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IAU

Interface Control Document
Inertial Navigation System

DIRECTORATE OF NAVIGATION & EMBEDDED COMPUTERS

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Interface Control Document
Inertial Navigation System (IAU)

RC-09-171409-1119

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Contents

List of Figures

List of Tables

INTRODUCTION

1.1. Purpose

This document establishes the interface control requirements for Inertial Navigation System (INS) of Integrated Avionics Unit (IAU).

1.2. Scope

This document refers to the INS-IAU and provides the system architecture and interface details of software, electrical and mechanical.

1.3. Document Overview

The document is organized as follows.

Chapter 2 explains overall description of the system, operating modes, reference frames and constraints & dependencies.

Chapter 3 provides the software interfaces and messages details.

Chapter 4 provides the electrical interface with interconnection diagrams and connector details.

Chapter 5 presented the installation recommendations and mechanical drawings.

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SYSTEM OVERVIEW

2.1. System Architecture

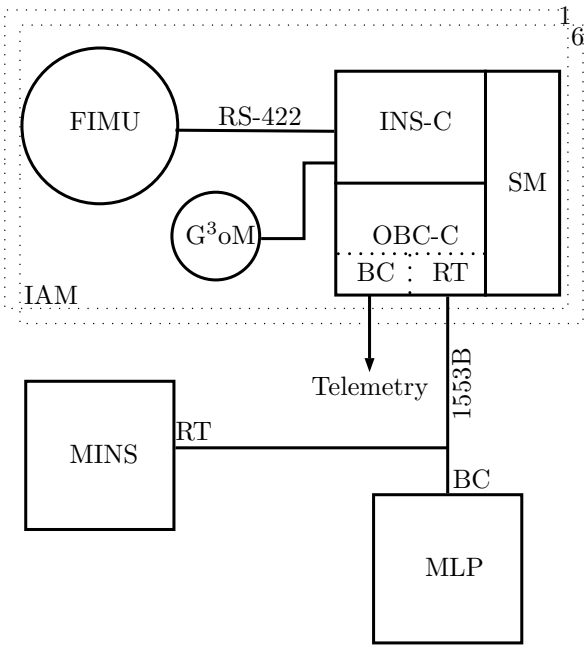

Figure 2.1: IAM-INS Block Diagram

2.2. Operating Modes

2.2.1. Operating modes diagram

There are five basic operating modes

- Start-up
- Stand-by
- Mission Data Load
- Mission Data Dump
- Position Test
- Levelling
- Navigation
- OFF/Power down

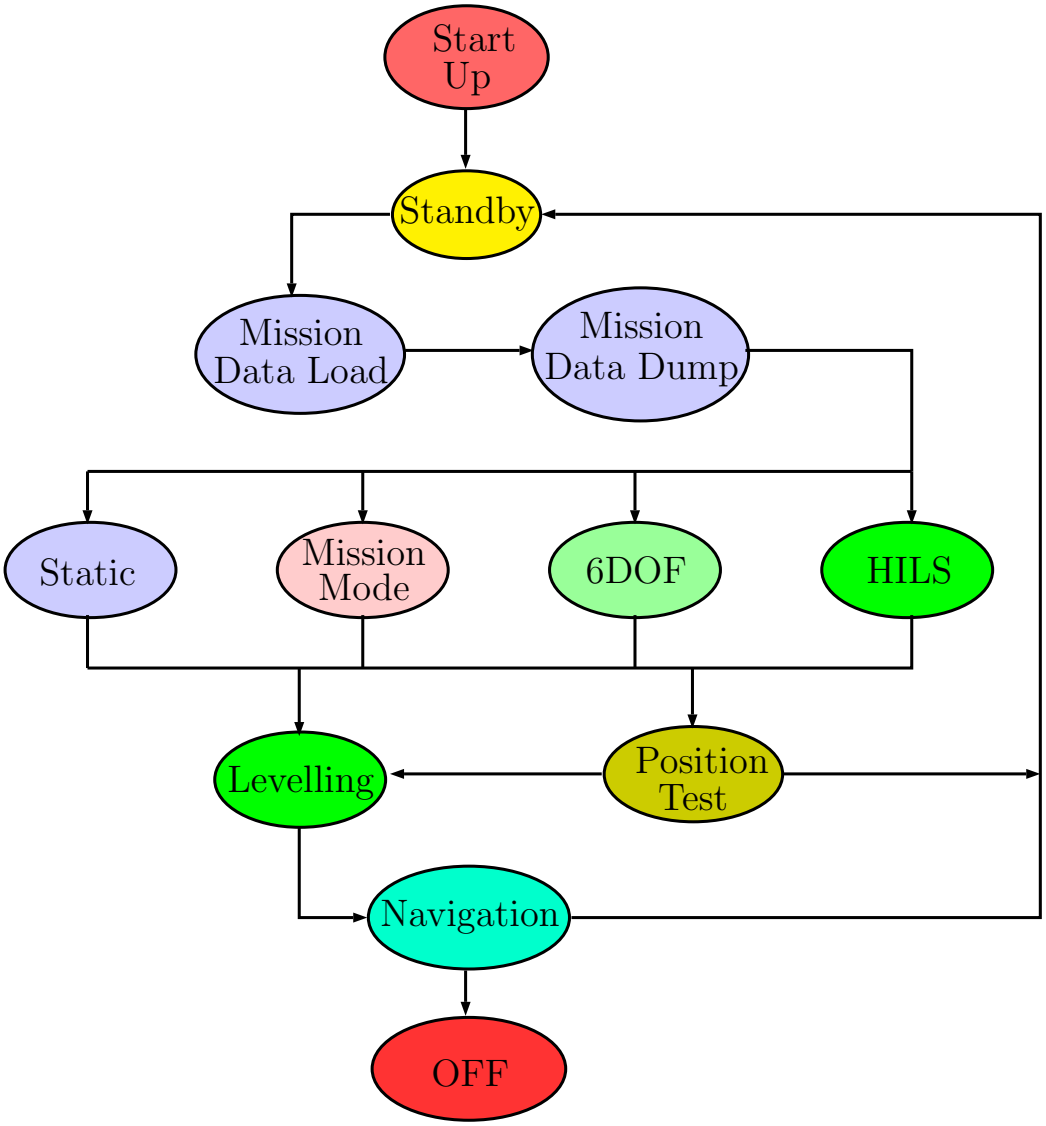

Figure 2.2: Command Sequence Chart

The Figure 2.2 shows the INS operating modes. The transition to stand-by are automatically managed by the system. The transition for other modes are managed by external commands.

2.2.2. Start-up

The operator starts up the IAU by connecting the power supply voltage and activating the ON command from LC .

After power on, the INS automatically runs its internal self-test, and starts system software initialization. All external interfaces (MIL-STD-1553B, serial lines & input/output discrete signals) are inactive.

After completion of start-up initialization (about 15 seconds), the INS automatically switches to Stand-by mode.

2.2.3. Stand-by

In Stand-by mode

- The INS is able to receive commands and to transmit status data on the MIL-STD-1553B bus
- The INS delivers the following data
  - Sensor Status
  - INS Status
  - Configuration & History
  - Rates & Accelerations
  - GPS and GNSS data

  sets the bits in INS Status
  - INS Active Mode [1] (Stand-by mode)
- The INS is waiting for an Mission Data Load command on MIL-STD-1553B bus.

From any mode except levelling, the INS comes back to Stand-by mode automatically.

2.2.4. Mission Data Load

INS enters into Mission Data Load mode upon receiving the MDL command

- `MDL` (Activity Command = 0x2107)

sets the bits in INS Status

- INS Active Mode [7] (Mission Data Load)

In this mode, INS initialized with position (Latitude, Longitude, Altitude), attitude (Heading, Roll, Pitch). After initialization It transit to Stand-by mode automatically.

