



HPLS[®]-2G

(HEADING, POSITIONING, AND LEVELING SYSTEM)

API Commands

VERSION 1.00

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ABBREVIATIONS

Abbreviation	Description

WARRANTY NOTICE

This Warranty covers products manufactured by Arazim, Ltd. (The "Company")

The Company warrants the products during the Warranty Period, under normal use and maintenance, to be free from defects in material and workmanship, and will substantially conform to the Company's specifications (attached) for the products. Yet the Company does not guarantee that the product will not endure any interruptions or faults. The product Data sheet, specifications and additional instructions are included in the User Manual.

This Warranty shall apply to all parties. All other warranties or settlements are excluded. In order to obtain a warranty service, the purchaser must provide the original purchase Invoice and serial number of the product.

The Purchaser is responsible for installing the product properly and to check and verify the functioning of the product. For any faults or claims the purchaser must contact and notify the Company within 14 days of the purchase of the product.

For any faults or deficiency on the purchaser's liability:

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- 2) Non-Conforming Report including Product Serial Number must be attached.
- 3) Transport of the product to and from Arazim Ltd. offices.

The Warranty shall apply only in Israel and is subject to the availability of replacement parts. The Company will not change the design or functionality of the product in order to conform to restrictions of countries in which the product is restricted for legal or regulation issues.

This warranty shall comply with all governed regulations for the products including all Import and export regulations and inspections.

Warranty Period for the company products is for 12 months unless stated otherwise by the Company. The warranty Period applies from the purchase date indicated on the purchase invoice. For products carrying longer Warranty Periods, all of the foregoing liabilities stated above will apply during the second- and third-year warranty periods (excluding payment collections) In addition the Company will not be obligated to the repair lead times.

The Company may charge for repair or replacements if required under any of the following conditions:

- Damage caused by accident or natural events such as fire/water; electrical discharges; Use of hardware or software, interfaces or devices not supplied by the Company and/or are not manufactured by Arazim, Ltd.
- Malice, negligence, abuse, misuse or improper installation of the products not complying with the user manual; expandable parts, external cover or color coatings; damage occurring in transport of the product by the Purchaser.
- Any changes, repairs or services performed on the product by any party other than Arazim, Ltd. including removal of the seal tag protecting the inner parts of the product from exposure.
- The Company is not obligated to adjust the product to any designation or purpose.
- The Company will not be liable for any claim by purchaser or any third party of direct or indirect damage including loss or deletion of applications or information, restoration expenses, loss of time and or profit, reputation damages including damages resulting using the product, any faults or services provided for the product.
- Any repair services for the products after the expiration of the warranty Period will bear charges.

The warranty and repair service will be executed in Israel and subject to the discretion of the Company whether to exchange parts, repair or replace the product. The product or parts may be reconditioned parts or used parts but will in all cases functionality will be equivalent to the original parts or even improved.

This Warranty Notice will apply to all parties and in lieu of any other agreements or contradictions.

1. INTRODUCTION

1.1. About the HPLS®-2G

The HPLS®-2G is a GPS-based, Heading Positioning and Leveling System. It is an extremely low-cost, yet highly professional, miniature, and rugged static orientation solution.

The HPLS® exhibits Heading accuracy down to 0.1° (or even less, depending on antenna separation) with Tilt / Leveling accuracy (Roll & Pitch) down to 0.25° . This accuracy and a high update rate of up to 20Hz allow the HPLS®-2G to suit a large variety of applications, from antenna positioning systems to accurate target acquisition systems.

The HPLS® is the first in a family of products that measures Heading and Leveling accurately for static and dynamic applications.

The HPLS®-2G comes with a new power regulation unit that complies with Mil-Std-461C and Mil-Std-1275B. It also provides greater Heading accuracy.

2. API COMMANDS

2.1. Overview

This appendix contains the API commands used to set the working mode via the HPLS®-2G intuitive user interface.

2.2. Interface

The HPLS®-2G communicates via two RS232 serial ports that work in PC levels standard (+/-6v to +/-15v), and an optional RS422 serial interface is also available


Serial Baud-Rate:	115200	bps	configurable
Start bit:	1	bit	constant
Byte size:	8	bit	constant
Stop bit:	1	bit	constant
Parity:	None	bit	constant
Hardware Flow:	None		constant
Software Flow	None		constant

Port A is the main HPLS®-2G port, whose frames include positioning, heading, and leveling information. Use Port A to configure the HPLS®-2G using dedicated API commands to control the port output ([API Commands](#)).

The HPLS®-2G is supplied with evaluation PC software (see: [HPLS®-2G UserGuide.pdf](#)) to configure Port A in a selected working mode, to exhibit incoming data in both number and graph views, and to record and load files.

Port B provides GPS messages according to the NMEA 0183 standard, with an additional message (\$GPHDT) that contains heading information. Ports may be configured independently.

The HPLS®-2G includes configuration software that can be used to configure message outputs and rates.

