UM-8084-109
Lodestar AHRS Messages

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1 Lodestar AHRS Messages Specification

1.1 Introduction

This specification document describes the different messages that can be input and output from the Lodestar when used as an Attitude and Heading Reference System (AHRS).

This specification document should be used in conjunction with the Lodestar AHRS operation manual (UM-8084-110) to configure the Lodestar for use as an AHRS.

List of Messages

Table 1 and Table 2 list the input and the output message formats used by the Lodestar Attitude and Heading Reference System, and the locations of their descriptions in this specification document.

Table 1 Input message formats used by the Lodestar AHRS

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2 Input Messages

2.1 GGA

Description This NMEA string outputs longitude and latitude at a UTC time

Format $--GGA, hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.xxx,M,x.x,M,x.x,xxxx*hh<CR><LF>

Field	Description
$	Start character
--	Sender Code (IN or GP)
GGA	Sentence Formatter
hhmmss.ss	UTC
llll.ll,a	Latitude, N/S 2 fixed digits degrees, 2 fixed digits minutes, variable digits of decimal minutes.
yyyyy.yy,a	Longitude, E/W 3 fixed digits degrees, 2 fixed digits minutes, variable digits of decimal minutes.
x	GPS quality Indicator 0-8
xx	Number of satellites
x.x	Horizontal dilution of precision
x.xxx,M	Antenna altitude above/below mean sea level (geoid), Meters (units of antenna altitude)
x.x,M	Geoidal Separation, Meters
x.x	Age of Differential data, not relevant.
xxxx	Differential Reference Station ID
*hh	Terminator and checksum
<CR><LF>	Terminator, return plus linefeed

Notes

- GPS quality Indicator shall not be a null field:
  - 0 = fix not available or invalid
  - 1 = GPS SPS mode
  - 2 = differential GPS, SPS mode
  - 3 = GPS PPS mode
  - 4 = Real Time Kinematic. Satellite system used in RTK mode with fixed integers
  - 5 = Float RTK. Satellite system used in RTK mode with floating solution
  - 6 = Estimated (dead reckoning) mode
  - 7 = Manual input mode
  - 8 = Simulator mode
- Geoidal Separation is difference between the WGS-84 Earth ellipsoid and mean sea level, “-“ is msl below ellipsoid.

Example $GPGGA,145750.00,4459.97858,N,00600.06971,E,2,07,1.4,0.000,M,0.0,M,2.2,0362*50

2.2 GLL

Description NMEA GLL format

Format $--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>

Field	Description
$	Start character
--	Sender Code (IN or GP)
GGL	Sentence Formatter
llll.ll,a	Latitude, N/S 2 fixed digits degrees, 2 fixed digits minutes, variable digits of decimal minutes.
yyyyy.yy,a	Longitude, E/W 3 fixed digits degrees, 2 fixed digits minutes, variable digits of decimal minutes.
hhmmss.ss	UTC
A	Status indicator
a	Mode indicator
*hh	Terminator and checksum
<CR><LF>	Terminator, return plus linefeed

Notes

- The Mode indicator can have any of the following values:
  - A = Autonomous
  - B = Differential
  - E = Estimated (dead reckoning)
  - M = Manual input
  - S = Simulator
  - N = Data not valid
- The Mode indicator supplements the Status indicator. The Status indicator should be set to V = Invalid for all values of Mode indicator except A = Autonomous and D = Differential. The Mode indicator and Status indicator must not be null.

Example $GPGLL,5119.82382,N,00100.00000,E,111524.00,A,D*60

2.3 ZDA

Description This NMEA string outputs UTC,day,month,year and local time zone

Format $--ZDA,hhmmss.sss,xx,xx,xxxx,xx,xx*hh<CR><LF>

Field	Description
$	Start character
--	Sender Code
ZDA	Sentence Formatter
,hhmmss.sss	Hours, minutes, seconds, and decimal seconds
,xx	Day, 01 to 31
,xx	Month, 01 to 12
,xxxx	Year
,xx	Local Zone hours 00 to ±13
,xx	Local Zone minutes 00 to 59
*hh	Terminator and checksum
<CR><LF>	Return plus linefeed

Example $GPZDA,162408.00,02,04,2007,,*6C

2.4 VTG

Description This NMEA string outputs speed and course over ground (SOG & COG)

