Agnikul Data Stripping Document V1.3

Version no	Change Log	Date
V1.0		6/10/2022
V1.1	Added Data format description in Agnikul Word Format. Incorporates changes according to range safety requirement (meeting: 13/10/2022)	14/10/2022
V1.2	Added IMU Status section	31/10/2022
V1.2.1	Corrected parameter size and parameter ID in GNSS ECEF Message Note Section (Page 54)	01/12/2022
V1.3	1. Added 2 FTS analog Parameter 2. Changed Parameter ID location for Avionics Battery voltage monitoring 3. Removed Avionics Battery current monitoring Parameter 4. Added & Updated FTS Digital signal monitorings 5. Added Gimbal Actuator Status Section 6. Added Parameters ID values 7.	17/03/2022

- **List of Documents & its version number used in this stripping document V1.3 are as follows:**

S.No.	Sheet name	Version number
1	Flight Measurement Plan	V1.6
2	IRIG_PCM1	V1.5
3	PCM1_Frame_Format	V1.5
4	Agnikul Word Arrangement	V2.0
5	Agnikul Data Summary	V2.0

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ACRONYMS & ABBREVIATIONS

UNITS:

mA	milliAmpere
A	Ampere
V	Volt
s	second
ms	milliseconds
deg C	degree Celsius
mbar	millibar
g	acceleration due to gravity
m	metre
mm	millimetre
m/s	metre per second
deg	degree
Km/hr	Kilometre per hour
Kg	Kilogram
kN	kilo Newton

ABBREVIATIONS:

MSB	Most Significant Byte
LSB	Least Significant Byte
Msb	Most Significant Bit
Lsb	Least Significant Bit
bps	bits per second
EC	Engine Computer
FC	Flight Computer
CRC	Cyclic Redundancy Check
IFG	Interframe Gap

Data Representation - Conventions:

IMPORTANT

1. **BYTE 0 & BIT 0 is the Least Significant BYTE / BIT in a word.**
2. **Floating Point data Encoding is according to IEEE Standard For Normalised Single - Precision Floating Point Numbers (32 bits) :**
   - **1 Bit for Sign**
   - **8 Bits of Exponent**
   - **23 Bits of Mantissa**
3. **“Reserved “ means reserved for future extensions according to requirement**

1. Scope of the document

This document describes the flight measurement plan (FMP) of Agnikul for the mission and also the PCM frame configuration sent out by the telemetry module. In addition, this document also describes the position of the flight data (Agnikul Word Format) in the PCM frame configuration for the range safety and flight monitoring purposes.

2. Vehicle Configuration

Agnibaan SOrTeD is a suborbital tech demonstrator, which is a pressure fed stage powered by an engine of 5.87 kN thrust. The vehicle is configured based on the stage 2 engine of the orbital vehicle Agnibaan. The details of Agnibaan SOrTeD are given in table 1.

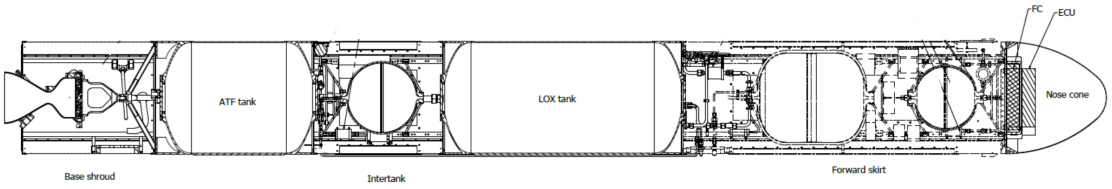

Fig1: Agnibaan SOrTeD

Table 1: Configuration details of Agnibaan SOrTeD

Parameters	Values
Vehicle Height (mm)	5970
Vehicle Diameter (mm)	500
Tank pressurisation - ATF	Helium
Tank pressurisation - LOX	Helium
Thrust Vector Control	(+/-) 4° gimbal range with 2 plane gimbaling
Attitude Control	Cold gas thrusters for Roll axis control
Propellants	LOX / Aviation Turbine Fuel (ATF)
No. of stages	1
Thrust (kN)	5.87
Sea level Isp (s)	219.43
Mass flow rate (kg/s)	2.7275
Vehicle Mass at liftoff (kg)	541
Structural mass (kg)	266
Propellant mass (kg)	275

Burn time (s)	100.83
Initial thrust/weight ratio	1.106

3. Agnibaan SOrTeD High level Telemetry Specification

3.1. The PCAMi 1000/CHS/03A is a three user module chassis. The three modules are as follows

3.1.1. The Controller Module is a PCAMi-1000/BCU-04 module which generates the PCM Pre-modulation signal.

3.1.2. PCAMi 1000/EBM 102 is a Gigabit Ethernet Bus Monitor module. This module accepts Ethernet UDP packets on a defined port address. The EBM 102 can monitor multiple packets simultaneously. The Ethernet packets are embedded to the PCM stream by the BCU 04 controller module.

3.1.3. PCAMi 1000/DVID 02 is a Digital Video acquisition module. The video is acquired using the HDMI interface. The acquired video is compressed using H.264 compression. The compressed video data is embedded to the PCM stream by the BCU 04 controller module.

3.1.4. The high level specifications are mentioned below

Table 2: Specifications of Telemetry Module

Specification	**Value**
Input	Ethernet TCP/IP & Analog data from Camera
Output	Serial PCM Data
Data rate (bps)	1998848
Code	Bi-Ph-L
Word Length	16 bits per word
Frame Length	976 words per minor Frame
Frame Sync Pattern	FE6B2840
SFID word location	1
Transmitter Frequency	2200 to 2300 MHz. For this mission 2237.5 or 2259 MHz which ever is acceptable
Tuning step	100 KHz

Output power	2 W, 1 W each in 2 ports
Modulation	FM
Modulating frequency	For this mission 2 MHZ Max
Deviation	3 MHz
Spurious	--60 dBc
Camera	Go Pro 7 camera
Antenna Gain	2 dB nominal --15 dB for 95 % coverage

3.2. Physical location of the antenna on the vehicle:

There are a total 10 antennas (4FTS + 2 GNSS + 2 Telemetry + 2 Tracking). The structure is divided into 4 sections by vertical stiffener. So three antennas are placed in 2 sections and 2 antennas are placed in other 2 sections. The angle between the antennas where 3 antennas are placed is 25 degree and whereas for 2 antennas it is 45 degree

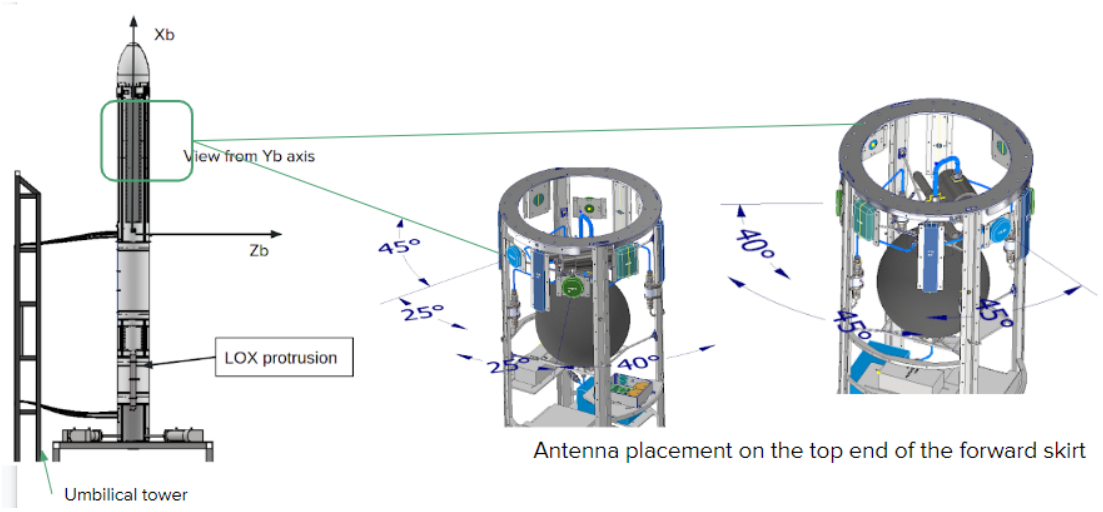

Figure 2: Antenna placement on the forward skirt of the vehicle

4. Parameters sent through telemetry

Total number of analog parameters = 44
Total number of digital parameters (digital communication - RS422) = 51
Total number of digital parameters (digital high-low signal) = 36
Resolution range for analog parameters = 8 to 16 bit
Resolution range for digital parameters (digital communication - RS422) = 8 to 32 bits
Sampling rate range = 1 to 2000 Hz (except FFT sensor)
Sampling rate for most of the analog parameters = 4 to 2000 KHz

Data generated (Data round off to 8bit/16 bit/32 bit) = 805,560 bps
Data generated + parameter id (8 bit) = 1,115,336 bps
Total Timestamp head (Secondary Header) = 202,528 bps
Total Primary Header = 50,632 bps
Total overheads (Primary header + Timestamp + parameter id) = 562,936 bps
Total data rate (without camera data) = 1,470,944 bps
Total PCM overheads = 6,144 bps
Camera Data rate = 521,760 bps

Total Telemetry data rate with camera data = 1,998,848 bps

5. Data packet format (Ethernet TCP/IP packet format with Agnikul Data arrangement)

The data packetization format for the parameters being sent through telemetry is shown in *Figure 5* and the customised packet design format is detailed in *Table 1*

Figure 3: Agnibaan SOrTeD data packetization format.

Ethernet Header	IP Header	TCP header	Primary Header	Secondary Header	Packet Body 1	Packet Body 2	Packet Body 3	Packet Body .N	CRC	IFG

Ethernet Fields:

a. Ethernet Header -
b. IP Header - 20 bytes
c. TCP Header - 20 bytes
d. Data field:
    i. Primary Header
    ii. Secondary Header
    iii. Packet Body
e. CRC - Cyclic Redundancy check
f. IFG - Interframe Gap

6. Agnikul Flight Measurement Plan V1.5.1

Note: Highlighted Data are Range Safety requirement

*** Some parameters might be added or reduced as per Mission requirements

S.No.	Avionics Package which is responsible for sending Data to Telemetry unit	Parameter ID Designation	Parameter ID	Description	Data Size (in bits)	Frequency (Hz)	Unit of Measurement	Data Type	Range Safety Requirements
1	Engine Package	Parameter-1 ID	P_C_PT_LOX_inj	LOX Injection Pressure to Engine	14	2000	bar	Analog	FALSE
2	Engine Package	Parameter-2 ID	P_F_PT_ATF_inj	ATF Injection Pressure to Engine	14	2000	bar	Analog	FALSE
3	Engine Package	Parameter-3 ID	P_E_PT_CC_1	Engine Chamber Pressure	14	2000	bar	Analog	TRUE
4	Engine Package	Parameter-4 ID	P_M_PT_inj	Methane Injection Pressure to Engine	14	2000	bar	Analog	FALSE
5	Engine Package	Parameter-5 ID	P_G_PT_inj	Gaseous Oxygen Injection Pressure to Engine	14	2000	bar	Analog	FALSE
6	Engine Package	Parameter-6 ID	P_I_PT_1	Igniter Chamber Pressure	14	2000	bar	Analog	TRUE
7	Engine Package	Parameter-7 ID	P_I_PT_2	Redundant Igniter Chamber pressure	14	2000	bar	Analog	TRUE
8	Engine Package	Parameter-8 ID	P_R_PT_RCS_2	RCS Thruster Injection Pressure	14	2000	bar	Analog	FALSE
9	Engine Package	Parameter-9 ID	P_VALS_IGS	MOV, MFV position status and Spark plug Status **(refer sheet Parameter ID: P_VALS_IGS_V1.0)**	8	500	-	Digital	FALSE
10	Engine Package	Parameter-10 ID	P_F_PT_ATF_Press_Tank	ATF Pressurant tank pressure	16	200	bar	Analog	FALSE
11	Engine Package	Parameter-11 ID	P_F_PT_ATF_Tank	ATF tank Pressure	16	200	bar	Analog	FALSE
12	Engine Package	Parameter-12 ID	P_F_PT_ATF_Press	ATF Pressurant pressure before pressurant valve	16	200	bar	Analog	FALSE
13	Engine Package	Parameter-13 ID	P_C_PT_LOX_Press_Tank	LOX Pressurant tank pressure	16	200	bar	Analog	FALSE
14	Engine Package	Parameter-14 ID	P_C_PT_LOX_Tank	LOX tank Pressure	16	200	bar	Analog	FALSE
15	Engine Package	Parameter-15 ID	P_C_PT_LOX_Press	LOX Pressurant pressure before pressurant valve	16	200	bar	Analog	FALSE
16	Engine Package	Parameter-16 ID	P_R_PT_RCS_1	RCS Pressurant tank Pressure	16	200	bar	Analog	FALSE
17	Engine Package	Parameter-17 ID	P_C_LS_LOX_Tank	Liquid Oxygen Tank level	16	200	mbar	Analog	FALSE
18	Engine Package	Parameter-18 ID	P_FTS&TTDS_M	FTS (P) Chain & Tracking Transponder Digital Status monitoring (refer table	16	100	V	Digital	TRUE