 Note	GPS can only be configured via Port B.
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2.3. API Command Structure

API commands follow the structure described in Table 1 and in the following bullet list.

Table 1. API Command Structure

Header	Data Size	API Command	Data	Data Checksum
2 bytes	1 byte	1 byte	n bytes	2 bytes

- **Header** -Two characters: “[>” = 0x5B ,0x3E
- **Data Size** – holds the number of bytes to follow the data size field location. It is **n** bytes for Data field + 3 (1 for API command and 2 for checksum).
- **API Command** - Command Identification.
- **Data** - the parameter portion of query/set commands
- **Data Checksum** - Ensures reliability of data reception, as it sums all the bytes after the Data Length field.

The API command message types are:

- Set commands – Commands with parameters to change HPLS®-2G internal registers and control the behavior. The HPLS®-2G should reply with “acknowledge” if the command was managed successfully.
- Query commands – Commands that acquire the HPLS®-2G internal registers values. If the command was managed successfully, the HPLS®-2G should reply with the same command id carrying the data requested.

 Note	All command messages must conform to the API command structure.
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Table 2 lists the API commands and command IDs that the Host Controller and the HPLS®-2G unit use to communicate.

Table 2. Host Controller API Commands and Command IDs

Command	Command ID
Acknowledge	0x81
Set Enter/Exit Configuration Mode	0x82
Get Read Configuration	0x83
Set Save Work Settings	0x84
Reserved	0x85
Set Soft Reset	0x86
Set Interface Baud-Rate	0x87
Set Frame Type	0x88
Set Frame Rate	0x89
Factory use only	0x8A
Get Board Type	0x8B
Get Firmware Version	0x8C
Get MSEP Value	0x8D
Get Enable/Disable Yaw Filter Mode	0x8E
Set Enable/Disable Yaw Filter Mode	0x8F
Set Heading Offset	0x94
Set MSEP Value	0x9F

Table 3. Informative Status Information

Part ID	Part Name	Quantity	PIN
Starting Initialization/BIT	0xA0	Status informing	0xA2
Ending Initialization/BIT	0xA1		

2.3.1. Immediate Set Commands

Set commands are used to change the current system behavior, by changing the internal RAM registers. In order to preserve the settings for the next power cycle, the user has to send Save command to store changes in Flash memory.

2.3.1.1. Acknowledge

This command acknowledges that HPLS®-2G received a *Set* command message without errors.

Table 4. Acknowledge Command


Item	Details
API Command Value	0x81
Data Size	0x03
Data	None

2.3.1.2. Enter/Exit Configuration Mode

This command must be executed before sending any API configuration commands. Otherwise, the command will have no effect and HPLS®2G will not send an Acknowledge message.

Table 5. Enter/Exit Configuration Mode Command

Item	Details
API Command Value	0x82
Data Size	0x04
Data	0x01 – Enters Configuration mode 0x00 – Exits Configuration mode
Return	API Acknowledge

 Note	<ul style="list-style-type: none"> • Entering configuration mode will stop any frame out messages. • Exiting configuration mode will start frame out transmission according to the last configuration selected.
---	---

2.3.2. Configuration Set Commands

2.3.2.1. Save Work Settings

This command must be executed to preserve the current configuration as the active configuration for the next power up. If this command is not sent, any previous configuration changes will be lost when the system is powered up.

Table 6. Save Work Settings Command

Item	Details
API Command Value	0x84
Data Size	0x03
Data	None
Return	API Acknowledge

2.3.2.2. Soft Reset

This command can be executed to restart the HPLS[®]-2G without a need to power cycle the unit. It can be used to verify that new settings were saved to flash successfully.

Table 7. Soft Reset

Item	Details
API Command Value	0x86
Data Size	0x03
Data	None
Return	API Acknowledge

2.3.2.3. Set Interface Baud Rate

This command must be executed so the user can configure the Port A interface baud-rate.

Table 8. Set Interface Baud Rate

Item	Details
API Command Value	0x87
Data Size	0x04
Data	See: Table 9. Baud Rates and Codes
Return	API Acknowledge

Table 9 lists the optional communication Baud rates and relevant configuration codes.

Table 9. Baud Rates and Codes

Baud	Code	Baud	Code
19200	0x00	230400	0x04
38400	0x01	460800	0x05
57600	0x02	921600	0x06
115200 (factory default)	0x03		

2.3.2.4. Set Frame Type

This command must be executed to configure the data frame type that HPLS®-2G sends to a user.

Table 10. Set Frame Type

Item	Details
API Command Value	0x88
Data Size	0x04
Data	See: Table 11
Return	API Acknowledge

Table 11. Frame Type Options

Code	Packet Type	Packet Type Name
0x00	Basic altitude and position information	HPLS_M1 (factory default)
0x01	M1 + MSEP (L1 GNSS) M1 + GMYAW (Multi Freq)	HPLS_M2
0x02	M2 + Date	HPLS_M3
0x03	M2 + IMU (Multi Freq Only)	HPLS_M4
0x04	Inclination raw data information	HPLS_CAL

2.3.2.5. Set Frame Rate

This command must be executed to configure the update rate of the selected frame rate.

