

REQUEST FOR QUOTATION

	BHARAT HEAVY ELECTRICALS LIMITED Electronics Division PB No. 2606, Mysore Road Bangalore - 560026 INDIA	RFQ NUMBER: RKR0000037 RFQ DATE : 28.12.2017	Due Date/Day: 19.01.2018 FRI Time : 13:00 HRS Tender Box : Reception Area Opening Venue: NEW ENGG. BLDG
MMI:PU:RF:003			
(address for communication) :		(for all correspondence) Purchase Executive : Rishav kumar Phone : 080 25146194 Fax : E-mail: rishav@bheledn.co.in	

1. Please drop your offer before due date & time in the tender at the reception of BHEL-ESD, Electronic city phase-1, Bangalore.
2. Offers by e-mail are also accepted. The offers by Email shall be sent to Email ID defnesdmm@bheledn.co.in
3. Reference documents to be completely read, understood and should be acceptable to bidder:
 - PS-460-0168 Rev-01
 - RFQ additional terms and conditions
 - Commercial clarifications (To be filled and submit along with offer)
 - ITB and GCC (Available in www.bheledn.co.in)
4. Items should be delivered to
 BHEL-ESD,
 PLOT NO 98,
 ELECTRONIC CITY PHASE 1,
 HOSUR ROAD,
 BANGALORE-560100,
 KARNATAKA.

Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
1	DS0830002389 MODBUS NMEA Protocol Translator * HSN/SAC : 8523 Test Certificate MODBUS NMEA Protocol Translator, as per PS-460-0168.	5	NO	5	01.03.2018

Total Number of Items - 1

- 1.
- 2.

TWO PART BID - SUBMIT TECHNICAL AND PRICE BID IN SEPARATE SEALED COVERS

NOTES :

1. This RFQ is Governed by :
 - a) INSTRUCTIONS TO BIDDERS/SELLERS (Doc No : BHEL:EDN:ITB-SHOP) available at **www.bheledn.com (RFQ-P0 Terms & Conditions)**
 - b) GENERAL CONDITIONS OF CONTRACT FOR PURCHASE (Doc no : BHEL:EDN:GCC-SHOP) available at **www.bheledn.com (RFQ-P0 Terms & Conditions)**
 - c) Any other specific Terms and Conditions mentioned.
2. Bidders / Representatives who would like to be present during opening of offers are required to furnish authorization letter for the same .
- * The HSN/SAC no mentioned against the line items in the RFQ are indicative only.

For and On behalf of BHEL.

Rishav kumar
Contrl Eqpmnt - ESD

1 OF 1

ADDITIONAL TERMS AND CONDITIONS

(RFQ NO. RKR0000037)

1. Separate offer in English language addressed to the Purchase Executive shall be made for this RFQ in two parts.

Two Part Bid : Offer shall be made in two parts as detailed below:

“Techno-commercial Bid (Part I Bid)” : Techno-commercial Bid to be placed in a separate envelope super scribed with RFQ No., Due Date and “Techno-commercial Bid (Part II Bid)”. This bid should contain all commercial terms i.e. delivery terms, payment terms, applicable taxes/duties etc.

“Price Bid (Part II Bid)” : Price of the offered item to be placed in a separate sealed envelope super scribed with RFQ No & Due Date.

The two sealed envelopes shall be placed in another sealed envelope super scribed with RFQ No & Due Date.

Techno-commercial bid will be opened on due date. Price bid (part II) will be opened for the vendors who are qualified in the Techno-commercial bid.

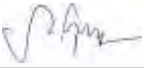
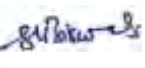
1. Reference documents to be completely read, understood and should be acceptable to bidder:
 - PS-460-0168 Rev-01
 - RFQ additional terms and conditions
 - Commercial clarifications (To be filled and submit along with offer)
 - ITB and GCC (Available in www.bheledn.co.in)
2. All technical specification to comply to BHEL Doc Ref No. PS-460-0168 Rev 01
3. Supplier has to give clause wise compliance to PS-460-0168 Rev 01
4. 2 year Standard Guarantee / Warranty required from the date of supply
5. Documents to be provided along with the offer:
 - Datasheets/ Catalogues
 - Distributor's authorization certificate , if applicable
6. Documents to be provided along with the supply of the items
 - a. Functional Test certificate

- b. Certificate of Conformance to specification
 - c. Conformation to be provided in Technical offer.
7. DELIVERY : 16 weeks from date of Purchase Order.
 8. Terms & Conditions shall be as per Doc Ref Doc no: BHEL: EDN: GCC – SHOP: Rev00, Instructions to bidders as per Doc no: BHEL: EDN: ITB – SHOP: Rev02, and Annexures.
 9. Price basis shall be firm; Price Variation Clause is NOT acceptable.
 10. Tender opening Time is 01:30 PM on the tender due date, Place: Tender opening room @ BHEL-ESD, Electronic city, Bangalore.
 11. Please drop your offer before due date & time in the tender box named **“Friday”** kept at the reception of BHEL-ESD, Electronic city, Bangalore.
 12. Items should be delivered to

**BHEL-ESD,
PLOT NO 98,
ELEGTRONIC CITY PHASE 1,
HOSUR ROAD,
BANGALORE-560100,
KARNATAKA.**

Commercial Terms Discussion For RKR0000037 (NMEA - MODBUS IBS protocol translator)

Sl. No.	BHEL Terms	Complied (Yes/No)	Remarks
1	Payment Terms (100% within 45 days after receipt and acceptance of material)		
2	Penalty (0.5% per week on the basic value of the undelivered quantity max upto 10%)		
4	Delivery time 16 weeks from the date of Purchase order		
5	Price Firm (PVC not acceptable- Prices should be firm till execution of order)		
6	Packing And Forwarding By Supplier		
7	Free Door Delivery at BHEL ESD		
8	Offer Validity (90 days from the tender opening)		
9	Taxes & duties to be mentioned in offer		
10	Warranty 2 year standard guarantee / warranty required from the date of supply		
11	Commissioning Offer should include commissioning of the system onboard the ship		
12	Demonstration Supplier to demonstrate the functionality of the unit at BHEL - ESD at the time of delivery		
13	Documents to be provided along with offer - Datasheets/ Catalogues - Clausewise technical compliance to the purchase specification - Distributor's authorisation certificate , if applicable		
13	Confirmation of Documents to be provided along with supply - Functional Test certificate - certificate of Conformance to specification		

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COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY		PURCHASE SPECIFICATION OF NMEA - MODBUS IBS PROTOCOL TRANSLATOR				
		REVISION 01			APPROVED 	
					PREPARED 	ISSUED 
					DATE 20-12-17	

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REVISION HISTORY SHEET FOR PURCHASE SPECIFICATION						
COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY	REV NO	DATE	NATURE OF CHANGE	REASON FOR CHANGE	PREPARED BY	APPROVED BY
	00	21/07/2017	First Issue	--	JJ	SP
	01	20/12/2017	Second issue	Added marine grade to avoid coml. Grade modules	JJ/GLB	SP

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		AUTHOR’S ABSTRACT: The purpose of this document is to define the features, functionalities and capabilities of NMEA-MODBUS IBS Protocol Translator to be supplied by BHEL-GE Avio for P71 IPMS project.		
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1. INTENT OF SPECIFICATION

- 1.1 This specification covers the features, functionalities and capabilities of the NMEA - MODBUS Protocol Translator to be developed & supplied.
- 1.2 It is not the intent to specify completely herein all the details of design and construction of equipment. However, the equipment shall be complete in all respects conforming to high standards of components which may not have been specifically mentioned, but are essential for satisfactory and trouble free operation/maintenance of the equipment.
- 1.3 The supplier while quoting shall go through the specifications in detail and all the attachments thereof and furnish all documentation as indicated elsewhere in the specification. Deviations from specifications, if any, should be clearly specified. Compliance shall be assumed if not mentioned otherwise.

