecimal representation becomes 57C.
The expected output ASCII string should be: ":D057C*<CR><LF>"

AMS

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: AMS
- Data sent: Heading, Roll, Pitch, Latitude, Status
- Data frame: ASCII Format (concatenation of following described frames)

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, refer to section 3.2.1.5.

<CR><LF>HEADING<SP>=<SP>hhh.hh			
where	<SP>	Space character	
	hhh.hh	True Heading in degrees	

<CR><LF>XTILT<SP>=<SP>appp.pp			
where	<SP>	Space character	
	a	a='+' when front up	Opposite of OCTANS convention
		a='-' when front down	
	ppp.pp	Pitch in degrees	

<CR><LF>TILT<SP>=<SP>arrr.rr			
where	<SP>	Space character	
	a	a='+' when port up	
		a='-' when port down	
	rrr.rr	Roll in degrees	

<CR><LF>LAT<SP>=<SP>dd:mm:ss<SP>a			
where	<SP>	Space character	
	dd	Latitude degrees	
	mm	Latitude minutes	
	ss	Latitude seconds	
	a	'N' or 'n' for Northern Hemisphere	
		'S' or 's' for Southern Hemisphere	

<CR><LF>STATUS<SP>=<SP>sssss<CR><LF>			
where	<SP> sssss	Space character ASCII text string: 'VALID' : Heading, Roll and Pitch Valid 'NOT READY': Alignment 'FAIL': Any other case	

ANSCHUTZ STD 20

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Anschutz Std20
- Data sent: Heading, Heading rate, Status
- Data frame: 18 bytes in binary format.

Byte 0	0x02	STX synchronization byte	
Byte 1 Byte 2	$01h_{15}h_{14}h_{13}h_{12}h_{11}h_{10}$ $01h_9h_8h_7h_6h_5h_4$	Heading MSB Heading LSB	Heading binary: $h_{15}h_{14}h_{13}h_{12}h_{11}h_{10}h_9h_8h_7h_6h_5h_4 0000$ LSB $360/2^{16}=0.00549$ degree
Byte 3	0x40		
Byte 4	0x40		
Byte 5	0x40		
Byte 6	0x40		
Byte 7	0x40		
Byte 8 Byte 9 Byte 10	01s0xxxx 01xxxxxx 01xxxxxx	Opposite Heading speed in °/min Bit 5, s = Sign (0 if positive, 1 if negative) Data is 2 complement binary coded with 16 bits and LSB = 0.08046°/min Warning: opposite heading rate	
Byte 11 Byte 12	010b000f 01g10100	Status b = 1 => Anomaly FOG or Accelerometer or Computation Overload fg = 00 => Heading, Roll or Pitch not valid fg = 01 => Alignment fg = 11 => Default value	
Byte 13	0x40		
Byte 14	0x40		
Byte 15	0x43		
Byte 16	01cccccc	Checksum	FF XOR byte 1 to 15 AND 00111111 OR 01000000
Byte 17	0x03	ETX synchronization byte	

ATLAS FANSWEEP 20

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Atlas Fansweep 20
- Data sent: Roll, Pitch, Heave, Status
- Data frame: The frame contains 9 bytes in binary format (MSB are sent first).

Data	Length	Description
DLE	1 byte	0x10
Roll	2 bytes	Unsigned 16 bit, i.e. 0..65535 representing 360° with a resolution of 360°/65536 range 0..360°
Pitch	2 bytes	Unsigned 16 bit, i.e. 0..65535 representing 360° with a resolution of 360°/65536 range 270°..90°
Heave	2 bytes	Signed 16 bit range –32767 mm to + 32767 mm Sign '+' when Octans goes up
Status	1 byte	0x06 for alignment fully settled 0x07 for alignment settling
DLE	1 byte	0x10

B&A CUSTOM 1

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Heading, Roll, Pitch, Heave
- Data frame: It is composed of
  - ❑ NMEA **$HEHDT** Frame see section 3.2.2.6
  - ❑ NMEA **$PHTRH** Non standard Frame see section 3.2.1.13
  - ❑ NMEA **$PHHRP** Frame see section 3.2.1.7

(1) And, If ZDA option selected:

- ❑ NMEA **$PHZDA** Frame see section 3.2.1.5

B&A CUSTOM 2

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Heading, Roll, Pitch, Heave, Surge, Sway, Linear Speeds, Rotation Speeds, Time and Date (1)
- Data frame: It is composed of
  - ❑ NMEA **$HEHDT** Frame see section 3.2.2.6
  - ❑ NMEA **$PHTRO** Frame see section 3.2.1.14
  - ❑ NMEA **$PHLIN** Frame see section 3.2.1.9
  - ❑ NMEA **$PHSPD** Frame see section 3.2.1.12
  - ❑ NMEA **$PHROT** Frame see section 3.2.1.11
  - ❑ NMEA **$PHTRH** standard Frame see section0
  - ❑ NMEA **$PHHRP** Frame see section 3.2.1.7

(1) And, If ZDA option selected:

- ❑ NMEA **$PHZDA** Frame see section 3.2.1.5

DCN STD NAV 1

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: DCN Nav protocol 100ms network (Spec DCN n° 19187 LSM/NAV June 96)
- Data sent: Status, Heading, Roll, Pitch, Heave
- Data frame: **11 fields - 27 bytes and , once on ten, 20 fields - 40 bytes** MSB are sent first.

Frame of 27 bytes sent 9 times out of 10

Message <F0><F1>…<F18>			
Field 0	Byte 0	Message size	Fixed value = 27
Field 1	Byte 1	Status 1*	See status specification table 1
Field 2	Byte 2	Status 2**	See status specification table 2
Field 3	Bytes 3 to 6	Hour	Set to 0x00
Field 4	Byte 7	Ageing	Fixed value = 4 ms
Field 5	Bytes 8 to 10	Heading	Unsigned 24 bits integer 2^{23} = 180°
Field 6	Bytes 11 to 13	Roll	Signed 24 bits integer +/-2^{23} = +/-90° (Positive when port side down) Warning: Opposite sign of OCTANS usual convention.
Field 7	Bytes 14 to 16	Pitch	Signed 24 bits integer +/-2^{23} = +/-90°
Field 8	Bytes 17 to 19	Latitude	Signed 24 bits integer ; MSB = 90 degrees
Field 9	Bytes 20 to 22	Longitude	Signed 24 bits integer ; MSB = 180 degrees (Last Longitude value received from GPS, If no longitude is received for more than 3 seconds, the field will be reset to 0)
Field 10	Bytes 23 to 24	North speed	Set to 0x00
Field 11	Bytes 25 to 26	West speed	Set to 0x00

Frame of 40 bytes sent 1 times out of 10

Message <F0><F1>…<F18>			
Field 0	Byte 0	Message size	Fixed value = 40
Field 1	Byte 1	Status 1*	See status specification table 1
Field 2	Byte 2	Status 2**	See status specification table 2
Field 3	Bytes 3 to 6	Hour	Set to 0x00
Field 4	Byte 7	Ageing	Fixed value = 4 ms
Field 5	Bytes 8 to 10	Heading	Unsigned 24 bits integer 2^{23} = 180°
Field 6	Bytes 11 to 13	Roll	Signed 24 bits integer +/-2^{23} = +/-90° (Positive when port side down) Warning: Opposite sign of PHINS usual convention.
Field 7	Bytes 14 to 16	Pitch	Signed 24 bits integer +/-2^{23} = +/-90°
Field 8	Bytes 17 to 19	Latitude	Signed 24 bits integer ; MSB = 90 degrees
Field 9	Bytes 20 to 22	Longitude	Signed 24 bits integer ; MSB = 180 degrees
Field 10	Bytes 23 to 24	North speed	Set to 0x00
Field 11	Bytes 25 to 26	West speed	Set to 0x00
Field 12	Bytes 27 to 28	Date	Fixed value = 0
Field 13	Bytes 29 to 30	Heave	Signed 16 bits integer +/-2^{15} = +/-360m (Positive when PHINS goes down) **Warning:** Opposite sign of OCTANS usual convention.
Field 14	Bytes 31 to 32	Speed norm	Signed 16 bits integer +/-2^{15} = +/-120 knots
Field 15	Bytes 33 to 34	Vertical speed	Set to 0x00
Field 16	Byte 35	Latitude std. deviation	Set to 0x00
Field 17	Byte 36	Longitude std. deviation	Set to 0x00
Field 18	Bytes 37 to 38	Heading std. deviation	Set to 0x00
Field 19	Byte 39	Error position	Set to 0x00

* Status specification table 1

Function	Bit	Value	Links with OCTANS status words
HRP validity	0	0 valid data 1 invalid data	OR of bits 30 of the OCTANS Sensor status 2: Failure mode bits 22, 23, 24 of the OCTANS Algorithm status 1: HRP_ERR
Sensor anomaly	1	0 sensor OK 1 sensor anomaly	OR of bits 0 to 6 of the OCTANS Sensor status 2: ACC, FOG, SRC ERR
Alignment	2	0 operational 1 alignment	Bit 1 of the OCTANS Algorithm status 1
Reserved	3	= 0	*Reserved field*
Reserved	4	= 1	Set to '1'
Reserved	5	= 0	*Reserved field*
Reserved	6	= 0	*Reserved field*
Reserved	7	**= 0**	*Reserved field*

** Status specification table 2

Function	Bit	Value	Links with OCTANS status words
Heading, attitude validity	0	0 if Heading, roll and pitch valid 1 if Heading, roll or pitch not valid	OR of bits 30 of the OCTANS Sensor status 2: Failure mode bits 22, 23, 24 of the OCTANS Algorithm status 1: HRP_ERR
FOGs validity	1	0 if FOG X, Y and Z valid 1 if FOG X, Y or Z not valid	OR of bits 0 to 2 of the OCTANS Sensor status 2: FOG ERR
Accelerometers validity	2	0 if ACC X, Y and Z valid 1 if ACC X ,Y or Z not valid	OR of bits 4 to 6 of the OCTANS Sensor status 2: ACC ERR
Optical source and FOG transmission validities	3	0 if Optical source and FOG transmission valid 1 if Optical source or FOG transmission not valid	Bit 3 of OCTANS Sensor status 2
Validity of the serial inputs	4	0 if all the serial inputs valid 1 if one or more serial inputs not valid	OR of bits 1 to 5 of the OCTANS System status 1
Validity of the serial outputs	5	0 if all the serial outputs are valid 1 if one or more serial outputs not valid	OR of bits 16 to 21 of the OCTANS System status 1
Reserved	6	= 0	
Reserved	7	= 0	

DCN STD NAV 10

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: DCN Nav protocol 10 ms network
  (Spec DCN n° 19187 LSM/NAV June 96)
- Data sent: Heading, Roll, Pitch, Heave
- Data frame:

The protocol contains 15 bytes in binary format with header.

Data	Length	Type	Description
Header	2	Binary	Byte 0: 0x0F, synchronization Byte 1: 00010xxx (binary) Bit 2: Alignment mode if 1 Bit 1: Anomaly if 1 Bit 0: data valid if 0
Heading	3	Binary	MSB: 180 degrees
Roll	3	Two complement	MSB: 90 degrees
Pitch	3	Two complement	MSB: 90 degrees
Vertical speed	2	Two complement	Unused, set to 0
Heave	2	Two complement	MSB: 360 meters

DOLOG HRP

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Binary frame
- Data sent: Status, Heading , Roll, Pitch, Heading Rate, Roll Rate, Pitch Rate
- Data frame:

The protocol contains **10 fields - 16 bytes**. MSB are sent first.

Message <F0><F1><F2>…..<F9>			
Field 0	Byte 0	0x02	Start of sentence
Field 1	Byte 1	Status	Bit 7, 6, 3, 2 and 1 not used Bit 5 : Alarm bit = 1 if Sensor error Bit 4 : Alignment bit = 1 for Alignment Bit 0 : Data valid bit = 1 for data valid
Field 2	Bytes 2 to 3	Heading	Unsigned 16 bits integer 2^{15} = 180° 0 to 359.99°
Field 3	Bytes 4 to 5	Roll	Signed 16 bits integer +/-2^{15} = +/-90° -90° to 89.99° (Positive when port side up)
Field 4	Bytes 6 to 7	Pitch	Signed 16 bits integer +/-2^{15} = +/-90° -90° to 89.99° (Positive when bow up) **Warning:** Opposite sign of the OCTANS usual convention
Field 5	Bytes 8 to 9	Heading rate*	Signed 16 bits integer +/-215 = +/-45°/s -45 to 44.99°/s (Positive when the OCTANS heading angle decreases) Warning: Opposite sign of the OCTANS usual convention
Field 6	Bytes 10 to 11	Roll rate*	Signed 16 bits integer +/-215 = +/-45°/s -45 to 44.99°/s (Positive when the OCTANS roll angle increases)
Field 7	Bytes 12 to 13	Pitch rate*	Signed 16 bits integer +/-215 = +/-45°/s -45 to 44.99°/s (Positive when the OCTANS pitch angle decreases) Warning: Opposite sign of the OCTANS usual convention
Field 8	Byte 14	Checksum	Negative sum of all the bytes before checksum byte (ignoring overflow)
Field 9	Byte 15	0x03	End of sentence

* The precision of the rotation rate data is limited to 3.6 deg/h to comply with the export regulation.

GYROCOMPAS 1

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Heading, Roll, Pitch, Status, Date and time (1)
- Data frame: it is composed of
  - ❑ NMEA **$HEHDT** Frame see section 3.2.2.6
  - ❑ NMEA **$PHTRO** Frame see section 3.2.1.14
  - ❑ NMEA **$PHINF** Frame see section 3.2.1.8

(1) And, If ZDA option selected:

- ❑ NMEA **$PHZDA** Frame see section 3.2.1.5

GYROCOMPAS 2

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Heading, Roll, Pitch, Heave, Status, Date and time (1)
- Data frame: It is composed of
  - ❑ NMEA **$HEHDT** Frame see section 3.2.2.6
  - ❑ NMEA **$PHTRH** Standard Frame see section 3.2.1.13
  - ❑ NMEA **$PHINF** Frame see section 3.2.1.8

(1) And, If ZDA option selected:

- ❑ NMEA **$PHZDA** Frame see section 3.2.1.5

HAM CUSTOM

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output TSS proprietary protocol and Output NMEA 0183 frame
- Data sent: Roll, Pitch, Heave, Linear accelerations, Status, Heading
- Data frame:

The frame contains

- The TSS335B frame (please see "TSS335B" protocol)
- The NMEA HEHDT frame (please see "HEHDT" protocol)

Note

The checksum in the NMEA HEHDT frame sent is not calculated.

HDMS THOMSON

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output HDMS system
- Data sent: Heading, Roll, Pitch, Heave
- Data frame:

The frame contains 10 bytes in binary format.

Message	00 90 RRRR PPPP hhhh HHHH		
Byte 0	0x00	Sync byte	
Byte 1	0x90	Sync byte	
Byte 2	0xRRRR	Roll LSB	Roll ± 180° LSB: 0.01° Sign “+” when port up
Byte 3		Roll MSB	
Byte 4	0xPPPP	Pitch LSB	Pitch ± 180° LSB: 0.01° **Warning:** Opposite sign of Octans convention Sign “+” when bow up
Byte 5		Pitch MSB	
Byte 6	0xhhhh	Heave LSB	Heave ± 10 m LSB: 0.01m Sign “+” when Octans goes up
Byte 7		Heave MSB	
Byte 8	0xHHHH	Heading LSB	Heading 0° to 360° LSB: 0.01°
Byte 9		Heading MSB	

Each data is “two complemented” coded except for Heading.

