Request for Proposal

On

Environmental Data Measurement Unit (EDMU)
&
Data Recorder Unit (DRU)

Design, Fabrication, Realization and Testing

HUMAN SPACE FLIGHT CENTRE
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v15.0

List of Acronyms

ADC	Analog and Digital converter
EDMU	Environmental Data Measurement Unit
DRU	Data Recorder Unit
APR	As Per Requirement
BOM	Bill of Material
DIO	Digital Input Output
GUI	Graphical User Interface
H/W	Hardware
S/W	Software
TM	Telemetry

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1 Introduction

To accelerate the ongoing efforts towards human spaceflight, it is essential to acquire, process and record extensive flight data specific to human-habitable environments. The generated data and analysis would enable further improvements in design of human-compatible systems.

The acquisition, processing and recording of such environmental data is required to be configured as a standalone, autonomous system which can operate without affecting the existing flight systems.

To acquire data related to a human-habitable environment, the development of reusable, autonomous, standalone and ruggedized Data Acquisition (DAQ) and Data Recording systems is essential. The system should cater to acquisition of data from various types of environmental sensors. Moreover, to support a human spaceflight mission, it should endure all flight and post-flight environments such as lift-off, atmospheric re-entry and touchdown. Adequate interfaces shall be available to enable reconfiguration and data extraction post mission. To ensure reliability, it should implement adequate failure isolation mechanisms to inhibit propagation of failure.

In this regard, an Environmental Data Measurement Unit (EDMU) and a Data Recorder Unit (DRU) are to be developed and realized.

The **Environmental Data Measurement Unit (EDMU)** shall be a standalone, self-powered unit which can perform continuous acquisition, conditioning, processing and recording of sensor data. Features of the unit shall include high resolution and sampling rate and dynamic range to support variety of sensors. The unit shall have appropriate interfaces for configuration, data extraction and status update in lab environment as well as in flight configuration at launch pad via umbilical. The unit shall possess configurable channel programming for gain scheduling, programmable filters, and user-defined output formats. The mechanical configuration shall ensure compatibility with all mission phases to withstand vibrations, shocks, and prevent water entry after touchdown. It shall have an operational capacity of at least 6 hours.

The **Data Recorder Unit (DRU)** shall be a standalone unit with interfaces to receive, process and record telemetry from a variety of sources during flight. It shall perform user-configurable data processing, including frame identification, frame stripping, checksum calculations, etc. to extract and record raw data. Support shall be provided for standard formats such as CCSDS and IRIG. The unit shall have appropriate interfaces for configuration, data extraction and status update in lab environment as well as in flight configuration at launch pad via umbilical. The mechanical configuration shall ensure compatibility with all mission phases to withstand vibrations, shocks, and ensure waterproofing to prevent water entry after touchdown. It shall have an operational capacity of at least 6 hours.

2 Scope of Work

The scope of work of the vendor is to provide a turnkey solution for the Environmental Data Measurement Unit (EDMU) and Data Recorder Unit (DRU) that are built-to-specifications. The work definition involves the design, development, testing and qualification of the packages. The vendor shall also be responsible for fabrication, acceptance testing and delivery of flight packages and accessories. HSFC shall provide the technical specifications and operational conditions for the packages, along with guidelines for each development process.

All components, materials and consumables required for design, development and testing shall be sourced or realised by the vendor. Tools, equipment and software for design, simulation, testing and qualification shall be the responsibility of the vendor. **No Free Issue Materials (FIM) shall be provided by HSFC.**

2.1 Major Types of Activities

The realisation of the packages involves the following major types of activities:

1. **System and Interface design:** System and bus selection, component selection, harness design, interface design, enclosure requirements and design, ground interface design, etc.
2. **Circuit design and Simulation:** Circuit schematic design and simulation, PCB design and inspection, etc.
3. **PCB & Electronics Realisation and Testing:** Component sourcing & inspection, PCB fabrication & inspection, component assembly, harness fabrication, component inspection & testing, etc.
4. **Software/Firmware Realisation and Testing:** Software requirements generation, software system design, code implementation & inspection, software module simulation & testing, software integration and testing, etc.
5. **Mechanical Chassis Design and Analysis:** requirements and constraints generation, electrical & mechanical interface design, assessment of environmental & integration requirements, analysis, etc.
6. **Mechanical Chassis Fabrication, Assembly and Qualification:** Material sourcing, fabrication of components, inspection, trial assembly and testing, etc.
7. **System integration and functional testing:** assembly, integration & interfacing of electrical and mechanical components, functional testing of system, qualification testing, etc.
8. **Design Documentation and User Manual Generation:** Documentation of design, components, fabrication, testing & qualification, and user manual for hardware and software implementation, testing, data transfer, maintenance, troubleshooting, etc.

2.2 Distribution of Activities

The scope of work for vendor and HSFC for each activity is given in the table as follows:

Sl. No.	Activity	Activity Description	Scope of Work
Phase 1: Design			
1.	Requirements & Guidelines	The detailed documents for the design and qualification requirements as well as realization guidelines will be provided by ISRO post release of PO. These documents include: • System Concept/Requirement Document for Packages • Guidelines for design, fabrication, realisation • Package Qualification and Testing guidelines/requirement Document	HSFC
2.	Design Proposal	• Architecture • Interfaces • Mass, Volume, Size, Power Estimation • Software/OS/Firmware Requirements • System/Component Selection • Material Selection • Test Plan	Vendor
3.	Quality Control Plan	Implementation plan of ISRO guidelines for design, procurement, component screening, fabrication and realisation processes	Vendor
4.	Preliminary Design Review Level-1	**Generation of PDR Level-1 document**: By vendor Consisting of: • Design Proposal • System Design • Circuit Design • Software requirements and design	Vendor
		Review of PDR document and clearance for Phase 2	HSFC
Phase 2: Functional Verification (Realisation of Engineering Model)			
1.	Engineering Model Realisation	Vendor shall complete the following activities: • Electronics Design & Fabrication • Software Design & Coding • Mechanical Chassis Realisation The above activities require the following: • Component Procurement • Design generation and simulation • Fabrication & Testing	Vendor

		**No screening is required for components of engineering model*	
2.	Functional Testing of Engineering Model	• Testing of engineering model against functional requirements.	Vendor
3.	Preliminary Design Review - 2	**Generation of PDR Level-2 document**: By vendor Consisting of: • Test reports for functional testing of engineering model • Change in design/architecture/ components/software (if any)	Vendor
		Review of PDR Level-2 Document and clearance for Phase 3	HSFC
Phase 3: Qualification (Realisation of Qualification Model)			
1.	Qualification Model Realisation & Functional Testing	Realisation of Qualification Model **Screened components to be utilised*	Vendor
2.	Environmental Testing & Qualification	• Testing as per ETL levels specified by HSFC • Waterproofing tests *Testing locations and facilities determined based on mutual discussions*	Vendor
3.	Critical Design Review	**Generation of CDR document**: By vendor Consisting of: • Final design and realisation details • Details of components and processes • Test reports for qualification testing of engineering model Change in design/architecture/components/ software (if any) shall be documented.	Vendor
		Review of CDR Document and clearance for Phase 4	HSFC
Phase 4: Acceptance (Realisation of Flight Models)			
1.	Flight Model Realisation	Realisation of Flight Model as per quantity requirements, including hardware, software and accessories	Vendor
2.	Acceptance Testing	Acceptance testing for all packages as per plan provided by HSFC	Vendor
3.	Delivery & Acceptance		

In addition to the nominal flow of activities, vendor shall provide support as follows:

1. **Support for Inspection and Rework –** Provision for inspection at various levels of realization and testing shall be established. In case of non-compliance with guidelines or unsatisfactory performance of product during inspection, the vendor is required to incorporate modifications based on the suggestions/requirements of ISRO.

2. **Provision for Upgrades/Improvements –** During the development of the system, changes or improvements in the system requirements proposed by ISRO shall be accommodated by vendor.
3. **Post-Delivery Support –** Support for post-delivery additional requirements, system upgradation, repair and replacement should be given by the vendor along with a warranty of at least one year. An Annual Maintenance Contract, post warranty, shall also be quoted separately by the vendor.
4. **Pre-Flight Support –** Vendor shall provide support for assembly, integration and testing of units before flights.
5. **Generation of User Manuals** – The vendor shall prepare a User Manual for each package describing the design features, interfaces as well as the operational limits of the package. The document shall cover details of procedures/software (e.g.: channel configuration and programming, storage file structure and format, etc) required by end user to operate the package.

3 Requirements for Environmental Data Measurement Unit (EDMU)

The Environmental Data Measurement Unit (EDMU) is required for standalone acquisition, processing and recording of various environmental parameters specific to human habitability. The overall functional requirements, electrical and mechanical specifications are detailed in this chapter.