2.2.5. Mission Data Dump

INS enters into Mission Data Dump mode upon receiving the MDD command

- `MDD` (Activity Command = 0x0406)

sets the bits in INS Status

- INS Active Mode [6] (Mission Data Dump)

INS initialized position and attitude is verified in this mode. MDD mode to Stand-by mode enters automatically.

2.2.6. Position Test

INS enters into Position Test mode upon receiving the PTD command from Stand-by mode

- `PTD` (Activity Command = 0x1602)

sets the bits in INS Status

- INS Active Mode [2] (Position Test)

After successful completion of position test, it automatically transit to Stand-by mode.

2.2.7. Alignment Modes

The alignment mode is available is levelling

- Levelling

During alignment it is required the INS should be on stationary platform.

2.2.7.1. Levelling

This procedure allows minimize stationary position after system power on. It assumes that heading from Mission Data Load (`MDL`).

If stationary and in the Stand-by mode, upon receipt of the Levelling command

- `MDL` (Activity Command = 0x1204)

The INS enters the Static levelling mode if Mission Data bit (INS Status) is not set and sets the bits in INS Status

- INS Active Mode [4] (Alignment)
- Alignment Mode [1] (Static Levelling)

else the INS remains in the current mode. The Static levelling uses the position coordinates and attitudes from the Mission Data Load. At the end of levelling sets the bits in INS status

- Sets once the bit Attitude available [1]

During levelling, the vehicle will be stationary.

At the successful completion of Static levelling (about Alignment time (MDL)), the INS enters the Navigation mode after receiving the Navigation command (Activity Mode (MDL)= 0x1408).

Tests done during the Alignment

The initial position (GPS, or inserted position) used to perform the alignment must be consistent with its given precision.

- GPS: GPS precision
- Inserted position: < 50 m precision

Otherwise

- The INS will not always be able to detect error on the initial position
- The performance of navigation may be degraded depending on the initial position error
- The heading and attitudes may be subjected to degradation depending on the navigation time and distance travelled

In case of corrupted or erroneous data, a new alignment is required to restore system full performances.

Completion of the Alignment

Remaining alignment time is given in seconds in the message ADR .

At the successful completion of Alignment, the INS enters the Navigation mode after receiving the command.

All the data supplied by the INS are valid with the specified accuracy.

2.2.8. Navigation Mode

Upon completed alignment, the INS switches to Navigation mode with navigation command. All the data supplied by the system are then valid with the specified accuracy.

The current mode INS ACTIVE MODE [1000] indicates that the INS is in navigation mode.

2.2.8.1. Aiding Sources

The optimal navigation supplied by the INS is based on a Kalman filter, modelling the three navigation axes and capable of taking into account all the available aiding to improve the inertial accuracy.

The INS uses the following aiding sources

- GPS aiding

GPS Aiding

The INS uses GPS data in its optimal navigation solution - GPS information will allow a performance which is not travelled distance dependant for long time navigations.

The INS indicates

- Hybridization, bit 14 of INS Status OPTIMAL NAVIGATION
- GPS position available, bit 3 of GPS Receiver Status
- GLONASS position available, bit 1 of GPS Receiver Status
- GPS and GLONASS combined position available, bit 1 of GPS Receiver Status

2.2.9. Power Down

The INS can be powered down at any time. No specific command is necessary to shut down the INS else than power switch.

The INS no longer performs any interface function with external equipment.

SOFTWARE INTERFACE

3.1. FIMU Interface

Source : FIMU
Frequency : 2.5 ms
Destination : INS-C
Phase : All

Table 3.1: FIMU Data

Byte	Parameter	Unit	Scale Factor	Min.	Max.	Format
1-2	Header (0x752B)					U16
3-4	IMU Status					U16
5-8	Gyro-X	rad/s	5.0e-8			S32
9-12	Gyro-Y	rad/s	5.0e-8			S32
13-16	Gyro-Z	rad/s	5.0e-8			S32
17-18	Accl-X (N)					U16
19-20	Accl-X (P)					U16
21-22	Accl-Y (N)					U16
23-24	Accl-Y (P)					U16
25-26	Accl-Z (N)					U16
27-28	Accl-Z (P)					U16
29-30	Multiplexed Data					
31	Counter			0	255	U8
32	Checksum					U8

Table 3.2: IMU Status

Bit No.	Parameter	Description	
MSB 15-08	Reserved	-	
07	IMU Not Ready	1 - Not Ready	0 - Ready
06	IMU Fail	1 - Fail	0 - Normal
05	Accl-Z Fail	1 - Fail	0 - Normal
04	Accl-Y Fail	1 - Fail	0 - Normal
03	Accl-X Fail	1 - Fail	0 - Normal
02	Gyro-Z Fail	1 - Fail	0 - Normal
01	Gyro-Y Fail	1 - Fail	0 - Normal
LSB 00	Gyro-X Fail	1 - Fail	0 - Normal

Table 3.3: FIMU Multiplexed Data

Counter Value	Parameter	Unit	Scale Factor	Format
0	Gyro-X Temperature	°C	0.25	S16
1	Gyro-Y Temperature	°C	0.25	S16
2	Gyro-Z Temperature	°C	0.25	S16
3	Accl-X Temperature	°C	0.25	S16
4	Accl-Y Temperature	°C	0.25	S16
5	Accl-Z Temperature	°C	0.25	S16
6	IMU Serial Number			U16
7	IMU Software Version			U16

3.2. 6DOF Interface

Source : 6DOF
Frequency : 2.5 ms
Destination : INS-C
Phase : All

Table 3.4: 6DOF Data

Byte	Parameter	Unit	Scale Factor	Min.	Max.	Format
1-2	Header (0x752B)					U16
3-4	Reserved					
5-8	Gyro-X	rad/s				SPF
9-12	Gyro-Y	rad/s				SPF
13-16	Gyro-Z	rad/s				SPF
17-20	Accl-X	m/s^2				SPF
21-24	Accl-Y	m/s^2				SPF
25-28	Accl-Z	m/s^2				SPF
29-30	Reserved					
31	Counter			0	255	U8
32	Checksum					U8

3.3. G^3oM/G^2oM/G^2IoM Receiver Interface

The SMARTGPSGLS production board (G^3OM) is dual antenna, 28-channel GPS-GLONASS-GAGAN miniature receiver is interfaced via UART to INS core. The G^3OM receiver hardware details and interface message format available in SMARTGPSGLS user guide. The (G^2OM) is single antenna, 16-channel GPS-GAGAN on Module receiver. The (G^2IOM) is single antenna, 28-channel GPS-IRNSS GAGAN on Module receiver.

3.4. INS Messages

Table 3.5: IAM-INS Interface Messages

Message ID	Data Description	Freq.	OA	No. of Words	Phase
OBC-C to INS-C Messages					
CMD	Command & Mission Data	*	0x000	26	Checkout
HDR	Transfer Alignment Data	5 ms	0x080	32	All
INS-C to OBC-C Messages					
CAH	Configuration & History	*	0x400	32	Checkout
MDD	Mission Data Dump	*	0x100	26	Checkout
PTD	Position Test Data	*	0x180	32	Checkout
ADR	Alignment Data	*	0x200	32	Levelling
SRA	Rates & Accelerations	2.5 ms	0x280	32	All
ATT	Attitude Data	10 ms	0x300	32	Navigation
EPV	Position & Velocity	20 ms	0x380	32	Navigation
KFC	KF Corrections	1 s	0x480	32	Navigation
PVG	GPS Position & Velocity	1 s	0x500	32	All
PVS	GNSS Position & Velocity	1 s	0x580	32	All
SVG	GPS Satellite IDs and SNR	1 s	0x600	32	All
SVS	GNSS SV IDs and SNR	1 s	0x680	32	All
PRG	GPS Pseudo Range	1 s	0x700	32	Navigation
DRG	GPS Delta Pseudo Range	1 s	0x780	32	Navigation
QRG	GPS Quality of PR & DPR	1 s	0x800	32	Navigation
SP1	GPS Satellite Position 1	1 s	0x880	32	Navigation
SP2	GPS Satellite Position 2	1 s	0x900	32	Navigation
SP3	GPS Satellite Position 3	1 s	0x980	32	Navigation
SV1	GPS Satellite Velocity 1	1 s	0xA00	32	Navigation
SV2	GPS Satellite Velocity 2	1 s	0xA80	32	Navigation
SV3	GPS Satellite Velocity 3	1 s	0xB00	32	Navigation
SBG	GPS Satellite Clock Bias	1 s	0xB80	32	Navigation
SDG	GPS Satellite Clock Drift	1 s	0xC00	32	Navigation
SP4	GNSS Satellite Position 1	1 s	0xC80	32	Navigation
SP5	GNSS Satellite Position 2	1 s	0xD00	32	Navigation
SV4	GNSS Satellite Velocity 1	1 s	0xD80	32	Navigation
SV5	GNSS Satellite Velocity 2	1 s	0xE00	32	Navigation
PRR	GPS PR Residue	1 s	0xE80	32	Navigation
DRR	GPS DPR Residue	1 s	0xF00	32	Navigation
PRR	GNSS PR & DPR Residue	1 s	0xF80	32	Navigation