HEAVE POSTPRO

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: NMEA 0183
- Data sent: Heave
- Data frame:

Conventions about time

The clock gives time starting when system is turned on. Time is reset to 0 every 24 hour. Early block versions used IEEE 32 floats to store time, which lacks accuracy when hours increase. Thus this floating point representation was replaced by a fixed point datation of 100us granularity in new bloc versions.

Conventions about data types

Each telegram description uses following convention:

Type name	Description
Byte	Unsigned 8 bit integer
Character	Signed 8 bit integer
Word	Unsigned 16 bit integer
Short	Signed 16 bit integer
DWord	Unsigned 32 bit integer
Long	Signed 32 bit integer
Float	IEEE Float 32 bits
Double	IEEE Float 64 bits

All 16 and 32 bits integers are represented in Big endian convention (MSB sent first)

Conventions about encryption

Only the the data fields of the ACC are enciphered. A new encrypting key is sent every 6000 frame that enables the decoding of the 6000 previous frames (hence every 60 second at 100 Hz).

Every 32 bits field is encoded as follow: Byte1 XOR KeyH, Byte2 XOR KeyL, Byte3 XOR KeyH and Byte4 XOR KeyL.

Heave Telegram description (version 0x01)

Data	Format	Units
Header	Byte	Value : ‘$’
Telegram size	Byte	NN bytes
Telegram identification	Byte	30
Data bloc version	Byte	0x10
Data validity time	Dword	PHINS time tag in steps of 100us
Telegram counter	Word	N/A
Decoding key	Word	KeyH then KeyL
ACC X on COG	Float	meters/second^2 in terrestrial frame (enciphered)
ACC Y on COG	Float	meters/second^2 in terrestrial frame (enciphered)
ACC Z on COG	Float	meters/second^2 in terrestrial frame (enciphered)
Real Time Surge	Float	meters (INS level)
Real Time Sway	Float	meters (INS level)
Real Time Heave	Float	meters (INS level)
Smart Heave Delay	Dword	in steps of 100us
Smart Heave	Float	Delayed heave in meters (INS level)
Heave Status	Byte	0x01 if Heave Ok
Real Time Heave Mode	Byte	Real Time Heave Filter mode: 1-Slight, 2-Moderate, 3-Rough, 4-Automatic
Heave Period	Float	Estimated Heave Period
Heave Amplitude	Float	Estimated Heave Amplitude

HEHDT

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183
- Data sent: Heading, Date and time (1)
- Data frame: It is composed of
  - NMEA **$HEHDT** Frame see section 3.2.2.6

(1) And, If ZDA option selected:

  - NMEA **$PHZDA** Frame see section 3.2.1.5

HEHDT FIXED

This protocol is not available for all products.
Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: This output is not NMEA 0183 compatible (there is no NMEA checksum in this data frame).
- Data sent: Heading, Date and time (1)
- Data frame:

$HEHDT,xxx.x,T<CR><LF>			
where:	**xxx.x**	is the true heading in degrees	**3 digits before and 1 digit after** the decimal point
	T	is a fixed character = 'T'	

$--ZDA,hhmmss.ss,dd,mm,yyyy,hh,mm*hh<CR><LF> (1)			
where:	**hhmmss.ss**	is UTC time	System Time or UTC Time if time synchronized
	dd	is the UTC day	
	mm	is the UTC month	
	yyyy	is the UTC year	
	hh	is the local zone hours	
	mm	is the local zone minutes	
	hh	is the checksum	

(1) If ZDA option selected.

HEHDT HEROT

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183
- Data sent: Heading Rate, Date and time (1)
- Data frame: It is composed of
    - NMEA **$HEHDT** Frame see section 3.2.2.6
    - NMEA **$HEROT** Frame see section 3.2.2.7

(1) And, If ZDA option selected:

- NMEA **$PHZDA** Frame see section 3.2.1.5

HETHS HEROT

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183
- Data sent: Heading, Heading Rate, Validity status
- Data frame: It is composed of
  - NMEA **$HETHS** Frame see section 3.2.2.8
  - NMEA **$HEROT** Frame see section 3.2.2.7

And, If ZDA option selected:

- NMEA **$PHZDA** Frame see section 3.2.1.5

IFREMER VICTOR V3

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output Ifremer proprietary protocol compatible with Seatex MRU6 system
- Data sent: Heading, Roll, Pitch, Heave, Rotation rates, Accelerations
- Data frame: The frame contains a header, 10 fields with 4 bytes in binary format per field and a checksum. Data are coded in IEEE floating point standard. MSB are sent first and LSB in last position.

Message	<Q><n><id><F1><F2>…..<F8><F9><s>	
Byte 0	'Q'	Sync
Byte 1	0x29	Number of bytes: Fields and user id. (4*10 + 1 = 41)
Byte 2	0x0C	User id. Octans id is fixed to 12
Field 1 Bytes 3 to 6	Roll	radians IEEE floating point format
Field 2 Bytes 7 to 10	Pitch	radians IEEE floating point format
Field 3 Bytes 11 to 14	Heading	radians IEEE floating point format
Field 4 Bytes 15 to 18	XV2 Rot rate	radians per second IEEE floating point format (pitch speed)
Field 5 Bytes 19 to 22	XV3 Rot rate	radians per second IEEE floating point format (opposite heading speed)
Field 6 Bytes 23 to 26	XV1 Rot rate	radians per second IEEE floating point format (roll speed)
Field 7 Bytes 27 to 30	XV2 acceleration	m/s2 IEEE floating point format
Field 8 Bytes 31 to 34	XV3 acceleration	m/s2 IEEE floating point format
Field 9 Bytes 35 to 38	XV1 acceleration	m/s2 IEEE floating point format
Field 10 Bytes 39 to 42	Heave	IEEE floating point format
Byte 43	Checksum	Addition of all the bytes for 0 to 42 discarding overflow

IG03

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output IG03
- Data sent: Heading, Roll, Pitch , Position
- Data frame: ASCII Format

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

Short Format:

$HHH.H,N,XX<CR><LF>			
where:	**HHH.H**	Heading in degree	
	N	'N' fix character	
	XX	2 digits hexadecimal Status	See Status Table Below

Long Format:

$HHH.H,N,XX,aLL.L,SS,aRR.R,aPP.P<CR><LF>			
where:	**HHH.H**	Heading in degree	
	N	'N' fix character	
	XX	Status	See Status Table below
	aLL.L	aLL.L is the latitude in degrees a ='+' for Northern hemisphere a='-' for Southern hemisphere	
	SS	is the speed in knots	
	aRR.R	aRR.R is the roll angle in degrees a='+' for port up a='-' for port down.	Opposite of OCTANS convention
	aPP.P	aPP.P is the pitch angle in degrees a='-' for bow up a='+' for bow down	

The table below details status byte bit definition according to OCTANS User status bit description (see Table 9):

Status byte bit index	Description	Corresponding User status bits
0 to 4	N/A	
5	'1' = Heading not valid '0' = Heading Valid	User Status bit 15: SENSOR_ERR: User or User Status bit 5: ALIGNMENT
6	N/A	
7	'1' = Alignment '0' = Navigation	User Status bit 5: ALIGNMENT

IMU_BINARY

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Standard: Binary protocol

Data sent: Rotation rates, Linear Accelerations, Sensor Status and Temperature

Data frame: The frame contains 10 fields - 37 bytes. MSB are sent first.

These data are only accessible for IMU90 product.

Message <F0><F1><F2>…..<F10>			
Field 0	Byte 0	'$'	Synchronization byte
Field 1	Byte 1 to 4	Time stamp (0-24)	Unsigned 32 bit integer. LSB= 50 µs
Field 2	Byte 5 to 8	XV1 delta rotation	IEEE float 32 bits in radian **Note 1**
Field 3	Byte 9 to 12	XV2 delta rotation	IEEE float 32 bits in radian
Field 4	Byte 13 to 16	XV3 delta rotation	IEEE float 32 bits in radian
Field 5	Byte 17 to 20	XV1 delta velocity	IEEE float 32 bits in m/s **Note 1**
Field 6	Byte 21 to 24	XV2 delta velocity	IEEE float 32 bits in m/s
Field 7	Byte 25 to 28	XV3 delta velocity	IEEE float 32 bits in m/s
Field 8	Byte 29 to 32	Sensor status	Unsigned 32 bit integer. sensor status 2
Field 9	Byte 33 to 34	Sensor temperature	Signed 16 bit integer. x10 Kelvin **Note 2**
Field 10	Byte 35 to 36	Checksum	Unsigned 16 bit integer **Note 3**

Note 1 : Delta rotation is the integration of the gyro readings in the time interval of output data rate. We define t1 as the time validity of the delta rotation data, Δt the output data rate and t2 the instant of output of first bit of data telegram. Then (t2-t1) is the latency on data and delta rotation is the integration of rotation angle from t1-Δt to t1.

Delta velocity is the integration of accelerometer readings in the time interval of output data rate in the same manner as delta rotation.

Note 2: to convert value to °C= (Temperature/10)-273.15. This is the mean value of TFOGX1, TFOGX2, TFOGX3, TACCX1, TACCX2, TACCX3.

Note 3 : Sum of all bytes from byte 0 to byte 34.

IMU RAWDATA

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Standard: ASCII protocol

Data sent: Rotation rates, Linear Accelerations, Sensor Status and Temperature

Data frame: The frame contains 12 fields - 32 bytes.

These data are only accessible for IMU90 product.

Message <F0><F1><F2>…..<F11>			
Field 0	Byte 0	0x55	Synchronization byte
Field 1	Byte 1	0..255	Counter **Note 1**
Field 2	Byte 2 to 3	See below	Status **Note 2**
Field 3	Byte 4 to 7	XV1 delta rotation	IEEE Float 32 bits in radian **Note 5**
Field 4	Byte 8 to 11	XV2 delta rotation	IEEE Float 32 bits in radian
Field 5	Byte 12 to 15	XV3 delta rotation	IEEE Float 32 bits in radian
Field 6	Byte 16 to 19	XV1 delta velocity	IEEE Float 32 bits in m/s
Field 7	Byte 20 to 23	XV2 delta velocity	IEEE Float 32 bits in m/s **Note 5**
Field 8	Byte 24 to 27	XV3 delta velocity	IEEE Float 32 bits in m/s
Field 9	Byte 28	Temperature	Signed 8 bit integer in °C **Note 4**
Field 10	Byte 29 to 30	See below	Checksum **Note 3**
Field 11	Byte 31	0xAA	Stop byte

Note 1: The counter starts from 0 and is incremented by 1 for each message transmitted. Counter wraps back to 0 when it reaches the maximum value of 255. The counter is used to detect lost messages at receiver.

Note 2: The status is described hereafter:

Bit 0	FOG X1 anomaly (bit 0 of sensor status 2)
Bit 1	FOG X2 anomaly (bit 1 of sensor status 2)
Bit 2	FOG X3 anomaly (bit 2 of sensor status 2)
Bit 3	FOG Acquisition error (OR of bit 19 to 24 of Sensor status 1)
Bit 4	Accelerometer X1 anomaly (bit 4 of sensor status 2)
Bit 5	Accelerometer X2 anomaly (bit 5 of sensor status 2)
Bit 6	Accelerometer X3 anomaly (bit 6 of sensor status 2)
Bit 7	Sensor error (OR of bit 0 to 6 of present status)
Bit 8	Optical source error (bit 3 of sensor status 2)
Bit 9	Temperature error (bit 7 of sensor status 2)
Bit 12-15	Reserved

Note 3

The CRC is defined as follows and is computed based on data fields 0 to 9.

Name:	"CRC-16/CCITT"
Width:	16
Poly:	0x1021, (or X16+X12+X5+1)
Init:	FFFF
Reflected input:	True
Reflected output:	True

Note 4

Temperature is coded in 2's complement signed integer format, ranging from -128°C to +127°C.

The temperature represents the mean temperature of T_{FOGX1}, T_{FOGX2}, T_{FOGX3}, T_{ACCX1}, T_{ACCX2}, T_{ACCX3}.

Note 5

Delta rotation is the integration of the gyro readings in the time interval of output data rate. We define t1 as the time validity of the delta rotation data, Δt the output data rate and t2 the instant of output of first bit of data telegram. Then (t2-t1) is the latency on data and delta rotation is the integration of rotation angle from t1-Δt to t1.

Delta velocity is the integration of accelerometer readings in the time interval of output data rate in the same manner as delta rotation.

IXBLUE STANDARD BIN V2, V3

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Important

The value of the heave without lever arm is set to 0 when selecting Smart heave in the web-based user interface with this protocol for the output settings.

Conventions

Validity time fields

Output mode

If the protocol is used as output, the validity time fields contain internal system time that can be synchronized with GPS UTC time when UTC time is sent to system at regular intervals (i.e: every second). To improve accuracy it is recommended to input a 1 PPS pulse at pulse input of system. If no UTC is received, the internal time starts at 0 at system boot time. The time fields are formatted in steps of 100 µs and cycle from 0 to 24h, thus covering [0:863999999] steps of 100 µs.

Input mode

If the protocol is used as input, the validity time field is used to provide external sensor validity time, formatted in steps of 100 µs. Three cases can be distinguished:

- Time stamp shall be positive or null to send timestamp ([0:863999999] steps of 100 µs). In this case, used timestamp corresponds to the transmitted timestamp.
- Time stamp shall be negative to indicate sensor delay. In this case, used timestamp correspond to reception time minus transmitted delay.
- Time stamp shall be 0x7FC0000 if no time information has to be sent. In this case, external sensor timestamp corresponds to reception timestamp
- Data types

Each telegram description uses following convention:

Type name	Description
Byte	Unsigned 8 bit integer
Character	Signed 8 bit integer
Word	Unsigned 16 bit integer
Short	Signed 16 bit integer
DWord	Unsigned 32 bit integer
Long	Signed 32 bit integer
Float	IEEE Float 32 bits
Double	IEEE Float 64 bits

All 16 and 32 bits integers are represented in Big Endian convention (MSB sent first)

Direction

Given that the protocol can used both as output or input, the following conventions is used to indicate if a data is used in output mode, input mode or both (mainly apply on bit masks):

Type name	Description
I	Filled/Used in input mode only
O	Filled/Used in output mode only
I/O	Filled/Used in both input and output mode

Frames

Different frames are used to express data:

- AHRS body frame (X1, X2, X3)
- Vehicle frame (XV1, XV2, XV3) that coincide with vessel frame after rough and fine misalignment are stored into the system using the web-based user interface.
- Sensor (i.e: EM LOG) reference frame (XS1, XS2, XS3).
- Local geographical frame (XNorth, XWest ,XUp)
- Horizontal vehicle frame (XV1H, XV2H, XV3H) is vehicle frame compensated from roll an pitch. It lies in geographical horizontal plane.

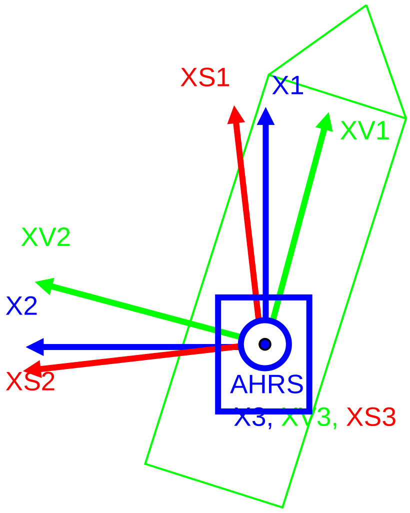


Figure 8: Vehicle, Body and sensor reference frame

Altitude convention

Altitude can referenced to Geoïdal model (mean sea level) if managed by the GPS input. In this case, geoïdal separation field is a valid IEEE float that contains distance between geoid and ellipsoid at current position. Otherwise if GPS does not manage mean sea level altitude, the altitude field if referenced from ellipsoid and geoidal separation field contains NaN value 0x7FC00000.