				Parameter ID: P_FTS&TTDS_M_V1.0)					
19	Engine Package	Parameter-19 ID	P_FTSD_R	FTS (R) Chain Digital Status monitoring (refer table **Parameter ID: P_FTSD_R_V1.0)**	16	100	V	Digital	TRUE
20	Engine Package	Parameter-20 ID	P_TTPS_2	Tracking Transponder pulse signal	8	100	-	pulse signal	FALSE
21	Engine Package	Parameter-21 ID	P_ITSM_A1	ITS (P): TCD battery T/M	8	100	V	Analog	FALSE
22	Engine Package	Parameter-22 ID	P_ITSM_A2	ITS (P): Squelch Monitoring Live	8	100	V	Analog	FALSE
23	Engine Package	Parameter-23 ID	P_ITSM_A3	ITS (P): SSM_1 Live	8	100	V	Analog	FALSE
24	Engine Package	Parameter-24 ID	P_ITSM_A4	ITS (P): SSM_2 Live	8	100	V	Analog	FALSE
25	Engine Package	Parameter-25 ID	P_ITSM_A5	ITS (P): +5V1 TM	8	100	V	Analog	FALSE
26	Engine Package	Parameter-26 ID	P_ITSM_A6	ITS (P): +/-5V3 TM	8	100	V	Analog	FALSE
27	Engine Package	Parameter-27 ID	P_ITSM_A7	ITS (P): 28V TM	8	100	V	Analog	FALSE
28	Engine Package	Parameter-28 ID	P_SARBM_A1	SARB (P) Analog Status Monitoring	8	100	V	Analog	FALSE
29	Engine Package	Parameter-29 ID	P_ITSR_A1	ITS (R): TCD battery T/M	8	100	V	Analog	FALSE
30	Engine Package	Parameter-30 ID	P_ITSR_A2	ITS (R): Squelch Monitoring Live	8	100	V	Analog	FALSE
31	Engine Package	Parameter-31 ID	P_ITSR_A3	ITS (R): SSM_1 Live	8	100	V	Analog	FALSE
32	Engine Package	Parameter-32 ID	P_ITSR_A4	ITS (R): SSM_2 Live	8	100	V	Analog	FALSE
33	Engine Package	Parameter-33 ID	P_ITSR_A5	ITS (R): +5V1 TM	8	100	V	Analog	FALSE
34	Engine Package	Parameter-34 ID	P_ITSR_A6	ITS (R): +/-5V3 TM	8	100	V	Analog	FALSE
35	Engine Package	Parameter-35 ID	P_ITSR_A7	ITS (R): 28V TM	8	100	V	Analog	FALSE
36	Engine Package	Parameter-36 ID	P_SARBR_A1	SARB (R) Analog Status Monitoring	8	100	V	Analog	FALSE
37	Engine Package	Parameter-37 ID	P_ITSM_A8	ITS (P): +5V2 TM	8	100	V	Analog	FALSE
38	Engine Package	Parameter-38 ID	P_ITSR_A8	ITS (R): +5V2 TM	8	100	V	Analog	FALSE
39	Engine Package	Parameter-39 ID	P_DESTM	Main DEST battery voltage MON	8	100	V	Analog	FALSE
40	Engine Package	Parameter-40 ID	P_DESTR	Redundant DEST battery voltage MON	8	100	V	Analog	FALSE
41	Engine Package	Parameter-41 ID	P_AB_TS	Health measurement for Avionics battery (temperature sensing)	8	100	deg C	Analog	FALSE
42	Engine Package	Parameter-42 ID	P_AB_VS	Health measurement for Avionics battery (voltage sensing)	8	100	V	Analog	FALSE
43	Engine Package	Parameter-43 ID	P_C_RTD_inj	LOX_Injection Temperature to Engine	16	4	deg C	Analog	FALSE
44	Engine Package	Parameter-44 ID	P_F_RTD_inj	ATF Injection Temperature to Engine	16	4	deg C	Analog	FALSE
45	Engine Package	Parameter-45 ID	P_F_RTD_ATF_Press_Tank	ATF Pressurant tank Temperature	16	4	deg C	Analog	FALSE

46	Engine Package	Parameter-46 ID	P_R_RTD_RCS	RCS Pressurant tank Temperature	16	4	deg C	Analog	FALSE
47	Engine Package	Parameter-47 ID	P_C_RTD_LOX_Press_Tank	LOX Pressurant tank Temperature	16	4	deg C	Analog	FALSE
48	Engine Package	Parameter-48 ID	P_FS_TM_1	Temperature data validation at Forward skirt level	`16	4	deg C	Analog	FALSE
49	Engine Package	Parameter-49 ID	P_FS_Acc_1	Vibration data validation at forward skirt level (FFT Data) **(refer table Parameter ID: P_FS_Acc_1_V1.0)**	336	1	g	Analog	FALSE
50	Engine Package	Parameter-50 ID	P_CMD_EMGA-PL_E1	Stroke length command from Engine Computer for Pitch Gimbal Actuator	16	100	mm	Digital - RS422	FALSE
51	Engine Package	Parameter-51 ID	P_CMD_EMGA-YL_E1	Stroke length command from Engine Computer for Yaw Gimbal Actuator	16	100	mm	Digital - RS422	FALSE
52	Engine Package	Parameter-52 ID	P_EMGA-P_E1	Stroke length feedback from Pitch Gimbal Actuator	16	100	mm	Digital - RS422	FALSE
53	Engine Package	Parameter-53 ID	P_EMGA-Y_E1	Stroke length feedback from Yaw Gimbal Actuator	16	100	mm	Digital - RS422	FALSE
54	Engine Package	Parameter-54 ID	P_EMGAV_P_E1	Pitch Gimbal Actuator Voltage data	8	100	V	Digital - RS422	FALSE
55	Engine Package	Parameter-55 ID	P_EMGAA_P_E1	Pitch Gimbal Actuator Current data	8	100	mA	Digital - RS422	FALSE
56	Engine Package	Parameter-56 ID	P_EMGAT_P_E1	Pitch Gimbal Actuator Temperature data	8	100	deg C	Digital - RS422	FALSE
57	Engine Package	Parameter-57 ID	P_EMGAV_Y_E1	Yaw Gimbal Actuator Voltage data	8	100	V	Digital - RS422	FALSE
58	Engine Package	Parameter-58 ID	P_EMGAA_Y_E1	Yaw Gimbal Actuator Current data	8	100	mA	Digital - RS422	FALSE
59	Engine Package	Parameter-59 ID	P_EMGAT_Y_E1	Yaw Gimbal Actuator Temperature data	8	100	deg C	Digital - RS422	FALSE
60	Engine Package	Parameter-60 ID	P_EMGA_STATUS	Gimbal Actuator health status and error	32	100	-	Digital - RS422	FALSE
61	Engine Package	Parameter-61 ID	P_EC_TS	Health parameter (Temperature) for Engine Computer	8	4	deg C	Digital - I2C	FALSE
62	Engine Package	Parameter-62 ID	P_EC_CS	Health parameter (Current) for Engine Computer	8	4	mA	Digital - I2C	FALSE
63	Engine Package	Parameter-63 ID	P_EC_VS	Health parameter (Voltage) for Engine Computer	8	4	V	Digital - I2C	FALSE
64	Engine Package	Parameter-64 ID	P_CMD_EC	Engine computer will give command to particular valves to open or close based on command id or sequence id received from Flight computer **(refer table Parameter ID: P_CMD_EC_V1.0)**	8	50	-	Digital - Ethernet	FALSE

65	Engine Package	Parameter-65 ID	P_EC_SEQ	There are several sequences executed by the Engine computer. Sequence ID of particular sequence is executed by EC with timestamp is captured by telemetry unit **(refer table Parameter ID: P_EC_SEQ_V1.0)**	8	50	-	Digital - Ethernet	FALSE
66	Engine Package	Parameter-66 ID	P_EC_Reserved_1	Reserved 8 bit parameter for Engine Computer	8	50	-	Digital - Ethernet	FALSE
67	Engine Package	Parameter-67 ID	P_EC_Reserved_2	Reserved 32 bit parameter for Engine Computer	32	50	-	Digital - Ethernet	FALSE
68	Engine Package	Parameter-68 ID	P_EC_Reserved_3	Reserved 32 bit parameter for Engine Computer	32	50	-	Digital - Ethernet	FALSE
69	Engine Package	Parameter-69 ID	P_EC_FAULT_STATUS	Fault ID raised by Engine Computer **(refer table Parameter ID: P_EC_FAULT_STATUS_V1.0)**	8	1000	-	Digital - Ethernet	FALSE
70	Engine Package	Parameter-70 ID	P_EC_STATUS	Engine Computer status ID. **(refer table Parameter ID: P_EC_STATUS_V1.0)**	32	1000	-	Digital - Ethernet	FALSE
71	Flight Package	Parameter-167 ID	P_CDT_Time	CDT Timer Value with IMU data @500 Hz	32	500	ms	Digital - Ethernet	TRUE
72	Flight Package	Parameter-71 ID	P_IMUR-X_M	Vehicle Angular rate data (X-axis) in Body Frame - Main FC IMU	32	500	deg/s	Digital - RS422	TRUE
73	Flight Package	Parameter-72 ID	P_IMUR-Y_M	Vehicle Angular rate data (Y-axis) in Body Frame - Main FC IMU	32	500	deg/s	Digital - RS422	TRUE
74	Flight Package	Parameter-73 ID	P_IMUR-Z_M	Vehicle Angular rate data (Z-axis) in Body Frame - Main FC IMU	32	500	deg/s	Digital - RS422	TRUE
75	Flight Package	Parameter-74 ID	P_IMUA-X_M	Vehicle Acceleration (X-axis) in Body Frame - Main FC IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	500	g	Digital - RS422	TRUE
76	Flight Package	Parameter-75 ID	P_IMUA-Y_M	Vehicle Acceleration (Y-axis) in Body Frame - Main FC IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	500	g	Digital - RS422	TRUE
77	Flight Package	Parameter-76 ID	P_IMUA-Z_M	Vehicle Acceleration (Z-axis) in Body Frame - Main FC IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	500	g	Digital - RS422	TRUE
78	Flight Package	Parameter-77 ID	P_IMU_STATUS_M	IMU status bytes for gyro, accelerometer , inclinometer & AUX measurement	32	500	-	Digital - RS422	TRUE
79	Flight Package	Parameter-171 ID	P_IMU Reserved -1	Reserved 32 bit parameter for IMU data	32	500	-	Digital - RS422	FALSE

80	Flight Package	Parameter-172 ID	P_IMU Reserved -2	Reserved 32 bit parameter for IMU data	32	500	-	Digital - RS422	FALSE
81	Flight Package	Parameter-173 ID	P_IMU Reserved -3	Reserved 32 bit parameter for IMU data	32	500	-	Digital - RS422	FALSE
82	Flight Package	Parameter-174 ID	P_IMU Reserved -4	Reserved 32 bit parameter for IMU data	32	500	-	Digital - RS422	FALSE
83	Flight Package	Parameter-167 ID	P_CDT_Time	CDT Timer Value with GNC data @100 Hz	32	100	ms	Digital - Ethernet	TRUE
84	Flight Package	Parameter-78 ID	P_GNC_POS-X_FC	Vehicle position (X-axis) in LPI Frame	32	100	m	Digital - Ethernet	TRUE
85	Flight Package	Parameter-79 ID	P_GNC_POS-Y_FC	Vehicle position (Y-axis) in LPI Frame	32	100	m	Digital - Ethernet	TRUE
86	Flight Package	Parameter-80 ID	P_GNC_POS-Z_FC	Vehicle position (Z-axis) in LPI Frame	32	100	m	Digital - Ethernet	TRUE
87	Flight Package	Parameter-81 ID	P_GNC_VEL-X_FC	Vehicle velocity (X-axis) in LPI Frame	32	100	m/s	Digital - Ethernet	TRUE
88	Flight Package	Parameter-82 ID	P_GNC_VEL-Y_FC	Vehicle velocity (Y-axis) in LPI Frame	32	100	m/s	Digital - Ethernet	TRUE
89	Flight Package	Parameter-83 ID	P_GNC_VEL-Z_FC	Vehicle velocity (Z-axis) in LPI Frame	32	100	m/s	Digital - Ethernet	TRUE
90	Flight Package	Parameter-84 ID	P_GNC_PR_FC	Vehicle Pitch Rate (Y-axis) in Inertial Euler Angles convention	32	100	deg/s	Digital - Ethernet	TRUE
91	Flight Package	Parameter-85 ID	P_GNC_YR_FC	Vehicle Yaw Rate (Z-axis) in Inertial Euler Angles convention	32	100	deg/s	Digital - Ethernet	TRUE
92	Flight Package	Parameter-86 ID	P_GNC_RR_FC	Vehicle Roll Rate (X-axis) in Inertial Euler Angles convention	32	100	deg/s	Digital - Ethernet	TRUE
93	Flight Package	Parameter-87 ID	P_GNC_PA_FC	Vehicle Pitch angle (Y-axis) in Inertial Euler Angles convention	32	100	deg	Digital - Ethernet	TRUE
94	Flight Package	Parameter-88 ID	P_GNC_YA_FC	Vehicle Yaw angle (Z-axis) in Inertial Euler Angles convention	32	100	deg	Digital - Ethernet	TRUE
95	Flight Package	Parameter-89 ID	P_GNC_RA_FC	Vehicle Roll angle (X-axis) in Inertial Euler Angles convention	32	100	deg	Digital - Ethernet	TRUE
96	Flight Package	Parameter-90 ID	P_CMD_EMGA-PA_E1	Engine deflection command for pitch from Flight Computer	16	100	deg	Digital - Ethernet	FALSE
97	Flight Package	Parameter-91 ID	P_CMD_EMGA-YA_E1	Engine deflection command for yaw from Flight Computer	16	100	deg	Digital - Ethernet	FALSE
98	Flight Package	Parameter-92 ID	P_CMD_RCS	Commanded RCS Valve State **(refer table Parameter ID: P_CMD_RCS_V1.0)**	8	100	-	Digital - Ethernet	FALSE
99	Flight Package	Parameter-167 ID	P_CDT_Time	CDT Timer Value with GNC Guidance data @10 Hz	32	10	ms	Digital - Ethernet	TRUE
100	Flight Package	Parameter-93 ID	P_CMD_PA	Commanded Pitch Angle in Inertial Euler Angles convention from Guidance	32	10	deg	Digital - Ethernet	TRUE
101	Flight Package	Parameter-94 ID	P_CMD_YA	Commanded Yaw Angle in Inertial Euler Angles convention from Guidance	32	10	deg	Digital - Ethernet	TRUE