* indicates that the message is transmitted as and when required.

OBC-C to INS-C Interface Messages

3.4.1. Command & Mission Data

Message ID: CMD

Source	:	OBC-C	Destination	:	INS-C
Offset Address	:	0x000	Sub Address	:	1
Frequency	:	As Required	Phase	:	All

Table 3.6: Command & Mission Data

Word	Parameter	Unit	Min.	Max.	Format
1	Activity Command				U16
2	Mode Command				U16
3-4	Reserved				
5-8	Latitude	deg	-90.00	90.00	DPF
9-12	Longitude	deg	-179.99	180.00	DPF
13-14	Altitude	m			SPF
15-16	ψ	deg	-179.99	180.00	SPF
17-18	ϕ	deg	-179.99	180.00	SPF
19-20	θ	deg	-90.00	90.00	SPF
21-22	Alignment Time	s	10	60	SPF
23-24	Navigation Time	s			SPF
25	Mission Data Validity				U16
26	CMD Command Echo				U16

3.4.1.1. Activity Command

Table 3.8: Activity Details

S.No	Activity Command	Activity to be performed
1	0x0308	Configuration & History
2	0x2107	Mission Data Load
3	0x0406	Mission Data Dump
4	0x1602	Position Test
5	0x1204	Static Levelling
6	0x1408	Navigation
7	0x2010	Two Position TA
8	0x0521	AGNS Data Upload

3.4.1.2. Mode Command

Table 3.9: Mode Command

S.No	Mode Command	INS Mode
1	0x0000	Mission Mode
2	0x0320	Static Simulation
3	0x0840	HILS Mode (Half Simulation)
4	0x0680	6 DOF Mode (Full Simulation)

3.4.1.3. Mission Data Validity

Table 3.10: Mission Data Validity

Bit No.	Parameter	Description
MSB 15-14	TA Position	10 - Second Position 01 - First Position
13	Hybridization Disable	1- Disable 0 - Enable
12	Reserved	
11-10	GNSS Messages Schedule	11 - 0.2 sec 10 - 0.25 sec 01 - 0.5 sec 00 - 1 sec
09-07	Reserved	
06-05	Attitude Source	00 - Radar Computer 01 - MINS 10 - Transfer Alignment 11 - Stored Heading
04	Position Source	1 - MINS 0 - RC
03	Reserved	
02	Heading	1 - Valid 0 -Invalid
01	Levelling Angles	1 - Valid 0 -Invalid
LSB 00	Position	1 - Valid 0 -Invalid

3.4.2. Transfer Alignment Message

Message ID: HDR

Source	:	OBC-C	Destination	:	INS-C
Offset Address	:	0x080	Sub Address	:	20
Frequency	:	5 ms	Phase	:	Checkout

Table 3.11: MINS High Data Rate Message

Word	Parameter	Refresh Rate	Unit	Min.	Max.	Format
1-4	Latitude	20 ms	deg	-90	89.99	DPF
5-8	Longitude		deg	-180.0	179.99	DPF
9-10	Altitude		m			SPF
11-12	Heading	10 ms	deg	0	359.99	SPF
13-14	Roll		deg	-180.0	179.99	SPF
15-16	Pitch		deg	-90	89.99	SPF
17-18	X Rate #1	5ms	rad/s	-6.98	6.98	SPF
19-20	Y Rate #1		rad/s	-6.98	6.98	SPF
21-22	Z Rate #1		rad/s	-6.98	6.98	SPF
23-24	X Rate #2		rad/s	-6.98	6.98	SPF
25-26	Y Rate #2		rad/s	-6.98	6.98	SPF
27-28	Z Rate #2		rad/s	-6.98	6.98	SPF
29	MINS Status					U16
30	Hours (MSB) & Minutes (LSB)					U16
31	Seconds					U16
32	Real Time Count					U16

3.4.3. Configuration & History

Message ID: CAH

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x400	Sub Address	:	1
Frequency	:	As Required	Phase	:	Before Levelling

Table 3.12: Configuration & History

Word	Parameter	Unit	Min.	Max.	Format
1-2	INS Application Software Version				ASC
3-4	INS Application Software Checksum				U32
5-8	INS Application Software Date				ASC
9-10	Calibration Software Version				ASC
11-12	Calibration Data Checksum				U32
13-16	Calibration Date				ASC
17-18	G^3oM Software Version				U32
19-20	G^3oM Software Checksum				U32
21	FIMU Software Version				U16
22	FIMU Serial Number				U16
23-24	INS Number				ASC
25	Configuration Status				U16
26	CAH Command Echo				U16
27-28	M2S Mis-alignment X Stored	deg			SPF
29-30	M2S Mis-alignment Y Stored	deg			SPF
31-32	M2S Mis-alignment Z Stored	deg			SPF

G^3oM Software Version Scale Factor = 0.1

3.4.4. Mission Data Dump

Message ID: MDD

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x100	Sub Address	:	1
Frequency	:	As Required	Phase	:	Checkout

Table 3.13: Mission Data Dump Data

Word	Parameter	Unit	Min.	Max.	Format
1	Activity Command				U16
2	Mode Command				U16
3-4	Reserved				
5-8	Latitude	deg	-90.00	90.00	DPF
9-12	Longitude	deg	-179.99	180.00	DPF
13-14	Altitude	m			SPF
15-16	ψ	deg	-179.99	180.00	SPF
17-18	ϕ	deg	-179.99	180.00	SPF
19-20	θ	deg	-90.00	90.00	SPF
21-22	Alignment Time	s	10		SPF
23-24	Navigation Time	s			SPF
25	Mission Data Validity				U16
26	MDD Command Echo				U16

3.4.5. Position Test Data

Message ID: PTD

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x180	Sub Address	:	1
Frequency	:	As Required	Phase	:	Checkout

Table 3.14: Position Test Data

Word	Parameter		Unit	Scale Factor	Min.	Max.	Format
1-2	Compensated	Gyro - X	°/hr				SPF
3-4		Gyro - Y	°/hr				SPF
5-6		Gyro - Z	°/hr				SPF
7-8		Accl - X	g				SPF
9-10		Accl – Y	g				SPF
11-12		Accl – Z	g				SPF
13-14	Raw	Gyro - X	°/hr				SPF
15-16		Gyro - Y	°/hr				SPF
17-18		Gyro - Z	°/hr				SPF
19-20		Accl - X	g				SPF
21-22		Accl - Y	g				SPF
23-24		Accl – Z	g				SPF
25	Accumulation Time		s	0.0025			U16
26	PTD Command Echo						U16
27	Gyro-X Temperature		°C	0.01			S16
28	Gyro-Y Temperature		°C	0.01			S16
29	Gyro-Z Temperature		°C	0.01			S16
30	Accl-X Temperature		°C	0.01			S16
31	Accl-Y Temperature		°C	0.01			S16
32	Accl-Z Temperature		°C	0.01			S16