Protocol description

The iXBlue StdBin protocol can be used both as output or input protocol.

The output telegram is used to get navigation data and received external sensors from the system. The input telegram is used to send external sensors data to the system.

Protocol structure

The structure of the protocol is the same whether it's used as input or output. Each protocol frame contains a header message, followed the message body that can contain a combination a different data blocks.

When used as output, the message body contains both navigation data blocks and external sensors data blocks (external sensors received by the system). When used as input, the message body only contains external sensors data blocks (to send to the system).

Additional command frames can be sent to the system, using specific command header, to send parameters to the product. The system will reply to these command frames with answer frames starting with answer header as detailed in next chapters.

Each message is terminated by a checksum to validate all the content of the telegram. This checksum is a DWord unsigned sum of all frame bytes, including the header and excluding the checksum itself.

Header	Body	Checksum

Protocol Use

As described in the following paragraphs, the protocol header is slightly different in input and output modes. However, the input mode manages both the input telegram coded as specified hereafter (including input header format) and the output telegram coming from another INS/AHRS (including output header format). This enables to loopback one system to another using iXBlue Std Bin protocol.

Message Headers

There are four types of headers in this protocol:

- Command header, used to send commands to the system
- Answer header, used to contain responses to a command sent to the system
- Output navigation data header, used to contains system navigation data and external sensor copies
- Input sensor data header, used to send external sensors to the system

The headers hold the protocol version, and for navigation messages, the bit masks that indicate which data block is present, the telegram size and other information depending on protocol direction.

Input message header for commands

Input messages that contain commands to be sent to the system are formatted using following header (available from version 3 only):

Data	Format	Units
Header 1	Byte	Value : 'C'
Header 2	Byte	Value : 'M'
Protocol version	Byte	0x03
Total telegram size	Word	Number of bytes of the message including 7 byte header

The body part of each command message contains a single command formatted as detailed in Advanced Configuration document. They are used to send parameters to the system.

Output message header for answers to commands

Output messages that contain answers to commands that were sent to the system are formatted using following header (available from version 3 only):

Data	Format	Units
Header 1	Byte	Value : 'A'
Header 2	Byte	Value : 'N'
Protocol version	Byte	0x03
Total telegram size	Word	Number of bytes of the message including 7 byte header

Output message header for navigation data

Version 0x2 header

Data	Format	Units
Header 1	Byte	Value : 'I'
Header 2	Byte	Value : 'X'
Protocol version	Byte	0x02
Navigation data blocks bit mask	DWord	Bloc combination identification bit mask Bit is set to 1 when bloc is output, 0 otherwise.
External data bit mask	DWord	Bloc combination identification bit mask Bit is set to 1 when bloc is output, 0 otherwise.
Total telegram size	Word	Number of bytes of the message including 21 byte header
Navigation data validity time	Dword	Validity time in steps of 100us (refer to § Validity time fields)
Counter	DWord	Cycling counter inside $[0:2^{32}-1]$

Version 0x3 header

Navigation data output telegram header version 3 is formatted as follows:

Data	Format	Units
Header 1	Byte	Value : ‘I’
Header 2	Byte	Value : ‘X’
Protocol version	Byte	0x03
Navigation data blocks bit mask	DWord	Bloc combination identification bit mask Bit is set to 1 when bloc is output, 0 otherwise.
Extended Navigation data block bit mask	DWord	Bloc combination identification bit mask Bit is set to 1 when bloc is output, 0 otherwise.
External data bit mask	DWord	Bloc combination identification bit mask Bit is set to 1 when bloc is output, 0 otherwise.
Total telegram size	Word	Number of bytes of the message including 25 byte header
Navigation data validity time	Dword	Validity time in steps of 100 us (refer to § Validity time fields)
Counter	DWord	Cycling counter inside $[0:2^{32}-1]$

Navigation data input message header

Navigation data input messages are used to send external sensor data to the system using the same structure as output messages.

Version 0x2 header

On protocol version 2, navigation data messages are formatted using following header:

Data	Format	Units
Header 1	Byte	Value : ‘I’
Header 2	Byte	Value : ‘X’
Protocol version	Byte	0x02
Navigation data blocks bit mask	DWord	Unused in input mode. Shall be set to 0x00000000
External data bit mask	DWord	Bloc combination identification bit mask Bit is set to 1 when bloc is output, 0 otherwise.
Total telegram size	Word	Number of bytes of the message including 21 byte header
External sensors time stamp reference	Byte	External sensors timestamp : 0x00: UTC time
RFU	7 Bytes	Shall be set to 0x00.

Version 0x3 header

On protocol version 3, navigation data messages are formatted using following header:

Data	Format	Units
Header 1	Byte	Value : 'I'
Header 2	Byte	Value : 'X'
Protocol version	Byte	0x03
Navigation data blocks bit mask	DWord	Unused in input mode. Shall be set to 0x00000000
Extended navigation data blocks bit mask	DWord	Unused in input mode. Shall be set to 0x00000000
External data bit mask	DWord	Bloc combination identification bit mask Bit is set to 1 when bloc is output, 0 otherwise.
Total telegram size	Word	Number of bytes of the message including 25 byte header
External sensors time stamp reference	Byte	External sensors timestamp : 0x00: UTC time
RFU	7 Bytes	Shall be set to 0x00.

Bit Masks description for navigation data messages

Navigation data blocks

Following table describes the navigation data blocks and their corresponding bit number:

Bit n°	Internal Block description	Dir.
0	Attitude & Heading	O
2	Real time Heave/Surge/Sway	O
3	Smart Heave™	O
4	Heading/Roll/Pitch Rate	O
5	Rotation rate in vessel frame, compensated from Earth rotation	O
6	Acceleration in vessel frame, compensated from gravity	O
9	Speed in geographic frame	O
13	System date	O
14	INS/AHRS sensor status	O
18	AHRS algorithm status	O
19	AHRS system status	O
20	AHRS user status	O
21	Heave, surge and sway speeds	O
22	Speed in vessel frame	O

Bit n°	Internal Block description	Dir.
23	Acceleration in geographic frame not compensated from gravity	O
24	Course and speed over ground	O
25	Temperatures (ACC/FOG/ANA)	O
26	Attitude quaternion data	O
28	Raw accelerations in vessel frame not compensated from gravity	O

Extended navigation data blocks

Following table describes the extended navigation data blocks and their corresponding bit number. This section is only available from protocol version 3:

Bit n°	Internal Block description	Dir.
0	Rotation accelerations in vessel frame	O
2	Raw rotation rate in vessel frame, not compensated from Earth rotation	O

External sensor data blocks

Following table details the external sensor and status blocks and their corresponding bit number:

Bit n°	Block description	Dir.
0	UTC data	I/O
1, 2, 3	GPS1, GPS2, manual GPS data	I/O
4, 5	EMLOG1, EMLOG 2 data	I/O

Navigation data blocks

The navigation data blocks are used in output mode only.

Attitude & Heading data block (bit n°0)

Attitude and Heading relates to Vehicle reference frame.

Data	Format	Units
Heading	Float	In degrees, inside [0°:360°[
Roll	Float	In degrees, positive when port up, inside [-180°:180°[
Pitch	Float	In degrees, positive bow down, inside [-90°:90°]

Heave/Surge/Sway data block (bit n°2)

Data	Format	Units
Real time heave without lever arm(*)	Float	In meters, positive up (XV3H direction)
Real time heave at selected lever arm	Float	In meters, positive up (XV3H direction)
Real time surge at selected lever arm	Float	In meters, positive forward in XV1H
Real time sway at selected lever arm	Float	In meters, positive port side in XV2H

(*) if the user specified the COG lever arm, this field corresponds to COG heave. Otherwise, if COG lever arm is not specified, this is the heave at the system position (i.e. center of body frame).

Smart Heave™ data block (bit n°3)

This block contains Smart Heave™ data and related time.

Data	Format	Units
Smart Heave Time(*)	Dword	Smart heave validity time (steps of 100us, refer to § Validity time field)
Smart Heave™ At primary lever arm (**)	Float	In meters, positive up (XV3H direction)

(*) The smart heave is delayed by 100s. This field contains the time of validity for the Smart Heave.

(**) The smart heave is only available on primary lever arm.

Heading/Roll/Pitch rate data block (bit n°4)

This block contains attitude rates data (derivative of heading, roll and pitch):

Data	Format	Units
Heading rotation rate	Float	In °/s, positive when heading increases
Roll rotation rate	Float	In °/s, positive when port going up
Pitch rotation rate	Float	In °/s, positive when bow going down

Body rotation rates data block in vessel frame (bit n°5)

This block contains rotation rates in vessel frame XV1, XV2, XV3, compensated from earth rotation, gyros biases and scale factors:

Data	Format	Units
Rotation rate XV1	Float	In °/s, positive when port is going up
Rotation rate XV2	Float	In °/s, positive when bow is going down
Rotation rate XV3	Float	In °/s, positive counter clock wise around XV3

Accelerations data block in vessel frame (bit n°6)

This block contains accelerations **at primary lever arm** in vessel frame XV1, XV2, XV3, compensated from gravity:

Data	Format	Units
Acceleration XV1	Float	In m/s^2, positive forward
Acceleration XV2	Float	In m/s^2, positive toward port
Acceleration XV3	Float	In m/s^2, positive up

Linear acceleration expressed in vessel frame, noted:

$$\underline{a}_v = \frac{d}{dt}(\underline{v}_v)$$

It is computed by compensating gravity and Coriolis acceleration from raw measured accelerations as body frame is not Galilean.

Speed data block in geographic frame (bit n°9)

This block contains speed data **at primary lever arm** in geographical frame:

Data	Format	Units
North velocity	Float	In m/s, positive north
East velocity	Float	In m/s, positive east
Up velocity	Float	In m/s, positive up

System date data block (bit n°13)

This is AHRS internal date if system is not date synchronized to GPS otherwise it is ZDA date.

Data	Format	Units
Day	Byte	Day inside [0:31], 0 if unavailable
Month	Byte	Month inside [0:12], 0 if unavailable
Year	Word	Year inside [0:65535], 0 if unavailable

AHRS Sensor Status (bit n°14)

This block contains sensor statuses are detailed in 2.2:

Data	Format	Units
Sensor Status 1	DWord	N/A
Sensor Status 2	DWord	N/A

AHRS Algorithm Status (bit n°18)

This block contains AHRS algorithm status are detailed in 2.2:

Data	Format	Units
Algorithm Status	DWord	N/A

AHRS System Status (bit n°19)

This block contains AHRS system status are detailed in 2.2:

Data	Format	Units
System Status 1	DWord	N/A
System Status 2	DWord	N/A
System Status 3	DWord	N/A

AHRS User Status (bit n°20)

This block contains AHRS user status are detailed in 2.2:

Data	Format	Units
User Status	DWord	N/A

Heave/Surge/Sway speed data block (bit n°21)

Data	Format	Units
Real time heave speed (at selected lever arm)	Float	In m/s, positive up in XV3H direction
Surge speed (at selected lever arm)	Float	In m/s, positive forward in XV1H
Sway speed (at selected lever arm)	Float	In m/s, positive port side in XV2H

Speed data block in vessel frame (bit n°22)

This block contains speed data **at primary lever arm** in vessel frame:

Data	Format	Units
XV1 velocity	Float	In m/s, positive along XV1
XV2 velocity	Float	In m/s, positive along XV2
XV3 velocity	Float	In m/s, positive along XV3

Acceleration data block in geographic frame (bit n°23)

This block contains accelerations **at primary lever arm** in geographical frame, not compensated from gravity:

Data	Format	Units
North acceleration	Float	In m/s^2, positive North
East acceleration	Float	In m/s^2, positive East
Vertical acceleration	Float	In m/s^2, positive up

Temperatures (bit n°25)

This block contains the average temperature data:

Data	Format	Units
Mean temperature FOG: Average(TEMP_FOG_X, TEMP_FOG_Y, TEMP_FOG_Z)	Float	In °Celsius
Mean temperature ACC: Average(TEMP_ACC_X, TEMP_ACC_Y, TEMP_ACC_Z)	Float	In °Celsius
Temperature [TEMP_ANA] (Sensor board temperature)	Float	In °Celsius

Attitude quaternion (bit n°26)

This block contains the attitude quaternion representation:

Data	Format	Units
Attitude quaternion component q0	Float	N/A
Attitude quaternion component q1	Float	N/A
Attitude quaternion component q2	Float	N/A
Attitude quaternion component q3	Float	N/A

See § Quaternions for details on quaternions definitions, operations and relationship with Euler angles.

Raw acceleration in vessel frame (bit 28)

This block contains the acceleration in vessel frame, at primary lever arm, not compensated from gravity:

Data	Format	Units
Acceleration XV1	Float	In m/s^2, positive forward
Acceleration XV2	Float	In m/s^2, positive toward port
Acceleration XV3	Float	In m/s^2, positive up

Extended navigation data blocks

Rotation accelerations in vessel frame (bit 0)

This block contains the rotation accelerations (derivate of compensated rotation rates: see § Body rotation rates data block in vessel frame) in vessel frame:

Data	Format	Units
Raw rotation acceleration XV1	Float	In $°/s^2$
Raw rotation acceleration XV2	Float	In $°/s^2$
Raw rotation acceleration XV3	Float	In $°/s^2$

Raw rotation rate in vessel frame (bit 2)

This block contains raw rotation rates in vessel frame, not compensated from Earth rotation:

Data	Format	Units
Raw rotation rate XV1	Float	In °/s
Raw rotation rate XV2	Float	In °/s
Raw rotation rate XV3	Float	In °/s

External sensors data blocks

The external sensors data blocks are used in both output and input mode.

- When used as output, the sensor blocks are sent only when the corresponding data is received by the system. The data validity time corresponds to the internal time or the UTC time if the system is UTC synchronized.
- When used as input, the sensor blocks are sent only to send external sensor data to the system. The time tag data corresponds to the sensor validity time. Refer to § Validity time fields for more details.

UTC data block (bit n°0)

Last UTC data block received or UTC data block to send:

Data	Format	Units
Data validity time	Dword	Time tag in steps of 100us (refer to § Validity time fields)
UTC Source	Byte	0: UTC1, 1: UTC2

GPS1, GPS2 and Manual GPS data blocks (bits n°1,2,3)

Last GPS1, GPS2 or Manual GPS data received or GPS data to send:

Data	Format	Units
Data validity time	Long	Time tag in steps of 100us (refer to § Validity time fields)
GPS identification	Byte	0: GPS1 1: GPS2 2: Manual GPS
GPS quality	Byte	Fixed to 1 for manual GPS
Latitude	Double	In degrees, positive North, inside [-90° :90°]
Longitude	Double	In degrees, positive East, inside [0° :360°[
Altitude	Float	In meters, positive up, in geoid reference

Data	Format	Units
Latitude standard deviation	Float	In meters
Longitude standard deviation	Float	In meters
Altitude standard deviation	Float	In meters
Latitude/Longitude covariance	Float	In meters^2 Fixed to 0 for manual GPS
Geoidal separation	Float	meters (See § Conventions)

EMLOG1 and EMLOG2 data blocks (bits n°4,5)

Last EMLOG1 or EMLOG2 data received or EMLOG data to send:

Data	Format	Units
Data validity time	Long	Time tag in steps of 100us (refer to § Validity time fields)
EMLOG ID	Byte	0: EMLOG1 1: EMLOG2
XV1 longitudinal water speed	Float	In m/s, positive forward
XV1 speed standard deviation	Float	In m/s

Quaternions conventions

Quaternion definition and operations

General expression of a quaternion

If q is a real number and $\underline{V}=\begin{bmatrix} V_x \\ V_y \\ V_z \end{bmatrix}$ a vector of the three dimensional Euclidian space, then the quaternion $Q = q + \underline{V}$ can be defined as:

$$Q = q + \underline{V} = \begin{bmatrix} q \\ V_x \\ V_y \\ V_z \end{bmatrix}$$

Where q and $\underline{V}$ are respectively the scalar part and the vector part of the quaternion Q.