2. GENERAL TERMS

- 2.1 The supplier must clearly quote for unit price as well as lot price for deliverables including accessories and cables if any, for indisputable calculations of lot prices in case of revised quantities later.
- 2.2 Any deviations with respect to the above specification should be brought out in the offer otherwise offer may be rejected.

3. SCOPE OF SUPPLY

- 3.1 The scope of supply will include the following deliverables:
 - a) NMEA - MODBUS Protocol Translator - 5 nos.
 - b) User Manual (Hard & Soft copy) - 5 nos.

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		4. EXCLUSIONS --- Nil -----		
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6. OVERVIEW OF NMEA - MODBUS PROTOCOL TRANSLATOR

6.1 The proposed **Protocol Translator** is a combination of Hardware & firmware which will function as a bidirectional protocol translator that will convert the electrical and communication protocols between NMEA 0183 to Modbus and vice versa.

The Protocol Translator shall:

- Translate the serial data coming from ships Integrated Bridge System (IBS) in NMEA 0183 over Ethernet format to Modbus over TCP/IP which will be sent to Integrated Platform Management System (IPMS) over Ethernet.
- Translate the serial data coming from IPMS in Modbus over TCP/IP format to NMEA 0183 over Ethernet which will be sent to IBS.
- It should have the provision to accept two redundant power supplies (24V DC).

6.2 Connection Description

The connection between IPMS and IBS shall be according to the following Single Line block diagram. The connection is redundant (two Ethernet lines connect IPMS to IBS).

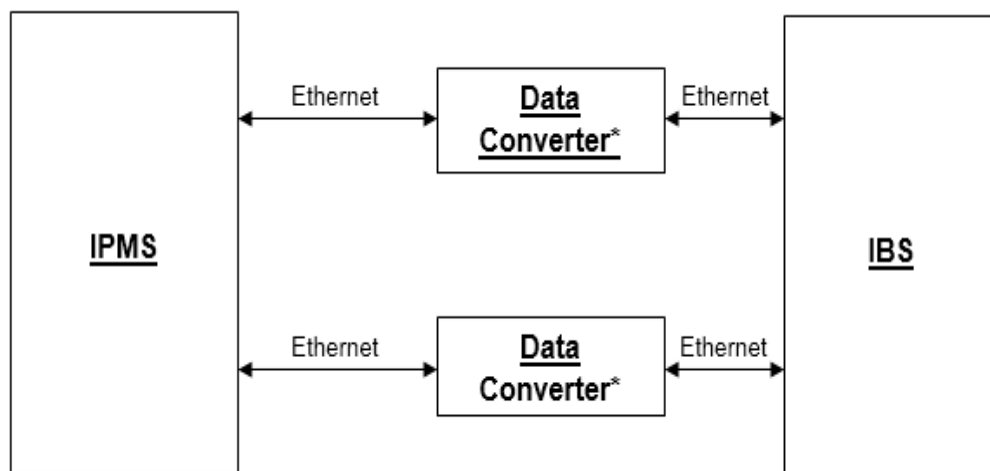


Figure 1 - Block Diagram Of IPMS-IBS Interface



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6.3 Interface Description

Physical interface type	: 100 Mbit/s Ethernet link
Direction Mode	: Bi-directional
IPMS - RTU40 IP Address	: 191.1.1.40 (Provided by IPMS)
IPMS - RTU49 IP Address	: 191.2.1.49 (Provided by IPMS)
IPMS (Ring 1 Router) IP address	: 191.1.0.111 (Provided by IPMS)
IPMS (Ring 2 Router) IP address	: 191.2.0.111 (Provided by IPMS)
Protocol Translator Ring 1 IP Address	: 10.8.1.152 (Provided by IBS)
Protocol Translator Ring 2 IP Address	: 10.8.2.152 (Provided by IBS)
IPMS Port No.	: 502
IPMS (Ring1/2) Subnet Mask	: 255.255.254.0
Protocol Translator Subnet Mask	: 255.255.255.0 (Provided by IBS)

The connection is redundant. IPMS is the communication Master. The lines are always active, data are at any time exchanged through the redundant line. The Communication is Asynchronous.

6.4 Hardware

The hardware should be based on a microcontroller and should be able to operate in marine environment continuously. The hardware module proposed to be used for protocol translator to be marine qualified for use in ships.

6.5 IPMS To IBS Communication

Input = MODBUS over TCP; Output = NMEA over TCP

A designated IPMS node (RTU 40 & RTU49) over Ethernet will act as MODBUS client/master, and will be listening to fixed port that is the server (converter). MODBUS to NMEA controller will do read and write operations based on the function calls of Modbus/NMEA and create NMEA sentence and transmit to IBS.



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Input = NMEA 0183 over TCP, Output = MODBUS over TCP

Here the Protocol Translator will listen to designated port for valid NMEA sentence. Upon reception of a valid NMEA sentence, it will fill decode the data and format the same and will update the Modbus registers of a MODBUS server inside the controller which will be queried by any IPMS node which is MODBUS MASTER the controller will take care of the function calls, error handling and communication failure for both IBS and IPMS.

6.6 Software

The software should take care of the conversion of serial data between IBS and IPMS as per the protocol information given in the preceding section of this document. The protocol standards are based on NMEA 0183 and Modbus, is custom formatted to the specific application.

The protocol conversion standards can be broadly divided into two sections:

- a) The data format and communication parameters for NMEA 0183 with applicable sentences corresponding to the signal information, valid sentences (function codes) and their break up.(for both IBS and IPMS).
- b) The data format and communication parameters for standard Modbus with signals and corresponding registers and function codes (for both IBS and IPMS).

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COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY	7. GENERAL COMMUNICATION ARCHITECTURE FOR NMEA 0183		
	7.1 General Description		
	NMEA 0183 devices implemented are designated both as talkers or listeners implementing an asynchronous interface. All data is transmitted in the form of sentences. Only printable ASCII characters are allowed, plus CR (Carriage Return) and LF (Line Feed). Each sentence starts with a "\$" sign and ends with <CR><LF>. There are three basic kinds of sentences: Talker Sentences, Proprietary Sentences and Query Sentences. a) Talker Sentences The general format for a talker sentence is: \$tsssd1,d2,...<CR><LF> The first two letters following the "\$" are the talker identifier. The next three characters (sss) are the sentence identifier, followed by a number of data fields separated by commas, followed by a checksum, and terminated by carriage return/line feed. The data fields are uniquely defined for each sentence type. An example talker sentence is: \$HCHDM,238,M<CR><LF> where "HC" specifies the talker as being a magnetic compass, the "HDM" specifies the magnetic heading message follows. The "238" is the heading value, and "M" designates the heading value as magnetic. b) Proprietary Sentences The standard allows individual manufacturers to define proprietary sentence formats. These sentences start with "\$P", then a 3 letter manufacturer ID, then a character identifying the message type, followed by whatever data the manufacturer wishes, following the general format of the standard sentences. c) Query Sentences A query sentence is a means for a listener to request a particular sentence from a talker. The general format is: \$ttlIQ,sss,[CR][LF]		



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The first two characters of the address field are the talker identifier of the requester and the next two characters are the talker identifier of the device being queried (listener). The fifth character is always a "Q" defining the message as a query. The next field (sss) contains the three letter mnemonic of the sentence being requested.

An example query sentence is:

\$CCGPQ,GGA<CR><LF>

where the "CC" device (computer) is requesting from the "GP" device (a GPS unit) the "GGA" sentence.

The GPS will then transmit this sentence once per second until a different query is requested.

The sentences sent by IBS will have the talker identifier set to IN.

The information sent by the IPMS are not foreseen in the NMEA 0183 standard, so they are considered as Proprietary: sentences sent by PMS will have the talker identifier set to PPMS (being P the identification of proprietary sentence and PMS the manufactured ID).