102	Flight Package	Parameter-95 ID	P_CMD_RA	Commanded Roll Angle in Inertial Euler Angles convention from Guidance	32	10	deg	Digital - Ethernet	TRUE
103	Flight Package	Parameter- 168 ID	P_Delta_PA	Delta Pitch Angle in Inertial Euler Angles convention [Vehicle Pitch angle (Y-axis) - Commanded Pitch Angle]	32	10	deg	Digital - Ethernet	TRUE
104	Flight Package	Parameter- 169 ID	P_Delta_YA	Delta Yaw Angle in Inertial Euler Angles convention [Vehicle Yaw angle (Y-axis) - Commanded Yaw Angle]	32	10	deg	Digital - Ethernet	TRUE
105	Flight Package	Parameter- 170 ID	P_Delta_RA	Delta Roll Angle in Inertial Euler Angles convention [Vehicle Roll angle (Y-axis) - Commanded Roll Angle]	32	10	deg	Digital - Ethernet	TRUE
106	Flight Package	Parameter-96 ID	P_FC_TS	Health parameter (Temperature) for Flight Computer	8	4	deg C	Digital - I2C	FALSE
107	Flight Package	Parameter-97 ID	P_FC_CS	Health parameter (Current) for Flight Computer	8	4	mA	Digital - I2C	FALSE
108	Flight Package	Parameter-98 ID	P_FC_VS	Health parameter (Voltage) for Flight Computer	8	4	V	Digital - I2C	FALSE
109	Flight Package	Parameter-99 ID	P_IMUT_M	Health parameter : Main FC IMU Temperature data	8	1	deg C	Digital - RS422	FALSE
110	Flight Package	Parameter-100 ID	P_IMUV_M	Health parameter : Main FC IMU Voltage data	8	1	V	Digital - RS422	FALSE
111	Flight Package	Parameter-101 ID	P_GNSS_PPS	GNSS pulse signal	8	1	-	Digital - RS422	FALSE
112	Flight Package	Parameter-102 ID	P_GNSS_GGA_LAT	GNSS GGA : Datum corrected Lattitude	32	1	deg min	Digital - RS422	FALSE
113	Flight Package	Parameter-103 ID	P_GNSS_GGA_LONG	GNSS GGA : Datum corrected Longitude	32	1	deg min	Digital - RS422	FALSE
114	Flight Package	Parameter-104 ID	P_GNSS_GGA_QI&HDOP	GNSS GGA : Quality indicator & HDOP	16	1	-	Digital - RS422	FALSE
115	Flight Package	Parameter-105 ID	P_GNSS_GGA_ALT	GNSS GGA : Datum and mean sea corrected altitude	32	1	m	Digital - RS422	FALSE
116	Flight Package	Parameter-106 ID	P_GNSS_GGA_GEOSEP	GNSS GGA : Geoidal separation (mean sea corrections)	16	1	m	Digital - RS422	FALSE
117	Flight Package	Parameter-107 ID	P_GNSS_VTG_SP&MI	GNSS VTG : Speed over ground in Km/hr & Mode indicator	32	1	speed in km/hr	Digital - RS422	FALSE
118	Flight Package	Parameter-108 ID	P_GNSS_GLL_LAT	GNSS GLL : Datum corrected Lattitude	32	1	deg min	Digital - RS422	FALSE
119	Flight Package	Parameter-109 ID	P_GNSS_GLL_LONG	GNSS GLL : Datum corrected Longitude	32	1	deg min	Digital - RS422	FALSE
120	Flight Package	Parameter-110 ID	P_GNSS_GLL_UTC	GNSS GLL : UTC Timestamp	32	1	hr:min:sec	Digital - RS422	FALSE

121	Flight Package	Parameter-111 ID	P_GNSS_GLL_STAT&MI	GNSS GLL : Status: Data valid or not valid Mode indicator : Autonomous , GNSS solution with corrections from SBAS satellites & Data not valid	8	1	-	Digital - RS422	TRUE
122	Flight Package	Parameter-112 ID	P_GNSS_GSA_MODE	GNSS GSA : Mode indicator	8	1	-	Digital - RS422	FALSE
123	Flight Package	Parameter-113 ID	P_GNSS_GSA_PRN_1	GNSS GSA : PRN number of satellite used for position fix	32	1	-	Digital - RS422	FALSE
124	Flight Package	Parameter-114 ID	P_GNSS_GSA_PRN_2	GNSS GSA : PRN number of satellite used for position fix	32	1	-	Digital - RS422	FALSE
125	Flight Package	Parameter-115 ID	P_GNSS_GSA_DOPVAL	GNSS GSA : PDOP, HDOP, VDOP values	32	1	-	Digital - RS422	TRUE
126	Flight Package	Parameter-116 ID	P_GNSS_ECEF_UTC	GNSS: UTC Time in ECEF Frame	32	1	hr:min:sec	Digital - RS422	TRUE
127	Flight Package	Parameter-117.0 ID	P_GNSS_ECEF_FHPOS_X	GNSS : position (X axis) in ECEF Frame (First half 32 bit)	32	1	m	Digital - RS422	TRUE
128	Flight Package	Parameter-117.1 ID	P_GNSS_ECEF_LHPOS_X	GNSS : position (X axis) in ECEF Frame (Last half 32 bit)	32	1	m	Digital - RS423	TRUE
129	Flight Package	Parameter-118.0 ID	P_GNSS_ECEF_FHPOS_Y	GNSS : position (Y axis) in ECEF Frame (First half 32 bit)	32	1	m	Digital - RS424	TRUE
130	Flight Package	Parameter-118.1 ID	P_GNSS_ECEF_LHPOS_Y	GNSS : position (Y axis) in ECEF Frame (Last half 32 bit)	32	1	m	Digital - RS425	TRUE
131	Flight Package	Parameter-119.0 ID	P_GNSS_ECEF_FHPOS_Z	GNSS : position (Z axis) in ECEF Frame (First half 32 bit)	32	1	m	Digital - RS426	TRUE
132	Flight Package	Parameter-119.1 ID	P_GNSS_ECEF_LHPOS_Z	GNSS : position (Z axis) in ECEF Frame (Last half 32 bit)	32	1	m	Digital - RS427	TRUE
133	Flight Package	Parameter-120 ID	P_GNSS_ECEF_VEL_X	GNSS : velocity (X axis) in ECEF Frame	32	1	m/s	Digital - RS422	TRUE
134	Flight Package	Parameter-121 ID	P_GNSS_ECEF_VEL_Y	GNSS : velocity (Y axis) in ECEF Frame	32	1	m/s	Digital - RS422	TRUE
135	Flight Package	Parameter-122 ID	P_GNSS_ECEF_VEL_Z	GNSS : velocity (Z axis) in ECEF Frame	32	1	m/s	Digital - RS422	TRUE
136	Flight Package	Parameter-123 ID	P_G1_P	Control gain constant - 1 (Pitch)	32	1	-	Digital - Ethernet	FALSE
137	Flight Package	Parameter-124 ID	P_G2_P	Control gain constant - 2 (Pitch)	32	1	-	Digital - Ethernet	FALSE
138	Flight Package	Parameter-125 ID	P_FLT_COEF_1_P	Filter coefficient constant - 1 (Pitch)	32	1	-	Digital - Ethernet	FALSE
139	Flight Package	Parameter-126 ID	P_FLT_COEF_2_P	Filter coefficient constant - 2 (Pitch)	32	1	-	Digital - Ethernet	FALSE
140	Flight Package	Parameter-127 ID	P_FLT_COEF_3_P	Filter coefficient constant - 3 (Pitch)	32	1	-	Digital - Ethernet	FALSE
141	Flight Package	Parameter-128 ID	P_FLT_COEF_4_P	Filter coefficient constant - 4 (Pitch)	32	1	-	Digital - Ethernet	FALSE

142	Flight Package	Parameter-129 ID	P_G1_Y	Control gain constant - 1 (Yaw)	32	1	-	Digital - Ethernet	FALSE
143	Flight Package	Parameter-130 ID	P_G2_Y	Control gain constant - 2 (Yaw)	32	1	-	Digital - Ethernet	FALSE
144	Flight Package	Parameter-131 ID	P_FLT_COEF_1_Y	Filter coefficient constant - 1 (Yaw)	32	1	-	Digital - Ethernet	FALSE
145	Flight Package	Parameter-132 ID	P_FLT_COEF_2_Y	Filter coefficient constant - 2 (Yaw)	32	1	-	Digital - Ethernet	FALSE
146	Flight Package	Parameter-133 ID	P_FLT_COEF_3_Y	Filter coefficient constant - 3 (Yaw)	32	1	-	Digital - Ethernet	FALSE
147	Flight Package	Parameter-134 ID	P_FLT_COEF_4_Y	Filter coefficient constant - 4 (Yaw)	32	1	-	Digital - Ethernet	FALSE
148	Flight Package	Parameter-135 ID	P_FC_FAULT_STATUS	Fault ID raised by Flight Computer **(refer table Parameter ID: P_FC_FAULT_STATUS_V1.0)**	8	1000	-	Digital - Ethernet	TRUE
149	Flight Package	Parameter-136 ID	P_FC_STATUS	Flight Computer send status like GO-NO GO status, ALS feedback, LMP status sent by flight computer comes under this parameter. **(refer table Parameter ID: P_FC_STATUS_V1.0)**	32	1000	-	Digital - Ethernet	TRUE
150	Flight Package	Parameter-137 ID	P_FC_SEQ	There are several sequences run by flight computer. Sequence ID or particular sequence is generated by FC and send to respective computer for execution ; same sequence id with timestamp is captured by telemetry unit also **(refer table Parameter ID: P_FC_SEQ_V1.0)**	8	50	-	Digital - Ethernet	FALSE
151	Flight Package	Parameter-138 ID	P_CMD_FC	Any command ID send by Flight Computer to respective computers **(refer table Parameter ID: P_CMD_FC_V1.0)**	8	50	-	Digital - Ethernet	FALSE
152	Flight Package	Parameter-139 ID	P_FC_Reserved_1	Reserved 32 bit parameter for Flight Computer	32	50	-	Digital - Ethernet	FALSE
153	Flight Package	Parameter-140 ID	P_FC_Reserved_2	Reserved 32 bit parameter for Flight Computer	32	50	-	Digital - Ethernet	FALSE
154	Flight Package	Parameter-141 ID	P_FC_Reserved_3	Reserved 32 bit parameter for Flight Computer	32	50	-	Digital - Ethernet	FALSE
155	Flight Package	Parameter-142 ID	P_FC_Reserved_4	Reserved 32 bit parameter for Flight Computer	32	50	-	Digital - Ethernet	FALSE
156	Payload Package	Parameter-143 ID	P_IMUR-X_PLD	Payload : Vehicle Angular rate data (X-axis) in Body Frame - Redundant IMU	32	500	deg/s	Digital - RS422	FALSE

157	Payload Package	Parameter-144 ID	P_IMUR-Y_PLD	Payload : Vehicle Angular rate data (Y-axis) in Body Frame - Redundant IMU	32	500	deg/s	Digital - RS422	FALSE
158	Payload Package	Parameter-145 ID	P_IMUR-Z_PLD	Payload : Vehicle Angular rate data (Z-axis) in Body Frame - Redundant IMU	32	500	deg/s	Digital - RS422	FALSE
159	Payload Package	Parameter-146 ID	P_IMUA-X_PLD	Payload : Vehicle Acceleration (X-axis) in Body Frame - Redundant IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	500	g	Digital - RS422	FALSE
160	Payload Package	Parameter-147 ID	P_IMUA-Y_PLD	Payload : Vehicle Acceleration (Y-axis) in Body Frame - Redundant IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	500	g	Digital - RS422	FALSE
161	Payload Package	Parameter-148 ID	P_IMUA-Z_PLD	Payload : Vehicle Acceleration (Z-axis) in Body Frame - Redundant IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	500	g	Digital - RS422	FALSE
162	Payload Package	Parameter-149 ID	P_IMU_STATUS _PLD	Payload : IMU status bytes for gyro, accelerometer , inclinometer & AUX measurement	32	500	-	Digital - RS422	FALSE
163	Payload Package	Parameter-150 ID	P_GNC_POS-X_ PLD	Vehicle position (X axis) in LPI Frame calculated by Payload	32	100	m	Digital - Ethernet	TRUE
164	Payload Package	Parameter-151 ID	P_GNC_POS-Y_ PLD	Vehicle position (Y axis) in LPI Frame calculated by Payload	32	100	m	Digital - Ethernet	TRUE
165	Payload Package	Parameter-152 ID	P_GNC_POS-Z_ PLD	Vehicle position (Z axis) in LPI Frame calculated by Payload	32	100	m	Digital - Ethernet	TRUE
166	Payload Package	Parameter-153 ID	P_GNC_VEL-X_ PLD	Vehicle velocity (X-axis) in LPI Frame calculated by Payload	32	100	m/s	Digital - Ethernet	TRUE
167	Payload Package	Parameter-154 ID	P_GNC_VEL-Y_ PLD	Vehicle velocity (Y-axis) in LPI Frame calculated by Payload	32	100	m/s	Digital - Ethernet	TRUE
168	Payload Package	Parameter-155 ID	P_GNC_VEL-Z_ PLD	Vehicle velocity (Z-axis) in LPI Frame calculated by Payload	32	100	m/s	Digital - Ethernet	TRUE
169	Payload Package	Parameter-156 ID	P_GNC_PR_PL D	Vehicle Pitch Rate (y axis) in Inertial Euler Angles convention calculated by Payload	32	100	deg/s	Digital - Ethernet	FALSE
170	Payload Package	Parameter-157 ID	P_GNC_YR_PL D	Vehicle Yaw Rate (z axis) in Inertial Euler Angles convention calculated by Payload	32	100	deg/s	Digital - Ethernet	FALSE
171	Payload Package	Parameter-158 ID	P_GNC_RR_PL D	Vehicle Roll Rate (x axis) in Inertial Euler Angles convention calculated by Payload	32	100	deg/s	Digital - Ethernet	FALSE
172	Payload Package	Parameter-159 ID	P_GNC_PA_PL D	Vehicle Pitch angle in Inertial Euler Angles convention calculated by Payload	32	100	deg	Digital - Ethernet	FALSE