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

Field	Description
$	Start character
--	Sender Code (e.g. GP, HE or IN)
VTG	Sentence Formatter
x.x,T	COG, degrees True
x.x,M,	COG, degrees Magnetic
x.x,N,	SOG, knots
x.x,K	SOG, km/hr
a	Mode Indicator
*hh	Terminator and checksum
<CR><LF>	Return plus linefeed

Notes

- The Mode indicator can have any of the following values:
  - A = Autonomous
  - D = Differential
  - E = Estimated (dead reckoning)
  - M = Manual input
  - S = Simulator
  - N = Data not valid

Example

$GPVTG,,T,,,,N,,K*03
$GPVTG,000.00,T,,M,0.00,N,0.0,K*60
$GPVTG,000.00,T,000.00,M,20.00,N,37.04,K*4C

2.5 ACK

Description Acknowledge device alarm. This sentence is used to acknowledge an alarm condition reported by a device. The Lodestar will on receipt of this telegram re-transmit the ALR telegram with the acknowledge flag set.

Format $__ACK,xxx*hh<CR><LF>

Field	Description
$HEACK	Header with gyrocompass sender code (IN or HE)
xxx	Unique alarm condition number (identifier) at alarm source, default 99
*hh	Terminator and checksum
<CR><LF>	Return plus linefeed

Example $HEACK,99*1C

3 Output Messages

3.1 PRDID

Description This Proprietary ADCP (RDI) telegram consists of pitch roll and heading

Format $PRDID,PPP.PP,RRR.RR,hhh.hh*hh*hh<CR><LF>

Field	Description
$PRDID	Header
Pitch	Pitch, -30.0 to +30.0, degrees
Roll	Roll, -30.0 to +30.0, degrees
Heading	True Heading, 0 to 359.99, degrees
*hh	Terminator and checksum
<CR><LF>	Terminator, return plus linefeed

Notes

- The data string has variable length with leading zeros and minus signs added where necessary.
- Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.
- The attitude measurements contained in the data string will be in real time.
- There is no status indicator in the data string. This data string does include the optional checksum allowed within the NMEA 0183 standard.
- The data string will include gyro heading information only if it is available. If there is no heading information available, the heading field will be null.

Example $PRDID,-0.17,-0.59,172.66*77

3.2 TSS1

Description The TSS proprietary string outputs accelerations, heave and roll and pitch.

Format :XXAAAASMHHHHQMRRRRSMPPPP<CR><LF>

Field	Description
:	Start character
XX	Horizontal Acceleration (not populated by Lodestar)
AAAA	Vertical Acceleration, vehicle frame
S	Space
M	Space if positive, minus if negative
HHHH	Heave
Q	Status Flag, H,h,F,f. Heading or Fully aided, settled or settling
M	Space if positive, minus if negative
RRRR	Roll
S	Space
M	Space if positive, minus if negative
PPPP	Pitch
<CR><LF>	Terminator, return plus linefeed

Notes

- Vertical acceleration is positive in the up direction.
- Horizontal acceleration is not populated by the Lodestar
- The motion measurements contained in the data string will be in real time, valid for the instant when the system begins to transmit the string.
- Motion measurements include ASCII-coded decimal values.
- Heave measurements are in cm in the range –99.99 to +99.99 metres. Positive heave is above datum.
- Roll and pitch measurements are in degrees in the range –99.99° to +99.99°. Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.
- Status flag H – The system is using heading from the settled gyrocompass.
- Status flag h – The gyrocompass heading is not settled.
- Status flag f – The system is receiving aiding data from both GGA and VTG NMEA messages but the gyrocompass is not settled.
- Status flag F – The system is receiving aiding data from both GGA and VTG NMEA messages and the gyrocompass is settled.

Example :003D04 0000H-0058 -0017

3.3 TSS2

Description This TSS proprietary string outputs heading, heave, roll and pitch.

Format :DDDDDSMHHHHQMRRRRSMPPPPE<CR><LF>

Field	Description
:	Start character
DDDDD	Heading x 100 degrees
S	Space
M	Space if positive, minus if negative
HHHH	Heave in centimetres
Q	Status Flag, H,h,F,f. Heading or Fully aided, settled or settling
M	Space if positive, minus if negative
RRRR	Roll x 100 degrees
S	Space
M	Space if positive, minus if negative
PPPP	Pitch x 100 degrees
E	Heading status flag, as for other TSS messages
<CR><LF>	Terminator, return plus linefeed