All sentences are sent via TCP on registered port.

7.2 Transmission Mode

A sentence may contain up to 74 characters plus "\$" and CR/LF. If data for a field is not available, the field is omitted, but the delimiting commas are still sent, with no space between them. The checksum field consists of a "*" and two hex digits representing the exclusive OR of all characters between, but not including, the "\$" and "*". Byte interpretation is Big Endian (higher order byte first).

7.3 Interface Priority

The communication is set up in multi-master mode, so each talker (IPMS or IBS) sends its messages asynchronously

7.4 Function Codes Supported

The following NMEA 0183 sentences shall be implemented in the IPMS and IBS. All the other codes are managed as unknown commands.

Sender	Talker Identifier	Sentence Identifier	Description
IBS	IN	RMC	Recommended Minimum Navigation Information
IBS	IN	HDM	Heading - Magnetic OSD Own Ship Data



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IBS	IN	ROT	Rate Of Turn
IBS	IN	MDA	Meteorological
IBS	IN	WPL	Waypoint Location
IBS	IN	RTE	Routes
IBS	IN	VBW	Dual Ground/Water Speed
IBS	IN	HTD	Heading/Track Control Data
IBS	IN	HSC	Heading Steering Command
IPMS	P	PMSA	IPMS - APMS status and data (type 1)
IPMS	P	PMSB	IPMS - APMS status and data (type 2)
IPMS	P	PMSC	IPMS - Propulsion System status (type 1)
IPMS	P	PMSD	IPMS - Propulsion System status (type 2)
IPMS	P	PMSE	IPMS - Propulsion System data
IPMS	P	PMSF	IPMS - NBCD status

Table 1 - NMEA 0183 Sentences Description

7.5 Data Elements

In the proceeding part of this document, the format and the content of all defined sentences is outlined.

7.6 Redundant Connection Handling

The connection between IPMS and IBS is redundant.

Both IPMS and IBS shall send the sentences on both network.

IPMS and IBS will normally listen for incoming sentences on both connections, but they will normally manage the incoming sentences only on connection #1: i.e. if both connection are alive the sentences received on connection #2 are discharged

In case of connection #1, the incoming sentences on connection #2 have to be managed.

7.7 Error Handling

- If data for a field is not available, the field is omitted, but the delimiting commas are still sent, with no space between them (refer to §4.2)
- IBS shall raise a communication (one of the 2 available) breakdown alarm if in any 5 sec period no valid message is received from the IPMS on that connection.

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COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARATHEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY		c) If the other connection is available, IBS should manage the sentence coming on this line.		
		d) In any case IBS shall continuously send its messages at the expected rate defined in §5 also on the failed connection.		
		e) IBS shall in any case check the availability of both lines, and issue an error whenever one of the connection fails.		
		f) IPMS shall raise a communication (one of the 2 available) breakdown alarm if in any 2 sec period no valid message is received from the IBS on that connection.		
		g) IF the other connection is available, IPMS should manage the sentence coming on this line.		
		h) In any case IPMS shall continuously send its messages at the expected rate defined in §5 also on the failed connection.		
		i) IPMS shall in any case check the availability of both lines, and issue an error whenever one of the connection fails.		



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8. EXCHANGED MESSAGES

All the data sentences exchanged, in both directions, between the IPMS and the IBS are defined in the following paragraphs.

8.1 IBS Sentences

The following are the messages sent by IBS to IPMS

8.1.1 INRMC

NMEA has its own version of essential gps pvt (position, velocity, time) data. It is called RMC, The Recommended Minimum.

The message is sent to IPMS every 1 sec ($f=1.0$ Hz).

The NMEA standard format is:

\$INRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A<CR><LF>

With an interpretation of:

RMC	Recommended Minimum sentence C
123519	Fix taken at 12:35:19 UTC
A	Status A=active or V=Void.
4807.038	Latitude 48 deg 07.038'
N	North (or S= South)
01131.000	Longitude 11 deg 31.000'
E	East (or W= West)
022.4	Speed over the ground in knots
084.4	Track angle in degrees (Track made good) True 230313 Date - 23rd of March 2013
003.1	Magnetic Variation, degrees E East (or W= West)
*6A	The checksum data, always begins with *.

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		8.1.2 INHDM The HDM sentence concerns the Heading Magnetic. The message is sent to IPMS every 1 sec (f=1.0 Hz) The NMEA standard format is: 123 \$--HDM,x.x,M*hh<CR><LF> With an interpretation of: 1) Heading Degrees, magnetic 2) M = magnetic 3) Checksum.	
		8.1.3 INROT The ROT sentence concerns the Rate of Turn. The message is sent to IPMS every 2 sec (f=0.5 Hz) The NMEA standard format is: 123 \$--ROT,x.x,A*hh<CR><LF> With an interpretation of: 1) Rate Of Turn, degrees per minute, "-" means bow turns to port 2) Status, A means data is valid 3) Checksum	



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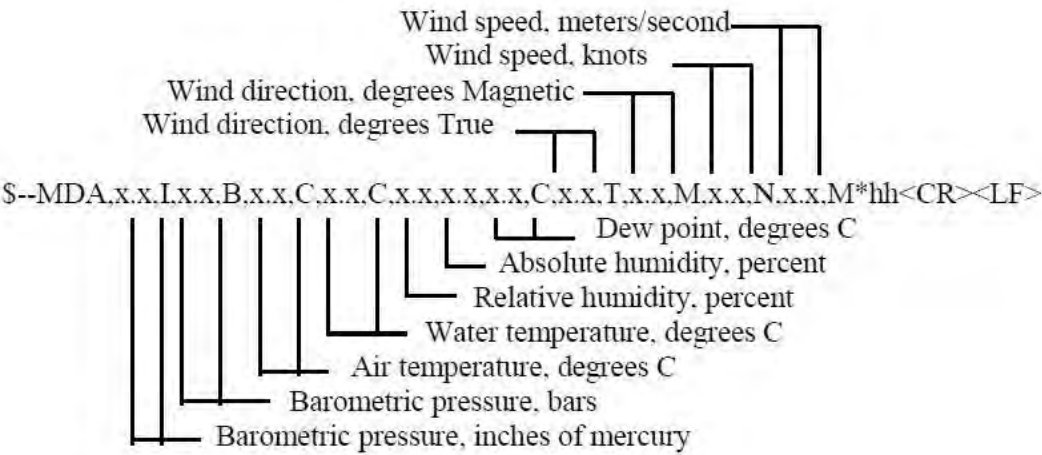
8.1.4 INMDA

The MDA sentence concerns the meteorological composite, in particular the

- Barometric Pressure
- Air & Water Temperature
- Relative Humidity
- Dew Point
- Wind Speed & Direction relative to surface of the earth

The message is sent to IPMS every 5 sec (f=0.2 Hz)

The NMEA standard format is:



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		8.1.5 INWPL															
COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY		The Waypoint Location data provides essential waypoint data. It is output when navigating to indicate data about the destination and is sometimes supported on input to redefine a waypoint location. Note that waypoint data as defined in the standard does not define altitude, comments, or icon data. When a route is active, this sentence is sent once for each waypoint in the route, in sequence. When all waypoints have been reported, the RTE sentence (refer to §5.1.6) is sent in the next data set. In any group of sentences, only one WPL sentence, or an RTE sentence, will be sent. The message(s) is sent to IPMS every time the route is changed. The NMEA standard format is: \$INWPL,4807.038,N,01131.000,E,WPTNME*5C<CR><LF> With an interpretation of: <table><tr><td>WPL</td><td>Waypoint Location</td></tr><tr><td>4807.038</td><td>Latitude 48 deg 07.038'</td></tr><tr><td>N</td><td>North (or S= South)</td></tr><tr><td>01131.000</td><td>Longitude 11 deg 31.000'</td></tr><tr><td>E</td><td>East (or W= West)</td></tr><tr><td>WPTNME</td><td>Waypoint Name</td></tr><tr><td>*5C</td><td>The checksum data, always begins with *</td></tr></table>		WPL	Waypoint Location	4807.038	Latitude 48 deg 07.038'	N	North (or S= South)	01131.000	Longitude 11 deg 31.000'	E	East (or W= West)	WPTNME	Waypoint Name	*5C	The checksum data, always begins with *
		WPL	Waypoint Location														
		4807.038	Latitude 48 deg 07.038'														
		N	North (or S= South)														
		01131.000	Longitude 11 deg 31.000'														
		E	East (or W= West)														
		WPTNME	Waypoint Name														
		*5C	The checksum data, always begins with *														