173	Payload Package	Parameter-160 ID	P_GNC_YA_PLD	Vehicle Yaw angle in Inertial Euler Angles convention calculated by Payload	32	100	deg	Digital - Ethernet	FALSE
174	Payload Package	Parameter-161 ID	P_GNC_RA_PLD	Vehicle Roll angle in Inertial Euler Angles convention calculated by Payload	32	100	deg	Digital - Ethernet	FALSE
175	Payload Package	Parameter-162 ID	P_TS_PLD	Health parameter (Temperature) for Payload	8	4	deg C	Digital - I2C	FALSE
176	Payload Package	Parameter-163 ID	P_CS_PLD	Health parameter (Current) for Payload	8	4	mA	Digital - I2C	FALSE
177	Payload Package	Parameter-164 ID	P_VS_PLD	Health parameter (Voltage) for Payload	8	4	V	Digital - I2C	FALSE
178	Payload Package	Parameter-165 ID	P_IMUT_PLD	Payload : Redundant IMU Temperature data	8	1	deg C	Digital - RS422	FALSE
179	Payload Package	Parameter-166 ID	P_IMUV_PLD	Payload : Redundant IMU Voltage data	8	1	V	Digital - RS422	FALSE
180	Telemetry Package	BCU_3.3V Data	P_TMPCU_P3.3V	Health parameter: 3.3V of Telemetry Processing Unit	16	2	V	Digital - TTL	FALSE
181	Telemetry Package	BCU_5V Data	P_TMPCU_P5V	Health parameter: 5V of Telemetry Processing Unit	16	2	V	Digital - TTL	FALSE
182	Telemetry Package	BCU_P8V Data	P_TMPCU_P8V	Health parameter: +8V of Telemetry Processing Unit	16	2	V	Digital - TTL	FALSE
183	Telemetry Package	BCU_N8V Data	P_TMPCU_N8V	Health parameter: -8V of Telemetry Processing Unit	16	2	V	Digital - TTL	FALSE
184	Telemetry Package	BCU_Temperature Data	P_TMPCU_TEMP	Health parameter: Temperature of Telemetry Processing Unit	16	2	deg C	Digital - TTL	FALSE
185	Telemetry Package	BCU_PWRUP_COUNT	P_TMPCU_PWRUP_COUNT	Health parameter: power up count of Telemetry Processing Unit	16	2	-	Digital - TTL	FALSE

7. PCM Frame Configuration:

Frame Length (Word per minor frame)	:	976
Sub-frame Size (Minor frames per major frame)	:	64
Word Length(Bits per word)	:	16
Major frame frequency	:	2
Bit rate (bps)	:	1998848
Data Polarity	:	Normal
Synchronisation pattern	:	FE6B2840
Synchronisation bits	:	32
SFID pos	:	1
Bits per minor frame	:	15616
SFID Alignment	:	0
PCM Code(PMF)	:	BIPH-L
PCM Code(TTL)	:	NRZ-L
PCM Code(RS422)	:	NRZ-L
PMF Level	:	0.500000
Fill Pattern	:	ABCD

8. Internal packetization format V2.4E :

Table 5: Agnibaan SOrTeD - Internal Packet Format

Data size = 8/16/32 bits					
Fields		**Sub fields**	**Size (in bits)**	**Size (in bytes)**	**Comments**
Primary Header		Channel ID	2		
		Parameter Count	6		max. 64
			8	1	
Secondary Header		Parameter Timestamp	32	4	look for 32 bit timestamp
Packet Body		Parameter ID	8		
		Data	8/16/32		variable data size
		Total	16/24/40	2/3/5	

9. Agnikul Word Format :

9.1. Primary Header : (refer Table 5)

- Channel ID : 2 bits
- Parameter Count : 6 bits (Range: 0 to 63)

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Channel ID [7: 6]		Parameter Count [5:0]					

Bit 7 to Bit 6 : Channel ID

Bit 7	Bit6	Channel ID	Channel
0	0	0	Engine DAQ
0	1	1	Engine Computer
1	0	2	Flight Computer
1	1	3	Payload Computer

Bit 5 to Bit 0 : Parameter count

9.2. Secondary Header : (refer Table 5)

- Timestamp : 32 bits

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15
Hours [31:27]					Minutes [26:21]						Seconds [20:15]					
Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
Milliseconds [14:0]																

lsb

Bit 31 to Bit 27 : 5 bits for Hours (range (in decimal value) 0 to 23)
Bit 26 to Bit 21 : 6 bits for Minutes (range (in decimal value) 0 to 99)
Bit 20 to Bit 15 : 6 bits for Minutes (range (in decimal value) 0 to 59)
Bit 14 to Bit 0 : 15 bits for Minutes (range (in decimal value) 0 to 999)

9.3. **Packet Body :** (refer Table 5)

9.3.1. Parameter ID:

- 8 bits

9.3.2. Parameter Data :

refer to individual sections based on data frequency and respective package computers.

—----------Purposely kept blank—----------

9.4. Engine Package: Data Acquisition Data

9.4.1. 2000 Hz frequency data:

Data type is **16 bit unsigned integer** from which Bit 15 & Bit 14 is allocated for data at 1ms time interval and 0.5 ms time interval identification (timestamp resolution is 1 ms).

Remaining 14 bits are allocated for parameter data (applicable for parameters mentioned in below table).

S.No.	Parameter ID Designator	Parameter ID	Description	Actual Data Size (in bits)	Data Type	Frequency (Hz)
ETH_1	**Parameter-1 ID**	P_C_PT_LOX_inj	LOX Injection Pressure to Engine	14	uint16_t	2000
ETH_1	**Parameter-2 ID**	P_F_PT_ATF_inj	ATF Injection Pressure to Engine	14	uint16_t	2000
ETH_1	**Parameter-3 ID**	P_E_PT_CC_1	Engine Chamber Pressure	14	uint16_t	2000
ETH_1	**Parameter-4 ID**	P_M_PT_inj	Methane Injection Pressure to Engine	14	uint16_t	2000
ETH_1	**Parameter-5 ID**	P_G_PT_inj	Gaseous Oxygen Injection Pressure to Engine	14	uint16_t	2000
ETH_1	**Parameter-6 ID**	P_I_PT_1	Igniter Chamber Pressure	14	uint16_t	2000
ETH_1	**Parameter-7 ID**	P_I_PT_2	Redundant Igniter Chamber pressure	14	uint16_t	2000
ETH_1	**Parameter-8 ID**	P_R_PT_RCS_2	RCS Thruster Injection Pressure	14	uint16_t	2000

9.4.1.1. Data Format:

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
T.I.[15:14]		Parameter Data [13:0]													

Bit 15 to Bit 14 -

Bit 15	Bit 14	Time Indicator (T.I.) Encrypted Information
0	0	Data at 0.5 ms time interval
0	1	Invalid
1	0	Invalid
1	1	Data at 1 ms time interval

Bit 13 to Bit 0 - 14 bit Parameter Data (parameter mentioned in above table)

9.4.2. 500 Hz frequency data:

Data type is **8 bit unsigned integer** from which

- Bit 0 is allocated for Digital Data ID: P_C_LS_MOV (MOV position status)
- Bit 1 is allocated for Digital Data ID: P_F_LS_MFV (MFV position status)
- Bit 2 is allocated for Digital Data ID: P_IGS_ST (Spark plug Status)

- Bit 3 to Bit 7 is Reserved
  (applicable for parameters mentioned in below table).

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_2	Parameter-9 ID	P_VALS_IGS	MOV, MFV position status and Spark plug Status	8	uint8_t	500

9.4.2.1. Data Format:

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved [7:0]					P_IGS_ST [2]	P_F_LS_MFV [1]	P_C_LS_MOV [0]

Bit 7 to Bit 3 - Reserved Bits

Bit 2 - Spark plug Status (Digital Data ID: **P_IGS_ST**)

Bit 2	Spark Plug Encrypted Information
0	Ignition OFF
1	Ignition ON

Bit 1 - MFV position status (Digital Data ID: **P_F_LS_MFV**)

Bit 1	Valve Encrypted Information
0	Valve status : OPEN
1	Valve status : CLOSE

Bit 0 - MOV position status (Digital Data ID: **P_C_LS_MOV**)

Bit 0	Valve Encrypted Information
0	Valve status : OPEN
1	Valve status : CLOSE

9.4.3. 200 Hz frequency data:

Data type is 16 bit unsigned integer. All 16 bits are allocated to parameter data (applicable for parameters mentioned in below table).

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)

ETH_3	**Parameter-10 ID**	P_F_PT_ATF_Press_Tank	ATF Pressurant tank pressure	16	uint16_t	200
ETH_3	**Parameter-11 ID**	P_F_PT_ATF_Tank	ATF tank Pressure	16	uint16_t	200
ETH_3	**Parameter-12 ID**	P_F_PT_ATF_Press	ATF Pressurant pressure before pressurant valve	16	uint16_t	200
ETH_3	**Parameter-13 ID**	P_C_PT_LOX_Press_Tank	LOX Pressurant tank pressure	16	uint16_t	200
ETH_3	**Parameter-14 ID**	P_C_PT_LOX_Tank	LOX tank Pressure	16	uint16_t	200
ETH_3	**Parameter-15 ID**	P_C_PT_LOX_Press	LOX Pressurant pressure before pressurant valve	16	uint16_t	200
ETH_3	**Parameter-16 ID**	P_R_PT_RCS_1	RCS Pressurant tank Pressure	16	uint16_t	200
ETH_3	**Parameter-17 ID**	P_C_LS_LOX_Tank	Liquid Oxygen Tank level	16	uint16_t	200

9.4.3.1. Data Format:

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

Bit 15 to Bit 0 : Parameter Data (refer above table for Parameter ID)

9.4.4. 100 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_4	**Parameter-18 ID**	P_FTS&TTDS_M	FTS (P) Chain & Tracking Transponder Digital Status monitoring	16	uint16_t	100
ETH_4	**Parameter-19 ID**	P_FTSD_R	FTS (R) Chain Digital Status monitoring	16	uint16_t	100
ETH_4	**Parameter-20 ID**	P_TTPS_2	Tracking Transponder pulse signal	8	uint8_t	100
ETH_4	**Parameter-21 ID**	P_ITSM_A1	ITS (P): TCD battery T/M	8	uint8_t	100
ETH_4	**Parameter-22 ID**	P_ITSM_A2	ITS (P): Squelch Monitoring Live	8	uint8_t	100
ETH_4	**Parameter-23 ID**	P_ITSM_A3	ITS (P): SSM_1 Live	8	uint8_t	100
ETH_4	**Parameter-24 ID**	P_ITSM_A4	ITS (P): SSM_2 Live	8	uint8_t	100
ETH_4	**Parameter-25 ID**	P_ITSM_A5	ITS (P): +5V1 TM	8	uint8_t	100

ETH_4	**Parameter-26 ID**	P_ITSM_A6	ITS (P): +/-5V3 TM	8	uint8_t	100
ETH_4	**Parameter-27 ID**	P_ITSM_A7	ITS (P): 28V TM	8	uint8_t	100
ETH_4	**Parameter-28 ID**	P_SARBM_A1	SARB (P) Analog Status Monitoring	8	uint8_t	100
ETH_4	**Parameter-29 ID**	P_ITSR_A1	ITS (R): TCD battery T/M	8	uint8_t	100
ETH_4	**Parameter-30 ID**	P_ITSR_A2	ITS (R): Squelch Monitoring Live	8	uint8_t	100
ETH_4	**Parameter-31 ID**	P_ITSR_A3	ITS (R): SSM_1 Live	8	uint8_t	100
ETH_4	**Parameter-32 ID**	P_ITSR_A4	ITS (R): SSM_2 Live	8	uint8_t	100
ETH_4	**Parameter-33 ID**	P_ITSR_A5	ITS (R): +5V1 TM	8	uint8_t	100
ETH_4	**Parameter-34 ID**	P_ITSR_A6	ITS (R): +/-5V3 TM	8	uint8_t	100
ETH_4	**Parameter-35 ID**	P_ITSR_A7	ITS (R): 28V TM	8	uint8_t	100
ETH_4	**Parameter-36 ID**	P_SARBR_A1	SARB (R) Analog Status Monitoring	8	uint8_t	100
ETH_4	**Parameter-37 ID**	P_ITSM_A8	ITS (P): +5V2 TM	8	uint8_t	100
ETH_4	**Parameter-38 ID**	P_ITSR_A8	ITS (R): +5V2 TM	8	uint8_t	100
ETH_4	**Parameter-39 ID**	P_DESTM	Main DEST battery voltage MON	8	uint8_t	100
ETH_4	**Parameter-40 ID**	P_DESTR	Redundant DEST battery voltage MON	8	uint8_t	100
ETH_4	**Parameter-41 ID**	P_AB_TS	Health measurement for Avionics battery (temperature sensing)	8	uint8_t	100
ETH_4	**Parameter-42 ID**	P_AB_VS	Health measurement for Avionics battery (voltage sensing)	8	uint8_t	100

9.4.4.1. Data Format:

- 16 bit Data : Parameter-18 ID (P_FTS&TTDS_M) & Parameter-19 ID (P_FTSD_R)

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

a. Parameter-18 ID (P_FTS&TTDS_M) : Data type - uint16_t bits allocation . All FTS Digital status data is high/ low signal, so each bit represents each respective digital status.