3.4.6. Alignment Data

Message ID: ALN

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x200	Sub Address	:	1
Frequency	:	20 ms	Phase	:	Checkout

Table 3.15: Leveling Angles

Word	Parameter	Refresh Rate	Unit	Min.	Max.	Format
1-2	INS Time	20 ms	s			SPF
3-4	Remaining Alignment Time		s			SPF
5-6	ψ		deg			SPF
7-8	ϕ		deg			SPF
9-10	θ		deg			SPF
11-12	Gyro - X Drift	@end	°/hr			SPF
13-14	Gyro - Y Drift		°/hr			SPF
15-16	Gyro - Z Drift		°/hr			SPF
17-18	Accl - X Residue		mg			SPF
19-20	Accl - Y Residue		mg			SPF
21-22	Accl - Z Residue		mg			SPF
23	Gyro Temperature	20 ms	°C			S16
24	Accl Temperature		°C			S16
25	INS Status					U16
26	ALN Command Echo					U16
27-28	M2S Mis-alignment X	@end	deg			SPF
29-30	M2S Mis-alignment Y		deg			SPF
31-32	M2S Mis-alignment Z		deg			SPF

Temperature Scale Factor = 0.01

3.4.7. Rates & Accelerations

Message ID: SRA

Source	:	INS-C	Destination	:	OBC-C
Offset	:	0x280	Sub Address	:	16
Frequency	:	2.5 ms	Phase	:	All

Table 3.16: Inertial Sensors Raw Data

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Compensated	Rate – X	deg/s			SPF
5-6		Rate – Y	deg/s			SPF
7-8		Rate – Z	deg/s			SPF
9-10		Accl – X	m/s^2			SPF
11-12		Accl – Y	m/s^2			SPF
13-14		Accl – Z	m/s^2			SPF
15-16	Raw	Gyro – X	deg/s			SPF
17-18		Gyro – Y	deg/s			SPF
19-20		Gyro – Z	deg/s			SPF
21-22		Accl – X	m/s^2			SPF
23-24		Accl – Y	m/s^2			SPF
25-26		Accl – Z	m/s^2			SPF
27	GPS Time Elapsed Count		2.5 *ms*			U16
28	Header Fail Count					U16
29	Packet Miss Count					U16
30	Checksum Fail Count					U16
31	Sensor Status					U16
32	INS Status					U16

3.4.8. Attitude Data (ECEF to Body)

Message ID: ATT

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x300	Sub Address	:	17
Frequency	:	10 ms	Phase	:	Navigation

Table 3.17: Attitude Data (ECEF to Body)

Word	Parameter		Unit	Min.	Min.	Format
1-2	INS Time		s			SPF
3-4	Pure	q_0	-			SPF
5-6		q_1	-			SPF
7-8		q_2	-			SPF
9-10		q_3	-			SPF
11-12	Pure	ψ	deg			SPF
13-14		ϕ	deg			SPF
15-16		θ	deg			SPF
17-18	Hybrid	q_0	-			SPF
19-20		q_1	-			SPF
21-22		q_2	-			SPF
23-24		q_3	-			SPF
25-26	Hybrid	ψ	deg			SPF
27-28		ϕ	deg			SPF
29-30		θ	deg			SPF
31	Reserved					
32	INS Status					U16

3.4.9. ECEF Positions & Velocities

Message ID: EPV

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x380	Sub Address	:	18
Frequency	:	20 ms	Phase	:	Navigation

Table 3.18: ECEF Velocities & Positions

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Pure	Velocity – X	m/s			SPF
5-6		Velocity – Y	m/s			SPF
7-8		Velocity – Z	m/s			SPF
9-10		Position – X	m			SPF
11-12		Position – Y	m			SPF
13-14		Position – Z	m			SPF
15-16	Hybrid	Velocity – X	m/s			SPF
17-18		Velocity – Y	m/s			SPF
19-20		Velocity – Z	m/s			SPF
21-22		Position – X	m			SPF
23-24		Position – Y	m			SPF
25-26		Position – Z	m			SPF
27-28	Pure g		m/s^2			SPF
29-30	Hybrid g		m/s^2			SPF
31	FIMU Temperature		$^\circ C$			S16
32	INS Status					U16

Temperature Scale Factor = 0.01

3.4.10. KF Corrections (ECEF Frame)

Message ID: KFC

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x480	Sub Address	:	19
Frequency	:	1 s	Phase	:	Navigation

Table 3.19: KF Corrections (ECEF Frame)

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Corrections	Position - X	m			SPF
5-6		Position - Y	m			SPF
7-8		Position - Z	m			SPF
9-10		Velocity - X	m/s			SPF
11-12		Velocity - Y	m/s			SPF
13-14		Velocity - Z	m/s			SPF
15-16		Quat - q1				SPF
17-18		Quat - q2				SPF
19-20		Quat - q3				SPF
21-22		Acc Bias - X	m/s^2			SPF
23-24		Acc Bias - Y	m/s^2			SPF
25-26		Acc Bias - Z	m/s^2			SPF
27-28		Gyro Bias - X	deg/s			SPF
29-30		Gyro Bias - Y	deg/s			SPF
31	Reserved					
32	GNSS MI [0x9181]					U16

3.4.11. GPS Velocities, Positions & Receiver Status

Message ID: PVG

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x500	Sub Address	:	20
Frequency	:	1.0 s	Phase	:	All

Table 3.20: GPS Velocities, Positions & Receiver Status

Word	Parameter	Unit	Min.	Max.	Format
1-2	INS Time	s			SPF
3-4	Velocity X	m/s			SPF
5-6	Velocity Y	m/s			SPF
7-8	Velocity Z	m/s			SPF
9-10	Position X	m			SPF
11-12	Position Y	m			SPF
13-14	Position Z	m			SPF
15-16	Latitude	deg			SPF
17-18	Longitude	deg			SPF
19-20	Altitude	m			SPF
21-22	GPS PDOP				SPF
23-24	GPS HDOP				SPF
25-26	GPS Clock Bias	m			SPF
27-28	User Clock Bias	sec			SPF
29-30	Solution Time	s			U32
31	GNSS Receiver Status				U16
32	GNSS MI [0xA1X1]				U16

3.4.12. GNSS Velocities, Positions

Message ID: PVS

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x580	Sub Address	:	22
Frequency	:	1.0 s	Phase	:	All

Table 3.21: GNSS Velocities, Positions & Receiver Status

Word	Parameter	Unit	Min.	Max.	Format
1-2	INS Time	s			SPF
3-4	Velocity X	m/s			SPF
5-6	Velocity Y	m/s			SPF
7-8	Velocity Z	m/s			SPF
9-10	Position X	m			SPF
11-12	Position Y	m			SPF
13-14	Position Z	m			SPF
15-16	Latitude	deg			SPF
17-18	Longitude	deg			SPF
19-20	Altitude	m			SPF
21-22	GNSS PDOP				SPF
23-24	GNSS HDOP				SPF
25-26	GNSS Clock Bias	m			SPF
27-28	User Clock Drift	s/s			SPF
29-30	Gyro Bias - Z	deg/s			SPF
31	Constel of Channel 1-16				U16
32	GNSS MI [0xC1X1]				U16

3.4.13. GPS Satellite IDs and Signal to Noise Ratio

Message ID: SVG

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x600	Sub Address	:	21
Frequency	:	1.0 s	Phase	:	All