Table 12. Set Frame Rate

Item	Details
API Command Value	0x89
Data Size	0x04
Data	See: Table 13
Return	API Acknowledge

Table 13. Frame Rate Options

Code	Frame Rate
0x00	1
0x01	2
0x02	5
0x03	10 (factory default)
0x04	20

2.3.2.6. Enable/Disable Yaw Filter Mode

This command must be executed to enable or disable the use of the Gauss-Markov filter over the Heading (Yaw) channel.

Table 14. Enable/Disable GM Yaw Filter

Item	Details
API Command Value	0x8F
Data Size	0x04
Data	0x00 – Disable Filter 0x01 – Enable Filter
Return	API Acknowledge

2.3.2.7. Set Heading Offset

This command must be executed to add or reduce a constant value from the azimuth measurement.

Table 15. Set Heading Offset

Item	Details
API Command Value	0x94
Data Size	0x07
Data	Heading Offset (float)
Return	API Acknowledge

2.3.2.8. Set MSEP (Manual Separation) Value

This command must be executed to set the measured distance between the centers of two antennas.

Table 16. Set MSEP Value

Item	Details
API Command Value	0x9F
Data Size	0x05
Data	MSEP Value (float)
Return	API Acknowledge

2.3.3. Configuration Query Commands

Query (Get) commands pull requested data from RAM, rather than from flash memory. Query commands invoke a message response from the HPLS®-2G unit with the API command sent in the query and a new data body that includes the requested parameters.

2.3.3.1. Get Configuration

This command must be executed to load the actual HPLS®-2G unit settings.

Table 17. Get Configuration

Item	Details
API Command Value	0x83
Data Size	0x00
Data	None
Return	API Command Reply Value: 0x83

Table 18. HPLS®-2G – Reply for Get Configuration

Item	Details
API Command Value	0x83
Data Size	0x07
Data	Param 1: Baud Rate (see Table 8 and Table 9) Param 2: Frame Type (see Table 10 and Table 11) Param 3: Frame Rate (see Table 12 and Table 13) Param 4: Work Mode (for Factory Use)

2.3.3.2. Get Board Type

This command must be executed to read the current board type registration number.

Table 19. Get Board Type

Item	Details
API Command Value	0x8B
Data Size	0x03
Data	None

Item	Details
Return	API Command Reply Value: 0x8B

Table 20. HPLS®-2G – Reply for Get Board Type

Item	Details
API Command Value	0x8B
Data Size	0x04
Data	0x00 – Board Not Recognized 0x01 – Multi Freq Ver 1.0 0x02 – Multi Freq Ver 2.0

2.3.3.3. Get FW Version

This command must be executed to load the current HPLS®-2G Firmware version.

Table 21. Get FW Version

Item	Details
API Command Value	0x8C
Data Size	0x03
Data	None
Return	API Command Reply Value: 0x8C

Table 22. HPLS®-2G – Reply for Get FW Version

Item	Details
API Command Value	0x8C
Data Size	0x07
Data	Param 1: Version (unsigned char) Param 2: Sub-Version (unsigned char) Param 3: Build (unsigned short) (big endian)

2.3.3.4. Get MSEP value

This command must be executed to read the last MSEP value entered to the GPS configuration.

Table 23. Get MSEP Value

Item	Details
API Command Value	0x8D
Data Size	0x03
Data	None
Return	API Command Reply Value: 0x8D

Table 24. HPLS®-2G – Reply for Get MSEP Value

Item	Details
API Command Value	0x8D
Data Size	0x07
Data	MSEP Value (Float)

2.3.3.5. Get Yaw Filter Status

This command must be executed to read the activity status of the Yaw Filter. This command is only relevant for HPLS®-2G Multi Frequency.

Table 25. Get Yaw Filter Status

Item	Details
API Command Value	0x8E
Data Size	0x03
Data	None
Return	API Command Reply Value: 0x8E

Table 26. HPLS®-2G – Reply for Get Yaw Filter Status

Item	Details
API Command Value	0x8E
Data Size	0x04
Data	0x00 – Filter is Disabled 0x01 – Filter is Enabled

2.3.3.6. Get Heading Offset

This command must be executed to read the predefined heading offset from the HPLS®-2G unit.

Table 27. Get Heading Offset

Item	Details
API Command Value	0x93
Data Size	0x03
Data	None
Return	API Command Reply Value: 0x93

Table 28. HPLS®-2G – Reply for Get Heading Offset

Item	Details
API Command Value	0x93
Data Size	0x07
Data	Heading Offset (float)

2.3.4. HPLS®-2G Status API Messages

During the API process, status information messages are created and sent from the HPLS®-2G unit to the host controller on-the-fly, without having to enter either configuration mode or calibration mode. These API messages inform the host controller that a specific process has begun or finished with or without errors.