Conjugate of a quaternion:

If $Q = \begin{bmatrix} q0 \\ q1 \\ q2 \\ q3 \end{bmatrix}$ is a quaternion, the conjugate $\bar{Q}$ of Q is given by:

$$\bar{Q} = \begin{bmatrix} q0 \\ -q1 \\ -q2 \\ -q3 \end{bmatrix}$$

Product of two quaternions

If $P = \begin{bmatrix} p0 \\ p1 \\ p2 \\ p3 \end{bmatrix}$ and $Q = \begin{bmatrix} q0 \\ q1 \\ q2 \\ q3 \end{bmatrix}$ are two quaternions, the product of P by Q, written $P.Q$ is given by:

$$P.Q = \begin{bmatrix} p0 \\ p1 \\ p2 \\ p3 \end{bmatrix} \cdot \begin{bmatrix} q0 \\ q1 \\ q2 \\ q3 \end{bmatrix} = \begin{bmatrix} p0q0 - p1q1 - p2q2 - p3q3 \\ p0q1 + p1q0 + p2q3 - p3q2 \\ p0q2 - p1q3 + p2q0 + p3q1 \\ p0q3 + p1q2 - p2q1 + p3q0 \end{bmatrix}$$

Conjugation of a vector V by a quaternion Q

$$Q.\underline{V}.\overline{Q} = \begin{bmatrix} q0 \\ q1 \\ q2 \\ q3 \end{bmatrix} \cdot \begin{bmatrix} 0 \\ Vx \\ Vy \\ Vz \end{bmatrix} \cdot \begin{bmatrix} q0 \\ -q1 \\ -q2 \\ -q3 \end{bmatrix}$$

$$= \begin{bmatrix} 0 \\ (q0^2 + q1^2 - q2^2 - q3^2)Vx + 2(q1q2 - q0q3)Vy + 2(q1q3 + q0q2)Vz \\ 2(q1q2 + q0q3)Vx + (q0^2 - q1^2 + q2^2 - q3^2)Vy + 2(q2q3 - q0q1)Vz \\ 2(q1q3 - q0q2)Vx + 2(q2q3 + q0q1)Vy + (q0^2 - q1^2 - q2^2 + q3^2)Vz \end{bmatrix}$$

Attitude quaternion definition

Definition

Quaternion Q_{Geob} represents the rotation required to get from geographical frame to body frame:

For a vector V, V_b being its expression in body frame and V_{geo} its expression in geographical frame, the transformation from geographical frame to body frame is done through V_{geo} conjugation by quaternion Q_{Geob} :

$$V_b = Q_{Geob}.V_{geo}.\overline{Q_{Geob}}$$

Here we note «.» the usual product in quaternion space and $\overline{Q_{Geob}}$ the conjugate of quaternion Q_{Geob}.

Relationship between attitude quaternion and Euler angles

H is heading angle, positive from North to East (indirect)

P is pitch angle, positive when bow gets down

R is roll angle, positive when port side gets up

[A'] and [A''] are intermediate frames where:

[A'] is the image of geographical frame by heading rotation (-H, X_{UP})

[A''] is the image of [A'] by pitch rotation (P, $Y_{A'}$)

[v] is the image of [A''] by roll rotation (R, $X_{A''}$)

To get from geographical frame to vessel frame, we successively apply:

A heading rotation of -H degrees around X_{UP}, represented by quaternion:

$$Q_{A'Geo} = \left(\cos\left(\frac{H}{2}\right) - \sin\left(\frac{H}{2}\right) X_{UP}\right)$$

A pitch rotation P, around axis YA' represented by the quaternion

$$Q_{A''A'} = \left(\cos\left(\frac{P}{2}\right) + \sin\left(\frac{P}{2}\right)\mathrm{Y}_{A'}\right)$$

Roll rotation R around axis XA'' represented by quaternion :

$$Q_{vA''} = \left(\cos\left(\frac{R}{2}\right) + \sin\left(\frac{R}{2}\right)\mathrm{X}_{A''}\right)$$

The global transition quaternion from geographical frame to vessel frame is thus the product:

$$Q_{Geov} = \left(\cos\left(\frac{R}{2}\right) - \sin\left(\frac{R}{2}\right)\mathrm{X}_{A''}\right).\left(\cos\left(\frac{P}{2}\right) - \sin\left(\frac{P}{2}\right)\mathrm{Y}_{A'}\right).\left(\cos\left(\frac{H}{2}\right) + \sin\left(\frac{H}{2}\right)\mathrm{X}_{UP}\right)$$

Or:

$$Q_{Geov} = \begin{bmatrix} cos\left(\frac{R}{2}\right) \\ -sin\left(\frac{R}{2}\right) \\ 0 \\ 0 \end{bmatrix} \cdot \begin{bmatrix} cos\left(\frac{P}{2}\right) \\ 0 \\ -sin\left(\frac{P}{2}\right) \\ 0 \end{bmatrix} \cdot \begin{bmatrix} cos\left(\frac{H}{2}\right) \\ 0 \\ 0 \\ sin\left(\frac{H}{2}\right) \end{bmatrix}$$

That can be developed as:

$$Q_{Geov} = \begin{bmatrix} cos\left(\frac{R}{2}\right).cos\left(\frac{P}{2}\right)cos\left(\frac{H}{2}\right) - sin\left(\frac{R}{2}\right).sin\left(\frac{P}{2}\right).sin\left(\frac{H}{2}\right) \\ -sin\left(\frac{R}{2}\right).cos\left(\frac{P}{2}\right).cos\left(\frac{H}{2}\right) - cos\left(\frac{R}{2}\right).sin\left(\frac{P}{2}\right)sin\left(\frac{H}{2}\right) \\ sin\left(\frac{R}{2}\right).cos\left(\frac{P}{2}\right).sin\left(\frac{H}{2}\right) - cos\left(\frac{R}{2}\right).sin\left(\frac{P}{2}\right).cos\left(\frac{H}{2}\right) \\ cos\left(\frac{R}{2}\right).cos\left(\frac{P}{2}\right).sin\left(\frac{H}{2}\right) + sin\left(\frac{R}{2}\right).sin\left(\frac{P}{2}\right).cos\left(\frac{H}{2}\right) \end{bmatrix}$$

Standard deviation of attitude quaternion

Definition

Attitude quaternion Q_{Geov} can be written as follows :

$$Q_{Geov} = Q_{bv} Q_{nb} Q_{Geon}$$

Introducing the error quaternions for Q_{nb} and Q_{Geon}, the above can be rewritten as follows :

$$Q_{Geov} = Q_{bv}\hat{Q}_{nb}\left(1-\frac{\eta}{2}\right)\hat{Q}_{Geon}\left(1-\frac{\gamma}{2}\right) \quad (0.1)$$

Introducing the error quaternion for Q_{Geov}, we can write :

$$Q_{Geov} = \hat{Q}_{Geov}\left(1-\frac{\xi}{2}\right)$$

$$Q_{Geov} = Q_{bv}\hat{Q}_{Geob}\left(1-\frac{\underline{\xi}}{2}\right) \text{(0.2)}$$

with $\underline{\xi}$ defined as the (small) rotation vector to get from actual [Geo] frame to erroneous [Geo] frame.

Equating Eq. **Erreur ! Source du renvoi introuvable.** and Eq.(0.2) yields:

$$\hat{Q}_{Geob}\left(1-\frac{\underline{\xi}}{2}\right) = \hat{Q}_{nb}\left(1-\frac{\underline{\eta}}{2}\right)\hat{Q}_{Geon}\left(1-\frac{\underline{\gamma}}{2}\right)$$

$$\left(1-\frac{\underline{\xi}}{2}\right) = \hat{Q}_{nGeo}\left(1-\frac{\underline{\eta}}{2}\right)\hat{Q}_{Geon}\left(1-\frac{\underline{\gamma}}{2}\right)$$

Neglecting the second order terms, we can write:

$$\left(1-\frac{\underline{\xi}}{2}\right) = 1-\frac{\underline{\gamma}}{2}-\hat{Q}_{nGeo}\frac{\underline{\eta}}{2}\hat{Q}_{Geon}$$

$$\underline{\xi} = \underline{\gamma}+\hat{Q}_{nGeo}\underline{\eta}\hat{Q}_{Geon}$$

Finally, we can write the covariance matrix on vector $\underline{\xi}$, i.e., the so-called "attitude quaternion covariance", as follows :

$$\boxed{\sigma^2\left(\underline{\xi}\right) = \sigma^2\left(\underline{\gamma}\right)+\hat{C}_n^{Geo}\sigma^2\left(\underline{\eta}\right)\left(\hat{C}_n^{Geo}\right)^T}$$

The standard deviations on vector $\underline{\xi}$ components are noted:

$$\sigma\left(\underline{\xi}_1\right)$$

$$\sigma\left(\underline{\xi}_2\right)$$

$$\sigma\left(\underline{\xi}_3\right)$$

N.B.: $\sigma^2\left(\underline{\gamma}\right)$, $\hat{C}_n^{Geo}$ and $\sigma^2\left(\underline{\eta}\right)$ are computed by the navigation algorithm.

Expression of Euler angles covariance from error vector covariance

The covariance of vector $\underline{\eta}$ is related to the covariance of the roll, pitch and yaw variances as follows :

$$\sigma^2\begin{pmatrix}\delta R\\ \delta T\\ -\delta A\end{pmatrix} = F\sigma^2\begin{pmatrix}v_x\\ v_y\\ v_z\end{pmatrix}F^t$$

where

$$F = \begin{pmatrix} -\dfrac{\cos\hat{A}}{\cos\hat{T}} & \dfrac{\sin\hat{A}}{\cos\hat{T}} & 0 \\ -\sin\hat{A} & -\cos\hat{A} & 0 \\ -\tan\hat{T}\cos\hat{A} & \tan\hat{T}\sin\hat{A} & -1 \end{pmatrix}$$

IXSEA ICCB1

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard:
- Data sent: Status, Heading , Roll, Pitch, Horizontal speed over ground, Checksum
- Data frame: the frame contains **7 fields - 15 bytes**. MSB are sent first.

Message <F0><F1><F2>…..<F6>			
Field 0	Byte 0	0x02	Start of sentence
Field 1	Byte 1	Status	Status byte (see table below)
Field 2	Bytes 2 to 4	Heading	Unsigned 24 bits integer 2^{24} = 360° LSB = 0.00002146°
Field 3	Bytes 5 to 7	Roll	Signed 24 bits integer +/-2^{23} = +/-180° Sign “+” when port side up LSB = 0.00002146°
Field 4	Bytes 8 to 10	Pitch	Signed 24 bits integer +/-2^{23} = +/-180° **Warning:** Opposite sign of OCTANS usual convention Sign “+” when bow up LSB = 0.00002146°
Field 5	Bytes 11 to 12	Horizontal speed norm over ground	Unsigned 16 bits integer LSB= 1 cm/s
Field 6	Bytes 13 to 14	Checksum (CRC16-CCITT)	Computed on bytes 1 to 12

The table below details status byte bit definition according to OCTANS System status byte tables (see Table 6 and Table 7) and OCTANS User status bit table (see Table 8):

Status byte bit index	Description	Corresponding System or User status bits
0	‘1’ = Data is invalid ‘0’ = Data is valid	User status bits 1 or 2 or 27
1	‘1’ = Initial alignment ‘0’ = End of initial alignment	User status bit 5
2	‘1’ = Fine alignment in progress ‘0’ = End of fine alignment	N/A
3	‘1’ = Internal sensor error ‘0’ = Internal sensor OK	User status bits 15 or 28
4	‘1’ = Algorithm error ‘0’ = Algorithm OK	User status bits 1 or 2 or 27
5	‘1’ = Input stream error ‘0’ = Input stream OK	System status 1 bits 0, 1, 2, 3, 4, 5
6	‘1’ = Output stream error ‘0’ = Output stream OK	System status 1 bits 16, 17, 18, 19, 20, 21
7	N/A	

IXSEA TAH

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: NMEA 0183 Output
- Data sent: Roll, Pitch, Heading, Heave, surge, sway, linear speeds, heading rotation rate Checksum
- Data frame: This protocol has a fixed length. All data are padded with “0” to maintain fixed length of protocol.

Important

The value of the heave without lever arm is set to 0 when selecting Smart heave in the web-based user interface with this protocol for the output settings.

$PHOCT,01,hhmmss.sss,G,AA,HHH.HHH,N,eRRR.RRR,L,ePP.PPP,K,eFF.FFF, M,eHH.HHH,eSS.SSS,eWW.WWW,eZZ.ZZZ,eYY.YYY,eXX.XXX,eQQQ.QQ*hh	
$PHOCT	is the header
01	is the protocol version identifier
hhmmss.sss	is the UTC valid time of observations hh is the local zone hours (from 00 to 23 hours) mm is the local zone minutes (from 00 to +59) ss.sss is the local zone seconds (from 00.000 to +59.999)
G	is UTC Time status: T=Valid E=Invalid (*)
AA	is the OCTANS latency for heading, roll, pitch AA= 03 (OCTANS IV) AA= 25 (OCTANS III) (data latency in ms to be used if UTC time of observations is not used) (**)
HHH.HHH	is the true heading in degree (from 000.000 to 359.999)
N	is the True Heading status: T=Valid E=Invalid I=Initializing
eRRR.RRR	is the Roll in degree (e= +/-, positive if port side up) from -180.000 to +180.000
L	is the Roll status: T=Valid E=Invalid I=Initializing
ePP.PPP	is the Pitch degree (e= +/-, positive if bow down), from –90.000 to +90.000
K	is the Pitch status: T=Valid E=Invalid I=Initializing
eFF.FFF	is the Heave without Lever arms applied in meters

$PHOCT,01,hhmmss.sss,G,AA,HHH.HHH,N,eRRR.RRR,L,ePP.PPP,K,eFF.FFF, M,eHH.HHH,eSS.SSS,eWW.WWW,eZZ.ZZZ,eYY.YYY,eXX.XXX,eQQQ.QQ*hh	
	(e= +/-, positive up) from -99.999 to +99.999
M	is the Heave status (also used for surge, sway & speed) : T=Valid E=Invalid I=Initializing
eHH.HHH	is the Heave with Chosen lever arms applied in meters (e= +/-, positive up) from –99.999 to +99.999
eSS.SSS	is the Surge with Lever arms applied in meters (e= +/-) from –99.999 to +99.999
eWW.WWW	is the Sway with Lever arms applied in meters (e= +/-) from –99.999 to +99.999
eZZ.ZZZ	is the Heave speed with Lever arms in meters/s (e= +/-) from –99.999 to +99.999
eYY.YYY	is the Surge speed with Lever arms in meters/s (e= +/-) from –99.999 to +99.999
eXX.XXX	is the Sway speed with Lever arms in meters/s (e= +/-) from –99.999 to +99.999
eQQQQ.QQ	is the heading rate of turns in degree/minute (e= +/-) from –9999.99 to +9999.99
hh	is the NMEA checksum: hexadecimal encoded XOR of all bytes excluding the starting character '$' and the stop one '*

(*) UTC time is valid (G=T) if both PPS pulse and &ZDA telegram are received and valid. If either PPS or ZDA telegram are not received or valid, UTC time flag is invalid : G=E.