Table 3.22: Satellite IDs and Signal to Noise Ratio

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time					SPF
3	GPS	Satellite ID 2 & 1				U16
4		Satellite ID 4 & 3				U16
5		Satellite ID 6 & 5				U16
6		Satellite ID 8 & 7				U16
7		Satellite ID 10 & 9				U16
8		Satellite ID 12 & 11				U16
9		Satellite ID 14 & 13				U16
10		S/N Ratio 2 & 1	dB-Hz			U16
11		S/N Ratio 4 & 3	dB-Hz			U16
12		S/N Ratio 6 & 5	dB-Hz			U16
13		S/N Ratio 8 & 7	dB-Hz			U16
14		S/N Ratio 10 & 9	dB-Hz			U16
15		S/N Ratio 12 & 11	dB-Hz			U16
16		S/N Ratio 14 & 13	dB-Hz			U16
17	GMT	Year				U16
18		Month (MSB) & Day (LSB)				U16
19		Hours (MSB) & Minutes (LSB)				U16
20		Seconds				U16
21-22	GPS Week Number					U32
23-24	GPS Time		s			U32
25-26	GPS Time (ns)		ns			U32
27-28	Time Tag		ms			U32
29-30	Interval Length		s			S32
31	Ephemeris of Channel 1-16					U16
32	GNSS MI [0xA1X2]					U16

3.4.14. GNSS Satellite IDs and Signal to Noise Ratio

Message ID: SVS

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x680	Sub Address	:	
Frequency	:	1.0 s	Phase	:	All

Table 3.23: Satellite IDs and Signal to Noise Ratio

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time					SPF
3	GNSS	Satellite ID 1				S16
4		Satellite ID 2				S16
5		Satellite ID 3				S16
6		Satellite ID 4				S16
7		Satellite ID 5				S16
8		Satellite ID 6				S16
9		Satellite ID 7				S16
10		Satellite ID 8				S16
11		Satellite ID 9				S16
12		S/N Ratio 2 & 1	dB-Hz			U16
13		S/N Ratio 4 & 3	dB-Hz			U16
14		S/N Ratio 6 & 5	dB-Hz			U16
15		S/N Ratio 8 & 7	dB-Hz			U16
16		S/N Ratio 9	dB-Hz			U16
17	GAGAN Satellite ID 2 & 1					U16
18	GAGAN S/N Ratio 2 & 1		dB-Hz			U16
19-20	GPS Sync Time		s			SPF
21-22	IRNSS Week Number					U32
23-24	IRNSS Time		s			U32
25-26	IRNSS Time (ns)		ns			U32
27	Status of Channel 1-8					U16
28	Status of Channel 9-16					U16
29	Status of Channel 17-23					U16
30	Constel of Channel 17-23					U16
31	Ephemeris of Channel 17-23					U16
32	GNSS MI [0xC1X2]					U16

3.4.15. GPS Pseudo Range

Message ID: PRG

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x700	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.24: Pseudo Range

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Pseudo Range	Channel No 1	m			S32
5-6		Channel No 2	m			S32
7-8		Channel No 3	m			S32
9-10		Channel No 4	m			S32
11-12		Channel No 5	m			S32
13-14		Channel No 6	m			S32
15-16		Channel No 7	m			S32
17-18		Channel No 8	m			S32
19-20		Channel No 9	m			S32
21-22		Channel No 10	m			S32
23-24		Channel No 11	m			S32
25-26		Channel No 12	m			S32
27-28		Channel No 13	m			S32
29-30		Channel No 14	m			S32
31	Almanac of Channel 1-8					U16
32	GNSS MI [0xA183]					U16

3.4.16. GPS Delta Pseudo Range

Message ID: DRG

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x780	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.25: Delta Pseudo Range

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Delta Pseudo Range	Channel No 1	m			SPF
5-6		Channel No 2	m			SPF
7-8		Channel No 3	m			SPF
9-10		Channel No 4	m			SPF
11-12		Channel No 5	m			SPF
13-14		Channel No 6	m			SPF
15-16		Channel No 7	m			SPF
17-18		Channel No 8	m			SPF
19-20		Channel No 9	m			SPF
21-22		Channel No 10	m			SPF
23-24		Channel No 11	m			SPF
25-26		Channel No 12	m			SPF
27-28		Channel No 13	m			SPF
29-30		Channel No 14	m			SPF
31	Almanac of Channel 9-23					U16
32	GNSS MI [0xA184]					U16

3.4.17. Quality of Pseudo Range & Delta Pseudo Range

Message ID: QRG

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x800	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.26: Quality of Pseudo Range

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3	PR Quality	Channel No 2 & 1				U16
4		Channel No 4 & 3				U16
5		Channel No 6 & 5				U16
6		Channel No 8 & 7				U16
7		Channel No 10 & 9				U16
8		Channel No 12 & 11				U16
9		Channel No 14 & 13				U16
10		Channel No 16 & 15				U16
11		Channel No 18 & 17				U16
12		Channel No 20 & 19				U16
13		Channel No 22 & 21				U16
14		Channel No 24 & 23				U16
15		Channel No 26 & 25				U16
16		Channel No 28 & 27				U16
17	DPR Quality	Channel No 2 & 1				U16
18		Channel No 4 & 3				U16
19		Channel No 6 & 5				U16
20		Channel No 8 & 7				U16
21		Channel No 10 & 9				U16
22		Channel No 12 & 11				U16
23		Channel No 14 & 13				U16
24		Channel No 16 & 15				U16
25		Channel No 18 & 17				U16
26		Channel No 20 & 19				U16
27		Channel No 22 & 21				U16
28		Channel No 24 & 23				U16
29		Channel No 26 & 25				U16
30		Channel No 28 & 27				U16
31	Reserved					U16
32	GNSS MI [0xA185]					U16

3.4.18. GPS Satellite Position 1

Message ID: SP1

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x880	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.27: GPS Satellite Position

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Position	Channel No 1-X	m			S32
5-6		Channel No 1-Y	m			S32
7-8		Channel No 1-Z	m			S32
9-10		Channel No 2-X	m			S32
11-12		Channel No 2-Y	m			S32
13-14		Channel No 2-Z	m			S32
15-16		Channel No 3-X	m			S32
17-18		Channel No 3-Y	m			S32
19-20		Channel No 3-Z	m			S32
21-22		Channel No 4-X	m			S32
23-24		Channel No 4-Y	m			S32
25-26		Channel No 4-Z	m			S32
27-28		Channel No 5-X	m			S32
29-30		Channel No 5-Y	m			S32
31	Measurement Quality Ch 1-16					U16
32	GNSS MI [0xA186]					U16

3.4.19. GPS Satellite Position 2

Message ID: SP2

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x900	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.28: GPS Satellite Position 2

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Position	Channel No 5-Z	m			S32
5-6		Channel No 6-X	m			S32
7-8		Channel No 6-Y	m			S32
9-10		Channel No 6-Z	m			S32
11-12		Channel No 7-X	m			S32
13-14		Channel No 7-Y	m			S32
15-16		Channel No 7-Z	m			S32
17-18		Channel No 8-X	m			S32
19-20		Channel No 8-Y	m			S32
21-22		Channel No 8-Z	m			S32
23-24		Channel No 9-X	m			S32
25-26		Channel No 9-Y	m			S32
27-28		Channel No 9-Z	m			S32
29-30		Channel No 10-X	m			S32
31	Health of Satellite 1-8					U16
32	GNSS MI [0xA187]					U16

3.4.20. GPS Satellite Position 3

Message ID: SP3

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0x980	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.29: GPS Satellite Position 3

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Position	Channel No 10-X	m			S32
5-6		Channel No 10-Z	m			S32
7-8		Channel No 11-X	m			S32
9-10		Channel No 11-Y	m			S32
11-12		Channel No 11-Z	m			S32
13-14		Channel No 12-X	m			S32
15-16		Channel No 12-Y	m			S32
17-18		Channel No 12-Z	m			S32
19-20		Channel No 13-X	m			S32
21-22		Channel No 13-Y	m			S32
23-24		Channel No 13-Z	m			S32
25-26		Channel No 14-X	m			S32
27-28		Channel No 14-Y	m			S32
29-30		Channel No 14-Z	m			S32
31	Health of Satellite 9-23					U16
32	GNSS MI [0xA188]					U16