2.3.4.1. Starting Initialization/BIT

This command is sent from the HPLS®-2G to the Host controller:

- Before the initialization process begins.
- At each power up.

This command is followed by the “Ending Initialization” API command, which sends initialization results to the Host controller.

Table 29. Starting Initialization/BIT

Item	Details
API Command Value	0xA0
Data Size	0x03
Data	None
Return	None

2.3.4.2. Ending Initialization

This command is sent from the HPLS®-2G to the Host controller immediately after an initialization/BIT process ends. All initialization results are wrapped and sent to the host controller in one message.


 Important	<p>The developer must wrap this command to ensure that any power up or calibration process that might influence initialization is sent without errors before the system is started.</p>
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Table 30. Ending Initialization

Item	Details
API Command Value	0xA1
Data Size	0x04
Data	see: Table 31
Return	None

Table 31. Ending Codes and Commands

Code	Command
0x00	Inc. BIT Fail
0x01	GPS Communication Fails
0x02	BIT PASS

3. APPENDIX A: COMMUNICATIONS

3.1. Overview

This Appendix contains information regarding the HPLS®-2G interface and details on factory default settings. API commands may be used to change some communication parameters, for example, Baud rate or Frame rate (Section 2).

3.2. Interface

The HPLS®-2G communicates via two RS232 serial ports that work in PC levels standard (+/-6v to +/-15v), and an optional RS422 serial interface is also available


Serial Baud-Rate:	115200	bps	configurable
Start bit:	1	bit	constant
Byte size:	8	bit	constant
Stop bit:	1	bit	constant
Parity:	None	bit	constant
Hardware Flow:	None		constant
Software Flow	None		constant

Port A is the main HPLS®-2G port, whose frames include positioning, heading, and leveling information. Use Port A to configure the HPLS®-2G using dedicated API commands to control the port output (Section 2).

The HPLS®-2G is supplied with evaluation PC software (see Chapter 4) to configure Port A in a selected working mode, to exhibit incoming data in both number and graph views, and to record and load files.

Port B provides GPS messages according to the NMEA 0183 standard, with an additional message (\$GPHDT) that contains heading information. Ports may be configured independently.

The HPLS®-2G includes configuration software that can be used to configure message outputs and rates.

 Note	GPS can only be configured via Port B.
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3.2.1. HPLS®-2G Main Port Messages (Port A)

Every Port A message contains Heading, Position, Roll, and Pitch, and relevant statistical information.

3.2.1.1. Message Structure


All Port A messages follow the structure described in Table 32 and in the following bullet list.

Table 32. General Frame Structure

Header	Data Size	Packet Type	Valid Field	Data Checksum	Data Fields
2 bytes	1 byte	1 byte	2 bytes	2 bytes	N bytes

The general frame structure includes these items:

- **Header** -Two characters: “[>” = 0x5B ,0x3E
- **Data Size** - Holds the number of bytes to follow the data size field location
- **Packet Type** - The data field contents.
- **Valid Fields** - System status (GPS Lock), Power BIT information and validity of message arrival
A value of 0 indicates that the valid field is outdated, while a value of 1 indicates that the valid field is updated.
- **Data Checksum** - Ensures reliability of data reception, as it sums all the bytes of the **Data Fields**
- **Data Fields** – Contain the actual data that the host controller will use, which depends on the frame type used

 Tip	Valid fields and Data checksum are expressed in big endian, while all other fields are expressed in little endian.
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3.2.1.2. Frame Type Messages available via Port A

HPLS®-2G uses the frame type messages, described in Table 33, via the microcontroller unit (MCU) and Port A.

Table 33. HPLS®-2G Messages List


Packet Type Name	Frame Type ID		Remarks
	L1-GNSS	MULTI-FREQ	
HPLS_M1	0x11 (17D)	0x33 (51D)	Basic information
HPLS_M2	0x2A (42D)	0x34 (52D)	L1-GNSS: M1 + MSEP MULTI-FREQ: M1 + GM-YAW
HPLS_M3	0x2B (43D)	0x35 (53D)	M2 + DATE
HPLS_M4	--	0x36 (54D)	L1-GNSS: -- MULTI-FREQ:M2 + IMU DATA
HPLS_CAL			Inclination Raw Data Information for Factory use only

Table 5 describes the valid bit fields map, for all messages in HPLS®-2G.