S.No.	Parameter ID	Parameter Description	Data Bit no	Digital Data Status ID	FTS Digital Status Description	Unit of Measurement	Data Type
1	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 0	P_ARMP_D1	CMS Status Main ARM Plug	Volts	Digital

2	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 1	P_ITSM_D2	SAFE/ARM relay status for T/M	Volts	Digital
3	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 2	P_ITSM_D3	Destruct relay status for T/M	Volts	Digital
4	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 3	P_ITSM_D4	SAFE command OCI output for T/M	Volts	Digital
5	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 4	P_ITSM_D5	Decoder Health status OCI T/M	Volts	Digital
6	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 5	P_ITSM_D6	LPST enable/disable status OCI output for T/M	Volts	Digital
7	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 6	P_ITSM_D7	Destruct command OCI output for T/M	Volts	Digital
8	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 7	P_ITSM_D8	ITS INT/EXT STATUS	Volts	Digital
9	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 8	P_CEUM_D1	Prime S/A Relay Status	Volts	Digital
10	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 9	P_CEUM_D2	Prime Destruct Relay Status	Volts	Digital
11	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 10	P_CEUM_D3	Prime Battery ON/OFF Relay Status	Volts	Digital
12	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 11	P_RSR 1	Reserved	Volts	Digital
13	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 12	P_RSR 2	Reserved	Volts	Digital
14	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 13	P_RSR 3	Reserved	Volts	Digital
15	P_FTS&TTDS_M	FTS (P) Chain: Digital Status	Bit 14	P_SARBM_D1	SARB (P): SARB (P) Digital Status Monitoring	Volts	Digital
16	P_FTS&TTDS_M	Tracking Transponder : Digital Status	Bit 15	P_TT_DS1	TT : Tracking Transponder Digital Status	Volts	Digital

b. Parameter-19 ID (P_FTSD_R) : Data type - uint16_t bits allocation . All FTS Digital status data is high/ low signal, so each bit represents each respective digital status.

S.No.	Parameter ID	Parameter Description	Data Bit no	FTS Digital Status Data ID	FTS Digital Status Description	Unit of Measurement	Data Type
1	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 0	P_ARMR_D1	CMS Status Redundant ARM Plug	Volts	Digital
2	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 1	P_ITSR_D2	SAFE/ARM relay status for T/M	Volts	Digital
3	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 2	P_ITSR_D3	Destruct relay status for T/M	Volts	Digital
4	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 3	P_ITSR_D4	SAFE command OCI output for T/M	Volts	Digital
5	P_FTSD_R	FTS (R) Chain:	Bit 4	P_ITSR_D5	Decoder Health status OCI T/M	Volts	Digital

		Digital Data Status					
6	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 5	P_ITSR_D6	LPST enable/disable status OCI output for T/M	Volts	Digital
7	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 6	P_ITSR_D7	Destruct command OCI output for T/M	Volts	Digital
8	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 7	P_ITSR_D8	ITS INT/EXT STATUS	Volts	Digital
9	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 8	P_CEUR_D1	Redundant S/A Relay Status	Volts	Digital
10	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 9	P_CEUR_D2	Redundant Destruct Relay Status	Volts	Digital
11	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 10	P_CEUR_D3	Redundant Battery ON/OFF Relay Status	Volts	Digital
12	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 11	P_RSR 4	Reserved	Volts	Digital
13	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 12	P_RSR 5	Reserved	Volts	Digital
14	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 13	P_RSR 6	Reserved	Volts	Digital
15	P_FTSD_R	FTS (R) Chain: Digital Data Status	Bit 14	P_SARBR_D1	SARB (R): SARB (R) Digital Status Monitoring	Volts	Digital
16	P_FTSD_R	Reserved	Bit 15	Reserved	Reserved	-	-

- 8 bit Data : applicable for Parameter-20 ID to Parameter-42 ID

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [7:0]							

Bit 7 to Bit 0 : Parameter Data

9.4.5. 4 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_5	**Parameter-43 ID**	P_C_RTD_inj	LOX_Injection Temperature to Engine	16	uint16_t	4
ETH_5	**Parameter-44 ID**	P_F_RTD_inj	ATF Injection Temperature to Engine	16	uint16_t	4

ETH_5	**Parameter-45 ID**	P_F_RTD_ATF_Press_Tank	ATF Pressurant tank Temperature	16	uint16_t	4
ETH_5	**Parameter-46 ID**	P_R_RTD_RCS	RCS Pressurant tank Temperature	16	uint16_t	4
ETH_5	**Parameter-47 ID**	P_C_RTD_LOX_Press_Tank	LOX Pressurant tank Temperature	16	uint16_t	4
ETH_5	**Parameter-48 ID**	P_FS_TM_1	Temperature data validation at Forward skirt level	16	uint16_t	4

9.4.5.1. Data Format:

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

Bit 15 to Bit 0 : Parameter Data (refer above table for Parameter ID)

9.4.6. 1 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_6	**Parameter-49 ID**	P_FS_Acc_1	Vibration data validation at forward skirt level (FFT Data)	336	uint16_t	1

9.4.6.1. Data Format:

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

ACCR_FREQ_ID [15:10]	ACCR Data [9:0]

ACCR_FREQ_ID Bit 15 to Bit 10	Frequency [Hz]	10 bit Accelerometer data w.r.t frequency (Bit 9 to Bit 0)
1	20	ACCR Data_1
2	25.198421	ACCR Data_2
3	31.74802104	ACCR Data_3
4	40	ACCR Data_4
5	50.396842	ACCR Data_5
6	63.49604208	ACCR Data_6
7	80	ACCR Data_7
8	100.793684	ACCR Data_8
9	126.9920842	ACCR Data_9
10	160	ACCR Data_10
11	201.587368	ACCR Data_11
12	253.9841683	ACCR Data_12
13	320	ACCR Data_13
14	403.174736	ACCR Data_14
15	507.9683366	ACCR Data_15
16	640	ACCR Data_16
17	806.3494719	ACCR Data_17
18	1015.936673	ACCR Data_18
19	1280	ACCR Data_19
20	1612.698944	ACCR Data_20
21	2031.873347	ACCR Data_21

9.5. Engine Package: Engine Computer data

9.5.1. 100 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_7	Parameter-50 ID	P_CMD_EMGA-PL_E1	Stroke length command from Engine Computer for Pitch Gimbal Actuator	16	uint16_t	100

ETH_7	**Parameter-51 ID**	P_CMD_EMGA-YL_E1	Stroke length command from Engine Computer for Yaw Gimbal Actuator	16	uint16_t	100
ETH_7	**Parameter-52 ID**	P_EMGA-P_E1	Stroke length feedback from Pitch Gimbal Actuator	16	uint16_t	100
ETH_7	**Parameter-53 ID**	P_EMGA-Y_E1	Stroke length feedback from Yaw Gimbal Actuator	16	uint16_t	100
ETH_7	**Parameter-54 ID**	P_EMGAV_P_E1	Pitch Gimbal Actuator Voltage data	8	uint8_t	100
ETH_7	**Parameter-55 ID**	P_EMGAA_P_E1	Pitch Gimbal Actuator Current data	8	uint8_t	100
ETH_7	**Parameter-56 ID**	P_EMGAT_P_E1	Pitch Gimbal Actuator Temperature data	8	uint8_t	100
ETH_7	**Parameter-57 ID**	P_EMGAV_Y_E1	Yaw Gimbal Actuator Voltage data	8	uint8_t	100
ETH_7	**Parameter-58 ID**	P_EMGAA_Y_E1	Yaw Gimbal Actuator Current data	8	uint8_t	100
ETH_7	**Parameter-59 ID**	P_EMGAT_Y_E1	Yaw Gimbal Actuator Temperature data	8	uint8_t	100
ETH_7	**Parameter-60 ID**	P_EMGA_STATUS	Gimbal Actuator health status and error	32	uint32_t	100

9.5.1.1. Data Format:

- 16 bit Data

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

Bit 15 to Bit 0 : Parameter Data

- 8 bit Data

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [7:0]							

Bit 7 to Bit 0 : Parameter Data (refer above table for respective Parameter ID)

9.5.2. 4 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_8	Parameter-61 ID	P_EC_TS	Health parameter (Temperature) for Engine Computer	8	uint8_t	4
ETH_8	Parameter-62 ID	P_EC_CS	Health parameter (Current) for Engine Computer	8	uint8_t	4
ETH_8	Parameter-63 ID	P_EC_VS	Health parameter (Voltage) for Engine Computer	8	uint8_t	4

9.5.2.1. Data Format:

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [7:0]							

Bit 7 to Bit 0 : Parameter Data (refer above table for respective Parameter ID)

9.5.3. 50 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_9	Parameter-64 ID	P_EC_SEQ	There are several sequences executed by the Engine computer. Sequence ID of particular sequence is executed by EC with timestamp is captured by telemetry unit	8	uint8_t	50
ETH_9	Parameter-65 ID	P_CMD_EC	Engine computer will give command to particular valves to open or close based on command id or sequence id received from Flight computer	8	uint8_t	50
ETH_9	Parameter-66 ID	P_EC_Reserved_1	Reserved 8 bit parameter for Engine Computer	8	uint8_t	50
ETH_9	Parameter-67 ID	P_EC_Reserved_2	Reserved 32 bit parameter for Engine Computer	32	uint32_t	50
ETH_9	Parameter-68 ID	P_EC_Reserved_3	Reserved 32 bit parameter for Engine Computer	32	uint32_t	50

9.5.3.1. Data Format :

- 8 bit Data : Parameter-64 ID to Parameter-66 ID

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [7:0]							

Bit 7 to Bit 0 : Parameter Data (refer above table for respective Parameter ID)

Note: 1 P_EC_SEQ & P_CMD_EC detailed list will be shared later

Note: 2 Reserved parameter can be subject to changes as per Mission Requirements

- 32 bit Data : Parameter-67 ID & Parameter-68 ID

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

lsb

Bit 31 to Bit 0 : 32 bit parameter data

Note : Reserved parameter can be subject to changes as per Mission Requirements

9.5.4. 1000 Hz frequency data :

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_10	**Parameter-69 ID**	P_EC_FAULT_STATUS	Fault ID raised by Engine Computer	8	uint8_t	1000
ETH_10	**Parameter-70 ID**	P_EC_STATUS	Engine Computer status ID	32	uint32_t	1000

9.5.4.1. Data Format :

- 8 bit Fault ID : Range of Fault ID - 1 to 255
  (The exact list of Fault IDs with description will be shared later.)

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Fault ID [7:0]							

Bit 7 to Bit 0 : 8 bit Fault ids raised by engine computer

- 32 bit Engine Status ID : The exact list of Status IDs with description will be shared later.

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
STATUS ID [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
STATUS ID [15:0]															

lsb

Bit 31 to Bit 0 : 32 bit Engine Status ID

9.6. Flight Computer Package: Flight Computer

9.6.1. 500 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_11	Parameter-167 ID	P_CDT_Time	CDT Timer Value with IMU data @500 Hz (counter value in ms)	32	uint32_t	500
ETH_11	Parameter-71 ID	P_IMUR-X_M	Vehicle Angular rate data (X-axis) in Body Frame - Main FC IMU	32	uint32_t	500

ETH_11	**Parameter-72 ID**	P_IMUR-Y_M	Vehicle Angular rate data (Y-axis) in Body Frame - Main FC IMU	32	uint32_t	500
ETH_11	**Parameter-73 ID**	P_IMUR-Z_M	Vehicle Angular rate data (Z-axis) in Body Frame - Main FC IMU	32	uint32_t	500
ETH_11	**Parameter-74 ID**	P_IMUA-X_M	Vehicle Acceleration (X-axis) in Body Frame - Main FC IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	uint32_t	500
ETH_11	**Parameter-75 ID**	P_IMUA-Y_M	Vehicle Acceleration (Y-axis) in Body Frame - Main FC IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	uint32_t	500
ETH_11	**Parameter-76 ID**	P_IMUA-Z_M	Vehicle Acceleration (Z-axis) in Body Frame - Main FC IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	uint32_t	500
ETH_11	**Parameter-77 ID**	P_IMU_STATUS_M	IMU status bytes for gyro, accelerometer , inclinometer & AUX measurement	32	uint32_t	500
ETH_11	**Parameter-171 ID**	P_IMU Reserved -1	Reserved 32 bit parameter for IMU data	32	uint32_t	500
ETH_11	**Parameter-172 ID**	P_IMU Reserved -2	Reserved 32 bit parameter for IMU data	32	uint32_t	500
ETH_11	**Parameter-173 ID**	P_IMU Reserved -3	Reserved 32 bit parameter for IMU data	32	uint32_t	500
ETH_11	**Parameter-174 ID**	P_IMU Reserved -4	Reserved 32 bit parameter for IMU data	32	uint32_t	500

9.6.1.1. Data Format:

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

lsb

Bit 31 to Bit 0 : Parameter Data of parameters mentioned in above list.

Note : Reserved parameter can be subject to changes as per Mission Requirements

Note : CDT value is in millisecond (ms) . It basically gives counter value.