3.1 Feature Requirements

The following major features are required during operational phase:

1. Acquisition of shock, strain, vibration, acoustic, audio, video data
2. Signal conditioning, digital filtering, time-domain processing and recording of data
3. In-built power source for at least 6 hours of continuous operation
4. Ruggedization to sustain conditions during lift-off, orbital phase, re-entry, and touchdown at sea

A functional block diagram depicting the various requirements is shown below:

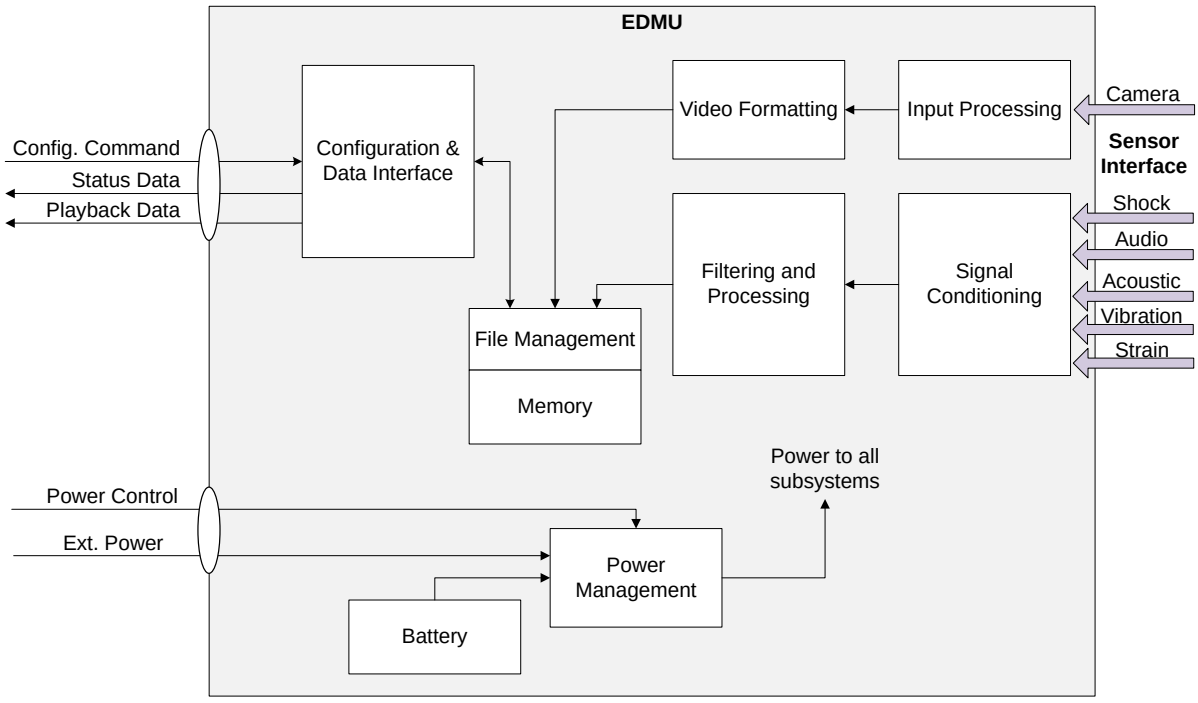

Figure 3.1: Functional Block Diagram for EDMU

In addition to the above operational features, the following auxiliary features are also required:

1. Configurability of filters, signal conditioners, processing, sampling rate, etc.
2. External power interface for charging and battery bypass operation
3. Interface for remote configuration, status monitoring and playback via cable mode

4. Re-usability of package for multiple missions with minimal ground servicing
5. Interface to user system for configuration, diagnostics and data download at high data rate

3.2 Functional Specifications

Various functional requirements including general specifications as well as specific requirements for sensors, video and audio data acquisition is detailed in this subsection.

The general functional requirements are tabulated as follows:

Table 3.1: General Specifications of EDMU

Sl. No.	Parameter	Specification
1.	Mode of acquisition	Continuous or command based
2.	Configurable Parameters	Sampling Rate, Filter Configuration
3.	Usable Memory	4 TB, expandable to 8 TB
4.	Recording & Storage Format	• File system-based storage • Auto-switchover to new file based on time/file size • User-configurable file size
5.	Logging time accuracy	1ms or better
6.	Time-stamping	Based on internal timer Provision for timer start/stop/reset via user commands

3.2.1 Sensor Data Acquisition Requirements

The sensor acquisition requirements are tabulated as follows:

Table 3.2: Sensor Acquisition Specifications of EDMU

Sl. No.	Parameter	Types of Sensors			
		Shock	Acoustics	Vibration	Strain
1.	Sensor Output Type	Charge/Voltage			
2.	No of Channels	16	8	8	32
3.	Bandwidth	1.5kHz	8kHz	2kHz	1kHz
4.	Dynamic range/ Resolution	40dB	40dB	40dB	12-bit
5.	Input Range				

3.2.2 Video Data Acquisition Requirements and Design Considerations

Video data is required to be acquired, processed and recorded for multiple locations. The video acquisition requirements are given as follows:

Table 3.3: Video Acquisition Specifications of EDMU

Sl. No.	Parameter	Specification
1.	No. of locations	Up to 4
2.	Sensor Type	CMOS
3.	Frame rate	30/60fps
4.	Resolution	4k/1080p
5.	Compression	H.264 software adjustable
6.	FOV requirement	160^{o} or better

The design considerations for video data acquisition is as follows:

- Mounting interfaces shall be designed to suit the camera configuration
- Camera assembly shall comply with the environmental requirements specified for EDMU

3.2.3 Audio Data Acquisition Requirements and Design Considerations

It is required to measure audio data at multiple locations. Additionally, various features such as high dynamic range and frequency are also desirable. The audio acquisition requirements are tabulated as follows:

Table 3.4: Audio Acquisition Specifications of EDMU

Sl. No.	Parameter	Specification
7.	No. of locations	Up to 4
8.	Dynamic Range	120 dB
9.	Frequency	20Hz to 20 kHz

The design considerations for audio data acquisition is as follows:

- Vendor shall identify suitable microphone system to meet specifications.
- The quantity and configuration of microphones shall be decided to meet specifications for each location.
- In case requirements cannot be met with single microphone per location, vendor may configure multiple microphones with different dynamic range/frequency for each location.
- Mounting interfaces shall be designed to suit the microphone configuration
- Camera assembly shall comply with the environmental requirements specified for EDMU

3.3 Ground Interface Specifications and Design Considerations

The EDMU package requires data interface for two types of operation:

1. **Interface for Remote Configuration and Monitoring**

   This operation will be utilised during launch pad conditions for configuration and status monitoring where EDMU package is assembled and integrated as per flight requirement. Communication shall ensure error control, support for long cable length, and redundancy.

2. **Interface for Offline Configuration**

   This operation will be utilised for offline configuration and data recovery in lab environments where EDMU package may be in open condition. High bitrate for data transfer, access to all configuration files and data shall be provided in this mode.

The ground interface specifications are tabulated as follows:

Table 3.5: Ground Interface Specifications for EDMU

Sl. No.	Parameter	Specification
1.	Connector Type	D-sub/Circular connector for all interfaces Compatible with all environmental requirements
Remote Configuration & Monitoring Interface Specifications		
2.	Operational Requirement	Remote Interface shall be used in flight configuration of package
3.	Length of wire/harness	Up to 200m
4.	Protocol Requirements	PHY Layer: Support for required length DL Layer: Error detection and packet rejection e.g. RS-422, IP, etc.
5.	Ground Interface	Hardware & Software for ground interface unit to be realized as per requirement
6.	Response Time	Less than 100ms
Offline Interface Specifications		
7.	Data Rate	100Mbps or better
8.	Protocol	Any commonly used standard/enterprise protocol e.g. TCP/IP, USB, etc.
9.	User Interface	GUI based software for configuration and file access

The design considerations for audio data acquisition is as follows:

1. Based on design parameters and constraints, vendor may cater to both requirements with single interface, or provide dedicated interfaces for each operation.
2. Vendor may provide additional ground interface unit hardware for interface with user systems

3.4 Power Interface Specifications

The EDMU shall be a standalone unit with internal power storage capability using batteries. The electrical power specifications of the package are tabulated as follows:

Table 3.6: Power Specifications of EDMU

Sl. No.	Parameter	Specification
1.	Type of Battery	Li-ion chemistry, rechargeable
2.	Battery Capacity during operation	At least 6 hours
3.	Battery Bypass Input Voltage Range	26-42V
4.	Package Power Control	Via Command
5.	DC-DC Converter efficiency	85% or better
6.	Battery Configuration	Replaceable battery unit
7.	Interface Connectors	D-sub/Circular connector
8.	Power Command (ON/OFF)	Signal via connector interface
9.	Camera/sensor powering	Provided from EDMU power source

3.5 Mechanical Specifications

The mechanical specifications of the package are tabulated as follows:

Table 3.7: Mechanical Specifications of EDMU

Sl. No.	Parameter	Specification
1.	Package Weight	~2.5kg
2.	Dimensions (Maximum Envelope LxBxH in mm)	160x160x50

3.6 Operational and Environmental Specifications

3.6.1 Operational Life

The realised packages shall be utilised for multiple missions. The operational life requirements are tabulated as follows.

Operational Life	5 years
Storage Life	5 years (as per environmental conditions specified in ISRO-PAS-207)

3.6.2 Radiation Tolerance

The realised qualification and flight packages shall be designed for radiation tolerance of at least 10k Rad level of radiation.