Table 34. Valid Bit Field Message Mapping

Bit Number	Description	Bit Number	Description
15	Primary Lock	7	Turn On Inclinometer BIT
14	Secondary Lock	6	PPS Valid
13	DGPS Lock	5	Temperature Valid
12	Diff Lock	4	Inclination Pitch Valid
11	HDT Lock	3	Inclination Roll Valid
10	Static Status	2	CSEP Valid
9	Yaw Filter Valid	1	HDT Valid
8	Turn On GPS BIT	0	GGA Valid

- Lock\Status bits - (bits 10-15) System status information
- BIT bits - (bits 7,8) Two bits (built-in test results), examined and set only when HPLS®-2G is powered up.
- Valid bits - (bits 0-6,9) Indicate receipt of a new value

 Note	Bits 9 and 10 are only used by the MULTI-FREQ system. L1-GNSS does not use these bits.
---	--

3.2.1.3. L1-GNSS FRAME TYPES


3.2.1.3.1. Frame Type 17 - HPLS M1 - Basic Information

Data Size: 0x3D (61D)

Frame Type ID (L1-GNSS): 0x11 (17D)

Table 35. Field Type 17D

Field Name	Length (Bytes)	Data Type (c)	Remarks
Index	2	Unsigned short	
Software Version	2	Unsigned short	
CSEP	4	Float	
GPS UTC	8	Double	
GPS Latitude	8	Double	
GPS Longitude	8	Double	
GPS Altitude	4	Float	
Quality	1	Unsigned char	
Number of Satellites	1	Unsigned char	
Reserved	2	Unsigned short	
Temperature	4	Float	
Roll	4	Float	
Pitch	4	Float	
Yaw	4	Float	

 Note	The Yaw field accuracy is retained as long as the CSEP value does not differ from the given MSEP by more than +/- 10 mm.
---	--

3.2.1.3.2. Frame Type 42 - HPLS M2

Data Size: 0x41 (65D)
 Frame Type ID: 0x2A (42D)

Table 36. Field Type 42

Field Name	Length (Bytes)	Data Type (c)	Remarks
Index	2	Unsigned short	
Software Version	2	Unsigned short	
CSEP	4	Float	
GPS UTC	8	Double	
GPS Latitude	8	Double	
GPS Longitude	8	Double	
GPS Altitude	4	Float	
Quality	1	Unsigned char	
Number of Satellites	1	Unsigned char	
Reserved	2	Unsigned short	
Temperature	4	Float	
Roll	4	Float	
Pitch	4	Float	
Yaw	4	Float	
MSEP	4	Float	

3.2.1.3.3. Frame Type 43 - HPLS M3 - TBD

Data Size: 0x59 (89D)
 Frame Type ID: 0x2B (43D)

Table 37. Field Type 43

Field Name	Length (Bytes)	Data Type (c)	Remarks
Index	2	Unsigned short	
Software Version	2	Unsigned short	
CSEP	4	Float	
GPS UTC	8	Double	

Field Name	Length (Bytes)	Data Type (c)	Remarks
GPS Latitude	8	Double	
GPS Longitude	8	Double	
GPS Altitude	4	Float	
Quality	1	Unsigned char	
Number of Satellites	1	Unsigned char	
Reserved	2	Unsigned short	
Temperature	4	Float	
Roll	4	Float	
Pitch	4	Float	
Yaw	4	Float	
MSEP	4	Float	
Day	1	Unsigned char	
Month	1	Unsigned char	
Year	2	Unsigned short	

3.2.1.4. Multi-Freq FRAME TYPES


3.2.1.4.1. Frame Type 51 - HPLS M1 - Basic Information

Data Size: 0x3D (61D)

Frame Type ID (Multi-Freq):0x33 (51D)

Table 38. Field Type 51

Field Name	Length (Bytes)	Data Type (c)	Remarks
Index	2	Unsigned short	
Software Version	2	Unsigned short	
CSEP	4	Float	
GPS UTC	8	Double	
GPS Latitude	8	Double	
GPS Longitude	8	Double	
GPS Altitude	4	Float	
Quality	1	Unsigned char	
Number of Satellites	1	Unsigned char	
Reserved	2	Unsigned short	
Temperature	4	Float	
Roll	4	Float	
Pitch	4	Float	
GMYaw	4	Float	Filtered Yaw Static Dependent

 Note	<p>The Yaw field accuracy is retained as long as the CSEP value does not differ from the given MSEP by more than +/- 10 mm. For Multi-Freq system, the GMYaw is guaranteed when system is static, otherwise standard Yaw accuracy is given.</p>
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3.2.1.4.2. Frame Type 52 - HPLS M2

Data Size: 0x41 (65D)

Frame Type ID: 0x34 (52D)

Table 39. Field Type 52

Field Name	Length (Bytes)	Data Type (c)	Remarks
Index	2	Unsigned short	
Software Version	2	Unsigned short	
CSEP	4	Float	
GPS UTC	8	Double	
GPS Latitude	8	Double	
GPS Longitude	8	Double	
GPS Altitude	4	Float	
Quality	1	Unsigned char	
Number of Satellites	1	Unsigned char	
Reserved	2	Unsigned short	
Temperature	4	Float	
Roll	4	Float	
Pitch	4	Float	
Yaw	4	Float	
GMYaw	4	Float	Filtered Yaw

3.2.1.4.3. Frame Type 53 - HPLS M3 - TBD

Data Size: 0x59 (89D)