9.6.2. 100 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_12	Parameter-167 ID	P_CDT_Time	CDT Timer Value with GNC data @100 Hz (counter value in ms)	32	uint32_t	100
ETH_12	Parameter-78 ID	P_GNC_POS-X_FC	Vehicle position (X-axis) in LPI Frame	32	float	100
ETH_12	Parameter-79 ID	P_GNC_POS-Y_FC	Vehicle position (Y-axis) in LPI Frame	32	float	100
ETH_12	Parameter-80 ID	P_GNC_POS-Z_FC	Vehicle position (Z-axis) in LPI Frame	32	float	100
ETH_12	Parameter-81 ID	P_GNC_VEL-X_FC	Vehicle velocity (X-axis) in LPI Frame	32	float	100
ETH_12	Parameter-82 ID	P_GNC_VEL-Y_FC	Vehicle velocity (Y-axis) in LPI Frame	32	float	100
ETH_12	Parameter-83 ID	P_GNC_VEL-Z_FC	Vehicle velocity (Z-axis) in LPI Frame	32	float	100
ETH_12	Parameter-84 ID	P_GNC_PR_FC	Vehicle Pitch Rate (Y-axis) in Inertial Euler Angles convention	32	float	100
ETH_12	Parameter-85 ID	P_GNC_YR_FC	Vehicle Yaw Rate (Z-axis) in Inertial Euler Angles convention	32	float	100
ETH_12	Parameter-86 ID	P_GNC_RR_FC	Vehicle Roll Rate (X-axis) in Inertial Euler Angles convention	32	float	100
ETH_12	Parameter-87 ID	P_GNC_PA_FC	Vehicle Pitch angle (Y-axis) in Inertial Euler Angles convention	32	float	100
ETH_12	Parameter-88 ID	P_GNC_YA_FC	Vehicle Yaw angle (Z-axis) in Inertial Euler Angles convention	32	float	100
ETH_12	Parameter-89 ID	P_GNC_RA_FC	Vehicle Roll angle (X-axis) in Inertial Euler Angles convention	32	float	100

9.6.2.1. Data Format:

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

lsb

Bit 31 to Bit 0: Parameter Data of parameters mentioned in above list.
Note : CDT value is in millisecond (ms) . It basically gives counter value.

9.6.3. 100 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_13	**Parameter-90 ID**	P_CMD_EMGA-PA_E1	Engine deflection command for pitch from Flight Computer	16	float	100
ETH_13	**Parameter-91 ID**	P_CMD_EMGA-YA_E1	Engine deflection command for yaw from Flight Computer	16	float	100
ETH_13	**Parameter-92 ID**	P_CMD_RCS	Commanded RCS Valve State	8	uint8_t	100

9.6.3.1. Data Format:

- 16 bit Command:

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Gimbal Actuator Command [15:0]															

Bit 15 to Bit 0 : Gimbal Actuator Command

- 8 bit RCS valve command:

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved [7:4]				RCS 4	RCS 3	RCS 2	RCS 1

Bit 7 to Bit 4 - Reserved Bits
Bit 3 - RCS valve 4 (Valve ID: **R_EV_RCS_4**)

Bit 2	RCS valve 4 Command

0	VALVE OPEN
1	VALVE CLOSE

Bit 2 - RCS valve 3 (Valve ID: **R_EV_RCS_3**)

Bit 2	**RCS valve 3 Command**
0	VALVE OPEN
1	VALVE CLOSE

Bit 1 - RCS valve 2 (Valve ID: **R_EV_RCS_2**)

Bit 2	**RCS valve 2 Command**
0	VALVE OPEN
1	VALVE CLOSE

Bit 0 - RCS valve 1 (Valve ID: **R_EV_RCS_1**)

Bit 2	**RCS valve 1 Command**
0	VALVE OPEN
1	VALVE CLOSE

S.No.	Parameter ID	Parameter Description	Data Bit no	RCS Valve ID	Valve Description	Frequency	Data Type
1	P_CMD_RCS	Commanded RCS Valve State	Bit 0	R_EV_RCS_1	Command given to RCS valve 1	100	Digital
2	P_CMD_RCS	Commanded RCS Valve State	Bit 1	R_EV_RCS_2	Command given to RCS valve 2	100	Digital
3	P_CMD_RCS	Commanded RCS Valve State	Bit 2	R_EV_RCS_3	Command given to RCS valve 3	100	Digital
4	P_CMD_RCS	Commanded RCS Valve State	Bit 3	R_EV_RCS_4	Command given to RCS valve 4	100	Digital
5	P_CMD_RCS	Commanded RCS Valve State	Bit 4 to Bit 7	-	Reserved	100	-

9.6.4. 10 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)

ETH_14	**Parameter-167 ID**	P_CDT_Time	CDT Timer Value with GNC data @10 Hz	32	uint32_t	10
ETH_14	**Parameter-93 ID**	P_CMD_PA	Commanded Pitch Angle in Inertial Euler Angles convention from Guidance	32	float	10
ETH_14	**Parameter-94 ID**	P_CMD_YA	Commanded Yaw Angle in Inertial Euler Angles convention from Guidance	32	float	10
ETH_14	**Parameter-95 ID**	P_CMD_RA	Commanded Roll Angle in Inertial Euler Angles convention from Guidance	32	float	10
ETH_14	**Parameter- 168 ID**	P_Delta_PA	Delta Pitch Angle in Inertial Euler Angles convention [Vehicle Pitch angle (Y-axis) - Commanded Pitch Angle]	32	float	10
ETH_14	**Parameter- 169 ID**	P_Delta_YA	Delta Yaw Angle in Inertial Euler Angles convention [Vehicle Yaw angle (Y-axis) - Commanded Yaw Angle]	32	float	10
ETH_14	**Parameter- 170 ID**	P_Delta_RA	Delta Roll Angle in Inertial Euler Angles convention [Vehicle Roll angle (Y-axis) - Commanded Roll Angle]	32	float	10

9.6.4.1. Data Format:

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

lsb

Bit 31 to Bit 0 : Parameter Data

Note : CDT value is in millisecond (ms). It basically gives counter value.

9.6.5. 4 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_15	**Parameter-96 ID**	P_FC_TS	Health parameter (Temperature) for Flight Computer	8	uint8_t	4

ETH_15	**Parameter-97 ID**	P_FC_CS	Health parameter (Current) for Flight Computer	8	uint8_t	4
ETH_15	**Parameter-98 ID**	P_FC_VS	Health parameter (Voltage) for Flight Computer	8	uint8_t	4

9.6.5.1. Data Format:

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [7:0]							

Bit 7 to Bit 0 : Parameter Data

9.6.6. 1 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_16	**Parameter-99 ID**	P_IMUT_M	Health parameter : Main FC IMU Temperature data	8	uint8_t	1
ETH_16	**Parameter-100 ID**	P_IMUV_M	Health parameter : Main FC IMU Voltage data	8	uint8_t	1
ETH_16	**Parameter-101 ID**	P_GNSS_PPS	GNSS pulse signal	8	uint8_t	1
ETH_16	**Parameter-102 ID**	P_GNSS_GGA_LAT	GNSS GGA : Datum corrected Latitude	32	uint32_t	1
ETH_16	**Parameter-103 ID**	P_GNSS_GGA_LONG	GNSS GGA : Datum corrected Longitude	32	uint32_t	1
ETH_16	**Parameter-104 ID**	P_GNSS_GGA_QI&HDOP	GNSS GGA : Quality indicator & HDOP	16	uint16_t	1
ETH_16	**Parameter-105 ID**	P_GNSS_GGA_ALT	GNSS GGA : Datum and mean sea corrected altitude	32	uint32_t	1
ETH_16	**Parameter-106 ID**	P_GNSS_GGA_GEOSEP	GNSS GGA : Geoidal separation (mean sea corrections)	16	uint16_t	1
ETH_16	**Parameter-107 ID**	P_GNSS_VTG_SP&MI	GNSS VTG : Speed over ground in Km/hr & Mode indicator	32	uint32_t	1
ETH_16	**Parameter-108 ID**	P_GNSS_GLL_LAT	GNSS GLL : Datum corrected Latitude	32	uint32_t	1
ETH_16	**Parameter-109 ID**	P_GNSS_GLL_LONG	GNSS GLL : Datum corrected Longitude	32	uint32_t	1
ETH_16	**Parameter-110 ID**	P_GNSS_GLL_UTC	GNSS GLL : UTC Timestamp	32	uint32_t	1

ETH_16	**Parameter-111 ID**	P_GNSS_GLL_STAT&MI	GNSS GLL : Status: Data valid or not valid Mode indicator : Autonomous , GNSS solution with corrections from SBAS satellites & Data not valid	8	uint8_t	1
ETH_16	**Parameter-112 ID**	P_GNSS_GSA_MODE	GNSS GSA : Mode indicator	8	uint8_t	1
ETH_16	**Parameter-113 ID**	P_GNSS_GSA_PRN_1	GNSS GSA : PRN number of satellite used for position fix	32	uint32_t	1
ETH_16	**Parameter-114 ID**	P_GNSS_GSA_PRN_2	GNSS GSA : PRN number of satellite used for position fix	32	uint32_t	1
ETH_16	**Parameter-115 ID**	P_GNSS_GSA_DOPVAL	GNSS GSA : PDOP, HDOP, VDOP values	32	uint32_t	1
ETH_16	**Parameter-116 ID**	P_GNSS_ECEF_UTC	GNSS: UTC Time in ECEF Frame	32	uint32_t	1
ETH_16	**Parameter-117.0 ID**	P_GNSS_ECEF_FHPOS_X	GNSS : position (X axis) in ECEF Frame (First half 32 bit)	32	uint32_t	1
ETH_16	**Parameter-117.1 ID**	P_GNSS_ECEF_LHPOS_X	GNSS : position (X axis) in ECEF Frame (Last half 32 bit)	32	uint32_t	1
ETH_16	**Parameter-118.0 ID**	P_GNSS_ECEF_FHPOS_Y	GNSS : position (Y axis) in ECEF Frame (First half 32 bit)	32	uint32_t	1
ETH_16	**Parameter-118.1 ID**	P_GNSS_ECEF_LHPOS_Y	GNSS : position (Y axis) in ECEF Frame (Last half 32 bit)	32	uint32_t	1
ETH_16	**Parameter-119.0 ID**	P_GNSS_ECEF_FHPOS_Z	GNSS : position (Z axis) in ECEF Frame (First half 32 bit)	32	uint32_t	1
ETH_16	**Parameter-119.1 ID**	P_GNSS_ECEF_LHPOS_Z	GNSS : position (Z axis) in ECEF Frame (Last half 32 bit)	32	uint32_t	1
ETH_16	**Parameter-120 ID**	P_GNSS_ECEF_VEL_X	GNSS : velocity (X axis) in ECEF Frame	32	uint32_t	1
ETH_16	**Parameter-121 ID**	P_GNSS_ECEF_VEL_Y	GNSS : velocity (Y axis) in ECEF Frame	32	uint32_t	1
ETH_16	**Parameter-122 ID**	P_GNSS_ECEF_VEL_Z	GNSS : velocity (Z axis) in ECEF Frame	32	uint32_t	1
ETH_16	**Parameter-123 ID**	P_G1_P	Control gain constant - 1 (Pitch)	32	float	1
ETH_16	**Parameter-124 ID**	P_G2_P	Control gain constant - 2	32	float	1

			(Pitch)			
ETH_16	**Parameter-125 ID**	P_FLT_COEF_1_P	Filter coefficient constant - 1 (Pitch)	32	float	1
ETH_16	**Parameter-126 ID**	P_FLT_COEF_2_P	Filter coefficient constant - 2 (Pitch)	32	float	1
ETH_16	**Parameter-127 ID**	P_FLT_COEF_3_P	Filter coefficient constant - 3 (Pitch)	32	float	1
ETH_16	**Parameter-128 ID**	P_FLT_COEF_4_P	Filter coefficient constant - 4 (Pitch)	32	float	1
ETH_16	**Parameter-129 ID**	P_G1_Y	Control gain constant - 1 (Yaw)	32	float	1
ETH_16	**Parameter-130 ID**	P_G2_Y	Control gain constant - 2 (Yaw)	32	float	1
ETH_16	**Parameter-131 ID**	P_FLT_COEF_1_Y	Filter coefficient constant - 1 (Yaw)	32	float	1
ETH_16	**Parameter-132 ID**	P_FLT_COEF_2_Y	Filter coefficient constant - 2 (Yaw)	32	float	1
ETH_16	**Parameter-133 ID**	P_FLT_COEF_3_Y	Filter coefficient constant - 3 (Yaw)	32	float	1
ETH_16	**Parameter-134 ID**	P_FLT_COEF_4_Y	Filter coefficient constant - 4 (Yaw)	32	float	1

9.6.6.1. Data Format:

- For Parameter-99 ID (P_IMUT_M), Parameter-100 ID (P_IMUV_M) & Parameter-101 ID (P_GNSS_PPS) :

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [7:0]							

Bit 7 to Bit 0 : Parameter Data

Note : For GNSS GGA Message :

GGA Message	**Field**	**Parameter Data Format**	**Prescaler**	**Actual Data (Param Data / prescaler)**
GNSS_GGA_LAT	Latitude	xxxxxxxx	10,000	xxxx.xxxx
GNSS_GGA_LONG	Longitude	yyyyyyyyy	10,000	yyyyy.yyyy
GNSS_GGA_QI&HDOP	QI - Quality Indicator	q	1	q
	HDOP - Horizontal Dilution Of Precision	hhh	10	hh.h

GNSS_GGA_ALT	Altitude (s = Altitude sign (+/-)) {s = 0 (+ve) or s = 1 (-ve)}	saaaaaaaaa	100	aaaaaaa.aa
GNSS_GGA_GEOSEP	Geoidal separation (s = +/- sign)	sbbbb	10	bbb.b