(**)The attitude and heading latency of data is as follows
OCTANS: 2.5 ms +/-100 µs rounded to 3 ms in the protocol.

(***) Heave is output without lever arm (field **eFF.FFF)** and Heave with chosen lever arm (Primary, A, B, C) (field **eHH.HHH).**

JAMSTEC/KAIKOU

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output JAMSTEC Kaikou proprietary protocol
- Data sent: Heading, Roll, Pitch, Heave, Linear accelerations, Roll speed, Pitch speed, Heading speed, Status
- Data frame: The frame contains 24 bytes in binary format with an header and an “end of frame” fields.

Message	00 90 RRRR PPPP hhhh HHHH X1X1 X2X2 X3X3 SRSR SPSP SHSH SS 91		
Byte 0	0x00	Header LSB	
Byte 1	0x90	Header MSB	
Byte 2	0xRRRR	Roll LSB	Roll ± 180° LSB: $180°/2^{15}$ = 0.00549° Sign “+” when port up
Byte 3		Roll MSB	
Byte 4	0xPPPP	Pitch LSB	Pitch ± 180° LSB: $180°/2^{15}$ = 0.00549° Sign “+” when bow up Warning: Opposite sign of Octans usual convention
Byte 5		Pitch MSB	
Byte 6	0xhhhh	Heave LSB	Heave ± 327 m LSB: $327/2^{15}$ = 0.00997m Sign “+” when Octans goes down Warning: Opposite sign of Octans usual convention
Byte 7		Heave MSB	
Byte 8	0xHHHH	Heading LSB	Heading 0° to 360° LSB: $360°/2^{16}$ = 0.00549°
Byte 9		Heading MSB	
Byte 10	0xX1X1	XB_{V1B} acceleration LSB	XB_{V1B} acceleration ± 3.0g LSB: $3.0/2^{15}$ = 91.6 µg
Byte 11		XB_{V1B} acceleration MSB	
Byte 12	0xX2X2	XB_{V2B} acceleration LSB	XB_{V2B} acceleration ± 3.0g LSB: $3.0/2^{15}$ = 91.6 µg Warning: Opposite sign of Octans usual convention
Byte 13		XB_{V2B} acceleration MSB	

Message	00 90 RRRR PPPP hhhh HHHH X1X1 X2X2 X3X3 SRSR SPSP SHSH SS 91		
Byte 14	0xX3X3	XB_{V3B} acceleration LSB	XB_{V3B} acceleration ± 3.0g LSB: 3.0/2P15P = 91.6 µg Warning: Opposite sign of Octans usual convention
Byte 15		XB_{V3B} acceleration MSB	
Byte 16	0xSRSR	Roll speed LSB	Roll speed ± 60°/s LSB : 60/2P15P = 0. 00183 °/s
Byte 17		Roll speed MSB	
Byte 18	0xSPSP	Pitch speed LSB	- Pitch speed ± 60°/s LSB : 60/2P15P = 0.00183 °/s Warning: Opposite sign of Octans usual convention
Byte 19		Pitch speed MSB	
Byte 20	0xSHSH	Heading speed MSB	heading speed ± 60°/s LSB : 60/2P15P = 0. 00183 °/s Warning: Opposite sign of Octans usual convention
Byte 21		Heading speed MSB	
Byte 22	0xSS	Status	0xFF ⇒ OK 0xAA ⇒ alignment 0x00 ⇒ error
Byte 23	0x91	End of frame	

Each data is “two complemented” coded except Heading.

MAHRS

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: ASCII standard
- Data sent: Status, Roll, Pitch, Heading, Speed, Heave, Surge, Sway, Time
- Each field is separated by <Space> Character. Frame ended with <CR><LF>
- Fix length message : **56 bytes in ASCII format**

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

:S<SP>MRRRR<SP>MPPPP<SP>HHHHH<SP>MSSSS<SP>MEEEE<SP>MUUUU<SP>MWWWW <SP>hhmmss.ss <CR><LF>			
where:	**:**	Header character	0x3A
	S	Status	'h' for alignment mode[Note 1] 'H' for nominal mode[Note 3] 'f' GPS Aided mode & alignment mode[Note 2] 'F' GPS Aided mode & nominal mode[Note 4]
	<SP>	Space character	0x20
	MRRRR	Roll	Roll ± 90° (i.e.: -8551=-85.51°) Unit : 0.01° M is the space character when port up M is the minus character when port down
	<SP>	Space character	0x20
	MPPPP	Pitch	Pitch ± 90° (i.e.: 7223=+72.23°) Unit : 0.01° M is the space character when bow up M is the minus character when bow down **Warning:** Opposite sign of iXBlue usual convention
	<SP>	Space character	0x20
	HHHHH	Heading	Heading 0 to 359.99° (i.e.: 18210=+182.10°) Unit : 0.01°
	<SP>	Space character	0x20
	MSSSS	External Speed (GPS speed)	Longitudinal speed: 0 to 99.99 m/s (i.e.: 5542=+55.42 m/s) Unit : 0.01 m/s Speed cannot be negative although there is space for a minus sign. Also, when speed not available the SSSS is replaced by "----" (four minus signs).
	<SP>	Space character	0x20

:S<SP>MRRRR<SP>MPPPP<SP>HHHHH<SP>MSSSS<SP>MEEEE<SP>MUUUU<SP>MWWWW <SP>hhmmss.ss <CR><LF>			
	MEEEE	Heave	Heave: ± 99 m (i.e.: -0756=-7.56 m) Unit: 1 cm M is the space character when system goes up M is the minus character when system goes down
	<SP>	Space character	0x20
	MUUUU	Surge	Surge: ± 99 m (i.e.: 0322=+3.22 m) Unit: 1 cm M is the space character when system goes forward M is the minus character when system goes backward
	<SP>	Space character	0x20
	MWWWW	Sway	Sway: ± 99 m (i.e.: 0022=+0.22 m) Unit: 1 cm M is the space character when system starboard M is the minus character when system port
	<SP>	Space character	0x20
	hhmmss.ss	GPS Time	Copy of last GGA UTC Time If GGA UTC time is not received (after timeout= 3 s) field will be fixed to “888888.88” default value.
	<CR><LF>	End of frame	0x0D 0x0A

Note 1 : System status 2 bit 2 (GPS1 detected) or bit 3 (GPS2 detected) set to 0 and Algo status bit 0 (Alignment) set to 1

Note 2 : System status 2 bit 2 (GPS1 detected) or bit 3 (GPS2 detected) set to 1 and Algo status bit 1 (Alignment) set to 1

Note 3 : System status 2 bit 2 (GPS1 detected) or bit 3 (GPS2 detected) set to 0 and Algo status bit 0 (Alignment) set to 0

Note 4 : System status 2 bit 2 (GPS1 detected) or bit 3 (GPS2 detected) set to 1 and Algo status bit 1 (Alignment) set to 0

MDL (trim cube)

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output MDL ASCII standard
- Data sent: Heading, Roll, Pitch
- Data frame:

HhhhhP±xxxxR±yyyy<CR><LF>

where: hhhh is the heading in degrees multiplied by 10

xxxx is the pitch in degrees multiplied by 100

yyyy is the roll in degrees multiplied by 100

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

MDL 2

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output MDL ASCII standard
- Data sent: Heading, Roll, Pitch, Gyro status
- Data frame:

HhhhhP±xxxxR±yyyyQ<CR><LF>

where: hhhh is the heading in degrees multiplied by 10

xxxx is the pitch in degrees multiplied by 100

yyyy is the roll in degrees multiplied by 100

Q is the gyro status as follows:

M Gyro alignment mode

E Gyro reports good data

N reports invalid data

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

MINIFOG OTG MSG8

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: binary protocol
- Data sent: Heading, Roll, Pitch, Heading rate, Roll rate, Pitch rate, Gyro status
- Data frame:

MiniFOG_OTG_MSG8 (OceanTools Gyro & Rotation Rates)			
Heading delimiter	Byte 1	Value : 'H'	Delimiters to identify the start of heading data
Heading	Byte 2 to 5	Value : In degrees, range in [0°:360°[	Heading of the ship, LSB = 0.1°
Pitch delimiter	Byte 6	Value : 'P'	Delimiters to identify the start of Pitch data
Pitch Sign	Byte 7	Value :'+' or '-'	Sign of Pitch value
Pitch	Byte 8 to 11	Value : in degrees, positive bow up, inside [-90°:90°]	Pitch of the ship, LSB = 0.1°
Roll delimiter	Byte 12	Value : '+'	Delimiters to identify the start of Roll data
Roll Sign	Byte 13	Value :'+' or '-'	Sign of Roll value
Roll	Byte 14 to 17	Value : in degrees, positive port up, inside [-90°:90°]	Roll of the ship, LSB = 0.1°
Heading rate delimiter	Byte 18	Value : 'X'	Delimiters to identify the start of Heading rate data
Heading rate sign	Byte19	Value : '+' or '-'	Sign of Heading rate value
Heading rate	Byte 20 to 23	Value : In degrees/second, range]-100°/s:100°/s[	Heading rate of the ship, LSB = 0.01 °/s
Pitch rate delimiter	Byte 24	Value : 'Y'	Delimiters to identify the start of Pitch rate data
Pitch rate sign	Byte 25	Value : '+' or '-'	Sign of Pitch rate value
Pitch rate	Byte 26 to 29	Value : in degrees/second, range]-100°/s:100°/s[	Pitch rate of the ship LSB = 0.01 °/s
Roll rate delimiter	Byte 30	Value : 'Z'	Delimiters to identify the start of Pitch rate

MiniFOG_OTG_MSG8 (OceanTools Gyro & Rotation Rates)			
Roll rate sign	Byte 31	Value : '+' or '-'	Sign of Roll rate value
Roll rate	Byte 32 to 35	Value : in degrees/second, range]-100°/s:100°/s[	Roll rate of the ship LSB = 0.01 °/s
Gyro Status	Byte 36	Value : 'E' or 'D'	Status of Gyro is defined with the help of user status, see Note1
End point	Byte 37	Value : <CR>	Carriage return
	Byte 38	Value : <LF>	Line feed

Note 5: Gyro status shall be:
'E' when word "HRP invalid" is "false" (available on IXBLUE "User status" message)
Otherwise it shall be 'D'.

Example:
A packet reading "***H3214P-0132R+0012X+0012Y+0000Z-0085E<cr><lf>***"
Wild be : ***Heading*** 321.4°, ***Pitch*** 13.2° Up, ***Roll*** 1.2° to Starboard.
Heading rotation 0.12°/sec increasing heading, ***Pitch rotation*** 0°/sec pitch, ***Roll rotation*** 0.85°/sec to Port.

MOTION SENSOR 1

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Roll, Pitch, Heave, Surge, Sway, Status, Date and time (1)
- Data frame: It is composed of
  - NMEA **$HEHDT** Frame see section 3.2.2.6
  - NMEA **$PHTRO** Frame see section 3.2.1.14
  - NMEA **$PHLIN** Frame see section 3.2.1.9
  - NMEA **$PHINF** Frame see section 3.2.1.9

(1) And, If ZDA option selected:

- NMEA **$PHZDA** Frame see section 3.2.1.5

MOTION SENSOR 2

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Heading, Roll, Pitch, Heave, Surge, Sway, Status, Linear Speeds, Date and time (1)
- Data frame: It is composed of
  - NMEA **$HEHDT** Frame see section 3.2.2.6
  - NMEA **$PHTRO** Frame see section 3.2.1.14
  - NMEA **$PHLIN** Frame see section 3.2.1.9
  - NMEA **$PHSPD** Frame see section 3.2.1.12
  - NMEA **$PHINF** Frame see section 3.2.1.9

(1) And, If ZDA option selected:

- NMEA **$PHZDA** Frame see section 3.2.1.5

MOTION SENSOR 3

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Heave, Surge, Sway, Status, Linear Speeds, Status, Date and Time (1)
- Data frame: It is composed of
  - ❑ NMEA **$PHLIN** Frame see section 3.2.1.9
  - ❑ NMEA **$PHSPD** Frame see section 3.2.1.12
  - ❑ NMEA **$PHINF** Frame see section 3.2.1.9

(1) And, If ZDA option selected:

- ❑ NMEA **$PHZDA** Frame see section 3.2.1.5

MOTION SENSOR 4

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Heading, Roll, Pitch
  Heave, Surge, Sway with and without lever arms compensation.
  Linear speeds with lever arms compensation.
  Status, Date and time (1)

Important

The value of the heave without lever arm is set to 0 when selecting Smart heave in the web-based user interface with this protocol for the output settings.

- Data frame: It is composed of
  - NMEA **$HEHDT** Frame see section 3.2.2.6
  - NMEA **$PHPOS** Frame see section 3.2.1.10
  - NMEA **$PHVIT** Frame see section 3.2.1.15
  - NMEA **$PHTRO** Frame see section 3.2.1.14
  - NMEA **$PHINF** Frame see section 3.2.1.9

(1) And, If ZDA option selected:

- NMEA **$PHZDA** Frame see section 3.2.1.5

NMEA PRDID

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183.
- Data sent: Heading, Roll, Pitch, Date and time (1)
- Data frame:

$PRDID,sxxx.xx,syyy.yy,zzz.zz,*hh<CR><LF>

where: xxx.xx is the pitch in degrees with sign s=+ when port up and s=- when port down

Warning: opposite sign from OCTANS convention

yyy.yy is the roll in degrees with sign s=+ when bow up and s=- when bow down

zzz.zz is the heading

hh is the checksum

$--ZDA,hhmmss.ss,dd,mm,yyyy,hh,mm*hh<CR><LF> (1)

where: hhmmss.ss is UTC time synchronized with the last PPS frame received

dd is the UTC day (from 01 to 31)

mm is the UTC month (from 01 to 12)

yyyy is the UTC year

hh is the local zone hours (from 00 to ± 13 hours)

mm is the local zone minutes (from 00 to +59)

(1) If ZDA option selected.

OCTANS STANDARD

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible
- Data sent: Heading, Roll, Pitch, Heave, Surge and Sway, Linear speeds, Vessel speed and latitude compensation values, Status, Date and Time (1)

Important

The value of the heave without lever arm is set to 0 when selecting Smart heave in the web-based user interface with this protocol for the output settings.