Frame Type ID: 0x35 (53D)

Table 40. Field Type 53

Field Name	Length (Bytes)	Data Type (c)	Remarks
Index	2	Unsigned short	
Software Version	2	Unsigned short	
CSEP	4	Float	
GPS UTC	8	Double	
GPS Latitude	8	Double	
GPS Longitude	8	Double	
GPS Altitude	4	Float	
Quality	1	Unsigned char	
Number of Satellites	1	Unsigned char	
Ext. Flags	2	Unsigned short	
Temperature	4	Float	
Roll	4	Float	
Pitch	4	Float	
Yaw	4	Float	
GMYaw	4	Float	Filtered Yaw
Day	1	Unsigned char	
Month	1	Unsigned char	
Year	2	Unsigned short	

3.2.1.4.4. Frame Type 54 - HPLS M4 - TBD

Data Size: 0x71 (113D)

Frame Type ID: 0x36 (54D)

Table 41. Field Type 54

Part ID	Part Name	Quantity	Remarks
Index	2		
Software Version	2		
CSEP	4	Float	
GPS UTC	8	Double	
GPS Latitude	8	Double	
GPS Longitude	8	Double	
GPS Altitude	4	Float	
Quality	1	Unsigned char	
Number of Satellites	1	Unsigned char	
Ext. Flags	2	Unsigned short	
Temperature	4	Float	
Roll	4	Float	
Pitch	4	Float	
Yaw	4	Float	
GMYaw	4	Float	Filtered Yaw
Acc-X	4	Float	
Acc-Y	4	Float	
Acc-Z	4	Float	
Gyro-X	4	Float	
Gyro-Y	4	Float	
Gyro-Z	4	Float	

3.2.2. NMEA 0183 Messages (Port B)

NMEA 0183, a communications standard established by the National Marine Electronics Association (NMEA), provides data definitions for a variety of navigation instruments and related equipment (such as gyrocompasses, Loran receivers, echo sounders, and GPS receivers).

NMEA 0183 functionality, standard on all GPS equipment, uses an ASCII character format so it is possible to read data, via a receiving device, with terminal software.

Table 42. Port B Messages

Message Code	Port B Defaults	Max Rate [Hz]	Description
GSA	Off	1	GPS DOP and active satellite information
GST	Off	1	GNSS pseudo-range error statistics
GSV	Off	1	GNSS satellite in view
PRE	Off	1	Range residual message
ZDA	Off	20	UTC time and date information
GGA	10	20	Detailed GPS position information
GLL	Off	20	Latitude and longitude data
GNS	Off	20	Fixes data for single or combined satellite navigation systems
RMC	Off	20	Recommended minimum specific GNSS data
VTG	Off	20	Course overground and ground speed
HDT	10	20	True heading of the vessel
SHR	Off	1	True Heading of the vessel with standard deviation
GBS	Off	1	Position Errors in meters
HPR			True Heading of the vessel

3.2.3. NMEA 0183 - Generic Message Structure

The system transmits the data from all messages in sentences that contain only printable ASCII characters, in addition to the CR (carriage return - 0x0D) and LF (line feed - 0x0A) characters.

Table 43. NMEA Generic Message Structure

				Repeatable 1...N				
Parameter	Header	Talker Field	Message Code	Delimiter	Data Field	Pre- CkSum	Checksum	Footer
Value	\$	GP	ZZZ	,		*	CC	<CR><LF>
Bytes	1	2	3	1	x	1	2	2

In the NMEA 0183 generic message structure:

- Every sentence starts with a \$ sign and ends with <CR> and/or <LF> characters.
- A GP character (the GPS talker code) follows every header.
- The message code is appended to the GPS talker code (for example, GPGGA, or GPGLL).
- A comma delimiter follows the message code to separate data fields, which may contain characters and/or numbers.
- Numbers can be either integers or floats, but floats include a period as part of the data field.
- An asterisk (*) at the end of the data field information indicates that the characters following it are part of the checksum.
- The checksum includes all characters, except for the \$ and * characters.

3.2.4. GPS Message Information

The tables in this section describe the data field structures and meanings for each GPS message.

Table 44. GGA Message

Message	GGA
Description	Detailed GPS position information
Rates [Hz]	0,1,2,3,4,10,20
Message Format	
\$GPGGA,HHMMSS.SS,DDMM.MMMMM,S,DDDMM.MMMMM,S,N,QQ,PP.P,AAAA.AA,M,±XX.XX,M, SSS,AAAA*CC<CR><LF>	
Message Field	Description
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
DDMM.MMMM M	Latitude in degrees, minutes, and decimal minutes
S	S => N (North Latitude) or S (South latitude)
DDDMM.MMM MM	Longitude in degrees, minutes, and decimal minutes
S	S => E (East longitude) or W (West longitude)
N	Quality indicator
•	0 = no position
•	1 = un-differentially corrected position (autonomous)
•	2 = differentially corrected position
QQ	Number of satellites used in position computation
PP.P	Horizontal dilution of precision (HDOP), ranging from 0.0 to 9.9
AAAA.AA	Antenna altitude
M	Altitude units in meters
+/-XX.XX	Geoidal separation (needs geoidal height option)
M	Geoidal separation units, in meters
SSS	Age of differential corrections, in seconds
AAAA	Reference station identification
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 45. GLL Message