Notes

- The angle measurements are in hundredths (i.e. x 100)
- The motion measurements contained in the data string will be in real time, valid for the instant when the System begins to transmit the string.
- Motion measurements include ASCII-coded decimal values.
- Heave measurements are in cm in the range –99.99 to +99.99 metres. Positive heave is above datum.
- Roll and pitch measurements are in degrees in the range –99.99° to +99.99°. Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.
- Status flag is as for TSS1
    - Status flag H – The system is using heading from the settled gyrocompass.
    - Status flag h – The gyrocompass heading is not settled.
    - Status flag f – The system is receiving aiding data from both GGA and VTG NMEA messages but the gyrocompass is not settled.
    - Status flag F – The system is receiving aiding data from both GGA and VTG NMEA messages and the gyrocompass is settled.
- Heading Status flag can take the following values:
    - A – If Status flag above is H or h
    - f – if Status flag above is f
    - F – if Status flag above is F

Example :17263 0001H-0058 -0017A

3.4 TSS3

Description The TSS proprietary string outputs remote heave, heave, roll and pitch.

Format :RMhhhhSMHHHHQMRRRRSMPPPP<CR><LF>

Field	Description
:R	Start character and format identifier
M	Space or minus sign
hhhh	Remote Heave
S	Space
M	Space if positive, minus if negative
HHHH	Heave
Q	Status Flag, H,h,F,f. Heading or Fully aided, settled or settling
M	Space if positive, minus if negative
RRRR	Roll
S	Space
M	Space if positive, minus if negative
PPPP	Pitch
<CR><LF>	Terminator, return plus linefeed

Notes

- After the start character (a colon, ASCII 3Ah) the TSS3 data string includes an upper case 'R' to identify the string as using TSS3 remote heave format.
- The motion measurements contained in the data string will be in real time, valid for the instant when the System begins to transmit the string.
- Motion measurements include ASCII-coded decimal values.
- Heave measurements are in cm in the range –99.99 to +99.99 metres. Positive heave is above datum.
- Roll and pitch measurements are in degrees in the range –99.99° to +99.99°. Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.
- Status flag H – The system is using heading from the settled gyrocompass.
- Status flag h – The gyrocompass heading is not settled.
- Status flag f – The system is receiving aiding data from both GGA and VTG NMEA messages but the gyrocompass is not settled.
- Status flag F – The system is receiving aiding data from both GGA and VTG NMEA messages and the gyrocompass is settled.
- Status flag A – General alarm

Example :R 0001 0001H-0059 -0017

3.5 EM1000

Description Format suitable for use with Simrad EM series multibeam sonars.

Format ABRRPPAAHH bytes 0-9

Byte	Field		Field
0	A	MSB	Header, 0x00
1	BB	LSB	Header, 0x90
2	RR	LSB	Roll, Range +/- 20 deg. Units 0.01 deg.
3		MSB	
4	PP	LSB	Pitch, Range +/- 20 deg. Units 0.01 deg.
5		MSB	
6	AA	LSB	Heave +/- 20m, units 1 cm
7		MSB	
8	HH	LSB	Heading Range 0-359.99 deg. Units 0.01 deg.
9		MSB	

Notes

- MSB = most significant byte, LSB = least significant byte
- The data string is a 10-byte message of 16-bit 2's complement numbers, each expressed as two binary-coded digits.
- Positive heave is above datum. Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.
- The motion measurements contained in the data string will be in real time.
- The data string does not include a status flag.
- The system updates the heading field in the data string only when it receives new heading information from the gyrocompass. Depending on the transmission rate of the gyrocompass there may therefore be a difference between the instantaneous heading and the value included in the data output string.
- The gyro heading is NOT a 2's complement number.

Example 00900200FF730000 hex

3.6 EM3000

Description Format suitable for use with Simrad EM3000 series multibeam sonars.

Format ABRRPPAAHH bytes 0-9

Byte	Field
A	Header, MSB, 0x00
B	Header LSB, 0x90 when settled or 0x91 when unsettled
RR	Roll, Range 0-359.99 deg. Units 0.01 deg.
PP	Pitch, Range 0-359.99 deg. Units 0.01 deg.
AA	Heave +/- 20m, units 1 cm
HH	Heading Range 0-359.99 deg. Units 0.01 deg.

Notes

- MSB = most significant byte, LSB = least significant byte
- The data string is a 10-byte message of 16-bit 2's complement numbers, each expressed as two binary-coded digits.
- Positive heave is above datum. Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.
- The motion measurements contained in the data string will be in real time.
- The Status byte = 91h for an unsettled unit or 90h for a settled unit.
- The system updates the heading field in the data string only when it receives new heading information from the gyrocompass. Depending on the transmission rate of the gyrocompass there may therefore be a difference between the instantaneous heading and the value included in the data output string.
- The gyrocompass heading is NOT a 2's complement number.