- Data frame: It is composed of

Standard frames:

- NMEA **$HEHDT** Frame see section 3.2.2.6
- NMEA **$HETHS** Frame see section 3.2.2.8
- NMEA **$PHTRO** Frame see section 3.2.1.14
- NMEA **$PHLIN** Frame see section 3.2.1.9
- NMEA **$PHSPD** Frame see section 3.2.1.12
- NMEA **$PHCMP** Frame see section 3.2.1.6
- NMEA **$PHINF** Frame see section 3.2.1.9

(1) And, If ZDA option selected: Time and Date

- NMEA **$PHZDA** Frame see section 3.2.1.5

Additional frames sent on the repeater port:

- NMEA **$TIME** Frame see section 3.2.1.19
- NMEA **$PHZDA** Frame see section 3.2.1.5
- NMEA **$STSYS** Frame see section 3.2.1.18
- NMEA **$STALG** Frame see section 3.2.1.16
- NMEA **$STSOR** Frame see section 3.2.1.17
- NMEA **$ST_HL** Frame see section 3.2.1.16

PAHRS

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Data sent: Heading, pitch, roll, heading rate, pitch rate, roll rate, polar heading, polar heading rate and OCTANS status.
The data field delimiter is the comma character.

Data frame:

$PBAE,AHRS,H.HHH,P.PPP,R.RRR,h.hhh,p.ppp,r.rrr,A.AAA,B.BBB,ssssssss,ttttttt,uuuuuuuu*hh<CR><LF>		
$PBAE	Start of proprietary sentence and Manufacturer ID	
AHRS	Sentence identifier	
H.HHH	Heading in degrees 0° to 359.999° Positive and increasing when bow turns starboard.	**Note 6**
P.PPP	Pitch in degrees ±90.000° Positive for front side/bow up	**Note 6, Note 7**
R.RRR	Roll in degrees ±180.000 Positive for left side/port up	**Note 6, Note 7**
h.hhh	Heading rate in degrees/sec ±100.000°/sec. Positive when heading angle increasing	**Note 6**
p.ppp	Pitch rate in degrees/sec ±100.000°/sec. Positive when pitch angle increasing	**Note 6**
r.rrr	Roll rate in degrees/sec ±100.000°/sec. Positive when roll angle increasing	**Note 6**
A.AAA	Polar Heading in degrees 0° to 359.999° Positive and increasing when bow turns starboard	**Note 6**
B.BBB	Polar Heading rate in degrees/sec ±100.000°/sec. Positive when polar heading angle increasing	**Note 6**
ssssssss	AHRS User Status	**8 ASCII characters representing the 32-bit OCTANS user status word encoded as 8 hexadecimal characters.**
ttttttt	AHRS System Status 1	**8 ASCII characters representing the 32-bit OCTANS System status 1 word encoded as 8 hexadecimal characters.**

$PBAE,AHRS,H.HHH,P.PPP,R.RRR,h.hhh,p.ppp,r.rrr,A.AAA,B.BBB,ssssssss,tttttttt,uuuuuuuu*hh<CR><LF>		
uuuuuuuu	AHRS System Status 2	**8 ASCII characters representing the 32-bit OCTANS System status 2 word encoded as 8 hexadecimal characters.**
*	Checksum field delimiter	
hh	Checksum field value	**Hexadecimal value of the XOR of each character in the sentence, between, but excluding $ and ***
<CR><LF>	End of sentence	

Note 6:

3 digits after the decimal point and necessary digits and minus sign before. Hence to transmit a Pitch of -10.76 degrees, the following characters -10.760 will be sent.

Note 7:

Sign convention of the roll and pitch are set to ISO Convention.

	ISO Convention
Roll > 0	for left-side / port up
Pitch > 0	for front-side / bow up

Note 8:

Null data parameter is output if that parameter is invalid.

This is defined below

if OR(Bit=5,15,27,30, 31 of OCTANS user status)= 1 then telegram output shall be:

$PBAE,AHRS,,,,,,,,,ssssssss,tttttttt,uuuuuuuu*hh<CR><LF>

POS MV GROUP111

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Standard: Binary POS MV Group 111 Aplanix proprietary protocol

Data sent: Delayed Heave, Real time heave

Data frame: The frame contains a header, 15 fields with 84 bytes in binary format. Reference document: POSMV 320 V3 Ethernet SCSI ICD 30 January 2003 POS MV GROUP111

Message <F0><F1><F2>…..<F15>				
Field 0	Byte 0 to 3	$GRP	char	Group start
Field 1	Bytes 4 to 5	111	ushort	Group ID
Field 2	Bytes 6 to 7	76	ushort	Bytes count
Field 3	Bytes 8 to 15	Time 1	double	Seconds (NOT USED)
Field 4	Bytes 16 to 23	Time 2	double	Seconds (NOT USED)
Field 5	Bytes 24 to 31	Distance tag	double	meters (NOT USED)
Field 6	Bytes 32	Time types	byte	Value: bits 0-3 (*) 0: Time 1: AHRS time 1: Time 1: GPS time (NOT USED) 2: Time 1: UTC time Value: bits 4-7 (*) 0: Time 2: AHRS time (NOT USED) 1: Time 2: GPS time (NOT USED) 2: Time 2: UTC time (NOT USED) 3: Time 2: User time (NOT USED)
Field 7	Byte 33	Distance type		Value: bits 0-3 0: N/A 1: distance (NOT USED)
Field 4	Bytes 34 to 37	Smart Heave	float	Delayed heave in meters, positive down
Field 5	Bytes 38 to 41	Smart Heave RMS	float	Delayed heave standard deviation in meters (NOT USED)

Message <F0><F1><F2>…..<F15>				
Field 6	Bytes 42 to 45	Status	ulong	Bit 0=1 : Smart heave Valid Bit1=1 : Real-Time heave Valid Bit 2 to 31 : Reserved
Field 7	Bytes 46 to 49	Real Time Heave	float	in meters, positive down
Field 8	Bytes 50 to 53	Real Time Heave RMS	float	standard deviation in meters (NOT USED)
Field 9	Bytes 54 to 61	Heave Time 1	double	Delayed heave time seconds
Field 10	Bytes 62 to 69	Heave Time 2	double	(NOT USED)
Field 11	Bytes 70 to 73	Rejected IMU data count	ulong	(NOT USED)
Field 12	Bytes 74 to 77	Out of range IMU data count	ulong	(NOT USED)
Field 13	Bytes 78 to 79	Pad	byte	Set to 0
Field 14	Bytes 80 to 81	Checksum	ushort	16 bit sum of all data in the data group: byte 34 to 103
Field 15	Bytes 82 to 83	$#	char	Group end

(*) Only AHRS time or UTC time will be flagged. UTC time is flagged when AHRS time synchronization with GPS is valid (ZDA or ZDA+PPS valid). It is highly recommended to use PPS pulse for accurate timing.

POSTPROCESSING

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Please note that this protocol is not detailed in this documentation.

To get more information about this protocol, contact iXBlue.

PSXN019

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible with Seatex MRU system
- Data sent: Roll, Pitch, Heave, Date
- Data frame: Contains 1 NMEA data frames: the PSXN frame hereafter

$PSXN,S,ddd,X1,X2,X3,X4,,*hh<CR><LF>		
S	Status S = 10 for valid data S = 11 for invalid *d*ata	**Note 1**
ddd	User identification = 019	**Three** fixed Ascii characters
X1	Roll in radian Positive for left-port side up	**Note 2**
X2	Pitch in radian Positive for front side-bow up **Warning:** Opposite sign of OCTANS usual convention	**Note 2**
X3	Heave in meters Positive when OCTANS goes up	**Note 2**
X4	Date in second since 1 January 1970 00:00:00 (Epoch Time)	**Note 3** **Note 4**
hh	Checksum	

Note 1 S = 11 when one of the OCTANS User status HRP_NOT_VALID or FAILURE_MODE or DEGRADED_MODE is set.

S = 10 otherwise

Note 2 X1, X2, X3 are written as floats in scientific format, with 3 digits after the decimal point and the number of digits before the decimal point depending of value (example : –2.564e01)

Note 3 Integer format

Note 4 Epoch Time needs UTC synchronization. Otherwise it starts from 0 at system start-up.

PTNTHPR

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: ASCII
- Data sent: Heading, Roll, Pitch, Validity Status
- Data frame:

$PTNTHPR,h.h,a,p.p,b,r.r,c*hh<CR><LF>		
$PTNTHPR,	Start of proprietary sentence	
h.h,	Heading in degrees 0° to 360° Positive and increasing when bow turns starboard.	**Note 1**
a,	Heading status	**Note 2**
p.p,	Pitch in degrees ±90° Positive for front side-bow down	**Note 1**
b,	Pitch status	**Note 2**
r.r,	Roll in degrees ±180° Positive for left side-port side up	**Note 1**
c	Roll status	**Note 2**
*	Checksum field delimiter	
hh	Checksum field value	Hexadecimal value of the XOR of each character in the sentence, between, but excluding $ and *
<CR><LF>	End of sentence	

Note 1: 1 digit after the decimal point and necessary digits and minus sign before.

Note 2: Status table of HMR3000 and corresponding OCTANS status table are described below:

Since we cannot dissociate alarm for heading, roll and pitch independently, the alarm status will be identical for the 3 physical parameters heading, roll and pitch.

If the status field indicates low or high alarm, then the heading, roll and pitch fields will be null ",,".

Status letter	HMR3000	OCTANS User status	
L	low alarm	Bit 30= 1	Degraded mode
M	low warning	bit 7 or bit 16 or bit 17 or bit 18 or bit 19 or Bit 20 or Bit 21 or Bit 22 or Bit 23	DSP overload or Input A,B,R Error or CPU overload or OUTPUT A,B,C,R full
N	normal	Bit 27=0 & Bit 31= 0	Heading/Roll/Pitch valid and No Failure mode

Status letter	HMR3000	OCTANS User status	
O	high warning	Bit 3= 1 or Bit 15= 1	Heave init or Sensor Error
P	high alarm	Bit 27 or Bit 31 = 1	Heading/Roll/Pitch Invalid or Failure mode
C	Tuning analog circuit	N/A	

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

SEAPATH

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Standard: Binary PFreeHeave® Kongsberg Seatex proprietary protocol

Data sent: Time, Latitude, Longitude, Altitude, Heave, North Velocity, East Velocity, Down Velocity, Roll, Pitch, Heading, Roll Rate, Pitch Rate, Yaw Rate, Status.

Data frame: 18 fields - 42 bytes. All multi-byte data is sent MSB first.

Message <F0><F1><F2>…..<F17>			
Field 0	Byte 0	'q'	Synchronization byte
Field 1	Bytes 1 to 4	System time (Synchro with GPS time)	32 bits integer (seconds)
Field 2	Byte 5	System time (Synchro with GPS time) Fraction of seconds	Unsigned 8 bits integer 0.01 seconds (0 to 99)
Field 3	Bytes 6 to 9	Latitude (Note 2) '+': North of equator	Signed 32 bits integer +/-2^{31} = +/- 180°
Field 4	Bytes 10 to 13	Longitude (Note 2) '+': East of Greenwich	Signed 32 bits integer +/-2^{31} = +/- 180°
Field 5	Bytes 14 to 17	Altitude (Note 2)	Signed 32 bits integer (centimeters)
Field 6	Bytes 18 to 19	Heave "+" when down	Signed 16 bits integer (centimeters) **Warning:** Opposite sign of GYRO usual convention
Field 7	Bytes 20 to 21	North Velocity	Signed 16 bits integer (centimeters/second)
Field 8	Bytes 22 to 23	East Velocity	Signed 16 bits integer (centimeters/second)
Field 9	Bytes 24 to 25	Down Velocity	Signed 16 bits integer (centimeters/second)
Field 10	Bytes 26 to 27	Roll Sign "+" when port side up	Signed 16 bits integer +/-2^{15} = +/- 180°
Field 11	Bytes 28 to 29	Pitch Sign "+" when bow up	Signed 16 bits integer +/-2^{15} = +/- 180° **Warning:** Opposite sign of GYRO usual convention
Field 12	Bytes 30 to 31	Heading	Unsigned 16 bits integer 2^{15} = 180°
Field 13	Bytes 32 to 33	Roll rate (Note 1) Positive when roll increases	Signed 16 bits integer +/-2^{15} = +/-180°/s

Field 14	Bytes 34 to 35	Pitch rate (Note 1) Positive when pitch increases	Signed 16 bits integer +/-2^{15} = +/-180°/s **Warning:** Opposite sign of GYRO usual convention
Field 15	Bytes 36 to 37	Heading rate (Note 1) Positive when heading increases	Signed 16 bits integer +/-2^{15} = +/-180°/s
Field 16	Bytes 38 to 39	Status (Note 3)	0x00AA : Invalid data 0x0000 : Data valid
Field 17	Bytes 40 to 41	Checksum (CRC) (Note 4)	Computed on bytes 1 to 39

Note 1: on dual use products, rotation rate resolution is limited to 3.6 deg/h to comply with export regulation

Note 2: position and altitude are duplicated from GPS input

Note 3: data is flagged as invalid when HRP invalid is flagged (ALIGNMENT or HEADING ERROR bits in gyrocompass algorithm status 1)

Note 4: CRC is computed as follows:

```
unsigned short blkcrc(unsigned char* bufptr, unsigned len)
{
unsigned char i;
unsigned short data;
unsigned short crc = 0xffff;
        if (len == 0)
                return ~crc;
        do
        {
                for (i = 0, data = (unsigned short)(0xff & *bufptr++); i < 8; i++, data >>= 1)
                {
                        if ((crc & 0x0001) ^ (data & 0x0001))
                        {
                                crc = (crc >> 1) ^ 0x8408;
                        }
                        else
                        {
                                crc >>= 1;
                        }
                }
        } while (--len);

        crc = ~crc;
        data = crc;
        crc = (crc << 8) | ((data >> 8) & 0xff);

        return crc;
}
```

SEATEX DHEAVE

This protocol is not available for all products.
Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Standard:	Binary PFreeHeave® Kongsberg Seatex proprietary protocol
Data sent:	Smart Heave™ and Time validity of data.
Data frame:	The frame contains a header, 6 fields with 13 bytes in binary format. The signed integers are represented as two-complement numbers. For multi-byte elements, the MSB (Most Significant Byte) is transmitted first. The PFreeHeave® output is delayed by a few minutes due to the processing.

Message <F0><F1><F2>…..<F6>				
Field 0	Byte 0	0xAA	Unsigned	Header
Field 1	Byte 1	0x52	Unsigned	Header
Field 2	Bytes 2 to 5	Time (*)	Integer	In seconds
Field 3	Bytes 6 to 7	0 to 9999	Unsigned	Time, fraction of second: 0.0001 s
Field 4	Bytes 8 to 9	Smart Heave™	Integer	Delayed heave, in centimeters, positive down
Field 5	Byte 10	Status word	Bit-fields	0 : Heave is valid 1 : Heave is invalid
Field 6	Bytes 11 to 12	Checksum (**)	Unsigned	See Note 1

(*) The time fields contain time of validity of the data. The integer second part of time is counted from 1970-01-01 UTC time, ignoring leap seconds.

((**) Checksum is calculated as a 16-bit Block Cyclic Redundancy Check of all bites between, but not including the Header and Checksum fields. The CRC algorithm is describes in Note 1.

Note 1: Cyclic redundancy check algorithm

The 16-bit Block Cyclic Redundancy Check algorithm used to calculate the checksum in some formats is described in C and Fortran source code below.