Message	GLL
Description	Latitude and longitude data
Rates [Hz]	0,1,2,10,20
Message Format:	
\$GPGLL,DDMM.MMMMM,S,DDDMM.MMMMM,S,HHMMSS.SS,S*CC<CR><LF>	
Message Field	Description
DDMM.MMMM M	Latitude in degrees, minutes, and decimal minutes
S	S = N (North Latitude) or S = S (South latitude)
DDDMM.MMM MM	Longitude in degrees, minutes, and decimal minutes
S	S = E (East longitude) or S = W (West longitude)
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
S	Status S = A (valid) or S = V (invalid)
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 46. GNS Message

Message	GNS
Description	Fixes data for single or combined (GPS, GLONASS, potential future satellite systems, and systems combining these) satellite navigation systems
Rates [Hz]	0,1,2,10,20
Message Format:	
\$GPGNS,hhmmss.ss,lll.ll,a,yyyyy.yy,a,mm,ss,h.h,a.a,g.g,d.d,r.r*CC<CR><LF>	
Message Field	Description
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
lll.ll	Latitude
a	N/S
yyyyy.yy	Longitude
a	E/W
mm	Mode indicator
ss	Total number of satellites in use, 00-99
h.h	HDOP
a.a	Antenna altitude, in meters, re: mean-sea-level (geoid)
g.g	Geoidal separation (in meters)
d.d	Age of differential data
r.r	Differential reference station ID
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 47. GSA Message

Message	GSA
Description	GPS DOP and active satellite information. Only satellites used in the position computation are present in this message. Null fields are present when data is unavailable due to the number of satellites tracked.
Rates [Hz]	0,1
Message Format:	
\$GPGSA,A,B,CC ... OO,P.P,Q.Q,R.R*CC<CR><LF>	
Message Field	Description
A	Satellite acquisition mode (M = manually forced to 2D or 3D, A = automatic swap between 2D and 3D)
B	Position mode (1 = fix not available, 2 = 2D fix, 3 = 3D fix)
CC ... OO	Satellites used in the position solution; a null field occurs if a channel is unused
P.P	Position Dilution of Precision (PDOP) = 1.0 to 9.9
Q.Q	Horizontal Dilution of Precision (HDOP) 1.0 to 9.9
R.R	Vertical Dilution of Precision (VDOP) = 1.0 to 9.9
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 48. GST Message

Message	GST
Description	GNSS pseudo-range error statistics and position accuracy
Rates	0,1
Message Format:	
\$GPGST,HHMMSS.SS,A.A,B.B,C.C,D.D,E.E,F.F,G.G*CC<CR><LF>	
Message Field	Description
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
A.A	Root mean square (rms) value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudo-ranges and differential GNSS (DGNSS) corrections.
B.B	Standard deviation of semi-major axis of error ellipse, in meters
C.C	Standard deviation of semi-minor axis of error ellipse, in meters
D.D	Error in Ellipse's semi major axis origination, in decimal degrees, true north
E.E	Standard deviation of latitude error, in meters
F.F	Standard deviation of longitude error, in meters
G.G	Standard deviation of altitude error, in meters
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 49. GSV Message

Message	GSV
Description	GNSS satellite in view Null fields occur where data is unavailable due to the number of satellites tracked.
Rates	0,1
Message Format:	
\$GPGSV,T,M,N,II,EE,AAA,SS,...II,EE,AAA,SS*CC<CR><LF>	
Message Field	Description
T	Total number of messages
M	Message number (1 to 3)
N	Total number of satellites in view
II	Satellite number
EE	Elevation, in degrees (0 to 90)
AAA	Azimuth (true), in degrees (0 to 359)
SS	Signal strength, in dB-Hz (0 - 99)
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 50. RMC Message

Message	RMC
Description	Contains recommended minimum specific GNSS data
Rates	0,1,2,10
Message Format:	
\$GPRMC,HHMMSS.SS,A,DDMM.MMM,N,DDDMM.MMM,W,Z.Z,Y.Y,DDMMYY,D.D,V*CC<CR><LF>	
Message Field	Description
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
A	Status: A = Valid, V = Invalid
DDMM.MMM	Latitude in degrees, minutes, and decimal minutes
N	Latitude location: N = North, S = South
DDDMM.MMM	Longitude in degrees, minutes, and decimal minutes
W	Longitude location: E = East, W = West
Z.Z	Ground Speed, in knots
Y.Y	Track made good, reference to true north
DDMMYY	UTC date of position fix in day, month, and year
D.D	Magnetic Variation, in degrees
V	Variation sense (E = East, W = West)
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 51. PRE-Message