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		8.1.5 INRTE The RTE sentence is sent to indicate the names of the waypoints used in an active route. There are two types of RTE sentences. This route sentence can list all of the waypoints in the entire route or it can list only those still ahead. Because an NMEA sentence is limited to 74 characters there may need to be multiple sentences to identify all of the waypoints. The data about the waypoints themselves have been sent in a series of WPL sentences in previous cycles of the NMEA data. The message(s) is sent to IPMS every time the route is changed or a waypoint is reached (in this case only those waypoint still ahead are transmitted). The NMEA standard format is: \$INRTE,2,1,c,0,W3IWI,DRIVWY,32CEDR,32-29,32BKLD,32-I95,32-US1,BW-32*69<CR><LF> With an interpretation of: <table><tr><td>RTE</td><td>Waypoints in active route</td></tr><tr><td>2</td><td>Total number of sentences needed for full data</td></tr><tr><td>1</td><td>This is sentence 1 of 2</td></tr><tr><td>c</td><td>Type c = complete list of waypoints in this route</td></tr><tr><td>w</td><td>First listed waypoint is start of current leg</td></tr><tr><td>0</td><td>Route identifier</td></tr><tr><td>W3IWI</td><td>Waypoint identifiers (names)</td></tr><tr><td>*69</td><td>Checksum.</td></tr></table>		RTE	Waypoints in active route	2	Total number of sentences needed for full data	1	This is sentence 1 of 2	c	Type c = complete list of waypoints in this route	w	First listed waypoint is start of current leg	0	Route identifier	W3IWI	Waypoint identifiers (names)	*69	Checksum.
RTE	Waypoints in active route																		
2	Total number of sentences needed for full data																		
1	This is sentence 1 of 2																		
c	Type c = complete list of waypoints in this route																		
w	First listed waypoint is start of current leg																		
0	Route identifier																		
W3IWI	Waypoint identifiers (names)																		
*69	Checksum.																		



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The HDT sentence are sent by IBS to IPMS. It provides information on actual vessel heading in degrees True.

The NMEA standard format is:

S--HDT,x.x,T*hh<CR><LF>
 └──Heading, degrees True

8.1.7 INHSC

The HSC sentences are sent by IBS to IPMS.

The NMEA standard format is:

\$--HSC,x.x,T,x.x,M*hh<CR><LF>

└┐└┐ Commanded heading, degrees Magnetic

└┐ Commanded heading, degrees True



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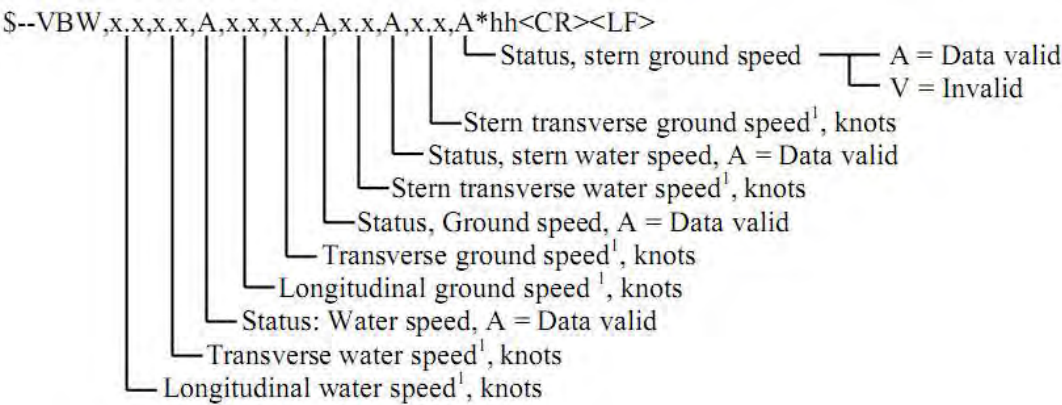
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8.1.8 INVBW

The VBW sentence are sent by IBS to IPMS, regarding Water Referenced and Ground Referenced Speed data.

The NMEA standard format is:



Note:

- Transverse Speed: “-“ = Port
- Longitudinal Speed: “-“ = Astern



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8.2 IPMS Sentences

The following are the messages sent by IPMS to IBS. They are proprietary sentences with PPMS (PPMSx where x is A to F) as Sentence identifier.

8.2.1 PPMSA

The proprietary sentence PPMSA is sent by IPMS to communicate the main APMS status and data.

The message is sent to IBS every 2 sec ($f=0.5$ Hz)

The format is:

\$PPMSA,A,b.bb,c.cc,D,e. ee,f. ff,G,h. hh,i. ii,J,k. kk,l. ll*hh<CR><LF>

With an interpretation of:

A	Status of DG1 (R= Running, S= Stopped, F= Failure)
b.bb	DG1 power available (in Mw)
c.cc	DG1 power generated (in Mw)
D	Status of DG2 (R= Running, S= Stopped, F= Failure)
e. ee	DG2 power available (in Mw)
f. ff	DG2 power generated (in Mw)
G	Status of DG3 (R= Running, S= Stopped, F= Failure)
h. hh	DG3 power available (in Mw)
i. ii	DG3 power generated (in Mw)
J	Status of DG4 (R= Running, S= Stopped, F= Failure)
k. kk	DG4 power available (in Mw)
l. ll	DG4 power generated (in Mw)
*hh	The checksum data, always begins with *

Note: It is assumed that the “power available” and “power generated” values in case of Stopped or Failure DG are null, so no data are transmitted.



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8.2.2 PPMSB

The proprietary sentence PPMSB is sent by IPMS to communicate the main APMS status and data.

The message is sent to IBS every 2 sec (f=0.5 Hz)

\$PPMSB,M,n.nn,o.oo,P,q.qq,r.rr,S,t.tt,u.uu,V,w.ww,x.xx,*hh<CR><LF>

With an interpretation of:

M	Status of DG5 (R= Running, S= Stopped, F= Failure)
n.nn	DG5 power available (in Mw)
o.oo	DG5 power generated (in Mw)
P	Status of DG6 (R= Running, S= Stopped, F= Failure)
q.qq	DG6 power available (in Mw)
r.rr	DG6 power generated (in Mw)
S	Status of DG7 (R= Running, S= Stopped, F= Failure)
t.tt	DG7 power available (in Mw)
u.uu	DG7 power generated (in Mw)
V	Status of DG8 (R= Running, S= Stopped, F= Failure)
w.ww	DG8 power available (in Mw)
x.xx	DG8 power generated (in Mw)
*hh	The checksum data, always begins with *

Note: It is assumed that the “power available” and “power generated” values in case of Stopped or Failure DG are null, so no data are transmitted.



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8.2.3 PPMSC

The proprietary sentence PPMSC is sent by IPMS to communicate the main Propulsion System status.