C code

```
#define POLY 0x8408
unsigned short blkcrc(
unsigned char *bufptr, /* message buffer */
unsigned long len /* number of bytes */
)
{
unsigned char i;
unsigned short data;
unsigned short crc = 0xffff;
if (len == 0L) {
return ~crc;
}
do {
for (i=0, data = (unsigned short) (0xff & *bufptr++);
i < 8;
i++, data >>= 1) {
if ((crc & 0x0001) ^ (data & 0x0001)) {
crc = (crc >> 1) ^ POLY;
} else {
crc >>= 1;
}
}
} while (--len);
crc = ~crc;
data = crc;
crc = (crc << 8) | ((data >> 8) & 0xff);
return crc;
}
```

SHINKAI 6500 HDT

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output JAMSTEC Shinkai 6500 proprietary protocol
- Data sent: Heading, Roll, Pitch
- Data frame: The frame contains 18 bytes in the following format

Message		
Byte 0	0x02	Binary, Frame header (STX)
Byte 1	0x30 to 0x39	Heading: ASCII 0 (0x30) to 9 (0x39), Number of hundreds in heading
Byte 2	0x30 to 0x39	Heading: ASCII 0 (0x30) to 9 (0x39), Number of tens in heading
Byte 3	0x30 to 0x39	Heading: ASCII 0 (0x30) to 9 (0x39), Number of units in heading
Byte 4	0x30 to 0x39	Heading: ASCII 0 (0x30) to 9 (0x39), First decimal place (10^{-1}) in heading
Byte 5	0x30 to 0x39	Heading: ASCII 0 (0x30) to 9 (0x39), Second decimal place(10^{-2}) in heading
Byte 6	0x20 or 0x2B	Roll sign "(space) " or "-" : ASCII "(space)"(0x20) "-" (0x2B), Sign "- " when port down
Byte 7	0x30 to 0x39	Roll: ASCII 0 (0x30) to 9 (0x39), Number of tens in roll
Byte 8	0x30 to 0x39	Roll: ASCII 0 (0x30) to 9 (0x39), Number of units in roll
Byte 9	0x30 to 0x39	Roll: ASCII 0 (0x30) to 9 (0x39), First decimal point in roll
Byte 10	0x30 to 0x39	Roll: ASCII 0 (0x30) to 9 (0x39), Second decimal point in roll
Byte 11	0x20 or 0x2B	Pitch sign "(space) " or "-" : ASCII "(space)"(0x20) "-" (0x2B) Sign "- " when bow down Warning : opposite convention / OCTANS convention
Byte 12	0x30 to 0x39	Pitch: ASCII 0 (0x30) to 9 (0x39), Number of tens in pitch
Byte 13	0x30 to 0x39	Pitch: ASCII 0 (0x30) to 9 (0x39), Number of units in pitch
Byte 14	0x30 to 0x39	Pitch: ASCII 0 (0x30) to 9 (0x39), First decimal place (10^{-1}) in pitch
Byte 15	0x30 to 0x39	Pitch: ASCII 0 (0x30) to 9 (0x39), Second decimal place (10^{-2}) in pitch
Byte 16	0x03	Binary, End of frame (ETX)
Byte 17		BCC, Block Check Character: Binary, XOR of the 16 bytes 1 to 16

For example: When heading 359.12 Roll +35.41 and Pitch -12.52, Data frame would be as follows;

SIMRAD EM

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output Simrad proprietary protocol
- Data sent: Heading, Roll, Pitch, Heave, Status
- Data frame:

The frame contains 10 bytes in binary format.

Message	SS 90 RRRR PPPP hhhh HHHH		
Byte 0	0xSS	Sync byte Sensor status	0x90 ⇒ OK 0x9A ⇒ alignment
Byte 1	0x90	Sync byte	
Byte 2	0xRRRR	Roll LSB	Roll ± 180° LSB : 0.01° Sign "+" when port up
Byte 3		Roll MSB	
Byte 4	0xPPPP	Pitch LSB	Pitch ± 180° LSB : 0.01° Sign "+" when bow up Warning: Opposite sign of Octans usual convention
Byte 5		Pitch MSB	
Byte 6	0xhhhh	Heave LSB	Heave ± 10 m LSB : 0.01 m Sign "+" when Octans goes up
Byte 7		Heave MSB	
Byte 8	0xHHHH	Heading LSB	Heading 0° to 360° LSB : 0.01°
Byte 9		Heading MSB	

Each data is "two complemented" coded except Heading.

STOLT OFFSHORE

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible with Seatex MRU system
- Data sent: Heading, Roll, Pitch, Roll speed, Pitch speed, Heading speed

$PSXN,S,ddd,X1,X2,X3,X4,X5,X6,*hh<CR><LF>		Note 3
S	Status S = 10 for data valid S = 11 for data invalid	Note 1
ddd	User identification = 014	**Three** fixed Ascii characters
X1	Pitch in radian **Warning:** Opposite sign of OCTANS usual convention	Note 2
X2	Roll in radian	Note 2
X3	Heading in radian	Note 2
X4	Pitch speed in radian/second, positive when PSXN pitch value increases **Warning:** Opposite sign of OCTANS usual convention	Note 2
X5	Roll speed in radian/second, positive when roll increases	Note 2
X6	Heading speed in radian/second, positive when heading decreases	Note 2
hh	Checksum	Note 2

Note 1: S = 10 when OCTANS User status HRP_NOT_VALID is set to 0
S = 11 when OCTANS User status HRP_NOT_VALID is set to 1

Note 2: x1, x2, x3, x4, x5, x6 are written as floats in scientific format
(for example –2.5648e01)

Note 3: Telegram sample:

$PSXN,11,014,-4.000e-03,-1.350e-02,1.254e-01,0.000e+00,0.000e+00,0.000e+00,*0B<CR><LF>

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

TAH BIN

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Data frame: The frame contains 17 fields – 59 bytes. For data coded on several bytes, the bytes are sent MSB byte first.

Message <F0><F1><F2>…..<F16>			
Field 0	Byte 0	ID	Fixed value = 42 (0x2A)
Field 1	Byte 1	Message Length	Fixed value = 59 (0x3B)
Field 2	Bytes 2-5	Status	32 bits of the OCTANS user status
Field 3	Bytes 6-9	Time	Unsigned 32 bits integer; [0 to 86400 s] LSB=20.1us System time or UTC time if synchronized.
Field 4	Bytes 10-13	Heading	IEEE Float 32 bits; [0 to 360 deg] Positive and increasing when bow turns starboard.
Field 5	Bytes 14-17	Roll	IEEE Float 32 bits; ±90 deg Positive for left-port side up.
Field 6	Bytes 18-21	Pitch	IEEE Float 32 bits; ±90 deg Positive for front side-bow down.
Field 7	Bytes 22-25	Heave **Note 1**	IEEE Float 32 bits; mm Positive when OCTANS goes up
Field 8	Bytes 26-29	Surge **Note 1**	IEEE Float 32 bits; mm
Field 9	Bytes 30-33	Sway **Note 1**	IEEE Float 32 bits; mm
Field 10	Bytes 34-37	Heading rate	IEEE Float 32 bits; deg/s
Field 11	Bytes 38-41	Roll rate	IEEE Float 32 bits; deg/s
Field 12	Bytes 42-45	Pitch rate	IEEE Float 32 bits; deg/s
Field 13	Bytes 46-49	Heave speed **Note 1**	IEEE Float 32 bits; mm/s
Field 14	Bytes 50-53	Surge speed **Note 1**	IEEE Float 32 bits; mm/s
Field 15	Bytes 54-57	Sway speed **Note 1**	IEEE Float 32 bits; mm/s
Field 16	Byte 58	Checksum	Integer 8 bits; XOR of all the data bytes, not including the Checksum byte

Note 1: with Lever Arm Compensation

TAH BIN SMT

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Data frame: The frame contains 17 fields – 59 bytes. For data coded on several bytes, the bytes are sent MSB byte first.

Message <F0><F1><F2>…..<F16>			
Field 0	Byte 0	ID	Fixed value = 42 (0x2A)
Field 1	Byte 1	Message Length	Fixed value = 59 (0x3B)
Field 2	Bytes 2-5	Status	32 bits of the OCTANS user status (see 2.2)
Field 3	Bytes 6-9	Time	Unsigned 32 bits integer; [0 to 86400 s] LSB=86400/(2^32-1) ≈ 20.1us System time or UTC time if synchronized.
Field 4	Bytes 10-13	Heading	IEEE Float 32 bits; [0 to 360 deg] Positive and increasing when bow turns starboard.
Field 5	Bytes 14-17	Roll	IEEE Float 32 bits; ±90 deg Positive for left-port side up.
Field 6	Bytes 18-21	Pitch	IEEE Float 32 bits; ±90 deg Positive for front side-bow down.
Field 7	Bytes 22-25	Heave (**note 1**)	IEEE Float 32 bits; mm Positive when OCTANS goes up
Field 8	Bytes 26-29	Surge (**note 1**)	IEEE Float 32 bits; mm
Field 9	Bytes 30-33	Sway (**note 1**)	IEEE Float 32 bits; mm
Field 10	Bytes 34-37	Heading rate (**note 2**)	IEEE Float 32 bits; deg/s
Field 11	Bytes 38-41	Roll rate (**note 2**)	IEEE Float 32 bits; deg/s
Field 12	Bytes 42-45	Pitch rate (**note 2**)	IEEE Float 32 bits; deg/s
Field 13	Bytes 46-49	Heave speed (**note 1**)	IEEE Float 32 bits; mm/s
Field 14	Bytes 50-53	Surge speed (**note 1**)	IEEE Float 32 bits; mm/s
Field 15	Bytes 54-57	Sway speed (**note 1**)	IEEE Float 32 bits; mm/s
Field 16	Byte 58	Checksum	Integer 8 bits; XOR of all the data bytes, not including the Checksum byte

Note 1: with Lever Arm Compensation.

Note 2: Filtered data: Uses Butterworth second order low pass filter. The default cutoff frequency is set to sampling frequency (200 Hz) / 4. The cutoff frequency is configurable using specific Web MMI command FilterConfX = Fc (where X corresponds to output port identifier and Fc the cutoff frequency 0 < Fc < 200 Hz).

TCM 1/2

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output (Trimble)TCM standard
- Data sent: Heading, Roll, Pitch
- Data frame:

Chhh.hPxx.xRyy.y*hh<CR><LF>

where: hhh.h is the heading in degrees

xx.x is the pitch in degrees

yy.y is the roll in degrees

hh is fixed to FF

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

TCM 2

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: ASCII, NMEA compliant
- Data sent: Heading, Pitch, Roll, Date and Time (1)
- Data frame:

$Chhh.hPspp.pRsrr.r*hh<CR><LF>

where: $C is a header

hhh.h is the heading, ranging from 0 to 359.9

P is a separator for pitch

spp.p is the signed pitch in degrees

s = - bow down ; s = no character when bow up

ranging from –89.9 to +90.0, with

Warning: reverse convention / standard OCTANS convention

R is a separator for roll

Srrr.r is the signed roll in degrees

s = - port down ; s = no character when port up

ranging from –179.9 to +180.0

hh is the NMEA checksum : XOR of hexa-coded ASCII characters from $ (excluded) to * (excluded)

$--ZDA,hhmmss.ss,dd,mm,yyyy,hh,mm*hh<CR><LF> (1)

where: hhmmss.ss is UTC time synchronized with the last PPS frame received

dd is the UTC day (from 01 to 31)

mm is the UTC month (from 01 to 12)

yyyy is the UTC year

hh is the local zone hours (from 00 to ± 13 hours)

mm is the local zone minutes (from 00 to +59)

(1) If ZDA option selected.

TECHSAS

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183
- Data sent: Heading, Roll, Pitch, Heave, standard deviations for Heading, Roll and Pitch, Status flags
- Data frame:

$PASHR,hhmmss.sss,H.HH,T,aR.RR,bP.PP,cD.DD,r.rrr,p.ppp,h.hhh,x,y*hh<CR><LF>		
hhmmss.sss	is the UTC of the data	
H.HH	is the heading in degrees, no sign character	2 digits after decimal point
T	is a fixed character = 'T'	
aR.RR	is the roll in degrees and a, its sign character '+' when port up, '–' when port down	2 digits after decimal point
bP.PP	is the pitch in degrees and b, its sign character '–' when bow down, '+' when bow up **Warning:** Opposite sign of OCTANS usual convention	2 digits after decimal point
cD.DD	is the heave in meters and c, its sign character '–' when OCTANS goes up, '+' when OCTANS goes down **Warning:** Opposite sign of OCTANS usual convention	
r.rrr	Roll standard deviation; Fixed value = 0.0	3 digits after decimal point
p.ppp	Pitch standard deviation; Fixed value = 0.0	3 digits after decimal point
h.hhh	Heading standard deviation; Fixed value = 0.0	3 digits after decimal point
x	is the speed or latitude aiding status flag 0 when manual speed or manual latitude used, otherwise 1	x = 0 when one of those OCTANS User status bit is set to 1 MANUAL_SPEED_USED MANUAL_LATITUDE_USED otherwise x = 1
y	is the sensor error status flag 1 when ACC or FOG error, otherwise 0	y = 1 when one of those OCTANS User status bit is set to 1 FOG_X1_ANOMALY FOG_X2_ANOMALY FOG_X3_ANOMALY ACC_X1_ANOMALY ACC_X2_ANOMALY ACC_X3_ANOMALY otherwise y = 0
hh	is the checksum	

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

TMS CCV IMBAT AHRS

This protocol is not available for all products.
Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output Thomson Marconi Sonar proprietary protocol
- Data sent: Roll, Pitch, Heave, Heading, Linear accelerations, Rotations rates, Status.
- Data frame: 13 fields - 24 bytes. LSB are sent first.

Message <F0><F1>…<F12>			
Field 0	Bytes 0 to 1	Header	Fixed value = 0x0090
Field 1	Bytes 2 to 3	Roll	+/-180° ; LSB = 180° / 2^{15} Sign "+" when port up
Field 2	Bytes 4 to 5	Pitch	+/-180° ; LSB = 180° / 2^{15} Sign "+" when bow up **Warning:** Opposite sign of PHINS usual convention.
Field 3	Bytes 6 to 7	Heave	+/-327 m ; LSB = 327m / 2^{15} Sign "+" when AHRS goes down **Warning:** Opposite sign of PHINS usual convention.
Field 4	Bytes 8 to 9	Heading	0° to 360° ; LSB = 360° / 2^{16}
Field 5	Bytes 10 to 11	XV1 acceleration*	+/-0.5 g; LSB = 0.5g / 2^{15}
Field 6	Bytes 12 to 13	-XV2 acceleration*	+/-0.5 g; LSB = 0.5g / 2^{15} **Warning:** Opposite sign of PHINS usual convention.
Field 7	Bytes 14 to 15	-XV3 acceleration*	+/-0.5 g; LSB = 0.5g / 2^{15} **Warning:** Opposite sign of PHINS usual convention.
Field 8	Bytes 16 to 17	XV1 rotation rate*	+/-20°/s; LSB = 20°/s / 2^{15}
Field 9	Bytes 18 to 19	-XV2 rotation rate*	+/-20°/s; LSB = 20°/s / 2^{15} **Warning:** Opposite sign of PHINS usual convention.
Field 10	Bytes 20 to 21	-XV3 rotation rate*	+/-20°/s; LSB = 20°/s / 2^{15} **Warning:** Opposite sign of PHINS usual convention.
Field 11	Byte 22	Status	0xFF if Ok 0xAA if Alignment 0x00 if Error
Field 12	Byte 23	End of sentence	Fixed value = 0x91

TOKIMEC PTVF

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible, Tokimec proprietary
- Data sent: Heading, Roll, Pitch, Roll speed, Pitch speed, Heading speed, Speed of the vessel, Status
- Data frame:

$PTVF,abbbbP,accccR,ddd.dT,aeee.ePR,afff.fRR,aggg.gAR,ajj.jN,yyyMD,zzzzAL*hh<CR><LF>

where:

abbbb is the pitch
bb(deg).bb(min)
a [-] bow up / [space] bow down
acccc is the roll in degrees
cc(deg).cc(min)
a [-] port up / [space] port down

Warning: due to the coding, roll values larger than 99.99 degrees and lower than -99.99 degrees are saturated with a resolution of 1 degree

ddd.d is the heading in degrees
aee.e is the pitch speed in degrees/second OR
(if pitch speed < 100)
aeee.e is the pitch speed in degrees/second
(if pitch speed >= 100)
a [-] bow up / [space] bow down
aff.f is the roll speed in degrees/second OR
(if roll speed < 100)
afff.f is the roll speed in degrees/second
(if roll speed >= 100)
a [-] port up / [space] port down
agg.g is the heading speed in degrees/second OR
(if heading speed <100)
aggg.g is the heading speed in degrees/second OR
(if heading speed >= 100)
a [-] heading decreases / [space] heading increases
ajj.j is the vessel speed in knot
a [-] Astern / [space] Ahead
yyy Unused
zzzz status
hh is a checksum

zzzz is the hexadecimal value of the following status which is similar to $PHINF except it only uses 4 hexadecimal numbers.