Message	PRE
Description	Satellite range residuals and estimated position error
Rates	0,1
Message Format:	
\$GPRRE,N,II,RR ... II,RR,HHH.H,VVV.V*CC<CR><LF>	
Message Field	Description
N	Number of satellites used in position computation
II	Satellite number
RR	Range residual, in meters
HHH.HH	Horizontal position error estimate, in meters
VVV.V	Vertical position error estimate, in meters
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 52. VTG Message

Message	VTG
Description	Course overground and ground speed
Rates	0,1,2,10,20
Message Format:	
\$GPVTG,TTT,T,MMM,M,NNN.NN,N,KKK.KK,K,X*CC<CR><LF>	
Message Field	Description
TTT	True course overground (COG) in degrees (000 to 359)
T	True course overground indicator (always 'T')
MMM	Magnetic course over ground in degrees (000 to 359)
M	Magnetic course overground indicator (always 'M')
NNN.NN	Speed overground in knots
N	Speed overground in knots indicator (always 'N')
KKK.KK	Speed overground in km/h
K	Speed overground in km/h indicator (always 'K')
X	Mode A = Autonomous mode D = Differential mode E = Estimated (dead reckoning) mode M = Manual input mode S = Simulator mode N = Data not valid
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 53. ZDA Message

Message	ZDA
Description	UTC time and date information
Rates	0,1,2,10,20
Message Format:	
\$GPZDA,HHMMSS.SS,DD,MM,YYYY,XX,YY*CC<CR><LF>	
Message Field	Description
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
DD	Day (0 to 31)
MM	Month (1 to 12)
YYYY	Year
XX	Local zone description in hours (-13 to 13)
YY	Local zone description in minutes (0 to 59)
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 54. HDT Message

Message	HDT
Description	True heading of the vessel This is the direction that the vessel (antennas) is pointing and is not necessarily the direction of vessel motion (the course over ground).
Rates	0,1,2,10,20
Message Format:	
\$GPHDT,x.x,T*CC<CR><LF>	
Message Field	Description
x.x	Current Heading, in degrees
T	Indicates true heading (always T)
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 55. SHR Message

Message	SHR
Description	Time, Heading, Roll or Pitch data
Rates	0,1
Message Format:	
\$PASHR,HHMMSS.SS,HHH.HH,T,RRR.RR,PPP.PP,heave,rr.rrr,pp.ppp,hh.hhh,QF *CC<CR><LF>	
Message Field	Description
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
HHH.HH	Heading Value in decimal degrees
T	True Heading (T displayed if heading is relative to true North).
RRR.RR	Roll in decimal degrees (- sign will be displayed when applicable)
PPP.PP	Pitch in decimal degrees (- sign will be displayed when applicable)
Heave	Heave, in meters
rr.rrr	Roll standard deviation in decimal degrees
pp.ppp	Pitch standard deviation in decimal degrees
hh.hhh	Heading standard deviation in decimal degrees
QF	Quality Flag: 0=No Position, 1= All non-RTK Fixed, 2 = RTK Fixed
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 56. GBS Message

Message	GBS
Description	Used to support Receiver Autonomous Integrity Monitoring (RAIM)
Rates	0,1
Message Format:	
\$PSAT,GBS,HHMMSS.SS,II.I,LL.L,aa.a,ID,p.ppppp,b.b,s.s,flag*CC<CR><LF>	
Message Field	Description
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
II.I	Expected error in latitude
LL.L	Expected error in longitude
aa.a	Expected error in altitude
ID	ID number of failed satellite
p.ppppp	Probability of HPR fault
b.b	Estimate of range bias, in meters, on failed satellite
s.s	Standard deviation of range bias estimate
flag	Based on Horizontal radius: 0=Good, 1=Warning, 2=Bad or fault
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

Table 57. HPR Message

Message	HPR
Description	Proprietary NMEA message that provides Heading, Pitch, Roll and Time
Rates	0,1,2,10,20
Message Format:	
\$PSAT,HPR,HHMMSS.SS,heading,pitch,roll,type*CC<CR><LF>	
Message Field	Description
HHMMSS.SS	UTC time in Hours [HH], Minutes [MM], and seconds [SS.SS] of GPS Position
Heading	Heading (degrees)
Pitch	Pitch (degrees)
Roll	Roll (degrees)
type	N for GPS derived Heading, G for Gyro derived Heading
*CC	Checksum
<CR>	Carriage return
<LF>	Line feed

AUTHORIZATION TABLE

Document Information					
Document:	<Document Name>	Site:	<SITE NAME>		
Purpose:	<Operational Document/Acceptance Document/Technical Reference Document>				
Authorization					
Approved by:	Role	Name	Approval Date	Signature	

TABLE OF REVISIONS

Ver. #	Description	Author/s	Date
<0.0>			<DAY> <MONTH> <YEAR>