- For Parameter-102 ID (P_GNSS_GGA_LAT)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
a	P_GNSS_GGA_LAT [31:16]														
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P_GNSS_GGA_LAT [15:0]															

lsb

Bit 31 : 'a' signify latitude direction

Bit 31	"a"
0	North
1	South

Bit 30 to Bit 0 : GNSS GGA Message Latitude (refer above GGA **Note section**)

- For Parameter-103 ID (P_GNSS_GGA_LONG)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
b	P_GNSS_GGA_LONG [31:16]														
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P_GNSS_GGA_LONG [15:0]															

lsb

Bit 31 : 'b' signify longitude direction

Bit 31	"b"
0	East
1	West

Bit 30 to Bit 0 : GNSS GGA Message Longitude (refer above GGA **Note section**)

- For Parameter-104 ID (P_GNSS_GGA_QI&HDOP)

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
GGA_QI [15:10]						GGA_HDOP [9:0]									

Bit 15 to Bit 10 : GNSS GGA message Quality Indicator

QI value (BIt 15 to Bit 10)	**Description**
0	No fix
1	GNSS Fix Available without SBAS corrections
2	GNSS Fix Available with SBAS corrections
x	Invalid Data

Bit 9 to Bit 0 : GNSS GGA Message Horizontal Dilution Of Precision. (HDOP) (refer above GGA **Note section**)

- For Parameter-105 ID (P_GNSS_GGA_ALT)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
s	P_GNSS_GGA_ALT [31:16]														
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P_GNSS_GGA_ALT [15:0]															

lsb

Bit 31 : s = Altitude sign (+/-)

Bit 31	**"s" indicates**
0	positive altitude value
1	negative altitude value

Bit 31 to Bit 10 : GNSS GGA Message Altitude (refer above GGA **Note section**)

- For Parameter-106 ID (P_GNSS_GGA_GEOSEP)

msb **lsb**

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
s	P_GNSS_GGA_GEOSEP [31:16]														

Bit 15 : s = Geoidal separation sign (+/-)

Bit 15	**"s" indicates**
0	positive Geoidal separation value

1	negative Geoidal separation value

Bit 14 to Bit 0 : GNSS GGA Message Altitude (refer above GGA **Note section**)

Note : For GNSS VTG Message :

VTG Message	Field	Parameter Data Format	Prescaler	Actual Data (Param Data / prescaler)
GNSS_VTG_SP&MI	Speed	sssssss	100	sssss.ss
	Mode Indicator	a	1	a

- For Parameter-107 ID (P_GNSS_VTG_SP&MI)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
MI [31:30]		VTG_SPEED [29:16]													
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
VTG_SPEED [15:0]															

lsb

Bit 31 to Bit 30 : MI - Mode Indicator

MI (Bit 31 to Bit 30)	Description
0	Invalid
1	Autonomous mode
2	GNSS solution with corrections from SBAS satellites
3	Data not valid.

Bit 29 to Bit 0 : GNSS VTG Message Speed (refer above VTG **Note section**)

Note : For GNSS GLL Message :

GLL Message	Field	Parameter Data Format	Prescaler	Actual Data (Param Data / prescaler)
GNSS_GLL_LAT	Latitude	xxxxxxxx	10,000	xxxx.xxxx
GNSS_GLL_LONG	Longitude	yyyyyyyyy	10,000	yyyyy.yyyy
GNSS_GLL_UTC	UTC Time	hhmmssss	100	hhmmss.ss
GNSS_GLL_STAT&MI	STATUS	a	1	a
	Mode Indicator (MI)	b	1	b

- For Parameter-108 ID (P_GNSS_GLL_LAT)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
a	P_GNSS_GLL_LAT [31:16]														
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P_GNSS_GLL_LAT [15:0]															

lsb

Bit 31 : 'a' signify latitude direction

Bit 31	"a"
0	North
1	South

Bit 30 to Bit 0 : GNSS GLL Message Latitude (refer above GLL **Note section**)

- For Parameter-109 ID (P_GNSS_GLL_LONG)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
b	P_GNSS_GLL_LONG [31:16]														
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P_GNSS_GLL_LONG [15:0]															

lsb

Bit 31 : 'b' signify longitude direction

Bit 31	"b"
0	East
1	West

Bit 30 to Bit 0 : GNSS GLL Message Longitude (refer above GLL **Note section**)

- For Parameter-110 ID (P_GNSS_GLL_UTC)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
P_GNSS_GLL_UTC [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

P_GNSS_GLL_UTC [15:0]

lsb

Bit 31 to Bit 0 : GNSS GLL Message UTC Time of position fix (refer above GLL **Note section**)

- For Parameter-111 ID (P_GNSS_GLL_STAT&MI)

msb

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved [8:3]						MI [2:1]		STATUS

lsb

Bit 8 to Bit 3 : Reserved bits

Bit 2 to Bit 1 : GNSS GLL Message Mode Indicator (MI) (refer above GLL **Note section**)

MI (Bit 2 to Bit 1)	Description
0	Invalid
1	Autonomous mode
2	GNSS solution with corrections from SBAS satellites
3	Data not valid.

Bit 0 : GNSS GLL Message Status of GLL Data (refer above GLL **Note section**)

Bit 0	STATUS
0	Data valid
1	Data Not valid

Note : For GNSS GSA Message :

GSA Message	Field	Parameter Data Format	Prescaler	Actual Data (Param Data / prescaler)
GNSS_GSA_MODE	Mode of operation	a	1	a
	Mode Indicator (MI)	b	1	b
GNSS_GSA_PRN_1	PRN no. of Satellite 1 to 6	c	1	c
GNSS_GSA_PRN_2	PRN no. of Satellite 6 to 12	c	1	c
GNSS_GSA_DOPVAL	PDOP	ppp	10	pp.p

	HDOP	hhh	10	hh.h
	VDOP	vvv	10	vv.v

- For Parameter-112 ID (P_GNSS_GSA_MODE)

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
a	MI [6:0]						

Bit 7 : Mode of operation could be manual or automatic

Mode Bit 7	**"a" Description**
0	Automatic mode
1	Manual mode

Bit 6 to Bit 0 : Mode indicator

MI (Bit 6 to Bit 0)	**Description**
0	Fix not available
1	2D position fix or Altitude hold mode
2	3D position fix.
x	Invalid

- For Parameter-113 ID (P_GNSS_GSA_PRN_1)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
GNSYS_ID [31:30]		s1 [29:25]					s2 [24:20]					s3 [19:15]			
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
s3	s4 [14:10]						s5 [9:5]					s6 [4:0]			

lsb

Bit 31 to Bit 30 : GNSS System / Constellation ID

GNSYS_ID (Bit 31 to Bit 30)	**Description**
0	GPS
1	GLONASS
2	SBAS
3	NavIC

Bit 29 to Bit 0: Satellite Identification

Max 12 satellite used for position fix:

1. GPS : Satellite Identification value = PRN value = 1 to 32
2. GLONASS : Satellite Identification value = 1 to 32
   SV ID = Satellite Identification value + 64 = 65 to 96
3. SBAS : Satellite Identification value = 1 to 19 ;
   SV ID = Satellite Identification value + 32 = 33 to 51
   PRN number = SV ID + 87
4. NavIC (IRNSS) : Satellite Identification value = PRN value = 1 to 15

Allocated Bits		Range of Satellite number			
	GNSYS_ID ->	0	1	2	3
	Satellite used for pos fix	GPS	GLONASS	SBAS	NavIC (IRNSS)
Bit 29 to Bit 25	s1	1 to 32	1 to 32	1 to 19	1 to 15
Bit 24 to Bit 20	s2	1 to 32	1 to 32	1 to 19	1 to 15
Bit 19 to Bit 15	s3	1 to 32	1 to 32	1 to 19	1 to 15
Bit 14 to Bit 10	s4	1 to 32	1 to 32	1 to 19	1 to 15
Bit 9 to Bit 5	s5	1 to 32	1 to 32	1 to 19	1 to 15
Bit 4 to Bit 0	s6	1 to 32	1 to 32	1 to 19	1 to 15

- For Parameter-114 ID (P_GNSS_GSA_PRN_2)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
GNSYS_ID [31:30]		s7 [29:25]					s8 [24:20]					s9 [19:15]			
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
s3	s10 [14:10]						s11 [9:5]					s12 [4:0]			

lsb

Bit 31 to Bit 30 : GNSS System / Constellation ID

GNSYS_ID (Bit 31 to Bit 30)	Description
0	GPS
1	GLONASS
2	SBAS
3	NavIC

Bit 29 to Bit 0: Satellite Identification

Max 12 satellite used for position fix:

5. GPS : Satellite Identification value = PRN value = 1 to 32
6. GLONASS : Satellite Identification value = 1 to 32
   SV ID = Satellite Identification value + 64 = 65 to 96
7. SBAS : Satellite Identification value = 1 to 19 ;
   SV ID = Satellite Identification value + 32 = 33 to 51
   PRN number = SV ID + 87
8. NavIC (IRNSS) : Satellite Identification value = PRN value = 1 to 15

Allocated Bits		Range of Satellite number			
	GNSYS_ID ->	0	1	2	3
	Satellite used for pos fix	GPS	GLONASS	SBAS	NavIC (IRNSS)
Bit 29 to Bit 25	s7	1 to 32	1 to 32	1 to 19	1 to 15
Bit 24 to Bit 20	s8	1 to 32	1 to 32	1 to 19	1 to 15
Bit 19 to Bit 15	s9	1 to 32	1 to 32	1 to 19	1 to 15
Bit 14 to Bit 10	s10	1 to 32	1 to 32	1 to 19	1 to 15
Bit 9 to Bit 5	s11	1 to 32	1 to 32	1 to 19	1 to 15
Bit 4 to Bit 0	s12	1 to 32	1 to 32	1 to 19	1 to 15

- For Parameter-115 ID (P_GNSS_GSA_DOPVAL)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
GNSYS_ID [31:30]		GSA PDOP [29:20]										GSA HDOP [19:16]			
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
GSA HDOP [16:10]						GSA VDOP [9:0]									

lsb

Bit 31 to Bit 30 : GNSS System / Constellation ID

GNSYS_ID (Bit 31 to Bit 30)	Description
0	GPS
1	GLONASS
2	SBAS

3	NavIC

Bit 29 to Bit 20 : PDOP value (refer above GSA **Note section**)

Bit 19 to Bit 10 : HDOP value (refer above GSA **Note section**)

Bit 9 to Bit 0 : VDOP value (refer above GSA **Note section**)

Note : For GNSS ECEF Message

ECEF Message	Field	Parameter Data Format	Prescaler	Actual Data (Param Data / prescaler)
GNSS_ECEF_UTC	UTC Time in ECEF Frame	hhmmssss	100	hhmmss.ss
GNSS_ECEF_POS_X	64 Bit position - X axis	sxxxxxxxxxx	100	sxxxxxxxx.xx
GNSS_ECEF_POS_Y	64 Bit position - Y axis	syyyyyyyyyy	100	syyyyyyyy.yy
GNSS_ECEF_POS_Z	64 Bit position - Z axis	szzzzzzzzzz	100	szzzzzzzz.zz
GNSS_ECEF_VEL_X	32 Bit velocity - X axis	sxxxxxxxx	100	sxxxxxx.xx
GNSS_ECEF_VEL_Y	32 Bit velocity - Y axis	syyyyyyyy	100	syyyyyy.yy
GNSS_ECEF_VEL_Z	32 Bit velocity - Z axis	szzzzzzzz	100	szzzzzz.zz

Note:
In the above fields data 's' represents the sign (+/-) bit.

64 bit GNSS_ECEF_POS_X :

1. GNSS_ECEF_POS_X [63:32] = P_GNSS_ECEF_FHPOS_X [31:0] (parameter data)
2. GNSS_ECEF_POS_X [31:0] = P_GNSS_ECEF_LHPOS_X [31:0] (parameter data)

64 bit GNSS_ECEF_POS_Y :

3. GNSS_ECEF_POS_Y [63:32] = P_GNSS_ECEF_FHPOS_Y [31:0] (parameter data)
4. GNSS_ECEF_POS_Y [31:0] = P_GNSS_ECEF_LHPOS_Y [31:0] (parameter data)

64 bit GNSS_ECEF_POS_Z :

5. GNSS_ECEF_POS_Z [63:32] = P_GNSS_ECEF_FHPOS_Z [31:0] (parameter data)
6. GNSS_ECEF_POS_Z [31:0] = P_GNSS_ECEF_LHPOS_Z [31:0] (parameter data)

- 32 bit Parameter Data format applicable for Parameter-116 ID to Parameter-122 ID .

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Parameter Data [15:0]

lsb

Bit 31 to Bit 0 : Parameter Data.

a. For Parameter-116 ID (P_GNSS_ECEF_UTC) (refer above ECEF **Note section**)
b. For Parameter-117.0 ID (P_GNSS_ECEF_FHPOS_X) & Parameter-117.1 ID (P_GNSS_ECEF_LHPOS_X) refer above ECEF **Note section.**
c. For Parameter-118.0 ID (P_GNSS_ECEF_FHPOS_Y) & Parameter-118.1 ID (P_GNSS_ECEF_LHPOS_Y) refer above ECEF **Note section.**
d. For Parameter-119.0 ID (P_GNSS_ECEF_FHPOS_Z) & Parameter-119.1 ID (P_GNSS_ECEF_LHPOS_Z) refer above ECEF **Note section.**
e. For Parameter-120 ID (P_GNSS_ECEF_VEL_X) refer above ECEF **Note section.**
f. For Parameter-121 ID (P_GNSS_ECEF_VEL_Y) refer above ECEF **Note section.**
g. For Parameter-122 ID (P_GNSS_ECEF_VEL_Z) refer above ECEF **Note section.**

- 32 bit Parameter Data format applicable for Parameter-123 ID to Parameter-134 ID .

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

lsb

Bit 31 to Bit 0 : Parameter Data.