The message is sent to IBS every 2 sec ($f=0.5$ Hz)

The format is:

\$PPMSC,A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T*hh<CR><LF>

With an interpretation of:

- | | | |
|---|-----------------------|--|
| A | ECU1 available | (possible values "1" = Available, "0" = Not Available) |
| B | ECU2 available | (possible values "1" = Available, "0" = Not Available) |
| C | ECU3 available | (possible values "1" = Available, "0" = Not Available) |
| D | ECU4 available | (possible values "1" = Available, "0" = Not Available) |
| E | GT1 Status | (possible values "1" = Running, "0" = Not Running) |
| F | GT1 Status | (possible values "1" = Stopped, "0" = Not Stopped) |
| G | GT2 Status | (possible values "1" = Running, "0" = Not Running) |
| H | GT2 Status | (possible values "1" = Stopped, "0" = Not Stopped) |
| I | GT3 Status | (possible values "1" = Running, "0" = Not Running) |
| J | GT3 Status | (possible values "1" = Stopped, "0" = Not Stopped) |
| K | GT4 Status | (possible values "1" = Running, "0" = Not Running) |
| L | GT4 Status | (possible values "1" = Stopped, "0" = Not Stopped) |
| M | GT1 Clutch engaged | (possible values "1" = Engaged, "0" = Not Engaged) |
| N | GT1 Clutch disengaged | (possible values "1" = Disengaged, "0" = Not Disengaged) |
| O | GT2 Clutch engaged | (possible values "1" = Engaged, "0" = Not Engaged) |

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COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY		P	GT2 Clutch disengaged	(possible values “1” = Disengaged, “0”= Not Disengaged)
		Q	GT3 Clutch engaged	(possible values “1” = Engaged, “0”= Not Engaged)
		R	GT3 Clutch disengaged	(possible values “1” = Disengaged, “0”= Not Disengaged)
		T	GT4 Clutch engaged	(possible values “1” = Engaged, “0”= Not Engaged)
		S	GT4 Clutch disengaged	(possible values “1” = Disengaged, “0”= Not Disengaged)
				The checksum data, always begins with a *.



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8.2.3 PPMSD

The proprietary sentence PPMSD is sent by IPMS to communicate the main Propulsion System status.

The message is sent to IBS every 2 sec ($f=0.5$ Hz)

The format is:

\$PPMSD,M,N,O,P,Q,R,a,b,c,d,e,f,g,h,i,j*hh<CR><LF>

With an interpretation of:

M	Port Shaft Output shaft brake engaged	(possible values "1" = Engaged, "0"= Not Engaged)
N	Port Shaft Output shaft brake disengaged	(possible values "1" = Disengaged, "0"= Not Disengaged)
O	Stbd Shaft Output shaft brake engaged	(possible values "1" = Engaged, "0"= Not Engaged)
P	Stbd Shaft Output shaft brake disengaged	(possible values "1" = Disengaged, "0"= Not Disengaged)
Q	GT1 Input shaft brake engaged	(possible values "1" = Engaged, "0"= Not Engaged)
R	GT1 Input shaft brake disengaged	(possible values "1" = Disengaged, "0"= Not Disengaged)
a	GT2 Input shaft brake engaged	(possible values "1" = Engaged, "0"= Not Engaged)
b	GT2 Input shaft brake disengaged	(possible values "1" = Disengaged, "0"= Not Disengaged)
c	GT3 Input shaft brake engaged	(possible values "1" = Engaged, "0"= Not Engaged)
d	GT3 Input shaft brake disengaged	(possible values "1" =

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COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY				Disengaged, “0”= Not Disengaged)
	e	GT4 Input shaft brake engaged	(possible values “1” = Engaged, “0”= Not Engaged)	
	f	GT4 Input shaft brake disengaged	(possible values “1” = Disengaged, “0”= Not Disengaged)	
	g	Turning Device Port Shaft engaged	(possible values “1” = Engaged, “0”= Not Engaged)	
	h	Turning Device Port Shaft disengaged	(possible values “1” = Disengaged, “0”= Not Disengaged)	
	i	Turning Device Stbd Shaft engaged	(possible values “1” = Engaged, “0”= Not Engaged)	
	j	Turning Device Stbd Shaft disengaged	(possible values “1” = Disengaged, “0”= Not Disengaged)	
	*hh	The checksum data, always begins with *.		

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		8.2.4 PPMSE																				
COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY		The proprietary sentence PPMSE is sent by IPMS to communicate the main Propulsion System analogue data. The message is sent to IBS every 1 sec (f= 1Hz) The format is: \$PPMSE,XX.X,XX.X,XXX,XXX,XXXXX,XXXXX,XXXXX,XXXXX*hh<CR><LF> With an interpretation of: <table><tr><td>xx.x</td><td>Port Propeller PITCH position (Degree)</td></tr><tr><td>xx.x</td><td>Stbd Propeller PITCH position (Degree)</td></tr><tr><td>xxx</td><td>Port Shaft speed (rpm)</td></tr><tr><td>xxx</td><td>Stbd Shaft speed (rpm)</td></tr><tr><td>xxxxx</td><td>GT1 Gas Generator speed (rpm)</td></tr><tr><td>xxxxx</td><td>GT2 Gas Generator speed (rpm)</td></tr><tr><td>xxxxx</td><td>GT3 Gas Generator speed (rpm)</td></tr><tr><td>xxxxx</td><td>GT4 Gas Generator speed (rpm)</td></tr><tr><td>*hh</td><td>The checksum data, always begins with *</td></tr></table>			xx.x	Port Propeller PITCH position (Degree)	xx.x	Stbd Propeller PITCH position (Degree)	xxx	Port Shaft speed (rpm)	xxx	Stbd Shaft speed (rpm)	xxxxx	GT1 Gas Generator speed (rpm)	xxxxx	GT2 Gas Generator speed (rpm)	xxxxx	GT3 Gas Generator speed (rpm)	xxxxx	GT4 Gas Generator speed (rpm)	*hh	The checksum data, always begins with *
		xx.x	Port Propeller PITCH position (Degree)																			
		xx.x	Stbd Propeller PITCH position (Degree)																			
		xxx	Port Shaft speed (rpm)																			
		xxx	Stbd Shaft speed (rpm)																			
		xxxxx	GT1 Gas Generator speed (rpm)																			
		xxxxx	GT2 Gas Generator speed (rpm)																			
		xxxxx	GT3 Gas Generator speed (rpm)																			
		xxxxx	GT4 Gas Generator speed (rpm)																			
		*hh	The checksum data, always begins with *																			

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COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY	8.2.5	PPMSF				
		The proprietary sentence PPMSF is sent by IPMS to communicate the NBCD Status. The message is sent to IBS every 2 sec (f=0.5 Hz) The format is: \$PPMSF,M*hh<CR><LF> With an interpretation of: Value of M = A for NBCD status Z, Value of M = B for NBCD status Z-A, Value of M = C for NBCD status Y Value of M = D for NBCD status Y-A Value of M = E for NBCD status X.				

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	9. GENERAL COMMUNICATION ARCHITECTURE FOR MODBUS		
	9.1 Modbus Communication Architecture The communicating system over MODBUS TCP/IP includes the following device types. MODBUS TCP/IP Client and Server devices connected to a TCP/IP network. The MODBUS protocol defines a simple Protocol Data Unit (PDU) independent of the underlying communication layers. The mapping of MODBUS protocol on specific buses or networks can introduce some additional fields on the Application Data Unit (ADU). ADU Additional address Function code Data Error check PDU		
	A dedicated header is used on TCP/IP to identify the MODBUS Application Data Unit. It is called the MBAP header (MODBUS Application Protocol header). This header provides some differences compared to the MODBUS RTU application data unit used on serial line. The MODBUS ‘Slave Address’ field usually used on MODBUS Serial Line is replaced by a single byte ‘Unit Identifier’ within the MBAP Header. The ‘Unit Identifier’ is used to communicate via devices such as bridges, routers and gateways that use a single IP address to support multiple independent MODBUS end units. All MODBUS requests and responses are designed in such a way that the recipient can verify that a message is finished. For function codes where the MODBUS PDU has a fixed length, the function code alone is sufficient. For function codes carrying a variable amount of data in the request or response, the data field includes a byte count. When MODBUS is carried over TCP, additional length information is carried in the MBAP header to allow the recipient to recognize message boundaries even if the message has been split into multiple packets for transmission. The existence of explicit and implicit length rules, and use of a CRC-32 error check code (on Ethernet) results in an infinitesimal chance of undetected corruption to a request or response message.		
	MODBUS TCP/IP ADU MBAP Header Function code Data PDU		



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9.2 MBAP Header Description

The MBAP Header contains the following fields.