3.4.21. GPS Satellite Velocity 1

Message ID: SV1

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xA00	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.30: GPS Satellite Velocity 1

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF velocity	Channel No 1-X	m/s			S32
5-6		Channel No 1-Y	m/s			S32
7-8		Channel No 1-Z	m/s			S32
9-10		Channel No 2-X	m/s			S32
11-12		Channel No 2-Y	m/s			S32
13-14		Channel No 2-Z	m/s			S32
15-16		Channel No 3-X	m/s			S32
17-18		Channel No 3-Y	m/s			S32
19-20		Channel No 3-Z	m/s			S32
21-22		Channel No 4-X	m/s			S32
23-24		Channel No 4-Y	m/s			S32
25-26		Channel No 4-Z	m/s			S32
27-28		Channel No 5-X	m/s			S32
29-30		Channel No 5-Y	m/s			S32
31	Measurement Quality Ch 17-23					U16
32	GNSS MI [0xA189]					U16

3.4.22. GPS Satellite Velocity 2

Message ID: SV2

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xA80	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.31: GPS Satellite Velocity 2

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Velocity	Channel No 5-Z	m/s			S32
5-6		Channel No 6-X	m/s			S32
7-8		Channel No 6-Y	m/s			S32
9-10		Channel No 6-Z	m/s			S32
11-12		Channel No 7-X	m/s			S32
13-14		Channel No 7-Y	m/s			S32
15-16		Channel No 7-Z	m/s			S32
17-18		Channel No 8-X	m/s			S32
19-20		Channel No 8-Y	m/s			S32
21-22		Channel No 8-Z	m/s			S32
23-24		Channel No 9-X	m/s			S32
25-26		Channel No 9-Y	m/s			S32
27-28		Channel No 9-Z	m/s			S32
29-30		Channel No 10-X	m/s			S32
31	Firmware Version					U16
32	GNSS MI [0xA18A]					U16

3.4.23. GPS Satellite Velocity 3

Message ID: SV3

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xB00	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.32: Quality of Pseudo Range

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Velocity	Channel No 10-X	m/s			S32
5-6		Channel No 10-Z	m/s			S32
7-8		Channel No 11-X	m/s			S32
9-10		Channel No 11-Y	m/s			S32
11-12		Channel No 11-Z	m/s			S32
13-14		Channel No 12-X	m/s			S32
15-16		Channel No 12-Y	m/s			S32
17-18		Channel No 12-Z	m/s			S32
19-20		Channel No 13-X	m/s			S32
21-22		Channel No 13-Y	m/s			S32
23-24		Channel No 13-Z	m/s			S32
25-26		Channel No 14-X	m/s			S32
27-28		Channel No 14-Y	m/s			S32
29-30		Channel No 14-Z	m/s			S32
31	CBIT 3					U16
32	GNSS MI [0xA18B]					U16

3.4.24. GPS Satellite Clock Bias

Message ID: SBG

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xB80	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.33: GPS Satellite Clock Bias

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Clock Bias	Channel No 1	s			S32
5-6		Channel No 2	s			S32
7-8		Channel No 3	s			S32
9-10		Channel No 4	s			S32
11-12		Channel No 5	s			S32
13-14		Channel No 6	s			S32
15-16		Channel No 7	s			S32
17-18		Channel No 8	s			S32
19-20		Channel No 9	s			S32
21-22		Channel No 10	s			S32
23-24		Channel No 11	s			S32
25-26		Channel No 12	s			S32
27-28		Channel No 13	s			S32
29-30		Channel No 14	s			S32
31	CBIT 1					U16
32	GNSS MI [0xA18C]					U16

3.4.25. GPS Satellite Clock Drift

Message ID: SDG

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xC00	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.34: GPS Satellite Clock Drift

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Clock Drift	Channel No 1	s/s			S32
5-6		Channel No 2	s/s			S32
7-8		Channel No 3	s/s			S32
9-10		Channel No 4	s/s			S32
11-12		Channel No 5	s/s			S32
13-14		Channel No 6	s/s			S32
15-16		Channel No 7	s/s			S32
17-18		Channel No 8	s/s			S32
19-20		Channel No 9	s/s			S32
21-22		Channel No 10	s/s			S32
23-24		Channel No 11	s/s			S32
25-26		Channel No 12	s/s			S32
27-28		Channel No 13	s/s			S32
29-30		Channel No 14	s/s			S32
31	CBIT 2					U16
32	GNSS MI [0xA18D]					U16

3.4.26. GNSS Satellite Position 1

Message ID: SP4

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xC80	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.35: GNSS Satellite Position 1

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Position	Channel No 15-X	m			S32
5-6		Channel No 15-Y	m			S32
7-8		Channel No 15-Z	m			S32
9-10		Channel No 16-X	m			S32
11-12		Channel No 16-Y	m			S32
13-14		Channel No 16-Z	m			S32
15-16		Channel No 17-X	m			S32
17-18		Channel No 17-Y	m			S32
19-20		Channel No 17-Z	m			S32
21-22		Channel No 18-X	m			S32
23-24		Channel No 18-Y	m			S32
25-26		Channel No 18-Z	m			S32
27-28		Channel No 19-X	m			S32
29-30		Channel No 19-Y	m			S32
31	PBIT 1					U16
32	GNSS MI [0xC183]					U16

3.4.27. GNSS Satellite Position 2

Message ID: SP5

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xD00	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.36: GNSS Satellite Position 2

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Position	Channel No 19-Z	m			S32
5-6		Channel No 20-X	m			S32
7-8		Channel No 20-Y	m			S32
9-10		Channel No 20-Z	m			S32
11-12		Channel No 21-X	m			S32
13-14		Channel No 21-Y	m			S32
15-16		Channel No 21-Z	m			S32
17-18		Channel No 22-X	m			S32
19-20		Channel No 22-Y	m			S32
21-22		Channel No 22-Z	m			S32
23-24		Channel No 23-X	m			S32
25-26		Channel No 23-Y	m			S32
27-28		Channel No 23-Z	m			S32
29	GAGAN Corrections Availed					U16
30	GAGAN Corrections Applied					U16
31	PBIT 2					U16
32	GNSS MI [0xC184]					U16

3.4.28. GNSS Satellite Velocity 1

Message ID: SV4

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xD80	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.37: GNSS Satellite Velocity 1

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Velocity	Channel No 15-X	m/s			S32
5-6		Channel No 15-Y	m/s			S32
7-8		Channel No 15-Z	m/s			S32
9-10		Channel No 16-X	m/s			S32
11-12		Channel No 16-Y	m/s			S32
13-14		Channel No 16-Z	m/s			S32
15-16		Channel No 17-X	m/s			S32
17-18		Channel No 17-Y	m/s			S32
19-20		Channel No 17-Z	m/s			S32
21-22		Channel No 18-X	m/s			S32
23-24		Channel No 18-Y	m/s			S32
25-26		Channel No 18-Z	m/s			S32
27-28		Channel No 19-X	m/s			S32
29-30		Channel No 19-Y	m/s			S32
31	PE Health Status					U16
32	GNSS MI [0xC185]					U16

3.4.29. GNSS Satellite Velocity 2

Message ID: SV5

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xE00	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.38: GNSS Satellite Velocity 2

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	ECEF Velocity	Channel No 19-Z	m/s			S32
5-6		Channel No 20-X	m/s			S32
7-8		Channel No 20-Y	m/s			S32
9-10		Channel No 20-Z	m/s			S32
11-12		Channel No 21-X	m/s			S32
13-14		Channel No 21-Y	m/s			S32
15-16		Channel No 21-Z	m/s			S32
17-18		Channel No 22-X	m/s			S32
19-20		Channel No 22-Y	m/s			S32
21-22		Channel No 22-Z	m/s			S32
23-24		Channel No 23-X	m/s			S32
25-26		Channel No 23-Y	m/s			S32
27-28		Channel No 23-Z	m/s			S32
29	Checksum LW					U16
30	Checksum HW					U16
31	Reserved					
32	GNSS MI [0xC186]					U16