STATUS value for TOKIMEC PTVF protocol:

Bit 0	Heading invalid
Bit 1	Roll invalid
Bit 2	Pitch invalid
Bit 3	Heave init
Bit 4	*Reserved*
Bit 5	Initialization
Bit 6	*Reserved*
Bit 7	*Reserved*
Bit 8	FOG X1 anomaly
Bit 9	FOG X2 anomaly
Bit 10	FOG X3 anomaly
Bit 11	FOG acq error
Bit 12	Accelerometer X1 anomaly
Bit 13	Accelerometer X2 anomaly
Bit 14	Accelerometer X3 anomaly
Bit 15	Sensor error

$--ZDA,hhmmss.ss,dd,mm,yyyy,hh,mm*hh<CR><LF> (1)

where: hhmmss.ss is UTC time synchronized with the last PPS frame received

dd is the UTC day (from 01 to 31)

mm is the UTC month (from 01 to 12)

yyyy is the UTC year

hh is the local zone hours (from 00 to ± 13 hours)

mm is the local zone minutes (from 00 to +59)

TOKIMEC PTVG

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output NMEA 0183 compatible, Tokimec proprietary
- Data sent: Heading, Roll, Pitch
- Data frame:

$PTVG,abbbbP,accccR,ddd.dT*hh<CR><LF>

where: abbbb is the pitch

bb(deg).bb(min)

a [-] bow up / [space] bow down

acccc is the roll in degrees

cc(deg).cc(min)

a [-] port up / [space] port down

Warning: due to the coding, roll values larger than 99.99 degrees and lower than -99.99 degrees are truncated with a resolution of 1 degree

ddd.d is the heading in degrees

hh is a checksum

$--ZDA,hhmmss.ss,dd,mm,yyyy,hh,mm*hh<CR><LF> (1)

where: hhmmss.ss is UTC time synchronized with the last PPS frame received

dd is the UTC day (from 01 to 31)

mm is the UTC month (from 01 to 12)

yyyy is the UTC year

hh is the local zone hours (from 00 to ± 13 hours)

mm is the local zone minutes (from 00 to +59)

TSS1/DMS

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output TSS proprietary protocol
- Data sent: Roll, Pitch, Heave, Linear accelerations, Status Accelerations are compensated from earth gravity. All values are saturated to maximum value
- Data frame: The frame contains 27 bytes in ASCII format

:XXAAAA<SP>MHHHHQMRRRR<SP>MPPPP<CR><LF>			
where:	**:**	Header character	0x3A
	XX	Horizontal acceleration (in plane X_{V1}, X_{V2})	Acc: 0 to 9.81 m.s^{-2} Unit: 3.83 cm.s^{-2} **(ASCII representation of a 8 bits unsigned integer hexadecimal value)**
	AAAA	X_{V3} acceleration	Acc: ± 20.48 m.s^{-2} Unit: 0.0625 cm.s^{-2} Sign "+" when system goes up **(ASCII representation of a 16 bits signed 2 complement integer hexadecimal value)**
	<SP>	Space character	0x20
	MHHHH	Heave	Heave: ± 99 m Unit: 1 cm M is the space character when system goes up M is the minus character when system goes down
	Q	Status character	'h' for alignment mode 'H' for nominal mode

:XXAAAA<SP>MHHHHQMRRRR<SP>MPPPP<CR><LF>			
	MRRRR	Roll	Roll ± 90° Unit : 0.01° M is the space character when port up M is the minus character when port down
	<SP>	Space character	0x20
	MPPPP	Pitch	Pitch ± 90° Unit : 0.01° Sign "+" when bow up M is the space character when bow up M is the minus character when bow down **<u>Warning:</u>** Opposite sign of usual convention
	<CR><LF>	End of frame	0x0D 0x0A

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

TSS335B

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

- Standard: Output TSS proprietary protocol
- Data sent: Roll, Pitch, Heave, Linear accelerations, Status. Accelerations are compensated from earth gravity. All values are saturated to maximum value.
- Data frame: The frame contains 27 bytes in ASCII format with an header and an "end of frame" fields.

:XXAAAA<SP>MHHHHQMRRRR<SP>MPPPP<CR><LF>			
where:	**:**	Header character	0x3A
	XX	Horizontal acceleration (in plane X_{V1}, X_{V2})	Acc: 0 to 9.81 $m.s^{-2}$ Unit: 3.83 $cm.s^{-2}$ **(ASCII representation of a 16bits unsigned integer hexadecimal value)**
	AAAA	X_{V3} acceleration	Acc: ± 20.48 $m.s^{-2}$ Unit: 0.0625 $cm.s^{-2}$ Sign "+" when system goes up **(ASCII representation of a 32bits signed 2 complement integer hexadecimal value)**
	<SP>	Space character	0x20
	MHHHH	Heave	Heave: ± 99 m Unit: 1 cm M is the space character when system goes up M is the minus character when system goes down
	Q	Status character	'?' for alignment mode space character for nominal mode
	MRRRR	Roll	Roll ± 90° Unit : 0.01° M is the space character when port up M is the minus character when port down
	<SP>	Space character	0x20
	MPPPP	Pitch	Pitch ± 90° Unit : 0.01° Sign "+" when bow up M is the space character when bow up M is the minus character when bow down **Warning:** Opposite sign of usual convention
	<CR><LF>	End of frame	0x0D 0x0A

If ZDA tick box is checked a $PHZDA telegram is added to the protocol output messages, see section 3.2.1.5.

TUS

This protocol is not available for all products.

Refer to the tables of the section 4.4.1 to know if this protocol is available for your product.

Standard: Binary protocol

Data sent: Heading, Roll, Pitch, Heave speed, Surge speed, Sway speed, Linear accelerations, Rotation rates, Status

Data frame: The frame contains 16 fields - 29 bytes. LSB are sent first. Except Heading, each data is “two complemented” coded

Message <F0><F1>…<F12>			
Field 0	Bytes 0 to 1	Header	Header LSB = 0x00 ; Header MSB = 0x90
Field 1	Bytes 2 to 3	Roll	+/-180° ; LSB = $180/2^{15}$= 0.00549° Sign “+” when port up
Field 2	Bytes 4 to 5	Pitch	+/-180° ; LSB = $180/2^{15}$= 0.00549° Sign “+” when bow up
Field 3	Bytes 6 to 7	Heave speed	+/-327 m/s ; LSB = $327/2^{15}$=0.00997 m/s Sign “+” in down direction
Field 4	Bytes 8 to 9	Surge speed	+/-327 m/s ; LSB = $327/ 2^{15}$=0.00997 m/s Sign “+” in forward direction
Field 5	Bytes 10 to 11	Sway speed	+/-327 m/s ; LSB = $327/ 2^{15}$=0.00997 m/s Sign “+” in left direction
Field 6	Bytes 12 to 13	Heading	0° to 360° ; LSB = $360/2^{16}$= 0.00549°
Field 7	Bytes 14 to 15	XV1 acceleration*	+/-0.5 g; LSB = $0.5/ 2^{15}$. Positive in XV1 direction (forward)
Field 8	Bytes 16 to 17	-XV2 acceleration*	+/-0.5 g; LSB = $0.5/2^{15}$= 15.2 µg Sign “+” in opposite direction of XV2 (right)
Field 9	Bytes 18 to 19	-XV3 acceleration*	+/-0.5 g; LSB = $0.5/2^{15}$ =15.2 µg Sign “+” in opposite direction of XV3 (down)
Field 10	Bytes 20 to 21	Roll rate*	+/-20°/s; LSB = $20/2^{15}$=0.00061 °/s Sign “+” when rotating port up
Field 11	Bytes 22 to 23	Pitch rate*	+/-20°/s; LSB = $20/2^{15}$=0.00061 °/s Sign “+” when rotating bow up
Field 12	Bytes 24 to 25	Heading rate*	+/-20°/s; LSB = $20/2^{15}$=0.00061 °/s Sign “+” when heading decreases

Message <F0><F1>…<F12>			
Field 13	Byte 26	Status**	0xFF if Ok 0xAA if Initial alignment (5 first minutes) 0x00 if Error
Field 14	Byte 27	Checksum	Addition of all the bytes from 0 to 26 discarding overflow
Field 15	Byte 28	End of sentence	Fixed value = 0x91

*To comply with export regulation, the resolution of rotation rate data is limited to 3.6 deg/h and the resolution of acceleration data is limited to 1 mg. Accelerations are compensated from g.

**Status specification table

Function	Value	Links with OCTANS status word
Alignment	0xAA	Bit 1 of the OCT IV LSB Algorithm Status word (see Table 5)
Error	0x00	Bit 27 and 30 of the OCT IV MSB User status word (see Table 9)
Ok	0xFF (Status default value)	None

5 PULSE INTERFACES

The following protocols are available for interfacing through the pulse ports:

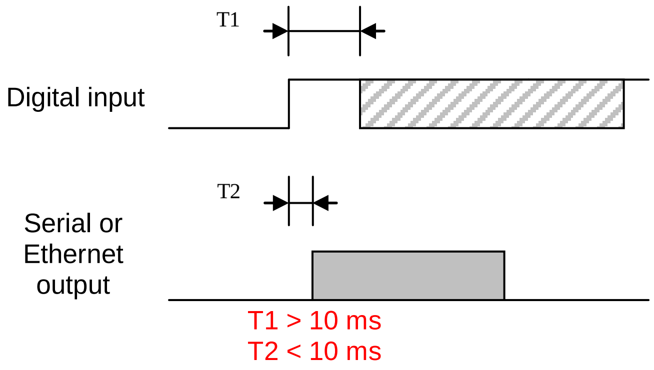
- INPUT:
  - SEROUT X Synchro (on port pulse in B or C)
  - PPS rising edge & ZDA (on port pulse in A)
  - PPS falling edge & ZDA (on port pulse in A)
  - ZDA & PPS rising edge (on port pulse in A)
  - ZDA & PPS falling edge (on port pulse in A)
- OUTPUT:
  - SEROUT X RTC (on port pulse out A or B)

SEROUT X Synchro

Description of protocol is similar for X = A, B or C depending on the serial port considered.

- Standard: none
- Definition: On pulse input (B or C) rising edge, serial or Ethernet output X (A, B or C) samples data corresponding to its configuration.
- Scale factor: No effect

The input pulse should have the following characteristics: TTL 5V



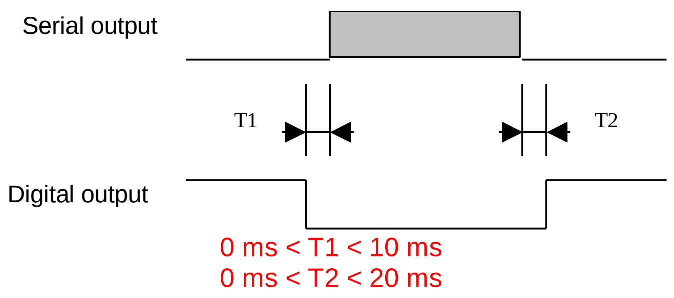
Caution

If the serial output sampling clock is not set to 0 in the configuration of serial port X, data will be sent according to the sampling clock and the pulse rising edge.

SEROUT X RTC OUTPUT

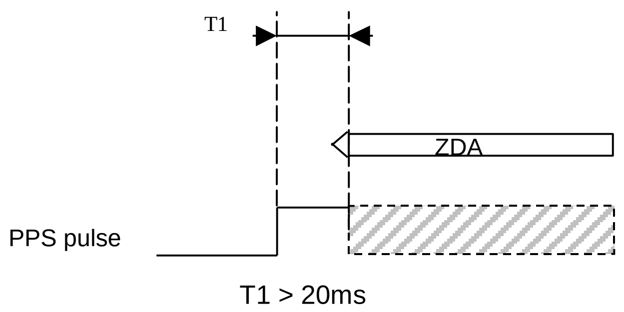
Description of protocol is similar for X = A, B or C depending on the serial port considered.

- Standard: none
- Definition: The digital output (A or B) is used as RTC signal of the serial X output (A, B or C)
- Scale factor: No effect



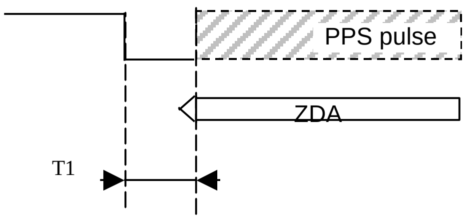
PPS rising edge & ZDA

- Standard: none
- Definition: on pulse input rising edge, the OCTANS internal clock is sampled and can be synchronized with the next external time information (for example GPS ZDA frame).
- Scale factor: No effect
- Available on port D



PPS falling edge & ZDA

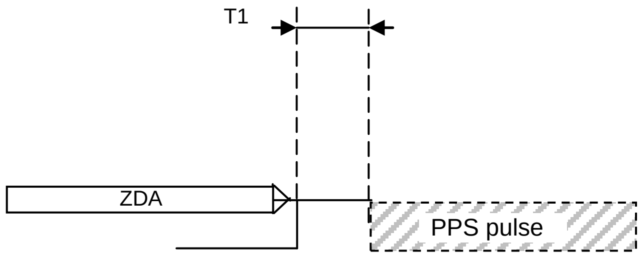
- Standard: none
- Definition: On pulse input falling edge, the OCTANS internal clock is sampled and can be synchronized with the next external time information (for example GPS ZDA frame).
- Scale factor: No effect
- Available on port D



T1 > 20ms

ZDA & PPS rising edge

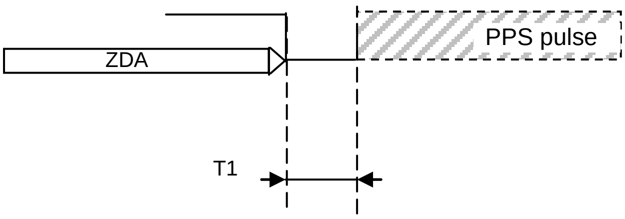
- Standard: none
- Definition: on pulse input rising edge, the OCTANS internal clock is sampled and can be synchronized with the preceding external time information (for example GPS ZDA frame).
- Scale factor: No effect
- Available on port D



T1 > 20 ms

ZDA & PPS falling edge

- Standard: none
- Definition: On pulse input falling edge, the OCTANS internal clock is sampled and can be synchronized with the preceding external time information (for example GPS ZDA frame).
- Scale factor: No effect
- Available on port D



T1 > 20 ms