Example 00900200FF730000 hex

3.7 PHTRO

Description This proprietary Octans telegram consists of pitch and roll. This is similar to the NMEA 0183 standard. The units for the measurements are degrees; the angles are as described below.

Format $PHTRO,x.xx,a,y.yy,b*hh<CR><LF>

Field	Description
$PHTRO	Header
x.xx	x.xx is the pitch in degrees
,	comma
a	a is 'M' for bow up, 'P' for bow down
,	comma
y.yy	y.yy is the roll in degrees
,	comma
b	b is 'B' for port down, 'T' for port up
*hh	Terminator and checksum
<CR><LF>	Carriage return and linefeed characters

Notes

- The data string has variable length with a leading zero if magnitude < 1 and minus signs added where necessary e.g. –0.59.
- By default, positive roll is port-side up, starboard down, positive pitch is bow down, stern up. The "a" and "b" codes will be "P" and "T" respectively.
- The attitude measurements contained in the data string will be in real time, valid for the instant when the system begins to transmit the first byte of the string.
- There is no status indicator in the data string.

Example $PHTRO,-0.17,P,-0.56,B*46

3.8 HDT

Description NMEA True Heading

Format $HEHDT,x.x,T*hh<CR><LF>

Field	Description
$	Start Character
HE	Talker identifier
HDT	Mnemonic for true heading
,	Comma separator
xxx.xxx	Heading in degrees and decimal fraction
,	Comma separator
T	Heading Type **T**rue/**G**rid/**M**agnetic
*hh	Checksum
<CR><LF>	Terminator, return plus linefeed

Notes

- The Heading type indicator is always ‘T’ when transmitted by the Lodestar, to indicate that heading information is with respect to true north.

Example $HEHDT,172.597,T*20

3.9 THS

Description This telegram is the NMEA defined "True heading and status" telegram - actual vessel heading in degrees true produced by any device or system producing true heading.

Format $__THS,XX.XX,a*hh<CR><LF>

Field	Description
$	Start Character
_	Talker identifier (HE)
THS	Mnemonic for true heading and status
,	Comma separator
XX.XX	Heading in degrees and decimal fraction
,	Comma separator
a	Mode indicator
*hh	Checksum
<CR><LF>	Terminator, return plus linefeed

Notes

- This sentence includes a "mode indicator" field providing critical safety related information about the heading data, and replaces the deprecated HDT sentence. The sender code for a north seeking gyrocompass is "HE". For inertial navigation systems "IN" is used, though IN is for integrated navigation systems, see ISO 61162-1 for details.
- Mode indicator states:
  - A = Autonomous (aided with GGA and VTG)
  - E = Estimated (dead reckoning, neither GGA and VTG are present)
  - M = Manual input
  - S = Simulator mode
  - V = Data not valid (including standby)

Example $HETHS,172.59,E*11

3.10 MDL

Description This message provides heading, pitch and roll in degrees

Format HaaaaPbccccRdeeee<CR><LF>

Field	Description
H	Heading start character
aaaa	Heading in tenths of degrees i.e. aaa(deg).a(decimal)
P	Pitch start character
b	[+] bow down or [-] stern down
cccc	Pitch in hundredths of degrees i.e. cc(deg).cc(decimal)
R	Roll start character
d	[+] port down or [-] starboard down
eeee	Roll in hundredths of degrees i.e. ee(deg).ee(decimal)
<CR><LF>	Terminator, return plus linefeed

Example H1726P-0016R-0058

3.11 TEMP

Description This format provides the temperature of the x, y and z sensors and the x, y and z sensor cases, using the NMEA TXT sentence.

Format $HETXT,d,d,dd,dd,dd,dd,dd,dd,dd*hh<CR><LF>

Field	Description
$	Start Character
HE	Talker identifier
TXT	Mnemonic for text message
d	Total number of messages (01 - 99)
d	Message number (01 – 99)
d	Text identifier (01 - 99)
dd.d	X sensor temperature, degrees Celsius
dd.d	Y sensor temperature, degrees Celsius
dd.d	Z sensor temperature, degrees Celsius
dd.d	X case temperature, degrees Celsius
dd.d	Y case temperature, degrees Celsius
dd.d	Z case temperature, degrees Celsius
*hh	checksum
<CR><LF>	Terminator, return plus linefeed

Notes

- This message follows the standard spec for the __TXT message, where the first number is the total number of messages, the second number is the message number and the third the text identifier.
- Following this there are 6 integer numbers and a checksum.