4 Requirements for Data Recorder Unit

The Data Recorder Unit (DRU) is required for standalone acquisition, processing and recording of data generated by various onboard sources of Telemetry data. The overall functional requirements, electrical and mechanical specifications are detailed in this chapter.

4.1 Feature Requirements

The following major features are required during operational phase:

1. Acquisition and recording of telemetry data in various electrical specifications and frame formats such as CCSDS, IRIG
2. Frame extraction and processing of data
3. In-built power source for at least 6 hours of continuous operation
4. Ruggedization to sustain conditions during lift-off, orbital phase, re-entry, and touchdown at sea

A functional block diagram depicting the various requirements is shown below:

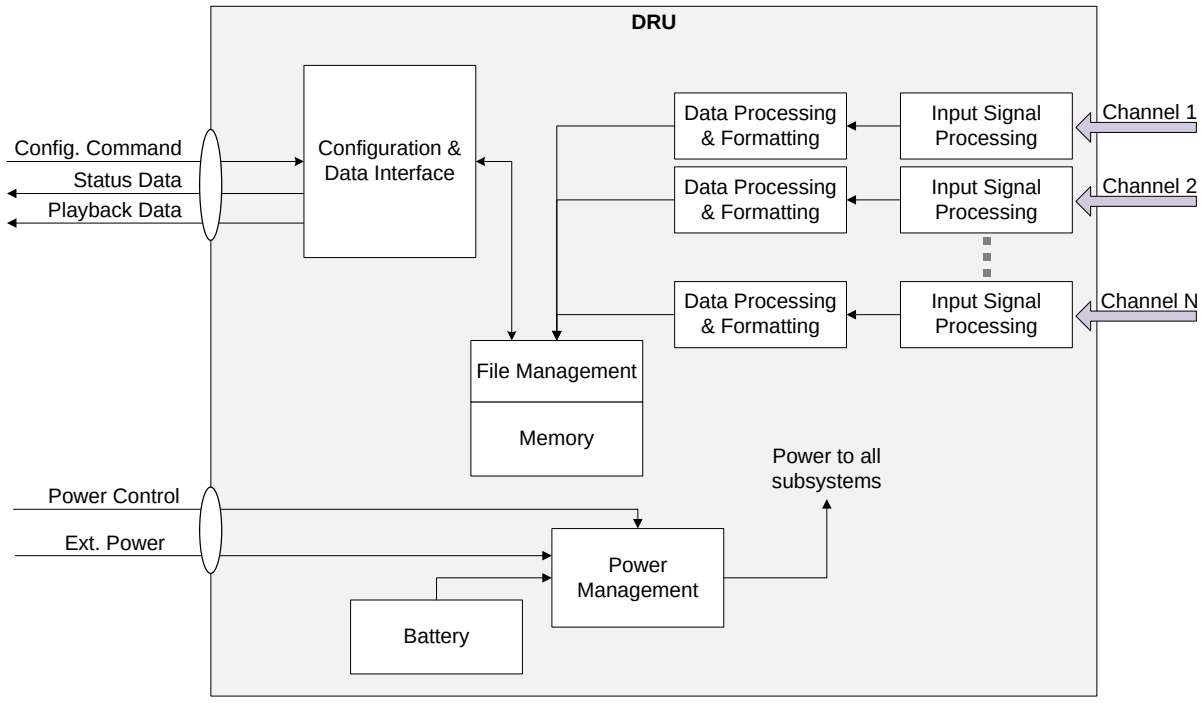

Figure 4.1: Functional Block Diagram for DRU

In addition to the above operational features, the following auxiliary features are also required:

1. Configurability of input frame format, frame extraction and processing requirements
2. External power interface for charging and battery bypass operation
3. Interface for remote configuration and status monitoring via cable mode (up to 200m)

4. Re-usability of package for multiple missions with minimal ground servicing
5. Interface to user system for configuration, diagnostics and data download at high data rate

4.2 Functional Specifications

DRU shall acquire signal in various signal specifications and extract & process data as per data format specifications. Various functional requirements including general specifications as well as specific requirements for signal acquisition and data processing is detailed in this subsection.

The general functional requirements are tabulated as follows:

Table 4.1: General Specifications of DRU

Sl. No.	Parameter	Specification
1.	Mode of acquisition	Continuous or command or event based
2.	Configurable Parameters	Sampling Rate, Filter Configuration
3.	Usable Memory	4 TB, expandable to 8 TB
4.	Recording & Storage Format	• File system-based storage • Auto-switchover to new file based on time/file size • User-configurable file size
5.	Logging time accuracy	1ms or better
6.	Time-stamping	Based on internal timer Provision for timer start/stop/reset via user commands
7.	Record Start/Stop	Data recording control based on: - Ground command - Digital pulse/level signal from flight avionics - Internal Timer
8.	No. of input channels	At least 4 independent channels for data acquisition

4.2.1 Specifications for Signal Acquisition

The specific requirements for signal acquisition are given as follows:

Table 4.2: Signal Acquisition Specifications of DRU

Sl. No.	Parameter	Specification
1.	Input Signal Specification	Support for at least differential, TTL, NRZ-L, Manchester, MIL-STD-1553B, LVDS, RS-422, RS-485 Each channel configurable independently
2.	Bitrate	Up to 10Mbps
3.	1553B	Support for Bus-A & B configuration

4.2.2 Specifications for Data Extraction & Processing

The specific requirements for data extraction & processing are given as follows:

Table 4.3: Data Extraction & Processing Specifications of DRU

Sl. No.	Parameter	Specification
4.	Data Formats	Support for at least CCSDS (Packet TM & AOS), IRIG, MIL-STD-1553B
5.	Frame Sync	Support for user-defined sync marker of variable length
6.	Frame Parameter Processing	Extraction & processing of the following parameters from user-defined word location and format: Frame Length, Frame ID, Sub-frame ID & other user data
7.	Error Detection	User-defined error detection with support for at least CRC, 2's complement checksum Support for user-defined location of error correction words
8.	1553B Requirements	Data acquisition from all/user-selected RT addresses

4.3 Ground Interface Specifications and Design Considerations

The DRU package requires data interface for two types of operation:

3. **Interface for Remote Configuration and Monitoring**

   This operation will be utilised during launch pad conditions for configuration and status monitoring where DRU package is assembled and integrated as per flight requirement. Communication shall ensure error control, support for long cable length, and redundancy.

4. **Interface for Offline Configuration**

   This operation will be utilised for offline configuration and data recovery in lab environments where DRU package may be in open condition. High bitrate for data transfer, access to all configuration files and data shall be provided in this mode.

The ground interface specifications are tabulated as follows:

Table 4.4: Ground Interface Specifications of DRU

Sl. No.	Parameter	Specification
10.	Connector Type	D-sub/circular connector for all interfaces Compatible with all environmental requirements
Remote Configuration & Monitoring Interface Specifications		
11.	Operational Requirement	Remote Interface shall be used in flight configuration of package
12.	Length of wire/harness	Up to 200m
13.	Protocol Requirements	PHY Layer: Support for required length

		DL Layer: Error detection and packet rejection e.g. RS-422, IP, etc.
14.	Ground Interface	Hardware & Software for ground interface unit to be realized as per requirement
15.	Response Time	Less than 100ms
Offline Interface Specifications		
16.	Data Rate	100Mbps or better
17.	Protocol	Any commonly used standard/enterprise protocol e.g. TCP/IP, USB, etc.
18.	User Interface	GUI based software for configuration and file access

The considerations for ground interface design is as follows:

1. Based on design parameters and constraints, vendor may cater to both requirements with single interface, or provide dedicated interfaces for each operation.
2. Vendor may provide additional ground interface unit hardware for interface with user systems

4.4 Power Interface Specifications

The DRU shall be a standalone unit with internal power storage capability using batteries. The electrical power specifications of the package are tabulated as follows:

Table 4.5: Power Specifications of DRU

Sl. No.	Parameter	Specification
1.	Type of Battery	Li-ion, rechargeable
2.	Battery Capacity during operation	At least 6 hours
3.	Battery Bypass Input Voltage Range	26-42V
4.	Package Power Control	Via Command
5.	DC-DC Converter efficiency	85% or better
6.	Battery Configuration	Replaceable battery unit
7.	Interface Connectors	D-sub/circular connectors
8.	Power Command (ON/OFF)	Signal via D-sub interface

4.5 Mechanical Specifications

The mechanical specifications of the package are tabulated as follows:

Table 4.6: Mechanical Specifications of DRU

Sl. No.	Parameter	Specification
3.	Package Weight	~0.5kg
4.	Dimensions (Maximum Envelope LxBxH in mm)	160x160x50

4.6 Operational and Environmental Specifications

4.6.1 Operational Life

The realised packages shall be utilised for multiple missions. The operational life requirements are tabulated as follows.

Operational Life	5 years
Storage Life	5 years (as per environmental conditions specified in ISRO-PAS-207)

4.6.2 Radiation Tolerance

The realised qualification and flight packages shall be designed for radiation tolerance of at least 10k Rad level of radiation.

5 Guidelines & Requirements for Realisation of Packages

The packages to be realised are required to follow the standard guidelines for the various processes such as design, component procurement, fabrication and testing. The following sub-chapters detail the various guidelines and requirements.