3.4.30. Pseudo Range Residue

Message ID: PRR

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xE80	Sub Address	:	
Frequency	:	1 s	Phase	:	Navigation

Table 3.39: Pseudo Range Residue

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Pseudo Range Residue	Channel No 1	m			SPF
5-6		Channel No 2	m			SPF
7-8		Channel No 3	m			SPF
9-10		Channel No 4	m			SPF
11-12		Channel No 5	m			SPF
13-14		Channel No 6	m			SPF
15-16		Channel No 7	m			SPF
17-18		Channel No 8	m			SPF
19-20		Channel No 9	m			SPF
21-22		Channel No 10	m			SPF
23-24		Channel No 11	m			SPF
25-26		Channel No 12	m			SPF
27-28		Channel No 13	m			SPF
29-30		Channel No 14	m			SPF
31	Reserved					
32	GNSS MI [0x9182]					U16

3.4.31. Delta Pseudo Range Residue

Message ID: DRR

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xF00	Sub Address	:	
Frequency	:	1 s	Phase	:	Navigation

Table 3.40: Delta Pseudo Range Residue

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	Delta Pseudo Range Residue	Channel No 1	m/s			SPF
5-6		Channel No 2	m/s			SPF
7-8		Channel No 3	m/s			SPF
9-10		Channel No 4	m/s			SPF
11-12		Channel No 5	m/s			SPF
13-14		Channel No 6	m/s			SPF
15-16		Channel No 7	m/s			SPF
17-18		Channel No 8	m/s			SPF
19-20		Channel No 9	m/s			SPF
21-22		Channel No 10	m/s			SPF
23-24		Channel No 11	m/s			SPF
25-26		Channel No 12	m/s			SPF
27-28		Channel No 13	m/s			SPF
29-30		Channel No 14	m/s			SPF
31	Reserved					
32	GNSS MI [0x9183]					U16

3.4.32. GNSS Pseudo Range & Delta Pseudo Range Residue

Message ID: RRS

Source	:	INS-C	Destination	:	OBC-C
Offset Address	:	0xF80	Sub Address	:	
Frequency	:	1.0 s	Phase	:	Navigation

Table 3.41: PR & DPR Residue

Word	Parameter		Unit	Min.	Max.	Format
1-2	INS Time		s			SPF
3-4	PR Residue	Channel No 15	m			SPF
5-6		Channel No 16	m			SPF
7-8		Channel No 17	m			SPF
9-10		Channel No 18	m			SPF
11-12		Channel No 19	m			SPF
13-14		Channel No 20	m			SPF
15-16		Channel No 21	m			SPF
17-18	DPR Residue	Channel No 15	m/s			SPF
19-20		Channel No 16	m/s			SPF
21-22		Channel No 17	m/s			SPF
23-24		Channel No 18	m/s			SPF
25-26		Channel No 19	m/s			SPF
27-28		Channel No 20	m/s			SPF
29-30		Channel No 21	m/s			SPF
31	Reserved					U16
32	GNSS MI [0x9184]					U16

3.4.33. Status Word Definition

3.4.33.1. INS Status

Table 3.42: INS Mission Status

Bit No.	Parameter	Description	
MSB 15	INS Ready	1 - For 1553B Command	0 - Busy
14	Hybridization	1 - ON	0- OFF
13-12	Operation Mode	00 - Mission Mode 01 - Constant Simulation 10 - HILS Mode (Half Simulation) 11 - 6 DOF Mode (Full Stimulation)	
11-10	Attitude Available	11 - Reserved 10 - Heading & Levelling Angles Available 01 - Levelling Angles Available 00 - Not Available	
09-08	Alignment Mode	01 - Static Levelling 10 - Two Position TA 11 - Rate Matching TA	
07-04	INS Active Mode	0001 - Standby 0010 - Position Test 0111 - Mission Data Load 0110 - Mission Data Dump 0100 - Alignment 1000 - Navigation	
03	Mission Data	1 - Data required	0 - Data not required
02	Sensor Temperature	1 - NOT OK	0 - OK
01	Sensor Data Validity	1 - Data Not Valid	0 - Data valid
LSB 00	INS Health	1 - NOT OK	0 - OK

3.4.33.2. Sensor Status

Table 3.43: Inertial Sensors Status

Bit No.	Parameter	Description
MSB 15	FIMU Packet Header Fail	1 - NOT OK 0 - OK
14	FIMU Packet Checksum Fail	1 - NOT OK 0 - OK
13	FIMU Packet Fail	1 - NOT OK 0 - OK
12	FIMU Packet Time out	1 - NOT OK 0 - OK
11	Z - Accl Abs Fail	1 - NOT OK 0 - OK
10	Y - Accl Abs Fail	1 - NOT OK 0 - OK
09	X - Accl Abs Fail	1 - NOT OK 0 - OK
08	Z - Gyro Abs Fail	1 - NOT OK 0 - OK
07	Y - Gyro Abs Fail	1 - NOT OK 0 - OK
06	X - Gyro Abs Fail	1 - NOT OK 0 - OK
05	Z - Accl Fail	1 - NOT OK 0 - OK
04	Y - Accl Fail	1 - NOT OK 0 - OK
03	X - Accl Fail	1 - NOT OK 0 - OK
02	Z - Gyro Fail	1 - NOT OK 0 - OK
01	Y - Gyro Fail	1 - NOT OK 0 - OK
LSB 00	X - Gyro Fail	1 - NOT OK 0 - OK

3.4.33.3. Configuration Status

Table 3.44: Configuration Status

Bit No.	Parameter	Description
MSB 15-14	M2S Mis-alignments	10 - Valid 00 - Not Valid
13-03	Reserved	-
02	FIMU Software Checksum	1 - NOT OK 0 - OK
01	CAL Data Checksum	1 - NOT OK 0 - OK
LSB 00	NAV Application Checksum	1 - NOT OK 0 - OK

3.4.33.4. GPS Receiver Status

Table 3.45: GPS Receiver Status

Bit No.	Parameter	Description
MSB 15-08	Reserved	-
07	Position Availability	1 - Available 0 - Not Available
06	DGPS	1 - ON 0 - OFF
05	Almanac Availability	00 - Available and OK 01 - Status not known 10 - Available but old 11 - Not Available
04		
03	GPS Position	1 - Available 0 - Not Available
02	GLONASS Position	1 - Available 0 - Not Available
01	GPS+GLONASS Position	1 - Available 0 - Not Available
LSB 00	GPS Time	1 - Available 0 - Not Available

3.4.33.5. GPS PR/DPR Quality Status

Table 3.46: GPS PR/DPR Quality Status

Bit No.	Parameter	Description
MSB 15	Channel - 16 Quality	1 - OK 0 - NOT OK
14	Channel - 15 Quality	1 - OK 0 - NOT OK
13	Channel - 14 Quality	1 - OK 0 - NOT OK
12	Channel - 13 Quality	1 - OK 0 - NOT OK
11	Channel - 12 Quality	1 - OK 0 - NOT OK
10	Channel - 11 Quality	1 - OK 0 - NOT OK
09	Channel - 10 Quality	1 - OK 0 - NOT OK
08	Channel - 09 Quality	1 - OK 0 - NOT OK
07	Channel - 08 Quality	1 - OK 0 - NOT OK
06	Channel - 07 Quality	1 - OK 0 - NOT OK
05	Channel - 06 Quality	1 - OK 0 - NOT OK
04	Channel - 05 Quality	1 - OK 0 - NOT OK
03	Channel - 04 Quality	1 - OK 0 - NOT OK
02	Channel - 03 Quality	1 - OK 0 - NOT OK
01	Channel - 02 Quality	1 - OK 0 - NOT OK
LSB 00	Channel - 01 Quality	1 - OK 0 - NOT OK