Example $HETXT,1,1,66,43.1,43.5,42.9,43.8,42.9,43.9*7C

3.12 TXT

Description For the transmission of short text messages. Longer text messages may be transmitted by using multiple sentences. Used particularly for additional information following an alarm condition. This sentence is used to provide more detailed information on the cause of an alarm condition reported by a device.

Format $__TXT,xx,xx,xx,c—c*hh<CR><LF>

Field	Description
$__TXT	Header with sender code
xx	Total number of sentences
xx	Sentence number
xx	Text identifier
ccc	ccc = Textual information on alarm source
*hh	Checksum
<CR><LF>	Terminator, return plus linefeed

Notes

- The sender code for a north seeking gyrocompass is “HE”. For inertial navigation systems “IN” is used, though IN is for integrated navigation systems, see ISO 61162-1 for details.

Example :0003ADA31BA8,{$INTXT,01,01,3,External Power Supply was Not Good, now cleared*2C}*55

3.13 ALR

Description This telegram indicates the local alarm condition and status

Format $__ALR,hhmmss.ss,xxx,A,B,c---c*hh<CR><LF>

Field	Description
$HEALR	Header with compass sender code
hhmmss.ss	Time of Alarm condition, UTC
xxx	Unique alarm condition number (identifier) at alarm source, default 99
A	Alarm condition (A = threshold exceeded, V = not exceeded)
B	Alarm's acknowledge state (A = acknowledged, V = unacknowledged)
c—c	Alarm's description text (e.g. "External Power Supply Failed")
*hh	Checksum
<CR><LF>	Terminator, return plus linefeed

Notes

- This sentence is used to report an alarm condition on a device and its current state of acknowledgement. In particular for the Lodestar it will indicate if the external power supply has failed and the unit is running under the backup battery. When the external power is restored, the ALR report will also be sent.
- The sender code for a north seeking gyrocompass is "HE". For inertial navigation systems "IN" is used, though IN is for integrated navigation systems, see ISO 61162-1 for details
- The message is repeated either when the cause of the alarm changes, when an acknowledgement is received or after 60 seconds, whichever is the sooner.
- If an acknowledgement is received, this is retained in the repeated alarm message as long as the cause of the alarm message does not change.

Example :0003E482E0A7,{$INALR,150951.00,099,A,V,Alarm: Status = 0x00000004*78}*7

3.14 SON2

Description Lodestar provides a Sonardyne proprietary SON2 telegram, consisting of UTC time, pitch, roll and heading with an estimated heading error. The heading error of the gyro-compass algorithm can not be measured, only estimated from the sensor noise.

Format $PRDID,PPP.PP,RRR.RR,hhh.hh*hh*hh<CR><LF>

Field	Description
:	Start character
hhmmssss	UTC time, hours, minutes, seconds and milliseconds
M	Space if positive, minus if negative
RRRRRR	Roll x 1000 degrees
M	Space if positive, minus if negative
PPPPPP	Pitch x 1000 degrees
M	Space if positive, minus if negative
HHHHHH	Heading x 1000 degrees
M	Space separator
VVV	Estimated variance
S	Status Flag, U,u,A,a,V,v,G,g
<*CR*><*LF*>	Terminator, return plus linefeed

Notes

- Positive roll is starboard down, port up.
- Positive pitch is bow up, stern down.
- The SON2 data string contains 39 characters in six data fields.
- The time is UTC time expressed as time of day hours, minutes, seconds and milliseconds.
- The angle measurements are in thousandths (i.e. x 1000 degrees)
- The motion measurements contained in the data string will be in real time, valid for the instant when the System begins to transmit the string.
- Due to the definition of the angles, the actual range of roll and pitch together are restricted. But the format allows for roll and pitch in degrees in the range –179.999° to +180.000°. Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.
- The precision of the heading estimate is $\tan^{-1}(\sigma/15)$ secant latitude rms when the filter time constant is 1 hr. σ is the angular random walk (°/√ hr). After half an hour after start up the filter time constant is effectively ½ hr and so the result is root 2 times worse. If you allow it to run for 2 hrs the result is √2 times better than the 1 hr case. Note that the number is rms so only 95 % of the time is the heading precision within 2 times the figure. An optimist would say that σ is 0.007°/√ hr. So be aware of the cost of cutting short the settling time.
- The Status flag can take one of the following values:
  If there is both VTG and GGA the status is A or a
  If there is VTG only the status is V or v
  If there is GGA only the status is G or g
  If there is neither VTG nor GGA the status is U or u
  Upper case denotes the Gyros have settled, lower case denotes the Gyros are settling.
  If outputting u or U status, as soon as a VTG and/or GGA is received the status changes appropriately. However if VTG and/or GGA is not seen, it takes 5 seconds for the new (lesser) status to be updated on the message.
-