5.1 General Guidelines

The general guidelines are listed as follows:

1. ISRO qualified PCB fabrication and assembly process line of the vendor including fabricator & inspector shall be used for fabrication of units. Necessary certification shall be provided by the vendor.
2. HSFC may visit the vendor facility to assess their capability after receiving the quote.
3. Vendor shall have capability in terms of ISRO qualified fabrication, test and storage facilities as well as necessary technical expertise to build, optimize, test and deliver the high reliability product.
4. All guidelines and quality requirements provided by ISRO shall be applicable for any sub-contractors/sub-vendors if any.

5.2 Guideline Documents

The following documents shall be adhered to for relevant processes of realisation:

ISRO-PAS-100 Issue-3 Nov 2012	Non-conformance control requirements for ISRO projects
ISRO-PAS-201 Issue-3 Nov 2012	Failure Reporting, Analysis and corrective Action procedures
ISRO-PAS-202 Issue-2 Aug 2014	Environmental Test Specification Requirements for ISRO Space Craft.
ISRO-PAS-207	Storage, Handling and Transportation requirements for Electronic Hardware
ISRO-PAX-300 Issue-5, Nov. 2012	Workmanship Standards for the Fabrication of Electronic Packages
ISRO-PAX-301 Issue-3, April 2013	Design Requirements for Printed circuit Board Layout
ISRO-PAX-304 Issue-2, June 2014	Test Specifications and Requirements for Multilayer Printed Circuit Boards
ISRO-PAX-305 April 2002	Qualification Requirements and workmanship standards for the fabrication of Microwave Integrated Circuits
MIL-STD-202G	Test Method Standard Electronic and Electrical Component Parts
MIL-STD-461E	Requirements for the control of Electromagnet Interference Characteristics of subsystems and equipment

MIL-PRF-19500M	Performance specifications for Semi-conductor devices

5.3 Guidelines for Component Selection, Procurement & Handling

The following guidelines shall be followed for component selection and procurement:

5.3.1 Guidelines for Electronic Components

1. All components shall be selected only from Preferred Parts List provided by HSFC.
2. All components in qualification and flight packages shall be screened as per guidelines provided by ISRO.
3. Components selected shall be of MIL grade or better for qualification and flight packages.
4. Vendor shall ensure that all the parts and fabricated hardware are stored under controlled environment in a Bonded-Store till their actual use as per procedure outlined in ISRO-PAS-207.
5. Any failure observed in above components during fabrication, optimization and testing shall need to be informed to HSFC immediately with condition under which failure has been observed. If the failure of above components is more than 10% of lot, than same lot shall not be used until further clearance from HSFC.

5.3.2 Guidelines for Mechanical Components

1. The following information shall be recorded for mechanical components including fasteners, spring, plain washers, nuts etc.:
    a. Raw material identification details, relevant in-house incoming inspection & test reports.
    b. Materials batch / lot Nos. information
    c. Parts identification records
    d. Inspection reports for both bought out & in-house fabricated hardware.
    e. Process documentation like process log, applicable process documents etc.
    f. Certificate of Compliance (CoC) supplied by sub-vendor/manufacturer for bought out items.
2. Mechanical parts shall undergo dimensional measurements and visual inspection including plating / thermal painting workmanship point of view.
6. All inspection and clearance records for the materials shall be maintained by the vendor.

5.3.3 Guidelines for Materials

1. Vendor shall ensure use of ISRO approved / qualified materials. Procurement of all the mechanical and electronic fabrication materials shall be done as per ISRO Approved Materials List (DML) and specifications.

2. Materials list consisting of the name of vendor, shelf life, qualifying agency, location of application in the sub-systems shall be submitted to HSFC for approval.
3. Any other materials, which are not available in DML, shall first be qualified & cleared by HSFC prior to their use.
4. Vendor shall review compliance of Material Test Report (MTR) & CoC of the manufacturer.
5. Non-metallic materials shall have a Total Mass Loss (TML) of less than 1% and Collectable Volatile Condensable Materials (CVCM) of less than 0.1% when subjected to a test condition of +125ºC and 1x10-6 torr pressure for 24 hours.

   NOTE: If CoC contains outgassing parameters, then separate test not required. All inspection and clearance records for the materials shall be maintained by the vendor.
6. Ferrous and non-ferrous material used shall be of corrosion resistance type or suitably treated to resist corrosion caused by atmospheric conditions existent in storage or normal operational conditions. Only non-magnetic materials shall be used; except where use of magnetic materials is essential.
7. Materials, which are nutrients for fungus, shall not be used. Pure tin-plated (greater than 97% purity) items are not allowed due to inherent risk of tin-whisker growth.
8. On receipt of the material, all information inclusive of CoC, Reports and vendor's verification shall be shared with HSFC for review and final approval
9. All the materials shall be stored as per manufacturer's recommendation. These shall be mandatorily used within their shelf life.
10. Vendor shall procure / use only ISRO qualified PCBs/plated/painted parts etc. and subject these to HSFC acceptance plan prior to FM hardware realization.
11. Witness samples shall be prepared for all fabricated batches/lots of Bare PCBs / Plated / Painted mechanical parts. Batch Acceptance testing shall be carried out by HSFC-QA approved test plans. Only items from accepted batches will be cleared for use in FM fabrication. QC shall visually examine the actual parts/components at 100% basis and the same shall be cleared based on acceptance/test results of witness sample.
12. Any non-conformances observed on these samples shall be a cause for rejection of fabricated batch/lot and a final disposition shall be taken after discussion with HSFC.

5.4 Guidelines for Design and Realisation Processes

5.4.1 Guidelines for Electronics Design

The following guidelines shall be followed for Electronics Design:

1. All design activities shall be completed as per ISRO guidelines provided by HSFC.
2. All designs generated by the vendor shall be reviewed and cleared by HSFC before commencing fabrication activities.

3. The electrical operating conditions of active devices shall be selected such that junction/ channel temperatures of all solid-state devices shall not exceed +110ºC under nominal operating and worst-case environmental conditions.

5.4.2 Guidelines for Software/Firmware Realisation

The following guidelines shall be followed for Software/Firmware realisation:

1. All processes for software requirements generation, design, implementation, testing and qualification shall be as per Software Process guidelines provided by HSFC.
2. Software implementation (coding) shall adhere to guidelines prescribed in DO-178B.
3. All designs and implementation including architecture, code, etc. shall be reviewed by HSFC before further process.

5.4.3 Guidelines for Chassis Design

The following guidelines are to be followed:

1. The package chassis shall be designed using anodised aluminium alloy.
2. The stiffness of the package shall be at least 120Hz.

5.4.4 Guidelines for Processes

1. Fabrication, inspection and testing activities for electronic systems shall be completed as per ISRO guidelines ISRO-PAX-300/305/206, whichever applicable.
2. All electronic fabrication processes to be used for FM hardware realization shall be ISRO qualified. Similarly, the processes used for surface treatment of the box like plating and coating in realizing the hardware shall also be ISRO qualified. All the processes shall be carried out in accordance with PIDs reviewed by ISRO.
3. Vendor is required to provide a list of processes to be used to realize the hardware along with their qualification status, at the time of bid.
4. Process qualification should have a validity throughout the contract period. In case of expiry of certification within contract tenure, vendor shall get him re-certified without proceeding for further work.
5. The vendor shall provide the list of activities carried out by their sub-contractors (if any) along with the qualification status of the processes concerned, with intimation to HSFC for all such cases prior to sub-contracting.
6. Fabrication work shall be carried out certified operators with experience of previous projects with ISRO.
7. Online QC shall be ensured by the vendor for all fabrication activities with detailed logs for all activities.

5.4.5 Guidelines for Process Documentation

1. Vendor shall prepare Product Realization Document (PRD), identifying all the activities, methods / procedures & inspection check points that will be followed for realization of the units. All the activities involved for realization of FM like units shall be addressed in this document. The PRD shall be submitted to HSFC for approval.
2. Vendor shall prepare Process Identification Document (PID) including detailed manufacturing process flow chart indicating critical process parameters, inspection checks points, instruments used in manufacturing these components including parameter setting etc. for all stages of fabrication, assembly and testing. Only PIDs approved by HSFC shall be followed for FM hardware realisation.
3. Before start of wiring and assembly activity, a generalized fabrication sequence/ flowchart detailing each step of fabrication, functional verification stages, QC and QA inspection/audit etc. shall be prepared by the vendor in consultation with HSFC and to be submitted HSFC for approval. HSFC approved fabrication sequence shall only be implemented. The fabrication/assembly flowchart shall include the following minimum:
    a. Flow of fabrication activities
    b. Approved drawing nos.
    c. Name of processes and PID numbers, as applicable.
    d. Intermediate functional verification / electrical testing
    e. Specific instruction for Storage & Handling, if any
    f. Permanent/Temporary torque values.
    g. Fabrication alerts / Specific instructions, caution notes etc., if any.
    h. Potting/ Dam-fill requirement for components.
    i. Any environmental test which is a part of fabrication process or for electrical performance check and selection of TBD component values.
    j. Marking & Identification of unit.
    k. QA-HSFC audit stages
4. For traceability of fabrication/assembly/testing activities, Vendor shall maintain, a fabrication history sheets for each unit, where-in all the fabrication activities and QC inspection comments are logged. This shall include any non-conformance reported by QC and its close-out, if any.