OK : Quality 6

3.4.33.6. GPS SNR Status

Table 3.47: GPS SNR Status

Bit No.	Parameter	Description
MSB 15	Channel - 16 SNR	1 - OK 0 - NOT OK
14	Channel - 15 SNR	1 - OK 0 - NOT OK
13	Channel - 14 SNR	1 - OK 0 - NOT OK
12	Channel - 13 SNR	1 - OK 0 - NOT OK
11	Channel - 12 SNR	1 - OK 0 - NOT OK
10	Channel - 11 SNR	1 - OK 0 - NOT OK
09	Channel - 10 SNR	1 - OK 0 - NOT OK
08	Channel - 09 SNR	1 - OK 0 - NOT OK
07	Channel - 08 SNR	1 - OK 0 - NOT OK
06	Channel - 07 SNR	1 - OK 0 - NOT OK
05	Channel - 06 SNR	1 - OK 0 - NOT OK
04	Channel - 05 SNR	1 - OK 0 - NOT OK
03	Channel - 04 SNR	1 - OK 0 - NOT OK
02	Channel - 03 SNR	1 - OK 0 - NOT OK
01	Channel - 02 SNR	1 - OK 0 - NOT OK
LSB 00	Channel - 01 SNR	1 - OK 0 - NOT OK

OK : 33 < SNR < 50

3.4.33.7. GNSS Message Index

Table 3.48: GNSS Message Index

Bit No.	Parameter	Description
15-12	Message type	1001 - KF 1010 - GPS 1100 - IRNSS
11-08	Cycle No	C* [1 - 5]
07-04	INS Active Mode	0001 - Standby 0010 - Position Test 0111 - Mission Data Load 0110 - Mission Data Dump 0100 - Alignment 1000 - Navigation
03-00	Message No	M* [1 - 15]

ELECTRICAL INTERFACE

4.1. Interconnection Diagram

4.2. Connector Lists

MECHANICAL INTERFACE

5.1. Installation Recommendations

5.1.1. Structural modes

In order to avoid amplification phenomena of vibration or shock level applied to the INS during firing, the mounting plate with the INS bolted on it shall not offer modes for a frequency range lower than 1100 Hz. The surtension coefficient of the modes that remain over 1100 Hz shall be no more than 10.

5.1.2. Flatness

On the mounting area, the mounting plate flatness shall not be over 0.03 mm.

5.1.3. Fixation materials and procedure

INS shall be fixed on the mounting plate with 4 M10 CHC stamp Steel Class 12-9 with dichromate zincing surfacing. The length of the screw shall be over 45 mm with a non-thread maximal length of 20 mm.

Symbol Z Grade A flat slice with dichromate zincing surfacing shall be mounted under screw heads.

Screw tightening torque is fixed to 45 Nm (can be adjusted depending of the application). The tightening shall preferably be executed in cross in order to distribute tightening strains.

Hole screw cutting shall be equipped with added worms (helical type) in order to reinforce screw cuttings, to allow the application of specified torque and at least to authorize the replacement of the equipment. These added worms shall be put in place using `loctite` glue to reduce galvanic torque between the different metallic pieces (Steel/Aluminium). Hole screw cutting don't have to be lubricated and necessitate no thin jet of glue but a cleaning with a dry cloth.

5.1.4. Ground connection

Braided metallic wire shall connect mechanic ground of the INS to carrier mechanic ground.

The length of this braid shall be as short as possible in regard to operational conditions.

5.1.5. INU ventilation

The INU does not need forced ventilation to operate normally.

But some void spaces around the INU shall be preserved in order to allow natural convection.

These areas shall be more than 3 cm length around visible faces of the equipment nevertheless (if no space is available on the carrier structure) an acceptable space of 5 cm over 1 face only shall be dedicated to convection (excepted for the front face with the connector).

5.2. Mechanical Drawing

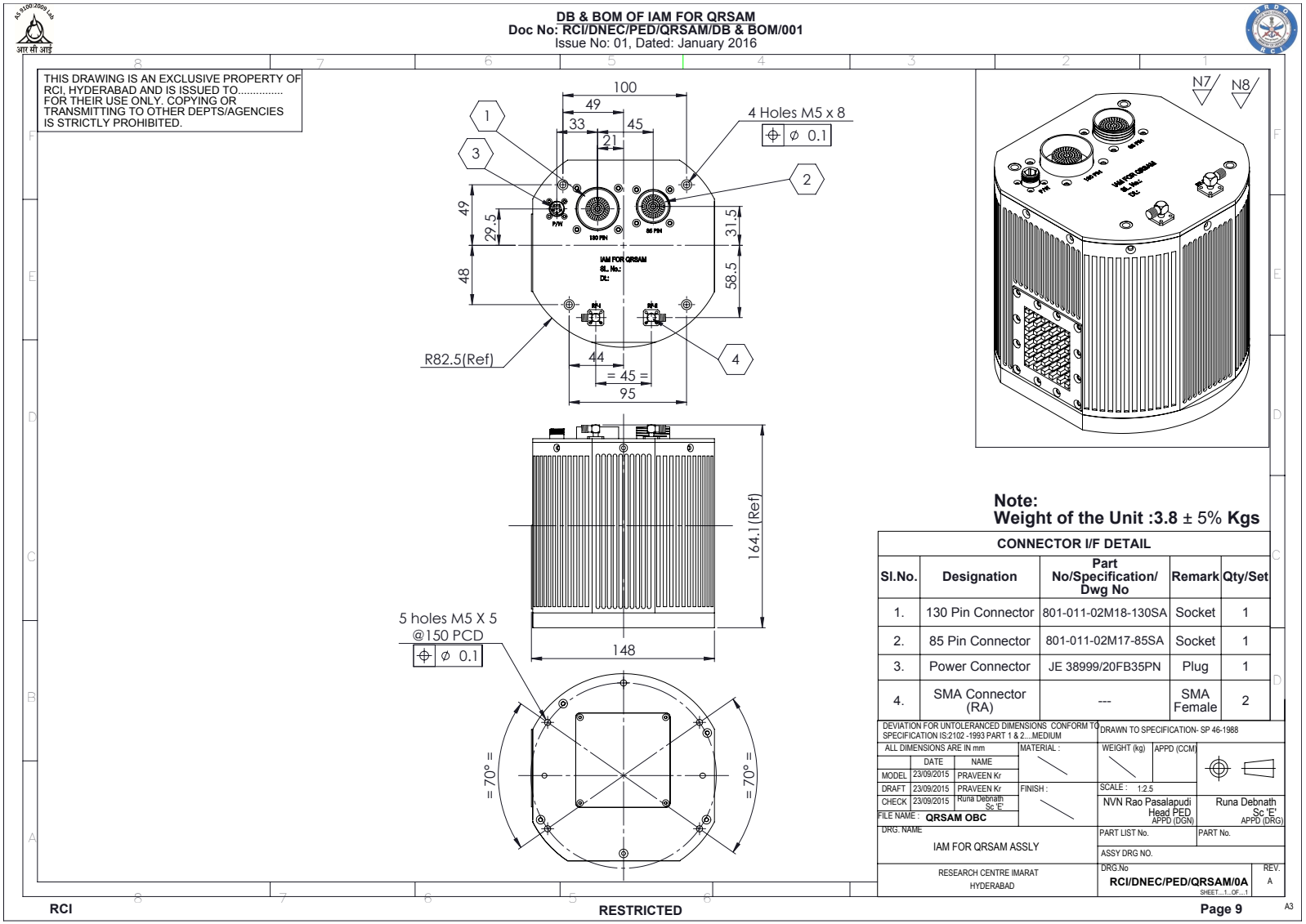

Figure 5.1: IAU Mechanical Drawing

Index

CHANGE RECORD

Change record information is provided in Table R.1

Table R.1: Change Record

Issue	Date	Sections	Note
1.4	Nov 2019		GNSS messages added
1.3	Jul 2019		Status words updated
1.2	Apr 2019		TA messages added
1.1	May 2017		Removed unused messages
1.0	Mar 2017		Initial release

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