9.6.7. 1000 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_17	**Parameter-135 ID**	P_FC_FAULT_STATUS	Fault ID raised by Flight Computer	8	uint8_t	1000
ETH_17	**Parameter-136 ID**	P_FC_STATUS	Flight Computer send status like GO-NO GO status, ALS feedback, LMP status sent by flight computer comes under this parameter.	32	uint32_t	1000

9.6.7.1. Data Format:

- 8 bit Fault ID : Range of Fault ID - 1 to 255
  (The exact list of Fault IDs with description will be shared later.)

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Fault ID [7:0]							

Bit 7 to Bit 0 : 8 bit Fault ids raised by Flight computer

- 32 bit Flight computer Status ID : The exact list of Status IDs with description will be shared later.

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
STATUS ID [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
STATUS ID [15:0]															

lsb

Bit 31 to Bit 0 : 32 bitFlight Computer Status ID

9.6.8. 50 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_18	**Parameter-137 ID**	P_FC_SEQ	There are several sequences run by a flight computer. Sequence ID or particular sequence is generated by FC and send to respective computer for execution ; same sequence id with timestamp is captured by telemetry unit also	8	uint8_t	50
ETH_18	**Parameter-138 ID**	P_CMD_FC	Any command ID send by Flight Computer to respective computers	8	uint8_t	50
ETH_18	**Parameter-139 ID**	P_FC_Reserved_1	Reserved 32 bit parameter for Flight Computer	32	uint32_t	50
ETH_18	**Parameter-140 ID**	P_FC_Reserved_2	Reserved 32 bit parameter for Flight Computer	32	uint32_t	50
ETH_18	**Parameter-141 ID**	P_FC_Reserved_3	Reserved 32 bit parameter for Flight Computer	32	uint32_t	50
ETH_18	**Parameter-142 ID**	P_FC_Reserved_4	Reserved 32 bit parameter for Flight Computer	32	uint32_t	50

9.6.8.1. Data Format:

- 8 bit Data : Parameter-137 ID & Parameter-138 ID

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Parameter Data [7:0]

Bit 7 to Bit 0 : Parameter Data (refer above table for respective Parameter ID)

Note: 1 P_FC_SEQ & P_CMD_FC detailed list will be shared later

Note: 2 Reserved parameter can be subject to changes as per Mission Requirements

- 32 bit Data : Parameter-139 ID to Parameter-142 ID

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

lsb

Bit 31 to Bit 0 : 32 bit parameter data

Note : Reserved parameter can be subject to changes as per Mission Requirements

9.7. Payload Package: Payload Computer

9.7.1. 500 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_19	Parameter-143 ID	P_IMUR-X_PLD	Payload : Vehicle Angular rate data (X-axis) in Body Frame - Redundant IMU	32	uint32_t	500
ETH_19	Parameter-144 ID	P_IMUR-Y_PLD	Payload : Vehicle Angular rate data (Y-axis) in Body Frame - Redundant IMU	32	uint32_t	500
ETH_19	Parameter-145 ID	P_IMUR-Z_PLD	Payload : Vehicle Angular rate data (Z-axis) in Body Frame - Redundant IMU	32	uint32_t	500

ETH_19	**Parameter-146 ID**	P_IMUA-X_PLD	Payload : Vehicle Acceleration (X-axis) in Body Frame - Redundant IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	uint32_t	500
ETH_19	**Parameter-147 ID**	P_IMUA-Y_PLD	Payload : Vehicle Acceleration (Y-axis) in Body Frame - Redundant IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	uint32_t	500
ETH_19	**Parameter-148 ID**	P_IMUA-Z_PLD	Payload : Vehicle Acceleration (Z-axis) in Body Frame - Redundant IMU (with reference to 1 g = 9.80665 m/s^2, Standard Gravity)	32	uint32_t	500
ETH_19	**Parameter-149 ID**	P_IMU_STATUS_PLD	Payload : IMU status bytes for gyro, accelerometer , inclinometer & AUX measurement	32	uint32_t	500

9.7.1.1. Data Format:

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

lsb

Bit 31 to Bit 0 : Parameter Data of parameters mentioned in above list.

9.7.2. 100 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_20	**Parameter-150 ID**	P_GNC_POS-X_PLD	Vehicle position (X axis) in LPI Frame calculated by Payload	32	float	100
ETH_20	**Parameter-151 ID**	P_GNC_POS-Y_PLD	Vehicle position (Y axis) in LPI Frame calculated by Payload	32	float	100
ETH_20	**Parameter-152 ID**	P_GNC_POS-Z_PLD	Vehicle position (Z axis) in LPI Frame calculated by Payload	32	float	100
ETH_20	**Parameter-153 ID**	P_GNC_VEL-X_PLD	Vehicle velocity (X-axis) in LPI Frame calculated by Payload	32	float	100
ETH_20	**Parameter-154 ID**	P_GNC_VEL-Y_PLD	Vehicle velocity (Y-axis) in LPI	32	float	100

			Frame calculated by Payload			
ETH_20	**Parameter-155 ID**	P_GNC_VEL-Z_PLD	Vehicle velocity (Z-axis) in LPI Frame calculated by Payload	32	float	100
ETH_20	**Parameter-156 ID**	P_GNC_PR_PLD	Vehicle Pitch Rate (y axis) in Inertial Euler Angles convention calculated by Payload	32	float	100
ETH_20	**Parameter-157 ID**	P_GNC_YR_PLD	Vehicle Yaw Rate (z axis) in Inertial Euler Angles convention calculated by Payload	32	float	100
ETH_20	**Parameter-158 ID**	P_GNC_RR_PLD	Vehicle Roll Rate (x axis) in Inertial Euler Angles convention calculated by Payload	32	float	100
ETH_20	**Parameter-159 ID**	P_GNC_PA_PLD	Vehicle Pitch angle in Inertial Euler Angles convention calculated by Payload	32	float	100
ETH_20	**Parameter-160 ID**	P_GNC_YA_PLD	Vehicle Yaw angle in Inertial Euler Angles convention calculated by Payload	32	float	100
ETH_20	**Parameter-161 ID**	P_GNC_RA_PLD	Vehicle Roll angle in Inertial Euler Angles convention calculated by Payload	32	float	100

9.7.2.1. Data Format:

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Parameter Data [31:16]															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [15:0]															

lsb

Bit 31 to Bit 0: Parameter Data of parameters mentioned in above list.

9.7.3. 4 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_21	Parameter-162 ID	P_TS_PLD	Health parameter (Temperature) for Payload	8	uint8_t	4
ETH_21	Parameter-163 ID	P_CS_PLD	Health parameter (Current) for Payload	8	uint8_t	4
ETH_21	Parameter-164 ID	P_VS_PLD	Health parameter (Voltage) for Payload	8	uint8_t	4

9.7.3.1. Data Format:

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [7:0]							

Bit 7 to Bit 0 : Parameter Data

9.7.4. 1 Hz frequency data:

S.No.	Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
ETH_22	Parameter-165 ID	P_IMUT_PLD	Payload : Redundant IMU Temperature data	8	uint8_t	1
ETH_22	Parameter-166 ID	P_IMUV_PLD	Payload : Redundant IMU Voltage data	8	uint8_t	1

9.7.4.1. Data Format:

msb **lsb**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Parameter Data [7:0]							

Bit 7 to Bit 0 : Parameter Data

9.8. Telemetry Processing Unit: Telemetry Computer

9.8.1. Telemetry Health Parameters:

Parameter ID Designator	Parameter ID	Description	Data Size (in bits)	Data Type	Frequency (Hz)
BCU_3.3V Data	P_TMPCU_P3.3V data	Health parameter: 3.3V of Telemetry Processing Unit	16	uint16_t	2
BCU_5V Data	P_TMPCU_P5V data	Health parameter: 5V of Telemetry Processing Unit	16	uint16_t	2
BCU_P8V Data	P_TMPCU_P8V data	Health parameter: +8V of Telemetry Processing Unit	16	uint16_t	2
BCU_N8V Data	P_TMPCU_N8V data	Health parameter: -8V of Telemetry Processing Unit	16	uint16_t	2

BCU_Temperature Data	P_TMPCU_TEMP data	Health parameter: Temperature of Telemetry Processing Unit	16	uint16_t	2
BCU_PWRUP_COUNT	P_TMPCU_PWRUP_ COUNT data	Health parameter: power up count of Telemetry Processing Unit	16	uint16_t	2

9.8.2. Video Data in PCM Frame:

Block 1----------> PCM Word Address : 424
No of Occurrences : 5
Block 2----------> PCM Word Address : 444
No of Occurrences : 46
Block 3----------> PCM Word Address : 604
No of Occurrences : 8
Block 4----------> PCM Word Address : 639
No of Occurrences : 34
Block 5----------> PCM Word Address : 688
No of Occurrences : 46
Block 6----------> PCM Word Address : 833
No of Occurrences : 23
Block 7----------> PCM Word Address : 883
No of Occurrences : 34
Block 8----------> Word Address : 932
No of Occurrences : 39

10. IMU Status: (P_IMU_STATUS_M & P_IMU_STATUS_PLD)

msb

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Gyrometer Status								Accelerometer Status							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Inclinometer Status								Temperature error							

lsb

Bit 31 to Bit 24:

Bits	Gyroscope STATUS bit Information	Comment

Bit 24	0=OK, 1=X-channel	Bits 0-2 will flag the overload channel(s) Bits 0-2 will flag the error channel(s)
Bit 25	0=OK, 1=Y-channel	
Bit 26	0=OK, 1=Z-channel	
Bit 27	0=OK, 1=Error in measurement-channel	
Bit 28	0=OK, 1=Overload	
Bit 29	0=OK, 1=Outside operating conditions	
Bit 30	0=OK, 1=Start-Up	
Bit 31	0=OK, 1=System integrity error	

Bit 23 to Bit 16:

Bits	Accelerometer STATUS bit Information	Comment
Bit 16	0=OK, 1=X-channel	Bits 0-2 will flag the overload channel(s) Bits 0-2 will flag the error channel(s)
Bit 17	0=OK, 1=Y-channel	
Bit 18	0=OK, 1=Z-channel	
Bit 19	0=OK, 1=Error in measurement-channel	
Bit 20	0=OK, 1=Overload	
Bit 21	0=OK, 1=Outside operating conditions	
Bit 22	0=OK, 1=Start-Up	
Bit 23	0=OK, 1=System integrity error	

Bit 15 to Bit 8:

Bits	Inclinometer STATUS bit Information	Comment
Bit 8	0=OK, 1=X-channel	Bits 0-2 will flag the overload channel(s) Bits 0-2 will flag the error channel(s)
Bit 9	0=OK, 1=Y-channel	
Bit 10	0=OK, 1=Z-channel	
Bit 11	0=OK, 1=Error in measurement-channel	
Bit 12	0=OK, 1=Overload	
Bit 13	0=OK, 1=Outside operating conditions	
Bit 14	0=OK, 1=Start-Up	
Bit 15	0=OK, 1=System integrity error	

Bit 7 to Bit 0: Temperature error

11. Gimbal Actuators Status : P_EMGA_STATUS

ETH_7	**Parameter-60 ID**	P_EMGA_STATUS	Gimbal Actuator health status and error	32	uint32_t	100

Pitch & Yaw Gimbal Actuator Status					
Parameter ID Designator	**Parameter ID**	**Description**	**Data Size**	**Bit no.**	**Status Description**
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	0	Relative Humidity sensor value greater than threshold "ovHumi"
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	1	Temperature sensor value greater than threshold "ovTemp"

Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	2	Emergency shutdown condition met, motor disabled
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	3	Supply voltage is greater than upper limit
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	4	Actuator position is beyond retracted limit "spMin"
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	5	Actuator position is beyond extended limit "spMax"
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	6	Actuator has run against retracted physical stop
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	7	Actuator has run against extended physical stop
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	8	Supply voltage has been below the lower limit
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	9	Supply voltage has been above the upper limit
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	10	Bridge driver fault has occurred
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	11	HARDWARE.TXT contained errors upon startup
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	12	CONFIG.TXT contained errors upon startup
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	13	Critical errors found in configuration files, motor disabled
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	14	Supply voltage is lower than lower limit
Parameter-60 ID	P_EMGA_STATUS	Pitch Gimbal Actuator health status & error	uint32_t	15	Error caused CPU warm reset
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	16	Relative Humidity sensor value greater than threshold "ovHumi"
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	17	Temperature sensor value greater than threshold "ovTemp"
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	18	Emergency shutdown condition met, motor disabled
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	19	Supply voltage is greater than upper limit
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	20	Actuator position is beyond retracted limit "spMin"
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	21	Actuator position is beyond extended limit "spMax"
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	22	Actuator has run against retracted physical stop
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	23	Actuator has run against extended physical stop
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	24	Supply voltage has been below the lower limit

Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	25	Supply voltage has been above the upper limit
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	26	Bridge driver fault has occurred
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	27	HARDWARE.TXT contained errors upon startup
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	28	CONFIG.TXT contained errors upon startup
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	29	Critical errors found in configuration files, motor disabled
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	30	Supply voltage is lower than lower limit
Parameter-60 ID	P_EMGA_STATUS	Yaw Gimbal Actuator health status & error	uint32_t	31	Error caused CPU warm reset

12. Parameters ID values allocation

13. Command List with IDs

14. EC Status

15. FC Status

16. EC Fault Status with IDs

17. FC Fault Status with IDs

18. DOCUMENTS TO BE SUBMIT LATER:

- **Parameter ID values**
- **Command ID values with description**
- **Fault IDs with description**

- Engine Computer Status IDs with description

- Flight Computer Status IDs with description

- Data Conversion Doc - Agnikul_Agnibaan_SOrTeD_Stripping_Software_Data Conversion