5.4.6 Guidelines for Quality Control and Audit

1. Vendor's in-house Quality Control (QC) shall carry out 100% inspection of all the fabricated / processed units as well as on-line inspection during the electronic & mechanical fabrication activity as per HSFC approved fabrication sequence / PIDs.
2. QC inspection work shall be carried out by ISRO certified inspectors.

3. All fabrication and inspection records / history sheets, as per approved fabrication sequence / PIDs / guidelines etc., shall be generated and maintained by the vendor QC.
4. Any non-conformances observed at any stage of fabrication shall be recorded and disposed-off through the vendor's NCR board with HSFC consultation.
5. The QA audit shall be carried by HSFC from both electronic & mechanical point of view for vendor along with qualified subcontractors also.
6. The frequency for QA audit shall be decided by HSFC and intimated to the Vendor. Audit by HSFC shall be carried out on QC accepted hardware.
7. Audit by HSFC shall cover Electronic & Mechanical aspects for the following,
    a. Patterned MIC Substrate / PFT / Bare PCB, as applicable
    b. Machined package/ cover etc.
    c. Surface finishing (plating / painting)
    d. Wired Substrate / PCB
    e. Packaging & fixing of cards/ substrates/ connectors & internal harness
    f. Audit for integrated package level.
    g. Test setup and unit level testing.
8. HSFC shall audit/ inspect all related facilities, activities which the vendor will carryout to realize the hardware. Fabrication processes, cleanliness records, QC inspected hardware, process log books/history records, overall documentation, parts & material evaluation/test reports, facilities, procedures followed etc. shall be followed as per ISRO guidelines.
9. The audit report will be generated by HSFC. The Vendor shall generate close outs on the discrepancies observed during audit by taking appropriate corrective actions and submit the same to HSFC for review and acceptance.
10. The disposition on the non-conformances on actual hardware, if any, which cannot be closed by the auditee, shall be closed through vendor's NCRB, with approval from HSFC, after reviewing the impact of the non-conformance on reliability of the non-conformed hardware for intended use.
11. The corrective actions implemented by the vendor shall be documented after necessary review and approval by HSFC.
12. Based on the compliance to ISRO guidelines and closeouts for audit observations by the vendor, stage wise clearance shall be given by HSFC.
13. Real-time On-line Audit / Virtual Audit: Based on confidence level build-up on fabricated hardware, HSFC may opt for on-line audit of hardware, provided vendor facility, process line, their quality system, etc. found satisfactory. Vendor shall have the required resources / infrastructure for Real-time On-line Audit, as per HSFC-QA requirements.

5.4.7 Guidelines for Marking and Identification

1. The units shall be identified by assigning unique serial number (may be assigned by HSFC) on the exterior surface of both package & cover by a suitable process applicable for space use.
2. Marking shall not degrade the performance and quality of the unit.
3. In addition to functional markings like input / output, frequency etc. following marking shall appear on each unit.

HSFC Logo	ISRO Logo
Unit Name	Unit Number
Specification Number / Contract Number	Serial Number
Name of the Manufacturer	Date of Manufacture

4. The permanency of the marking shall be sufficient to withstand the specified environmental conditions and normal cleaning operations using Isopropyl Alcohol and other cleaning solvents.
5. The marking method to demonstrate the same shall be specified by the manufacturer.

5.4.8 Guidelines for Storage and Transportation

1. Storage of fabricated hardware, parts & materials shall be done as per ISRO-PAS-207.
2. Active & Passive Component shall be stored in controlled environment under Class 100,000 clean room with round-the-clock controlled temperature (22±3ºC) & humidity (45 to 55% RH).
3. Parts shall be stored in such manner as to prevent damage due to undue stresses.
4. ESD protection care shall be taken while receiving & issue of components.
5. Manufacturer instruction for storage & handling of parts shall strictly be followed during the storage.
6. Dry N2 (Nitrogen) purged packaging and storage cabinets shall be used for storage of critical components and oxygen sensitive items like PCBs / mechanical hardware.
7. Transport container shall be hermetic with damping material inside for the transportation of the unit by air or road without any degradation / damage.
8. Each unit shall be packaged in individual ESD protective packaging along with appropriate transportation container for protection from heat, humidity, dust, mechanical shock & vibrations during transportation.
9. The individual unit packages and transportation containers shall be clearly marked with following instructions along with other mandatory markings.
    a. “ESD sensitive units”
    b. “To be opened only under clean environment with ESD precautions”

c. “High reliability systems”

5.5 Requirements for Qualification and Acceptance Testing

5.5.1 General Guidelines for Testing and Acceptance

1. All the specification requirements of this RFP shall be verified by testing.
2. Vendor is required to generate test procedure & plan, clearly showing test set-up and connection details including groundings. This test procedure shall be sent to HSFC for review & clearance.
3. Testing shall be done as per HSFC approved test procedure using calibrated test & measuring instruments.
4. The measurement accuracy, calibration, etc. of the test instruments shall be verified and the factors shall be stated in the test plan and procedures document submitted by the vendor.
5. Deviation from the agreed system specifications shall be treated as non-compliance, and may be a cause to reject the units.
6. Any failure observed at any stage shall be reported to HSFC immediately. This shall be followed by detailed failure analysis by Vendor, clearly identifying the cause of failure as random or design related.
7. Any modifications required in electrical, mechanical or process related aspects shall be approved by HSFC.
8. In case of mechanical or electrical design related failures; a retest plan or modification in the test plan may be necessary. Based on the failure analysis, such retest plan / modified test plan shall be decided and implemented after approval by HSFC. This may include re-qualification of process or the unit.

5.5.2 Environmental Tests

The various environmental tests are tabulated as follows:

Table 5.1: Details of Environmental Tests

Test Set A: Environmental Tests
Test 1: Humidity Test
Objective: To assess the resistance of the package to high humidity conditions and variation in temperature cycle associated with humid conditions. **Applicability:** Qualification Model **Test Cycle:** The temperature of the chamber shall be raised to the upper temperature limit of 50°C +/-39°C in a period of 2 +/-0.5 hours and a relative humidity of not less than 95%RH. These

conditions of temperature and humidity shall be maintained for further 6 ± 0.5 hours. During the remaining period to complete 24 hours cycle (i.e. over a nominal 16 hour period) the temperature shall be decreased gradually to 38°C or lower. The humidity shall be maintained as high as possible but shall not fall below 65%RH. The package shall be checked by having the normal power immediately on removal from the chamber. This shall be repeated for two cycles.

Package Tests:

Before and after humidity soak, isolation rests are to be done. Acceptance criteria is >100MΩ. Immediately after insulation test, power the package and conduct health check. All parameters are to be within specification.

Test 2: Operational Hot Soak

Objective: To ensure the performance of the package at ambient temperature for continuous duration.

Applicability: Qualification Model & Flight Model

Test Procedure: Keep the package in an oven whose temperature is set at T°C ± 1°C. The package is to be kept in the chamber for A hours without switching on. After this, switch on the package and keep in on condition for another B hours. After this do all the necessary test as specified in the test matrix.

	QM	FM
T	40°C	40°C
A	2	2
B	3	3

Test 3: Hot Soak

Objective: To confirm all specifications of the package holds good in the maximum temperature specified.

Applicability: Qualification Model & Flight Model

Test Procedure:

Same procedure as Operational Hot Soak with following parameters

	QM	FM
T	70°C	60°C
A	5	2
B	0.5	0.5

Test 4: Cold Soak

Objective: To confirm all specifications of the package holds good in the minimum temperature specified.

Applicability: Qualification Model & Flight Model

Test Procedure:

Same procedure as Operational Hot Soak with following parameters

	QM	FM
T	8°C	13°C

	A	5	2	
	B	0.5	0.5	

Test 5: Water-proofing Test

Requirement: IP68 rating

Water-proofness is to be ensured by providing fluoro-silicone 'O' rings or sealing compounds.

Test Procedure: Water proofness shall be established by testing as per IS 8252, part VI, Grade A.

5.5.3 Vibration and Shock Tests

The various Vibration and Shock tests are tabulated as follows:

Table 5.2: Details of Vibration and Shock Tests

Test Set B: Vibration and Shock Tests

Test 1: Vibration Sine

Objective: To ensure the capabilities of packages under periodic transient excitation caused by instabilities and transients during mission operations.

Applicability: Qualification Model

Test Procedure:

The package is to be mounted on a vibration fixture with the mounting plate, specified torque levels have to be given to the mounting screws while mounting the plate and the package.

Test level

Longitudinal		**Lateral**		**Sweep Rate**	**Axis**
Frequency	**Level**	**Frequency**	**Level**		
10-16 Hz	20mm DA	10-16 Hz	20mmDA	20 Octave/minute	All three axes
16-100Hz	10g	16-100Hz	6g		

During vibration carried out the tests as given in the test matrix. Physically check the package for any sound of loose parts and visually check for any cracks, bends etc.

Test 2: Vibration Random

Objective: To confirm the performance of the package under random vibration environment.