Fields	Length	Description	Client	Server
Transaction Identifier	2 Bytes	Identification of a MODBUS Request / Response transaction.	Initialized by the client	Recopied by the server from the received request
Protocol Identifier	2 Bytes	0 = MODBUS protocol	Initialized by the client	Recopied by the server from the received request
Length	2 Bytes	Number of following bytes	Initialized by the client (request)	Initialized by the server (response)
Unit Identifier	1 Byte	Identification of a remote slave connected on a serial line or on other buses	Initialized by the client	Recopied by the server from the received request

The header is 7 bytes long:

Transaction Identifier - It is used for transaction pairing; the MODBUS server copies in the response the transaction identifier of the request.

Protocol Identifier - It is used for intra-system multiplexing. The MODBUS protocol is identified by the value 0.

Length - The length field is a byte count of the following fields, including the Unit Identifier and data fields.

Unit Identifier - This field is used for intra-system routing purpose. It is typically used to communicate to a MODBUS TCP slave through a gateway between an Ethernet TCP-IP network and a MODBUS serial line. This field is set by the MODBUS Client in the request and must be returned with the same value in the response by the server.

All MODBUS/TCP ADU are sent via TCP on registered port 502.

9.3 Transmission Mode

IPMS & IBS shall be setup to communicate on a MODBUS network using RTU (Remote Terminal Unit) mode, each 8-bit byte in a message contains two 4-bit hexadecimal characters. The main advantage of this mode is that its greater character density allows better data throughput than ASCII for the same baud rate. Each message must be transmitted in a continuous stream.

The format for each byte in RTU mode is:

Coding System: 8-bit binary, hexadecimal 0-9, A-F

Two hexadecimal characters contained in each 8-bit field of the message.

Byte interpretation is Big Endian (higher order byte first).



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9.4 Interface Priority

The IPMS is the Master in this configuration, so the IBS (Server/CONVERTER in this case) will always reply answer on request.

9.5 Function Codes Supported

The following function codes are supported. All other codes will be considered as illegal/invalid.

03: Read Holding registers

16: Preset Multiple Registers.

9.6 Data Elements

The content of the dedicated memory areas is outlined in accordance with the commands described in the above paragraph.

9.7 Error Handling

When a message is sent from a master to a slave device the function code field tells the slave what kind of action to perform. When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response).

For a normal response, the slave simply echoes the original function code.

For an exception response, the slave returns a code that is equivalent to the original function code with its most-significant bit set to a logic 1.

IBS shall raise a communication breakdown alarm if in any 2 sec period no valid message is received from the master (IPMS).

IPMS shall raise a communication breakdown alarm if in any 2 sec period no valid reply is received from the slave (IBS).

In any case the master shall continuously send its messages at the expected rate.

All the data telegrams exchanged between the IPMS RTUs and the IBS are defined in the below Table. All unused bits must be set to 0 (zero).

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9.8 Messages From IBS To IPMS

9.8.1 Navigation Data (NAVDT)

SUB SYSTEM	REG. NO.	FUNCTION CODE	READ / WRITE	DESCRIPTION	UNIT (Analogue Signals)	DATA TYPE (IPMS Side)	DATA SIZE	TEXT_1 (Digital Signals)	TEXT_1 VALUE (Digital Signals)	TEXT_2 (Digital Signals)	TEXT_2 VALUE (Digital Signals)	CALIBRATION RANGE (Analogue Signals)	FACTOR (Analogue Signals)	Notes	NMEA Identifier
(NAV) Analogue Data	40000	03	R	UTC Hours	N.A.	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 24	1		INRMC
(NAV) Analogue Data	40001	03	R	UTC Minutes	N.A.	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 60	1		INRMC
(NAV) Analogue Data	40002	03	R	UTC Seconds	N.A.	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 60	1		INRMC
(NAV) Analogue Data	40003	03	R	UTC Status	Active or Void	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means Active 1 means Void	INRMC
(NAV) Analogue Data	40004	03	R	Latitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 90	1	12 means 12 Degree	INRMC
(NAV) Analogue Data	40005	03	R	Latitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	INRMC
(NAV) Analogue Data	40006	03	R	Latitude	S or N	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means S 1 means N	INRMC
(NAV) Analogue Data	40007	03	R	Longitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 180	1	123 means 123 Degree	INRMC
(NAV) Analogue Data	40008	03	R	Longitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	INRMC
(NAV) Analogue Data	40009	03	R	Longitude	E or W	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means E 1 means W	INRMC
(NAV) Analogue Data	40010	03	R	Speed over the ground	kn	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 5000	0.1	1234 means 123.4 kn	INRMC
(NAV) Analogue Data	40011	03	R	Speed through the water	kn	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 5000	0.1	1234 means 123.4 kn	INVBW
(NAV) Analogue Data	40012	03	R	Heading	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 3600	0.1	1234 means 123.4 Degree	INHDT
(NAV) Analogue Data	40013	03	R	Turning Radius	m	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 5000	1		NOT AVAILABLE
(NAV) Analogue Data	40014	03	R	Rate of Turn Value	Degree / minute	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 20000	0.01	123 means 1.23 Degree/minute	INROT
(NAV) Analogue Data	40015	03	R	Rate of Turn Validity	Port, Stbd or Invalid	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 2	1	1 0 means Port means Stbd means Invalid	INROT
(NAV) Analogue Data	40016	03	R	Speed (made good)	kn	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 5000	0.1	1234 means 123.4 kn	INRMC
(NAV) Analogue Data	40017	03	R	Heading (made good)	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 3600	0.1	1234 means 123.4 Degree	INRMC
(NAV) Analogue Data	40018	03	R	Warning (cross boundaries)	N.A	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 no warning 1 warning	NOT AVAILABLE
(NAV) Analogue Data	40019	03	R	Parallel Index line	m	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 60000	1		NOT AVAILABLE
(NAV) Analogue Data	40020	03	R	Course to Steer (CTS)	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 3600	0.1	1234 means 123.4 Degree	INHSC
(NAV) Analogue Data	40021	03	R	Course Over Ground (COG)	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 3600	0.1	1234 means 123.4 Degree	INRMC

Note: 'NOT AVAILABLE' - Cannot be provided by IBS

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SUB SYSTEM	REG. NO.	FUNCT ION CODE	READ / WRITE	DESCRIPTION	UNIT (Analogue Signals)	DATA TYPE (IPMS Side)	DATA SIZE	TEXT_1 (Digital Signals)	TEXT_1 VALUE (Digital Signals)	TEXT_2 (Digital Signals)	TEXT_2 VALUE (Digital Signals)	CALIBRATION RANGE (Analogue Signals)	FACTOR (Analogue Signals)	Notes	NMEA Identifier
(NAV) Analogue Data	40022	03	R	WO Latitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 90	1	12 means 12 Degree	NOT AVAILABLE
(NAV) Analogue Data	40023	03	R	WO Latitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	NOT AVAILABLE
(NAV) Analogue Data	40024	03	R	WO Latitude	S or N	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means S 1 means N	NOT AVAILABLE
(NAV) Analogue Data	40025	03	R	WO Longitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 180	1	123 means 123 Degree	NOT AVAILABLE
(NAV) Analogue Data	40026	03	R	WO Longitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	NOT AVAILABLE
(NAV) Analogue Data	40027	03	R	WO Longitude	E or W	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means E 1 means W	NOT AVAILABLE
(NAV) Analogue Data	40028	03	R	Track angle True	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 3600	0.1	1234 means 123.4 Degree	INRMC
(NAV) Analogue Data	40029	03	R	UTC Day	N.A.	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	1 ÷ 31	1		INRMC
(NAV) Analogue Data	40030	03	R	UTC Month	N.A.	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	1 ÷ 12	1		INRMC
(NAV) Analogue Data	40031	03	R	UTC Year	N.A.	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 9999	1		INRMC
(NAV) Analogue Data	40032	03	R	Magnetic Variation	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 3600	0.1	1234 means 123.4 Degree	INRMC
(NAV) Analogue Data	40032	03	R	Magnetic Variation	E or W	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means E 1 means W	INRMC
(NAV) Analogue Data	40033	03	R	Spare											
(NAV) Analogue Data		03	R	Spare											
(NAV) Analogue Data	40040	03	R	Spare											