Example :152359000 000222-000022 359999 1234S

3.15 POSMV GROUP 111 Heave and True Heave

Description This telegram contains data for delayed heave calculations along with time matched real-time heave data. Heave sign is positive down.

Format

Byte	Field	Format	Description / value
1-4	Start	char	$GRP
5-6	ID	ushort	111
7-8	Byte count	ushort	76 (Bytes)
9-16	Time 1	double	seconds
17-24	Time 2	double	seconds
25-32	Distance tag	double	metres
33	Time type	byte	Bit2 set = Time1 UTC time (fixed) Bit4 set = Time2 POS time (fixed)
34	Distance type	byte	0 = N/A (fixed)
35-38	True heave	float	(,) metres
39-42	True heave RMS	float	[0,) metres
43-46	Status	Ulong	Bit0 set = True heave valid Bit1 set = realtime heave valid
47-50	Heave	float	(,) metres
51-54	Heave RMS	float	[0.) metres
55-62	Heave time 1	double	seconds
63-70	Heave time 2	double	seconds
71-74	Rejected IMU data count	ulong	[0,)
75-78	Out of range data count	ulong	[0,)
79-80	Pad	byte	0
81-82	Checksum	ushort	
83-84	Group end	char	$#

Notes

- Time 1 is the system time of validity for the data. The type of data is indicated in the time type field. UTC time is the seconds of the week.
- Time 2 is the system time of validity for the data. The type of data is indicated in the time type field. POS time is the time in seconds since power on.
- The checksum is calculated so that the sum of short pairs (16 bits) over the complete telegram has a sum of zero.
- Byte is 8 bits MSB first.
- Short is the INTEL format 16 bits MSB first.
- Long is 32 bits MSB first.
- Float is INTEL format from IEEE-754 floating point definition.
- Double is 8 bytes, MSB first.
- MSB = Most Significant Bit, LSB = Least Significant Bit

3.16 POSMV GROUP 113 Heave and True Heave Metrics

Description This telegram contains quality data for delayed heave calculations.

Format

Byte	Field	Format	Description / value
1-4	Start	char	$GRP
5-6	ID	ushort	113
7-8	Byte count	ushort	68 (Bytes)
9-16	Time 1	double	seconds
17-24	Time 2	double	seconds
25-32	Distance tag	double	metres
33	Time type	byte	Bit2 set = Time1 UTC time (fixed) Bit4 set = Time2 POS time (fixed)
34	Distance type	byte	0 = N/A (fixed)
35-42	Heave time 1	double	Seconds
43-50	Quality control 1	double	0 (fixed)
51-58	Quality control 2	double	0 (fixed)
59-66	Quality control 3	double	0 (fixed)
67-70	Status	Ulong	0 (fixed). Quality control not used.
71-72	Pad	byte	0
73-74	Checksum	ushort	
75-76	Group end	char	$#

Notes

- Time 1 is the system time of validity for the data. The type of data is indicated in the time type field. UTC time is the seconds of the week.
- Time 2 is the system time of validity for the data. The type of data is indicated in the time type field. POS time is the time in seconds since power on.
- The checksum is calculated so that the sum of short pairs (16 bits) over the complete telegram has a sum of zero.
- Byte is 8 bits MSB first.
- Short is the INTEL format 16 bits MSB first.
- Long is 32 bits MSB first.
- Float is INTEL format from IEEE-754 floating point definition.
- Double is 8 bytes, MSB first.
- MSB = Most Significant Bit, LSB = Least Significant Bit

4 References

IEC 61162-1 Maritime navigation and Radiocommunication equipment and systems – Digital interfaces
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Single talker and multiple listeners

IEC 61162-2 Maritime navigation and Radiocommunication equipment and systems – Digital interfaces
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Single talker and multiple listeners, high-speed transmission