Applicability: Qualification Model

Test Procedure:

The package is to be mounted on a vibration fixture with the mounting plate, specified torque levels have to be given to the mounting screws while mounting the plate and the package.

Frequency (Hz)	**PSD(g^2/Hz)**		**G_{rms} Level**		**Duration**		**Axis**
	QM	**FM**	**QM**	**FM**	**QM**	**FM**	
20	0.002	0.001	13.5	9	120	60	All three axes
60	0.002	0.001					
250	0.138	0.062					
1000	0.138	0.062					
2000	0.034	0.015					

During vibration carried out the tests as given in the test matrix. Physically check the package for any sound of loose parts and visually check for any cracks, bends etc.
Test 3: Shock Test
Objective: To verify the resistance of the package to mechanical shocks by applying simple reproducible impulsive accelerations. **Applicability:** Qualification Model **Test Procedure** This test has to be done for QM only using drop shock tester or simulating the shock in the vibration shaker system. **Test level** Amplitude : 50g Duration : 10ms Shape : Half sine pulse No of shocks : 6 Shocks (One/axis/direction)

5.5.4 EMI Tests

The various EMI tests are tabulated as follows:

Table 5.3: Details of EMI Tests

Test Set C: EMI Tests
All tests shall be as per specifications in MIL-STD-462C with details as follows:
Test 1: Conducted Susceptibility CS01
Objective: The purpose of test is to measure equipment or sub-system susceptibility to CW emission in the frequency ranges 30Hz-50Hz on power lines feeding all DC, power leads connected externally to the package. **Applicability:** Qualification Model **Test Procedure:** As per test CS01 of standard **Acceptance Criteria:** All test results shall be within specifications
Test 2: Conducted Susceptibility CS02
Objective: The purpose of this test is to measure subsystem susceptibility to CW emission on power lines including all ungrounded DC power leads connected externally to the package. **Applicability:** Qualification Model **Test Procedure:** As per test CS02 of standard **Acceptance Criteria:** All test results shall be within specifications
Test 3: Conducted Susceptibility CS06
Applicability: Qualification Model & Flight Model **Precautions:** No spike should be applied without powering the package. **Test Procedure:** As per test CS06 of standard **Acceptance Criteria:** All test results shall be within specifications

Test 4: Radiated Susceptibility – Magnetic Induction Field RS02

Objective: To determine if the package is susceptible to magnetic fields generated by the flow of Current in the nearby lines

Applicability: Qualification Model

Test Procedure: As per test RS02 of standard

Acceptance Criteria: All test results shall be within specifications

Test 5: Radiated Susceptibility RS03

Objective: To determine whether the package does not exhibit deviation or malfunctions in the presence of electric field of specified intensity.

Applicability: Qualification Model & Flight Model

Precautions: No spike should be applied without powering the package.

Test Procedure: As per test RS03 of standard

Acceptance Criteria: All test results shall be within specifications

For QM Package:

1. 20MHz-10GHz:

(At spot Freq. 30MHz, 50MHz, 80MHz, 100MHz, 150MHz, 240MHz.434MHz, 543MHz, 4GHz, 7GHz. & 10GHz)

Field Intensity (Volts/metre): 5V/m

2. S-Band and any on-board transmitting frequency

(At spot Freq. of 60MHz, 434MHz, 2211 MHz, 2237.5MHz, 2259MHz & 5.6GHz)

Field Intensity (Volts/meter): 20V/m

For FM Package

S-Band and any on-board transmitting frequency

(At Spot Freq. of 434MHz, 2211 MHz, 2237.5MHz, 2259MHz & 5.6GHz)

Field Intensity (Volts/ meter): 20V/m

Test 6: Conducted Emission – CE01

Objective: to measure the conducted emission on DC input power leads of the package which connect externally or interface with other equipment not part of the package.

Applicability: Qualification Model

Test Procedure: As per test CE01 of standard

Acceptance Criteria: All test results shall be within specifications

Test 7: Conducted Emission – CE03

Objective: to measure the conducted emission on DC input power leads of the package which connect externally or interface with other equipment not part of the package.

Applicability: Qualification Model

Test Procedure: As per test CE03 of standard

Acceptance Criteria: All test results shall be within specifications

Test 8: Radiated Emission – RE

Objective: to confirm that fields existing from test package including their wires and cables are equal to, or below acceptable specification limits.

Applicability: Qualification Model

Test Procedure: As per test RE of standard

Acceptance Criteria: All test results shall be within specifications

6 Terms for Project Activities

6.1 Flow of Activities

The flow of activities for realisation of packages are shown in the figure below:

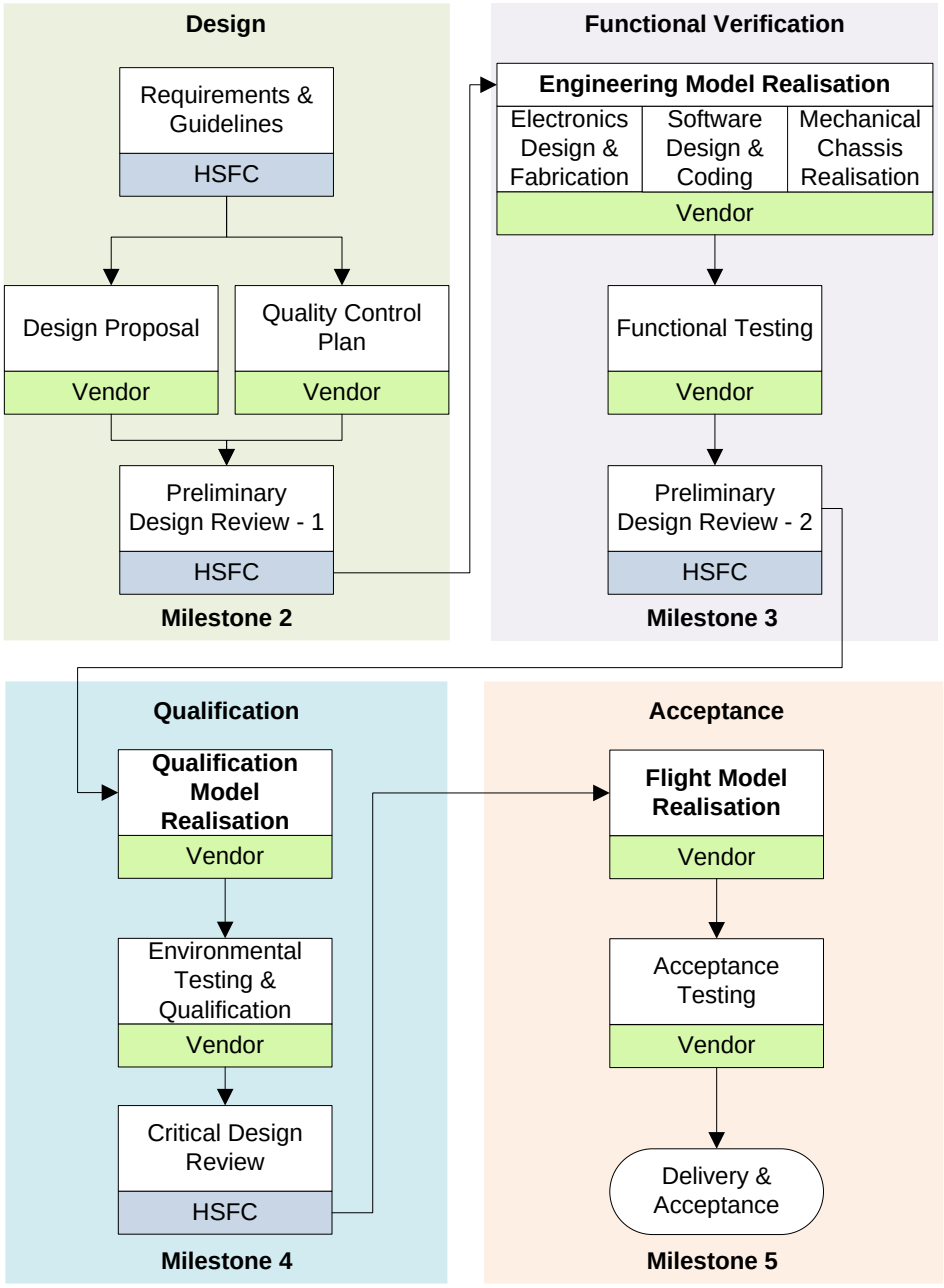

Figure 6.1: Flow of Activities for Realisation of EDMU and DRU

6.2 Project Milestones

With respect to the project realisation, the following milestones are required for compliance by the vendor:

Table 6.1 Project Milestones

Milestone No.	Milestone	Milestone Description
Milestone 1	Release of PO	~~~
Milestone 2	Preliminary Design Review Level-1	**Review & clearance of PDR Level-1 Document** including: 1. System Architecture & Interfaces Design 2. Mass, Volume, Size, Power Estimation 3. Electronic Circuit Design 4. Software/OS/Firmware Requirements 5. System/Component/Material Selection 6. Test Plan
Milestone 3	Preliminary Design Review Level-2	**A. Realisation & Delivery of Engineering Model** **B. Completion of Functional Testing** **C. Review & clearance of PDR Level-2 Document** including: 1. Details of design and implementation of engineering model 2. Test reports for functional testing of engineering model 3. Change in design/architecture/ components/software (if any) from proposed design
Milestone 4	Critical Design Review	**A. Realisation & Delivery of Qualification Model** **B. Completion of Qualification Testing** **C. Review & clearance of CDR Document** including: 1. Details of design and implementation of qualification model 2. Details of components and processes utilised 3. Test reports for qualification testing 4. Change in design/architecture/ components/software (if any) from engineering model
Milestone 5a	Flight Model Delivery & Acceptance *Part A*	**A. Delivery of Flight Hardware: One set** of hardware, software, ground interface units and other accessories **B. Review and clearance of Acceptance Tests**
Milestone 5b	Flight Model Delivery & Acceptance *Part B*	**A. Delivery of Flight Hardware:** Remaining sets of hardware, software, ground interface units and other accessories **B. Review and clearance of Acceptance Tests**

6.3 Deliverables

The vendor shall provide the following as deliverables:

Table 6.2: List of Deliverables

Sl. No.	Category	Deliverables
1.	EDMU Realisation, Testing and Qualification	a. 1 Engineering Model b. 1 Qualification model
2.	EDMU Flight Deliverables	a. 4 Flight Models b. 4 spare batteries c. Flight software and firmware d. Ground Interface Units & Software
3.	DRU Realisation, Testing and Qualification	a. 1 Engineering Model b. 1 Qualification model
4.	DRU Flight Deliverables	a. 4 Flight Models b. 4 spare batteries c. Flight software and firmware d. Ground Interface Units & Software
5.	Documentation	a. Preliminary Design Plan b. Quality Control Plan c. Fabrication & Realisation Plan d. Test and Qualification Plan e. Test and Qualification Report f. System Design Document g. User Reference Manual

6.4 Payment Schedule

HSFC shall release the following Milestone payment:

Payment 1

1. **Milestones to be completed:**
   a. Milestone 1: Release of PO
   b. Milestone 2: Completion of Preliminary Design Review Level-1
2. **Payment:** 10% of the total cost of EDMU and DRU shall be released within 30 days on pro-rata basis
3. **Payment to be released against submission of the following documents:**
   a. Tax Invoice.

b. After successful submission of Design Document of EDMU and DRU and Completion of PDR Level-I clearance by HSFC backed by a certificate issued by User Division and duly approved by Competent Authority.

c. Submission of Equivalent Bank Guarantee. BG will be returned after completion of 2nd Milestone Activity.

Payment 2

1. **Milestones to be completed:**
   a. Milestone 3: Completion of Preliminary Design Review Level-2
   b. Milestone 4: Completion of Critical Design Review
2. **Payment:** 20% of the total cost of EDMU and DRU shall be released within 30 days on pro-rata basis
3. **Payment to be released against submission of the following documents:**
   a. Tax invoice.
   b. Realization of Engineering Model of EDMU and DRU, completion of Engineering Testing, Review and clearance of PDR Level-2 Document and delivery of engineering model of EDMU and DRU.
   c. Realization of Qualification Model of EDMU and DRU, completion of qualification Testing, Review and clearance of CDR Document and delivery of Qualification Model of EDMU and DRU.
   d. An MIRV for acceptance of Engineering Model and Qualification Model of EDMU and DRU.

Payment 3

1. **Milestones to be completed:**
   a. Milestone 5a: Flight Model Delivery & Acceptance Part A
2. **Payment:** 20% of the total cost of EDMU and DRU shall be released within 30 days on pro-rata basis
3. **Payment to be released against submission of the following documents:**
   a. Tax invoice.
   b. Realization of One Set of Flight Models of EDMU and DRU, including hardware software, ground interface units and accessories, and completion of Acceptance Testing.
   c. An MIRV for acceptance of One Set of Flight Model including hardware software, ground interface units and accessories of EDMU and DRU.

Payment 4

1. **Milestones to be completed:**
   a. Milestone 5b: Flight Model Delivery & Acceptance Part B
2. **Payment:** Balance 50% Total Cost of EDMU & DRU +100% tax shall be released within 30 days on pro-rata basis
3. **Payment to be released against submission of the following documents:**
   a. Tax invoice.

b. Realization of Remaining Set of Flight Models of EDMU and DRU, including hardware software, ground interface units and accessories, and completion of Acceptance Testing.

c. An MIRV for acceptance of Remaining Set of Flight Model including hardware software, ground interface units and accessories of EDMU and DRU.

6.5 Delivery Schedule

Table 6.3. Delivery Schedule Format

Milestone No.	Milestone Description	Delivery Schedule
Milestone 1	Release of PO	T_0
Milestone 2	Review and Clearance of PDR Level-1	$T_1 = T_0 + 6$ months
Milestone 3	Review and Clearance of PDR Level-2	
Milestone 4	Review and Clearance of CDR	
Milestone 5a	Delivery of one set of flight hardware, software, ground interface units and other accessories	
Milestone 5b	Delivery of remaining sets of flight hardware, software, ground interface units and other accessories	$T_2 = T_1 + 6$ months

6.6 Reviews

- The **Preliminary Design Review Level-1** submitted by vendor shall be cleared and reviewed by HSFC. Vendor is required to submit the **Preliminary Design Review Document Level-1.**
- Based on approved designs, vendor shall generate the **Fabrication and Realisation Plan** for review by HSFC.
- A **Quality Control Plan** shall be generated by the vendor in consultation with HSFC, which shall contain the guidelines and checklists for quality control during all realisation activities. This shall be reviewed by HSFC.
- The **System Test and Qualification Plan** as well as the corresponding **Test and Evaluation Report** shall be submitted to HSFC for review and clearance.
- The **Preliminary Design Review Level-2** submitted by vendor shall be cleared and reviewed by HSFC. Vendor is required to submit the **Preliminary Design Review Document Level-2.**
- The finalised design shall be submitted by vendor for **Critical Design Review** by HSFC. The

design and realisation aspects of the Qualification Model shall be highlighted in the **Critical Design Review Document**.

- The vendor shall submit **the qualification model** for each package to HSFC for inspection and clearance. Post review, clearance will be provided for delivery of all items.
- The test reports of **component level testing and evaluation** shall be submitted for review by HSFC.
- The **test reports for software testing** shall be submitted for review by HSFC.

6.7 Warranty and Repair & Maintenance Contract

- The vendor shall offer **Post-Delivery Support** for post-delivery improvements, repair and replacement, which includes comprehensive warranty and comprehensive Repair & Maintenance Contract. This Support is applicable for all deliverables. The period of comprehensive warranty shall be of **one year**, and shall start from the date of delivery of complete system as per PO.
- The **Comprehensive Repair & Maintenance Contract** shall include pre-flight and post-flight servicing of the flight packages based on prior notice given by HSFC. Servicing shall include maintenance of mechanical components, waterproofing, testing and diagnostics.
- The **Comprehensive Repair & Maintenance Contract** shall be for **three years (quarterly basis)**, and shall commence after completion of warranty period.
- Payment for the **Comprehensive Repair & Maintenance Contract** shall be done on quarterly basis after approval of competent authority.

6.8 Delivery Terms and Acceptance Criteria

The following are delivery terms and acceptance criteria for the deliverables:

1. **For Clearance for Delivery** to HSFC, vendor is required to provide Test Reports for functionality tests performed at vendor's site of all equipment mentioned in deliverables.
2. Post clearance for delivery, vendor is required to deliver all items to HSFC.
3. Post-inspection and testing of items will be carried out by HSFC for **acceptance** of the items.

6.9 Ownership and Non-Reusability

Ownership: The ownership of hardware and software including all designs, documents, and information shall remain with ISRO.

Non-Reusability Agreement: The vendor shall not copy, reproduce, distribute, publish, display, perform, modify, create derivative works, transmit, or in any way exploit the designs/documents/information of the system, nor shall they distribute any part of this content over any network, including a local area network, sell or offer it for sale, or use such content to

construct any kind of database. Copying or storing any content of the system is expressly prohibited for the vendor without prior written permission of ISRO.

7 Instructions for Tender and Bidding

7.1 Quotation Procedure

1. The party shall submit their quotations in two-part bid format:
   a. Technical & Commercial Bid: The technical details and the commercial terms and conditions shall be provided as part of the bid. **The party shall not reveal any price details** as part of Technical & Commercial bid which will lead to automatic disqualification of the party.
   b. Price Bid: The price details quoted by the party shall be included in the price bid in the provided bid quotation format.
2. A pre-bid meeting shall be held to discuss the technical requirements and details of the system with the interested parties. Quotations received from parties who did not participate in the Pre-bid meeting shall be considered invalid.
3. The party shall submit quotation for the entire scope of work defined in this RFP. **Incomplete quotations will be summarily rejected.** Deviation(s), if any, in the bidder's proposal with respect to this document shall be explicitly mentioned in a schedule of deviations to be provided in the bid. If the bidder does not mention any deviation, it shall be construed by the Department that the bidder agrees to comply with each and every aspect of this document.