Note: 'NOT AVAILABLE' - Cannot be provided by IBS

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9.8.2 Meteo Data (INMDA)

SUB SYSTEM	REG. NO.	FUNCTION CODE	READ / WRITE	DESCRIPTION	UNIT (Analogue Signals)	DATA TYPE (IPMS Side)	DATA SIZE	TEXT_1 (Digital Signals)	TEXT_1 VALUE (Digital Signals)	TEXT_2 (Digital Signals)	TEXT_2 VALUE (Digital Signals)	CALIBRATION RANGE (Analogue Signals)	FACTOR (Analogue Signals)	Notes	NMEA Identifier
Meteo Data (MD) Analogue Data	40041	03	R	MD Barometric Pressure	"Hg	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 60000	0.001	31234 means 31.234 "Hg	NOT AVAILABLE
Meteo Data (MD) Analogue Data	40042	03	R	MD Barometric Pressure	Bar	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 6000	0.001	1234 means 1.234 Bar	INMDA
Meteo Data (MD) Analogue Data	40043	03	R	MD Air Temperature	°C	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 2000 (-100 ÷ +100) with 100 Offset	0.1 Scale Factor 100 °C Offset	956 means -4.4 °C 1234 means +23.4 °C	INMDA
Meteo Data (MD) Analogue Data	400 44	03	R	MD Water Temperature	°C	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 2000 (-100 ÷ +100) with 100 Offset	0.1 Scale Factor 100 °C Offset	956 means -4.4 °C 1234 means +23.4 °C	NOT AVAILABLE
Meteo Data (MD) Analogue Data	400 45	03	R	MD Relative Umidity	%	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 2000	0.1	975 means 97.5 %	INMDA
Meteo Data (MD) Analogue Data	400 46	03	R	MD Absolute Umidity	%	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 2000	0.1	975 means 97.5 %	NOT AVAILABLE
Meteo Data (MD) Analogue Data	400 47	03	R	MD Dew Point	°C	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 2000 (-100 ÷ +100) with 100 Offset	0.1 Scale Factor 100 °C Offset	956 means -4.4 °C 1234 means +23.4 °C	INMDA
Meteo Data (MD) Analogue Data	400 48	03	R	MD Wind Direction, True	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 3600	0.1	1234 means 123.4 Degree	INMDA
Meteo Data (MD) Analogue Data	400 49	03	R	MD Wind Direction, Magnetic	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 3600	0.1	1234 means 123.4 Degree	NOT AVAILABLE
Meteo Data (MD) Analogue Data	400 50	03	R	MD Wind Speed	kn	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 5000	0.1	1234 means 123.4 kn	INMDA
Meteo Data (MD) Analogue Data	400 51	03	R	MD Wind Speed	m/s	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 4000	0.1	1234 means 123.4 m/s	INMDA
Meteo Data (MD) Analogue Data	400 52	03	R	Spare											
Meteo Data (MD) Analogue Data		03	R	Spare											
Meteo Data (MD) Analogue Data	40060	03	R	Spare											

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5.3.3 Waypoint Location (INWPL & INRTE)

SUB SYSTEM	REG. NO.	FUNCTION CODE	READ / WRITE	DESCRIPTION	UNIT (Analogue Signals)	DATA TYPE (IPMS Side)	DATA SIZE	TEXT_1 (Digital Signals)	TEXT_1 VALUE (Digital Signals)	TEXT_2 (Digital Signals)	TEXT_2 VALUE (Digital Signals)	CALIBRATION RANGE (Analogue Signals)	FACTOR (Analogue Signals)	Notes	NMEA Identifier
Waypoint Location(WPL) Analogue Data	40061	03	R	WPL1 Latitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 90	1	12 means 12 Degree	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40062	03	R	WPL1 Latitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40063	03	R	WPL1 Latitude	S or N	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means S 1 means N	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40064	03	R	WPL1 Longitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 180	1	123 means 123 Degree	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40065	03	R	WPL1 Longitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40066	03	R	WPL1 Longitude	E or W	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means E 1 means W	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40067	03	R	WPL2 Latitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 90	1	12 means 12 Degree	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40068	03	R	WPL2 Latitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40069	03	R	WPL2 Latitude	S or N	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means S 1 means N	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40070	03	R	WPL2 Longitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 180	1	123 means 123 Degree	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40071	03	R	WPL2 Longitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40072	03	R	WPL2 Longitude	E or W	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means E 1 means W	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40073	03	R	WPL3 Latitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 90	1	12 means 12 Degree	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40074	03	R	WPL3 Latitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40075	03	R	WPL3 Latitude	S or N	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 1	1	0 means S 1 means N	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40076	03	R	WPL3 Longitude	Degree	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 180	1	123 means 123 Degree	INWPL/RTE
Waypoint Location(WPL) Analogue Data	40077	03	R	WPL3 Longitude	'	Ana. Input	Word	N.A.	N.A.	N.A.	N.A.	0 ÷ 59999	0.001	12345 means 12.345 '	INWPL/RTE



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9.9 Message From IPMS To IBS

9.9.1 APMS Status (PPMSA & B)

SUB SYSTEM	REG. NO.	FUNCTION CODE	READ / WRITE	DESCRIPTION	UNIT (Analogue Signals)	DATA TYPE (IPMS Side)	DATA SIZE	TEXT_1 (Digital Signals)	TEXT_1 VALUE (Digital Signals)	TEXT_2 (Digital Signals)	TEXT_2 VALUE (Digital Signals)	CALIBRATION RANGE (Analogue Signals)	FACTOR (Analogue Signals)	Notes	NMEA Identifier
APMS status (1)	40100	16	W		N.A.	Dig. Output	Word	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	PPMSA
-	.0	16	W	DG1 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSA
-	.1	16	W	DG1 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSA
-	.2	16	W	DG1 STATUS FAILURE	N.A.	Dig. Output	Bit	Not Failure	0	Failure	1	N.A.	N.A.	N.A.	PPMSA
-	.3	16	W	DG2 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSA
-	.4	16	W	DG2 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSA
-	.5	16	W	DG2 STATUS FAILURE	N.A.	Dig. Output	Bit	Not Failure	0	Failure	1	N.A.	N.A.	N.A.	PPMSA
-	.6	16	W	DG3 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSA
-	.7	16	W	DG3 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSA
-	.8	16	W	DG3 STATUS FAILURE	N.A.	Dig. Output	Bit	Not Failure	0	Failure	1	N.A.	N.A.	N.A.	PPMSA
-	.9	16	W	DG4 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSA
-	.10	16	W	DG4 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSA
-	.11	16	W	DG4 STATUS FAILURE	N.A.	Dig. Output	Bit	Not Failure	0	Failure	1	N.A.	N.A.	N.A.	
-	.12	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.13	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.14	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.15	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
APMS status (2)	40101	16	W		N.A.	Dig. Output	Word	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.0	16	W	DG5 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSB
-	.1	16	W	DG5 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSB
-	.2	16	W	DG5 STATUS FAILURE	N.A.	Dig. Output	Bit	Not Failure	0	Failure	1	N.A.	N.A.	N.A.	PPMSB
-	.3	16	W	DG6 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSB
-	.4	16	W	DG6 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSB
-	.5	16	W	DG6 STATUS FAILURE	N.A.	Dig. Output	Bit	Not Failure	0	Failure	1	N.A.	N.A.	N.A.	PPMSB
-	.6	16	W	DG7 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSB
-	.7	16	W	DG7 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSB
-	.8	16	W	DG7 STATUS FAILURE	N.A.	Dig. Output	Bit	Not Failure	0	Failure	1	N.A.	N.A.	N.A.	PPMSB
-	.9	16	W	DG8 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSB

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9.9.2 Propulsion System Status (PPMSC & D

SUB SYSTEM	REG. NO.	FUNCTION CODE	READ / WRITE	DESCRIPTION	UNIT (Analogue Signals)	DATA TYPE (IPMS Side)	DATA SIZE	TEXT_1 (Digital Signals)	TEXT_1 VALUE (Digital Signals)	TEXT_2 (Digital Signals)	TEXT_2 VALUE (Digital Signals)	CALIBRATION RANGE (Analogue Signals)	FACTOR (Analogue Signals)	Notes	NMEA Identifier
Propulsion System status (1)	40130	16	W		N.A.	Dig. Output	Word	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.0	16	W	ECU1 AVAILABLE	N.A.	Dig. Output	Bit	Not Available	0	Available	1	N.A.	N.A.	N.A.	PPMSC
-	.1	16	W	ECU2 AVAILABLE	N.A.	Dig. Output	Bit	Not Available	0	Available	1	N.A.	N.A.	N.A.	PPMSC
-	.2	16	W	ECU3 AVAILABLE	N.A.	Dig. Output	Bit	Not Available	0	Available	1	N.A.	N.A.	N.A.	PPMSC
-	.3	16	W	ECU4 AVAILABLE	N.A.	Dig. Output	Bit	Not Available	0	Available	1	N.A.	N.A.	N.A.	PPMSC
-	.4	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.5	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.6	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.7	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.8	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.9	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.10	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.11	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.12	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.13	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.14	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.15	16	W	Spare	N.A.	Dig. Output	Bit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
Propulsion System status (2)	40131	16	W		N.A.	Dig. Output	Word	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
-	.0	16	W	GT1 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSC
-	.1	16	W	GT1 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSC
-	.2	16	W	GT2 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSC
-	.3	16	W	GT2 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSC
-	.4	16	W	GT3 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSC
-	.5	16	W	GT3 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSC
-	.6	16	W	GT4 STATUS RUNNING	N.A.	Dig. Output	Bit	Not Running	0	Running	1	N.A.	N.A.	N.A.	PPMSC
-	.7	16	W	GT4 STATUS STOPPED	N.A.	Dig. Output	Bit	Not Stopped	0	Stopped	1	N.A.	N.A.	N.A.	PPMSC
-	.8	16	W	GT1 CLUTCH ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSC
-	.9	16	W	GT1 CLUTCH DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSC

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Output</td><td>Bit</td><td>Not Engaged</td><td>0</td><td>Engaged</td><td>1</td><td>N.A.</td><td>N.A.</td><td>N.A.</td><td>PPMSC</td></tr><tr><td>-</td><td>.11</td><td>16</td><td>W</td><td>GT2 CLUTCH DISENGAGED</td><td>N.A.</td><td>Dig. Output</td><td>Bit</td><td>Not Disengaged</td><td>0</td><td>Disengaged</td><td>1</td><td>N.A.</td><td>N.A.</td><td>N.A.</td><td>PPMSC</td></tr><tr><td>-</td><td>.12</td><td>16</td><td>W</td><td>GT3 CLUTCH ENGAGED</td><td>N.A.</td><td>Dig. Output</td><td>Bit</td><td>Not Engaged</td><td>0</td><td>Engaged</td><td>1</td><td>N.A.</td><td>N.A.</td><td>N.A.</td><td>PPMSC</td></tr><tr><td>-</td><td>.13</td><td>16</td><td>W</td><td>GT3 CLUTCH DISENGAGED</td><td>N.A.</td><td>Dig. Output</td><td>Bit</td><td>Not Disengaged</td><td>0</td><td>Disengaged</td><td>1</td><td>N.A.</td><td>N.A.</td><td>N.A.</td><td>PPMSC</td></tr><tr><td>-</td><td>.14</td><td>16</td><td>W</td><td>GT4 CLUTCH ENGAGED</td><td>N.A.</td><td>Dig. 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Output</td><td>Bit</td><td>Not Engaged</td><td>0</td><td>Engaged</td><td>1</td><td>N.A.</td><td>N.A.</td><td>N.A.</td><td>PPMSD</td></tr><tr><td>-</td><td>.5</td><td>16</td><td>W</td><td>GT1 INPUT SHAFT BRAKE DISENGAGED</td><td>N.A.</td><td>Dig. Output</td><td>Bit</td><td>Not Disengaged</td><td>0</td><td>Disengaged</td><td>1</td><td>N.A.</td><td>N.A.</td><td>N.A.</td><td>PPMSD</td></tr><tr><td>-</td><td>.6</td><td>16</td><td>W</td><td>GT2 INPUT SHAFT BRAKE ENGAGED</td><td>N.A.</td><td>Dig. Output</td><td>Bit</td><td>Not Engaged</td><td>0</td><td>Engaged</td><td>1</td><td>N.A.</td><td>N.A.</td><td>N.A.</td><td>PPMSD</td></tr><tr><td>-</td><td>.7</td><td>16</td><td>W</td><td>GT2 INPUT SHAFT BRAKE DISENGAGED</td><td>N.A.</td><td>Dig. Output</td><td>Bit</td><td>Not Disengaged</td><td>0</td><td>Disengaged</td><td>1</td><td>N.A.</td><td>N.A.</td><td>N.A.</td><td>PPMSD</td></tr><tr><td>-</td><td>.8</td><td>16</td><td>W</td><td>GT3 INPUT SHAFT BRAKE ENGAGED</td><td>N.A.</td><td>Dig. 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Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSC	-	.11	16	W	GT2 CLUTCH DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSC	-	.12	16	W	GT3 CLUTCH ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSC	-	.13	16	W	GT3 CLUTCH DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSC	-	.14	16	W	GT4 CLUTCH ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSC	-	.15	16	W	GT4 CLUTCH DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSC	Propulsion System status (3)	40132	16	W		N.A.	Dig. Output	Word	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		-	.0	16	W	PORT SHAFT OUTPUT SHAFT BRAKE ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSD	-	.1	16	W	PORT SHAFT OUTPUT SHAFT BRAKE DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSD	-	.2	16	W	STBD SHAFT OUTPUT SHAFT BRAKE ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSD	-	.3	16	W	STBD SHAFT OUTPUT SHAFT BRAKE DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSD	-	.4	16	W	GT1 INPUT SHAFT BRAKE ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSD	-	.5	16	W	GT1 INPUT SHAFT BRAKE DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSD	-	.6	16	W	GT2 INPUT SHAFT BRAKE ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSD	-	.7	16	W	GT2 INPUT SHAFT BRAKE DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSD	-	.8	16	W	GT3 INPUT SHAFT BRAKE ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSD	-	.9	16	W	GT3 INPUT SHAFT BRAKE DISENGAGED	N.A.	Dig. Output	Bit	Not Disengaged	0	Disengaged	1	N.A.	N.A.	N.A.	PPMSD	-	.10	16	W	GT4 INPUT SHAFT BRAKE ENGAGED	N.A.	Dig. Output	Bit	Not Engaged	0	Engaged	1	N.A.	N.A.	N.A.	PPMSD
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9.9.3 Propulsion System Analogue Data (PPMSE)

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9.9.4 NBCD Status (PPMSF)

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