7.2 Pre-Tender Discussions / Clarifications

1. A pre-bid meeting will be held with interested parties to discuss the technical requirements & details of the system and to provide clarifications.
2. Only parties who have participated in the pre-bid meeting will be qualified for submitting quotations.
3. The pre-bid meeting shall be conducted within 10 days of tender release.
4. Vendor who have participated in the pre-bid meeting can seek clarifications regarding the project within 15 days from the pre-bid meeting.
5. **Offers from parties who have not attended pre-bid meeting will be summarily rejected.**

7.3 Details to be submitted in Technical & Commercial Bid

The technical and commercial bid should contain details of the party and how the party proposes to realise the system.

7.3.1 Company Profile

1. A total company profile may be submitted for ISRO to assess the capabilities of the company.
2. Details on the management, product line, annual turnover, past experience in realizing similar systems and the list of clients, especially for aerospace industry should be highlighted.
3. The technical offer should contain a plan of action on how the company proposes to realise the system.
4. All components should be from standard, reputed manufacturers.
5. The strengths of the company in realizing similar systems shall be given in detail.
6. Facilities, equipment and manpower details relevant to the project shall be provided including adequate training and certification details.

7.3.2 Execution Plan

1. The party shall provide execution plan for detailed engineering, procurement, inspection, shop fabrication, supply, site fabrication, installation and commissioning with the quotation. Details of infrastructural facilities available with the party for carrying out the activities shall be brought out.
2. The list of vendors from whom the bidder proposes to source Procured Components as given in deliverables shall be given. Any change from the submitted list shall be with the written consent from the Department. The Department will have the right to scrutinize and to agree/ disagree with the vendors proposed by the party.
3. The list of sub-contractors with whom the bidder proposes to sub-delegate part of the work shall be provided. Any change from the submitted list shall be with the written consent from the Department. The bidder shall highlight the works proposed to be done in their own factory and the works proposed to be done by their sub-contractors. The Department will have the right to scrutinize and to agree/ disagree with the sub-contractors proposed by the party.
4. The Department will have the right to scrutinize and to agree/ disagree with the sub-vendors/ sub-contractors proposed by the bidder. The party has to make a technical presentation of this proposal at HSFC Bangalore for evaluation and short-listing by HSFC (if required)

NOTE: The bidders shall provide proof of similar contract successfully executed across ISRO or any other companies.

7.4 Vendor Eligibility Criteria

1. Vendor must be Indian industry having experience of development, qualification and delivery of aerospace-qualified data acquisition systems, processor systems, including electronic design, chassis design, fabrication and qualification. Vendor to provide adequate details of past completed and ongoing projects to support the claim. The projects shall be with aerospace organisation, preferably ISRO/DoS.
2. Vendor should have necessary technical expertise to build, optimise, test and deliver the high-reliability product and shall have sufficient test engineers having technical experience in the field of instrumentation, digital systems, PCB design, testing & optimization. Details of current design and testing team to be provided.
3. The vendor should have a proven record of accomplishment and expertise in precision mechanical design, fabrication& testing, particularly in chassis design, simulation, structural analysis, waterproofing, etc.
4. **In case vendor is not having previous heritage of developing and delivering aerospace-qualified similar hardware meeting all above requirements, the bid is liable to rejection.**
5. At the time of bid, vendor must have own line / facility certified as per ISRO-PAX-300 for electronic fabrication (PCB wiring & assembly along with certified manpower), storage and testing. Vendor shall provide the documentary proof for certified facility as well as manpower (fabricator & inspectors) along with the bid.
6. The vendor should have ISRO approved supply chain for sourcing bare PCBs, as per ISRO-PAX 304, to realise the required hardware. Additionally, they should have appropriate storage facilities as per the above standards to ensure the material's integrity and prevent contamination or damage.
7. Process qualification should be valid throughout the contract period. In case of expiry of certification within contract tenure, it will be vendor's responsibility to be re-certified without proceeding for further work.
8. In case any new or delta qualification is required during the tenure of contract, the same shall be executed by vendor as per approved qualification plan.
9. The vendor shall provide the list of activities carried out by their sub-contractors (if any) along with the qualification status of the processes concerned, with intimation to HSFC for all such cases prior to subcontracting.
10. If need may arise, HSFC may visit the vendor's premises for verification of information related to Purchase Orders/space/ manpower etc. and other infrastructure, facilities & equipment.
11. The bid of vendor, who is not able to substantiate/provide sufficient proof of the technical requirements laid down in this RFP, is liable to be rejected.
12. The vendor shall provide the list of activities carried out by their sub-contractors (if any) along with the qualification status of the processes involved. Vendor will have to provide

appropriate proofs indicating readiness of sub-contractor to execute the work as per guidelines in this document.

13. The vendor's must maintain their infrastructure facility, including clean rooms, fabrication tools, ESD (Electrostatic Discharge) aids, machinery, and equipment. HSFC may audit this periodically.
14. Vendor shall provide list of available instruments required to execute the proposed realisation plan along with bid. (HSFC will subject this to physical verification if deemed necessary during evaluation of technical bids.) The equipment shall be appropriately calibrated and testing by authorised agencies.

7.5 Bid Evaluation Matrix (To be filled by vendor)

Table 7.1 : Bid Evaluation Matrix

Sl no	Evaluation Criteria	Party response (*)
1	Design and development of package (capability and capacity to design and realize the system)	Core competence and previous experience in similar system to be provided.
2	Realization	Fabrication facility details to be provided
3	Test facility	Details to be provided for subsystem testing.
4	Execution of similar project (financial capability)	Past experience in similar project
5	Documentation as per HSFC requirement (compliance to be indicated)	Yes/No
6	ISRO qualified processes as per ISRO-PAX	Yes/No
7	Clarity on scope of work	Yes/No
8	Clarity on the Component and material requirements	Yes/No
9	Inspection to be offered to HSFC	Yes/No
10	HSFC Audit provisions	Yes/No
11	Availability controlled environment storage area (bonded store)	Yes/No
12	Compliance to RFP Technical requirements, R&QA requirements and other Terms & Conditions.	Yes/No
13	Compliance to delivery schedule	Yes/No
14	Point to Point Compliance to purchase commercial terms and conditions	Yes/No
15	Warranty	To be included in costs (Price Bid)
16	AMC provisions	To be quoted separately(Price Bid)

** - Any deviation from expected response is required to be justified with appropriate supporting proof/documentation/reasons. HSFC shall scrutinise the responses and seek clarifications if required.*

7.6 Bid Quotation format for Price Bid (To be filled by vendor)

Table 7.2. Bid Quotation Format

Sl. No.	Category	Cost
1.	Design, Realisation and Testing of EDMU	
1.1.	Completion of Milestone 2 (PDR Level-1) for EDMU	
1.2.	Completion of Milestone 3 (PDR Level-2) for EDMU including: • Realisation & Delivery of Engineering Model • Completion of Functional Testing • Review & clearance of PDR Level-2 Document	
1.3.	Completion of Milestone 4 (CDR) for EDMU including: • Realisation & Delivery of Qualification Model • Completion of Qualification Testing • Review & clearance of CDR Document	
1.4.	Completion of Milestone 5 (Flight Model Delivery & Acceptance) for EDMU including: • Delivery of Flight Hardware and accessories • Review and clearance of Acceptance Tests	
2.	Design, Realisation and Testing of DRU	
2.1.	Completion of Milestone 2 (PDR Level-1) for DRU	
2.2.	Completion of Milestone 3 (PDR Level-2) for DRU including: • Realisation & Delivery of Engineering Model • Completion of Functional Testing Review & clearance of PDR Level-2 Document	
2.3.	Completion of Milestone 4 (CDR) for DRU including: • Realisation & Delivery of Qualification Model • Completion of Qualification Testing Review & clearance of CDR Document	
2.4.	Completion of Milestone 5 (Flight Model Delivery & Acceptance) for DRU including: • Delivery of Flight Hardware and accessories • Review and clearance of Acceptance Tests	
3.	Repair & Maintenance Contract	

3.1.	Repair & Maintenance Contract for all units of EDMU flight deliverables	
3.2.	Repair & Maintenance Contract for all units of DRU flight deliverables	

Note: The cost of warranty shall be included in the prices quoted by the vendor.

7.7 Compliance Matrix (To be filled by vendor)

Table 7.3 Item-wise Compliance Matrix

S. No.	Item	Scope of Work	Compliance by vendor
1.	Scope of Work	• Distribution of Activities as per Section 2.2	
2.	Requirements for EDMU	• Feature Requirements • Functional Requirements • Ground Interface Requirements • Power Interface Requirements • Mechanical Specifications	
3.	Requirements for DRU	• Feature Requirements • Functional Requirements • Ground Interface Requirements • Power Interface Requirements • Mechanical Specifications	
4.	Guidelines and Requirements for Realisation	• Guidelines for Component Selection • Guidelines for Electronic Design and Fabrication • Guidelines for Software Realisation • Guidelines for Radiation Tolerance • Guidelines for Chassis Realisation • Requirements for Qualification and Acceptance	
5.	Terms for Project Activities	• Flow of Activities • Project Milestones • Deliverables • Payment Schedule • Delivery Schedule	

		• Reviews • Warranty and Repair & Maintenance • Delivery Terms and Acceptance Criteria • Ownership and Non-reusability	
6.	Instructions to Bidders	• Quotation Procedure • Pre-tender discussions and Clarifications • Details to be submitted with bid	